Symposium Handbook

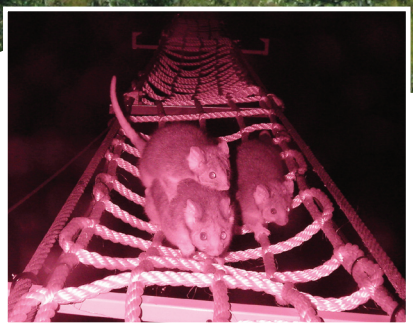
BREAKING THE BARRIERS:

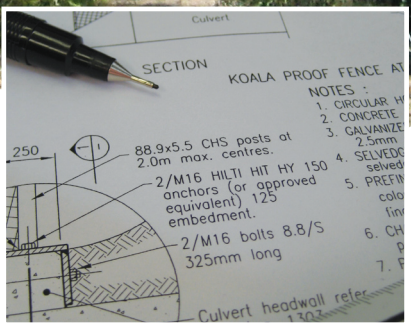
Engineering Solutions to Ecological Problems

NATIONAL SYMPOSIUM

6, 7 & 8 May 2009

Hilton Brisbane, 190 Elizabeth Street, Brisbane Queensland





ENVIRONMENT INSTITUTE OF AUSTRALIA AND NEW ZEALAND

Welcome to Brisbane

This important Symposium was borne from a growing realisation that while addressing the obvious ecological impact of transport infrastructure was clearly 'on the agenda', just how this was to be done was far from clear. The prominence of issues such as road-kill and habitat fragmentation within community and political environments confronted the reality that very little was known with certainty. Road authorities, state and local governments, as well as engineers and consultants, are increasingly being faced with the challenge of attempting to meet heightened environmental standards but without access to proven methods or approaches.

Although attempts to mitigate the ecological impacts of roads and other forms of linear infrastructure have been applied in many locations overseas, especially in Europe and North America, such approaches have only recently commenced in Australia. Moreover, the many environmental, societal and jurisdictional differences between countries often mean that such approaches cannot simply be applied or copied here. The frustration often expressed by planners and engineers about the lack of information and design applicable to local conditions was sincere and understandable.

Nonetheless, extraordinary advances have been made in this country in recent years. New designs and approaches have been trialed and assessed. Mistakes have been made, yet critical lessons have been learned. Meanwhile, the demand for effective environmental standards continues to rise. It is in this context that the *Breaking the Barriers: Engineering Solutions to Ecological Problems Symposium* is being presented.

We are of the strong opinion that this symposium is timely and potentially may be of great influence: there is much to learn from one another. We also hope that the event will be constructively critical, where failures can be discussed as freely as successes. In such an atmosphere, understanding and knowledge can be increased and shared, with the real potential for considerable long-term influence.

Let's make the most of this unique event.

Darryl Jones

On behalf of the Symposium Steering Committee, Brisbane.

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Thursday 7 May 2009

8.30	Wildlife signage and other traffic calming devices	**Nick Mooney** Wildlife Management Branch & Fox Eradication Branch, Tasmania
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4.00-5.30	Symposium Workshop: The future of breaking the barriers	Introduction by **Amelia Selles** - Program Officer Flora and Fauna, Planning Section, Natural Environment and Sustainability Branch, City Planning and Sustainability Division, Brisbane City Council.

What you need to bring for the field trip:

Full water bottle

Comfortable walking shoes

Hat

Sun tan lotion

Sense of adventure

Rain protection (spray jacket or umbrella) if weather is doubtful

Field Trip Friday 8th May 2009

The field trip for the '*Breaking the Barriers: Engineering Solutions to Ecological Problems'* symposium will be to two road infrastructure projects in Brisbane, Queensland. Compton Road, Kuraby involved an arterial road upgrade from two to four lanes in 2004 between two significant bushland remnants. Extensive research, monitoring and evaluation have been undertaken at this site. Hamilton Road, McDowall has involved a road extension within a significant regional ecological corridor. Extensive community involvement in wildlife surveys were undertaken pre-construction. Post-construction monitoring is currently underway.

Wildlife mitigation measures viewed on the field trip will include vegetated land bridges, underpasses, rope bridges, glider poles and wildlife exclusion fencing. Presenters at the sites will outline the end-to-end process involved in these projects, commenting on the key learnings and recommendations that have stemmed from the projects.

Compton Road, Kuraby Presenters

- Paul Mack, Brisbane City Council – Project Planning, Design and Construction.
- Thomas Creevey, Karawatha Forest Protection Society – Community Involvement.
- Matt de-Glas, Brisbane City Council – Structure Maintenance.
- Darryl Jones, Griffith University – Research, Monitoring and Evaluation (All Wildlife).
- Steve Wilson, Queensland Museum – Research, Monitoring and Evaluation (Reptiles).
- Brendan Taylor, Southern Cross University – Research, Monitoring and Evaluation (Arboreal Mammals).

Hamilton Road, Mc Dowall Presenters

- Mary O'Hare, Brisbane City Council – Project Planning, Design and Construction.
- Ben Holmes, Brisbane City Council – Community Involvement.
- Ross Goldingay, Southern Cross University – Research, Monitoring and Evaluation (Arboreal Mammals).
- Cathryn Dexter, Griffith University – Research, Monitoring and Evaluation (All Wildlife).

Schedule

Group A	Group B
9:00 Depart from Hilton, Brisbane	9:00 Depart from Hilton, Brisbane
10:00 Arrive Compton Road, Kuraby	10:00 Arrive Hamilton Road, McDowall
10:00 – 11:30 Presentations	10:00 – 12:00 Presentations
11:30 Depart for Downfall Creek Environment Centre	12:00 Depart for Downfall Creek Environment Centre
12:30 Arrive Downfall Creek Environment Centre	12:30 Arrive Downfall Creek Environment Centre
12:30 – 13:30 Lunch	12:30 – 13:30 Lunch
13:30 Depart Downfall Creek Environment Centre for Hamilton Road, McDowall	13:30 Depart Downfall Creek Environment Centre for Compton Road, Kuraby
14:00 Arrive Hamilton Road, McDowall	14:30 Arrive Compton Road, Kuraby
14:00 – 16:00 Presentations	14:30 – 16:00 Presentations
16:00 Depart Hamilton Road for Hilton, Brisbane	16:00 Depart Compton Road for Hilton, Brisbane

Sessions

9.00am **Wednesday 6 May 2009**

Wildlife crossing structures: The road to success

Dr Edgar van der Grift
Senior Ecologist, Department of Landscape Ecology and ALTERRA Research Institute, Wageningen University, Netherlands

Biography

Edgar van der Grift works as a senior research scientist at Alterra, Wageningen University and Research Institute, Wageningen, The Netherlands. His work focuses on the assessment of the impacts of habitat fragmentation on wildlife populations and the effectiveness of measures that aim to reduce such fragmentation and increase habitat connectivity, e.g. the establishment of landscape linkages, ecological corridors and wildlife crossing structures at roads and railroads. Besides his scientific research he acts as a consultant for policy makers, road planners and conservation groups during the preparation and implementation phase of projects that aim for the establishment of effective ecological networks and road mitigation measures. He has been involved in the planning and implementation of a 410 million euro national defragmentation program that aims to decrease the barrier effect of existing trunk roads, railroads and waterways. Currently he is preparing a monitoring program to evaluate the effectiveness of the measures taken as part of this program, including assessments of the impact of wildlife crossing structures on population persistence.

Abstract

Roads and railroads may have a severe impact on wildlife. They have the potential to cause mortality in wildlife, disrupt animal movement and affect both the amount and quality of wildlife habitat. Consequently, transport networks can potentially jeopardize the long-term persistence of wildlife populations, communities and ecosystems. Around the world, road administrations and nature conservation organisations currently spend considerable amounts of money annually on engineering solutions – such as wildlife crossing structures – to increase the permeability of transport corridors for wildlife. In the Netherlands the construction of wildlife passages increasingly becomes standard procedure when building new roads. Furthermore, in 2004 a 410 million euro defragmentation program has been launched to improve habitat connectivity across existing (rail)roads. The question that consequently rises in response to such investments is: does it work?

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Previous studies – in the Netherlands and elsewhere – have clearly demonstrated that many species of wildlife will use wildlife passages to cross transport corridors. They have also shown that the rate of passage use varies according to species and depends primarily on the design/dimensions of the structure and their position in the landscape. Although knowledge about the use and performance of a wildlife passage provides proof of passage acceptance by wildlife and the existence of a certain level of habitat connectivity, little conclusions can be derived about to what extent pre-road conditions have been restored, genetic interchange is guaranteed, what impact the exchange of individuals across the transport corridor has on the fitness of these individual animals, and even less about the viability of the population or persistence of the community/ecosystem the animals are part of. Hence in most studies the effectiveness of wildlife passages at reducing the risk of population extinction or ecosystem change remains unclear.

To fill these knowledge gaps, monitoring studies are needed which focus on the assessment of the effectiveness of wildlife passages in terms of reaching an increase in population viability. Whether wildlife passages are effective or not can only be tested if, prior to the monitoring, a clear definition of success is provided. To define success, and ultimately to assess the extent to which success is achieved, for each wildlife passage clear objectives should be worked out. Subsequently the following main questions need to be answered in order to set up a proper monitoring plan: (1) What is the best study design? (2) What are suitable research species? (3) What are suitable research sites? (4) Which research methods/techniques (surveys/analyses) are most promising? (5) What measurement schemes should be used? (6) What are the estimated costs? It is recommended to use population models prior to the start of the monitoring to simulate the monitoring and assess the best study design and measurement scheme. Such simulations may provide valuable insights in the probability to assess a mitigation effect in relation to e.g. the number of research sites or the duration of the monitoring. Hence, money and efforts can be spent more efficiently and better-founded decisions can be made what monitoring actions to start and what not.

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10.25am **Wednesday 6 May 2009**

Why do we need mitigation measures?

Dr Rodney van der Ree
Senior Ecologist, Australian Research Centre for Urban Ecology, Royal Botanic Gardens, Melbourne

Biography

Dr Rodney van der Ree's research interests range widely, but focus primarily on the impacts of humans and human activities on plants and animals. Rodney was awarded his Doctorate from Deakin University in Melbourne in 2000 for his research on the impacts of the loss and fragmentation of habitat on arboreal fauna. His PhD investigated the ecology of possums and gliders in a highly-cleared agricultural landscape where suitable habitat occurred as a network of narrow linear strips along streams and roadsides. The role of corridors and habitat networks in supporting viable populations of wildlife was central to Rodney's thesis. He is continuing to study the impacts of habitat fragmentation on population dynamics and dispersal using genetic techniques to explore the role and function of landscape connectivity.

Rodney is currently the Senior Ecologist at The Australian Research Centre for Urban Ecology, a research division of the Royal Botanic Gardens Melbourne. He is continuing to investigate the consequences of building cities and towns and other infrastructure on fauna, flora and ecological processes. This includes quantifying the decline of mammals in Melbourne since European settlement as well as studying native species that have successfully adapted and benefited from the expansion of human settlements. Rodney is currently leading a team of researchers and postgraduate students on an ARC Linkage Project (with funds > $600,000) which aims to quantify and mitigate the barrier effect of roads, traffic and other linear infrastructure on a range of species of wildlife, including arboreal marsupials, skinks and invertebrates. This involves considerable review of existing literature as well as using novel field and genetic techniques to measure fragmentation effects. In collaboration with VicRoads and the NSW RTA, the project will test the effectiveness of various experimental mitigation structures (canopy bridges and glider poles). Rodney is recognised nationally and internationally as an expert on road ecology and urban ecology, and has presented the results of his research in plenary lectures and invited seminars across Australia and in Europe and N America.

Notes:

Abstract

Roads, railways and other linear infrastructure are pervasive components of most landscapes throughout the world. Combined with the effect of vehicles, they have the potential to cause mortality in wildlife, severely disrupt animal movement, reduce the amount and quality of habitat and increase the risk of local extinction. Around the world, management agencies and conservation organisations currently spend considerable amounts of money annually on engineering solutions to increase the permeability of roads for wildlife. A large body of research and monitoring has clearly demonstrated that many species of wildlife will use these structures to cross the linear infrastructure. This research has also shown that the rate of use of the structures varies according to species and depends on the characteristics of the structure, including its dimensions, position in the landscape and surrounding habitat. However, the effectiveness of these measures at reducing the risk of population extinction remains unclear.

We evaluated the use and effectiveness of wildlife crossing structures (tunnels, culverts, overpasses) by reviewing studies published in the refereed scientific and the "grey" literature and assessed the extent to which studies could demonstrate an increase in population viability (see van der Ree *et al* 2007, van der Ree *et al*. 2008). We included papers from journals, conference proceedings, university theses and reports from management agencies and consultants. Research published in English and other languages (French, Spanish, Dutch and German) was included. The majority of studies found an effect at the level of the individual animal, with individuals of many species detected using the structures. One study of the 24 found in the refereed scientific literature demonstrated a positive effect at the population level. Published in 1989, Mansergh and Scotts demonstrated how an under-road tunnel provided connectivity and restored the social organisation of the mountain pygmy-possum (*Burramys parvus*). The mountain pygy-possum is a small critically endangered marsupial from south-eastern Australia whose habitat coincides with alpine ski resorts. In contrast, many studies in both the refereed and non-refereed literature were limited by inadequate replication; insufficient detail of the physical characteristics of the crossing structure, road or traffic; and a failure to adequately describe the population of wildlife and habitat adjacent to the road.

We continued the research of Mansergh and Scotts and used a > 20 yr data set on population size to build a population

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viability model to predict the effect of the tunnel on population persistence (van der Ree *et al*. in press). Briefly, the tunnel constructed under the road that divided the population of *Burramys parvus* reduced but did not completely remove the negative effect of the road. The expected minimum population size of the population with a tunnel remained 15% lower than that of an undivided population.

The significant financial cost involved in mitigation demands that effectiveness be appropriately measured and reported to ensure that future mitigation efforts reflect best available practice. Primary measures of effectiveness must consider a range of temporal and spatial scales, including individual and population level effects and multi-species effects. This includes the extent to which: (a) individual animals and species use the structure; (b) that the risk of extinction has been reduced and by how much; (c) restoration of animal movement, social organisation or gene flow; and (d) the effect on multiple species, communities, and ecosystems.

A major limitation in advancing this field is the often piecemeal or project by project approach to assessment and mitigation. A more co-ordinated approach, with some minimum research standards is required to prevent duplication of research and maximize transferability of results. The placing of data in the public domain, with more regular symposia and workshops to ensure knowledge transfer and raise community awareness of the issues will assist in achieving better environmental outcomes.

References

Mansergh, I. M., and D. J. Scotts. 1989. Habitat continuity and social organisation of the mountain pygmy-possum restored by tunnel. *Journal of Wildlife Management* 53:701-707.

van der Ree R., M. A. McCarthy, D. Heinze & I. M. Mansergh. (in press) Under-road tunnel restores population dynamics of endangered pygmy-possum. *Ecology and Society*.

van der Ree R., E. A. van der Grift, C. Mata & F. Suarez. (2007) Overcoming the barrier effect of roads – how effective are mitigation strategies? An international review of the effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife. In: *International Conference on Ecology and Transportation* (eds C. L. Irwin, D. Nelson and K. P. McDermott) pp. 423-31. Center for Transportation and The Environment, North Carolina State University, Raleigh, NC, Little Rock, Arkansas, USA.

van der Ree R., D. T. Clarkson, K. Holland, N. Gulle & M. Budden. (2008) Review of Mitigation Measures used to deal with the Issue of Habitat Fragmentation by Major Linear Infrastructure, Report for Department of Environment, Water, Heritage and the Arts (DEWHA), Contract No. 025/2006, Published by DEWHA.

Notes:

10.55am **Wednesday 6 May 2009**

The law and planning: What currently dictates mitigation measures?

Dr Darryl Low Choy
Associate Professor, Griffith University and Research Member, Centre for Urban Research, Queensland

Biography

Dr Darryl Low Choy is an Associate Professor in the School of Environment at Griffith University, Brisbane, Australia. He teaches in the Environmental Planning Program and researches in the Urban Research Program. His research interests include collaborative regional planning and management, regional landscape and open space management, peri urban and rural planning, the role of local government in environmental and natural resource management, planning opportunities for climate change adaption, and the relationship between science and planning.

He chairs the Queensland State Government's Regional Landscape and Open Space Advisory Committee associated with the SEQ regional planning initiative. He is a member of the Rural Futures Committee and the CEOs Committee for Natural Resource Management.

He is a Director and Chairman of the City of Brisbane Arts and Environment Limited. He is assisting the Gold Coast City Council in their current *Bold Future* initiative and has been appointed to advise the NSW Natural Resources Commission.

Abstract

A Joined-up Regional Landscape: *A Roadmap to connect the parts*

The paper will address the question: Can local scale wildlife barrier mitigation measures exist in isolation or do they need a broader spatial context for support and long term viability?

The landscapes of our metropolitan regions are complex entities which are extricably linked to their nearby urban communities. These landscapes are often fragmented through urbanisation and peri-urbanisation resulting in the artificial delineation of property and institutional entities. In regions experience rapid growth, landscape fragmentation can be particularly acute. Hence, there are strong imperatives to address the negatives of fragmented landscapes through some form of coordinated set of linked initiatives.

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The paper argues that an organising spatial management framework is required into which these otherwise isolated local scale wildlife barrier mitigation measures can fit. This is required in order to provide purpose and meaning to the isolated initiatives. However, this framework will have to address a range of community landscape values that embrace the more traditional values such as biodiversity, outdoor recreation, rural production and the like, through to the emerging values of ecosystem services and the indigenous landscape.

The paper will case study the South East Queensland region and its regional planning process. It will briefly examine the regional planning initiatives associated with the notion of a regional landscape framework and the role that landscape corridors can play as part of that framework. The paper will conclude with an overview of an intended roadmap designed to bring these conceptual landscape corridors into reality in the SEQ context.

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11.40am **Wednesday 6 May 2009**

Decision-making in road ecology: Developing the framework

Professor John A. Bissonette
Research Scientist, United States Geological Survey and Leader, Utah Cooperative Fish and Wildlife Research Unit, College of Natural Resources, Utah State University, United States of America

Biography

John A. Bissonette is a research scientist with the U.S. Geological Survey. He leads the Utah Cooperative Fish and Wildlife Research Unit and is a professor in the College of Natural Resources at Utah State.

His research interests include landscape effects on wildlife species. He is interested in the conceptual foundation for landscape ecology and how it might be used in real life applications. His current research involves aspects of road ecology. In addition to peer reviewed paper and reports, he has published five volumes: Integrating People and Wildlife for a Sustainable Future (with P. Krausman, The Wildlife Society, 1995), Wildlife and Landscape Ecology: Effects of Pattern and Scale (Springer 1997), Landscape Ecology and Resource Management: Linking Theory with Practice (with I. Storch, Island Press 2003), Temporal dimensions of Landscape Ecology: Wildlife Responses to Variable Resources (with I.Storch, Springer-Verlag 2007), and is co-author of Road Ecology: Science and Solutions (Island Press 2003). He has been invited to present keynote addresses in Australia, Germany, and Portugal, and was a Senior Fulbright Scholar at the Technique University of Munich in

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2002 and a Mercator Visiting Professor at Albert-Ludwigs University in Freiburg, Germany in 2005. He has taught landscape ecology workshops in Portugal and Germany and is a Certified Wildlife Biologist.

When not working or travelling, he rides his horse, Smarty Pants Too, in the mountains of Utah and his Harley on the back roads of the West.

Abstract

The built infrastructure of the roaded landscape has changed the nature of nature. Landscapes that once provided access to resources for abundant wildlife populations have been changed. In many cases landscape integrity (nutrient cycling, energy flow) and permeability (scaled animal movement) have been compromised and biodiversity impacted. Species that once were able to move across the landscape to find needed resources with little difficulty, now find the built infrastructure as barriers to free movement.

In many areas the most vulnerable species (high trophic level, narrow habitat requirements, and those with large area requirements) have been severely reduced or eliminated. Piecemeal and local solutions have been developed, but larger extent landscape-wide efforts are needed to insure the well being of a country's biota. This is not a trivial task. Given increasing human populations, higher traffic volumes and speed, as well as a dramatically increasing number of vehicle miles driven each year, the problem for engineers and planners concerned with highway construction has become one not only of providing the transportation services that people demand but at the same time, maintaining the ecosystem services (clean air, water, fertile soil) as well as open space and landscape permeability that insure the wellbeing of both humans and wildlife.

These issues are global. In the U.S., we have addressed the roaded landscape issue with the development of a web-based Decision Guide for engineers and biologists (www.wildlifeandroads.org) funded by the U.S. National Academy of Sciences and Engineering-Transportation Research Board-National Cooperative Highway Research Program. The guide is intended to be used in mitigation decisions involving wildlife crossings. The overarching purpose is to restore landscape permeability while at the same time improving human safety on the roads. The decision guide provides background ecological information on the installation of wildlife crossings, including an assessment of appropriate spacing for structures in hotspot

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areas of wildlife mortality on the road. In this presentation, I discuss the elements of the Decision Guide, address some technical issues of maintaining a well functioning web site, and end with some take-home lessons for biologists and engineers who will need to work together to construct wildlife friendly crossing structures.

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1.30pm **Wednesday 6 May 2009**

Wildlife mitigation measures: Concept Planning

Kevin Roberts
Senior Environmental Specialist (Biodiversity), New South Wales Roads and Traffic Authority

Biography

Kevin Roberts is employed as the NSW Roads and Traffic Authority's (RTA) Senior Environmental Specialist for biodiversity within the Authority's Environment Branch. In this role, Kevin provides advice and input across the state to RTA planning and operational staff and contractors on issues that may result from their work on biodiversity. He is currently working in partnership with the Department of Environment and Climate Change to prepare guidelines on managing the biodiversity impacts of road projects including managing the impact of roads on biodiversity connectivity. Kevin joined the RTA at the beginning of 2007 following a career of nearly twenty years with the various environment and conservation agencies that now form the Department of Environment and Climate Change in NSW.

Abstract

NSW comprises a road network of 184 118 km length. Most of this network is managed by local authorities with some funding support from the NSW and Commonwealth Governments. The RTA manages 17 932 km of the road network comprising State Roads and Motorways.

The land adjacent to the road is managed by a range of bodies – local authorities, Conservation Agencies, other State infrastructure Agencies, private companies and individuals. Regulation governing roads, roadside environments and their management is complex – roads legislation, OH&S legislation, contract law, planning legislation, and environmental protection legislation all apply to the construction and operation of roads. These regulatory frameworks impact on the delivery of wildlife connectivity measures in a number of ways. A simple example is where construction of a fauna underpass requires the provision of safe access for essential maintenance.

Notes:

Roads impact on biodiversity and are a barrier to fauna and flora movement but they affect different types of species in different ways including having different impacts on the same species at different times of the year. At any one time there are a range of road projects underway – these could include maintenance of a culvert structure or construction of a new four lane divided motorway.

Given this complex operational environment, how does a road authority make decisions to invest a proportion of its assessment, construction and maintenance budget into measures designed to facilitate connectivity across its infrastructure?

In NSW, the RTA has invested considerably in measures to improve connectivity – notably on major highway upgrades such as the Hume and Pacific Highways but also in much smaller projects.

The RTA invests in connectivity measures for the following reasons:

1. As part of the RTA's commitment to minimise the environmental impact of its work.

2. As a response to community expectations to provide safe crossing for fauna.

3. Because conditions of approval require connectivity measures to be implemented

4. Because we have successfully implemented mitigation measures on past projects.

5. Because it presents a design challenge and opportunity for innovation

This presentation provides a brief overview of how an agency such as the RTA plans for incorporating connectivity measures into road projects and argues for the development of a standard approach that combines engineering and science with project management systems that delivers a good outcome for biodiversity consistent with delivery of public value.

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2.00pm **Wednesday 6 May 2009**

Current best practice techniques for designing barrier mitigation

Dr Sarah Robinson-Wolrath
Senior Environmental Officer (Standards), Environment and Heritage, Design, Environment and Stewardship, Queensland Department of Transport and Main Roads.

Alison McKirdy
Graduate Environmental Officer, Environment and Heritage, Engineering and Technology, Queensland Department of Transport and Main Roads.

Biography

Dr. Sarah Robinson-Wolrath is a Senior Environmental Officer in the Environment and Heritage Branch of Main Roads. She has been working within the Branch for a year now focussing on developing the Fauna Sensitive Road Design Manual Volume 2: Preferred Practices. Her background has focussed on Animal Ecology, having been awarded her PhD in 2006 in Sweden. She began work at Main Roads with the view to put her specialised knowledge and skills into practice by contributing to improving environmental management practices.

Alison McKirdy has been working for Main Roads for just 1 year as a Graduate Environmental Officer. She has a honours degree in Environmental Science (Biology). She has been responsible for research and development of the FSRD manual.

Abstract

The effects of roads and traffic on fauna are numerous. To mention a few:

1. Loss, fragmentation and degradation of habitat;
2. Mortality of fauna due to collisions with vehicles;
3. Disturbance due to vehicle movement, noise, headlights and so on;
4. Invasion by weeds, disease, dust, pollution and feral fauna;
5. Changed microclimatic conditions.

The aim of fauna sensitive road design is to reduce/eliminate the impact of road infrastructure on fauna. Main Roads has increasingly recognised the importance of ameliorating the effects of road infrastructure on fauna and the environment which they inhabit. The objectives which Main Roads adopts with respect to fauna sensitive road design are as follows:

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1. Avoid environmentally sensitive areas
2. Identify the nature of the issues (for example, roadkill, habitat fragmentation).
3. Identify goals for mitigation (for example, eliminate roadkill, reconnect populations)
4. Design structures for faunal groups, communities and ecosystem processes.
5. Monitor mitigation structures
6. Maintain mitigation structures

Introduction

The consequences for wildlife due to road infrastructure include traffic, mortality, habitat loss and degradation, pollution, altered microclimate and hydrological conditions, and increased human activity in adjacent areas. All these factors cause considerable loss and disturbance of natural habitats. In addition, roads create barriers to animal movement, which can lead to isolation and eventually population decline.

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Habitat fragmentation, the splitting of natural habitats and ecosystems into smaller and more isolated patches, is recognised globally as one of the biggest threats to the conservation of biological diversity (Forman et al. 2003). Within Queensland, population growth has spurred a need for increased road infrastructure which, if not managed properly, will create barriers and prove to be detrimental to the health of our environment. The immediate and obvious consequences of poor or non-integrated planning, include increased animal fatalities on our roads. The other, more detrimental effect of road barriers, is that which creates population isolation, habitat fragmentation and degradation which is not easily detectable and, therefore, has only recently become highlighted as an issue which must be addressed (van der Ree et al., 2007).

Over recent years, the Queensland Department of Main Roads has increasingly recognised the importance of ameliorating the effects of road infrastructure on fauna and the environment which they inhabit. This is evidenced by the release of *Fauna Sensitive Road Design Volume 1 – Past and Existing Practices* manual in 2001, and now the production of this volume, *Fauna Sensitive Road Design Volume 2 – Preferred Practices. Volume 1* of this two-part series generated a large amount of interest in all sectors of development at a local, state-wide, national and international level. The upcoming release of Volume 2: Preferred Practices is highly anticipated and is expected to be widely used and applied at all levels.

This paper discusses the outcomes and recommendations from the development of the second volume of the Fauna Sensitive Road Design Manuals. The aim of the *Fauna*

Sensitive Road Design Manual Volume 2 is to outline and provide guidelines to preferred practices aimed to reduce/eliminate the impact of road infrastructure on fauna. Specifically, in this manual we list and outline preferred practices and suggest the minimum requirements to achieve fauna sensitive road design. Main Roads has and will continue to address (through updates on the manual) four crucial questions:

1. How well do certain practices/mitigation measures work?
2. Under what circumstances do particular structures function best?
3. And, for which species?
4. How can overall performance be maintained and improved?

Considerable effort has been taken to make these guidelines applicable to Australian conditions; however, local knowledge, data and experience should always be used to enhance, modify or even replace the recommendations provided within these guidelines. The aim of appropriate Fauna Sensitive Road Design should always be to produce the best overall, locally relevant, outcome. With this background it is important to emphasise that there are no 100% correct solutions. The manual is, therefore, not a substitute for the advice of local experts such as ecologists, planners and engineers and should be used to complement such advice and local knowledge.

Notes:

3.00pm **Wednesday 6 May 2009**

RTA Upgrading road infrastructure: Feedback from the ground.

Greg Collins
Regional Environmental Advisor, New South Wales Roads and Traffic Authority

Biography

Greg Collins is employed at the Roads and Traffic Authority of NSW (RTA) as a Senior Environmental Officer in the RTA's Northern Region extending from Port Macquarie and Gunnedah to the Queensland border, excluding the Pacific Highway Upgrade. In this role. Greg provides advice and support on all environment aspects as part of teams charged with developing and implementing works across this diverse part of the state. He is currently managing a multidisciplinary team to carry out this broad range of tasks. Greg is considered a "new boy" at the RTA having joined just over a decade ago. Prior to this he had stints with Local Government and a number of State resource and conservation agencies.

Notes:

Greg also lists career highlights of nearly twenty years to include a safari guide in Kakadu World Heritage Area and a abalone diver in South Australia (cut short after an encounter with a threatened Great White Shark, at the time it was doing all the threatening).

Abstract

The Roads and Traffic Authority of NSW (RTA) is responsible for the management of approximately 17, 900 kilometres of State road network . Each year the traffic and freight demands on this network increase, and the RTA is required to effectively maintain its existing network and upgrade infrastructure to enable it to meet service requirements. This places the RTA in a unique position to take advantage of opportunities to improve biodiversity outcomes across the state in particular outcomes related to biodiversity.

The delivery of these upgrades and maintenance are a primary concern for the RTA as it balances several drivers to achieve efficient outcomes. The road network sits contextually within a spectrum of legislation covering roads, contracts, OH&S and environment. When this is overlain with funding requirements it is easy to see how decisions must consider a multitude of issues to ensure a positive outcome.

Another critical aspect is land tenure adjacent to the road network. Managed by a range of bodies, both public and private, this places the road network as only a thin strip of land within the broader landscape. An example of this is where a project requires the provision of a glider crossing. Road design and site specific studies have identified individual takeoff and landing trees at the one location this can be achieved for several kilometres. The trees are marked and the RTA enters property negotiations with the private landholder to purchase the required land with the trees in place, the negotiations break down over an unrelated issue and the compulsory acquisition process is required during which time the owner logs the area removing the trees. The requirement on the project remains and a lesser alternative must be found.

In NSW, the RTA has invested considerably in measures to improve connectivity. No matter what works are undertaken from a major new infrastructure project to minor maintance, this is achieved through a system of contract delivery, and it is critical for all involved in biodiversity outcomes related to road infrastructure to consider how their work will be achieved on the ground via one of these contracts.

The interaction of the scientific and planning disciplines with this area of project/maintenance delivery has provided a rich area for feedback. This presentation provides a brief overview of some of the challenges and results an agency such as the RTA can meet and achieve as

it incorporates connectivity measures into road projects. It also highlight areas symposium participants can focus upon to demonstrate that biodiversity outcomes can also be consistent with delivery of public value.

Notes:

3.20pm **Wednesday 6 May 2009**

Mountain Pygmy Possum: 20 years of research

Dr Ian Mansergh
Victorian Department of Sustainability and Environment

Biography

Ian Mansergh is an ecologist whose career spans detailed field flora and fauna research, through to biodiversity policy, land-use and climate change within the Victorian Government (at Research Institutes and policy units). He led the team producing *Victoria's Biodiversity* and in 2007 moved to Climate Change policy within the Victorian Government (Dept. Sustainability and Environment).

He has experience ranging from: detailed ecological research on threatened species (eg Mountain Pygmy-possum), land management in alps and forests and strategy development related to biodiversity and land use at the state and national levels. He has had published around 70 scientific articles covering topics ranging from zoology and ecology, eco-aboriginal themes, ecology, resource use and impacts and adaptation to climate change. He has been involved in several independent expert scientific committees and given seminars across Australia, in Europe and Canada.

He is currently involved in land and water use change and biodiversity in the context of adaptation to climate change with some recent work on biolinks, "visualisation" of landscapes under climate change. Apart from the detailed science, much of his research has explored emergent trends (e.g. greenhouse / wildlife / se Australia in 1987, linking socio-economic trajectories in land-use to biodiversity).

Abstract

Ecological connectivity of habitats is a major issue for conservation in Australia at multiple scales. The endangered Mountain Pygmy-possum (Burramys parvus) is the only Australian mammal restricted to the alpine – subalpine region and seen as the "canary in the coal mine" for global warming in Australia. Major alpine resorts and downhill skiing occur within each of its three regional and genetically distinct populations generating a history of land

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use and management conflicts. In the 1980's, the Mt Higginbotham – Mt Loch population (bisected by the Mt Hotham Alpine Resort) was (and remains) the largest, most viable population supporting the largest part of the total global population. In 1986 a corridor and tunnel were constructed on Mt Higginbotham, to mimic the boulder-field habitat and restore ecological connectivity of Burramys which was disrupted by a road and resort infrastructure. Facilitating access to migratory males, the "tunnel of love" achieved early notoriety and scientific success (Mansergh and Scotts 1989).

Analysis of annual monitoring data since 1981 indicates positive long-term effect of the tunnel. Habitat and population connectivity was restored and importantly remained ecologically within the larger demographic unit, local extinction being avoided. Although there were edaphic differences between the disturbed (tunnel) and control sites, at the latter: population abundance increased; social – age structure levels and survivability were restored; however, weights and fecundity remained lower. This paper reports on: the continuing ecological success of this installation over 23 years; subsequent efforts at other sites; and some of the broader and positive societal effects of the experiment in the scientific, educational and popular literature.

3.40pm **Wednesday 6 May 2009**

Localised wildlife extinctions and impacts on the regional population: Lessons from the Koala Coast

Dr Harriet Preece
Koala Conservation Unit, Threatened Species Branch, Sustainable Communities Division, Dept of Environment and Resource Management

Biography

Dr Harriet Preece works as a Senior Conservation Officer with the Threatened Species Branch of Queensland Department of Environment and Resource Management (DERM) in Brisbane. She has been working in koala conservation since the first Queensland koala State Planning Policy was drafted in 1995 and has previous experience working with national parks in several states. Her current work involves research and monitoring to support koala conservation in South East Queensland. Her PhD thesis was titled "Monitoring and modelling threats to koala populations in rapidly urbanising landscapes" and

Notes:

included an evaluation road mortality blackspots. Her research interests include landscape effects on wildlife using spatial ecology, remote sensing, spatial ecology and geographical information systems.

Abstract

Road kill is familiar sight along highways in many parts of the world. While some studies have documented the impact of linear infrastructure on local wildlife populations, rarely have the impacts on population dynamics been quantified for a regional population. The koala provides an ideal case study for examining species' that have large home ranges and are particularly vulnerable to road and rail effects because their frequent movements across roads and rail tracks increases the probability of a collision. Road and rail mortality are particularly insidious because they remove otherwise healthy individuals from the population.

Radio collaring of every koala on a 52ha urban bushland site known as the "Greater Glider Conservation Area", revealed the presence of a viable population of 45 koalas in 1996. However, while a few animals lived within the confines of the reserve, the majority of the resident koala population were found to have home-ranges that overlapped an adjacent main road, or extending into the neighbouring urban areas - thus exposing the majority of resident population to an elevated risk of mortality.

As a consequence of the high number of road kills and additional anthropogenic mortality, the population density gradually declined with a number of animals killed on the main road and other animals succumbing to disease as a result of stress. In 2005 the road was upgraded from two to four lanes and in the following year the koala population halved with only one female seen on the site and nine koalas in total. Consequently the site is now close to effective extinction. This pattern of population decline was evident in surveys conducted in 2005-2006 for bushland remnants on the urban footprint in the Koala Coast and is likely to be indicative of the pattern of decline throughout South East Queensland.

Lessons from the Koala Coast have enabled the delineation of 258 road and four rail blackspots. Radio-tracking demonstrates that wildlife with large home ranges are particularly sensitive to landscape permeability which needs to be enhanced to retain population viability. Crossing structures ideally need to be located every 200m along linear infrastructure to allow for the day-to-day movement of animals such as koalas. While fencing can be beneficial in funnelling wildlife to crossing structures, it can also be detrimental by preventing movement, dispersal and the exchange of recruits.

The importance of the urban koala population in bolstering

the bushland population has previously been underestimated. This has now been confirmed with the detection of a significant decline in koalas at bushland sites that have not experienced any loss or visible changes to habitat or habitat quality or an increase in anthropogenic influences. This previously large population of koalas, recently found to be genetically distinct from all other koalas in South East Queensland, is likely to follow other urban koala populations in other States towards effective extinction unless there is active management to reduce habitat loss and vehicle related mortality while concurrently increasing landscape permeability.

4.00pm **Wednesday 6 May 2009**

What can be learnt from case studies?

Dr Rodney van der Ree
Senior Ecologist, Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne

Biography

Please see 10.25am session.

Abstract

Roads and other types of linear infrastructure dissect most types of landscapes throughout the world. Road networks are continuing to expand, as new roads are constructed or existing roads are widened to accommodate an increasingly mobile society. The ecological impact of roads and traffic are potentially profound as the "road-effect zone" (after Forman *et al.*1997) may extend for many hundreds or thousands of metres either side of the road. Roads can have both positive and negative effects. For example, roads necessarily result in the loss of habitat, can cause the degradation of adjacent habitat and act as a barrier or filter to the movement of fauna. Other effects include noise and light pollution affecting wildlife and air and water-borne chemical pollution affecting plants and aquatic systems. On the positive side, vegetation along roadsides often represent the only native habitat in highly cleared landscapes, and thus may have significance for the conservation of biodiversity and maintenance of landscape processes. The significant challenge for management and conservation is to identify and quantify the extent to which roads and traffic disrupt and modify ecological processes and construct systems that minimise the negative consequences. The extreme cost to build a road in terms of dollars and potential environmental impact demands that we get it right.

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In this talk I will summarise the effects of linear infrastructure on wildlife species under three broad categories, proposed by Jaeger et al (2005). These are species that: (i) avoid the road surface; (ii) avoid traffic emissions and disturbance (e.g. light, noise, chemical emissions); (iii) avoid vehicles - the ability (or inability) of the animal to move out of the way of oncoming vehicles; and (iv) those that are attracted to the road. The use of these four categories is useful to characterise species responses because it allows us to identify the problem and consider suitable and logical approaches for mitigation.

Species that avoid the road typically have low-rates of mortality due to collision with vehicles because they rarely venture onto the road. For these species, barrier effects will be high and wildlife crossing structures may not help because the animals do not approach the road and will never reach the crossing structure. Road avoidance also encompasses the situation where the linear infrastructure is fenced or designed in such a way that it represents a complete barrier to movement. For example, a steep cutting or embankment may be a sufficient deterrence to create a barrier before the road is even reached. Habitat area and quality is reduced when animals avoid habitat adjacent to the road due to traffic emissions or disturbance. The size of this area will increase as traffic volume and/or traffic speed increases. Species that are able to avoid cars are those that are willing to attempt to cross the road and are able to do so without collision. Some species are attracted to the road (e.g. basking by reptiles) or the resources available on the roadside (e.g. carrion or increased grass growth), which, depending on their ability to avoid cars, may result in either negative or positive consequences.

Clearly the type and severity of road impacts on wildlife is dependent on the characteristics of the species, the landscape, road design and traffic conditions. The combinations of the different responses will require different types of mitigation. However, there are still significant knowledge gaps that must be filled to achieve successful mitigation and a sustainable road network. These include further study of *population processes* such as demography, dispersal, spatial patterning and comparing these with contiguous habitats to determine road effects and ultimately assess population viability. A potentially important area of research are *interactions and exchanges* between road systems and adjacent habitats, including the spatial extent and ecological impacts of the movement of biota, of altered hydrology, flows of sediments and

particles, and noise effects. Finally, an understanding of *landscape-level effects* of road systems, including properties of different network structures and the effects of road density on ecosystem processes, is also required.

References

Jaeger J. A. G., J. Bowman, J. Brennan, L. Fahrig, D. Bert, J. Bouchard, N. Charbonneau, K. Frank, B. Gruber & K. T. von Toschanowitz. (2005) Predicting when animal populations are at risk from roads: an interactive model of road avoidance behavior. *Ecol. Model.* 185, 329-48.

8.30am **Thursday 7 May 2009**

Wildlife signage and other traffic calming devices

Nick Mooney
Wildlife Management Branch & Fox Eradication Branch, Tasmania

Biography

Nick Mooney has been working with Tasmanian wildlife for more than 30 years. He pioneered management of Tasmanian raptors, widely communicating techniques in national and international forums. Nick has monitored reports of Thylacines and foxes in Tasmania, helped with responses to newly discovered wildlife diseases, whale strandings and oil spills and developed road-kill mitigation, protection of coastal penguins and developing rehabilitation of orphaned Tasmanian devils. Nick has put much effort into increasing community appreciation of wildlife and has used innovative tourism to this effect, skills augmented by guiding in Antarctic tourism. Finding practical solutions to problem wildlife-people interactions has been a key part of Nick's career. Nick sees the biggest contemporary ecological threat as establishment of foxes because of loss of devils from DFTD, a process that will threaten many species. Nick is an enthusiastic communicator and has over 30 scientific publications and numerous popular articles and media appearances to his credit.

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9.00am Thursday 7 May 2009

A "how to" guide to engineering barrier mitigation measures

David Southwell
Design Project Manager, City Design, Brisbane City Council, Queensland

Biography

David's areas of expertise include all aspects of the detailed design and management of roadworks, drainage and traffic management projects. David's role is to liase, consult and negotiate with relevant stakeholders including public interest groups, state government, service authorities, private companies and individuals. His responsibilities include supervising design staff and project managing the design component of the project to ensure delivery and budget constraints are met.

Abstract

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9.30am Thursday 7 May 2009

Mending the mistakes of the past: retrofitting, the challenges and costs

Richard Collins
Advisor, Biodiversity Planning, Redland City Council

Biography

Richard Collins works for Redland City Council in south east Queensland as Advisor – Biodiversity Planning. This role provides high level advice to senior managers, Councillors and the Mayor on the conservation of the city's biodiversity. It also requires strategic planning for biodiversity conservation in one of the fastest growing parts of Australia.

After graduating from Griffith University, Richard worked in a number of positions at the IndigiScapes Centre – an environmental education centre operated by Redland City Council before working as an Extension Officer for the Community Bushcare Program and Land for Wildlife.

Moving into the Environmental Management Group within the Planning Policy Division of Council, Richard developed the Voluntary Conservation Agreement program and the Your Backyard Garden program which provides conservation extension to urban householders.

Notes:

Richard lives on the Gold Coast with his wife Cathy, daughter Lily, ageing whippet Angel and a giant guinea pig called Possum.

Abstract

As the art and science of safely allowing fauna to cross busy roads and rail lines has developed there has been a strong emphasis on purpose built structures. While these structures may be impressive they are expensive. Their cost limits opportunities to provide the many crossing points demanded by a complex network of wildlife corridors across a city scale landscape. Richard Collins' work has demonstrated that there is a cheaper and more widely available way of ensuring safe fauna movement.

Inspired by the Queensland Premier's Koala Task Force, Richard looked carefully at the culverts and bridge structures underneath the Main Roads of Redland City as an alternative to purpose built structures. As part of the Koala Coast, Redland City has, arguably, the largest urban population of koalas in Australia and research by the Environmental Protection Agency showed that their numbers were in sharp decline. Death and fatal injury from vehicle strike was a significant factor in the koala's demise. Richard hoped that the existing structures would provide koalas with a way of moving safely throughout the city.

The presentation examines the method for understanding the spatial relationship between culverts and bridge structures and the network of fauna corridors. It describes how these structures were assessed against an ideal model for a fauna crossing and the cost of remedial work to convert an engineering solution for spanning a creek to an effective fauna crossing. The estimated cost of this work is often surprisingly small and in direct contrast to the cost of developing purpose built structures. The presentation also describes the final report which can be used as a catalogue for choosing which structures should be prioritised in line with budget demands and road upgrade programs.

Not surprisingly the work undertaken by Richard revealed some weaknesses in its methodology; weaknesses that will be avoided in the future as the program expands to roads managed by Council. The work also showed that culverts were being used by a surprising array of wildlife (this even included fish and aquatic invertebrates) and the consideration of the 'ideal' fauna crossing structure would need to take in to account their requirements too.

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Richard's concept has been warmly received and he is now working closely with the Department of Main Roads to develop a program for its implementation. How effective it will be in conserving the koala population of the Redlands remains to be seen but there is little doubt that a large number of species will benefit from the approach and that the fauna crossing dollar is capable of stretching much further than was once thought.

10.30am **Thursday 7 May 2009**

Are structures practical and economical to maintain?

Mahendra Mistry

Principal Engineer (Maintenance Management), Maintenance Management, Road and Delivery Performance, Queensland Department of Transport and Main Roads

Biography

Mahendra Mistry currently works for the Department of Transport and Main Roads in a head-office role looking after the department's road maintenance requirements. He is currently heading the Maintenance Management Unit (MMU) within the Engineering and Technology Group.

He is involved in all facets of maintenance of road (and sometimes bridge) infrastructure. The prime role of the MMU is to ensure that policies, practices, guidelines and standards are suitable for the current, ever changing, environment. He has been in this unit for the part 4 years having moved from the Rockhampton District Office in 2005. In Rockhampton he had been involved in delivering the maintenance programs for the district through various types of contracts. During this time he would constantly challenge the norm and as such gained extensive knowledge in dealing with maintenance related issues.

Prior to leading the maintenance area in Rockhampton he was involved in administering various types of projects including a bridge, a project involving deviation and upgrade of existing gravel road to a seal standard. During this project he came across considerable environmental factors. These included installation of a fauna (cattle) crossing and dealing with extremely sensitive soils subject to erosion. At the first sign of a drop of rain, the extremely dispersible soil needed to be treated immediately if the top soil was removed.

He was born in India and therefore considers himself a genuine Indian, but grew up in the UK. He completed all his education from late primary school to his engineering degree there. So when it comes to cricket, Mahendra has a good chance of picking the winning team (having a choice from India, England and Australia) – not that he follows the cricket much.

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Abstract

In order to answer this question, existing facilities are examined and comments from practitioners reviewed. In this presentation we will look at three geographical areas implementing different treatments from across Queensland. These are:

1) **Cairns** - Structures installed: canopy bridges over a highway

2) **Gympie** - Structure installed: sub-structure fauna access (bridging over creeks / riparian zones)

3) **Bundaberg** - Structure installed: ledges in culverts and fish baffles

Within Queensland, the Department of Main Roads, through their infrastructure projects, have recently started to make provisions for fauna crossing. As such, not much data is available on maintenance issues.

From the facilities provided to date issues have been identified. Canopy structures have been know to fail due to cyclonic conditions and as such appropriate provisions needs to be included. Continuous maintenance must be carried out in sub-structures to prevent weed infestation. This can subsequently lead to problems such as altered structure of habitats. Likewise, water quality will be affected and changes to drainage & hydrology characteristics will occur impacting on road asset. The installation of fish baffles to existing structures have impacted upon the hydrology of the structure and in particular affected some 'evacuation routes' as flood immunity has been reduced.

Lack of funding is a major contributor. This is as a result of not quarantining required funds for specific fauna structure maintenance and managing it with other competing priorities of the network. Priority for maintenance has always been safety first and as such other requirements fall short of attention. This not only includes environmental requirements but the road asset itself such as preventative measures.

Economical maintenance issues very much depends upon the priority placed on how much you value the asset. For example, the growth of vegetation 300 mm high is both acceptable and unacceptable depending upon the value placed upon the asset. It could be considered acceptable in rural environments, whereas in urban, this may be unacceptable. The same can be said for cost of maintenance of any part of the asset. If it is adequately valued, you simply have to make funding available.

At home, especially if you are a keen gardener, you may have immaculate gardens. The question is what would you do if you were made redundant and could no longer afford to maintain the gardens? You have to make harsh choices.

10.50am **Thursday 7 May 2009**

Design for both mitigation and traffic safety

Alan Chenoweth
Director, Chenoweth Environmental Planning and Landscape Architecture

Biography

Abstract

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11.10am **Thursday 7 May 2009**

Retrofit or new – it's amazing what a fishway can do

Ross Kapitzke
Environmental Engineer, James Cook University, Queensland

Biography

Ross Kapitzke is an Environmental Engineer specialising in multipurpose planning and design for waterways, with a particular focus on aquatic habitat and connectivity for fish and other aquatic fauna. Ross works through the School of Engineering and Physical Sciences at James Cook University and undertakes fish passage planning and design for Department of Main Roads, Brisbane City Council, design consultants and other agencies in Queensland. His work includes assessment, design and evaluation for aquatic connectivity and aquatic habitat enhancement; and design, development and testing of fishway facilities and fish passage devices for small waterway structures. Ross is undertaking a number of aquatic connectivity and habitat enhancement projects in Brisbane waterways, and has several prototype fishways operating in north Queensland and in Brisbane.

Abstract

Mitigation of impacts for aquatic connectivity is not a new concept for linear infrastructure projects in the northern hemisphere, where fish passage facilities have been successfully incorporated into road crossings and other waterway structures for some time. Barrier mitigation measures for Australian waterways are not yet well established however, and techniques cannot merely be translocated from other areas due to distinct differences in fish movement behaviour, waterway characteristics, and structure configurations. Nevertheless, waterway structures (e.g. road culverts, grade control, channelization) represent significant barriers to upstream migration of native freshwater fish and other aquatic fauna due to adverse hydraulic conditions (e.g. high velocity, shallow water depth, water surface drop). Aquatic connectivity impacts can be substantial for linear infrastructure projects that cross fish movement corridors with significant aquatic habitat values and aquatic fauna communities relying on migration for habitat colonisation or essential life cycle stages (e.g. spawning or growth). Just as the potential impacts are large, so too are the potential ecological and biodiversity benefits for linear infrastructure projects that can be achieved through appropriate corridor planning for aquatic connectivity, and through adoption of fish passage technology suited to Australian conditions.

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This paper identifies potential impacts on aquatic connectivity at road crossings and other waterway structures, and outlines planning and design approaches to mitigate barrier impacts, while meeting drainage, utility and other multipurpose requirements for the sites. Solutions to fish passage barrier problems are described, including innovative fishway facilities incorporating ramps, baffles and other devices in culvert and other waterway structures. Whilst bridges and arches are often the best solution, these measures need not necessarily be mandated to achieve aquatic connectivity goals. The approach taken goes beyond speculative unproven notions that fail to meet multipurpose requirements for fishway design, or other ad hoc measures such as merely placing rocks as roughening elements within the culvert barrels. It considers fish passage barriers through all hydraulic zones leading from downstream to upstream through the structure (e.g. downstream channel / culvert outlet / culvert barrel / culvert inlet), and provides for suitable hydraulic conditions, including flow continuity and attraction flows, for upstream fish passage. This approach can be used to address potential fish passage impacts in new projects, and for remediation of fish passage barriers through retrofit of existing structures.

Designers, scientists, environmental managers and other practitioners will benefit from this presentation, which will describe fish passage consulting, research and development activities undertaken through the School of Engineering and Physical Sciences at James Cook University. This includes design conceptualisation of fishway devices, development and testing of prototype fishway facilities, hydraulic laboratory model testing and evaluation of fishway designs, and hydraulic and biological monitoring and evaluation of fishway facilities in field conditions. Fishway planning and design will be illustrated with various fish passage projects undertaken for Department of Main Roads and other agencies in Queensland. The presentation will demonstrate the amazing outcomes that can be achieved for aquatic connectivity in linear infrastructure projects through careful conceptualisation, development and application of fishway facilities – either retrofit or new.

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11.30am **Thursday 7 May 2009**

One size does not fit all: how to manage frogs and semi aquatic wildlife

Dr Andrew Hamer
PostDoctoral Fellow, Australian Research Centre for Urban Ecology, Royal Botanic Gardens, Melbourne

Biography

Dr. Andrew Hamer is a Post-doctoral Fellow (Ecologist) at the Australian Research Centre for Urban Ecology. Andrew completed his PhD in 2003 at the University of Newcastle on the ecology of the green and golden bell frog. His PhD research contributed to a wetland restoration project and the management of an extant population on Kooragang Island in the Hunter estuary. Andrew has worked as an environmental consultant since 1995 in several companies and has completed numerous flora and fauna assessments and monitoring projects in New South Wales and Victoria. As a consultant, Andrew has assessed the impacts of proposed linear infrastructure projects on flora and fauna. Andrew has monitored populations of threatened frogs as part of new road developments, including the green-thighed frog and growling grass frog. Andrew has published over ten scientific publications in leading conservation journals on the ecology of amphibians. Andrew is currently engaged in several research projects on the ecology of frogs in urban areas.

Abstract

Andrew Hamer[1] & Aaron Organ[2]

[1]*Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne, c/o School of Botany, University of Melbourne, Parkville, VIC 3010, Australia;*
[2]*Ecology Partners Pty. Ltd., 420 Victoria Street, Brunswick, VIC 3056, Australia*

Amphibians and semi-aquatic reptiles such as freshwater turtles usually require a landscape mosaic of wetlands and waterways, as well as terrestrial habitats nearby in order to maintain viable populations. Many species make overland movements between ponds, swamps and streams during the breeding season or to find suitable overwintering sites. Roads can fragment wetland landscapes and result in high road mortality of individuals if they are constructed across

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movement routes or in close proximity to wetlands and waterways. Road construction can also destroy habitat for frogs and other semi-aquatic species. A range of factors indirectly affect these species within the "road-effect zone" that for some species of frogs is 800 m wide on each side of the road. The best way to mitigate potential impacts on these fauna from new road construction is to avoid locating the road in movement corridors and between wetlands. Where this is not feasible, specifically-designed fauna underpasses coupled with barrier fencing may facilitate movement between habitats that are fragmented by new roads, and reduce the risk of roadkill. Underpasses constructed to mitigate road impacts on species in North America and Europe have had demonstrated success in reducing roadkill. The destruction of wetlands during road construction is often "offset" by creating new wetlands nearby, although the effectiveness of this mitigation option over the long-term is uncertain.

We present a case study of mitigation measures implemented along the newly-constructed Pakenham Bypass on the south-east fringe of Melbourne that aimed to reduce the impact of habitat fragmentation and road mortality on the growling grass frog (*Litoria raniformis*), a nationally-listed threatened species on the *Environment Protection and Biodiversity Conservation Act 1999*. Ten underpasses and 32 ponds were created over a 20 kilometre stretch of the road to facilitate the movement and habitat requirements of this species in the local area. Monitoring of the population of *L. raniformis* has been conducted annually during the breeding season (September to March) since 2003 in order to determine if the new road is impacting on the population. Existing and newly-created waterbodies within one kilometre of the road were surveyed at night. Mark-recapture methods were used at six ponds to determine if individual frogs had moved across the road. The species was detected at around half of the waterbodies surveyed and new ponds were colonised. However, no movement of marked frogs across the road has been recorded.

Despite the proven effectiveness of underpasses to mitigate the impacts of roads on frogs and freshwater turtles in overseas studies, Australian studies have rarely documented the use of underpasses by these fauna. Future research on the effects of roads on frogs and other semi-aquatic species needs to be directed towards assessing the long-term use of underpasses and mitigation wetlands, and assessing the indirect impacts of roads on populations.

Notes:

1.00pm **Thursday 7 May 2009**

What can we learn from Roadkill?

Erin Roger
PhD candidate, School of Biological, Earth and Environmental Science, University of New South Wales

Biography

Erin is in her fourth and final year as a PhD candidate at the University of New South Wales. Her PhD project examines the survival and distribution of common wombats in road environments. The primary theme of Erin's work is the impact of human induced disturbance on common species and how these impacts can be mitigated. Erin has published the results of her PhD work in international journals such as *Biodiversity and Conservation* and *Diversity and Distribution* and presented her work at both international and national conferences as well as local radio. Her doctoral research will contribute to the field of road ecology by providing diverse, large-scale empirical data on selected issues of wombat ecology, using multidisciplinary approaches with focus on quantitative analysis. Erin is also a member and scientific advisor of Sydney's north shore Roadkill Committee Group. Erin also teaches at the University of New South Wales in the areas of Conservation Biology and Geographic Information Systems. She has also served as a contractual consultant to DEWHA and has broad interests in conservation and environmental policymaking.

Abstract

Over the next few decades, planning for rapid urbanisation that maximises human welfare and sustainability will be one of the greatest challenges to ensuring a sustainable global environment. The rapidly developing field of road ecology highlights a critical gap in our knowledge of current threats to biodiversity. The increasing evidence for population-level effects of roads and traffic on species reaffirms the importance of utilising road research in the decision-making process and the need to routinely consider mitigation in road construction projects. Recent studies have highlighted the importance of quantitative analysis in identifying the different mechanisms by which roads affect population persistence. Population modelling represents a sound method for assessing the effect of roads on animal abundance and persistence. It enables the explicit testing of competing management strategies for mitigating potential impacts and allows for sensitivity analysis of those parameters causing susceptibility.

In this presentation I discuss results from my doctoral work which aims to quantify the dispersion and survival of a common species in road-impacted environments. Three

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central themes have emerged from this work. Firstly, the need to pay increased conservation attention to common species, including the importance of identifying, monitoring and mitigating depletion events. Secondly, recognition of the variation in threatening processes across landscapes, and the need to understand how these threats operate in conjunction with each other. Thirdly, the importance of viewing landscapes as dynamic continuous habitat; moving away from the restricted view of roads as linear features. Doing so will aid in predicting how habitat features interact with organisms to affect their ability to persist across real landscapes. To this end, we emphasise the complex and non-linear nature of natural resource management and, thus, the importance of adopting multi-levelled integrated policies.

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1.20pm **Thursday 7 May 2009**

The importance of monitoring ground-dwelling animals and birds to inform planning and evaluate success

Associate Professor Darryl Jones
Centre for Innovative Conservation Strategies, Griffith University, Queensland

Biography

Darryl Jones is an Associate Professor in the Griffith School of Environment, Griffith University and is currently Director of the Centre for Innovative Conservation Strategies. He holds a Master in Natural Resources from the University of New England (Armidale, NSW) in wildlife management and a PhD in behavioural ecology from Griffith University. These two strands of his academic training – the applied and the pure – continue to inform his research. While maintaining his life-long interest in mound-building birds, he now concentrates on urban ecology – especially the management and conservation of the wild animals that live with us in the suburban environment. He is the author of six books including *The Megapodes* (1995, Oxford), *Magpie Alert: Learning to Live with a Wild Neighbour* (2002 UNSW Press) and *Mound-builders* (2008 CSIRO) and over 100 scientific papers. As well as formal science publishing, he is deeply committed to communicating to the public and writes many popular articles as well as a regular column on urban wildlife in *Wildlife Australia* magazine.

In 2004 he was asked to assist in designing a series of safe fauna crossing structures over Compton Road in southern Brisbane. Since then he has continued to monitor the remarkable use of the Compton Road Fauna Array by a huge variety of species, bringing this site to international attention. As a result of the success of this work, his road ecology research group is now involved in many different

Notes:

projects including the Ipswich and Gateway Motorway upgrades, Gap Creek Road and many fauna crossing studies in Brisbane, Redlands, the Gold Coast and Western Australia.

Abstract

Although large numbers of fauna crossing structures – especially culverts and overpasses – have been constructed throughout the world, the extent to whether these have been used by animals has only rarely been studied. Where monitoring of fauna use has occurred, this has often been for relatively brief periods of time. This lack of information has significant undermined evaluations of the effectiveness of these structures. Furthermore, although almost all studies of such structures have shown that animals do use them, it is not always clear what 'success' means. This presentation will address these issues with reference to the long-term monitoring of the Compton Road Fauna Array. As well as evidence of crossings by terrestrial mammals, the importance of overpasses as habitat for reptiles, amphibian and birds will be discussed.

Notes:

1.50pm **Thursday 7 May 2009**

The Challenges of monitoring gliders

Dr Ross Goldingay
Senior Lecturer, School of Environmental Science and Management, Southern Cross University, New South Wales

2.10pm **Thursday 7 May 2009**

Habitat quality on Landbridges: it's the little things that matter

Dr Tracey Churchill
Environmental Scientist, EcoSpider Consulting, Queensland

Biography

Abstract

Notes:

3.00pm **Thursday 7 May 2009**

The Queensland Wet Tropics: A case study in best practice planning through interdisciplinary collaboration

Dr Miriam Goosem Senior Research fellow, James Cook University, Queensland
Nigel Tucker Director/Senior Environmental Scientist , Biotropica Australia P/L, Queensland
David Rivett Principal, Environment North P/L, Queensland
Bruce Jennison Principal Conservation Officer, Wet Tropics Management Authority, Queensland

4.00pm **Thursday 7 May 2009**

The future of breaking the barriers

Introduction by **Amelia Selles** - Program Officer Flora and Fauna, Planning Section, Natural Environment and Sustainability Branch, City Planning and Sustainability Division, Brisbane City Council.

Poster Abstracts

Road Impacts on Wildlife: Statistics from the Australian Wildlife Hospital and the need for continuing investigation into the impact of roads on herpetofauna and further development of mitigation strategies.

Ben Nottidge (Senior Ecologist, Ecological Services Unit – Australia Zoo Wildlife Warriors Worldwide Ltd)

The Australian Wildlife Hospital (AWH) at Beerwah, South-east Queensland admits over 4000 sick, injured and orphaned wildlife each year. In the last year (2008), 34% of the total wildlife admitted were victims of road trauma. These victims included koalas, macropods, possums, gliders, echidnas, reptiles, amphibians, bats and birds. Since the Hospital's inception in 2004, a total of 3,730 or 22% of wild animals have been admitted as a result of road trauma however, the actual numbers would be considerably higher as not all wildlife injured on roads are admitted to the AWH. The cost to treat and rehabilitate wildlife injured from road trauma can be significant with a single Koala costing up to $4000 per hospitalisation over an average two month stay at the hospital.

The recorded statistics for herpetofauna (frogs & reptiles) are likely to be an under representation of the actual impact. This is probably due mainly to their colouration and often small size which makes them more unlikely to be avoided by drivers and also less likely to survive road strike and therefore be taken to a treatment facility.

Few studies have examined the impacts that roads may have on herpetofauna when compared to various mammals species and as a consequence, mitigation measures usually focus on mammal species in the form of fences and over passes. The few studies that have been completed in northern NSW and the Sunshine Coast found that significant numbers of threatened frog species (Wallum Sedgefrog and Wallum Froglet) may be killed as a direct result of road strike during times of activity where suitable habitat exists adjacent to roads.

In situations where mitigation measures (e.g. underpasses, fences) are proposed to reduce the impact of transport corridors, the biology and ecology of the target species should be understood to ensure the structures and materials used will be the most effective in preventing such species from entering a road or other corridor. Monitoring and maintenance is also an essential part of mitigating the impacts of roadkill as it can provide valuable information on strategies to improve future designs and also ensure structures aren't damaged and are still fulfilling their desired function.

Speed signs to prevent road kill: Lessons from the Koala Coast speedzone trial

David S. Dique, Jim Thompson, Harriet J. Preece*, Guy C. Penfold, Deidré L. de Villiers*, Ros S. Leslie

*Currently with Department of Environment and Resource Management (DERM)

Road signs and speed reduction are frequently recommended to mitigate road kill throughout the world. However, the success of these measures is rarely quantified. The Koala Speed Zone Trial was conducted between 1995 and 1999 to assess the effect of differential speed signs on the number of koalas (*Phascolarctos cinereus*) hit by vehicles in the Koala Coast. Based on information collected by Queensland Parks and Wildlife, 1407 koalas were hit by vehicles during the five year study (mean 281 koalas per year, range 251-315). Results of vehicle speed monitoring by Queensland Department of Main Roads suggested that there was no significant reduction in vehicle speed during the trial period which ran from August to

December to correspond with the breeding season. Consequently, there was no evidence to suggest that a reduction in the number of koalas hit by vehicles occurred during the trial. Approximately 70% of koalas were hit on arterial and sub-arterial roads and approximately 83% did not survive. The majority of koalas that were hit by vehicles were young healthy males, although the loss of 142 females per year is likely to be impacting heavily on the viability of the population. Koalas hit on roads with lower speed limits had slightly higher survival rates than koalas hit at higher speeds. However, vehicle speed was not the only factor that affected the number of koalas hit by vehicles. It is suggested that habitat destruction, koala density and traffic volume also contribute to road-associated koala mortality in the Koala Coast.

Note: this poster is based on the following published work:

Dique, D. S., Thompson, J., Preece, H. J., Penfold, G. C., De Villiers, D. L., and Leslie, R. S. (2003). Koala Mortality on Roads in South-East Queensland: the Koala Speed-Zone Trial. *Wildlife Research* **30**, 419-426.

Genetic approaches: essential tools for best-practice assessment, monitoring and mitigation of organismal responses to human transportation networks

Sunnucks, Paul[1], Taylor, Andrea[1], van der Ree, Rodney[2], Cesarini, Silvana[1], Herrod, Ashley[1,3], Troy, Shannon[1,4], Simmons, Jody[1].

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There is great concern about how landscape change will affect the persistence of native plants and animals. The science of population genetics (particularly 'molecular ecology' / 'landscape genetics') makes contributions that are otherwise impractical or impossible to the analysis and monitoring of landscape change. It can yield powerful information about where individuals and species move, what landscape features and arrangements constitute connected habitat versus filters/barriers, and help to parameterize assessments of whether any restricted mobility matters.

It is a common misconception that genetic signatures of landscape change take many generations to accumulate. In fact, genetic approaches can detect changes in population processes over years or decades - ie on a timescale relevant to monitoring and mitigation of the impacts of human transportation networks. The same genetic data that can infer mobility of individuals are also suitable for estimating gene flow at landscape scales, effective population sizes and trajectories. Coupled with a single capture per individual being sufficient for most purposes (in contrast to many traditional approaches) this makes molecular population genetic approaches highly efficient and even irreplaceable tools in assessment and monitoring. They are also cost-effective – consumables costs are around a modest 20% of payroll.

We outline some major attributes of genetic approaches in landscape management with specific reference to road networks, with examples drawn from our current program focussed on vertebrates living around sections of a major road less than 30 years old, the Hume Highway in southern Australia.

Enough about the birds (and mammals), what about the bees and the flowers and the trees?

SMEC has been involved in a range of infrastructure projects both nationally and internationally. SMEC have recently completed a review of mitigation measures to deal with the issue of habitat fragmentation by major linear infrastructure in conjunction with the Australian Research Centre for Urban Ecology for DEWHA.

SMEC has designed a number of innovative movement structures for vertebrate fauna as part of large infrastructure projects, for example:

- Fauna overpass and underpasses on road upgrades projects (specifically Hume and Pacific Highway);
- Fauna movement structures and design considerations for Gliders on road upgrades projects (specifically Hume and Pacific Highway);
- Fish friendly and amphibian friendly culverts on road upgrades projects (specifically Hume and Pacific Highway);

However, SMEC considers that one of the major impacts of large infrastructure projects, the alteration of flora species and communities from the creation of barriers to reproduction and alterations to hydrological regimes, is equally important as the measures being instated for charismatic animals.

The SMEC design and environmental team is currently working on the implementation of a number of innovative initiatives for the mitigation of impacts to these often overlooked impacts. This involves constructing pollinator (wasp) movement structures for threatened flora species, and ensuring water flow patterns are optimised and hydrological regime changes minimised for low-lying, water dependent endangered ecological communities. This also includes the installation of low flow channels within culverts to ensure the health of river and creek systems and innovative design to ensure continual flow of natural springs to wetland areas.

These projects will become the focus of the poster presentation which will look beyond previous methods of mitigating habitat fragmentation and focus on environmental design that maximises the retention of ecological communities as a whole.

Rodney van der Ree[1], Kylie Soanes[1], Sarah McCall[1], Silvana Cesarini[2], Chris Stewart[1], Nadine Gulle[1], Paul Sunnucks[2], Andrea Taylor[2]

[1]Australian Research Centre for Urban Ecology, C/- School of Botany, University of Melbourne, VIC, 3010.
[2]School of Biological Sciences, Monash University, Clayton, VIC

Few studies have quantified the barrier effect of roads with enough scale and replication for the results to be extrapolated in future decision making processes, and fewer have investigated the long term effectiveness of fauna crossing structures. Consequently a collaborative research project was undertaken which adopted a multispecies, large scale approach to determining the impact of an existing major road on local wildlife populations. The project also aimed to install several crossing structures and evaluate their effectiveness in mitigating the barrier effect of major roads on wildlife. Major partners in the project include VicRoads, Australian Research Centre for Urban Ecology, Melbourne University and Monash University.

Extensive trapping of possums and gliders at 23 highway, and 9 control sites was conducted over 2.5 years through several separate yet corresponding studies gathering information on the size, annual survival, demographics and genetic structure of local populations of arboreal mammals. Simultaneously conducted radiotracking surveys established home range and movement patterns. Road crossings of the highway were rarely detected, and only occurred at sites with tall vegetation in the highway median strip.

These results were used to determine priority sites for mitigation structures, both gliding poles and rope bridges, which were installed in mid-2007. The rope bridges were fitted with motion-activated cameras at each end to enable detection of complete crossings by wildlife. Ongoing monitoring over the following 18 month period has demonstrated the successful and repeated use of both types of crossing structure by several species of arboreal mammal. We will discuss the rate of use of the mitigation structures and highlight our approach to evaluate effectiveness at reducing the probability of extinction.

Fauna Connectivity and the Frankston Bypass (Peninsula Link) project, Melbourne, Victoria.

Mark Venosta, Senior Consultant Zoologist, Biosis Research Pty Ltd

The proposed Frankston Bypass will link to the existing Mornington Peninsula Freeway/EastLink connection at Carrum Downs and reconnect with the Moorooduc Hwy at Mount Martha, Victoria. The project has recently received state government approval.

The majority of fauna habitat within the road reservation is found in the northern section where areas such as The Pines Flora and Fauna Reserve, Willow Road Reserve and other large patches of indigenous vegetation provide linkages to other patches of surrounding habitat. The bypass will create a barrier to fauna movement in these areas.

Retaining fauna connectivity has been a key focus of the project within The Pines Flora and Fauna Reserve, where a known population of the nationally significant Southern Brown Bandicoot *Isoodon obesulus obesulus* exists. The bandicoot population is likely to be small and as such will be very susceptible to any negative impacts from road development. The reserve also provides habitat for a range of fauna once found more widely on the Mornington Peninsula.

This poster presents the proposed fauna connectivity measures and further work required both pre and post construction, which include a dedicated bridge underpass and multiple dedicated fauna culverts. Surveys that ascertain the current bandicoot population size are required and will need to continue during, pre and post construction to monitor the population and indicate the extent to which the structures are used. Land acquisition and revegetation will increase the area of adjacent habitat and predator control should improve population size and aid in countering negative effects of the bypass.

Avoiding, remedying, mitigating – a case study of flora and fauna management for a transmission line project in south-east Queensland

Jodi Rees – Senior Environmental Scientist, Parsons Brinckerhoff
Meredith Woodland – Senior Environmental Scientist, Parsons Brinckerhoff
Tatia Zubrinich – Environment and Communications Executive, Parsons Brinckerhoff

Parsons Brinckerhoff was commissioned by Powerlink Queensland to prepare an Environmental Impact Statement (EIS) and Environmental Management Plan (EMP) for the proposed 275/330 kV transmission line between Middle Ridge and Greenbank substations in south-east Queensland. The 108 km route traverses a range of habitat, including mapped remnant vegetation and cleared farmland.

Parsons Brinckerhoff conducted detailed site assessments of the alignment, including targeted studies for threatened species. The critically endangered Commonwealth-listed threatened ecological community, 'Swamp tea-tree (*Melaleuca irbyana*) forest of south-east Queensland' occurs in several places. This community as well as several threatened species triggered a referral to the Department of the Environment, Water, Heritage and the Arts. Seven 'not of concern', two 'of concern' and three 'endangered' remnant vegetation communities occur along the alignment, as well as five conservation areas. Wetlands of bioregional importance are also present.

The alignment traverses essential habitat for *Petrogale penicillata* (brush-tailed rock wallaby) and potential habitat for *Calyptorhynchus lathami* (glossy black-cockatoo). *Phascolarctos cinereus* (koala) was recorded at several locations, with extensive areas of habitat present. *Plectranthus habrophyllus* (no common name), *Melaleuca irbyana* (swamp tea-tree), and *Corymbia henryi* (large-leaved spotted gum – locally significant) were also recorded. Mitigation measures include detailed input into Environmental Work Plans, raising tower heights to span remnant vegetation, negotiating placement of towers to maximise spanning gullies, adjusting the alignment to avoid sensitive habitat/individual threatened species, lopping vegetation rather than mass clearing, using minimal disturbance techniques, using helicopter stringing over significant vegetation, utilising existing maintenance tracks, avoiding clearing along creeks and drainage lines, retaining vegetation along gully lines and on steep slopes, implementing pest management plans, implementing a revegetation program where clearing is unavoidable, contributing to local environmental management strategies (e.g. conservation areas), retaining hollow bearing trees and fauna feed trees where practical, avoiding raptor nests, utilising a fauna spotter/catcher during construction, and maintaining microhabitats.

Power to the birds

Butch Rossouw, Parsons Brinckerhoff, Brisbane

Steady decline in the numbers of the Cape Vulture, Gyps coprotheres, over the last decade has been experienced in South Africa, due to reduced breeding success, indiscriminate use of poison (mainly strychnine) and electrocution on powerlines, specifically as a result of roosting above insulators within the tower structure. Similar issues with low voltage powerlines have been experienced in Australia. The Cape Vulture is a large highly gregarious, carrion feeding bird, with a wingspan of 2.5 metres. Eskom power utility in South Africa, initiated a program focussing on engineering design innovation to develop mitigation strategies to prevent vulture mortalities. While electrocution of the birds resulted in death to the bird, it also had a knock-on effect for the power utility in that circuit flashovers within the electrical supply resulted. This affected the quality of supply to end users and increased maintenance costs to Eskom as a result of regular circuit breaker replacement. Electrocuted birds were also the cause of numerous bushfires. It was therefore in the interest of Eskom to develop a preventative strategy through engineering design to prevent the birds from roosting within specific zones of the tower structure.

A range of engineering design solutions was trialled over a period of approximately 4 years. Some options proved difficult to maintain, while some gave rise to other issues such as increased visual impacts through flicker effects. Other options were unsuccessful and resulted in increased bird mortality as a result of the devises injuring birds.

The preferred design solution gradually evolved over this period to a point where a retrofitted devise was selected for installation above existing insulators. This not only addressed the desired outcomes of the power utility by enhancing quality of supply and reducing maintenance costs, but also benefited the Cape Vulture, in that the number of vulture electrocutions decreased.

Life on the Edge: the effects of road proximity on the spatial distribution and density of lizards.

Micaela Main[AB], Jody Simmons[C], Paul Sunnucks[C] and Rodney Van der Ree[A]

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[B] Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment (DSE), 123 Brown Street Heidelberg, VIC 3084, Australia

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The road network in parts of Australia is distinct in that it often supports remnant strips of vegetation, including roadside verges, un-used road reserves and travelling stock reserves. These parallel and adjoining perpendicular strips of remnant vegetation have the capacity to support numerous species of fauna. This study investigated the ability of roadside vegetation in the Northern plains of Victoria to support reptile populations and examined the effect of proximity to the Hume Freeway on skink abundance. We compared the abundance of individuals in road reserves located perpendicular to the Hume freeway and at increasing distance from the freeway. We also compared the abundance of individuals in the freeway verge at varying distances from the perpendicular road reserve. Across nine sites, 228 pitfall traps were established in both the freeway verge and the road reserve. Out of the six species of reptile captured (five from the family Scincidae, one from the family Gekkonidae), three species *Carlia tertradactyla, Lampropholis guichenoti* and *Morethia boulengeri* made up 94.6% of the total number of captures. Detailed statistical habitat models were constructed for the three main species and the sum of all species using generalised linear mixed modelling. Both *L. guichenoti* and *M. boulengeri* demonstrated an increased abundance at distances closer to the freeway, as did the sum of all species. *L. guichenoti* also demonstrated an increased abundance of individuals in the freeway verge at distances closer to the adjoining road reserve. We will discuss the potential influences of vegetation structure and prey distribution that may contribute to this trend in density distribution and possible future management implications.

Linear infrastructure impacts, investigation and mitigation efforts in a high voltage electricity transmission line context.

Powerlink Queensland is undertaking research investigating the impact of lineal infrastructure in North Queensland on a critically endangered glider species, the Mahogany Glider (*Petaurus gracilis*). Research has been investigating movement patterns of this species within a habitat area which is bisected by a number of transport and utility corridors. Research outcomes will allow a quantification of the effects of electrical transmission easement corridors on the movement patterns of this species and allow better informed mitigation/management of these impacts during future construction works through glider habitat areas.

A separate refurbishment project has been undertaken on a large number of transmission structures in inland Queensland to mitigate a recently recognised impact of transmission structure design on glider species. It has been recognised that barbed wire anti-climbing devices in areas where transmission lines bisect high risk habitat areas have resulted in some gliders becoming entangled during easement crossing events. The project involved the removal of the old anti-climbing barriers and replacement with Powerlink designed and tested glider friendly structures.

A number of easement crossing barrier mitigation measures have been implemented by Powerlink on recent transmission line construction projects including nest boxes, glider poles, over-canopy transmission line design, incorporation of linkage corridors and selective clearing practices to encourage desirable species on easements.

The intent of this poster is to instigate discussion on potential and recognised impacts of linear infrastructure corridors on species and potential mitigation measures.

Effects of linear infrastructure, in particular the Pacific Highway Upgrade in NSW, on wildlife.

The poster relates to the identification and mitigation of the effects of linear infrastructure, in particular the Pacific Highway Upgrade in NSW, on wildlife. It is clear that roads and other linear infrastructure exert a range of effects on the natural environment. Often these impacts can be negative, unless appropriately considered and addressed.

Cover topics spanning the planning, design, installation, maintenance and monitoring of ecology projects designed to identify and ameliorate effects associated with major road projects.

The discussion covers examples of the additional measures undertaken by construction project teams in order to achieve good environmental outcomes when confronted with challenging issues once a project is approved and construction has begun.

Background

Officers from the NSW Department of Environment and Climate Change (DECC) actively participate in the route selection, design and construction of the Pacific Highway Upgrade. With a project of this magnitude and State significance, it is impossible to entirely avoid impacts to existing native vegetation and high conservation value landscape features.

Nonetheless, contractors, the NSW Roads and Traffic Authority (RTA) and DECC have often been able to identify innovative ways to reduce or avoid the impacts to biodiversity values or features initially planned for clearing.

This poster focuses on examples of retention and, in some cases, improvements to key natural features that are immediately adjacent to or within the planned road corridor. These natural features reduce the impact of a four lane highway whilst contributing to connectivity and habitat values.

Cost of structures

Due to cost and practicality constraints, it is not possible to construct land bridges, fauna underpasses and bridges over riparian areas at every location where the proposed motorway intersects such features. Rather, the focus is to strategically place well designed fauna connectivity structures to mitigate the barrier effects of the upgraded Pacific Highway.

A high-end structure, like a land bridge, can provide greater opportunity for a larger diversity of species than can a low end structure that is species-specific, like an invert pipe for fish. The cost of high-end structures such as the 'land bridge' on the Bonville upgrade, south of Coffs Harbour on the northern NSW Coast, is considerable and monitoring is used to provide data to guide future decision making regarding investment in various structure.

Planning and design stage

Costs can be reduced if all important factors, such as significant hollow trees, location of endangered ecological communities (EECs), stands of threatened flora species and key breeding habitats are identified early in the process. This allows design and strategic location to take these factors into account and saves additional costs in modifying design to accommodate such factors during the project.

Construction stage

During the highway construction phase, DECC consults closely with site environmental managers and RTA project staff to provide an ongoing biodiversity conservation expertise. Within the approved alignment, there can be scope for design refinement to avoid significant vegetation. An example of this is the work done to protect the *Angophora inopina* population on the Bulahdelah Upgrade.

During construction, it can become apparent that certain key habitat or biodiversity features can be retained. The poster will present a number of examples to illustrate effective biodiversity outcomes:

- Habitat tree preservation efforts at Coopernook to Herons Creek Upgrade
- Under-boring for the installation of transmission lines to facilitate glider crossings at Coopernook to Herons Creek - connecting existing habitat (at canopy height) with the rope bridge crossing
- Retention of vegetation at fauna underpass exit point at the Karuah to Bulahdelah Upgrade to retain existing tall native vegetation to maintain habitat connectivity and encourage early utilisation of the crossing structure.

Threatened species encounters

The greatest loss of habitat and impacts to wildlife occur during clearing and construction. Planning for the Pacific Highway Upgrade is extensively researched, carefully planned and involves significant involvement of government and external expertise.

Nonetheless, unforseen encounters with threatened species may occur on-site once construction commences. This is due to dynamic fauna patterns, seasonal movement and the often cryptic nature of wildlife.

In these cases the RTA and its contractors have responded by successfully providing additional mitigation measures. Examples include, extensive additional temporary exclusion fencing at Bonville to prevent Koala mortality during construction, and additional Wallum Froglet mitigation measures including fencing, culverts connecting habitat and monitoring populations at the Bulahdelah Upgrade. Pied Oyster-catchers bred successful on two occasions at the Brunswick Upgrade, largely due to additional measures instituted during the construction phase.

Conclusion

Through the planning, construction and maintenance stages of the Pacific Highway upgrade, there have been opportunities to refine design and construction approaches to improve biodiversity protection and conservation. This has been achieved through a number of approaches, including connectivity of habitats and maximising the retention of those features which allow a species to successfully survive in an area.

Reasonable ongoing monitoring has been adopted and is used to provide input to assist assessment of mitigation structures to ensure road funding maximises the benefits of the measures implemented. It is through the early design and assessment that this can be achieved, resulting in fewer design changes, and an acceptance and understanding of measures to be adopted and why.

Providing fauna crossing solutions on the Darra to Springfield Transport Corridor

The Horizon Alliance is incorporating fauna passage solutions in the design and construction of the Darra to Springfield Transport Corridor (DSTC). Stage 1 of the project includes constructing a new passenger railway line from Darra to Richlands and duplicating the Centenary Highway from two to four lanes between Richlands and the existing Logan Motorway interchange at Carole Park. This stage is due for completion in 2011 at an estimated cost of $800 million.

The DSTC Project passes through regionally important habitat in Greenbank Military Training Area and associated creeks (i.e. Bullockhead and Sandy Creek). Allowing provision for continued fauna movement has been a major environmental goal of the DSTC Project. Fauna crossing infrastructure (underpasses, rope ladders, glider poles and exclusion fencing) have been incorporated into detailed designs. Designated fauna crossings have been proposed along the length of the development. These coincide with known crossing locations along existing creek lines.

A monitoring program (combining sand track assessment and remote cameras) is being used to assess levels of fauna crossing before, during and after construction. The results of preconstruction and early construction monitoring indicate a diverse range of fauna cross beneath the Centenary Highway on a nightly basis, with movement increasing during the wet season. Fauna regularly recorded include macropods, bandicoots, rodents, possums, snakes, lizards and amphibians.

Existing fauna underpasses are periodically unavailable due to seasonal flooding. Ledges and raised culverts incorporated into underpass designs are expected to provide dry passage and reduce the seasonal disruption to fauna movement. Fauna crossing monitoring is ongoing and will contribute to knowledge on the efficacy of fauna crossing designs.

The project is being delivered by The Horizon Alliance – a collaboration between QR (Queensland Rail), the Department of Main Roads and John Holland Pty Ltd, GHD Pty Ltd and Kellogg Brown & Root Pty Ltd (KBR).

The effects of a major road on population processes of a small marsupial, Yellow-footed Antechinus *Antechinus flavipes*: evidence from genotypic analyses

Herrod, Ashley[1, 3], van der Ree, Rodney[2], Troy, Shannon[1, 4], Sunnucks, Paul[1], Taylor, Andrea C.[1]

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[4] Current address: School of Zoology, Hobart Campus, Life Sciences Building, University of Tasmania, Tasmania 7001, Australia

The original woodland habitat in northern Victoria has been largely cleared for agriculture, and less than 6% tree cover remains. Most remnant vegetation is arranged as narrow strips along streams and roadsides, with fewer, larger patches of habitat. Where the current study took place, Yellow-footed Antechinus *Antechinus flavipes* occurs within remnant roadside vegetation and road reserves (remnant linear strips of vegetation fragmented by farmland and dissected by major roads).

Genetic analyses are commonly used to quantify population processes for a variety of organisms and are informative at a range of spatial and temporal scales. For short-term and fine-scale population processes, a genotypic approach is appropriate. Using a genotypic approach with microsatellite loci, this study investigates dispersal and relatedness of Yellow-footed Antechinus between sampling locations on either side of the Hume Highway in southeastern Australia and genotypic structure of populations, to investigate the effects of the highway on Yellow-footed Antechinus at the population level.

The combination of genetic and traditional field ecology approaches was useful in determining the nature and extent of restriction to movement in the species via a filtering effect of the major road. The genotypic approach yielded information on population processes where a capture-mark-recapture method did or could not, including limited movement of individuals between sites separated by the highway, genetic differentiation of populations, and higher relatedness among individuals within populations on either side of the highway, than among individuals across the highway.

Wildlife Movement Solutions: Pinch-point Identification in Areas of Biodiversity Significance in Brisbane

E. Quinn [1], A. K. Selles [2] and G. Castley [3]

[1, 3] *Centre for Innovative Conservation Strategies, Griffith University, Brisbane, QLD*

[2] *Natural Environment and Sustainability Branch, Brisbane City Council, Brisbane, QLD*

Southeast Queensland is experiencing rapid growth. The expansion and construction of linear infrastructure, such as roads, is a key component of this growth.

The continual upgrading and addition of transport networks can result in fragmentation of habitat and ecological corridors, creating barriers to wildlife movement and dispersal. Biodiversity is therefore compromised because these areas are too small and/or isolated to sustain viable wildlife populations.

Pinch-points (sometimes called black-spots) are areas where habitat patches and ecological corridors are dissected by linear infrastructure, sometimes characterised by a high incidence of wildlife-vehicle collisions. Wildlife Movement Solutions are mitigation measures required to ensure connectivity across these pinch-points. They are defined as 'purpose-built, physical structures that increase the permeability of roads by facilitating safe passage of wildlife over or under it thereby enhancing connectivity, whilst preventing collision with vehicles'.

Brisbane City Council has created a benchmark for the implementation of Wildlife Movement Solutions with their project at Compton Road, Kuraby. Here Council set a national first for the greatest diversity of structures used in one location, including a completely vegetated fauna crossing bridge.

Brisbane City Council has subsequently overlayed its biodiversity asset mapping with its transport plan to produce a map that identified nine citywide priority areas for the implementation of Wildlife Movement Solutions. A detailed analysis is currently underway to identify pinch-points within these areas using a set of 17 criteria. These criteria draw on the available biodiversity information for these sites, as well as spatial information related to position and placement, to propose site specific solutions.

These mapping products and pinch-point analyses will then be utilised to inform a strategic citywide approach to Wildlife Movement Solutions aimed at retaining connectivity across the urban landscape.

Roadkill lessons for wildlife management

Danny Wotherspoon[1, 2] and Shelley Burgin[1]
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[2]Abel Ecology, Faulconbridge, Australia. info@abelecology.com.au

The study

- Roadkilled reptiles were recorded at an urban-bushland interface, on 2.0 km of low speed, low traffic volume roads in the Blue Mountains of New South Wales for seven years.
- Snakes and lizards, both nocturnal and diurnal were killed over most of the year, August to May:
  nine lizard species of 30 local species were killed
  nine snake species of 18 local species were killed.

The lessons to learn

- Roadkill has the potential to have a high impact on biodiversity.
- Species-specific behaviour can account for roadkill and thus be the basis for ameliorative road design and management

- Off-line alternate basking sites can be designed and constructed at low cost to provide structural habitat for reptile fauna.
- Design of such basking sites can take into account the differences in behaviour and habitat requirements of species occurring in any particular area.

Outcome
Low-cost off line alternate basking habitat designed for the needs of particular local species is expected to reduce roadkill.

Embracing Partnerships to Protect & Enhance Significant Remnant Vegetation

Strong and enduring partnerships have been developed between Landcare, Regional Councils, Main Roads and other stakeholders to deliver a major project that seeks to ensure the sustainable management of natural resources in the region. The '**Embracing Partnerships to Protect & Enhance Significant Remnant Vegetation**' project embraces a commitment from key stakeholders to strategically manage remnant vegetation along linear reserves (roads) and on adjoining private properties to achieve positive environmental outcomes.

Toowoomba, Southern Downs and Dalby Regional Councils, Main Roads, Department of Natural Resources and Water and five Regional Landcare Groups have all committed to the strategic and coordinated management of remnant vegetation along linear reserves and on private properties. This project has embraced the Landcare ethic of working holistically across the landscape to achieve positive outcomes. As such, linear reserves are seen as an integral component of the landscape.

A four step process

Implementation of this ongoing project has comprised four steps:

1. Development of enduring partnerships between Councils, Landcare Groups, landholders, Government Departments and Landcare to achieve sustainable natural resource outcomes,
2. Increased biodiversity values through coordinated management and connection of remnant vegetation throughout the Darling Downs region,
3. Implementation of Best Management Practices that address linear reserve management (especially road maintenance and construction) that contribute to positive environmental outcomes
4. Increased skills and knowledge of all stakeholders through workshops and technical extension activities.

An important component has been the development and implementation of an incentives program for Landholders and Council contributing to the adoption of Best Management Practices public and adjoining private lands.

Monitoring and evaluation has been undertaken of workshop participants using a 'Dartboard" method which has shown high level of preparedness to change existing work practices.

Squirrel Glider review for Morisset Structure Plan area, Lake Macquarie City Council (Fallding, M P & Smith, A P 2008)

The Squirrel Glider *Petaurus norfolcensis* is a listed threatened species which is widely distributed within Lake Macquarie local government area in NSW. The Morisset Structure Plan area forms part of the habitat for a population of the species occurring within the Wyong – Lake Macquarie area which is of state and

national significance. This population is being adversely affected by habitat clearing and fragmentation arising from urban development.

Squirrel Glider population, size and distribution, viability and habitat connectivity in the area was reviewed to inform the review of options for future land use, and the preparation of a structure plan for future urban development. The Morisset Structure Plan covers an area of 746 ha within a larger review area of approximately 3,500 ha

The biology of this species is sufficiently well understood to be able to take into account its habitat requirements in determining future land use. Studies show that density and probability of occurrence of Squirrel Gliders in native vegetation remnants increases significantly with increasing remnant size, decreasing distance to the nearest remnant, increasing size of the nearest remnant, and the occurrence of habitat corridor links.

A GIS analysis was undertaken to review conservation significance and to identify realistic land use options and their implications for the future of this species. Minimum habitat sizes for maintaining population viability were calculated, as well as minimum connectivity requirements. Likely barriers to connectivity were identified to enable the design of a land use pattern to maintain long term connectivity.

The assessment of Squirrel Glider habitat in the Morisset Structure Plan area showed about 361 ha of suitable habitat in the area, with an estimated population of about 140 individuals, forming part of a larger population. The population within the Structure Plan area contributes to the long term viability and range of the regional population and is currently connected by a network of Habitat Fragments. Many of the Habitat Fragments are tenuous and may potentially be lost in the short to medium term as a direct result of land use change. Most (74%) of the population of the species occurs in six Major Habitat Fragments (>100 ha) which comprise about 60% of the vegetated area. Long term viability of populations relies on protecting sufficient major habitat fragments, which are physically connected to other Minor and Small Habitat Fragments (4 ha–100 ha) by movement corridors which will facilitate dispersal and breeding.

The results of the review have now been included in land use planning principles included in strategic land use planning documents.

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Project: Tugun Bypass Project, PacificLink Alliance

The Tugun Bypass is a new section of the National Highway. The road provides an alternative, high speed link between Kennedy Drive in Tweed, New South Wales and Stewart Road in Currumbin, Queensland. Design and construction of the road was undertaken by the PacificLink Alliance, comprising SMEC Australia, AbiGroup and the Queensland Department of Main Roads, with construction completed in mid-2007.

Where possible, the alignment of the Tugun Bypass was carefully selected to avoid areas of high environmental value, however as with many 'green field' developments, complete avoidance was not possible. A number of standard and innovative environmental solutions were subsequently used to minimise the roads' 'barrier effect'. They included:

- Design and construction of fauna underpasses and an overpass for a range of terrestrial and aquatic species;
- Installation of fauna exclusion fencing for amphibians and ground-dwelling and arboreal mammals;
- Salvage of materials during clearing activities for use in habitat creation and to provide connectivity;
- Employment of 'minimal impact' construction methodologies to allow maximum retention of existing vegetation;
- Rehabilitation and revegetation of disturbed areas with locally endemic species, and where possible using locally collected seed.

Monitoring is currently being undertaken to assess the effectiveness of these controls and initial results are encouraging. Further information will be provided in this poster presentation and in the Queensland Department of Main Roads' Fauna Sensitive Road Design Volume 2.

Investigations for an urban development of a site in south-east Queensland

Conics has undertaken investigations for an urban development of a site in south-east Queensland. The area was previously used for mining purposes which has disturbed large tracts of vegetation on the site. However, patches of well vegetated, remnant open-forests and regrowth remain across the site. Conics has previously undertaken vegetation and fauna surveys on the site and identified the need for mitigation measures to minimise the impacts of the development upon the sites diverse fauna population.

Conics has identified the need for a wildlife corridor to facilitate ongoing ecological processes, which has been incorporated into the proposed development plans. As the wildlife corridor spans two roads, fauna crossings have been included in the development plans. One will require the retrofitting of a disused vehicle underpass.

A baseline study was undertaken to identify species currently utilizing the vehicle underpass, and species in the surrounding areas. This allowed for site specific recommendations to be made towards the retrofitting of the underpass, and the installation of associated mitigation measures. Monitoring was conducted in both the underpass, and in bushland surrounding the site. The monitoring carried out within the underpass indicated that it is currently largely unused by the native species present in the surrounding area.

Aurecon Poster

Aurecon (formerly trading as Connell Wagner) has been involved in the design of a number of road and other infrastructure projects over the last few years which have incorporated ecological considerations.

Our poster would summarise the importance of ecological staff collecting robust terrestrial and aquatic flora and fauna data, and incorporating this information into a design process which involves proponents, engineers, technical specialists and the statutory decision makers.

Our recent experience with road projects has shown that the attitudes of proponents, project managers and design engineers are changing to allow greater incorporation of ecological information into the design process and minimising the overall ecological impact of infrastructure projects.

Our poster will utilise the following case study projects to illustrate the changing attitudes and summarise the ecological benefits:

- Gateway Upgrade South (benefits included: strategy to provide compensatory habitat prior to clearing for road construction; design engineer sought early input which ensured better integration of the environmental goals into the design; and local environmental groups supported the design.

- Gateway Upgrade Project (benefits included fauna underpasses, some of which were dual purpose (eg bikeways)).

- Nerimbera Quarry Haul Road (benefits included: reducing the overall impact (direct and indirect) to a population of endangered Cycads endemic to the region; ecological surveys allowed for previously unmapped threatened species to be accurately recorded and added to Commonwealth and State ecological databases).

- Aldoga Banks Deviation Rail Project (ecological survey findings allowed the disturbance footprint to be moved away from intact remnant semi evergreen vine thicket communities containing multiple sub-populations of five threatened species).

The poster also highlights ecological methodologies, consultation and design strategies implemented during these projects.

Multiple individual southern brown bandicoots (*Isoodon obesulus fusciventer*) and foxes (*Vulpes vulpes*) use underpasses installed at a new highway in Perth, Western Australia

Ian M. HARRIS, Harriet R. MILLS and Roberta BENCINI
School of Animal Biology, The University of Western Australia, M092, 35 Stirling Hwy, Crawley, Western Australia, 6009

A 4.5km section of highway was built in 2005 through an area of remnant vegetation in Perth, Western Australia. Assessment of the area before construction identified potential impacts on an existing population of southern brown bandicoots (*Isoodon obesulus fusciventer*). Three underpasses constructed to provide a linkage between habitats that were fragmented by the highway were monitored for one year by detection of tracks in sand pads. Use of the underpasses by bandicoots was demonstrated with a total of 278 complete passes recorded between August 2005 and August 2006. One underpass accounted for 71% of these passes and was used already during construction while the other two accounted for 17% and 12% of passes and started to be used 102 and 161 days after construction. To investigate use by multiple individuals we trapped and fitted passive implant transponders to 56 bandicoots and installed a Trovan 650 scanner/decoder within the most frequently used underpass.

Eight different bandicoots were recorded using this underpass between August 2006 and August 2007, demonstrating use by multiple individuals. A dramatic decline in use of this underpass was observed after foxes (*Vulpes vulpes*) also started using it in August 2006. As we also failed to recapture any of the microchipped bandicoots we suspect that they had fallen victim of predation by foxes. This suggests that installation of underpasses without predator control may be detrimental to bandicoot populations.

Koala Conservation Partnership Project: Bridging the Gap Between Policy and Practice in the Moreton Bay Region

Prepared by Siobhan Bland, Coordinator Biodiversity & Natural Environment Policy, Moreton Bay Regional Council

A recent study undertaken by GHD and SEQ Catchments for the Environmental Protection Agency (EPA) and Moreton Bay Regional Council (MBRC), found that koala numbers had decreased by 45% in urban areas of the Pine Rivers District of the Moreton Bay Region (MBR) since 2001, and by 15% in bushland areas. The report concluded that 'a precautionary approach to future planning be adopted as a matter of urgency, to protect and enhance existing koala habitat' (GHD, 2008).
Research indicates that the state of the koala population in the wild is directly linked to koala movement through urban areas (GHD, 2008; Dique et al, 2003). Therefore, a strategy to secure the long term sustainability of koalas must include policy responses that relate to the protection and enhancement of existing populations and their habitat, as well as to buffering koalas from the impacts of climate change and urban development in the longer term.

The proposed Moreton Bay Koala Conservation Partnership Project aims to secure the long term sustainability of koala populations in the Moreton Bay Region. It draws from past and evolving planning and policy responses, and harnesses the opportunities provided by the Queensland Government's recent response to the recommendations of the Premier's Koala Taskforce (Koala Taskforce, 2008;).

Project partners include MBRC, SEQ Water, SEQ Catchments, EPA, Department of Main Roads and the Department of Infrastructure and Planning. This project focuses on the alignment of activities in order to achieve optimal investment in koala conservation. Project outcomes will include mapping, development guidelines, enhancement of existing koala habitat and reinstatement of linkages between habitat patches; koala friendly fencing and road crossing retrofits; and covenants to secure the on-ground investment. The project is an initiative of the Koala Lifeline Strategy under the Moreton Bay Local Nature Conservation Strategy, both in preparation, and firsts for MBRC.

References

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Roads are barriers to birds too: Avian use of a fauna-friendly overpass in Brisbane

Bond, A.R.F. and Jones, D.N.
Applied Road Ecology Group, Centre for Innovative Conservation Strategies, Griffith University

The environmental impacts of roads and other linear structures is quickly becoming an important concern for governments, road authorities and the community. This has led to the construction of a variety of wildlife road-crossing structures.

Overseas, the majority of these structures are aimed at facilitating the safe passage of various large mammal species that cause serious injury during wildlife-vehicle collisions. In Australia, this concept is in its infancy, but the focus here is also on larger mammals, particularly macropods, and there are now several land-bridges designed to allow animals to cross roads. Birds, however, have not usually been considered in studies of the faunal use of these structures, presumably because of the assumption that birds can simply fly over the barrier.

We studied the road barrier effect on birds living adjacent to Compton Road in Brisbane and investigated whether the presence of a well vegetated land-bridge influenced road crossing behaviour. Birds were observed during five minute periods at four sites either side of the land-bridge and four sites along the land-bridge between 0600 and 0900 hours. Observations have been taken intermittently for 11 months.

We observed a remarkable variety of species using the land-bridge, including species generally considered to be 'forest interior' specialists. We also found strong evidence of enhanced road crossing rates for smaller species, and found that even some larger species orientated their crossings to the structure. The number of birds observed crossing the road via the land-bridge was highly significantly greater than the number of birds crossing the road directly.

Although roads and other linear structures may not present themselves as a barrier to some medium to large birds, wide, busy roads may be an impenetrable barrier to smaller birds. This study has shown that a well vegetated connection of habitat between remnant bushland can increase the movements of some small and 'forest interior' bird species.

Breaking the road barrier at a multi-species level: An update of Compton Road

Bond, A.R.F., Wilson, J., and Jones, D.N.
Applied Road Ecology Group Centre for Innovative Conservation Strategies, Griffith University

Growing awareness and concern of the impacts of roads and other linear structures on wildlife has led to the implementation of wildlife road-crossing structures. Overseas, the majority of these structures are aimed at use by large to medium mammals associated with wildlife-vehicle collisions. In Australia, the use of such structures is in its infancy, and although the focus here is also on larger species of mammals, monitoring the use of crossing structures has included a wide range of species, including terrestrial and arboreal mammals of all sizes, reptiles, frogs and even birds and invertebrates.

The Compton Road fauna crossings array is the largest concentration of wildlife crossing structures in Australia. The 1.3km stretch of 4-lane road contains two faunal dedicated underpasses, three arboreal rope bridges, and a land-bridge with eight glider poles. Bond and Jones (2008) reported in the results of two years monitoring of the underpasses and land-bridge; since 2006 surveys has been minimal. To obtain an indication of current fauna use four years after construction, an intensive four-week survey monitoring was conducted. Both the land-bridge and underpasses were monitored using sand tracking on strips placed at both ends of the underpasses and one in the center of the land-bridge and were checked for prints and smoothed every two to three days.

A total of 223 tracks of 18 taxa were detected in the underpasses and 119 tracks of 11 taxa on the land-bridge.

Of the underpass detections, 46 (20.63%) were crossings, making a total of 23 completed crossings. Of the underpass detections, bandicoots (31.39%), agamid lizards (17.94%) and other unidentified lizards (14.35%) made up the three most frequent taxa using the underpasses. On the land-bridge, bandicoots (39.5%), wallabies (19.33%), birds (15.13%) and dasyurids (11.76%) made of the majority of tracks detected.

This snap-shot of data shows that almost four years since the completion of construction, these structures are still being regularly used by a variety of taxa. Bond, A., and Jones, D.N. 2008. Temporal trends in use of fauna-friendly underpasses and overpasses. *Wildlife Research* **35:** 103-112.

Wongaling corridors fauna crossing study: a case example in developing crossing options in a priority biodiversity area

David Francis (Senior Environmental Scientist, Chenoweth Environmental Planning & Landscape Architecture) and Tony O'Malley (Mission Beach Local Area Planning Officer, Terrain NRM)

Mission Beach is a Priority Biodiversity Area in Far North Queensland and supports one of the highest densities of the 'Endangered' cassowary in Australia, with approximately 79 independent birds.

The number one cause of cassowary mortality at Mission Beach is vehicle strike. Significant historic work at Mission Beach aimed to mitigate cassowary road deaths, including through passive means such as signage and psychological measures to slow traffic (e.g. the installation of line markings and rumble strips) and some modification of culverts and integration of fencing. Speed limits were also reduced. However cassowary road mortalities at Mission Beach continue, with four known road deaths in 2008.

An integrated fauna crossing strategy for the whole of Mission Beach is required to identify and implement regional priorities. In the meantime, the Wongaling Creek area was experiencing development proposals that would increase motor traffic through habitat and corridors. Terrain NRM engaged Chenoweth EPLA to undertake field work, knowledge review and community consultation (government, industry and community), and provide information on type, scale and cost of possible fauna crossing options for the main road. Chenoweth's solutions ranged from an elevated road structure and land bridge estimated to cost > $25 million through to speed limit reduction. This information was publicised, including to development assessment agencies.

The project provided timely expert information, engaged relevant stakeholders thereby facilitating ongoing 'ownership' of the problem and possible solutions, and helped scope out the future broader Mission Beach fauna crossing strategy. The process serves as an example for other priority biodiversity areas where decisions about development and conservation are being made.

Pipeline Construction & Wildlife Conservation

ENERFLEX, MACONNELL DOWELL, APIA, S. WILSON

As the Petroleum industry continues to expand within Australia, the subsequent threatening processes to biodiversity, natural resources and associated ecosystem services has identified the importance of effective mitigation measures around the linear infrastructure of pipelines.

The linear infrastructure of pipelines incorporates a broad range of stakeholder information exchange, including government authorities, company environmental advisors, construction staff, and environmental consultants to establish effective planning, design, construction, maintenance, monitoring and evaluation of mitigation measures for pipelines, throughout the 3 development phases, pre-construction, construction & rehabilitation. The Petroleum industry impact mitigation measures are strongly associated with the federal, state, and local government legislation pertaining to the protection of environmental values.

By embracing the challenges faced by conservation versus development, the (APIA) Australian Pipeline Industry Association has established nationally consistent guidelines for continued 'best practice' environmental management in Australia, APIA Code of Environmental Practice – Onshore Pipelines, 2005 (APIA CoEp) (and subsequent versions thereof).

Identified as a key ecological problem associated with pipeline linear infrastructure, requiring sustainable solutions is the potential impact to biodiversity from fauna entrapment in pipeline trenches and associated excavations. Environmental authorities in Qld, set conditions under 'Management of Fauna' to ensure petroleum activities are undertaken to minimise the potential risk of causing harm to fauna. The APIA CoEp, includes effective planning and design for mitigation measures to minimise this ecological problem, such as minimising length and time of trench open, ramps for fauna escape, shelter/refuge, and fauna monitors/handlers for rescue and relocation.

To address consistency and encourage best practice management, the petroleum industry has identified the need for companies to seriously address Fauna management training, to ensure effective mitigation measures are implemented. Training such as venomous & other fauna rescue and relocation workshops, has provided excellent industry feedback on improved fauna management practices, highlighting the potential conservation outcomes during pipeline construction. The petroleum industry encouragement and support of fauna management training is considered a high priority for continued 'best practice' environmental management in Australia.

Techniques for avoidance of long-term impacts on nationally significant grasslands during pipeline construction

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The construction of a 78km transfer pipeline for the Gippsland Water Factory project, mainly located along rail and road reserves aimed to have no long-term impacts on areas containing native grasslands of national significance, as well as threatened species such as Matted Flaxlily, *Dianella amoena*. This was achieved through a combination of detailed planning, transparent communication and on-site management techniques. Techniques were developed to avoid long-term impacts to the native vegetation, including drilling under areas of sensitivity; clearly marking 'no go' areas; temporarily removing 'blocks' of native vegetation; stockpiling sub-surface soil; and placement of plant and equipment on temporary hardstands. Application of these techniques resulted in no long-term impacts to the native grasslands of national significance. All impacts associated with the construction of the pipeline were limited to either, areas outside those classified as nationally significant or only temporary minor impacts to it. Where unavoidable, the temporary minor impacts on the native grassland involved the careful cutting, removal and subsequent replacement of 'blocks' of grass/topsoil to allow subsoil access for pipeline connection. Other measures included the temporary placement and movement of soil and plant/equipment on geofabric and plyboard timber panels. These measures ensured minimal disturbance to the soil profile and seed bank.

Supervision of all works by the environmental officer on-site ensured that construction crews conducted works in accordance with the prescribed management techniques. When all feasible design alternatives for avoidance of native grasslands have been exhausted during the concept design phase of an infrastructure project, careful planning and identification of potential impacts early in the planning stage mean that long terms impacts can be avoided.

Hume Highway Duplication Project

Jo Moss, Senipr Principal, SKM and Environment & Sustainability Manager, Hume Highway Southern Alliance1 and on behalf of the Northern Hume Alliance2 and the NSW Roads and Traffic Authority3

The Hume Highway Duplication Project involves upgrading five sections of existing single carriageway between Sturt Highway and Table Top in south-western New South Wales. The project involves significant earthworks and associated engineering activities and therefore poses many challenges in relation to balancing the development of a safe and efficient transport system while designing and constructing the duplication in such a way that it has minimised its impact on the environment. The project is being delivered through two alliance partnerships and is achieving long-term sustainable outcomes through a range of initiatives of which biodiversity is a key component.

The environment of the duplication has been significantly modified by intensive grazing and cropping and other developments. This has reduced the condition of the remnant vegetation, with the result of increasing the value of the remaining vegetation in terms of conservation and role in the broader network of wildlife corridors in the region. Remnant vegetation occurs mainly as long linear patches within the road reserve, as larger areas within the Travelling Stock Reserves that are adjacent to the road reserve or otherwise as isolated patches within the largely cleared landscape.
Vegetation communities listed as Endangered under the NSW *Threatened Species Conservation Act,* 1995, and *as* critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act,* 1999, occur within the road corridor. Five species of threatened animal were identified in the project study area, and another ten threatened species with potential to occur. Potential biodiversity impacts include vegetation loss or degradation, habitat fragmentation and/or loss, direct fauna mortality during construction and increased fauna loss during operation.

The project design incorporates a number of safeguards and these are being implemented to avoid, minimise and mitigate impacts on biodiversity. To address the residual impacts of construction, the RTA committed to implementation of an offset package that will contribute to the long term conservation of biodiversity within the region. The package has a number of key actions that focus on compensatory habitat and habitat improvement works, developed in discussion with government agencies including the NSW Department of Environment and Climate Change (DECC), the NSW Department of Primary Industries (DPI) and the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA).

This poster details and describes the specific measures that are being implemented on the Hume Highway Duplication Project to minimise environmental impact through design and construction.

1 *The Hume Highway Southern Alliance comprises of the Roads and Traffic Authority of New South Wales (RTA),*
Abigroup and Sinclair Knight Merz (SKM).
2 *The Northern Hume Alliance comprises of the Roads and Traffic Authority of New South Wales (RTA), Leighton*
Contractors, Maunsell AECOM, Coffey Partners and Snowy Mountains Engineering Corporation.
3 *The assistance of the RTA in the preparation of this poster is acknowledged.*

Fins not Fur: Why Fish Need Friends Too: **Aquatic Aspects of Assessing and Managing Impacts Associated with Linear Development**.

Ashley Morton, Lauren Thorburn and John Thorogood, frc environmental

Linear developments, including the construction of roads, rail lines and pipelines, can impact on aquatic ecosystems (fresh and estuarine) through direct disturbance and loss of habitat, and indirect impacts to water and habitat quality resulting from for example, vegetation clearing, erosion and altered water quality. Poor crossing design and construction can also obstruct fauna passage, which (depending on the order of the stream and its location in the catchment) has the potential to have far-reaching impacts on

the fauna habitat value of upstream aquatic habitat. Impacts may be avoided, minimised or mitigated via a range of management strategies based on an appropriate understanding of the ecosystems involved. Issues to be considered include: the disturbance and rehabilitation of bank and bed habitat; the proximity of the development to other linear development and waterway obstructions; and the dimensions of crossings (particularly culverts), to ensure adequate water depth, water velocities and light.

Solutions commonly involve: choosing the optimal location and alignment for the crossing, to avoid impacts to large trees stabilising the banks, or high quality in-stream habitats; the use of 'best-practice' erosion and sedimentation control plans during construction; rehabilitation of bed and bank habitat, and stabilisation of the banks with erosion control matting or similar; the construction of open-bottomed culverts that are as short and wide as possible (whist still ensuring adequate water depth); incorporation of light into waterway barrier design; the use of aquatic fauna transfer devices (eg. fishways, turtle lifts); and regular maintenance of crossings. This poster presents an overview of some recent work on linear developments, and highlights the importance of addressing aquatic ecological issues in conjunction with terrestrial ecology.

Barbed-wire as a wildlife hazard across our landscape.
Brisbane Bat Care

Barbed-wire is responsible for thousands of cruel injuries and slow painful deaths to bats, gliders, macropods and nocturnal birds. It is a major wildlife hazard across our landscape. In urban environments the problem is escalating exponentially as more barbed-wire is erected across our suburbs in industrial estates and commercial properties. The greatest threat is where landscapers plant wildlife attracting native, fruiting and flowering plants. These fences are a constant trap around flowering time and every year more animals are caught and suffer horrid deaths or face months of rehabilitation. The users of barbed-wire need to become more aware and accountable, to shoulder the enormous burden of these captures both in loss of life and the cost to volunteer organizations who perform the unenviable task of untangling, recovering and more often euthanasing this unfortunate wildlife. Care organizations are never recognised nor compensated by the users of barbed-wire for their ongoing community service.

Death by electrocution – old electrical wiring at what cost?
Brisbane Bat Care

Brisbane as with most established and older cities are strewn with old electrical wiring. This infrastructure is low on priority for reform and is responsible for thousands of electrocutions of bats and possums each year. If we were aware of the costs through outages caused by animal electrocutions due to old wiring , we maybe surprised at the cost to the community. If we were also aware of the suffering of the animals, we would most definitely be outraged. Many animals survive hideous burns to die publicly, often a slow agonizing death while others can receive shocks for up to 20 minutes before they die. The number of orphaned animals through electrocution is increasing yearly. We need to work towards limiting the cost to communities through power outages and find ways to decrease the number of animal deaths from old infrastructure.

An Introduction to Wildlife Movement Solutions in Brisbane

Brendan D. Taylor
B App Sc (Hons)

March 2008

INTRODUCTION

Roads and traffic are very much a part of our modern landscape. It is estimated that more than 32 million km of roads carve up the global land surface. Roads destroy habitats, fragment landscapes, cause wildlife road mortality and create barriers to wildlife movement. Roads also pollute waterways and soil, change hydrological flows, facilitate weed invasion and create noise pollution. Some ecologists bundle-up such adverse effects in what is termed the 'road effect zone'. This is the area of land extending an average of 100 m either side of the road that is described as experiencing some adverse ecological impact. The concept has been applied in the USA and resulted in claims that about one fifth of the country's land area is directly affected ecologically by roads. Brisbane has over 5000 km of public roads within a local government area of 1200 km^2. It is therefore likely that roads within Brisbane negatively affect a considerable part of its natural landscape.

Foremost in efforts to reduce the adverse effect of roads on wildlife has been the installation of crossing structures. Typically, these are engineering structures designed to assist an animal in crossing either under or over a road. Target species are generally land mammals but increasing interest in frogs, reptiles and arboreal animals (e.g. possums) has been evident in more recent years. Below-road crossing structures, commonly referred to as underpasses, are the most prevalent type and range in size from small drainage pipes to dry passage under bridges. Over-road structures, or overpasses, have taken the form of wildlife-dedicated land or green bridges, combined wildlife/vehicle overpasses, pole bridges, rope bridges and stepping-stone structures such as gliding poles (refer Appendix 1).

What has become evident from studies of engineering solutions to road effects both in Australia and overseas is that they may not work for all species and that sensitive road planning and thorough impact assessments are vital ingredients in the wildlife movement solutions mix. Further, monitoring programs too often simply report on crossing structure success at the individual level (e.g. a swamp wallaby using a land bridge) and fail to ascertain success at the population/community/ecosystem processes level. This is the level monitoring programs need to focus at.
This introduction presents key findings and recommendations arising out of research that has been conducted at Compton Road since 2004. Compton Road is an arterial road located in Kuraby that passes between two significant remnants of urban bushland - Karawatha Forest Reserve (KW) and Kuraby Bushland Reserve (KB). Together they form part of the regionally significant Karawatha to Greenbank Corridor. During 2004/05, 1.3km of Compton Road was upgraded from two lanes to four. As part of the upgrade, Brisbane City Council (BCC) installed a number of road crossing structures for wildlife (two fauna underpasses, exclusion fencing, a wildlife land-bridge with eight gliding poles and three rope-bridges) and funded a number of projects to assess their effectiveness. Much of the results to date of these projects are discussed in the '*Breaking the Barrier'* report (see reference list). The following findings and recommendations are largely drawn from this report and are supplemented by lessons learnt from other locations in Australia and overseas.

KEY FINDINGS & RECOMMENDATIONS

1) Understand the existing local wildlife populations
This is a critical first step that should inform the type and position of crossing structures. Understanding what species are present, where they are located and how abundant they are can be mapped onto the area in question and provide a guide as to how the road upgrade may impact on them. For example, knowledge of healthy populations of three species of kangaroo and the existence of several glider species in the surrounding bushland at Compton Road lead directly to the inclusion of the land-bridge and glider poles respectively.

2) Landscape connectivity and habitat continuity are important
Wildlife movement solutions are largely based on the ecological principle of landscape connectivity. That is, maintaining viable wildlife populations across Brisbane rests very much upon how well bushland remnants are connected. Crossing structures should therefore be used and placed in a way that attempts to restore bushland linkages. This includes locating the crossing structure entrances as close as practically possible to the bushland edge and ensuring that post-construction re-vegetation works plant-out any remaining gap between bushland and crossing structure entrances. This has been shown to encourage wildlife usage of crossing structures and is evident at Compton Road.

3) Select crossing structures that benefit a broad range of species
Selecting the most effective crossing structures needs to be informed by the range of species being accommodated and where they're located, the surrounding vegetation, local topography, project budget, etc. Wildlife underpasses/culverts and land bridges have been shown to be used by a broad range of species (e.g. frogs, snakes, lizards, wallabies, rats, koalas, bandicoots, echidnas and possums) and should be considered as useful generic structures. More targeted crossing structures, such as rope bridges and gliding poles have been used by possums and gliders.

4) Include exclusion fencing
Any wildlife movement solutions project should endeavour to reduce wildlife collisions with vehicles. This makes a lot of sense on economic, human safety and wildlife conservation grounds. Exclusion fencing at Compton Road greatly reduced wildlife-vehicle collisions and assisted in funnelling animals to the crossing structures. Choosing a fence design will depend on the animals present at a location, but should aim to prevent a broad range of wildlife from coming onto the road. Fencing at Compton Road includes a 'floppy-top' design to stop koalas and a barrier strip at the bottom to stop small animals getting through the chain mesh. Frequent inspection and repair is necessary as wildlife may exploit breaches in the fencing.

5) Habituation may take time
While there was evidence of use by some animals (e.g. wallabies) of the land bridge and underpasses at Compton Road very soon after construction, use by a broad range of species generally takes much longer. This appears to be the case for small glider use of the gliding poles on the Compton Road land bridge and may be linked to the maturity of the planted vegetation. The same may also be said for native rodents on the land bridge. This highlights how critical vegetation restoration works on and around the crossing structures is and the need for ongoing maintenance to encourage proper establishment.

6) Enhance attractiveness through vegetation restoration and 'furniture'
The rapid post-construction use of the land-bridge at Compton Road by macropods was probably related to the foraging opportunities afforded by the germination of edible grasses. Similar forms of experimental attraction should be considered in other locations. Also, placing large rocks, gravel, logs and ledges (sometimes referred to as 'furniture') within culverts and on land bridges may enhance their attractiveness to wildlife.

7) Plan for long-term monitoring before, during and after construction
Because of the infancy of this area of road planning, properly designed, long-term monitoring is critical for appraisals of the success or otherwise of crossing structures. Compton Road is a good example of the successful inclusion of ecologists in the early stages of project planning. This enabled the establishment of a comprehensive monitoring program. Moreover, Compton Road is regarded somewhat of a flagship in the field of fauna-friendly road design in Australia. However, road engineers and ecologists involved with

Compton Road often commented on the lack of reliable, detailed information on fauna mitigation in Australia. This highlights the urgent need to develop greater expertise and understanding of the conservation benefits or otherwise of crossing structures. Such information will better inform future road projects.

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APPENDIX 1

Definition of engineering structures used to minimise the fragmentation effects of roads and reconnect habitat (adapted from van der Ree *et al.* (2007) in Veage & Jones (2007)).

Structure	Description
OVERPASS	PERMITS PASSAGE OF ANIMALS ABOVE THE ROAD
Land Bridge	Also known as green bridge, eco-duct or wildlife bridge. Typically a 30 – 70 metre wide bridge that spans across the road. The bridge has soil over it, and is planted with vegetation and landscaped with habitat features (e.g. logs, rocks, small water-bodies etc).
Overpass (small roads)	A bridge above a major road/arterial, likely to allow human/stock access across the road. Typically is of narrow design not hourglass shape. The overpass road is commonly a minor road, possibly unsealed and one lane etc.
Canopy/Rope Bridge	A rope or pole suspended above traffic, either from vertical poles or roadside trees. Primarily established for arboreal and scansorial species.
Glider Pole	Vertical poles positioned in the centre median, on the road verge, or traversing the land bridge. They provide species that glide intermediary landing pads and launch opportunities.
Local Traffic Management	Traffic calming to reduce the speed or volume of traffic via signage, lighting, crosswalks, chicanes, road closures etc.
UNDERPASS	PERMITS PASSAGE OF ANIMALS BELOW THE ROAD
Culvert	Frequently square, rectangular or semi-circle in shape. Usually pre-cast concrete cells or arches made of steel. They may be specifically built for wildlife passage or drainage purpose, or a combination of both.
Tunnel	Also known as eco-pipe. Commonly round pipes of reasonably small diameter (< 1.5 metres).
Bridge	A structure that raises traffic above surrounding land or maintains the grade of the road. Often facilitating water underneath, movement of local traffic or assist wildlife passage.
NON-STRUCTURAL MITIGATION	COMMONLY INCORPORATES MORE SENSITIVE ROAD DESIGN THAT ASSISTS 'NATURAL' PERMEABILITY
Corridor Plantings	Essentially strips of vegetation, comprising of similar species either side of the road. Often crossing the road providing corridor movement for animals.

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