4. Impact Assessment

4.1 General Impacts

4.1.1 Vegetation Clearance

An outline of the impact areas along the proposed alignment are provided in Table 4.1 and a summary of required vegetation clearance within possible EECs is presented in Table 4.2 and likely clearance zones are shown in Figure 4.1. Removal areas are based on clearance of areas identified by TIDC as falling within the impact zone of the proposed alignment and associated construction zones. The remaining extent of each EEC within the Baulkham Hills LGA is based on 2003 aerials and was provided by Baulkham Hills Council as part of current work being undertaken (Sandra Dudley, Baulkham Hills Shire Council, pers. comm.). It is important to note that estimates based on 2001 aerials were larger, illuminating a rapid decline in community size over 2 years for all communities. Therefore the extent estimates provided for the purpose of this report based on 2003 aerials are likely to be an over estimate of the existing extent of the communities concerned (Sandra Dudley, pers. comm.). These extents do not include areas considered as remnant scattered trees (Sandra Dudley, pers. comm.).

The study area supported a total of four vegetation communities which may be remnants of endangered ecological communities with various degrees of disturbance, mostly associated with previous clearance for rural and residential land use and developments. Attempts have been made to limit the amount of vegetation clearance required via selection of an alignment that passes through already developed areas and placement of the rail link underground in a tunnel structure. However, some vegetation clearance is likely as the surface sections of the proposed alignment pass through vegetated areas. The surface portions of the new corridor would be 40 m wide or 60 m wide in the cut and cover and stabling facility sections. The actually clearing required within these sections would not in all cases involve the 40 / 60 metre wide corridor and as such as maximum clearance width of 50 metres has been assumed for the purposes of this assessment.

Within the existing rail corridor the existing line would be quadrupled and therefore would require the complete clearing of vegetation within the corridor. This vegetation is highly disturbed and consists predominantly of introduced species with the exception of three areas of remnant vegetation communities including two stands of the endangered Sydney Turpentine – Ironbark Forest. The proposal is likely to involve the removal of approximately 0.3 ha of this community. This community maintains a native understorey and canopy trees representative of this endangered community. It has a small level of weed invasion and high disturbance.

The proposed alignment passes through a number of areas of endangered ecological communities. The construction of the Franklin Road Station (underground) would occur adjacent to a community of the endangered Blue Gum High Forest. The construction zone would not encroach into this community. Clearance of adjacent vegetation would result in the clearance of canopy trees over properties.

Clearance within a second stand of Sydney Turpentine - Ironbark Forest may be necessary at Cattai Creek, west of the proposed Hills Centre Station. As the dive angle required to achieve an adequate depth in order to pass under Cattai Creek may not be attainable, cut and cover may be utilised to trench through this community resulting in an approximate clearance of 0.3 ha.

Continuation of the alignment once it emerges from the tunnel north of Norwest Business Park would require the clearance of Cumberland Plain Woodland of varying degrees of degradation for both construction zones and the alignment. Clearance within intact stands and remnant scattered trees of this community for the cut and cover tunnel as well as for the stabling yard would be necessary. This encompasses clearance of 1.6 ha of a remnant community on private property within the Balmoral Road construction zone as well as extensive clearance of approximately 9.8 ha of scattered trees for the Balmoral Road construction zone and 8.7 ha of scattered trees for the corridor impact zone. The extent of clearance required for the stabling yard cannot be determined as the footprint for this site has not been finalised.

The establishment of a viaduct structure adjacent to Old Windsor Road just south of Windsor Road would require supporting structures and construction areas. This would be considered a sensitive area as it is adjacent to Caddies Creek and the surrounding endangered River-flat Eucalypt Forest. Works associated with the construction of the viaduct would require no more than a 50 m wide clearance along it's length as well as a construction zone at the northern end of the structure. Complete clearance in these areas would result in the loss of 1.0 ha of River-flat Eucalypt Forest. This sensitive community and Caddies Creek would be considered in construction design and an attempt made to reduce the required clearing.

The corridor would open out at the end to a stabling yard. The footprint associated with the stabling yard has not been finalised, however clearance would result within private properties with scattered trees characteristic of the Cumberland Plain Woodland, gardens and paddocks to accommodate the stabling facilities as well as additional supporting infrastructure. The extent of clearance cannot be calculated at this stage. It is important to note that the impact zone would not extend into the Cumberland Plain Woodland at the northern extent of the alignment and a buffer zone would be considered to avoid indirect impacts.

These endangered communities and their respective levels of impact are discussed in detail in Section 4.2.3.

Table 4.1 Impact Zones

Impact	Community Impacted and Impact Notes	Approximate Clearance of EEC (ha)
Quadruplication (complete clearance within the existing corridor)	» Sydney Turpentine – Ironbark Forest: complete clearance of the two stands within the rail corridor; » Areas with high weed invasion, high disturbance as well as small patches of native vegetation with large remnant canopy trees along the fence line.	0.3
Franklin Road Station Construction Zone	» This impact zone will not encroach into the adjacent Blue gum High Forest and a buffer zone would be considered to avoid indirect impacts; » Removal of canopy trees over properties throughout the construction site with possible consideration of some retention for aesthetic purposes.	0
Cut and Cover through Cattai Creek (near proposed Hills Centre Station)	» Sydney Turpentine – Ironbark Forest: clearance of a 50 m width construction corridor through the vegetation surrounding Cattai Creek.	0.3
Balmoral Road Construction Zone	» Cumberland Plain Woodland: complete clearance of intact stand on uncleared portion of private property; » Cumberland Plain Woodland Scattered Trees: complete clearance of scattered canopy trees over properties; » Buffer zone of 40 m from Elizabeth Macarthur Creek	1.6 9.8
Above Ground Alignment (north of Norwest Business Park after surfacing) – not including those communities impacted by construction zones	» Cumberland Plain Woodland Scattered Trees: complete clearance of scattered canopy trees over properties; » River-flat Eucalypt Forest – clearance of edge of community that occurs along a drainage line the meets Windsor Road north of the Windsor Road / Old Windsor Road intersection.	8.7 0.1

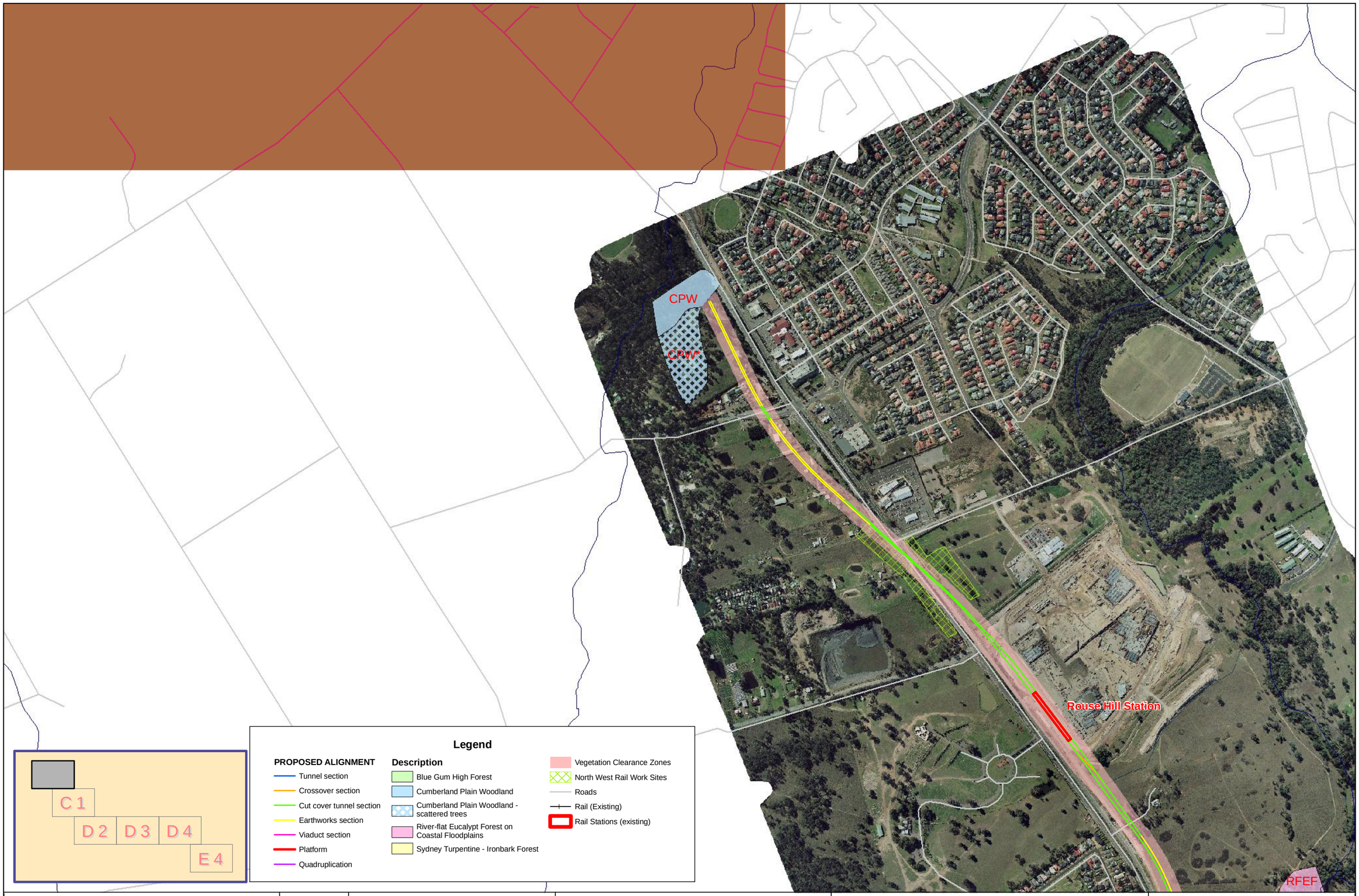
Impact	Community Impacted and Impact Notes	Approximate Clearance of EEC (ha)
Viaduct Structure (50 m width clearance) and Construction Zone	» River-flat Eucalypt Forest - Caddies Creek / Unnamed Watercourse: clearance associated with construction of viaduct, however clearance may be reduced with design of construction techniques for this portion; » River-flat Eucalypt Forest – Caddies Creek: clearance associated with construction zone.	0.8 0.1
Rouse Hill Stabling Yard	» Cumberland Plain Woodland Scattered Trees: undetermined extent of clearance of canopy trees scattered over properties. » The footprint for the stabling yard has not yet been finalised; » The stabling yard will not encroach into the intact portion of Cumberland Plain Woodland immediately at the northern extent of the alignment on land containing the endangered Cumberland Land Snail; » A buffer zone would be considered between the impact zone and vegetation community to avoid indirect impacts	Unavailable

Table 4.2 Vegetation Clearance

Vegetation Community	Location / Condition	Baulkham Hills LGA Extent[#] (ha)	Approximate Clearance (ha)	% Clearance	Total % Clearance
Cumberland Plain Woodland	» North of Norwest Business Park: private property that has retained characteristic understorey and canopy, low level weed invasion with evidence of grazing by Rabbits.	386.363	1.6	0.41 %	0.41 %
	» North of Norwest Business Park within Balmoral Road Construction Zone: remnant canopy trees scattered throughout properties with varied land use and modified understoreys.		9.8	N/A (as scattered trees not included in remaining extent)	
	» Along alignment within 50 m clearance zone: remnant canopy trees scattered throughout properties with varied land use and modified understoreys.		8.7		
	» Stabling yard site: remnant canopy trees characteristic of this community remain scattered throughout properties over modified lands that would be used for the stabling yard and associated facilities.		Unknown		
Sydney Turpentine - Ironbark Forest	» Within the rail corridor on the western and eastern side between Cheltenham and Beecroft Stations: small stands with characteristic understorey and canopy with high disturbance.	169.730	0.3	0.18 %	0.35 %
	» Along Cattai Creek near the proposed Hills centre Station: intact understorey with low weed invasion upslope of a weed dominated riverbed and edge.		0.3	0.18 %	

Vegetation Community	Location / Condition	Baulkham Hills LGA Extent[#] (ha)	Approximate Clearance (ha)	% Clearance	Total % Clearance
River-flat Eucalypt Forest on Coastal Floodplains	» Windsor Road within alignment: remnant canopy species over modified lands along a drainage line that meets Windsor Road.	561.000	0.1	0.02 %	0.18 %
	» Caddies Creek along viaduct alignment: high weed invasion in places with representative canopy trees.		0.8	0.14%	
	» Caddies Creek at viaduct construction site: high weed invasion in places with representative canopy trees.		0.1	0.02 %	

[#] = based on 2003 aerials



C 1
D 2
D 3
D 4
E 4

Legend

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest
- Vegetation Clearance Zones
- North West Rail Work Sites
- Roads
- Rail (Existing)
- Rail Stations (existing)

Metres
0 125 250 500

N

GHD MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (B1) Vegetation Clearance Zones

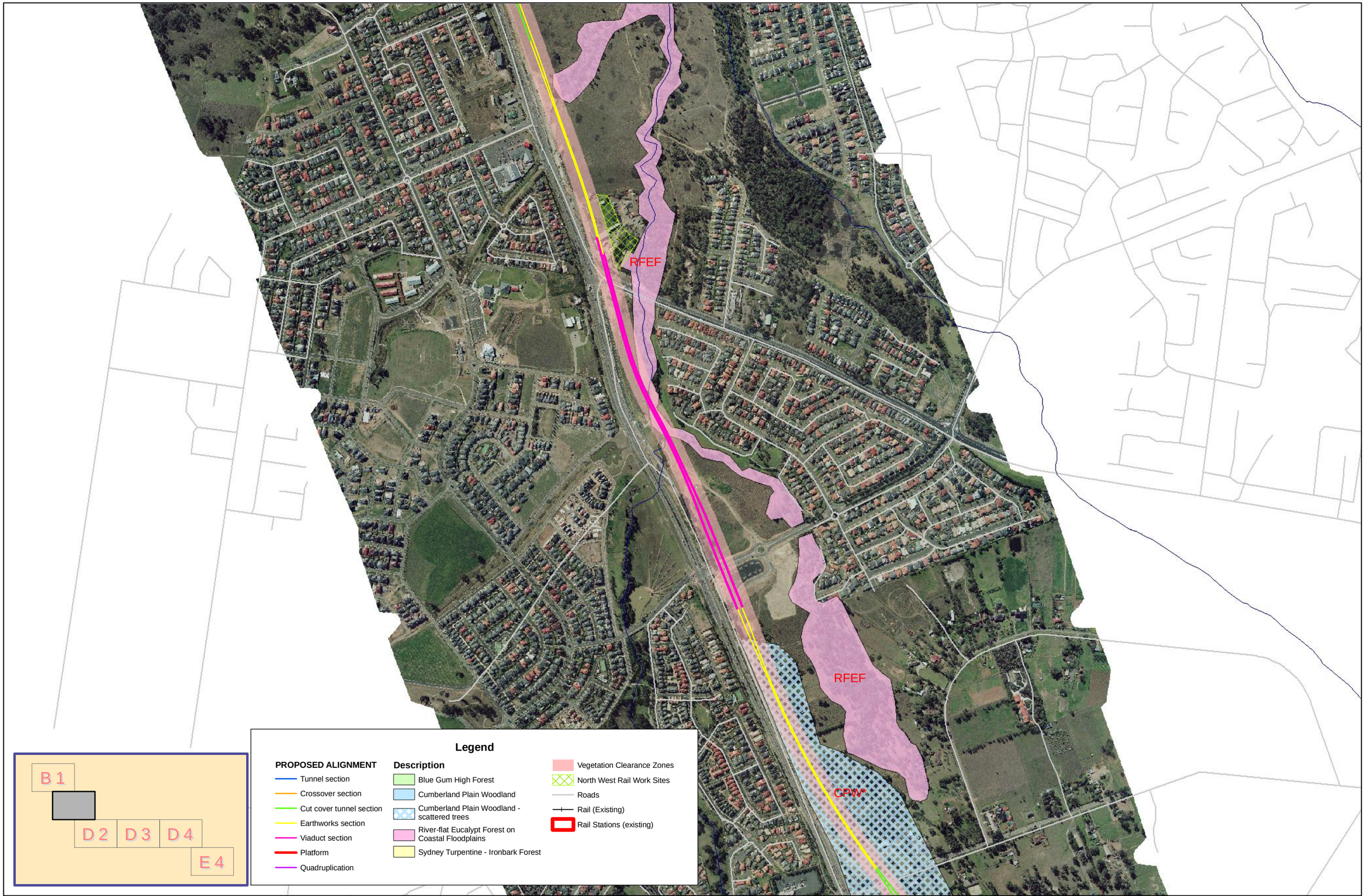
VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

PAGE 1 OF 6 | 1:10,000 | VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd



GHD MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (C1) Vegetation Clearance Zones

VERSION: DRAFT

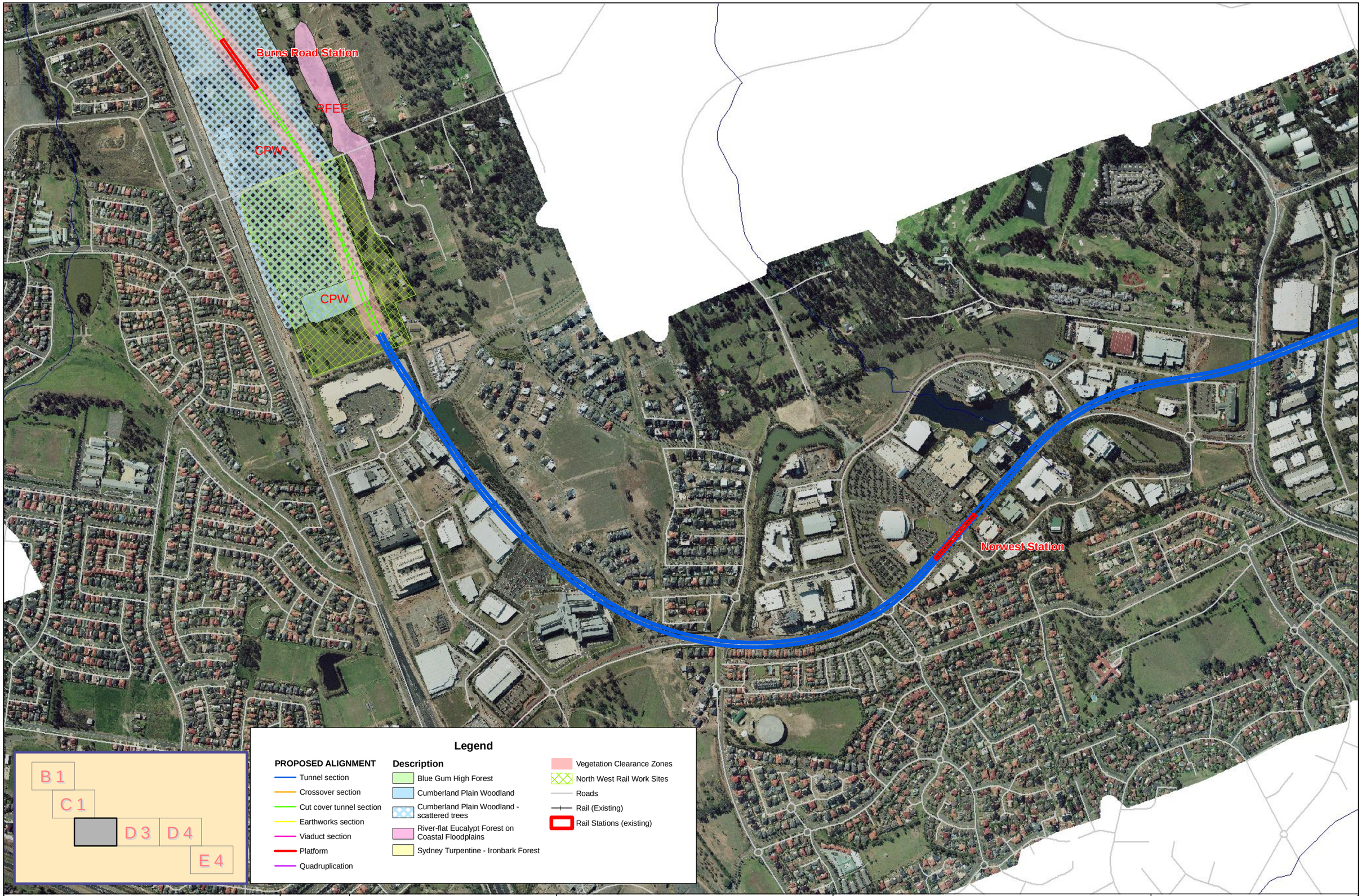
PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

1:10,000

VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd



GHD MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (D2) Vegetation Clearance Zones

VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

PAGE 3 OF 6 | 1:10,000 | VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd

Hills Centre Station

STIF

Castle Hill Station

B 1

C 1

D 2

D 4

E 4

Legend

PROPOSED ALIGNMENT

- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

Description

- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest
- Vegetation Clearance Zones
- North West Rail Work Sites
- Roads
- Rail (Existing)
- Rail Stations (existing)

Metres

0 125 250 500

N

GHD MANAGEMENT ENGINEERING ENVIRONMENT

10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (D3) Vegetation Clearance Zones

VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

PAGE 4 OF 6 | 1:10,000 | VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd

BGH

Franklin Road Station

B 1
C 1
D 2
D 3
E 4

Legend

PROPOSED ALIGNMENT

- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

Description

- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest
- Vegetation Clearance Zones
- North West Rail Work Sites
- Roads
- Rail (Existing)
- Rail Stations (existing)

Metres
0 125 250 500

N

GHD MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (D4) Vegetation Clearance Zones

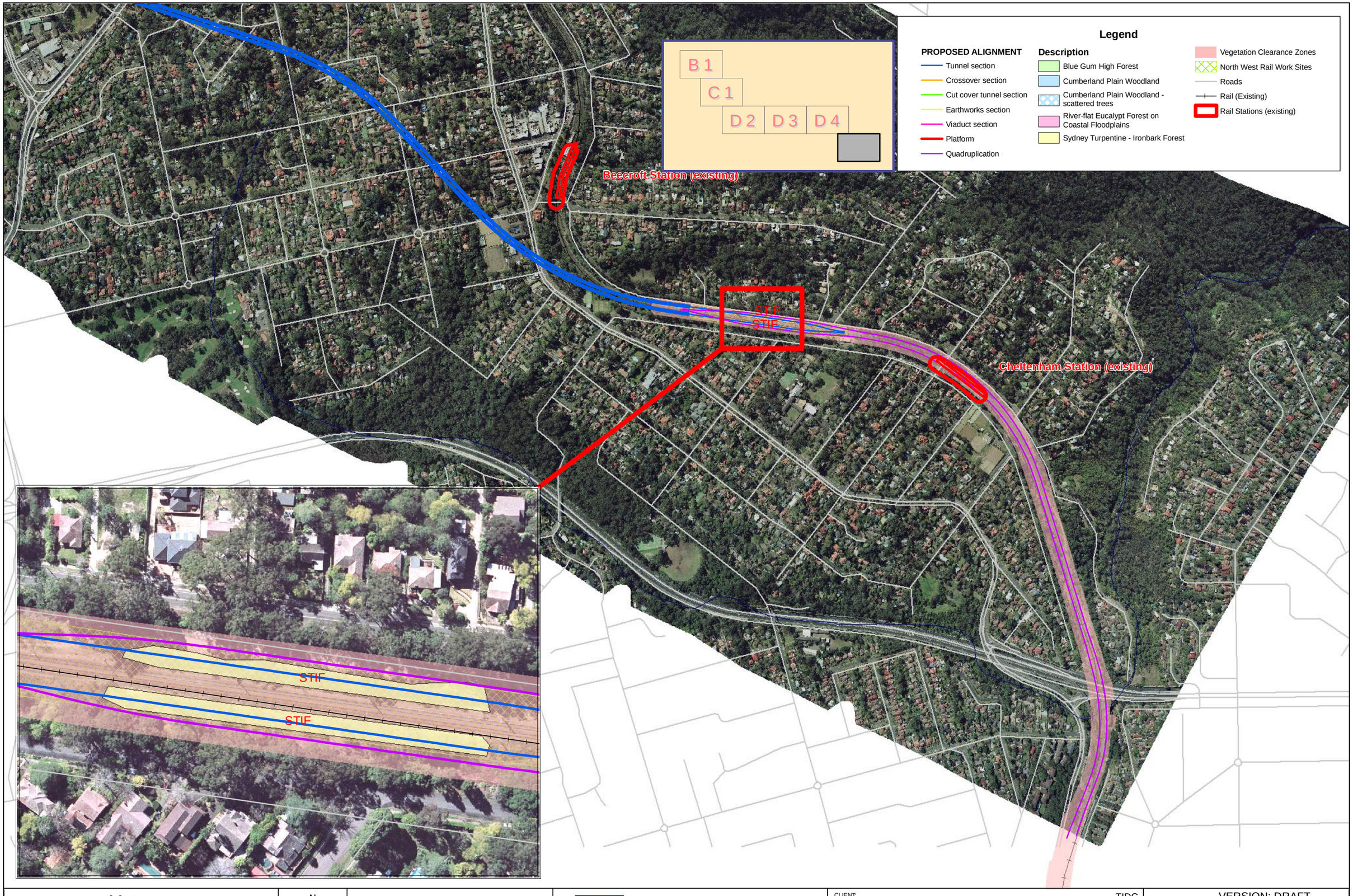
VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

PAGE 5 OF 6 | 1:10,000 | VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd



Metres
0 125 250 500

N

GHD MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street
SYDNEY NSW 2000
Telephone (61 2) 9239 7100
Facsimile (61 2) 9239 7193
Email: sydmail@ghd.com.au
Web Site: www.ghd.com.au

CLIENT: TIDC

PROJECT: North West Rail Link

Figure 4.1 (E4) Vegetation Clearance Zones

VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z008

PAGE 6 OF 6 | 1:10,000 | VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z008.mxd

4.1.2 Loss of Habitat for Ground-dwelling Mammals

Due to the highly modified nature and isolation of the vegetated areas through which the proposed alignment passes the study site offers restricted habitat for ground-dwelling mammals. It is considered unlikely that that the study area supports a substantial population of ground-dwelling mammals and therefore, it is considered unlikely that the proposal would put a local population of any of these species at risk of extinction. The Spotted-tailed Quoll (*Dasyurus maculatus*) is the only threatened ground-dwelling mammal recorded in the locality. As this species uses vast areas for foraging and denning it is unlikely that clearance of small area of vegetation and removal of logs and other potential denning sites would impact on an individual or population of this species.

4.1.3 Loss of Hollow-bearing Trees

Potential habitat for arboreal mammals, owls and microbats would also be lost as a consequence of the proposal in the form of hollow-bearing trees. However there were few hollow-bearing trees observed along the proposed alignment.

Removal of hollow-bearing trees at the site may reduce the amount of potential nest sites for the Eastern Pygmy-possum (*Cercartetus nanus*) that has been recorded within the locality in the past. This species uses a variety of habitats for nesting sites including Common Ring-tailed Possum dreys and abandoned bird-nests. Their removal is therefore unlikely to have impacts on this species.

Hollow-bearing trees and stags at the site may also provide roosting and nesting habitat for microchiropteran bats and owls. As for arboreal mammals, a number of species are likely to use the trees in the area and in areas where vegetation is isolated the removal of hollow-bearing trees is likely to impact on local family groups or populations. Furthermore, removal of hollow-bearing trees is not desirable and would be avoided wherever possible within construction zones for the proposal to reduce the potential for impacts on these species.

4.1.4 Hydrological Changes

Given the proposal will result in vegetation clearance adjacent to creeks, some changes to hydrological regimes at the site are possible. The tunnel structure would pass under a number of creeks at sufficient depth so as to not impact on the watercourses. The tunnel may not be able to pass at sufficient depth under Cattai Creek at Castle Hill due to local geological constraints as well as the necessary dive grade (from the Hills Centre Station) required to pass at a sufficient depth below this creek. As such, passing through this creek may require a cut and cover method requiring temporary blockage of the creek and clearance of vegetation. Once above ground the proposed alignment travels adjacent to a watercourse (of varying title) and at one point crosses over Caddies Creek on a viaduct structure. Construction of pylons within the watercourse should be avoided if possible. It is recommended that clearance of riparian vegetation be minimised to reduce impact on local watercourses and recommended management measures will consider the indirect effects of adjacent construction zones on watercourses.

4.1.5 Runoff and Sedimentation

Potential impacts on the adjacent vegetation are likely during construction from runoff and sedimentation if management measures are not implemented.

There is the potential for nutrients, pollutants and seeds of exotic species to be transported to the remaining vegetation along the route. Increased nutrient levels may create conditions more suitable for exotic species and therefore result in an increase in the level of weed invasion at the site.

There is also the potential for indirect impacts on watercourses along the route if management measures are not implemented. Sedimentation can prevent growth of many groundcover species as covering the leaf surface with sediment can prevent photosynthesis. Furthermore, in areas where sediment loads are high, sprouting of new seedlings may be prevented due to the layer of sediment. Therefore management measures to trap or filter runoff before it enters the retained and adjacent vegetation and watercourses are recommended. Replacement of removed soil should occur as soon as possible after construction.

4.1.6 Edge Effects

It is considered unlikely that the construction of the new rail link would increase edge effects along the majority of the route as it passes through highly modified areas and occasionally through remnant vegetation communities. Where the alignment passes through stands of native vegetation it is likely that these areas will be impacted by edge effects, however due to the current isolation and small size of such stands these areas would be currently impacted by edge effects from previous clearing and current construction. Weed invasion was common along the proposed route due to the high exposure to human activity and increasing urban development. Only small areas remained uncleared with original vegetation still present however these areas too were exposed to varying levels of weed invasion.

4.1.7 Isolation

The proposed vegetation clearance within the rail corridor is on the fringes of vegetation or exists as an isolated strip of vegetation and therefore is unlikely to increase isolation between current vegetated areas. Elsewhere along the route the remaining vegetation communities are of varying quality ranging from remnant canopy trees over residential paddocks and grazing pastures to communities with native groundcover. Those stands with greater diversity of species throughout the strata are currently isolated patches and clearance of a 50 m corridor within these patches would impact on the movement and dispersal of any species present and potentially make some species more prone to predation during movement into the cleared area.

It is recommended that management measures be implemented along the proposed alignment to ensure the isolation and disturbance does not result in the invasion of exotic species or increased erosion, sedimentation and runoff. Such measures are outlined in Section 5.

4.1.8 Alteration of Light, Noise and Dust Levels

Artificial noise and light levels are likely to increase during construction. During the construction phase, altered noise, dust and light levels would likely result in disturbance to some species during daylight hours. Post construction, operational noise is considered to be negligible for the tunnel section of the route however where the rail link passes above ground there will be noise impacts on the surrounding environment. Little is known of the impacts of noise on most species. However, in general short, sharp noises, such as those associated with sirens or the use of compressed air, are thought to be more disturbing than low level background noise to which species can become habituated. Noise may disturb birds and mammals, and may result in some roosting and foraging areas close to the proposed development becoming unsuitable for ongoing habitation.

Alteration to the light regime on the site may change the way in which fauna use this area. Some species, such as insects and bats, may be attracted to light sources whilst other species will avoid lit areas. Light may impact on the behaviour of insects, some of which may be pollinators of plants on the subject site. Insectivorous bats may be attracted to the site through the increase in the number of insects gathering around light sources. Without appropriate measures, altered light regimes may disrupt the movement patterns of a number of species.

Airborne dust levels are likely to increase during the construction phase. Dust can smother plants and could result in the loss of some species. The accumulation of sediment during construction may be washed into streams during rain events causing increased levels of turbidity and impacts on aquatic fauna and wading birds.

4.1.9 Key Threatening Processes

The following key threatening processes are considered relevant to the proposal:

» Clearing of native vegetation (TSC Act) and land clearance (EPBC Act);

» Removal of dead wood and trees (TSC Act);

» Invasion of native plant communities by exotic perennial grasses (TSC Act);

» Infection of native plants by *Phytopthora cinnamomi* (TSC Act & EPBC Act);

» Predation by the European Red Fox (TSC Act & EPBC Act); and

» Competition and grazing by the feral European Rabbit (TSC Act and EPBC Act)

The clearing of native vegetation / land clearance is a key threatening process for many threatened species. Clearing of vegetation along with the removal of dead wood and dead trees would result in removal of habitat for ground-dwelling and arboreal mammals as well as some bird species and reptiles. In order to reduce the impact of vegetation removal on fauna it is recommended that wherever possible removal of these resources be undertaken outside the breeding season for key threatened species with the potential to occur throughout the study area and hollows are checked and resident fauna removed before clearing. This should be undertaken in consultation with DEC. In addition to this, logs, fallen trees and debris should be moved into the adjacent vegetation or used in rehabilitation or offset areas to provide habitat for resident fauna.

Exotic grasses now dominate much of the previously cleared land within the study area. It is likely that, without correct precautions, additional clearance would result in the continued spread of these weeds. It

is imperative that recommended management measures be implemented in order to avoid this occurrence.

The apparent death of trees around the Cattai Creek area near the proposed Hills Centre Station may be due to infection by the root-rot fungus *Phytopthora cinnamomi*, however other factors may be causing these deaths and the presence of this pathogen can only be determined by laboratory testings. This proposal may facilitate the spread of this pathogen if work (for the potential cut and cover of this site) is to be carried out in the area. If this is the case strict management measures must be imposed on all movement in and out of this area and management measures must be imposed to address runoff from the area.

The threat of predation on native fauna from non-native species such as the European Red Fox (*Vulpes vulpes*) currently exists within the study area. The vegetation clearance required for the rail corridor is unlikely to increase this risk substantially as much of the environment is currently highly disturbed and very open, processes that facilitate predation by the red Fox.

The European Wild Rabbit is currently at very high numbers within the study area and the threat of competition and grazing by this species already exists. These populations are degrading the current habitat and potentially competing with native fauna in the area. The current proposal would result in additional land clearance at the shrub and ground level. This would increase suitable habitat for this pest species and potentially facilitate its continued range expansion into surrounding native vegetation.

4.2 NSW Threatened Species Assessment

An assessment of the impacts of this proposal on species, populations and ecological communities listed on Schedules 1, 1A and 2 of the NSW TSC Act was undertaken. The proposal would be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2005).

The study area supported potential and known habitat for a number of threatened flora and fauna species. However, not all of these species or their habitat are likely to be impacted by the proposal. Potentially impacted species are listed below in Table 4.3. Given the large number of fauna species, these have been separated into guilds for assessing impacts as in most cases species within each guild are likely to have similar habitat requirements. However, each flora species was considered separately due to their distinctive habitat requirements.

Table 4.3 Potentially Impacted Species

Species Name	Species Name	Species Name
Amphibians	**Microchiropteran Bats**	**Flora (continued)**
Giant Burrowing Frog	Eastern Bentwing-bat	*Grevillea juniperina subsp. Juniperina*
Giant Barred Frog	Eastern Freetail-bat	*Grevillea parviflora subsp. Parviflora*
Green and Golden Bell Frog	Greater Broad-nosed Bat	*Hibbertia superans*
Woodland Birds & Owls	Large-footed Myotis	*Leptospermum deanei*
Barking Owl	Yellow-bellied Sheathtail-bat	*Leucopogon fletcheri subsp. fletcheri*
Black-chinned Honeyeater (eastern subspecies)	**Megachiropteran Bats**	*Micromyrtus minutiflora*
Brown Treecreeper	Grey-headed Flying-fox	*Pimelea spicata*
Diamond Firetail	**Non-flying Mammals**	*Pultenaea parviflora*
Gang Gang Cockatoo Population, Hornsby & Ku-ring-gai LGA	Eastern Pygmy-possum	*Tetratheca glandulosa*
Gang-gang Cockatoo	**Invertebrates**	**Endangered Ecological Communities**
Hooded Robin	Cumberland Land Snail	Cumberland Plain Woodland
Masked Owl	**Flora**	Sydney Turpentine – Ironbark Forest
Pink Robin	*Acacia bynoeana*	River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
Powerful Owl	*Acacia pubescens*	
Regent Honeyeater	*Caladenia tessellata*	
Speckled Warbler	*Callistemon linearifolius*	
Square-tailed Kite	*Darwinia biflora*	
Superb Parrot	*Dillwynia tenuifolia*	
Swift Parrot	*Eucalyptus spp. Cattai*	

4.2.1 Fauna

Amphibians

Three frog species were identified as potentially occurring within suitable habitat in the study area. However the preferred sandy soils of the Giant Burrowing Frog may limit it to alluvial plains and creek side habitats in this area. These habitats would not be directly impacted by the proposal. Similarly the 40 / 60 m rail corridor would not extend into suitable creek habitat for the Giant Barred Frog. Indirect impacts such as run off from construction may be of concern for these species therefore mitigation measures have been suggested to avoid such impacts. Habitat exists for the Green and Golden Bell Frog within the study area, notably south of Balmoral Road within a large dam area and its adjoining drainage line. This site does not fall directly into the path of the proposed 40 / 60 m corridor however construction zones should avoid expansion into this area and ensure mitigation measurements against indirect impacts are in place. The Giant Burrowing Frog and Green and Golden Bell Frog are not at the limits of their distribution. As mentioned the Giant Barred Frog has not been recorded in the study area and any record would likely be an edge of range record for this species. As the proposed alignment does not impact directly on the areas of potential habitat it is considered unlikely that the proposal would disrupt the lifecycle of or have an impact on these species or their habitat.

Woodland Birds and Owls

The areas of woodland and forest likely to be impacted by this proposal are currently either highly modified remnants or very disturbed vegetated areas with substantial levels of weed invasion. A proportion of the canopy trees present in the area are winter flowering species (e.g. Forest Red Gum, Narrow-leaved Ironbark and Spotted Gum) which would provide an important foraging source for many bird species in this area, especially considering the small amount of remnant vegetation in the area. However, considering this isolation, the small areas of remnant vegetation and the disturbed nature of such stands along the proposed route, these areas may provide limited foraging however they are unlikely to support substantial populations as habitat requirements would be limited. Habitat requirements beyond foraging may not be supported in the remnant communities present in this area. While the proposal would require the removal of canopy trees within the above ground sections of the corridor, it is highly recommended that all other canopy trees be retained as a food source and remnants of the endangered ecological communities present in the area.

Owls have extremely large home ranges, e.g. Powerful Owl home range is around 500 to 1,000 ha, and may forage extensively throughout the locality. A number of owls may use the area for foraging however nesting and roosting requirements within hollows would be limited within the vicinity of the proposed corridor. Hollow–bearing trees were not observed frequently along the proposed route and therefore the area is unlikely to support viable populations and habitat requirements for individuals would be limited. As the proposed route passes through more urban, already modified areas, with better quality habitat in adjacent areas it is more likely that these areas would be used by nesting and roosting species and would be unlikely to be directly impacted by the required clearing. However, as mentioned above it is recommended that canopy trees be retained wherever possible and hollows be checked for signs of fauna occupancy.

The area of Cumberland Plain Woodland at the northern end of the railway provides connectivity with a greater area of vegetation and therefore greater habitat suitability for fauna. This area will not be impacted under the current proposed alignment.

It is considered unlikely that the required vegetation removal would have a substantial impact on the lifecycle of any threatened woodland birds or their habitat or place any local populations at risk of extinction. Furthermore, although a number of threatened woodland birds and owls are known to occur within or in close proximity to the study area, none are at the limits of their distribution.

Microchiropteran Bats

A number of threatened microbats have the potential to forage and roost within the study area. Potential roosting habitat in the form of hollows and under decorticating bark would be impacted by the proposal. Suitable foraging habitat exists in a number of locations within the study area, notably along the watercourses and over open water bodies. These areas will not be directly impacted by the proposal. The lights from the established railway may affect bat foraging as the abundance of insects likely to be attracted to the lights may encourage bats to forage over the new rail corridor. Roosting sites may be a limiting factor within the study area due to low presence of stags and hollows and therefore the area is unlikely to support large populations of these species, however the importance of suitable habitats existing in the area therefore increases as necessary habitat for individuals that are present in the area.

The proposal would not prevent migration or dispersal of any threatened microchiropteran bats and extensive areas of potential foraging and roosting habitat for these species occurs adjacent to the study area and throughout the locality. Therefore it is considered unlikely that the proposal would have a substantial impact on the lifecycle or habitat of any threatened bats. Furthermore, none are at the limits of their distribution.

Megachiropteran Bats

The Grey-headed Flying-fox may forage over the study area and may roost within the locality. However, no camps were recorded within the study area. This species is known to forage widely, however habitat is patchy and restricted in the area therefore removal of canopy trees should be avoided where possible so as to maintain any suitable foraging habitat. This species is not at the limit of its distribution.

Non – flying Mammals

Due to previous clearing habitat for ground–dwelling mammals is limited along the proposed alignment. Much of the land has been cleared for rural or residential use therefore very little understorey or groundcover remains. Cumberland Plain Woodland is naturally open woodland and therefore would provide suitable habitat only with the presence of substantial groundcover, a state not evident in the remnant stands in the study area. The woodland area at the north of the alignment may connect with suitable habitat and therefore indirect impacts on this area should be avoided so as to avoid encroachment on this small amount of habitat present in the area. Habitat may exist in the less disturbed riparian zones that are less accessible to humans and are therefore less disturbed with a greater diversity of species and vegetation coverage. These areas are not to be directly impacted by the vegetation clearance however mitigation measures have been recommended so as to avoid indirect impacts on these habitats and construction zones should avoid encroachment into these areas. Therefore it is considered unlikely that the proposal would have a substantial impact on the lifecycle or habitat of the Eastern Pygmy-possum and this species is not the limits of its distribution.

Invertebrates

The Cumberland Land Snail is restricted to the endangered Cumberland Plain Woodland and therefore any clearance within suitable stands of this community may impact on this species. This species is known to exist in the area and was identified during the current surveys in the Cumberland Plain Woodland at the northern end of the proposed alignment. As previously discussed, this area provides connectivity with a greater area of woodland with reduced disturbance and human influence. The existence of the endangered Cumberland Land Snail within this area indicates the suitability of existing habitat to support a population of this species and in fact has been acquired as compensatory habitat for this species. This area of vegetation at the northern extent of the proposal is not to be directly impacted upon under the current proposed alignment.

Habitat also exists for this species within the intact stand that will be cleared within the Balmoral Road construction zone. This is an isolated stand however many of the known populations exist within small isolated stands (DEC 2006) and while little is known of the movements of this species it is possible that this stand provides sufficient habitat to support a population of this species, therefore clearance of this stand may impact on any present population of this species. The clearance and degradation of Cumberland Plain Woodland remnants is considered a threat to the survival of this species therefore any clearance may be considered a significant impact and habitat offsets may be required.

Potential impacts of the proposal on current disturbance regimes

The proposal is considered unlikely to alter the current disturbance regimes as construction is to be undertaken through predominantly modified areas with maintained areas of vegetation and therefore reduced fire hazard.

Potential impacts on habitat connectivity

Vegetation within the study area is of a modified and disturbed nature and is currently patchy with limited connectivity and mostly provides limited habitat for any threatened species. The proposed alignment does not pass through any areas of 'core habitat' as mapped by NPWS (NPWS 2002). It is therefore considered unlikely that the construction would result in isolation of habitat for any threatened fauna species such that it would prevent dispersal or movement of the species and is therefore considered unlikely to constitute a significant impact on habitat connectivity.

Potential impacts on critical habitat

There are no areas identified as critical habitat present within the study area.

4.2.2 Flora

There is the potential for direct impacts on potential habitat for some threatened flora species due to vegetation clearance such as displacement or disturbance, as well as indirect impacts including runoff, sedimentation, edge effects (opening up remnants to weed invasion), disruption to the pollination cycle (if clearing is undertaken during flowering periods), disturbance to dormancy periods and seed banks. Mitigation measures outlined in Section 5 will be implemented during construction to minimise such impacts. However, due to the high level of disturbance, rural land usage, human access and impact it is not likely that these species would occur within the study area. The remnant vegetation communities that would normally potentially support suitable habitat for these threatened species are all of a modified or disturbed nature and at varying degrees of degradation. The remaining vegetation stands are also mostly isolated with the exception of the northern end of the alignment where the vegetation connects

with a larger woodland and riparian area around Second Ponds Creek beyond the scope of this proposal. Therefore it is considered unlikely that the proposal would have a substantial impact on the lifecycle of any flora species.

Potential impacts of the proposal on current disturbance regimes

The proposal is considered unlikely to alter the current fire regimes. Vegetation clearance may increase the level of weed invasion and continued spread into adjacent areas. Recommendations have been made in order to avoid the spread and establishment of weeds during and post construction.

Potential impacts on habitat connectivity

Given that the proposed clearing involves the removal of vegetation through mostly patchy and modified areas within properties and along roadsides, impacts on habitat connectivity will be minimal.

Potential impacts on critical habitat

There are no areas identified as critical habitat present within the study area.

4.2.3 Endangered Ecological Communities

Cumberland Plain Woodland

Only 9 % of the original extent of this community in NSW remains and most can be found on the Cumberland Plain (DEC 2006b). Locally, this community has an extent of less than 386 ha. This community was present in the northern end of the proposed alignment, north of Norwest Business Park. This community was patchy in its distribution with few isolated stands containing a native understorey and the majority containing only canopy species over cleared pasture / grazing land. Construction of the rail corridor along this section would require clearance of Cumberland Plain Woodland. The 50 m wide clearance for the alignment would pass through areas of varying quality. One small block of uncleared land contains species representative of this community other than canopy species and clearance in this area for the Balmoral Road construction area would result in the removal of the entire stand of approximately 1.6 ha. This represents 0.41 % of the remaining extent of this community. This is an isolated remnant and therefore is unlikely to result in further fragmentation.

At the northern end of the proposed alignment the existing remnant stand would be at the northern limit of the stabling facility and would not be impacted upon. The construction of the stabling yard and associated facilities would require clearing of scattered trees characteristic of this community. The footprint of the stabling yard has not yet been finalised and therefore the clearance area cannot be determined.

Where cut and cover techniques are to be used, it is recommended that a post-construction rehabilitation plan be implemented using species characteristic of this community in order to re-establish lost communities and assist in the long-term survival of this community in the area.

Sydney Turpentine – Ironbark Forest

Only 4.5 % of the original extent of this community in NSW remains and it is heavily fragmented (DEC 2006c). Two small stands of this community were present within the rail corridor. Quadruplication would result in the clearance of these stands, approximately 0.3 ha, which is 0.18 % of the remaining extent (less than 170 ha) in the Baulkham Hills LGA. This stand, although modified with weed invasion and a high level of disturbance, contained representative canopy species as well as midstorey and

groundcover species. This is an isolated linear stand therefore clearance is unlikely to result in further fragmentation.

This community was also present along Cattai Creek, near the proposed Hills Centre Station. Due to dive constraints on the tunnel structure it is likely that the construction would require a cut and cover process through this creek line. While the creek bed and edges are primarily areas of weeds, upslope from the creek there was native vegetation consistent with this community with a number of characteristic species and low weed invasion. Cut and cover through this area would involve the clearance and disturbance of a broad area estimated at approximately 0.3 ha. As this vegetation is continuous along the creek line, permanent removal of vegetation along the creek line would result in further fragmentation of this already highly fragmented community. It is therefore recommended that a post-construction rehabilitation and revegetation plan be implemented along this creek to avoid fragmentation by re-establishing the community along the creek line as well as improving its quality with ongoing weed management. Due to high level of weed invasion along this creek measurements for the control of runoff into the creek have also been recommended.

River-Flat Eucalypt Forest

The original extent of this community is reduced to approximately 30 % (DEC 2006d) of its original range in NSW. The current extent in the BaulkhamHills LGA is likely to be less than 561 ha. This community was present along the number of watercourses running adjacent to the proposed alignment and passes through properties identified as being impacted by the proposed route at three locations: at Windsor Road within the alignment; along Caddies Creek along the viaduct alignment and along Caddies Creek at the viaduct construction site. These impact zones would result in a maximum clearance of 1.0 ha. Any construction in these areas should use construction design that minimises the impact into this community and use the adjacent grasslands as well as ensuring the management of runoff into the community and associated creek line. Indirect impacts on this community would be mitigated against and are outlined in Section 5.2.

Due to the continuing diminishing extent of these communities within the local area it is likely that offsets would be required to compensate for community loss. The need for habitat offsets would be determined in consultation with DEC.

4.3 Commonwealth Threatened Species Assessment

A large number of threatened species are listed under the EPBC Act, however the majority of these species are unlikely to occur along the alignment due to the absence of suitable habitat. However, a number have been recorded within the locality (DEC 2005) and the proposal has the potential to impact on small areas of potential habitat for these species including:

Flora

- *Acacia bynoeana;*
- *Acacia pubescens;*
- *Caladenia tessellata;*
- *Cryptostylis hunteriana;*
- *Darwinia biflora;*
- *Dillwynia tenuifolia;*

- *Grevillea parviflora subsp. parviflora;*
- *Leptospermum deanei;*
- *Micromyrtus minutiflora;*
- *Pimelea spicata;*
- *Pultenaea parviflora;* and
- *Tetratheca glandulosa*.

Fauna

- Regent Honeyeater (*Xanthomyza phrygia*);
- Swift Parrot (*Lathamus discolor*);
- Superb Parrot (*Polytelis swainsonii*)
- Pink Robin (*Petroica haliaetus*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Green and Golden Bell Frog (*Litoria aurea*);
- Giant Burrowing Frog (*Heleioporus australiacus*); and
- Giant Barred Frog (*Mixophys iteratus*).

Endangered Ecological Communities

- Blue Gum High Forest;
- Cumberland Plain Woodland; and

Although listed under the EPBC Act, Sydney Turpentine – Ironbark Forest must be a stand greater than one hectare in order to be considered under this Act. The stands identified within the study area of the current proposal do not fulfil this criterion and therefore this community is not considered within the commonwealth threatened species assessment.

In line with the findings of the Part 3A assessment under the EP&A Act, it is considered that the proposal would be unlikely to have a significant impact on any threatened species listed under the EPBC Act or their habitat. Therefore, a Referral to the Department of Environment and Heritage (DEH) is not required.

5. Avoidance and Mitigation Recommendations

5.1 Avoidance

In order to avoid potential impacts on flora and fauna habitat along the proposed route the following measures have been implemented:

» The proposed alignment has been located so as to pass through previously developed and urbanised environments and avoid areas of significant vegetation wherever possible; and

» A large portion (16 km) will pass underground in a tunnel structure so as to minimise disturbance to existing habitat.

5.2 Mitigation

A number of mitigation and management measures would be implemented to prevent direct and indirect impacts of the proposal on flora and fauna and their habitat within the study area and locality. Additional measures may be identified may be identified during progress of design and development of the project. Recommended measures would typically include:

» Retain or replace habitat features, such as fallen logs, that may be used by fauna;

» Avoid hollow-bearing trees and stags where possible. Where avoidance of a hollow-bearing tree is not possible, hollow branches and trunks should be carefully removed and checked by an onsite ecologist for any fauna and then placed within the adjacent woodland area to provide habitat for other fauna species. Any fauna found within removed hollows should be captured and released at nightfall;

» Design and position construction sites so as to minimise vegetation clearance and encroachment into remnant vegetation by using already available disturbed areas;

» Avoid the removal of canopy trees within the alignment clearance area outside of the working corridor;

» Consider necessary buffer zones around construction areas from adjacent vegetation and creek lines;

» Prepare a Revegetation Plan in order to consider the following:

  – Where natural regeneration is not expected, re-plant areas with local provenance plant species;
  – Control of noxious weeds;
  – Ensure that any planting in bushland areas is appropriate to the bushland community; and
  – Restoration of riparian zones following direct or indirect disturbance.

» Include winter flowering eucalypts in the re-planting to replace those lost during clearance so as to replace lost habitat for winter flowering dependent species;

» Refer to the *Royal Botanical Gardens NSW Recommended* Phytophthora cinnamomi *protocols* for the necessary management of *Phytophthora cinnamomi*;

» Consider low level shielded lighting;

» Fencing of proposed development areas to ensure construction works do not breach the boundaries and enter the adjacent areas of vegetation;

- Installation of sediment detention basins, or similar, prior to construction to prevent untreated runoff and sediment entering drainage lines and creeks within the study area;
- Placement of stockpiles away from vegetated areas;
- Piling of soil that may contain seed of exotic species away from adjacent vegetation or drainage lines where they could be spread during rainfall events;
- Monitoring and management of weed invasion along the proposed alignment to ensure regeneration of native species takes place;
- Replace removed soil as soon as possible after construction to avoid sedimentation runoff into adjacent drainage lines and creeks; and
- Replace removed soil as soon as possible after construction to avoid smothering of plants and new seedlings.

5.3 Potential Offsets

DEC often requires the provision of offsets where clearing of endangered ecological communities with only a small proportion of the community remaining locally is to occur or when any loss of habitat for threatened species is likely to occur. Due to the limited distribution of the endangered ecological communities identified along the proposed alignment it is likely that any removal or clearance of these communities would require the provision of offsets. It is also likely that removal of suitable Cumberland Plain Woodland habitat for the Cumberland Land Snail would require the provision of offsets with similar habitat merits.

6. Conclusion

The proposed alignment for the NWRL was adjusted to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to threatened species and endangered ecological communities. As discussed, the impact assessment of the proposed alignment has been undertaken at a concept level and provides only a guide for further assessment requirements. Additional surveys would include:

- Detailed mapping of the edges of endangered ecological communities present along the proposed alignment and surrounding impact areas;
- Assessment of the impact of the stabling yard and associated facilities after finalisation of the footprint;
- Assessment of the location of structures associated with the tunnel such as air shafts and discharge/runoff outlets and their possible inclusion under SEPP 19;
- Investigation into the requirement for offset sites and, if necessary, potential suitable offset sites and liase with DEC on this matter.

It is considered likely that the provision of offsets would be required for the loss of endangered ecological communities as well as loss of Cumberland Land Snail habitat. The ratio of provisioning would be dependant on a number of factors including the condition of the community / habitat to be removed as well as the remaining extent of the community to be removed, however, the required offset would likely be larger than the amount to be removed. Consideration should be given to combining the need for offsets of various projects and approaching DEC with a consolidated idea of potential offset sites.

7. References

Auld BA & Medd RW 2002 *Weeds: An Illustrated Botanical Guide to the Weeds of Australia*. Inkata Press, Melbourne, VIC.

Bannerman SM & Hazelton PA 1990 *Soil Landscapes of the Penrith 1:100 000 Sheet.* Soil Conservation Service of NSW, Sydney, NSW.

Barker J, Grigg GC & Tyler MJ 1995 *A Field Guide to Australian Frogs*. Surrey Beattie & Sons, Chipping Norton, NSW.

Brooker MIH & Kleinig DA 1999 *Field Guide to Eucalypts*. Blooming Books, Hawthorn, VIC.

Bureau of Meteorology 2006. *Climate Records*. http://www.bom.gov.au/climate/

Chapman GA & Murphy CL 1989 *Soil Landscapes of the Sydney 1:100 000 Sheet.* Soil Conservation Service of NSW, Sydney, NSW.

Churchill S 1998 *Australian Bats*. Reed New Holland, Sydney, NSW.

Cropper S 1993 *Management of Endangered Plants* CSIRO Publications, East Melbourne, VIC

DEC 2004 *Draft Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2005 *Draft Guidelines for Threatened Species Assessment.* Department of Environment and Conservation, Hurstville, NSW.

DEC 2006 *Threatened Species Database Records*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2006a *Blue Gum High Forest – Endangered Ecological Community Profile*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2006b *Cumberland Plain Woodland – Endangered Ecological Community Profile*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2006c *Sydney Turpentine – Ironbark Forest – Endangered Ecological Community Profile*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2006d *River – flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Community Profile*. Department of Environment and Conservation, Hurstville, NSW.

DEC 2006e *Cumberland Land Snail – Species Profile.* Department of Environment and Conservation, Hurstville, NSW.

DEH 2005 *Protected Matters Search Tool – Matters of National Environmental Significance*. http://www.deh.gov.au/erin/ert/epbc/index.html

Harden G 1990 *Flora of New South Wales Volume 1*. New South Wales University Press, Australia.

Harden G 1991 *Flora of New South Wales Volume 2*. New South Wales University Press, Australia.

Harden G 1992 *Flora of New South Wales Volume 3*. New South Wales University Press, Australia.

Harden G 1993 *Flora of New South Wales Volume 4*. New South Wales University Press, Australia.

Hornsby Shire Council 2006 *Flora and Fauna Assessment Guidelines for Development Applications.* Hornsby Shire Council, Hornsby, NSW.

Menkhorst P & Knight F 2004 *A Field Guide to Mammals of Australia*. Oxford Press, South Melbourne, VIC.

NPWS 2002 *Native Vegetation of the Cumberland Plain, Final Edition.* National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee 1997 *Blue Gum High Forest – Endangered Ecological Community – Final Determination.* NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee 1997b *Cumberland Plain Woodland – Endangered Ecological Community – Final Determination.* NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee 1997 *Sydney Turpentine – Ironbark Forest 1998 – Endangered Ecological Community – Final Determination.* NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee 2004 *River – flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Community – Final Determination.* NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee 2006 *Blue Gum High Forest in the Sydney Basin Bioregion – Proposed critically endangered ecological community listing – Preliminary Determination.* NSW National Parks and Wildlife Service, Hurstville, NSW.

Pizzey G & Knight F 2003 *The Field Guide to Birds of Australia*. Harper Collins, Sydney, NSW.

Robinson L 1991 *Field Guide to the Native Plants of Sydney*. Kangaroo Press, Pymble, NSW.

Simpson K & Day N 1999 *Field Guide to the Birds of Australia*. Penguin Books, Ringwood, VIC.

SKM 2003 *North West Rail Link: Assessment of Environmental Issues, Flora and Fauna Assessment.* Report prepared for Transport Infrastructure Development Corporation.

SKM 2006 *North West Rail Link: Project Application and Preliminary Environmental Assessment.* Report prepared for Transport Infrastructure Development Corporation.

Appendix A

Flora Species List

Table 7.1 Flora Species List

Family	Scientific Name	Common Name
Adiantaceae	*Adiantum formosum*	Giant Maidenhair
	Cheilanthes sieberi	
Apiaceae	*Centella asiatica*	Pennywort
Apocynaceae	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush
Araceae	*Monstera deliciosa**	Fruit Salad Plant
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern
	*Asparagus asparagoides**	Bridal Creeper
Asteraceae	*Bidens pilosa**	Cobblers Peg
	Cassinia sp	
	*Conyza bonariensis**	Flaxleaf Fleabane
	*Onopordum acanthium**	Scotch Thistle
	*Senecio madagascariensis**	Fireweed
Cactaceae	*Opuntia* sp.	Prickly Pear
Cannaceae	*Canna indica**	Arrowroot
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
	Casuarina glauca	Swamp Oak

Family	Scientific Name	Common Name
Chenopodiaceae	*Einadia hastata*	
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Convolvulaceae	*Dichondra repens*	Kidney Weed
	*Ipomoea indica**	Morning Glory
Crassulaceae	*Bryophyllum delagoense**	Mother-of-millions
Davalliaceae	*Nephrolepis cordifolia**	Fishbone Fern
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Ericaceae	*Epacris pulchella*	Wallum Heath
	Leucopogon juniperinus	Prickly Beard-heath
	Monotoca scoparia	
Euphorbiaceae	*Ricinus communis**	Caster Oil plant
Fabaceae		
Sub Family Faboideae	*Daviesia ulicifolia*	Gorse Bitter Pea
	Glycine sp.	
	Hardenbergia violacea	False Sarsaprilla
Sub Family Mimosoideae	*Acacia falcata*	
	Acacia longifolia subsp. *longifolia*	Sydney Golden Wattle

Family	Scientific Name	Common Name
	Acacia parramattensis	Parramatta Wattle
	Acacia spp.	
	Acacia suaveolens	Sweet Scented Wattle
Juncaceae	*Juncus* sp.	
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Lomandraceae	*Lomandra filiformis*	
	Lomandra longifolia	Spiny-headed Mat-rush
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
Malaceae	*Cotoneaster* sp.*	
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Myrtaceae	*Angophora costata*	Sydney Red Gum
	Angophora floribunda	Rough-barked Apple
	Angophora hispida	Dwarf Apple
	Corymbia gummifera	Red Bloodwood
	Corymbia maculata	Spotted Gum
	Eucalyptus amplifolia	Cabbage Gum

Family	Scientific Name	Common Name
	Eucalyptus crebra	Narrow-leaved Ironbark
	Eucalyptus fibrosa	Red Ironbark
	Eucalyptus mollucana	Grey Box
	Eucalyptus pilularis	Blackbutt
	Eucalyptus piperita	Sydney Peppermint
	Eucalyptus punctata	Grey Gum
	Eucalyptus resinifera	Red Mahogany
	Eucalyptus saligna	Sydney Blue Gum
	Eucalyptus tereticornis	Forest Red Gum
	Kunzea ambigua	Tick Bush
	Leptospermum polygalifolium	Lemon-scented Tea-tree
	Lophostemon confertus	Brush Box
	Melaleuca ericifolia	Swamp Paperbark
	Melaleuca nodosa	Ball Honey Myrtle
	Syncarpia glomulifera	Turpentine
Oleaceae	*Ligustrum sinense**	Small Leaved Privet
	*Olea europaea**	African Olive

Family	Scientific Name	Common Name
Oxalidaceae	*Oxalis* sp.	
Phormiaceae	*Dianella caerulea*	Blue Flax-lily
Pinaceae	*Pinus* spp.	Pines
Pittosporaceae	*Bursaria spinosa*	Boxthorn
	Pittosporum undulatum	Sweet Pittosporum
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues
Poaceae	*Aristida ramosa*	Purple Wiregrass
	Aristida vagans	Threeawn Speargrass
	Austrodanthonia sp.	
	Bothriochloa macra	Red Grass
	*Chloris gayana**	Rhodes Grass
	Cynodon dactylon	Couch
	Dichelachne micrantha	Shorthair Plumegrass
	Entolasia marginata	Bordered Panic
	Entolasia stricta	Wiry Panic
	Eragrostis brownii	Brown's Lovegrass
	*Eragrostis curvula**	African Lovegrass

Family	Scientific Name	Common Name
	Imperata cylindrica	Blady Grass
	*Melinis repens**	Red Natal Grass
	Microlaena stipoides	Weeping Grass
	Panicum simile	Two-colour Panic
	Paspalum dilatatum	Paspalum
	Phragmites australis	Common Reed
	Phyllostachys sp.	A Bamboo
	Setaria sp.	A Pigeon Grass
	*Stenotaphrum secundatum**	Buffalo Grass
	Themeda australis	Kangeroo Grass
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
	*Grevillea robusta**	Silky Oak
	Hakea sericea	Needlebush
	Lomatia silaifolia	Crinkle Bush
	Persoonia levis	Smooth Geebung
Ranunculaceae	*Clematis aristata*	Old Man's Beard
Rosaceae	*Rubus ulmifolius**	Blackberry

Family	Scientific Name	Common Name
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsaparilla
Typhaceae	*Typha orientalis*	Broadleaf Cumbungi
Verbenaceae	*Lantana camara**	Lantana
	*Verbena bonariensis**	Purpletop
Xanthorrhoeaceae	*Xanthorrhoea* sp.	
Zamiaceae	*Macrozamia spiralis*	

* = introduced species

Appendix B

Fauna Species List

Table 7.2 Fauna Species List

Family	Scientific Name	Common Name	Record
Avifauna			
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	W
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	W
Anatidae	*Chenonetta jubata*	Australian Wood Duck	O
Corvidae	*Corvus coronoides*	Australian Raven	O
Halycyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	W
Artamidae	*Gymnorhina tibicen*	Australian Magpie	O
Psittacidae	*Platycercus elegans*	Crimson Rosella	O
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	O
Meliphagidae	*Manorina melanocephala*	Noisy Miner	O
Artamidae	*Cracticus torquatus*	Grey Butcher Bird	W
Artamidae	*Strepera graculina*	Pied Currawong	O
Columbidae	*Columba leucomela*	White-headed Pigeon	O
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	O
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	O
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	O

Family	Scientific Name	Common Name	Record
Cacatuidae	*Cacatua roseicapilla*	Galah	O
Mammals			
Leporidae	*Oryctolagus cuniculus**	European Wild Rabbit *	O
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ring-tail Possum	O
Invertebrates			
Camaenidae	*Meridolum corneovirens*	Cumberland Land Snail	S

W = Heard; O = Observed; S = Shell ; * = Introduced; Species listed under the TSC Act or EPBC Act are indicated in bold

GHD Pty Ltd ABN 39 008 488 373

57 Herbert Street Artarmon NSW 2064
Locked Bag 2727 St Leonards NSW 1590
T: (02) 9462 4700 F: (02) 9462 4710 E: Atnmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
	R. Michniewicz	David Petch		Julian Ardas		17/10/06