Heritage Items using Film or Digital Capture 2006. Upon completion of the archival record, one copy is to be lodged with the NSW State Library, the Heritage Office of the Department of Planning, and TIDC respectively.

Stop work provision — historic heritage

In accordance with provisions in the *Heritage Act 1977*, in the event that unanticipated historic structural fabric or cultural deposits are encountered during construction, work must cease immediately to allow an archaeologist to make an assessment of the finds. The archaeologist would consult with the Department of Planning Heritage Branch when any historic cultural material is identified.

Operation

Interpretive signage

It is recommended that interpretive signage is erected at Riverstone Station, including information on the history of the Station Complex, as well as the significance of the Richmond Line.

8.6 Flora and fauna

This section summarises the potential impacts of the Project on the existing biodiversity in and adjacent to the project area, based on the findings of Technical Paper 5 – Biodiversity Assessment in Volume 2. This section also provides management measures and recommendations to minimise the potential impact of the Project on existing biodiversity (refer Section 8.6.7). Existing flora and fauna identified in and adjacent to the existing rail corridor is described in Section 3.6.

8.6.1 Assessment approach

The key objectives of the biodiversity assessment were to undertake impact assessments for Threatened species, populations and communities that occur, or have potential habitat, within the project area (refer Section 3.6.2).

For species and communities listed under the EPBC Act significance assessments were undertaken in accordance with the administrative guidelines of the Department of the Environment, Water, Heritage and the Arts (DEWHA) (Department of the Environment and Heritage 2006).

The majority of the study area occurs within the NWGC certified area (refer Section 2.3).

Certification aims to achieve landscape-scale conservation, moving away from site-by-site decision-making and providing greater certainty in land-use planning. The main practical effect of certification is that it removes the need to undertake threatened species assessments for developments or activities within the area subject to certification.

Biodiversity certification switches off the need to undertake further significance assessments for threatened species and endangered ecological communities (EECs) in these areas under Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (the Seven Part Test). For species, populations and communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) that occur within non-certified areas, or outside the growth

centre, significance assessments were undertaken as required under the EP&A Act. These followed the methods suggested by the DECC's *Draft guidelines for Threatened species assessment under Part 3A* (DEC 2005).

A precautionary approach was taken for this biodiversity assessment. Notwithstanding the provisions conveyed by biodiversity certification, significance assessments were considered in accordance with the draft *Guidelines for Threatened Species Assessment* (DEC 2005) were conducted for threatened species that had a moderate or greater likelihood of occurring within the study area (refer Section 8.6.6).

8.6.2 Construction impacts

The construction of the Project would result in a range of direct biodiversity impacts in the proposed construction footprint, as well as potential indirect impacts in the surrounding landscape. A number of these impacts are listed as key threatening processes under Schedule 3 of the TSC Act and/or under the EPBC Act. The potential biodiversity impacts of the Project are discussed below.

Clearing of native vegetation

The Project would include the clearing of approximately 4.60 hectares of native vegetation (refer Table 8-36), which would be cleared for the new track, new stations, new car park at Vineyard and other rail infrastructure and ancillary uses. Clearing of native vegetation is recognised as a key threatening process under the following final determination titles:

- clearing of native vegetation under the TSC Act
- land clearance under the EPBC Act.

Native vegetation that would be removed within the corridor consists of patches of regrowth and remnant vegetation. Most of the regrowth vegetation is highly disturbed and the areas of remnant vegetation to be removed are relatively small.

An area of good condition Shale Gravel Transition Forest (listed as endangered under the TSC Act) occurs in the proposed site for the new Vineyard Station car park. This area has been identified as a 'core habitat' (refer Section 3.6.1); however, no threatened species were recorded in this area. The car park is proposed to be built in two phases, phase 1 would require the removal of approximately 0.44 hectares of vegetation and phase 2 would require the removal of approximately 0.53 hectares. The exact timing of the construction of the phase 2 car park is unknown and would be subject to further investigations and consideration of alternative locations in conjunction with GCC precinct planning (in any case construction of both phases of the car park forms part of Stage 2 of the overall Project, for which delivery has been deferred).

Potential loss of vegetation due to clearing associated with the Project is shown by vegetation community in Table 8-36. The area that would be impacted by the Project is shown in Figure 8-11. Figure 8-11 also shows the vegetation communities relative to the impact areas of the Project.

Table 8-36 Potential loss of vegetation

Vegetation community	TSC Act[1]	EPBC Act[2]	Approximate area (ha)
River-flat Eucalypt Forest on Coastal Floodplains	E	-	1.47
Cumberland Plain Woodland	E[3]	E[4]	1.34
Shale Gravel Transition Forest*	E	-	1.71*
Derived Grassland (previously shale gravel transition forest)	-	-	0.08
Total vegetation			**4.60**

Notes:
1: Listed as Endangered (E) under the TSC Act

2: Listed as Endangered (E) under the EPBC Act

3: On the 21 November 2008, the Scientific Committee, established under the TSC Act, made a preliminary determination to propose to list the Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community under the TSC Act. This preliminary determination was on public exhibition until 23 January 2009; a final determination has yet to be made by the Scientific Committee.

4: On the 1 October 2008, the Threatened Species Scientific Committee, established under the EPBC Act, nominated Cumberland Plain Woodland on the Finalised Priority Assessment List. This preliminary determination proposes to list this endangered ecological community as critically endangered under the EPBC Act. This proposed change in listing under the Act is yet to be determined.

* includes 0.44 hectares for phase 1 of the new Vineyard Station car park and 0.53 hectares for phase 2

Vineyard Station

An area of good condition Shale Gravel Transition Forest (listed as endangered under the TSC Act) occurs in the proposed site for the new Vineyard Station car park. This area has been identified as a core habitat (conservation significance assessment class, NSW National Parks and Wildlife Service 2002a); however, no threatened species were recorded in this area.

The car park is proposed to be built in two phases. phase 1 would require the removal of 0.44 hectares of vegetation and phase 2 the removal of 0.53 hectares. The exact timing of the construction of the phase 2 car park is unknown and would be subject to further investigations of biodiversity impacts and alternative locations.

Clearing for the proposed new Vineyard Station car park would result in the fragmentation of good condition Shale Gravel Transition Forest; however, it is unlikely to significantly increase the fragmentation of habitat in this area given it is already partially fragmented by existing roads and tracks.

Weed invasion is likely to impact the areas associated with the proposed car park and bus interchange. As stated previously, the vegetation in this area is in good to moderate condition and further weed invasion resulting from disturbance to this area is likely to threaten the viability of the native vegetation. Appropriate mitigation measures are required to be implemented during construction to avoid an increase in weed invasion in this area. Application of mitigation measures as described in Section 8.6.7 during construction would, therefore, significantly reduce any likelihood of weed invasion in the proposed Vineyard Station car park area. Weed invasion is further discussed for the Project in *Invasion and establishment of weeds* section below.

Figure 8-11a Vegetation communities relative to the area impacted by the Project

Note: Project detail shown is indicative only, subject to detailed design.

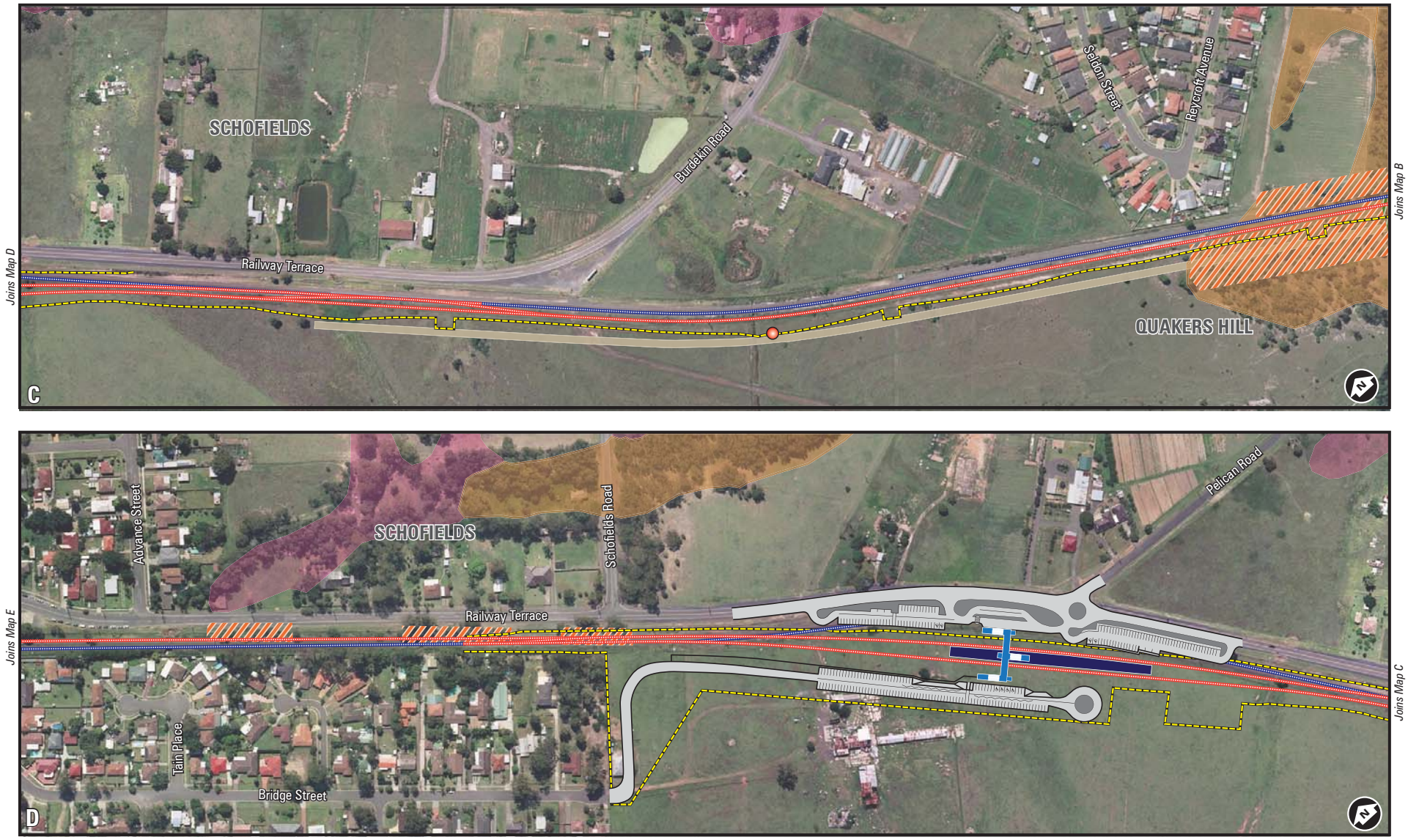

Figure 8-11b Vegetation communities relative to the area impacted by the Project

Note: Project detail shown is indicative only, subject to detailed design.

Figure 8-11c Vegetation communities relative to the area impacted by the Project

Note: Project detail shown is indicative only, subject to detailed design.

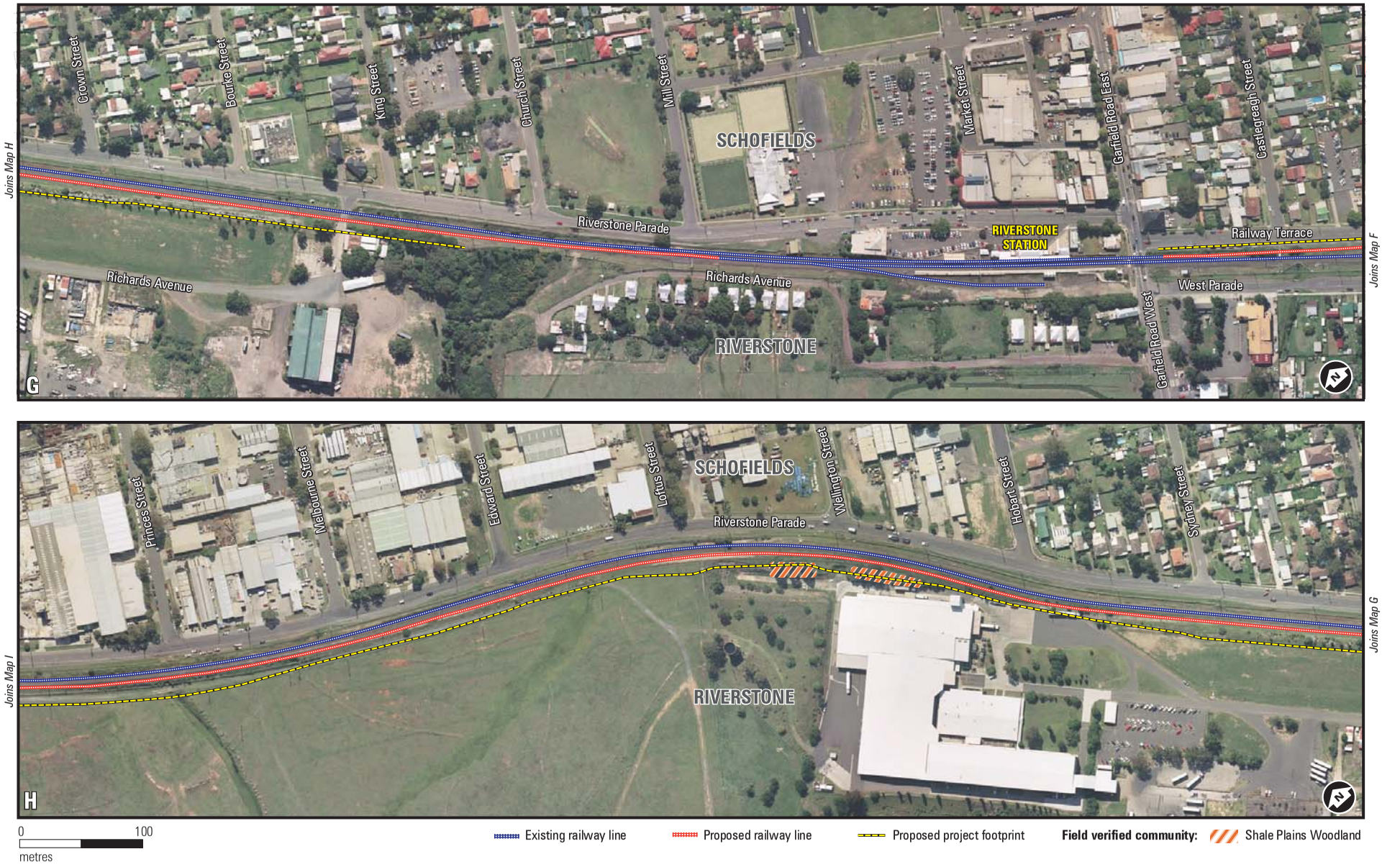

Figure 8-11d Vegetation communities relative to the area impacted by the Project

Note: Project detail shown is indicative only, subject to detailed design.

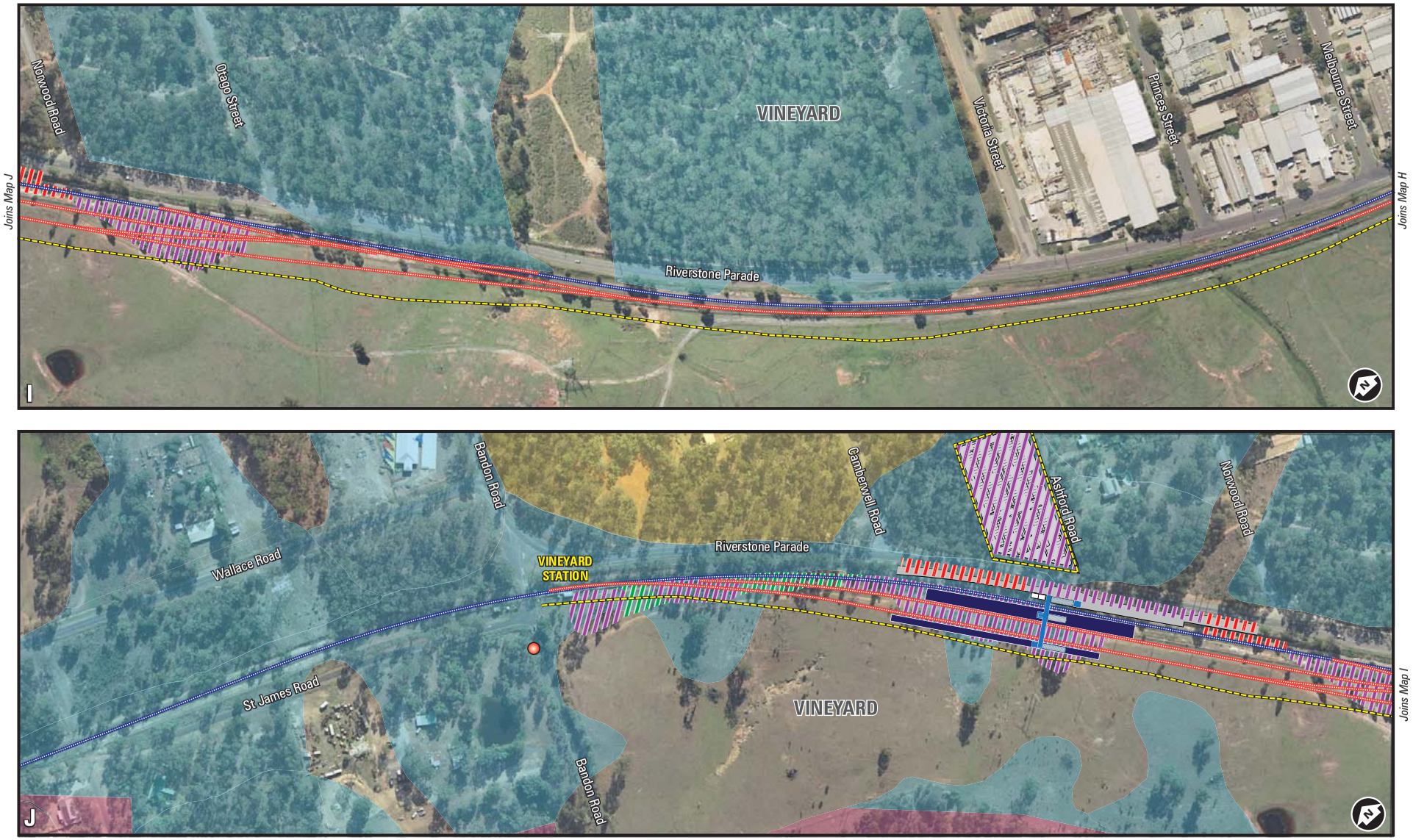

Figure 8-11e Vegetation communities relative to the area impacted by the Project

Note: Project detail shown is indicative only, subject to detailed design.

Disturbance of fauna habitats

The following disturbances to habitats are listed as key threatening processes under the TSC Act:

- clearing of native vegetation
- removal of dead wood and dead trees
- loss of hollow-bearing trees
- bush rock removal.

Clearing of native vegetation would result in the removal of fauna habitat elements, including direct and indirect feeding resources, dead trees (fallen and standing), tree hollows (often limited to small hollows only suitable for woodland birds), bush rock, dead wood (fallen) and leaf litter layer. Fauna use these habitat elements for shelter, for protection from predators, to find food, and to avoid extreme weather conditions and for breeding.

Fauna habitat elements (such as fallen timber and tree hollows) are limited resources, especially in modified landscapes, and are generally slow to develop following disturbance. Many threatened species of animal are dependent on one or more of these habitat elements to complete their life cycle (e.g. tree hollows for breeding).

The study area provides limited fauna resources. Bush rock is uncommon, and due to past disturbance and clearing, the majority of the trees in the study area are young and there is little dead wood. Only two significant hollow-bearing trees were recorded. Few scattered dead trees and fallen dead branches would be removed across study area. These are located within the proposed Vineyard Station area and Department of Defence land opposite Manorhouse Boulevard.

Invasion and establishment of weeds

One hundred and four species of weed were recorded, corresponding to 44% of the total number of flora species recorded in the study area (refer Section 3.6.2). This included 17 species listed as noxious weeds in the Hawkesbury River County Council noxious weed control area (includes Blacktown local government area (LGA)). Of these, three are also listed as weeds of national significance (refer Section 3.6.2.).

Construction activities have the potential to disperse weeds into areas of remnant vegetation where weed species do not currently occur. The most likely causes of weed dispersal associated with the Project would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery. This may, in turn, reduce the condition of vegetation communities and habitat quality for threatened species.

The study area has a high level of weed invasion with the majority of the vegetation dominated by weeds, particularly the central and southern sections. The northern section of the study area, in the vicinity of the new Vineyard Station and including the proposed car park and bus interchange, is in good to moderate condition and further weed invasion may threaten the viability of native vegetation in this area. However, the Project is unlikely to result in increased weed invasion in the study area, provided that appropriate mitigation measures are implemented during construction (refer Section 8.6.7).

Invasion and establishment of pest species

Thirteen of the key threatening processes under the TSC Act and EPBC Act relate to invasion and establishment, predation by, competition from, and change in habitat resulting from feral animal species. Three of these key threatening processes relate to the following feral animal species identified in the study area:

- predation by the European Red Fox, *Vulpes vulpes*
- predation by the Feral Cat, *Felis catus*
- competition and grazing by the feral European rabbit.

These pest species are likely to be already established within the study area and most likely already have an effect on native fauna populations in the locality. The construction of the Project is unlikely to increase impacts by pest species.

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands

The Project involves the crossing of a number of small drainage lines and the reconstruction of a number of drainage culverts. Construction may increase the velocity of stream flows. However, the impacts of increased velocity (such as erosion) are likely to be minimal as a majority of the drainage lines have concreted sides.

Habitat fragmentation and barrier effects

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. This new dividing habitat type is often artificial and inhospitable to the species remaining in the fragments (Department of Environment and Heritage 2005). Cleared areas present a barrier to the movement of some species, such as woodland dependent birds (Bennet and Radford 2004; Radford and Bennet 2007).

The project area is a largely cleared landscape that is already fragmented by roads, rail, industrial and urban development and rural land. The proposed rail duplication and associated stations and bus interchanges are adjacent to the existing rail line and would not significantly increase fragmentation or barrier effects.

As discussed in the *Clearing of Native Vegetation* section above, clearing for the proposed new Vineyard Station car park would potentially result in the fragmentation of good condition Shale Gravel Transition Forest; however, the Project is unlikely to significantly increase the fragmentation of habitat in this area as it is already partially fragmented by existing roads and tracks.

Edge effects

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and/or temperature) occurring along the edges of habitat fragments. These new environmental conditions can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators.

Vegetation and habitats in the study area are already highly fragmented as a result of past clearing, roads, rail, industrial and urban development, electricity easements and rural activities. Additional clearing is unlikely to result in any areas being introduced to new edge effects.

Noise and dust

Noise and dust levels would increase in the local area for a short period of time during construction. This may cause disturbance to fauna in the area, although given the proximity of the Project to the existing rail line and roads, it is expected that such impacts would be minor. Dust may also have impacts to flora, particularly if construction is undertaken during a dry period. Impacts of dust to flora are likely to be minor due to localised and short term nature of these impacts.

8.6.3 Operational impacts

Noise

The main operational impact of the Project on biodiversity would be noise from train operations. However, as the majority of animal species likely to occur within the project area would be accustomed to noise from residential areas, roads, and the existing rail line, additional operational impacts as a result of the Project are not expected.

Collision

The Project would result in more frequent train movements, which could consequently result in collision between trains and native fauna if they access the rail corridor along the length of the Project. Rail corridors in the Sydney metropolitan area are fenced, presenting a partial barrier to animals entering the rail corridor, and limiting the likelihood of collisions between fauna and trains.

It is considered unlikely that collision of native fauna with trains on the proposed new rail line would result in a significant impact on local populations of threatened species in the project area.

Changed hydrology and surface water run-off

The replacement and/or extension of a number of existing culverts along the length of the Project could alter surface flows into tributaries to Eastern Creek. Changed hydrology can alter ecosystems, including vegetation communities and fauna habitats (i.e. aquatic habitat). Changes to surface water flows associated with the replacement of culverts are likely to be minimal as no additional culverts are proposed as part of the Project. However, increased flows into surface water streams could occur during flood events, as the proposed culvert replacement would increase the capacity of these structures. Impacts associated with culvert replacement affecting receiving ecosystems during a flood event are expected to be minimal in comparison to impacts associated with surface run-off from areas outside of the project area.

8.6.4 Cumulative impacts

The potential biodiversity impacts of the Project have been considered. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the Project in a strategic context. This is necessary so that the impacts associated with the Project and other activities in the region are examined collectively.

The Project is located in a moderately developed landscape dominated by rural-residential and industrial development in which the remaining areas of remnant vegetation and associated habitat are fragmented. The Project footprint occurs adjacent to existing rail and road infrastructure.

This existing landscape is expected to change significantly over the next 25 to 30 years with the development of the NWGC (refer Section 3.14). The Project is located at the centre of the growth centre, adjacent to the planned precincts of Schofields, Schofields West, Alex Avenue, Riverstone, Riverstone West and Vineyard (refer Section 3.14). Based on preliminary planning information from the GCC, the NWGC will be developed to include a mix of major centres, town and village centres, local neighbourhoods and industrial/employment land.

The majority of the study area has been certified (refer Figure 3-20) with all threatened biodiversity within the study area occurring within certified areas. Biodiversity certification has considered the NWGC as a whole and as such the cumulative impacts have been assessed and offsets on a regional basis have been calculated for this region through planning mechanisms. As such the impacts are considered at a larger scale and take into consideration the cumulative impacts of projects within the region.

8.6.5 Impacts on threatened species and ecological communities

Threatened species, populations and ecological communities that were recorded and/or predicted to occur in the locality and along the rail alignment are described in Section 3.6.3. The following provides a summary of the findings of significance assessments undertaken for:

- species and communities listed under the EPBC Act (refer Section 8.6.1)
- species, populations and communities listed under the TSC Act that occur within non-certified areas, or outside of the NWGC (refer Section 8.6.1).

Further details of the significance tests undertaken for this Environment Assessment are provided in Appendix D of Technical Paper 5 (refer Volume 2).

EPBC Act assessment of significance

The study area supports the following threatened biodiversity listed under the EPBC Act:

- Cumberland Plain Woodland, listed as an endangered ecological community
- *Pultenaea parviflora*, listed as a Vulnerable species.

Commonwealth significance assessments were undertaken for Cumberland Plain Woodland and *Pultenaea parviflora* as part of this Environmental Assessment (refer Appendix D of Technical Paper 5 in Volume 2). The findings of these significance tests are discussed below.

Cumberland Plain Woodland

Cumberland Plain Woodland to be cleared for the Project comprised seven small, degraded, isolated patches within the rail corridor (totalling approximately 1.34 hectares). There is approximately 9,760 hectares of this community remaining (NSW National Parks and Wildlife Service 2002a). Since this broadscale mapping was completed, the area of Cumberland Plain vegetation communities is likely to have decreased. The removal of approximately

1.34 hectares of degraded and fragmented vegetation is not considered a significant area, and would be unlikely to reduce the extent of the community, such that its long-term survival is threatened. Within the study area, this community was in poor condition and subject to ongoing threats including weed invasion. These patches are mapped as 'other remnant vegetation' under the *Final Native Vegetation Mapping of the Cumberland Plain, Western Sydney* (NSW National Parks and Wildlife Service 2002a, 2002b) and are unlikely to be critical to the long-term survival of this community. The significance assessment for Cumberland Plain Woodland concluded that the Project would be unlikely to have a significant impact on this community.

Pultenaea parviflora

The Project would result in the loss of approximately 47 *Pultenaea parviflora* plants and approximately 260 square metres of its habitat. Approximately 200 square metres of habitat would be retained adjacent to the habitat being removed. Populations of this species vary from 10 to more than 5,000 plants (NSW National Parks and Wildlife Service 2004b), and as such, this population is considered to be relatively small. Due to the small size, high level of weed invasion, isolated and disturbed nature of the habitat and number of populations in the vicinity (including in conservation reserves), the removal of this habitat and part of the population is unlikely to have a significant impact on this species or its recovery.

Whilst the Project is unlikely to have a significant impact, the cumulative loss of habitat and plants as a result of other projects is likely to further threaten this species. The primary aim of environmental management is to avoid environmental impacts, and as such, it is recommended that the final layout and landscaping of the bus interchange avoid or minimise impacts to this threatened species and aim to retain this species within the site. Where avoidance is not possible, impacts should be mitigated. Translocation of plants is not a suitable alternative to in situ conservation, and due to the risks of failure and possible impacts to donor sites, should only be considered as a last resort when all other options have been examined (Vallee *et al.* 2004). Seed collection and storage could also be used to minimise the impact to this threatened species (DEWHA 2008a).

Once the Project design has been finalised and impacts minimised as far as possible, the potential of translocation of plants, and seed collection/storage could be examined in consultation with the DECC and the Department of the Environment, Water, Heritage and the Arts.

Other threatened species potentially occurring in study area

Two other threatened species may occur within the study area (Grey-headed Flying Fox and Large-eared Pied Bat), however, given the minimal extent of clearing, and lack of specialised habitat resources, these species are unlikely to use or be dependant on resources within the subject site.

Migratory species

While migratory species of bird may potentially fly over the site, the site would not be classed as an 'important habitat' as defined under the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment and Heritage 2006), in that the site does not contain habitat used by a migratory species occasionally or periodically within a region that:

- supports an ecologically significant proportion of the population of the species
- includes habitat used by a migratory species that is at the limit of the species range
- includes habitat in an area where the species is declining.

As such, it is unlikely that development within the rail alignment and associated areas would significantly affect migratory species.

TSC Act

The majority of the study area occurs within the NWGC, which is subject to biodiversity certification under Section 126G of the TSC Act (refer Section 2.3). Biodiversity certification identifies areas within the growth centres as either certified or non-certified.

The *Threatened Species Conservation Amendment (Special Provisions) Act 2008* was passed on 25 June 2008 and amends the TSC Act by inserting a new part to Schedule 7 (Savings, transitional and other provisions) of the Act. The new Part 7, Schedule 7 of the Act confers biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP). The amendment largely replicates the order to confer biodiversity certification on the Growth Centres SEPP that was issued by the Minister for the Environment on 11 December 2007 and resolves any uncertainty about the certification granted on the Growth Centres SEPP in accordance with Section 126G of the TSC Act.

Non-certified areas

Non-certified areas generally correspond with areas of higher conservation value (such as known locations of threatened species habitat). Development within non-certified areas requires threatened species assessments under the TSC Act. However, non-certified areas within the study area do not provide habitat for threatened biodiversity because:

- these areas do not contain native vegetation communities
- these areas are highly disturbed and modified consisting of mown grass and weeds
- targeted surveys failed to detect threatened flora species
- these areas do not contain specialised habitat resources for fauna, such as tree hollows, caves or suitable water bodies.

Assessment for these species is, therefore, not required under the TSC Act within the non-certified areas that were investigated as part of this Project.

Certified areas

Certified areas are generally those that are likely to be of lower conservation value; however, within the study area, all threatened biodiversity occurs within certified areas, including:

- all occurrences of EECs (Cumberland Plain Woodland, Shale Gravel Transition Forest and River-Flat Eucalypt Forest on Coastal Floodplains)
- all occurrences of *Pultenaea parviflora* and *Grevillia juniperina* subsp *juniperina*
- all potential habitat for threatened species.

However, a precautionary approach was taken and significance assessments were conducted for threatened communities and species that had a moderate or greater likelihood of occurring within the study area in accordance with the *Guidelines for Threatened Species Assessment* (DEC 2005; refer Section 8.6.6).

8.6.6 Biodiversity assessment

The biodiversity assessment was undertaken in accordance with the *Draft Guidelines for Threatened Species Assessment* (the 'Draft Guidelines'; DEC 2005). The objective of the assessment process under the Draft Guidelines is to provide information to enable decision makers to ensure that developments deliver a number of environmental outcomes, including the requirement to maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).

All threatened biodiversity and their habitats occur within areas accredited with biodiversity certification under the Growth Centres SEPP (refer Section 2.3). The main practical effect of certification is that it removes the need to undertake threatened species assessments for developments or activities within the area subject to certification.

A precautionary approach was taken and for the areas subject to biodiversity certification and significance assessments following the heads of consideration as outlined in the Draft Guidelines (DEC 2005) were conducted for threatened communities and species that had a moderate or greater likelihood of occurring within the study area. The significance assessments are presented in Appendix E of Technical Paper 5 (refer Volume 2) and summarised in Table 8-37.

The heads of consideration did not identify any significant impacts to threatened biodiversity likely to result from the Project. However, offsets determined in accordance with the biodiversity certification order for the Growth Centres SEPP will be implemented as part of the development of the NWGC.

Table 8-37 Summary of significance assessments undertaken for threatened ecological communities and species with a moderate or greater likelihood of occurring within the study area

Species or community	Conservation status		Likely to be significantly affected
	State [1]	National [2]	
Cumberland Plain Woodland	E	E	No. Only a small amount (1.34 hectares) of this community, which is in poor condition and highly fragmented, would be cleared.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	-	No. Only five small patches (1.47 hectares) would be cleared and these are highly fragmented and degraded.
Shale Gravel Transition Forest	E	-	No. A total of 1.71 hectares would be cleared, including: ▪ within the proposed bus interchange — a narrow strip (up to 3 metres wide), of degraded vegetation. This area contains *Pultenaea parviflora* ▪ the proposed Vineyard Station and rail alignment — young regrowth vegetation with past grazing. The area is disturbed and highly fragmented ▪ within the proposed Vineyard Station car park — good condition vegetation with a high diversity of native ground cover species.
Dillwynia tenuifolia	V	V	No. No individuals recorded and potential habitat for this species is disturbed and highly fragmented.
Micromyrtus minutiflora	E	-	No. No individuals recorded and potential habitat for this species is degraded and highly fragmented.
Pimelia spicata	E	E	No. No individuals recorded and potential habitat for this species is disturbed and highly fragmented.
Pultenaea parviflora	E	V	No. The Project would include loss of 47 *Pultenaea parviflora* plants, which is considered to be a small population. Approximately 0.02 hectares of habitat for this species would be retained. Due to the small population size, high weed invasion, isolation and disturbed nature of the habitat and number of populations in the vicinity (including within conservation reserves) the removal of this habitat and part of the population is unlikely to have a significant impact on this species or its recovery.

Species or community	Conservation status		Likely to be significantly affected
	State [1]	National [2]	
Grevillea juniperina subsp *juniperina*	V	-	No. Two *Grevillea juniperina* subsp *juniperina* plants were recorded within the study area, one of which would be removed as a result of the Project. This is unlikely to significantly affect the species or interfere with its recovery as it occurs as an isolated individual within a cleared paddock.
Cumberland Plain Land Snail (*Meridolum corneovirens*)	E	-	No. No evidence of the Cumberland Plain Land Snail was detected within the study area. Impacts to Cumberland Plain Land Snail within the study area would result in loss of 3.05 hectares of potential habitat; however this is fragmented, in poor condition and is subject to ongoing threats such as weed invasion.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	No. The Project would result in the removal of 3.05 hectares of Grey-Headed Flying-fox foraging habitat within the study area, and given the high mobility of the species this is unlikely to represent a significant reduction in the availability of foraging resources within the species' range. The Project would not affect or disrupt any Grey-headed Flying-fox roosting habitat (camps).
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-	No. The Project would result in the removal of approximately 4.60 hectares of Yellow-bellied Sheathtail Bat habitat within the study area, including the removal of two significant hollow-bearing trees. This area is relatively small in relation to similar habitats available in the local area.
Large-eared Pied Bat (*Chalinolobus dwery*i)	V	V	No. The Project would result in the removal of approximately 4.60 hectares of Large-eared Pied Bat habitat within the study area, including the removal of two significant hollow-bearing trees. This area is relatively small in relation to similar habitats available in the local area.
Eastern Freetail-bat (*Mormopterus norfolkensis*)	V	-	No. The Project would result in the removal of approximately 4.60 hectares of Eastern Freetail Bat habitat within the study area, including the removal of two significant hollow-bearing trees. However this area is relatively small in relation to similar habitats available in the local area, and this is unlikely to represent a significant reduction in the availability of foraging resources within the species' range.

Species or community	Conservation status		Likely to be significantly affected
	State [1]	National [2]	
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	No. The Project would result in the removal of approximately 4.60 hectares of Greater Broad-nosed Bat habitat within the study area, including the removal of two significant hollow-bearing trees. However, this area is relatively small in relation to similar habitats available in the local area.
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V	-	No. The Project would remove approximately 1.47 hectares of habitat suitable for foraging by the Glossy Black-cockatoo. This area is relatively small, poor in condition and fragmented in relation to similar habitats available in the local area. Important habitat resources such as nesting hollows/trees are not abundant in the area, nor would they be removed by the Project.
Powerful Owl (*Ninox strenua*)	V	-	No. The Project would remove approximately 4.60 hectares of potential foraging habitat for the Powerful Owl; however, this area is relatively small in relation to similar habitats available in the local area. Important habitat resources such as nesting hollows are not present within the study area.
Square-tailed Kite (*Lophoictinia isura*)	V	-	No. The Project would remove approximately 4.60 hectares of habitat suitable for foraging by the Square-tailed Kite, this area is relatively small in relation to larger areas of potential foraging habitat within the locality that would provide habitat for a wider variety of passerine bird species, which are the primary prey of the Square-tailed Kite. No nests consistent with the Square-tailed Kite were identified within the study area, nor would any be removed by the Project.
Speckled warbler (*Prryholaemus sagittatus*)	V	-	No. The Project would remove approximately 4.60 hectares of habitat suitable for foraging by the Speckled Warbler, this area is relatively small and of poor quality compared to larger areas of similar habitat available in the local area.
Diamond Firetail (*Stagonopleura guttata*)	V	-	No. The Project would remove approximately 4.60 hectares of habitat suitable for foraging by the Diamond Firetail, this area is relatively small and of poor quality compared to larger areas of similar habitat available in the local area.

Species or community	Conservation status		Likely to be significantly affected
	State [1]	National [2]	
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V	-	No. The Project would remove approximately 4.60 hectares of habitat suitable for foraging by the Black-chinned Honeyeater, this area is relatively small and of poor quality compared to larger areas of similar habitat available in the local area.
Painted Honeyeater (*Grantiella picta*)	V	-	No. The Project would remove approximately 4.60 hectares of habitat suitable for foraging for the Painted Honeyeater, this area is relatively small and of poor quality compared to larger areas of similar habitat available in the local area. There was no evidence of Mistletoe infestations within the study area.

Notes: 1. State conservation status: V= Vulnerable, E = Endangered, (TSC Act and *Fisheries Management Act 1994*).

2. National conservation status: V = Vulnerable, E = Endangered (EPBC Act).

8.6.7 Management measures

Avoidance of biodiversity impacts is the preferred management strategy for the Project. As described in Chapter 6, a large portion of the Project would be constructed within the existing rail corridor. Design of Project elements inside the existing rail corridor, where possible, has reduced the biodiversity impacts associated with Project, through avoiding the need to clear new areas.

Where potential biodiversity impacts cannot be avoided, they would be minimised during the construction and operation of the Project, as far as practicable. As part of the detailed design and prior to construction, detailed flora and fauna mitigation measures would be developed and presented as part of the environmental management plans and/or environmental control maps for the construction of the Project. The plans, would address:

- fencing of areas to prevent impacts to flora and fauna outside the area
- staff/contractor inductions
- pre-clearing surveys and fauna salvage/translocation
- rehabilitation and restitution of adjoining habitat
- weed control including management of construction vehicles
- pest management
- monitoring.

The plans would include clear objectives and actions for the Project including:

- minimise human interferences to flora and fauna
- minimise vegetation clearing/disturbance
- minimise impact to threatened species and communities
- minimise impacts to aquatic habitats and species

- flora and fauna monitoring undertaken at regular intervals.

In addition to the above general measures and objectives, the flora and fauna management measures would also include the specific measures outlined in the following sections.

Vegetation and habitat loss

Disturbance to areas of native vegetation and habitat would be unavoidable during the construction process. In order to avoid further disturbance to areas outside of those already identified, sensitive areas would be clearly identified during the construction process as 'no-go' areas. These would be marked on maps provided to contractors, as well as on the ground using high visibility fencing (such as barrier mesh). No direct disturbance would occur in these areas, including vehicle access.

A trained ecologist would accompany clearing crews in order to ensure disturbance is minimised. The adoption of these measures would limit the extent of habitat disturbance, prevent soil compaction and damage to vegetation.

Where possible, revegetation of areas disturbed by construction of the Project would be undertaken, thereby increasing the habitat value and visual amenity of the areas. Revegetation of the areas would include:

- planting of a range of locally occurring native shrubs, trees and groundcover plants (selection of the species for planting would need to be carried out in consultation with RailCorp to ensure suitability with respect to operational and maintenance requirements)
- measures to improve habitat including placement of logs, dead trees and stumps in the landscaping/rehabilitation works collected from areas cleared as part of the Project
- incorporating existing natural vegetation where possible
- focusing on riparian vegetation to protect waterways
- designing and constructing waterway crossings and creek diversions following the *Guidelines for Design of Fish Friendly Waterway Crossings* (Fairfull and Witheridge 2003) in consultation with DPI (Fisheries)
- maintaining native plantings through landscaping requirements included in the CEMP
- managing exotic weeds through weed management measures included in the CEMP.

Mortality

Where clearing of vegetation and fauna habitats would take place, clearing protocols would be put in place, including preparing an inventory of significant habitat trees and hollows to be removed, and checking hollow-bearing trees for the presence of bird nests and arboreal animals, such as possums, gliders, parrots and bats, prior to felling or pushing. Animals found to be occupying trees would be safely removed before the clearing of trees. A qualified ecologist would relocate removed animals locally into nearby habitat. Nest boxes or salvaged tree hollows would be provided in the nearby woodland for each relocated animal.

Weed management

Ninety-nine species of weed were recorded, corresponding to 44% of the species recorded in the study area. This included 17 species listed as noxious weeds in the Hawkesbury River County Council noxious weed control area (includes Blacktown LGA). Of these, three are also listed as weeds of national significance (Table 8-38).

Table 8-38 Noxious weeds recorded in the study area

Scientific name	Common name	Noxious weed[1]	WONS[2]
Bryophyllum delagoense	Mother of Millions	3	
Brassica rapa		3	
Cestrum parqui	Green Cestrum	3	
Cortaderia selloana	Pampas Grass	3	
Ageratina adenophora	Crofton Weed	4	
Echinochloa frumentacea	Siberian Millet	4	
Echium plantagineum		4	
Hypericum perforatum	St. Johns Wort	4	
Ligustrum lucidum	Large-leaved Privet	4	
Ligustrum sinense	Small-leaved Privet	4	
Lycium ferocissimum	African Boxthorn	4	
Opuntia stricta	Prickly Pear	4	
Rubus fruticosus	Blackberry complex	4	Y
Asparagus asparagoides	Bridal Creeper	5	Y
Lantana camara	Lantana	5	Y
Oxalis corniculata	Creeping Oxalis	5	
Oxalis latifolia	Fishtail oxalis	5	

Notes: 1. *Noxious Weeds Act 1993*: Class 3: The plant must be fully and continuously suppressed and destroyed. Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. Class 5: The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with.

2. Weeds of National Significance (Thorp & Lynch 2000).

Weed management protocols would be developed as part of the flora and fauna management measures and would outline measures including:

- identification of weed contaminated vegetation
- separation of this material once it is cleared
- disposal of weed contaminated material
- weed control methods focussing on noxious species, weeds of national significance and environmental weeds
- management of soil stockpiles to prevent weed spread/establishment
- prevention of the spread of weeds through construction activities, particularly from the southern section to the northern section of the Project through cleaning of vehicles (for example, vehicle washing).

Erosion and pollution

During construction, erosion potential would be minimised by staging works and minimising the extent of disturbed areas, not clearing areas until needed, as well as undertaking progressive restoration and revegetation. Erosion would be further minimised by retaining remaining vegetation cover, wherever possible, and by managing stormwater flows to reduce flow rates as much as possible. Following construction, erosion control would be achieved by implementing appropriate bank stabilisation measures, for example through the use of jute matting incorporating sterile seeds (e.g. millet) to provide stability. Native species would be planted in these areas.

Potential contaminants would not be stored in or in proximity to natural waterways; refuelling of machinery would similarly be undertaken at least 30 metres from natural waterways in clearly marked designated areas that are designed to contain spills and leaks. Chemical spill kits would be readily available and accessible to construction workers and all hazardous materials spills and leaks would be reported to site managers. All appropriate spill containment measures would be adopted and incorporated into the CEMP.

Monitoring

The Project will impact threatened biodiversity including *Pultenaea parviflora*, *Grevillea juniperina* subsp. *juniperina*, Shale Gravel Transition Forest, River-flat Eucalypt Forest and Cumberland Plain Woodland. Mitigation measures will be implemented to minimise the impacts and monitoring would be undertaken to measure the effectiveness of the proposed mitigation measures. Monitoring and reporting of the outcomes of management and mitigation actions is important in ensuring the effectiveness of the monitoring. This would feed back to the management plans in an adaptive manner.

Offsets

All native vegetation proposed to be cleared occurs within the NWGC biodiversity certified area, and as such no project-specific offsets are required under State legislation. Overall compensation for loss of habitat is provided under the biodiversity certification as part of the Growth Centres SEPP. Biodiversity certification will provide $530 million to purchase areas of high conservation value or to enter into private conservation agreements, both within and outside the Growth Centres.

8.7 Water quality and hydrology

8.7.1 Construction impacts

Water quality

The potential effect of the Project on water quality would primarily relate to potential pollution of stormwater run-off with sediments, fuels and other hazardous materials from construction sites. As discussed in Section 9.3.1, the widening of fill embankments, cuttings, excavations and clearing of vegetated land could result in increased erosion and subsequent sediment delivery to local waterways.

The potential impacts associated with increased sediment loading include increased turbidity and an increased potential for the transport of contaminants bound to sediment particles. The mobilisation of contaminants within stormwater run-off is of particular concern in areas that have been identified as moderately to highly likely to contain contaminated materials that may be uncovered during construction (refer Section 3.11). The transportation of