

Northern Link

10. Ecology



Northern Link

Phase 2 – Detailed Feasibility Study

CHAPTER 10

ECOLOGY

- September 2008

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10. Ecology

This chapter addresses Part B, Section 5.5 of the Terms of Reference (ToR). It describes the terrestrial and aquatic habitat values within the study corridor and areas affected by the Project. Ecological values are determined using existing Brisbane City Council and Queensland Government data, published literature and site surveys. The descriptions are with reference to flora and fauna, including rare and threatened species, communities, regional ecosystems and any adjacent environmentally sensitive areas.

Potential impacts of the project on these environmental values are assessed and mitigating environmental management measures recommended for identified potentially negative impacts, if any, caused by the project.

Species, specimens, habitats and communities listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), Nature Conservation Act 1992, the Vegetation Management Act 1999 or Brisbane City Plan that may potentially be impacted by the proposed activities are identified and recommendations made to avoid or mitigate the potential impacts as appropriate.

A full description of the study is provided in Technical Report No. 10 - Ecology in Volume 3 of the EIS.

10.1 Description of Existing Environment

The study corridor includes a highly urbanised area of Brisbane with significantly disturbed terrestrial and aquatic ecosystems. Original vegetation cover has been substantially cleared for development and urban land uses and surface drainages have mostly been confined to concrete stormwater drains. The western end traverses the edge of a large bushland system on the slopes of Mt Coot-tha, the Brisbane Botanic Gardens and isolated fragments of vegetation that exist in urban parks, private properties and along watercourses. A small wetland is mapped in the eastern portion of the study corridor within the Victoria Park Golf Course.

The proposed spoil placement sites are:

- Port of Brisbane, Lytton Precinct – specifically Port West Estate and Fisherman Islands;
- Swanbank Industrial Land Reclamation site; and
- Mt Coot-tha Quarry.

The location of these potential spoil placement sites is identified in Chapter 4, together with proposed quantities of spoil likely to be placed and proposed haulage methods and routes.

The Fisherman Islands reclamation area project was referred to the Commonwealth under the EPBC Act in 2000 and was declared a controlled action. A decision to approve the reclamation of 230ha for additional port land by way of an extension 1,800m northward of existing reclamation at Fisherman Islands including filling of the area was issued by the Minister for Environment and Heritage in 2001, with effect until 2029. The Port West Site (Clunies Flat) is yet to undergo development, including filling, and assessment of any proposed placement would be subject to the policies and development controls applied under the Strategic Land Use Plan for the Port of Brisbane. The Port West Estate is identified on the land use strategy map for the Port of Brisbane as not being an area of high ecological value. The land is largely clear of remnant native vegetation and has been identified in the land use strategy to accommodate maritime industries and/or port operational activities.

The Swanbank Industrial Land Reclamation site is an approved site for the placement of fill material and has been occurring for over 5 years at this site. The Mt Coot-tha Quarry has a deemed development approval for site for the handling of hard rock, including stockpiling and crushing. The Quarry is located close to the Western Freeway worksite, and it is proposed to transfer the spoil from the worksite to the quarry via a temporary conveyor. The existing environment along the conveyor alignment includes part of an open forest community along the northern side of the Western Freeway as well as the more cultivated landscape through an open section of the Mt Coot-tha Botanic Gardens. A section of land up to 8m wide for the construction and operation of the overhead conveyor, including an adjacent access track would need to be cleared and rehabilitated following the removal of the conveyor.

10.1.1 Legislative Context

Commonwealth

The *EPBC Act (1999)* prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas. The *EPBC Act* identifies Wetlands of International Significance, Threatened Species and Migratory Species' as matters of National Environmental Significance (NES) pertinent to this study. The project, including the potential spoil placement sites, has been referred under the *EPBC Act*¹ and a decision provided by the Commonwealth Minister on 30 November 2007, that the Project is not a controlled action in relation to the potential for the Project to have a significant impact on NES matters protected under the *EPBC Act*².

Queensland

The *Nature Conservation Act 1992* (and *Nature Conservation (Wildlife) Regulation 2006*) provides for the conservation and management of protected areas, reserves and native wildlife including endangered, vulnerable and rare species in Queensland. All native vertebrates and certain invertebrates are protected under Section 71 of the Act.

The Land Protection (Pest and Stock Route Management) Act 2002 and the Land Protection (Pest and Stock Route Management) Regulation 2003 provides for pest management in Queensland, and includes both weeds and Fire Ants.

The Vegetation Management Act 1999 (VM Act) provides for the conservation of remnant native vegetation and Regional Ecosystems (RE). It regulates the clearing of mapped remnant vegetation on freehold and leasehold land in Queensland. For the purposes of assessing significant projects, the VM Act is supported by the Regional Vegetation Management Code for South East Queensland Bioregion (the Code) and the Policy for Vegetation Offsets. The Code regulates the clearing of vegetation in a way that conserves remnant regional ecosystems, does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes.

Brisbane City Council Local Laws

Brisbane City Council's *Natural Assets Local Law 2003* (NALL) protects and manages vegetation within the city.

¹ The Referral was made on 1 November 2007

² Northern Link Parallel Tunnels, Brisbane Qld – EPBC 2007/3824

The NALL defines seven categories of protected vegetation, including Council Controlled Vegetation (CCV), Vegetation Protection Order (VPO), Significant Native Vegetation (SNV), Valued Urban Vegetation (VUV), Waterway Vegetation (WAV), Wetland Vegetation (WEV) and Significant Landscape Trees (SLT).

10.1.2 Methodology

Terrestrial Flora

The methods adopted for the flora investigations of the study corridor involved three stages:

- desktop data collection and review;
- survey and assessment of vegetation communities; and
- targeted searches for rare or threatened flora.

The desktop analysis involved a review of relevant databases, surveys and existing literature. In describing the terrestrial flora and mapped vegetation communities of the study corridor, a variety of data sources were used.

- Review of the existing vegetation mapping for the study corridor including the Queensland Herbarium's RE mapping and Brisbane City Council's vegetation community and RE mapping.
- Searches of the Queensland Herbarium HERBRECS, the Environmental Protection Agency's (EPA) Wildlife Online (WildNet) and the EPBC Act Protected Matters (Department of Environment, Water, Heritage and the Arts) databases.
- Information on existing significant trees and groups of trees within the study corridor identified under Brisbane City Council's NALL.

The conservation status of the flora species occurring or potentially occurring in the study corridor have been assessed at the state, regional and local context with reference to the EPBC Act, Nature Conservation Act (NC Act) and Brisbane City Council's *Natural Assets Planning Scheme Policy* (NAPSP).

Several vegetated areas which were publicly accessible within the study corridor were inspected on 4 December 2007 and are shown in Figure 1 in *Technical Report No. 10 - Ecology in Volume 3* of the EIS. Terrestrial flora was assessed at the only sites in the study corridor where sufficient vegetation remains to provide any habitat, namely:

- Mt Coot-tha Botanic Gardens and adjacent road reserve, Toowong;
- Toowong Cemetery, Toowong;
- Anzac Park gully and adjacent to Centenary Highway, Toowong;
- Gregory Park, Paddington;
- Blamey Street precinct, Kelvin Grove;
- Normanby Hotel precinct, Red Hill;
- York's Hollow, Herston; and
- The bikeway adjacent to Victoria Park (Busway overpass to York's Hollow), Herston.

Significant trees and other vegetation listed by Brisbane City Council under the *Natural Assets Planning Scheme Policy* (NAPSP) were inspected to verify the species and/or species composition.

Terrestrial Fauna

Fauna investigations involved a review of existing data sources and field survey. The highly urbanised and populated nature of the study corridor means that the fauna and flora are well known. In this environment, additions to faunal or floral registers from field surveys is highly unlikely because many records already exist in herbaria and museum databases courtesy of many people being interested in the local natural history. Accordingly reliance may be placed upon existing records as comprehensive registers of fauna and flora. Moreover, mapping of ecosystems or habitat areas may be accepted as accurate to the extent it is unlikely to be improved for the purpose of this EIS. For these reasons the field surveys undertaken were to verify findings of the desktop review.

The Birds Australia (BirdData), the EPA's WildNet, EPBC Act Protected Matters database, Brisbane City Council's fauna database and EPA's Biodiversity Planning Assessment (BPA) for the South East Queensland (SEQ) Bioregion were all reviewed to determine core habitat areas for rare or threatened fauna species and identified corridors at the state, regional and local scales.

Conservation status of fauna species occurring or potentially occurring in the study corridor have been assessed at the national, state and local levels with reference to the EPBC Act, NC Act and Brisbane City Council NAPSP along with a range of other sources.

Fauna searches within the study corridor were limited to spotlighting for nocturnal fauna on 11 December 2007 at the road reserve adjacent to the Botanic Gardens, the Toowong Cemetery and the Anzac Park.

Field investigations were undertaken on 11 December 2007 in order to verify the general findings of the desktop data at six sites, namely:

- Mt Coot-tha Botanic Gardens and adjacent road reserve, Toowong;
- Toowong Cemetery, Toowong;
- Anzac Park gully and adjacent to Centenary Highway, Toowong;
- Gregory Park, Paddington;
- Blamey Street precinct, Kelvin Grove; and
- York's Hollow and Victoria Park Golf Course, Herston.

Aquatic Flora and Fauna

Aquatic flora and fauna values were identified from the EPA Wildnet database, Brisbane City Council literature, and from riparian vegetation assessments.

10.1.3 Vegetation Communities and Flora Species

No threatened ecological communities listed under the EPBC Act occur within the study area of the Project.

The Queensland Herbarium has mapped one Regional Ecosystem (RE) occurring along either side of the Western Freeway from a location within the western half of the proposed Western Freeway worksite. This RE 12.11.5/12.12.5 (90/10) is listed in **Table 10-1** together with its vegetation management status under the VM Act.

Brisbane City Council has also mapped remnant and non-remnant vegetation at a smaller scale of 1:25,000 than that employed by the Queensland Herbarium (1:100,000 and 1:50,000 in some areas). Brisbane City Council maps remnant and non-remnant vegetation using the same RE codes as the Queensland Herbarium, however

Brisbane City Council mapping is not recognised under the Queensland VM Act. Brisbane City Council's mapping often overlaps with portions of the State RE mapping.

Brisbane City Council (BCC) has mapped three REs under the Queensland Herbarium classification system - RE 12.11.3, 12.11.5 and 12.11.19 as identified in **Table 10-1**. The majority of the remnant vegetation is described by BCC as RE 12.11.3, as distinct from 12.11.5 described in the Queensland Herbarium State mapping. A linear patch of RE 12.11.5 described by BCC occurs on the southern edge of the Western Freeway at Toowong and is classified as being of local and city wide significance. A smaller area of RE 12.11.9 is identified on the northern side of the Western Freeway, within the south-western section of the proposed Western Freeway worksite. This RE is classified as being Of Concern by the VM Act but is considered not of significance under the local Brisbane City Council classification. It is also not mapped as 12.11.9 by the VM Act.

Many patches of non-remnant vegetation have also been mapped by BCC within the study corridor. These are labelled as unconfirmed remnant, which include the native vegetation within Victoria Park Golf Course, as well as non-remnant regional ecosystems and unconfirmed non-remnants, being the majority of vegetation within the study corridor. The unconfirmed non-remnants are small patches, regrowth vegetation and plantings of trees that are not able to be classified under the RE system.

The location of these mapped vegetation communities within the study corridor are identified on **Figure 10-1A**, **Figure 10-1B** and **Figure 10-1C**.

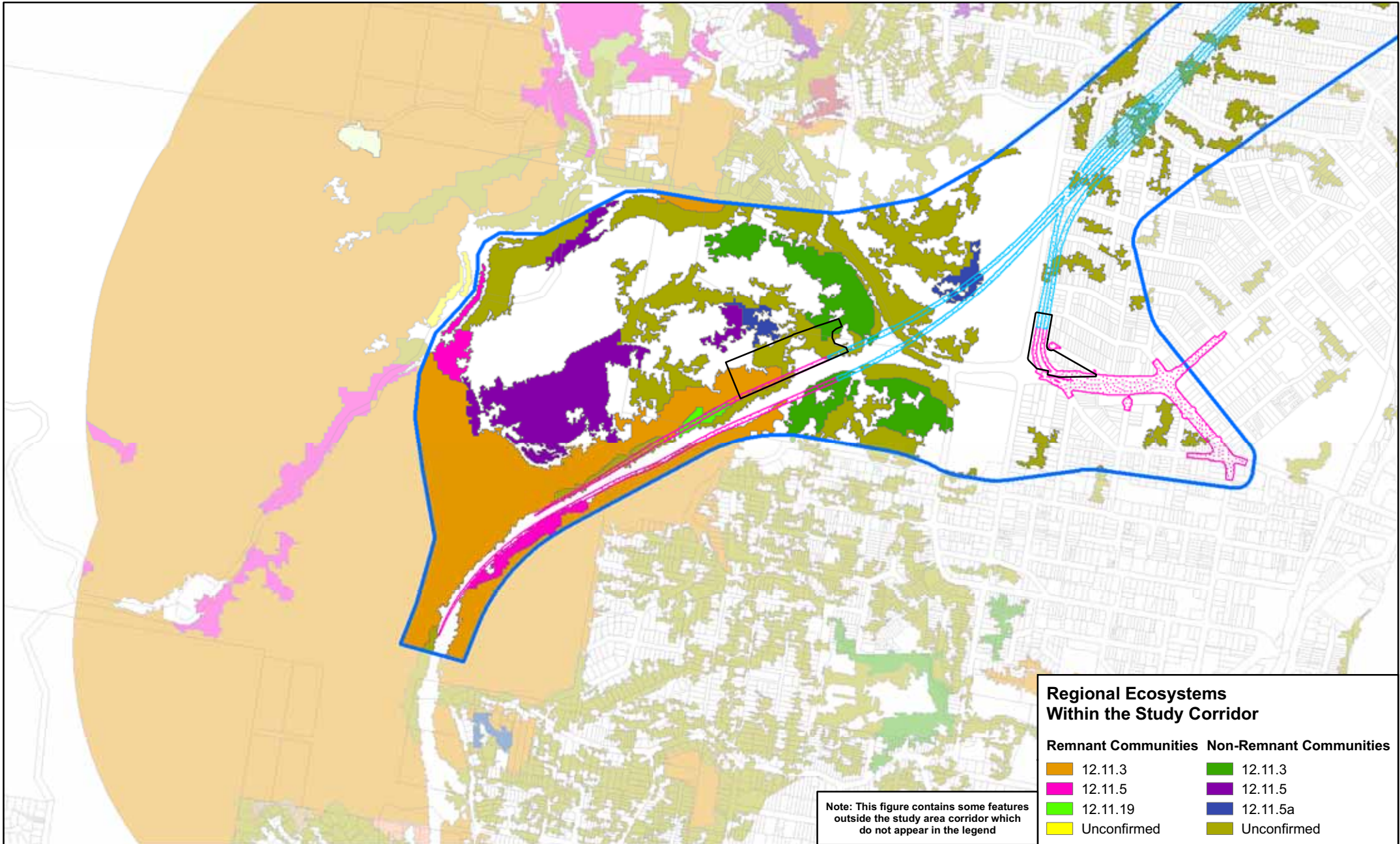
■ **Table 10-1 Mapped regional ecosystems and Brisbane City Council classified vegetation within the study corridor**

State Regional Ecosystem Mapping	VM Status	Brisbane City Council Regional Ecosystem Mapping	Brisbane City Council Status	Brief Description
12.11.5/12.12.5 (90/10)	Not Of Concern	12.11.3 (Remnant)	none	Open forest generally with <i>Eucalyptus siderophloia</i> , <i>E. propinqua</i> on metamorphics ± interbedded volcanics
		12.11.5 (Remnant)	Significant	Open forest complex with <i>Corymbia citriodora</i> , <i>E. siderophloia</i> , <i>E. major</i> on metamorphics ± interbedded volcanics
		12.11.19 (Remnant)	none	<i>E. fibrosa</i> open forest on metamorphics ± interbedded volcanics
Non-remnant Vegetation	None	Unconfirmed Remnant	none	Vegetation, such as small patches of regrowth vegetation or small groups of trees, that are unable to be classified as a Regional Ecosystem
Non-remnant Vegetation	None	12.11.3 (Non-remnant)	none	Open forest generally with <i>Eucalyptus siderophloia</i> , <i>E. propinqua</i> on metamorphics ± interbedded volcanic; however these patches do not attain the definition of remnant (see Table Notes)
Non-remnant Vegetation	None	12.11.5 (Non-remnant)	none	Open forest complex with <i>Corymbia citriodora</i> , <i>E. siderophloia</i> , <i>E. major</i> on metamorphics ± interbedded volcanics; however these patches do not attain the definition of remnant (see Table Notes)

State Regional Ecosystem Mapping	VM Status	Brisbane City Council Regional Ecosystem Mapping	Brisbane City Council Status	Brief Description
Non-remnant Vegetation	None	12.11.5a (Non-remnant)	none	Open forest complex with <i>Corymbia citriodora</i> , <i>E. siderophloia</i> , <i>E. major</i> on metamorphics ± interbedded volcanics; however these patches do not attain the definition of remnant (see Table Notes)
Non-remnant Vegetation	None	Unconfirmed Non remnant	none	Vegetation, such as small patches of regrowth vegetation or small groups of trees, that are unable to be classified as a Regional Ecosystem

Table Notes:

- Remnant woody vegetation - defined as vegetation where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
- Non-remnant - includes regrowth, heavily thinned or logged and significantly disturbed vegetation that fails to meet the structural and/ or floristic characteristics of remnant vegetation.



LEGEND

- | | |
|------------------------|---------------------------|
| Study Area Corridor | Proposed Alignment |
| Construction Worksites | Surface Works |
| | Tunnel Underground |

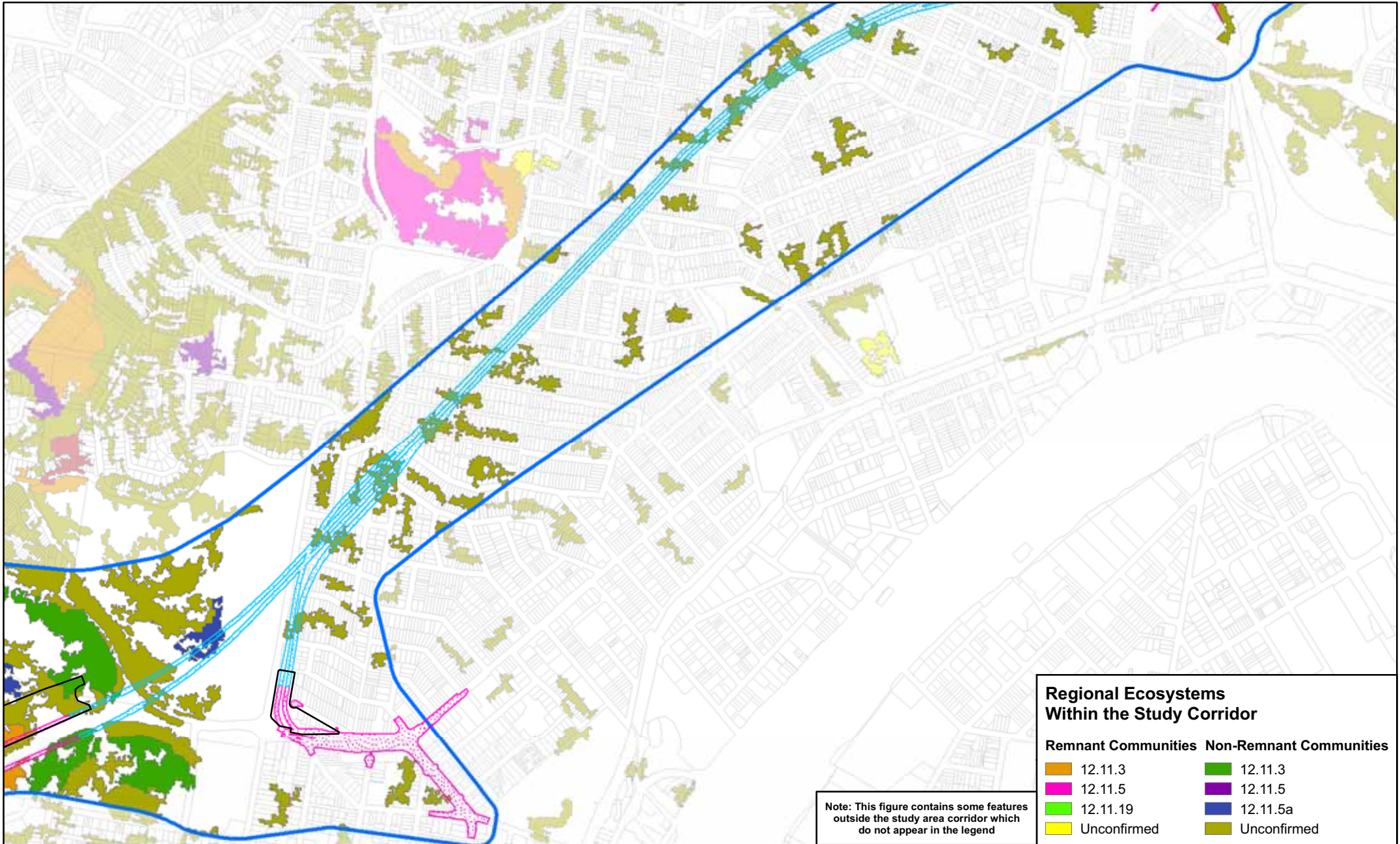
0 250 500
 metres
 Scale 1:15,000 (A4) N

NORTHERN LINK
 ENVIRONMENTAL IMPACT STATEMENT
 Figure 10 - 1A
**Vegetation Community Mapping
 Western Section**

**Regional Ecosystems
 Within the Study Corridor**

Remnant Communities	Non-Remnant Communities
12.11.3	12.11.3
12.11.5	12.11.5
12.11.19	12.11.5a
Unconfirmed	Unconfirmed





LEGEND

- Study Area Corridor
- Construction Worksites
- Proposed Alignment**
- Surface Works
- Tunnel Underground

0 250 500
 metres
 Scale 1:15,000 (A4) N

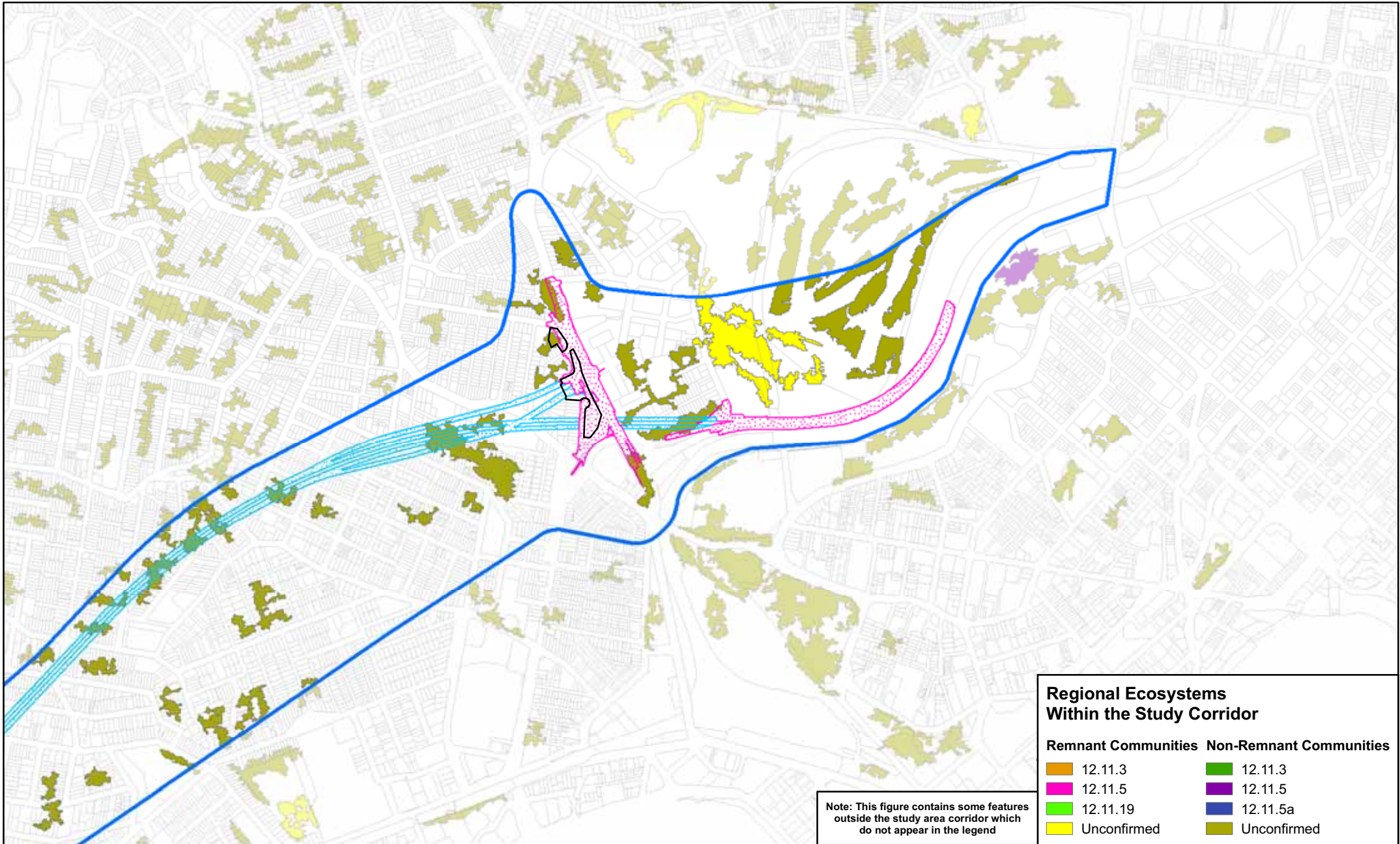
Regional Ecosystems Within the Study Corridor

Remnant Communities	Non-Remnant Communities
 12.11.3	 12.11.3
 12.11.5	 12.11.5
 12.11.19	 12.11.5a
 Unconfirmed	 Unconfirmed

Note: This figure contains some features outside the study area corridor which do not appear in the legend

NORTHERN LINK
 ENVIRONMENTAL IMPACT STATEMENT
 Figure 10 - 1B
 Vegetation Community Mapping
 Central Section





LEGEND

- | | |
|------------------------|---------------------------|
| Study Area Corridor | Proposed Alignment |
| Construction Worksites | Surface Works |
| | Tunnel Underground |

0 250 500
metres
Scale 1:15,000 (A4)



Note: This figure contains some features outside the study area corridor which do not appear in the legend

Regional Ecosystems Within the Study Corridor	
Remnant Communities	Non-Remnant Communities
12.11.3	12.11.3
12.11.5	12.11.5
12.11.19	12.11.5a
Unconfirmed	Unconfirmed

NORTHERN LINK
ENVIRONMENTAL IMPACT STATEMENT
Figure 10 - 1C
Vegetation Community Mapping
Eastern Section



Flora of Conservation Significance

Database searches indicate 649 flora species previously recorded, or mapped as occurring, within the study corridor. The full species list is provided in *Technical Report No. 10 – Ecology in Volume 3* of the EIS.

Fifteen endangered, vulnerable or rare (EVR) flora species (ie: those species listed under the EPBC Act and NC Act) may occur within the study corridor, based on the presence of suitable habitat (**Table 10-2**). Ten of these species are listed under the Commonwealth EPBC Act and seven under the Queensland NC Act.

■ Table 10-2 EVR flora species identified from database searches as potential occurrences within the study corridor

Scientific Name	Common Name	Status*	Source^	Likely Presence
<i>Alyxia magnifolia</i>		R (Qld)	3	Not Likely
<i>Arthraxon hispidus</i>	Hairy-joint Grass	VU (Aust) VU (Qld)	1	Not Likely
<i>Bosistoa selwynii</i>	Heart-leaved Bosistoa	VU (Aust)	1	Not Likely
<i>Bosistoa transversa</i>	Three-leaved Bosistoa	VU (Aust)	1	Not Likely
<i>Bulbophyllum globuliforme</i>	Miniature Moss-orchid	VU (Aust) R (Qld)	1	Not Likely
<i>Corchorus cunninghamii</i>	Native Jute	EN (Aust) EN (Qld)	2, 3	Not Likely
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	VU (Aust)	1	Not Likely
<i>Fontainea venosa</i>		VU (Aust) VU (Qld)	1	Not Likely
<i>Gossia gonoclada</i>	Angle-stemmed Myrtle	EN (Aust) EN (Qld)	2, 3	Possible
<i>Hydrocharis dubia</i>	Frogbit	VU (Aust) VU (Qld)	1	Not Likely
<i>Macadamia integrifolia</i>	Smooth-shelled Macadamia	VU (Aust) VU (Qld)	1	Not Likely#
<i>Maundia triglochoides</i>		VU (Qld)	3	Possible
<i>Picris conyzoides</i>		R (Qld)	3	Possible
<i>Sauropus macranthus</i>		VU (Aust) R (Qld)	2	Not Likely
<i>Symplocos harroldii</i>		R (Qld)	3	Not Likely

Table Notes:

* Status: EN = Endangered, VU = Vulnerable, R = Rare

(Aust) = Status under the Commonwealth EPBC Act

(Qld) = Status under the Queensland *Nature Conservation (Wildlife) Regulation 2006*

^ Source: 1 = DEWHA Protected Matters database; 2 = EPA Wildlife Online database; 3 = Queensland Herbarium HERBRECS database.

Planted specimens are known to occur within the study corridor, however, natural habitat for this species does not occur in the study corridor.

Thirteen flora species are recognised by Brisbane City Council as significant species within Brisbane City (**Table 10-3**).

■ **Table 10-3 Locally significant flora species within Brisbane City**

Scientific Name	Common Name	Brisbane City Council Status*	Source [^]	Likely Presence
<i>Bulbophyllum schillerianum</i>	Red Rope Orchid	2	3	Likely
<i>Capparis velutina</i>	Native Caper	3	3	Possible
<i>Cryptocarya microneura</i>	Brown Jack	2	2, 3	Possible
<i>Dendrobium tetragonum</i>	Tree Spider Orchid	2	3	Likely
<i>Echinostephia aculeata</i>	Prickly Snake Vine	2	2, 3	Not Likely
<i>Eucalyptus seeana</i>	Narrow-leaved Red Gum	2	2, 3	Possible
<i>Melodinus acutiflorus</i>		2	3	Not Likely
<i>Mucuna gigantea</i>		2	3	Likely
<i>Oberonia titania</i>	Red Fairy Orchid	2	2	Possible
<i>Rhinerrhiza divitiflora</i>	Rasp Root Orchid	2	3	Likely
<i>Rhodomyrtus psidioides</i>	Native Guava	2	2, 3	Possible
<i>Waterhousea floribunda</i>	Weeping Lilly Pilly	2	3	Known
<i>Wilkiea huegeliana</i>	Vieny Wilkea	2	3	Possible

Table Notes:

* Brisbane City Council Status: 2 = Restricted distribution within Brisbane City; 3 = Presumed extinct within Brisbane City.

[^] Source: 1 = DEWHA Protected Matters database; 2 = EPA Wildlife Online database; 3 = Queensland Herbarium Herbreccs database.

Field Observations

From the field surveys, 151 flora species were identified as occurring within the eight sites visited. These species are included in Appendix B of *Technical Report No. 10 - Ecology in Volume 3* of the EIS. Two species of conservation significance were identified during the survey; a Byfield Spider Flower (*Grevillea venusta*) was identified at the Toowong Cemetery and is listed as 'Vulnerable' under the EPBC Act and NC Act, and a Weeping Lilly Pilly (*Waterhousea floribunda*), which is considered to have a restricted distribution within Brisbane City under the NAPSP. The Byfield Spider Flower grows in sclerophyll forests and woodlands usually in riparian areas along coastal areas of central Queensland from Many Peaks Range to Shoalwater Bay. The specimen in the cemetery is likely to have been planted as a landscape plant.

A description of the eight sites visited is provided in **Table 10-4**.

■ **Table 10-4 Description of vegetation and flora species within selected sites**

Site	Vegetation Description
Road reserve adjacent to Mt Coot-tha Botanic Gardens	<p>This is an open expansive park area located between the Western Freeway and the Mt Coot-tha Botanic Gardens. This park is characterised by several large trees with a mown, grassy groundcover. Dominant trees include White Mahogany (<i>Eucalyptus acmenoides</i>), Tallowwood (<i>E. microcorys</i>), Grey gum (<i>E. propinqua</i>), Grey Ironbark (<i>E. siderophloia</i>), Queensland Blue Gum (<i>E. tereticornis</i>) and Brown Bloodwood (<i>Corymbia trachyphloia</i>). Several large Tallowwoods form an open forest community on an embankment adjacent to Mt Coot-tha Road</p> <p>A small clump of large Rusty Figs (<i>Ficus rubiginosa</i>) are located next to a waterway flowing from the gardens, under the freeway into Anzac Park. This waterway is channelised and does not contain aquatic or riparian vegetation.</p>
Toowong Cemetery	<p>The study corridor encompasses the western half of the cemetery. Vegetation within this area generally includes native and exotic species with ceremonial species planted in several areas. Trees in the cemetery include Bunya Pine (<i>Araucaria bidwillii</i>), Flame Tree (<i>Brachychiton acerifolius</i>), Bribie Island Pine (<i>Callitris rhombifolia</i>), Spotted Gum (<i>Corymbia citriodora</i>), Moreton Bay Ash (<i>C. tessellaris</i>), Tallowwood, Grey Gum, Sydney Blue Gum (<i>E. saligna</i>), Moreton Bay Fig (<i>Ficus macrophylla</i>) and Silky Oak (<i>Grevillea robusta</i>). Exotic trees include Chinese Elm (<i>Celtis sinensis</i>) and Camphor Laurel (<i>Cinnamomum camphora</i>).</p> <p>A waterway through the centre of the cemetery contains patches of riparian vegetation composed primarily of the exotic Camphor Laurel and Chinese Elm. The sedge Papyrus (<i>Cyperus papyrus</i>) was observed within the waterway.</p>
Anzac Park, Toowong	<p>Anzac Park is a large open park on the southern side of the Western Freeway. The majority of the park is characterised by large trees over mown grassy lawns. Tree species include Silky Oak, Carrol (<i>Backhousia myrtifolia</i>), Black Bean (<i>Castanospermum australe</i>), Brown Pine (<i>Podocarpus elatus</i>), Chinese Elm, Brushbox (<i>Lophostemon confertus</i>), Foambark (<i>Jagera pseudorhus</i>), Tallowwood and Cottonwood (<i>Hibiscus tiliaceus</i>).</p> <p>Several waterways and associated riparian vegetation occur within the park. The northern waterway contains abundant aquatic macrophytes and fringing sedges and rushes and a small lagoon occurs in the centre of the waterway. The southern waterway is an overflow area, which has been revegetated with a variety of species, including rainforest species. Dominant species include Moreton Bay Ash, Spotted Gum, Grey Ironbark, Bribie Island Pine, White Mahogany and Grey Gum. Riparian and rainforest species include Queensland Kauri Pine (<i>Agathis robusta</i>), Cabbage Palm (<i>Livistona australis</i>), Bolly Gum (<i>Litsea reticulata</i>) and Wheel-of-fire Tree (<i>Stenocarpus sinuatus</i>).</p>
Gregory Park, Paddington	<p>This park is located adjacent to a local school. It is used as a sporting field and for community park activities. The park contains a row of large figs (<i>Ficus</i> spp.) planted around the perimeter.</p>
McCaskie Park on Blamey Street	<p>This is typical urban open space park containing a number of large trees over a mown grassy lawn. Tree species include Hoop Pine (<i>Araucaria cunninghamiana</i>), Tallowwood, Weeping Fig (<i>Ficus benjamina</i>) and Jacaranda.</p>
Normanby Hotel precinct	<p>Similar to McCaskie Park with a number of large Weeping Figs that have been planted for landscape amenity values.</p>
York's Hollow, Herston	<p>This is a small waterbody, which adjoins to the Victoria Park Golf Course. Vegetation within this area includes Paperbarks (<i>Melaleuca quinquenervia</i> and <i>M. linariifolia</i>), Bottlebrush (<i>Callistemon viminalis</i> and <i>C. 'Little John'</i>), Matrush (<i>Lomandra longifolia</i> and <i>L. hystrix</i>), Weeping Lilly Pilly (<i>Waterhousea floribunda</i>) and Jointed Twigrush (<i>Baumea articulata</i>). Tree species within the park include Bunya Pine, Jacaranda (<i>Jacaranda mimosifolia</i>), Swamp Mahogany (<i>Eucalyptus robusta</i>), Narrow-leaved Red Ironbark (<i>E. crebra</i>), and Moreton Bay Fig.</p>
Bikeway adjacent to Victoria Park (Busway overpass to York's Hollow)	<p>This is a landscaped open space with a variety of trees and other vegetation, including Hoop Pine, White Bottlebrush (<i>Callistemon salignus</i>), Blue Quandong (<i>Elaeocarpus grandis</i>), Grey Ironbark and various common urban weeds and grasses</p>

Brisbane City Council has identified various areas within the study corridor that require protection due to their community, landscape amenity or historical values. These areas can include individual trees, groups of trees or other vegetation and are placed under a Vegetation Protection Order (VPO) under the NALL. As part of the field survey, all vegetation under a VPO was inspected to confirm the species' identity and any other notable features. These are listed in **Table 10-5**.

■ **Table 10-5 Significant vegetation protected under a VPO**

Tree No.	Location	Significant Vegetation
1	25 Latrobe Terrace, Paddington	1 Mango Tree (<i>Mangifera indica</i>)
2	9 Latrobe Terrace, Paddington	1 Eucalyptus spp.
3	289, 297A Given Terrace, Paddington	2 Mango Trees
4	267 Given Terrace, Paddington	1 Curtain Fig (<i>Ficus virens</i>)
5	251 and 257 Given Terrace, Paddington	Macadamia (<i>Macadamia</i> sp.), Fig (<i>Ficus</i> sp.), Doughwood
6	6 Martha Street, 31 and 33 Bowler Street, 231, 233 and 235 Given Terrace, Paddington	Jacaranda, Silky Oak
7	21 and 23 Guthrie Street, Paddington	2 Figs
8	25 Hall Street, Paddington	1 Hoop Pine (<i>Araucaria cunninghamiana</i>)
9	125 Musgrave Road, Red Hill	1 Curtain Fig
10	1 Musgrave Road, Paddington	several large Figs
11	575 Milton Road, Toowong	1 Crows Ash (<i>Flindersia australis</i>).
12	McCaskie Park, Normanby	Weeping Fig, Hoop Pine, Tallowwood, Jacaranda,
13	140A Kelvin Grove Road, Normanby	Line of Fig trees
14	Mt Coot-tha and surrounds	Remnant and non-remnant vegetation



Other Significant Landscape Trees identified by Brisbane City Council are listed in **Table 10-6**.

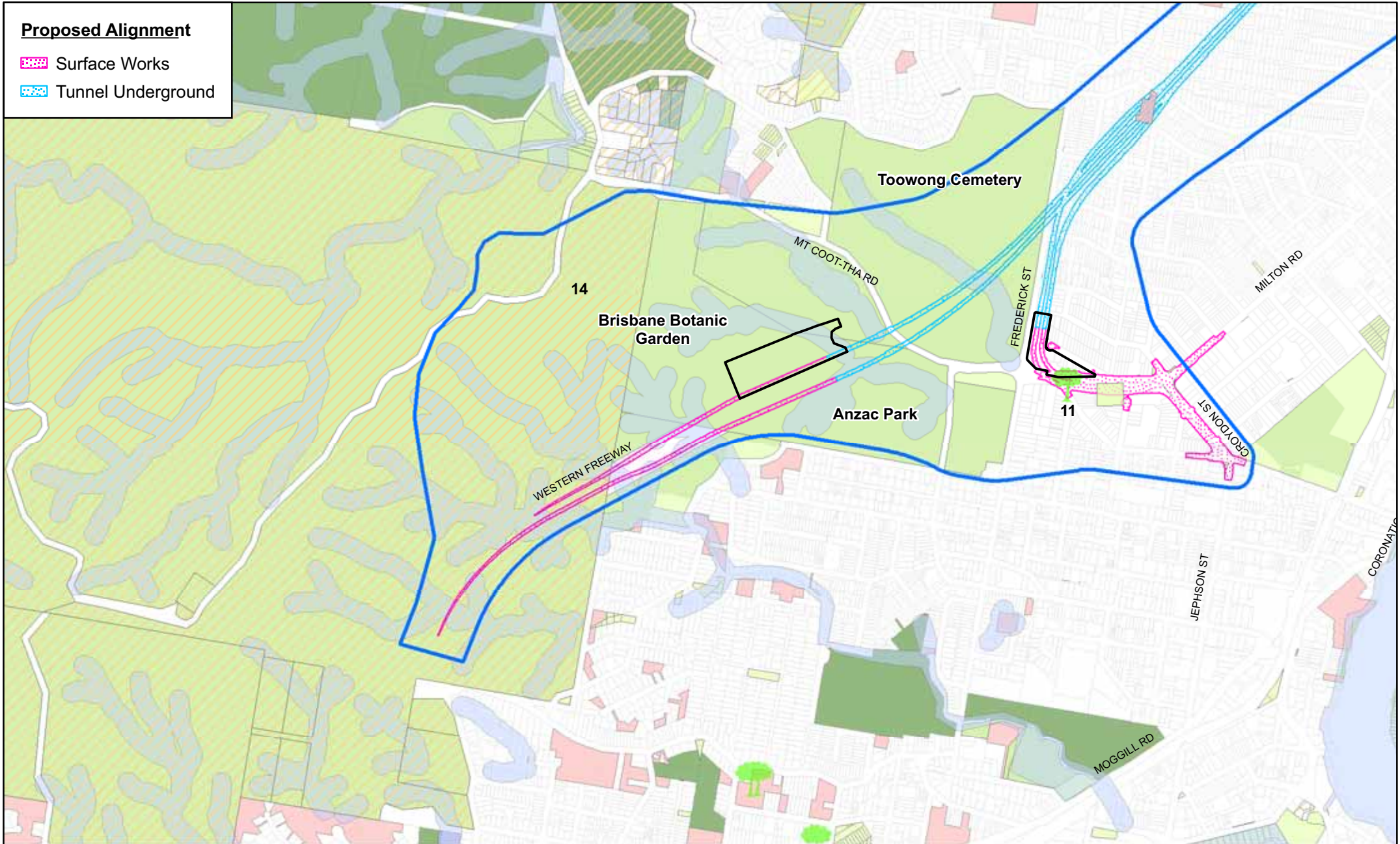
■ **Table 10-6 Significant Landscape Trees within the study corridor**

Location	Species and number
89 Agnes Street, Auchenflower	2 Poincianas (<i>Delonix regia</i>) and 1 Hoop Pine
85 Agnes Street, Auchenflower	2 Silky Oaks
79 Payne Street, Auchenflower	Gum-topped Box (<i>Eucalyptus moluccana</i>)
25 Gona Parade, Kelvin Grove	1 Leopard Tree (<i>Caesalpinia ferrea</i>)
Front garden of 2 Haig Road, Milton	2 Weeping Figs
Front garden of 35 Rockbourne Terrace, Paddington	1 Mango
146 Beck Street, Paddington	1 Poinciana
2 Agars Street, Paddington	1 Weeping Figs and 2 Mangoes



All forms of vegetation identified under the NALL including Council Controlled Vegetation (CCV), Vegetation Protection Order (VPO), Significant Native Vegetation (SNV), Valued Urban Vegetation (VUV), Waterway Vegetation (WAV), Wetland Vegetation (WEV), Significant Landscape Trees (SLT) as well as VPO protected trees are identified in **Figure 10-2A**, **Figure 10-2B** and **Figure 10-2C**.





Proposed Alignment





-  Surface Works
-  Tunnel Underground

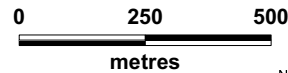


LEGEND

-  Study Area Corridor
-  Construction Worksites

-  Waterway Vegetation
-  Council Controlled Vegetation
-  Significant Landscape Trees
-  Valued Urban Vegetation

-  Vegetation Protection Orders
-  Wetland Vegetation
-  Significant Native Vegetation
-  VPO Individual Trees



Scale 1:15,000 (A4)





NORTHERN LINK
ENVIRONMENTAL IMPACT STATEMENT

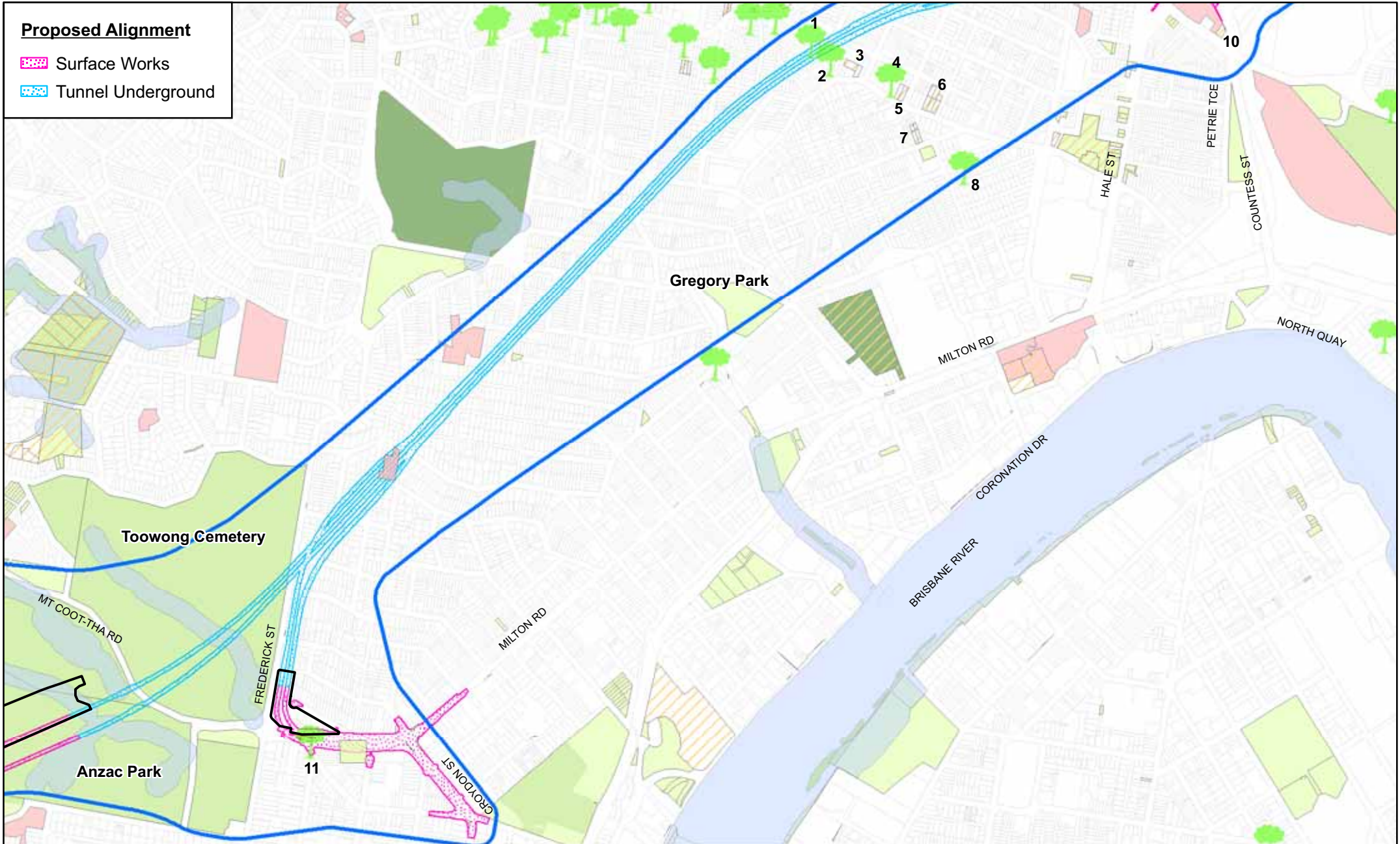
Figure 10 - 2A

NALL Vegetation - Western Section


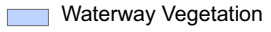
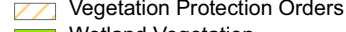

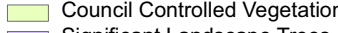
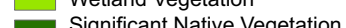
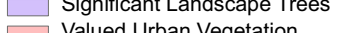
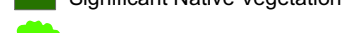
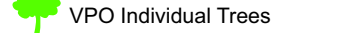


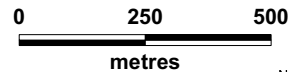
Proposed Alignment

-  Surface Works
-  Tunnel Underground



LEGEND

- | | | |
|---|---|--|
|  Study Area Corridor |  Waterway Vegetation |  Vegetation Protection Orders |
|  Construction Worksites |  Council Controlled Vegetation |  Wetland Vegetation |
| |  Significant Landscape Trees |  Significant Native Vegetation |
| |  Valued Urban Vegetation |  VPO Individual Trees |



Scale 1:15,000 (A4)





NORTHERN LINK
ENVIRONMENTAL IMPACT STATEMENT

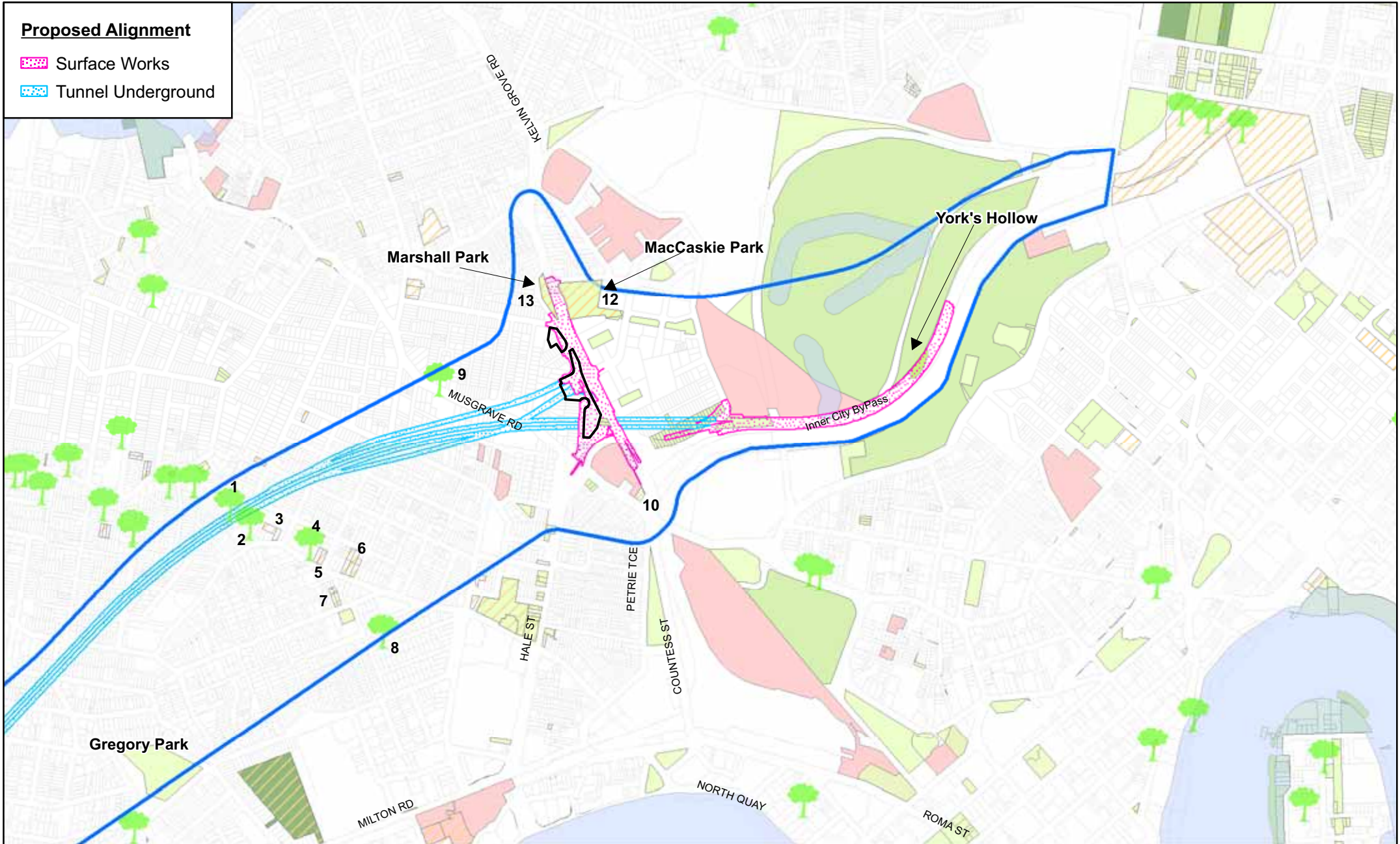
Figure 10 - 2B

NALL Vegetation - Central Section













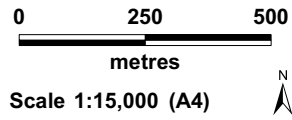
Proposed Alignment

-  Surface Works
-  Tunnel Underground



LEGEND

-  Study Area Corridor
-  Construction Worksites
-  Waterway Vegetation
-  Council Controlled Vegetation
-  Significant Landscape Trees
-  Valued Urban Vegetation
-  Vegetation Protection Orders
-  Wetland Vegetation
-  Significant Native Vegetation
-  VPO Individual Trees



NORTHERN LINK
ENVIRONMENTAL IMPACT STATEMENT

Figure 10 - 2C

NALL Vegetation - Eastern Section



10.1.4 Terrestrial Fauna and Habitat

Wildlife Corridors

The study corridor occurs at the periphery of the large habitat and movement system incorporating Mt Coot-tha and Brisbane Forest Park. Excluding this corridor, well vegetated connections do not occur within the study corridor due to the highly fragmented nature of existing vegetation. This limits movement opportunities for fauna and restricts the types of species potentially using such fragmented corridors. Some fauna species are likely to utilise waterway corridors in the western part of the study corridor that have sufficient vegetation cover.

Two wildlife corridors are mapped adjacent to the study corridor.

- A Bioregional Wildlife Corridor occurs north-west of the study corridor from the southern D'Aguilar Range to Mt Coot-tha and is identified as Regionally Significant by the Fauna Expert Panel Report (EPA 2004).
- A potential wildlife corridor (arboreal and avian) was mapped by Brisbane City Council from the far western end of the study corridor, east along the southern side of Stanley Street, Indooroopilly and linking to a waterway corridor along Toowong Creek. It is likely to provide limited movement opportunities for possums, gliders, bats and some birds.

Fauna of Conservation Significance

Database searches indicate 286 fauna species recorded from, or are likely occurrences within the study corridor. These include 11 frogs, 32 reptiles, 216 birds, 10 bats and 14 other mammals. Fauna potentially occurring in the study corridor and identified as rare, threatened, or otherwise significant are listed in **Table 10-7**.

■ Table 10-7 Terrestrial EVR Fauna species

Scientific Name	Common Name	Status*	Source^	Likely Presence
FROGS				
<i>Mixophyes iteratus</i>	Giant Barred Frog	EN (Aust) EN (Qld)	1	Not Likely
<i>Adelotus brevis</i>	Tusked Frog	VU (Qld)	2	Likely
REPTILES				
<i>Coeranoscincus reticulatus</i>	Three-toed Snake-tooth Skink	VU (Aust) R (Qld)	1	Not Likely
BIRDS				
<i>Accipiter novaehollandiae</i>	Grey Goshawk	R (Qld)	2, 3	Not Likely
<i>Cyclopsitta diophthalma coxeni</i>	Coxen's Fig-Parrot	EN (Aust) EN (Qld)	1	Not Likely
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU (Aust) EN (Qld)	1, 2	Not Likely
<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern)	VU (Aust) VU (Qld)	1	Not Likely
<i>Lathamus discolor</i>	Swift Parrot	EN (Aust) EN (Qld)	1, 2, 3	Possible
<i>Lophoictinia isura</i>	Square-tailed Kite	R (Qld)	2	Not Likely
<i>Melithreptus gularis</i>	Black-chinned Honeyeater	R (Qld)	2	Not Likely

Scientific Name	Common Name	Status*	Source [^]	Likely Presence
<i>Ninox strenua</i>	Powerful Owl	VU (Qld)	2, 3	Likely on forested slopes of Mt Coot-tha
<i>Phaethon rubricauda</i>	Red-tailed Tropicbird	VU (Qld)	2	Not Likely
<i>Podargus ocellatus plumiferus</i>	Plumed Frogmouth	VU (Qld)	2	Not Likely
<i>Polytelis alexandrae</i>	Princess Parrot	VU (Aust)	2	Not Likely
<i>Rostratula australis</i>	Australian Painted Snipe	VU (Aust) VU (Qld)	1	Not Likely
<i>Turnix melanogaster</i>	Black-breasted Button-quail	VU (Aust) VU (Qld)	1, 2	Not Likely
<i>Xanthomyza phrygia</i>	Regent Honeyeater	EN (Aust) EN (Qld)	1	Not Likely
MAMMALS				
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU (Aust) R (Qld)	1	Possible
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll (southeastern mainland population)	EN (Aust) VU (Qld)	1	Not Likely
<i>Phascolarctos cinereus</i>	Koala (southeast Queensland bioregion)	VU (Qld)	2	Possible
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	VU (Aust) VU (Qld)	1	Not Likely
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU (Aust)	1, 2	Known (field survey)

Table Notes :

* Status: EN = Endangered, VU = Vulnerable, R = Rare

Aust = Status under the Commonwealth EPBC Act

Qld = Status under the Queensland *Nature Conservation (Wildlife) Regulation 2006*

[^] Source: 1 = DEW Protected Matters database; 2 = EPA Wildlife Online database; 3 = Birds Australia Birddata database.

Threatened species previously sighted on Mt Coot-tha are the Swift Parrot (*Lathamus discolor*), Powerful Owl (*Ninox strenua*) and the Black-breasted Button-quail (*Turnix melanogaster*). The Swift Parrot is a seasonal migrant to south east Queensland and is a semi-regular visitor to the outer western suburbs of Brisbane (including Bardon, Kenmore and Chapel Hill) and was last recorded from Mt Coot-tha in 2002 (Birds Queensland 2008). The Powerful Owl is regularly recorded in the Mt Coot-tha area and has been observed at the JC Slaughter Falls picnic area (Birds Queensland 2008). This species occurs in tall open forest and woodlands, preferring to roost by day in dense vegetation within gullies. The Black-breasted Button-quail was recorded in 1993 within microphyll vine scrub along Ithaca Creek (*pers. comm.* G. Smith, October 2007). This species is generally restricted to south east Queensland within semi-evergreen vine thickets, dry sclerophyll forests and occasionally thickets of Lantana. A permanent population is known from the Enoggera Creek catchment where good quality habitat occurs. It is suspected that there are no permanent populations in the Mt Coot-tha area and that the record from 1993 may have been birds dispersing from the Enoggera population (*pers. comm.* G. Smith, October 2007).

Eighteen fauna species identified from database searches are recognised as regionally or otherwise significant, including one frog, three reptiles, eight birds and six mammals (**Table 10-8**). Four of these species are listed as

Near Threatened or Rare/Insufficiently Known under the relevant Action Plan for their taxon, whilst 17 are listed as Non-EVR Priority Taxa in the BPA for SEQ: Fauna Expert Panel Report (EPA 2006).

■ **Table 10-8 Regionally significant fauna**

Scientific Name	Common Name	AP*	BPA#	Source [^]	Likely Presence
FROGS					
<i>Pseudophryne major</i>	Large Toadlet		SEQ	2	Possible
REPTILES					
<i>Emydura macquarii signata</i>	Brisbane Short-necked Turtle	R/IK	SEQ	2	Likely
<i>Cacophis krefftii</i>	Dwarf Crowned Snake		SEQ	2	Likely
<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink		SEQ	2	Likely
BIRDS					
<i>Acrocephalus australis</i>	Australian Reed-Warbler		SEQ	2, 3	Likely
<i>Anthochaera chrysoptera</i>	Little Wattlebird		SEQ	2	Likely
<i>Glossopsitta concinna</i>	Musk Lorikeet		SEQ	2, 3	Likely
<i>Ixobrychus minutus</i>	Little Bittern	NT		2	Known (Brisbane City Council record within study corridor)
<i>Platycercus eximius</i>	Eastern Rosella		SEQ	2	Likely
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove		SEQ	2	Likely (Brisbane City Council record adjacent to study corridor)
<i>Ptilinopus superbus</i>	Superb Fruit-Dove		SEQ	2	Likely (Brisbane City Council record adjacent to study corridor)
<i>Tyto novaehollandiae novaehollandiae</i>	Masked Owl (southern subspecies)	NT	SEQ	2	Not Likely
MAMMALS					
<i>Petauroides volans</i>	Greater Glider		SEQ	2	Possible
<i>Petaurus norfolcensis</i>	Squirrel Glider	NT	SEQ	2	Likely
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		SEQ	2	Known (field survey)
<i>Pteropus alecto</i>	Black Flying-Fox		SEQ	2	Likely
<i>Pteropus scapulatus</i>	Little Red Flying-Fox		SEQ	2	Likely
<i>Syconycteris australis</i>	Eastern Blossom Bat		SEQ	2	Possible

Table Notes:

* Status under Action Plan for relevant taxon: R/IK = Rare or Insufficiently Known; NT = Near Threatened.

BPA: Identified as Non-EVR Priority Taxa by the Fauna Expert Panel for the SEQ BPA.

[^] Source: 2 = EPA Wildlife Online database; 3 = Birds Australia Birdata database.

Thirty-five species are recognised by Brisbane City Council as locally significant within Brisbane, including four reptiles, 27 birds and seven mammals (Appendix D of *Technical Report No. 10 – Ecology in Volume 3 of the EIS*).

In addition, 76 fauna species are listed as Migratory (45) and/or Marine (60) species under the Commonwealth EPBC Act 1999 (Appendix E in *Technical Report No. 10 - Ecology Volume 3* of the EIS). Habitats for the marine species indicated in this area on database searches are probably associated with the Brisbane River and the association to the study corridor for migratory and seabirds is limited to fly-overs.

Field Survey

Native fauna species identified during the field survey are the Brushtail Possum (*Trichosurus vulpecula*), Ringtail Possum (*Pseudocheirus peregrinus*) and Grey-headed Flying Fox (*Pteropus poliocephalus*). The Grey-headed Flying Fox is listed as a vulnerable species under the EPBC Act.

The fauna habitat value of selected sites within the study corridor was assessed during the field survey. A brief description of the sites and associated values are provided in **Table 10-9**.

■ **Table 10-9 Fauna habitat values of sites**

Site	Fauna Habitat Description
Road reserve adjacent to Mt Coot-tha Botanic Gardens	<p>This park contains large eucalyptus and fruiting species that provide roosting and feeding opportunities for arboreal mammals, birds and bats. Grey-headed flying foxes were observed feeding on fruit in large fig trees. Large eucalypts are also likely to provide a food source for these and other species during peak flowering.</p> <p>Hollows in trees within the park are fewer than expected due to the trimming of old branches which is conducted as part of the maintenance regime of the park. This limits nesting opportunities for possums and gliders and hollow nesting birds such as lorikeets (<i>Trichoglossus</i> spp.).</p> <p>The value of this park for other species (eg: small birds, mammals, reptiles and frogs) is generally limited due to the lack of vegetation below the canopy and lack of riparian vegetation along the waterways.</p>
Toowong Cemetery	<p>The cemetery contains a variety of fruiting and flowering trees and shrubs that provide foraging opportunities for a variety of urban fauna species. Grey-headed Flying Foxes were observed feeding in the large fig trees. Some large hollow-bearing trees were observed; however most trees were species that generally do not produce hollows (eg: Chinese Elm, Camphor Laurel, Figs).</p> <p>The value of this site for other species is generally limited due to the lack of vegetation below the canopy, except for patches of vegetation along the waterway. This vegetation may provide some value for small birds and frogs.</p>
Anzac Park, Toowong	<p>This park has higher value for urban wildlife than other vegetated areas within the study corridor. This is generally due to the presence of the waterway and lagoon and associated wetland and riparian vegetation. These values may provide habitat for common freshwater turtles, waterfowl and frogs. The comparably higher structural diversity of the vegetation surrounding the waterway also provides shelter sites and foraging opportunities for small birds and mammals.</p> <p>A good coverage of large trees may provide nesting opportunities for birds and arboreal mammals and foraging resources for a variety of other wildlife.</p>
Gregory Park, Paddington	<p>Despite the lack of other vegetation within this park, the row of fig trees are likely to provide a food source for fruit loving species, including the Grey-headed Flying Fox and birds. Use of this vegetation by wildlife is likely to be restricted to common arboreal mammals (ie: possums), birds and bats.</p>
McCaskie Park	<p>Despite the lack of other vegetation within this park, the fig trees and eucalypts are likely to provide a food source for some species, including the Grey-headed Flying Fox other bats and birds.</p>
Normanby Hotel precinct	<p>The fig trees are likely to provide a food source for fruit loving species, including the Grey-headed Flying Fox and birds. Use of this vegetation by wildlife is likely to be restricted to arboreal mammals, birds and bats.</p>

Site	Fauna Habitat Description
York's Hollow, Herston	The wetland is likely to be used by waterfowl and may contain freshwater turtles and fish. The fringing wetland vegetation may provide habitat for frogs and small birds. The surrounding tree species are also likely to provide roosting and nesting opportunities for arboreal mammals and birds and may provide a valuable food source for wildlife within a highly urbanised area.
Bikeway adjacent to Victoria Park (Busway overpass to York's Hollow)	Very little habitat value for wildlife. The planted trees within this area are likely to provide a food source for some birds and bats and may provide some roosting opportunities.

Pest Species

The introduced Cane Toad (*Rhinella marina*) is able to breed in almost any kind of semi-permanent water and feeds on invertebrates (predominantly insects and other arthropods), skinks, small snakes and frogs. The Cane Toad favours open ground on which to forage and therefore is likely to be abundant within the parks described previously and generally throughout the study corridor.

10.1.5 Aquatic Fauna

Database searches indicate freshwater turtles in the study corridor, namely, the Broad-shelled River Turtle (*Macrochelodina expansa*), Brisbane Short-necked Turtle (*Emydura macquarii signata*) and the Saw-shelled Turtle (*Wollumbinia latisternum*). All species are listed as of least concern under the NC Act.

The Broad-shelled River Turtle inhabits permanent lagoons, lakes, rivers and swamps in southern, central and South East Queensland (Wilson, 2005). It is generally found in silty waters, where it lies on the bottom of waterways concealed by a layer of silt (Couper, *et al.* 2007). It feeds on invertebrates and a variety of fish. The Saw-shelled Turtle is found in permanent lagoons, creeks and the upper reaches of larger rivers, generally east of the Great Dividing Range north from New South Wales and including the Northern Territory. This species is a predator on invertebrates, frogs and carrion and will graze on algae and aquatic macrophytes (Couper, *et al.* 2007).

The Brisbane Short-necked Turtle inhabits permanent slow flowing streams and large lagoons (Wilson, 2005) and is the most common turtle in the Brisbane River catchment (Couper, *et al.* 2007). It feeds on algae and aquatic macrophytes, but will occasionally take live invertebrates (Couper, *et al.* 2007). It has been listed as Rare or Insufficiently Known under the Action Plan for Australian Reptiles (Cogger, *et al.* 1993).

Field Survey

A number of small waterways and one wetland are mapped by Brisbane City Council as occurring within the study corridor. The waterways inspected during the field survey were generally channelised with little to no vegetation coverage or aquatic plants. Areas of semi-natural waterways within the study corridor may provide habitat values for aquatic and terrestrial fauna. However, due to the highly urbanised surroundings most waterways are likely to contain a narrow range of species. The waterways are listed in **Table 10-10** and a brief description provided.

■ **Table 10-10 Waterways and wetlands within the study corridor**

Location	Brief Description and Habitat Values
Several small creeks and tributaries occurring beneath the Western Freeway	<p>These creeks occur on the southern slopes of Mt Coot-tha, travelling underneath the Western Freeway before entering the suburban drainage network and eventually the Brisbane River. From the aerial photography, these waterways appear to be largely vegetated and undisturbed to the north of the freeway, becoming less so within the suburbs.</p> <p>Many of these waterways are likely to be ephemeral and may not provide significant values for aquatic fauna. The level of riparian vegetation fringing the waterways also becomes thinner and more disturbed from the slopes of Mt Coot-tha to suburban areas. Habitat values for other fauna are likely to be higher in the undisturbed northern portions of the waterways.</p>
Waterways within the Brisbane Botanic Gardens – Mt Coot-tha	<p>The study corridor partially encompasses the waterway and lagoon within the Brisbane Botanic Gardens. Both features have been landscaped as part of the Garden’s maintenance. However, both contain habitat values for aquatic fauna. The lagoon in particular contains abundant macrophytes and algae and is known to contain introduced turtles, eels and fish. The lagoon also contains habitat values for waterfowl and reptiles such as Water Dragons (<i>Physignathus lesueurii</i>).</p> <p>The waterways leave the Botanic Gardens and flow through a road reserve and underneath the Western Freeway. This portion of the waterways are channelised and generally do not contain any riparian vegetation</p>
Waterways within Anzac Park, Toowong	<p>The lagoon within Anzac Park contains abundant macrophytes and fringing rushes and sedges. It is likely that the lagoon and waterway provides habitat for aquatic fauna such as turtles, eels and fish. The riparian vegetation fringing the lagoon also contains a comparably higher structural and species diversity and is likely to provide habitat for a variety of terrestrial and arboreal fauna.</p>
Waterway within Toowong Cemetery	<p>The waterway within the Toowong Cemetery has been heavily disturbed and most of the native vegetation removed. Some patches of riparian vegetation remain, although most contain exotic weed species such as Chinese Elm and Camphor Laurel. The waterway itself is ephemeral and is likely to contain water only during storm events, therefore is of little value to aquatic fauna.</p>
Riparian gully between Cairns Street and Cambridge Terrace	<p>This waterway is not mapped by Brisbane City Council under the NALL and the gully is primarily a flow path for urban stormwater. Hence, there is unlikely to be any habitat for aquatic fauna. However, the vegetation within the gully is likely to provide habitat and food resources for urban terrestrial wildlife and may provide some nesting resources for birds.</p>
York’s Hollow within Victoria Park Golf Course	<p>These small wetlands are likely to provide habitat for some aquatic fauna. Some fringing aquatic vegetation is present; however, other surrounding vegetation is generally absent. This limits the habitat value of these wetlands for other fauna and is likely to provide some habitat and food resources for common waterfowl (eg: ducks and ibis) and other urban wildlife.</p>

10.2 Potential Impacts and Mitigation Measures

10.2.1 Vegetation Communities

Potential Impacts

Table 10-11 outlines areas of State and Brisbane City Council mapped vegetation communities, including both remnant and non-remnant vegetation, that would be cleared for the construction of the Project.

In total, the surface construction works would affect a total of 4.78ha of the Brisbane City Council mapped vegetation communities. The 4.78ha of affected vegetation can be further broken down into 1.6ha of remnant vegetation affected and 3.19ha of non-remnant vegetation affected. All of the affected remnant vegetation communities (1.6ha) are in the area of the Western Freeway connection associated with the construction of the ramps, surface road connections and the construction worksite, including the conveyor and ventilation station. Approximately 1.24ha of this affected vegetation is mapped by the BCC as remnant RE 12.11.3, along with approximately 0.16ha of remnant RE 12.11.5 on the southern side of the freeway and approximately 0.2ha of remnant RE 12.11.19 on the northern side of the freeway. The Brisbane City Council mapping identifies the small patch of 12.11.5 on the southern side of the freeway, where some 0.16ha would be cleared, as being of local and city wide significance under the NALL.

The loss of these areas of remnant native vegetation within the context of the widening of the existing Western Freeway corridor is not considered to be significant. These forested areas remain connected along their length either side of the freeway although their width would be marginally narrower, but without such impact that their continued viability would be significantly affected. The loss of some 0.16ha of RE 12.11.5 (Open forest complex with *Corymbia citriodora*, *E. siderophloia*, *E. major* on metamorphics ± interbedded volcanics) is unable to be avoided due to the design of the connecting exit ramp and the location of this area of remnant vegetation on the southern side of the freeway. There is a large cutting along the western extent of this ecosystem which would potentially remove almost half the width of this vegetation complex, as mapped, along this area. The loss of this area would be mitigated through the replanting of the dominant species within the proposed landscape rehabilitation of the cutting. This would depend on having a suitable substrate for replanting. It is not considered that the size of the area or its values are such that a formal offset agreement under the Queensland Government's Environmental Offsets Policy is required. The application of this policy should be treated as a last resort where avoidance and practical mitigation measures are unable to be implemented.

The majority of the 4.78ha of affected vegetation communities are mapped as non-remnant vegetation as well as "unconfirmed remnant" in the area of Victoria Park Golf Course for the ventilation outlet. Approximately 2.98ha of these communities may be cleared as a result of the Project construction. These areas include the majority of the Western Freeway worksite and the associated spoil conveyor, the western freeway entry ramp and surface road connection, small areas to be cleared for surface road works on the northern and southern ends of Kelvin Grove Road, and some within the northern area of the Kelvin Grove worksite. The areas affected by the permanent road works are small. Significant landscape works would be applied to the Project design to compensate for the loss of these non-remnant communities. Equally, the Western Freeway worksite would be rehabilitated following construction, including the potential to integrate the site within an extension of the Brisbane Botanic Gardens (Mt. Coot-tha) in consideration of their masterplan for this area.

■ **Table 10-11 Approximate areas of mapped vegetation to be removed**

State Regional Ecosystem Mapping	VM Status	Brisbane City Council Regional Ecosystem Mapping	Brisbane City Council Status	Location	Area to be cleared (ha)
12.11.5/12.12.5 (90/10)	Not Of Concern	12.11.3 (Remnant)	none	Both of the Western Freeway surface road connections and within the south-west section of the Western Freeway worksite for the ventilation station	1.24
		12.11.5	LCW*	Southern side of the Western Freeway connection	0.16
		12.11.19	none	Northern side of the Western Freeway connection	0.20
Non-remnant Vegetation	None	Unconfirmed Remnant	none	Victoria Park for the ventilation outlet	0.04
Non-remnant Vegetation	None	12.11.3 (Non-remnant)	none	North-east section of the Western Freeway worksite and southern side of Western Freeway (Anzac Park)	0.40
Non-remnant Vegetation	None	12.11.5 (Non-remnant)	none	Small area south of the quarry for the conveyor	0.20
Non-remnant Vegetation	None	12.11.5a (Non-remnant)	none	Not affected	0
Non-remnant Vegetation	None	Unconfirmed Non remnant	none	Majority of Western Freeway worksite, northern side of the Western Freeway surface connection and small areas within Kelvin Grove Road worksite and surface road connections;	2.55
Total					4.78

Table Note: * Significance under Schedule 5 of the NALL: LCW = Local/Citywide Significance

There is also some potential for dust fallout from the construction activities to indirectly impact on adjacent vegetation communities. Excessive release of dust has the potential to settle on plants, potentially inhibiting photosynthesis and hence plant metabolism and health. Impacts from dust are likely to be temporary, although this is dependent upon the number of consecutive days without rainfall and/or strong winds to remove dust layers.

Mitigation Measures

The following mitigation measures are proposed to mitigate the impacts on vegetation from the project construction. Mitigation includes strategies to manage short and long term impacts on vegetation.

Vegetation Management

The short term impacts (pre-construction to up to three years) on vegetation are proposed to be mitigated by the following measures.

- Identify vegetation to be removed and that to be retained on construction drawings and on site to minimise loss of habitat and vegetation.
- High priority should be given to the retention of mature trees during the planning and layout of the Western Freeway worksite to avoid the need for extensive and long term rehabilitation post construction.
- Trees and areas of other vegetation to be retained within the worksite should be clearly marked on construction drawings and protected by the use of stakes and suitable fencing. Protection fencing (stakes and suitable fencing wire) shall be erected at the dripline³ of individual trees or groups of trees. No activity, storage of materials (eg: spoil, fuels, oils, wastes, etc.) or parking of vehicles and machinery shall occur within this zone in order to protect surface roots from soil compaction and contamination.
- A Construction Air Quality Environmental Management Plan (EMP) Sub-Plan would be prepared addressing all worksites and areas of potential dust generation. Dustfall Limits to meet acceptable levels in the receiving environment, including health based goals for particulates (PM₁₀) would be established for the Project. Suitable mitigation measures (refer to chapter 8) are then applied to construction practices to minimise the generation of dust from the construction areas, such as through watering of open areas, spoil handling enclosures, and covering of truck loads. Regular monitoring of air quality would be undertaken for dust and other particulates to determine whether these environmental requirements are being met during construction. Generally these requirements are specified as approval conditions to protect surrounding residential and commercial activities from dustfall and would be expected to also meet the needs of surrounding vegetation communities.
- Monitoring by the contractor of vegetation clearing to ensure only approved areas are cleared.
- Avoid damage to the root zones of adjacent trees during construction - locate vehicle access, material storage and the cleaning of plant and equipment away from adjacent trees.
- Implement sedimentation and erosion control plans to reduce sediment leaving the project construction sites in surface water run-off and entering receiving environments particularly the Anzac Park gully, drainage lines and stormwater systems.
- Prepare a weed management plan prior to any construction or clearing activities occurring to prevent the spread of declared and other weeds.
- Revegetate disturbed areas with local native species (or landscape species depending upon location of revegetation area), as soon as possible after disturbance.
- Monitor revegetation plantings for up to two years post-construction to ensure success and that long-term impacts on native wildlife are minimised through restoration of habitat to at or beyond pre-construction condition.

Rehabilitation and Landscaping

The aim of the rehabilitation program within remnant and non-remnant communities is to restore the ecological values of cleared and impacted areas in the long term (from three to five years plus) by replanting with a suite of locally endemic species. Non native species would only be used where the use of these species is consistent with existing landscaping.

The *Landscape and Visual Masterplan* (Verge Urban Landscape Architecture, 2008) provides a number of different zones of landscaping depending upon the surrounding or pre-construction environment. Three zones relevant to ecology have been identified.

³ The dripline is defined as the vertical projection of the canopy edge to the ground.

- Revegetation – the aim of the revegetation zone is to protect, revegetate or rehabilitate areas adjacent to or impacted by the construction works. The protection zone includes vegetation within Anzac Park and vegetation within road reserves. The revegetation and rehabilitation zones include remnant vegetation adjacent to the Western Freeway and particularly along the proposed conveyor route. The site of the proposed water storage dam for the Botanic Gardens would also be rehabilitated in consultation with the Gardens.
- Landscape Open Space – these areas would be planted out along median strips and may assist with improving connectivity for some wildlife across the Western Freeway.
- Boulevard Treatments – these areas provide enhanced streetscape amenity to assist in visual mitigation and integration of infrastructure into the surroundings. These areas are primarily confined to existing urban areas and would include a mixture of native and introduced street trees, some of which are used as a food resource by fauna, including the Grey-headed Flying Fox.

10.2.2 Flora and Significant Trees

Potential impacts

No flora species listed as EVR under State or Commonwealth legislation would be impacted by the project construction.

Two flora species of conservation significance under State legislation were identified from within the study corridor during the field survey. Neither plant is likely to be impacted by the proposed construction works.

Significant vegetation affected by the Project and protected under the Brisbane City Council's VPO and also under BCC and State Heritage listings, include the following.

- A Crows Ash (*Flindersia australis*), located at 575 Milton Road, Toowong. This tree would require removal due to the proposed widening of Milton Road in order to provide for the Toowong connection ramps.
- Two Fig trees within Marshall Park on the western side of Kelvin Grove Road would also be removed for surface road construction.
- Two Fig trees on the western side of McCaskie Park would be affected by the proposed widening of Kelvin Grove Road at this location.

Mitigation measures

The loss of these significant landscape trees would be mitigated through suitable landscape rehabilitation as addressed in Chapter 14 (Urban Design and Visual Environment). The potential for transplanting should be pursued where possible. In this regard, the advice of an aborist is recommended during the detailed design phase of the project. Generally these species, including Crows Ash, would be included in the planting palette for streetscape and landscape amenity revegetation including the planting of super advanced stock of these species.

10.2.3 Groundwater Dependent Ecosystems

Potential Impacts

The preliminary hydrogeological assessment indicates that the underlying geology is typically impermeable with groundwater confined to fractured rock aquifers (ie: groundwater flow is through secondary features such as joints and fractures). Permeability is variable within the study corridor due to the number and aperture of

fractures/joints. In general, the risk of adverse effects caused by impacts to the groundwater flow is considered to be low in the eastern and central portions of the study corridor.

At the western end of the study corridor, the bored pile walls to the undrained cut and cover tunnels is not expected to alter the existing drainage patterns within this area. While the tunnel walls may impede its free flow the groundwater would pass around the tunnel (eg over the roof in gravel channels constructed for that purpose) thus avoiding any significant effect on ecosystems.

Mitigation Measures

With the expectation of minimum or no impact on groundwater dependent ecosystems, the need for mitigation measures beyond the design criterion of incorporating gravel drains across the roof of the cut and cover tunnels, would be minimal.

10.2.4 Weeds

Potential Impacts

Weed species are common throughout the study corridor comprising approximately 36% of the floral diversity. Nevertheless, the project construction has the potential to introduce new species into semi-natural ecosystems and contribute to the spread of existing species by topsoil disturbance and vehicle movements. The potential for significant impacts from weeds are considered low provided that appropriate weed hygiene and management measures are enforced.

Mitigation measures

Weed hygiene procedures would aim to prevent the introduction and spread of weeds throughout the project area. Weed hygiene procedures would be detailed in the *Design and Construction Environmental Management Plan* (EMP) and would include such strategies as dedicated vehicle wash-down facilities, minimisation of topsoil disturbance and minimising the time between disturbance and rehabilitation.

10.2.5 Habitat and Fauna Species

Potential Impacts

The project would involve the removal of up to 4.78 hectares of remnant and non-remnant vegetation as identified by Brisbane City Council mapping within the western portion of the study corridor with little loss at the eastern end. The areas of remnant vegetation to be cleared would occur as a result of widening to the Western Freeway, provision for the conveyor system and maintenance track to the Mt Coot-tha quarry and for the ventilation station and outlet site. In general, remnant vegetation is considered to provide higher quality habitat and resources (ie: food, nesting and shelter) for wildlife than non-remnant and regrowth vegetation, although there are exceptions to this rule. Within an urban environment, remnant vegetation is particularly important as refuge for species that are sensitive to disturbance.

Remnant vegetation within the study corridor is characterised by mature eucalypts and a high structural complexity of vegetation beneath the canopy. The loss of any of this vegetation translates to an effective loss of food, nesting and shelter resources for wildlife. The potential loss of remnant vegetation is not considered to have a significant adverse impact upon fauna in the area as the location of the proposed areas for clearing are in close proximity to large areas of remnant vegetation which are not proposed to be disturbed. It is considered that any species which are disturbed would migrate to the undisturbed areas. Non-remnant vegetation within the study corridor comprises small patches of mature and regrowth vegetation and landscaped areas. Fauna that

utilise this vegetation are generally adapted to the urban environment and can tolerate a level of disturbance. The potential loss of this type of vegetation is not expected to result in a significant impact on any urban fauna species.

There is some potential from construction activities to indirectly impact on local fauna. Fauna species currently occurring within the study area are likely to be exposed to indirect impacts such as noise, lighting, vibration and odours, which are common within urban environments. However, during construction activities, these impacts are concentrated and generally magnified. Potential impacts will be localised around the worksite at each connection and are likely to be more pronounced at the Western Freeway worksite due to its location adjacent to remnant vegetation.

Most of the fauna likely to occur within the study area are mobile and readily disperse through the urban landscape. Mobile fauna in the immediate vicinity of each worksite, and particularly the Western Freeway worksite, may temporarily move away from the worksites for the duration of the construction activities. This may particularly affect nocturnal fauna such as arboreal mammals, birds and bats, where concentrated lighting sources may deter these fauna from the worksites. Given the proximity of the Western Freeway worksite to the Western Freeway with artificial lighting, the addition of temporary light sources is expected to be negligible. Light spill onto surrounding areas is also controlled through the approval conditions for these major infrastructure projects.

Impacts from worksites are temporary and mobile fauna are expected to continue to utilise the study area once construction activities have ceased.

There is potential that vehicle strikes with fauna may increase during the operational phase of the project as a result of the additional lanes that fauna must cross.

Mitigation Measures

The NC Act and NC Regulation require that protected animals whose habitat has been or is about to be destroyed by human activities or natural disasters are cared for and rehabilitated. Compliance with this legislation would be required. These matters would be comprehensively addressed in the Fauna Management EMP.

Several specific fauna management measures are:

- inspection of tree hollows by a ‘Spotter-catcher’ (a person licensed by the EPA for fauna rescue) in the road reserve adjacent to the Brisbane Botanic Gardens, Anzac Park and adjacent to the Western Freeway prior to site clearance to determine the presence of arboreal mammals and bats, and implement a relocation plan for any fauna found;
- inspection of construction site works, such as trenches and culverts, by a Spotter-catcher each morning and after periods of inactivity to ensure fauna are not trapped or likely to be harmed by construction activities; and
- protection of all native fauna from intentional harm as a result of the construction works or worker actions.

10.2.6 Endangered, Vulnerable or Rare Species

Potential Impacts

Five species listed as Endangered, Vulnerable or Rare (EVR) under Queensland and/or Commonwealth legislation are known, likely or possible occurrences within the study corridor. The majority of suitable habitat

for these species occurs at the western end of the study corridor and is associated with adjacent remnant vegetation. The minimal amount of remnant vegetation to be cleared compared with adjacent patches is not considered to significantly impact on any of these EVR species. Nevertheless, some small potential exists for impacts on these species from vegetation clearance works or changes to hydrology and water quality.

The Tusked Frog (*Adelotus brevis*) is a likely occurrence in the study corridor, primarily within riparian vegetation at the western end of the tunnels. This species is generally common within Brisbane City and is known to breed in temporary ponds, wetlands and riparian vegetation including degraded sites. The project has the potential to impact on suitable breeding sites from vegetation clearance and earthworks which may result in altered hydrology and water quality (eg: sedimentation of breeding sites from runoff).

The Swift Parrot (*Lathamus discolor*) is a possible occurrence within the western portion of the study corridor. This species is known to feed on nectar from large, old flowering eucalypts within parks in outer western Brisbane suburbs. The project may require the removal of preferred feed trees. The removal of these trees is not expected to result in a significant impact on this species.

The Powerful Owl (*Ninox strenua*) is a likely occurrence within the lower slopes of Mt Coot-tha and may occasionally traverse the study corridor. This species actively hunts nocturnal species such as small gliders (*Petaurus* spp.) and Ringtail Possums (*Pseudocheirus peregrinus*). During the day it shelters within densely vegetated gullies in its more open forest habitat. The project has the potential to reduce the nesting resources of prey species (ie: hollow-bearing trees) thereby constituting a potential reduction in food resources. It is considered that the loss of these trees is unlikely to be a significant impact on the Powerful Owl.

The Koala (*Phascolarctos cinereus*) is considered a possible occurrence within the western portion of the study corridor. This species occurs in a variety of habitats provided that preferred food trees are present. The project would result in the removal of habitat for this species, although the minimal amount to be removed is unlikely to result in a significant impact on this species.

The Grey-headed Flying Fox (*Pteropus poliocephalus*) was observed during the field studies feeding on flowering *Eucalyptus* species and fruiting fig trees (*Ficus* spp.) within the road reserve adjacent to the Botanic Gardens and within the Toowong Cemetery. This species is common within Brisbane City and several permanent camps are located within the city. The nearest camp is at Indooroopilly Island, which lies approximately four kilometres to the south of the study corridor.

The species feeds on a variety of flowering and fruiting native species including Eucalypts, Bloodwoods, Callistemons, Brushbox, Banksias, Grevilleas, Figs, Lilly-pillys and Paperbarks and the fruits and berries from exotic plants (Australasian Bat Society, 2001). Flying foxes are also highly mobile and nightly foraging trips can range up to 50km away camps. The project would result in the removal of some of these plant species which translates to a loss of potential forage resources for the Grey-headed Flying Fox. There are unlikely to be any impacts on known camps as a result of the project. Considering the wide range of preferred food plants for this species and the distance over which it travels, the project is unlikely to significantly impact on this species.

Mitigation Measures

No specific mitigation measures are proposed for the above EVR species. General fauna and fauna habitat mitigation measures are described in **Section 10.2.5** apply to these species. In addition, the rehabilitation and landscaping measures described in **Section 10.2.1** are likely to minimise any long term impacts on these species.

10.2.7 Pest Animals

Potential Impacts

The Fisherman's Island spoil placement area is within the 'Red Imported Fire Ant restricted zone', as defined by the Queensland Department of Primary Industries and Fisheries (DPIF), and as such there is the potential for the project to facilitate the colonisation of new areas by the ant. Fire ants are attracted to areas of freshly disturbed soil, which would be the case at the spoil placement areas. As trucks would be returning to the tunnel construction site from the restricted area, there is a need to implement procedures to ensure fire ants are not spread from the restricted to unrestricted areas.

The red fire ant is a notifiable pest under the *Plant Protection Act 1989*. The *Plant Protection Regulation 2002* outlines pest control measures for movement of all 'high risk items' within and out of restricted areas. The movement of fire ants can occur through natural or human influenced processes. The *Plant Protection Regulation 2002* recognises the movement of red fire ants through 'high risk items' such as soil, baled hay and straw, landscaping and construction materials and machinery and equipment that may have come into contact with the ground. Fire ants are quickly attracted to freshly disturbed soil, particularly during mating flights. During mating flights the winged queen ants fly up to 2km to colonise suitable new areas.

The placement of spoil within the red fire ant restricted zone is controlled by the *Plant Protection Regulation 2002*. There are no procedures for the distribution of soil from an unrestricted site to restricted site. However, disturbance including compacting, covering, excavating or exposing soil of more than one cubic metre soil in a restricted zone requires an inspector's approval. Notification of the disturbance should be made seven days prior to the DPIF.

Other pest animals likely to occur within the project area include Cane Toads and mosquitoes. The project has the potential to create breeding sites for these pests, which includes standing water within artificial and/or natural containers.

Mitigation Measures

Controls on the movement of soil from unrestricted to restricted areas do not exist. However, trucks would be returning from the restricted area (ie: the spoil placement site) to the construction site at Kelvin Grove, which is outside the restricted area.

A variety of management actions would be implemented to manage fire ants during project construction.

- Spoil placement sites would be inspected to determine whether fire ants are present at the sites.
- Spoil placement sites would be inspected monthly during spoil placement, to monitor the presence of fire ants.
- Regular contact would be maintained with the Brisbane City Council Fire Ant Control Officer and the DPIF Fire Ant Control Centre during detailed design to agree on mitigation measures and plans for fire ant management during construction and during construction with regard to monitoring results.
- A risk management plan would be prepared to manage the movement of high risk material (soil), and the plan would be approved by DPIF.
- An inspection system of vehicles leaving spoil placement sites would be implemented to ensure vehicles are cleaned of loose soil or other material potentially capable of harbouring fire ants.

10.2.8 Wildlife Corridors

Potential Impacts

The project is unlikely to have a significant impact on any identified wildlife corridors within or adjacent to the study corridor. At the western connection, the existing Western Freeway presents a significant barrier to faunal movement between Mt Coot-tha and Toowong. The construction of the transition structures and road widening would increase the width of this barrier, although this is unlikely to significantly affect corridor values already impacted by the Western Freeway. The Project would result in the redistribution of the corridor edge further into the corridor interior which may impact on species sensitive to edge effects.

The loss of mapped remnant vegetation at the western connection is unlikely to significantly impact on the values of the bioregional corridor encompassing Mt Coot-tha, nor reduce the movement opportunities for fauna along this corridor. Additionally, minimal vegetation would be lost from the Brisbane City Council local corridor to the south of the study corridor. This is unlikely to significantly impact on movement opportunities for avian or arboreal species likely to utilise this corridor.

Mitigation Measures

No specific mitigation measures are envisaged due to the minimal impacts on identified wildlife corridors. The mitigation measures described in **Section 10.2.1** are likely to mitigate any potential impacts on wildlife corridors.

10.2.9 Aquatic Flora and Fauna

Potential Impacts

Potential impacts on aquatic flora and fauna may occur at the western end of the study corridor, specifically on the gully within Anzac Park, several creeks which cross the Western Freeway and York's Hollow. Works associated with the construction of tunnel entrances and widening of roads may have localised impacts on aquatic flora and fauna, although no significant ecological impacts are expected after the project is completed.

The drainage line through the Botanic Gardens is predominantly devoid of native vegetation cover so construction work within this area is unlikely to result in the loss of habitat for fauna. Conversely, the clearing of vegetation from the gully within Anzac Park and other drainage lines adjacent to Mt Coot-tha may impact on habitat for aquatic fauna such as turtles, fish and aquatic invertebrates. The layout of construction works areas has been designed to minimise impacts on the vegetation along these drainage lines. The loss of fringing vegetation can result in loss of shading, loss of shelter sites and loss of in-stream debris and snags leading to scouring and erosion during large rainfall events. These potential impacts are short-term only and following rehabilitation would be unlikely to result in long term impacts especially with minimisation of the impact.

Other potential impacts on aquatic flora and fauna are associated with the potential introduction of pollutants in stormwater runoff from construction activities. Hydrocarbons and other construction materials/chemicals can have a detrimental impact on aquatic flora and fauna. Mitigation measures to ensure that this does not occur are detailed in Chapter 7 (Hydrogeology).

Mitigation Measures

Stormwater runoff would be treated prior to release into drainage systems. Stormwater related issues such as erosion and sedimentation and proposed mitigation are discussed in Chapter 7 (Hydrogeology).