

Threatened Species: No threatened flora or fauna species were recorded during a traverse over the study area.

Grazing still occurs in Cumberland Plain Woodland and planted/exotic vegetation communities. Disturbance and grazing has limited native species richness, especially within the shrub layer. Clearing of vegetation has isolated vegetative patches of Cumberland Plain Woodland. Dispersion of flora and fauna species is limited.

Dumping of old building material has introduced alternative sheltering and basking opportunities for terrestrial species, in particular amphibians and reptiles and their prey items. The absence of a native shrub layer may reduce foraging resources for a number of threatened species, especially microbats and woodland bird species. Fragmentation of native vegetation also limits the availability of suitable foraging habitat for many threatened species. An assessment of the habitat attributes was conducted to determine the potential for the area to contain threatened fauna. The site contained potential habitat resources for threatened species, see Table L16 below.

Table L16. Summary of foraging resources and habitat for fauna species, Kellyville site (Tile 15).

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Hollow-bearing tree	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Numerous small hollows available. Suitable for micro-bats and small birds.
Flowering, fruiting, sap trees and fibrous bark	Nectivorous birds, arboreal mammals and Micro/Macro-bats.	Suitable micro-bat roosting in fibrous bark. Abundant winter flowering and few summer flowering species.
Vegetation connectivity	Migratory birds, and arboreal mammals and reptiles.	Fragmented habitat
Vegetation Structure	Diurnal/nocturnal birds, small ground mammals, micro and macro-bats, reptiles and amphibians.	Limited understorey will exclude some ground mammals and small birds.
Woody debris (logs and leaf litter)	Reptiles, invertebrates, small mammals	Few logs small present. Piles of timber and burn piles provide shelter. Limited leaf litter.
Water bodies, drainage line	Reptiles, amphibians, wading birds	Bath tubs provide some water bodies. A weedy drainage line located off study area.
Rocky outcrops	Reptiles, invertebrates	Metal sheeting provides alternative shelter and basking opportunities.

L.9 Burns Road to Samantha Riley Drive (Tile 16)

Where: Burns Road north along Old Windsor Rd to Samantha Riley Drive, Kellyville. The Hills Shire Council LGA

Description: the study area contains several large residential lots and extensive exotic grasslands.

Vegetation: the landscape is dominated by exotic grassland which extends throughout the site (Appendix C – Tile 16). Planted/exotic vegetation contains the occasional native herbs, scattered, tree or shrub). (Plate 18:)

Native vegetation is limited to scattered native canopy species and a mixture of native and exotic groundcover grasses or herbs. Only one native vegetation community is present within the area, Cumberland Plain Woodland. The largest patch is located to the southern portion of the study area.



Plate 19: large tracts of exotic grasslands mapped as Planted/Exotic are regularly mowed.



Plate 18: small pockets of Cumberland Plain Woodland (TSC) in good condition.

Table L17. Vegetation description, condition and recovery potential for Kellyville (Tile 16)

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Eucalyptus crebra</i> , <i>Angophora floribunda</i> , <i>Cirsium vulgare</i> and <i>Microlaena stipoides</i>	Moderate: Highly diverse ground cover species in small patches surrounded by exotic herbs and grasses.	Good.
Planted/Exotic	Not listed	<i>Pinus</i> sp., <i>Galium aparine</i> , <i>Cynodon dactylon</i> and <i>Anagallis arvensis</i> .	No remnant vegetation remains. Few native groundcover species present. High weed infestation.	Moderate.

Threatened Species: No threatened flora or fauna species were recorded during the site inspection.

The scattered trees within the site connect to a riparian corridor along Elizabeth Macarthur Creek, beyond the site boundary. This vegetative corridor provides access to additional scattered trees both within and outside the site boundary. Historical and current disturbances including vegetation clearing, mowing and infestation of weed within the vegetative community has reduced the availability of foraging resource for a number of threatened species. Natural regeneration within the pockets of Cumberland Plain Woodland has good regeneration and high recovery potential if disturbances are reduced. Limited logs, rocks and other foraging, basking and sheltering resources were available for threatened fauna species.

Planted/exotic vegetation communities provide limited habitat for threatened species. Cumberland Plain Woodland vegetation may provide supplementary foraging habitat but it is not a considered a sustainable source of resources.

An assessment of the habitat attributes was conducted to determine the potential for the area to contain threatened fauna. The site contained potential habitat resources for threatened species, see Table L18 below.

Table L18. Summary of foraging resources and habitat for fauna species, Kellyville site (Tile 16).

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Hollow-bearing trees	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Few scattered hollow-bearing trees of small size provide some sheltering habitat for threatened micro-bats.
Flowering, fruiting, sap trees and fibrous bark	Nectivorous birds, arboreal mammals and Micro/Macro-bats.	Suitable micro-bat roosting in fibrous bark. Abundant winter flowering and few Acacia summer flowering.
Vegetation connectivity	Migratory birds, and arboreal mammals and reptiles.	Vegetation is sparsely scattered over a large extent. Vegetation does not connect with large intact areas.
Vegetation structure	Diurnal/nocturnal birds, small ground mammals, micro and macro-bats, reptiles and amphibians.	Native vegetation is limited to a canopy and ground layer.
Woody debris (logs and leaf litter)	Reptiles, invertebrates, small mammals	No large logs present and limited accumulation of leaf litter available.
Water bodies, drainage line	Reptiles, amphibians, wading birds	Area may provide soaks following heavy rainfall A drainage line is located outside the study area.
Rocky outcrops	Reptiles, invertebrates	No record of rocks within the study area.

L.10 Samantha Riley Drive to Windsor Road (Tiles 16 & 17)

Where: Bounded by Windsor and Old Windsor Rd and Samantha Riley Dr to the south, Kellyville. The Hills Shire Council LGA

Description: contains extensive exotic grassland, Landscaping suppliers, the northern section of Caddies Creek, walking tracks and the bus T-way.

Vegetation: the majority of the study area contains exotic grassland which has been mapped as Planted/Exotic. This vegetation type also includes a planted garden of native species at the junction of Windsor and Old Windsor Rd. Native vegetation has been mapped within the study area and includes a very narrow band of Cumberland Plain Woodland along the T-way (Plate 21) to the south-west of the study area boundary and an extensive patch of River Flat Eucalypt Forest (Plate 21). River Flat Eucalypt Forest vegetation community extends along much of the banks of Caddies Creek. Native vegetation diversity is low and this community contains numerous exotic species.



Plate 21: planted Eucalyptus species along the T-way, Planted/Exotic vegetation community.



Plate 20: River Flat Eucalypt Forest contains a native canopy and groundcover and exotic species.

Table L19: Vegetation description, condition and recovery potential for Kellyville (Tiles 16-17)

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Eucalyptus tereticornis</i> , <i>Bursaria spinosa</i> and <i>Briza subaristata</i> .	Moderate: A very narrow band of regenerating CPW with a canopy layer, shrub and groundcover species present.	Moderate.
River Flat Eucalypt Forest	- TSC Act (EEC)	<i>Casuarina glauca</i> , <i>Eucalyptus amplifolia</i> , <i>Acacia decurrens</i> and <i>Themeda australis</i> .	Moderate: Species richness is low and weed infestation is high. Some areas are regularly mowed.	Moderate.
Planted/Exotic	Not listed	<i>Eucalyptus</i> sp., <i>Melaleuca</i> sp., <i>Lomandra longifolia</i> and <i>Avena fatua</i> .	Poor: Extensive exotic grassland. Some native plantings along T-way.	Moderate.

Threatened Species: No threatened flora or fauna species were recorded during the site inspection.

The riparian corridor, mapped as River Flat Eucalypt Forest, provides a foraging substrate for a number of threatening species including microbats, migratory birds and parrots. However, the vegetation forms a narrow vegetative band in a matrix of exotic grasses. Highly mobile species may utilise the River Flat Eucalypt Forest vegetation for foraging or sheltering and may provide a vegetative corridor for fauna dispersal. Habitat attributes (logs, hollows, rocks) were limited and generally confined to native vegetation communities such as the River Flat Eucalypt Forest or Cumberland Plain Woodland.

An assessment of the habitat attributes was conducted to determine the potential for the area to contain threatened fauna. The site contained potential habitat resources for threatened species, see Table L20.

Table L20. Summary of foraging resources and habitat for fauna species, Kellyville site (Tiles 16-17).

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Hollow-bearing trees	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Small to moderate size hollows are scattered throughout Cumberland Plain Woodland and River Flat Eucalypt Forest vegetation.
Flowering, fruiting, sap trees and fibrous bark	Nectivorous birds, arboreal mammals and Micro/Macro-bats.	Casuarina fruit and some winter flowering Eucalyptus species are present. Some planted nectar species.
Vegetation connectivity	Migratory birds, and arboreal mammals and reptiles.	Riparian corridor provides connectivity through site. Windsor Rd dissects River Flat Eucalypt Forest corridor.
Vegetation structure	Diurnal/nocturnal birds, small ground mammals, micro and macro-bats, reptiles and amphibians.	Generally, complexity is low with minimal shrub layer and narrow bands of native canopy species.
Woody debris (logs and leaf litter)	Reptiles, invertebrates, small mammals	Few logs available.
Water bodies, drainage line	Reptiles, amphibians, wading birds	Fringing vegetation is limited and dominated by exotic species.
Rocky outcrops	Reptiles, invertebrates	Few rocks located in area.

L.11 Windsor Road to Sanctuary Drive (Tile 17)

Where: bounded by Windsor Road to the south and west and Sanctuary Drive and housing development to the north, Kellyville. The Hills Shire Council LGA.

Description: the majority of the site has been cleared of native vegetation. Several isolated clumps of native vegetation mapped as River Flat Eucalypt Forest and Cumberland Plain Woodland remain intact (Appendix C – Tile 17). Weed invasion threatens to reduce the vegetation vitality and condition. There is a high recovery potential for the native vegetation communities with careful management.

Vegetation: three vegetation communities were identified. The most extensive is the Planted/exotic vegetation which occurred as exotic grasslands (**Plate 23**). Only two patches of River Flat Eucalypt Forest were mapped (**Plate 22**). The most extensive and rich in species diversity occurred behind the Landscape suppliers at the corner of Windsor and Old Windsor Rd. A second patch of River Flat Eucalypt Forest was located on the western arm of Caddies Ck contained a high proportion of weeds. A small plot of poor condition Cumberland Plain Woodland adjoined the River Flat Eucalypt Forest vegetation and contained regeneration of canopy species.



Plate 23: Planted/Exotic vegetation is dominated by cleared grasslands.



Table L21. Vegetation description, condition and

Plate 22: Narrow patch of River Flat Eucalypt Forest (Poor) with an exotic and native understorey.

recovery potential for Kellyville (Tile 17)

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Eucalyptus crebra</i> , <i>E. tereticornis</i> , <i>Acacia decurrens</i> , <i>Microlaena stipoides</i> and <i>Bromus catharticus</i> .	Moderate: Highly disturbed understorey and infested with exotic weeds.	Moderate.
River Flat Eucalypt Forest	- TSC Act (EEC)	<i>E. tereticornis</i> , <i>Casuarina cunninghamiana</i> , <i>Cirsium vulgare</i> and <i>Einadia hastate</i> .	Poor: Limited native diversity.	Moderate.

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Planted/Exotic	Not listed	<i>Eucalyptus</i> sp., <i>Liquidambar styraciflua</i> , <i>Melaleuca</i> sp., <i>Sida rhombifolia</i> and <i>Pennisetum clandestinum</i>	Poor. Exotic pastureland.	Poor.

Threatened Species: No threatened flora or fauna species were recorded during the site inspection.

The landscape was disturbed by the intersection of roads and regular mowing of exotic grasslands. The River Flat Eucalypt Forest and Cumberland Plain Woodland vegetation communities appeared to be have regenerated after past clearance. A few larger *E. tereticornis* contained flowering resources and hollows for arboreal species. However, the canopy layer was generally immature and lacked hollows. Similarly, rocks, logs and other foraging resources remain limited due to previous clearing activities. The site does provide great potential for successful recovery and important resources in a highly degraded and barren landscape. It may provide suitable additional foraging for threatened avian and microbat species.

An assessment of the habitat attributes was conducted to determine the potential for the area to contain threatened fauna. The site contained potential habitat resources for threatened species, see Table L22.

Table L22. Summary of foraging resources and habitat for fauna species, Kellyville site (Tile 17).

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Hollow-bearing trees	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Limited available hollow-bearing trees. Immature canopy strata and low regeneration.
Flowering, fruiting, sap trees and fibrous bark	Nectivorous birds, arboreal mammals and Micro/Macro-bats.	Few suitable resources. Widely scattered trees.
Vegetation connectivity	Migratory birds, arboreal mammals and reptiles.	Creek provides vegetative corridor for dispersal. Although not connected to large intact vegetation patch.
Vegetation structure	Diurnal/nocturnal birds, small ground mammals, micro and macro-bats, reptiles and amphibians.	No suitable cover for most species. Low complexity. Limited shrub layer.
Woody debris (logs and leaf litter)	Reptiles, invertebrates, small mammals	Area cleared of suitable woody debris and leaf litter. Some litter surrounding scattered eucalypts.
Water bodies, drainage line	Reptiles, amphibians, wading birds	Sediment pound provides access to water. Water fenced and disturbed and artificial.

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Rocky outcrops	Reptiles, invertebrates	Area cleared of suitable habitat. Limited and scattered rocks are present.

L.12 Rouse Hill Station (Tile 18)

Where: Bounded by White Hart Dr, Sanctuary Dr and Windsor Rd, Rouse Hill. The Hills Shire Council LGA

Description: site contained relatively recent development in the form of commercial buildings, roads, exotic grasslands, a drainage line with plantings and small disturbed patch of Cumberland Plain Woodland.

Vegetation: a small remnant patch of Cumberland Plain Woodland was present at the Rouse Hill Development Centre (Plate 22). CPW was characterised by a mature native canopy and few native groundcover species. There was no midstorey or shrub layer present.

A drainage line adjacent to White Hart Drive contained few large eucalypt trees, however, the soil was disturbed and native flora species were planted. This area also contained high number of exotic weeds (Plate 24). The remaining Planted/exotic vegetation occurred in landscaped gardens consisting of horticultural native and exotic tree, shrubs and groundcover species.



Plate 24: Planted/Exotic horticultural gardens in main shopping centre



Plate 25: Planted/Exotic, native revegetation along drainage line off White Hart Dr

Table L23. Vegetation description, condition and recovery potential for Kellyville (Tile 18)

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Angophora floribunda</i> , <i>Eucalyptus crebra</i> , <i>Callistemon</i> sp., <i>Brunoniella pumilio</i> and <i>Plantago lanceolata</i> .	Moderate: Area regularly mowed and limited to a canopy layer and mix of exotic native and exotic species.	Moderate.
Planted/Exotic	Not listed	<i>Corymbia citriodora</i> , <i>Lophostemon confertus</i> , <i>Bursaria spinosa</i> , <i>Brassica</i> sp. and <i>Cynodon dactylon</i> .	Moderate: Landscaped gardens and native planting along drainage.	Poor.

Threatened Species: No threatened flora or fauna species were recorded during the site inspection.

The study area is highly disturbed and fragmented by recent urban development. Soil disturbance and alteration of the landscape including clearing of native vegetation has reduced the potential for the study area to support threatened flora and fauna species. There is limited connectivity between isolated vegetative communities and an absence of large intact vegetative communities that may support threatened fauna. Highly mobile species may supplement foraging resources with planted and Cumberland Plain Woodland vegetation within the site. Winter flowering of planted *Corymbia citriodora* has potential to be a food supply for threatened migratory bird species.

An assessment of the habitat attributes was conducted to determine the potential for the area to contain threatened fauna.

Table L24. Summary of foraging resources and habitat for fauna species, Rouse Hill site (Tile 18).

HABITAT ATTRIBUTE	FAUNA GROUP	DESCRIPTION
Hollow-bearing trees	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Contains up to 10 hollow-bearing trees of varying size at the north and south boundaries.
Flowering, fruiting, sap trees and fibrous bark	Nectivorous birds, arboreal mammals and Micro/Macro-bats.	Contains planted winter flowering and other nectar species.
Vegetation connectivity	Migratory birds, and arboreal mammals and reptiles.	Vegetation is highly fragmented by roads, development and exotic grasslands.
Vegetation structure	Diurnal/nocturnal birds, small ground mammals, micro and macro-bats, reptiles and amphibians.	No shrub layer and regular mowing of Cumberland Plain Woodland has reduced structural complexity to a canopy and cropped groundcover layer.
Woody debris (logs and leaf litter)	Reptiles, invertebrates, small mammals	Horticultural gardens contain mulch layer and few small logs in the drainage line.
Water bodies, drainage line	Reptiles, amphibians, wading birds	Drainage line contains a high proportion of weeds and urban rubbish. Riparian habitat is limited.
Rocky outcrops	Reptiles, invertebrates	Drainage line contains some rock boulders for basking habitat.

L.13 Area 20 – Windsor Road Viaduct (Tile 18)

NOTE: No field survey was undertaken in this area as part of this project. The data and assessment relies on information developed for the rezoning of the Area 20 precinct of the NWGC (Eco Logical Australia 2010).

L.14 Area 20 – Windsor Road Viaduct to Tallawong Road (Tile 19)

NOTE: No field survey was undertaken in this area as part of this project. The data and assessment relies on information developed for the rezoning of the Area 20 precinct of the NWGC (Eco Logical Australia 2010).

L.15 Tallawong Road to First Ponds Creek (Tile 20)

Where: Schotfields Road and Tallawong Rd, The Ponds, Blacktown City Council LGA.

Description: A diverse landscape of market gardens and regenerating River Flat Eucalypt Forest and Cumberland Plain Woodland vegetation communities within rural properties.

Vegetation: market gardens are the main land-use within the site and include man-made dams and exotic plantings. The native vegetation communities were mapped as Cumberland Plain Woodland and River Flat Eucalypt Forest. Cumberland Plain Woodland was mapped as poor and moderate condition at the north-eastern boundary of the study area (Appendix C - Tile 20). A relatively large area of River Flat Eucalypt Forest was mapped as poor vegetation condition. RFEF was significantly altered by the dominance of exotic grasses and herbs in the ground layer (Plate 26). Cumberland Plain Woodland with a high level of weed infestation was mapped as poor condition (Plate 26). Some regeneration of canopy species was present within the Cumberland Plain Woodland community. Remaining Cumberland Plain Woodland and River Flat Eucalypt Forest are threatened by exotic invasion, isolation of patches and introduction of nutrients from agricultural practices.



Plate 27: River Flat Eucalypt Forest poor condition (TSC) native canopy with exotic grassland, moderate regeneration.



Plate 26: Cumberland Plain Woodland poor condition (TSC) exotic grasses and native canopy with some regeneration potential.

Table L25. Vegetation description, condition and recovery potential for Kellyville (Tile 20)

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Eucalyptus crebra</i> , <i>Angophora floribunda</i> , <i>Bursaria spinosa</i> and <i>Eragrostis curvula</i> .	Moderate: Some regeneration of native canopy. Groundcover dominated by exotic grasses and herbs.	Moderate:
Cumberland Plain Woodland	- TSC Act (CEEC)	<i>Eucalyptus eugenioides</i> , <i>Cestrum parqui</i> and <i>Stellaria media</i> .	Poor: Groundlayer completely underscrubbed. Surrounding vegetation contains native understorey.	Moderate.

VEGETATION COMMUNITY	STATUS	CHARACTERISTIC SPECIES	SITE CONDITION	RECOVERY POTENTIAL
River Flat Eucalypt Forest	- TSC Act (EEC)	<i>Casuarina cunninghamiana</i> , <i>Ligustrum sinense</i> , <i>Phalaris aquatic</i> and <i>Juncus acutus</i> .	Poor: High weed infestation and low species richness.	Moderate.
Planted/Exotics	Not listed	<i>Jacaranda mimosifolia</i> , <i>Phoenix canariensis</i> , <i>Eragrostis curvula</i> and <i>Pennisetum clandestinum</i> .	Poor: Significantly altered from natural environment. Area dominated by exotic species.	Poor.

Threatened Species: No threatened flora or fauna species were recorded during the site inspection. Farm dams were scattered throughout the site surrounded by Planted/exotic vegetation. These provide potential breeding and foraging habitat for threatened amphibians and foraging for migratory birds. It also provides potential supplementary foraging for Large-footed Myotis. However, nutrient enrichment from agricultural practices has encouraged the spread of weeds.

Recent underscrubbing of some Cumberland Plain Woodland has removed foraging resources and shelter of woodland birds and terrestrial invertebrates. An absence of native shrubs and groundcover species, logs, hollows and logs was noted throughout the site. However, the accumulation of timber and metal building material around farm lots may provide supplementary sheltering for reptile species.

Table L26. Summary of foraging resources and habitat for fauna species, First Ponds site (Tile 20).

HABITAT ATTRIBUTE	FAUNA GROUP	HABITAT DESCRIPTION
Hollow-bearing trees	Hollow-dependent species; owls, diurnal avian species, arboreal mammals, amphibians and micro-bats.	Limited hollows are present due to immature Ironbark canopy.
Flowering, fruiting, sap trees and fibrous bark	Nectarivorous birds, arboreal mammals and Micro/Macro-bats.	Planted Fig trees provides suitable foraging for Macro-bats and terrestrial migratory birds.
Vegetation connectivity	Migratory birds, and arboreal mammals and reptiles.	River Flat Eucalypt Forest connects with adjacent scattered trees. Limited large intact vegetation remains in the surrounding landscape.
Vegetation structure	Diurnal/nocturnal birds, small ground mammals, micro/macro-bats, reptiles and amphibians.	Limited native vegetation cover restricts the movement and habitat suitability for many threatened species.
Woody debris	Reptiles, invertebrates, small	No hollow logs recorded. Building material

HABITAT ATTRIBUTE	FAUNA GROUP	HABITAT DESCRIPTION
(logs and leaf litter)	mammals	provides suitable alternative habitat for reptiles and invertebrates.
Water bodies, drainage line	Reptiles, amphibians, wading birds	A significant number of farm dams are scattered throughout the site.
Rocky outcrops	Reptiles, invertebrates	No rocky outcrops recorded during the survey. Metal sheeting provides alternative habitat.

Appendix M State Significant Impact Assessments

M.1 NSW IMPACT ASSESSMENT

An assessment of the impacts of the Project on species, populations and ecological communities listed under Schedules 1 and 2 of the TSC Act has been completed. The Project will be assessed under Part 5.1 State Significant Infrastructure of the EP&A Act. This impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2004) for vegetation communities, the Cumberland Plain Land Snail and Green and Golden Bell Frog.

The proposed footprint of the NWRL supports areas of native vegetation including five EECs, and potential and known habitat for a number of threatened fauna species. A full list of species recorded within a 10 km radius of the construction footprint is found in Appendix A, however not all of these species or their habitats are likely to be impacted by the Project. Potentially impacted species are listed below. Each species has been assessed for potential impacts that may result from the Project. Fauna species have been grouped based on fauna groups and / or the habitat they are likely to use within the NWRL development area.

Endangered Ecological Communities

- Blue Gum High Forest in the Sydney Basin Bioregion
- Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion
- Cumberland Plain Woodland
- Shale/Sandstone Transition Forest
- River Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin, and South East Corner Bioregions

Threatened Flora

- *Epacris purpurascens* var. *purpurascens*

Threatened Fauna

Invertebrates

- Cumberland (Large) Land Snail (*Meridolum corneovirens*)

Amphibians

- Green and Golden Bell Frog (*Litoria aurea*)

Parrots

- Glossy Black-Cockatoo (*Calyptorhynchus lathamii*)

- Gang Gang Cockatoo (*Callocephalon fimbriatum*) (includes vulnerable population)
- Swift Parrot (*Lathamus discolor*)
- Turquoise Parrot (*Neophema pulchella*)

Owls

- Powerful Owl (*Ninox strenua*)
- Barking Owl (*Ninox corneovirens*)

Woodland Birds –ground and mid-storey foraging (passerines)

- Scarlet Robin (*Petroica boodang*)
- Varied Sittella (*Daphoenositta chrysoptera*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

Woodland Birds – canopy foraging (excluding parrots)

- Regent Honeyeater (*Anthochaera phrygia*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)
- Superb Fruit-Dove (*Ptilinopus superbus*)

Predominantly Tree-roosting Bats

- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- East Coast Freetail Bat (*Mormopterus norfolkensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)

Predominantly Cave-roosting Bats

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Large-footed (Southern) Myotis (*Myotis macropus*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)

Megabats

- Grey-headed Flying-Fox (*Pteropus poliocephalus*)

Mid-storey and log dependent Mammals

- Spotted-tailed Quoll (*Dasyurus maculatus*)

Migratory Terrestrial Species (EPBC Act)

- Fork-tailed Swift (*Apus pacificus*)

- White-throated Needletail (*Hirundapus caudacutus*)
- Black-faced Monarch (*Monarcha melanopsis*)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Rufous Fantail (*Rhipidura rufifrons*)
- Regent Honeyeater (*Anthochaera phrygia*)

Migratory Wetland Species (EPBC Act)

- Great Egret (*Ardea alba*)
- Cattle Egret (*Ardea ibis*)
- Latham's Snipe (*Gallinago hardwickii*)

M.2 SUMMARY OF IMPACTS

The following tables summarise the impacts to known or potential habitat for EECs and threatened fauna that are likely to be impacted by the proposed NWRL. The tables include (where appropriate) the community/species name; their conservation status at the state and federal level; an estimate of the amount of habitat likely to be directly or indirectly impacted; an estimate of the amount of habitat within the region; and the percentage of habitat to be lost as a result of the NWRL at the regional level.

Table 29: Summary of Impacts - Endangered Ecological Communities

VEGETATION COMMUNITY	TSC ACT	EPBC ACT	IMPACTED (HA)		TOTAL AREA IMPACTED (HA)	TOTAL AREA WITHIN ENTIRE DISTRIBUTION (HA)	% LOSS WITHIN ENTIRE DISTRIBUTION
			DIRECT IMPACTS	INDIRECT IMPACTS			
Blue Gum High Forest	CEEC	CEEC*	1.01	0.16	1.17	136 ha (SEWPaC 2011)	0.86
Sydney Turpentine-Ironbark Forest	EEC	CEEC**	0.32	0.43	0.75	1,484.38 ha *** 2,495 ha** (SEWPaC 2011)	0.05
Shale/Sandstone Transition Forest	EEC	EEC	0.78	0.38	1.16	9,950 ha (DECC 2005)	0.01
Cumberland Plain Woodland	CEEC	CEEC*	In GC	In GC	27.49	10,612 ha (DECCW 2010)	0.26
			11.22	1.07			
River Flat Eucalypt Forest	EEC	Not listed	In GC	In GC	4.13	5,313 ha (DECCW 2010)	0.08
			0.94	0.69			

Notes:

*Not all TSC listed vegetation patches meet the EPBC Act definition for STIF and CPW

**EPBC Act definition of STIF includes Blue Mountains Shale Cap Forest and Turpentine-Ironbark Forest.

*** Has been calculated from NPWS 2002b and DECCW 2009

GC = NWGC

Table 30: Assumptions used during calculation of direct and indirect impacts to primary and secondary habitat – Threatened Fauna

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Cumberland Plain Land Snail	Requires fallen logs, leaf litter and bark usually at the base of trees in Cumberland Plain Woodland and River Flat Eucalypt Forest to breed and forage. Unlikely to use patches of habitat more than 350m apart (Clark and Richardson 2002).	Clearing of good condition Cumberland Plain Woodland and River Flat Eucalypt Forest.	20m from good or moderate condition and 10m from poor condition Cumberland Plain Woodland and River Flat Eucalypt Forest.	Breeding and foraging habitat are the same and have been covered under impacts to primary habitat.		Extent of good condition Cumberland Plain Woodland and River Flat Eucalypt Forest identified by NPWS (2002b)
Green and Golden Bell Frog	Riparian zones and water bodies (including farm dams) with well-established fringing vegetation adjacent to open grassland areas for foraging, preferably not containing Gambusia.	Areas of 'potential breeding habitat' confirmed during target field surveys.	Mapped 'potential breeding habitat' within 50m of footprint	Areas providing 'potential movement corridors' confirmed during target field surveys.	Mapped 'potential movement corridors' within 10m of footprint	Not able to be determined by this study and not known from background research.
Glossy Black-cockatoo	Feeds exclusively on <i>Allocasuarina</i> and <i>Casuarina</i> species. Utilises large hollows for breeding.	Loss of any tree hollows 100-300mm within any native veg (excluding Cumberland Plain Woodland).	Any HBT 100-300mm within 50m of footprint within any native veg (excluding Cumberland Plain Woodland).	Loss of all native veg within the footprint excluding Cumberland Plain Woodland as it contains low densities of foraging trees	20m from good or moderate condition veg and 10m from poor condition veg (excluding Cumberland Plain Woodland)	Extent of the veg communities utilised for primary and secondary habitat within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Gang-gang Cockatoo	Breeds in tree hollows within Hornsby and Ku-ring-gai LGA's (Endangered Population). Otherwise, breeds in mountains and forages in the lowlands when non-breeding. Feeds on seeds of eucalypts and wattles; berries, fruits, nuts, insects.	Loss of tree hollows 100-300mm within footprint in Hornsby LGA	Any HBT 100-300mm within 50m of footprint in Hornsby LGA	Loss of all native veg throughout the entire footprint	20m from good or moderate condition veg and 10m from poor condition veg	Extent of the veg communities utilised for primary and secondary habitat within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Swift Parrot	Non-breeding winter migrant. Occurs in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.	None		Loss of any native veg throughout the entire footprint	20m from good or moderate condition vegetation and 10m from poor condition vegetation	Extent of the vegetation communities utilised for primary and secondary habitat within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Turquoise Parrot	Eucalypt woodland adjoining clearings. Spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows >50mm diameter in living or dead tree, fence stumps and posts.	Loss of tree hollows <100mm and 100-300mm within Cumberland Plain Woodland and River Flat Eucalypt Forest vegetation	HBT <100mm and 100-300mm within Cumberland Plain Woodland and River Flat Eucalypt Forest vegetation and within 50m of footprint	Cumberland Plain Woodland and River Flat Eucalypt Forest in good or moderate condition	20m from good or moderate condition Cumberland Plain Woodland and River Flat Eucalypt Forest	Extent of good or moderate condition Cumberland Plain Woodland and River Flat Eucalypt Forest on the Cumberland Plain (NPWS 2002b)
Powerful Owl	Old growth trees with large hollows and abundant prey items (including hollows and shrub layer as prey habitat).	Loss of hollows >300mm within Cheltenham and Cherrybrook sites.	HBT >300mm within 50m of Cheltenham and Cherrybrook sites.	Loss of any native vegetation at the Cheltenham, Cherrybrook and Epping sites.	50m from Cheltenham impact footprint (temporary impact)	Any good condition native vegetation >5ha patch size within Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009)

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Barking Owl	Old growth trees with large hollows and abundant prey items (including hollows and shrub layer as prey habitat).	Loss of hollows >300mm within Cheltenham and Cherrybrook sites.	HBT >300mm within 50m of Cheltenham and Cherrybrook sites.	Loss of any native vegetation at the Cheltenham, Cherrybrook and Epping sites.	50m from Cheltenham impact footprint (temporary impact)	Any good condition native vegetation >5ha patch size within Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009)
Scarlet Robin	Abundant logs and fallen timber. Insect feeder.	Loss of Cumberland Plain Woodland vegetation in good condition	20m from footprint in good condition Cumberland Plain Woodland	None – covered in primary habitat		Good condition Cumberland Plain Woodland vegetation (NPWS 2002b)
Brown Treecreeper	Dry open woodlands. Uncommon in coastal areas. Requires hollows in dead or live tree or tree stump for breeding. 80% diet is ants.	Loss of tree hollows 100-300mm within good condition Cumberland Plain Woodland and River Flat Eucalypt Forest	HBT (100-300mm) within 20m from footprint in good condition Cumberland Plain Woodland and River Flat Eucalypt Forest	Loss of good condition Cumberland Plain Woodland and River Flat Eucalypt Forest	20m from footprint in good condition Cumberland Plain Woodland and River Flat Eucalypt Forest	Good condition Cumberland Plain Woodland and River Flat Eucalypt Forest within the Cumberland Plain (NPWS 2002b)
Varied Sittella	Prefers rough-barked eucalypt species and mature smooth-barked gums with dead branches. Insect feeder.	Loss of any good condition vegetation within footprint	20m from footprint in any good condition vegetation	None – covered in primary habitat		Good condition vegetation within Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009)

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Black-chinned Honeyeater	Rarely recorded east of the Great Dividing Range. Nomadic and feeds on winter flowering gums.	None		Loss of Cumberland Plain Woodland, River Flat Eucalypt Forest or Shale/Sandstone Transition Forest vegetation	None	Extent of the vegetation communities utilised for primary and secondary habitat within the Cumberland Plain (NPWS 2002b).
Regent Honeyeater	Nomadic, non-breeding winter migrant. Feeds on winter flowering gums.	None		Loss of Cumberland Plain Woodland or River Flat Eucalypt Forest	20m from good or moderate condition Cumberland Plain Woodland or River Flat Eucalypt Forest and 10m from poor condition Cumberland Plain Woodland or River Flat Eucalypt Forest	Extent of the vegetation communities utilised for primary and secondary habitat within the Cumberland Plain (NPWS 2002b).
Superb Fruit-dove	Unlikely to breed within study area. No primary habitat (rainforest); only marginal secondary foraging habitat	None		Loss of moderate or poor condition native vegetation	None	All native vegetation within the Cumberland Plain and SMCMA study areas (NPWS 2002b and DECCW 2009)
Yellow-bellied Shearwater	Roosts singly or in groups of up to six, in tree hollows and buildings. Forages in most habitats across its very wide range, with and without trees.	Loss of tree hollows <100mm	HBT <100mm within 20m of footprint	Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Eastern False Pipistrelle	Prefers moist habitats with trees taller than 20m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark.	Loss of tree hollows <100mm	HBT <100mm within 20m of footprint	Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
East Coast Freetail Bat	Occurs in dry eucalypt forest, woodland, wet sclerophyll forests and forest edges. Primarily roosts in hollows or behind loose bark in mature eucalypts.	Loss of tree hollows <100mm	HBT <100mm within 20m of footprint	Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Greater Broad-nosed Bat	Associated with moist gullies in mature coastal forest, or rainforest. Forages along linear clearings (creeks, roads) in dense vegetation types. Usually roosts in tree hollows, but also found in buildings.	Loss of tree hollows <100mm	HBT <100mm within 20m of footprint	Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Eastern Bent-wing Bat	Wet and dry sclerophyll forests. Individuals use numerous roosts including mines, culverts, stormwater channels, buildings, and occasionally tree-hollows. Congregate in large numbers at a small number of nursery caves to breed and hibernate.	Cannot assess for cave-dwelling bats as do not have data (including potential man-made structures)		Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Large-footed Myotis	Will occupy most habitat types as long as they are close to water which is forages over for insects and small fish. Roosts in groups of 10-15 most commonly in caves, but also in tree hollows, amongst vegetation, under bridges, in mines, tunnels and stormwater drains.	Cannot assess for cave-dwelling bats as do not have data (including potential man-made structures)		Loss of water bodies	Water bodies within 50m of footprint	All water bodies within Cumberland Plain and SMCMA study area (NPWS 2002b and DECCW 2009).

SPECIES	SPECIFIC HABITAT REQUIREMENTS	PRIMARY HABITAT (BREEDING) ¹		SECONDARY HABITAT (FORAGING) ²		DEFINITION OF REGIONAL HABITAT ⁴
		DIRECT	INDIRECT	DIRECT	INDIRECT	
Large-eared Pied Bat	Found in well-timbered areas containing gullies. Forages for small, flying insects below the forest canopy. Roosts in caves, crevices in cliffs, old mine workings and disused mud nests of <i>Hirundo ariel</i> (Fairy Martin). Females (20-40) will gather in maternity roosts such as roof domes in sandstone caves.	Cannot assess for cave-dwelling bats as do not have data (including potential man-made structures)		Loss of any native vegetation throughout the entire footprint	Any native vegetation within 50m of footprint	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Grey-headed Flying-fox	Forage widely on nectar and pollen of native trees, rainforest fruits and cultivated gardens and fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	None – no camps present		All native vegetation clearing	None – habituated to light and noise	All native vegetation within the Cumberland Plain and SMCMA studies (NPWS 2002b and DECCW 2009).
Spotted-tailed Quoll	Requires maternal den sites (logs with cryptic entrances; rock outcrops; windrows; burrows), an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage. Individual dens may include tree hollows; small caves, or rocky-cliff faces. Females occupy home ranges up to 750 hectares and males up to 3500 hectares.	None – unlikely to breed within study area		Native vegetation clearing at Cheltenham and Epping sites	None	Any good condition native vegetation >5ha patch size within SMCMA and Cumberland Plain studies (NPWS 2002b and DECCW 2009).

Notes:

1. Primary habitat is defined as habitat critical to the lifecycle of the species including nesting and breeding sites;
2. Secondary habitat includes the foraging habitat that is generally widespread and accessible to the species.
3. Figures in brackets represent habitat within the NWGCs (biocertified).
4. The assessment of regional habitat should be considered to be highly indicative. It is for broad assessment purposes only and based on available GIS data and an understanding of the species habitat requirements.
5. It is noted that the GGBF could forage across a broader area than just movement corridors however there are significant limitations in making an adequate assessment of broader foraging habitat and consequently this type of habitat has not been included in 'secondary habitat' for this species.

Table 31: Tree hollows directly impacted by the proposed NWRL

VEGETATION COMMUNITY	DIRECT IMPACT			INDIRECT IMPACT (DISTANCE FROM CONSTRUCTION FOOTPRINT)								
	TREES WITH HOLLOWES OF VARYING DIAMETRE			WITHIN 10M			WITHIN 20M			WITHIN 50M		
				<100MM	100 - 300MM	>300MM	<100MM	100 - 300MM	>300MM	<100MM	100 - 300MM	>300MM
Blue Gum High Forest	1	1	0	0	0	0	0	0	0	0	0	0
Coastal Shale-Sandstone Forest	1	6	1	0	0	1	0	0	0	0	0	0
Cumberland Plain Woodland	27	6	1	1	2	3	2	0	0	1	0	0
River Flat Eucalypt Forest	4	1	2	3	3	3	2	6	0	4	3	0
Shale/Sandstone Transition Forest	3	5	0	4	3	1	3	1	0	7	3	0
Sydney Turpentine-Ironbark Forest	0	0	0	0	0	0	0	2	0	6	3	0
Planted/Exotic	16	21	7	1	3	2	5	10	2	5	1	1
Unmapped	6	3	0	0	5	1	0	0	0	5	6	3

Table 32: Summary of impacts – Threatened Fauna

SPECIES	TSC ACT	EPBC ACT	HABITAT IMPACTED (HA)				TOTAL IMPACTED (HA)	TOTAL DIRECT AND INDIRECT (HA)	AREA OF HABITAT WITHIN THE REGION (HA)	% OF HABITAT WITHIN THE REGION IMPACTED
			PRIMARY		SECONDARY					
			DIRECT	INDIRECT	DIRECT	INDIRECT				
Cumberland Plain Land Snail	E	-	0.63 (3.83)	2.43 (1.76)	Same as primary habitat		3.06 (5.59)	8.65	8519.73	0.10
Green and Golden Bell Frog	E	V	0.11 (0.50)	0.02 (0.00)	1.72 (1.53)	0.81 (0.20)	2.66 (2.23)	4.89	N/A	N/A
Glossy Black-cockatoo	V	-	13 (0) hollows	24 (0) hollows	4.83 (0.94)	3.24 (0.69)	8.07 (1.63)	9.70	33262.44	0.03
Gang-gang Cockatoo	V, E2	-	9 (0) hollows	8 (0) hollows	18.71 (12.16)	4.56 (1.76)	23.27 (13.92)	37.19	50009.98	0.07
Swift Parrot	E	E	None Known	None Known	18.71 (12.16)	4.56 (1.76)	23.27 (13.92)	37.19	50009.98	0.07
Turquoise Parrot	V	-	37 (0) hollows	24 (0) hollows	9.41 (5.22)	1.48 (0.79)	10.89 (6.01)	16.90	11474.3	0.15
Powerful Owl	V	-	2 (0) hollows	1 (0) hollows	2.39 (0.00)	2.32 (0.00)	4.71 (0.00)	4.71	17467.82	0.03
Barking Owl	V	-	2 (0) hollows	1 (0) hollows	2.39 (0.00)	2.32 (0.00)	4.71 (0.00)	4.71	17467.82	0.03
Scarlet Robin	V	-	0.63 (3.26)	0.00 (0.05)	Same as primary habitat		0.63 (3.31)	3.94	5250.71	0.08
Brown Treecreeper	V	-	0 (0) hollows	0 (0) hollows	0.63 (3.83)	0.00 (0.36)	0.63 (4.19)	4.82	8519.73	0.06
Varied Sittella	V	-	1.52 (3.83)	1.10 (0.36)	Same as primary habitat		2.62 (4.19)	6.81	19914.17	0.03
Black-chinned	V	-	None Known	None Known	16.05 (12.16)	None Known	16.05 (12.16)	28.21	43195.36	0.07
Superb Fruit-dove	V	-	None Known	None Known	17.19 (8.33)	None Known	17.19 (8.33)	25.52	50009.98	0.05
Regent Honeyeater	E	E & M	None Known	None Known	15.27 (12.16)	2.43 (1.76)	17.70 (13.92)	31.62	24785.67	0.13
Yellow-bellied Sheath-tail-bat	V	-	58 (0) hollows	19 (0) hollows	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10

Eastern False Pipistrelle	V	-	58 (0) hollows	19 (0) hollows	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10	
East Coast Freetail Bat	V	-	58 (0) hollows	19 (0) hollows	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10	
Greater Broad-nosed Bat	V	-	58 (0) hollows	19 (0) hollows	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10	
Eastern Bent-wing Bat	V	-	None Known	Known roosting culvert under M2 at Cheltenham	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10	
Large-footed Myotis	V	-	None Known	None Known	Foraging habitat comprises waterbodies such as small farm dams and creeklines which are not quantified.						N/A
Large-eared Pied Bat	V	V	None Known	None Known	18.71 (12.16)	13.56 (6.53)	32.27 (18.69)	50.96	50009.98	0.10	
Grey-headed Flying-fox	V	V	None Known	None Known	18.71 (12.16)	None Known	18.71 (12.16)	30.87	50009.98	0.06	
Spotted-tailed Quoll	V	E	None Known	None Known	1.38 (0.00)	None Known	1.38 (0.00)	1.38	17467.82	0.01	

Notes:

Primary habitat is defined as habitat critical to the lifecycle of the species including nesting and breeding sites;

Secondary habitat includes foraging habitat that is generally widespread and accessible to the species.

Figures in brackets represent habitat/impacts within and exclusive to the NWGCs (biocertified).

The assessment of regional habitat should be considered to be highly indicative. It is for broad assessment purposes only and based on available GIS data and an understanding of the species habitat requirements.

M.3 ENDANGERED ECOLOGICAL COMMUNITIES

M.3.1 Blue Gum High Forest in the Sydney Basin Bioregion

Blue Gum High Forest in the Sydney Basin Bioregion is the name given to the ecological community listed as critically endangered in Part 2 of Schedule 1A of the *Threatened Species Conservation Act 1995*. Blue Gum High Forest is described as a moist, tall open forest community dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum). *Angophora costata* (Smooth-barked Apple), *A. floribunda* (Rough-barked Apple), and *E. paniculata* (Grey Ironbark) also occur depending on slope and soil characteristics (OEH 2011b). The midstorey comprises mesophyllous shrubs (particularly in gullies) and small trees, and the ground stratum is often dense, containing a mixture of herb, grass, and fern species (OEH 2011b). A list of flora species characteristic of the ecological community is provided by the Scientific Committee in the Final Determination for Listing (OEH 2011).

Blue Gum High Forest is found on the north shore and northern suburbs of Sydney and has a highly restricted and fragmented geographic distribution comprised of a series of small remnant patches. The area of extant Blue Gum High Forest remaining in 2005 was estimated to be 95ha consisting of small fragmented remnants (SEWPaC 2011). Highly modified relics persist as small clumps of trees without a native understorey, or which have an understorey largely replaced by woody exotic species or by increased abundance of native and exotic grasses (OEH 2011b). Small scale clearing, the influx of stormwater, and dispersal of weed propagules from nearby urban areas pose significant ongoing threats to the survival of Blue Gum High Forest (OEH 2011b).

Across the NWRL study area, Blue Gum High Forest has only been identified at the proposed Cherrybrook site (Tile 6). The direct and indirect impacts to Blue Gum High Forest as a result of the proposal are shown in Table 29. The following section responds to the questions of the Improve or Maintain test (DEC and DPI 2005).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable; Blue Gum High Forest is not a threatened species or population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal is likely to reduce the habitat for Blue Gum High Forest through clearing vegetation to construct the Cherrybrook Railway Station. Table 29 shows the amount of Blue Gum High Forest that will be removed for construction of the station and associated works, including the percentage that this clearing represents across the entire regional distribution of the community.

Apart from direct removal of the vegetation community, there will be indirect impacts to the community through a reduction of the remaining Blue Gum High Forest remnant size, creation of new edges to the vegetation, and potential disturbance to soils and hydrology resulting from the works. The level of impact from indirect sources has been estimated and is shown in Table 29.

Impacts to Blue Gum High Forest have been avoided where possible. The areas of Blue Gum High Forest in good condition are located to the north of the proposed Cherrybrook Station and will not be impacted by the proposal. The Blue Gum High Forest that will be impacted by the Cherrybrook Station construction is of degraded condition. Mitigation measures to protect the remaining stand of Blue Gum High Forest adjacent to the proposed Cherrybrook Station include sediment and erosion control, weed removal, and bush regeneration. For the areas of Blue Gum High Forest that cannot be avoided an Offset Strategy (Appendix N) has been prepared.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Not applicable; Blue Gum High Forest is not a threatened species or population.

How is the proposal likely to affect current disturbance regimes?

The species composition of a Blue Gum High Forest remnant will be influenced by the size of the remnant, recent rainfall or drought conditions and by its disturbance history (including fire) (SEWPaC 2011). The number, and relative abundance, of species will change with time since fire, and may also change in response to changes in fire regime (including fire frequency) (SEWPaC 2011).

The presence of urban development surrounding the Blue Gum High Forest at Cherrybrook has resulted in a fire regime of fire suppression, and there was no evidence of recent fires or arson (for at least 20 years). The recommended minimum fire interval for Blue Gum High Forest is 25-30 years (RFS 2006) to maintain maximum biodiversity.

The lack of fire has encouraged the dominance of native mesic species like *Pittosporum undulatum*, and exotic mesic species including *Tradescantia albiflora* and *Ligustrum* spp. in the understorey. Mitigation measures proposed to protect the remaining stand of a mix of poor and good condition Blue Gum High Forest north of the proposed Cherrybrook Station (outside of the construction footprint via site-specific Vegetation Management Plan) include active weed control and bush regeneration activities targeting invasive weeds, and thinning of mesic native species where required to promote a diversity of native understorey groundcovers and shrubs.

Blue Gum High Forest is restricted to deep clay soils derived from shale, within areas of high annual rainfall (816-1250mm) (SEWPaC 2011). The current drainage patterns at the site have been impacted by surrounding urban development, including the construction of an open stormwater drain along the western edge of the remnant backing onto a residential area. This stormwater drain is currently heavily infested with weeds.

The Environmental Management Framework for the proposed station and railway line will include strict sediment and erosion control measures to ensure the runoff from the construction site is diverted away from the Blue Gum High Forest remnant, so as not to impact the existing drainage patterns or soil conditions of the site.

The Blue Gum High Forest remnant has been mapped as degraded. Weed invasion is currently high and there is the potential for the proposal to result in the introduction of further invasive species. A number of mitigation measures have been proposed to prevent the introduction of weeds to the construction site. Weed monitoring, control, and progressive rehabilitation will help to reduce the potential for the remaining Blue Gum High Forest vegetation to be invaded by weeds.

Overall, the proposal is unlikely to alter the current disturbance regimes such that it would place the community at risk of extinction. Mitigation measures will protect the existing soil and drainage patterns and weed control will reduce the current level of weed invasion.

How is the proposal likely to affect habitat connectivity?

The proposal will reduce the size of the remnant patch adjacent to the Cherrybrook Station by removing the southern extent of the patch as detailed in Table 29. While the overall size of the patch will be reduced habitat connectivity is unlikely to be affected due to the vegetation to be cleared currently being mostly surrounded by urban areas.

The next closest patch of Blue Gum High Forest is located approximately 135m to the northwest and separated via an area of planted/exotic vegetation and Roberts Road. This small patch consists of canopy trees only. While Blue Gum High Forest has been mapped within the general locality of Cherrybrook by the CMA, it generally exists as small fragments and has not been validated by ELA staff. Given the existing level of fragmentation and small patch size of Blue Gum High Forest throughout the landscape, the amount being impacted both directly and indirectly by the proposed NWRL is unlikely to significantly decrease the level of habitat connectivity at the landscape level.

How is the proposal likely to affect critical habitat?

Not applicable. Critical habitat has not been declared for Blue Gum High Forest.

M.3.2 Sydney Turpentine-Ironbark Forest

Sydney Turpentine-Ironbark Forest is an open forest, with dominant canopy trees including *Syncarpia glomulifera* (Turpentine), *Eucalyptus punctata* (Grey Gum), *Eucalyptus paniculata* (Grey Ironbark), and *E. eugenioides* (Thin-leaved Stringybark) (DECC 2005). In areas of high rainfall (over 1050 mm per annum) *E. saligna* (Sydney Blue Gum) is more dominant. The shrub stratum is usually sparse and may contain mesic species such as *Pittosporum undulatum* (Sweet Pittosporum) and *Polyscias sambucifolia* (Elderberry Panax) (DECC 2005).

Sydney Turpentine-Ironbark Forest occurs close to the Shale/Sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaus. It is a transitional community, between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges (DECC 2005).

Sydney Turpentine-Ironbark Forest occurs at the eastern end of the proposed NWRL at the following sites (for more detailed information consult Appendix L – Site Profiles):

Epping (Tile 1) – small area of clearing in south west corner of Sydney Turpentine-Ironbark Forest patch (TSC Act and EPBC Act) for construction area. Tunnelling underneath the STIF is unlikely to impact the vegetation.

Cheltenham (Tile 2) – Good condition (TSC Act only); small amount of clearing for construction.

Hills Centre Station (Tile 10) – poor condition (TSC Act and EPBC Act); some clearing of Sydney Turpentine-Ironbark Forest within construction boundary.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable; Sydney Turpentine-Ironbark Forest is a critically ecological endangered community and is not a threatened species or population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposed railway alignment dissects through or underneath Sydney Turpentine-Ironbark Forest at Epping, Cheltenham, and the Hills Centre Station. The proposal is likely to result in the direct clearing of vegetation at each of these locations. Additional vegetation removal is required during the diversion of Cattai Creek for the underground tunnelling of the NWRL link between the Hills Centre Station and Norwest Station. The location of this appears to avoid Sydney Turpentine-Ironbark Forest vegetation. Table 29 indicates the amount of Sydney Turpentine-Ironbark Forest that will be removed for construction of the station and associated works, including the percentage that this clearing represents across the entire distribution of the community.

Apart from direct removal of the vegetation community, there will be indirect impacts to the community through a reduction in size and/or fragmentation of the remaining Sydney Turpentine-Ironbark Forest remnant. Indirect impacts include; the creation of new edges to the vegetation, and potential disturbance to soils and hydrology resulting from the works. The level of impact from indirect sources has been estimated and is shown in Table 29.

Impacts to the Sydney Turpentine-Ironbark Forest community have been avoided where possible. Two patches of Sydney Turpentine-Ironbark Forest in good condition are located north-east of the Cheltenham construction area (Tile 2 and 3), with a small area of the southernmost patch proposed to

be cleared for construction. For the areas of Sydney Turpentine-Ironbark Forest that cannot be avoided an Offset Strategy (Appendix N) has been prepared. Mitigation measures to protect the remaining area of Sydney Turpentine-Ironbark Forest include the preparation of a VMP for Epping (Tile 1), Cheltenham (Tiles 2 and 3), and the Hills Centre Station (Tile 10).

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Not applicable; Sydney Turpentine-Ironbark Forest is not a threatened species or population.

How is the proposal likely to affect current disturbance regimes?

Direct impacts will result in the removal of Sydney Turpentine-Ironbark Forest from Epping, Cheltenham, and Hills Centre Station. Indirect impacts are also expected at each of these sites. The proposal is likely to affect the current disturbance regime on both the direct and indirect impacted Sydney Turpentine-Ironbark Forest communities.

The species composition of the Sydney Turpentine-Ironbark Forest remnants are influenced by the size of the remnant, recent rainfall or drought conditions, and by its disturbance history (including fire) (SEWPaC 2011). The number, and relative abundance, of species will change with time since fire, and may also change in response to changes in fire regime (including fire frequency) (SEWPaC 2011).

The presence of urban development surrounding the Sydney Turpentine-Ironbark Forest at each of the three sites has altered the natural fire regime. Fire suppression (>50 years since fire) can cause a loss of fire-dependant flora species. The best management practices for Sydney Turpentine-Ironbark Forest fire management recommend a fire frequency between 15 – 30 years to maintain maximum biodiversity (SMCMA 2008).

An absence of fire management within the Hills Centre Station, Epping, and Cheltenham study areas has provided suitable habitat for the establishment of exotic species such as *Cardiospermum grandiflorum* (Balloon Vine) and *Ligustrum lucidum* (Large Leaved Privet). Mitigation measures to protect the remaining stand of Sydney Turpentine-Ironbark Forest north of the proposed Epping and Hills Centre Stations, and Cheltenham study area include the implementation of a VMP incorporating weed control and bush regeneration.

Sydney Turpentine-Ironbark Forest occurs on fertile soils at the Shale/Sandstone transition, within areas of high rainfall (DECC 2005). Sydney Turpentine-Ironbark Forest community is prone to hydrological disturbances from urban development. Weed infestation, nutrient enrichment, accumulation of rubbish, and periodic flushing of creeks are considered current disturbances which affect the Epping, Cheltenham, and The Hills Centre Station study areas. Epping contains Sydney Turpentine-Ironbark Forest along a tributary that flows into Devlins Creek, and stormwater outlets off Castle Howard Rd contribute to the flow. Weed infestation is significant in this location. Similarly the hydrological flow along Cattai Creek at The Hills Centre Station has also been disturbed following the construction of urban infrastructure and the infestation of weeds. The current condition of Sydney Turpentine-Ironbark Forest at these locations is highly degraded. Hydrological flow plays a significant role in the species composition within the Sydney Turpentine-Ironbark Forest community, and the proposed NWRL alignment may further alter the current hydrological flow within these Sydney Turpentine-Ironbark Forest communities.

Mitigation measures to restore and rehabilitate the remaining STIF adjacent to the proposed NWRL construction areas will improve the condition of these areas through weed control and bush regeneration as described in a VMP. In addition, the Environmental Management Framework for the

proposed alignment of the railway and stations will include strict sediment and erosion control measures to ensure the runoff from the construction site is diverted away from the Sydney Turpentine-Ironbark Forest remnant, so as not to impact the existing drainage patterns or soil conditions of the site.

Weed invasion within the directly impacted areas of Sydney Turpentine-Ironbark Forest is currently high, and there is the potential for the proposal to result in the introduction and spread of further invasive species. A number of mitigation measures have been proposed to prevent the introduction of weeds to the construction site, and a weed control procedure will be developed as part of the Environmental Management Framework for the proposal, including use of clean plant and equipment. Weed monitoring, control, and progressive rehabilitation will help to reduce the potential for the remaining Sydney Turpentine-Ironbark Forest vegetation to be invaded by weeds.

Overall, the proposal is unlikely to alter the current disturbance regimes such that it would place the community at risk of extinction. Mitigation measures will protect the existing soil and drainage patterns and weed control will reduce the current level of weed invasion.

How is the proposal likely to affect habitat connectivity?

The proposal will reduce the extent of Sydney Turpentine-Ironbark Forest at the Epping, Cheltenham, and the Hills Centre Station (Table 29). According to the proposed alignment, the southern extent of Sydney Turpentine-Ironbark Forest will be removed from within the Epping study area (TSC and EPBC Act). Another smaller patch of Sydney Turpentine-Ironbark Forest (TSC Act only) occurs on the eastern side of Beecroft Road, and a small portion of the northern most extent of this patch will also be removed. The removal of Sydney Turpentine-Ironbark Forest from these two patches is unlikely to fragment the Sydney Turpentine-Ironbark Forest community at this location, but it will reduce the size of the current patches. Both patches are bounded by urban infrastructure and urban development, and their condition is mapped as poor (degraded).

Further reduction in the size of these patches of Sydney Turpentine-Ironbark Forest may reduce the resilience of native species within this community. Sydney Turpentine-Ironbark Forest has been mapped approximately 400m to the south-west of these patches in Boronia Park, Epping. It is separated by Carlingford Rd and urban development. The remaining vegetation surrounding the Epping Sydney Turpentine-Ironbark Forest community is also highly fragmented. Given the existing level of fragmentation and small patch size of Sydney Turpentine-Ironbark Forest throughout the landscape, the amount impacted both directly and indirectly by the proposed NWRL is unlikely to significantly decrease the level of habitat connectivity at the landscape level.

The loss of a small portion of a good condition patch of Sydney Turpentine-Ironbark Forest at Cheltenham will reduce the overall size of this patch, but will not fragment the community at this location. The STIF patch at this location fronts onto road and is surrounded on the other sides by Sydney Turpentine-Ironbark Forest and Coastal Shale-Sandstone Forest.

Sydney Turpentine-Ironbark Forest is present at the Hills Centre Station site as two separate patches connected via planted/exotic vegetation along Cattai Creek. The western most patch will be subject to indirect impacts, but the eastern patch will be cleared along its northern margin where it fronts a car park for the Council Works Depot. This patch is mapped as poor condition (TSC Act only) and is surrounded by industrial and residential development. While the extent of this patch will be reduced, given the already highly fragmented landscape, fragmentation between other areas of Sydney Turpentine-Ironbark Forest will not result.

How is the proposal likely to affect critical habitat?

Not applicable. Critical habitat has not been declared for Sydney Turpentine-Ironbark Forest.