Malaga to Ellenbrook Rail Works
Referral Supplementary Document
December 2019
Document Information

<table>
<thead>
<tr>
<th>Document Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared by</td>
<td>C Baxter</td>
</tr>
<tr>
<td>Reviewed by</td>
<td>M Ludlow</td>
</tr>
<tr>
<td>Prepared for</td>
<td>Environmental Protection Authority</td>
</tr>
<tr>
<td>Version / Revision</td>
<td>1A</td>
</tr>
<tr>
<td>Date</td>
<td>24/12/2019</td>
</tr>
</tbody>
</table>

Distribution List

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthony Sutton</td>
<td>Executive Director</td>
<td>EPA Services</td>
</tr>
<tr>
<td>Hans Jacob</td>
<td>Manager Infrastructure Assessment</td>
<td>EPA Services</td>
</tr>
<tr>
<td>Dehla Goundrey</td>
<td>Manager Strategic Assessment</td>
<td>EPA Services</td>
</tr>
</tbody>
</table>
# Contents

**Contents**

- Executive Summary ........................................................................................................................................ 9
  - Proposal Title: Malaga to Ellenbrook Rail Works ................................................................. 9

## 1. Introduction .......................................................................................................................... 20
  1.1. Purpose and scope ........................................................................................................... 20
  1.2. Proponent ..................................................................................................................... 20
  1.3. Environmental Impact Assessment Process ................................................................... 20
    1.3.1. Environmental Protection Act 1986 ........................................................................ 20
    1.3.2. Environment Protection and Biodiversity Conservation Act 1999 ....................... 20
    1.3.3. Other approvals and legislation ............................................................................... 21

## 2. The Proposal ........................................................................................................................ 23
  2.1. Background .................................................................................................................... 23
    2.1.1. Land use planning and zoning ................................................................................. 23
    2.1.2. Sustainability ........................................................................................................... 24
    2.1.3. Project Alternatives .................................................................................................. 24
  2.2. Proposal description ....................................................................................................... 30
    2.2.1. Development Envelope ............................................................................................ 32
    2.2.2. Railway tracks and infrastructure ............................................................................. 32
    2.2.3. Stations ................................................................................................................... 32
    2.2.4. Bridges and underpasses ........................................................................................ 33
    2.2.5. Temporary construction areas .................................................................................. 33
    2.2.6. Malaga Station Precinct ........................................................................................... 34
    2.2.7. Future rail stabling facility ........................................................................................ 34
    2.2.8. Stormwater Drainage Infrastructure ......................................................................... 34
    2.2.9. Dewatering and groundwater abstraction requirements ........................................... 34
  2.3. Local and regional context .............................................................................................. 39
    2.3.1. Geology and soils .................................................................................................... 39
    2.3.2. Hydrology ............................................................................................................... 39

## 3. Stakeholder consultation .................................................................................................... 41
  3.1. Key stakeholders ............................................................................................................. 41
  3.2. Stakeholder engagement process ................................................................................... 42
  3.3. Stakeholder consultation ................................................................................................. 42

## 4. Environmental principles .................................................................................................. 48
4.1. Environmental Factors ........................................................................................................ 50

5. Flora and vegetation ........................................................................................................ 54
5.1. EPA objective ................................................................................................................ 54
5.2. Policy and guidance ........................................................................................................ 54
5.3. Receiving environment .................................................................................................. 54
5.3.1. Surveys and studies ................................................................................................ 54
5.3.2. Survey type and coverage ..................................................................................... 56
5.3.3. Interim Biogeographical Regionalisation of Australia ....................................... 58
5.3.4. Geology, landform and soils ............................................................................... 58
5.3.5. DBCA managed lands and reserves ................................................................... 58
5.3.6. Bush Forever Sites ............................................................................................... 58
5.3.7. Wetlands ............................................................................................................... 59
5.3.8. Regional ecological linkages ............................................................................... 60
5.3.9. Vegetation associations ....................................................................................... 63
5.3.10. Heddle Vegetation complexes ........................................................................... 64
5.3.11. Vegetation types .................................................................................................. 65
5.3.12. Vegetation condition ............................................................................................ 69
5.3.13. Threatened and priority ecological communities ............................................ 76
5.3.14. Other conservation significant ecological communities ................................... 76
5.3.15. Conservation significant flora ............................................................................ 76
5.3.16. Dieback ................................................................................................................ 83
5.3.17. Weeds ................................................................................................................... 83
5.4. Assessment of impacts to Flora and Vegetation ....................................................... 88
5.5. Further investigations .................................................................................................... 91
5.6. Predicted outcome ......................................................................................................... 91

6. Terrestrial Fauna ............................................................................................................ 92
6.1. EPA objective ............................................................................................................... 92
6.2. Policy and guidance ..................................................................................................... 92
6.3. Receiving environment ............................................................................................... 92
6.3.1. Surveys and studies ............................................................................................... 92
6.3.2. Fauna habitat ........................................................................................................ 97
6.3.3. Conservation significant fauna ............................................................................ 104
6.3.4. Subterranean fauna ............................................................................................. 113
6.3.5. Short-range endemics .......................................................................................... 113
6.3.6. Black Cockatoo Species ...................................................................................... 113
9.3.5. Amenity ................................................................................................................................. 151
9.4. Assessment of impacts to Social Surroundings ........................................................................... 152
9.5. Predicted outcome ..................................................................................................................... 155
10. Offsets .......................................................................................................................................... 156
11. Conclusion ..................................................................................................................................... 157
12. References .................................................................................................................................... 158
13. Appendices ..................................................................................................................................... 165

Tables

Table 1: Proponent details .................................................................................................................. 20
Table 2: Other approvals requirements .............................................................................................. 21
Table 3: Summary of the Proposal ...................................................................................................... 30
Table 4: Key Proposal Characteristics ............................................................................................... 31
Table 5: Stakeholder consultation ...................................................................................................... 43
Table 6: Environmental Principles .................................................................................................. 48
Table 7: Assessment of Other Environmental Factors ...................................................................... 51
Table 8: Summary of environmental investigations relevant to terrestrial flora and vegetation ...... 54
Table 9: DBCA managed lands and reserves .................................................................................... 58
Table 10: Bush Forever Sites in or within 1 km of the development envelope .................................. 59
Table 11: Pre-European extent, current extent and reservation status of vegetation associations within the Western Australia, Perth IBRA subregion and City of Swan .................................................. 63
Table 12: Vegetation complexes within the development envelope .............................................. 64
Table 13: Extent of vegetation complexes within the development envelope, Swan Coastal Plain and City of Swan ........................................................................................................................................ 64
Table 14: Broad vegetation types within the development envelope .............................................. 65
Table 15: Vegetation units within the development envelope (RPS 2019) ........................................ 67
Table 16: Threatened and Priority flora recorded within a 5 km radius of the development envelope with a moderate to high likelihood of occurrence ................................................. 77
Table 17: Impacts and preliminary mitigation for Flora and Vegetation ........................................... 88
Table 18: Proposed flora and vegetation surveys .............................................................................. 91
Table 19: Summary of terrestrial fauna investigations ...................................................................... 93
Table 20: Terrestrial Ecosystem (2018) mapped fauna habitat sites and descriptions .................... 97
Table 21: Fauna habitat types mapped intersecting and/or within the vicinity of the development envelope .................................................................................................................................. 99
Table 22: Fauna habitat types mapped within the Drumpellier Drive portion of the development envelope (AECOM, 2016) ........................................................................................................... 103
Table 23: Conservation significant fauna potentially occurring within the development envelope (Terrestrial Ecosystems, 2018) .................................................................................................................. 105
Table 24: Area of Black Cockatoo foraging habitats mapped within the development envelope (Terrestrial Ecosystems 2018) ................................................................................................................................. 114
Table 25: Potential impacts and preliminary mitigation for Terrestrial Fauna ........................................... 120
Table 26: Potential impact to Black Cockatoo from the Proposal based on Commonwealth referral guidelines (Australian Government, 2012; Terrestrial Ecology, 2018) .............................. 121
Table 27: Summary of environmental investigations relevant to terrestrial environmental quality 124
Table 28: Impacts and preliminary mitigation for Terrestrial Environmental Quality .............................. 129
Table 29: Further environmental investigations relevant to terrestrial environmental quality .......... 131
Table 30: Summary of environmental investigations relevant to Inland Waters .................................. 132
Table 31: Current status of wetlands that intersect the development envelope ................................... 135
Table 32: Impacts and preliminary mitigation for Inland Waters ......................................................... 142
Table 33: Further environmental investigations relevant to inland waters ......................................... 144
Table 34: Environmental investigations undertaken within and/or adjacent to the development envelope ..................................................................................................................................... 146
Table 35: Registered Aboriginal sites that intersect with the development envelope .............................. 147
Table 36: Lodged Aboriginal heritage sites ............................................................................................. 149
Table 37: Impacts and preliminary mitigation for Social Surroundings ................................................. 152

Figures

Figure 1: The Proposal ................................................................................................................. 26
Figure 2: Metropolitan Region Scheme Zoning ............................................................................. 27
Figure 3: Indicative proposal activities .......................................................................................... 36
Figure 4: Regional Context ............................................................................................................ 40
Figure 5: Flora and Vegetation – Survey type and coverage ......................................................... 57
Figure 6: Regional Linkages ........................................................................................................ 62
Figure 7: Vegetation types ........................................................................................................... 70
Figure 8: Vegetation Condition ..................................................................................................... 73
Figure 9: Conservation Significant Communities ............................................................................. 84
Figure 10: Conservation Significant Flora ..................................................................................... 87
Figure 11: Terrestrial Fauna survey type and coverage .................................................................. 95
Figure 12: Black Cockatoo survey coverage ................................................................................. 96
Figure 13: Terrestrial fauna habitat ............................................................................................. 110
Figure 14: Black Cockatoo habitat .............................................................................................. 116
Figure 15: Acid Sulfate Soil Risk ................................................................................................. 127
Figure 16: Contaminated Sites .................................................................................................... 128
Figure 17: Geomorphic Wetlands and Surface Water Features .................................................. 136
Figure 18: Groundwater features ................................................................................................ 141
Figure 19: Aboriginal and European Heritage Sites ................................................................. 150
Executive Summary

Proposal Title: Malaga to Ellenbrook Rail Works

The Malaga to Ellenbrook Rail Works (the Proposal) is located between 12 to 22 kilometres (km) north-east of the Perth CBD, within the City of Swan. The Proposal connects to the proposed Bayswater to Malaga railway line at the eastern edge of the Tonkin Highway road reserve.

The Public Transport Authority of Western Australia (PTA) is proposing to develop the Malaga to Ellenbrook Rail Works (the Proposal) as part of the Western Australian Government’s METRONET vision. Table ES1 provides a summary of the Proposal.

The Proposal includes the installation of 13 km of new dual railway track which spurs off the proposed Bayswater to Malaga Rail Works line, and includes the construction and operation of three new stations at Malaga, Whiteman Park and Ellenbrook with intermodal rail, bus, carpark, and active mode (cycling and walking) facilities at each station and potential rail stabling. A potential future station is also proposed at Bennett Springs (Figure 1).

The Proposal’s 501 ha development envelope extends east from the Tonkin Highway, north of Marshall Road to Bennett Springs where the railway alignment turns to the north to run adjacent to Drumpellier Drive (formerly Lord Street), passing under Gnangara Road and turning to the northeast to terminate south of The Parkway in Ellenbrook (Figure 1).

Table ES2 provides a detailed summary of the location and extent of physical and operational elements of the Proposal.

The PTA is committed to engaging with stakeholders to ensure that all stakeholders’ views can be considered during the development of the Proposal. The PTA1 has a dedicated community consultation team that has extensively consulted with key stakeholders to inform the portfolio of METRONET Projects. Extensive Stakeholder consultation has been conducted for this Proposal across a range of stakeholder groups identified in Section 3.1.

Community engagement has centred around communities along the Proposal’s alignment as well as those that may benefit from the Proposal. A dedicated METRONET website has been established, providing a detailed overview of the project, allowing interested parties to inquire about METRONET and register for project specific updates.

There has also been early engagement and continuous consultation with government agencies and local government authorities on the potential social and environmental impacts of this Proposal. The PTA attends a monthly Environmental Stakeholder Reference Group (ESRG) with Department of Water and Environmental Regulation (DWER) and Department of Biodiversity, Conservation and Attractions (DBCA) to consult on matters pertaining to this Proposal and has sought and applied technical and strategic advice on key environmental factors associated with this Proposal.

The PTA is referring this Proposal to the Environmental Protection Authority (EPA) under Section 38 of the Environmental Protection Act 1986 (EP Act). The constraints analysis, environmental surveys, studies and assessments undertaken to date indicate there are potential environmental impacts that will require planning, mitigation and management to meet the EPA’s objectives for environmental

---

1 Note: As well as direct PTA engagement, representatives of the METRONET Office, which is a collaboration of key State Government agencies involved in the planning of METRONET projects, have also been part of the consultation process during the planning of the proposed works to date.
factors. This document provides information about preliminary environmental investigations undertaken to support the environmental assessment of the Proposal.

Based on environmental investigations undertaken to date and the PTA’s knowledge and understanding from implementing previous rail infrastructure approvals within the Perth metropolitan area, the preliminary key factors are considered to be:

- Flora and vegetation;
  - Terrestrial environmental quality;
  - Terrestrial fauna;
  - Inland waters; and
  - Social surroundings.

Further surveys and studies are progressing to assess and evaluate potential environmental impacts of the Proposal and these studies will be utilised to inform and guide the PTA in avoiding, mitigating, managing and offsetting the potential impacts. As detailed design progresses the PTA will endeavour as far as practicable to avoid potential impacts such as the clearing of vegetation. After implementation of the mitigation hierarchy, the PTA considers that the EPA’s objectives can be met.

Environmental studies, surveys and assessments undertaken to support the Proposal have identified that there is the potential for significant impacts to Matters of National Environmental Significance, in particular Commonwealth listed species and threatened ecological communities (TECs). The Proposal has been referred to the Commonwealth for approval under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). A decision has not been made to date on whether the Proposal requires Commonwealth assessment but it is anticipated that the Proposal will be a Controlled Action and will require Commonwealth approval. The PTA has requested that the EPBC Act referral is assessed by the EPA under an individual accredited assessment process.

The Proposal’s relevant environmental factors, preliminary potential environmental impacts and preliminary mitigation measures are summarised and compared against EPA Objectives in Table ES3.

Table ES1 – Summary of the Proposal

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal title</td>
<td>Malaga to Ellenbrook Rail Works</td>
</tr>
<tr>
<td>Proponent name</td>
<td>Public Transport Authority of Western Australia</td>
</tr>
<tr>
<td>Short description</td>
<td>The Proposal is to construct and operate a 13km new dual railway track, which connects to the Bayswater to Malaga Rail Works proposal. The Proposal includes the construction and operation of three new stations at Malaga, Whiteman Park and Ellenbrook, with provision for a future Bennett Springs East Station. Provision will also be made for a potential future Rail Stabling Facility at Henley Brook within Whiteman Park.</td>
</tr>
<tr>
<td>Element</td>
<td>Location</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Physical elements</strong></td>
<td></td>
</tr>
<tr>
<td>Permanent infrastructure, including:</td>
<td>Construction of railway tracks and associated infrastructure</td>
</tr>
<tr>
<td>Railway tracks and associated infrastructure</td>
<td>A 13 km dual track railway which connects to the proposed Bayswater to Malaga railway track. The railway track extends from the eastern edge of the Tonkin Highway road reserve heading generally east across the Marshall Road paddocks of Whiteman Park. In Bennett Springs, the railway alignment turns to the north to run adjacent to Drumpellier Drive (formerly Lord Street), passing under Gnangara Road and turning to the northeast to terminate at Ellenbrook Station (Figure 1). Provision for a potential future rail stabling facility east of Drumpellier Drive in Whiteman.</td>
</tr>
<tr>
<td>Malaga Station</td>
<td>Construction of railway stations and associated facilities</td>
</tr>
<tr>
<td>Future Bennet Springs East Station</td>
<td>Including intermodal rail, bus, ‘park and ride’, ‘kiss and ride’ and active mode (walking/cycling) facilities.</td>
</tr>
<tr>
<td>Whiteman Park Station</td>
<td>Malaga Station</td>
</tr>
<tr>
<td>Ellenbrook Station</td>
<td>Future Bennet Springs East Station</td>
</tr>
<tr>
<td>Construction and access areas</td>
<td>Whiteman Park Station</td>
</tr>
<tr>
<td></td>
<td>Ellenbrook Station</td>
</tr>
<tr>
<td></td>
<td>Construction and Access Areas</td>
</tr>
</tbody>
</table>
### Operational elements

| Rail and Bus Services | The passenger railway is proposed to operate as an extension to the proposed Bayswater to Malaga railway track, extending 13 km to Ellenbrook (Figure 1). Rail and bus services are proposed to operate at Malaga Station, Bennett Springs East Station, Whiteman Park Station and Ellenbrook Station. | The construction and access areas will be located within the 501 ha development envelope (Figure 1). |
Table ES3 – Summary of preliminary assessment of environmental factors

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flora and vegetation</strong></td>
<td><strong>EPA Objective</strong> To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</td>
</tr>
</tbody>
</table>
| **Policy and guidance** | • *Biodiversity Conservation Act 2016* (WA).  
  • *Biosecurity and Agriculture Management Act 2007* (WA) (BAM Act).  
  • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a).  
  • Environmental Protection Bulletin 20 – Protection of naturally vegetated areas through planning and development (EPA 2013a).  
  • State Planning Policy No. 2.8 Bushland Policy for the Perth Metropolitan Region (WAPC 2010).  
  • *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.  
  • Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems (EPA 2006).  
  • Statement of Environmental Principles, Factors and Objectives. (EPA 2018b). |
| **Potential impacts**    | • Based on current studies, 123 ha of native vegetation of Degraded or better condition, and 190 ha of vegetation of Completely Degraded condition, may potentially be cleared in a development envelope of 501 ha for the Proposal.  
  • Clearing of Bush Forever site 304, where 81.70 ha is within the development envelope. The PTA is currently undertaking further planning and design work to reduce the amount of clearing required to implement the Proposal.  
  • Clearing of up to 23.06 ha of Banksia Woodland of the Swan Coastal Plain TEC. This TEC is a subset of the Banksia dominated woodlands of the Swan Coastal Plain IBRA Region PEC (Priority 3) in Good or better condition.  
  • Potential indirect impacts to areas of groundwater dependent vegetation, such as areas of TEC and PEC due to dewatering activities or changes to drainage regimes.  
  • Clearing of the following conservation significant flora which occur, or have a high likelihood of occurring, within the development envelope:  
    • *Anigozanthos humilis subsp. chrysanthus* (Priority 4) – recorded in the development envelope;  
    • *Cyathochaeta teretifolia* (Priority 3) – recorded in the survey area; and  
    • *Caladenia huegelii* (Threatened) – high likelihood of occurring within the survey area. |
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
</table>
| Mitigation    | **Avoid**  
- The Proposal development envelope has been designed to minimise the potential impacts to native vegetation.                                                                                       |
|               | **Minimise**  
- PTA will utilise cleared areas for laydown and temporary construction where practicable.  
- The PTA is committed to further investigate avoiding areas of vegetation where practicable.  
- The PTA will aim to minimise the clearing footprint of native vegetation further during the detailed design phase, where practicable, to minimise the overall potential impact. |
|               | A Construction Environmental Management Plan (CEMP) will be developed which will include measures to mitigate clearing impacts to vegetation.                                                               |
| Predicted outcome | Through completion of comprehensive baseline studies, optimisation of the project footprint to utilise existing disturbed areas and implementation of stringent management measures, the Proposal will meet the EPA's objective to protect flora and vegetation so that biological diversity and ecological integrity are maintained. |
| Terrestrial Fauna |                                                                                                                                                                                                     |
| EPA Objective | To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.                                                                                                       |
| Policy guidance and guidance |  
- Biodiversity Conservation Act 2016 (WA).  
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c).  
- Statement of Environmental Principles, Factors and Objectives. (EPA 2018b). |
| Potential impacts |  
- Clearing of up to an estimated 43 ha of fauna habitat within the development envelope. This estimation is assuming the worst case scenario, as a final design footprint has not yet been finalised. Of the 43 ha, 36.8 ha is considered completely degraded and of low fauna habitat value.  
- Direct and indirect impacts to fauna habitat due to clearing.  
- Potential impacts to conservation significant fauna due to clearing.  
- Loss of ecological connectivity within portions of Whiteman Park where the railway will cross Bennett Brook. |
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
</table>
| • Fragmentation of fauna habitat and Whiteman Park.  
• Potential indirect impacts to fauna values within the vicinity of the development envelope. |

**Mitigation**

*Avoid:*

• The proposal was designed to prioritise placement within existing linear infrastructure corridors where practicable, to minimise vegetation clearing.

• The PTA will further investigate avoiding areas of fauna habitat during the detailed design phase, where practicable.

*Minimise:*

Within the Proposal’s development envelope, the clearing of fauna habitats will be minimised as far as practical in the final proposal design.

• A CEMP will be developed and implemented during construction including mitigation and management measures.

**Predicted outcome**

The PTA considers that through implementation of the mitigation hierarchy and implementation of the CEMP, the Terrestrial Fauna environmental factor can be managed during the construction and operation of the Proposal, and the EPA’s objective will be met.

### Terrestrial Environmental Quality

**EPA Objective**

To maintain the quality of land and soils so that environmental values are protected.

**Policy and guidance**

• Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016b).

• *Contaminated Sites Act 2003.*

• Assessment and Management of Contaminated Sites (DWER 2014).

• Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DWER 2015a).

• Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DWER 2015b).

• Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (DoH 2009).

**Potential impacts**

• Disturbance to ASS during excavation activities may result in oxidation of ASS and leaching of metals in the vicinity of the proposal.

• Localised and temporary dewatering as a result of excavation activities below the groundwater level may result in oxidation of ASS and leaching of metals in the vicinity of the proposal.

• Disturbance to known or suspected contaminated sites, including drawing in of contaminated groundwater outside the development envelope, has the potential to mobilise existing contaminants, increasing the risk of adverse impacts to environmental values.
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Contamination of groundwater and soils from construction or stockpiling activities.</td>
<td></td>
</tr>
</tbody>
</table>

**Mitigation**

**Avoid:**

- All hazardous substances will be stored outside of Public Drinking Water Source Areas.
- The Proposal has been designed to avoid excavation and large-scale dewatering in ASS high risk areas, where practicable.

**Minimise**

- Detailed ASS and hydrological studies will be undertaken to assess the ASS and contamination risks of the Proposal.
- Preliminary and if required detailed site investigations will be undertaken to identify potential impacts from known contaminated sites.
- Further ASS investigations will be undertaken once the design has been finalised by the construction contractor and potential disturbance depths and locations are known.
- An ASS and Dewatering Management Plan (ASSDMP) will be prepared and implemented by the construction contractor.
- A CEMP will be prepared and implemented by the contractor to detail the management of construction works associated with the Proposal.
- A groundwater monitoring program may be required to assess the effectiveness of ASS management measures and validate that the Proposal has not resulted in an increase in the type or extent of contamination.

**Rehabilitate:**

- The contractor will undertake remediation of ASS if disturbance is unavoidable in accordance with the ASSDMP.
- Upon completion of works, any treatment pad areas will be appropriately decommissioned, comprising validation, and if required remediation, of the ground surface where the treatment pad and associated infrastructure was located.

**Predicted outcome**

The PTA considers that through implementation of the mitigation hierarchy and implementation of the CEMP, the Terrestrial Environmental Quality environmental factor can be managed during the construction and operation of the Proposal, and the EPA’s objective will be met.

**Inland Waters**

**EPA Objective**

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

**Policy guidance**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspect</strong></td>
<td><strong>Description</strong></td>
</tr>
</tbody>
</table>
| | • A guide to managing and restoring wetlands in Western Australia (DEC 2012c).  
• Wetlands Conservation Policy for Western Australia (Government of Australia 1997). |
| **Potential impacts** | • Direct impacts to surface water and changes to surface water flows.  
• Direct impact to surface water quality due to contamination from spills, incidents or uncontrolled surface water flows.  
• Impact to groundwater dependent vegetation and groundwater users due to changes to surface water flows.  
• Direct or indirect impacts to Conservation Category Wetlands (CCWs) and Resource Enhancement Wetlands (REWs) that intersect or are adjacent to the development envelope.  
• Potential impacts to groundwater levels and quantity due to potential dewatering and/or groundwater abstraction.  
• Potential impacts to groundwater dependent vegetation due to hydrological changes associated with temporary groundwater dewatering and abstraction. |
| **Mitigation** | **Avoid**  
• Dewatering and water abstraction will be minimised, as far as practicable, in the development envelope.  
**Minimise**  
The PTA will undertake a number of measures to minimise impacts on groundwater, including:  
• Following detailed design, a review of dewatering and groundwater abstraction activities, if required, will be undertaken to evaluate the potential direct and indirect impacts to environmental values.  
• Dewatering impacts will be managed under a Rights in Water and Irrigation Act 1914 (RIWI Act) dewatering licence to minimise potential impacts to environmental values including groundwater dependent vegetation.  
• An ASS Management Plan will be developed to manage impacts associated with ASS including the potential oxidation of ASS in or near wetlands.  
• A CEMP will be developed and implemented, which will include measures to mitigate risks to groundwater including chemical and fuel storage and spill response in the development envelope.  
• The PTA’s Spill Response Framework and Procedures will be implemented to contain chemical and fuel spills and to ensure no contaminants enter the groundwater. |
<p>| <strong>Predicted outcome</strong> | The project will meet the EPA’s objective to protect inland waters and to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected, following the completion of comprehensive baseline studies, optimisation of the Proposal’s footprint to utilise existing disturbed areas and implementation of targeted environmental management measures and offsets if significant residual impacts remain. In addition, potential |</p>
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>direct and indirect impacts to surface and groundwater can be managed in accordance with licensing issued under the RIWI Act.</td>
</tr>
</tbody>
</table>

### Social Surroundings

<table>
<thead>
<tr>
<th>EPA Objective</th>
<th>To protect social surroundings from significant harm.</th>
</tr>
</thead>
</table>
| Policy and guidance | • Environmental Factor Guideline: Social Surroundings (EPA 2016g).  
• *Aboriginal Heritage Act* 1972.  
• *Environmental Protection (Noise) Regulations* 1997.  
• State Planning Policy 5.4 Road and rail noise (WAPC 2019).  
• Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration (Standards Australia 2018).  
• Rail Infrastructure Noise Guideline (EPA 2013b).  
• Visual Landscape Planning in Western Australia Manual (WAPC 2007).  
• A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DEC 2011). |

### Potential impacts

The potential impacts to Registered Aboriginal Sites as a result of implementing the Proposal include:

- Site ID 3692: Clearing of riparian vegetation and construction of a railway bridge across Bennett Brook.
- Site ID 551: No new impacts to the Site.
- Site ID 552: The railway alignment passes to the east of this Site, impacts will be minimal.
- There are no State Registered sites of European Heritage located within the development envelope. The City of Swan’s Municipal Heritage Inventory lists Whiteman Park as a place of cultural heritage significance.

Amenity Impacts:

- **Operational Noise and Vibration**: A preliminary noise and vibration assessment on a preliminary railway design indicates that noise and vibration levels are likely to exceed the project criteria unless mitigation measures are implemented.
- **Construction noise and vibration**: Construction noise and vibration may have a temporary impact on sensitive receivers during construction.
- **Dust**: Construction of the Proposal will result in dust from construction activities. If airborne dust extends beyond the development envelope, this may become a nuisance to residents in residential areas near or adjacent to the Proposal.
- **Visual**: Permanent visual intrusion impacts to nearby receptors from the construction of elevated rail, road bridges and noise walls/barriers.
- **Natural Landscapes**: Access to the southern and eastern extents of Whiteman Park will be impacted temporarily during construction and once
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitigation</td>
<td>the railway is operational alternative access arrangements will need to be implemented.</td>
</tr>
</tbody>
</table>

**Mitigation**

*Avoid:*
- The Proposal has been designed to utilise the existing cleared areas and road reserve where land has already been disturbed and cleared for recent projects (i.e. Drumpellier Drive).
- The Proposal has been designed to utilise areas with minimal sensitive receptors.

*Minimise:*
- The PTA commits to the following measures in relation to Aboriginal heritage:
  - Seek s18 approval for disturbance to Registered Aboriginal Sites required to be disturbed for the Proposal.
  - During construction, cease disturbance activities as soon as possible in the event of finding potential Aboriginal artefacts, objects or remains.
  - Ensuring Noongar monitors are on site for ground disturbing works as agreed during consultation.
- Further noise and vibration modelling assessment to be undertaken based on the final design and operational requirements. Recommended mitigation measures outlined in the pending modelling will be documented in a Noise and Vibration Management Plan (NVMP) and any mitigation measures implemented to achieve compliance with the project criteria.
- Residents in the vicinity of any proposed noise walls/barriers will be consulted as to the location, height, materials, design and colour.
- The Proposal has been designed to minimise direct and indirect impacts to Whiteman Park. The PTA will continue consultation with the Western Australian Planning Commission (WAPC), Department of Planning, Lands and Heritage (DPLH) and Whiteman Park operators to minimise impacts to park access. Public access to Whiteman Park will be maintained throughout construction and operation of the Proposal.
- A CEMP will be developed and implemented to outline appropriate management measures for managing dust impacts.
- The project’s community consultation program will continue, with feedback to be considered during detailed engineering design.

**Predicted outcome**

The Proponent considers that through the implementation of appropriate avoidance and mitigation measures and implementation of a CEMP and NVMP, the Social Surroundings environmental factor can be appropriately managed during the construction and operation of the Proposal, such that the EPA’s objective will be met.
1. Introduction

1.1. Purpose and scope

The Public Transport Authority of Western Australia (PTA) is referring the Malaga to Ellenbrook Rail Works Proposal to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act).

The purpose of this Supporting Document is to provide information to support the referral. This document provides information on the Proposal’s activities, the potential environmental impacts (including the significance of those impacts) and the Proposal’s mitigation and management measures. This document has been prepared in accordance with the EPA’s Instructions on how to prepare an Environmental Review Document (EPA 2018a).

1.2. Proponent

The proponent of this Proposal is the PTA. All correspondence regarding this Proposal should be forwarded to the key contact in Table 1.

<table>
<thead>
<tr>
<th>Proponent contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Miranda Ludlow</td>
</tr>
<tr>
<td>Postal Address: 116 West Parade</td>
</tr>
<tr>
<td>Email: <a href="mailto:miranda.ludlow@pta.wa.gov.au">miranda.ludlow@pta.wa.gov.au</a></td>
</tr>
<tr>
<td>Telephone: 0434 362 186</td>
</tr>
</tbody>
</table>

1.3. Environmental Impact Assessment Process

This supporting document aims to provide information for the EPA to determine whether to assess the Proposal. The PTA has consulted with government agencies and key stakeholders to obtain feedback for input into this document to inform the preliminary environmental impact assessment of the Proposal.

1.3.1. Environmental Protection Act 1986

The EP Act is the key legislative tool for environmental protection in Western Australia. The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment. Part IV of the EP Act (environment impact assessment) is administered by the EPA and the Minister for the Environment. The Proposal is being referred under Part IV of the EP Act.

1.3.2. Environment Protection and Biodiversity Conservation Act 1999

A proposed action that may have a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A proposed action that may have a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth under the EPBC Act. The PTA
considers that this Proposal has the potential to significantly impact MNES and has referred it to the Commonwealth Department of the Environment and Energy (DotEE) for approval under the EPBC Act.

The MNES that are likely to be significantly impacted by this Proposal are the direct or indirect impacts on Commonwealth listed species and threatened ecological communities (TECs). There are two listed Black Cockatoo species, Carnaby’s Cockatoo (*Calyptorhynchus latirostris*) listed as endangered and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) listed as vulnerable, that may be directly impacted by a loss of foraging habitat and potential breeding trees. The Proposal will also directly impact, through proposed clearing, areas of Good or better condition Banksia Woodlands of the Swan Coastal Plain TEC, Commonwealth listed as endangered.

Two other listed species the Grand Spider Orchid (*Caladenia huegelii*) and Black-stripe Minnow (*Galaxiella nigrostriata*), both listed as Endangered, have a high likelihood of occurring within the development envelope and therefore may also be impacted by this proposal, although studies to date have not identified their presence within the development envelope.

A migratory species protected as a MNES, the Glossy Ibis (*Plegadis falcinellus*), was observed near Horse Swamp in close proximity to the development envelope. The habitat within the development envelope is not critical for the survival of this species and the species is expected to move to adjacent areas when disturbed. It is considered unlikely the Glossy Ibis will be significantly impacted by the Proposal.

The PTA referred this Proposal to DotEE on 23 September 2019, this was validated and published for public comment on 4 December 2019, with comments closing 18 December 2019. A decision has not been made to date on whether the Proposal requires Commonwealth assessment, but it is anticipated that the Proposal will be a Controlled Action and will require Commonwealth approval. The PTA has requested that the EPBC Act referral is assessed by the EPA under an individual accredited assessment process.

### 1.3.3. Other approvals and legislation

The Proposal will be required to comply with the requirements of other relevant state legislation and regulation. Table 2 provides an overview of other approvals that may be required to implement the Proposal.

**Table 2: Other approvals requirements**

<table>
<thead>
<tr>
<th>Potential activities</th>
<th>Type of approval</th>
<th>Legislation regulating the activity</th>
<th>Decision Making Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of railway, stations, related car parks and public transport interchange facilities outside of the rail corridor.</td>
<td>Development application(s).</td>
<td><em>Planning and Development Act 2005.</em></td>
<td>City of Swan and Western Australian Planning Commission (WAPC).</td>
</tr>
<tr>
<td>Groundwater abstraction may be required to provide a construction water supply or for dewatering for piling to construct bridges or install/relocate services.</td>
<td>5C or 26D Licence.</td>
<td><em>Rights in Water and Irrigation Act 1914 (RIWI Act).</em></td>
<td>DWER.</td>
</tr>
<tr>
<td>Potential activities</td>
<td>Type of approval</td>
<td>Legislation regulating the activity</td>
<td>Decision Making Authority</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>For any potential construction activities that may be required out of hours.</td>
<td>Out of hours Noise Management Plan (NMP).</td>
<td><em>Environmental Protection (Noise) Regulations 1997.</em></td>
<td>City of Swan as required.</td>
</tr>
</tbody>
</table>


2. The Proposal

2.1. Background

The Western Australian Government has developed a vision to implement and build METRONET, which will aid in transforming Perth’s public transport network (METRONET 2019). The long-term vision (i.e. to 2050) is for a public transport network to support a population of 3.5 million people.

The Public Transport Authority of Western Australia (PTA) is proposing to develop the Morley-Ellenbrook Line (MEL) Project as part of METRONET. The MEL Project consists of a 21 kilometres (km) railway line that will connect Ellenbrook to the existing passenger railway network at Bayswater. The Bayswater to Malaga Rail Works have previously been referred to the EPA with a decision made that these works did not warrant formal assessment under Part IV of the EP Act. This Proposal is for the Malaga to Ellenbrook Rail Works.

The Proposal is one of METRONET’s priority projects, seeking to:

1. Improve connectivity and integrated transport options within Perth’s north-eastern suburbs.
2. Reduce car dependency and congestion and change travel behaviours within the north-eastern suburbs and within Greater Perth.
3. Improve liveability through the creation of ‘places’, and improved urban form, that build on the character and identity of the local area and encourage urban consolidation.
4. Mitigate project deliverability risks by minimising impacts where possible to major infrastructure, community infrastructure, amenity and the environment.
5. Unlock the economic development potential of Perth’s north-eastern suburbs and provide improved access to employment opportunities.

2.1.1. Land use planning and zoning

The Proposal has been designed to provide better public transport options for the growing Ellenbrook town centre and Perth’s north-eastern suburbs. The north-eastern suburbs are one of Australia’s fastest growing areas with the population expected to almost double to 415,000 by 2031.

The indicative railway alignment travels through the following Metropolitan Region Scheme zonings (illustrated on Figure 2):

- Malaga Station – currently urban deferred land proposed to be residential in the future. To the west and south of the station is already urban residential development.
- Malaga Station to future Bennett Springs East Station – currently parks and recreation but identified as a Planning Investigation Area as part of the Perth and Peel @ 3.5 Million North-East sub-regional planning framework. This site was identified as having the potential for future infill residential development but requires further detailed planning to determine whether it is possible and/or appropriate to rezone the land for this purpose.
- Future Bennett Springs East Station – currently urban deferred land with semi-rural lots containing residences and businesses. Future residential development.
- Future Bennett Springs East Station to Gnangara Road/Drumpellier Drive – the western side of the railway is Whiteman Park which is reserved for parks and recreation and the eastern side is Drumpellier Drive and mostly urban zoned land, with some rural and parks and recreation. The majority of the urban zoned land has already been developed.
2.1.2. Sustainability

A Sustainability Strategy has been developed by the METRONET Office (MO) to clearly define 'sustainability' in the context of METRONET and articulate the specific commitments to achieving sustainable outcomes. The strategy is intended to align with and support key State Government policies and directions, including: *Perth and Peel @ 3.5 Million*; *Our Priorities: Sharing Prosperity*; the *Waterwise Perth Action Plan*; and the *Waste Strategy 2030*. It provides a framework to ensure that sustainability is considered and embedded consistently across all METRONET transport infrastructure projects and station precinct planning/developments.

The Proposal will be implemented in accordance with the METRONET Sustainability Strategy to ensure delivery in an economically, socially and environmentally responsible manner. The strategy articulates the planning, procurement, design and construction-phase commitments, deliverables and responsibilities for each METRONET project. These include: a sustainability opportunities workshop; water management strategy options assessment; Sustainability Management Plan; sustainability audits and performance reports; station environmentally sensitive design, life cycle assessment; and water sensitive urban design and precinct planning incorporated into design. The PTA has also committed to seeking Green Building Council of Australia 4-Star Green Star ‘design’ and ‘as built’ accreditation for the Malaga and Ellenbrook Stations. An Infrastructure Sustainability Council of Australia Rating for the Proposal is also being considered.

The outputs of several program-wide Strategic Initiatives will also feed into the Proposal’s planning, design and delivery, to guide and support sustainability initiatives, including:

- Sustainability Reference Group with external stakeholders;
- Climate Change Network Vulnerability and Risk Assessment;
- Station Precinct Resilience Assessment Framework;
- Resource Recovery Opportunities Review;
- Landscape Design Guideline;
- Water Sensitive Urban Design Review;
- Photovoltaic Opportunities Review;
- Metering and Monitoring Review; and
- Workforce Evaluation.

Implementation of the strategy will be monitored, reviewed and updated over time to reflect any changes or evolving delivery needs.

2.1.3. Project Alternatives

The PTA has conducted an extensive planning exercise to identify the most appropriate option to deliver better public transport to Perth’s north-eastern suburbs, whilst also identifying opportunities to facilitate transit oriented development and increase the number of people living within walking distance from stations. During the development of the MEL project’s business case over 100 options were assessed, including "do nothing", bus rapid transit, light rail and heavy rail options. Of the initial long list of options, 14 were assessed in greater detail with a multi criteria analysis undertaken to ensure environmental and social factors were given equal weight to economic, engineering and other factors.

The final heavy rail option and alignment was chosen as it represented the best option in terms of patronage, connectivity to the existing rail network, constructability, utilisation of existing cleared transport corridors, minimisation of impacts to environmental and Aboriginal heritage values, opportunities to facilitate transit oriented developments; and opportunities to provide better public transport to Whiteman Park which is a major tourist attraction.
The final alignment, design and construction requirements will be determined by the construction contractor and subject to approval by the PTA. The PTA will direct the contractor to minimise environmental and social impacts as far as practicable.
Figure 1 The Proposal
METRONET | Malaga to Ellenbrook Rail Works Proposal
Figure 2C Metropolitan Region Scheme Zoning

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

Zoning Classification
- Industrial
- Other regional roads
- Parks and recreation
- Primary regional roads
- Public purpose
- Railways
- Rural
- Rural - water protection
- Urban
- Urban deferred

Public Transport Authority

Date Printed: 23/12/2019
Created by: D. Whiteley
Approved by: C. Baxter
Scale: 1:20,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50

Base Data: Nearmap 2019, Landgate 2019. Sources: Exi, HERE, Garmin, USGS, Intermap, NRCMAP A, NRCan, Exi Japan, METI (East China (Shanghai), East Korea, East Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
2.2. Proposal description

The PTA is proposing to implement the Proposal, which is to construct and operate a passenger railway line between Malaga and Ellenbrook, with three new stations at Malaga, Whiteman Park and Ellenbrook plus a future station at Bennett Springs East. The Proposal includes a 13 km dual track railway that will connect to the proposed Bayswater to Malaga Rail Works. The development envelope includes the area to be occupied by permanent infrastructure as well as temporary construction and access areas required to construct the Proposal (Figure 3).

Table 3 formally identifies the Proposal and proponent and provides a short description of the Proposal. Further details of the proponent’s identity are provided in Table 1.

Table 3: Summary of the Proposal

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal title</td>
<td>Malaga to Ellenbrook Rail Works</td>
</tr>
<tr>
<td>Proponent name</td>
<td>Public Transport Authority of Western Australia</td>
</tr>
<tr>
<td>Short description</td>
<td>The Proposal is to construct and operate a 13 km new dual railway track, which connects to the Bayswater to Malaga Rail Works. The Proposal includes the construction and operation of three new stations at Malaga, Whiteman Park and Ellenbrook, with provision for a future Bennett Springs East Station. Provision will also be made for a future Rail Stabling Facility at Henley Brook within Whiteman Park.</td>
</tr>
</tbody>
</table>

The key physical and operational elements of the Proposal and the locations and proposed extents of these elements are presented in Table 4.
### Table 4: Key Proposal Characteristics

<table>
<thead>
<tr>
<th>Element</th>
<th>Location</th>
<th>Proposed extent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent infrastructure, including:</td>
<td>Construction of railway tracks and associated infrastructure</td>
<td>Disturbance of up to 501 ha development envelope, including native vegetation clearing of up to:</td>
</tr>
<tr>
<td>Railway tracks and associated infrastructure</td>
<td>A 13 km dual track railway which connects to the proposed Bayswater to Malaga railway track. The railway track extends from the eastern edge of the Tonkin Highway road reserve heading generally east across the Marshall Road paddocks of Whiteman Park. In Bennett Springs, the railway alignment turns to the north to run adjacent to Drumpellier Drive (formerly Lord Street), passing under Gnangara Road and turning to the northeast to terminate at Ellenbrook Station (Figure 1).</td>
<td>- 123 ha of native vegetation Degraded or better condition.</td>
</tr>
<tr>
<td>Malaga Station</td>
<td>Provision for a potential future rail stabilising facility east of Drumpellier Drive in Whiteman.</td>
<td>- 190 ha of vegetation in Completely Degraded condition.</td>
</tr>
<tr>
<td>Future Bennet Springs East Station</td>
<td>Construction of railway stations and associated facilities</td>
<td></td>
</tr>
<tr>
<td>Whiteman Park Station</td>
<td>Including intermodal rail, bus, ‘park and ride’, ‘kiss and ride’ and active mode (walking/cycling) facilities.</td>
<td></td>
</tr>
<tr>
<td>Ellenbrook Station</td>
<td><strong>Malaga Station</strong> Located approximately 500 m east of Tonkin Highway, west of Beechboro Road North (Figure 1).</td>
<td></td>
</tr>
<tr>
<td>Construction and access areas</td>
<td><strong>Future Bennet Springs East Station</strong> Provision for a future station in the general vicinity of Dulwich Street in Bennett Springs (Figure 1).</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Whiteman Park Station</strong> Located approximately 4.5 km northeast of the proposed Malaga Station. Adjacent to the intersection of Drumpellier Drive (formerly Lord Street) and Whiteman Drive East in Whiteman Park (Figure 1).</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ellenbrook Station</strong> Located approximately 6 km north of the proposed Whiteman Park Station, south of The Parkway in the town centre of Ellenbrook (Figure 1).</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Construction and Access Areas</strong> Where practicable the PTA will locate construction and access areas in areas of existing or planned future disturbance.</td>
<td></td>
</tr>
<tr>
<td><strong>Operational Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail and Bus Services</td>
<td>A passenger railway is proposed to operate as an extension to the proposed Bayswater to Malaga Rail Works, extending 13 km to Ellenbrook (Figure 1). Rail and bus services are proposed to operate at Malaga Station, Bennett Springs East Station (future station), Whiteman Park Station and Ellenbrook Station.</td>
<td>The construction and access areas will be located within the 501 ha development envelope.</td>
</tr>
</tbody>
</table>
2.2.1. Development Envelope

Passenger railways are designed according to specific design requirements and taking into consideration the local planning context. For the Proposal, the passenger service and local planning context requirements include:

- The railway delivers services that passengers want and must provide a comfortable trip.
- The railway must be located to service existing and future residential land developments.
- The curve of the rail alignment must be minimised to:
  - reduce rail noise (wheel squeal) impacts to passengers and nearby residences;
  - ensure high speeds can be maintained to ensure travel times are competitive with private vehicle travel; and
  - minimise ongoing maintenance requirements (i.e. a tighter curve is subject to greater wear and requires substantially more maintenance than straight track).

The design of passenger railway has three key requirements, and is considerably more constrained than road design as it must be

1. As flat as possible;
2. As straight as possible; and
3. As short or direct as possible (i.e. shortest length of track, shortest journey time).

Upon selection of the preferred indicative alignment, the development envelope and design have been iteratively modified to minimise environmental and Aboriginal heritage impacts (where practicable), specifically:

- Avoidance of Horse Swamp Conservation Category Wetland.
- Minimising the width of the development envelope to its minimum extent at Bennett Brook.
- Avoidance of areas of Bush Forever Sites.
- Minimisation of impacts to Registered Aboriginal Sites.
- Construction of at-grade railway tracks and stations to avoid and minimise groundwater interaction.

The 501 ha development envelope allows for flexibility during detailed design of the railway infrastructure and future station precincts. Construction and access areas have been selected within the development envelope to coincide with proposed future urban development. The permanent railway and associated infrastructure will be contained within the development envelope.

2.2.2. Railway tracks and infrastructure

Railway tracks and stations will be constructed ‘at-grade’ for most of the rail line. Whiteman Park Station will be elevated to provide continued access to Whiteman Park. A number of minor road realignments are planned within the development envelope, to accommodate the construction and operation of the railway infrastructure.

The Proposal includes permanent infrastructure for maintenance and emergency vehicle access, drainage, overhead electrification for traction, signalling, communications and other services, access roads and pathways, and access control (e.g. fences and gates).

Two sections of Principal Shared Path (PSP) will also be constructed alongside the railway to tie into the existing PSP network to provide access for pedestrians and cyclists. These sections are planned between Gnangara Road and Ellenbrook Station, and in the vicinity of Whiteman Park Station.

2.2.3. Stations

The Proposal includes three new railway stations and provision for a future station:
• The proposed Malaga Station will be located approximately 500 m east of Tonkin highway near Beechboro Road North in Whiteman. Primary access to the station will be via the existing Beechboro road North. The station will include intermodal interchanges for bus services, ‘park and ride’, ‘kiss and ride’ and active mode facilities.
• Elevated Whiteman Park Station, adjacent to the intersection of Drumpellier Drive and Whiteman Drive East in Whiteman Park.
• Ellenbrook Station, south of The Parkway in Ellenbrook.
• Bennett Brook East Station (future station), in the vicinity of Dulwich Street in Bennett Springs. This station is expected to be constructed after the rail line is completed.

The new stations at Malaga, Whiteman Park and Ellenbrook Station will include intermodal interchanges for bus services, ‘park and ride’, ‘kiss and ride’ and active mode facilities.

2.2.4. Bridges and underpasses

The railway will need to pass across existing roads, infrastructure and watercourses. The following grade separations are planned, which will require the construction of bridges or underpasses:
• Beechboro Road North, Whiteman – rail under road.
• Bennett Brook – rail over watercourse.
• Dulwich Street – rail under road.
• Whiteman Drive East / Youle-Dean Road – rail over road.
• Whiteman Park Station Underpass – rail over pedestrian access.
• Lord Street/Drumpellier Drive/Gnangara Road – rail under road.
• Ellenbrook Christian College – rail over pedestrian access.

2.2.5. Temporary construction areas

Temporary construction areas will be required within the development envelope for site offices, welding of sections of rail and to temporarily store materials and equipment during construction of the Proposal. Temporary construction areas will be preferentially located in existing cleared areas.

Construction activities that may occur within the temporary construction areas include but are not limited to:
• Temporary placement of construction materials (rail lengths, sleepers, pipes, stockpiles of materials such as ballast, kerbing, lighting infrastructure, fencing materials, signage, landscaping materials, drainage, etc.).
• Water storage dams, ponds, basins for storage of dewatering effluent, displaced water, stormwater runoff from hardstands and production water. Dams will be designed to allow evaporation and/or infiltration of water.
• Access tracks for machinery and plant to access construction areas and/or future railway reserve.
• Parking of vehicles and machinery.
• Storage of chemicals and dangerous goods in bunded, suitably sized areas.
• Storage and use of heavy equipment including: trucks, plant piling rigs, front end loaders, excavators, water trucks, graders and static and vibrating rollers, delivery trucks, concrete trucks and pumps, concrete vibrators, cranes and power generators.
• Storage and use of other equipment including portable toilets, site offices, sea containers for secure storage, concrete wash down bunds and rubbish skip bins.
• Flash butt welding plant to weld together lengths of rail trucked to the construction site to enable faster placement on the sleepers.

Where practicable, the PTA will locate temporary construction areas in areas of existing or planned future disturbance.

2.2.6. Malaga Station Precinct
The land surrounding the Malaga Station is owned by the WA Planning Commission (WAPC) and zoned as urban deferred (see Figure 2C). This site has been identified by the METRONET office as a priority location for a transit oriented development site. Development WA (formerly Landcorp) is currently undertaking planning for this development with the intention of commencing construction shortly after construction of this Proposal. The PTA has identified this site as an ideal location for the flash butt welding plant as it would allow lengths of rail to be transported south and west simultaneously in the most efficient manner during construction. The current preferred location for Malaga Station is also located in close proximity to two sand dunes which will require significant cutting to achieve the final ground levels for the station. The PTA propose to undertake vegetation clearing and bulk earthworks across a portion of the urban deferred land for construction of this Proposal. The final clearing footprint in this location will be confirmed with Development WA once they have completed their planning.

2.2.7. Future rail stabling facility
The Proposal includes provision for a future rail stabling facility, which is likely to be located to the west of the alignment within Whiteman Park. The facility will likely include:

• Stow roads for 12 six-car trains.
• Arrival roads and provision for connection to the railway to the north and south.
• Driver sign-on and amenities building.
• Office building for maintenance staff.
• Road access including 40 car parking bays.
• Maintenance access roads.
• Lighting.
• Drainage infrastructure.
• Security fencing.
• Footpaths for accessing trains.
• Overhead line equipment and signalling equipment.

2.2.8. Stormwater Drainage Infrastructure
Permanent and temporary Stormwater infrastructure will be installed for the construction and operation of the Proposal. The drainage infrastructure will provide adequate stormwater storage and infiltration to cater for storm events and to prevent adverse impacts to proposed and existing infrastructure. The drainage design will incorporate water-sensitive urban design (WSUD) elements and integrate with the existing drainage networks to prevent adverse impacts on infrastructure and environmental values.

2.2.9. Dewatering and groundwater abstraction requirements
The depth to groundwater varies along the development envelope. Dewatering may be required for the construction of stations, bridges and installation or relocation of services. The dewatering
requirements for the Proposal will not be fully understood until detailed design has been completed by the construction contractor.

Abstraction of groundwater may also be required for construction purposes such as dust suppression.

If dewatering or groundwater abstraction is required, the PTA or its contractors will obtain the appropriate licences under the RIWI Act obtained from the Department of Water and Environmental Regulation (DWER), as well as applying appropriate mitigation strategies.
Figure 3A Indicative Proposal Activities

Legend
- Development envelope
- Indicative Rail Stabling extent
- Proposed Railway Station
- Indicative Railway Station extent
- Indicative Railway Alignment
METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 3B Indicative Proposal Activities

Legend
- Development envelope
- Indicative Railway Station extent
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment
METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 3C: Indicative Proposal Activities

Legend
- Development envelope
- Indicative Railway Station extent
- Proposed Railway Station
- Indicative Railway Alignment

Base Data: Nearmap 2019, Landgate 2019, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, Esri Japan, METI, Get China (Hong Kong), Geoinform (Thailand), NSCIC, (c) OpenStreetMap contributors, and the GIS User Community
2.3. Local and regional context

The Proposal is located within the Perth subregion of the Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion of the Swan Coastal Plain. It intersects the City of Swan, starting approximately 12 km northeast of Perth’s CBD (Figure 4).

The Proposal connects to the proposed Bayswater to Malaga Rail Works at the eastern edge of the Tonkin Highway road reserve, within remnant bushland. The indicative alignment extends east across the Marshall Road paddocks through cleared former pasture land. In Bennett Springs, the railway alignment turns to the north to run adjacent to Drumpellier Drive (formerly Lord Street), passing under Gnangara Road and turning to the northeast to terminate south of The Parkway in Ellenbrook.

The majority of land to the south and east of the Proposal is reserved for future urban development or has already been developed for urban uses including residential housing. Existing housing estates in close proximity to the Proposal include Malaga and Ballajura to the west of the development envelope, Bennett Springs to the south, Dayton and Brabham to the east and Ellenbrook to the north. Whiteman Park is to the north and west of the development envelope.

2.3.1. Geology and soils

The development envelope is located within the Bassendean dune system, classified as an extensive system of shoreline deposits and coastal dunes running in a north-south direction that covers a 15 km wide zone of the Swan Coastal Plain (Gozzard 2007). Typically, the Bassendean dune system is relatively featureless, comprising low hills of unconsolidated sediments and sandy swamps between the dunes.

The associated vegetation complexes of the Bassendean sands consist of a variation of Corymbia calophylla, Eucalyptus marginata, as well as Melaleuca and Banksia species. These vegetation complexes generally occur in wetter areas.

Landforms across a large portion of the development envelope (along Drumpellier Drive and Ellenbrook town centre) have been historically disturbed due to urban development. The exception to this is near Malaga Station, which is located within sand dunes, and through the Marshall Road paddocks of Whiteman Park where the topography is low lying and remains largely unaltered. The landscape in this area is generally flat and dominated by palusplain, with scattered low hills of quartz sand comprising the Bassendean dunes.

2.3.2. Hydrology

The Perth Groundwater Atlas (DWER 2019) indicates that the topography of the development envelope is relatively flat, ranging between approximately 20 and 45 m Australian Height Datum (AHD). Elevation within the development envelope has a gentle north to south slope, with the gradient identified across the broader area gently sloping from east to west.
3. Stakeholder consultation

The PTA is committed to engaging with stakeholders to ensure that all stakeholders’ views can be considered during the development of the Proposal. The PTA has undertaken consultation in regard to the broader METRONET portfolio of works, including for this Proposal.

3.1. Key stakeholders

**Federal Government**

- Department of the Environment and Energy
- Department of Infrastructure, Transport, Cities and Regional Development (DITCaRD)
- Infrastructure Australia

**State Government**

- Department of Biodiversity Conservation and Attractions
- Department of Communities
- Department of Fire and Emergency Services
- Department of Local Government, Sport and Cultural Industries
- Department of Planning, Lands and Heritage
- Department of Transport
- Department of Water and Environmental Regulation
- Development WA (formerly Landcorp and Metropolitan Redevelopment Authority)
- Environmental Protection Authority
- Infrastructure Western Australia
- Main Roads Western Australia
- Office of the Government Architect
- State Design Review Panel
- Water Corporation
- Western Australian Planning Commission
- Whiteman Park Management

**Local Government**

- City of Swan

**Industry/utilities**

- AGIG/Dampier Bunbury Pipeline (DBP)
- ATCO Gas
- NBN Co
- Optus
- Telstra
- Water Corporation
- Western Power
Other Stakeholders

- Conservation Council of WA
- Ellenbrook Christian College (Swan Christian Association)
- Friends of Lightning Swamp
- LWP (Ellenbrook Station)
- METRONET Noongar Reference Group
- Northern Valleys Wildlife
- PEET (Whiteman Park Station)
- Perth Wildlife Rescue Network
- Registered Knowledge Holders for Aboriginal heritage sites under the *Aboriginal Heritage Act 1972*
- South East Regional Central for Urban Landcare (SERCUL)
- South West Aboriginal Land and Sea Council (on behalf of the Whadjuk People)
- Urban Bushland Council
- Whadjuk Working Party
- Wildlife Care WA
- Wildlife Society, Eastern Hills Branch

3.2. Stakeholder engagement process

The PTA has a dedicated community consultation team that has extensively consulted with key stakeholders to inform the portfolio of METRONET Projects. Community engagement has been centred around communities along the Proposal’s alignment as well as those that may benefit from the Proposal. A dedicated METRONET website has been established, providing a detailed overview of the projects, allowing interested parties to inquire about METRONET and register for project updates.

The PTA, DWER and DBCA attend a monthly Environmental Stakeholder Reference Group (ESRG) to consult on environmental matters pertaining to the Proposal and seek technical and strategic advice on key environmental factors and investigations relevant to the Proposal’s environmental approvals. The ESRG includes technical officers from DWER and the DBCA. The ESRG meetings have been held on a monthly basis since March 2019 and will continue for the foreseeable future.

Environmental community groups were sent letters in August 2019, providing an environmental update on the broader MEL Project. Further consultation and briefings with the key environmental community groups are scheduled to occur in early 2020.

3.3. Stakeholder consultation

As part of the development of the Proposal, the PTA has already conducted extensive consultation across a range of stakeholder groups represented by the stakeholders identified in Section 3.1. PTA will continue to consult with relevant stakeholders before, during and after the environmental assessment process. A summary of all consultation undertaken to date is provided in Table 5.
<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Date</th>
<th>Engagement</th>
<th>Summary</th>
<th>Outcome/Proponent Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Project announcement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community / Residents</td>
<td>January 2018</td>
<td>Consultation</td>
<td>Community priorities were to increase public transport, more entertainment and leisure options, while they also wanted restaurants/cafes/bars, parks/recreation areas and retail near stations. Concerns raised were safety and noise.</td>
<td>Survey results were collated and shared with the planning team to inform the analysis of options for the rail alignment, as well as the precincts within a walkable area from each station. Community concerns expressed through the survey were addressed at an information event with the Minister for Transport providing an update on the project and leading a Q&amp;A session. The presentation and Q&amp;A summary were uploaded to the METRONET website the following day and promoted through electronic direct mail and social media. The survey results were also distributed in a fact sheet to the 46,000 residences within the project area. The survey results and feedback were also provided to the METRONET Office and Minister’s Office.</td>
</tr>
<tr>
<td>Environmental Community / Businesses</td>
<td>September 2018</td>
<td>Consultation Survey</td>
<td>Feedback on sentiment was very positive from all groups. Concerns around construction timelines and impacts, as well as local crime, bus routes and environmental factors at Whiteman Park.</td>
<td>Interview notes and feedback was shared with the planning team to inform the analysis of options for the rail alignment, as well as the precincts within a walkable area from each station. The participating community groups were provided with ‘third-party presentation packs’ that included fact sheets, talking points and presentation guidelines to inform them of the project to date and help them discuss the project with their members/stakeholders.</td>
</tr>
<tr>
<td>EPA</td>
<td>November 2018</td>
<td>Meeting</td>
<td>Initial discussion introducing the Proposal. Presentation on known environmental values and proposed studies.</td>
<td>Arrange a site visit to the key environmental values within and adjacent the Proposal. PTA to continue liaison throughout the Project.</td>
</tr>
<tr>
<td>Stakeholder</td>
<td>Date</td>
<td>Engagement</td>
<td>Summary</td>
<td>Outcome/Proponent Response</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EPA, DWER &amp; DBCA</td>
<td>December 2018</td>
<td>Site visit</td>
<td>Representatives from EPA Services Unit, DBCA and DWER undertook a site visit to the broader METRONET Program, including aspects of this Proposal.</td>
<td>Further consultation with DBCA Wetland Assessment branch to advise on potential impacts to nearby Wetlands, in particular Horse Swamp.</td>
</tr>
<tr>
<td>EPA, DWER &amp; DBCA</td>
<td>December 2018</td>
<td>Meeting</td>
<td>Discussion on Conservation Category Wetland mapping, ecological values and mapped boundary extents to inform design considerations.</td>
<td>Further assessment of wetland values and extents. Design considerations to avoid potential impacts to wetlands within Whiteman Park.</td>
</tr>
<tr>
<td>City of Swan</td>
<td>January 2019</td>
<td>Meeting</td>
<td>Initial discussions introducing the Proposal. Discussion on the known and potential environmental values within the Proposal area.</td>
<td>PTA to continue liaison throughout the Project.</td>
</tr>
<tr>
<td>DBCA (Wetlands Assessment Branch)</td>
<td>January 2019</td>
<td>Site Visit</td>
<td>A representative from DBCA wetlands assessment branch undertook a site visit of the broader MEL Project.</td>
<td>Further assessment of wetland values and extents. Design considerations to avoid potential impacts to wetlands within Whiteman Park.</td>
</tr>
<tr>
<td>DWER (Noise Branch)</td>
<td>January 2019</td>
<td>Meeting</td>
<td>Initial discussions introducing the Proposal. Summary of adopted design criteria, inputs and modelling methodology for the operational noise and vibration assessment.</td>
<td>Preliminary noise and vibration modelling to be reviewed by DWER (Noise Branch).</td>
</tr>
<tr>
<td>Community / Residents</td>
<td>February 2019</td>
<td>Door Knock Survey</td>
<td>Half of the residents report being likely to use the proposed railway for entertainment and events with around a third using it weekly. The Proposal would encourage around a quarter of residents who</td>
<td>Positive sentiment towards the broader MEL Project. Residents wanting improved public transport connections to Perth CBD, with majority of the residents currently driving to the CBD.</td>
</tr>
<tr>
<td>Stakeholder</td>
<td>Date</td>
<td>Engagement</td>
<td>Summary</td>
<td>Outcome/Proponent Response</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>currently use the train (driving to Midland Line) less than once every three months for their work commute, to use the train more often if a station was located within 3 km of their home.</td>
<td>Feedback forms collected from community members were individually responded to following each pop-up session. Feedback (both formal and anecdotal) was used to inform the alignment announcement communications. A summary of feedback was provided to the project team, METRONET Office and Minister’s Office. Community members who signed up to receive more information were registered in the email database to keep them informed of the project’s progress.</td>
</tr>
<tr>
<td>Community / Residents</td>
<td>February – April 2019</td>
<td>Shopping Centre pop-up displays</td>
<td>General positive feedback but also looking for exact alignment, station locations and start dates. Minor concerns raised around direct impacts, location of stations, parking and lack of consultation.</td>
<td>Collection of stories were shared with the METRONET Station Precincts team as background information for precinct planning, public art etc. This was the first stage of story collection and will be expanded as the project progresses.</td>
</tr>
<tr>
<td>Community Residents</td>
<td>February – April 2019</td>
<td>Story collection</td>
<td>Collection of community history, stories and visions for the future of the area. Promoted through email updates/website, social media, community groups and schools.</td>
<td></td>
</tr>
<tr>
<td>DBCA &amp; DWER</td>
<td>March 2019 - Ongoing</td>
<td>Meeting</td>
<td>Technical officers from DWER &amp; DBCA advise on proposed environmental scopes and studies to support the environmental approvals process of the broader MEL Project.</td>
<td>PTA to continue liaison throughout the Project. DWER &amp; DBCA technical officers have reviewed scope of works associated with Terrestrial Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality and Inland Waters. PTA to continue monthly liaison throughout the Project.</td>
</tr>
<tr>
<td>DPLH</td>
<td>April 2019</td>
<td>Meeting</td>
<td>Initial discussions introducing the Proposal. Discussion prior to request for Section 18 application to partially disturb Aboriginal Heritage Sites (Site ID 551 &amp; 552).</td>
<td>Request for Section 18 application to partially disturb Aboriginal Heritage Sites (Site ID 551 &amp; 552).</td>
</tr>
<tr>
<td>Stakeholder</td>
<td>Date</td>
<td>Engagement</td>
<td>Summary</td>
<td>Outcome/Proponent Response</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SWALSC</td>
<td>April 2019</td>
<td>Survey</td>
<td>Ethnographic and archaeological survey of the Proposal area. Request for Section 18 application to partially disturb three registered Aboriginal Heritage sites.</td>
<td>Section 18 Application to partially disturb the registered Aboriginal Heritage Site ‘Bennett Brook in Toto’ (Site ID 3942) will be undertaken upon final design.</td>
</tr>
<tr>
<td>DITCaRD (then DIRDaC)</td>
<td>April 2019</td>
<td>Site visit</td>
<td>Key DITCaRD officers undertook a site visit to look at the METRONET project sites, including the broader MEL Project with senior members of the METRONET and PTA team.</td>
<td>Conditional approval for the proposed railway alignment. Monitors to be engaged for all new ground disturbance associated with railway construction. A further heritage survey to be undertaken once proposed railway station designs are finalised.</td>
</tr>
<tr>
<td>DotEE</td>
<td>July 2019</td>
<td>Site visit</td>
<td>DotEE undertook a site visit to look at the METRONET Program, including the broader MEL Project.</td>
<td>Further discussion regarding the environmental approvals strategy required.</td>
</tr>
<tr>
<td><strong>Post-Project announcement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Roads WA</td>
<td>August 2019</td>
<td>Meeting</td>
<td>Project design restrictions and land access interface. Environmental approvals strategy.</td>
<td>Collaboration between PTA and Main Roads WA to undertake the associated works for the MEL project. PTA to continue liaison throughout the Project.</td>
</tr>
<tr>
<td>Environmental Community Groups</td>
<td>2 August 2019</td>
<td>Letters</td>
<td>Letters sent to key environmental community groups inviting each community group to meet and work collaboratively.</td>
<td>Future environmental community briefing to be undertaken with interested environmental community groups.</td>
</tr>
<tr>
<td>Stakeholder</td>
<td>Date</td>
<td>Engagement</td>
<td>Summary</td>
<td>Outcome/Proponent Response</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Community</td>
<td>August – September 2019</td>
<td>Community drop-In</td>
<td>General community feedback included seeking exact alignment, station locations and operational start dates. Minor community concerns included location of stations, parking and lack of consultation. Feedback forms collected from community members were individually responded to following each drop-in session. A summary of feedback was provided to the project team, METRONET Office and Minister’s Office.</td>
<td></td>
</tr>
<tr>
<td>METRONET Noongar Reference Group</td>
<td>February 2019 - ongoing</td>
<td>Meeting</td>
<td>Input into the METRONET Gnarla Biddi Strategy. Input into Project Noongar Cultural Context Document. Development of the Proposal’s Noongar Cultural Context Document (NCCD) that will facilitate Noongar input into placemaking and design. PTA to continue liaison throughout the Project.</td>
<td></td>
</tr>
</tbody>
</table>
4. Environmental principles

Table 6 lists how each of the principles for environmental management outlined in Section 4A of the EP Act have been considered for this Proposal.

<table>
<thead>
<tr>
<th>Proponent contact details</th>
<th>The Proposal will be developed within a development envelope that has largely been disturbed by existing infrastructure and established development. As such, scientific certainty around the few existing environmental values and likely impacts is relatively high. The PTA has also undertaken consultation with relevant government agencies to minimise any uncertainty surrounding any environmental impacts of the Proposal. The preferred alignment has been determined through a process which has drawn on detailed environmental information. Modifications to the development envelope have been made to avoid in the first instance, and then to minimise environmental impacts, where practicable to do so. Detailed design plans, when coupled with the development and implementation of a CEMP and PTA standard operating procedures, will largely avoid or minimise impacts to the identified environmental factors within the development envelope.</th>
</tr>
</thead>
</table>
| The Precautionary Principle  
*Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*  
*In this application of the precautionary principle, decisions should be guided by:*  
*careful evaluation to avoid, where practicable, serious or irreversible damages to the environment; and*  
*an assessment of the risk-weighted consequences of various options.* | Infrastructure Australia has recognised the low density in Perth's north-east corridor as contributing to high car dependency. By better integrating transport and long-term land use planning, the Proposal will encourage more sustainable development and intensify development near activity centres and railway stations through this area benefiting current and future residents. At a local scale, the Proposal will result in longer term denser urban development around station precincts, making more sustainable and active forms for travel such as walking and cycling more attractive. The resulting reduced reliance on cars and other road transport will lead to lower emissions and less traffic congestion in the local area. On a larger scale, a shift towards the use of mass transit such as this Proposal will lead to lower air pollutants and less traffic congestion generally. The information contained in this referral demonstrates that the Proposal can be implemented to avoid significant impacts on the health, diversity and productivity of the environment for the benefit of future generations. |
| The Principle of Intergeneration Equity  
*The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.* | The PTA recognises that costs will be incurred in the management and monitoring of environmental values associated with the Proposal. These have been incorporated into the cost estimate for the Proposal. All available information on environmental factors surrounding the development envelope has been sought and included in the consideration of alternative alignment options. Minimising potential impacts to the identified ecological attributes has been a fundamental factor in the design process. |
| The Principle of the Conservation of Biological Diversity and Ecological Integrity  
*Conservation of biological diversity and ecological integrity should be a fundamental consideration.* | Environmental factors were considered when evaluating design options for the Proposal. Minimising potential impacts to the identified ecological attributes has been a fundamental factor in the consideration of alternative alignments and will inform detailed design considerations within the development envelope. The development envelope has been designed to be located within degraded areas as far as possible. The PTA has iteratively modified the development envelope of its preferred alignment during planning to avoid or minimise ecological impacts outside of existing cleared areas. |
| Principles in relation to Improved Valuation, Pricing and Incentive Mechanisms.  
*Environmental factors should be included in the valuation of assets and services.* | |
**The polluter pays principle – those who generate pollution and waste should bear the cost if containment avoidance or abatement.**  
The users of goods and services should pay prices based on the full life cycles costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.  
Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.

The PTA will be responsible for funding the Proposal’s costs of environmental avoidance, mitigation, management and offsets.

---

**The Principle of Waste Minimisation**  
All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.

In planning the Proposal, the PTA has been considerate of the principle of waste minimisation, including the destination and use of removed materials. The railway will be constructed largely at-grade, minimising the need for removal of large amounts of fill typically associated with greenfield railway developments. Where excavation is required, the PTA’s objective is to reuse all excess fill which is determined to meet criteria for reuse within the MEL project. If excess reusable material cannot be used within the MEL project the PTA will offer the material for use on other State Government projects.

The contractor will be required as part of a CEMP to take all reasonable and practicable measure to reduce waste generation and dispose of construction wastes appropriately. In general, waste will be minimised during construction by adopting the hierarchy of waste controls: avoid, minimise, reuse, recycle and safe disposal.
4.1. Environmental Factors

The PTA commissioned an environmental constraints desktop analysis in early 2019 to review existing information relating to the EPA’s environmental factors in a large study area which encompasses the development envelope (ELA 2019; Appendix A). The analysis considered information in a range of reports, studies and investigations undertaken for other projects in the same area. Spatial datasets were also reviewed to determine the extent of mapping available and potential gaps in knowledge. Additional information was obtained through consultation with stakeholders where necessary.

Through the constraints analysis process, a number of the EPA's environmental factors were identified as being not relevant to the Proposal and were excluded from further consideration (Table 7). In accordance with the Statement of Environmental Principles, Factors and Objectives (EPA 2018b), the relevant environmental factors for this Proposal and included in this referral are:

- Flora and vegetation.
- Terrestrial fauna.
- Terrestrial environmental quality.
- Inland waters.
- Social surroundings.

Sections 5 to 9 provide further information on the environmental factors listed above. See Table 7 below for other environmental factors considered not relevant to this Proposal.
### Table 7: Assessment of Other Environmental Factors

<table>
<thead>
<tr>
<th>EPA theme</th>
<th>Factor</th>
<th>Objective</th>
<th>Relevant to the Proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea</td>
<td>Benthic Communities and Habitats</td>
<td>To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.</td>
<td>Marine and coastal values are not present within the vicinity of the Proposal.</td>
</tr>
<tr>
<td></td>
<td>Coastal Processes</td>
<td>To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.</td>
<td>Not a relevant factor.</td>
</tr>
<tr>
<td></td>
<td>Marine Environmental Quality</td>
<td>To maintain the quality of water, sediment and biota so that environmental values are protected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marine Fauna</td>
<td>To protect marine fauna so that biological diversity and ecological integrity are maintained.</td>
<td></td>
</tr>
</tbody>
</table>
| Land      | Landforms                       | To maintain the quality of land and soils so that environmental values are protected. | The landforms within the development envelope are not considered to be significant, as defined in the Environmental Factor Guideline Landforms (EPA 2018c). The only landforms of note are the dunes near Malaga Station and they are not significant as they do not represent:  
  - Variety – they are not good or important examples of their type and are well represented over the local, regional and national scale.  
  - Ecological importance – the dunes do not have a distinctive or exclusive role in maintaining existing ecological and physical processes. Although the sand dunes contain Banksia woodland TEC and PEC these communities are not found exclusively on the dunes.  
  - Scientific importance - the dunes do not provide evidence of past ecological processes nor are they of important geomorphological or geological interest.  
  - Rarity – the dunes are not rare at a national, regional or local level.  
  - Social importance – the dunes do not support significant amenity, cultural or heritage values.  
  The dunes do meet the ‘Integrity’ significance criterion as they are relatively intact with Banksia woodland TEC/PEC in Good to Excellent condition, however the PTA believes that this single criterion does not |
<table>
<thead>
<tr>
<th>Subterranean Fauna</th>
<th>To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A desktop assessment undertaken for the MEL project determined that no subterranean fauna species listed under the Biodiversity Conservation Act 2016 (BC Act) or EPBC Act are likely to occur or have known habitat within the development envelope (Invertebrate Solutions 2019; Appendix B). Two stygofauna species were determined to be present within the desktop assessment study area. Due to the highly uniform nature of the Gnangara Mound within the Bassendean Sands that are present throughout the development envelope, these species are likely to be relatively widespread across the northern Swan Coastal Plain. The desktop assessment determined that there were no troglofauna records within the development envelope and there is a very low likelihood of troglofauna being present within the development envelope due to a lack of interconnected voids. Given the narrow linear nature of the Proposal, and the low subterranean habitat values present within the development envelope, it is considered unlikely that the Proposal would result in any significant impacts to subterranean fauna (Invertebrate Solutions 2019; Appendix B). Not a relevant factor.</td>
</tr>
</tbody>
</table>

| Air | Air quality | To maintain air quality and minimise emissions so that environmental values are protected. | At a local scale, the Proposal will result in improved air quality due to the reduction in private vehicle use as people use the new railway. It will also result in a reduction in greenhouse gas emissions as the electricity powered trains generate fewer tonnes of carbon dioxide equivalent per passenger kilometre than cars or buses. It is acknowledged that the electricity powering the trains is provided by the Perth grid which is currently dominated by electricity generated by coal powered plants, however as the proportion of renewable energy generation increases the tonnes of carbon dioxide equivalent per passenger kilometre travelled by rail will decrease. Not a relevant factor. |
| People | Human Health | To protect human health from significant harm. | EPA assessment of the Human Health factor is limited to consideration of radiation. Radiation will not be generated or encountered during the construction or operation of the Proposal. Not a relevant factor. |
5. Flora and vegetation

5.1. EPA objective
To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

5.2. Policy and guidance
The following legislation, policies and guidance are relevant to the flora and vegetation factor. All environmental investigations have been undertaken to meet the requirements of these policies and guidelines:

- *Biodiversity Conservation Act 2016 (WA)*.
- *Biosecurity and Agriculture Management Act 2007 (BAM Act)*.
- Environmental Factor Guideline: Flora and Vegetation (EPA 2016a).
- Environmental Protection Bulletin 20 – Protection of naturally vegetated areas through planning and development (EPA 2013a).
- State Planning Policy No. 2.8 Bushland Policy for the Perth Metropolitan Region (WAPC 2010).
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

5.3. Receiving environment

5.3.1. Surveys and studies
Table 8 lists the relevant flora and vegetation surveys that have been undertaken or are currently being undertaken to inform the assessment of terrestrial flora and vegetation factor within the development envelope (Figure 5). Almost all of the development envelope is covered by current flora and vegetation surveys, with the final gaps to be surveyed in 2020. The areas which have not yet been surveyed are existing roads which may require upgrading as part of construction of the Proposal.

METRONET has a dedicated Stakeholder Reference Group that includes officers from the DWER and DBCA who have provided feedback on each of the environmental survey scopes to ensure that they meet the policy and guidelines requirements and will provide robust data to support the environmental impact assessment process for the Proposal.

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation.</th>
</tr>
</thead>
</table>
| Detailed Flora and Vegetation Assessment: METRONET Ellenbrook Alignment (Appendix C) | **Scope:** Level 2 Flora and Vegetation Survey. To describe flora and vegetation values of the survey area and determine the spatial location and conservation significance of these values. This report documents the combined results of the Spring 2017, Spring 2018 and Autumn 2019 surveys.  
**Consultant:** RPS  
**Survey date/s:** October 2017, October 2018, April 2019  
**Report date:** June 2019 |
<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Morley-Ellenbrook Line: <em>Caladenia huegelii</em> Targeted Flora Survey (Appendix D)</strong></td>
<td><strong>Scope:</strong> Resurvey four locations previously identified by RPS (2019) as containing suitable habitat for the Threatened Flora <em>Caladenia huegelii</em> within the development envelope.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Eco Logical Australia</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> 26th to 28th September 2019</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> December 2019 (Draft)</td>
</tr>
<tr>
<td><strong>Baseline Wetland Vegetation Monitoring Report</strong></td>
<td><strong>Scope:</strong> Baseline monitoring of wetland vegetation associated with two Conservation Category Wetlands (CCWs): UFI 8724 (Horse Swamp) and UFI 8726 (Mussel Pool); and two Resource Enhancement Wetlands (REW$s$): UFI 8678 and UFI 8679, within the development envelope at Whiteman Park.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> RPS</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> 17-18 April 2019; 7 May 2019</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> September 2019</td>
</tr>
<tr>
<td><strong>Caladenia huegelii targeted survey report</strong></td>
<td><strong>Scope:</strong> Undertake a review of remnant Banksia woodland vegetation within the indicative development envelope in terms of its potential to support <em>Caladenia huegelii</em>.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> RPS</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date:</strong> 28th September 2018</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> January 2019</td>
</tr>
<tr>
<td><strong>Level 2 Flora and Vegetation Assessment of Hepburn, Beechboro, and Marshall Road Sites</strong></td>
<td><strong>Scope:</strong> Level 2 survey comprised a desktop assessment of Threatened and Priority flora and ecological communities data, aerial imagery analysis and review of relevant biological assessment reports, followed by a comprehensive flora and vegetation field assessment, including quadrat assessment, vegetation community analysis and mapping, and vegetation condition mapping.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Terratree</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> 20 and 27 October 2016</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> January 2017</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> AECOM</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> 22nd, 29th October 2015</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> 2016</td>
</tr>
<tr>
<td><strong>Level 2 Spring Flora and Vegetation Assessment: Perth-Darwin National Highway</strong></td>
<td><strong>Scope:</strong> A Level 2, flora and vegetation survey was undertaken, with a total of 120 flora sampling sites, consisting of 93 quadrats and 27 relevés established and sampled. The survey included re-sampling of 29 quadrats previously established in 2013. A statistical multivariate analysis of the floristic data.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Coffey</td>
</tr>
<tr>
<td>Investigation</td>
<td>Details of investigation.</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>
|               | **Survey date/s:** 15 to 19 September 2014; 22 to 26 September 2014; and 17 to 19 November 2014.  
|               | **Report date:** May 2015 |
| General Stratigraphy, Wetland Hydrology and Wetland Vegetation: Swan Valley Bypass – NorthLink WA. | **Scope:** To identify key wetlands along and adjoining the proposed alignment and determining their general stratigraphy, wetland hydrology, mapping and characterising wetland vegetation.  
Wetland vegetation assemblages were mapped using aerial photography and field verification.  
**Consultant:** 360 Environmental  
**Survey date/s:** 4, 8, 12, 13, 20 & 22 November 2013; 2, 9, 18-20 December 2013, 30 January 2014  
**Report date:** July 2014 |

### 5.3.2. Survey type and coverage

Figure 5 shows the consolidated survey coverage of the above flora and vegetation surveys over the development envelope. Overall 97.2% of the survey area has been surveyed (approximately 486 ha), with 2.8% unsurveyed (14 ha). The unsurveyed portions of the development envelope are existing roads which may require upgrading as part of construction of the Proposal and will be surveyed in Spring 2020.
Figure 5 Flora and Vegetation Survey Type and Coverage

Survey
- Detailed Flora and Vegetation Assessment (RPS June 2019 (spring 2017, spring 2018, autumn 2019))
- Level 1 Flora and Vegetation Assessment - 2015 (AECOM 2016)
- Reconnaissance Flora and Vegetation Survey (GHD 2019)
- Detailed Flora and Vegetation Assessment (Coffey 2015)

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment
5.3.3. Interim Biogeographical Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into bioregions based on major biological and geographical/geological attributes (Thackway and Cresswell 1995). The IBRA currently recognises 89 bioregions and 419 biological subregions in Australia. The development envelope lies within the Perth (SWA02) subregion of the Swan Coastal Plain bioregion.

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone and the vegetation is described by Mitchell et al. (2002) as Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvials.

5.3.4. Geology, landform and soils

The majority of the development envelope is located on Bassendean Sand which results from aeolian sand and coastal sediments. It is described as basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geological Survey of WA and Geoscience Australia 2008). A small portion of the development envelope within Whiteman Park is underlain by Lake deposits 38492, which comes from lacustrine sediment. It is described as lacustrine or residual mud, clay, silt and sand commonly gypsiferous and/or saline; playa, claypan and swamp deposits; peat; peaty sand and clay; halitic and gypsiferous evaporites. A small area around Bennett Brook is located on the Guildford formation, which is described as alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate (Geological Survey of WA and Geoscience Australia 2008).

5.3.5. DBCA managed lands and reserves

Two DBCA Managed Lands or Reserves are located adjacent to the development envelope (Table 9 and Figure 4). No regional parks are located within or adjacent to the development envelope.

<table>
<thead>
<tr>
<th>Site Identifier</th>
<th>Site Name</th>
<th>Category</th>
<th>Class</th>
<th>Purpose</th>
<th>Tenure</th>
<th>Vesting</th>
<th>Location relative to Development Envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td>F 65</td>
<td>Gnangara-Moore River State Forest</td>
<td>State Forest</td>
<td>A Class Reserve</td>
<td>State Forest</td>
<td>Crown land Conservatio</td>
<td>Adjacent to portion of development envelope along corner of Gnangara Rd and Drumpellier Drive</td>
<td></td>
</tr>
<tr>
<td>R 44853</td>
<td>Orchid Park</td>
<td>Nature Reserve</td>
<td>N/A</td>
<td>Conservation of Flora and Fauna</td>
<td>Crown land Conservatio</td>
<td>Adjacent to western portion of development envelope boundary on Beechboro Rd Nth, to the south of Marshall Rd</td>
<td></td>
</tr>
</tbody>
</table>

5.3.6. Bush Forever Sites

Bush Forever identifies regionally significant bushland for protection within the Swan Coastal Plain portion of the Perth metropolitan region. Bush Forever sites have been identified on the basis of criteria relating to their conservation value and a target of protecting at least 10% of each vegetation complex, which is representative of regional ecosystems and habitats (Government of Western Australia 2000a). Bush Forever aims to protect a comprehensive representation of all ecological communities originally occurring in the region (Government of Western Australia 2000b).

There are seven Bush Forever sites located within one kilometre of the development envelope. One of these sites is located within the development envelope (Table 10).
Table 10: Bush Forever Sites in or within 1 km of the development envelope

<table>
<thead>
<tr>
<th>Site number</th>
<th>Site name</th>
<th>Bush Forever Size ha</th>
<th>Area within Development Envelope</th>
<th>Location relative to Development Envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td>304</td>
<td>Whiteman Park, Whiteman/West Swan</td>
<td>2801.22ha</td>
<td>81.70 ha</td>
<td>Development envelope is situated in the southern portion of the Site at Marshall Paddocks and intersects the Site’s eastern boundary along the northern portion of the alignment / Drumpellier Drive (formerly Lord Street).</td>
</tr>
<tr>
<td>305</td>
<td>Bennett Brook Reserve</td>
<td>39.46 ha</td>
<td>0</td>
<td>Approximately 50 m south of the development envelope along Marshall Road.</td>
</tr>
<tr>
<td>200</td>
<td>Caversham Airbase Bushland, West Swan / Whiteman</td>
<td>139.15 h</td>
<td>0</td>
<td>Adjacent to the development envelope east of Drumpellier Drive.</td>
</tr>
<tr>
<td>192</td>
<td>Wetherall Road Bushland (site 1)</td>
<td>43.58</td>
<td>0</td>
<td>Approximately 300 m west of the development envelope near Drumpellier Drive and 500 metres north of Gnangara Road in Ellenbrook.</td>
</tr>
<tr>
<td>195</td>
<td>Wetherall Road Bushland (site 2)</td>
<td>0.96</td>
<td>0</td>
<td>Approximately 700 m west of the development envelope on Drumpellier Drive and 900 metres north of Gnangara Road in Ellenbrook.</td>
</tr>
<tr>
<td>399</td>
<td>Melaleuca Park</td>
<td>4262.42</td>
<td>0</td>
<td>Approximately 600 m to the north west of the development envelope in Ellenbrook.</td>
</tr>
<tr>
<td>480</td>
<td>Tonkin/Reid Hwy</td>
<td>18.90</td>
<td>0</td>
<td>Within the intersection of Tonkin Hwy and Reid Hwy approximately 500 metres south of the development envelope.</td>
</tr>
</tbody>
</table>

Approximately 81.70 ha of Bush Forever site 304 is within the development envelope, however only a portion of this is expected to represent regionally significant vegetation. Measures in State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region relate only to bushland within a Bush Forever site meeting the criteria for regionally significant vegetation. The Proposal has been designed to not intercept Bush Forever site 200.

5.3.7. Wetlands

The Swan Coastal Plain is characterised by a chain of wetlands, many of which contain important ecosystems supporting a range of valuable species including plants, animals, invertebrates, fungi, bacteria and algae. The area within and around Whiteman Park which is adjacent to the development envelope contains several wetlands. This area is classified as flat, Palusplain and subject to seasonal waterlogging. The depth to groundwater is also known to be shallow at this location and the wetlands are generally associated with the intersection of groundwater with the ground surface.

The development envelope contains seven ephemeral wetlands which may contain important ecological values. Three of the wetlands are Conservation Category Wetlands which are the highest priority wetlands and require protection. Four of the remaining wetlands within the development area are Resource Enhancement Wetlands which require management and restoration to improve their conservation value.

Further information regarding wetlands are detailed in Section 8.3.3 Geomorphic Wetlands.

Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems that require access to groundwater to meet all or part of their water requirements for the community of plants, animals and ecological
processes they support (ELA 2019). Groundwater is therefore responsible for supporting a range of environmental values including the hydrological regime of some wetlands. In the development envelope and surrounding area, the shallow groundwater table is therefore important to support and maintain GDEs (ELA 2019).

Previous flora and vegetation surveys indicate that GDEs occur within the development envelope (RPS 2019; Coffey 2015a). RPS (2019) mapped the vegetation and flora within the development envelope in 2017, 2018 and 2019 and identified flora species and plant communities that are considered to be GDEs. Coffey (2015a) completed a flora survey of a portion of the development envelope in 2014 which identified several flora species that were groundwater dependent.

Other important groundwater dependent values surrounding the development envelope include areas of remnant vegetation and wetlands including (Figure 17):

- Bennett Brook is a groundwater fed stream where groundwater levels are ultimately responsible for defining the hydrological regime.
- Lightning Swamp terrestrial and wetland vegetation which lies directly adjacent to the development envelope to the south-west of the Tonkin Highway / Reid Highway interchange.
- The Banksia dominated woodlands of the Swan Coastal Plain PEC/TEC located within the development envelope, where depths to groundwater are generally less than 5 m below ground level.

5.3.8. Regional ecological linkages

In the Perth region, regional and local ecological linkages have been identified following a methodology outlined in the Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (Molloy et al. 2004) which defines an ecological linkage as a series of non-contiguous natural areas that connect larger natural areas by forming stepping stones through the altered landscape that allows the movement over time of organisms (animals, seeds, pollen) between these larger areas and across the landscape.

The survey area forms part of a regionally significant ecological linkage, Greenways 32, 39, 21, 40, and 38 (Tingay and Associates 1998), which extends from Bennett Brook north through Whiteman Park to the northern-most part of the survey area in Ellenbrook (Figure 6). These linkages happen to intersect with the areas within the survey area that have the highest conservation significance, for example, Bennett Brook and the wetlands identified as likely FCT17 records within Whiteman Park.

The Regional Ecological Linkage Network plan’s aim is to link protected regionally significant natural areas through the retention of the local natural areas in the best condition, so they can act as linkage corridors to enable flora and fauna dispersal between regionally significant areas (WALGA 2004). The development envelope intersects two historically mapped ecological linkages:

- A north-south corridor connecting Gnangara-Moore River State Forest, Whiteman Park and remnant vegetation along Bennett Brook. The linkage is relatively unbroken, although southern parts are increasingly surrounded by urbanisation (ELA 2019). The development envelope crosses this linkage at Bennett Brook, where a rail bridge is proposed to be constructed across the watercourse, allowing water flow and ecological function to be maintained beneath the infrastructure.
- An east-west corridor connecting Whiteman Park to vegetation on the eastern side of Drumpellier Drive (to the former Caversham airbase). This linkage is also increasingly affected by urban development. The development envelope crosses this linkage at Drumpellier Drive adjacent to Youle-Dean Road (ELA 2019). Due to the upgrade of Lord Street (Drumpellier Drive) the east-west linkage has already been fragmented and as a result, however the development envelope
will additionally impact on the ecological linkage by widening the gap created by Drumpellier Drive and blocking the movement of fauna with 1.8-metre-high chain mesh fencing on either side of the railway.
5.3.9. Vegetation associations

The Proposal is located within the South West Province and Darling Botanical District (Beard 1990). The development envelope is located within the Drummond Botanical subdistrict within the Swan Coastal Plain Subregion, which is mainly comprised of Banksia low woodland on leached sands with Melaleuca swamps on poorly drained areas and woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) on less leached soils (Beard 1990).

The Perth region was mapped by Beard (1979) at a 1:250,000 scale. Shepherd et al. (2002) have updated Beard’s mapping to reflect the National Vegetation Information System (NVIS) standards.

There are four broad-scale vegetation associations within the development envelope (Beard 1979; Shepherd et al. 2002):

- **Vegetation Association 1001**: Medium very sparse woodland; Jarrah, with low woodlands; Banksia and Casuarina (*Casuarina obesa*).
- **Vegetation Association 1009**: Medium woodland; marri and river gum.
- **Vegetation Association 1018**: Mosaic: Medium forest; Jarrah-Marri / Low woodland; banksia / Low forest; Teatree / Low woodland (*Casuarina obesa*).
- **Vegetation Association 949** – Low woodland banksia.

The remnant extent and reservation status of these vegetation associations within Western Australia, SWA02 Perth IBRA Subregion, and City of Swan are presented in Table 11.

Three of these vegetation associations (1001, 1018 and 1009) have between 10% and 30% of their pre-European extent remaining within the Perth (SWA02) Subregion.

**Table 11: Pre-European extent, current extent and reservation status of vegetation associations within the Western Australia, Perth IBRA subregion and City of Swan**

<table>
<thead>
<tr>
<th>Vegetation Association</th>
<th>Scale</th>
<th>Pre-European extent (ha)</th>
<th>Current extent (ha) remaining</th>
<th>% Pre-European extent remaining</th>
<th>% of current extent in secure tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001</td>
<td>Western Australia</td>
<td>57,410</td>
<td>12,792</td>
<td>22.28%</td>
<td>2.80%</td>
</tr>
<tr>
<td></td>
<td>SWA02 Bioregion</td>
<td>57,410</td>
<td>12,792</td>
<td>22.28%</td>
<td>2.80%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>8,868</td>
<td>2,354</td>
<td>26.54%</td>
<td>2.21%</td>
</tr>
<tr>
<td>1018</td>
<td>Western Australia</td>
<td>14,059</td>
<td>2,415</td>
<td>17.18%</td>
<td>0.71%</td>
</tr>
<tr>
<td></td>
<td>SWA02 Bioregion</td>
<td>13,946</td>
<td>2,389</td>
<td>17.13%</td>
<td>0.71%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>6,013</td>
<td>961</td>
<td>15.98%</td>
<td>8.98%</td>
</tr>
<tr>
<td>1009</td>
<td>Western Australia</td>
<td>18,225</td>
<td>2,995</td>
<td>16.43%</td>
<td>0.02%</td>
</tr>
<tr>
<td></td>
<td>SWA02 Bioregion</td>
<td>18,183</td>
<td>2,973</td>
<td>16.35%</td>
<td>0.02%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>8,522</td>
<td>369</td>
<td>4.33%</td>
<td>0.00%</td>
</tr>
<tr>
<td>949</td>
<td>Western Australia</td>
<td>218,194</td>
<td>123,039</td>
<td>53.39%</td>
<td>13.77%</td>
</tr>
<tr>
<td></td>
<td>SWA02 Bioregion</td>
<td>184,476</td>
<td>104,034</td>
<td>56.39%</td>
<td>14.88%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>16,235</td>
<td>7,965</td>
<td>49.06%</td>
<td>2.74%</td>
</tr>
</tbody>
</table>

Heddle et al. (1980) mapped regional vegetation as vegetation complexes based on major geomorphic units on the Swan Coastal Plain. Vegetation complex mapping has recently been revised by Webb et al. (2016).

5.3.10. Heddle Vegetation complexes

Heddle et al. (1980) mapped vegetation complexes which occur within the development envelope are listed in Table 12.

Table 12: Vegetation complexes within the development envelope

<table>
<thead>
<tr>
<th>Vegetation complex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bassendean Complex – Central and South</td>
<td>Vegetation ranges from woodland of <em>Eucalyptus marginata</em> (Jarrah), <em>Allocasuarina fraseriana</em> (Sheoak) and Banksia species to low woodland of Melaleuca species, and sedgelands on the moister sites. This area includes the transition of <em>Eucalyptus marginata</em> (Jarrah) to <em>Eucalyptus todtiana</em> (Prickly bark) in the vicinity of Perth</td>
</tr>
<tr>
<td>Bassendean Complex - North</td>
<td>Vegetation ranges from low open forest and low open woodland of Banksia species and <em>Eucalyptus todtiana</em> (Prickly bark) to low woodland of Melaleuca species and sedgelands which occupy wetter sites.</td>
</tr>
<tr>
<td>Southern River Complex</td>
<td>Open woodland of <em>Corymbia calophylla</em> (Marri), <em>Eucalyptus marginata</em> (Jarrah) and Banksia species with fringing woodland of <em>Eucalyptus rudis</em> (Flooded Gum), <em>Melaleuca raphiophylla</em> (Swamp Paperbark) along creek beds</td>
</tr>
</tbody>
</table>


The extent of vegetation complexes within Swan Coastal Plain and City of Swan are provided in Table 13. Although two vegetation complexes, Bassendean Complex – Central and South and Southern River have below 30% of their Pre-European extents remaining within the Swan Coastal Plain Interim Biogeographical Region of Australia (IBRA) region, neither is below the 10% retention target for intensely developed areas (Government of Western Australian 2019).

Table 13: Extent of vegetation complexes within the development envelope, Swan Coastal Plain and City of Swan

<table>
<thead>
<tr>
<th>Vegetation Complex</th>
<th>Scale</th>
<th>Pre-European extent (ha)</th>
<th>Current extent remaining (ha)</th>
<th>% pre-European extent remaining</th>
<th>% of current extent in secure tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bassendean Complex – Central and South</td>
<td>Swan Coastal Plain</td>
<td>87,476.26</td>
<td>23,508.66</td>
<td>26.87%</td>
<td>1.86%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>4,676.35</td>
<td>1,470.94</td>
<td>31.45%</td>
<td>-</td>
</tr>
<tr>
<td>Bassendean Complex - North</td>
<td>Swan Coastal Plain</td>
<td>79,057.35</td>
<td>56,659.67</td>
<td>71.67%</td>
<td>25.93%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>14,216.86</td>
<td>7,286.43</td>
<td>51.25%</td>
<td>-</td>
</tr>
<tr>
<td>Southern River Complex</td>
<td>Swan Coastal Plain</td>
<td>58,781.48</td>
<td>10,832.18</td>
<td>18.43%</td>
<td>1.18%</td>
</tr>
<tr>
<td></td>
<td>City of Swan</td>
<td>8,627.35</td>
<td>1,424.15</td>
<td>16.51%</td>
<td>-</td>
</tr>
</tbody>
</table>
5.3.11. Vegetation types

RPS undertook a detailed flora and vegetation assessment including the Proposal’s development envelope over four seasons Spring 2017, Spring 2018, and Autumn and Spring 2019. The results of the surveys are summarised below. A consolidated report will be prepared in 2020 to inform the environmental impact assessment process for this Proposal.

The survey area consists predominantly of isolated pockets of intact native wetland and upland vegetation surrounded by highly modified and degraded tracts of cleared or modified land. The survey area comprises 24 vegetation units, categorised into 6 broad vegetation types (described in Table 14).

RPS (2019) identified 18 vegetation units in the survey area, including upland, wetland and transitional vegetation types (Figure 7). These 18 vegetation types are considered to represent native vegetation. An additional six vegetation types are not considered to represent native vegetation and are described by RPS (2019) as highly modified and degraded.

Table 14: Broad vegetation types within the development envelope

<table>
<thead>
<tr>
<th>Broad vegetation type</th>
<th>Number of vegetation units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified/cleared</td>
<td>6</td>
<td>Cleared farm land with remnant isolated native trees, the recent clearing for Perth to Darwin Highway and Drumpellier Drive, other infrastructure including carparks, buildings and quarries, pine plantations, areas of rehabilitation, and private lots with some remnant trees but no intact native vegetation.</td>
</tr>
<tr>
<td>Marri on low slopes and flats</td>
<td>3</td>
<td>Vegetation units ranged from sparse woodland to closed forest. The units were differentiated based on their co-dominant species, i.e., Banksia spp., Jarrah (Eucalyptus marginata) generally on lower slopes, or Melaleuca preissiana and Xanthorrhoea preissii on the flats.</td>
</tr>
<tr>
<td>Low-lying Banksia woodland</td>
<td>2</td>
<td>The units were differentiated based on their dominant and co-dominant tree and shrub species.</td>
</tr>
<tr>
<td>Banksia woodland on dune slopes and crests</td>
<td>2</td>
<td>Banksia attenuata and B. menziesii were the dominant tree species in both units which were differentiated based on the presence of co-dominant tree species (e.g. Eucalyptus todtiana), and different dominant shrub species.</td>
</tr>
<tr>
<td>Melaleuca wetland/dampland</td>
<td>7</td>
<td>This broad vegetation type occurred throughout the floodplains, palusplains, sumplands and damplands which are dominant features within the survey area. <em>Melaleuca preissiana</em> was the dominant tree species in this broad vegetation type with <em>M. rhaphiophylla</em> as a dominant or co-dominant in some of the vegetation units. Other co-dominant tree species included <em>Eucalyptus rudis</em> subsp. <em>rudis</em> and <em>Corymbia calophylla</em>. Dominant shrub species differed between the vegetation units.</td>
</tr>
<tr>
<td>Eucalyptus rudis wetland / dampland / creekline.</td>
<td>4</td>
<td>This vegetation occurred along the banks (floodplains) of Bennett Brook, extending onto the palusplains. <em>Melaleuca rhaphiophylla</em> occurred as a co-dominant tree species in three of the four vegetation units.</td>
</tr>
</tbody>
</table>

Source: RPS (2019).
<table>
<thead>
<tr>
<th>Vegetation unit</th>
<th>Description</th>
<th>Area within development envelope (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Ba.As.Jf</td>
<td>Banksia attenuata Low Isolated Trees over Acacia saligna and Jacksonia furcellata Tall Sparse Shrubland over a mixed exotic Closed Grassland.</td>
<td>4.9</td>
</tr>
<tr>
<td>Ba.Bm.Bi.Xp.</td>
<td>Banksia attenuata , B. menziesii and B. ilicifolia Low Woodland over Xanthorrhoea preissii Mid Open Shrubland over Scholtzia involucrata Low Sparse Shrubland over an Open to Closed Rushland / Forbland.</td>
<td>9.6</td>
</tr>
<tr>
<td>Ba.Bm.Si.Po</td>
<td>Banksia attenuata and Banksia menziesii Low Woodland over a mixed Low Shrubland including Scholtzia involucrata, Eremaea pauciflora var. pauciflora, Hibbertia hypericoides, and Calytrix angulata Low Shrubland over Patersonia occidentalis var. occident* .</td>
<td>0.88</td>
</tr>
<tr>
<td>C/M</td>
<td>Completely cleared or modified. Includes private lots and infrastructure (roads, carparks, buildings, quarries) - some remnant trees but no intact native vegetation.</td>
<td>149.1</td>
</tr>
<tr>
<td>Cc./Em./Af.Bm.Xp</td>
<td>Corymbia calophylla / Eucalyptus marginata / Allocasuarina fraseriana Sparse Woodland to Mid Open Forest with isolated clumps of trees over Xanthorrhoea preissii shrubland over an exotic Closed Grassland/Herbland.</td>
<td>0.95</td>
</tr>
<tr>
<td>Cc.Em.Xp</td>
<td>Corymbia calophylla Sparse Woodland to Mid Open Forest with Eucalyptus marginate isolated clumps of trees over Xanthorrhoea preissii shrubland over an exotic Closed Grassland/Forbland</td>
<td>1.31</td>
</tr>
<tr>
<td>Cc./Mp./Er.Cleared</td>
<td>Isolated remnant Corymbia calophylla, Melaleuca preissiana and/or Eucalyptus rudis over pasture/weeds - previously cleared.</td>
<td>166.1</td>
</tr>
<tr>
<td>Cc./Mp.Xp.Cleared</td>
<td>Isolated remnant Corymbia calophylla, Melaleuca preissiana and/or Eucalyptus rudis over pasture/weeds - previously cleared.</td>
<td>64.4</td>
</tr>
<tr>
<td>Cc.Mp.Xp.</td>
<td>Corymbia calophylla Mid Open Forest to Mid Closed Forest over Melaleuca preissiana Low isolated trees to Low Woodland over Xanthorrhoea preissii isolated Shrubs to Mid Open Shrubland over Dielsia stenostachya Rushland with a mixed exotic Open Grassland.</td>
<td>18.0</td>
</tr>
<tr>
<td>Cc.Ti.Pe</td>
<td>Corymbia calophylla Mid Open Forest over Taxandria linearifolia Tall Closed Shrubland to Tall Sparse Shrubland over Pteridium esculentum Mid Closed Shrubland to Mid Sparse Shrubland.</td>
<td>1.49</td>
</tr>
<tr>
<td>Er.</td>
<td>Eucalyptus rudis Closed an exotic Closed Grassland.</td>
<td>1.01</td>
</tr>
<tr>
<td>Er.Mr.</td>
<td>Eucalyptus rudis subsp. rudis and Melaleuca raphiophylla Mid Open Forest over a mixed exotic Closed Forbland / Grassland.</td>
<td>16.5</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Area (ha)</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Er.Mr.As/Tl.</td>
<td><em>Eucalyptus rudis</em> subsp. <em>rudis</em> Mid Open Forest over <em>Melaleuca rhaphiophylla</em> Low Woodland over <em>Astartea scoparia</em> / <em>Taxandria linearifolia</em> isolated Shrubs over <em>Juncus pallidus</em> and <em>Lepidosperma longitudinale</em> Sparse Sedgeland over <em>Centella asiatica</em>.</td>
<td>1.08</td>
</tr>
<tr>
<td>Er.Mr.LI.</td>
<td><em>Eucalyptus rudis</em> and <em>Melaleuca rhaphiophylla</em> Closed Forest over <em>Lepidosperma longitudinale</em> Sedgeland.</td>
<td>2.6</td>
</tr>
<tr>
<td>Et.Ba.Bm.Ah.</td>
<td><em>Banksia attenuata</em> and <em>B. menziesii</em> Low Woodland with <em>Eucalyptus todtiana</em> Isolated Trees over <em>Allocasuarina humilis</em> Mid Open Shrubland over <em>Hibbertia hypericoides</em>, <em>Conostephiium pendulum</em> and <em>Astroloma xerophyllum</em> Low Open Shrubland to Low Sparse Shrubland*.</td>
<td>23.9</td>
</tr>
<tr>
<td>Eucs.</td>
<td>Planted eastern states Eucalypts.</td>
<td>0.46</td>
</tr>
<tr>
<td>Mp.As.</td>
<td><em>Melaleuca preissiana</em> Low Woodland to Low Open Forest over <em>Astartea scoparia</em> Mid Shrubland to Mid Sparse Shrubland over a mixed Open Sedgeland/Rushland/Forbland/Grassland.</td>
<td>3.62</td>
</tr>
<tr>
<td>Mp.Tl.Ca.</td>
<td><em>Melaleuca preissiana</em> isolated trees to Mid Closed Forest over <em>Taxandria linearifolia</em> Tall Closed Shrubland to Tall Sparse Shrubland over an Open to Closed Rushland/Sedgeland including <em>Cyathochaeta avenacea</em>, <em>Dielsia stenostachya</em>, <em>Lepidosperma longitudinale</em> *.</td>
<td>0.39</td>
</tr>
<tr>
<td>Mp.Tl.Ct.</td>
<td><em>Melaleuca preissiana</em> isolated trees to Mid Closed Forest over <em>Taxandria linearifolia</em> Tall Closed Shrubland to Tall Sparse Shrubland over an Open to Closed Rushland / Sedgeland including <em>Cyathochaeta teretifolia</em>, <em>Dielsia stenostachya</em> and <em>Lepidosperma longitudinale</em></td>
<td>7.6</td>
</tr>
<tr>
<td>Mp.Xp.</td>
<td><em>Melaleuca preissiana</em> Low isolated trees to Low Woodland over <em>Xanthorrhoea preissii</em> isolated Shrubs to Mid Open Shrubland over a mixed exotic Open Grassland.</td>
<td>18.2</td>
</tr>
<tr>
<td>Mr./Standing Water</td>
<td><em>Melaleuca rhaphiophylla</em> over a mixed exotic Closed Forbland/Sedgeland on wetland fringe and over standing water in wetland.</td>
<td>1.56</td>
</tr>
<tr>
<td>Mr.Ml.Tl.As.</td>
<td><em>M. rhaphiophylla</em> Low Woodland over <em>M. lateritia</em>, <em>Taxandria linearifolia</em> and <em>Astartea affinis</em> Tall Shrubland over <em>Centella asiatica</em> Low Forbland on wetland fringe and standing water in wetland.</td>
<td>1.8</td>
</tr>
<tr>
<td>Pp.</td>
<td><em>Pinus pinaster</em> plantation.</td>
<td>7.62</td>
</tr>
<tr>
<td>Rehab</td>
<td>Rehabilitated areas and native regrowth (post clearing).</td>
<td>3.00</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td><strong>486.4 / 505.7</strong></td>
</tr>
</tbody>
</table>
5.3.12. Vegetation condition

188 ha of the development envelope is cleared/no vegetation. This includes cleared farmland, buildings, roads, tracks, and cleared and developed private lots.

Vegetation condition within the 501 ha development envelope ranges from Excellent to Completely Degraded. A large proportion of the vegetation within the development envelope is Completely Degraded condition 190 ha. The Degraded condition throughout much of the remnant trees over pasture vegetation units is due to historical grazing by livestock and kangaroos and weed infestation. 123 ha (25%) of the native vegetation within the development envelope is Degraded or better condition. The vegetation in the best condition was recorded on the slopes and crests of dunes and comprised Banksia woodland with a dense or mid-dense shrub layer. Several small patches of wetland vegetation within the development envelope were mapped in Good, Very Good and Excellent condition occurring along the eastern side of Whiteman Park. See below for a further breakdown of the condition of this native vegetation:

- Excellent – 4.75 ha.
- Very Good - 16.42 ha.
- Very Good – Good – 0.88 ha.
- Good - 9.08 ha.
- Good – Degraded – 11.67 ha.
- Degraded – 54.91 ha.
- Degraded - Completely Degraded 10.14 ha.
- Unsurveyed – 14.50 ha.

Flora and vegetation technical studies are currently being finalised and will enable vegetation condition to be further refined throughout the environmental approvals process, and in accordance with the mitigation hierarchy.
METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 7C Vegetation Types

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway

Vegetation Type
- CiM
- Cc./Mp./Er.Cleared
- Er.Mr.
- Er.Mr.LI.
- Mp.As.
- Mr.M1.TI.As.
- Rehab

Figure 8A Vegetation Condition

Legend

- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

Vegetation Condition

- Very Good
- Very Good - Good
- Good
- Good - Degraded
- Degraded
- Completely Degraded
- Unsurveyed Area


METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 8A Vegetation Condition
## 5.3.13. Threatened and priority ecological communities

Threatened ecological communities (TECs) are formally protected under the Western Australian BC Act and/or the Commonwealth EPBC Act. The Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of Priority ecological communities (PECs) for ecological communities of conservation concern not listed under the BC Act. PECs are typically those that have been the subject of little research and/or are known from only a few collections or sight records under threat from potential impacts.

A DBCA ecological communities database search was undertaken in 2018 within a 3 km radius of the development envelope (RPS 2019). A buffered search was used to ensure that conservation significant values nearby to the development envelope were detected. Database records were buffered to ensure that they are returned in nearby searches and to avoid revealing their precise location. Nine State-listed TECs and PECs (or their buffers) were found from 348 records in the search area (RPS 2019).

RPS’s 2019 field survey did not record any State-listed TECs within the development envelope (RPS 2019). However, RPS (2019) confirmed the presence of the EPBC Act-listed Banksia Woodlands of the Swan Coastal Plain TEC, which is synonymous with the State-listed Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3).

RPS (2019) floristic analysis identified the potential presence of Priority 3 PEC SCP23b Swan Coastal Plain *Banksia attenuata–Banksia menziesii* woodlands (FCT23b). Coffey (2015a) recorded FCT23b within their survey area and this adds strength to the likelihood that the one site RPS identified does represent conservation significant FCT23b (RPS 2019).

The survey area intersects the buffers of numerous records of the Banksia Woodlands of the Swan Coastal Plain Ecological Community, which encompasses all Banksia woodland FCTs including those with state-listed conservation significance as well as those not currently listed at state level as conservation significant. The Banksia Woodlands of the Swan Coastal Plain Ecological Community within the development envelope, is represented by the two Banksia woodland vegetation units mapped and described by RPS (2019). All the Banksia Woodland vegetation within the development envelope meets the diagnostic characteristics for the Commonwealth listed Banksia Woodlands of the Swan Coastal Plain TEC. however many areas did not meet the minimum condition or patch size thresholds and therefore do not qualify Banksia Woodlands of the Swan Coastal Plain TEC.

Figure 9 shows the location of TEC and PEC records from the flora and vegetation survey in relation to the development envelope.

### 5.3.14. Other conservation significant ecological communities

**Eucalyptus rudis/Taxandria linearifolia wetlands in Bassendean Dunes (FCTS17)**

*Eucalyptus rudis/Taxandria linearifolia* wetlands in Bassendean Dunes (FCTS17) was determined to be present within the survey area via the multivariate analysis of the floristic data (RPS 2019). It was represented by wetland sites PTAQ13, PTAQ20 and METQ07. This community type is considered ‘rare’ on the Swan Coastal Plain (Keighery et al.2012).

### 5.3.15. Conservation significant flora

RPS (2019) conducted a desktop search of the DBCA and WA Herbarium (WAH) Specimen database and identified a total of 46 species of conservation significance which occurred within a 5 km radius of the RPS (2019) survey area (Figure 10). This included five Threatened flora species, three Priority 1, five Priority 2, 22 Priority 3 and 11 Priority 4 flora taxa.

Of the 46 species identified with the potential to occur:
two species were recorded in the survey area (one in development envelope) during the field surveys; 
two were assessed as having a high likelihood of occurring; and 
11 were assessed as having a moderate likelihood of occurring within the development envelope.

This likelihood assessment is based on habitat preference and proximity of known records to the survey area (Table 16) (RPS 2019). A discussion of each of these species is provided below.

**Table 16: Threatened and Priority flora recorded within a 5 km radius of the development envelope with a moderate to high likelihood of occurrence**

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation status</th>
<th>Preferred habitat (soil and landform)</th>
<th>Likelihood of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anigozanthos humilis subsp. Chrysanthus</td>
<td>– – P4</td>
<td>Slope with white to grey sand. Underlying geology: Bassendean Dune System.</td>
<td>High</td>
</tr>
<tr>
<td>Caladenia huegelii</td>
<td>Cr</td>
<td>Grey or brown sand, clay loam.</td>
<td>High</td>
</tr>
<tr>
<td>Carex tereticaulis</td>
<td>– – P3</td>
<td>Grey sand.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Conospermum undulatum</td>
<td>Vu Vu</td>
<td>Low plain/swamp. White-grey sand. Bassendean-Southern River complex. Seasonal dampland. Probably burnt within last 5 years.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cyathochaeta teretifolia</td>
<td>– – P3</td>
<td>Grey sand, sandy clay. Swamps, creek edges.</td>
<td>High</td>
</tr>
<tr>
<td>Eryngium pinnatifidum subsp. Palustre (G. J. Keighery 13459)</td>
<td>– – P3</td>
<td>Dampland; grey sand.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Hydrocotyle striata</td>
<td>– – P1</td>
<td>Clay. Springs.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Jacksonia sericea</td>
<td>– – P4</td>
<td>Calcareous and sandy soils.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Poranthera moorokatta</td>
<td>– – P2</td>
<td>Dampland; light grey to grey sand over light grey-grey clay.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stachystemon sp. Keysbrook (R. Archer 17/11/99)</td>
<td>– – P1</td>
<td>Dry flat, grey sand some humus, over humus and sand, well drained.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stylidium longitubum</td>
<td>– – P4</td>
<td>Sandy clay, clay. Seasonal wetlands.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stylidium trudgenii</td>
<td>– – P3</td>
<td>Dampland – wetland. Peat, soggy.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Trithuria occidentalis</td>
<td>En Cr</td>
<td>In water, muddy open.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Verticordia lindleyi subsp. lindleyi</td>
<td>– – P4</td>
<td>Gravelly soil.</td>
<td>High</td>
</tr>
</tbody>
</table>

Source: adapted from RPS 2019 and Wildlife Conservation (Rare Flora) Notice 2018
**Recorded species**

No Threatened flora species listed under BC Act or the EPBC Act were recorded within the RPS (2019) survey area. Two Priority Flora species were recorded within the survey area, one of which occurs within the development envelope:

- *Anigozanthos humilis* subsp. *chrysanthus* (Priority 4) – recorded in the development envelope
- *Cyathochaeta teretifolia* (Priority 3) – recorded in the survey area

*Anigozanthos humilis* subsp. *chrysanthus* (Priority 4) was recorded in the development envelope adjacent to the proposed Malaga Station and *Cyathochaeta teretifolia* (Priority 3) was recorded adjacent to the development envelope west of Drumpellier Drive (New Lord Street) (Figure 10).

*Anigozanthos humilis* subsp. *chrysanthus* (Priority 4)

*Anigozanthos humilis* subsp. *chrysanthus* is a rhizomatous, perennial herb growing 0.2 to 0.4 m high and is listed as Priority 4 by the DBCA. The species occurs on grey or yellow sand and flowers are characteristically yellow and appear between July and October (RPS 2019).

*Anigozanthos humilis* subsp. *chrysanthus* was recorded in one quadrat (PTAQ08) and adjacent to another (PTAQ12) within the *Banksia attenuata* and *B. menziesii* with emergent *Eucalyptus todtiana* low woodland vegetation unit (Et.Ba.Bm.Ah.) occurring on dune slopes and crests (RPS 2019). See Figure 10 showing the location of the two records between Hepburn Avenue, Marshall Road and Beechboro Road North, within the development envelope.

These two records will be directly impacted by the Proposal.

*Cyathochaeta teretifolia* (Priority 3)

*Cyathochaeta teretifolia* is a rhizomatous, clumped, robust perennial sedge which grows to 2 m high and 1 m wide and is listed as Priority 3 by the DBCA. *C. teretifolia* occurs on grey sand and sandy clay in swamps and along the banks of creeks and has brown flowers (RPS 2019).

*C. teretifolia* was recorded at two locations within the survey area; one within Resource Enhancement Wetland (REW) dampland (UFI 8679) and one within Conservation Category Wetland (CCW) sumpland (UFI 8548) (Figure 10 and Figure 17). The DBCA database has also identified an additional record within Bennett Brook CCW UFI 15259. All locations are outside of the development envelopment within Whiteman Park and therefore will not be directly impacted by the Proposal and are not discussed further.

**High likelihood species**

*Caladenia huegelii* (Critically Endangered – BC Act / Endangered – EPBC Act)

*Caladenia huegelii* (Grand spider orchid) is listed as Critically Endangered under BC Act and Endangered under the EPBC Act. It has been recorded at several locations within 5 km of the development envelope (RPS 2019).

Two targeted surveys have been undertaken for *Caladenia huegelii* within the survey area:

- RPS undertook a targeted search during September 2018 for *C. huegelii* during the species’ documented flowering period (between mid-September and mid-October). The survey identified that the year was considered an ‘average year’ to identify the species. (RPS 2019). No individuals of *Caladenia huegelii* were detected during the 2018 targeted survey.
• ELA undertook a targeted search between 26-28 September 2019, during the species’ documented flowering period (between mid-September and mid-October). No individuals of *Caladenia huegelii* were detected during the 2019 targeted survey.

No *C. huegelii* were recorded within the survey area or the development envelope.

While no individuals of this species were recorded at this time, the Survey Guidelines for Australia’s Threatened Orchids Guidelines for Detecting Orchids Listed as ‘Threatened’ under the EPBC Act (Commonwealth of Australia 2013) indicate that the lack of individuals is not necessarily indicative of true absence in the area in any given year. Further targeted flora surveys will be undertaken during peak flowering period in 2020 (late September / early October) within suitable/supporting habitat to comply with the survey guidelines outlined in the recovery plan for the species.

The METRONET Stakeholder Reference Group will continue to be consulted to advise on the appropriate survey timing to target this species in 2020.

**Verticordia lindleyi** subsp. *lindleyi* (Priority 4)

*Verticordia lindleyi* subsp. *lindleyi* is an erect shrub growing 0.2-0.75 m high with pink flowers that is listed as Priority 4 by the DBCA. The species grows in sand/sandy clay or gravelly in winter-wet depressions and flowers in May or November to January (RPS 2019). There are four records in the location area, one within Whiteman Park, two in the suburb of Brabham and one in Guildford.

The species has a high likelihood of occurrence within the survey area due to the presence of suitable habitat and the close proximity of records. Further targeted flora surveys will be undertaken during the flowering period in 2020 (May, November-January) within suitable/supporting habitat.

The METRONET Stakeholder Reference Group will continue to be consulted to advise the appropriate survey timing to target this species in 2020.

**Moderate likelihood species – terrestrial**

*Conospermum undulatum* (Vulnerable / Vulnerable)

*Conospermum undulatum* (Wavy-leaved Smoke bush) is listed as Vulnerable under both the BC act and the EPBC Act. *C. undulatum* is an erect shrub to 1.5 m tall with distinctive fibrous, longitudinally fissured stems, hairless leaves and white flowers (RPS 2019).

*Conospermum undulatum* is a geographically restricted species known from 25 historical populations between the Swan and Canning Rivers. However, only 20 populations currently contain extant plants. Habitat is sand and sandy clay soils, often over laterite, on flat or gently sloping sites in Banksia and jarrah/marri woodland. There are also a few records from slightly swampy habitats, and it can occur in association with the SCP20a ecological community.

The closest locations of this species are approximately 10 km southeast of the survey area in Redcliffe (RPS 2019). While *C. undulatum* has the potential to occur within the development envelope, the species was not recorded during the field surveys (RPS 2019) and no other previous investigations have recorded the species within the surveyed extent of the development envelope.

Further targeted flora surveys will be undertaken during the flowering period in 2020 (May - October) within suitable/supporting habitat to comply with the survey guidelines for the species. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Calectasia elegans** (Priority 2)

*Calectasia elegans* (Elegant Tinsel Lily) is a small, branched shrub to about 50 cm high with stiff, erect branchlets covered by old leaves and leaf sheaths (Barrett et al. 2015) and is listed as Priority 2 by the DBCA. The species grows on grey sand (RPS 2019).
There is one record of *Calectasia elegans* within a 5 km buffer of the survey area, located in the suburb of Melaleuca, north of the Proposal.

*Calectasia elegans* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during the peak flowering period in 2020 within suitable/supporting habitat. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Carex tereticaulis** (Priority 3)

*Carex tereticaulis* is a monoecious and rhizomatous perennial grass-like sedge with a tufted habit and is listed as Priority 3 by the DBCA. The species has brown flowers and typically grows to a height of 0.7 m, it grows along watercourses or in wet areas on grey Bassendean sand over sand, or black peaty sand (RPS 2019).

There are two records of the species south-east of the Proposal in the suburbs of Guildford and Caversham.

*Carex tereticaulis* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period in 2020 (September to October) within suitable/supporting habitat. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Eryngium pinnatifidum** subsp. **palustre** (G. J. Keighery 13459) (Priority 3)

*Eryngium pinnatifidum* subsp. *palustre* (Blue Devil) is a flowering plant which is listed as Priority 2 by the DBCA. The species grows in damplands on grey sand (RPS 2019).

There is one record of *E. pinnatifidum* subsp. *palustre* within a 5 km buffer of the survey area, located 2.5 km north-east of the development envelope in Ellenbrook.

*E. pinnatifidum* subsp. *palustre* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period in 2020 within suitable/supporting habitat. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Jacksonia sericea** (Priority 4)

*Jacksonia sericea* is a low spreading shrub growing to 0.6 m high and is listed as Priority 2 by the DBCA. The species has orange flowers and grows on calcareous and sandy soils (RPS 2019).

*Jacksonia sericea* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period in 2020 (December – February) within suitable/supporting habitat. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Poranthera moorokatta** (Priority 2)

*Poranthera moorokatta* is a small, rare, monoecious, erect annual species known only from two locations: Kings Park and Ellenbrook. It is listed as Priority 2 by the DBCA (RPS 2019).

There is one record of the species north of the Proposal north of the Ellenbrook town centre. The Ellenbrook population of the species occurs with *Astartea aff. fascicularis*, *Banksia littoralis*, *Calothamnus lateralis*, *Centrolepis aristata*, *Melaleuca preissiana*, *Pericalymma ellipticum* var. *ellipticum* and *Phyllangium paradoxum* in a shallow dampland on mixed grey and white sand with scattered leaf litter (Barrett 2012).

*Poranthera moorokatta* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering
period in 2020 within suitable/supporting habitat. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Stachystemon sp. Keysbrook (Priority 1)**

*Stachystemon* sp. Keysbrook is a small rare plant known from three locations in south-west Western Australia, and is listed as Priority 1 by the DBCA. The species grows in well drained dry flat areas on grey sand over humus and sand (Western Australian Herbarium 2017; and RPS 2019).

There are two records of the species located within Whiteman Park, immediately adjacent to the Proposal. The closest records are located approximately 500m west of the development envelope.

*Stachystemon sp. Keysbrook* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period in 2020 within suitable/supporting habitat.

The ESRG have reviewed the likelihood and advised no further comment. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Stylidium longitubum (Priority 4)**

*Stylidium longitubum* (Jumping Jacks, species of trigger plant) is an erect annual (ephemeral) herb growing to 0.05-0.12 m high, and is listed as Priority 4 by the DBCA. The species grows in seasonal wetlands on sandy clay/clay and has pink flowers (Western Australian Herbarium 2017; and RPS 2019).

There are a number of records of this species occurring within 5 km of the Proposal, the majority of which are located to the east of the development envelope. The nearest record is located immediately north of the development envelope in the southern and central portion of Whiteman Park, south of Bennet Brook.

*Stylidium longitubum* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period (October to December) in 2020 within suitable/supporting habitat.

The ESRG have reviewed the likelihood and advised no further comment. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

**Stylidium trudgenii (Priority 3)**

*Stylidium trudgenii* (a species of trigger plant) is a caespitose perennial herb growing to 0.05-0.5 m high and is listed as Priority 3 by the DBCA. The species grows in wetlands (damplands), margins of winter-wet swamps and depressions on grey sand, dark grey to black sandy peat (soggy) (Western Australian Herbarium 2017; and RPS 2019).

There are a number of records of this species occurring within 5 km of the Proposal. The nearest records are located immediately north of the development envelope in the suburb of Ellenbrook. *Stylidium longitubum* has the potential to occur within the development envelope due to the presence of suitable habitat. Further targeted flora surveys will be undertaken during peak flowering period in 2020 within suitable/supporting habitat.

The ESRG have reviewed the likelihood and advised no further comment. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.
Moderate likelihood species – aquatic

*Trithuria occidentalis* (Critically Endangered / Endangered)

*Trithuria occidentalis* (Western Trithuria or Swan Hydatella) is listed as Critically Endangered under the BC Act and Endangered under the EPBC Act. *Trithuria occidentalis* is an aquatic herb, 2 to 3cm high, with tufted, linear, usually reddish leaves, 1mm wide by 2 to 3cm long, which are usually submerged until the pool dries up.

There are two records of *Trithuria occidentalis* within a 5 km buffer of the survey area. The species is currently known from one confirmed location near Ellenbrook, approximately 3.2 km east of the Proposal. There is also a possible second location in Upper Swan in which the species has not been relocated since 1978, located approximately 4.7 km south-east of the Proposal.

The species grows partly submerged on the edge of shallow, winter-wet claypans in very open shrubland of *Melaleuca lateritia* (DEC 2012a).

Rigorous survey effort has been undertaken to search for *Trithuria occidentalis* between 2015 and 2019 (Coffey 2015a, RPS 2019), however to date the species has not been recorded within the development envelope or in the local area.

In winter, *Trithuria occidentalis* is submerged in wet shallow claypans, flowering as the water recedes, while in summer it occurs as seed in the dried up mud of the claypans. The species will be targeted in winter 2020 during the wetland flora and vegetation survey, consistent with the critical survey timing in the species recovery plan (DEC 2012a).

The ESRG have reviewed the likelihood and advised no further comment. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

*Hydrocotyle striata* (Priority 1)

*Hydrocotyle striata* (sometimes called water pennywort) is a prostrate, perennial aquatic or semi-aquatic herb and is listed as Priority 1 by the DBCA (Western Australian Herbarium 2017; RPS 2019). It grows on that clay soils in springs, and has been recorded at two locations along Bennett Brook within Whiteman Park, immediately north of the development envelope (Western Australian Herbarium 2017; RPS 2019).

The ESRG have reviewed the likelihood and advised no further comment. The ESRG will be consulted to advise the appropriate survey timing to target this species in 2020.

Flora of other conservation significance

There are a number of other criteria (apart from the Commonwealth and Western Australian criteria for Threatened and Priority flora) under which flora taxa of the Perth Metropolitan Region (PMR) may be considered to be of ‘other’ conservation significance. These taxa are listed by *Bush Forever: Volumes 1 & 2* (WAPC 2000a, 2000b) as significant under various categories which include being confined to scarce or refugial habitats; having an uncommon form; belonging to regionally significant populations; being outside, disjunct from, or at the limit of their known geographical range; being undescribed taxonomic entities or being poorly reserved. These taxa are not protected under State or Commonwealth legislation but are required to be assessed as part of flora and vegetation assessments.

A total of six taxa were recorded within the survey area that are conservation significant based on geographic range anomalies, belonging to significant populations, being poorly reserved, or endemic to the Swan Coastal Plain or the Perth metropolitan portion of the Swan Coastal Plain (Table 12).
Table 12: Significant flora of the Perth Metropolitan Region

<table>
<thead>
<tr>
<th>Other flora species of conservation significance</th>
<th>Significance*</th>
<th>Location within the survey area</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aotus cordifolia</em></td>
<td>p, s</td>
<td>PTAQ13, PTAQ20</td>
</tr>
<tr>
<td><em>Burchardia bairdiae</em></td>
<td>r, s</td>
<td>PTAQ14</td>
</tr>
<tr>
<td><em>Conostephium minus</em></td>
<td>p, s, e</td>
<td>opportunistic</td>
</tr>
<tr>
<td><em>Conostylis aculeata</em> subsp. <em>cygnorum</em></td>
<td>e</td>
<td>PTAQ08, PTAQ11, PTAQ12</td>
</tr>
<tr>
<td><em>Dielsia stenostachya</em></td>
<td>e</td>
<td>PTAQ13, PTAQ14, PTAQ15, PTAR10, PTAR12</td>
</tr>
<tr>
<td><em>Verticordia nitens</em></td>
<td>s</td>
<td>PTAQ15</td>
</tr>
</tbody>
</table>

*Adapted from Table 13 (WAPC 2000)

r - populations at the northern or southern limit of their known geographic range

d - populations disjunct from their known geographic range

p - considered to be poorly reserved (applies to all Threatened and Priority taxa)

s - significant populations (applies to all Threatened and Priority taxa)

X - considered lost in the PMR

e - taxa endemic to the Swan Coastal Plain

The ESRG will be consulted to advise the appropriate survey timing to target these species in 2020.

5.3.16. Dieback

*Phytophthora* Dieback (Dieback) is a soil borne pathogen with a range of hosts in the southwest of WA. While some plants species are resistant, others are susceptible to the disease caused by the pathogen resulting in chlorosis, dieback and usually death (Wills and Keighery 1994).

Limited assessments of the prevalence of *Phytophthora* Dieback within the development envelope have been undertaken to date. Terratree (2014) assessed the vegetation within and adjacent to PDNH which covers parts of the Malaga section of the development envelope, with most areas considered to be ‘excluded’ due to lack of vegetation in Good or better condition as required to provide adequate numbers of disease indicator species to sample (ELA 2019). The majority of the development envelope has been heavily disturbed by urban development and road infrastructure projects. It is likely that dieback is present within the site, even if it is not detectable through dieback mapping due to the highly modified nature of the vegetation and lack of indicator species or protectable vegetation. The development envelope is likely to be described as “Unmappable”.

5.3.17. Weeds

RPS (2019) recorded a total of 75 introduced flora species within the survey area. Of these 75 species, two are Declared Pests under Section 22(2) of the BAM Act; *Zantedeschia aethiopica* (Arum Lily) and *Moraea flaccida* (Cape Tulip). None of the weeds recorded were listed as Weeds of National Significance (WONS).
Figure 9A Conservation Significant Communities

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

TEC/PEC Banksia Woodlands of the Swan Coastal Plain Ecological Community
Figure 9B Conservation Significant Communities

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment

Community of other Conservation Significance
- Eucalyptus rudis/Taxandria lineatfolia
- wetlands in Bassendean Dunes (FCT17)
Figure 9C Conservation Significant Communities
5.4. Assessment of impacts to Flora and Vegetation

Table 17 provides an evaluation of the potential impacts that the Proposal may have on flora and vegetation and the PTA's proposed mitigation hierarchy to minimise impacts.

Table 17: Impacts and preliminary mitigation for Flora and Vegetation

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impacts</th>
<th>Preliminary Mitigation Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native vegetation clearing</td>
<td>Clearing of native vegetation within a development envelope of 501 ha. 188 ha of the development envelope is considered to be cleared/no vegetation. Vegetation condition within the development envelope ranges from Excellent to Completely Degraded. 190 ha of vegetation is considered to be in Completely Degraded condition comprising plantations, cleared farmland, buildings, roads, tracks, and developed private lots. The Degraded condition throughout much of the remnant trees over pasture vegetation units is due to historical grazing by livestock and kangaroos and weed infestation. 123 ha of native vegetation is considered to be in Degraded or better condition. See below for a breakdown of the condition of this native vegetation: Excellent – 4.75 ha. Very Good - 16.42 ha. Very Good – Good – 0.88 ha. Good - 9.08 ha. Good – Degraded – 11.67 ha. Degraded – 54.91 ha. Degraded - Completely Degraded 10.14 ha. Unsurveyed – 14.50 ha. The largest impact to vegetation complexes within the development envelope is Southern River Complex with up to 418.31 ha impacted. Bassendean Complex Central and South is up to 71.41 ha and Bassendean Complex North is up to 11.08 ha impacted. At a regional scale the potential impact is 3.86% for Southern River Complex, 0.30% for Bassendean Complex central and South and 0.02% for Bassendean Complex North. The implementation of the Proposal is not anticipated to reduce any of the vegetation complexes below EPA’s 10% level of pre-clearing extent retention target for urban areas on the Swan Coastal Plain. Approximately 81.70 ha (3.21%) of 2,542.23 ha Bush Forever site 304 is within the development envelope. The majority of</td>
<td>Avoid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The Proposal development envelope has been designed to minimise the potential impacts to native vegetation by avoiding clearing as far as practicable.</td>
</tr>
<tr>
<td></td>
<td>Minimise</td>
<td>• PTA will utilise cleared areas for laydown and temporary construction where practicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The PTA is committed to further avoiding areas of native vegetation where practicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The PTA will aim to minimise the clearing of native vegetation further during the detailed design phase, where practicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A CEMP will be developed which will include measures to mitigate clearing impacts to vegetation.</td>
</tr>
<tr>
<td></td>
<td>Rehabilitate</td>
<td>• As this Proposal is for the construction and operation of permanent linear rail infrastructure, there are limited opportunities for rehabilitation. The operational railway corridor will be managed by the PTA in perpetuity, in accordance with the PTA’s Urban Rail Reserve Vegetation Management Plan (PTA 2016). Where practicable, landscaping around train stations will use local native species. The PTA will reinstate construction laydown areas commensurate with pre-construction conditions.</td>
</tr>
</tbody>
</table>
the bushland within the development envelope has been mapped as Completely Degraded (RPS 2019) and as such does not meet the criteria as significant bushland.

The PTA will continue to apply the mitigation hierarchy throughout the environmental approvals process.

---

### Potential Clearing of TECs/PECs

The proposal may potentially clear up to 23.06 ha of the EPBC Act-listed Bankia Woodlands of the Swan Coastal Plain TEC, which is synonymous with the State-listed Bankia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3). RPS (2019) recorded one confirmed EPBC-listed TEC within the Development envelope. The permanent loss of up to 23.06 ha of Bankia Woodland of the Swan Coastal Plain. This TEC is a subset of the Bankia dominated woodlands of the Swan Coastal Plain IBRA Region PEC (Priority 3) in Good or better condition.

Three PECS were recorded within the Development envelope, which are associated with the Bankia Woodland TEC:

- Bankia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3) (hereafter referred to as Bankia woodlands PEC)
- SCP21c – Low lying *Bankia attenuata* woodlands or shrublands (Priority 3)
- SCP23b – Swan Coastal Plain *Bankia attenuata* – *Bankia menziesii* woodlands (Priority 3).

PECs are ecological communities with insufficient information available to be considered a TEC or which are rare but not currently threatened.

No other PECs or Threatened Ecological Communities (TECs) have been identified as occurring within the development envelope.

---

### Permanent loss of conservation significant flora species

*Anigozanthos humilis* subsp. *chrysanthus* was recorded at two locations within the development envelope. *A. humilis* subsp. *chrysanthus* is known from grey or yellow sands dune slopes and has been recorded within the Swan Coastal Plain IBRA regions. No *Caladenia huegelii* have been recorded within the Development envelope.

---

**Avoid**
- The Proposal development envelope has been designed to minimise the potential impacts to native vegetation.

**Minimise**
- PTA will utilise cleared areas for laydown and temporary construction where practicable
- The PTA is committed to further investigate avoiding areas of vegetation where practicable.
- The PTA will aim to minimise the clearing footprint of native vegetation further during the detailed design phase, where practicable, to minimise the overall potential impact.
- A CEMP will be developed which will include measures to mitigate clearing impacts to vegetation.

**Rehabilitate**
- As this Proposal is for the construction and operation of permanent linear rail infrastructure, there are limited opportunities for rehabilitation. The operational railway corridor will be managed by the PTA in perpetuity, in accordance with the PTA’s Urban Rail Reserve Vegetation Management Plan (PTA 2016). Where practicable, landscaping around train stations will use local native species.
- The PTA will reinstate construction laydown areas commensurate with pre-construction conditions.

---

**Minimise**
- Potential habitat for *C. huegelii* includes *Bankia Dominated Woodlands of the Swan Coastal Plain IBRA Region* (P3). Providing there will remain a high level of protection afforded to the *Bankia Dominated Woodlands of the Swan Coastal Plain IBRA Region* (P3), it is considered the potential directs impacts to this species not to be significant on a regional scale. Further targeted
| Degradation of adjacent vegetated areas. | **Edge effects and Indirect Impacts**  
One Bush Forever site is adjacent to the development envelope.  
Areas of TEC and PEC could potentially be associated with local groundwater levels.  
As a precautionary approach PTA will continue to apply the mitigation hierarchy to avoid and minimise impacts to areas outside of the development envelope.  
The Proposal is unlikely to have direct or indirect impacts on the condition of vegetation outside the development envelope. Potential impacts of construction, such as dust, erosion, vegetation damage through human access and waste, can be adequately managed through the construction phase of the Proposal.  
**Dieback**  
The potential for the spread and/or introduction of weeds or Dieback within the development envelope could occur as a result of construction through the movement of vehicles and plant machinery, as well as via personnel. Given the low number of weeds the risk of the spreading and/or introduction of weed species is low. Weeds and Dieback can be appropriately managed through hygiene measures outlined in the CEMP.  
**Weeds**  
No Weeds of National Significance have been mapped within the development envelope. |
|---|---|
| | **surveys are being undertaken for C. huegelii within the flowering period.**  
Minimise  
- The PTA will aim to minimise the clearing footprint of native vegetation further during the detailed design phase, where practicable, to minimise the overall potential impact.  
- Temporary stormwater control measures such as swales and bunding will be used around laydown areas to avoid stormwater runoff into adjacent areas outside of the development envelope.  
A CEMP will be developed and implemented with weed and hygiene management measures which may include:  
- Declared plant knowledge, identification and reporting to be included in contractor inductions.  
- PTA will report and control declared pests in accordance with the control requirements specified for a particular species under the BAM Act. |
5.5. Further investigations

There are a number of additional flora and vegetation investigations proposed, and these are listed in Table 18.

Table 18: Proposed flora and vegetation surveys

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation.</th>
</tr>
</thead>
</table>
| Consolidated detailed flora and vegetation assessment: Morley-Ellenbrook Line | **Scope:**
Detailed flora and vegetation survey of previously unsurveyed areas of vegetation within a 500 m buffer of a section of the indicative rail alignment. The core scope of work includes:
- Detailed flora and vegetation survey of the intact remnant native vegetation portions of the project area that have not already been the subject of a two-visit detailed flora and vegetation survey
- Targeted Threatened and Priority Flora surveys of known or potentially suitable habitat for each of the target species within the project area at the appropriate time (the documented peak flowering time) within the intact remnant native vegetation portion of the project area that has not already been the subject to a two-visit detailed flora and vegetation survey.
- Establishment and sampling of approximately seventeen floristic sites including bounded 10 m × 10 m quadrats (or quadrats of other dimensions tailored to characteristics of the vegetation encountered, e.g. narrower transects) and unbounded relevés.

**Consultant:** RPS  
**Survey date/s:** October/November 2019  
**Anticipated Report date:** March 2020

| *Caladenia huegelii* Targeted Survey. | **Scope:**
Resurvey four locations previously identified by RPS (Spring 2018) & ELA (Spring 2019) as containing suitable habitat for the Threatened Flora *Caladenia huegelii* within the development envelope.

**Consultant:** TBC  
**Survey date/s:** October 2020  
**Anticipated Report date:** December 2020

5.6. Predicted outcome

Through completion of comprehensive baseline studies, optimisation of the project footprint to utilise existing disturbed areas and implementation of stringent management measures, and offsetting remaining impacts, it is predicted that the project will be able to meet the EPA’s objective to protect flora and vegetation so that biological diversity and ecological integrity are maintained.
6. Terrestrial Fauna

6.1. EPA objective
The EPA’s objective for terrestrial fauna is to protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

6.2. Policy and guidance

- *Biodiversity Conservation Act 2016 (WA).*
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c).

6.3. Receiving environment

6.3.1. Surveys and studies
A number of terrestrial fauna surveys, summarised in Table 19 and Figure 11, have been conducted within and in proximity to the development envelope. Figure 12 illustrates the Black Cockatoo survey coverage. Terrestrial fauna surveys within Table 19 were conducted between 2006-2019 for projects that intersected and/or were within thin the vicinity of the development envelope, including Northlink – Perth to Darwin National Highway project (MRWA), Ellenbrook Bus Rapid Transit project (PTA), Bayswater to Malaga Rail Works Proposal (PTA) and Malaga to Ellenbrook Rail Works Proposal (PTA). Several surveys overlap at Drumpellier Drive (formerly Lord Street).

The surveys ranged between level 1, level 2, reconnaissance, detailed and targeted surveys and Black Cockatoo assessments. In addition, one aquatic fauna survey was conducted within part of Bennett Brook (North Metro Catchment Group 2006). As described in section 5.3.1.1, there is a small proportion of the development envelope which has not yet been surveyed which consists of existing roads which require upgrade and these areas will be surveyed in 2020.

As indicated in Table 19, additional fauna surveys are being conducted and/or are scheduled for 2020, to address Proposal information gaps and/or portions of the development envelope yet to be surveyed.

Terrestrial fauna investigations conducted, or scheduled, specifically for this Proposal include:

- Wetland and Migratory Bird Survey in Whiteman Park (Terrestrial Ecosystems in prep 2019);
- Level 1 Fauna Risk Assessment and Black Cockatoo Habitat Assessment for the alternative Ellenbrook Rail Line Alignments of METRONET (Terrestrial Ecosystems 2018);
- Aquatic Fauna Survey of Bennett Brook (WRM, scheduled for 2020);
- Short-Range Endemic Impact Assessment (Malaga to Ellenbrook Rail Works) (Invertebrate Solutions, scheduled for 2020);
- Subterranean Fauna Impact Assessment (Invertebrate Solutions 2019); and
• Terrestrial Fauna and Black Cockatoo Assessment (ELA, scheduled for 2020).

## Table 19: Summary of terrestrial fauna investigations

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
</table>
| Wetland and Migratory Bird Survey in Whiteman Park | **Scope:** Review of Birds Australia database for Whiteman Park for every year since 1992. The survey methodology adopted was to slowly walk along the edge or around the perimeter of each waterbody or inundated area recording bird species and the number of individuals for each species. Where required, binoculars and a spotting scope were used to identify species and count the number of individuals.  
**Consultant:** Terrestrial Ecosystems  
**Survey dates:** 15, 16 & 26 November 2018; 28 September 2019; 5, 6, 12 & 14 October 2019  
**Report date:** December 2019 |
| Level 1 Fauna Risk Assessment and Black Cockatoo Habitat Assessment for the alternative Ellenbrook Rail Line Alignments of Metronet | **Scope:** Level 1 fauna risk assessment to identify threatened or priority vertebrate fauna likely to be in the Study Area. Included a Black Cockatoo habitat assessment. The project area was visually assessed, and potential Black Cockatoo trees were assessed from ground level.  
**Consultant:** Terrestrial Ecosystems  
**Survey dates:** 24-27 November 2017  
**Report date:** April 2018 |
| Ellenbrook Bus Rapid Transit Biological Assessment | **Scope:** Level 1 fauna assessment including assessment of relevant matters of national environmental significance. Included a Black Cockatoo habitat assessment.  
**Consultant:** AECOM  
**Survey dates:** 22 & 29 October 2015  
**Report date:** February 2016 |
| NorthLink WA Level 2 Targeted Fauna Assessment: Perth-Darwin National Highway | **Scope:** Level 2 fauna assessment to identify and assess ecological values and significance, including fauna movement survey and a Black Cockatoo habitat assessment.  
**Consultant:** Coffey  
**Survey dates:** 9 – 17 September 2014  
**Report date:** March 2015 |
| Lot 800 Youle-Dean Road, Brabham – Kangaroo Population and Management | **Scope:** Baseline kangaroo survey for Lot 800 Youle-Dean Road, Brabham. Survey to identify the approximate number of kangaroos present on the site and the potential management of the kangaroos prior to development.  
**Consultant:** PGV Environmental  
**Survey dates:** 6 – 9 May 2014  
**Report Date:** May 2014 |
| Lot 800 Youle-Dean Road, Brabham – Black Cockatoo Habitat Assessment | **Scope:** Black Cockatoo habitat assessment to update methodology and information provided in a 2007 ATA Environmental Carnaby’s Cockatoo assessment.  
**Consultant:** PGV Environmental  
**Survey dates:** 22 April 2014; 1 & 6 May 2014  
**Report Date:** May 2014 |
<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brabham LSP 3 Area – Black Cockatoo Habitat</strong></td>
<td><strong>Scope:</strong> Significance Test for Commonwealth Matters of National Environmental Significance (MNES) listed under the EPBC Act, which includes an assessment of the impacts of the proposed development on MNES.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> PGV Environmental</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> 7 April 2014</td>
</tr>
<tr>
<td></td>
<td><strong>Report Date:</strong> May 2014</td>
</tr>
<tr>
<td><strong>Freshwater Fish Survey of Bennett Brook</strong></td>
<td><strong>Scope:</strong> To replicate a similar survey undertaken in 1998, and determine the species composition and distribution of native fresh water fish in Bennett Brook.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> North Metro Catchment Group</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> September 2005 to February 2006</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> June 2006</td>
</tr>
<tr>
<td><strong>Kangaroo Management – Technical Advice</strong></td>
<td><strong>Scope:</strong> Expert advice in regard to management of the kangaroo population in the vicinity of Whiteman Park.</td>
</tr>
<tr>
<td></td>
<td>A technical memorandum describing the current kangaroo population, distribution, monitoring and management in Whiteman Park. Discussion on the potential impact on kangaroo populations and movement of both construction and operation of a railway line. Consideration of potential management options for kangaroos. Recommendation for any further work.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Bamford Consulting Ecologists</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> Not applicable</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> scheduled for February 2020</td>
</tr>
</tbody>
</table>
Figure 11 Terrestrial Fauna Survey Type and Coverage

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment

Survey
- Level 2 Targeted Fauna Assessment (Colley 2015)
- Level 1 Fauna Assessment (AECOM 2016)
- Black Cockatoo habitat assessment/kangaroo survey (PGV Environmental 2014)
- Desktop Assessment (Aurora Environmental 2014)
- Desktop Assessment (Emerge Associates 2014)
- Level 1 Fauna Assessment (Terrestrial Ecosystems 2018)
METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 12 Black Cockatoo Survey Coverage

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)

Survey
- Level 1 Fauna Assessment (AECOM 2016)
- Level 2 Targeted Fauna Assessment (Coffey 2015)
- Black Cockatoo habitat assessment/kangaroo survey (PGV Environmental 2014)
- Level 1 Fauna Assessment (Terrestrial Ecosystems 2018)

- Indicative Railway Alignment

6.3.2. Fauna habitat

Terrestrial Ecosystems (2018) mapped 15 fauna habitat types within and/or intersecting the development envelope, as depicted within Figure 13 and summarised within Table 20. The habitat types within the development envelope have variable quality ranging from cleared areas and infrastructure, to native vegetation of good quality (Terrestrial Ecosystems 2018). There is 114.96 ha of fauna habitat mapped inside the development envelope.

Terrestrial Ecosystems (2018) divided the survey of the development envelope into 6 fauna habitat sites, described in Table 20.

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Fauna habitat contained within site</th>
<th>Condition</th>
<th>Environmental values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>• Grasses and weed species &lt;br&gt; • Grasstrees with scattered Jarrah and <em>Nuytsia floribunda</em> &lt;br&gt; • Introduced shrubs &lt;br&gt; • Open Jarrah / Marri woodland &lt;br&gt; • Open Paperbark over Grasstrees.</td>
<td>Degraded with an abundance of weeds and partially cleared areas</td>
<td>Contained a few plants that would occasionally provide a food source for Black Cockatoos.</td>
</tr>
<tr>
<td>2</td>
<td>• Paperbark woodland. &lt;br&gt; • Pasture.</td>
<td>Wetland surrounded by pasture. The understorey in the treed area is grassed which has been grazed, so it is a highly disturbed site.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>• Grasses and weed species &lt;br&gt; • Open Jarrah / Marri woodland &lt;br&gt; • Open Marri woodland &lt;br&gt; • Paperbark and Flooded Gum open woodland &lt;br&gt; • Paperbark woodland.</td>
<td>Contains a highly disturbed pasture and has multiple stands of mature Marri, Jarrah, Flooded Gum and Paperbark trees.</td>
<td>Contained a few plants that would occasionally provide a food source for Black Cockatoos. One Black Cockatoo tree hollow located within Bennett Brook.</td>
</tr>
<tr>
<td>4</td>
<td>• Flooded Gum open woodland &lt;br&gt; • Paperbark wetland with a single line of Flooded Gums around the outside.</td>
<td>Wetland surrounded by Paperbark and Flooded Gum trees and is highly disturbed.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>• Marri woodland with scattered Jarrah, Banksia, Sheoak and Melaleuca. &lt;br&gt; • Paperbark woodland. &lt;br&gt; • Open Paperbark and Marri woodland. &lt;br&gt; • Paperbark and Flooded Gum open woodland.</td>
<td>Highly disturbed site with scattered mature Marri, and Flooded Gum and Paperbark woodlands over grass and weeds.</td>
<td>Northern portion of site contains plants that are a preferred food source for Black Cockatoos. One tree with hollow.</td>
</tr>
<tr>
<td>6</td>
<td>• Paperbark woodland. &lt;br&gt; • Open Marri woodland.</td>
<td>A disturbed site with mature Marri and Paperbark trees over Grass</td>
<td>Central portion of site contains plants that are a preferred food source for Black Cockatoos.</td>
</tr>
</tbody>
</table>
Trees in some area and grasses and weeds.

One tree with hollow on the northern boundary.

The remainder of the areas within and surrounding the development envelope that were not mapped are cleared, degraded, devoid of native vegetation and/or developed.

Terrestrial Ecosystems (2018) grouped the 15 fauna habitat types, mapped within the survey area into the following categories:

- Melaleuca around inundated areas;
- Banksia woodlands;
- Marri/Jarrah woodlands;
- Pasture;
- Woollybush shrublands; and
- Highly disturbed areas, many of which are devoid of native vegetation.

Fauna habitat to the east of Tonkin Highway in Whiteman Park is described as a mixture of *Eucalypt/Corymbia* woodland, Dampland and Banksia woodlands and paddock (Terrestrial Ecosystems 2018). The majority of habitat heading north along Drumpellier Drive is *Eucalypt/Corymbia* woodland, with modified vegetation adjacent to urban development. The area around Ellenbrook town centre is described as cleared (AECOM 2016). The majority of fauna habitat types present within the development envelope have been disturbed or cleared as a result of historical activities, with some mapped in Poor to Good condition (Terrestrial Ecosystems 2018).
<table>
<thead>
<tr>
<th>Habitat type code (refer to Figure 13)</th>
<th>Fauna habitat type</th>
<th>Habitat quality</th>
<th>Corresponding Site No. from Table 20</th>
<th>Mapped extent within development envelope (ha)</th>
<th>Mapped extent outside development envelope (ha)</th>
<th>Description in relation to development envelope</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Flooded Gum open woodland</td>
<td>Variable</td>
<td>3</td>
<td>2.65</td>
<td>4.01</td>
<td>Located within Whiteman Park and Marshall Rd lands. Intersects Drumpellier Drive and connects to Habitat Z into Horse Swamp to the west.</td>
<td>Highly disturbed pasture.</td>
</tr>
<tr>
<td>E</td>
<td>Grasstrees with scattered Jarrah and <em>Nuytsia floribunda</em></td>
<td>1</td>
<td></td>
<td>14.62</td>
<td>0.09</td>
<td>Located in Marshall Rd lands, east of Tonkin Highway and north of Marshall Rd, within the proposed location for Malaga Station. Adjacent Habitat J.</td>
<td>Degraded.</td>
</tr>
<tr>
<td>F</td>
<td>Introduced shrubs</td>
<td>Variable</td>
<td>1</td>
<td>1.54</td>
<td>0.79</td>
<td>Located in Marshall Rd lands, in the corner north of Marshall Rd and east of Tonkin Hwy.</td>
<td>Degraded.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Hectares</td>
<td>Rainfall (mm)</td>
<td>Erosion Risk</td>
<td>Location Details</td>
<td>Status</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Marri woodland with scattered Jarrah, Banksia, Sheoak and Melaleuca</td>
<td>5</td>
<td>8.25</td>
<td>27.07</td>
<td>Located in Whiteman Park, west of Drumpellier Drive, surrounding registered Aboriginal wetland sites comprised of Habitats O and U.</td>
<td>Highly disturbed</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Open Banksia / Jarrah woodland with scattered Nuytsia floribunda and Sheoak</td>
<td>3</td>
<td>0.51</td>
<td>10.85</td>
<td>Located within Marshall Rd lands North of Marshall Rd and west of the proposed location for Bennett Springs East Station.</td>
<td>Highly disturbed pasture</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Open Jarrah / Marri woodland</td>
<td>1</td>
<td>20.11</td>
<td>0.08</td>
<td>Located within Marshall Rd lands, east of Tonkin Highway and north of Marshall Rd, within the proposed location for Malaga Station. Adjacent Habitats E and W.</td>
<td>Degraded</td>
<td></td>
</tr>
</tbody>
</table>
| N | Paperbark and Flood Gum open woodland                                       | 3 & 5    | 14.69         | 33.14        | Located within Marshall Rd lands and Whiteman Park:  
  - West of Drumpellier Drive extending south into Horse Swamp, adjacent Habitat U.  
  - North of Marshall Rd, alongside Bennett Brook, extending west.  
  - At the corner of Marshall Rd and Tonkin Hwy.                                                                                      | Highly disturbed pasture and wetland |
| O | Paperbark woodland                                                          | 2, 3, 5 & 6 | 13.07        | 32.20        | Located within Marshall Rd lands and Whiteman Park:  
  - Within Habitat P, north of Marshall Rd, centrally located between the proposed locations for the                                                                 | Highly disturbed to disturbed pasture/wetland |

Public Transport Authority • Malaga to Elenbrook Rail Works
<table>
<thead>
<tr>
<th></th>
<th>Habitat Type</th>
<th>Adjacent Sites</th>
<th>Disturbance</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Pasture</td>
<td>Bennett Springs East and Malaga Stations. &lt;br&gt;• Adjacent Habitat G and Y, north of Marshall Rd, west of the proposed location for the Bennett Springs East Station. &lt;br&gt;• In patches west of Drumpellier Drive, extending north from the proposed location for Whiteman Park Station, adjacent Habitats Y and H. &lt;br&gt;• Within Registered Aboriginal Site/wetland sites.</td>
<td>Located within Marshall Rd lands surrounding Habitat O, north of Marshall Rd, centrally located between the proposed locations for the Bennett Springs East and Malaga Stations.</td>
<td>Highly disturbed pasture surrounded by wetland.</td>
</tr>
<tr>
<td>U</td>
<td>Open Paperbark and Marri woodland</td>
<td>Poor</td>
<td>Located within Whiteman Park. &lt;br&gt;• Intersects and runs west of Drumpellier Drive. &lt;br&gt;• Adjacent Habitats N, O and H, wetland areas. &lt;br&gt;• Intersects proposed location for Whiteman Park Station.</td>
<td>Highly disturbed.</td>
</tr>
<tr>
<td>W</td>
<td>Open Paperbark over Grasstrees</td>
<td>Located east of Tonkin Highway and north of Marshall Rd, within the proposed location for</td>
<td>Degraded.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Area 1</td>
<td>Area 2</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Y</td>
<td>Open Marri woodland</td>
<td>3 &amp; 6</td>
<td>5.52</td>
<td>Located within Marshall Rd lands and Whiteman Park:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Adjacent Habitat O, north of Marshall Rd, centrally located between the proposed locations for the Bennett Springs East and Malaga Stations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• West of Drumpellier Drive, surrounded by Habitat O, known wetland areas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Highly disturbed pasture &amp; disturbed.</td>
</tr>
<tr>
<td>Z</td>
<td>Paperbark wetland with a single line of Flooded Gums around the outside</td>
<td>4</td>
<td>24.33</td>
<td>Located within Horse Swamp within Whiteman Park.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Located entirely outside the development envelope, but connected to Habitat C which intersects the development envelope at Drumpellier Drive.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Highly disturbed wetland.</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>114.96</td>
<td>151.56</td>
<td></td>
</tr>
</tbody>
</table>
AECOM (2016) divided the Drumpellier Drive portion of the development envelope into the following fauna habitats, summarised in Table 22. Alignment with Terrestrial Ecosystem (2018) mapping is also indicted.

Table 22: Fauna habitat types mapped within the Drumpellier Drive portion of the development envelope (AECOM, 2016)

<table>
<thead>
<tr>
<th>Habitat type</th>
<th>Description</th>
<th>Habitat value</th>
<th>Mapped extent within development envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banksia woodland</td>
<td>Banksia attenuata, Banksia littoralis, Casuarina obesa low woodland with emergent Corymbia calophylla over *Carpobrotus edulis, Patersonia occidentalis and Calytrix angulata low open heathland over Podotheca gnaphaloides, *Ehrharta calycina and *Ursinia anthemoides low open grassland</td>
<td>Moderate value. Potential foraging habitat for Black Cockatoos.</td>
<td>Limited mapped extent alongside Gnangara Road. RPS and Coffey flora and vegetation surveys also noted Banksia woodland within Whiteman park. This was not reflected in the Terrestrial Ecosystems survey report which mapped the area as Eucalypt/Corymbia woodland and grasstrees.</td>
</tr>
<tr>
<td>Eucalypt/Marri woodland</td>
<td>Corymbia calophylla, Eucalyptus marginata, Eucalyptus patens and Eucalyptus rudis over a mix of native shrubs including Xanthorrhoea preissii, Dasypogon bromeliifolius, Nuytsia floribunda, Allocauarina sp., Banksia species and/or over a mix of introduced grasses.</td>
<td>High value. Microhabitats provide potential foraging, shelter and breeding habitat.</td>
<td>Predominantly located east of Drumpellier Drive in Whiteman Park. Limited mapped extent surrounding areas of Dampland vegetation.</td>
</tr>
<tr>
<td>Melaleuca over introduced grasses</td>
<td>Isolated Melaleuca preissiana and/or Melaleuca rhiphophylla trees over common pasture grasses.</td>
<td>Moderate value habitat.</td>
<td>Located either side of Drumpellier Drive, into Whiteman Park. Aligns with Habitat O and Y.</td>
</tr>
<tr>
<td>Melaleuca woodland</td>
<td>Melaleuca preissiana, Melaleuca rhiphophylla and Eucalyptus rudis low to mid woodland over a mixture of native and introduced species including Acacia saligna, *Lupinus angustifolius and *Brassica sp., Xanthorrhoea preissii, Taxandria linearifolia and Aotus gracillima low to high open shrubland over *Pentameris pallida, *Ehrharta longiflora and *Vulpia myuros low to high open grassland</td>
<td>High value. Microhabitats provide potential foraging, shelter and breeding habitat.</td>
<td>Small isolated patches located within Whiteman Park, west of Drumpellier Drive. One patch located in proximity to the <em>Melaleuca</em> swampland. Aligns with Habitat H -</td>
</tr>
</tbody>
</table>
Melaleuca swampland (seasonally waterlogged)

*Melaleuca rhaphiophylla* and *Eucalyptus rudis* low woodland over, *Acacia saligna* and *Viminaria juncea* low open shrubland over *Cyperus papyrus*, *Cyperus polystachyos* and *Holcus lanatus* high closed sedgeland

Moderate value, particularly for amphibians and Quenda, where thick understorey is present.

Limited mapped extent throughout Whiteman Park, between Charlton Way and Woollcott Avenue on Drumpellier Drive and adjacent to Youle-Dean Road along Drumpellier Drive. One mapped location west of Drumpellier Drive, located predominantly outside the development envelope.

Swampland (open water areas)

Wet swampland of native and introduced shrubs and grasses.

Moderate value. Provides habitat for waterbirds (including migratory), amphibians and other aquatic species, and an important water source for local fauna.

Limited mapped extent within Whiteman Park. One mapped location within the Registered Aboriginal Site/wetland site. Aligns with Habitat O.

6.3.3. Conservation significant fauna

Based on the previous terrestrial fauna surveys and database searches (DBCA 2007-2019, DBCA 2019), 17 fauna species of conservation significance were either recorded within or assessed as likely to occur within the development envelope. Table 22 lists these species and their conservation status (Commonwealth and State level), likelihood of occurring within the development envelope, distribution and habitat.

Oceanic or pelagic species identified in the database searches were omitted from Table 22 given the distance of the Proposal to the ocean.
Table 23: Conservation significant fauna potentially occurring within the development envelope (Terrestrial Ecosystems, 2018)

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Status (EPBC Act / BC Act)</th>
<th>Likelihood of being located within the development envelope</th>
<th>Potential impact vegetation clearing will likely have on conservation significant species</th>
<th>Distribution and habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carnaby's Cockatoo (Calyptorhynchus latirostris)</td>
<td>EN / EN</td>
<td>Recorded foraging within the survey area (Terrestrial Ecosystems 2018).</td>
<td>Low potential impact</td>
<td>Carnaby’s Cockatoo is endemic to southwest WA with populations extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DotEE 2019a; DSEWPAC 2012). Carnaby’s Cockatoo foraging habitat includes native shrubland, kwongan heathland and woodland dominated by proteaceous plant species including Banksia, Hakea and Grevillea, and pine plantations (DSEWPAC 2012; DPaW 2013).</td>
</tr>
<tr>
<td>Baudin’s Cockatoo (Calyptorhynchus baudinii)</td>
<td>EN / Vulnerable</td>
<td>Likely to forage in the development envelope, previously recorded within the survey area (AECOM 2016).</td>
<td>Low potential impact</td>
<td>Baudin’s Cockatoo is found in southwest WA with populations extending from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup (DotEE 2019b; DSEWPAC 2012). Baudin’s Cockatoo foraging habitat includes Eucalyptus woodlands and forest, and proteaceous woodland and heath (DSEWPAC 2012).</td>
</tr>
<tr>
<td>Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)</td>
<td>VU / VU</td>
<td>Recorded foraging within the survey area (Terrestrial Ecosystems 2018; AECOM 2016).</td>
<td>Low potential impact</td>
<td>Forest Red-tailed Black Cockatoo is found in southwest WA with populations extending north to Perth and east to Wundowie, Mount Helena, Christmas Tree Well, North Bannister, Mount Saddleback, Rocky Gully and the upper King River (DotEE 2019c; DSEWPAC 2012). Forest Red-tailed Black Cockatoo foraging habitat includes jarrah and marri woodlands and forests.</td>
</tr>
<tr>
<td>Australian Painted Snipe (Rostratula benghalensis australis)</td>
<td>EN / EN</td>
<td>Possibly.</td>
<td>Low potential impact</td>
<td>The Australian Painted Snipe has been recorded at wetlands in all states of Australia, however it is most common in eastern Australia (DotEE 2019d). This species generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans, sometimes utilising areas that are lined with</td>
</tr>
<tr>
<td>Species</td>
<td>Conservation Status (EPBC Act / BC Act)</td>
<td>Likelihood of being located within the development envelope</td>
<td>Potential impact vegetation clearing will likely have on conservation significant species</td>
<td>Distribution and habitat</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------</td>
<td>------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Fork-tailed Swift (<em>Apus pacificus</em>)</td>
<td>Migratory (Mi) / Mi</td>
<td>May infrequently fly over the development envelope.</td>
<td>Low potential impact</td>
<td>The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia. In Western Australia there are widespread but scattered records of the Fork-tailed Swift along much of the coastline, with some sparsely scattered inland records, especially in the Wheatbelt (DotEE 2019d). They are almost exclusively aerial, and are most commonly found over inland plains, but sometimes above foothills or in coastal areas (DotEE 2019d).</td>
</tr>
<tr>
<td>Grey wagtail (<em>Motacilla cinerea</em>)</td>
<td>Mi / Mi</td>
<td>Highly unlikely.</td>
<td>Low potential impact</td>
<td>Preferred habitat in Australia is banks and rocks in fast-running freshwater including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the development area. It is highly unlikely to be in the development envelope due to a lack of suitable habitat.</td>
</tr>
<tr>
<td>Glossy Ibis (<em>Plegadis falcinellus</em>)</td>
<td>Mi / Mi</td>
<td>Previously recorded within the survey area.</td>
<td>Low potential impact</td>
<td>In Australia, the Glossy Ibis is generally located east of the Kimberley in Western Australia and the Eyre Peninsula in South Australia (DotEE 2019e).</td>
</tr>
<tr>
<td>Rainbow bee-eater (<em>Merops ornatus</em>)</td>
<td>Mi / Mi</td>
<td>Previously recorded within the survey area (AECOM, 2016).</td>
<td>Low potential impact</td>
<td>The Rainbow Bee-eater is found throughout mainland Australia, widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to winter over.</td>
</tr>
<tr>
<td>Mammals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chuditch (<em>Dasyurus geoffroii</em>)</td>
<td>VU / VU</td>
<td>Highly unlikely.</td>
<td>Low potential impact</td>
<td>The Chuditch currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland and requires adequate numbers of suitable den and refuge sites and sufficient prey biomass to survive (DEC 2012b). The majority of records are found in the</td>
</tr>
<tr>
<td>Species</td>
<td>Conservation Status (EPBC Act / BC Act)</td>
<td>Likelihood of being located within the development envelope</td>
<td>Potential impact vegetation clearing will likely have on conservation significant species</td>
<td>Distribution and habitat</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Western Brush Wallaby</strong> (<em>Macropus irma</em>)</td>
<td>- / P4</td>
<td>May be within the development envelope, previously identified within Whiteman Park (AECOM, 2016).</td>
<td>Will move to adjacent areas when disturbed, so potential impacts are low.</td>
<td>The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. This species' optimum habitat is open forest or woodland, seasonally wet flats with low grasses and open thickets (DotEE 2019d).</td>
</tr>
<tr>
<td><strong>Southern Brown Bandicoot/ Quenda</strong> (<em>Isoodon obesulus subsp. fusciventer</em>)</td>
<td>- / P4</td>
<td>Likely, previously identified within Whiteman Park (AECOM, 2016).</td>
<td>Individuals may be lost during vegetation clearing. Low potential impact.</td>
<td>Quenda are widely but patchily distributed through south-western WA, from around Guilderton to east of Esperance and inland to Hyden. This species prefers low, dense vegetation such as heath and swampy habitat and is often associated with forests, woodland, shrubland and riparian areas. Given this species is widespread in remnant bushland in the greater Perth metropolitan area, it is highly probable that it is present in the development envelope.</td>
</tr>
<tr>
<td><strong>Water Rat</strong> (<em>Hydromys chrysogaster</em>)</td>
<td>- / P4</td>
<td>Possibly.</td>
<td>If present, then individuals may be lost during vegetation clearing. Low potential impact.</td>
<td>The water rat inhabits lakes, dams, beaches, mangroves and offshore islands. The Swan River and riparian vegetation provides suitable habitat.</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Black-striped Snake</strong> (<em>Neelaps calonotos</em>)</td>
<td>- / P3</td>
<td>Possibly.</td>
<td>If present, then individuals may be lost during vegetation clearing. Low potential impact.</td>
<td>The Black-striped Snake occurs only along the Swan Coastal Plain with the bulk of this species’ known distribution occurring in the Perth region, however there have been recent records of this species further north near Dongara and Eneabba suggesting it has a broader distribution (Bush et al. 2010).</td>
</tr>
<tr>
<td><strong>Jewelled Sandplain Ctenotus</strong> (<em>Ctenotus gemmula</em>)</td>
<td>- / P3</td>
<td>Possibly.</td>
<td>If present, then individuals maybe lost during vegetation</td>
<td>The Jewelled Sandplain Ctenotus is scarce on the Swan Coastal Plain as it is the northern extent of its range (Bush et al. 2010).</td>
</tr>
<tr>
<td>Species</td>
<td>Conservation Status (EPBC Act / BC Act)</td>
<td>Likelihood of being located within the development envelope</td>
<td>Potential impact vegetation clearing will likely have on conservation significant species</td>
<td>Distribution and habitat</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Western Swamp Tortoise (Pseudemydura umbrina)</td>
<td>CE</td>
<td>Unlikely.</td>
<td>Unlikely to impact species due to distance to known species locations.</td>
<td>The Western Swamp Tortoise is known from three locations including Ellen Brook Nature Reserve, Twin Swamps Nature Reserve and Mogumber Nature Reserve. The closest known occurrence of this species is within the Twin Swamps Nature Reserve, which is approximately 7 km east of Ellenbrook. It is considered unlikely to occur within the development envelope.</td>
</tr>
<tr>
<td>Black-stripe minnow, (Galaxiella nigrostriata)</td>
<td>EN</td>
<td>Possibly.</td>
<td>Low potential impact</td>
<td>The Black-striped minnow is restricted to the ephemeral peat wetlands of south western Australia where it has a distribution ranging from Lake Chandala, north of Muchea, south to Augusta and along the south western coastline to the west of Albany (TSSC 2018). This species is believed to have once inhabited Bennett Brook and has more recently been recorded nearby in Ellen Brook (North Metro Catchment Group 2006).</td>
</tr>
<tr>
<td>Graceful Sun-moth (Synemon gratiosa)</td>
<td>P4</td>
<td>Possibly.</td>
<td>If present, then individuals may be lost during vegetation clearing. Low potential impact.</td>
<td>Habitat for sun moth is in the Swan Coastal Plain (Banksia woodland on Spearwood and Bassendean dunes, where the second known host plant Lomandra hermaphrodita is widespread.</td>
</tr>
<tr>
<td>Short-tongued bee (Leioproctus douglasiellus)</td>
<td>Critically Endangered (CE) / Endangered (EN)</td>
<td>Highly unlikely.</td>
<td>None.</td>
<td>Leioproctus douglasiellus occurs in three locations within the Perth metropolitan area ranging from Cannington to Forrestdale and it has been found on two plant species: Goodenia filiformis and Anthotium junciforme.</td>
</tr>
<tr>
<td>Species</td>
<td>Conservation Status (EPBC Act / BC Act)</td>
<td>Likelihood of being located within the development envelope</td>
<td>Potential impact vegetation clearing will likely have on conservation significant species</td>
<td>Distribution and habitat</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>This bee is found on clay-based wetlands and vegetation that is subject to seasonal inundation. The development envelope is a considerable distance from its known locations, so proposed vegetation clearing is unlikely to impact on this species.</td>
</tr>
</tbody>
</table>
Figure 13C Terrestrial Fauna Habitat

Habitat Type (Terrestrial Ecosystems 2018)
- Habitat E
- Habitat F
- Habitat G
- Habitat I
- Habitat J
- Habitat N
- Habitat O
- Habitat P
- Habitat W
- Habitat Y

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment
The following four conservation significant fauna species were previously recorded within the fauna survey area:

- Carnaby’s Cockatoo (*Calyptorhynchus latirostris*);
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*);
- Glossy Ibis (*Plegadis falcinellus*); and
- Quenda (*Isoodon obesulus* subsp. *Fusciventer*).

The following eight conservation significant fauna species were identified as likely to occur within the development envelope, given the proximity of nearby records and/or availability of suitable habitat including:

- Fork-tailed Swift (*Apus pacificus*);
- Baudin’s Cockatoo (*Calyptorhynchus baudinii*);
- Australian Painted Snipe (*Rostratula benghalensis australis*);
- Western brush wallaby (*Macropus Irma*);
- Water rat (*Hydromys chrysogaster*);
- Black-striped Snake (*Neelaps calonotos*);
- Jewelled Sandplain Ctenotus (*Ctenotus gemmula*);
- Black-stripe minnow (*Galaxiella nigrostriata*); and
- Graceful Sun-moth (*Synemon gratiosa*).

The remaining four species listed in Table 22 are considered unlikely to occur within the development envelope.

- Grey wagtail (*Motacilla cinerea*);
- Chuditch (*Dasyurus geoffroii*);
- Short-tongued bee (*Leioproctus douglasiellus*); and
- Western Swamp Tortoise (*Pseudemydura umbrina*).

### 6.3.4. Subterranean fauna

A desktop assessment revealed that no subterranean fauna species listed under BC Act or EPBC Act are likely to occur or have known habitat within the development envelope (Invertebrate Solutions 2019). Subterranean fauna is not discussed further as the Proposal is unlikely to have a significant impact (Invertebrate Solutions 2019).

### 6.3.5. Short-range endemics

A short-range endemic survey was being conducted at the time of writing, with the report due in early 2020.

### 6.3.6. Black Cockatoo Species

Carnaby’s Cockatoo and Forest Red-tailed Black Cockatoo were both recorded within the development envelope during recent surveys (Terrestrial Ecosystems 2018) and (AECOM 2016). Baudin’s Cockatoo was recorded nearby in Whiteman Park and is therefore considered to have the potential to occur in the development envelope (AECOM 2016).

**Foraging habitat**

Foraging habitat for all three Black Cockatoo species was recorded within the development envelope. The majority of foraging habitat was assessed as low quality; however, a number of moderate to high quality foraging areas exist along Drumpellier Drive and some small areas east of
Tonkin Highway (Coffey 2015b; Terrestrial Ecosystems 2018). An area of pine plantation occurs within the development envelope which provides suitable foraging and roosting habitat for Carnaby’s Cockatoo and potentially for Baudin’s Cockatoo.

Black Cockatoos will forage in Proteaceae shrubland, Jarrah and Marri woodland when the understorey has been highly degraded or removed, so the overall quality of the fauna habitat may misrepresent foraging opportunities for Black Cockatoos (Terrestrial Ecosystems 2018).

Terrestrial Ecosystems (2018) divided the development envelope into four foraging habitat types during the survey, presented in Table 24 and Figure 14. The quantity of the three foraging habitat types for Black Cockatoos is as shown in Table 24. Approximately 20% of the development envelope contains good quality (e.g. rated 2 or 3) foraging habitat for Black Cockatoos (Terrestrial Ecosystems 2018).

Table 24: Area of Black Cockatoo foraging habitats mapped within the development envelope (Terrestrial Ecosystems 2018)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Habitat characteristics</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Contained no or very few plants that provide a food source for Black Cockatoos.</td>
<td>253.42</td>
</tr>
<tr>
<td>1</td>
<td>Contained a few plants that would occasionally provide a food source for Black Cockatoos.</td>
<td>64.52</td>
</tr>
<tr>
<td>2</td>
<td>Contained plants that are a preferred food source for Black Cockatoos.</td>
<td>81.10</td>
</tr>
<tr>
<td>3</td>
<td>Contained an abundance of plants that are a preferred food source for Black Cockatoos.</td>
<td>7.68</td>
</tr>
</tbody>
</table>

AECOM (2016) mapped 63.07 ha of foraging habitat of which 3.97 ha was mapped within the Proposal’s development envelope, presented in Figure 14. Mapped foraging habitat did not have a high diversity of foraging species for Black Cockatoos. For example, mapped Eucalypts over grassland habitat was predominantly grassland rather than the Eucalypts and introduced pine plantation, which is a food source for Carnaby’s and Baudin’s Black Cockatoo. Suitable foraging species that were present were observed in low numbers.

Breeding trees

Potential breeding trees for Carnaby’s Cockatoo and Forest Red-tailed Black Cockatoo include tall trees with a diameter to breast height (DBH) over 500 mm and/or the presence of suitable hollows. To date, surveys have identified 194 suitable potential breeding trees throughout the development envelope, including some with hollows. Potential breeding trees are mapped in Figure 14.

The development envelope contains 10 trees with hollows that may be suitable for Black Cockatoo nesting sites, but one was an active Galah nest and another contained bees (Terrestrial Ecosystems 2018).

No suitable breeding habitat for Baudin’s Cockatoo is present within the development envelope and it is located outside the known breeding areas for the species.

Roosting habitat

Baudin’s and Carnaby’s Cockatoo roosting habitat generally includes tall trees in proximity to riparian environments or nearby water sources, whereas Forest Red-tailed Black Cockatoos generally roost in any tall tree, particularly jarrah and marri, or any large trees on the edges of forests. Potential roosting habitat for all three Black Cockatoo species occurs within the Eucalypt/Corymbia woodland,
Wetland, Dampland and Pine Plantation habitat types within (or in proximity to) the development envelope (Terrestrial Ecosystems 2018; Coffey 2015b; and PGV Environmental 2014).

No known roosting sites occur within the development envelope. Known Black Cockatoo roost sites occur within Whiteman Park (approximately 1.8 km west), along Gnangara Road (approximately 800 m west), and within the Gnangara Pine Plantation (approximately 7.6 km west) (Peck et al. 2017). A potential roosting site has been recorded by the DBCA in Whiteman Park near Mussel Pool, outside of the development envelope. While potential roosting habitat was identified in a number of surveys along Drumpellier Drive, evidence of roosting such as scats or feathers were not recorded.
Figure 14A Black Cockatoo Habitat

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway
- Foraging habitat (AECOM 2016)

Foraging Habitat (Terrestrial Ecosystem 2018)
- Contained plants that are a preferred food source for Black-Cockatoos.

Potential Black Cockatoo Breeding Trees
- Potential Black Cockatoo Breeding Trees (no hollows)
- Corymbia calophylla (Marri) with a small hollow
- Dead Stag with a hollow
METRONET | Malaga to Ellenbrook Rail Works Proposal
Figure 14B Black Cockatoo Habitat

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment
- Foraging habitat (AECOM 2016)

Foraging Habitat (Terrestrial Ecosystem 2018)
- Contained no or very few plants that provide a food source for Black-Cockatoos
- Occasionally contained plants that would provide a food source for Black-Cockatoos
- Contained plants that are a preferred food source for Black-Cockatoos

Potential Black Cockatoo Breeding Trees
- Potential Black Cockatoo Breeding Trees (no hollows)
  - Corymbia calophylla (Marri) with a small hollow
  - Eucalyptus rudis with a small hollow
  - Eucalyptus rudis with small hollows
  - Dead Stag with a hollow

Potential Black Cockatoo Breeding Trees (no hollows)
- Corymbia calophylla (Marri) with a small hollow
- Eucalyptus rudis with a small hollow
- Eucalyptus rudis with small hollows
- Dead Stag with a hollow

Potential Black Cockatoo Breeding Trees (Future)
- Corymbia calophylla (Marri) with a small hollow
- Eucalyptus rudis with a small hollow
- Eucalyptus rudis with small hollows
- Dead Stag with a hollow

Base Data: Nearmap 2019, Landgate 2019, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Figure 14C **Black Cockatoo Habitat**

**Legend**
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

**Foraging Habitat (Terrestrial Ecosystem 2018)**
- Contained no or very few plants that provide a food source for Black-Cockatoos
- Contained a few plants that would occasionally provide a food source for Black-Cockatoos
- Contained plants that are a preferred food source for Black-Cockatoos.
6.3.7. Migratory species

A wetland bird survey was undertaken in November 2018, at several locations including Horse Swamp, Bennett Brook, Mussel Pool, seasonal wetlands and dams in the Whiteman. A total of 21 water bird species were identified with one listed migratory species, the Glossy Ibis (Plegadis falcinellus), recorded at Horse Swamp (Terrestrial Ecosystems in prep 2019). This species has a regional distribution across the east of the Kimberley in Western Australia and is also known to be patchily distributed in the rest of Western Australia (DotEE 2019e). Its preferred habitat types 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 (DotEE 2019e). This species is also occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (DotEE 2019e). The Ord River is a known breeding area for this species in Western Australia, with core breeding areas located outside of Western Australia (DotEE 2019e).

All species recorded during the November 2018 survey are common on the Swan Coastal Plain (Terrestrial Ecosystems in prep 2019).

The wetland areas in Whiteman Park are breeding sites for numerous wetland birds (i.e. Banded Lapwing, Pacific Black Duck, Black Swan, Black-Fronted Dotterel, Dusky Moorhen, Black-winged Stilt, Eurasian Coot, Australian Grebe, Grey Teal and Australian Wood Duck). None of these species are considered migratory (i.e. breed in the northern hemisphere and spend the northern hemisphere winter in Western Australia or elsewhere in the southern hemisphere) (Terrestrial Ecosystems in prep 2019).

The draft Perth and Peel Green Growth Plan for 3.5 million (DPC 2015) documents include consideration of important habitat for migratory shorebirds across the Perth and Peel region. No migratory wetland species habitat areas relevant to the development envelope were identified in the draft Perth and Peel Green Growth Plan for 3.5 million (DPC 2015).

6.3.8. Mammals

The Western Brush Wallaby (Macropus irma) and Quenda (Isoodon obesulus subsp. fusciventer) were confirmed to occur at Whiteman Park, the latter in high numbers, during an annual trapping survey (AECOM 2016, Pers. Comm. Kellie Morley – Senior Environmental Officer).

The Quenda is considered likely to occur within the development envelope as potential indirect evidence was recorded at the southern portion of the study area, south of Reid Highway (AECOM 2016). Quenda is found in woodland, heath and shrub communities on the Swan Coastal Plain and prefers a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan 2008). The Quenda is considered likely to utilise the Banksia Woodland, Marri Woodland and Melaleuca Woodland habitats.

6.3.9. Black-striped minnow (Galaxiella nigrostriata)

A baseline aquatic fauna survey of Bennett Brook, immediately upstream and downstream of the proposed railway bridge, will be conducted in winter 2020. This survey will confirm the presence of conservation significant species, including the Black striped-minnow, and assess the potential impacts from the Proposal. More information will be provided following receipt of this report in 2020.

6.4. Assessment of impacts to Terrestrial Fauna

The Proposal will clear up to an estimated 43 ha of fauna habitat within the development envelope. This estimate is assuming the worst case scenario, as a final design footprint has not yet been prepared.
Of the 43 ha, 36.8 ha is considered completely degraded and of low fauna habitat value.

The proposal will result in the following impacts due to construction and/or operation of the Proposal:

- Direct and indirect impacts to fauna habitat due to clearing.
- Potential impacts to conservation significant fauna due to clearing.
- Loss of ecological connectivity within portions of Whiteman Park, as Whiteman Park forms part of a north-south ecological linkage, including Bush Forever site 304.
- Fragmentation of fauna habitat and Whiteman Park.
- Potential indirect impact to fauna values outside of the development envelope.

An east-west linkage has recently been fragmented due to the upgrade of Lord Street (Drumpellier Drive).

Table 25 provides an evaluation of the potential impacts that the Proposal may have on terrestrial fauna and the PTA’s proposed mitigation hierarchy to minimise impacts.

**Table 25: Potential impacts and preliminary mitigation for Terrestrial Fauna**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impacts</th>
<th>Preliminary Mitigation Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing of fauna habitat</td>
<td>• Direct removal of and disturbance to fauna habitat.</td>
<td><strong>Avoid:</strong></td>
</tr>
<tr>
<td></td>
<td>• Reduction in Black Cockatoo foraging habitat.</td>
<td>• The proposal was designed to</td>
</tr>
<tr>
<td></td>
<td>• Clearing of potentially suitable Carnaby’s and Forrest Red-tailed Black Cockatoo</td>
<td>prioritise placement within</td>
</tr>
<tr>
<td></td>
<td>breeding trees.</td>
<td>existing linear infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Death and/or injury to fauna.</td>
<td>corridors where practicable,</td>
</tr>
<tr>
<td></td>
<td>• Disturbance and/or impacts to conservation significant fauna populations.</td>
<td>avoiding clearing of vegetation</td>
</tr>
<tr>
<td></td>
<td>• Fragmentation of fauna habitat causing potential restrictions to dispersal</td>
<td>and fauna habitat.</td>
</tr>
<tr>
<td></td>
<td>and/or loss of genetic diversity and ecological diversity.</td>
<td>• The PTA will further investigate</td>
</tr>
<tr>
<td></td>
<td>• Reduced ecological connectivity.</td>
<td>avoiding areas of fauna habitat</td>
</tr>
<tr>
<td></td>
<td>• Potential increased predation and/or competition for resources due to reduction</td>
<td>during the detailed design phase,</td>
</tr>
<tr>
<td></td>
<td>in habitat.</td>
<td>where practicable.</td>
</tr>
<tr>
<td></td>
<td>• Increased indirect impacts to fauna habitat due to clearing for linear</td>
<td><strong>Minimise:</strong></td>
</tr>
<tr>
<td></td>
<td>infrastructure increasing edge effects and/or reducing vegetation condition.</td>
<td>Within the Proposal’s development</td>
</tr>
<tr>
<td></td>
<td>• Noise, vibration, and or light effects.</td>
<td>envelope, the clearing of fauna</td>
</tr>
<tr>
<td></td>
<td>• Potential increase in weed incursion.</td>
<td>habitats will be minimised as far</td>
</tr>
<tr>
<td></td>
<td>• Potential indirect impacts due to increased waste and/or contamination.</td>
<td>as practical in the final</td>
</tr>
<tr>
<td></td>
<td>• Cumulative impacts including loss of Swan Coastal Plain habitat, wetland habitat</td>
<td>proposal design.</td>
</tr>
<tr>
<td></td>
<td>and Bush Forever habitat.</td>
<td>A CEMP will be developed and</td>
</tr>
</tbody>
</table>

implemented during construction including the following mitigation measures:

- Vegetation clearing will be avoided or minimised where practicable.
- Clearing will be demarcated in the field and will be restricted to the development envelope.
- Manage indirect impacts to surrounding native fauna habitat.
- Vegetation to be cleared will be searched by a fauna specialist prior to clearing and found fauna species will be relocated.
- Fauna mortality from construction activities or vehicle strike will be documented during construction and reported to the DBCA.
Table 26 summarises the potential impact to Black Cockatoos due to vegetation clearing within the development envelope based on the criteria within the Australian Government (2012) referral guidelines for Black Cockatoos.

Table 26: Potential impact to Black Cockatoo from the Proposal based on Commonwealth referral guidelines (Australian Government, 2012; Terrestrial Ecology, 2018)

<table>
<thead>
<tr>
<th>Risk item</th>
<th>Discussion with regard to Carnaby’s, Forest Red-tailed and Baudin’s Black Cockatoos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing of any known nesting tree.</td>
<td>No known nesting trees were recorded in the project area.</td>
</tr>
<tr>
<td>Clearing or degradation of any part of a vegetation community known to contain breeding habitat</td>
<td>The project is outside the DBCA mapped potential breeding habitat.</td>
</tr>
<tr>
<td>Clearing of more than 1ha of quality foraging habitat.</td>
<td>There is more than 1ha of quality foraging habitat in the project area.</td>
</tr>
<tr>
<td>Clearing or degradation (including pruning the top canopy) of a known night roosting site.</td>
<td>Clearing will not impact on a known roosting site.</td>
</tr>
<tr>
<td>Creating a gap of greater than 4 km between patches of Black Cockatoo habitat (breeding, foraging or roosting).</td>
<td>Clearing will not create a gap of greater than 4km between patches of Black Cockatoo habitat.</td>
</tr>
</tbody>
</table>

Uncertainty: referral recommended or contact the department

Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.

Clearing or disturbance in areas surrounding Black Cockatoo breeding, foraging or night roosting habitat that has the potential to degrade habitat through introduction of weeds or changes in vegetation structure.

Based on the vague information provided in the Great Cocky count (Peck et al. 2017), there are no roosting sites near the project area. There are no known nesting trees recorded in the project area, but this
invasive species, edge effect, hydrological changes, increased human visitation or fire.  

| Actions that do not directly affect the listed species but that have a potential for indirect impacts such as increasing competitors for nest hollows. | species will forage in the project area, and the planned project will increase human visitation to the area.  

| Actions with the potential to introduce known plant disease such as Phytophthora spp. To an area where the pathogen was not previously known. | The project area contains 10 trees with hollows that may be suitable for cockatoo nesting sites, but one was an active Galah nest and another contained bees. There is no evidence to indicate that clearing these trees will result in a significant increased competition for tree hollows.  

| Low risk of significant impacts: referral may not be required | With the implementation of appropriate hygiene standards during vegetation clearing, diseases are unlikely to be introduced to the site.  

| Actions that do not affect Black Cockatoo habitat or individuals. | N/A  

| Actions whose impacts occur outside the modelled distribution of the three Black Cockatoo species. | N/A  

Terrestrial Ecosystems (2018) assessed potential impacts to Black Cockatoos against Table 3 of the Revised draft referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso* guidelines (Department of the Environment and Energy 2017). Results are as follows:

- The development envelope contains a pine plantation, which based on the information contained in Table 3 (Department of the Environment and Energy 2017) gives a score of 5;
- it is also on the Swan Coastal Plain, which adds 3;
- contains trees that could be used as a nesting site by Black Cockatoos which adds 2;
- contains trees with a DBH greater than 500mm which adds another 2;
- It is probably greater that 12km from a breeding site which is -1
- contains *Phytophthora cinnamomi* which equates to -1, giving a total score of 10.
- The project area also contains a Banksia woodland which gives a score of 7;
- is on the Swan Coastal Plain, which adds 3;
- contains trees that could be used as a nesting site by Black Cockatoos which adds 2;
- contains trees with a diameter at breast height greater than 500mm which adds 2;
- It is probably greater that 12km from a breeding site which is -1;
- The project area contains *Phytophthora cinnamomi*, which equates to -1, giving a total score of 12. The maximum score is 10.

Based on an assessment of potential impacts against the criteria in the Australian Government (2012) referral guidelines for Black Cockatoos and (Department of the Environment and Energy 2017), the Proposal should be referred to the DotEE for approval under the EPBC Act as:

- It could result in the clearing of more than 1ha of quality foraging habitats  
- Clearing of the vegetation could have a significant impact on Black Cockatoos.

**6.5. Further investigations**

The following additional investigations are scheduled for 2020:
• Aquatic Fauna Survey of Bennett Brook.
• Short-Range Endemic Impact Assessment (Malaga to Ellenbrook Rail Works).
• Terrestrial Fauna and Black Cockatoo Assessment.

Survey and assessment results will be reported to the State and Commonwealth accordingly.

6.6. Predicted outcome

The PTA considers that through implementation of the mitigation hierarchy and implementation of the CEMP, the Terrestrial Fauna environmental factor can be managed during the construction and operation of the Proposal, and the EPA’s objective will be met.
7. Terrestrial Environmental Quality

7.1. EPA objective
To maintain the quality of land and soils so that environmental values are protected.

7.2. Policy and guidance
The following legislation, policies and guidance are relevant to the Terrestrial environmental quality factor. All environmental investigations have been undertaken to meet the requirements of these policies and guidelines:
- Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (DoH 2009).
- Assessment and Management of Contaminated Sites (DER 2014).
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2015a).
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER 2015b).
- Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016g).

7.3. Receiving environment

7.3.1. Surveys and studies
Table 27 lists the relevant environmental investigations that have been undertaken or are currently being undertaken to inform the assessment of terrestrial environmental quality.

Table 27: Summary of environmental investigations relevant to terrestrial environmental quality

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling and Analysis Quality Plan, Tonkin Gap Project</td>
<td>Scope: To prepare a Sampling and Analysis Quality Plan (SAQP) to outline the proposed intrusive investigations required to close-out certain gaps in the characterisation of several parcels of land located within the Tonkin Highway road reserve</td>
</tr>
<tr>
<td></td>
<td>Consultant: Senversa</td>
</tr>
<tr>
<td></td>
<td>Survey date/s: Not Applicable</td>
</tr>
<tr>
<td></td>
<td>Report date: April 2019</td>
</tr>
<tr>
<td>Preliminary Site Investigation: Former liquid waste disposal facility</td>
<td>Scope: To assess the potential for contamination and the types of contaminants present at a site based on current and historical land uses and activities. Identification of potential contaminant pathways and sensitive receptors in the vicinity of the site provides a preliminary understanding of the risk posed by potential contamination.</td>
</tr>
<tr>
<td></td>
<td>Consultant: Golder</td>
</tr>
<tr>
<td></td>
<td>Survey date/s: 21 August 2014 (Site Walkover)</td>
</tr>
<tr>
<td></td>
<td>Report date: 2015</td>
</tr>
</tbody>
</table>


7.3.2. Geology and soil

The majority of the development envelope is located on Bassendean Sand (Gozzard 2007) which results from aeolian sand and coastal sediments. It is described as basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geological Survey of WA and Geoscience Australia 2008). A small portion of the development envelope within Whiteman Park is underlain by Lake deposits 38492, which comes from lacustrine sediment. It is described as lacustrine or residual mud, clay, silt and sand commonly gypsiferous and/or saline; playa, claypan and swamp deposits; peat; peaty sand and clay; halitic and gypsiferous evaporites. A small area around Bennett Brook is located on the Guildford formation, which is described as alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate (Geological Survey of WA and Geoscience Australia 2008).

7.3.3. Acid sulfate soils

Acid sulphate soils (ASS) are naturally occurring soils, sediments or organic substrates that are formed under water logged conditions.

The Bassendean Sand unit is highly leached and contains no buffering capacity to neutralise the formation of acid and acid by-products which can form on oxidation of the material. At the zone of groundwater fluctuation within the Bassendean Sands, the formation of ferruginous podzols known as Coffee Rock horizons are present and can be a major contributor to elevated iron concentrations in groundwater (Davidson 1995). DWER recognises the Bassendean Sands as being of particular concern regarding ASS, due to being devoid of carbonate minerals and the potential to contain highly reactive pyrite (DER 2014).

The Guildford Clays which are present in places at shallow depths beneath the Bassendean Sand are known to be acid generating in nature. The clay forms a semi-confining layer within the superficial aquifer and is discontinuous in nature. Exposure of the Guildford Clay and potential oxidation during excavation and dewatering activities presents a risk of acid generation during construction activities (Coffey 2015c; Jacobs 2018).

Department of Water and Environmental Regulation (DWER) ASS risk mapping (Figure 15) identifies that the majority of the development envelope (411.91 ha) as being of moderate to low risk of ASS. There are five areas that total 27.14 ha within the development envelope which are considered to be at High to Moderate risk of ASS:

- north of the proposed Whiteman Park Station;
- north of the proposed Bennett Springs East Station (Future Station);
- two areas west of the proposed Bennett Springs East Station (Future Station); and
- the eastern most edge of the development envelope, in Malaga.

The areas where there is a high probability of occurrence are generally limited to small low lying areas (Jacobs 2018). Isolated peaty deposits associated with humic wetlands present a risk of net acid production from the oxidation of sulphide bearing minerals and organic materials, albeit the rate of generation is typically slower than that of the Bassendean Sand Unit.
7.3.4. Contaminated sites

A Contaminated Sites Database search was undertaken to determine if any properties within the development envelope have been classified under the Western Australian Contaminated Sites Act 2003. There are no registered contaminated sites within the development envelope (Figure 16).

However, site 9916 intersects the development envelope, and site 31 is adjacent to the development envelope and both sites are related to the former Liquid Waste Disposal Facility Lexia. These sites are classified as ‘Possibly Contaminated – Investigation Required’ due to potential groundwater quality impacts beneath the northwest portion of the development envelope to the north and south of Gnangara Road.

Another site 5435 is classified as ‘Possibly Contaminated – Investigation Required’ adjacent to the development envelope to the south of Marshall Road.

Within a two kilometre buffer of the Proposal, at Ellenbrook, Bennet Brook Station location and below Marshall Road in Malaga there are an additional 22 sites with varying contamination classifications.
METRONET | Malaga to Ellenbrook Rail Works Proposal

Figure 15  Acid Sulfate Soil Risk

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment

Acid Sulfate Soil Risk:
- High to moderate risk
- Moderate to low risk

Base Data: Nearmap 2019, Landgate 2019, Sources: ESRI, HERE, Garmin, USGS, Nearmap, INCREMENT P, NTGCan, East Japan, METI, East China (Hong Kong), East Korea, East (Thailand), MSSDC, (c) OpenStreetMap contributors, and the GIS User Community.
METRONET | Malaga to Ellenbrook Rail Works Proposal
Figure 16 Contaminated Sites

Legend
- Development envelope
- Proposed Railway Station
- Proposed Railway Station (Future)
- Indicative Railway Alignment
### Contaminated Site ID

Classification
- Contaminated - remediation required
- Contaminated - restricted use
- Possible Contamination - awaiting classification
- Possibly Contaminated - investigation required
- Remediated for restricted use
- Decontaminated
7.4. Assessment of impacts to Terrestrial Environmental Quality

Table 28 provides an evaluation of the potential impacts that the Proposal may have on Terrestrial Environmental Quality and the PTA’s proposed mitigation hierarchy to minimise impacts.

Table 28: Impacts and preliminary mitigation for Terrestrial Environmental Quality

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impacts</th>
<th>Preliminary Mitigation Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid Sulfate Soils</td>
<td>Disturbance to ASS during excavation activities may result in oxidation of ASS and leaching of metals in the vicinity of the proposal.</td>
<td>Avoid:</td>
</tr>
<tr>
<td></td>
<td>Localised and temporary dewatering as a result of excavation activities below the ground level may result in oxidation of ASS and leaching of metals in the vicinity of the proposal.</td>
<td>• The proposal has been designed to avoid excavation and large-scale dewatering in ASS high risk areas, where practicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimise:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prior to commencement of earthworks, detailed site investigations will be conducted within the development envelope to identify excavation sites that have the potential to intersect ASS (or suspected contaminated) areas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Further ASS investigations will be undertaken once the design has been finalised by the construction contractor and potential disturbance depths and locations are known.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• An ASS and Dewatering Management Plan (ASSDMP) will be prepared and implemented by the construction contractor where excavation is required below ground level in areas of “High to Moderate” risk or excavations below the water table in areas of “Moderate to Low” risk.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A CEMP will be prepared and implemented by the contractor to detail the management of construction works associated with the Proposal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A groundwater monitoring program may be required to assess the effectiveness of ASS management measures and validate that the Proposal has not resulted in contamination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rehabilitate:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The contractor will undertake remediation of ASS if disturbance is unavoidable in accordance with the ASSDMP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Upon completion of works, any treatment pad areas will be appropriately decommissioned, comprising validation, and if required remediation, of the ground surface where the treatment pad and associated infrastructure was located.</td>
</tr>
<tr>
<td>Contaminated Soils / Groundwater</td>
<td>Health risk to workers undertaking deep excavation in the southern section of the development envelope due to encountering potential contaminants. Disturbance of contaminated or potentially contaminated soils and groundwater within the development envelope due to excavation or dewatering. Disturbance to known or suspected contaminated sites has the potential to mobilise existing contaminants, increasing the risk of adverse impacts to environmental values, by further oxidation and movement of contamination within underlying soil and groundwater. Disturbance of (drawing in) contaminated groundwater outside of the development envelope due to dewatering. Contamination of groundwater and soils from construction or stockpiling activities.</td>
<td></td>
</tr>
<tr>
<td>Minimise:</td>
<td>Prior to commencement of earthworks, detailed site investigations will be conducted within the development envelope to identify excavation sites that have the potential to intersect any contaminated (or suspected contaminated) areas. Stockpiles of potentially contaminated material will be tested and if unable to be reused will be disposed of at an appropriately licenced landfill facility. Risks associated with working on potentially contaminated sites during construction will require specific management through the implementation of a CEMP prepared by the appointed contractor. In the event that other contamination is encountered during construction, the Contractor's CEMP will outline an unexpected finds protocol to detail how contamination will be managed. A groundwater monitoring program may be required to assess the effectiveness of mitigation measures associated with contamination and validate that the Proposal has not resulted in an increase in the type or extent of contamination. Rehabilitate:</td>
<td>Upon completion of works, any stockpile or treatment pad areas will be appropriately decommissioned, comprising validation, and if required remediation of the ground surface where the treatment pad and associated infrastructure was located.</td>
</tr>
</tbody>
</table>
7.5. Further investigations

Further ASS investigations will be undertaken once the design has been finalised by the contractor and potential disturbance depths and locations are known. Upcoming studies are outlined in Table 29.

Prior to commencement of earthworks, detailed site investigations will be conducted within the development envelope to identify excavation sites that have the potential to intersect any contaminated (or suspected contaminated) areas.

Table 29: Further environmental investigations relevant to terrestrial environmental quality

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary Acid Sulfate Soils</td>
<td><strong>Scope:</strong> To undertake a preliminary Acid Sulfate Soil (ASS) investigation within the</td>
</tr>
<tr>
<td>Investigation</td>
<td>development envelope associated with the proposed rail alignment.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Coffey</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> November / December 2019</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> February 2020</td>
</tr>
<tr>
<td>Contamination Preliminary Site</td>
<td><strong>Scope:</strong> To undertake a PSI to identify the presence of possible contaminating</td>
</tr>
<tr>
<td>Investigation</td>
<td>activities, as a result of both historical or current land use, that may impact the</td>
</tr>
<tr>
<td></td>
<td>Proposal within the development envelope. The PSI will include:</td>
</tr>
<tr>
<td></td>
<td>1. Broad desktop assessment within the entire development envelope;</td>
</tr>
<tr>
<td></td>
<td>2. Targeted desktop assessment – selected areas within the development envelope;</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td></td>
<td>3. Targeted site inspection – selected areas within the development envelope.</td>
</tr>
<tr>
<td></td>
<td><strong>Consultant:</strong> Coffey</td>
</tr>
<tr>
<td></td>
<td><strong>Survey date/s:</strong> December 2019</td>
</tr>
<tr>
<td></td>
<td><strong>Report date:</strong> February 2020</td>
</tr>
</tbody>
</table>

7.6. Predicted outcome

The PTA considers that through implementation of the mitigation hierarchy and implementation of the CEMP, the Terrestrial Environmental Quality environmental factor can be managed during the construction and operation of the Proposal, and the EPA’s objective will be met.
8. Inland Waters

8.1. EPA objective
To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

8.2. Policy and guidance
The following policies and guidance are relevant to the inland waters factor:

- Environmental Factor Guideline: Inland Waters (EPA 2018d);
- A guide to managing and restoring wetlands in Western Australia (DEC 2012c);
- Environmental Water Provisions Policy for Western Australia (Water and Rivers Commission 2000); and
- Wetlands Conservation Policy for Western Australia (Government of Australia 1997).

8.3. Receiving environment

8.3.1. Surveys and studies

Table 30: Summary of environmental investigations relevant to Inland Waters

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater Monitoring Well and Surface Water Staff Gauge Installation Report - Morley-Ellenbrook Line – Letter report</td>
<td>Scope: Install additional groundwater bores and surface water monitoring equipment, as recommended by Coffey (September 2019), to ensure sufficient data is available for input into future flood modelling to inform rail alignment levels and drainage requirements and to adequately assess the effects of the development on wetlands and groundwater dependant ecosystems. Provide a summary of the monitoring well construction records and bore logs for the newly installed monitoring wells, together with data for the additional surface water installations.</td>
</tr>
<tr>
<td>Consultant: Coffey</td>
<td>Survey date/s: October 2019</td>
</tr>
<tr>
<td>Report date: 29 Nov 2019</td>
<td></td>
</tr>
<tr>
<td>METRONET - Morley to Ellenbrook Line Baseline Hydrology 2018 - 2019 Annual Report</td>
<td>Scope: Provide a baseline assessment of hydrological regimes (groundwater and surface water) and develop a dataset to support future planning, environmental approvals and engineering design for the rail alignment. Review and analyse hydrological monitoring data results between November 2018 to August 2019, including review of the attached RPS report titled Hydrology fieldwork results: November 2018 (report February 2019). Provision of recommendations for additional ground and surface water monitoring locations</td>
</tr>
<tr>
<td>Consultant: Coffey</td>
<td>Survey date/s: November 2018 – August 2019</td>
</tr>
<tr>
<td>Report date: 27 September 2019</td>
<td></td>
</tr>
<tr>
<td>Baseline Wetland Vegetation Monitoring</td>
<td>Scope: Collection of baseline data at representative sites within areas of wetland vegetation considered to be potentially at risk of vegetation degradation, and /or hydrological changes as a result of the proposed infrastructure development. Provision of a baseline measure of vegetation composition, structure, and health prior to development that can then be used in ongoing monitoring.</td>
</tr>
<tr>
<td>Consultant: RPS</td>
<td>Survey date/s: 17 April, 18 April &amp; 7 May 2019</td>
</tr>
</tbody>
</table>
8.3.2. Surface water

The Proposal’s development envelope is within the Swan-Avon – Lower Swan catchment and intersects two sub-catchments: Bennett Brook catchment in the south and Ellenbrook catchment in the north (RPS 2019).

Surface water and wetlands present within the development envelope are generally associated with the intersection of groundwater with the ground surface in interdunal swales or depressions. Some wetlands may be perched groundwater in areas of low permeability where underlying clays, peat or iron-cemented sands create a semi-confining or confining layer, though given shallow depth to groundwater through most of the development envelope this is more likely to be a seasonal occurrence in the early wet season.

The most significant surface water features within and close to the development envelope are Bennett Brook and its associated wetlands chains (Figure 17). Bennett Brook is a slow flowing stream, approximately 17 km in length, with a catchment of 217 km² (Coffey 2015d). The Bennett Brook retains a natural channel form through the development envelope and supports environmental values including riparian vegetation and fauna habitat. The waterway is also associated with
significant Aboriginal cultural values. Bennett Brook originates in Whiteman Park as a superficial groundwater aquifer, which rises and feeds wetlands during winter months.

Groundwater pumping for metropolitan water supply in the northern extent of the Bennett Brook catchment has lowered groundwater levels and, in turn, reduced groundwater flow into Bennett Brook. The Bennett Brook generally flows from early August until early November, depending on seasonal rainfall conditions (SERCUL 2013) and discharges into the Swan River at Success Hill in Bassendean (Government of Western Australia 2011a).

Monitoring of water and sediment quality was conducted annually in Bennett Brook from 2003 over a period of at least 12 years approximately 1.5 km south (downstream) of its intersection with the development envelope. The annual monitoring events record exceedances of criteria for pH, electrical conductivity, total suspended solids, nutrients and metals (SERCUL 2013). Monitoring is currently being undertaken in the vicinity of the planned Bennett Brook crossing to inform assessment and reporting of potential impacts. A number of constructed drains and degraded natural surface water flow pathways with relatively small catchment areas also pass through the development envelope (see Figure 17). Geomorphic wetlands

The Development envelope is located within a portion of the Swan Coastal Plain classified as a Palusplain wetland type. Palusplain wetlands are classified as seasonally waterlogged flats and these wetland features are located within and adjacent to the Development envelope (Figure 17).

The Geomorphic Wetlands of the Swan Coastal Plain dataset is the primary dataset for wetland identification on the Swan Coastal Plain. It assigns each wetland a management category based on its condition and environmental value.

Eight wetlands with potential ecological values (three Conservation Category Wetlands (CCWs) and four Resource Enhancement Wetland (REW) are shown in the dataset intersecting the Development envelope. CCWs and REWs are considered significant ecosystems by the EPA (2018) and are listed in Table 31.

Bennett Brook (UFI 15259) is a conservation category wetland which originates in Whiteman Park and will intersect the development envelope. Bennett Brook is a superficial groundwater aquifer which floods the nearby wetlands in the winter months. Surface water flows from Bennett Brook through to Mussel Pool and then into the Swan River near Bassendean. Although only a small portion of the wetland (0.8 ha) intersects the development envelope, Bennett Brook contains important environmental values and impacts associated with the Proposal will need to be well managed.

A large REW (134.99 ha’s) occurs in the southern portion of the development envelope and is associated with an unknown wetland (UFI 15752). Approximately 56% of this wetland occurs in the development envelope and mitigation strategies will be developed to manage potential or actual impacts on environmental values to this wetland.
Table 31: Current status of wetlands that intersect the development envelope

<table>
<thead>
<tr>
<th>UFI (wetland name, if available)</th>
<th>Conservation status</th>
<th>Wetland type</th>
<th>Total Area (ha)</th>
<th>Extent of wetland within development envelope (ha)</th>
<th>Extent of wetland outside the development envelope (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15259 (Bennett Brook)</td>
<td>CCW</td>
<td>Floodplain</td>
<td>88.72</td>
<td>0.8</td>
<td>87.92</td>
</tr>
<tr>
<td>8728</td>
<td>CCW</td>
<td>Palusplain</td>
<td>3.75</td>
<td>1.2</td>
<td>2.55</td>
</tr>
<tr>
<td>8417</td>
<td>CCW</td>
<td>Palusplain</td>
<td>0.66</td>
<td>0.66</td>
<td>0</td>
</tr>
<tr>
<td>15752</td>
<td>Resource Enhancement Wetland</td>
<td>Palusplain</td>
<td>239.57</td>
<td>134.99</td>
<td>104.58</td>
</tr>
<tr>
<td>8806</td>
<td>Resource Enhancement Wetland</td>
<td>Palusplain</td>
<td>15.53</td>
<td>1.55</td>
<td>13.98</td>
</tr>
<tr>
<td>8678</td>
<td>Resource Enhancement Wetland</td>
<td>Sumpland</td>
<td>2.29</td>
<td>0.77</td>
<td>1.52</td>
</tr>
<tr>
<td>15757</td>
<td>Resource Enhancement Wetland</td>
<td>Sumpland</td>
<td>33.96</td>
<td>2.05</td>
<td>31.91</td>
</tr>
</tbody>
</table>

The development envelope also intersects nine Multiple Use Wetland (MUWs). These are not considered ‘significant ecosystems’ for the purpose of impact assessment (EPA 2018d) and development has occurred over many of these MUWs on the Swan Coastal Plain. However, these MUWs may retain hydrological values such as flood storage.

None of the identified wetlands are considered nationally or internationally significant. The nearest nationally important wetland (Ellen Brook Swamps System) includes Ellen Brook Swamp and Twin Swamps, which are located approximately 4 km east and more than 6 km northeast of the development envelope respectively.

Of regional significance is Horse Swamp (UFI 8724) an ephemeral and conservation category wetland that is approximately 18.7 ha in area and located in the south-eastern portion of Whiteman Park. Horse Swamp has been subject to substantial historical clearing; however, the wetland contains significant ecological value. The boundary of the development envelope is located 70 metres from the wetland as shown in the Geomorphic Wetland database layer. However, consultation with stakeholders has identified that there is the potential for flooding impacts from Horse Swamp into the development envelope.

Mussel Pool (UFI 8726) is a conservation category wetland that is located within Whiteman Park and outside the development envelope. The boundary of the development envelope is located approximately 615 metres south of Mussel Pool and this wetland is not considered to be impacted by the Proposal.

Further investigations of the wetlands located in and near the development envelope are currently being undertaken to support the environmental approvals process.
Figure 17A Geomorphic Wetlands and Surface Water Features

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

Geomorph Wetlands
- Conservation
- Multiple Use
- Resource Enhancement
- Nonperennial Watercourse

METRONET | Malaga to Ellenbrook Rail Works Proposal

Date Printed: 23/12/2019
Created By: D. Whiteley
Approved by: C. Baxter
Scale: 1:20,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
Figure 17C: Geomorphic Wetlands and Surface Water Features

Legend
- Development envelope
- Proposed Railway Station
- Indicative Railway Alignment

Geomorphic Wetlands
- Conservation
- Multiple Use
- Not Applicable
- Resource Enhancement

Surface water monitoring location

Perennial Watercourse
Nonperennial Watercourse

Base Data: Nearmap 2019, Landgate 2019, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
8.3.3. Groundwater

Aquifers
Groundwater resources in the development envelope include the Mirrabooka, Leederville and Yarragadee aquifers. These are overlaid by superficial formations including the transmissive Bassendean Sand deposits which comprise a superficial aquifer. The thickness of the superficial aquifer ranges between 30 m and 55 m with an average of approximately 35 m (DWER 2019). The hydraulic conductivity of the Bassendean Sand ranges between 10 m/day and 50 m/day (Main Roads 2015).

Groundwater levels and direction
Groundwater levels are generally shallow across the development envelope. The Perth groundwater atlas shows groundwater at or near the ground surface through parts of Whiteman Park, increasing in depth around Ellenbrook, with maximum depth to groundwater of approximately 11 m. The groundwater is generally 3 m to 10 m below the ground surface.

Given the unconfined nature of the superficial aquifer, groundwater levels change with seasonal rainfall patterns and recharge is rapid (Coffey 2015d). Groundwater generally flows from the Gnangara Mound in an easterly to southerly direction, with groundwater discharging to Ellen Brook to the east or Swan River to the south (Coffey 2015d).

Groundwater quality
Groundwater quality within the development envelope and surrounds is influenced by existing and historic land uses, local geology, recharge and discharge zones and seasonal fluctuations in groundwater levels. Groundwater quality in the wider superficial aquifer is typically good, with salinity generally increasing, but remaining low, further from the crest of the Gnangara Mound which is located approximately 15 km north of the development envelope (Coffey 2015d). A substantial amount of groundwater quality monitoring has been previously undertaken in the area, in particular for the NorthLink WA project. Nutrient levels have been found to vary and are influenced by land use (Coffey 2015d). The NorthLink WA study found groundwater in the region is generally acidic with pH ranging from 4 to 6. Additional groundwater monitoring is currently underway to support planning and management of potential impacts of the Proposal.

Groundwater dependent values
The Gnangara groundwater mound is a proclaimed Public Drinking Water Source Area (PDWSA). Priority areas within the PDWSA are defined to guide land use decision making. The development envelope intersects the Priority 1, 2 and 3 PWSA areas (Figure 18). According to State government guidance (DoW 2016), railway lines are considered acceptable (or compatible with conditions) in Priority 1, 2 and 3 PDWSAs (DoW 2016). Associated infrastructure and development such as station precincts are compatible with conditions in Priority 3 areas. One station (Ellenbrook Station) is located in a Priority 3 area.

Other important groundwater dependent values surrounding the development envelope include areas of remnant vegetation and wetlands including:

- Bennett Brook, a groundwater fed stream where groundwater levels are ultimately responsible for defining the hydrologic regime (Figure 18).
- The Banksia dominated woodlands of the Swan Coastal Plain TEC/PEC (Figure 9), where depths to groundwater is generally less than 5 m below ground level.
Dewatering and groundwater abstraction may directly and/or indirectly impact groundwater dependent values including wetlands, groundwater dependent ecosystems, groundwater dependent vegetation and other groundwater users. The extent of potential direct and indirect impacts of dewatering/abstraction to groundwater dependent values depends on a number of factors including:

- Location, volume, duration, timing, extent and rate of dewatering and localised groundwater drawdown.
- Groundwater recharge rate.
- Seasonal groundwater levels.
- Proximity of groundwater dependent values to dewatering activities.
- Groundwater/surface water connectivity.
- The sensitivity of the values to drawdown impacts.

Further groundwater investigations are currently in progress to provide additional information for environmental impact assessment and mitigation strategies.
## 8.4. Assessment of impacts to Inland Waters

Table 32 provides an evaluation of the potential impact that the Proposal may have on inland waters, groundwater and surface water and PTA’s proposed mitigation to minimise environmental impacts.

### Table 32: Impacts and preliminary mitigation for Inland Waters

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impacts</th>
<th>Preliminary Mitigation Hierarchy</th>
</tr>
</thead>
</table>
| **Surface Water** | Direct impacts to surface water and changes to surface water flows. Direct impact to surface water quality due to contamination from spills, incidents or uncontrolled surface water flows. Potential impact to groundwater dependent vegetation and groundwater users due to changes to surface water flows. | **Avoid**  
• Surface water flows from importance wetlands will be maintained across the development envelope.  
• Clearing of wetland dependent vegetation and habitat will be avoided in the development envelope, where practicable. |
| **Geomorphic Wetlands (including CCWs and REWS)** | Direct or indirect impacts to CCWs and REWs that intersect or are adjacent to the development envelope due to:  
• Clearing,  
• Dewatering,  
• Groundwater abstraction,  
• Surface water run-off,  
• Groundwater contamination,  
• Hydrological changes,  
• Oxidation of Acid Sulfate Soils (ASS),  
• Spills, and  
• Dust. | **Avoid**  
• If practicable, surface water will be managed on-site as per Water Sensitive Urban Design (WSUD) principles and surplus water disposed of through existing stormwater storage and drainage infrastructure where available.  
• Clearing of wetland dependent vegetation and habitat will be avoided in the development envelope, where practicable. |
| **Groundwater** | Direct impact to groundwater levels and quantity due to potential dewatering and/or groundwater abstraction. | **Avoid**  
Dewatering and water abstraction will be minimised, if practicable, in the development envelope. |
Potential impacts to groundwater dependent vegetation due to hydrological changes associated with temporary groundwater dewatering and abstraction.

The PTA will undertake a number of measures to minimise impacts on groundwater, including:

- Following detailed design, a review of dewatering and groundwater abstraction activities, if required, will be undertaken to evaluate the potential direct and indirect impacts to environmental values.
- Groundwater monitoring is currently being undertaken and will be used to assess and minimise potential direct and indirect impacts to groundwater and inform the management of dewatering and abstraction activities.
- Dewatering impacts will be managed under a RIWI Act dewatering licence to minimise potential impacts to environmental values including groundwater dependent vegetation.
- A Dewatering and Groundwater Management Plan, approved by DWER, will be prepared and implemented to ensure that no dewatering effluent is discharged to wetlands, waterways or drains and to minimise the volume, rate and duration of dewatering, where possible.
- An ASS Management Plan will be developed to manage impacts associated with ASS including the potential oxidation of ASS in or near wetlands. A CEMP will be developed and implemented, which will include measures to mitigate risks to groundwater including chemical and fuel storage and spill response in the development envelope.
- The PTA's Spill Response Framework and Procedures will be implemented to contain chemical and fuel spills and to ensure no contaminants enter the groundwater.
8.5. Further investigations

Further inland waters investigations will be undertaken once the design has been finalised by the contractor and potential disturbance depths and locations are known. Currently planned inland waters investigations are outlined in Table 33.

Table 33: Further environmental investigations relevant to inland waters

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
</table>
| Preliminary wetland assessment - Morley Ellenbrook Line Wetland Values Assessment | **Scope:** Undertake a wetland values assessment, in order to fill knowledge gaps and develop a greater understanding of the ecological and conservation values of all wetlands within, and adjacent to, the development envelope. This wetland values assessment will be used to inform the selection of a subset of wetlands that have sufficiently high conservation value within, or just outside of, the development envelope, at which detailed, on-ground ecological surveys are to be undertaken in the future to confirm the conservation status and collect baseline data for wetland EIA.

**Consultant:** Wetland Research and Management (WRM)
**Survey date/s:** October/November 2019
**Anticipated report date:** January 2020 |
| Morley Ellenbrook Line - Wetlands detailed ecological assessment | **Scope:** Targeted and detailed aquatic values ecological assessment of selected wetlands within and adjacent the development envelope. Conduct quantitative/semi-quantitative ecological surveys of macroinvertebrates, zooplankton and water quality. Conduct qualitative/observational surveys for fish, crayfish, turtles, frogs and water rats, in order to confirm the presence and record distribution of conservation significant species.

Prepare a technical report detailing the aquatic fauna ecological values of the selected wetlands, and describe the ‘baseline data’ for each wetland as a precursor for future monitoring and impact assessment.

Collate results from relevant concurrent ecological surveys undertaken within the development envelope, specifically flora and vegetation surveys, water bird surveys, monthly water quality monitoring, hydrological surveys/modelling (if available), and the current aquatic fauna technical report to form a comprehensive inventory of fauna and flora values at each wetland.

Produce a report describing the overall ecological values of high conservation value wetlands within the development envelope, including surface water quality, flora and faunal community composition and conservation significance, and summarise potential risk to the values of these wetlands from the project.

**Consultant:** WRM
**Survey date/s:** scheduled 31 Aug-4 Sep 2020
**Anticipated report date:** Late Nov 2020 |
| Aquatic Fauna Survey of Bennett Brook | **Scope:** To undertake an aquatic fauna survey of Bennett Brook upstream and downstream of the proposed rail infrastructure at the Bennett Brook crossing point (rail bridge).

**Consultant:** WRM
**Survey date/s:** Late Winter 2020
**Anticipated Report date:** December 2020 |
8.6. Predicted outcome

The project will meet the EPA’s objective to protect inland waters and to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected, following the completion of comprehensive baseline studies, optimisation of the Proposal’s footprint to utilise existing disturbed areas and implementation of targeted environmental management measures and offsets if significant residual impacts remain. In addition, potential direct and indirect impacts to surface and groundwater can be managed in accordance with licensing issued under the RIWI Act.
9. Social Surrounds

9.1. EPA objective
To protect social surroundings from significant harm.

9.2. Policy and guidance
The following policies and guidance are relevant to the social surroundings factor:

- *Aboriginal Heritage Act 1972;*
- *Environmental Protection (Noise) Regulations 1997;*
- Visual Landscape Planning in Western Australia Manual (WAPC 2007);
- A Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and Other Related Activities (DEC 2011);
- Rail Infrastructure Noise Guideline (EPA 2013b);
- Environmental Factor Guideline: Social Surroundings (EPA 2016h);
- Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration (Standards Australia 2018); and
- State Planning Policy 5.4 Road and rail noise (WAPC 2019).

9.3. Receiving environment

9.3.1. Surveys and studies
Table 34 lists the relevant investigations which were undertaken and are proposed to assess the social surroundings of the development envelope.

Table 34: Environmental investigations undertaken within and/or adjacent to the development envelope

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Details of investigation</th>
</tr>
</thead>
</table>
| Morley Ellenbrook Line: Preliminary Design Noise and Vibration Assessment – Part 2 | **Scope:** Desktop assessment of existing and future railway noise and vibration levels. Provision of in principle recommendations for improvements where they may be required. Report detailing noise and vibration results for the Malaga to Ellenbrook Rail Works.  
**Consultant:** SLR  
**Survey date/s:** Not applicable  
**Anticipated report date:** August 2019 |
| Desktop Aboriginal Heritage Analysis of Proposed Morley to Ellenbrook Railway Line (Appendix E) | **Scope:** Preliminary Aboriginal heritage assessment of the Proposal corridor. Search of the register of Aboriginal Sites within 100m of development envelope. Report assessing the construction constrains arising from heritage considerations. Provision of recommendations pertaining to the management of Aboriginal heritage impacts.  
**Consultant:** R. & E. O’Connor Pty Ltd  
**Survey date/s:** Not applicable  
**Anticipated report date:** February 2018 |
| Aboriginal heritage Survey: Morley Ellenbrook Railway Line (Appendix F)       | **Scope:** Arrange and carry out the Aboriginal heritage consultation and field survey for the Proposal. Assist PTA with implementation and the Noongar Standard Heritage Agreement (NSHA) – as applies to formal consultation between PTA and Whadjuk Working Party (through SWALSC). Conduct an Aboriginal heritage survey in accordance with NSHA with representatives nominated by SWALSC. Arrange for a |
9.3.2. Aboriginal heritage

Two Aboriginal heritage studies (a desktop assessment, Appendix E, and a consultative survey, Appendix F) have been undertaken for the Proposal (R. & E. O’Connor Pty Ltd 2019; R. & E. O’Connor Pty Ltd 2018). A total of three sites registered under the Aboriginal Heritage Act 1972 (AH Act) were found to intersect the development envelope (Figure 19). The Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System shows the alignment intersecting also with Site Number 3840 ‘Bennett Brook Camp Area’, however the footprint of that site is confirmed as outside the development envelope (R. & E. O’Connor Pty Ltd 2019). The studies involved a consultative process and field survey of the proposed railway alignment with Whadjuk representatives as nominated by the South West Aboriginal Land and Sea Council (SWALSC) under the Noongar Standard Heritage Agreement with the PTA. Knowledge Holders for the registered Aboriginal heritage sites were also consulted as nominated by the DPLH.

A basic description of each site is included in Table 35. Further descriptions and attributes of each registered site are found below. No other Aboriginal heritage sites were identified by the Aboriginal survey participants within, or in close proximity to, the indicative railway alignment.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site name</th>
<th>Site type</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>551</td>
<td>Lord Street North 1</td>
<td>Ceremonial</td>
<td>May have been disturbed in previous Lord Street road construction activities.</td>
</tr>
<tr>
<td>552</td>
<td>Lord Street North 2</td>
<td>Ceremonial, Mythological, Water Source</td>
<td>May have been disturbed in previous Lord Street road construction activities.</td>
</tr>
<tr>
<td>3692</td>
<td>Bennett Brook: in Toto</td>
<td>Mythological</td>
<td>Restricted site</td>
</tr>
</tbody>
</table>

**Site ID 551 – Lord Street North 1**

This site is located alongside Drumpellier Drive at the eastern edge of Whiteman Park. Described as a stand of paperbarks and Tea-trees, this site is believed to be an old ‘initiation ground’. The Tea-trees are said to be symbolic of the old people who used the meeting ground (R. & E. O’Connor Pty Ltd 2018). During the extension of Drumpellier Drive, part of the site was granted approval to be
disturbed, on the condition that every endeavour was made to limit encroachment onto the site and the remaining portion be fenced with an appropriate memorialisation provided (Brad Goode & Associates 2015). This has been completed, with representatives of the Aboriginal people of the area assessing this fenced location as consistent with details of the actual site location, and that as a cool shady place, the location was also consistent with use as a corroboree place (Brad Goode & Associates 2016). The PTA has received approval from the Minister for Aboriginal Affairs under Section 18 of the AH Act, for the partial disturbance of the registered Aboriginal heritage site ID 551 (Reference 69-14789).

Site ID 552 – Lord Street North 2
Located further south along Drumpellier Drive, this site is described as a permanent pool surrounded by reeds, grass trees and paperbarks (R. & E. O’Connor Pty Ltd 2018). Site ID 552 is defined by a sacred fresh water source associated with the *Dugatch* (*Waugal*) dreaming (R. & E. O’Connor Pty Ltd 2019, Brad Goode & Associates 2015). Consultation with relevant Aboriginal survey participants have also identified this area as a possible kangaroo increase site, important in maintaining the kangaroo population in the area (Brad Goode & Associates 2015). The PTA has received approval from the Minister for Aboriginal Affairs under Section 18 of the AH Act, for the partial disturbance of the Registered Aboriginal Site ID 552 (Reference 69-14789).

Site ID 3692 – Bennett Brook in Toto
The Bennett Brook in Toto site is a mythological site held under Restricted Access. The site was recorded to include the Brook and the banks on either side. The site extends approximately 7 km from headwaters of the Bennett Brook in Whiteman Park to the confluence of Bennett Brook and the Swan River (Amergin Consulting 2015). The entire brook is of significance to the Whadjuk people as it was formed by the *Waugul*, whose spiritual essence is believed to still exist there (Coffey 2015e). It is reported that Aboriginal groups would move along the reaches of Bennett Brook hunting and gathering food while moving from camps in the Guildford area to Lake Gnangara and beyond (Whiteman Park 2019).

The spiritual and cultural health of Aboriginal people is considered to be dependent on the health and vitality of living water, stemming from a close connection to country which is difficult for many non-Aboriginal people to appreciate or even understand (Estill & Associates 2005). Bennett Brook is recognised by the Aboriginal people as a ‘living water’ source, and thus has special significance associated with it. However, since the original recording of its status in 1984, numerous developments have taken place both over and in the near vicinity of Bennett Brook with the approval of the Aboriginal people (R. & E. O’Connor Pty Ltd 2018).

The Proposal requires the construction of a rail bridge over Bennett Brook. The consultative survey undertaken for the Proposal confirmed the significance of Bennett Brook. A Section 18 approval under the AH Act will be required but no application has yet been made in this regard.

9.3.3. Lodged Aboriginal sites
A further three sites of Aboriginal heritage are lodged with the DPLH, but do not fit the criteria of a registered site (see Table 35). These sites have undergone varying levels of disturbance and degradation due to localised developments and potentially little of these sites remain. Most of these sites were associated with artefacts or scatters, with any signs of artefacts collected at the time of recording (Amergin Consulting 2015; Ethnosciences 2017). In previous reports, some of these sites were listed as “registered” under the AH Act, however recent studies have downgraded them to “lodged” due to the level of disturbance of these sites. No additional surveys or Section 18 approvals are required to disturb these sites.
Table 36: Lodged Aboriginal heritage sites

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Site name</th>
<th>Site type</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>3180</td>
<td>Marshall, Beechboro</td>
<td>Artefacts/Scatter</td>
<td>Previously disturbed by the construction of Marshall Road</td>
</tr>
<tr>
<td>3618</td>
<td>Whitemans Cutting</td>
<td>Artefacts/Scatter</td>
<td>Site heavily altered</td>
</tr>
<tr>
<td>3619</td>
<td>Whitemans Quarry</td>
<td>Artefacts/Scatter</td>
<td>-</td>
</tr>
</tbody>
</table>

9.3.4. European heritage

There are no State Registered sites of European Heritage located within the development envelope. The City of Swan’s Municipal Heritage Inventory lists Whiteman Park as a place of cultural heritage significance (Figure 19).
Figure 19 Aboriginal and European Heritage Sites
9.3.5. Amenity

The Proposal is situated amongst relatively undeveloped areas of the Marshall Road paddocks and Whiteman Park, and the built-up areas at Ellenbrook. Aspects of the social surroundings are described below in relation to noise, vibration, dust, and visual amenity.

Noise and Vibration

Operational rail noise and vibration criteria for the Proposal were developed in consultation with the DWER Noise Branch and documented in SLR Morley - Ellenbrook Line Preliminary Design Noise and Vibration Assessment - Part 2 (SLR 2019; Appendix G). The SLR report demonstrates that the adopted noise and vibration criteria can be met with the implementation of noise and vibration mitigation measures. The report is based on a preliminary track design and train operating plan which will be finalised by the construction contractor. The scope of the construction contract will include the following requirements:

- Compliance with the noise and vibration criteria outlined in the SLR report.
- Reassessment of noise and vibration once the track design and train operating plan are finalised.
- Identification of noise and vibration mitigation measures required to meet the criteria. Mitigation measures may include track treatments such as rail dampers (noise reduction), ballast matting (vibration damping) and/or noise barriers/walls. The final mitigation measures will be determined by the construction contractor but must be approved by the PTA. The contractor will be required to consult with local residents and relevant local government authorities to identify the most appropriate measures to be implemented and must take into consideration effectiveness, local preferences, visual amenity, safety, maintainability and cost.
- Preparation of a noise and vibration management plan outlining the final mitigation measures to be implemented, which must be approved by the PTA prior to operation commencing.

Post construction the PTA will undertake operational noise and vibration monitoring within 3 and 15 months post construction to ensure that the noise and vibration criteria have been met.

Development applications will be required for the construction of train stations, carparks and noise walls. Operational noise and vibration impacts will be assessed by the relevant local government authority or development assessment panel and approvals may include noise and vibration conditions.

The preliminary noise and vibration assessment considered current road noise and modelled railway noise from the Proposal at all residences in the vicinity of the Proposal (SLR 2019). Below is a summary of the airborne noise assessment findings, based on the preliminary design:

- 200 residences are modelled to be above airborne noise trigger levels, which triggers the consideration of noise controls.
- 16 residences are modelled to be above the airborne noise design level, which means mitigation must be provided.
- Without mitigation, operational noise levels are forecast to be highest in the areas of Ellenbrook.

The preliminary noise and vibration assessment also considered ground-borne vibration (GBV) and ground-borne noise (GBN) below is a summary of the findings, based on the preliminary design:

- 33 residential properties are forecast to have GBV levels up to 9 dB above the relevant investigation trigger level prior to any specific mitigation.
- 53 residential properties are forecast to have GBN levels up to 13 dB above the relevant investigation trigger level prior to any specific mitigation.
Dust
The DWER conducts hourly air quality monitoring at a number of permanent monitoring stations in the Perth metropolitan area. The closest station to the development envelope is Caversham. A review of air quality as measured in December 2019 indicated that both PM2.5 and PM10 concentrations were below the defined air quality index as prescribed by the National Environment Protection (Ambient Air Quality) Standard (NEPC 2019).

Dust emissions can occur during land clearing and earth moving activities, and type of construction activities. The risk of dust impacts from a demolition/construction site causing loss of amenity is related to the following:

- The nature of the activities being undertaken;
- The duration of the activities;
- The size of the cleared area; and
- Meteorological conditions.

The PTA will manage the potential for dust impacts through the implementation of a CEMP.

Visual Amenity
The topography of the landscape surrounding the development envelope is typically flat, with areas becoming undulated further north outside the development envelope (Coffey 2015e). The land uses surrounding the southern portion of the Proposal is currently zoned parks and recreation and rural residential. Where the indicative railway alignment turns north adjacent to Drumpellier Drive, the majority of the development envelope is within Whiteman Park and Drumpellier Drive road reserve, and is adjacent to urban residential development on the eastern side.

Natural Landscapes (Whiteman Park)
Whiteman Park provides recreational and conservation amenity value to the community and the development envelope is located adjacent to and in some locations extends into Whiteman Park. Whiteman Park is the largest recreation and conservation park in the Perth metropolitan region, covering an area of nearly 4,000 ha (Whiteman Park 2019). Originally used for the purpose of grazing cattle, Whiteman Park was converted into a Public Open Space with the development of the popular picnic spot of Mussel Pool in the 1960s (Whiteman Park 2019). The creation of this parkland also served to protect the Gnangara Water Mound, a vital source of drinking water for the Perth metropolitan area. Whiteman Park now encompasses strong themes of education and environmental conservation, transport and cultural heritage, through both the Park infrastructure, and the social aesthetic value of the Park.

9.4. Assessment of impacts to Social Surroundings
Table 37 provides an evaluation of the potential impact that the Proposal may have on social surroundings and PTA’s proposed mitigation to minimise impacts.

Table 37: Impacts and preliminary mitigation for Social Surroundings

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impacts</th>
<th>Preliminary Mitigation Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal heritage</td>
<td>The SWALSC/Whadjuk Working Party nominees and Registered Knowledge Holders gave conditional approval for the Proposal in relation to the three relevant Aboriginal sites (R. &amp; E. O’Connor Pty Ltd 2019). Below are the potential</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The Proposal has been designed to utilise the existing cleared areas and road reserve where land has already been disturbed and cleared</td>
<td></td>
</tr>
</tbody>
</table>
impacts to the Aboriginal sites as a result of implementing the Proposal:

- **Site ID 3692**: The impact of a railway bridge across Bennett Brook will include spiritual and environment/physical. The spiritual impact will be minimised to the satisfaction of the Aboriginal survey participants. The impact to environment/physical will be permanent however, as the bridge will be a permanent structure and paperbark trees associated with this waterway will be removed within the construction corridor.

- **Site ID 551**: No new impacts to the Aboriginal site.

- **Site ID 552**: Where the railway alignment passes to the east of this site (Figure 19), impacts will be minimal. The Noongar (Noongar) representatives were satisfied that the permanent water body located in the northwest corner of the site is the focus of this site, and will not be impacted (approximately 100 m west of the proposed works). Impacts to the wetland areas associated with the permanent water body will be confined to the western margin of Drumpellier Drive, and will be minimised.

---

**Amenity: Noise and Vibration**

**Operational noise and vibration**

Approximately 200 residences between Malaga and Ellenbrook are likely to experience airborne noise levels above the ‘Airborne Noise Trigger Level’ (SLR 2019). Specifically, 16 residences are modelled to be above the ‘Airborne Noise Design Level’ which means mitigation must be provided (SLR 2019).

The vibration modelling determined that 33 residential properties are forecast to experience for recent projects (i.e. Drumpellier Drive).

**Minimise:**

The PTA commits to the following measures:

- Seek s18 approval for disturbance to registered Aboriginal heritage sites required to be disturbed for the Proposal.
- During construction, cease disturbance activities as soon as possible in the event of finding Aboriginal artefacts/objects and report findings to DPLH, the WA Museum and the WA Police if any skeletal material is found.

Following the Aboriginal heritage consultative process and field survey, conditional approval is as follows:

- Two Noongar monitors on site when geotechnical investigations are taking place in areas where the ground surface has not been previously disturbed.
- Noongar monitors present for all new ground disturbance associated with railway construction.
- Another Noongar meeting to discuss final plans to take place when the Bennett Brook crossing is designed.
- Noongar names for the proposed railway stations and Noongar involvement in artwork there.
- When the precise locations of the stations are finalised, a further heritage survey of them will be carried out.

One group included a further condition:

- Minimal disturbance to the area in which site 552 is located. Disturbance between the existing access footpath and Drumpellier Drive (formerly New Lord Street) should be minimised.

**Avoid:**

The Proposal has been designed to utilise areas with minimal sensitive receptors.

**Minimise:**

Further noise and vibration modelling assessment to be undertaken based on the final design and operational requirements. Recommended
GBV levels up to 9 dB above the relevant investigation trigger level. The vibration modelling also determined that 53 residences are forecast to have GBN levels up to 13 dB above the relevant investigation trigger level.

**Construction noise and vibration**
Construction noise and vibration may have a temporary impact on sensitive receivers during construction.

### Construction noise and vibration
- Boundary noise walls, to achieve compliance with airborne noise trigger levels for operational rail noise.
- Engineering treatments such as ballast matting and/or sleeper pads with suitable trackform will be applied as appropriate to mitigate vibration from railway operations.
- A Noise and Vibration Management Plan (NVMP) will be developed by the construction contractor to demonstrate how the Proposal’s noise and vibration criteria will be met. The NVMP will be provided to DWER for review.
- Construction noise and vibration will be managed in accordance with the [Environmental Protection (Noise) Regulation 1997](https://www.legislation.wa.gov.au/Legislation/Regulation/View/1997/1658). The construction contractor will be required to address construction noise and vibration management in the CEMP.
- If construction is required outside of standard construction hours, an out of hours noise management plan will be prepared and approved by the City of Swan in accordance with the [Environmental Protection (Noise) Regulations 1997](https://www.legislation.wa.gov.au/Legislation/Regulation/View/1997/1658).
- Noise and vibration controls during construction works will be in accordance with [AS 2436-2010 (R2016) Guide to noise and vibration control on construction, demolition and maintenance sites](https://www.ansi.org/standards-search/standards/444683).

### Dust

Construction of the Proposal will result in dust from construction activities. If airborne dust extends beyond the development envelope, this may become a nuisance to residents in residential areas near or adjacent to the Proposal. The generation of dust is likely to vary dependent on the activities, and weather conditions including strength and direction of prevailing winds. If significant levels of dust are deposited on vegetation, this could potentially impact vegetation health.

**Minimise:**
A CEMP will be developed and implemented to outline appropriate management measures, including the following:
- Use of water for dust suppression.
- Temporarily cease construction (where practicable) during high wind conditions to avoid dust generation and offsite dust.

### Visual

Permanent visual intrusion impacts to nearby receptors from the construction of elevated rail, road bridges and noise walls/barriers.

**Minimise:**
- The project’s community consultation program will continue,
with feedback to be considered during detailed engineering design.

- Residents in the vicinity of any proposed noise walls/barriers will be consulted as to the location, height, materials, design and colour.

<table>
<thead>
<tr>
<th><strong>Amenity: Natural Landscapes</strong></th>
<th><strong>Minimise:</strong></th>
</tr>
</thead>
</table>
| Access to the southern and eastern extents of Whiteman Park will be impacted temporarily during construction and permanently during operation | - The Proposal has been designed to minimise direct and indirect impacts to Whiteman Park.  
- The PTA will continue consultation with the WAPC, DPLH and Whiteman Park operators to minimise impacts to park access.  
- Public access to Whiteman Park will be maintained throughout construction and operation of the Proposal. |

### 9.5. Predicted outcome

The Proponent considers that through the implementation of appropriate avoidance and mitigation measures (as outlined in Table 37) and implementation of a CEMP and NVMP, the Social Surroundings environmental factor can be appropriately managed during the construction and operation of the Proposal, such that the EPA’s objective will be met.

No impacts to European heritage are expected to occur as a result of the Proposal.
10. Offsets

Following consideration of proposed impact avoidance, minimisation and mitigation measures, predicted significant residual environmental impacts from the implementation of the Proposal will be offset.

The PTA anticipates that the Proposal’s significant residual impacts will include Carnaby’s Black Cockatoo and Forest Red-tailed Black Cockatoo potential breeding trees, Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, Bush Forever sites and Conservation Category Wetlands.

The PTA will prepare a proposal specific offsets strategy to support the State and Commonwealth’s assessment of the Proposal under the EP Act and EPBC Act which will outline the following:

- The quantity and extent of the significant residual impact of each environmental value.
- The quantum of impact in accordance with the Commonwealth’s Offset Calculator.
- The proposed offset for each significant residual impact including specific information on each land acquisition site.
- The strategy and governance to implement each offset.
- Application of the WA Environmental Offsets Policy (Government of Western Australia 2011b), WA Environmental Offsets Guidelines (Government of Western Australia 2014) and the EPBC Act Environmental Offsets Policy (Australian Government 2012).
- Application of the Commonwealth Offsets calculator.
- The completed WA Offsets template.
- Roles and responsibilities of respective stakeholders.

The PTA has an extensive offset portfolio and has an offsets team dedicated to the planning, management and delivery of offsets for METRONET projects.

Strategic planning for the Proposal’s anticipated significant residual impacts has commenced, which includes banking offset sites for future use. The PTA is confident that the current offset portfolio contains a sufficient quantity of Black Cockatoo habitat and Banksia Woodlands of the Swan Coastal Plain TEC to satisfy the Proposal’s offset requirements. Negotiation to purchase additional offset sites has commenced and additional offsets for other environmental values are being sought.

Additionally, the PTA has reached an agreement with Murdoch University to contribute funding to their Black Cockatoo research proposal as an indirect offset component of the Black Cockatoo offsets package for two previous METRONET projects. The PTA is likely to attribute 10% of the total Proposal’s Black Cockatoo offset requirement to Murdoch University as an additional contribution.

The PTA regularly consults with internal and external stakeholders regarding offsets planning and implementation. This includes personnel from the DBCA, DWER, WAPC, DPLH and Local Government working collaboratively address offset requirements and/or provide advice.

With a dedicated team working to address Proposal’s offset requirements, recent experience preparing offset strategies for similar projects and knowledge of the State and Commonwealth offset policies and guidelines, the PTA is confident that the proposed offsets strategy will offset the significant residual impacts of the Proposal.
11. Conclusion

The PTA has referred the Malaga to Ellenbrook Rail Works Proposal to the EPA under Section 38 of the EP Act. The PTA has considered the potential impacts to the EPA factors:

- Flora and vegetation.
- Terrestrial environmental quality.
- Terrestrial fauna.
- Inland waters.
- Social surroundings.

The PTA has applied the mitigation hierarchy and considers that the impacts of this Proposal on the EPA factors are able to be mitigated or managed to enable the EPA's objectives to be met.
12. References


Beard, J. S. 1990. Plant Life of Western Australia, Kangaroo Press Pty Ltd, Kenthurst NSW.


Coffey. 2015e. Public Environmental Review Perth-Darwin National Highway (Swan Valley Section) September 2015, Volume 1: Main text, Main Roads Western Australia, Perth.


Department of Water (DoW). 2016. Water Quality Protection Note No. 25, Land use compatibility tables for public drinking water source areas.

Department of Environment Regulation. 2014. Assessment and management of contaminated sites. Contaminated sites guidelines.

Department of Environment Regulation. 2015a. Identification and investigation of acid sulfate soils and acidic landscapes.

Department of Environment Regulation. 2015b. Treatment and management of soil and water in acid sulfate soil landscapes.


Environmental Protection Authority (EPA). 2013b. Rail Infrastructure Noise Guideline. Environment Protection Authority, Sydney, NSW.


Environmental Protection Authority (EPA). 2016h. Environmental Factor Guideline: Social Surroundings, EPA, Western Australia. Published December 2016.
Environmental Protection Authority (EPA). 2018a. Instructions on how to prepare an Environmental Review Document, EPA, Western Australia. Published April 2018.


Environmental Protection Authority (EPA). 2019. Carnaby’s Cockatoo in Environmental Impact Assessment in the Perth and Peel Region. EPA, Perth, Western Australia


Geological Survey Western Australia and Geoscience Australia. 2008. Surface Geology of Australia 1:250,000 Western Australia


Government of Western Australia. 2011a. Local Water Quality Improvement Plan: Bennett Brook Catchment.


Government of Western Australia. 2014. WA Environmental Offsets Guidelines. Published August 2014.


North Metro Catchment Group. 2006. Freshwater Fish Survey of Bennett Brook.


PGV Environmental. 2014. Brabham LSP 3 Area – Black Cockatoo Habitat Assessment. Prepared for Department of Housing, Western Australia.


13. Appendices
Desktop review and impact assessment of Subterranean Fauna for the Morley-Ellenbrook Line (Invertebrate Solutions 2019)
Desk-top Aboriginal Heritage Analysis of Proposed Morley to Ellenbrook Railway Line (R. & E. O'Connor Pty Ltd 2018)
Detailed Flora and Vegetation Assessment. METRONET Morley-Ellenbrook line (RPS 2019)