

5. Proposed avoidance, management and mitigation measures

5.1 Overview

The proposal has been designed to minimise the potential impacts on flora and fauna and their habitats. In areas where significant vegetation is located, the construction footprint will be reduced as far as practicable. To further avoid the potential for biodiversity impacts the concept design will be refined during the detailed design process, with the aim of reducing the amount of vegetation clearing required.

During the initial planning phase, Roads and Maritime completed a route options report and consulted with OEH before deciding on the proposed option with support from OEH. Roads and Maritime also completed an ecological constraints assessment (ngnvironmental 2011) for the proposed route.

The current proposal, including the concept design has been undertaken in line with the following amelioration policy (Roads and Maritime Services 2011):

- Avoid and minimise impacts on habitat through the planning process.
- Mitigate impacts on habitat, through the use of a range of amelioration measures.
- Offset unavoidable residual impacts (see chapter 6).

Safeguards and mitigation measures that will be implemented are listed in section 5.11.

5.2 Connectivity mitigation

To minimise fragmentation impacts on fauna species in the study area, Roads and Maritime will develop a wildlife crossing management plan. The plan will address at a minimum:

- Construction and placement of rope bridges in consultation with a Squirrel Glider specialist (see Figure 5.1).
- Barbed wire fences will not be installed in wildlife crossing zones due to the known incidence of Squirrel Gliders getting entangled and killed on these fences.
- Tree and shrub planting areas under the bridge and on batter slopes will be undertaken to assist in revegetation and woodland bird movement.
- Locally native species will be used for revegetation. Species will be consistent with those for the Commonwealth scientific committee determination of Box-Gum Woodland.
- Roads and Maritime will investigate the planting of trees and shrubs in the land zoned E2 north-west of the proposal, to assist future movement of Squirrel Gliders and other fauna across the landscape.
- Trees and shrubs will be planted on the western side of the new Camp Access Road in the roadside reserve and land owned by Roads and Maritime to assist future north-south movement of Squirrel Gliders and other fauna.
- In accordance with benchmark levels of fallen logs for the vegetation types occurring in the study area, placement of fallen logs will not exceed 50 metres per 1000 square metres (DECC 2008).

The proposal would fragment known habitat for the endangered population of the Squirrel Glider. This can be mitigated by installing crossing structures (rope/canopy bridges) across the Olympic Highway, as described in section 4.1.3.

There are potential differences in the efficiency of poles versus rope bridges with respect to survival rates. Rope bridges would be constructed instead of glider poles, due to the uncertainty associated with the possible increased mortality of juveniles using glider poles. Glider poles still require gliders to glide across the road, which potentially places them in front of oncoming vehicles (ARCUE 2013, see Appendix D).

Tall trees are used widely by Squirrel Gliders as launching sites to glide across the road. Tall trees will be retained on the edges of the development site as they are critical in maintaining natural connectivity (ARCUE 2013, see Appendix D). To prevent and/or reduce mortality due to collision with vehicles, tree planting adjacent to the development site will be designed to lead to crossing structures.

5.3 Exclusion zones

An exclusion zone plan will be implemented in line with RTA (2011b) - *Biodiversity Guidelines Guide 2: Exclusion zones*. The exclusion zone plan will be developed as part of the Construction Environmental Management Plan (refer to section 5.12). As a minimum, exclusion zones will include any parts of the proposal that form a boundary with an E2 zone (see Figure 3.1). Exclusion zones will be established to prevent inadvertent damage or clearing in the E2 zone (including groundcover vegetation).

Exclusion zones may also be established for other areas that need to be protected to stop the spread of certain features such as pathogens and weeds, or to prevent access to contaminated land or heritage sites.

5.4 Protection and short term replacement of hollows

Final design and construction will retain hollow-bearing trees wherever possible while still meeting operational objectives for road safety, design and sediment basin operation. This includes hollow-bearing trees that are on the margins of the development site.

In accordance with Roads and Maritime Biodiversity Guidelines (RTA 2011b), nest boxes will be installed in the study area at a minimum ratio of 1:1 for the loss of hollows greater than five centimetres. Seventy per cent of nest boxes will be installed within six months before the commencement of clearing activities.

The types and ratios of nest boxes will be incorporated into the nest box strategy to be prepared as part of the Wildlife Crossing Management Plan.

5.5 Felling of hollow-bearing trees

Hollow-bearing trees will be felled according to the staged process outlined in the Roads and Maritime Biodiversity Guidelines (RTA 2011a):

- *Biodiversity Guideline Guide 1: Pre-clearing process* will be implemented prior to commencement of the proposal.
- *Biodiversity Guideline Guide 4: Clearing of vegetation and removal of bushrock* will be used to remove hollow bearing trees. The staged process includes:
 - Contact vet and/or wildlife carer.
 - An experienced and licensed wildlife carer and/or ecologist should be present.
 - Remove non-habitat vegetation.

- Leave habitat for a minimum of 24 hours.
- Remove habitat.
- Inspect habitat.
- Relocate habitat.
- Reporting.

The staged habitat removal process minimises mortalities and injuries and has been implemented in similar Roads and Maritime projects in the region (J. Stokes, Roads and Maritime, pers. comm.). These projects include the Hume Highway duplication and Hume Highway bypasses that occurred in similar Box-Gum Woodland providing habitat for Squirrel Gliders.

5.6 Habitat provisions

Golden Wattle and Box-Gum eucalypt species will be incorporated into the landscaping and revegetation program in the study area to provide habitat for woodland birds such as the Superb Parrot.

Squirrel Gliders are known to use relatively young regrowth, provided large trees with hollows are nearby (ARCUE 2013). Therefore some of the revegetation effort will target areas surrounding isolated hollow-bearing trees. Locations of hollow-bearing trees in the study area are provided in Figure 4.2.

5.7 Rehabilitation

Areas within the development site that are disturbed during construction will be progressively revegetated. Revegetation will be undertaken during construction to assist in managing erosion and sedimentation and will continue until completion of construction in accordance with landscaping plans. In addition to revegetating disturbed areas within the development site, strategic revegetation is also proposed to minimise fragmentation of fauna habitat. Areas subject to strategic revegetation include (see Figure 5.1):

- The existing road adjacent to Silvalite Reserve.
- The southern glider crossing location between the sections of cut and fill to facilitate future movement of Squirrel Gliders and other fauna from east to west and north to south.
- The western side of the realigned Camp Access Road to assist future north-south movement of Squirrel Gliders and other fauna.
- Under the proposed road-over-rail bridge and on adjacent batter slopes to aid fauna passage and woodland bird movement.

In addition, Roads and Maritime will investigate the potential for planting trees and shrubs in the land zoned E2 on the agricultural research station north-west of the proposal to assist future movement of Squirrel Gliders and other fauna across the landscape.

Locally native species will be used for revegetation. Species will be consistent with those for the Commonwealth scientific committee determination of Box-Gum Woodland.

Revegetation will be undertaken in accordance with RTA (2011b) – *Biodiversity Guidelines Guide 3: Re-establishment of native vegetation* and RTA (2008) – *Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding* and Roads and Maritime QA Specification R179 – *Landscape planting*.

It is anticipated that revegetation will utilise a number of standard Roads and Maritime techniques, including hydroseeding, hydromulching, direct seeding or planting with established

plants or seedlings. Roads and Maritime has had proven success with these techniques and their associated maintenance requirements for similar projects in the region, including the Hume Highway duplication and Hume Highway bypasses.

Tree plantings adjacent to the proposal will be designed to lead to road crossing structures for fauna species. The tree planting design and placement of these structures will be developed in consultation with relevant fauna specialists. Revegetation will also target areas surrounding isolated hollow-bearing trees to assist in long term fauna habitat development.

In addition to revegetation, some of the large woody debris generated by the proposal will be relocated outside the development site and retained as habitat on the ground. Placement of woody debris on the ground will not exceed the upper benchmark for total length of fallen logs for Western Slopes Grassy Woodland in the Murrumbidgee catchment (50 metres per 1000 square metres) (DECC 2008b).

5.8 Soil and water quality safeguards and management measures

Safeguards and management measures for minimising the impacts of the proposal on the environment through soil and water quality impacts are provided in section 5.11.

5.9 Mitigation effectiveness

Effective reconnection of habitat for Squirrel Gliders across the Olympic Highway in the medium term (within about 12 to 18 months) is essential (ARCUE 2013, see Appendix D). Monitoring of artificial crossing structures, including rope bridges and glider poles on the Hume Highway Duplication has recorded Squirrel Gliders using rope/canopy bridges to cross the four lane dual carriageway (ARCUE 2012, van der Ree *et al.* 2010 and Soanes and van der Ree unpublished data). These structures are in a similar vegetation community (Box-Gum Woodland) and fragmented rural landscape. The studies demonstrate at least a degree of success in using this measure to retain connectivity for this species (ARCUE 2013, see Appendix D).

Squirrel Gliders are known to use multiple hollows, and change hollows every few days, with some individuals using 10 to 15 hollows over the period of a few months (van der Ree unpub data). The loss of natural hollows would impact on the resident Squirrel Glider population. Nest boxes should only be viewed as a short term replacement for the loss of natural hollows. The efficacy of nest boxes for Squirrel Gliders in a similar landscape has been documented (Durant *et al* 2009), with older nest boxes having a higher rate of occupation than new nest boxes. Squirrel Gliders have been observed to use nest boxes installed in woodland on the Hume Highway at Tarcutta (SMEC 2012 and 2013).

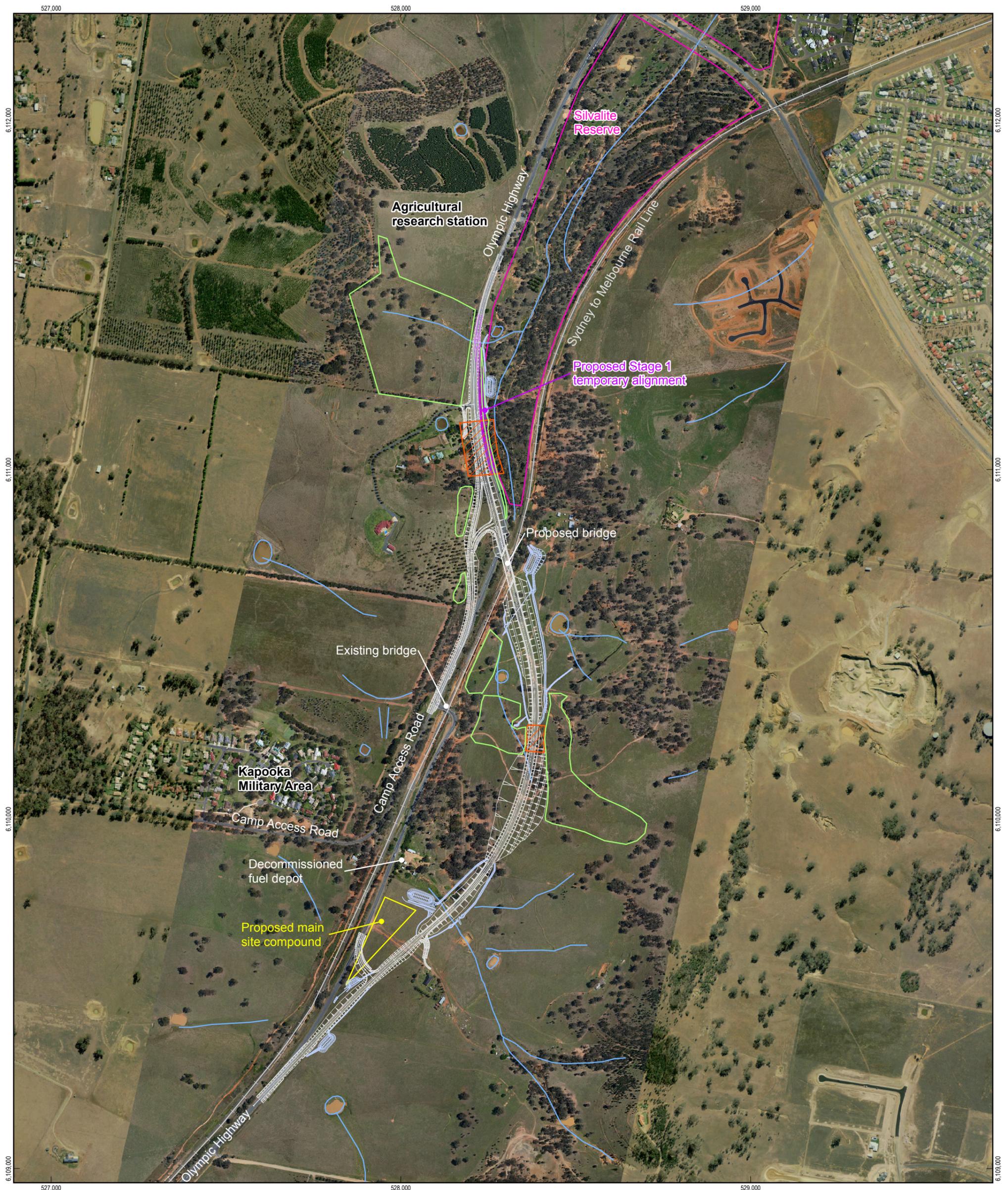
Revegetation and associated hollow replacement is a long term measure (over a period of more than 100 years), which though likely to be effective would not provide short or medium term habitat for hollow dependent fauna.

5.10 Ongoing monitoring

Ongoing monitoring for the proposal is not required for the following reasons:

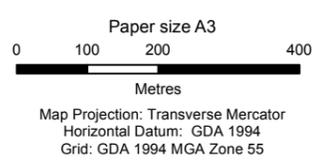
- There would be no significant impact on any threatened fauna species as a result of the proposal.
- To minimise the impacts on fauna species in the study area, Roads and Maritime will develop a Wildlife Crossing Management Plan in consultation with OEH.
- Mitigation measures (eg glider rope bridges, nest boxes and strategic revegetation) are proposed to minimise the effect of fragmentation on threatened fauna species.

- Previous monitoring of the proposed mitigation measures in similar locations for the same target species has proven these measures are effective (SKM 2011, van der Ree and Soanes, unpub data in ARCUE 2013 (see Appendix D) and Soanes *et al* 2013).
- Compared to other projects in the region (eg Hume Highway Duplication and Bypasses) the potential impacts of the proposal are of a smaller scale.
- The only significant impact as a result of the project is to Box-Gum Woodland. The impacts of this will be offset in accordance with State and Federal Offset Policies (see chapter 6).
- The proposed offset site has been assessed using the DoE offsets assessment guide (DSEWPaC 2012) and covers above and beyond what is required to offset the residual impacts of the project on Box-Gum Woodland, as well as State and/or Commonwealth listed fauna species.
- Monitoring will be undertaken at the offset site in accordance with the management plan for the site.



LEGEND

Proposed road	Proposed main site compound	Area within which glider crossing structures would be erected
Proposed Stage 1 temporary alignment	Silvalite Reserve	Tree planting
Proposed drainage		
Railway line		
Existing drainage		



Roads and Maritime Services
Kapooka bridge replacement preliminary documentation

Job Number	23-14107
Revision	0
Date	20 Nov 2013

Proposed locations for Squirrel Glider crossings and tree plantings

Figure 5.1

5.11 Summary of safeguards and management measures

Table 5.1 and Table 5.2 below provide a description of the mitigation measures that deal with direct impacts to the matters of national environmental significance as well as indirect impacts that may occur outside the development site. Additional safeguards and mitigation measures are provided in the review of environmental factors (GHD 2013a).

Table 5.1: Ecological safeguards and management measures to be implemented for the proposal

Impact	Environmental safeguards	Responsibility	Timing
Loss of native vegetation habitat	<ul style="list-style-type: none"> A detailed biodiversity management plan will be prepared as part of the Contractor's Environmental Management Plan (CEMP) to minimise the ecological impacts of the proposal. The biodiversity management plan will include the limits of clearing and exclusion zones. An exclusion zone plan will be implemented in line with RTA (2011a) - Biodiversity Guidelines Guide 2: Exclusion zones. Exclusion zones will include any parts of the proposal that form a boundary with an E2 zone. Exclusion zones will be established to prevent unnecessary clearing or disturbance to the E2 zone (including groundcover vegetation). 	Project manager	Pre-construction
Weed spread and establishment	<ul style="list-style-type: none"> A weed management plan will be prepared before works commence, for implementation before, during and after the works. 	Project manager and contractor	Pre-construction
Loss of mature trees, including hollow-bearing trees	<ul style="list-style-type: none"> Removal of mature trees, including hollow-bearing trees, will be minimised wherever possible while still meeting operational objectives for road safety, design and sediment basin operation. Hollow-bearing trees to be retained will be protected by a physical barrier or fence Pruning or lopping of limbs will be conducted in preference to tree removal wherever possible. Hollow-bearing trees to be retained will be defined by survey before clearing. Nest boxes will be installed at a minimum 1:1 ratio for the loss of hollows greater than five centimetres in diameter, as detailed in RTA (2011a) - Biodiversity Guidelines Guide 8: nest boxes. Seventy per cent of nest boxes will be installed in the six months prior to and 30 per cent will be installed 	Project manager and contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>of a weed control program.</p> <ul style="list-style-type: none"> All new vehicles to site will be cleaned to reduce the incidence of weed spread and establishment. The spread of introduced plant species within the limits of the proposal will be monitored by the contractor and Roads and Maritime during construction. Weed control will be undertaken if introduced plant species become prevalent in the limits of the proposal. Declared noxious weeds will be managed according to the requirements of the Noxious Weeds Act 1993. Weed infested topsoil will be disposed of or treated and will not be stockpiled adjacent to any areas of native vegetation. 		
Chemical and fuel impacts on native vegetation	<ul style="list-style-type: none"> Any herbicides used for weed control will be applied to the manufacturer's specifications and as outlined in the manufacturers Material Safety Data Sheet. Broad spectrum non-selective herbicides (residual herbicides) will not be used. Herbicides selected for use will be appropriate for the species being treated. Spraying of herbicides will not be undertaken in windy weather or within such distance of a watercourse as would permit any of the herbicide to enter the water. Mitigation measures for preventing and managing spills of fuels and chemicals will be implemented, such as refuelling and keeping fuels in bunded areas only. 	Project manager and contractor	Construction
Pathogen spread and establishment	<ul style="list-style-type: none"> Measures for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi will be implemented, as detailed in RTA (2011a) – Biodiversity Guidelines Guide 7: Pathogen management. 	Project manager and contractor	Construction
Bushfire	<ul style="list-style-type: none"> Mitigation measures for preventing and managing bushfire risk will be identified in a Bushfire Management Plan to be prepared as part of the contractors CEMP. 	Project manager and contractor	Construction
Loss of woody debris habitat	<ul style="list-style-type: none"> In consultation with Wagga Wagga City Council, some of the large woody 	Project manager and contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>debris generated by the proposal will be relocated outside the limits of the proposal and retained as habitat on the ground. The woody debris retained will be spread in a fashion that replicates the natural occurrence of woody debris in the environment and will not be stacked.</p> <ul style="list-style-type: none"> • Placement of woody debris on the ground will not exceed the upper benchmark for total length of fallen logs for Western Slopes Grassy Woodland in the Murrumbidgee catchment (50 metres per 1000 square metres) (DECC 2008). • Woody debris will be re-used as detailed in RTA (2011a) - Biodiversity Guidelines Guide 5: Re-use of woody debris and bushrock. • Relocation of woody debris will be done in a manner that discourages removal for firewood (eg inside fences rather than outside fences). 		
Impacts to fauna	<ul style="list-style-type: none"> • Where practicable, vegetation removal will occur outside the main fauna breeding season (August to January) to avoid potential breeding disturbance to fauna, particularly the Squirrel Glider and woodland birds. • The pre-clearing process detailed in RTA (2011a) - Biodiversity Guidelines Guide 1: Pre-clearing process will be implemented before commencement of the works. • Clearing of vegetation will be undertaken as detailed in RTA (2011a) - Biodiversity Guidelines Guide 4: Clearing of vegetation and removal of bushrock. • Fauna handling during vegetation removal will be undertaken by a licensed fauna ecologist or wildlife carer, as detailed in RTA (2011a) - Biodiversity Guidelines Guide 9: Fauna handling. • Barbed wire fences will not be installed in wildlife crossing zones due to the known incidence of Squirrel Gliders getting entangled and killed on these fences. 	Project manager and contractor	Construction
Impacts to threatened species	<ul style="list-style-type: none"> • If unexpected threatened fauna or flora species are discovered, works will stop immediately and the Roads and Maritime Unexpected Threatened Species Find Procedure in RTA (2011a) – Biodiversity Guidelines Guide 1: Pre-clearing process will be followed. 	Project manager and contractor	Construction
Loss of habitat	<ul style="list-style-type: none"> • Tall trees on the edge of the proposal site should be retained where safety 	Project manager	Construction

Impact	Environmental safeguards	Responsibility	Timing
connectivity	<p>requirements permit, to maintain natural connectivity for Squirrel Gliders (eg at Silvalite Reserve and on the northern approaches to the bridge).</p> <ul style="list-style-type: none"> • The existing road adjacent to Silvalite Reserve will be ripped and restored (bitumen pavement removed and revegetated with local native species) to minimise fragmentation of fauna habitat. These works will commence as soon as the road is no longer required for traffic access. • Shrubs will be planted under the bridge and on batter slopes to assist in revegetation and to aid fauna passage and woodland bird movement. • Rope bridges will be constructed at two locations – north of the proposed bridge from Silvalite Reserve to freehold land to the west; and within the Planning Agreement Areas south of the proposed bridge, at the transition between the large cut and fill areas. Specific advice from OEH and a Squirrel Glider specialist should be sought to advise on the exact location and design of crossing structures and which tall trees should be retained. • Trees and shrubs will be planted at the southern glider crossing location (in consultation with Wagga Wagga City Council) between the sections of cut and fill to facilitate future movement of Squirrel Gliders and other fauna from east to west and north to south. • Trees and shrubs will be planted on the western side of the realigned Camp Access Road location to assist future north-south movement of Squirrel Gliders and other fauna. The planting will comply with road safety requirements. • Roads and Maritime will investigate the potential for planting trees and shrubs in the land zoned E2 north-west of the proposal, to assist future movement of Squirrel Gliders and other fauna across the landscape. 		
Deterrence of fauna by road lighting	<ul style="list-style-type: none"> • Road lighting that directs light down to the road and minimises light pollution of the night sky will be used to minimise disorientation of nocturnal species moving through the area. This will include use of LED lights and/or low pressure lights with longer wave lengths (orange or red colour spectrum) where feasible to minimise impacts to microbats. 	Project manager	Construction
Weed spread and establishment	<ul style="list-style-type: none"> • Weed control will be undertaken during operation if declared noxious weed species become prevalent in the limits of the proposal. 	Project manager	Operation

Table 5.2: Soil and water quality safeguards and management measures to be implemented for the proposal

Impact	Environmental safeguards	Responsibility	Timing
Soils and water quality - soil erosion, sedimentation and water quality	<ul style="list-style-type: none"> • A soil and water management plan will be prepared as part of the CEMP for the proposal in accordance with Roads and Maritime specification G38 – Soil and Water Management and the Blue Book - Soils and Construction - Managing Urban Stormwater Volume 1 (Landcom 2004) and Volume 2D (DEC 2008a). • The soil and water management plan will include but not be limited to: <ul style="list-style-type: none"> – A primary erosion and sedimentation control plan and a maintenance schedule for ongoing maintenance of temporary erosion and sediment controls. – A sediment basin management plan to guide appropriate management of runoff during construction and operation. – An incident emergency spill plan which will include measures to avoid spillages of fuels, chemicals, and fluids onto any surfaces or into any adjacent/nearby waterways. • An accredited soil conservationist will be engaged to provide advice during development and implementation of the soil and water management plan. The soil conservationist will regularly review and inspect works throughout the construction phase. 	Project manager and contractor	Pre-construction
Soils and water quality - soil erosion and sedimentation	<ul style="list-style-type: none"> • Sediment and erosion controls (including sediment basins), clean water diversions and culverts will be constructed and be on line before the commencement of earthworks. • Sediment basins will be regularly serviced and maintained to comply with water quality and capacity requirements. • Energy dissipaters will be installed to reduce flow velocity and potential erosion as required. • Clearing of vegetation and stabilisation/revegetation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes. • Site stabilisation of disturbed areas will be undertaken progressively as stages are completed. • Topsoil will be stockpiled separately for possible reuse in landscaping and 	Project manager and contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>rehabilitation works.</p> <ul style="list-style-type: none"> • During construction of trenches for utility pipeline relocations, topsoil will be excavated separately to the subsoil and will be placed on top of the backfilled trenches to promote rapid regeneration of groundcover vegetation. • High risk soil and erosion activities such as earthworks will not be undertaken immediately before or during high rainfall or wind events. • Permanent catch drains will be installed behind proposed cut faces to act as diversion drains during the construction phase. • Erosion and sediment control measures will be maintained until the works are complete and areas are stabilised by revegetation. 		
Soils and water quality - water contamination	<ul style="list-style-type: none"> • All fuels, chemicals, and liquids will be stored at least 50 metres away from any drainage lines and will be stored in an impervious bunded area within the compound sites. • The refuelling of plant and planned maintenance of machinery and plant will be undertaken 50 metres away from waterways. • Machinery will be checked daily for leaks of oil, fuel or other liquids. • Control of dirty water will be managed onsite to avoid release in to drainage lines and/or waterways. • Potable water will be used for wash down. • Containment material will be used to capture/filter water used in vehicle wash- downs. • Concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site. • Visual monitoring of local water quality (ie turbidity, hydrocarbon spills/slicks) will be undertaken on a regular basis to identify any potential spills or deficient erosion and sediment controls. A record will be kept of these inspections. • Emergency spill kits will be kept on-site at all times. • All staff will be inducted about incident and emergency procedures and made aware of the locations of emergency spill kits. • Should a spill occur during construction, the emergency response plan will 	Project manager and contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>be implemented, and the Roads and Maritime senior regional environmental officer contacted. OEH will also be notified as per Part 5.7 of the POEO Act.</p>		
Soils and water quality - soil contamination	<ul style="list-style-type: none"> If soil contamination is discovered during construction, works will cease immediately, the site will be temporarily fenced and access will be restricted. Soil sampling and analysis will be conducted to assess the extent and nature of the contamination. Remediation will be conducted in line with the guidelines in Managing Land Contamination: Planning Guidelines SEPP 55–Remediation of Land (NSW Government 1998). 	Project manager and contractor	Construction

5.12 Construction environmental management plan

A construction environmental management plan (CEMP) will be prepared to implement safeguards and management measures during construction as detailed in section 5.11. The CEMP will be developed in accordance with the requirements set out in the Roads and Maritime *QA Specification G36 – Environmental Protection (Management System)* and in accordance with NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) publication '*Guideline for the Preparation of Environmental Management Plans*'.

The CEMP will include an environmental policy that contains a commitment to the principles of Ecologically Sustainable Development as detailed in the NSW *Protection of the Environment Administration Act 1991*. Specifically, the CEMP will:

- Describe all relevant elements of the construction contractor's environmental management system and how these will apply to during construction.
- Address all aspects and construction stages of the proposal.
- Identify how safeguards and management measures will be implemented and who will be responsible for the implementation.
- Include a site-specific environmental induction and training requirements that describes the minimum level of training, experience and/or qualifications required for staff and subcontractors.
- Include inspection and monitoring requirements to validate the impacts predicted for the proposal, to measure the effectiveness of safeguards and management measures and the implementation of the CEMP,
- Include a process to periodically review the effectiveness and proper implementation of the CEMP which identifies opportunities for continual improvement of the environmental management processes and practices.

In addition, the CEMP will include specific sub-plans containing information relevant to key environmental management issues. The following specific sub-plans will be prepared as part of the CEMP:

- Biodiversity management plan, including a wildlife crossing management plan and nest box strategy.
- Construction noise and vibration management plan.
- Soil and water management plan.
- Traffic management plan.
- Aboriginal heritage management plan.