PROPOSED BRIDGE AND ROAD UPGRADE, RAILWAY PARADE, UPPER SWAN

ENVIRONMENTAL ASSESSMENT

Prepared for:	City of Swan
Report Date:	8 February 2013
Version:	1
Report No.	2012-78

pgv ENVIRONMENTAL

CONTENTS

List of Attachments

Plates

Tables

Figures

Appendices

1 INTRODUCTION

1.1 Background

The City of Swan is developing rapidly and as a result an alternative route west from new development in The Vines is becoming increasingly a priority. In creating a new route the City of Swan proposes to upgrade the road on Railway Parade between Apple Street to Maralla Road, construct a bridge on Railway Parade over the Ellen Brook in Upper Swan and upgrade Apple Street from Railway Parade to Great Northern Hwy (Figure 1).

In 2000 the Western Australian Planning Commission imposed, as a condition of its adoption of a Structure Plan for the then Lot 4 Railway Parade, Upper Swan, and the requirement for provision of road access from Railway Parade. This was to be a 25m wide road which provides the primary connection between Lot 4 to Ellenbrook Village 7B to the north.

The bridge and roadway on Railway Parade and Apple Street are to be constructed with two lanes and constructed to withstand loads in accordance with a Network 1 road that can carry traffic including the following:

- Road train to 20m and 50t (Semi and Pig);
- Articulated vehicle to 19m, 4.6m high and 42.5t (carrying livestock, vehicles, a multi-modal container or towing an over-height semi-trailer);
- B-Double to 20m and 50t; and
- Twin-steer Prime mover towing semi-trailer to 19m and 47.5t.

1.2 Purpose and Scope

PGV Environmental has been commissioned by the City of Swan to undertake an Environmental Assessment of the proposed bridge alignment and to use the results to identify the relevant stakeholders to be consulted during the design and construction stages. The assessment includes information on the following environmental factors.

Physical characteristics including a description of:

- Landform of the site;
- Drainage and water bodies;
- Geological, hydrogeological and hydrological characteristics; and
- Acid Sulphate Soil Risk Mapping.

Recent and present land use including:

- Federal, State and Local Government Environmental Policy areas search;
- Surrounding land uses;
- Any records from the Contaminated Sites Database;
- Assessment of current and historical activities on the subject site and surrounding areas which have the potential to result in contamination issues at the site; and

- Heritage features.

Flora, vegetation and fauna including:

- The results from Declared Rare and Priority Flora and Fauna and Threatened Ecological Community searches of the Department of Environment and Conservation (DEC) Databases;
- Results from the Commonwealth Protected Matters Search Tool which will identify possible matters of Environmental Significance listed under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) that may occur on the sites; and
- An assessment of the likelihood of conservation significant flora, vegetation and fauna being present on the sites.

The impact of the construction of the bridge and upgrade of the road on the site has been assessed in the context of impact on the above factors.

1.3 Zoning

The site has several different zonings under the Metropolitan Region Scheme (MRS). To the south of Ellen Brook the site and adjacent areas are Zoned 'Rural' (Figure 2). The area of the site that is Ellen Brook is zoned as 'Parks and Recreation'.

The land to the north of Ellen Brook is zoned 'Urban'. The eastern boundary of the site abuts the Millendon Junction Narngulu Railway which is zoned 'Railway' under the MRS. The area to the east of the Railway is zoned 'Rural' (Landgate 2012a) (Figure 2).

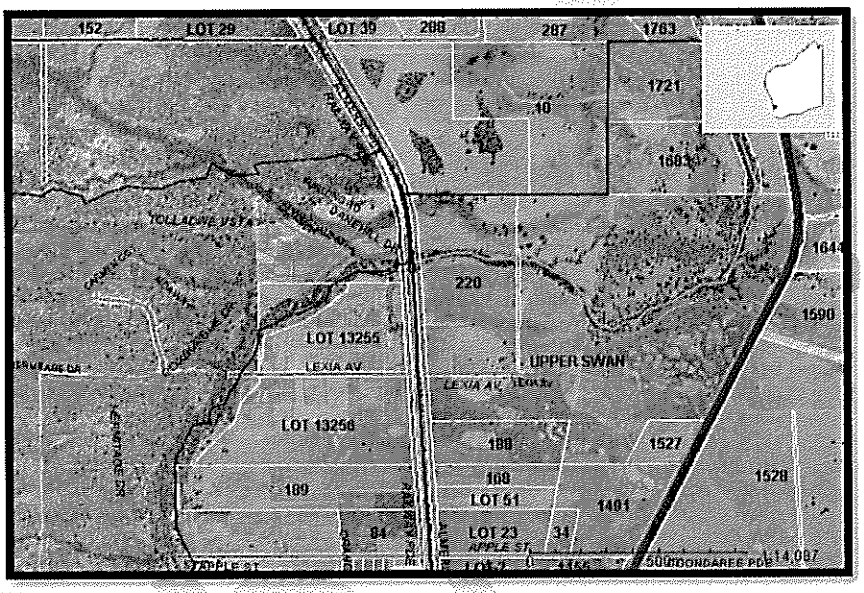
Railway Parade is a gazetted as a Local Road in the *City of Swan Local Planning Scheme* (LPS) *No.17 District Zoning Scheme* (WAPC, 2008) (Figure 3). Ellen Brook is zoned as 'Parks and Recreation' and is shown as being flood prone. The land the south of Ellen Brook is zoned 'General Rural' in the LPS. The land to the east of the railway is zoned 'Special Use 6' which is an area that has restrictions on subdivision to protect the Western Swamp Tortoise. To the north-west of Ellen Brook is an area zoned as 'Residential Development' and 'Special Use 4' zone. These areas are part of the Ellenbrook development and as such are zoned for a mixture of purposes such as residential, commercial and retail. To the north of Lexia Drive and to the east of the railway is a small area zoned for 'Additional Use 42' which allows stockfeed manufacturing and wholesale activity (Figure 3).

2 EXISTING ENVIRONMENT

2.1 Past and Existing Land Use

The Millendon Junction Narngulu Railway has been established for more than 100 years and extends from Perth to Geraldton for 425km. Historical aerial photography from 1965 shows the railway and the adjoining Railway Parade road reserve which has been cleared. The western side of the site has mostly been cleared although native vegetation occurs a short distance to the west. Ellen Brook retains some native vegetation along its alignment (Plate 1).

Plate 1: Aerial Photography from 1965 (Landgate 2012b).

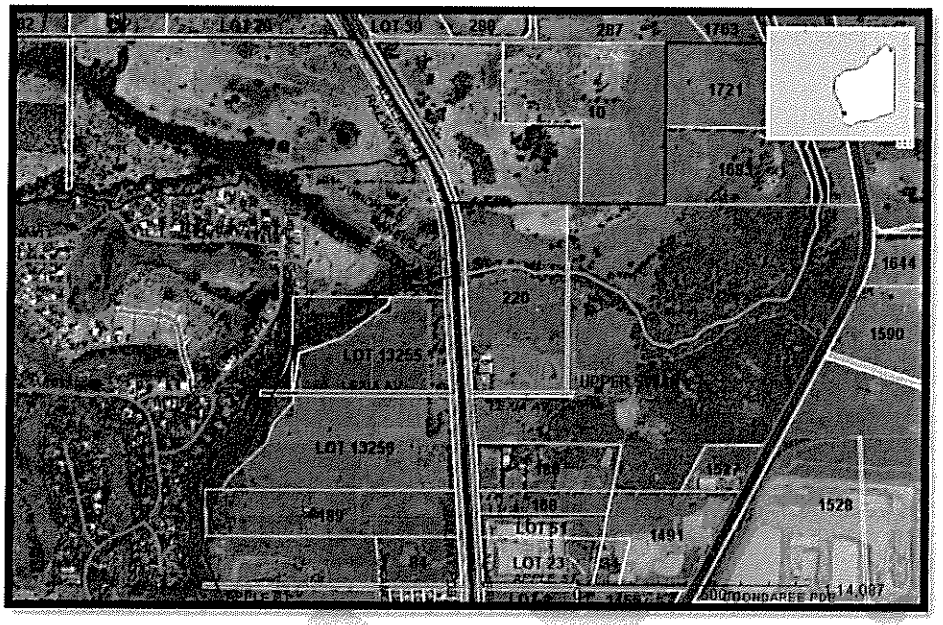


The 1965 aerial photograph shows the remains of a small bridge over Ellen Brook as well the rail bridge on the right hand side (Plate 2).

Plate 2: Aerial Photography from 1965 showing the bridge over the Ellen Brook (Landgate 2012b).

Between 1977 and 1979 the vegetation to the north of Ellen Brook was cleared up to Maralla Road (Plate 3).

Plate 3: Aerial Photography from 1979 showing land that was cleared (Landgate 2012b).



Between 1979 and 1981 there has been some development commenced in close proximity to the Ellen Brook. To the south a dwelling has been established on the site. To the north of Ellen Brook an area has been excavated to form a dam (Plate 4).

Plate 4: Aerial Photography from 1981 showing new buildings and a dam (Landgate 2012b).

The small bridge is still evident in 1981 however has been removed by 1985 (Plate 5).

Plate 5: Aerial Photography from 1985 showing the bridge is removed (Landgate 2012b).

There is evidence of the old bridge on the site in 2012 (Plate 6).

Plate 6: Old Footings of the Bridge

2.2 Surrounding Land Use

Surrounding land uses include a vineyard to the south-west and cleared agricultural property to the east and north. To the west is some vegetated land and the Vines Development which is bound by Damialling Drive. A clay extraction site occurs to the south-east.

2.3 Topography

The site is very gently undulating north and south of the Ellen Brook and ranges in elevation from approximately 18 to 22m AHD (DoW, 2012). There is a small depression to the north of Ellen Brook with an elevation of approximately 15mAHD. The creek bed of Ellen Brook is at 12mAHD (Figure 1).

2.4 Geomorphology and Soils

The site is located on the eastern side of the Swan Coastal Plain. The Swan Coastal Plain is generally flat and is approximately 20 to 30 kilometres wide, consisting of a series of geomorphic entities running parallel to the coastline.

The site is predominately located on the Pinjarra System which occurs on the Swan Coastal Plain between Perth and Capel. The Pinjarra system consists of poorly drained coastal plain with variable alluvial and aeolian soils. The Pinjarra System has variable vegetation including Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Wandoo, paperbark, sheoaks and Flooded Gum (*Eucalyptus rudis*). Soils mapped in Ellen Brook are classified in the Pinjarra Wet System which is described as undifferentiated wet soils associated with water.

The north of the site is mapped in the Yanga System which is described as poorly drained plain with pale sands and deep sandy duplex, wet, semi-wet and saline wet soils. The vegetation associated with this system is generally Banksia, Prickly-bark (*Eucalyptus todtiana*), Marri, Swamp Sheoak (*Casuarina obesa*) or paperbark woodlands.

The phases of soils within the soil systems that have been mapped on the site are outlined in Table 1 and shown on Figure 4.

Table 1: Land Unit Descriptions

Land Unit	Description
213Pj – Pinjarra Subsystem (Pj)	
213Pj_J Pinjarra, Phase J	Brown sandy loam over a yellow mottled clay and a grey mottled clay.
213Pj_VC Pinjarra, Phase VC	Variable soils associated with drainage lines
213PjSW1 Pinjarra, Phase SWSw1	River margins and low flats with poorly drained variable alluvial soils, subject to frequent flooding.
213Pj_Hsb Pinjarra, Phase Hsb	Brown sand with nil to few gravels over mottled clay.
213Pj_Hs Pinjarra, Phase Hs	Grey to greyish-brown sand with nil to few gravels over mottled clay.
213PjW Pinjarra Wet System	
231PjW_Claypan Pinjarra Wet, Claypan Phase	Claypan
213Ya – Yanga System (Ya)	
213Ya_10x Yanga 10x Phase	Very gently to gently sloping plains, well drained and some imperfectly drained. Shallow red sands with bog iron exposed in places and underlying within a metre of the surface. Low woodland of *Eucalyptus rudis* and Jam on the lower slopes.

Land Unit	Description
213Ya_8x Yanga 8x Phase	Flat plain with occasional low dunes. Subject to seasonal inundation. Deep white and pale yellow sands interspersed with swamp and generally underlain by siliceous/humic pans at depth.

During the site visit it was noted that the south side of the banks of Ellen Brook had some outcropping of what is assumed to be granite (Plate 7). It is possible that the granite was placed on the site to stabilise the footings for the old bridge.

Plate 7: Granite located to the South of Ellen Brook

2.4.1 Acid Sulphate Soils

Acid sulphate soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulphides which, when exposed to atmospheric oxygen in the presence of water, form sulphuric acid. ASS form in protected low energy environments such as barrier estuaries and coastal lakes and commonly occurs in low-lying coastal lands such as Holocene marine muds and sands. When disturbed, these soils are prone to produce sulphuric acid and mobilise iron, aluminium, manganese and other heavy metals. The release of these reaction products can be detrimental to biota, human health and built infrastructure.

The ASS Risk on the site has been mapped by the DEC (Landgate, 2012b) as being Moderate to Low (<3m from the surface) in Ellen Brook and in the north of the site (Figure 5). The remainder of the site is mapped as having a Low (<3m from the surface) risk. There is a small area around Lexia Avenue that is mapped as High to Moderate (<3m from the surface).

2.5 Groundwater Hydrology

The groundwater under the site has geological formations that have been grouped into three distinct aquifers:

- Superficial Swan Aquifer (unconfined);
- Leederville Aquifer (confined); and
- Yarragadee north (confined) (DoW, 2012a)

The Superficial Aquifer is part of the Gnangara Mound and the Kardinya Shale Member of the Osborne Formation separates this from the Leederville Aquifer (DoW, 2012a).

The depth to groundwater over the site varies with the topography from approximately 3.5m near the Ellen Brook to about 7m to the south and 4m in the north of the site (DoW, 2012b). Groundwater is at approximately 11.5 to 20mAHD.

Groundwater generally flows towards Ellen Brook (DoW, 2012b).

2.6 Surface Hydrology

Surface water on the site generally drains towards Ellen Brook and other low-lying areas within the site.

2.6.1 Ellen Brook

Ellen Brook starts below Muchea and flows into the Swan River approximately 7km to the south-west of the site. The Brook is fed from the Dandaragan Plateau which is the northern end of the Darling Range and smaller watercourses along the way including Sawpit Gully, Ki-It Monger Brook and Nambab Brook.

The part of Ellen Brook within the site is classified as a Conservation Category Floodplain called Ellen Brook Floodplain (Unique Feature Identifier (UFI) 15734) in the Department of Environment and Conservation's Geomorphic Wetland Mapping database.

The Ellen Brockman Integrated Catchment Group commissioned the *Restoration Concept Plan for the Riparian Section of the Ellen Brook* (Ecoscape, 2006). The condition of the section of Ellen Brook within the site was rated as C Grade Foreshore which is eroding or erosion prone (from Penn and Scott, 1995). This rating has been further refined and the part of Ellen Brook within the site is rated as C2 to the west of the railway which is described as:

> *Surface erosion exposed soil - Here the foreshore is exposed in significant areas and has begun to erode.*

To the east of the railway Ellen Brook was rated as C3 which is described as:

> *Erosion and subsidence present - Soil is washed away from between any tree roots and trees are being undermined. Unsupported embankments are subsiding into the waterway. Localised erosion is present.*

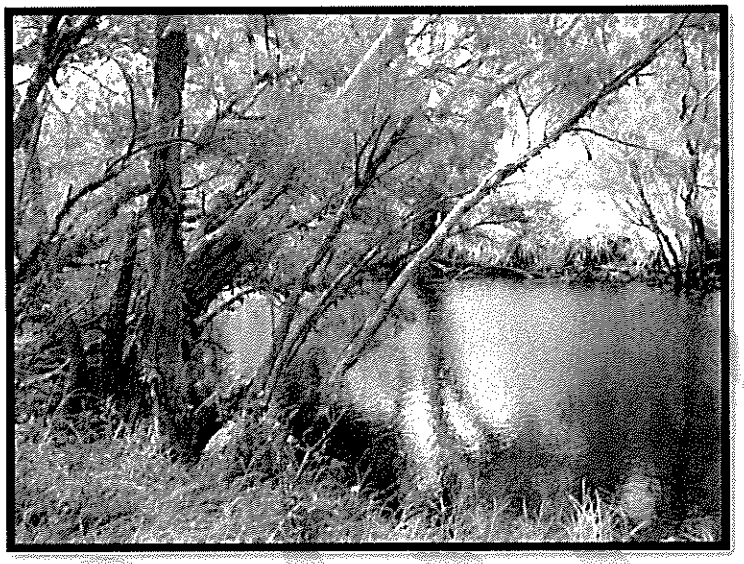
The part of Ellen Brook within the site was given a rating of Priority 6 for rehabilitation in the restoration concept plan. This is the lowest priority within Ellen Brook and was rated as such because:

- It is not accessible by the public and the land has little opportunity for interpretation due to closeness of private property and the land-uses within them;
- It is highly disturbed due to land uses;

- There is little or no understorey;
- Erosion and subsidence is present; and
- No known previous restoration works have been undertaken in this area of Ellen Brook.

A site visit conducted by PGV Environmental in November 2012 confirmed that this part of Ellen Brook is degraded with very little understorey other than weeds (Plate 8). There was some evidence of bank erosion.

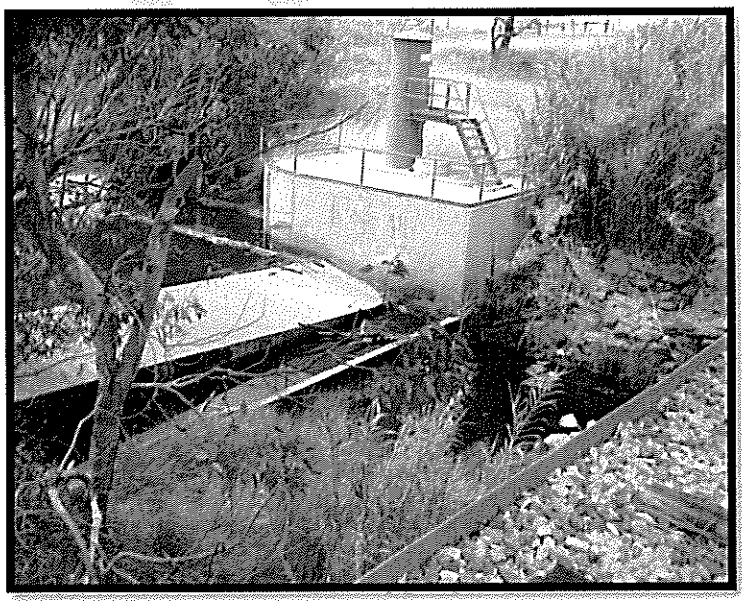
Plate 8: Ellen Brook with some Trees and a Weedy Understorey



2.6.2 Flow Gauging Station

The Ellen Brook Flow Gauging Station is located on the southern bank of Ellen Brook a short distance to the east of the railway bridge (Plate 9). The station was established in 1965 and contains a tower which is linked to a telemetered pressure gauge. The station can measure water flow as well as water quality factors such as salinity, nitrogen and phosphorus levels.

Plate 9: Ellen Brook Flow Gauging Station



2.6.3 Wetlands

Resource Enhancement and Multiple Use Wetlands occur on the site (Figure 6).

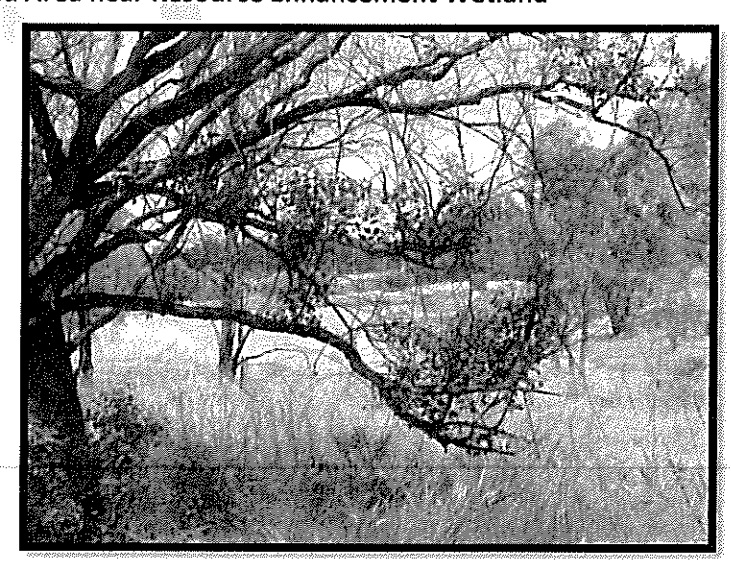
A Multiple Use Palusplain (UFI 15282) occurs to the south of Ellen Brook Immediately to the north of Ellen Brook is a Multiple Use Palusplain that extends north and is located on the site near Maralla Avenue (UFI 15732) (Figure 6). A Palusplain is defined as a seasonally waterlogged flat (Semeniuk, 1987). These mapped palusplain areas are highly degraded and have been mostly cleared of native vegetation.

A Resource Enhancement Palusplain (UFI 15733) occurs to the north of Ellen Brook and adjacent to the western side of the rail reserve (Figure 6). This wetland is degraded and the vegetation consists of trees over weeds (Plate 10).

Plate 10: Degraded Vegetation in the Resource Enhancement Wetland (UFI 15733)

To the west of the Resource Enhancement Wetland is an area that has been excavated to create a man-made dam and is likely to hold water for most of the year (Plate 11).

Plate 11: Excavated Area near Resource Enhancement Wetland



It is likely that the construction of this dam has impacted on the hydrology of the Resource Enhancement wetland by diverting surface water.

2.7 Vegetation

2.7.1 Bioregional Data

The site is in the Southwest Botanical Province within the northern Swan Coastal Plain Region. The vegetation is mapped as Beard vegetation type e3Mi which is Medium woodland; marri (Beard, 1990).

2.7.2 Threatened and Priority Ecological Communities

A search of the DEC's Threatened (TEC) and Priority Ecological Communities (PEC) database was conducted for the site (Appendix 1; 51-1012EC). There are no known occurrences of any TECs or PECs on the site. Six TECs and four PECs have been recorded in the vicinity of the site (Table 4). The EPBC Act Protected Matters Search Tool database search also identified two of the TECs as being present within the area (Appendix 2).

Table 4: Threatened and Priority Ecological Communities Identified in Database Searches

Community Identification	Community Name	Status under Wildlife Cons. Act	Status under EPBC Act
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	Critically Endangered	Endangered
SCP3c	*Eucalyptus calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	Critically Endangered	Endangered
Muchea Limestone	Shrublands and woodlands on Muchea Limestone	Endangered	Endangered
SCP08	Herb rich shrublands in clay pans (Part of 'Claypans of the Swan Coastal Plain')	Vulnerable	Critically Endangered
SCP15	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain	Vulnerable	
SCP18	Shrublands on calcareous silts of the Swan Coastal Plain	Vulnerable	
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	Priority 3	
SCP22	*Banksia ilicifolia* woodlands	Priority 3	
SCP23b	Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands	Priority 3	
SCP25	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands	Priority 3	

Conservation Codes are outlined in Appendix 3

2.7.3 Vegetation Description

A site inspection was undertaken by PGV Environmental on 28 November 2012. The vegetation on most of the site was found to be highly degraded with large areas totally cleared and other areas containing native trees containing a totally weed infested understorey.

Riparian vegetation exists on the banks of the Ellen Brook and other low-lying areas (Plate 12). The vegetation consists of Flooded Gum (*Eucalyptus rudis*) and Paperbarks (*Melaleuca rhaphiophylla*) with an understorey consisting of weeds such as Watsonia (*Watsonia bulbillifera*), (*Typha orientalis*), Arum Lily (*Zantedeschia aethiopica*) and Wild Oats (*Avena fatua*). The upper banks of the Ellen Brook on the southern side contain some Marri trees over weeds with Cornflag dominant (Plate 13). The southern side of Ellen Brook contains scattered Flooded Gums and planted Tasmanian Blue Gums (*Eucalyptus globulus*) (Plate 14).

Plate 12: Weedy Vegetation in the Vicinity of Ellen Brook

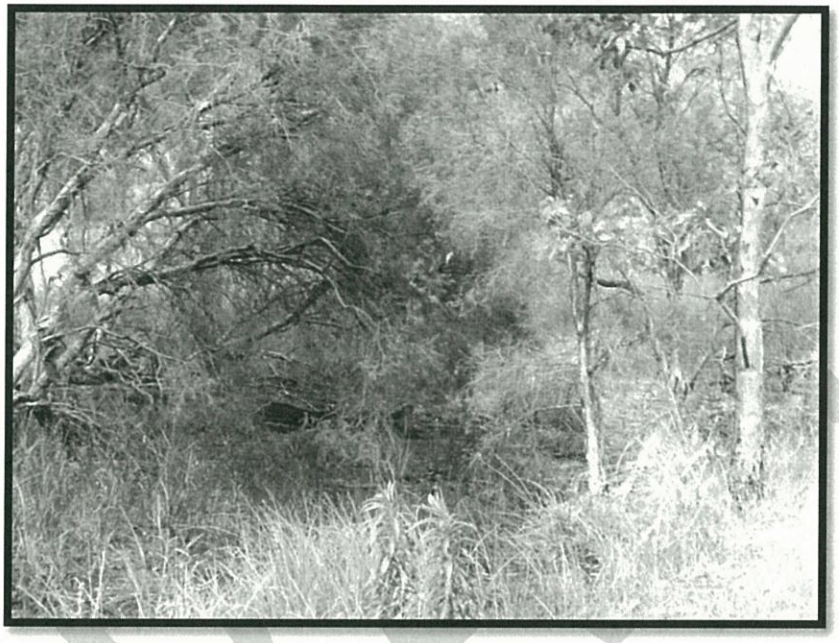


Plate 13: Marri Vegetation to the South of Ellen Brook

Plate 14: Vegetation to the North of Ellen Brook

A section of the eastern road reserve south of Ellen Brook contained Marri vegetation with some native heath understorey including *Jacksonia sternbergiana, Xanthorrhoea preissii* and *Hakea prostrata* (Plate 15). While the area contained numerous weeds, especially Lovegrass (*Eragrostis curvula*), the site may contain conservation significant flora species or ecological communities. A spring flora and vegetation survey is recommended for this area.

Plate 15: Roadside vegetation along the southern part of Railway Parade

The highly degraded vegetation was considered not likely to represent any of the TECs and PECs listed. The vegetation on the eastern side of the road reserve south of Ellen Brook was in slightly better condition and could potentially represent one of the Ecological Communities in Table 4. A spring flora and vegetation survey is recommended in this area to identify the community type.

2.7.4 Vegetation Condition

The vegetation condition over the site ranged from Completely Degraded for the areas predominantly cleared of native vegetation up to Good to Degraded for the areas containing some remnant native species in the southern road reserve (Table 5).

Table 5: Vegetation Condition Rating Scale.

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

2.8 Flora

A search of the DEC Threatened Flora Database, the WA Herbarium database and the Declared Rare and Priority Flora Species List identified nine Threatened and 26 Priority plant species that have been located in the vicinity of the site (Table 6 and Appendix 4). The Naturemap database search had no additional species (DEC, 2012a; Appendix 5)

The nine Threatened species under the *Wildlife Conservation Act 1950* are also listed under the EPBC Act. Nine additional Endangered species were identified by the EPBC Act Protected Matters Search Tool (SEWPaC, 2012a) (Appendix 2).

Table 6: List of Flora Species Identified from Database Searches.

Species	Common Name	Status under Wildlife Cons. Act	Status under EPBC Act
Acacia anomala	Grass Wattle, Chittering Grass Wattle	Threatened	Vulnerable
Andersonia gracilis	Slender Andersonia	Threatened	Endangered
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	Threatened	Endangered
Centrolepis caespitosa		Priority 4	Endangered
Darwinia foetida	Muchea Bell	Threatened	Critically Endangered
Drakaea elastica	Glossy-leaved Hammer-orchid	Threatened	Endangered
Eleocharis keigheryi	Keighery's Eleocharis	Threatened	Vulnerable
Eucalyptus balanites	Cadda Road Mallee	Threatened	Endangered
Grevillea althoferorum subsp. *fragilis*	Split-leafed Grevillea	Threatened	Endangered
Grevillea christineae	Christine's Grevillea	Threatened	Endangered
Grevillea curviloba subsp. *curviloba*	Curved-leaf Grevillea	Threatened	Endangered
Grevillea curviloba subsp. *incurva*	Narrow curved-leaf Grevillea	Threatened	Endangered
Lepidosperma rostratum	Beaked Lepidosperma	Threatened	Endangered
Thelymitra dedmaniarum (*Thelymitra manginii*)	Cinnamon Sun Orchid	Threatened	Endangered
Thelymitra stellata	Star-sun Orchid	Threatened	Endangered
Trithuria occidentalis (*Hydatella dioica*)	Swan Hydatella	Threatened	Endangered
Verticordia plumosa var. pleiobotrya	Narrow-petalled Feather-flower	Threatened	Endangered
Ornduffia calthifolia (*Villarsia calthifolia*)	Mountain Villarsia	Threatened	Endangered
Schoenus sp. Bullsbrook (J.J. Alford 915)		Priority 2	
Stenanthemum sublineare		Priority 2	
Stylidium aceratum	Wongan Hills Triggerplant	Priority 2	
Stylidium squamellosum	Maze Triggerplant	Priority 2	
Adenanthos cygnorum subsp. *chamaephyton*	Woolly-bush	Priority 3	
Chamaescilla gibsonii	Blue Stars	Priority 3	
Cyathochaeta teretifolia		Priority 3	
Eryngium pinnatifidum subsp. *palustre*	Blue Devils	Priority 3	
Guichenotia tuberculata		Priority 3	
Haemodorum loratum		Priority 3	
Halgania corymbosa		Priority 3	
Meionectes tenuifolia		Priority 3	
Platysace ramosissima		Priority 3	
Schoenus capillifolius		Priority 3	

Species	Common Name	Status under Wildlife Cons. Act	Status under EPBC Act
Schoenus sp. Waroona (G.J. Keighery 12235)		Priority 3	
Stylidium asteroideum	Star Triggerplant	Priority 3	
Stylidium longitubum	Jumping Jacks	Priority 3	
Stylidium trudgenii		Priority 3	
Tetratheca pilifera	Lilac Bells	Priority 3	
Cyanicula ixioides subsp. *ixioides*	Yellow China Orchid	Priority 4	
Darwinia pimelioides	Sunset Bell	Priority 4	
Hydrocotyle lemnoides	Aquatic Pennywort	Priority 4	
Oxymyrrhine coronata		Priority 4	
Persoonia sulcata	Snottygobble	Priority 4	
Schoenus natans	Floating Bog-rush	Priority 4	
Tripterococcus paniculatus		Priority 4	

A list of the definitions of the Conservation Codes is in Appendix 3.

It is highly unlikely that any of these species would occur in the highly degraded parts of the site. It is possible that some species, particularly shrub species, occur in the slightly better condition vegetation in the southern road reserve. A flora spring flora survey is recommended for the southern road reserve vegetated area.

Table 7: Likelihood of Identified Significant Flora Species occurring on the Site

Species	Preferred Habitat*	Likelihood of presence on site
Acacia anomala	Lateritic soils. Slopes	Unlikely
Andersonia gracilis	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible
Caladenia huegelii	Grey or brown sand, clay loam	Unlikely
Centolepis caespitosa	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible
Darwinia foetida	Grey-white sand on swampy, seasonally wet sites and on winter-damp to wet clay	Unlikely
Drakaea elastica	White or grey sand. Low-lying situations adjoining winter-wet swamps	Possible
Eleocharis keigheryi	Clay, sandy loam. Emergent in freshwater: creeks, claypans	Possible
Eucalyptus balanites	Sandy soils with lateritic gravel.	Unlikely
Grevillea althoferorum subsp. *fragilis*	Peaty sand, clay.	Possible
Grevillea christineae	Clay loam, sandy clay, often moist	Possible
Grevillea curviloba subsp. *curviloba*	Grey sand. Winter-wet heath	Possible
Grevillea curviloba subsp. *incurva*	Sand, sandy loam. Winter-wet heath	Possible
Lepidosperma rostratum	Peaty sand, clay	Possible
Thelymitra dedmaniarum (*Thelymitra manginii*)	Granite	Unlikely
Thelymitra stellata	Sand, gravel, lateritic loam	Unlikely

Species	Preferred Habitat*	Likelihood of presence on site
Trithuria occidentalis (*Hydatella dioica*)	Muddy (inundated) areas	Possible
Verticordia plumosa var. pleiobotrya	Clay, sandy loam. Seasonally inundated swamps, road verges.	Possible
Ornduffia calthifolia (*Villarsia calthifolia*)	+ Restricted to the Porongurup Range where it is found in moist sheltered positions on the upper slopes of granite outcrops	Highly Unlikely
Schoenus sp. Bullsbrook (J.J. Alford 915)	Grey peaty sand. Low-lying flats	Possible
Stenanthemum sublineare	Littered white sand. Coastal plain	Possible
Stylidium aceratum	Sandy soils. Swamp heathland.	Possible
Stylidium squamellosum	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	Unlikely
Adenanthos cygnorum subsp. *chamaephyton*	Grey sand, lateritic gravel	Unlikely
Chamaescilla gibsonii	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans	Possible
Cyathochaeta teretifolia	Grey sand, sandy clay. Swamps, creek	Possible
Eryngium pinnatifidum subsp. *palustre*	Clay, sandy clay. Claypans, seasonally wet flats.	Possible
Guichenotia tuberculata	Sand clay over laterite, sand	Unlikely
Haemodorum loratum	Grey or yellow sand, gravel	Unlikely
Halgania corymbosa	Gravelly soils, soils over granite	Unlikely
Meionectes tenuifolia	Aquatic species	Possible
Platysace ramosissima	Sandy soils	Possible
Schoenus capillifolius	Brown mud. Claypans	Possible
Schoenus sp. Waroona (G.J. Keighery 12235)	Clay or sandy clay. Winter-wet flats.	Possible
Stylidium asteroideum	Gravelly soils	Unlikely
Stylidium longitubum	Sandy clay, clay. Seasonal wetlands.	Possible
Stylidium trudgenii	Grey sand, dark grey to black sandy peat. Margins of winter-wet swamps, depressions	Possible
Tetratheca pilifera	Gravelly soils	Unlikely
Cyanicula ixioides subsp. *ixioides*	Laterite, gravel	Unlikely
Darwinia pimelioides	Loam, sandy loam. Granite outcrops	Unlikely
Hydrocotyle lemnoides	Swamps	Possible
Oxymyrrhine coronata	Lateritic habitats on the Darling Range	Unlikely
Persoonia sulcata	Lateritic or granitic soils	Unlikely
Schoenus natans	Winter-wet depressions	Possible
Tripterococcus paniculatus	Grey, black or peaty sand. Winter-wet flats.	Possible

* sourced from Florabase (DEC, 2012b), SEWPaC SPRAT Database (SEWPaC, 2012b), + Gilfillan and Barrett, 2004, ++ Moody and Les, 2007, +++ Hort, 2013 and ++++ Rye, 2009

2.9 Bush Forever

Ellen Brook has been identified as part of Bush Forever Site 300, Maralla Road Bushland, Ellenbrook/Upper Swan. This site is 641.5ha and links to Bush Forever sites 301 and 399 (Figure 7). The part of Site 300 that is within the site has been identified as Bush Forever as it is vegetation associated with a creekline. The boundary of the Bush Forever site coincides with the Conservation Category Wetland boundary.

2.10 Fauna

2.10.1 DEC Database Search Results

A search of the DEC Threatened Fauna Database (Appendix 6) indicates that fourteen species that are listed as rare or priority have been located in the vicinity of the site. Four of these species were also identified in the Naturemap database searches (Appendix 5; DEC, 2012a). The search of the Protected Matters Search Tool (Appendix 2) identified nine additional species. The species identified in the database searches are summarised in Table 8.

Table 8: List of Fauna Species Identified from DEC Database Searches.

Scientific Name	Common Name	Status under Wildlife Cons. Act	Status under EPBC Act
Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black-Cockatoo	Schedule 1	Vulnerable.
Calyptorhynchus baudinii	Baudin's Cockatoo	Schedule 1	Vulnerable
Calyptorhynchus latirostris	Carnaby's Cockatoo	Schedule 1	Endangered
Dasyurus geoffroii	Chuditch, Western Quoll	Schedule 1	Vulnerable
Macrotis lagotis	Greater Bilby	Schedule 1	Vulnerable
Pseudemydura umbrina	Western Swamp Turtle, tortoise	Schedule 1	Critically Endangered
Rostratula benghalensis	Painted Snipe	Schedule 1	Vulnerable
Apus pacificus	Fork-tailed Swift	Schedule 3	Migratory
Ardea alba	Great Egret	Schedule 3	Migratory/ Wetland
Ardea ibis	Cattle Egret	Schedule 3	Migratory/ Wetland
Haliaeetus leucogaster	White-bellied Sea-eagle	Schedule 3	Migratory
Meeorps ornatus	Rainbow Bee-eater	Schedule 3	Migratory
Plegadis falcinellus	Glossy Ibis	Schedule 3	
Rostratula australis	Australian Painted Snipe	Schedule 3	Vulnerable
Morelia spilota subsp. *imbricata*	Carpet Python	Schedule 4	
Galaxiella nigrostriata	Black-stripe Minnow	Priority 3	
Neelaps calonotos	Black-striped Snake	Priority 3	
Synomen gratiosa	Graceful Sun-moth	Priority 4	Endangered
Isoodon obesulus subsp. *fusciventer*	Southern Brown Bandicoot	Priority 5	
Macropus eugenii subsp. *derbianus*	Tammar Wallaby (WA subsp)	Priority 5	

The DEC classifies fauna under five different Priority codes and rare and endangered fauna are classified under the Wildlife Conservation (Specially Protected Fauna) Notice 2008 into four schedules of taxa (DEC, 2011). These are outlined in Appendix 3.

2.10.2 Habitat

Fauna habitat can be assessed using a number of factors including, the size of the habitat, the level of habitat connectivity, availability of specific resources (e.g. tree hollows) and overall vegetation quality. The habitat was assessed according to the following categories:

> ***High quality fauna habitat*** *– These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.*
>
> ***Very good fauna habitat*** *- These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.*
>
> ***Good fauna habitat*** *– These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.*
>
> ***Disturbed fauna habitat*** *– These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.*
>
> ***Highly degraded fauna habitat*** *– These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Faunal assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.* (Coffey Environments, 2009)

The habitat in the vegetated areas on the site around Ellen Brook consists of mostly parkland cleared areas however this vegetated area does provide connectivity with other parts of the brook. Therefore this habitat is considered to be Good to Disturbed Fauna Habitat. In the road verge along Railway Parade to the south the existing vegetation has more understorey and therefore is considered to be Good Fauna Habitat. To the north of Ellen Brook the vegetation is more fragmented and has exotic tress planted. This area is considered to be Disturbed Fauna habitat.

2.10.3 Conservation Significant Species

Outlined below is a short description of each of the species that were identified in the database searches and their preferred habitat. The preferred habitat has been used to determine the likelihood of each species to be present on the site.

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)

Forest Red-tailed Black Cockatoos frequent the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (SEWPaC, 2012a). It nests in tree hollows with a depth of 1-5m, that are predominately Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and Karri (*E. diversicolor*) and it feeds primarily on the seeds of Marri.

Forest Red-Tailed Black Cockatoos may potentially visit the site given the presence of Marri trees.

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

This species is most common in the far south-west of Western Australia. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Black Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands, where it feeds mainly on Marri seeds and various Proteaceous species.

Baudin's Black Cockatoos are seasonally present on the Swan Coastal Plain however are usually found south of the Swan River (Johnstone and Kirkby, 2011). Therefore Baudin's Black Cockatoo is unlikely to be present on the site.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Cockatoo is found in the south-west of Australia from Kalbarri through to Ravensthorpe. It has a preference for feeding on the seeds of *Banksia, Dryandra, Hakea, Eucalyptus, Grevillea, Pinus* and *Allocasuarina* spp. It is nomadic often moving toward the coast after breeding. It breeds in tree hollows that are 2.5 – 12m above the ground and have an entrance 23-30cm with a depth of 1-2.5m. Nesting mostly occurs in smooth-barked trees (e.g. Salmon Gum, Wandoo, Red Morrell). Eggs are laid from July to October, with incubation lasting 29 days (SEWPaC, 2012b).

This species has been observed near the site but there is no suitable breeding habitat however there is limited feeding habitat that may be utilised the Carnaby's Black Cockatoos.

Chuditch, Western Quoll (*Dasyurus geoffroii*)

The Chuditch is Western Australia's largest carnivorous marsupial. It is found in South-west Western Australia in sclerophyll forest, dry woodland and mallee shrubland (SEWPaC, 2012b).

The Chuditch is highly unlikely to be present on the site due to the lack of suitable habitat.

Greater Bilby (*Macrotis lagotis*)

The greater Bilby is a nocturnal omnivorous marsupial that shrub species, such as *Acacia kempeana* and *A. hilliana*, which have root-dwelling larvae that provide a constant food source for the Greater Bilby. They also utilise Spinifex hummocks which are quite uniform and discrete, providing runways between hummocks, enabling easier movement and foraging (SEWPaC, 2012b.).

The Bilby is highly unlikely to be present on the site due to the lack of suitable habitat and food source.

Western Swamp Tortoise (*Pseudemydura umbrina*)

The Western Swamp Tortoise is restricted to very few wild populations. During winter and spring, the tortoises live in the water. This species is carnivorous feeding on insects, larvae and tadpoles (Burbidge and Kuchling, 1994). In the drier, hotter months they shelter under leaf litter and in holes and aestivate (sleep) (SEWPaC, 2012b).

The Western Swamp Tortoise occurs in the Ellen Brook Nature Reserve which is approximately 1km upstream from the site. The tortoise has not been recorded in this part of the Ellen Brook and is highly unlikely to be present.

Painted Snipe (*Rostratula benghalensis*)

The Painted Snipe predominately occurs on the eastern coast of Australia and inhabits inland and coastal shallow ephemeral and permanent freshwater wetlands particularly where there is a cover of vegetation, including grasses

This species is unlikely to be present.

Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is almost exclusively aerial and is not known to breed in Australia. They are seen in inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities (SEWPaC, 2012b).

This species is unlikely to be found on the site.

Great Egret, White Egret (*Ardea alba* (*modesta*))

The Eastern Great Egret has been reported in a wide range of wetland habitats and usually frequents shallow waters (SEWPaC, 2012b). This species feeds on fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals (SEWPaC, 2012b).

This species is unlikely to be present on the site due to the proximity of development and the rail.

Cattle Egret (*Ardea ibis*)

The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands with breeding in Western Australia recorded in the far north in Wyndham in colonies in wooded swamps such as mangrove forests (SEWPaC, 2012b). This species forages away from water on low lying grasslands, improved pastures and croplands generally in areas that have livestock eating insects, frog, lizards and small mammals (SEWPaC, 2012b).

This species could possibly occur near the site at intervals but is unlikely to be present on the site.

White-bellied Sea-Eagle (*Haliaeetus leucogaster*)

The White-bellied Sea-Eagle is found in coastal habitats with large areas of open water, especially those close to the sea-shore. This species feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal (SEWPaC, 2012b).

This species prefers open water and as such is unlikely to be present on the site.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eaters that breed in southern Australia are migratory. After breeding, they move north and remain there for the duration of the Australian winter. However, populations that breed in northern Australia are considered to be resident, and in many northern localities the Rainbow Bee-eater is present throughout the year (SEWPaC, 2012b). The Rainbow Bee-eater nests in a burrow dug in the ground. It is found across the better-watered parts of WA including islands preferring lightly wooded, sandy country near water (SEWPaC, 2012b).

The proximity of the rail means that this species is highly unlikely to be present on the site.

Glossy Ibis (*Plegadis falcinellus*)

The Glossy Ibis is the smallest ibis known in Australia. This species preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (SEWPaC, 2012b).

This species may be present on the site however is unlikely to be present for a length of time due to the proximity of human populations and the existing rail.

Australian Painted Snipe (*Rostratula australia*)

The Australian Painted Snipe is a stocky wading bird that generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (SEWPaC, 2012b).

This species may be present on the site however is unlikely to be present for a length of time on the site due to the proximity of human populations and the existing rail.

Carpet Python (*Morelia spilota imbricata*)

The Carpet Python is a large snake found across the south-west of Western Australia, from Northampton, south to Albany and eastwards to Kalgoorlie including undisturbed remnant bushland near Perth and the Darling Ranges. This subspecies has been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands and grasslands (AROD, 2012). This species prefers denser understorey vegetation, which provides concealment from both predators and prey (Corey and Doody, 2010).

The vegetation on the site near the Ellen brook is largely devoid of understorey and is not suitable habitat and the presence of the road and rail in the southern part of the site means that this species is unlikely to be present.

Black-striped Minnow (*Galaxiella nigrostriata*)

The Black-striped Minnow occurs in temporary black-water swamps where the water is typically acidic (pH 4.5-6.5) (Smith *et al.*, 2002). This species feeds on small insects, larvae of aquatic insects and micro-crustaceans. Breeding is associated with winter rains (Fishbase, 2012).

This species has an outlier population recorded in Melaleuca in a temporary water body and is more common to the far south-west of Western Australia (Smith *et al.*, 2002). The site does not contain ideal habitat for this species and therefore it is unlikely to be present.

Black-striped snake (*Neelaps calonotos*)

This species occurs on dunes and sand plains vegetated with heaths and Eucalypt/*Banksia* woodlands. It feeds largely on skinks and its distribution is restricted and threatened by urban development (DEC, 2012c).

The habitat on the site is not typical of this species and therefore it is unlikely to be present.

Graceful Sun-moth (*Synemon gratiosa*)

The Graceful Sun-moth is a diurnal moth with dull coloured brown to black forewings and brightly coloured orange hind wings. The larvae burrow into the rhizomes of *Lomandra maritima* and *Lomandra hermaphrodita* exclusively and therefore require the presence of one or both of these species to be present in an area (Bishop *et al.* 2011).

Lomandra maritima or *L. hermaphrodita* is unlikely to be present on the site therefore the Graceful Sun-moth is unlikely to be present on the site

Southern Brown Bandicoot (*Isoodon obesulus* subsp. *fusciventer*)

Southern Brown Bandicoots are small grey marsupials that prefer dense scrub (up to one metre high), often in or near swampy vegetation. Their diet includes invertebrates (including earthworms, adult beetles and their larvae), underground fungi, subterranean plant material, and very occasionally, small vertebrates (DEC, 2012c).

No individuals or typical cone like diggings of this species were identified on the site and the lack of understorey in sheltered places mean this species is unlikely to be present.

Tammar (*Macropus eugenii* subsp. *derbianus*)

Tammars are small wallabies that prefer dense, low vegetation for daytime shelter and open grassy areas for feeding. It is generally found in coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland (DEC, 2012c).

Tammars were once found over the south-west however in recent years they have not been recorded on the Swan Coastal Plain and are highly unlikely to be present on the site.

The likelihood of each species identified in the database searches being present on the site is summarised in Table 9.

Table 9: Likelihood of Conservation Significant species being present on the site

Scientific Name	Common Name	Likelihood to occur on the site
Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black-Cockatoo	Possible
Calyptorhynchus baudinii	Baudin's Cockatoo	Unlikely
Calyptorhynchus latirostris	Carnaby's Cockatoo	Possible
Dasyurus geoffroii	Chuditch, Western Quoll	Highly Unlikely
Macrotis lagotis	Greater Bilby	Highly Unlikely
Pseudemydura umbrina	Western Swamp Turtle, tortoise	Highly Unlikely
Rostratula benghalensis	Painted Snipe	Highly Unlikely
Apus pacificus	Fork-tailed Swift	Unlikely
Ardea alba	Great Egret	Unlikely
Ardea ibis	Cattle Egret	Unlikely
Haliaeetus leucogaster	White-bellied Sea-eagle	Unlikely
Meeorps ornatus	Rainbow Bee-eater	Highly Unlikely
Plegadis falcinellus	Glossy Ibis	Unlikely
Rostratula australis	Australian Painted Snipe	Unlikely
Morelia spilota subsp. *imbricata*	Carpet Python	Unlikely
Galaxiella nigrostriata	Black-stripe Minnow	Unlikely
Neelaps calonotos	Black-striped Snake	Unlikely
Synomen gratiosa	Graceful Sun-moth	Highly Unlikely
Isoodon obesulus subsp. *fusciventer*	Southern Brown Bandicoot	Unlikely
Macropus eugenii subsp. *derbianus*	Tammar Wallaby (WA subsp)	Highly Unlikely

Therefore two Schedule 1 listed species (Carnaby's Black Cockatoo and Forest Red-tailed Black-Cockatoo) possibly utilise the Marri and Flooded Gums trees on the site.

2.11 Heritage

2.11.1 Aboriginal heritage

There are no registered Aboriginal Heritage Sites on the site. There is one listed 'Heritage Place' located on the site and the site ID is 3525 (DIA, 2012; Appendix 7). The Heritage Place is listed as Ellen Brook: Upper Swan and is described as a Mythological site.

2.11.2 European Heritage

There are no listed Heritage Sites or Interim Heritage Sites on the site (Landgate, 2012b; Heritage Council of Western Australia, 2012; SEWPaC, 2012c) and none listed on the Swan Municipal Inventory (Landgate, 2012b).

3 IMPACT OF DEVELOPMENT

3.1 Past and Existing Land Use

There has been some residential development and vegetation has been successively cleared in the area. The activities are unlikely to be sources of contamination. Therefore it is unlikely the past and existing land use will impede the upgrading of the road and the construction of the bridge.

3.2 Surrounding Land Use

The construction of the bridge and road upgrades will not impact on the rail or surrounding agricultural land. The existing land use that may provide some impediment to the proposal is the existing residents as the traffic load on the constructed road will be higher in volume than it is now.

The site is not in the Swan Valley Planning Act area.

Therefore the surrounding existing residents should be consulted at an early stage of planning.

3.3 Geomorphology and Soils

The soils on the site do not provide an impediment to the construction of the road however there were areas that had a High to Moderate and a Moderate to Low risk of ASS.

The WAPC *Acid Sulphate Soils Planning Guidelines* (WAPC, 2009) indicate that "*acid sulphate soils are technically manageable in the majority of cases*". ASS Investigation and Management Plans will be prepared at subdivision stage once the detailed design of the site is finalised. This will be undertaken in accordance with the *Acid Sulphate Soils Guideline Series: Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes* (DEC, 2009a) and Draft *Treatment and Management of Soils and Water in Acid Sulphate Soil Landscapes* (DEC, 2009b). Therefore soils and geomorphology are not an impediment to the construction of the road and bridge.

3.4 Groundwater

The general flow of groundwater to Ellen Brook means that any potential pollutants during and post construction must be removed to prevent contamination to the groundwater. The impact of the development of the road and bridge will need to be managed within the framework and process detailed in the WAPC's urban water management planning guideline document *Better Urban Water Management* (WAPC, 2008) and most likely will require an Urban Water Management Plan.

The vegetation on the site that is to be retained around the bridge area relies on a high water table. To avoid potential impacts on groundwater levels (which in turn could affect adversely affect wetland areas), no design or construction activities should permanently alter the current groundwater levels in this area.

3.5 Surface Water

Surface water on the site adjacent to Ellen Brook is highly modified. The railway and roads constructed on the site have altered flows and these have been historically changed for at least a century. There are also several excavated areas acting as drains and dams within the site. Surface water discharge from the bridge and upgraded road should be able to be managed using Water Sensitive Urban Design as outlined *in Better Urban Water Management* (WAPC, 2008).

Baseline studies and detailed hydrological modelling should be undertaken prior to construction to determine the current hydrological regime can be effectively managed. Construction methods proposed will need to prevent silt, rubbish and pollutants being discharged into Ellen Brook during construction or in the event of significant rainfall during or post construction.

3.6 Ellen Brook

Railway Parade will traverse a section of Ellen Brook which is a Conservation Category (CC) Wetland (UFI 15734). The construction of a bridge on the site will impact on riparian vegetation and has the potential to impact on the water quality and quantity downstream. This may be an impediment to the approval for the construction of the bridge.

The site is not within the Swan River Trust Development Control Area and therefore this body will not be an approving authority however they should be consulted during the design process.

This part of Ellen Brook was included in the Riparian Concept Plan that was prepared by the Ellen Brockman Integrated Catchment Group. This group has significant experience in rehabilitation and weeding the riparian area within Ellen Brook and should be consulted during the design and rehabilitation process.

The objectives for managing Conservation Category wetlands have been defined by Hill *et al.* (1996) and in *Environmental Guidance for Planning and Development – Guidance Statement No. 33* (EPA, 2008). These are outlined below in Table 2.

Table 2: Management Objectives for Conservation Category Wetlands

Management Category	General Description	EPA Management Objectives (EPA, 2008)
Conservation Category Wetland (CCW)	Wetlands which support high levels of attributes and functions.	Highest priority wetlands. Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: • reservation in national parks, • crown reserves and State owned land, • protection under Environmental Protection Policies, and • wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.

Revegetation and weeding of nearby sections of Ellen Brook should be investigated as an offset for the small amount of clearing that will need to occur to construct the bridge.

3.7 Wetlands

Aside from Ellen Brook there are mostly Multiple Use wetlands on the site and one small Resource Enhancement wetland. Resource Enhancement or Multiple Use wetlands do not have protection under Environmental Protection Policies (EPA, 2008) however may be considered significant by the DEC. Construction in the wetland areas may be a constraint to the development of the bridge and road upgrades.

The management categories and objectives for these wetlands are outlined in Table 3.

Table 3: Management Objectives for Resource Enhancement and Multiple Use Wetlands

Management Category	General Description	EPA Management Objectives (EPA, 2008)
Resource Enhancement Wetland (REW)	Wetlands which may have been partially modified but still support substantial ecological attributes and functions.	Priority wetlands. Ultimate objective is to manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored to Conservation category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.
Multiple Use Wetland (MUW)	Wetlands with few attributes which still provide important wetland functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

The Resource Enhancement wetland is highly modified and has only minimal tree cover. To protect as many of the trees as possible a wetland management plan may be required for the parts of the Resource Enhancement wetland that are not proposed to have Railway Parade constructed on it.

3.8 Gauging Station

The Ellen Brook Flow Gauging Station is an important asset used to monitor the health of Ellen Brook. The station is on the eastern side of the railway and therefore not likely to be directly impacted. Indirect impacts may occur during construction such as dust, vibration, diversion of flows or dewatering which may impact on the accuracy of the results of the station's measurements. The construction of the bridge will need to be undertaken to minimise these possible impacts on the station. The Department of Water will need to be kept informed during all stages of works to ensure data from this period is analysed with the potential impacts in mind.

3.9 Vegetation

The development of the site will result in clearing vegetation on the site which is mostly in Degraded to Completely Degraded condition. The vegetation is unlikely to be representative of a TEC or PEC

and is unlikely to be significant. A Vegetation and Rehabilitation Management plan may be required for the protection of the remaining vegetation and to guide the implementation of a rehabilitation program. Revegetation and weeding of nearby sections of Ellen Brook should be investigated as an offset for clearing to construct the bridge and upgrade the road.

3.10 Flora

There are a number of priority species that could possibly be present on the site. Priority species are not protected under the *Wildlife Protection Act, 1950* however the EPA may consider the vegetation to be significant if these species are present. Therefore a Level 2 spring flora survey should be undertaken prior to the road alignment being designed to ensure that any threatened or priority species present on the site are protected as much as possible. This should be undertaken in accordance with *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* - Guidance Statement No. 51 (EPA, 2004a).

3.11 Bush Forever

The Bush Forever and Related Lands MRS Amendment No. 1082/33 gave statutory effect in the MRS that applies in addition to the underlying local government town planning scheme zoning provisions. Under State Planning Policy (SPP) 2.8 *Bushland Policy for the Perth Metropolitan Region* (WAPC, 2010) there is:

> *a general presumption against the clearing of regionally significant bushland, or other degrading activities.*

The exception relevant to the proposed road and bridge construction is:

> *except where a proposal or decision—*
>
> *(a) is consistent with existing approved uses or existing planning/environmental commitments or approvals.*

The site is shown as a local road reserve within City of Swan's LPS 17 and therefore as an existing approved use the clearing of vegetation may be permitted. The WAPC is the current approving authority for impacts on Bush Forever and therefore should be consulted during the design process.

It is likely that a vegetation management plan for the parts of the site that are not going to be cleared will be required along with methods for rehabilitation of areas that are disturbed during the construction of the road and bridge.

3.12 Fauna

Two Schedule 1 listed species (Carnaby's Black Cockatoo and Forest Red-tailed Black-Cockatoo) have been determined to possibly be present on the site. The habitat requirements for Carnaby's Black Cockatoo include foraging (*Banksia* species, Parrot Bush and other Proteaceous shrubs), roosting (tall eucalypts and pines) or breeding habitat (Eucalypt trees). There are very few Proteaceous shrubs and no trees on the site therefore it is concluded that the site contains very little suitable habitat for Carnaby's Black Cockatoo. Development of the road and bridge is unlikely to impact on this species.

The Forest Red-tailed Black Cockatoo feeds on Marri seeds and there are a few specimens of this tree on the site. While the removal of these trees is unlikely to have a significant impact on this species any trees that can be retained within the road reserve should be.

The two Black Cockatoo species that have been determined to possibly be present on the site are listed under the EPBC Act and as such any impact will need to be examined in the context of the *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (SEWPaC, 2009). Once the design and actual area of clearing has been determined it is suggested that this is revisited to ensure the project does not have to be referred to the Department of Sustainability, Environment, Water, Populations and Communities under the EPBC Act.

The Western Swamp Tortoise is located in the Ellenbrook Nature Reserve which is a Class A nature reserve (which under the Western Australian Land Act the Nature Reserve cannot be cancelled, reduced in area or used for any other purpose unless by Act of Parliament). This reserve is vested in the National Parks and Nature Conservation Authority and managed by the Western Australian Department of Environment and Conservation (Burbidge and Kuchling, 1994). The *Western Swamp Tortoise Recovery Plan* looks to ensure there is no impact on the quality and quantity of water in the reserve.

The Ellenbrook Nature Reserve is located approximately 1km upstream (of watercourse – this is approximately 500m as the crow flies) of the site. The construction of the bridge is highly unlikely to impact on the water quantity due to the separation of the site and the habitat area for the tortoise. Water quality in the reserve is highly unlikely to be impacted as the site is downstream of the habitat area.

The site is on the boundary within the Environmental Protection (Western Swamp Tortoise Habitat) Policy (EPP) and as such any development in the area must not include the following activities:

(a) the application of fertilisers and pesticides; and
(b) the disposal of liquid and solid wastes; and
(c) the discharge of polluting substances; and
(d) the extraction of basic raw materials; and
(e) the construction of drainage systems; and
(f) the placement of fill; and
(g) the abstraction of groundwater; and
(h) the clearing of vegetation; and
(i) the lighting of unauthorised fires. (EPA, 2011).

Parts e, f, g and h may describe activities to do with the construction of the bridge. Guidance Statement 7, *Protection of the Western Swamp Tortoise Habitat, Upper Swan/Bullsbrook* (EPA, 2006) states, *the Western Swamp Tortoise Habitat EPP has the purpose of protecting Western Swamp Tortoise habitat*. The statement reiterates the potential for the activities listed in the EPP to degrade the Western Swamp Tortoise habitat and suggests management plans to address factors associated with development in the area. The relevant management plans for the construction of the road and bridge are likely to be required to address the following issues in the context of potential impacts on the Western Swamp Tortoise:

- Nutrient and drainage management;
- Fire management; and
- Native vegetation protection and revegetation.

The Western Swamp Tortoise is also listed as Critically Endangered and under the EPBC Act. Under this Act a significant impact is determined by the sensitivity, value and quality of the environment which is to be impacted and the intensity, duration, magnitude and geographic extent of the impacts. If a proposed action is deemed to have a significant impact, this action should be referred to the Minister. Therefore if any risks to groundwater quality or quantity, fire risk and impacts on the vegetation in the Western Swamp Tortoise habitat that are identified during the studies for the Urban Water Management Plan and other design studies for the site will need to be examined in the context of the *Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (SEWPaC, 2009).

It is not likely that a Level 2 Fauna survey as outlined by *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56.* (EPA, 2004b) will be required for the site.

3.13 Heritage

The 'Heritage Place' located on the site is registered with the Department of Indigenous Affairs and as such advice on the implications under the *Aboriginal Heritage Act 1976* of the Heritage Place mapped over the site will need to be investigated.

3.14 Consultation

The following groups are recommended to be consulted during the planning of the bridge:

- Existing landowners along the proposed upgraded area of the road;
- Swan River Trust;
- Ellen Brockman Integrated Catchment Group;
- Department of Environment and Conservation;
  - Land Use Planning Branch; and
  - Wetlands Branch.
- Environmental Protection Authority;
- Department of Indigenous Affairs;
- Department of Planning;
- Department of Water; and
- Department of Transport.

The Commonwealth Depart of Sustainability, Environment, Water, Populations and Communities (SEWPaC) may need to be consulted if any Matters of National Significance are going to be impacted by the development of the road and bridge however at this point this appears to be unlikely to be required.

4 SUMMARY AND CONCLUSIONS

The Environmental Factors that were studied in this investigation were:

- Past and Existing Land Use;
- Surrounding Land Use;
- Topography;
- Geomorphology and Soils;
- Surface and Groundwater;
- Wetlands;
- Vegetation;
- Flora;
- Fauna; and
- Heritage.

The results of the Environmental Assessment have been summarised in Table 10.

Table 10: Environmental Assessment

Factor	Description	Constraint to Development	Further Studies Required	Future Studies/ Management Plans	Consultation Required
Past and Existing Land Use	A road has been cleared on the site in the past, rail has been constructed for over a century	No	No	No	DoP, WAPC, DoT
Surrounding Land Use	Mostly rural	No	No	No	Surrounding residents
Geomorphology and Soils	Varied soil types from riverine to upland	No	No	Geotechnical studies prior to construction	DoT
	ASS risk mapped on the site	No	Yes	ASS Investigation and if required Management Plan	DEC, ~~DoW~~
Groundwater	Groundwater flows to Ellen Brook and therefore could have downstream impacts	Possibly	Yes	Detailed groundwater studies and modelling for the design of the bridge. Urban Water Management Plan	~~DoW~~, DEC, EPA
	Impacts to groundwater in Western Swam Tortoise habitat	Unlikely	Yes		DEC, DoW, EPA, Possibly SEWPaC

Factor	Description	Constraint to Development	Further Studies Required	Future Studies/ Management Plans	Consultation Required
Surface Water	Surface Water flows to Ellen Brook	Possibly	Yes	Detailed surface water studies and modelling for the design of the bridge. Urban Water Management Plan	DEC (Wetlands), SRT, DoW
Ellen Brook	Ellen Brook is a main tributary to the Swan River	Possibly	No (except Surface and Groundwater studies)	Urban Water Management Plan, Vegetation and Rehabilitation Management Plan	DEC (Wetlands), SRT, EBICG, EPA, DoW
Gauging Station	Water quality and quantity measurement for Ellen Brook	Possibly	No	Construction Environmental Management Plan	DoW, EBICG
Wetlands	Two Multiple Use Wetlands	Unlikely	No	No	No
	One Resource Enhancement Wetland	Possibly	No	Wetland Management Plan or discussed in the Urban Water Management Plan	DEC (Wetlands Branch), EPA, DoW
Vegetation	Vegetation mostly degraded	Unlikely	No	Vegetation and Rehabilitation Management Plan	DEC, EPA,
Rehabilitation	In areas disturbed by construction and potentially degraded areas as an offset	NA	No		EBICG, DEC
Flora	Possible Priority flora present	Possibly	Yes	Level 2 Spring Flora Survey. LOS spring 2013	DEC, EPA
Bush Forever	Ellen Brook wetland boundary is a Bush Forever site	Possibly	No	Vegetation Management Plan and Construction Environmental Management Plan	WAPC, DEC, EPA, EBICG
Fauna	Black Cockatoos	Unlikely	Possibly	Significant Impact studies for Black Cockatoos	DEC, EPA, possibly SEWPaC
	Western Swamp Tortoise			Not required	DEC, EPA, Possibly SEWPaC
Heritage	Heritage Place 3525	Possibly	Yes	Section 18 Clearance if required	DIA