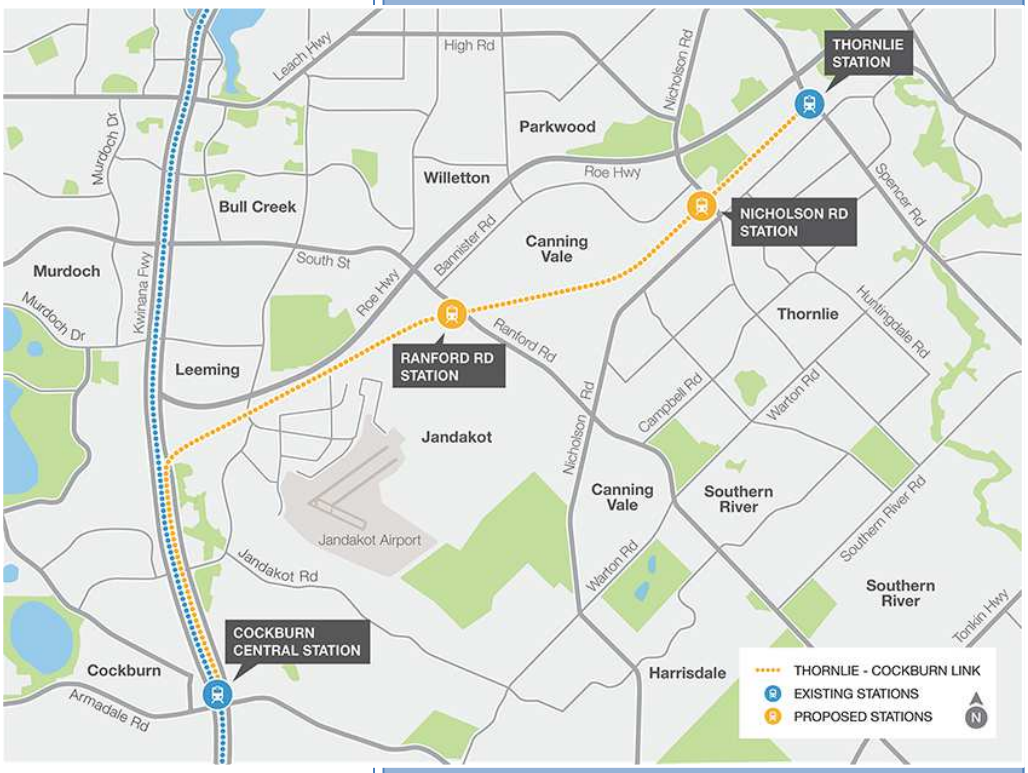
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Thornlie – Cockburn Link
Supplementary Environmental Report



Prepared For:	Public Transport Authority Public Transport Centre West Parade PERTH WA 6000
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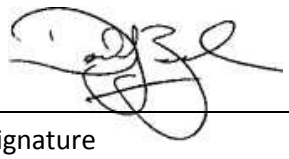
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Report No: AP2018-009

Author:	Caitlin Hewitt Project Environmental Scientist		6 June 2018
		Signature	Date
Reviewed by:	Paul Zuvela Manager – EIA Group & Director		6 June 2018
		Signature	Date

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EXECUTIVE SUMMARY

The Public Transport Authority (PTA) of Western Australia proposes to construct and operate the METRONET Thornlie – Cockburn Link (TCL) Project (the Proposal) (Figure 1). The Proposal includes construction of a 14.5 kilometre (km) new dual railway track within existing railway and road reserves, to extend the existing Thornlie spur line to Cockburn Central station as well as the duplication of 3 km of railway track between Beckenham Junction and Thornlie train station. To enable the construction of this dual passenger line, approximately 11 km of existing freight line will be relocated within the rail reserve. Modifications to existing train stations, bridges and roads will be required and two new train stations will be constructed at Ranford Road and Nicholson Road in Canning Vale as well as the construction of a principal shared path. In summary:

- 54% of the development envelope is clear of native vegetation, with the majority of vegetation in a Degraded-Completely Degraded condition.
- 39% of the development envelope contains Completely Degraded native vegetation.
- Less than 7% of the development envelope contains Excellent to Degraded native vegetation.
- The Proposal will not impact any Threatened or Priority Flora, Black Cockatoo roosting habitat or current Black Cockatoo nesting hollows.
- The Proposal will result in:
    - Clearing of 54.88 hectares (ha) of native vegetation, assuming that the entire development envelope is cleared.
    - Clearing of 2.85 ha of Banksia Woodland of the Swan Coastal Plain Threatened Ecological Community (TEC) across three separate patches (which is protected under the *Environment Protection and Biodiversity Conservation Act 1999*).
    - Clearing of 4.42 ha of Low lying *Banksia attenuata* woodlands or shrublands (Floristic Community Type 21c) which is a State listed Priority Ecological Community (Priority 3). Of this, 2.85 ha is also a component of the Federally listed TEC.
    - The TCL development envelope overlaps 29.90 ha of Bush Forever sites. Of this area, 23.78 ha comprises native vegetation. Assuming nearly the entire development envelope is cleared (excluding a 0.94 ha area of vegetation type VT05 in Bush Forever Site 246), the construction of the TCL project will clear 22.84 ha of vegetation within Bush Forever Sites 245, 246, 388 and 456. More than 86% of the vegetation to be cleared in Bush Forever areas is in Degraded-Completely Degraded condition. The loss per condition rating being:
        - Good condition – 2.54 ha
        - Good-Degraded condition – 0.21 ha
        - Degraded condition – 0.31 ha
        - Degraded-Completely Degraded condition – 19.78 ha
    - The TCL development envelope encroaches into 0.40 ha of a modified Conservation Category Wetland (CCW) (UFI 7446) within Bush Forever Site 456. A total of 0.12 ha of this area is already cleared, 0.24 ha is Degraded-Completely Degraded and the remaining 0.04 ha is Good and Good-Degraded.

  - The TCL development envelope encroaches into 5.66 ha of Resource Enhancement Wetlands (REWs) (UFI 7447, 15926 and 13332), with 0.74 ha of this already cleared and the remaining 4.92 ha being of variable condition ranging from Very Good to Degraded. The 0.94 ha of wetland vegetation (VT05) within and adjacent to Wetland UFI 15926 (within Bush Forever Site 246) will be avoided during construction.
  - Clearing 27.64 ha of Black Cockatoo foraging habitat of variable quality.
  - Clearing 96 potential Black Cockatoo habitat trees (i.e. trees with diameter at breast height (DBH) > 500 mm).
- The Proposal may result in the following indirect impacts:
  - Changes to hydrological regimes resulting from drainage infiltration, abstraction of groundwater to supply construction water and dewatering.
  - Introduction or spread of dieback.
  - The introduction or spread of weeds.
- The Proposal will disturb two registered Aboriginal heritage sites (Canning River – ID: 3538 and Swan River – ID: 3536).
- Construction impacts (e.g. disturbance of contaminated soils, dewatering of acid sulfate soils / contaminated groundwater, noise and vibration emissions, groundwater drawdown, and social impacts) will be managed by the appointed Contractor in accordance with PTA standards and under a PTA approved construction environmental management plan.

Net positive outcomes that will be achieved as a result of the Proposal include:

- On commencement of operations on the TCL, 4,000 people are expected to board trains at Ranford and Nicholson Road stations daily (over 28,000 people weekly by 2031). State government forecasts the passenger numbers will be boosted continually as the population grows to the projected 3.5 million people by 2050.
- Improved opportunities for public transport use in the south-eastern corridor of the Perth Metropolitan region with expected flow on benefits of reduced traffic congestion.
- The TCL will provide an alternative route to the south (e.g. Mandurah), which will be extremely beneficial for transporting patrons to and from events at the new Perth Stadium.
- Jobs will be created and flow–on economic benefits are expected.
- Improved noise and vibration mitigation measures for residents living adjacent to the existing freight rail, with the installation of noise walls and ballast matting.
- Environmental offsets will be offered for significant residual impacts. Based on the impact assessment these are considered to be:
  - Direct loss of 2.85 ha of *Banksia* Woodlands of the Swan Coastal Plain TEC within the development envelope. The loss per condition rating is:
    - Excellent — 0.10 ha
    - Very Good — 0.03 ha

  - Good — 2.60 ha
  - Degraded – 0.08 ha
  - Not surveyed – 0.04 ha
- Direct loss of 2.68 ha of vegetation within Bush Forever Site 388. This vegetation is in a Degraded or better condition and contains attributes consistent with Banksia Woodland of the Swan Coastal Plain TEC, black cockatoo foraging habitat and a REW.
- Clearing 27.64 ha of Black Cockatoo foraging habitat of variable quality.
- Clearing 96 potential Black Cockatoo habitat trees (trees with diameter at breast height > 500 mm).

1 INTRODUCTION

1.1 PURPOSE AND SCOPE

Aurora Environmental (Aurora) were commissioned by the Public Transport Authority (PTA) to prepare a referral to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986*. This Supplementary Environmental Report has been prepared along with the referral form to provide additional detail on the METRONET Thornlie – Cockburn Link (TCL) Project (the Proposal) (Figure 1).

The Proposal includes construction of 14.5 kilometres (km) of new dual railway track within existing railway and road reserves, to extend the existing Thornlie passenger line to Cockburn Central Station as well as the duplication of 3 km of railway track between Beckenham Junction and Thornlie station. To enable the construction of the dual passenger line, approximately 11 km of existing freight line will be relocated approximately 10 m to the north within the railway reserve. Modifications to existing train stations, bridges and roads will be required and two new train stations will be constructed at Ranford Road and Nicholson Road in Canning Vale as well as the construction of a principal shared path (PSP).

The TCL Project is an important component of the State Government's METRONET Vision which aims to transform Perth's public transport network, providing greater opportunities for use of public transport as a means to reducing road congestion. At the same time, the Proposal will be a catalyst to drive growth, employment opportunities and the development of activity centres around key nodes, such as train stations.

The format and content of this Supplementary Environmental Report has been prepared in accordance with *Instructions on How to Prepare an Environmental Review Document* (EPA, 2016a). The purpose of the report is to describe and assess the significance of the environmental impacts to the EPA's environmental factors associated with the construction of the TCL Project. This document addresses the environmental impacts and management requirements associated with the TCL Project.

1.2 PROPONENT

Table A provides the details of the proponent.

TABLE A: PROPONENT CONTACT DETAILS

Contact Details	
Name	Public Transport Authority (PTA)
Australian Business Number (ABN)	61 850 109 576
Postal Address	Public Transport Centre, West Parade PERTH WA 6000
Proponent Contact	Miranda Ludlow Environmental Manager, Infrastructure Planning and Land Services (08) 9326 3972

1.3 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

1.3.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. The Act provides for the prevention, control and abatement of pollution and

environmental harm, for the conservation, preservation, protection, enhancement and management of the environment. The Act is administered by the EPA and the Minister for the Environment.

1.3.1.1 Part IV of the *Environmental Protection Act 1986*

Following recommendations made as a result of the independent EPA legal and governance review in early 2016, updated procedures for environmental impact assessment were formally gazetted under Section 122 of the EP Act on 13 December 2016 as the *Environmental Impact Assessment (Part IV Divisions 1 and 2 Administrative Procedures 2016* (Administrative Procedures). The Administrative Procedures are the highest level document under the Act and provide the overarching framework for the EPA to undertake environmental impact assessment.

The Administrative Procedures identify the following key stages:

- Stage 1: Referral of a proposal to the EPA
- Stage 2: EPA to decide whether or not to assess a referred proposal
- Stage 3: Assessment of proposals
- Stage 4: EPA report on the assessment of proposal
- Stage 5: Deciding if proposal may be implemented and implementation of proposals.

The PTA, in discussions with the EPA chairman and representatives from the EPA Services Unit, has determined that the Proposal warrants referral to the EPA under Section 38 of the EP Act.

Technical studies have been completed by subject matter experts and have been utilised to form the basis of the Proposal. Where possible, modifications to the design and layout of the railway, stations, and roads have been implemented to avoid or reduce environmental impacts. The development envelope for the Proposal is presented in Figure 2.

1.3.2 Commonwealth Legislation and Guidance

The *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* protects Matters of National Environmental Significance (MNES), and is administered by the Commonwealth Minister for the Environment and Energy. If an action is likely to have a significant impact on any MNES a referral to the Department of the Environment and Energy (DoEE) is required.

Flora and Fauna Surveys (GHD, 2018; GHD, 2013) indicated the presence of MNES protected under the EPBC Act within or near the development envelope. As such a referral has been made to the Commonwealth DoEE. MNES that relate to the TCL Project are nationally threatened species, such as Carnaby's Black Cockatoo, *Caladenia huegelii*, and an ecological community – the *Banksia* Woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC).

The MNES that are considered by the Commonwealth Government are only a subset of the matters that the EPA considers in its assessment of a project. The EPA may require offsets for impacts to other environmental matters which are not protected under the *EPBC Act 1999*. In situations where these values overlap, the *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014) indicates that State Government agencies cooperate with the DoEE to align offsets and avoid duplication to the fullest extent practicable.

1.4 PART C OF EPA REFERRAL FORM – OTHER APPROVALS AND REGULATION

Table B provides the information required by Part C of the Referral Form.

TABLE B: OTHER APPROVALS AND REGULATION

State and Local Government Approvals			
Is rezoning of any land required before the proposal can be implemented?			No
If this proposal has been referred by a decision–making authority, what approval(s) are required from you?			Not applicable
Proposal Activities	**Land Tenure/Access**	**Type of Approval**	**Legislation / Regulation**
Modifications to the banks of the Canning River	Crown Land	A permit to interfere with bed and banks (Section 11/17/21A)	*Rights in Water and Irrigation Act 1914*
Disturbance to Aboriginal heritage site	Canning River (Crown Land)	Approval under Section 18	*Aboriginal Heritage Act 1972*
Clearing of native vegetation	Crown Land	Vegetation clearing permit	*Environmental Protection Act 1986*
Construction activities	Crown Land	Approval of Noise Management Plan for construction activities outside of prescribed hours	*Environmental Protection (Noise) Regulations 1997*
Construction activities	Canning River (Crown Land)	Development Approval and/or Permits for activities within the Development Control Area.	*Swan and Canning Rivers Management Act 2006*
Storage and handling of hazardous materials may be required during construction	Crown Land	Licence	*Dangerous Goods Safety Act 2004*
Abstraction of water	Crown Land	Licence to take water (Section 5C)	*Rights in Water and Irrigation Act 1914*
Dewatering	Crown Land	Licence to take water (Section 5C)	*Rights in Water and Irrigation Act 1914*
Development of train stations, car parks and public transport interchange outside of the rail corridor	Crown Land	Development Application/s	*Planning and Development Act 2005*

2 THE PROPOSAL

2.1 BACKGROUND

The Western Australian Government is committed to building METRONET, a vision to transform Perth's public transport network. The long term vision (i.e. to 2050) is for a public transport network to support a population of 3.5 million people. METRONET is the State Government's long-term public transport plan to:

- Create connected and vibrant communities;
- Reduce road congestion; and
- Act as a catalyst for enhanced land-use planning outcomes.

The PTA is proposing to implement the first stage of METRONET's priority projects, which includes the connection of the existing Thornlie Station (located on a spur from the Armadale line), to Cockburn Central Station on the Mandurah line (Figure 1). The PTA is part of the Government's Transport Portfolio. The Portfolio is committed to working with the community to deliver integrated land and transport infrastructure and services for sustainable growth.

The Proposal has the following primary objectives:

- Alleviate existing and future capacity pressures on the existing passenger rail network and the surrounding road network;
- Provide a viable transport alternative to private vehicle transport in Perth's South Metropolitan Region to increase connectivity and capacity;
- Address public transport service gaps between existing rail corridors in Perth's South Metropolitan Region; and
- Strengthen the resilience of the passenger rail system in the Southern Metropolitan Area.

By providing a new passenger connection between Thornlie Station and Cockburn Central, the TCL will enhance the existing passenger rail network and address the 'southern services gap' by providing a 17.5 km extension connecting the Thornlie Line to Cockburn Central, with two new stations and park and ride facilities constructed at Ranford Road and Nicholson Road in Canning Vale. Bus operations will also be enhanced, with bus interchanges provided at the new stations and new buses to operate additional, connecting services through surrounding areas.

2.2 JUSTIFICATION

The *Perth and Peel @ 3.5 million* planning framework (https://www.planning.wa.gov.au/10586.aspx) released by the Western Australian government in March 2018 estimates the Perth and Peel region will experience considerable population growth with a population of 2.9 million expected by 2031 and 3.5 million expected by 2050.

Population growth in the southern metropolitan region is increasing. The latest *Delivering Directions 2031 Report Card 2014* (WAPC, 2014) stated that between June 2012 and June 2013 the population of the Perth and Peel regions increased by more than 67,600 people, a 3.5 percent annual increase. The statistics for the south-eastern metropolitan subregion (encompassing the City of Armadale, City of Gosnells and City of Serpentine–Jarrahdale) suggests the highest average annual population growth rate

of approximately 6 percent per year. Locally, the combined areas of Canning Vale East, Canning Vale West, Forrestdale, Harrisdale, Piara Waters, Huntingdale and Southern River have experienced significant growth in recent years and are projected to do so in the future.

The *Perth and Peel @ 3.5 million* planning framework, specifically the South Metropolitan Peel Sub-regional Planning Framework, sets out the minimum infill dwelling targets to 2050 (Table C). The TCL will assist with the anticipated demand for public transport due to the population increase.

TABLE C: SOUTH METROPOLITAN PEEL SUB-REGION MINIMUM INFILL DWELLING TARGETS TO 2050

Local Government	Dwelling Target	Estimated Population
Armadale	15020	33040
Gosnells	12800	28160
Serpentine-Jarrahdale	1370	3010
Cockburn	14680	32300

Assuming a minimum of one car per dwelling, this will increase the number of cars using roads by 43,870 when the population reaches 3.5 million people. The TCL will address existing and future traffic congestion through the provision of a viable alternative to private vehicle mode of transport and significantly impact on car dependency rates.

The TCL will support sustainability outcomes as it will integrate with other transport modes (e.g. buses, cycling) and train transport is considered an environmentally superior outcome to private vehicle transport due to the reduction in greenhouse gas emissions. Workers outside the region will be able to more easily access the Canning Vale industrial estate through better integrated public transport connections, with bus services linking Nicholson Road and Ranford Road stations. Ranford Road Station will become an important transport interchange hub, providing the area with a more convenient service and reducing demand at Murdoch Station. The new Ranford Road Station and surrounding precinct will improve access into Canning Vale employment area with safe pedestrian and cycle linkages. The new Nicholson Road Station will provide opportunity for the development of an integrated, transit-oriented centre for the Huntingdale, Langford and Canning Vale communities, through a mix of housing, employment and convenience retail.

The new station precincts will be earmarked for transit-oriented development, providing the catalyst for land use enhancement in adjacent areas to promote liveability, connectivity and sustainability through increased housing densities, improved community amenity and greater local employment in the longer term. In the medium–to–longer term, the stations will be a catalyst for change within the walkable catchment of 400 metres from the station, encouraging the transformation of underutilised urban and industrial land into new transit-oriented precincts featuring:

- A diversity of housing, including medium–to–high density around the stations;
- High amenity public spaces leading into and around the stations;
- Greater diversity of land use at key locations to provide increased amenity and local economic activity, including office, retail, cafes and entertainment;
- Pathways and cycleways connecting the stations to surrounding residential and employment areas;

- The transformation of existing industrial areas close to the stations into contemporary, smart, high-amenity and intensive employment zones; and
- The opportunity for local, high-frequency public transport linking Nicholson Road and Ranford Road stations through the Canning Vale employment area to Murdoch Station.

As the TCL will offer transport that is accessible to a wider range of users it will generate increased patronage of Perth's train network. Intensification of land uses and improved land use planning outcomes around stations associated with transit-oriented development will stimulate economic growth and employment opportunities.

Building service resilience is a key component of the PTA's *Strategic Plan 2013-2017*. The TCL will alleviate capacity constraints for commuters accessing Murdoch Station on the Mandurah Line and the surrounding road network. In addition, it will strengthen the resilience of the passenger rail system in the Southern Metropolitan Area. The TCL will provide an alternative route to the south (e.g. Mandurah), which will be extremely beneficial for transporting patrons to and from events at the new Perth Stadium. Current predictions estimate 3,000 commuters will travel south on the Armadale line from the Perth stadium station and approximately 10,000 travellers on the Mandurah line will commute via Perth, whom could travel south via the TCL instead.

2.3 PROPOSAL DESCRIPTION

2.3.1 Existing Train Network

The existing Thornlie passenger line and bus network in the vicinity of the Proposal is shown in Appendix 1. The Thornlie spur line is a 3 km track that intersects with the Armadale line slightly north of Roe Highway, between the Kenwick and Beckenham stations. Currently 750 trains run on the Thornlie line weekly (375 trains in each direction).

The existing key freight rail network in the Perth Metropolitan Region is shown in Appendix 1. The Midland to Kwinana freight line runs the length of the existing railway reserve in which the Proposal is planned to occur. The freight rail network is owned by the State Government, but leased to a private rail operator, Arc Infrastructure, until December 2049 (Department of Transport, no date). Around 600 freight trains are scheduled on the network each week, with much of the activity centred on the Midland to Kwinana freight line (Department of Transport, 2017).

2.3.2 Proposed TCL

The TCL comprises 17.5 km of rail between the existing Mandurah line and Armadale line within the existing railway reserve. Figure 2 presents the TCL development envelope, development footprint and survey area. The TCL development envelope is 119.37 ha and is shown in more detail on:

- Figure 3.1 – Section between the existing Cockburn Central station, via the Glen Iris Tunnel to approximately Hope Road, Jandakot.
- Figure 3.2 – Section between the Glen Iris Tunnel and Ranford Road, Canning Vale.
- Figure 3.3 – Section between Ranford Road and Thornlie station.
- Figure 3.4 – Section between Thornlie station and the existing Armadale line.
- Figure 4 – Proposed Ranford Road station which shows more detail in this area than Figure 3.2.

The development envelope incorporates all activities associated with the Proposal including construction aspects (e.g. laydown areas etc.). A development footprint of 95.67 ha is also shown on the above listed figures and Figure 2, which is the likely extent of the rail corridor for the TCL once constructed. The development footprint may be adjusted within the development envelope subject to detailed design and practicalities being considered. For the purposes of this referral, it has been assumed that clearing of the entire development envelope will occur. This represents a worse-case scenario. Potential impacts may be less than this once detailed design investigations have been completed.

2.3.2.1 Railway tracks

The Proposal requires:

- Construction of dual railway tracks connecting Thornlie and Cockburn Central Stations (Figures 3.1, 3.2, 3.3 and 3.4) along with associated earthworks, traffic signals, communications, drainage infrastructure, lighting, noise barriers, fencing, landscaping and signage.
- Realignment of the existing dual freight railway tracks to the north within the existing railway reserve, to make room to install the new passenger dual railway tracks.
- Widening of the existing Mandurah Line tracks between the Glen Iris Tunnel and Cockburn Central Station. This will involve realigning the existing Mandurah Line tracks from the existing Glen Iris Tunnel to Cockburn Central Station to allow for two extended TCL tracks to run in between them, converging into a single track at Cockburn Central Station.
- Duplication of the 3 km of existing single track from Beckenham Junction to Thornlie Station (Figure 3.4).

2.3.2.2 Stations

The Proposal requires:

- Construction of two new stations:
  - Nicholson Road station — a new railway station and bus interchange with bus passenger transfer, drop-off area, walk on/cycle transfers, car parking bays and a mixture of shelters and U-rails for bicycles (Figure 3.3).
  - Ranford Road station — a new railway station and bus interchange with bus passenger transfer, drop-off area, walk on/cycle transfers, car parking bays and a mixture of shelters and U-rails for bicycles (Figure 3.2 and Figure 4).
- Modification of two existing stations:
  - Thornlie Station — will be modified to accommodate six–car trains and other works to allow the station to function as a ‘through’ station on the TCL to the existing Cockburn Central Station (Figure 3.4).
  - Cockburn Central Station — will be modified by extending the existing platform. This will allow the Thornlie Line to be extended into Cockburn Central allowing the new TCL to operate independently of Mandurah Line operations.

2.3.2.3 Bridges

Modifications to bridges will be undertaken including:

- Duplication of the Canning River Rail Bridge (Figure 3.4).
- Modification of the Ranford Road Bridge (Figure 3.2).
- Modification of the Karel Avenue Road Bridge (Figure 3.2).
- Grade separation of Cameron Street to Elliot Place pedestrian crossing (Figure 3.3).

2.3.2.4 Temporary Construction Laydown Areas

Temporary construction laydown areas are currently proposed adjacent to the TCL:

- North of the existing freight line and west of Ranford Road (Figure 3.2 and 3.3).
- Within Tom Bateman Reserve (Figure 3.3).
- On the Canning River floodplain (Figure 3.3).
- In the McCowan Street road reserve in Kenwick (Figure 3.4).

Construction activities that may occur within the laydown areas include but are not limited to:

- Laydown area for temporary placement of construction materials (steel, timber, railway track, pipes, stockpiles of materials, kerbing, lighting infrastructure, fencing materials, signage, landscaping materials etc.).
- Temporary storage of potentially contaminated soils excavated from the former landfill.
- Water storage dams/ponds/basins for storage of dewatering effluent / displaced water / stormwater runoff from hardstands / production water. Dams are to allow evaporation/infiltration of water.
- Access tracks for machinery / plant to access construction area / 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 / hand tools.
- Storage and use of other equipment including; portable toilets, site offices, sea containers for secure storage, concrete wash down bunds and rubbish skip bins.

2.3.2.5 Roads / Paths

- Construction of a portion (1.37 ha) of the Jandakot Eastern Link Road (Figure 4). The portion of road reserve south of the proposed Ranford Road station will be constructed to allow access into the station. A Metropolitan Regional Scheme Amendment (No. 1312/57) for the Jandakot Eastern Link Road which rezoned approximately 6.14 ha of land (including 4 ha of Bush Forever Site 388) from 'Rural' zone and 'Public Purposes' to 'Other Regional Road Reserve' was approved by the Minister for Planning on 11 July 2017. This scheme amendment was referred to the EPA, whom advised on 28 August 2016, that the amendment was 'Scheme Not Assessed – Advice Given'. The EPA identified three preliminary environmental factors relevant to the scheme amendment; Flora and Vegetation, Terrestrial Fauna and Inland Waters Environmental Quality.

- Construction of Principal Shared Paths (PSP). Approximately 12 km of PSP will help connect the new rail line to the community. This includes 11 km along the rail alignment between Thornlie Station and Kwinana Freeway and 1 km on the south side of Ranford Road connecting Ranford Station to the Roe Highway PSP.

2.3.2.6 Stormwater Drainage Infrastructure

Conceptual drainage designs for the TCL incorporate the following infrastructure along the TCL:

- Open surface 'V' drains — a standard 500 mm or 375 mm deep drain is proposed for areas adjacent to the freight and passenger rail lines, where the allotted space is restricted to 2.0m between the rail formation and the access road/ reserve boundary. The design of the open drain changes according to the available space by varying the width and depth while maximizing hydraulic efficiency. In some areas pit and pipe drainage will be used to ensure design requirements related to flooding depth are maintained at acceptable levels.
- Drain blocks — drain blocks (i.e. a weir structure) are likely to be spaced along the V drains to provide a detention area for water to infiltrate at suitable locations. The general infiltration rate is predicted to be 5m/day in areas of reasonable clearance to groundwater with permeable sand expected within the drain. Blocks will be spaced to control the 10 year runoff in the table drain to target an overall control of discharge to either prevent runoff in areas of low slope or reduce flows to near to pre-developed runoff in areas of increased slope or reduced drain capacity.
- Pit to pipe — A pit to pipe system, where water is collected and transported for discharge elsewhere, is used where space restrictions constrain the installation of a surface V drain or the groundwater table is high. Based on conceptual designs pit to pipe may be used along the length of the Kwinana Freeway, upstream and downstream of Nicholson Road station, Thornlie station and to the west of Karel Avenue.
- Culverts — Some existing culverts along the proposed alignment are over 40 years old. Where these culverts require extending or alteration they will be replaced.
- Open infiltration basins and closed detention basins — basins are included in the conceptual design to reduce post–development flows to pre-development levels and to maintain flood immunity. Locations for basins were chosen based on suitable clearance to groundwater and availability of adjacent undeveloped land. Basins are proposed around Thornlie station, Nicholson Road station, at Karel Avenue, at Glen Iris Tunnel and adjacent to Kwinana Freeway. Conceptual basin storage volumes range from 50 m^3 to 4,700 m^3. Footprints of basins range from 100 m^2 to 8,000 m^2.

The PTA is committed to implementing best practice Water Sensitive Urban Design (WSUD) principles in the design of the stormwater management approach for the TCL railway and station infrastructure, particularly given a portion of the project is located within the Jandakot Underground Water Pollution Control Area (UWPCA).

The PTA recognise the following benefits of adopting a WSUD approach to stormwater management:

- Maintain hydrological regimes by maximising infiltration at-source.
- Reduce stormwater runoff volumes and peak flow rates.
- Prevent water quality impacts on groundwater and receiving water bodies; and

- Enhance public amenity through implementation of waterwise landscape designs.

The following WSUD strategies will be implemented where feasible on the TCL Project:

- Manage the first 15mm of rainfall at-source as much as practical;
- Minimise the volume of water directed to large drainage basins by maximising infiltration at source within the railway corridor open drains;
- Choose water efficient fixtures and appliances at station sites to reduce the use of mains water and water consumption;
- Adopt waterwise landscape design and install water efficient irrigation systems within the station sites;
- Provide for flood protection of critical infrastructure, as the railway must remain operable during major flood events.

During the planning phase of the TCL project, the PTA has consulted with the Department of Water and Environmental Regulation (DWER) Urban Water branch and the Water Corporation with regards to the adoption of WSUD and management of impacts to the UWPCA and associated wellhead protection zones. This consultation will be ongoing through the construction phase of the project and into operations. The pathways for adopting WSUD and protecting the UWPCA on the TCL project are as follows:

1. Develop detailed drainage designs in consultation with the DWER Urban Water branch and in accordance with the following guidelines:
   - Decision process for stormwater management in Western Australia, November 2017 (DWER, 2017).
   - Stormwater Management Manual for Western Australia 2004-07 (DoE, 2004).
   - WSUD brochures published by the DWER (available www.dwer.wa.gov.au).
2. Incorporate the adoption of WSUD into procurement and contractual documentation.
3. Implement the following Water Quality Protection Notes (WQPN) that are of relevance to 'railway' land uses, as identified in DWER's *Land Use Compatibility Tables for Public Drinking Water Source Areas* (DoW, 2016):
   - Contaminant Spills – Emergency Response (DoW, 2006a)
   - Roads Near Sensitive Water Resources (DoW, 2006b)
   - Tanks for Mobile Fuel Storage in Public Drinking Water Source Areas (DoW, 2013)
   - Infrastructure Corridors Near Sensitive Water Resources (DoW, 2007)
4. Incorporate management actions to avoid potential impacts to the groundwater and wellhead protection zones within the Construction Environmental Management Plan (CEMP).
5. Ensure groundwater abstraction bores are located a suitable distance from other groundwater bore users and Water Corporation production bores.
6. PTA to maintain the stormwater management system and landscaping elements during the operational phase.

METRONET will also be providing design guidance for development of the METRONET station precincts. This includes supporting environmentally sustainable urban development and better urban water management practices, along with guidance regarding opportunities to integrate WSUD from the early stages of station precinct design.

2.3.2.7 Dewatering Requirements

The depth to groundwater varies along the TCL (Figure 5). In the absence of Annual Average Maximum Groundwater Level (AAMGL) data for the majority of the TCL, the Maximum Groundwater Level (MGL) sourced from the DWER's Perth Groundwater Map (https://maps.water.wa.gov.au/#/webmap/gwm) have been used by project engineers in conceptual designs of the TCL.

The water table is high / shallow between Beckenham Junction and Hughes Street, Canning Vale. In some sections the MGL is above the design and existing surface level.

The water table is lower / deeper between Hughes Street (Chainage 5900) and Cockburn Central station (Chainage 17500). The predicted MGL is greater than 1.5m below the rail formation and dewatering is unlikely to be required.

Basing the design on MGLs is conservative, as the Perth Groundwater Map dataset does not fully account for the effects of local topography and therefore may potentially over predict levels (higher than actual).

In summary, there is currently no large scale dewatering required for the TCL. The footings associated with the Canning River rail bridge, Elliot Place footbridge and station buildings may require dewatering but this is expected to be localised and of short duration.

2.4 OUTCOMES AND BENEFITS

On commencement of operations on the TCL, over 4,000 people are expected to board trains at Ranford and Nicholson Road stations daily (over 28,000 people weekly). State government forecasts the passenger numbers will be boosted continually as the population grows to the projected 3.5 million people by 2050.

The economic, transport and urban growth benefits of the proposed action are listed below.

2.4.1 Economic Benefits

- Public transport user time and resource savings;
- Increase in PTA fare revenue;
- Reduction in vehicle operating costs;
- Road decongestion benefits;
- Road crash cost savings;
- Externality cost savings (emissions, pollution, noise etc.); and
- Time savings relating to new Perth Stadium trips.

2.4.2 Transport Benefits

- New high-transit rail services and stations along the TCL will provide commuters in service gap areas with quicker and more convenient access to key employment and service centres.

- Workers outside the region will be able to more easily access the Canning Vale industrial estate through better integrated public transport connections, with bus services linking Nicholson Road and Ranford Road stations.
- Ranford Road Station will become an important transport interchange hub, providing the area with a more convenient service and reducing demand at Murdoch Station. The new station and surrounding precinct will improve access into Canning Vale employment area with safe pedestrian and cycle linkages.
- Nicholson Road Station will provide opportunity for the development of an integrated, transit-oriented centre for the Huntingdale, Langford and Canning Vale communities, through a mix of housing, employment and convenience retail.

2.4.3 Urban Growth Benefits

New station precincts at Ranford Road and Nicholson Road will provide longer-term opportunities to intensify land use and capitalise on the station infrastructure investment with new housing choices, decentralised employment opportunities and enhanced community amenity. The TCL is expected to support the growth of the Murdoch Activity Centre (Murdoch), Canning City Centre (Cannington) and Burswood Peninsula (Burswood).

2.5 SUMMARY

A summary of the Proposal is provided in Table D and E.

TABLE D: SUMMARY OF THE PROPOSAL

Summary of the Proposal	
Proposal title	Thornlie to Cockburn Link
Proponent name	Public Transport Authority
Short description	The Proposal includes construction of 14.5 km of new dual railway track within existing railway and road reserves, to extend the existing Thornlie passenger line to Cockburn Central Station along with the duplication of 3 km of single track from Beckenham Junction to Thornlie Station and the relocation of 11 km of freight line within the existing rail reserve. Modifications to existing stations, bridges and roads will be undertaken, and two new stations will be constructed at Ranford Road and Nicholson Road in Canning Vale as well as the construction of a principal shared path.

TABLE E: LOCATION AND PROPOSED EXTENT OF PHYSICAL AND OPERATIONAL ELEMENTS

Element	Location	Proposed Extent
Physical Elements		
14.5 km dual railway track, new bridges, modified bridges and operational areas.	Figures 3.1, 3.2, 3.3 and 3.4.	Clearing of up to 0.55 ha of native vegetation within a development envelope of 119.37 ha.
3 km of duplicated rail from Beckenham Junction to Thornlie Station, modification of Thornlie Station to allow through movement of trains, new bridges and modified bridges.	Figure 3.4	Clearing of up to 18.74 ha of native vegetation within a development envelope of 119.37 ha.
Temporary construction laydown areas within the development envelope but outside the development footprint.	Figures 3.2, 3.3 and 4	Clearing of up to 22.66 ha of native vegetation within a development envelope of 119.37 ha.
New stations	Figures 3.2, 3.3 and 4	Clearing of up to 11.62 ha of native vegetation within a development envelope of 119.37 ha.
New road (portion of Jandakot Eastern Link Road)	Figure 4	Clearing of up to 1.31 ha of native vegetation within a development envelope of 119.37 ha.
Operational Elements		
Noise	Figures 3.1, 3.2, 3.3 and 3.4.	Reduction in noise levels to below existing levels, where reasonable and practicable.
Vibration	Figures 3.1, 3.2, 3.3 and 3.4.	Reduction in vibration levels to below existing levels, where reasonable and practicable.

2.6 TENURE OF THE DEVELOPMENT ENVELOPE

The rail corridor comprises parcels held in fee simple by the PTA, State of WA, WAPC, Water Corporation and Main Roads WA with Crown Land comprising Crown Reserves, Dedicated Public Roads, Unallocated Crown Land and Unallocated Crown Land (formerly Closed Roads). The PTA will acquire additional portions of State owned land for the purposes of drainage, pedestrian bridge, communications, maintenance and operational requirements associated with the TCL. Land required for temporary construction, access for construction and lay down areas will be secured via licence or lease agreements with various Local Governments, more specifically the City of Gosnells and the City of Canning, and State Government Agencies.

The WAPC has purchased the land for Nicholson Road Station. Land at Ranford Road Station is owned by the City of Canning, to be acquired by the PTA for railway purposes.

2.7 LOCAL AND REGIONAL CONTEXT

2.7.1 Planning Context

2.7.1.1 Perth and Peel @ 3.5 million

Regionally the TCL Project, as part of METRONET, follows the intent of the *Perth and Peel @ 3.5 million* planning framework (DPLH, 2018) (https://www.planning.wa.gov.au/10586.aspx) released by the Western Australian government in March 2018. Perth and Peel are expected to experience considerable population growth with a population of 2.9 million expected by 2031 and 3.5 million expected by 2050. The Perth and Peel @ 3.5million strategic suite of documents clearly spells out what our city could look like in the future, how we can maintain our valued lifestyle and how we can realistically accommodate a substantially increased population.

The overarching document builds on the vision laid down in *Directions 2031 and Beyond* and provides a link across the four sub-regional land use planning and infrastructure frameworks that define the Perth and Peel spatial plan for the next 30 years.

The frameworks adhere to the principles detailed in *Directions 2031 and Beyond*. They are recognised under the State Planning Framework (State Planning Policy No.1) and are to be taken into account when preparing and reviewing strategies, policies and plans.

Some 800,000 new homes are required to accommodate the projected population growth to 3.5 million by 2050 and this will be delivered through a mix of infill and greenfield development with targets of 47 per cent and 53 per cent respectively.

2.7.1.2 South Metropolitan Peel Sub-region

The South Metropolitan Peel Sub-regional Planning Framework (the framework) is one of three frameworks prepared for the outer sub-regions of Perth and Peel; North-West, North-East and South Metropolitan Peel (includes the Metropolitan South-West, Metropolitan South-East and Peel Sectors). Combined with the Central Sub-regional Planning Framework, these establish a long-term and integrated framework for land use and infrastructure provision. The frameworks build upon the principles of *Directions 2031 and Beyond* and are key instruments for achieving a more consolidated urban form that will reduce dependence on new urban greenfield developments to accommodate the anticipated population growth by increasing residential density and urban infill development targets.

The South Metropolitan Peel sub-region covers an area of almost 5,000 square kilometres and comprises the cities of Armadale, Cockburn, Gosnells, Kwinana, Mandurah and Rockingham, as well as the shires of Murray, Serpentine–Jarrahdale and Waroona.

The infill development target for the South Metropolitan Peel sub-region is 44,230 dwellings by 2031, and 75,510 dwellings by 2050.

2.7.1.3 Metropolitan Region Scheme

The TCL follows an existing freight rail corridor between Thornlie and the Kwinana Freeway (around South Lake/Jandakot) and is therefore located predominantly within existing railway land, zoned ‘Railways Reserve’ under the Perth Metropolitan Region Scheme. Areas of the development envelope with zoning other than ‘Railways Reserve’ are:

- A portion of the proposed Ranford Road station, located in Canning Vale, will encroach into 'Rural' land.
- The portion of the Jandakot Eastern Link Road proposed to be built as part of the TCL is reserved as 'Other Regional Roads Reserve'.
- A portion of the TCL will encroach into 'Urban' land to the north of the Caladenia Grove Wetland Reserve.
- A portion of the railway reserve is through Bush Forever Site No 245 (Ken Hurst Park).
- Lots 302, 303 and 1008 Ranford Road north of the existing railway reserve are zoned 'Industrial'.
- Lot 500 Ranford Road is zoned 'Rural and Bush Forever area – Site No 388'.
- A portion of land (Lot 8 on Diagram 73520) south of the existing railway reserve and north of Karel Avenue reserved as 'Public Purposes Reserve - Water Catchments'.
- The section of the TCL adjacent to the Mandurah line from the Glen Iris Tunnel to Cockburn Central Station is reserved as 'Primary Regional Roads Reserve'.
- Two sections (on Lot 5 on Plan 16275) north of Hope Road are zoned/reserved 'Rural – Water Protection' and 'Public Purposes – State Energy Commission Reserve'.
- 459 Nicholson Road Canning Vale is zoned 'Urban'.
- Lot 501 on Plan 52412 Thornlie reserved as 'Parks and Recreation Reserve – Bush Forever Area – Site No 456'.
- Along the Canning River, areas reserved as 'Waterway'.
- Two areas to the north and south of Kenwick Link are reserved as 'Primary Regional Roads Reserve'.
- A small portion of road reserve along Cameron Street Thornlie for the new pedestrian bridge zoned as 'Urban'.
- Adjacent to the Canning River areas are reserved as 'Parks and Recreation Reserve – Bush Forever Area – Site No 246'.
- A portion northeast of Kenwick Link is zoned 'Urban'.
- A section where the alignment connects under and to the north of Albany Highway (through a tunnel) is reserved as 'Other Regional Road'.
- A small portion north of Albany Highway, east of Yule Brook, reserved as 'Other Regional Road'.

2.7.2 Transport Context

METRONET is included in the *Perth and Peel @ 3.5 million* planning framework and the Department of Transport's *Transport @ 3.5 Million Perth and Peel Transport Plan*, which sets the vision for a generational change to Perth and Peel's transport network. A key component of transport planning is for Perth to be a connected city with high-quality global and local infrastructure networks including roads, public transport, energy, water, communication and globally competitive, highly accessible airport and sea port infrastructure.

The *Perth and Peel @ 3.5 million* and South Metropolitan Peel Sub-regional Planning Framework outlines a number of road extensions, realignments and / or upgrades as well as the following passenger rail transport plans for the sub-region:

- Extending the Thornlie rail line to Cockburn Central (i.e. this Proposal) – with stations at Nicholson Road and Ranford Road (also forms part of a proposed future Circle Line);
- Extending the Armadale rail line to Byford – with the station being located to integrate with Byford and surrounding localities; and
- An additional station on the Mandurah rail line at Karnup.

Further investigation is required for the following longer term passenger rail infrastructure options:

- Completing a proposed future Circle Line that connects the Joondalup, East Wanneroo/Ellenbrook, Midland, Armadale, Mandurah and Fremantle rail lines – including extending the Forrestfield-Airport rail line to connect to Thornlie rail line and connecting the Thornlie rail line to Fremantle;
- Better integration of the Australind service with the metropolitan passenger rail service between Perth and Mundijong to improve operational efficiency;
- Potential strategic additional southern metropolitan rail line as well as possible further high speed extension to Bunbury in the long term; and
- A long-term contingency station on the Mandurah rail line at Gordon Road.

The TCL is a strategic transport link that will support future growth and accessibility across the South Metropolitan Peel sub-region, while providing a direct opportunity for localised integration at Nicholson Road and Ranford Road stations as discussed in Section 2.2.

It will provide residents in this region with direct access to employment, sporting and recreation opportunities at Canning Vale, Cannington Strategic Metropolitan Centre, Burswood Peninsula and the eastern end of the Perth central business district. The TCL will also encourage contra-flow travel into Cockburn Central, Rockingham and Mandurah.

Ranford Road Station will become an important transport interchange hub, providing the area with a more convenient service and reducing demand at Murdoch Station. A key focus for this station will be improving access into the Canning Vale employment area with safe, comfortable pedestrian and cycle linkages.

Nicholson Road Station provides the opportunity for development of an integrated, transit oriented centre for the Huntingdale, Langford and Canning Vale communities, through a mix of housing, employment and convenience retail.

2.7.3 Environmental Context

The Proposal is located within the Perth Metropolitan Region (Figure 1) on the Swan Coastal Plain. Elements of the Proposal are within four Local Government Areas; Cockburn, Canning, Melville and Gosnells, and pass over the Canning River through the Swan River Trust Development Control Area administered by the Department of Biodiversity, Conservation and Attractions (DBCA) (Figure 3.4).

Regional elevation ranges from approximately 40m Australian Height Datum (AHD) in the west to around 10m AHD prior to Canning River, where the elevation is approximately 3m AHD. The region is characterised by a Mediterranean climate with mild wet winters and hot dry summers. Typically, strong

offshore breezes occur during the daytime followed by corresponding onshore breezes as the land cools during the evening.

The majority of the development envelope comprises Bassendean Sands described as white to pale grey at surface, yellow at depth. Sands are likely to be greater than 30m deep and overlie the Guildford Formation, described as sandy silty pale brown clay. In places limestone may be present at depth (Jordan, 1986). Sands are highly permeable. Pockets of peaty sand and peat-rich sand intersect the development envelope. Around the Canning River the geology is Guildford Formation. The section between the Canning River and Beckenham Junction is sandy clay, clay and Bassendean Sands.

Soil-landscape mapping of the South West of Western Australia (DAFWA, 2007) indicates the Proposal sits within the Pinjarra Zone, Bassendean Zone and just into the Spearwood Dunes of the Perth Coastal Zone. Acid sulfate soils (ASS) mapping indicates the Proposal is located within high and moderate risk areas.

The Proposal is located within the Jandakot and Perth proclaimed groundwater areas, and within multiple subareas; South Lakes, Airport, City of Canning, City of Melville, City of Cockburn and City of Gosnells.

The Proposal is situated in the South West Botanical Province of Western Australia (Beard, 1990) within the Interim Biogeographic Region of Australia (IBRA) Swan Coastal Plain (SWA) bioregion and the Perth (SWA2) subregion (Environment Australia, 2000). The SWA bioregion is a low lying coastal plain, mainly covered with woodlands. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

Regional vegetation mapped by Heddle et al. (1980) based on major geomorphic units on the SWA indicates two vegetation complexes on Aeolian deposits of the SWA and two vegetation complexes of fluviatile deposits of the SWA are present within the survey area:

- Southern River Complex: Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *E. rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds (system6 42 on Aeolian deposits).
- Bassendean Complex-Central and South: Vegetation ranges from woodland of *E. marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - *Banksia* species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *E. marginata* (Jarrah) to *E. todtiana* (Pricklybark) in the vicinity of Perth (system6 44 on Aeolian deposits).
- Guildford Complex: A mixture of open forest to tall open forest of *C. calophylla* (Marri) – *E. wandoo* (Wandoo) – *E. marginata* (Jarrah) and woodland of *E. wandoo* (Wandoo) (with rare occurrences of *E. lane-poolei* (Salmon White Gum)). Minor components include *E. rudis* (Flooded Gum) – *M. rhaphiophylla* (Swamp Paperbark) (system6 32 on fluviatile deposits).
- Swan Complex: Fringing woodland of *E. rudis* (Flooded Gum) – *M. rhaphiophylla* (Swamp Paperbark) with localised occurrence of low open forest of *Casuarina obesa* (Swamp Sheoak) and *M. cuticularis* (Saltwater Paperbark) (system6 33 fluviatile deposits).

No Commonwealth, National or World or State heritage listed places are within or adjacent to the Proposal.

Key environmental features close to the Proposal are:

- Noise measurements of the existing freight operations have been undertaken and SLR (2018) has identified 707 residential noise sensitive premises currently subject to noise emissions from the existing freight railway. Of these premises 75% currently receive noise emissions from the freight railway which are above State Planning Policy target levels.
- The existing ground borne vibration (GBV) levels and ground borne noise (GBN) levels generated by the existing freight operations are 10-20 dB above recommended Australian Standard trigger levels.
- The Proposal is located in the vicinity of the Jandakot Mound, a source of Perth's drinking water supply. Within the Jandakot Mound is an area defined as the 'Underground Water Pollution Control Area' (UWPCA). The section of TCL between the Kwinana Freeway and Jandakot is within the UWPCA and traverses Priority 1, Priority 2 and Priority 3 designated areas (Figure 6).
- The Canning River is a major surface water receptor intersected by the Proposal and an Environmentally Sensitive Area protected under the EP Act. The Canning River is also a registered aboriginal heritage site (ID: 3538, mythological site, Figure 3.4).
- Within the development envelope, five wetlands confirmed by GHD (2018) as comprising dampland vegetation will be affected by the TCL construction and operation. This comprises:
    - One conservation category wetland (CCW) (Unique Feature Identifier (UFI): 7446) located at Tom Bateman Reserve (Figure 3.3).
    - Three resource enhancement wetlands (REW) located south of the proposed Ranford Road station (UFI:13332, Figure 3.2), the Canning River (UFI: 7447, Figure 3.4) and 100m north of the Canning River (UFI: 15926, Figure 3.4).
    - One multiple use wetland (MUW) (UFI: 13621) located in the City of Gosnells near the proposed Nicholson Road station and Tom Bateman Reserve (Figure 3.3).
- The development envelope will intersect portions of four Bush Forever Sites protected under the EP Act:
    - Canning River and Southern River Bush Forever Site (No. 246).
    - Tom Bateman Reserve / Nicholson Road Bushland Bush Forever Site (No. 456).
    - Ken Hurst Park Bush Forever Site (No. 245).
    - Jandakot Airport Bush Forever Site (No. 388).

3 STAKEHOLDER ENGAGEMENT

3.1 KEY STAKEHOLDERS

The following have been identified as key stakeholders for the Proposal:

- Federal Government:
  - Minister for Environment and Energy and DoEE.
- State Government:
  - Minister for Transport, Planning and Lands
  - Minister for Environment and Disability Services
  - Minister for Finance, Energy, Aboriginal Affairs and Treasurer
  - Members for Southern River and Jandakot
- State Government Agencies:
  - EPA
  - Department of Water and Environmental Regulation (DWER)
  - DBCA
  - Department of Planning, Lands and Heritage (DPLH)
- Local Government:
  - City of Gosnells
  - City of Canning
  - City of Cockburn
  - City of Melville
- Industry:
  - Arc Infrastructure
  - ATCO Gas
  - APA Group
  - BP
  - Water Corporation
  - Western Power
- Traditional Owners / Representatives:
  - South West Aboriginal Land and Sea Council (SWALSC)
  - Whadjuk Working Party
- Community:
  - Freight and Logistics Council

- Wildflower Society of WA
- Urban Bushland Council WA Inc.
- Friends of Ken Hurst Park
- Adjoining residents

3.2 STAKEHOLDER ENGAGEMENT PROCESS

A Communications and Stakeholder Engagement Plan has been developed by the PTA to guide the community relations activities for the various phases (i.e. planning, design and procurement; and Construction and commissioning) of the TCL Project.

The Communications and Stakeholder Engagement Plan's community relations activities include:

- Identifying and resolving issues that affect stakeholders, residents, businesses and other community members, and managing their information needs;
- Issuing communication to stakeholders;
- Establishing and maintaining relationships with local community groups, residents, businesses, local governments and other stakeholders where relevant;
- Identifying and responding to local issues, including preparation of, and contribution to, communication strategies to address issues;
- Responding to email, telephone and general inquiries from the public and stakeholders, including directing enquiries to relevant project staff and ensuring timely responses;
- Managing complaints and claims;
- Liaising with relevant PTA project managers and contractor project managers on issue close-outs and residual community matters; and
- Managing the PTA's database of stakeholders.

Further, a dedicated METRONET website has been established. In addition to providing a detailed overview of the TCL Project, this allows interested parties to inquire about METRONET through a dedicated email address and register for project updates.

3.3 STAKEHOLDER CONSULTATION

To inform preliminary planning for the TCL Project and confirm its development footprint, PTA has consulted extensively with key stakeholders. Table F identifies the key government and community stakeholders consulted for the TCL project.

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
Federal Government				
Minister for Environment and Energy	Granting of Approval under *EPBC Act 1999*	No consultation conducted to date.		
DoEE	• Regulator of the *EPBC Act 1999* • Decision Making Authority (DMA)	8 December 2017 / Meeting 13/04/2018	An initial briefing on METRONET and the TCL was provided. Project referred to the Commonwealth under the EPBC Act.	The key outcomes from the meeting were that: • The PTA will refer the TCL Project to the EPA and DoEE with a request to trigger an accredited assessment. • The MNES that will potentially impacted by the TCL Project include: Threatened Species and Ecological Communities – Caladenia huegelii, Black Cockatoo habitat (foraging and potential breeding) and Banksia Woodlands of the Swan Coastal Plain TEC. Discussions during the meeting influenced the design of the TCL and information included in the EPBC referral.
Politicians				
Minister for Transport, Planning and Lands Honourable Rita Saffioti	Minister responsible for the delivery of METRONET projects.	2 August 2017 / Community Information Session	The Minister jointly hosted a presentation to the public on the TCL Project.	Presentation and Q&A session were well received with eight feedback forms submitted with follow-up queries. These queries were responded to directly by the METRONET Office.
Minister for Environment and Disability Services Honourable Stephen Dawson	Granting of Ministerial Statement	No consultation conducted to date.		

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
Minister for Finance, Energy, Aboriginal Affairs and Treasurer Honourable Ben Wyatt	Granting of Section 18 Approval under the *Aboriginal Heritage Act 1972*.	12 February 2018 / Letter	Consent pursuant to Section 18(3) for impacts to Sites ID 3536 (Swan River) and ID 3538 (Canning River) for the purpose of Canning River Railway Bridge	Consent and conditions noted.
Member for Southern River Terry Healy	TCL is within the Member's electorate.	2 August 2017 / Community Information Session	The Member jointly hosted a presentation to the public on the TCL Project.	Presentation and Q&A session were well received with eight feedback forms submitted with follow-up queries. These queries were responded to directly by the METRONET Office.
Member for Jandakot Yaz Mubarakai	TCL is within the Member's electorate.	2 August 2017 / Community Information Session	The Member jointly hosted a presentation to the public on the TCL Project.	Presentation and Q&A session were well received with eight feedback forms submitted with follow-up queries. These queries were responded to directly by the METRONET Office.
State Government				
EPA represented by the Chairman	• Regulator of Part IV of the EP Act	4 September 2017 / Meeting	An initial briefing on METRONET was provided.	Discussions during the meeting influenced the design of the TCL and information included in this Supplementary Environmental Report.
DWER including the EPA Services Unit	• Regulator of Part V of the EP Act • Regulator of the *Rights in Water Irrigation Act 1914* • Regulator of the *Environmental Protection (Noise) Regulations 1997* • DMA • Provide advice on our opportunities/restrictions for groundwater	4 September 2017 / Meeting		
		8 December 2017 / Meeting	An update on the TCL Project was provided.	Discussions during the meeting influenced the design of the TCL and information included in this Supplementary Environmental Report.
		20 February 2018 / Meeting	A pre-referral meeting was held to discuss updates to the TCL Project. Specific information was requested on: • Potential impacts to the Canning River floodway and flood fringe. • Jandakot UWPCA and priority	Discussions during the meeting influenced the design of the TCL and information included in this Supplementary Environmental Report.

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
	abstraction and Water Sensitive Urban Design		areas. • Details to be included in a Construction Environmental Management Plan. • Management of groundwater and surface water impacts. • Mitigation measures.	
DWER (Water Source Protection Planning Branch)		11 January 2018 / Meeting	Discussions on the TCL Project, and possible interactions with the Jandakot UWPCA and priority areas.	Advice and guidance incorporated into TCL planning, and included in this Supplementary Environmental Report.
		7 March 2018 / Email	Follow-up of previous meeting's actions, and provision of general advice for the Jandakot UWPCA and priority areas.	
DWER (Floodplain Management Branch)		22 March 2018 / Email	Advice and guidance provided on development on floodplains with the objective of minimising flood risk and damage.	
DWER (Urban Water Branch)		Ongoing	Advice and guidance being provided for incorporation of Water Sensitive Urban Design initiatives.	Advice and guidance to be incorporated into TCL detailed design phase.
DWER (Noise Branch)		27 March 2018 / Letter	Technical Expert Report titled Review of Draft Noise and Vibration Assessment Reports: METRONET – Yanchep Rail Extension and Thornlie-Cockburn Link.	Advice and guidance incorporated into TCL planning and TCL Noise and Vibration Assessment Report, and to be incorporated into TCL detailed design phase.
DBCA	• Regulator of wetlands and Swan River Trust Development Control	28 December 2017 / Meeting	Discussion of activities to be performed within the Swan River Trust Development Control Area and	Advice and guidance incorporated into TCL planning, and included in this Supplementary Environmental Report.

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
	Area • DMA • Establishment of appropriate offsets.		likely approvals required.	
		16 February 2018 / Meeting	Discussion of offsets package for residual significant impacts of the TCL.	Discussions during the meeting influenced the preparation of a suitable offsets package.
DPLH	• Regulator of *Land Administration Act 1997* • DMA	6 February 2018 / Meeting	Discussion regarding status of environmental approvals and offsets for the Jandakot Eastern Link Road.	Discussions during the meeting incorporated into TCL planning, and included in this Supplementary Environmental Report.
Local Government				
Gosnells Canning Cockburn Melville	• Regulator of the *Planning and Development Act 2005* • TCL within the City's jurisdiction.	Ongoing	Discussion regarding TCL interface with Local Government land.	Considered to be positive engagement.
Industry				
Arc Infrastructure ATCO Gas APA Group BP Western Power Water Corporation	Interface of TCL Project with assets located within or adjacent to the development envelope.	Ongoing	Discussions regarding TCL interface with assets.	Considered to be positive engagement.
	Provide advice on wellhead protection zones.	11 January 2018 / Meeting	Discussions on the TCL Project, and possible interactions with Water Corporation existing or proposed bores and/or wellhead protection zones.	Advice and guidance incorporated into TCL planning, and included in this Supplementary Environmental Report.

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
Traditional Owners				
SWALSC and Whadjuk people	TCL crosses Aboriginal heritage site.	18 September 2017 and 4 October 2017 / Consultation and inspection of the development envelope.	Whadjuk representatives have given their conditional approval, indicating that disturbance to aboriginal heritage sites will be minimal and that the proposed action will be beneficial to the general community.	Considered to be positive engagement.
Community				
Freight and Logistics Council	TCL adjacent to Midland to Kwinana freight line.	31 August 2017 / Presentation	Thornlie-Cockburn Link interface with freight. No issues raised.	Considered to be positive engagement.
Urban Bushland Council WA Inc	Interest in Bush Forever sites.	7 December 2017 / Meeting	Discussion on the TCL Project.	Expressed concern but were appreciative of early consultation.
		14 February 2018 / Meeting	The group identified that there is very sensitive vegetation in the area, and that the project will definitely have public interest and should be formally assessed by the EPA. Queries were raised around the low density nature of housing in this area, what is the rationale for this project.	PTA response was the area is currently under serviced by public transport, and would take pressure off the roads and the Mandurah railway line. The PTA is committed to undertaking additional consultation with the Urban Bushland Council to inform detailed design for the TCL project.
Friends of Ken Hurst Park represented by three members (including member of the Wildflower Society of WA).	TCL adjacent to Ken Hurst Park	7 February 2018 / Meeting	Discussion on the TCL Project. The group's key concerns included potential impacts on their vehicle access to the park, the management of indirect impacts associated with dieback and construction activities, and the fragmentation of the park through the installation of secure fencing alongside the railway. Note: Eddy Wajon also a member of the Wildflower Society of WA.	The PTA will ensure that access to Ken Hurst Park is not impacted by the TCL Project. The PTA also agreed to have ongoing consultation with the group during the EPA referral process and construction phase.

TABLE F: STAKEHOLDER CONSULTATION

Stakeholder	Project Role / Interest	Date / Form	Issues/Topics Raised	Proponent Response/Outcome
Adjoining residents	TCL adjacent to residents' properties (i.e. sharing a boundary with the rail reserve).	21 November 2017 / Letter	Invite to attend a noise and vibration community workshop.	Owners of 41 properties registered to attend.
		2 December 2017 / Community workshop	Noise/vibration early mitigation recommendations.	65 property owners attended representing 37 properties. Concerns were raised around existing noise and vibration, construction and proposed train operations. Overall the groups were supportive of early recommendations for noise and vibration mitigation measures. A full description of the consultation is provided in the SLR (2018) report.
		5 December 2017 / Community workshop	Noise/vibration early mitigation recommendations.	
		6 December 2017 / Email	Follow-up email to reissue survey form to 65 property owners whom attended the workshops.	13 survey forms completed and returned (including the ones from the workshops). Queries raised in feedback forms were responded to directly by the METRONET Office.
		22 December 2017 / Email	Second follow-up email to reissue survey form to 65 property owners whom attended the workshops.	
		22 December 2017 / Letter	Letter sent via registered post to property owners whom did not attend the community workshop. 143 property owners share a rail reserve boundary.	27 survey forms completed and returned. As per the workshop, concerns were raised about the project, however there was general support for the project and mitigation measures proposed. Queries raised in feedback forms were responded to directly by the METRONET Office.

4 ENVIRONMENTAL INVESTIGATIONS

PTA commissioned a number of technical studies to define the environmental attributes of the development envelope and its surrounds (Table G).

TABLE G: SUMMARY OF TECHNICAL STUDIES COMPLETED FOR THE TCL

Environmental Factor	Report Title	Date	Author	Key Assessment Standards	Description	Appendix
Flora and Vegetation and Terrestrial Fauna	Thornlie–Cockburn Link Project Flora and Fauna Survey	March 2018	GHD	Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b). Technical Guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment (EPA, 2016c). EPBC Act Referral Guidelines for Three Black Cockatoo Species (DSEWPaC, 2012).	Describes the flora, vegetation and fauna values of the survey area. Includes a desktop review and results of field surveys: • Detailed flora and vegetation survey conducted between 6 to 8 September 2017, 6 October 2017, 14 February 2018 and 1 March 2018. • Targeted survey for *Caladenia huegelii* conducted on 6 October 2017. • Level 1 fauna survey conducted between 6 to 8 September 2017 and 14 February 2018. • Targeted Black Cockatoo assessment conducted between 6 to 8 September 2017 and on 14 February 2018. • Dampland vegetation assessment of Geomorphic Wetlands of the Swan Coastal Plain conducted on 14 February 2018.	2
	Thornlie Extension Environmental Assessment	September 2013	GHD	Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004a) Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002).	The scope and purpose of this report is to provide an assessment of potential environmental constraints associated with the proposed extension of the Thornlie spur line including the construction of two new train stations, drainage infrastructure and duplication of the existing bridge over the Canning River. The environmental assessment was based on a review of available desktop information, including published literature, government databases and other publicly available data sources, in addition to the findings of Level 1 flora and fauna surveys (undertaken between 24 and 27 September 2012) of five targeted investigation areas within the Project area.	3
Terrestrial Environmental Quality	Lots 302, 303 and 500 Ranford Road, Canning Vale Preliminary Site Investigation	June 2016	GHD	Contaminated Sites Guidelines: Assessment and management of contaminated sites (DER, 2014). National Environment Protection (Assessment of Site Contamination) Measure, as amended 2013 (NEPC, 1999). Contaminated Sites Ground and Surface Water Chemical Screening Guidelines (DoH, 2014). Assessing risks posed by hazardous ground gases to buildings C665 (Construction Industry Research and Information Association (CIRIA), 2007)). Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2011). Guidelines for the Assessment and Management of Hazardous Ground Gases NSW EPA, 2012) BS 8576 Guidance on investigation for ground gas –Permanent gases and Volatile Organic Compounds (VOCs) (British Standards Institution, 2013). Petroleum Products in Drinking Water (WHO, 2008).	This report describes the work undertaken on the former landfill located at the proposed site for the Ranford Road station: • Preliminary Site Investigation including desktop assessment, site inspection and preliminary conceptual site model. • Sampling and analysis plan for a limited investigation. • Soil sampling and results from four test pits. • Installation of four groundwater monitoring wells and four ground gas monitoring wells. • Groundwater sampling and results from four groundwater monitoring wells. • Landfill gas monitoring and results from four ground gas monitoring wells.	4
	Ranford Road METRONET Sampling and Analysis Plan for	October 2017	GHD	Contaminated Sites Guidelines: Assessment and management of contaminated sites (DER,	This report was prepared to address data gaps from the Preliminary Site Investigation (GHD, 2016) and guide field investigations during the Detailed Site Investigation of Lots 302, 303 and	5

TABLE G: SUMMARY OF TECHNICAL STUDIES COMPLETED FOR THE TCL

Environmental Factor	Report Title	Date	Author	Key Assessment Standards	Description	Appendix
	Detailed Site Investigation			2014). Assessing risks posed by hazardous ground gases to buildings C665 (CIRIA, 2007). Interim guideline on the assessment and management of perfluoroalkyl and polyfluoroalkyl substances (DER, 2014). Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Site in Western Australia (DoH, 2009). National Environment Protection (Assessment of Site Contamination) Measure, as amended 2013 (NEPC, 1999). Draft Landfill Gas Fugitive Emissions Monitoring Guidelines (EPA Victoria, 2011). Best Practice Environmental Management – Siting, Design, Operation and Rehabilitation of Landfills (EPA Victoria, 2010). Guidelines for the Assessment and Management of Hazardous Ground Gases NSW EPA, 2012).	500 Ranford Road, Canning Vale.	
Social Surroundings	Thornlie–Cockburn Link Noise and Vibration Assessment	15 January 2018	SLR Consulting Australia Pty Ltd	State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC, 2009).	This report describes: • Airborne noise modelling prediction and assessment • Ground–borne vibration (GBV) prediction and assessment • Ground–borne noise (GBN) prediction and mitigation/control • Existing noise and vibration environment, and existing rail traffic noise and vibration emissions.	6
	Noise and Vibration Management Plan Thornlie–Cockburn Link Transport Corridor Rail Operations	16 April 2018	SLR Consulting Australia Pty Ltd		This report describes: • PTA's management commitments for airborne noise, GBV and GBN. • Noise and vibration monitoring methodology and assessment criteria. • Complaint handling procedure. • Corrective actions.	7
	Aboriginal Heritage Survey	September 2017	R. O'Connor	Aboriginal Heritage Procedures Manual (Department of Indigenous Affairs, 2002). Aboriginal Heritage Due Diligence Guidelines (Department of Aboriginal Affairs, 2013).	This report describes the aboriginal heritage survey. The survey methodology undertaken was: • examination of existing aboriginal heritage sites database. • On-site inspection of areas of proposed works by the anthropologist to decide upon a suitable venue for the initial survey meeting. • consultation with Whadjuk representatives nominated by SWALSC after consideration of the Activity Notice. • inspection of areas of proposed works by nominated Whadjuk representatives.	8
	Addendum to report on Thornlie-Cockburn Link, Aboriginal Heritage Survey	October 2017	R. O'Connor	Aboriginal Heritage Due Diligence Guidelines (Department of Aboriginal Affairs, 2013).	A second inspection as requested by Whadjuk representatives was undertaken on 4 October 2017 of the proposed Nicholson Road Station site and the northern bank of the Canning River. This addendum report details the methodology, execution and results of that additional consultative process and Aboriginal heritage survey.	9

5 ENVIRONMENTAL PRINCIPLES AND FACTORS

5.1 PRINCIPLES

Table H lists how each of the principles for environmental management outlined in Section 4a of the EP Act has been considered for the Proposal.

TABLE H: ENVIRONMENTAL PRINCIPLES

Principle	Consideration
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 the application of the precautionary principle, decisions should be guided by:* *(a) Careful evaluation to avoid, where practicable, serious or irreversible damages to the environment; and* *(b) An assessment of the risk-weighted consequences of various options.*	Throughout the design of the Proposal, the precautionary principle has been applied, where potential impacts could cause serious or irreversible damage. For example, the proposed location for the TCL has taken into account potential *Caladenia huegelii* habitat, and where possible these areas have been avoided to reduce impacts on this Threatened species. An example is avoidance of Caladenia Grove Wetland Reserve (Reserve 48617, Figure 3.2 and 4), an area previously included in the development envelope but known as a location of 14 previous records of *C. huegelii*. All of this Reserve was removed from the development envelope. Therefore, direct loss of *C. huegelii* plants in the Caladenia Grove Wetland Reserve is unlikely as a result of the Proposal. Furthermore, another example of careful evaluation to avoid, where practicable, serious or irreversible damages to the environment was the modification of the location and extent of the development envelope in relation to TECs. PTA has managed to: • completely avoid one TEC patch (Patch 2 on Figure 7.1 and 7.2). • avoid 99% of one TEC patch (Patch 4 on Figure 7.2). • avoid 92% of 'Excellent' TEC (Patch 1 on Figure 7.1). Through the re-design of the TCL development envelope it is now planned to avoid 74% of the surveyed *Banksia* Woodlands of the Swan Coastal Plain TEC (initially 11.15 ha was to be cleared and through avoidance and minimisation of impacts by PTA this has been revised to 2.85 ha). A total of 2.81 ha of this ecological community is known to be in Degraded condition or better. A further 0.04 ha was not surveyed as it was not accessible at the time of the survey and the condition is unknown.
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.*	PTA recognises the importance of sustainable development and considers that this project will contribute positively to current and future health and environment outcomes, with a net benefit in terms of greenhouse emissions as more people opt to use the TCL in place of using private vehicles. Implementation of the Proposal will provide benefits for future generations and will not have a negative impact on health, diversity or productivity. The project will improve accessibility for a range of people. In terms of intergenerational equity, this Proposal is aimed towards achieving an efficient transport system by 2050, so

TABLE H: ENVIRONMENTAL PRINCIPLES

Principle	Consideration
	the increasing population will experience less road traffic congestion.
The Principle of the Conservation of Biological Diversity and Ecological Integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	Site specific studies have been sourced or undertaken to determine the presence of Threatened and Priority flora, fauna and ecological communities. The Proposal will not substantially reduce the extent of any vegetation type or habitat on the Swan Coastal Plain.
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 of 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.*	PTA recognises and accepts the costs of managing and monitoring the outcomes of the project, which have been factored into the feasibility of the project. When goods and services are procured during the construction and operational phases of the project, decisions will be made which incorporate valuation, pricing and incentive mechanisms.
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.*	The Contractor will be required as part of the Construction Environmental Management Plan to take all reasonable and practicable measure to reduce waste generation and disposal of construction wastes appropriately. It is expected that wastes will be minimised through adoption of the hierarchy of waste controls; avoid, minimise, recycle and safe disposal.

5.2 KEY ENVIRONMENTAL FACTORS

The PTA and Aurora completed an assessment of all environmental factors and an environmental risk assessment during initial planning phases of the TCL Project. The assessments were informed by a number of technical studies as listed in Table G. On the basis of both assessments, the key environmental factors are considered to be:

- Flora and Vegetation.
- Terrestrial Fauna.
- Terrestrial Environmental Quality.
- Hydrological Processes.
- Inland Waters Environmental Quality.
- Social Surroundings.

Sections 6.0 to 11.0 describe the environmental impact assessment for each factor listed above. Each section identifies the EPA's objective for the environmental factor, details the receiving environment, identifies potential impacts that may occur, provides an assessment of the potential impacts, proposes mitigation strategies that will be used to minimise the identified impacts and provides a description of the predicted outcome.

For context the nomenclature referred to in the following sections is:

Survey area: Refers to the area surveyed by GHD in multiple flora and fauna surveys. This area was 147.23 ha.

Development envelope: The development envelope incorporates the permanent footprint of the TCL and construction access and laydown areas. This area encompasses 119.37 ha.

Development footprint: The development footprint is the likely extent of the permanent railway corridor for the TCL once constructed. This area encompasses 95.67 ha.

For the purposes of this referral, it has been assumed that clearing of the entire development envelope will occur. This represents a worse-case scenario. Potential impacts may be less than this once detailed design investigations have been completed. This approach offers flexibility in the detailed design phase where minor modifications to the development footprint may be required.

6 FLORA AND VEGETATION

6.1 EPA OBJECTIVE

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

6.2 POLICY AND GUIDANCE

- *EPBC Act 1999*
- *WC Act 1950 / Biodiversity Conservation Act 2016*
- Environmental Factor Guideline – Flora and Vegetation (EPA, 2016d)
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a).
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (WAPC, 2010).

6.3 ENVIRONMENTAL INVESTIGATION

The following environmental investigations were undertaken to assess the flora and vegetation values of the development envelope:

- Thornlie–Cockburn Link Project Flora and Fauna Survey (GHD, 2018)
- Thornlie Extension Environmental Assessment (GHD, 2013)

Table G provides a brief description of each of these investigations and identifies the assessment standards used to inform the scope and content of the individual investigations. Flora values of the development envelope are shown in Figures 8.1, 8.2, 8.3 and 8.4.

6.4 RECEIVING ENVIRONMENT

6.4.1 Regional Biogeography

The development envelope is situated in the South West Botanical Province of WA (Beard, 1990) within the SWA bioregion and the Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (DoEE, 2017).

The SWA bioregion is a low lying coastal plain, mainly covered with woodlands. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

6.4.2 Broad Vegetation Mapping and Extents

Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. The mapping indicates that two vegetation associations intersect the survey area:

- Medium woodland; Jarrah, Marri and Wandoo (Association 968)
- Medium very sparse woodland; Jarrah, with low woodland; *Banksia* and Casuarina (Association 1001).

The pre-European mapping has been adapted and digitised by Shepherd et al. (2002). The extent of the vegetation associations has been determined by the statewide vegetation remaining extent calculations maintained by DBCA (latest update February 2018, Government of Western Australia, 2018). The current extent of Vegetation Association 968 is less than 30 % of its pre-European extent at the IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels, and the current extent of Vegetation Association 1001 is less than 30 % of its pre-European extents at all levels (State, IBRA bioregion, IBRA subregion and LGA).

Regional vegetation mapped by Heddle et al. (1980) based on major geomorphic units on the SWA indicates two vegetation complexes on Aeolian deposits of the SWA and two vegetation complexes of fluviatile deposits of the SWA are present within the survey area:

- Southern River Complex: Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *E. rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds (System 6 42 on Aeolian deposits);
- Bassendean Complex–Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - *Banksia* species to low woodland of Melaleuca species, and sedgelands on the moister sites. This area includes the transition of *E. marginata* (Jarrah) to *E. todtiana* (Pricklybark) in the vicinity of Perth (System 6 44 on Aeolian deposits);
- Guildford Complex: A mixture of open forest to tall open forest of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) – *E. marginata* (Jarrah) and woodland of *E. wandoo* (Wandoo) (with rare occurrences of *E. lane-poolei* (Salmon White Gum)). Minor components include *E. rudis* (Flooded Gum) – *Melaleuca rhaphiophylla* (Swamp Paperbark) (System 6 32 on fluviatile deposits);
- Swan Complex: Fringing woodland of *Eucalyptus rudis* (Flooded Gum) – *Melaleuca rhaphiophylla* (Swamp Paperbark) with localised occurrence of low open forest of *Casuarina obesa* (Swamp Sheoak) and *M. cuticularis* (Saltwater Paperbark) (System 6 33 fluviatile deposits).

The DBCA has assessed the vegetation complexes mapped by Heddle et al. (1980) against presumed pre-European extents within the SWA IBRA bioregion and the Cities of Canning, Cockburn, Gosnells and Melville respectively. All vegetation complexes have less than 30% of their pre-European extents remaining within the SWA IBRA bioregion and in their LGA. Across the SWA IBRA bioregion all vegetation complexes have greater than 10% remaining, except the Guildford Complex (5.01% remaining). Less than 10% of the pre-European extent remains of some vegetation complexes within three of the four LGAs:

- City of Gosnells – (Guildford Complex) 8.42%
- City of Canning – (Bassendean Complex – Central and South) 5.54%
- City of Melville – (Bassendean Complex – Central and South) 7.84%

6.4.2.1 Vegetation Types

GHD (2018) identified 76.25 ha (approximately 50%) of the survey area (147.23 ha[1]) contained small areas of scattered remnant bushland. However, the remaining 70.94 ha (approximately 50%) of the survey area has been cleared and modified by infrastructure and weed invasion (Table I).

Seven of the nine surveyed vegetation types occur within the development envelope and development footprint (Table I) (Figures 9.1 to 9.9).

TABLE I: VEGETATION TYPES WITHIN THE SURVEY AREA, DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Vegetation Type	Description	Extent in Survey Area (ha)	Extent in Development Envelope (ha)	Extent in Development Footprint (ha)
Banksia menziesii and B attenuata woodland (VT01)	Occasional *Eucalyptus todtiana/ Nuytsia floribunda/ Banksia illicifolia* woodland *B. menziesii B attenuata* sparse shrubland *Xanthorrhoea preissii* diverse heathland	6.00	3.76	3.76
Regelia inops Hypocalymma angustifolium shrubland (VT02)	Isolated trees of *Melaleuca preissiana/ Banksia ilicifolia/ B. littoralis* shrubland *Regelia inops Hypocalymma angustifolium* closed herbland *Phlebocarya ciliatum Dasypogon bromeliifolius*	4.43	0.01	0.01
Banksia spp. isolated trees Regelia inops Hypocalymma angustifolium shrubland (VT02a)	Isolated clumps of trees *B. attenuata/ B. ilicifolia/ B.* shrubland *Regelia inops Hypocalymma angustifolium* closed herbland *Phlebocarya ciliatum Dasypogon bromeliifolius*	1.42	0.62	0.62
Melaleuca preissiana M. rhaphiophylla open woodland (VT03)	*Melaleuca preissiana M. rhaphiophylla* open woodland isolated clumps *Juncus pallidus* closed grassland **Cynodon dactylon *Cenchrus clandestinus*	2.94	2.94	0
Adenanthos cygnorum shrubland (VT04)	Isolated clumps of trees *Corymbia calophylla Eucalyptus todtiana* sparse shrubland *Adenanthos cygnorum sparse grassland *Cenchrus setaceus*	3.91	2.98	2.80
Eucalyptus rudis Melaleuca rhaphiophylla open forest (VT05)	*Eucalyptus rudis Melaleuca rhaphiophylla* open forest introduced herbland/ grassland	1.06	1.05	0.06
Scattered natives amongst weeds (VT06)	Isolated trees *Corymbia calophylla/ Eucalyptus rudis/ E. todtiana/ E. gomphocephala/ *Eucalyptus* spp. introduced herbland/ grassland	26.13	20.21	16.80

[1] The total survey area within Table I differs from this number as the areas have been generated from the associated shapefiles. This slight difference in totals is associated with rounding the various areas within the overall survey area to two decimal places, rather than an error in the numbers or mapping.

TABLE I: VEGETATION TYPES WITHIN THE SURVEY AREA, DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Vegetation Type	Description	Extent in Survey Area (ha)	Extent in Development Envelope (ha)	Extent in Development Footprint (ha)
Grassland/ Herbland (VT07)	Weedy closed grassland/ herbland with occasional natives	23.21	23.20	8.13
Corymbia calophylla open woodland (VT08)	*Corymbia calophylla* open woodland *Jacksonia furcellata Acacia pulchella* sparse mid shrubland *Phlebocarya ciliatum Dasypogon bromeliifolius* herbland	1.14	0.07	0
Melaleuca rhaphiophylla woodland (VT09)	*Melaleuca rhaphiophylla Eucalyptus rudis woodland Lepidosperma longitudinale Juncus pallidus open sedgeland Centella asiatica closed herbland*	0.40	0	0
Cleared / railway		70.94	64.49	63.45
Not surveyed but inferred to be VT01		5.61	0.04	0.04
	TOTAL AREA	**147.19**	**119.37**	**95.67**

Vegetation condition was mapped as Degraded-Completely Degraded or Cleared in the majority (87%) of the survey area, with a 1.25 ha patch of VT01: *Banksia* Woodland rated as Excellent (Table J).The majority of the vegetation within the development envelope and footprint is Degraded-Completely Degraded or Cleared (93%) (Table J). Vegetation condition within the development envelope is shown on Figures 10.1 to 10.9.

TABLE J: VEGETATION CONDITION IN THE SURVEY AREA, DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Condition	Extent in Survey Area (ha)	Extent in Development Envelope (ha)	Extent in Development Footprint (ha)
Excellent	1.25	0.10	0.10
Very Good	3.07	0.03	0.03
Good	5.57	3.19	3.17
Good - Degraded	3.68	2.63	1.63
Degraded	3.92	2.10	2.09
Degraded - Completely Degraded	53.16	46.80	25.17
Cleared / railway	70.97	64.48	63.44
Not surveyed	5.61	0.04	0.04
TOTAL AREA	**147.23**[2]	**119.37**	**95.67**

[2] The total survey area within Table J has been generated from the associated shapefiles. This slight difference in totals is associated with rounding the various areas within the overall survey area to two decimal places, rather than an error in the numbers or mapping.

6.4.3 Bush Forever Sites

The development envelope intersects portions of four Bush Forever Sites. A description of each Bush Forever Site is listed in Table K. The vegetation type and condition of each Bush Forever site is shown in Figures 11.1 to 11.8.

TABLE K: BUSH FOREVER SITES INTERSECTED BY THE DEVELOPMENT ENVELOPE

Bush Forever Site[3]	Landform Element[3]	Area in Development Envelope (ha)	Vegetation Condition in Development Envelope	Area in Development Footprint (ha)	Vegetation Condition in Development Footprint
Ken Hurst Park, Leeming Site No. 245 (Figures 11.1 and 11.2)	Bassendean Dunes	4.12	• 3.36 ha – Cleared • 0.76ha Degraded-Completely Degraded	4.12	• 3.36 ha – Cleared • 0.76ha Degraded-Completely Degraded
Canning and Southern Rivers, Beckenham to Martin / Kelmscott Site No. 246 (Figures 11.3 and 11.4)	Estuaries, Rivers and Creeks	16.81	• 2.05 ha – Cleared • 13.77 ha Degraded-Completely Degraded • 0.05 ha Degraded. • 0.94 ha Good-Degraded	4.01	• 1.95 ha – Cleared • 2.03 ha Degraded-Completely Degraded • 0.03 ha Degraded.
Jandakot Airport, Jandakot Site No. 388 (Figures 11.5 and 11.6)	Bassendean Dunes	3.04	• 0.35 ha – Cleared • 0.01 ha Degraded-Completely Degraded • 0.01 ha Degraded. • 0.15 ha Good-Degraded • 2.51 ha Good	3.04	• 0.35 ha – Cleared • 0.01 ha Degraded-Completely Degraded • 0.01 ha Degraded. • 0.15 ha Good-Degraded • 2.51 ha Good

[3] Source: Government of Western Australia (2000)

TABLE K: BUSH FOREVER SITES INTERSECTED BY THE DEVELOPMENT ENVELOPE

Bush Forever Site[3]	Landform Element[3]	Area in Development Envelope (ha)	Vegetation Condition in Development Envelope	Area in Development Footprint (ha)	Vegetation Condition in Development Footprint
Nicholson Road Bushland, Langford/Thornlie Site No. 456 (Figures 11.7 and 11.8)	Foothills/Pinjarra Plain	5.93	• 0.38 ha – Cleared • 5.22 ha Degraded-Completely Degraded • 0.25 ha Degraded. • 0.06 ha Good-Degraded • 0.02 ha Good	0.31	• 0.06 ha Degraded-Completely Degraded • 0.25 ha Degraded.
	TOTAL	**29.90**		**11.47**	

Bush Forever areas represent approximately 25% of the development envelope (29.90 ha), with 23.78 ha comprising native vegetation. However, more than 80% of this vegetation is mapped as Degraded-Completely Degraded.

Of this 29.90 ha Bush Forever areas in the development envelope, 12.56 ha is within gazetted railway reserves, representing approximately 10% of the development envelope (comprising the whole portion of the rail corridor that is within Ken Hurst Park and part of Sites 246 and 456). Approximately 4.61 ha of the Bush Forever areas in gazetted railway reserve is vegetated. This includes vegetation types VT01 (0.96 ha), VT05 (0.07 ha), VT 06 (0.98 ha) and VT07 (2.60 ha). The majority of this vegetation is in Degraded-Completely Degraded condition (3.60 ha) with the balance being Degraded (0.04 ha), Good-Degraded (0.17 ha) and Good (0.80). The other portion (15%) intersects Bush Forever sites reserved as Parks and Recreation and Other Regional Roads.

6.4.4 Flora Species

One hundred and sixty five (165) flora taxa (including subspecies and varieties) representing 49 families and 125 genera were recorded from the survey area during the field surveys. This total comprised of 103 native taxa and 62 introduced flora taxa. Dominant families recorded from the survey area included:

- Myrtaceae (23 taxa)
- Fabaceae (22 taxa)
- Proteaceae (15 taxa).

The uplands centred on the Bassendean Dunes and Dandaragan Plateau are known for species rich understorey, with the number of flora taxa typically recorded in 100 m^2 within this area ranges from 30-59 taxa (GoWA, 2000 as cited in GHD, 2018). Based on described quadrats, species diversity ranged from 14 to 39 taxa (average 24) per 100 m^2. The highest floristic diversity was recorded in Quadrat 1 (located within VT01) with 39 taxa. The survey area's diversity is considered to be low to moderate, with a lower floristic diversity compared to historic records for the area. The lower diversity is attributed to disturbance through clearing and weed invasion. No Threatened or Priority flora was recorded in the GHD survey area.

6.4.5 Threatened Flora

Whilst GHD's (2018) desktop review identified the potential presence of 85 conservation significant flora species, no conservation significant flora were recorded in the development envelope during the surveys.

Caladenia huegelii (Giant Spider Orchid) listed as Threatened under the *Wildlife Conservation Act 1950* (*WC Act 1950*) and the *EPBC Act 1999*, was not recorded during the surveys, but is known to occur in areas adjacent to the development envelope (e.g. Ken Hurst Park, Jandakot Airport, Caladenia Grove Wetland Reserve). Three surveys were undertaken of the alignment, including two targeted surveys during September and October 2017 for *C. huegelii* to identify its presence or potential presence. Suitable habitat within the survey area included:

- *Banksia menziesii* and *B. attenuata* woodland (VT01 = 6.00 ha).
- Regelia inops Hypocalymma angustifolium shrubland (VT02 = 4.43 ha).

- Banksia spp. isolated trees Regelia inops Hypocalymma angustifolium (VT02a = 1.42 ha).

Known suitable habitat for the species was intensively searched, however no individuals were recorded. *C. huegelii* is generally found in deep sandy soils of *Banksia* spp. – *Eucalyptus marginata* woodlands and favours areas of dense undergrowth. Of the 4.39 ha of suitable habitat that occurs within the development envelope 0.13 ha was rated Excellent to Very Good and therefore had dense undergrowth that was favourable for the species to grow.

A targeted *C. huegelii* survey was undertaken in October 2015 of the Jandakot Eastern Link Road, but no individuals were recorded (Astron, 2016). A survey of the Ranford Road Bushland (Bush Forever site 388) in September 2015 also failed to locate any individuals of the species (NACMS, 2016).

6.4.6 Priority Flora

Dodonaea hackettiana (Hackett's Hopbush) is listed as Priority 4 under the *WC Act 1950* and is not listed under the *EPBC Act 1999*. Astron (2016) recorded *Dodonaea hackettiana* within the northern section of the Jandakot Eastern Link Road within quadrat 1. NACMS (2016) also found the species in an isolated patch in the north-west of Ranford Road Bushland; however, they believed the species may have been introduced to the site, as it is not known to occur in the area. NACMS state that it is a coastal species naturally occurring on sandy soils and outcropping limestone, which are not present within Ranford Road Bushland. GHD (2013) previously recorded the species in the survey area near the Ranford Road Waste Transfer Station, however this location was revisited during the 2017 survey and no individuals were observed (GHD, 2018).

6.4.7 Threatened and Priority Ecological Communities

GHD's (2018) desktop review identified five conservation significant Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) potentially present in the survey area.

The outcomes of the Level 2 survey were:

- Of the seven vegetation types within the survey area, VT01 (*Banksia menziesii and B attenuata* woodland) and VT02a (*Banksia spp. isolated trees Regelia inops Hypocalymma angustifolium shrubland*) are of relevance in terms of PECs / TECs.
- One Federally listed TEC (*Banksia* Woodlands of the Swan Coastal Plain) was recorded in four separate patches (Figures 8.2, 8.3 and 4). The woodland's prominent tree layer comprises *Banksia* with scattered Eucalypts with other tree species often present among or emerging above the *Banksia* canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC, 2016).
- No State listed TECs were recorded in the survey area.
- One State listed PEC (Low lying *Banksia attenuata* woodlands or shrublands, Floristic Community Type 21c (Priority 3)) was recorded in the survey area. This PEC occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana, Banksia attenuata*, *B. menziesii, Regelia ciliata, Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland (GHD, 2018).
- Areas of the Federally listed TEC overlap the PEC, i.e. Floristic Community Type 21c is also a component of the Federally listed TEC.

- The area associated with the Caladenia Grove Wetland Reserve (which is not within the development envelope) was not surveyed but inferred to be the Federally listed TEC– *Banksia* Woodlands of the Swan Coastal Plain.
- The total area of VT01 and VT02a is 13.03 ha comprising:
  - VT01 = 6.00 ha surveyed + 5.61 ha (inferred) = 11.61 ha
  - VT02a = 1.42 ha
- The total area of the State listed PEC is 13.03 ha i.e. area of VT01 + VT02a + inferred area.
- Of the 13.03 ha of the PEC, 11.15 ha of this vegetation is consistent with the description of the Federally listed *Banksia* Woodland on the Swan Coastal Plain TEC.

The development envelope and the development footprint intersect three patches of Federally listed TEC (Figures 7.1 and 7.2). The TEC occupies 2.85 ha within the development envelope and the development footprint. The vegetation condition and area of these patches are listed in Table L.

TABLE L: BANKSIA WOODLANDS OF THE SWAN COASTAL PLAIN TEC BY CONDITION RATING

TEC Condition	Patch Number	Location	Area of TEC within Development Envelope	Area of TEC within Development Footprint
Excellent	1	Near Karel Avenue (Figure 7.1)	0.10 ha	0.10 ha
Very Good			0.03 ha	0.03 ha
Good			0.38 ha	0.38 ha
Good-Degraded			0 ha	0 ha
Degraded			0.08 ha	0.08 ha
Very Good	2	North of railway corridor and Ken Hurst Park (Figures 7.1 and 7.2)	0 ha	0 ha
Good			0 ha	0 ha
Not Surveyed			0 ha	0 ha
Good	3	South of Jandakot Eastern Link Road (Figure 7.2)	2.22 ha	2.22 ha
Inferred TEC (but condition not surveyed)	4	In railway reserve north of Caladenia Grove Wetland Reserve (Figure 7.2)	0.04 ha	0.04 ha
		TOTAL	**2.85 ha**	**2.85 ha**

Of the 1.57 ha extent of PEC (that is not consistent with the TEC description) within the development envelope and footprint, 0.14 is rated as Good and 1.43 is rated as Good-Degraded (Figure 4).

6.4.8 Geomorphic Wetlands Vegetation

The GHD (2018) desktop review identified 18 mapped geomorphic wetlands (Swan Coastal Plain dataset) that intersected the survey area (Table M). A field assessment (GHD, 2018) was undertaken to verify the mapping contained in the Swan Coastal Plain dataset. The assessment found that there are a number of inaccuracies in the Swan Coastal Plain dataset as summarised in Table M.

Of relevance to the TCL project, the assessment identified seven mapped wetlands in the development envelope that support native wetland vegetation (**bolded** in Table M). Ten wetlands

have either been cleared or landscaped (Table M) and one wetland UFI 6776 within the Caladenia Grove Wetland Reserve) was not surveyed due to access restrictions.

TABLE M: MAPPED GEOMORPHIC WETLANDS INTERSECTING THE SURVEY AREA

Name	Wetland UFI	Management Category	Wetland Type	Wetland Assessment	Is the Wetland within the Development Envelope?
Unknown	6655	Multiple use wetland (MUW)	Sumpland	Cleared for road and rail infrastructure.	Yes, but does not contain wetland vegetation.
Unknown	**6776**	**Resource Enhancement Wetland (REW)**	**Dampland**	**The REW was unable to be assessed due to access restrictions. 360 Environmental (2012 as cited in GHD, 2018) have previously surveyed the area and their vegetation units considered to be synonymous with GHD's were; VT01, VT02 and VT06. GHD concluded that 0.03 ha of dampland vegetation (VT02) is within the survey area.**	**Yes, however only 0.1 ha of VT06 (Scattered natives amongst weeds) is mapped within the development envelope. As no dampland vegetation is mapped within the development envelope, it is not considered an REW.**
Unknown	6911	Conservation category wetland (CCW)	Not assessed	Does not contain wetland vegetation.	Yes, but not representative of a wetland due to the presence of dryland vegetation (VT01).
Unknown	**13332**	**CCW**	**Dampland**	**Comprised 4.95 ha of dampland vegetation (VT02 and VT02a).**	**Yes, refer to Table N**
Unknown	**6912**	**CCW**	**Dampland**	**Comprised 0.57 ha of dampland vegetation (VT02).**	**No**
Unknown	6910	CCW	Dampland	Not accessible. Remnant bushland in Caladenia Grove Wetland Reserve was observed to be synonymous with dryland vegetation (VT01).	No
Unknown	7155	MUW	Dampland	Cleared areas for rail and infrastructure, not considered to be wetland vegetation.	Yes, but not considered to be representative of a wetland.
Unknown	15299	REW	Dampland	Man-made drain, the native vegetation has been significantly altered and landscaped.	Yes, but not considered to be representative of a REW.
Unknown	13537	REW	Dampland	Highly disturbed with invasive weeds, adjacent to a road, not considered to be wetland vegetation.	Yes, but not representative of a wetland.

TABLE M: MAPPED GEOMORPHIC WETLANDS INTERSECTING THE SURVEY AREA

Name	Wetland UFI	Management Category	Wetland Type	Wetland Assessment	Is the Wetland within the Development Envelope?
Unknown	**7446**	**CCW**	**Dampland**	**Comprised 0.38 ha of dampland vegetation (VT09)**	**Yes, refer to Table N**
Unknown	**13621**	**MUW**	**Dampland**	**Comprised 2.88 ha of dampland vegetation (VT03 and VT07).**	**Yes, refer to Table N**
Unknown	7499	REW	Palusplain	Cleared parkland with scattered natives amongst weeds. Vegetation is not considered to be wetland vegetation.	Yes, but not considered to be representative of a wetland.
Hester Park Canning River	**7447**	**REW**	**Floodplain**	**Comprised 0.10 ha of dampland vegetation (VT05).**	**Yes, refer to Table N**
Canning River Palusplain	14900	CCW	Palusplain	Dampland vegetation exists within this CCW, but not within the survey area.	Yes, however the portion within the development envelope is Completely Degraded as it is comprised of grass and does not contain wetland vegetation.
Canning River Palusplain	14899	MUW	Palusplain	Cleared parkland, does not contain wetland vegetation.	Yes, but does not contain any wetland vegetation.
Canning River Palusplain	15925	CCW	Palusplain	Dampland vegetation exists within this CCW, but not within the survey area.	Yes, however the portion within the development envelope is Completely Degraded as it is comprised of grass and does not contain wetland vegetation.
Canning River Palusplain	**15926**	**REW**	**Dampland**	**Comprised 0.68 ha of dampland vegetation (VT05).**	**Yes, refer to Table N**
Canning River Palusplain	14450	MUW	Palusplain	Does not contain wetland vegetation.	Yes, but does not contain wetland vegetation.

The TCL will affect five of the wetlands assessed by GHD (2018) as supporting native dampland vegetation. These five wetlands are described in Table N. Other wetlands listed in Table M are not considered further in the impact assessment of this report (i.e. Section 6.6.7), as PTA does not consider they represent the values of their assigned management category.

TABLE N: WETLANDS WITHIN THE DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Wetland UFI	Management Category	Location	DBCA[4] Mapped Area of wetland (ha)	GHD Survey				Development Envelope			Development Footprint	
				Wetland Extent in the Survey Area[5] (ha)	Area of Dampland Vegetation in Survey Area[6] (ha)	Vegetation Type in the Surveyed portion of the Wetland	Vegetation Condition in the Surveyed portion of the Wetland	Wetland Extent (ha)	Vegetation Condition	Dampland Vegetation Extent (ha)	Wetland Extent (ha)	Dampland Vegetation Extent (ha) and Condition
7446	CCW	Tom Bateman Reserve (Figures 12.1 and 12.2)	3.09	1.97	0.38	VT08 – *Corymbia calophylla* woodland VT09 – *Melaleuca rhaphiophylla* woodland	Good – Completely Degraded	0.40	Cleared	0.12	0.08	0.02
									Degraded-Completely Degraded	0.24		0.06
									Good, Good-Degraded	0.04		-
7447	REW	Canning River (Figures 13.1 and 13.2)	94.19	4.09	0.1	VT05 – *Eucalyptus rudis Melaleuca rhaphiophylla* open forest VT06 – Scattered natives amongst weeds VT07 – Grassland/ Herbland	Good – Completely Degraded	4.06	Cleared	0.74	1.57	0.69
									Degraded-Completely Degraded	3.32		0.88
15926	REW	100m north of Canning River (Figures 13.1 and 13.2)	0.88	0.86	0.68	VT05 – *Eucalyptus rudis Melaleuca rhaphiophylla* open forest	Good – Degraded	0.86	Degraded-Completely Degraded	0.08	0	-
									Good-Degraded	0.78		-
13332	REW	South of Canning Vale landfill and recycling facility (Figures 14.1 and 14.2)	21.39	5.4	4.95	VT02a – *Banksia* spp. isolated trees *Regelia inops Hypocalymma angustifolium* shrubland VT02 – *Regelia inops Hypocalymma angustifolium* shrubland	Very Good to Degraded	0.74	Good	0.74	0.74	0.74
13621	MUW	City of Gosnells (Figures 12.1 and 12.2)	166.44	15.28	2.88	Cleared VT07 – Grassland/ Herbland VT03 – *M. preissiana, M. rhaphiophylla* open woodland VT06 – Scattered natives amongst weeds	Degraded - Completely Degraded	14.36	Cleared	7.23	10.95	7.18
									Degraded-Completely Degraded, Degraded	7.12		3.77
									Good-Degraded	0.01		-

[4] Source: Geomorphic wetlands, Swan Coastal Plain database accessed on NationalMap (https://nationalmap.gov.au/)
[5] Source: GHD (2018)
[6] Source: GHD (2018)

6.4.8.1 Australian Wetlands Database

Brixton Street Swamps (WA074) is a wetland of national significance listed on the Australian Wetlands Database. The site is a good example of shrub swamp of the Swan Coastal Plain (on clay soil) and one of the few significant remaining areas within the Perth Metropolitan Area. It was identified as meeting one RAMSAR Criterion for listing as a Wetland of International Importance (Jaensch and Watkins 1999).

It is a recognised CCW (UFI: 15255) and Bush Forever site (ID: 387) and therefore protected under the EP Act. The Urban Bushland Council WA consider the Brixton Street Swamps as the most floristically diverse Bush Forever site on the Swan Coastal Plain with at least 518 native taxa and comprising a third of the taxa recorded on the Swan Coastal Plain (Urban Bushland Council WA Inc, 2018).

The CCW / Bush Forever site is less than 250 m from the eastern extent of the development envelope (Figure 3.4). The TCL is located outside the boundary of the 200m buffer zone to this wetland and will not impact the Brixton Street Swamps as the impacts are localised to the development envelope.

6.4.9 Introduced Flora and Declared Pests

GHD (2018) identified 62 introduced flora taxa within the survey area. The most commonly recorded weed species were; *Hypochaeris glabra, Ursinia anthemoides, Solanum nigrum, Pelargonium capitatum, Gladiolus caryophyllaceus, Ehrharta calycina, Sonchus oleraceus, Arctotheca calendula, Briza minor* and *Cenchrus setaceus*.

Six Declared Pests (under the *Biosecurity and Management Act 2007* (WA)) and two Weeds of National Significance (WONS) were identified within the survey area:

- *Zantedeschia aethiopica* (Arum Lilly) – Declared Pest
- *Moraea flaccida* (One-leaf Cape Tulip) – Declared Pest
- *Echium plantagineum* (Paterson's Curse) – Declared Pest
- *Rubus laudatus* (Blackberry) – Declared Pest
- *Lantana camara* (Lantana) – Declared Pest and WONS.
- *Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WONS.

6.4.10 Phytophthora Dieback

The *Ken Hurst Park Strategic Management Plan 2014-2019* (Waters, 2014) includes mapping of the extent of *Phytophthora cinnamomi* dieback infestation within Ken Hurst Park (Figure A).

FIGURE A: EXTRACT FROM WATERS (2014) EXTENT OF DIEBACK INFESTATION IN 2002 AND 2013 WITHIN KEN HURST PARK.



The assumed extent of dieback infestation is 20.94 ha (based on 2013 mapping). According to the management plan, this is currently managed through the application of phosphite and maintaining unfavourable conditions of closed tree canopy and deep litter to reduce soil temperature.

As the development envelope is adjacent to mapped dieback infested areas, PTA will manage soil movements within this area in accordance with appropriate hygiene protocols to reduce the risk of spreading dieback elsewhere along the development envelope.

6.5 POTENTIAL IMPACTS

The potential impacts to flora and vegetation are:

- Clearing of 54.88 ha of native vegetation.
- Clearing of 22.84 ha of bushland within Bush Forever sites.
- Clearing of 2.85 ha of *Banksia* Woodland of the Swan Coastal Plain TEC.
- Clearing of 4.42 ha of Priority 3 PEC - Low lying *Banksia attenuata* woodlands or shrublands (Floristic Community Type 21c).

- Clearing 12.33 ha[7] of vegetation associated with the wetlands listed in Table N, with the majority (10.76 ha) of this vegetation being Degraded-Completely Degraded.
- Indirect impacts related to stormwater infiltration, dewatering, spread of dieback, and dust may affect surrounding native vegetation.

6.6 ASSESSMENT OF IMPACTS

6.6.1 Impacts to Regional Vegetation

The Proposal will not significantly reduce the extent of regional vegetation associations (Table O). Both Association 968 and 1001 will have less than 30% of their pre-European extents remaining within the IBRA bioregion, IBRA sub-region and LGAs prior to and after the TCL.

TABLE O: EXTENT OF VEGETATION ASSOCIATIONS REMAINING AFTER TCL

Vegetation Association	Scale	Pre-European Extent (ha)	Current Extent (ha)	Remaining Before TCL (%)	Current extent in Development Envelope (ha)	Remaining after the TCL (%)
SWA IBRA bioregion		1,501,221.93	578,432.17	38.53	54.88	38.53
Perth IBRA sub-region		1,117,757.03	464,855.95	41.59	54.88	41.58
968	State: WA	296,715.07	94,970.94	32.00	17.75	32.00
	SWA IBRA bioregion	36,188.20	8,938.45	24.70	17.75	24.65
	Perth IBRA sub-region	36,188.20	8,938.45	24.70	17.75	24.65
	LGA: Gosnells	3,643.74	342.52	9.40	17.75	8.91
1001	State: WA	57,410.23	12,704.45	22.13	37.14	22.06
	SWA IBRA bioregion	57,410.23	12,704.45	22.13	37.14	22.06
	Perth IBRA sub-region	57,410.23	12,704.45	22.13	37.14	22.06
	LGA: Canning	5,025.14	330.33	6.57	14.16	6.29
	LGA: Cockburn	7,328.39	2,038.06	27.81	9.13	27.69
	LGA: Gosnells	5,173.51	598.25	11.56	13.05	11.31
	LGA: Melville	1,503.38	150.43	10.01	0.80	9.95

[7] 12.33 ha is the sum of the dampland vegetation extent in the development envelope, excluding cleared areas as listed in Table N.

All four vegetation complexes will have greater than 10% remaining within the LGAs after the TCL, with the exception of the Guildford Complex (5% remaining), which will have the same extent as prior to the implementation of the Proposal (Table P).

TABLE P: EXTENT OF VEGETATION COMPLEXES REMAINING AFTER TCL

Vegetation Complex	Pre-European Extent (ha)	Current extent (ha)	Remaining before TCL (%)	Current extent in development envelope (ha)	Remaining after TCL (%)
Southern River Complex	58,781.48	10,828.04	18.42	11.79	18.40
Bassendean Complex – Central and South	87,476.25	23,533.09	26.90	24.67	26.87
Guildford Complex	90,513.13	4,522.01	5.00	2.56	4.99
Swan Complex	15,194.13	2,055.56	13.53	15.88	13.42

6.6.2 Impacts to Vegetation Types

Assuming the entire development envelope is cleared, the Proposal will clear 54.88 ha of native vegetation, noting there is native vegetation in 46% of the development envelope (Table Q). Of the 54.88 ha, 32.22 ha will be cleared for the development footprint. Vegetation condition is Degraded-Completely Degraded or Cleared in the majority (95%) of the development envelope.

TABLE Q: VEGETATION TYPES AND CONDITION TO BE CLEARED WITHIN THE DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Vegetation Type	Condition	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Banksia menziesii and B attenuata woodland (VT01)[8]	Excellent	0.10	0.10
	Very Good	0.03	0.03
	Good	2.12	2.12
	Good-Degraded	1.43	1.43
	Degraded	0.08	0.08
	Subtotal for VT01	***3.76***	***3.76***
Regelia inops Hypocalymma angustifolium shrubland (VT02)	Degraded	0.01	0.01
	Subtotal for VT02	***0.01***	***0.01***
Banksia spp. isolated trees *Regelia inops Hypocalymma angustifolium shrubland* (VT02a)[9]	Good	0.62	0.62
	Subtotal for VT02a	***0.62***	***0.62***

[8] Vegetation type is considered to be part of the Federally listed TEC and state listed PEC.
[9] Vegetation type is considered to be part of the Federally listed TEC and state listed PEC.

TABLE Q: VEGETATION TYPES AND CONDITION TO BE CLEARED WITHIN THE DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Vegetation Type	Condition	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Melaleuca preissiana M. rhaphiophylla open woodland (VT03)	Degraded-Completely Degraded	2.94	0
	Subtotal for VT03	***2.94***	***0***
Adenanthos cygnorum shrubland (VT04)	Good-Degraded	0.17	0.17
	Degraded	1.66	1.66
	Degraded-Completely Degraded	1.15	0.97
	Subtotal for VT04	***2.98***	***2.80***
Eucalyptus rudis Melaleuca rhaphiophylla open forest (VT05)	Good-Degraded	0.94	0
	Degraded	0.05	0.03
	Degraded-Completely Degraded	0.06	0.03
	Subtotal for VT05	***1.05***	***0.06***
Scattered natives amongst weeds (VT06)	Good	0.43	0.43
	Good-Degraded	0.03	0.03
	Degraded	0.30	0.30
	Degraded-Completely Degraded	19.45	16.04
	Subtotal for VT06	***20.21***	***16.80***
Grassland/ Herbland (VT07)	Degraded-Completely Degraded	23.20	8.13
	Subtotal for VT07	***23.20***	***8.13***
Corymbia calophylla open woodland (VT08)	Good	0.01	0
	Good-Degraded	0.06	0
	Subtotal for VT08	***0.07***	***0***
	Not surveyed	**0.04**	**0.04**
	TOTAL	**54.88**	**32.22**

6.6.3 Impacts to Bush Forever Sites

SPP 2.8 indicates that clearing in Bush Forever areas is permitted where a proposal or decision is consistent with the overall purpose and intent of a Crown Reserve or can be reasonably justified with regard to wider environmental, social, economic or recreational needs (WAPC, 2010).

The TCL project intersects 29.90 ha of 1,580.92 ha (i.e. less than 2%) of four Bush Forever Sites (245, 246, 388 and 456) as listed in Table R. The impacted Bush Forever areas include:

- Cleared land (6.14 ha) i.e. where the area has previously been cleared or railway already exists.
- Poorly vegetated areas (19.76 ha), i.e. where the vegetation is in Degraded-Completely Degraded condition.
- Areas with vegetation in a Degraded condition or better (4 ha) comprising:
  - Vegetation mapped as Degraded – 0.31 ha;
  - Vegetation mapped as Good-Degraded – 1.15 ha; and
  - Vegetation mapped as Good – 2.54 ha.

Bush Forever Site 245 - Ken Hurst Park

The TCL development envelope intersects 4.12 ha of this 81.89 ha Bush Forever area (or 5.03%) and is contained wholly within land reserved for Railway Purposes. However, 3.36 ha of the 4.12 ha does not contain any native vegetation, i.e. is already cleared. The remaining 0.76 ha comprises vegetation type VT06, scattered natives amongst weeds, and is in Degraded-Completely Degraded condition.

The clearing required within Bush Forever Site 245 is regarded to be insignificant due to the small area containing native vegetation and the degraded condition of the vegetation. As no significant impacts are expected to Bush Forever Site 245, no offset is proposed.

Bush Forever Site 246 - Canning and Southern Rivers, Beckenham to Martin/Kelmscott

The TCL development envelope intersects 16.81 ha of this 489.69 ha Bush Forever area (or 3.43%). The ecological attributes of the area within the development envelope have been significantly degraded due to historical clearing and past land use activities.

In total, 15.82 ha out of the 16.81 ha is Cleared (2.04 ha) or Degraded-Completely Degraded (13.78 ha). PTA has committed to retaining a 0.94 ha area of VT05 (*Eucalyptus rudis Melaleuca rhaphiophylla* open forest introduced herbland/ grassland) that is mapped as Good-Degraded and is inclusive of Wetland UFI 15926 (an REW). A 0.05 ha area of Degraded vegetation VT05 adjacent to the Canning River will be cleared for the TCL project.

The clearing required within Bush Forever Site 246 is regarded to be insignificant due to the small area containing native vegetation, the substantially degraded condition of the vegetation and PTA's commitment to retain the 0.94 ha of VT05 (inclusive of Wetland UFI 15926). As no significant impacts are expected to Bush Forever Site 246, no offset is proposed.

Bush Forever Site 388 - Jandakot Airport

The TCL development envelope intersects 3.04 ha of this 910.02 ha Bush Forever area (or 0.33%). The majority of the impacted vegetation is in Good condition (2.52 ha) and an additional 0.15 ha in Good-Degraded condition. This includes 2.33 ha of vegetation that is representative of Banksia Woodland on the Swan Coastal Plain TEC, which also provides Black Cockatoo foraging habitat and partially coincides with wetland UFI 13332 which is a REW. An additional 0.01 ha of vegetation type VT02 in Degraded condition will be impacted by the TCL project. All remaining areas of Bush Forever

Site 388 impacted by the TCL comprise cleared land (0.35 ha) or Degraded-Completely Degraded (0.01 ha).

Due to the multiple ecological attributes impacted within Bush Forever Site 388, PTA will provide an offset to compensate the loss of these attributes. The area to be offset includes all impacted areas of Bush Forever Site 388 in a Degraded or better condition, totaling 2.68 ha.

Bush Forever Site 456 - Nicholson Road Bushland

The TCL development envelope intersects 5.93 ha of this 99.32 ha Bush Forever area (or 5.97%). The majority of the impacted vegetation is Degraded-Completely Degraded (5.23 ha) with an additional 0.37 ha that is already cleared. The remaining 0.33 ha is comprised of vegetation type VT06 (0.25 ha), being scattered natives amongst weeds in a Degraded condition, and vegetation type VT08 (0.08 ha), being *Corymbia calophylla* Open Woodland in Good and Good-Degraded condition.

The impacted portion of Bush Forever Site 456 also overlaps the western and southern margins of a mapped CCW (UFI 7446) totaling 0.40 ha (Figures 12.1 and 12.2). Whilst the wetland is mapped as a CCW, the vegetation condition along these two margins has been degraded. Further details about the impacts to this wetland are provided in Section 6.6.7.

The clearing required within Bush Forever Site 456 is regarded to be insignificant due to the highly degraded condition of the native vegetation. As no significant impacts are expected to Bush Forever Site 456, no offset is proposed.

TABLE R: AREAS OF BUSHLAND WITHIN BUSH FOREVER SITES TO BE CLEARED

Bush Forever Site Name	Site No.	Total Site Area (ha)[10]	Within Development Envelope			Within Development Footprint		
			Site Overlap (ha)	Condition of Bushland to be Cleared	Type and Area of Bushland to be Cleared (ha)	Site Overlap (ha)	Condition of Bushland to be Cleared	Type and Area of Bushland to be Cleared (ha)
Ken Hurst Park, Leeming	245	81.89	4.12	Degraded-Completely Degraded	VT06 – 0.76	4.12	Degraded-Completely Degraded	VT06 – 0.76
				Cleared	3.36		Cleared	3.36
Canning and Southern Rivers, Beckenham to Martin/Kelmscott	246	489.69	16.81	Degraded	VT05 – 0.05	4.01	Degraded	VT05 – 0.03
				Degraded-Completely Degraded	VT05 – 0.05 VT06 – 0.30 VT07 – 13.43		Degraded-Completely Degraded	VT05 – 0.02 VT06 – 0.10 VT07 – 1.91
				Cleared	2.04		Cleared	1.95
Jandakot Airport, Jandakot	388	910.02	3.04	Good	VT01 – 1.59 VT02a – 0.62 VT06 – 0.31	3.04	Good	VT01 – 1.59 VT02a – 0.62 VT06 – 0.31
				Good-Degraded	VT01 – 0.12 VT06 – 0.03		Good-Degraded	VT01 – 0.12 VT06 – 0.03
Jandakot Airport, Jandakot	388	910.02	3.04	Degraded	VT02 – 0.01		Degraded	VT02 – 0.01
				Degraded-Completely Degraded	VT06 – 0.01		Degraded-Completely Degraded	VT06 – 0.01
				Cleared	0.35		Cleared	0.35
Nicholson Road Bushland,	456	99.32	5.93	Good	VT08 – 0.02	0.31	Good	0

[10] Based on Bush Forever 2000 layer presented on NationalMap (2018).

TABLE R: AREAS OF BUSHLAND WITHIN BUSH FOREVER SITES TO BE CLEARED

Bush Forever Site Name	Site No.	Total Site Area (ha)[10]	Within Development Envelope			Within Development Footprint		
			Site Overlap (ha)	Condition of Bushland to be Cleared	Type and Area of Bushland to be Cleared (ha)	Site Overlap (ha)	Condition of Bushland to be Cleared	Type and Area of Bushland to be Cleared (ha)
Langford/Thornlie				Good-Degraded	VT08 – 0.06		Good-Degraded	0
				Degraded	VT06 – 0.25		Degraded	VT06 – 0.25
				Degraded-Completely Degraded	VT03 – 2.94 VT06 – 2.29		Degraded-Completely Degraded	VT06 – 0.06
				Cleared	0.37		Cleared	0
TOTAL		**1,580.92**	**29.90**		**22.84**	**11.48**		**5.82**

6.6.4 Impacts to Threatened Flora

No individual plants of *Caladenia huegelii* were recorded in the survey area (GHD, 2018) and therefore none were within the development envelope. As no individuals were recorded in the development envelope, the species will not be impacted through direct clearing for the TCL. Known populations of *Caladenia huegelii* exist within 100 m of the development envelope within the Caladenia Grove Wetland Reserve. The detailed design will take this population into account when planning locations of drainage basins to ensure minimize indirect impacts (such as hydrological changes) to populations of *Caladenia huegelii*.

Based on the most recent survey data (GHD, 2018) individuals of *Dodonaea hackettiana* were not recorded, therefore the species is unlikely to be directly impacted by clearing for the TCL.

6.6.5 Impacts to TEC

6.6.5.1 Direct Impacts

The Proposal will result in clearing of 2.85 ha of the Federally listed TEC within the development envelope. The majority of the impacted TEC has been impacted by various disturbance factors which have influenced the vegetation condition. The loss per condition rating (using the condition rating scale adapted by EPA (2016) for the South West Botanical Province) is:

- Excellent – 0.10 ha
- Very Good – 0.03 ha
- Good – 2.60 ha
- Degraded – 0.08 ha
- Inferred TEC (but condition not surveyed) – 0.04 ha

GHD (2018) identified four patches of vegetation consistent with the description of the Federally listed TEC. Of these, three patches will be impacted by the TCL proposal with one patch not being impacted (i.e. Patch 2). The proposed clearing will marginally reduce the extent of the TEC Patches 1, 3 and 4 as described below.

<u>Patch 1 in Excellent, Very Good, Good, Good-Degraded and Degraded condition near Karel Avenue (Figure 7.1)</u>

Due to historical clearing for the freight line, the patch adjacent to Karel Avenue is already fragmented by the railway easement to the north, Karel Avenue/Berrigan Drive to the west and south, urban development to the east.

The land to be cleared for the development envelope (Lot 8 on Diagram 73520) has previously been disturbed and comprises scattered natives amongst weeds (VT06). Part of the *Banksia* Woodland TEC (i.e. Patch 1) encroaches onto Lot 8 from the west (Figure 7.1). The main part of the patch is separated by an 8m track that runs southwest to northeast, splitting the vegetation into two 95m long sections. A portion of the patch to the west (both west and east of Karel Avenue) outside of the survey area is considered by GHD (2018) as part of the same patch, given Karel Avenue is <30m wide. A small portion of Patch 1 will be cleared on the western extent of the patch (Lot 5 on Plan 16275).

Therefore, the surveyed Patch 1 size is 2.00 ha, but may be larger if the unsurveyed vegetation is included (approximately 3.14 ha, see Figure 7.1). Clearing of 0.59 ha will reduce the patch size by a

worst case of 30% to approximately 1.4 ha. The reduction in patch size will not increase fragmentation of the TEC.

Patch 3 in Good condition at proposed Ranford Road station and Jandakot Eastern Link Road partially within Bush Forever Site 388 (Figure 7.2)

The patch is already fragmented to the north by the former landfill and current waste transfer station, to the east by Ranford Road and to the south by residential development.

A review of current aerial photography, studies for the full extent of the Jandakot Eastern Link Road (Astron, 2016) and the NACMS (2016) flora and fauna survey, indicates this patch extends further southwest within Bush Forever Site 388. The inferred area of TEC based on the NACMS report is 16.65 ha (Figure 7.2).

Therefore, the size of Patch 3 combining the inferred TEC mapped by NACMS and GHD's mapping is 17.85 ha. The reduction of 2.22 ha represents a loss of 12% of the patch. However, the reduction in the patch will not increase fragmentation of the TEC. The clearing represents a small reduction when taking into account the extent of vegetation consistent with the TEC description within the remainder of Bush Forever Site 388.

Patch 4 Not surveyed patch north of Caladenia Grove Wetland Reserve (Figure 7.2)

The 4.88 ha patch is fragmented on all sides by the freight line (north), Ranford Road (west) and residential areas (east and south). The very small (0.04 ha or 0.8%) decrease in patch size will not increase fragmentation of this patch.

Loss of TEC

The DoEE's conservation advice for the *Banksia* Woodland TEC (DoEE, 2016) reports that there is an estimated 253,540.6 ha of *Banksia* woodlands TEC in the Perth (SWA02) IBRA sub-region. The loss of 2.85 ha resulting from the Proposal represents approximately 0.000013% of the ecological community's estimated remaining extent. Therefore, it is unlikely that this reduction would be regarded as significant in the context of the overall distribution of the ecological community.

At a local level there is 144.65 ha of mapped vegetation consistent with the TEC within two Bush Forever sites (388 and 245) directly adjacent to the development envelope. The area of vegetation within these sites is approximately:

- 40 ha within Ken Hurst Park (Bush Forever Site No. 245) (Waters, 2014).
- 16.65 ha south of the proposed Jandakot Eastern Link Road within Bush Forever Site No. 388 (NACMS, 2016).
- 88 ha within the Jandakot Airport Bush Forever Site (No. 388) based on February 2018 aerial photography and mapping of vegetation communities[11].

The proposed clearing is unlikely to significantly reduce the extent at a local level given the extent remaining of this ecological community in Bush Forever areas.

[11] H1, H2 and J1 presented on Figure 7 of Jandakot Airport, Environment Strategy (JAH, 2009).

6.6.5.2 Indirect Impacts

Banksia attenuata woodlands are considered to be groundwater dependent ecosystems as they comprise eucalypts and banksia species that are facultative phreatophytes i.e. species that utilise groundwater when rainfall and surface water are unavailable. Coupled with long-term climatic drying, groundwater drawdown may cause the rate of groundwater decline to exceed potential root reach or growth rate, or physiological tolerance (Sommer and Froend 2011). Continued groundwater decline also has the potential to change the composition and structure of the *Banksia attenuata* woodlands from deep rooted to shallow rooted plant species (DPAW, 2016).

Based on conceptual designs of the TCL, dewatering is not proposed within the vicinity of TECs therefore, they will not be affected by drawdown associated with dewatering. The dewatering requirements for the Proposal will not be fully understood until detailed design has been completed, however, as described in Section 2.3.2.7, the water table is lower (i.e. deeper) between Ranford Road (Chainage 9200) and Cockburn Central station (Chainage 17500). The predicted MGL is greater than 1.5m below the rail formation and dewatering is unlikely to be required.

The PTA proposes to utilise up to four groundwater production bores to source construction water. Where possible pre-existing production bores will be utilised or new bores will be installed. Bores will be screened within the Superficial aquifer to abstract water for construction purposes. Abstraction in the vicinity of TECs is not currently proposed. The use of new bores or pre-existing bores will be subject to water transfer arrangements, hydrological assessment and licensing as required by the DWER.

Drainage infiltration may alter local hydrological conditions. Water from the V drain running alongside the passenger rail line is expected to discharge into an infiltration basin located between Karel Avenue and Hope Road, adjacent to inferred TEC Patch 1 (Figure 7.1). The basin has conceptually been designed to infiltrate all rail runoff in events up to and including the 100 year ARI. The conceptual design assumes a pipe will connect this basin, to one to the north of the development envelope to allow water from the southern basin to discharge to the northern basin in extreme and major events, consistent with regional drainage patterns. The storage volume of the infiltration basin adjacent to the inferred TEC Patch 1 is 2,750m^3. The basin is proposed to be 2.5m deep, with the top at 31.0mAHD and the base located at 28.5mAHD, which is above the MGL of 22mAHD in this location[12]. Patch 1 is located at a height of approximately 34.8mAHD, and is separated from groundwater by 12.8m. It is assumed Patch 1 will still be able to access groundwater and will still receive direct rainfall, therefore the TEC is unlikely to be affected by the position of the infiltration basin.

No other infiltration basins or drains are proposed adjacent to other TECs within the development envelope.

The proposed clearing of the TEC may increase weed abundance and diversity in remaining portions of the patches.

[12] Source: Perth Groundwater Map, https://maps.water.wa.gov.au/#/webmap/gwm

Given the nature of the TCL, it is unlikely fertilisers, herbicides or other chemicals[13] will be used in significant quantities. Therefore, it is unlikely that the quality or integrity of remaining patches of the TEC would be affected.

The patches proposed for clearing are not associated with recovery of an ecological community; therefore, these communities will be unaffected.

Dieback has been recorded adjacent to the development envelope (e.g. Ken Hurst Park), however hygiene management controls will be in place relating to soil movement, therefore adverse impacts to the quality or integrity of an occurrence of an ecological community is not expected from this disease.

6.6.6 Impacts to PEC

The Proposal will result in clearing of:

- 1.57 ha of Low lying *Banksia attenuata* woodlands or shrublands PEC (that is not considered TEC).
- 2.85 ha of Low lying *Banksia attenuata* woodlands or shrublands PEC (that is a component of the Federally listed TEC).

The PEC is known from 27 point locations over about 230 km from Chittering to Gelorup, with 317.5 ha currently mapped (as of August 2016, TSSC, 2016). Therefore, clearing of 4.42 ha represents a reduction of 1.4% of the total mapped PEC and is not considered to be a significant impact as the clearing is highly unlikely to change the conservation status of the PEC.

No indirect impacts are expected to occur as the entire PEC located within the development envelope will be cleared.

6.6.7 Impacts to Wetland Vegetation

As outlined in Section 6.4.9, the Geomorphic Wetlands of the Swan Coastal Plain dataset does not accurately represent the wetlands within the TCL project area. Of the 18 wetlands from the dataset shown in the development envelope, seven wetlands were found to support native wetland vegetation. Ten wetlands did not contain native vegetation (i.e. had been cleared, landscaped or are completely degraded) and one wetland was inaccessible.

The assessment of impacts to wetlands only addresses those wetlands which support wetland vegetation (i.e. those wetlands shown in bold font in Table M). Clearing of the development envelope will affect the following areas of vegetation within DBCA mapped CCW and REW:

- 0.40 ha of a modified CCW (UFI: 7446, Tom Bateman Reserve, Bush Forever Site 456). The development envelope encroaches into the southern and western margins of Wetland UFI 7446, affecting 13% of the wetland as mapped in the Geomorphic Wetlands of the Swan Coastal Plain dataset (Figures 12.1 and 12.2). The impacted area will be used for construction activities (refer to Section 2.3.2.4). GHD (2018) mapped the impacted area of Wetland UFI 7446 as VT03 – *Melaleuca preissiana / M. rhaphiophylla* open woodland, VT06 – Scattered natives amongst

[13] Chemicals often used in construction include; cleaners, truck washes, degreaser, adhesives, paint, primer, paint thinner, motor oil, diesel, lubricants / corrosion inhibitors, herbicide, hardener, joint sealant, concrete, mortar, render, toilet freshener, solvent, silicone etc.

weeds and VT08 – *Corymbia calophylla* woodland. The impacted area includes 0.12 ha of cleared land, 0.24 ha of Degraded-Completely Degraded vegetation (VT03 and VT06) and 0.04 ha of Good/Good-Degraded vegetation (VT08) (Figures 12.1 and 12.2). Given the poor condition of the wetland vegetation in the impacted area and the nature of the proposed activities, it is unlikely that this wetland will be significantly impacted in terms of vegetation clearing or hydrological impacts.

- 4.06 ha of a highly modified REW (UFI: 7447, Canning River). The railway, Canning River bridge duplication and construction activities will impact 4% of the wetland as mapped in the Geomorphic Wetlands of the Swan Coastal Plain dataset. GHD (2018) mapped the impacted area of Wetland UFI 7447 as VT05 – *Eucalyptus rudis Melaleuca rhaphiophylla* open forest (0.1 ha), VT06 – Scattered natives amongst weeds (0.06 ha) and VT07 – Grassland/Herbland (3.157 ha). VT05 is considered as the only vegetation type representative of native wetland vegetation. The impacted area contains 0.74 ha of cleared land with the remaining areas mapped as Degraded-Completely Degraded. Construction of the TCL project will not significantly impact the ecological or hydrological processes within Wetland UFI 7447 due to the small and degraded nature of the impacted area.
- 0.74 ha of REW (UFI: 13332, south of Canning Vale landfill and recycling facility and within Bush Forever Site 388). The construction of a portion of the Jandakot Eastern Link Road and the proposed Ranford Road station will impact approximately 3% of the wetland, as mapped in the Geomorphic Wetlands of the Swan Coastal Plain dataset. GHD (2018) mapped the impacted area of Wetland 13332 as VT02a – *Banksia* spp. isolated trees *Regelia inops Hypocalymma angustifolium* shrubland, VT02 – *Regelia inops Hypocalymma angustifolium* shrubland and VT06 – Scattered natives amongst weeds. The impacted area was assessed as being in Good condition. Construction of the TCL project will not significantly impact the ecological or hydrological processes within Wetland UFI 13332 as it will only impact a small proportion of the wetland.
- 0.86 ha of REW (UFI 15926) is within the development envelope. Wetland UFI 15926 comprises vegetation mapped as VT05 – *Eucalyptus rudis Melaleuca rhaphiophylla* open forest in 'Good-Degraded' condition and VT07 – Grassland/Herbland. This wetland will not be impacted as PTA will avoid clearing vegetation VT05 and will exclude construction activities from occurring within Wetland UFI 15926.

Following construction activities, 2.38 ha of three of the four wetlands will be permanently affected by the siting of the TCL. Wetland UFI 15926, a REW, located 100m north of the Canning River, will not be impacted. As the impacted areas are located within Bush Forever sites, an offset to address impacts to Bush Forever areas can adequately compensate the loss of wetland vegetation. The identified impacts to the wetlands in the TCL development envelope are not considered significant in terms of affecting the ecological or hydrological functions of the individual wetlands.

In summary the following areas and condition of vegetation within a CCW and REW will be impacted by the Proposal:

Wetland UFI 7446, CCW in Bush Forever Site 456

- 0.04 ha of Good/Good-Degraded vegetation.
- 0.24 ha of Degraded-Completely Degraded vegetation.

- 0.12 ha of cleared area.

The above impacts are not considered to be significant residual impacts.

Wetland UFI 7447, REW, Canning River in Bush Forever Site 246

- 3.32 ha of Degraded-Completely Degraded vegetation.
- 0.74 ha of cleared area.

The above impacts are not considered to be significant residual impacts.

Wetland UFI 13332, REW in Bush Forever Site 388

- 0.74 ha of Good vegetation.

The above impact is considered to be a significant residual impact.

6.7 MITIGATION

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for the flora and vegetation factor is outlined in Table S.

TABLE S: MITIGATION HIERARCHY FOR FLORA AND VEGETATION FACTOR

Avoid	• GHD (2018) identified 1.25 ha of Excellent vegetation within the survey area. Initially all 1.25 ha was planned to be cleared for the TCL. However, PTA redesigned the location of construction laydown and drainage areas to avoid 99% of the Excellent vegetation. • Four patches of *Banksia* Woodlands of the Swan Coastal Plain TEC were identified in the survey area and to avoid impacts to these patches, PTA has completed several revisions of the development envelope and reconfigured it to: - completely avoid one of these patches (Patch 2 on Figure 7.1 and 7.2). - avoid 99% of one of these patches (Patch 4 on Figure 7.2). - avoid 92% of 'Excellent' TEC (Patch 1 on Figure 7.1). Through the re-design of the development envelope, it is now planned to avoid 74% of the surveyed *Banksia* Woodlands of the Swan Coastal Plain TEC (initially 11.15 ha was to be cleared and through avoidance and minimisation of impacts by PTA this has been revised to 2.85 ha). A total of 2.68 ha of this vegetation is assessed as Good or Degraded condition, with the remaining 0.13 ha being Excellent to Very Good (0.04ha has not been surveyed and therefore does not have an associated condition rating). • The proposed location for the TCL has taken into account potential *Caladenia huegelii* habitat, and where possible these areas have been avoided to reduce impacts on this Threatened species. An example is avoidance of Caladenia Grove Wetland Reserve (Reserve 48617, Figure 4), an area previously included in the development envelope but known as a location of 14 previous records of *C. huegelii*. The Reserve was removed from the development envelope to avoid potential loss of *C. huegelii* plants as a result of the Proposal. • Known populations of *Caladenia huegelii* exist within 100 m of the development envelope within the Caladenia Grove Wetland Reserve. The detailed design will take this population into account when planning locations of drainage basins to minimise indirect impacts (such as hydrological changes) on populations of *Caladenia huegelii*. • Dampland vegetation (0.94 ha) within and adjacent to REW (UFI: 15926) will be retained. PTA will avoid clearing this vegetation and exclude construction activities occurring with

TABLE S: MITIGATION HIERARCHY FOR FLORA AND VEGETATION FACTOR

	this REW. • Groundwater abstraction bores will be located away from Banksia Woodlands TEC (where possible), to avoid drawdown of the groundwater beneath the TEC. The separation distance will be based on specific modelling of volumes and drawdown associated with the production bores as determined by a hydrogeological assessment in accordance with Operational Policy 5.12 Hydrogeological Reporting Associated with a Groundwater Well Licence (DoW, 2009a).
Minimise	• PTA has completed several revisions of the development envelope and reconfigured it to reduce the extent of the impact on two TEC patches (Patch 1 and 3 on Figure 6). • A CEMP will be prepared and implemented during construction of the TCL. Specific measures relevant to the factor to be included in the CEMP are: - Clearing is strictly restricted to the development envelope. - Declared pests and other weed species are not distributed offsite. - *Phytophthora* dieback is not introduced to the surrounding vegetation through the implementation of strict hygiene protocols. - Control of dust to avoid indirect impacts on surrounding vegetation. - Control of vehicular access to surrounding vegetation. • The CEMP will be prepared in accordance with objectives for dieback threat listed in the Ken Hurst Park Strategic Management Plan 2014-2019 (Waters, 2014).
Rehabilitate	• During the operational phase, herbicide application will be implemented along the length of the railway reserve within an 8m track corridor on a 6-monthly basis and on an annual basis along fences and rail structures.
Offset	PTA is working with DBCA to develop an offset package to mitigate significant residual environmental impacts that remain after application of the above listed mitigation measures.

6.8 PREDICTED OUTCOME

6.8.1 Residual Impacts

Following mitigation, the residual impacts for the flora and vegetation factor are:

- Clearing 54.88 ha of native vegetation.
- Clearing of 2.85 ha of *Banksia* Woodland of the Swan Coastal Plain TEC.
- Clearing of 4.42 ha of Low lying *Banksia attenuata* woodlands or shrublands (Floristic Community Type 21c) which is a state listed PEC (Priority 3). Of the 4.42 ha, 2.85 ha is also a component of the Federally listed TEC.
- Assuming that the entire development envelope is cleared, the implementation of the TCL will result in clearing of 22.84 ha of vegetation within Bush Forever sites.
- Impacting 0.40 ha of a CCW(UFI 7446), with 0.04 ha of Good/Good-Degraded vegetation being cleared. The balance of the impacted area is either cleared or contains vegetation that is Degraded-Completely Degraded.
- Impacting 4.80 ha of two REWs (UFI 7447 and 13332). Only 0.74 ha is comprised of vegetation that is in Good condition. The remaining 4.06 ha is cleared or Degraded-Completely Degraded.

6.8.2 Significant Impacts

Following the applied significance test, PTA believes the TCL will cause the following significant impacts:

- Direct loss of 2.85 ha of *Banksia* Woodlands of the Swan Coastal Plain TEC within the development envelope. The loss per condition rating is:
  - Excellent — 0.10 ha
  - Very Good — 0.03 ha
  - Good — 2.60 ha
  - Degraded – 0.08 ha
  - Not surveyed – 0.04 ha
- Direct loss of 2.68 ha of vegetation within Bush Forever Site 388. This vegetation is in a Degraded or better condition and contains attributes consistent with Banksia Woodland of the Swan Coastal Plain TEC, black cockatoo foraging habitat and a REW.
- Direct loss of 0.74 ha of vegetation associated with Wetland UFI 13332 (a REW) in Bush Forever Site 388.

Most of the above impacts are contained within Bush Forever Site 388, e.g. there is overlap between the Bush Forever Site 388 and the wetland vegetation or Banksia Woodland on the Swan Coastal Plain TEC. Therefore, a single offset for the Bush Forever impacts could compensate all of these impacts, instead of providing individual offsets for each impact.

6.8.3 Offsets

PTA is working with DBCA to secure an appropriate offset to compensate the loss of vegetation in the TCL development envelope. Details of the offset will be outlined in an Offsets Strategy. PTA predict that implementation of the CEMP and execution of an appropriate offsets package will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.

7 TERRESTRIAL FAUNA

7.1 EPA OBJECTIVE

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

7.2 POLICY AND GUIDANCE

- *EPBC Act 1999*
- *WC Act 1950 / Biodiversity Conservation Act 2016*
- Environmental Factor Guideline –Terrestrial Fauna (EPA, 2016e).
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys (EPA, 2016c).

7.3 ENVIRONMENTAL INVESTIGATION

The following environmental investigations were undertaken to assess the terrestrial fauna values of the development envelope:

- Thornlie–Cockburn Link Project Flora and Fauna Survey (GHD, 2018).
- Thornlie Extension Environmental Assessment (GHD, 2013).

Table G provides a brief description of each these investigations and identifies the assessment standards used to inform the scope and content of the individual investigations.

7.4 RECEIVING ENVIRONMENT

7.4.1 Fauna Values of the Survey Area

The Level 1 Fauna assessment identified the following fauna values of the survey area:

- 65 species (native and introduced) were recorded in the survey area comprising 44 birds, 11 reptiles, 7 mammals and 3 frogs.
- 45 conservation significant species were identified from database searches as being present or potentially being present in the survey area. An additional 34 species were included within the desktop review following a review of species listed under Schedules 1 to 4 of the *WC Act 1950*. Of these, GHD assessed 10 species to be present or likely to be present (refer to Table 19 and Appendix E of GHD, 2018).
- Four conservation significant species were recorded in the survey area; Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*), Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) and the Rainbow Bee Eater[14] (*Merops ornatus*). Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) was previously recorded in 2013 (GHD, 2013) but not in 2017.

[14] Since the 2017 survey the Rainbow Bee Eater's conservation status was downgraded from Schedule 5 'International Agreement' to none by the WA Minister for Environment in the *Wildlife Conservation (Specially Protected Fauna) Notice 2017* (gazetted January 2018) .

- Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) has previously been recorded in the Caladenia Grove Wetland Reserve and the Ranford Road Bushland (Bush Forever site 388) during the 2015 survey (NACMS, 2016).
- Seven other species are likely to occur in the survey area based on the desktop review, but were not recorded during the surveys. These were the; Great Egret (*Ardea modesta*), Peregrine Falcon (*Falco peregrinus*), Perth Slider (*Lerista lineata*), Jewelled South West Ctenotus (*Ctenotus gemmula*), Black Striped Snake (*Neelaps calonotos*), Graceful Sunmoth (*Synemon gratiosa*), and the cricket (*Throscodectes xiphos*).
- Black Cockatoo habitat was identified within the survey area comprising 32.51 ha of foraging habitat and 176 potential habitat trees; however, there is no evidence of these trees currently being used for nesting or containing hollows suitable for breeding.
- Eight broad fauna habitats were mapped, with three of high ecological value. These three habitats cover 25% of the survey area (Table T).

The vegetation types associated with habitats listed in Table T and observations of conservation significant fauna are presented on Figures 8.1, 8.2, 8.3 and 8.4.

TABLE T: HABITAT TYPES WITHIN THE SURVEY AREA

Habitat Type	Description	Habitat Value for Conservation Significant Fauna	Associated Vegetation Types	Extent within Survey Area (ha)
Banksia woodland	This habitat type is dominated by *Banksia* species including *B. attenuata* and *B. menziesii* with some areas of *B. ilicifolia*. Shrub layers of *Allocasuarina, Acacia, Hakea, Xanthorrhoea, Macrozamia* and scattered Jarrah. This habitat was often very dense and had excellent litter cover and woody debris. Few large logs were present due to the lack of large tree species, however large skirts from *Xanthorrhoea* and *Zamia* palms would provide excellent cover for terrestrial fauna species. Soils were predominantly deep sands with no recent fire scarring evident. Numerous reptiles and bush birds were recorded in this habitat type due to the vegetation type and dense cover available.	High – three conservation significant species were recorded in this habitat type; Carnaby's Black Cockatoo, Southern Brown Bandicoot and Rainbow bee-eater.	VT01	6.00 ha 5.61 ha (Caladenia Grove Wetland Reserve not surveyed but inferred) Total = 11.61
Melaleuca woodland	This habitat type was primarily within low lying areas and consisted of individual plants or dense groupings of *Melaleuca rhaphiophylla*. This habitat was within areas that had received historical disturbance or clearing including that of the Canning River (which had squatters' disturbance evident). This habitat was also dominated by a ground layer or understorey of introduced grasses and weeds. Some common wetland birds were recorded in these areas including White Ibis, Black Duck and Swamp-hen. Very little litter was present and woody debris varied from absent to abundant with fallen logs and debris present, this looked to be dependent on previous impacts and fire.	Low to Medium depending on condition; Southern Brown Bandicoot was recorded in this habitat type.	VT03 and VT09	3.34
Ephemeral low shrubland	An ephemeral low lying area consisting low shrubs of *Regelia inops* and *Hypocalymma angustifolium* with *Phlebocarya ciliata* and *Dasypogon bromeliifolius* herbs. Some areas also	Medium; no species of conservation significance were recorded in this habitat type.	VT02	4.43

TABLE T: HABITAT TYPES WITHIN THE SURVEY AREA

Habitat Type	Description	Habitat Value for Conservation Significant Fauna	Associated Vegetation Types	Extent within Survey Area (ha)
	had weed incursion and appeared to be associated with historical disturbances. The habitat was mostly open with little litter or woody debris and no logs present, however where herbs had died and created matted vegetation which provided good cover for small reptiles. The soils were sands with no evidence of recent fire. Few fauna species were recorded in this habitat type however species that preferred open areas like small skinks were numerous. Lots of droppings from Western Grey Kangaroos were present and the area is likely utilised at night time for grazing.			
Open *Banksia* woodland over low shrubland	This habitat type is dominated by *Banksia ilicifolia* with sparse *Allocasuarina, Melaleuca, Nuytsia* and *Xanthorrhoea* species over low native shrubs of *Regelia* and *Hypocalymma* with *Phlebocarya and Dasypogon* herbland understorey. The vegetation varies slightly in species composition throughout the survey area but is dominated by *Banksia ilicifolia*. This habitat had grey sandy soils with good litter cover and scattered woody debris. No large logs were present due to the lack of large trees. This habitat provides excellent cover for small bush birds with numerous honeyeaters (flowering *B. ilicifolia*) and aerial bird species recorded. This area also had a Western Grey Kangaroo population persisting and appeared to move between the remnant patches of bush present in the area.	High; Carnaby's Black Cockatoo was recorded (via feeding evidence) in this habitat type.	VT02a	1.42
Mixed tall woodland/clumped trees	This habitat type is dominated by Tuart (*Eucalyptus gomphocephala*), Marri (*Corymbia calophylla*) or Flooded Gum (*E. rudis*) with a mixed understory of weeds. The vegetation varies slightly in species composition and density throughout the survey area depending on the amount of disturbance but is always dominated by large Eucalypts. This	High – two conservation significant species were recorded in this habitat type; Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo.	VT06 and VT08	24.02

TABLE T: HABITAT TYPES WITHIN THE SURVEY AREA

Habitat Type	Description	Habitat Value for Conservation Significant Fauna	Associated Vegetation Types	Extent within Survey Area (ha)
	habitat had areas of deep sandy soils or clay lateritic composition. Depending on disturbance, impacted the amount of litter and woody debris cover. Some of the woody debris areas were very thick and able to provide refuge areas for ground dwelling mammals and reptiles. Few large logs were present in this habitat which is likely an artefact of historical fire activity, although little evidence of fire activity was recorded during the survey.			
Waterbodies / Canning River / or man-made pools	Portions of the survey area include low lying areas with surface water present and a small area of the Canning River. All of the water bodies show historical disturbances of which most are completely modified. This includes areas dug out to form pools/ponds or surface water amongst grassy paddocks. Some native vegetation was present including sedges, reeds, *Melaleuca rhaphiophylla* and *E. rudis*. At one paddock pool (between Wilfed Road and the rail corridor) several Forest Red-tailed Black Cockatoo were recorded utilising the water source after feeding in nearby Marri. Additionally, numerous common wetland birds were recorded in these areas including White Ibis, Black Duck and Swamp-hen. The Canning River portion of the survey area has three rail bridge crossings present with trimmed/modified vegetation. A thin strip of riparian vegetation remains along the river however within the survey area only a small amount is present. The understorey in mostly weeds with evidence of squatters' dwellings. Very few fauna species were recorded due to human activity in the area.	Medium; Forest Red-tailed Black Cockatoo was recorded in this habitat type.	VT05	1.06
Scattered isolated shrublands (scattered islands or scattered	This habitat type was dominated by shrubs including *Adenanthos, Acacia, Banksia, Xanthorrhoea, Melaleuca* and *Nuytsia* species. This habitat was often only scattered shrubs,	Medium to high depending on composition; two conservation significant species were recorded in	VT04	3.91

TABLE T: HABITAT TYPES WITHIN THE SURVEY AREA

Habitat Type	Description	Habitat Value for Conservation Significant Fauna	Associated Vegetation Types	Extent within Survey Area (ha)
clumps)	but areas of dense clumps were present. Litter cover was present and small fine woody debris was scattered. Few large logs were present due to the lack of large tree species, however, the density of the vegetation provides excellent cover for terrestrial fauna species. Soils were predominantly deep sands. No recent fire scars were evident. Some sections of the survey area, particularly in the western portion, have a considerable amount of dumped rubbish. Numerous birds were recorded in this habitat type due to the flowering plants present.	this habitat type; Carnaby's Black Cockatoo (feeding evidence only) and Southern Brown Bandicoot (digs).		
Mixed grasslands in paddocks	This habitat type is mostly paddocks or cleared areas with weedy regrowth. This habitat had very little composition and few fauna species were present during the field survey. In areas of exposed substrate Rainbow Bee-eater may utilise the space for breeding purposes.	Low	VT07	26.46
Cleared / railway				70.94
			TOTAL WITHIN SURVEY AREA	**147.19**

7.4.2 Conservation Significant Fauna

Four conservation significant species were recorded in the survey area; Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*), Southern Brown Bandicoot / Quenda (*Isoodon obesulus fusciventer*) and the Rainbow Bee Eater (*Merops ornatus*). Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) was previously recorded in 2013 (GHD, 2013) but not in 2017. These species are described below.

7.4.2.1 Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Black Cockatoo is listed as Endangered under the *EPBC Act 1999* and *WC Act 1950*.

This species mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by Hakea, *Banksia* and Grevillea species. The species also occurs in forests containing Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) or Karri (*E. diversicolor*). Breeding usually occurs in the western Wheatbelt region of WA, with flocks moving to the higher rainfall coastal area to forage after the breeding season. This species feeds on the seeds of a variety of native plants, including *Allocasuarina*, *Banksia*, *Eucalyptus*, *Grevillea* and *Hakea*, and some introduced plants (DSEWPaC, 2012).

The species was recorded within survey area via observation and feeding evidence (GHD, 2018).

7.4.2.2 Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*)

Forest Red-tailed Black Cockatoo is listed as Vulnerable under the *EPBC Act 1999* and *WC Act 1950*.

Forest Red-tailed Black Cockatoo typically occurs in dense Jarrah (*Eucalyptus marginata*), Karri (*E. diversicolor*) and Marri (*Corymbia calophylla*) forests, however the species also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*). Habitats also tend to have an understorey of *Banksia* spp., *Persoonia* spp., *Allocasuarina* spp. In recent years the species has been recorded utilising areas of the Swan Coastal Plain for resources (Johnstone et al, 2017). The Forest Red-tailed Black Cockatoo generally nests in hollows in live or dead trees of Marri, Karri, Wandoo, Bullich, Blackbutt, Tuart and Jarrah (DSEWPaC, 2012) in the Darling Range and recently on the Swan Coastal Plain.

The species was recorded within the survey area via observation and feeding evidence (GHD, 2018).

7.4.2.3 Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

Baudin's Black Cockatoo is listed as Endangered under the *EPBC Act 1999* and *WC Act 1950*.

Baudin's Black Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri (*Corymbia calophylla*) and Eucalyptus species, especially Karri (*E. diversicolor*) and Jarrah (*E. marginata*). The species also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), and Yate (*E. cornuta*).

Baudin's Black Cockatoo breeds in the Jarrah, Marri and Karri forests of the deep south-west in areas averaging more than 750 mm of rainfall annually. The range of the species extends from Albany to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Boyup Brook. Preferred roosts are in areas with a dense canopy close to permanent water sources that provide the birds with protection from weather conditions (DSEWPaC, 2012).

The survey area represents marginal habitat for this species. The 2013 survey recorded the species foraging in the survey area, however this is considered to be an opportunistic record. The species was not recorded during the 2017 survey.

7.4.2.4 Southern Brown Bandicoot / Quenda (*Isoodon obesulus fusciventer*)

Quenda are not listed under the *EPBC Act 1999*, but are listed as Priority 4 under the *WC Act 1950*.

The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland close to dense cover (Van Dyck and Strahan, 2008).

There is suitable habitat within the survey area. The species was recorded within the survey area via observation, digs and scats. There are records present within the survey area.

7.4.3 Introduced Fauna

Eleven introduced fauna species were recorded in the survey area. These were the; Eastern Long-billed Corella, Turtle Dove, Laughing Dove, Feral Pigeon, Laughing Kookaburra, Rainbow Lorikeet, Fox, Dog, Cat, House Mouse and Rabbit.

7.5 POTENTIAL IMPACTS

- Clearing of 54.88 ha of fauna habitat.
- Clearing of 27.64 ha of Black Cockatoo foraging habitat.
- Clearing of 96 potential Black Cockatoo habitat trees (trees with diameter at breast height >500mm).
- Clearing of conservation significant species habitat.
- Death or injury to fauna during construction and operation of the TCL.
- Indirect impacts (disturbance and avoidance behaviour) related to construction and operation of the TCL.

7.6 ASSESSMENT OF IMPACTS

7.6.1 Direct Impacts to Fauna Habitat

The Proposal will result in clearing of 54.88 ha (46%) of habitat within the development envelope (Table U). Of the 54.88 ha, 32.22 ha of habitat will be cleared for the development footprint.

TABLE U: CLEARING OF HABITAT TYPE WITHIN THE DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Habitat Type	Associated Vegetation Type	Extent within Survey Area (ha)	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Banksia woodland	VT01	6.00	3.76	3.76
Melaleuca woodland	VT03 and VT09	3.34	2.94	0
Ephemeral low shrubland	VT02	4.43	0.01	0.01

TABLE U: CLEARING OF HABITAT TYPE WITHIN THE DEVELOPMENT ENVELOPE AND DEVELOPMENT FOOTPRINT

Habitat Type	Associated Vegetation Type	Extent within Survey Area (ha)	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Open *Banksia* woodland over low shrubland	VT02a	1.42	0.62	0.62
Mixed tall woodland/clumped trees	VT06 and VT08	24.02	20.28	16.80
Water bodies / Canning River / or man-made pools	VT05	1.06	1.05	0.06
Scattered isolated shrublands (scattered islands or scattered clumps)	VT04	3.91	2.98	2.80
Mixed grasslands in paddocks	VT07	26.46	23.20	8.13
Not surveyed but inferred to be *Banksia* woodland		5.61	0.04	0.04
TOTAL FAUNA HABITAT		**76.25**	**54.88**	**32.22**
Cleared / railway		70.94	64.49	63.45
TOTAL		**147.19**	**119.37**	**95.67**

7.6.2 Direct Impacts to Black Cockatoos

7.6.2.1 Foraging Habitat

The Proposal will result in clearing of 27.64 ha of Black Cockatoo foraging habitat within the development envelope (Table V). Of the 27.64 ha, 24.02 ha (approximately 87%) of habitat will be cleared for the development footprint.

TABLE V: DIRECT IMPACTS TO BLACK COCKATOO FORAGING HABITAT

Habitat Type	Associated Vegetation Type	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Banksia woodland	VT01	3.76	3.76
Open *Banksia* woodland over low shrubland	VT02a	0.62	0.62
Mixed tall woodland/clumped trees	VT06 and VT08	20.28	16.80
Scattered isolated shrublands (scattered islands or scattered clumps)	VT04	2.94	2.80
Not surveyed but inferred to be *Banksia* woodland	VT01	0.04	0.04
TOTAL		**27.64**	**24.02**

Given the historical fragmentation of the *Banksia* woodland communities used for foraging, and that the proposed action will clear in a linear area adjacent to previously cleared areas where freight trains continue to operate, the reduction in foraging habitat is unlikely to affect the survival or cause decline of the three Black Cockatoo species. However, the 2012 Referral Guidelines (DSEWPaC,

2012) consider removal of more than 1 ha to be high risk of a significant impact; therefore the potential removal of 27.64 ha is considered a high risk of causing a significant impact.

7.6.2.2 Breeding Habitat

The development envelope does not contain any hollows that are suitable for black cockatoo breeding; therefore, no impacts to current breeding habitat will occur. The nearest confirmed breeding site is located approximately 11 km from the development envelope near Douglas Road in the City of Armadale (from DBCA records). Based on this, the habitat within the development envelope is not regarded as being critical to the survival of the species. As the development envelope does not contain any current breeding habitat, the breeding cycles of the population will not be disrupted.

The development envelope contains 96 Black Cockatoo habitat trees (trees with DBH >500mm) that may be suitable for hollows to form, and therefore potentially support future breeding. As these trees are not currently used by the species they are not considered critical habitat, but could be important habitat in the future.

7.6.2.3 Roosting Habitat

No roosting habitat was identified in the development envelope; therefore, no impacts to roosting habitat will occur.

7.6.3 Direct Impacts to Southern Brown Bandicoots Habitat

The Proposal will potentially clear 9.72 ha of Southern Brown Bandicoot habitat within the development envelope (Table W). Of the 9.72 ha, 6.56 ha of habitat will be cleared for the development footprint.

TABLE W: DIRECT IMPACTS TO SOUTHERN BROWN BANDICOOT HABITAT

Habitat Type	Associated Vegetation Type	Area within Development Envelope (ha)	Area within Development Footprint (ha)
Banksia woodland	VT01	3.76	3.76
Melaleuca woodland	VT03 and VT09	2.94	0
Scattered isolated shrublands (scattered islands or scattered clumps)	VT04	2.98	2.80
Not surveyed but inferred to be *Banksia* woodland		0.04	0.04
TOTAL		**9.72**	**6.56**

The estimated area of occupancy for the Southern Brown Bandicoot (*Isoodon obesulus*) is 3,500km^2 (or 350,000 ha) (Burbidge and Woinarski, 2016). No data is available for the subspecies *Isoodon obesulus subsp. fusciventer* which occurs in the southwest of Australia and was recorded in the development envelope. Based on the current area of occupancy for the species, the removal of 9.72 ha of habitat within the development envelope will reduce the overall area of occupancy by 0.003%. On a regional scale and species level, the clearing is not considered to have a significant impact on the species available habitat given the small reduction (0.003%) in area.

On a local scale, adult males have a home range of 2 to 7 ha, and adult females have a home range of 1 to 3 ha. Individuals are usually solitary, though overlap in home ranges of individuals has been recorded (DEC, 2012). GHD (2018) recorded three dig/scat locations of the species within the development envelope (Figure 8.2 and 8.3). Therefore, it is likely the home ranges of a small number of individuals will be affected by the Proposal. Habitat is available for this species elsewhere on the Swan Coastal Plain (i.e. between Guilderton and Esperance (DEC, 2012)), and therefore whilst disturbed by construction works, it is likely these individuals will move away from the cleared area to more suitable habitat in surrounding vegetation and Bush Forever sites. Given the large area of occupancy, small extent of habitat to be cleared and small number of individuals recorded within the development envelope, coupled with the ability of individuals to move to other suitable habitat surrounding the TCL, the impact to the Southern Brown Bandicoot is not considered to be significant.

7.6.4 Death or Injury to Fauna During Construction and Operation of the TCL.

7.6.4.1 Construction

Vehicle strike can pose a risk to some wildlife, particularly but not exclusively to ground dwelling species, including the conservation significant Quenda. While some mobile species such as birds have the potential to move away from machinery or vehicles, other species that are less mobile may have difficulty moving. A collision with an individual animal may result in injuries or death for the animal.

The Proposal involves construction of rail and associated infrastructure, requiring clearing of native vegetation, excavation of soil and the operation of vehicles and plant. Native fauna may need to cross these alignments and navigate away from approaching vehicles/plant, increasing the risk of fauna mortality from vehicle strikes. However, speed limits will be imposed during construction and the numbers of Quenda or other conservation significant species frequenting the development envelope is expected to be low. Although some mortality may occur as a result of vehicle strikes, this is likely to be limited individuals and it is not expected that collisions from fauna will affect a species at a population level. Information relating to fauna mortality will be documented by the contractor and reported as a requirement of the CEMP.

7.6.4.2 Operations

Currently the freight corridor is poorly fenced which may allow fauna to transit from one side of the corridor to the other. However, this is likely to be an infrequent occurrence as fauna would possibly avoid the freight corridor due to noise or vibration from freight trains.

The TCL will improve fencing to exclude fauna from entering the railway corridor. This may reduce the risk of land dwelling fauna being injured or killed by passing freight and passenger trains.

7.6.5 Indirect Impacts

Fauna may be disturbed during construction (due to clearing activities and noise emissions) and operation of the railway (noise and vibration) which may affect the local population through interruption and temporary avoidance behaviour of the associated activities. Given the construction works will be of short duration in any one location, as the railway is built and progressed along the alignment, the effects on any local population will be temporary. In addition the TCL is being constructed within an existing rail alignment where freight trains are already operational. Therefore fauna are likely to already avoid the area. The consequence of this interruption and temporary avoidance behaviour on fauna is considered minor and insignificant.

7.7 MITIGATION

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for the terrestrial fauna factor is outlined in Table X.

TABLE X: MITIGATION HIERARCHY FOR TERRESTRIAL FAUNA FACTOR

Avoid	• As the project design has evolved, opportunities to reduce clearing impacts have been identified. Subsequent changes to the development envelope have avoided 33% of the foraging habitat for Black Cockatoos. Initially 40.96 ha was planned to be cleared, and this was reduced to 27.64 ha. • 45% of potential Black Cockatoo habitat trees will be avoided, through revised design of the TCL development envelope. There are 176 potential Black Cockatoo habitat trees within the survey area, and through modification of the boundaries of the development envelope, 80 trees will be avoided.
Minimise	• Using the existing rail corridor has minimised the area of vegetation to be cleared. Of the vegetation to be cleared 50% is considered to be medium to low value fauna habitat. • A CEMP will be prepared and implemented during construction of the TCL. Specific measures relevant to the factor to be included in the CEMP are: - Clearing is strictly restricted to the development envelope. - Pre-clearing fauna trapping/relocation will be implemented. - Fauna handler to be present/on call during clearing. - Regular inspections of the development envelope for trapped fauna (in excavations or equipment) during construction works. Relocation of trapped fauna immediately. - Minimise duration of open excavations. - Fauna ramps in open trenches. - Fencing of TCL corridor to exclude fauna.
Rehabilitate	No rehabilitation of terrestrial fauna habitat is proposed.
Offset	PTA is working with DBCA to develop an offset package to mitigate residual environmental impacts that remain after application of the above listed mitigation measures.

7.8 PREDICTED OUTCOME

7.8.1 Residual and Significant Impacts

Following mitigation, the residual impacts which are considered to be significant for the Terrestrial Fauna factor are:

- Clearing of 27.64 ha of Black Cockatoo foraging habitat.
- Clearing of 96 potential Black Cockatoo habitat trees (trees with DBH>500mm).

7.8.2 Offsets

PTA is working with DBCA to secure an appropriate offset to compensate the loss of black cockatoo foraging habitat and the potential habitat trees. Details of the offset will be outlined in an Offsets Strategy. However, PTA predict that implementation of the CEMP and the execution of an appropriate offsets package will result in positive outcomes for the environment that

counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.

8 TERRESTRIAL ENVIRONMENTAL QUALITY

8.1 EPA OBJECTIVE

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

8.2 POLICY AND GUIDANCE

- Environmental Factor Guideline –Terrestrial Environmental Quality (EPA, 2016f)
- *Contaminated Sites Act 2003*
- Assessment and Management of Contaminated Sites (DER, 2014).
- Identification and Investigation of Acid Sulfate Soils (ASS) and Acidic Landscapes (DER, 2015a).
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER, 2015b)

8.3 ENVIRONMENTAL INVESTIGATION

The following environmental investigations were undertaken in accordance with the requirements of the C*ontaminated Sites Act 2003* to assess the terrestrial environmental quality of the development envelope:

- Lots 302, 303 and 500 Ranford Road, Canning Vale Preliminary Site Investigation (GHD, 2016).
- Ranford Road METRONET Sampling and Analysis Plan for Detailed Site Investigation (GHD, 2017a).

Table G provides a brief description of each of these investigations and identifies the assessment standards used to inform the scope and content of the individual investigations.

PTA has appointed a DWER accredited Contaminated Sites Auditor (the Auditor) to oversee the contaminated sites investigation at the Ranford Road Station site (being part Lots 302, 303 and 500 Ranford Road, Canning Vale). The Auditor has reviewed and approved both the Preliminary Site Investigation and Sampling and Analysis Plan. The Detailed Site Investigation (DSI) was not completed at the time of this report but will be prepared to the satisfaction of the Auditor.

Aurora reviewed the DWER's ASS risk mapping to assess the potential for ASS to be present within the development envelope.

8.4 RECEIVING ENVIRONMENT

8.4.1 Geology and Soils

The majority of the development envelope comprises Bassendean Sands described as white to pale grey at surface, yellow at depth. Sands are likely to be greater than 30m deep and overlie the Guildford Formation, described as sandy silty pale brown clay. In places limestone may be present at depth (Jordan, 1986). Sands are highly permeable. Pockets of peaty sand and peat-rich sand intersect the development envelope. Around the Canning River the geology is Guildford Formation. The section between the Canning River and Beckenham Junction is sandy clay, clay and Bassendean Sands.

Soil-landscape mapping of the South West of Western Australia (DAFWA, 2007) indicates the Proposal sits within the Pinjarra Zone, Bassendean Zone and just into the Spearwood Dunes of the Perth Coastal Zone.

8.4.2 Acid sulfate soils

ASS risk mapping (NationalMap, 2018) indicates the majority of the development envelope is located within moderate to low risk areas of ASS occurring within 3m of the natural soil surface, but high to moderate risk of ASS occurring beyond 3m. Several pockets of high risk areas (Figure 15), where ASS is potentially present within 3m of the natural ground surface occur along the alignment. These are associated with the Canning River sediments and mapped wetlands.

8.4.3 Contaminated Sites

The proposed Ranford Road station location within the development envelope is considered contaminated or possibly contaminated, due to former landfill activities (Figure 16). It therefore represents poor quality of land and soils with limited environmental values:

The Preliminary Site Investigation (PSI) (GHD, 2016) and Sampling and Analysis Plan (SAP) (GHD, 2017a), which investigated Lots 302, 303 and 500 associated with the Ranford Road station site, included a Conceptual Site Model (CSM) which describes the preliminary risks to human health and the environment, based on identified contamination sources, transport mechanisms, exposure pathways and receptors. Prior to completion of the DSI (interim), the following risks to the environment were documented:

- Very low risk to ecological receptors[15] from groundwater contaminants (metals, hydrocarbon, pesticides, major ions, nutrients and per- and poly-fluoroalkyl substances (PFAS)) and surface water contaminants (metals, hydrocarbon, pesticides, major ions and nutrients) identified in the general landfill area.
- Low risk to terrestrial flora and fauna from ground gases (CO_2, CO, H_2S, CH_4 and vapours) identified in the general landfill area. Future development risk is considered to be Moderate without appropriate management measures.
- Low risk to ecological receptors[16] from hydrocarbons from the City of Canning Waste Transfer Station.
- Very Low risk to ecological receptors[17] from hydrocarbons from the oil pipelines in the vicinity of the development envelope, with appropriate operational/management measures.

8.5 POTENTIAL IMPACTS

Potential impacts to terrestrial environmental quality include:

- Changes to soil quality.
- Potential disturbance of ASS due to excavation, dewatering or removal of riverine sediments.
- Contamination of soils from construction activities associated with storage of chemicals and potential spills.

[15] GHD (2017a) list these as; aquatic organisms, downgradient surface water features, terrestrial flora and fauna.
[16] GHD (2017a) list these as; aquatic organisms, downgradient surface water features, terrestrial flora and fauna.
[17] GHD (2017a) list these as; aquatic organisms, downgradient surface water features, terrestrial flora and fauna.

- Removal of landfill waste materials.

8.6 ASSESSMENT OF IMPACTS

8.6.1 Changes to Soil Quality

The *Environmental Factor Guideline – Terrestrial Environmental Quality* (EPA, 2016f) defines Terrestrial Environmental Quality as the '*chemical, physical and biological and aesthetic characteristics of soils'*. The beneficial uses of good quality soil are primarily agriculture, maintaining drinking water quality, recreation and cultural values. Ecosystem health values that are supported by soils include biodiversity, water quality, and seed banks.

The majority of the development envelope comprises good quality of soil that supports the following beneficial uses:

- Soils under the existing freight lines are important economically, as they support existing railway infrastructure.
- Soils under existing vegetation are important as they support biodiversity.
- Soils within the Jandakot Mound Underground Water Pollution Control Area (UWPCA) are important for maintaining drinking water quality.

However, portions of the development envelope associated with the Ranford Road station site that contain landfill waste material are not representative of the natural soils, and are considered to have poor soil quality with no current beneficial use. These landfill waste materials are likely to contain asbestos and physical hazards and may contain concentrations of contaminants that may have impacted groundwater.

The Proposal may alter the soil quality within the development envelope through:

- Disturbance of ASS (through dewatering and excavation) which may cause acidification of soils and release of metals to groundwater. This could affect the soils supporting existing vegetation and those within the UWPCA, which may adversely impact the value of those soils.
- Inappropriate storage of chemicals which can lead to leaks and spills of dangerous goods which may contaminate soil, land and water, which may adversely impact the value of those soils with economic, biodiversity values and those soils important for maintaining drinking water quality.
- Removal and/or capping of landfill waste material which is likely to improve soil quality and may result in a beneficial use by supporting a new station that has associated economic value. The PTA is designing the station to reduce the amount of cut / waste material that will require removal offsite. This is considered a more sustainable option rather than disturbing substantial quantities of waste material that would otherwise need be moved to a different landfill.

ASS and dangerous goods handling can be managed during construction by the contractor to avoid significant impacts to soil quality. The removal of and/or capping of landfill waste material is likely to have a positive impact and be a sustainable option for terrestrial environmental quality.

8.7 MITIGATION

In developing the Proposal, the PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for the terrestrial environmental quality factor is outlined in Table Y.

TABLE Y: MITIGATION HIERARCHY FOR TERRESTRIAL ENVIRONMENTAL QUALITY FACTOR

Avoid	• The Proposal has been designed to avoid large scale dewatering where possible, and the majority of the railway will be positioned at the same level as existing freight lines, therefore avoiding the need for significant excavations in moderate ASS risk areas. • The methodology for crossing the Canning River has been reviewed by engineers and a range of possible crossings (e.g. construction of a tunnel, various bridge structures etc.) was considered. A bridge has been chosen, with no footings to be placed within the river itself, rather the bridge span will extend the width of the river and support footings placed within the land adjacent to the banks. This will avoid direct impacts to the Canning River and associated oxidation of riverine sediments. • The grade separation of Cameron Street to Elliot Place will utilise an overhead bridge rather than an underground tunnel to avoid dewatering and excavation of ASS. • Existing tunnels (e.g. Glen Iris and Kenwick Link) will be utilised rather than create new tunnels. This will avoid dewatering and excavation of ASS. • No dangerous goods will be stored within UWPCA and therefore spills and leaks into the Jandakot Mound water source will be avoided. • By utilising the existing railway corridor, the value of the soils within the corridor will be maintained as the land use will be the same.
Minimise	• Preparation of Site Management Plans (SMPs) and / or Remediation Action Plans (RAPs) for the proposed Ranford Road station site, in accordance with *Assessment and Management of Contaminated Sites* (DER, 2014) to manage landfill waste materials. The SMPs and RAPs will be reviewed/approved by a DWER accredited Contaminated Sites Auditor. • Implementation of SMPs and / or RAPs. Site Remediation Reports will be prepared to document the implementation of remediation and validation works and these reports will be reviewed/approved by the Contaminated Sites Auditor. • Risks associated with working on potentially contaminated sites during construction will require specific management through the implementation of a CEMP. • In the event that other contamination is encountered during construction, the CEMP will outline an unexpected finds protocol to detail how contamination will be managed. The protocol will include triggers for consultation with DWER, local government, DBCA (if within the Swan River Trust Development Control Area) and the parties responsible for the contamination (if they can be identified). • The detailed design for the Ranford Road Station will be finalised once the final DSI and SMP/RAP are completed. • Investigation of ASS conditions in high risk areas and preparation of an ASS and Dewatering Management Plan if required.
Rehabilitate	Rehabilitation of the landfill portion within the development footprint (i.e. Ranford Road station site) through onsite capping strategies and management of ground gases through engineered solutions. The project will target a reclassification of the developed portion to 'remediated for restricted use'.
Offset	As no residual significant impacts are expected, no offset is proposed for this factor.

8.8 PREDICTED OUTCOME

No residual impacts are expected as a result of the Proposal. It is likely that through implementation of the CEMP and SMP in accordance with the *Contaminated Sites Act 2003*, the EPA's objective will be met and a positive outcome achieved in relation to the former landfill.

9 HYDROLOGICAL PROCESSES

9.1 EPA OBJECTIVE

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

9.2 POLICY AND GUIDANCE

Environmental Factor Guideline – Hydrological Processes (EPA, 2016g).

9.3 ENVIRONMENTAL INVESTIGATION

A desktop assessment has been undertaken by Aurora Environmental to assess the ground and surface water values within the development envelope. A wetland assessment of the survey area was undertaken by GHD (2018).

9.4 RECEIVING ENVIRONMENT

9.4.1 Rainfall

Jandakot receives on average 823 mm of rainfall per year, based on 39 years of climate data (between 1972 and 2018) for the Jandakot Airport (station ID: 9172)(BoM, 2018a). The average annual evaporation for the Perth region is 1,600 – 1,800 mm (BoM, 2018b). The data indicates more water evaporates than infiltrates per year, suggesting the TCL will operate in a drying climate with decreasing groundwater and/or surface water levels.

9.4.2 Surface Water

The development envelope is located within the following four unproclaimed surface water catchments:

- Swan–Avon Lower Swan.
- Coastal.
- Swan–Avon Canning River.
- Bartram Road.

9.4.2.1 Canning River

The Canning River is a major tributary of the Swan River and is a proclaimed river under the *Rights in Water and Irrigation Act 1914*.

The development envelope traverses the Canning River, an ESA, Bush Forever site (ID: 246) and REW (UFI: 7447) (Figure 9.2). The development envelope will occupy 16.82 ha of the Bush Forever site and 4.06 ha of the REW. Vegetation within the REW has been mapped as *Eucalyptus rudis Melaleuca rhaphiophylla* open forest (GHD, 2018).

Portions of the development envelope and development footprint will be located within the 1 in 100 (1%) annual exceedance probability (AEP) floodway and flood fringe mapping (Figure 17). The flood fringe is that part of the floodplain where development may be considered acceptable subject to certain conditions that will provide adequate flood protection. The floodway is that part of the 1 in 100 (1%) AEP floodplain where development that is considered obstructive to major flows is not acceptable as it would increase flood levels upstream.

9.4.2.2 Geomorphic Wetlands

Refer to Section 6.4.8 for a description of wetlands within the development envelope.

9.4.3 Groundwater

The Proposal is located within the Jandakot and Perth proclaimed groundwater areas, and within multiple subareas; South Lakes, Airport, City of Canning, City of Melville, City of Cockburn and City of Gosnells.

The Jandakot Mound, a superficial (unconfined) aquifer, is an important source of Perth's drinking water supply and is located in the vicinity of the western end of the development envelope. The deep (partially confined) Leederville and deep (mostly confined) Yarragadee aquifers underlie the Jandakot Mound, separated by a confining layer of Kardinya shale (DoW, 2017). Groundwater levels across the Jandakot Mound have generally declined over the last 40 years (DoW, 2017). The historical maximum groundwater level on the Jandakot Mound is approximately 28mAHD.

The superficial aquifer is hosted by Bassendean Sands and groundwater flows from the Jandakot Mound northwest towards the Swan/Canning Rivers, and northeast towards the Canning River (Figure 5).

The Perth Groundwater Map (https://maps.water.wa.gov.au/#/webmap/gwm) indicates the depth to groundwater[18] is approximately 14m below the existing ground surface at the proposed Ranford Road station, with the water table situated at approximately 22 m AHD. MGL in the vicinity of the station was recorded at 25mAHD. Groundwater flow direction is north flowing from Jandakot Mound (Figure 5).

Depth to groundwater[19] is approximately 2m below the existing ground surface at the proposed Nicholson Road station, with the water table situated at approximately 13 m AHD. MGL in the vicinity of the station was recorded at 15mAHD (i.e. at existing ground surface). Groundwater flow direction beneath the station is northeast towards the Canning River (Figure 5).

The depth to groundwater is shallowest beneath the development envelope in the vicinity of the Canning River, where MGL is approximately 3mAHD (Figure 5).

9.4.3.1 Underground Water Pollution Control Area

Within the Jandakot Mound is an area defined as the UWPCA. The section of TCL between the Kwinana Freeway and Jandakot is within the UWPCA and traverses Priority 1 and Priority 3 designated areas (Figure 6).

The *State Planning Policy 2.3 Jandakot Groundwater Protection* (WAPC, 2017) defines Priority areas within the UWPCA:

> *Priority one (P1) area – This is the highest level of protection and normally will apply to land owned by the State, with low intensity and low-risk land use such as forestry. Use of this land for protection of the public water supply outweighs virtually all other considerations and the*

[18] Groundwater levels are estimated based on recorded groundwater levels measured in May 2003 (end of summer).
[19] Groundwater levels are estimated based on recorded groundwater levels measured in May 2003 (end of summer).

object is to ensure that there is no degradation of water resources in these areas (i.e. risk avoidance/prevention).

Priority two (P2) area – Normally includes private rural with few buildings, with low-risk, low-intensity land use. These areas have a high priority for public water supply use. The management objective is to ensure there is no increased risk of pollution to the water source (i.e. risk minimisation). Restricted development may take place under specific guidelines.

Priority three (P3) area – Generally includes areas where water-supply needs co-exist with other land uses such as housing, commercial sites and light industry. Management controls, rather than land use restrictions dominate the water management and protection policy for these areas. The areas are defined to minimise the risk of pollution to the water source (i.e. risk management).

9.4.3.2 Production Bores and Wellhead Protection Zones

The *State Planning Policy 2.3 Jandakot Groundwater Protection* (WAPC, 2017) defines wellhead protection zones as areas regulated to address contamination of public drinking water abstraction bores. It has a radius of 500 metres in P1 areas, and 300 metres in P2 and P3 areas. The section of TCL between the Kwinana Freeway and Jandakot is within the vicinity of Jandakot Mound production bores and wellhead protection zones (Figure 6). Specifically, Production Bore J400 (which abstracts water from the superficial aquifer) and the corresponding wellhead protection zone intersects the development envelope (Figure 6).

9.4.3.3 Groundwater Users

Superficial Aquifer

The DWER's latest annual compliance report for the Jandakot Mound (DoW, 2017) lists the licensed entitlements for public water supply and private use from the Superficial aquifer (Table Z).

TABLE Z: LICENSED ENTITLEMENTS FOR PUBLIC WATER SUPPLY AND PRIVATE USE FROM THE SUPERFICIAL AQUIFER

GROUNDWATER AREA	SUBAREA	ALLOCATION/LIMIT (GL/YEAR)	PUBLIC WATER SUPPLY ENTITLEMENT FOR 2015-16 (GL)	PRIVATE LICENSED ENTITLEMENT FOR 2015-16 (GL)
Jandakot	South Lakes	0.82	No data	0.57
	Airport	2.64	1.20	0.87
Perth	City of Canning	3.50	No data	2.74
	City of Melville	5.50	No data	4.08
	City of Cockburn	1.00	No data	0.54
	City of Gosnells	5.50	No data	3.28

The DWER's Water Information Reporting (WIR) database indicates there are 12 registered bores located within a 1 km radius of the proposed Ranford Road station (GHD, 2016). The majority of bores are listed as being owned by the DWER, with some listed as being for the purpose of irrigation.

The WIR database indicates there are 37 registered bores located within a 1 km radius of the proposed Nicholson Road station.

Unregistered bores may exist down-gradient from proposed station sites, and may be used for irrigation purposes and other non-potables uses (such as commercial use).

Leederville / Yarragadee aquifer

The DWER's Water Register (DWER, 2018) indicates a groundwater licence (GWL: 165600) has been granted in the vicinity of the development envelope for abstraction of water from the Leederville aquifer. The licence granted to the City of Gosnells allows the abstraction of 696,000 kL for irrigation of various parks/reserves in the City. No other licences for the aquifer have been granted adjacent to the development envelope.

9.5 POTENTIAL IMPACTS

The potential impacts to hydrological processes are:

- Dewatering / displacement of water to install footings and to extend or modify bridges.
- Construction and permanent siting of the TCL within the Canning River floodway and flood fringe which may obstruct surface water flows.
- Alteration to hydrological regimes of wetlands.
- Construction activities within the UWPCA and Wellhead Protection Zones which may cause pollution and affect water quality.
- Abstraction of groundwater for construction purposes and drawdown of groundwater which may affect private and public groundwater users.

9.6 ASSESSMENT OF IMPACTS

9.6.1 Dewatering / Displacement of Water for the installation of bridge footings

Based on the current knowledge of groundwater conditions and project design, some temporary localised groundwater dewatering may be needed to facilitate construction of the proposed infrastructure (e.g. Canning River rail bridge and pedestrian bridge footings) within the development envelope. Dewatering requirements could also be influenced by the construction method adopted which may result in groundwater displacement as opposed to dewatering.

The effects of the drawdown/displacement will be localised and temporary and last the minimum period to allow the completion of construction. Where dewatering is required, the impacts to groundwater systems can be minimised through infiltration of dewatering effluent (subject to the water quality being suitable). As dewatering would likely be undertaken for short periods and in localised areas, it is anticipated that groundwater conditions will quickly return to pre-construction conditions. As a result, the impacts to other Superficial aquifer users or vegetated areas in close proximity to areas where dewatering is needed will likely be short-term.

A more detailed assessment of dewatering requirements will be undertaken once detailed design has been completed and the preferred construction methods are better defined. This will include an assessment of the drawdown associated with production bores to be used for supplying water for construction purposes. The assessment will determine the depth of predicted drawdown and the likely volume of water to be extracted and hence be able to predict the cone of depression at any location where dewatering or groundwater abstraction is required. Where impacts are predicted to other groundwater users or groundwater dependent ecosystems, the contractor will implement

remedial actions during dewatering activities to manage potential impacts to these receptors. If necessary, a dewatering licence application will be submitted to the DWER.

9.6.2 Impacts to Canning River Flood Regime

Due to the flexibility incorporated into the design of the development envelope, no impacts or alterations to the Canning River flood regime is expected. Advice from the DWER (S. Rodgers, pers. comm. 22 March 2018), based on review of the Canning River Flood Study, suggests the following flood levels are expected under major rainfall events:

- 1 in 10 AEP flood level 3.1 m AHD.
- 1 in 25 AEP flood level 3.4 m AHD.
- 1 in 100 AEP flood level 3.95 m AHD.

Proposed development (i.e. filling, building, etc.) that is located outside of the floodway (Figure 17) is considered acceptable with respect to major flooding. However, a minimum habitable floor level of 500 mm above the appropriate 1% AEP flood level is recommended to ensure adequate flood protection.

Proposed development (i.e. filling, building, etc.) located within the floodway that is considered obstructive to major flows is not acceptable as it would increase flood levels upstream. No new buildings are acceptable in the floodway.

Therefore, PTA will implement the following restrictions on activities within the floodway to meet the DWER requirements and ensure no obstruction to major flows of the Canning River during flood events:

- No new permanent buildings constructed in the floodway.
- No filling within the floodway.
- Mobile fuel storage tanks will not be sited in the floodway as it may not be possible to obtain 2m separation distance to groundwater.
- No permanent (>12 months) fuel storage tanks sited in the floodway.
- No storage of chemicals or dangerous goods, even if appropriately bunded, in the floodway.
- No stockpiles of potentially contaminated soil to be sited in the floodway.

The new Canning River Bridge footings/pillars will be placed adjacent to existing footings/pillars and therefore will not narrow the river course or restrict flow beyond the current situation.

Based on the above restrictions and proposed placement of footings/pillars, the risk of obstructing flows during major flood events is considered low, and therefore no significant impacts to the hydrological processes of the Canning River flood regime are likely.

9.6.3 Alteration to hydrological regimes of CCW and REWs

The development envelope intersects the following areas of CCW and REW:

- 0.40 ha of CCW (UFI: 7446, Tom Bateman Reserve). The development envelope encroaches on the southern and western fringes of the mapped wetland, affecting 13% of the DBCA mapped wetland. This area will be used for construction activities (refer to Section 2.3.2.4).

- 4.06 ha of REW (UFI: 7447, Canning River). The railway, Canning River bridge duplication and construction activities will occur within 4% of the DBCA mapped wetland.
- 0.74 ha of REW (UFI: 13332, south of Canning Vale landfill and recycling facility). The portion of Jandakot Eastern Link Road and the proposed Ranford Road station will be constructed in 3% of the DBCA mapped wetland.

The elevation of the affected area of CCW (UFI: 7446) is approximately 13mAHD at the same level as the existing freight corridor (Figure 10). Therefore, water is unlikely to pool in these areas of the wetland and will continue to naturally infiltrate into Bassendean Sands. V drains will be constructed adjacent to the train line, which will collect and infiltrate rainfall to groundwater, similar to natural conditions. The wetland is part of the larger wetland system (MUW UFI: 13621), therefore the impacts in the development envelope are minor in the context of the scale of the dampland. It is very unlikely that alteration to this 13% of the CCW will significantly affect the hydrological processes of this wetland.

The elevation of the affected area of REW (UFI: 7447) within the development footprint is approximately 6mAHD at the same level as the existing freight corridor (Figure 13.1). Surrounding areas slope from 6–7mAHD down towards the river. Where possible PTA will not disturb the surface water flows into the river through design of the bridge duplication and siting of the new headwall. It is very unlikely that alteration to this 4% of the REW will significantly affect the hydrological processes of this wetland/portion of the river.

The northern portion of the REW (UFI: 13332), which will be affected by the construction of a portion of the Jandakot Eastern Link Road and the new station, is at an elevation of approximately 26mAHD, and at a higher elevation to southern portions of the REW which range in elevation from 24-25mAHD (Figure 14.1). This suggests surface water is more likely to pool in the southern portion and water runs towards these lower lying areas. As the road and station are likely to be filled to a higher elevation to existing levels, it is likely that flows to the south will continue uninterrupted, with no change to the hydrological regime, but less water may flow from this area due to it being captured in road drains. The application of water sensitive urban design principles will encourage infiltration where possible to help reduce hydrological changes. Therefore, the impact to the hydrological regime on this wetland is considered to be negligible and insignificant.

Hydrological processes of REW (UFI: 15926) may be adversely affected if this area is used for construction laydown e.g. stockpiling of construction materials. However PTA has committed to retaining the vegetation within and adjacent to this wetland and therefore will not conduct laydown activities within the REW or alter the hydrological regime. Runoff from surrounding adjacent areas may be obstructed from entering the REW by temporary placement of construction materials and parking of vehicles and machinery. Review of historical aerial photographs from 1953 (source: NearMap and Landgate) suggests no permanent water body exists within the wetland but the soil appears to hold moisture as the wetland core appears greener than the surrounding land outside the wetland during winter months. The vegetation within the REW (VT05) is already highly disturbed and was rated by GHD (2018) as Good-Degraded. The adjacent areas to the REW, which comprise Degraded-Completely Degraded grassland/herbland (VT07) (Figures 13.1 and 13.2) may be used for construction laydown but are likely to have a minor impact on the hydrological regime. It is noted that the hydrological processes are likely to have been historically altered; given the area surrounding this wetland has been modified since 1953, therefore the water that feeds the wetland

core is likely to be representing a modified hydrological regime. Any minor impact to water flow will be temporary. Following completion of construction, pre–construction conditions will be re–instated.

PTA will implement the following restrictions on activities within CCW (UFI: 7446) and REWs (UFI: 7447, UFI: 13332):

- No new buildings constructed in the wetlands.
- Mobile fuel storage tanks will not be sited in the wetlands.
- No permanent (>12 months) fuel storage tanks sited in the wetlands.
- No storage of chemicals or dangerous goods, even if appropriately bunded, in the wetlands.
- No stockpiles of potentially contaminated soil to be sited in the wetlands.

As a result, the implementation of measures above, the hydrological processes of CCW (UFI: 7446) and REWs (UFI: 7447, UFI: 13332 and UFI:15926) are unlikely to be affected by the Proposal.

9.6.4 Impacts to UWPCA and Wellhead Protection Zones.

The section of TCL between the Kwinana Freeway and Jandakot is within the UWPCA and traverses Priority 1 and Priority 3 designated areas. The new passenger railway line will traverse the wellhead protection zone for Production Bore J400 (Figure 6) which abstracts water from the Superficial aquifer.

As the TCL will follow the existing freight line and no new railway stations are proposed in the UWPCA or wellhead protection zone there will be no impacts to hydrological processes of the UWPCA or wellhead protection zone. In addition, PTA will implement the following restrictions on activities within these areas:

- No dewatering without prior approval from the Water Corporation.
- Mobile fuel storage tanks will not be sited in these areas.
- No permanent (>12 months) fuel storage tanks sited in these areas.
- No elevated fuel storage tanks will be sited in these areas.
- No storage of chemicals or dangerous goods.
- No storage of petroleum products.
- No stockpiles of potentially contaminated soil to be sited in these areas.
- No chemicals, noxious or other polluting matter discharged to the environment.

Consultation with Water Corporation (C. Loos, pers. comm. 7 March 2018) indicated the highest risk for the drinking water source is likely to be during construction of the re-alignment of the railway. Depending on the proximity and the nature of construction, the Water Corporation may consider not using J400 during the construction period. This risk will be considered again closer to the time of construction and a requirement for continued consultation with the Water Corporation will be included in the CEMP.

9.6.5 Impacts from abstraction of production water

The location of abstraction bores for construction water for the Proposal will be determined prior to the construction phase. However, bores may be placed in either the Superficial or Leederville aquifers. The effects of the drawdown may temporarily impact other aquifer users that have bores within the cone of depression of abstraction bores, or any vegetation reliant on groundwater within the cone of depression. Hydrogeological modelling of the proposed depth of abstraction and volume of water will be undertaken to determine the cone of depression prior to installing production bores. Where impacts are predicted to other groundwater users or groundwater dependent ecosystems, the contractor will implement remedial actions during abstraction to manage adverse impacts to these receptors. In accordance with the *Rights in Water and Irrigation Act 1914* a licence to take water will be required prior to constructing any abstraction bores. Based on DWER advice ((G. Simmons pers. comm. 21 March 2018), a hydrogeological assessment in accordance with *Operational Policy 5.12 Hydrogeological Reporting Associated with a Groundwater Well Licence* (DoW, 2009a) is likely to be required..

9.7 MITIGATION

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for the hydrological processes factor is outlined in Table AA.

TABLE AA: MITIGATION HIERARCHY FOR HYDROLOGICAL PROCESSES FACTOR

Avoid	• Avoid the need for dewatering during construction, as practicable and consistent with construction requirements, through design and construction methodology. • Incremental launch is the preferred methodology for construction of the Canning River rail bridge, as there will be no disruption to the flow of the Canning River.
Minimise	• WSUD principles will be incorporated into the drainage design as described in Section 2.3.2.6. • Restrictions will be in place for construction activities within floodway/CCW/REWs/UWPCA and wellhead protection zones to avoid obstructing flows and impacting these receptors. • Where dewatering cannot be avoided, minimising the extent and duration of dewatering where possible and maximising infiltration and/or utilisation of discharge water from dewatering operations (if of acceptable water quality) for construction purposes in designated infiltration areas, to ensure the aquifer is recharged as quickly as possible. • Hydrogeological modelling of the proposed depth of drawdown and volume of large scale dewatering will be undertaken to determine the cone of depression prior to dewatering at relevant locations, based on the proposed construction methodology. • A CEMP will be prepared and implemented during construction of the TCL. Specific measures relevant to the factor to be included in the CEMP are: - Dewatering management measures / remedial actions including monitoring and reporting requirements. - Restriction of activities that are prohibited within the floodway/CCW/REWs/UWPCA and wellhead protection zones. - Consultation with Water Corporation during construction of the re-alignment of the railway in the UWPCA and wellhead protection zone for Production Bore J400. - Production bores will be sited away from *Banksia* Woodlands TEC where possible, to avoid drawdown of the groundwater beneath the TEC. The separation distance will be based on specific modelling of volumes and drawdown associated with the production

TABLE AA: MITIGATION HIERARCHY FOR HYDROLOGICAL PROCESSES FACTOR

	bore . A hydrogeological assessment is likely to be required. • The CEMP will be prepared in accordance with relevant environmental approvals.
Rehabilitate	Drainage basins will be landscaped where possible in line with WSUD principles. Stabilisation and revegetation of the impacted portion of the Canning River foreshore within the development envelope will be undertaken following construction works.
Offset	As no residual impacts are expected, no offset is proposed for this factor.

9.8 PREDICTED OUTCOME

PTA predict that implementation of the CEMP will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.

10 INLAND WATERS ENVIRONMENTAL QUALITY

10.1 EPA OBJECTIVE

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

10.2 POLICY AND GUIDANCE

- Environmental Factor Guideline – Inland Waters Environmental Quality (EPA, 2016h)
- State Planning Policy 2.3 Jandakot Groundwater Protection (WAPC, 2017)
- Water Quality Protection Note (WQPN) 10: Contaminant Spills Emergency Response (DoW, 2006a)
- WQPN 25: Land Use Compatibility Tables for Public Drinking Water Source Areas (DoW, 2016)
- WQPN 44: Roads Near Sensitive Water Resources (DoW, 2006b)
- WQPN 60: Tanks for Mobile Fuel Storage in Public Drinking Water Source Areas (DoW, 2013)
- WQPN 83: Infrastructure Corridors Near Sensitive Water Resources (DoW, 2007)
- WQPN 84: Rehabilitation of Disturbed Land in Public Drinking Water Source Areas (DoW, 2009b)

10.3 ENVIRONMENTAL INVESTIGATION

A desktop assessment has been undertaken by Aurora to assess the ground and surface water values within the development envelope. A wetlands assessment in the survey area was undertaken by GHD (2018).

10.4 RECEIVING ENVIRONMENT

10.4.1 Surface Water

Refer to Section 9.4.2 for a description of surface water and Section 6.4.8 for a description of wetlands within the development envelope.

10.4.2 Groundwater

Refer to Section 9.4.3 for a description of groundwater.

10.4.3 Beneficial Uses of Groundwater

In the surrounding area, uses of untreated groundwater are expected to include irrigation of gardens including the growing of vegetables, parks and other landscaped areas and use for commercial purposes such as dust suppression. Scheme water is provided to the surrounding area and although flushing toilets and washing vehicles with untreated groundwater cannot entirely be precluded, this is unlikely to occur (GHD, 2016).

The environmental value of groundwater in the surrounding area is therefore expected to comprise:

- Non-potable use of groundwater.
- Protection of aquatic ecosystems (Canning River).

10.4.3.1 Contaminated Groundwater within the Development Envelope

Potentially contaminated groundwater may be associated with the former landfill (i.e. at the proposed Ranford Road station site) as described in Section 8.4.3. Any dewatering or groundwater abstraction within close proximity to a known or potentially contaminated site will be managed appropriately.

10.4.3.2 Other Contaminated Sites within 400m of the Development Envelope

A search of the DWER's Contaminated Sites Database indicates several registered sites are within close proximity (within 400m) of the development envelope (Table AB).

TABLE AB: REGISTERED SITES WITHIN CLOSE PROXIMITY (WITHIN 400M) OF THE DEVELOPMENT ENVELOPE

Property Address	Distance from Development Envelope	Figure	Current Zoning under the Metropolitan Region Scheme	Classification under the *Contaminated Sites Act 2003*	Nature and Extent of Contamination
2 Dundee Street (John Connell Reserve) Leeming – former landfill.	215m north	3.2	Parks and Recreation Reserve	Contaminated – remediation required.	Asbestos and hydrocarbons present in soils, nutrients and iron present in groundwater.
85 Bannister Road Canning Vale.	110m north	3.2	Industrial	Remediated for restricted use.	Hydrocarbons, heavy metals and ammonia present in groundwater.
265 Bannister Road Canning Vale.	250m north	3.2	Industrial	Remediated for restricted use.	Nickel is present in groundwater and asbestos in soils.
14 Wittenberg Drive Canning Vale.	70m north	3.3	Industrial	Remediated for restricted use.	Lead contaminated soil.
60 Bannister Road Canning Vale.	330m north	3.3	Industrial	Contaminated – restricted use.	Hydrocarbons are present in groundwater as a plume extending offsite from beneath the north-east portion of the site.

10.5 POTENTIAL IMPACTS

The potential impacts to inland waters environmental quality are:

- Risks to groundwater quality and the Canning River from contaminated groundwater.
- Impacts to Canning River from displacement of soil and water for the installation of bridge footings.
- Dewatering of ASS or spread of contaminated groundwater via dewatering or groundwater abstraction.
- Impacts to water quality of CCW and REWs.

- Impacts to drinking water quality within the UWPCA and wellhead protection zones.

10.6 ASSESSMENT OF IMPACTS

10.6.1 Risks to Groundwater Quality and the Canning River from Contaminated Groundwater

Groundwater beneath the former landfill at the proposed location of the Ranford Road station site contains sources of contamination. The groundwater flow direction from this area is north/northeast towards the Canning River, located approximately 4.9 km away at its nearest point.

The risks associated with contaminated groundwater are:

- Enhanced degradation of wastes by biological processes as a result of drainage infiltration (e.g. swales and/or soak wells) receiving run-off from low permeability sealed surfaces and concentrated infiltration within parts of the waste mass with resultant increased leachate generation.
- Consolidation/compression of the remaining waste mass from development loadings during/following construction phase, creating a short-term 'pulse' of leachate potential as void spaces are reduced.
- Potential for enhanced vertical migration of leachate associated with deep foundations such as piled foundations (if required to penetrate the remaining waste mass thickness in order to transmit development structure loadings to suitable strata beneath the remaining part of the landfill waste mass).

In the context of the Proposal, some disturbance of the waste mass is expected, which may result in enhanced leachate generation and migration from the waste mass in the short-term. This will require management during construction to mitigate risks posed to relevant receptors. However, in the longer term development features represent effective engineering measures (as part of an integrated solution) to mitigate leachate generation from the waste mass due to source removal and pathway modification, with likely associated reduction in risk.

10.6.2 Impacts to Canning River from Displacement of Soil and Water for the Installation of Bridge Footings

The preferred methodology for construction of the bridge duplication is incremental launch, whereby the building of the superstructure is completed in segments in a casting yard, and put together by working from one end of the bridge to the other end. Each segment is match-cast against the previous one and prestressed to the section of superstructure already built. The entire superstructure is then jacked forward a distance equal to the length of this segment. This process is repeated until the bridge is in its final position. The bridge is likely to be supported by pillars.

Pillars will be constructed on the river banks adjacent to existing pillars outside of the channel of the Canning River to avoid disrupting or diverting surface water flows. The width of the river is approximately 20m at the crossover point. The bridge will span the river without needing to place pillars into the river channel. Displaced water and drilling muds will not be discharged to the Canning River, but will be either treated (prior to reuse or re-infiltration onsite) or disposed offsite. Therefore, no impacts to the water quality of the Canning River are expected from the duplication of the bridge.

A new headwall outlet will be constructed on the banks of the Canning River, and a section of pit to pipe (alongside the passenger rail from Lester Drive) will discharge water to the river at this outlet.

Note: this outlet will replace a pre-existing culvert and will be subject to approval from DBCA (Rivers and Estuaries branch). Potentially contaminated water could be discharged to the river, however PTA propose to implement WSUD to manage water quality before discharge. Water may be treated in a suitably sized vegetated bioretention area that will ensure treatment of the first 15mm of rainfall runoff (equivalent to 1 yr 1 hr ARI). PTA may alternatively install two gross pollutant traps to capture litter/debris in water prior to it entering the river. Therefore, no impacts to the water quality of the Canning River are expected from discharge outlet.

10.6.3 Dewatering of ASS or Drawing in Contaminated Groundwater

Dewatering may be required to install footings to extend or modify bridges along the TCL alignment. Drawdown of the water table may oxidise ASS which could lead to acidification of groundwater and release of heavy metals from surrounding soils. As groundwater flows towards an ESA (Canning River), the plume could potentially affect aquatic organisms within the river or riparian vegetation, through a reduction in water quality.

To manage potentially oxidising ASS, PTA intends to implement the following measures:

- Avoid the need for dewatering, as practicable and consistent with operational requirements, through design.
- Where dewatering cannot be avoided:
  - minimising the extent and duration of dewatering where possible.
  - conducting an ASS Investigation in the location of proposed dewatering.
- Hydrogeological modelling of the proposed depth of drawdown and volume of large scale dewatering will be undertaken to determine the cone of depression prior to dewatering, based on the proposed construction methodology.
- Dewatering will be mitigated through infiltration of dewatering effluent where possible if water quality is suitable, to ensure the aquifer is recharged as quickly as possible.
- If ASS is present, implementation of management measures such as soil neutralisation, raising the pH of dewatering effluent prior to infiltration, groundwater and dewatering effluent monitoring in accordance with DER (2015b) guidelines. These soil and groundwater management and monitoring regimes will be outlined in sub-plans to the CEMP where required.

Based on the preference to avoid large scale dewatering, through construction design and planning processes, and the implementation of management measures to minimise ASS oxidation, the risk of acidification of groundwater and release of heavy metals impacting the water quality of the Canning River is considered low.

As identified in Section 10.4.3 portions of the development envelope are underlain by locally contaminated groundwater. Groundwater abstraction (for construction water) and dewatering (depending on the extent of dewatering cones of depression), could intersect contaminated groundwater during construction works. This may exacerbate the extent of contamination. This potential risk will be carefully managed by:

- Understanding the groundwater characteristics of any abstracted groundwater prior to dewatering or the installation of groundwater production bores.

- Hydrogeological modelling of the proposed depth of drawdown and volume of dewatering (if any) will be undertaken to determine the cone of depression prior to dewatering, based on the proposed construction methodology.
- Where hydrogeological modelling suggests a risk of drawing contaminated water into the development envelope, the PTA/Contractor will review the available technical reports (including any pre-existing Site Management Plans (SMPs)) for those sites and consider how the construction may be affected by existing sources of contamination. Where appropriate management measures will be incorporated into the CEMP, or where warranted a specific sub–plan may be developed, to minimise the dewatering cone of depression to avoid drawing down contaminated groundwater from these sites (and avoiding the requirement to manage potentially contaminated dewatering effluent).
- If drawdown of contaminated water cannot be avoided, establishing a strategy for managing contaminated waste (e.g. constructing a lined pond to capture contaminated water, treating prior to discharge or directly pumping contaminated water into containment vessels for disposal at a licensed liquid disposal facility). These strategies will be developed in consultation with DWER, DBCA (if within the Swan River Trust DCA) and the parties responsible for the contamination (if they can be identified).

Given the localised and short term nature of the likely groundwater abstraction and dewatering activities, the knowledge available about the location of contaminated groundwater, and the steps that will be taken to carefully manage dewatering for the Proposal, it is expected that no significant impacts to groundwater quality will occur as a result of dewatering for the TCL.

10.6.4 Impacts to Water Quality of CCW and REWs

The development envelope will affect the following areas of CCW and REW:

- 0.40 ha of CCW (UFI: 7446, Tom Bateman Reserve). The development envelope encroaches on the south and west fringe of the mapped wetland, affecting 13% of the DBCA mapped wetland. This area will be used for construction activities (refer to Section 2.3.2.4).
- 4.06 ha of REW (UFI: 7447, Canning River). The railway, Canning River bridge duplication, installation of a new headwall and discharge outlet, and construction activities will occur within 4% of the DBCA mapped wetland.
- 0.74 ha of REW (UFI: 13332, south of Canning Vale landfill and recycling facility). The portion of Jandakot Eastern Link Road and the proposed Ranford Road station will be constructed in 3% of the DBCA mapped wetland.

A spill or leak of chemicals or dangerous goods within or adjacent to CCW or REWs has the potential to adversely affect the water quality of any water bodies within the wetlands or surface water / groundwater feeding the wetlands. The CEMP will include spill and leak response procedures, with the basic process being:

- The leak or spill will be contained and cleaned up immediately using absorbent materials.
- The incident will be reported to Supervisors, whom will engage the services of a licensed controlled waste contractor. They will be contacted immediately to clean up the spill and prevent its spread offsite, or if already offsite, further from the site.

- Contaminated soil or water affected will be removed from the site and appropriately disposed of.
- Clean up materials (e.g. absorbent materials) used in the spill response will be disposed of appropriately to landfill.
- Incident reporting will be completed to regulators and stakeholders as appropriate.

In addition, PTA will implement the following restrictions on construction activities within the CCW and REWs:

- Mobile fuel storage tanks will not be sited in the wetlands as it may not be possible to obtain 2m separation distance to groundwater.
- No permanent (>12 months) fuel storage tanks sited in the wetlands.
- No storage of chemicals or dangerous goods, even if appropriately bunded, in the wetlands.
- Any areas where chemicals are being stored will be bunded to ensure that pollutants are not washed into adjacent wetland areas during rainfall events.

No significant impacts are planned to the water quality of CCW or REWs, and management measures as listed above will be in place to control unplanned releases. In addition, the restrictions placed on activities within the wetlands will further reduce the risks to water quality.

10.6.5 Impacts to Drinking Water Quality within the UWPCA and Wellhead Protection Zones

The section of TCL between the Kwinana Freeway and Jandakot is within the UWPCA and traverses Priority 1 and Priority 3 designated areas. The new passenger railway lines will traverse the wellhead protection zone for Production Bore J400 (Figure 6) which abstracts water from the Superficial aquifer.

As the TCL will follow the existing freight line and no new railway stations are proposed in the UWPCA or wellhead protection zone there will be no impacts to drinking water quality in the UWPCA or wellhead protection zone. In addition, PTA will implement the following restrictions on activities within these areas:

- No dewatering within the well head protection zone.
- Fuel storage tanks will not be sited in these areas.
- No permanent (>12 months) fuel storage tanks sited in these areas.
- No elevated fuel storage tanks will be sited in these areas.
- No storage of chemicals or dangerous goods.
- No storage of petroleum products.
- No stockpiles of potentially contaminated soil to be sited in these areas.
- No chemicals, noxious or other polluting matter discharged to the environment.

Consultation with Water Corporation (C. Loos, pers. comm. 7 March 2018) indicated the highest risk for the drinking water source is likely to be during construction of the re-alignment of the railway. Depending on the proximity and the nature of construction, the Water Corporation may consider not using J400 during the construction period. This risk will be considered again closer to the time of

construction and a requirement for continued consultation with the Water Corporation has been included in the CEMP.

10.7 MITIGATION

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for the inland waters environmental quality factor is outlined in Table AC.

TABLE AC: MITIGATION HIERARCHY FOR INLAND WATERS ENVIRONMENTAL QUALITY FACTOR

Avoid	• Rail bridge footings have been planned to be placed outside of the channel of the Canning River to avoid affecting water quality of the river. • Avoid the need for dewatering during construction, as practicable and consistent with operational requirements, through design.
Minimise	• Understanding the groundwater characteristics of any abstracted water, prior to dewatering or the installation of groundwater production bores. • WSUD principles will be incorporated into the drainage design as described in Section 2.3.2.6. • Restrictions will be in place for construction activities within floodway/CCW/REWs/UWPCA and wellhead protection zones to avoid impacts to these receptors. • Where dewatering cannot be avoided, minimising the extent and duration of dewatering where possible and maximising infiltration and/or utilisation of discharge water from dewatering operations (if of acceptable water quality) for construction purposes, in designated infiltration areas, to ensure the aquifer is recharged as quickly as possible. • Hydrogeological modelling of the proposed depth of drawdown and volume of large scale dewatering will be undertaken to determine the cone of depression prior to dewatering, based on the proposed construction methodology. • A CEMP will be prepared and implemented during construction of the TCL. Specific measures relevant to the factor to be included in the CEMP are: - If ASS is present, incorporation of management measures such as soil neutralisation, groundwater and dewatering effluent monitoring in accordance with DER (2015b) guidelines. - Where hydrogeological modelling suggests a risk of drawing contaminated water into the development envelope, PTA/Contractor will review the available technical reports (including any pre-existing SMPs) for those sites and consider how the construction may be affected by existing sources of contamination. Where appropriate management measures will be incorporated into the CEMP (or activity specific sub plan) to minimise the dewatering cone of depression to avoid drawing down contaminated groundwater from these sites (and avoid the requirement to manage potentially contaminated dewatering effluent). - In the event that other contamination is encountered during construction, development and implementation of a strategy for dealing with the contamination in consultation with DWER, DBCA (if within the Swan River Trust DCA) and the parties responsible for the contamination (if they can be identified). - Chemical storage areas will be bunded to ensure that pollutants are not washed into adjacent areas during rainfall events. - Restriction of activities that are prohibited within the CCW/REWs/UWPCA and wellhead protection zones.

TABLE AC: MITIGATION HIERARCHY FOR INLAND WATERS ENVIRONMENTAL QUALITY FACTOR

	- Uncontrolled release of chemicals (leak or spill) will be cleaned up immediately. • The CEMP will be prepared in accordance with relevant environmental approvals.
Rehabilitate	• No rehabilitation of water quality is proposed. • Drainage basins may be landscaped where possible in line with WSUD principles. • Stabilisation and revegetation of the impacted Canning River foreshore will be undertaken following construction works.
Offset	As no residual impacts are expected, no offset is proposed for this factor.

10.8 PREDICTED OUTCOME

The PTA predict that implementation of the CEMP will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.

11 SOCIAL SURROUNDINGS

Four components of the social surroundings are described in this section; noise, vibration, aboriginal heritage and culture, and European heritage.

11.1 EPA OBJECTIVE

To protect social surroundings from significant harm.

11.2 NOISE

11.2.1 Policy and Guidance

- Environmental Factor Guideline – Social Surroundings (EPA, 2016i).
- State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP5.4) (WAPC, 2009) (currently under review).

Note: The *Environment Protection (Noise) Regulations 1997* do not apply to the TCL as trains are generally exempt under Regulation 3.

11.2.2 Environmental Investigation

The following environmental investigation was undertaken to assess the social surroundings of the development envelope:

- Thornlie – Cockburn Link Noise and Vibration Assessment (SLR, 2018).

Table G provides a brief description of this investigation and identifies the assessment standards used to inform the scope and content of the individual investigations.

11.2.3 Receiving Environment

Noise measurements of the existing freight operations have been modelled and SLR (2018) has identified that greater than 50% of the 707 residential noise sensitive premises are currently subject to noise emissions from existing infrastructure greater than the Default Design Level[20]. The SLR report notes:

- During the daytime period 354 residential premises receive average noise levels > 60 decibels (dB), the Default Design Level.
- During the night time period 366 residential premises receive average noise levels > 55dB, Default Design Level.
- Maximum levels (> 80dB Default Design Level) are received at 508 residential premises (74%), with the greatest level being 99 dB.

11.2.4 Potential impacts

The potential impacts are noise emissions on nearby residential receptors will increase (without controls) and more residences will be affected.

[20] As the existing environment noise levels exceed the 'Rail Operations - Airborne Noise Trigger Level', the 'Rail Operations - Airborne Noise Design Level' is used for the modelling. The 'default' design level is 5dB above the trigger level.

11.2.5 Assessment of Impacts

11.2.5.1 TCL Operational Profile

The train numbers modelled for the assessment of impacts for existing and future rail traffic are listed in Table AD.

TABLE AD: MODELLED FUTURE RAIL VOLUMES FOR EXISTING FREIGHT AND PROPOSED PASSENGER LINES

Lines	Normal Service Volumes, Both Up and Down Directions			Modelled Speed Limit (km/hr)	Basis
	Total (24 hrs)	Day (6:00am to 10:00pm)	Night-time (10:00pm to 6:00am)		
Existing freight lines	24	18	6	70 Up 50 Down	Future scenario at year 2021
Future freight lines	24	18	6	80	
TCL	128	112	16	80	2017 timetables
Mandurah Lines	128	112	16	100	
Armadale lines (continuation)	144	126	18	80	

For all rail operations, the modelled scenarios for concurrent rail operations included both the dual gauge and passenger main lines with rail traffic data for the relevant assessed scenarios as provided by the PTA and listed in Table AE. Stowed / parked trains were not included in the modelling. Consideration of the estimated increase in noise levels due to rail traffic growth (estimated 20 years in the future) in accordance with SPP5.4 was captured in the modelling.

11.2.5.2 Assessment Criteria

The objective of the SPP5.4 is for noise levels not to exceed noise targets and / or limits presented in Table AE. As the TCL is a major redevelopment and not a new railway, PTA are not required to comply with the noise targets and limits in Table AF, but these targets and limits were considered when proposing mitigation measures.

TABLE AE: SPP5.4 OUTDOOR CRITERIA

Time of Day	Noise Target	Noise Limit / Design Level
Day (6:00am to 10:00pm)	L_{Aeq}[21] 55 dB	L_{Aeq} 60 dB
Night-time (10:00pm to 6:00am)	L_{Aeq} 50 dB	L_{Aeq} 55 dB

[21] The 'energy average noise level' evaluated over a defined time period. The L_{Aeq} can be likened to a noise dose representing the cumulative effects of all the noise events occurring in the relevant time period. Sound levels are expressed in dB re 20 µPa.

11.2.5.3 Modelling Predictions

All residential, commercial and industrial dwellings immediately adjacent to the rail corridor (i.e. the first row) were identified as potential noise sensitive receptors. Where the noise levels are predicted to meet the criteria listed in Table AF, it was considered that noise levels will be achieved at all receptors beyond the first row and at a greater distance from the rail corridor.

Based on the modelling the predicted impacts on receptors from the TCL trains will be lower than currently received from the freight operations, if the freight operations ceased. However, when freight operations and the TCL trains are operating simultaneously cumulative noise levels at noise sensitive premises are modelled to be greater by 2 dB at the majority of residences adjacent to the rail corridor. Predicted airborne noise figures are shown in Appendix E of SLR (2018).

11.2.5.4 Consultation Process and Proposed Mitigation Measures

Adjoining residents were consulted regarding noise impacts through workshops and subsequent surveys, as described in Table F, and in full detail in SLR (2018) (Appendix 7).

During the consultation process, the PTA were asked to justify why the TCL is proposed to be located at the same level as the existing freight line, rather than lowering the new passenger lines, which would reduce noise, vibration and visual amenity impacts to nearby receptors. Engineers tasked with designing the TCL list the following reasons for keeping the alignment at the same height:

- Due to depth of existing services, lowering the TCL may impact on buried services and create additional impacts and costs to move these services.
- Due to depth of groundwater, which may be at or above design and existing surface elevations in some portions of the development envelope.
- The existing freight grade is currently at maximum operating grade in multiple locations along the alignment. This provides limited opportunity to refine earthworks and subsequent retaining walls. The passenger and freight will share a common formation (sub-structure).
- Having a level difference would require more complex construction staging due to working adjacent to an operating railway. This has the potential to delay the project and incur additional costs.
- The height of existing bridges is a governing factor. The rail cannot be lowered without undermining or adversely impacting existing bridge foundations.
- Lowering the rail would impact on the existing drainage network and outfall levels. The outfall levels are proposed to be maintained in the new drainage design.

Mitigation measures were discussed with residents during the consultation process and overall general support was achieved. A combination of noise walls, generally a minimum of 2.4m high and maximum height of 4m, are proposed to achieve the criteria listed in Table AF as far as practicable (noting the noise walls are subject to factors such as visual amenity, community consultation and detailed engineering design). Internal surfaces of some noise walls are proposed to have engineered sound absorptive finishes to improve performance instead of increased heights (and therefore potential visual amenity issues).

Subject to detailed design considerations, each noise wall is proposed to be constructed as follows:

- Each wall will have a weighted sound reduction index of not less than 20 dB as defined by Australian Standard AS/NZS ISO 717.1:2004 Acoustics – rating of sound insulation in buildings and building elements. Part 1: airborne sound insulation.
- Sound absorptive finishes on certain noise walls will have a minimum weighted performance co–efficient of 0.70 (Class C) when installed and rated to Australian Standard *AS ISO 11654 Acoustics – Rating of sound absorption – Material and systems*.
- Noise walls will form a continuous façade with no gaps or openings. Any gaps are to be closed with an acoustic seal. The panels of the noise walls will be securely fixed and designed to minimise rattle wand whistle under heavy wind gusts.

11.2.5.5 Outcome

The construction of noise walls in appropriate locations is expected to reduce predicted noise levels to the limit/design level listed in Table AF and hence meet the objectives of SPP5.4. By implementing noise mitigation measures and moving the freight rail further north in the railway reserve, the received noise levels at the majority of receptors are expected to improve compared to existing levels, thus overall the TCL is likely to have a positive amenity impact.

11.2.6 Mitigation

In developing the Proposal, the PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for noise emissions is outlined in Table AF.

TABLE AF: MITIGATION HIERARCHY FOR NOISE EMISSIONS

Avoid	There are no avoidance strategies for noise emissions.
Minimise	• Consultation with identified noise sensitive receptors has been undertaken, with general support for the construction of noise walls to mitigate noise levels. • Implementation of a Noise and Vibration Management Plan for the operating phase. This Plan is provided in Appendix 7. Proposed noise mitigation and management measures include: - Construction of noise walls (as described in Section 11.2.5.4). - Within three months and again at 18 months post commissioning of the TCL noise levels will be monitored against baseline levels and assessment criteria to verify the project has achieved the design levels. - Corrective actions listed in the Plan will be implemented if required based on monitoring results. - Implementation of a complaint handling procedure. - Continued community engagement and consultation. • Track maintenance will be undertaken to reasonably maintain the operational performance of the relevant railway infrastructure and reduce wear to trains. This will involve regular inspection of the rail condition and rail rectification / grinding to remove excessive roughness or corrugation which may develop over time.
Rehabilitate	There are no rehabilitation strategies proposed for noise.
Offset	No offset is proposed.

11.3 VIBRATION

11.3.1 Policy and Guidance

- Environmental Factor Guideline – Social Surroundings
- Australian Standard 2670.2 Evaluation of Human Exposure to Whole–Body Vibration

11.3.2 Environmental Investigation

The following environmental investigations were undertaken to assess the social surroundings of the development envelope:

- Thornlie–Cockburn Link Noise and Vibration Assessment (SLR, 2018).

Table G provides a brief description of this assessment and identifies the assessment standards used to inform the scope and content of the individual investigations.

11.3.3 Receiving Environment

Freight trains currently cause vibration, with the measured level of an average freight train travelling at 80km/hr at a distance of 10m being 130 dB re 1nm/s[22]. At a distance of 40m the vibration level reduces to 112 dB re 1nm/s. Regenerated noise is more likely to be noticeable at this distance from the railway.

Humans in buildings located 40m away as a freight train passes by may notice the vibration, as humans may perceive vibration when levels are greater than 104 dB re 1nm/s when standing 20m away.

The existing ground borne vibration (GBV) levels and ground borne noise (GBN) levels are 10-20 dB above recommended Australian Standard trigger levels for human exposure. These trigger levels are typically ten times lower than trigger levels set for preventing cosmetic damage to buildings.

Modelling indicates currently 468 residents are subject to vibration levels greater than 106 dB re 1nm/s (trigger level), with levels ranging from 108 dB re 1nm/s to 127 dB re 1nm/s. 128 residents are also affected by GBN greater than the trigger value (35 db re 20 µPa[23]). Levels of GBN range from 35 db re 20 µPa to 57 db re 20 µPa.

The modelling also suggests 34 commercial/industrial premises are subject to vibration levels greater than 118 dB re 1nm/s (trigger level), with levels ranging from 119 to 125 dB re 1nm/s. All of these premises were modelled with GBN levels less than the trigger value (55 dB re 20 µPa).

11.3.4 Potential impacts

The potential impacts are vibration emissions on nearby residential receptors will increase (without controls) which may lead to annoyance of residents.

[22] $L_{V, RMS, 1s}$ - Maximum unweighted Root Mean Square vibration velocity over a 1 second period.
[23] db re 20 µPa – sound pressure levels (i.e. decibels) referenced to 20 micro Pascals (i.e. re 20 µPa).

11.3.5 Assessment of Impacts

11.3.5.1 TCL Operational Profile

The train numbers modelled for the assessment of impacts for existing and future rail traffic are listed in Table AE.

11.3.5.2 Assessment Criteria

Vibration trigger levels intended to apply to existing buildings and future buildings are presented in Table AG.

TABLE AG: VIBRATION TRIGGER LEVELS

PARAMETER	CRITERION	VALUE
Rail Operations – Design Level	Vibration levels from rail operations will be managed as low as reasonably practicable	demonstrated
Rail Operations Building Vibration Trigger Level	Mitigation of vibration via ground or structural pathways must be considered where the vector sum Rail Operations Building Vibration Trigger Level is exceeded as applicable to the 95th percentile train pass-by event measured at a reasonably representative location of the building occupancy, with appropriate use of frequency weightings from *ISO 2631.1:1997* as amended or *AS ISO 2631.2:2014*.	
	Medical clinical treatment, surgery or recovery areas, or facilities operating precision equipment	Curve 1 ($L_{v,RMS,1s}$ 100dB)
	Residential and hotel accommodation	Curve 2 ($L_{v,RMS,1s}$ 106dB
	Commercial premises, Public buildings, Churches and community centres and the like	Curve 4 (Lv,RMS,1s 112dB)
	Light and general industrial buildings	Curve 8 ($L_{v,RMS,1s}$ 118dB)
Rail Operations Regenerated Noise/GBN Trigger Level	Mitigation of vibration via ground or structural pathways must be considered where the Rail Operations Regenerated Noise Trigger Level is exceeded as applicable to the 95th percentile train pass-by event and measured at centre of reasonably representative interior space(s) of each building usage.	
	Residential and hotel accommodation, 10pm to 6am	L_{ASmax} 40dB
	Residential and hotel accommodation, 6am to 10pm	
	Commercial premises, Public buildings, Churches and community centres and the like	L_{ASmax} 45dB
	Retail and point of sale areas, Occupiable light and general industrial buildings	L_{ASmax} 50dB

11.3.5.3 Modelling Predictions

The SLR (2018) modelling predicts little change in GBV and GBN levels at adjacent residential premises as a result of the proposed passenger rail operations; given vibration emissions from the existing freight train operations are significantly higher.

11.3.5.4 Consultation Process and Proposed Mitigation Measures

Adjoining residents were consulted regarding vibration impacts through workshops and subsequent surveys, as described in Table F, and in full detail in SLR (2018) (Appendix 7). Mitigation measures were discussed with residents during the consultation process and overall general support was achieved. Resilient ballast matting will be installed under selected portions of the passenger and freight lines to reduce the propagation of vibration experienced within buildings.

Subject to detailed design, installation of resilient ballast matting will be considered for tracks proposed to be re-laid or constructed within 90m (for freight track) and 45m (for passenger track) of existing or proposed residential areas.

11.3.5.5 Outcome

Whilst the modelling predicts little change in GBV and GBN levels at adjacent residential premises, it is expected that with the installation of ballast matting in conjunction with moving the freight rail further north in the railway reserve the vibration levels at the majority of receptors will improve compared to existing levels. Therefore, the TCL is likely to have a positive impact on amenity for adjacent residences.

11.3.6 Mitigation

In developing the Proposal, the PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for vibration emissions is outlined in Table AH.

TABLE AH: MITIGATION HIERARCHY FOR VIBRATION EMISSIONS

Avoid	There are no feasible avoidance strategies for vibration emissions.
Minimise	Implementation of a Noise and Vibration Management Plan for the operating phase. This Plan is provided in Appendix 7. Proposed vibration mitigation and management measures include installing resilient ballast matting under selected portions of the passenger and freight lines to reduce the propagation of any GBN experienced within buildings.
Rehabilitate	There are no rehabilitation strategies proposed for vibration emissions.
Offset	No offset is proposed.

11.4 ABORIGINAL HERITAGE AND CULTURE

11.4.1 Policy and Guidance

- Environmental Factor Guideline – Social Surroundings (EPA, 2016i).
- *Aboriginal Heritage Act 1972*
- Section 18 Approval (Appendix 10).

11.4.2 Environmental Investigation

The following environmental investigations were undertaken to assess the social surroundings of the development envelope:

- Aboriginal Heritage Survey (R. O'Connor, 2017a).
- Addendum to report on Thornlie-Cockburn Link, Aboriginal Heritage Survey (R. O'Connor, 2017b).

Table G provides a brief description of each these investigations and identifies the assessment standards used to inform the scope and content of the individual investigations.

11.4.3 Receiving Environment

The Proposal is within the Whadjuk Indigenous Land Use Agreement area. Consultation and inspection of the development envelope was undertaken on 18 September and 4 October 2017 by representatives of the Whadjuk people nominated by the South West Aboriginal Land and Sea Council (SWALSC).

The survey identified:

- One registered site – Canning River (ID: 3538, mythological site).
- One potential site identified during consultation with the Whadjuk survey participants – wetland area at the proposed location of the Nicholson Road station (Figure 3.3).

It is noted that an additional registered site – Swan River (ID: 3536, mythological site) also intersects the development envelope.

The Canning River site (ID: 3538) is listed on the Permanent Register due to its association with a Waugal (Rainbow Serpent) myth. However, the banks and surrounding floodplain may also be seen by Aboriginal people either as a buffer zone or as an integral part of the site. In the case of the Canning River, it is R. O'Connor's opinion that the Aboriginal site should be seen as the area within the 100-year flood level.

The potential site at the proposed Nicholson Road station was identified due to the presence of water, which was mentioned as sacred to the Whadjuk survey participants as a place where the Waugal comes to the surface when it is travelling underground. On application to the DPLH, this site was not considered a registered site. Further investigation (RPS, 2018) commissioned by PTA indicated this water was actually a man-made dam constructed on the site in 1995.

11.4.4 Potential impacts

The potential impacts are disturbance/damage to known and unknown Aboriginal heritage sites.

11.4.5 Assessment of Impacts

Whadjuk representatives have given their conditional approval, indicating that disturbance to Aboriginal heritage sites will be minimal and that the TCL will be beneficial to the general community.

A Section 18 approval under the WA *Aboriginal Heritage Act 1972* was granted by the WA Minister for Aboriginal Affairs on 12 February 2018 (Appendix 10) for disturbance of two sites (ID 3536: Swan River and ID 3538: Canning River) . The approval is subject to the following two conditions:

- PTA are to provide a report to the Registrar of Aboriginal Sites within 60 days of the completion of the Purpose, advising whether and to what extent the Purpose has impacted on all or any sites location on the land.
- Invites in writing, two nominated members from the Whadjuk people native title claim group representatives consulted for ground disturbing works on the land where it intersects within the boundaries of Aboriginal sites ID 3536 (Swan River) and ID 3538 (Canning River).

11.4.6 Mitigation

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for aboriginal heritage and culture is outlined in Table AI.

TABLE AI: MITIGATION HIERARCHY FOR ABORIGINAL HERITAGE AND CULTURE

Avoid	The PTA has designed the duplication of the rail bridge over Canning River to avoid placement of pillars in the river.
Minimise	• A CEMP will be prepared and implemented during construction of the TCL. Specific measures relevant to the factor to be included in the CEMP are: - Aboriginal monitors will be present when initial ground disturbance is undertaken at the registered and potential aboriginal sites. - The contractor is to prepare and implement an Aboriginal heritage management protocol outlining procedures to be implemented if during works potential Aboriginal heritage sites/artefacts are identified.
Rehabilitate	There are no rehabilitation strategies proposed for Aboriginal heritage and culture.
Offset	No offset is proposed.

11.5 EUROPEAN HERITAGE

11.5.1 Policy and Guidance

- Environmental Factor Guideline – Social Surroundings (EPA, 2016i)
- *Heritage of Western Australia Act 1990*

11.5.2 Environmental Investigation

A search of the following databases was undertaken by Aurora:

- World heritage list (http://www.environment.gov.au/heritage/places/world-heritage-list)
- Commonwealth heritage list (http://www.environment.gov.au/heritage/places/commonwealth-heritage-list)
- National heritage list (http://www.environment.gov.au/heritage/places/national-heritage-list)
- State heritage list (http://inherit.stateheritage.wa.gov.au/Public/)

11.5.3 Receiving Environment

No World, Commonwealth, National, State heritage listed places exist within or adjacent to the development envelope.

11.5.4 Potential impacts

No impacts to European heritage will occur as a result of the Proposal.

11.5.5 Assessment of Impacts

No impacts to European heritage will occur as a result of the Proposal.

11.5.6 Mitigation

In developing the Proposal, PTA has applied the mitigation hierarchy to reduce its potential impacts on the environment. The mitigation hierarchy for European heritage is outlined in Table AJ.

TABLE AJ: MITIGATION HIERARCHY FOR EUROPEAN HERITAGE

Avoid	European heritage places have been avoided.
Minimise	Not required.
Rehabilitate	Not required.
Offset	Not required.

11.6 PREDICTED OUTCOME TO SOCIAL SURROUNDINGS FACTOR

The PTA predict that implementation of the CEMP and execution of an Operational Noise and Vibration Management Plan will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.

12 ENVIRONMENTAL OFFSETS

12.1 OVERVIEW

As outlined in this environmental assessment, construction of the TCL will result in residual environmental impacts related to clearing of native vegetation. PTA has applied the hierarchy of avoid, minimise and mitigate during its planning and design of the project to reduce the extent of these impacts as far as practical. However, the construction of the TCL will impact native vegetation that is:

- Within Bush Forever sites.
- Representative of the *Banksia* woodland of the Swan Coastal Plain TEC.
- Growing in association with wetlands (CCW and REWs).
- Black cockatoo habitat.

In preparing this assessment, it has been assumed that all of the native vegetation found within the development envelope will be cleared. This is likely to be an over-estimate of the clearing requirements. Within the 119.37 ha development envelope, 54.88 ha comprises native vegetation. Almost 90% of the 54.88 ha is Degraded-Completely Degraded, reflecting the high level of disturbance in the development envelope. The loss per vegetation condition rating is:

- Excellent — 0.10 ha
- Very Good — 0.03 ha
- Good — 3.19 ha
- Good to Degraded — 2.63 ha
- Degraded to Completely Degraded — 48.89 ha
- Condition not surveyed — 0.04 ha

12.2 BUSH FOREVER SITES

State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (WAPC, 2010) indicates that the Policy only applies if a proposal or a decision will have an adverse impact upon regionally significant bushland in Bush Forever areas. An adverse impact includes direct impacts (i.e. clearing of regionally significant bushland) and indirect impacts arising from proposals abutting regionally significant bushland in Bush Forever areas

Indirect impacts on Bush Forever Sites from the TCL project can be managed via the preparation and implementation of a CEMP, so that regionally significant bushland is not adversely affected by the construction of the TCL. Therefore, the requirement to offset focuses upon the direct impacts arising from the project.

The development envelope intersects Bush Forever Sites 245, 246, 388 and 456, with an overlap of 29.90 ha. A total of 6.14 ha[24] does not contain any native vegetation (i.e. cleared). A total of

[24] This figure has been rounded to 2 decimal places.

12.56 ha of Bush Forever land is within areas reserved for railway purposes. Whilst these areas contain some native vegetation (totaling 4.61 ha – comprised of VT01, 0.96 ha; VT05, 0.07 ha; VT06, 0.98 ha; and VT07, 2.60 ha), the majority of this vegetation is in Degraded-Completely Degraded condition (3.60 ha) with the balance being Degraded (0.04 ha), Good-Degraded (0.17 ha) and Good (0.80 ha). SPP 2.8 notes that existing cleared or developed areas within Bush Forever are not intended for protection through the Policy or are excluded from future development (WAPC, 2010). On this basis, these areas are not adversely impacted and therefore do not require an offset.

Offset strategies are required where there is any loss of regionally significant bushland where appropriate and practical (WAPC, 2010). The remaining 23.77 ha of Bush Forever areas within the development envelope contains native vegetation that may be cleared for the TCL project. As outlined in Section 6.6.3, the impact to Bush Forever Sites 245, 246 and 456 are not considered to be significant due to the highly disturbed nature of the impacted areas.

Of the 23.77 ha of vegetation in the portion of the development envelope that overlaps Bush Forever areas (Sites 245, 246, 388 and 456), 2.68 ha requires to be offset due to impacts on vegetation consistent with the Banksia Woodland of the Swan Coastal Plain TEC, black cockatoo foraging habitat and REW.

12.3 BANKSIA WOODLAND OF THE SWAN COASTAL PLAIN TEC

Construction of the TCL will clear up to 2.85 ha *Banksia* Woodlands of the Swan Coastal Plain TEC, impacting three patches as outlined below:

- Patch 1 – 0.59 ha in the development envelope;
- Patch 3 – 2.22 ha in the development envelope;
- Patch 4 – 0.04 ha in the development envelope.

The loss per condition rating is:

- Excellent — 0.10 ha
- Very Good — 0.03 ha
- Good — 2.60 ha
- Degraded — 0.08 ha
- Inferred TEC (but condition not surveyed) — 0.04 ha

It has been assumed that all of the 2.85 ha will require an offset. However, as majority of the 2.85 ha is located within Bush Forever Site 388 it is likely that the Bush Forever offset requirements will be sufficient to compensate the proposed loss of the *Banksia* Woodland of the Swan Coastal Plain TEC. Furthermore, the potential offset requirements for Black Cockatoo habitat may also contribute towards the protection of *Banksia* woodland communities.

12.4 WETLANDS

The assessment of impacts to wetlands in Section 6.6.7 concluded that the TCL project will not have a significant impact on the ecological or hydrological functions of the wetlands in the TCL development envelope.

The loss of wetland vegetation can be adequately compensated through the provision of an offset for the impacts to Bush Forever Site 388 as discussed in Section 12.2. This offset will need to ensure that it compensates the loss of 0.74 ha of wetland vegetation that was identified as being impacted within Bush Forever Site 388.

12.5 BLACK COCKATOO HABITAT

The TCL project will require clearing of up to 27.64 ha of Black Cockatoo foraging habitat and 96 potential habitat trees. This loss is regarded as a significant residual impact which will require an offset. PTA is working with DBCA to identify a suitable offset of sufficient scale to compensate the loss of black cockatoo foraging habitat.

13 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

As the Proposal involves the clearing of vegetation representative of a TEC protected under the *EPBC Act 1999* and Black Cockatoo habitat, approval may be required from the Commonwealth Minister for the Environment. An initial meeting was held with Commonwealth DoEE representatives on 8 December 2017 to introduce the TCL project and gain initial feedback.

A referral was made to the DoEE in April 2018, with a request for an accredited assessment on the basis of the following likely environmental outcomes on matters protected under the *EPBC Act 1999*:

- Direct loss of 2.85 ha of *Banksia* Woodlands of the Swan Coastal Plain TEC within the development envelope. The loss per condition rating (using the condition rating scale adapted by EPA (2016) for the South West Botanical Province) is:
  - Excellent - 0.10 ha
  - Very Good - 0.03 ha
  - Good - 2.60 ha
  - Degraded - 0.08 ha
  - Inferred TEC (but condition not surveyed) - 0.04 ha
- Direct loss of 27.64 ha of Black Cockatoo foraging habitat of variable condition and value.
- Direct loss of 96 potential Black Cockatoo habitat trees (trees with DBH>500mm) within the development envelope.
- No loss of Black Cockatoo roosting habitat.
- No loss of current Black Cockatoo nesting hollows.
- No deaths of individual Black Cockatoo as a result of clearing activities.

14 HOLISTIC IMPACT ASSESSMENT

This Supplementary Environmental Report provides:

- A detailed assessment of the potential environmental impacts and proposed environmental management strategies for relevant environmental factors.
- The information required to support the assessment of the environmental acceptability of the Proposal by the PTA to construct and operate the Thornlie – Cockburn Link within the Cities of Gosnells, Canning, Melville and Cockburn.

The environmental factors identified for the Proposal have been considered against EPA objectives, as defined in EPA's (2016j) *Statement of Environmental Principles, Factors and Objectives*. The environmental factors relevant to this Proposal are:

- Flora and Vegetation.
- Terrestrial Fauna.
- Terrestrial Environmental Quality.
- Hydrological Processes.
- Inland Waters Environmental Quality.
- Social Surroundings.

The factors identified above have been assessed in this Supplementary Environmental Report. In undertaking the assessment, the PTA has considered the following principles outlined in the *Environmental Protection Act 1986*:

1. The precautionary principle;
2. The principle of intergenerational equity;
3. Principles relating to improved valuation, pricing and incentive mechanisms;
4. The principle of the conservation of biological diversity and ecological integrity; and
5. The principle of waste minimisation.

The residual significant impacts on the whole environment are summarised in Table AK, along with a discussion of the predicted outcomes in relation to environmental principles and the EPA's environmental objectives.

TABLE AK: PREDICTED OUTCOMES IN RELATION TO ENVIRONMENTAL PRINCIPLES AND EPA'S ENVIRONMENTAL OBJECTIVES

Environmental Factor	Significant Residual Impacts on Whole Environment	Predicted Outcomes	Connection to Environmental Principles / Environmental Objectives
Flora and Vegetation	• Direct loss of 2.85 ha of *Banksia* Woodlands of the Swan Coastal Plain TEC within the development envelope. The loss per condition rating is: - Excellent — 0.10 ha - Very Good — 0.03 ha - Good — 2.60 ha - Degraded – 0.08 ha - Not surveyed – 0.04 ha • Direct loss of 2.68 ha of vegetation within Bush Forever Site 388. This vegetation is in a Degraded or better condition and contains attributes consistent with Banksia Woodland of the Swan Coastal Plain TEC, black cockatoo foraging habitat and a REW. • 0.74 ha of wetland vegetation growing in association with a REW (UFI 13332) in Bush Forever Site 388.	Implementation of the CEMP and execution of an appropriate offsets package will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore PTA believe the EPA's objective will be met.	The PTA has applied the ***Precautionary Principle*** through careful evaluation of the TCL alignment to avoid, where practicable clearing TEC, PECs and Threatened flora (i.e. *Caladenia huegelii*) by redesigning the development envelope extent several times to reduce environmental impacts. By offering an offset for those impacts to TEC, PEC and Bush Forever bushland that are residual following mitigation, this will achieve environmental gains for the whole environment. An assessment of the risk-weighted consequences of various options was completed, with the chosen location for the TCL to be within an existing mostly cleared or degraded freight corridor (54% of the development envelope is cleared, 41% contains Degraded-Completely Degraded vegetation) to minimise the effect on the whole environment, instead of creating a new railway corridor in an area with better quality vegetation. The development envelope will involve clearing just 0.13 ha of 'Excellent' and 'Very Good' vegetation, therefore adhering to the ***Principle of Intergeneration Equity*** by ensuring that the health of diversity and productivity of the environment is maintained for the benefit of future generations. Ecological communities represent biologically diverse and integral components of ecosystems, therefore by

TABLE AK: PREDICTED OUTCOMES IN RELATION TO ENVIRONMENTAL PRINCIPLES AND EPA'S ENVIRONMENTAL OBJECTIVES

Environmental Factor	Significant Residual Impacts on Whole Environment	Predicted Outcomes	Connection to Environmental Principles / Environmental Objectives
			reducing the area of these to be cleared, specifically clearing the minimal amounts of these communities possibly aids in conservation efforts. Therefore, reducing the amount of TEC to be cleared from 11.15 ha to 2.85 ha adheres to the ***Principle of the Conservation of Biological Diversity and Ecological Integrity***.
Terrestrial Fauna	• Clearing of 27.64 ha of Black Cockatoo foraging habitat of variable quality. • Clearing of 96 potential Black Cockatoo habitat trees (trees with diameter at breast height > 500 mm).	Implementation of the CEMP and execution of an appropriate offsets package will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore PTA believe the EPA's objective will be met.	The PTA has applied the ***Precautionary Principle*** through careful evaluation of the TCL alignment to avoid, where practicable clearing Black Cockatoo habitat by redesigning the development envelope extent several times to gain the best environmental outcomes. By offering an offset for Black Cockatoo habitats that are residual following mitigation, this will achieve environmental gains for the whole environment. An assessment of the risk-weighted consequences of various options was completed, with the chosen location for the TCL to be within an existing mostly cleared or degraded freight corridor (48% of the development envelope) with 75% of the development containing medium to low value fauna habitat, to minimise the effect on the whole environment, instead of creating a new railway corridor in an area with better quality vegetation and habitat. PTA has aimed to achieve the ***Principle of Intergeneration Equity*** through the redesign of the

TABLE AK: PREDICTED OUTCOMES IN RELATION TO ENVIRONMENTAL PRINCIPLES AND EPA'S ENVIRONMENTAL OBJECTIVES

Environmental Factor	Significant Residual Impacts on Whole Environment	Predicted Outcomes	Connection to Environmental Principles / Environmental Objectives
			development envelope to reduce the number of potential Black Cockatoo habitat trees to be cleared. Through a reduction in clearing of fauna habitats from a possible loss of 40.96 ha which was revised to 27.64 ha, PTA has aimed to achieve the ***Principle of the Conservation of Biological Diversity and Ecological Integrity***.
Terrestrial Environmental Quality	No significant residual impacts are expected as a result of the Proposal.	It is likely that the EPA's objective will be met and a positive outcome achieved in relation to the former landfill.	The PTA may inadvertently through the construction of the TCL, remediate portions of a former landfill (subject to detailed design), therefore adhering to the principles of ***Principles in relation to Improved Valuation, Pricing and Incentive Mechanisms*** The polluter in this circumstance is not the PTA; however, they will bear the cost of contamination clean-up and ultimately dispose of wastes required to construct the project. As all reasonable and practicable measures will be taken to minimise the generation of waste, and dispose of wastes at existing locations within the development envelope, and ensure no discharge into the environment, PTA will be adhering to the **Principle of Waste Minimisation**.
Hydrological Processes	No significant residual impacts are expected as a result of the Proposal.	PTA predict that implementation of the CEMP and execution of an appropriate offsets package will result in positive outcomes for the environment that	The PTA has applied the ***Precautionary Principle*** through careful evaluation of the TCL alignment to avoid or minimise residual significant impacts on 17 mapped geomorphic wetlands.

TABLE AK: PREDICTED OUTCOMES IN RELATION TO ENVIRONMENTAL PRINCIPLES AND EPA'S ENVIRONMENTAL OBJECTIVES

Environmental Factor	Significant Residual Impacts on Whole Environment	Predicted Outcomes	Connection to Environmental Principles / Environmental Objectives
		counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.	
Inland Waters Environmental Quality	No significant residual impacts are expected as a result of the Proposal.	PTA predict that implementation of the CEMP will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.	The PTA has applied the ***Precautionary Principle*** through careful evaluation of the TCL alignment to avoid residual significant impacts on hydrological processes.
Social Surroundings	No significant residual impacts are expected as a result of the Proposal.	PTA predict that implementation of the CEMP and execution of an Operational Noise and Vibration Management Plan will result in positive outcomes for the environment that counterbalances or provides gains to the environment, and therefore believe the EPA's objective will be met.	The PTA adheres to the ***Principle of Intergeneration Equity*** by recognising the importance of sustainable development and considers that the Proposal will contribute positively to current and future health and environment outcomes, with a net benefit in terms of greenhouse emissions as more people opt to use the TCL in place of using private vehicles. Implementation of this Proposal will provide benefits for future generations and will not have a negative impact on health, diversity or productivity. The project will improve accessibility for a range of people. In terms of intergenerational equity, this Proposal is aimed towards achieving an efficient transport system by 2050, so the increasing population traffic will be less congested. In addition the implementation of the TCL noise and vibration mitigation measures is likely to improve the

TABLE AK: PREDICTED OUTCOMES IN RELATION TO ENVIRONMENTAL PRINCIPLES AND EPA'S ENVIRONMENTAL OBJECTIVES

Environmental Factor	Significant Residual Impacts on Whole Environment	Predicted Outcomes	Connection to Environmental Principles / Environmental Objectives
			amenity of existing and future nearby residents.

A summary of the PTA's commitments for the TCL are listed in Table AL.

TABLE AL: PROPONENT COMMITMENTS

Environmental Factor	Construction Commitments	Operations Commitments
Flora and Vegetation	• Clearing no more than 54.88 ha of native vegetation. • Avoiding the Caladenia Grove Wetland Reserve (Reserve 48617, Figure 4) and Threatened species *Caladenia huegelii.* • Dampland vegetation (0.94 ha) within and adjacent to REW (UFI: 15926) will be retained. PTA will avoid clearing this vegetation and exclude construction activities occurring with this REW. • A CEMP will be prepared and implemented during construction of the TCL.	• Herbicide application will be implemented along the length of the railway reserve within an 8m track corridor on a 6-monthly basis and on an annual basis along fences and rail structures. • Implementation of an Environmental Offsets Package.
Terrestrial Fauna	• A CEMP will be prepared and implemented during construction of the TCL.	Implementation of an Environmental Offsets Package.
Terrestrial Environmental Quality	• Preparation of Site Management Plans (SMPs) and / or Remediation Action Plans (RAPs) for Lots 79 Bannister Road and Lots 302, 303 and 500 Ranford Road, in accordance with *Assessment and Management of Contaminated Sites* (DER, 2014) to manage landfill waste materials. The SMPs and RAPs will be reviewed/approved by a DWER accredited Contaminated Sites Auditor. • Implementation of SMPs and / or RAPs. Site Remediation Reports will be prepared to document the implementation of remediation and validation works and these reports will be reviewed/approved	Implementation of SMPs and / or RAPs relevant to the Operations phase.

TABLE AL: PROPONENT COMMITMENTS

Environmental Factor	Construction Commitments	Operations Commitments
	by the Contaminated Sites Auditor. • Risks associated with working on Lots 79 Bannister Road and Lots 302, 303 and 500 Ranford Road during construction will require specific management through the implementation of a CEMP. • In the event that other contamination is encountered during construction, the CEMP will outline an unexpected finds protocol to detail how contamination will be managed. The protocol will include triggers for consultation with the DWER, DBCA (if within the Swan River Trust Development Control Area) and the parties responsible for the contamination (if they can be identified). • The detailed design for the Ranford Road Station will be finalised once the final DSI and RAP are completed. • Investigation of ASS conditions in high risk areas and preparation of an ASS and Dewatering Management Plan if required.	
Hydrological Processes	• WSUD principles will be incorporated into the drainage design as described in Section 2.3.2.6. • Restrictions will be in place for construction activities within floodway/CCW/REWs/UWPCA and wellhead protection zones to avoid obstructing flows and impacting these receptors. • Where dewatering cannot be avoided, minimising the extent and duration of dewatering where possible and maximising utilisation of discharge water from dewatering operations (if of acceptable water quality) for construction purposes, in designated infiltration areas, to ensure the aquifer is recharged as quickly as possible.. • Hydrogeological modelling of the proposed depth of drawdown and volume of large scale dewatering will be undertaken to determine the cone of depression prior to dewatering at relevant	• Maintenance of WSUD infrastructure.

TABLE AL: PROPONENT COMMITMENTS

Environmental Factor	Construction Commitments	Operations Commitments
	locations, based on the proposed construction methodology. • Approval under the *Rights in Water and Irrigation Act 1914* to abstract groundwater will be obtained prior to the installation of production bores. • A CEMP will be prepared and implemented during construction of the TCL.	
Inland Waters Environmental Quality	• WSUD principles will be incorporated into the drainage design as described in Section 2.3.2.6. • Restrictions will be in place for construction activities within floodway/CCW/REWs/UWPCA and wellhead protection zones to avoid obstructing flows and impacting these receptors. • Understanding the groundwater characteristics of any abstracted water, prior to dewatering or the installation of groundwater production bores. • Where dewatering cannot be avoided, minimising the extent and duration of dewatering where possible and maximising utilisation of discharge water from dewatering operations (if of acceptable water quality) for construction purposes. • Hydrogeological modelling of the proposed depth of drawdown and volume of large scale dewatering will be undertaken to determine the cone of depression prior to dewatering at relevant locations, based on the proposed construction methodology. • Dewatering will be mitigated through infiltration of dewatering effluent in designated infiltration areas, to ensure the aquifer is recharged as quickly as possible. • A CEMP will be prepared and implemented during construction of the TCL.	• Maintenance of WSUD infrastructure.

TABLE AL: PROPONENT COMMITMENTS

Environmental Factor	Construction Commitments	Operations Commitments
Social Surroundings	• A CEMP will be prepared and implemented during construction of the TCL.	• Implementation of a Noise and Vibration Management Plan for the operating phase (refer to Appendix 7). • Track maintenance will be undertaken by the PTA and Arc Infrastructure to reasonably maintain the operational performance of the relevant railway infrastructure and reduce wear to trains. This will involve regular inspection of the rail condition and rail rectification / grinding to remove excessive roughness or corrugation which may develop over time.

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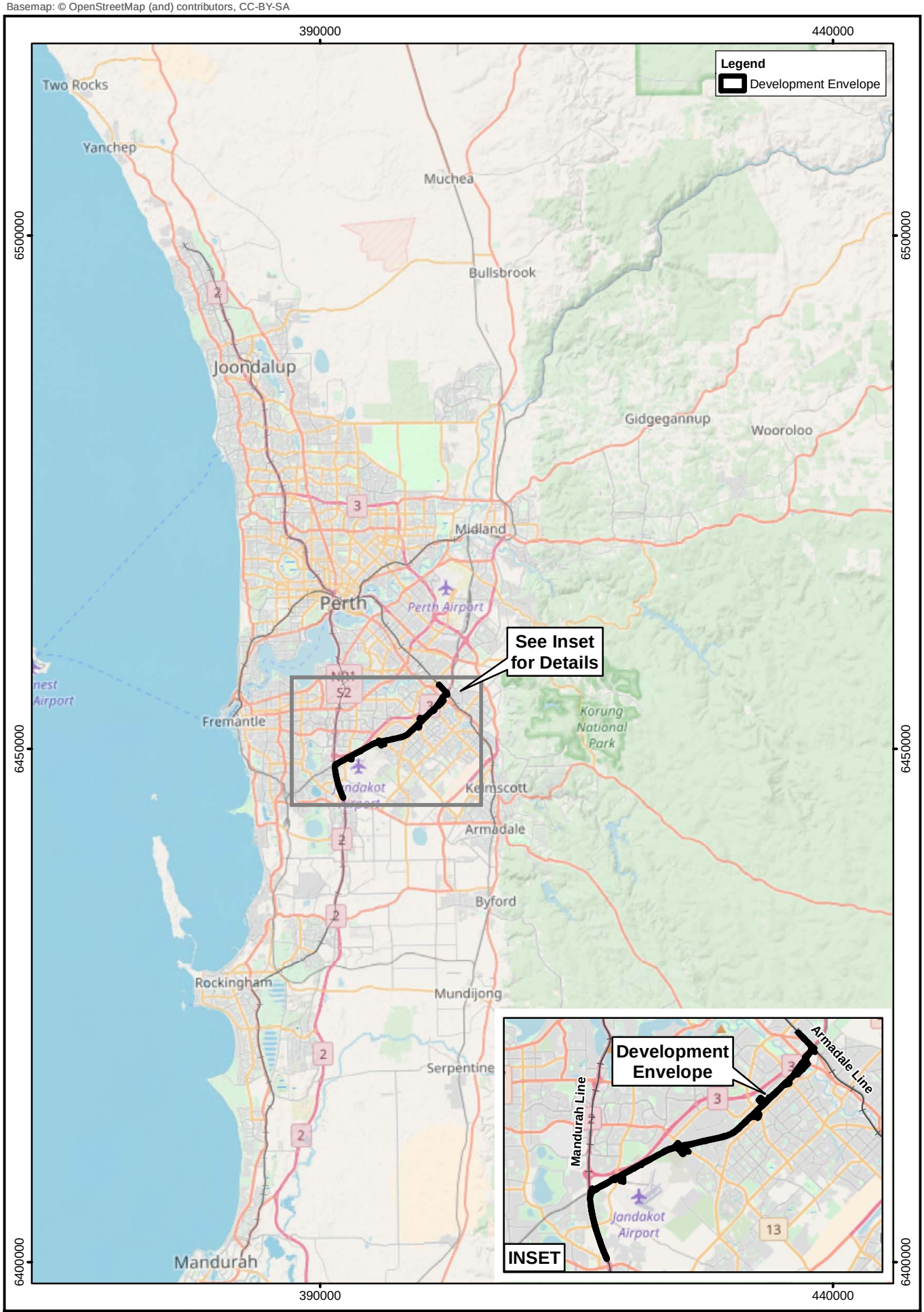
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FIGURES

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N

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Scale: 1:500,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F01

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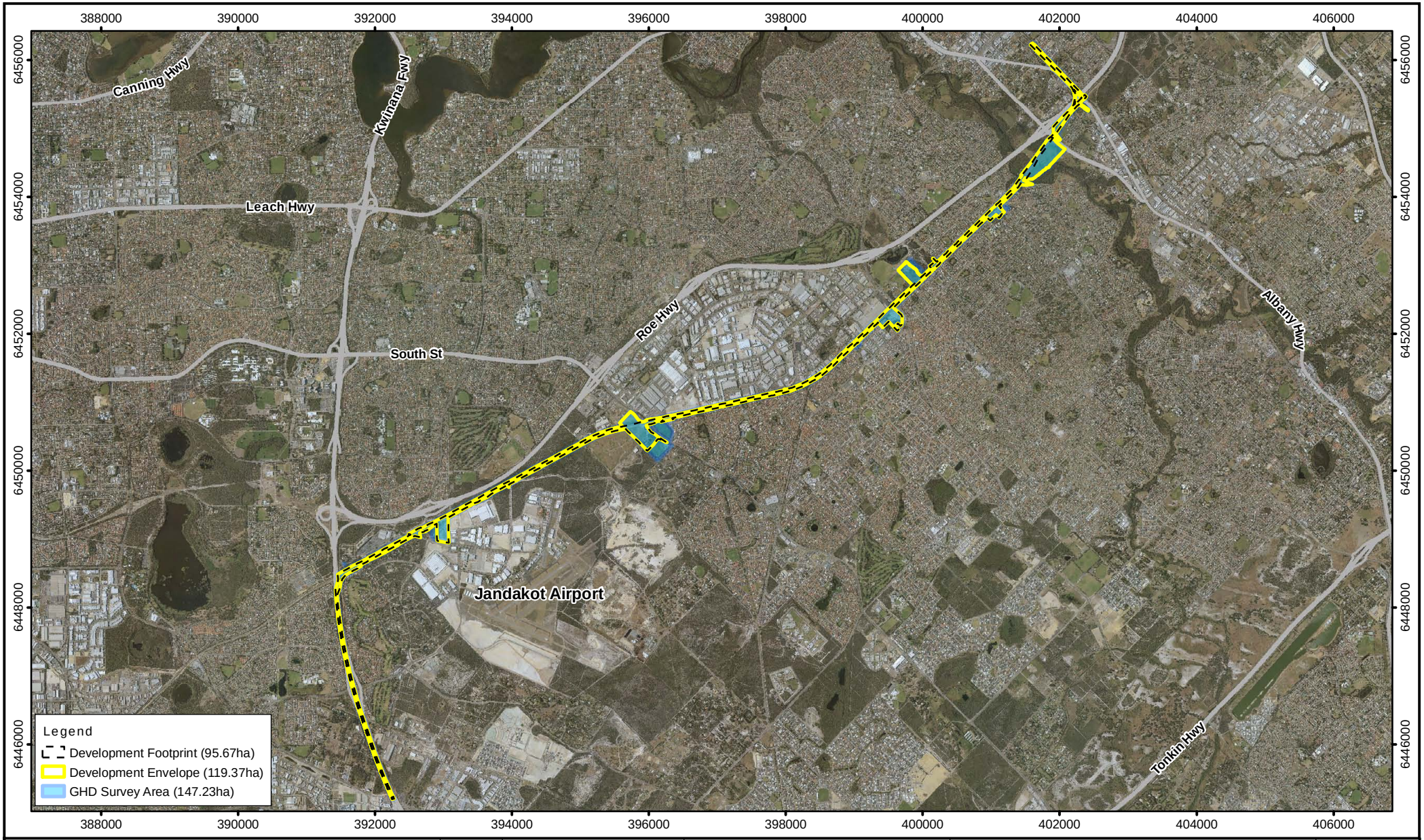
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Thornlie to Cockburn Link Project

Regional Location

Supplementary Environmental Report

Figure: 1



Imagery: Landgate (Nov 2017)

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Scale: 1:75,000
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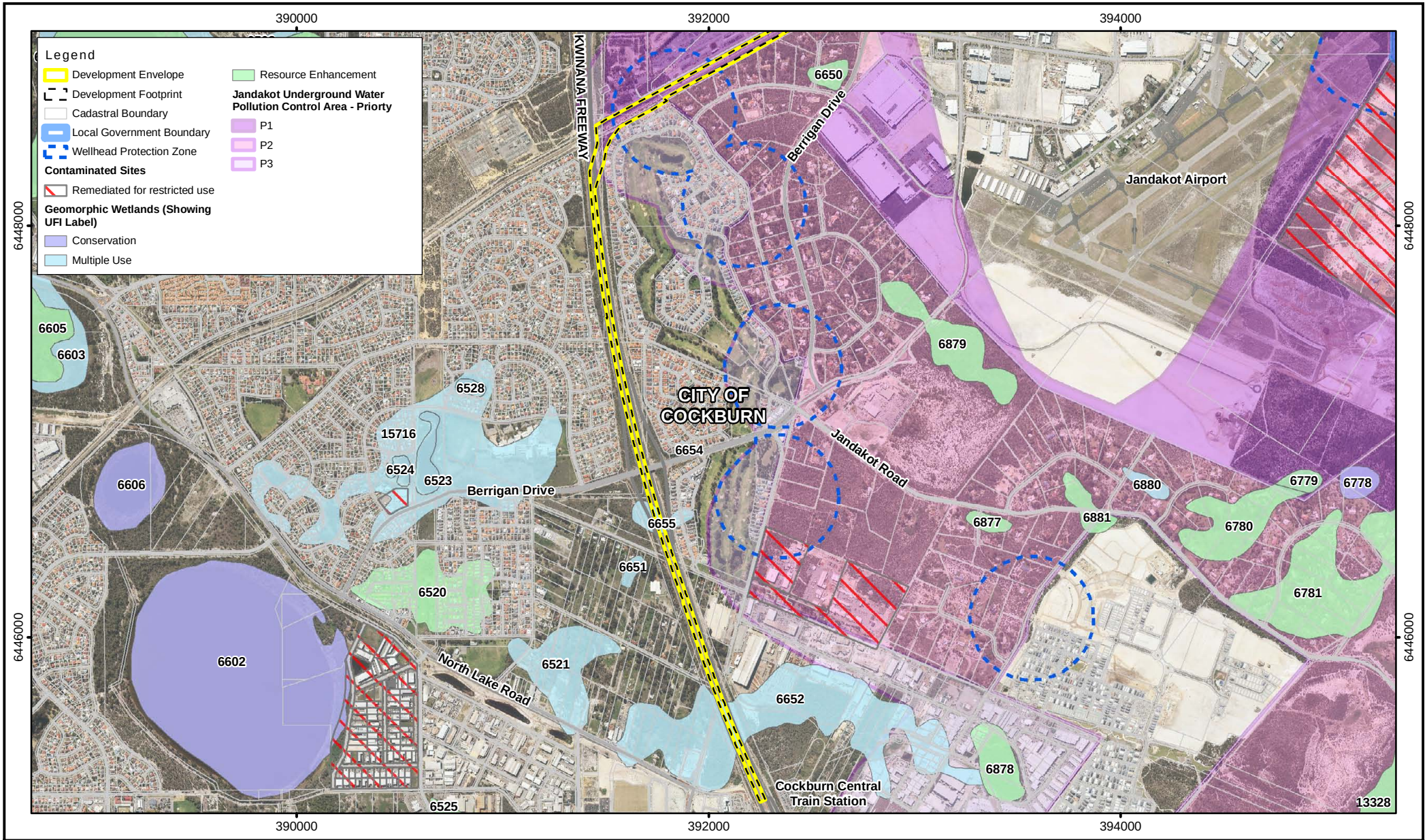
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Thornlie to Cockburn Link Project

Development Envelope

Supplementary Environmental Report

Figure: 2



Local Gov Bndry, Cadasta: Landgate
Wellhead Water Priority & Contaminated Sites: DWER
Roads: MRWA
Geomorphic Wetlands: DBCA
Imagery: Landgate (Aug 2017)

N

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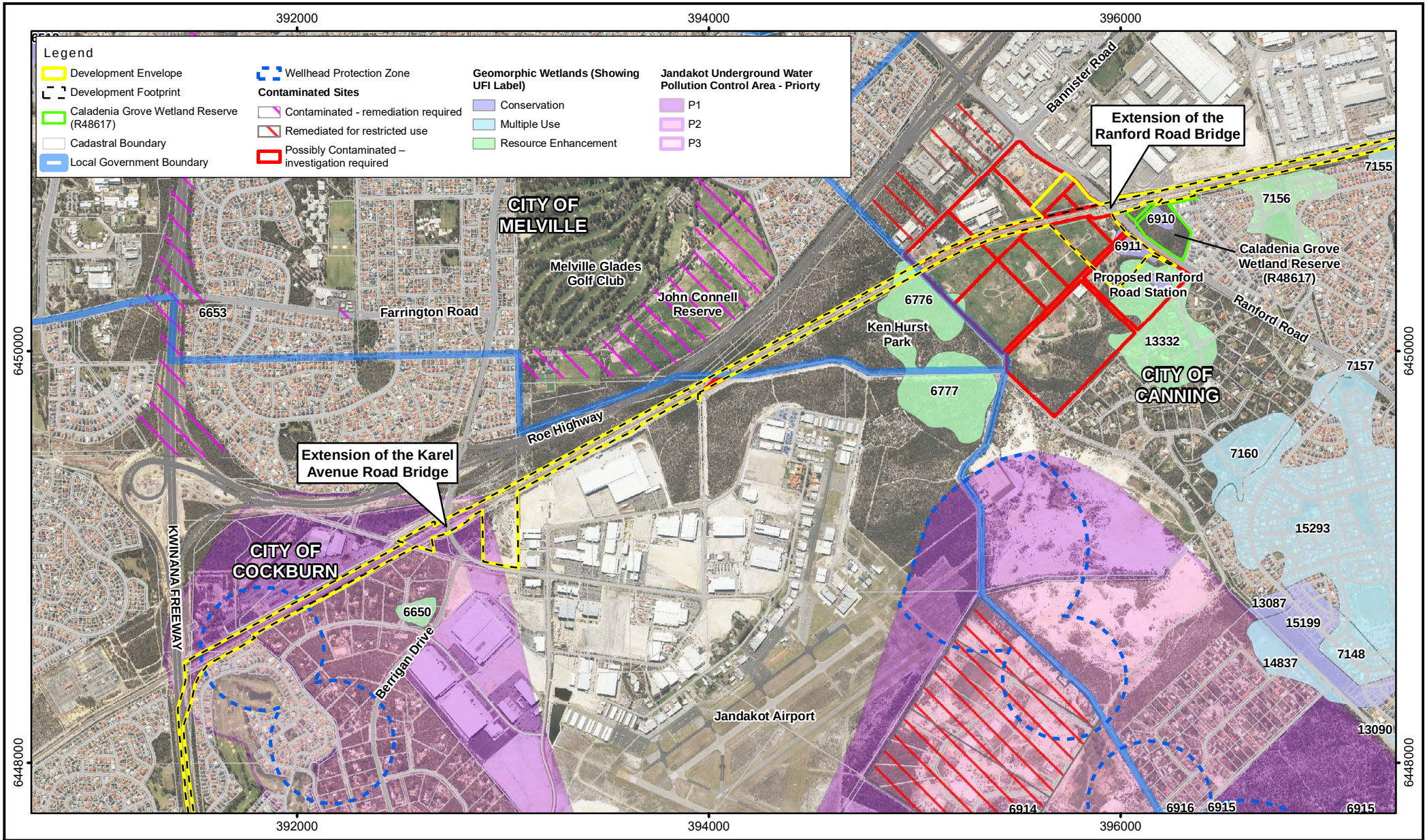
Thornlie to Cockburn Link Project

Development Envelope

Supplementary Environmental Report

Figure:

3.1



Local Gov Bndry, Cadasta: Landgate
Wellhead Water Priority & Contaminated Sites: DWER
Roads: MRWA
Geomorphic Wetlands: DBCA
Imagery: Landgate (Aug 2017)

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Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F03_02
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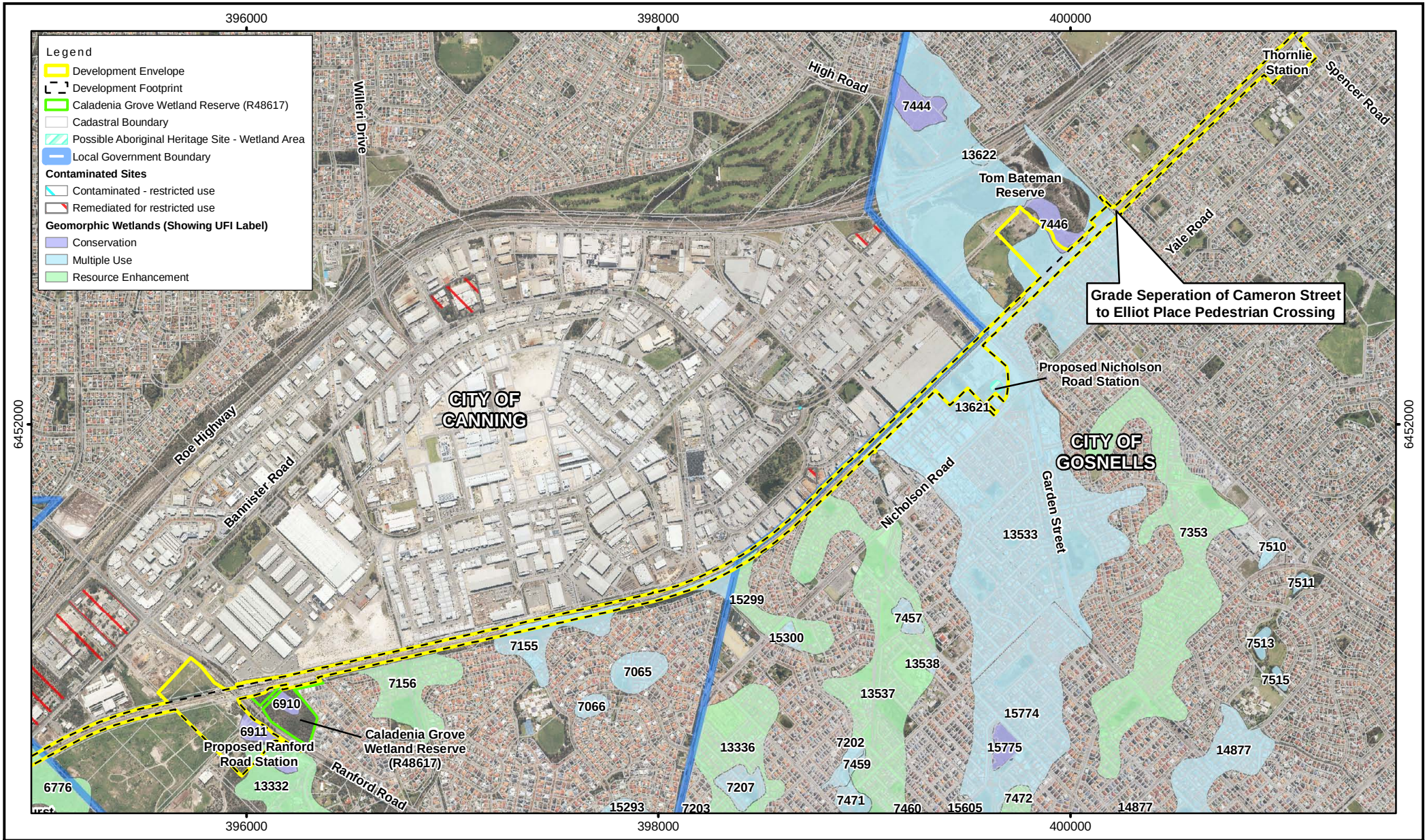
Thornlie to Cockburn Link Project

Development Envelope

Supplementary Environmental Report

Figure:

3.2



Cadasta: Landgate
Local Gov Bndry: Landgate
Contaminated Sites: DWER
Roads: MRWA
Geomorphic Wetlands: DBCA
Imagery: Landgate (Aug 2017)

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F03_03
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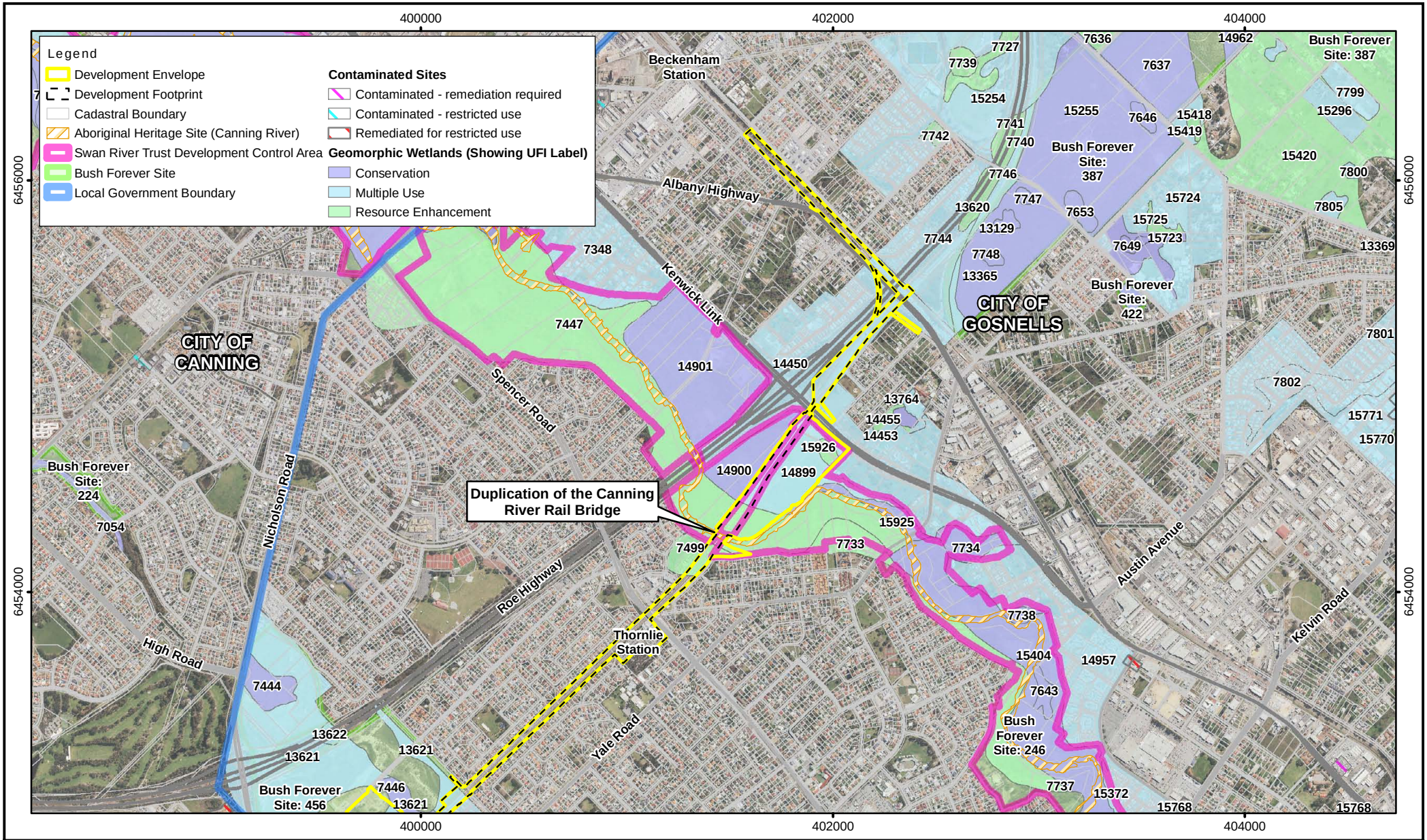
Thornlie to Cockburn Link Project

Development Envelope

Supplementary Environmental Report

Figure:

3.3



Local Gov Bndry, Cadasta: Landgate
Wellhead Water Priority & Contaminated Sites: DWER
Roads: MRWA
SRTDCA, Geomorphic Wetlands: DBCA
Imagery: Landgate (Aug 2017)

N

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Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F03_04
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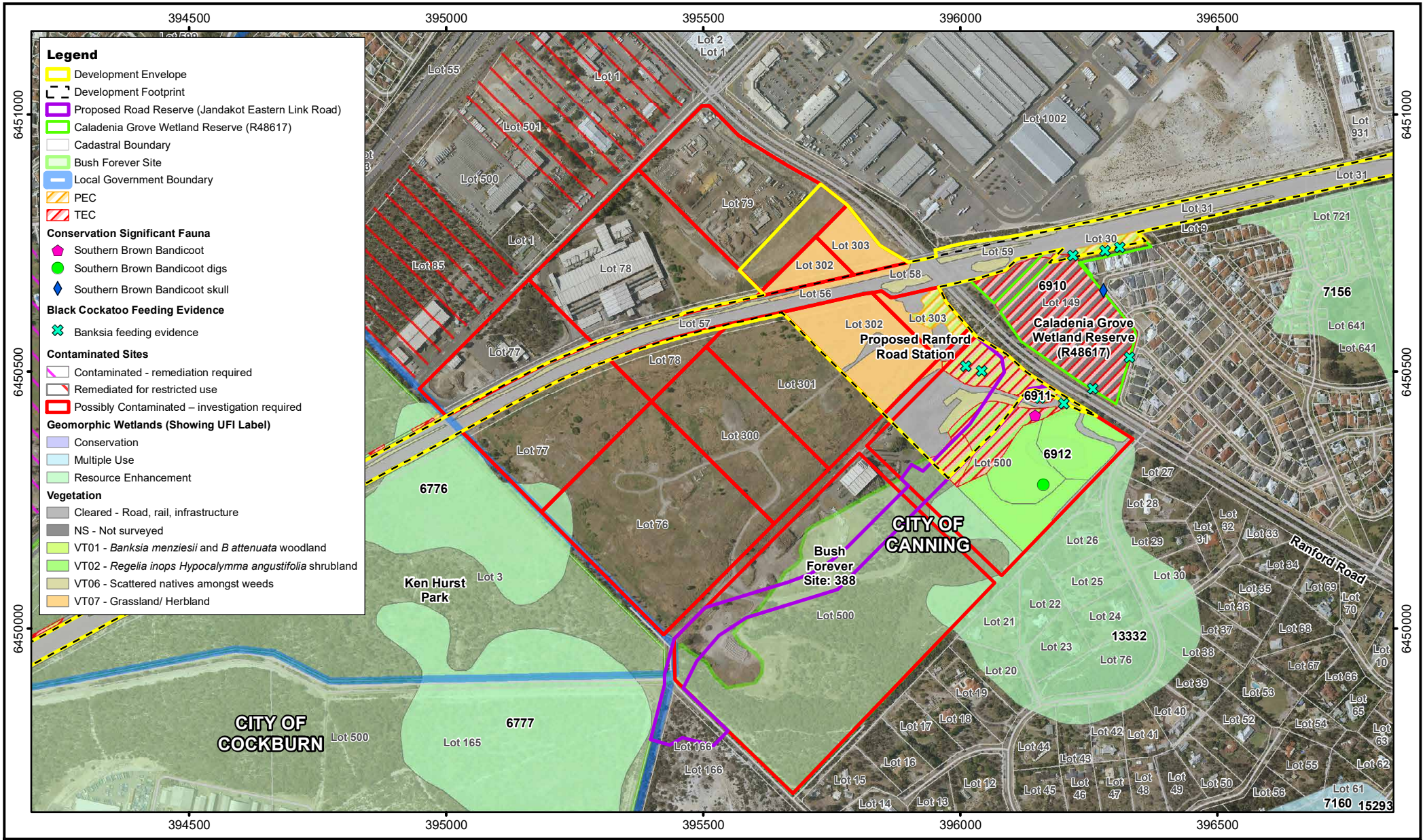
Thornlie to Cockburn Link Project

Development Envelope

Supplementary Environmental Report

Figure:

3.4



Local Gov Bndry, Cadasta: Landgate
Contaminated Sites: DWER
Roads: MRWA
Geomorphic Wetlands: DBCA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora/Fauna: GHD

N

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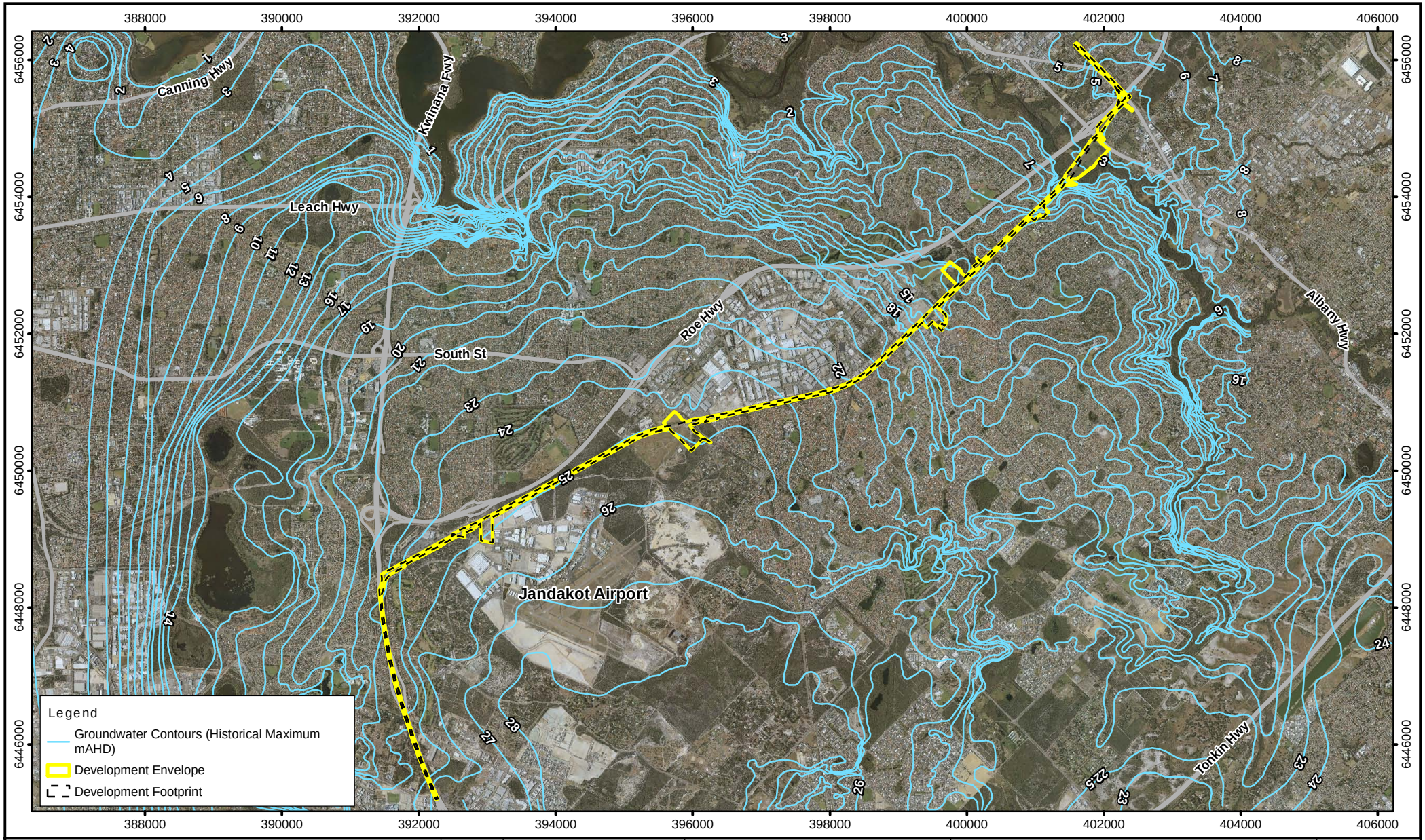
Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
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Thornlie to Cockburn Link Project

Proposed Ranford Road Station

Supplementary Environmental Report

Figure: **4**



Imagery: Landgate (Nov 2017)

N

0 0.75 1.5km

Scale: 1:75,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F05

Date: May 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001

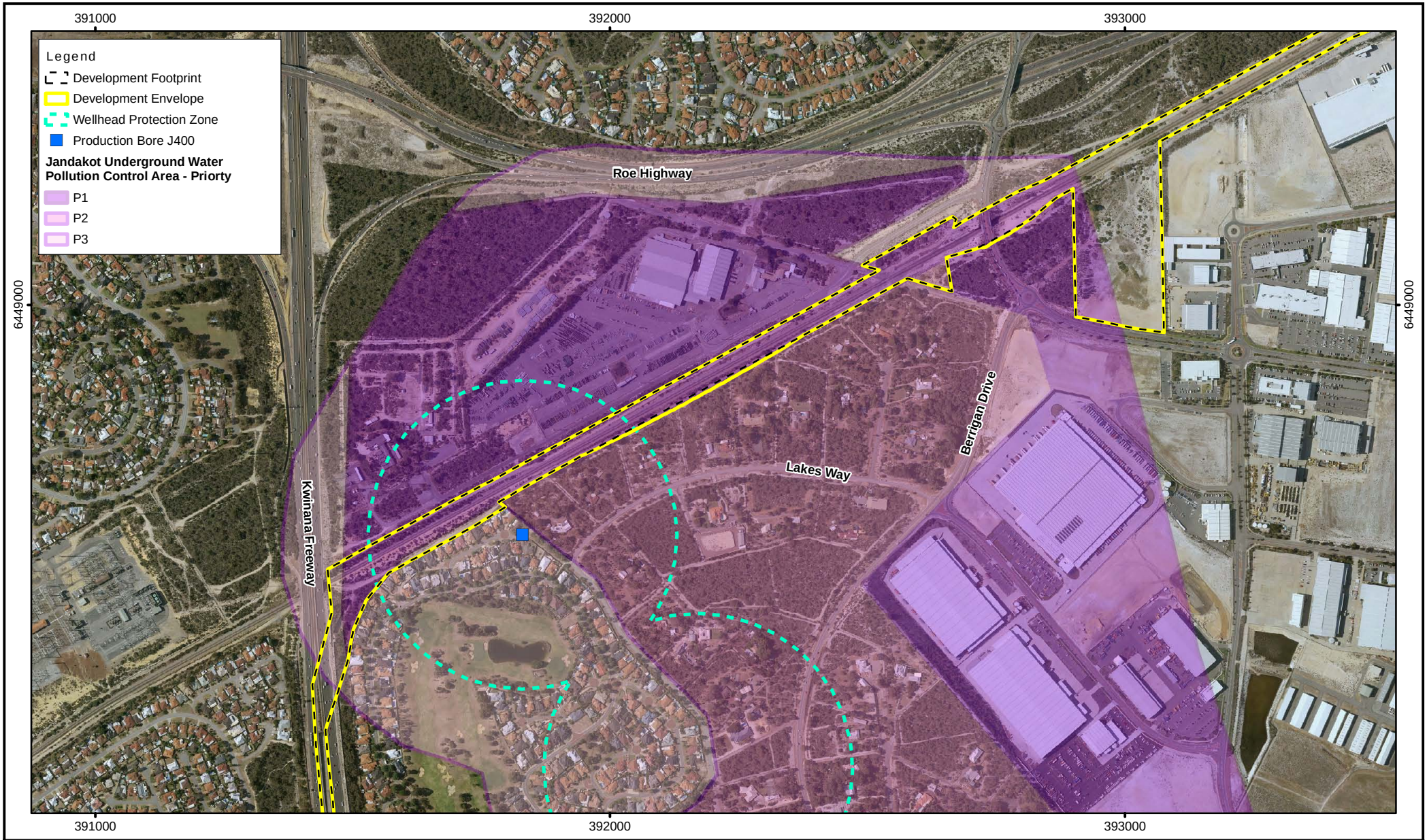
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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project

Superficial Aquifer

Supplementary Environmental Report

Figure: **5**



Cadasta: Landgate
Floodplains, Bores: DWER
Roads: MRWA
Imagery: Landgate (Nov 2017)

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F06
Date: May 2018 | Rev: A | A4

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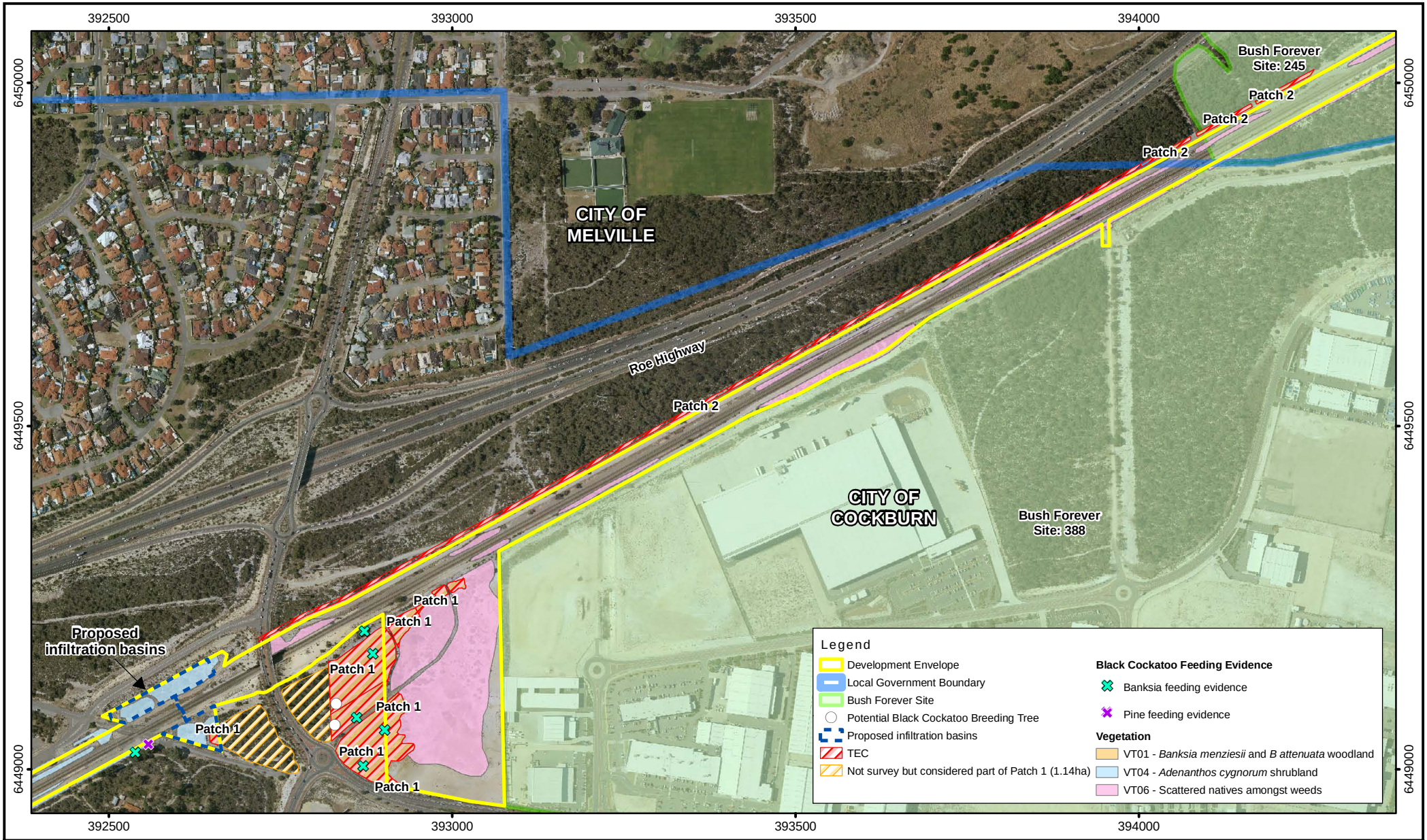
Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
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Thornlie to Cockburn Link Project

Jandakot Mound

Supplementary Environmental Report

Figure: **6**



Local Gov Bndry: Landgate
Bush Forever: DPLH
Flora/Fauna: GHD
Imagery: Landgate (Aug 2017)

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

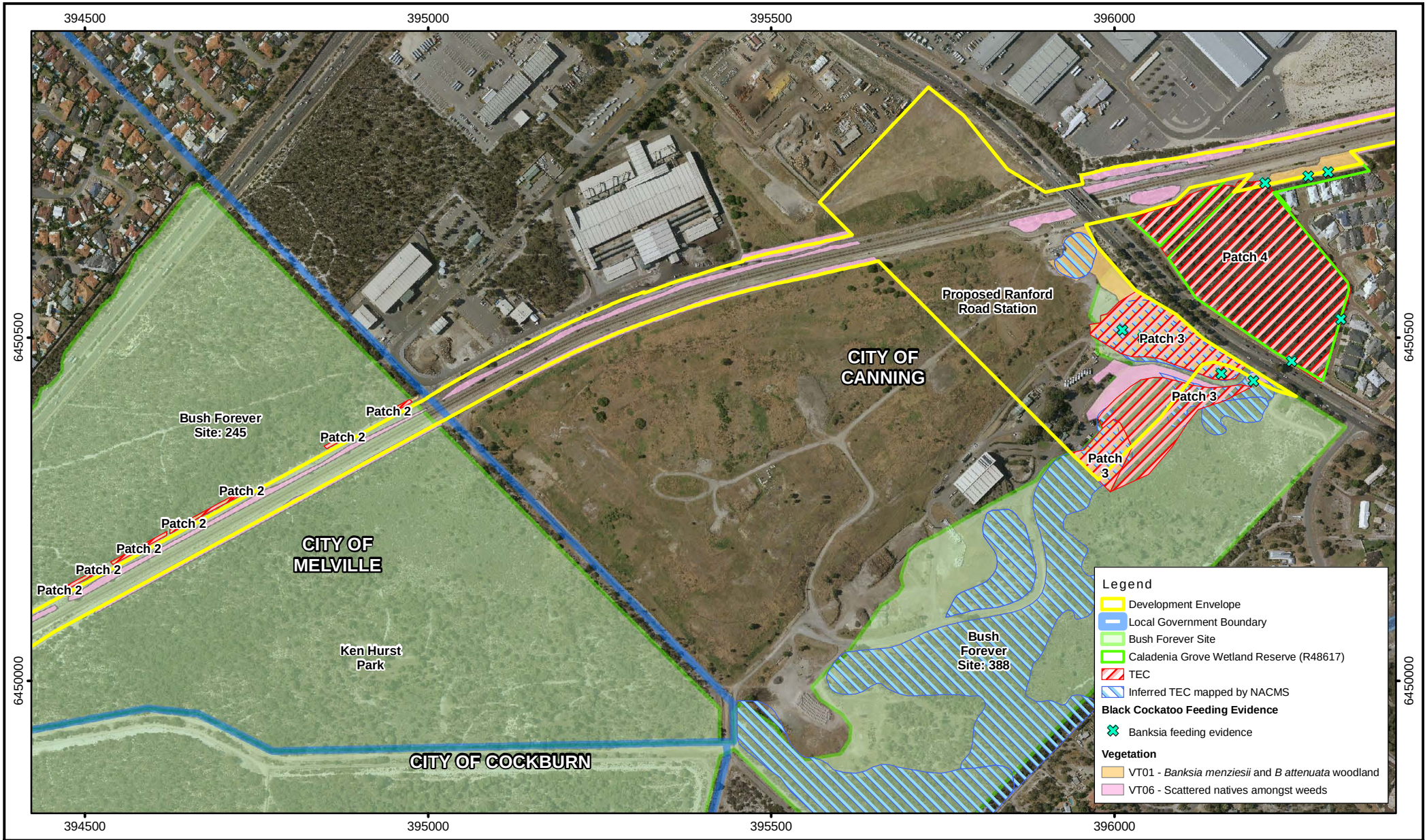
CAD Ref: a2600_SR_F07_01
Date: June 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001
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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project
Threatened Ecological Community Patch Analysis
Supplementary Environmental Report

Figure:
7.1



Local Gov Bndry: Landgate
Bush Forever: DPLH
Flora/Fauna: GHD
Imagery: Landgate (Aug 2017)

N

0 75 150m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F07_02
Date: June 2018 | Rev: A | A4

Aurora environmental
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Thornlie to Cockburn Link Project
Threatened Ecological Community Patch Analysis
Supplementary Environmental Report

Figure:
7.2



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora/Fauna: GHD

N

0 250 500 m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F08_01
Date: May 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

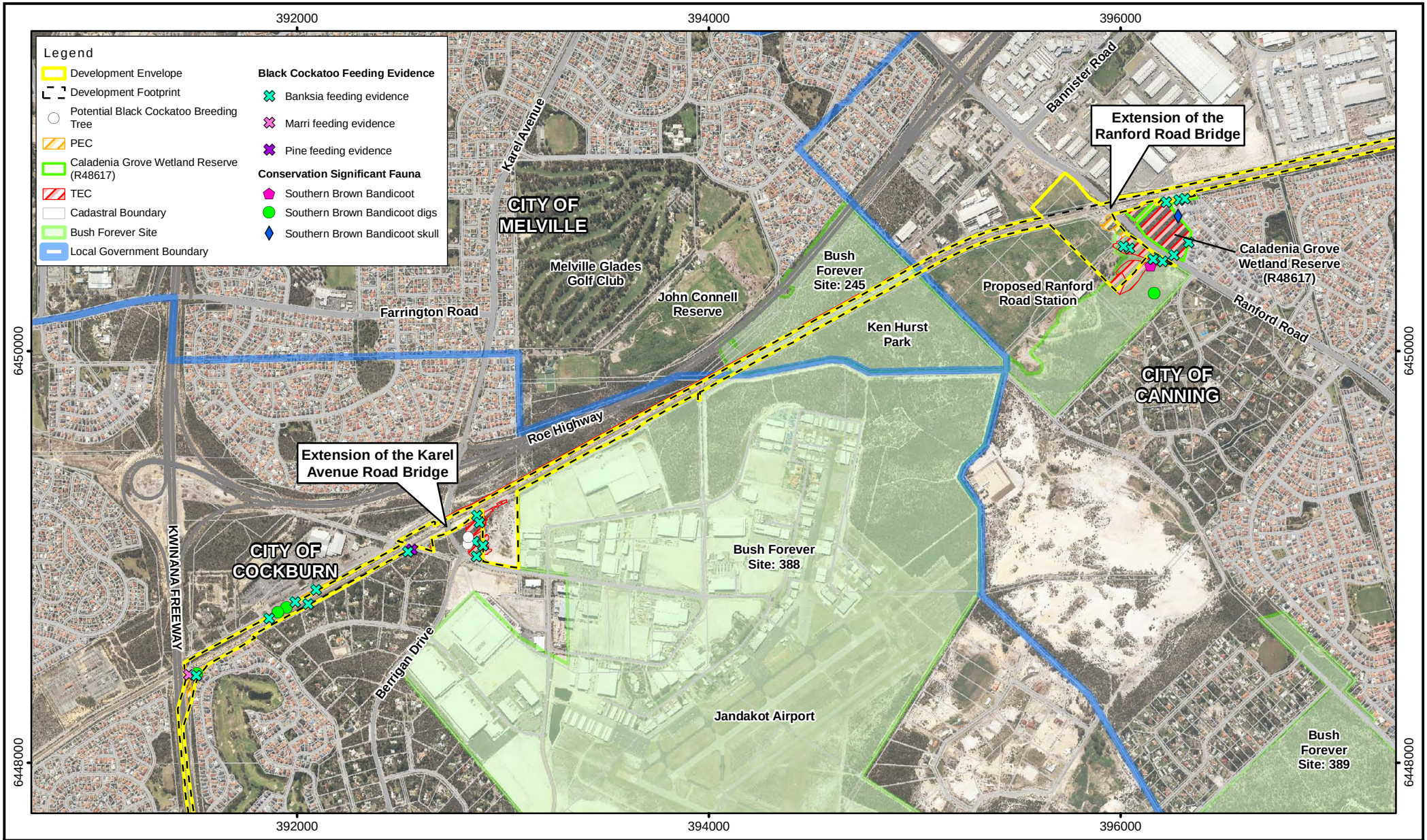
Thornlie to Cockburn Link Project

Flora and Fauna Values

Supplementary Environmental Report

Figure:

8.1



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora/Fauna: GHD

N

0 250 500m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F08_02
Date: May 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

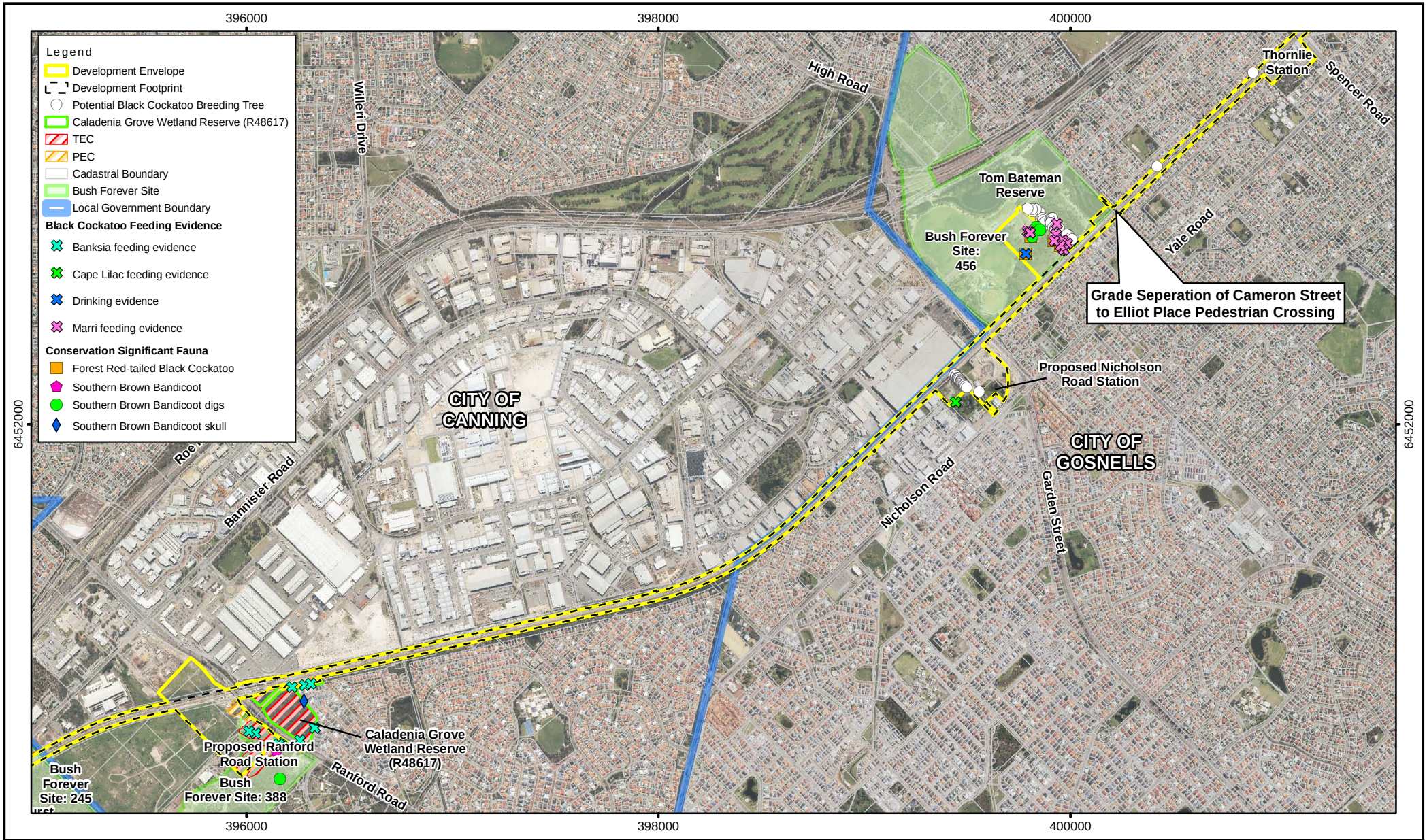
Thornlie to Cockburn Link Project

Flora and Fauna Values

Supplementary Environmental Report

Figure:

8.2



Cadasta: Landgate
Local Gov Bndry: Landgate
Roads: MRWA
Bush Frever: DPLH
Flora/Fauna: GHD
Imagery: Landgate (Aug 2017)

N

0 250 500m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F08_03
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Flora and Fauna Values

Supplementary Environmental Report

Figure:

8.3



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora/Fauna: GHD

N

0 250 500m
Scale: 1:25,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F08_04
Date: May 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Flora and Fauna Values

Supplementary Environmental Report

Figure:

8.4



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure: 9.1



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m

Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09

Date: June 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001

Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

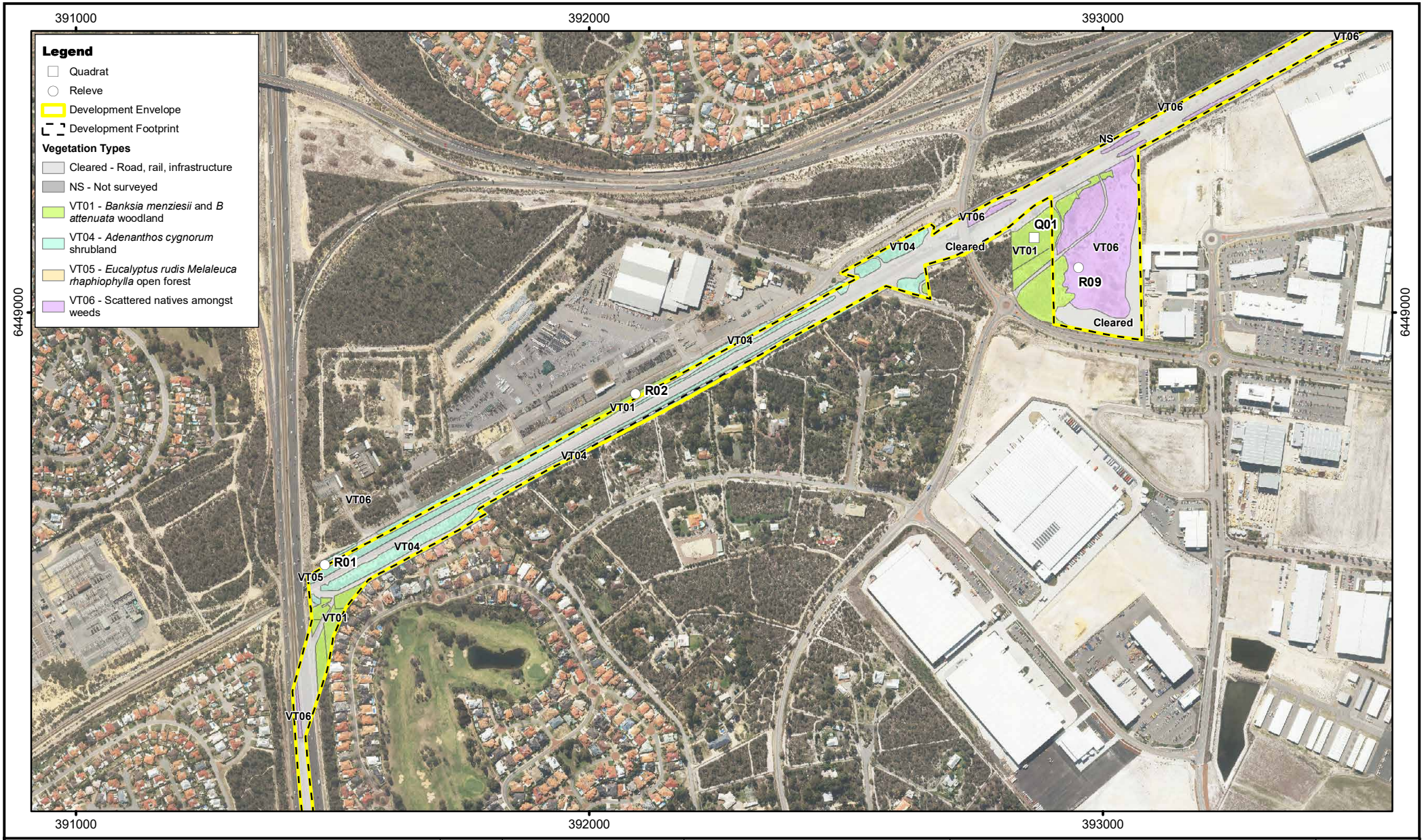
Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.2



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.3



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.4



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.5



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.6



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure: 9.7



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.8



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F09
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Types

Supplementary Environmental Report

Figure:

9.9



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.1



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001
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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.2



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

Aurora environmental
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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.3



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

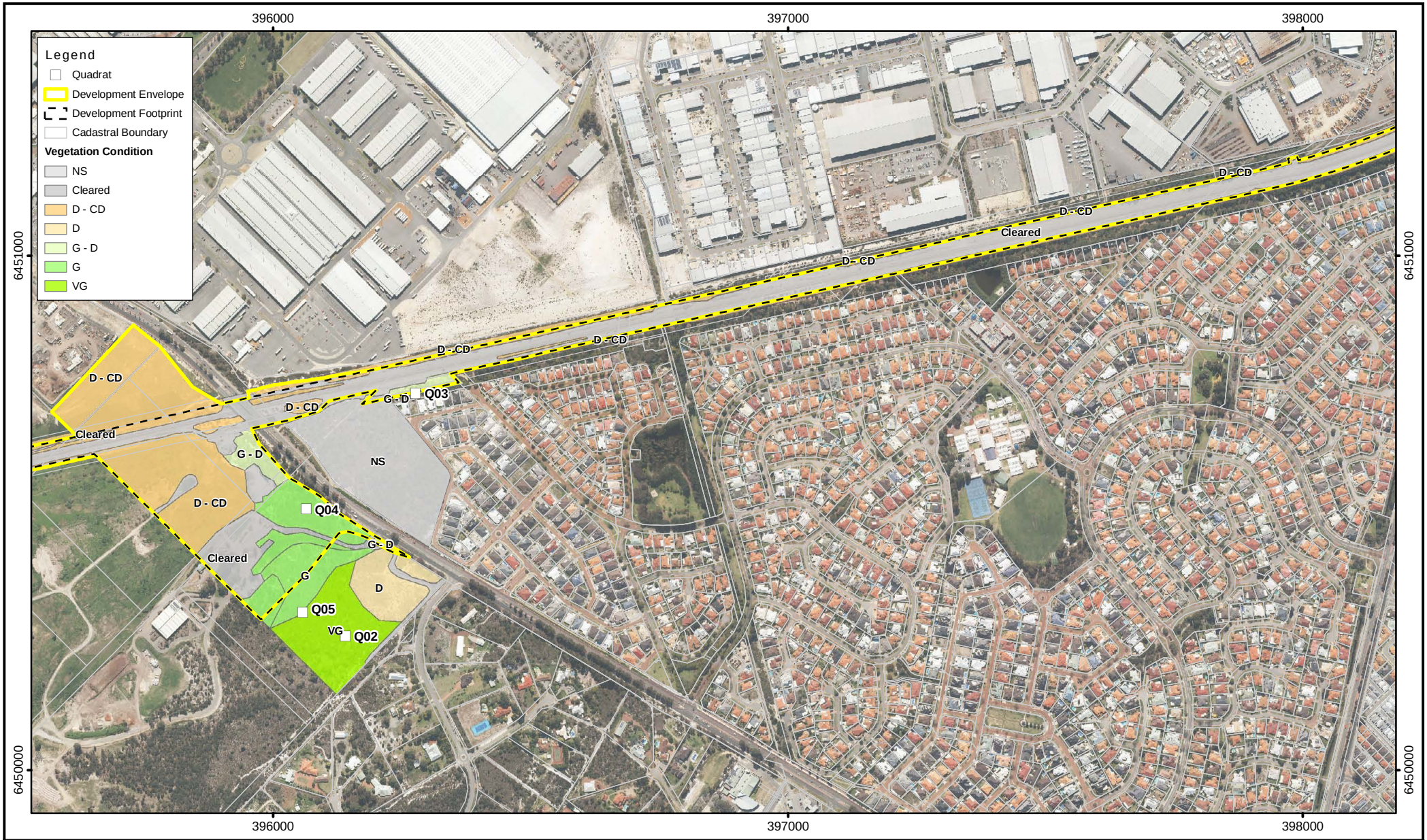
Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.4



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

Aurora environmental
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Drawn: CAD Resources ~ www.cadresources.com.au
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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.5



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001
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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.6



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.7



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.8



Cadasta: Landgate
Imagery: Landgate (Aug 2017)
Vegetation: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F10
Date: May 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Vegetation Condition

Supplementary Environmental Report

Figure:

10.9



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_01
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Bush Forever Site No. 245
Ken Hurst Park Vegetation Types

Supplementary Environmental Report

Figure:

11.1



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_02
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Bush Forever Site No. 245 Ken Hurst Park Vegetation Condition

Supplementary Environmental Report

Figure: 11.2



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_03
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project
Bush Forever Site No. 246
Canning and Southern River
Vegetation Types
Supplementary Environmental Report

Figure:
11.3



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_04
Date: June 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001
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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project
Bush Forever Site No. 246
Canning and Southern River
Vegetation Condition
Supplementary Environmental Report

Figure:
11.4



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_05
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Bush Forever Site No. 388 Jandakot Airport Vegetation Types

Supplementary Environmental Report

Figure: **11.5**



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 70 140 m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_06
Date: June 2018 | Rev: A | A4

Aurora environmental
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Thornlie to Cockburn Link Project

Bush Forever Site No. 388 Jandakot Airport Vegetation Condition

Supplementary Environmental Report

Figure:

11.6



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_07
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project
Bush Forever Site No. 456 Nicholson Road Bushland Vegetation Types
Supplementary Environmental Report

Figure: **11.7**



Local Gov Bndry, Cadasta: Landgate
Roads: MRWA
Bush Frever: DPLH
Imagery: Landgate (Aug 2017)
Flora: GHD

N

0 100 200 m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F11_08
Date: June 2018 | Rev: A | A4

Aurora environmental
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Author: C. Hewitt | AU Ref: PTA2018-001
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Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project
Bush Forever Site No. 456
Nicholson Road Bushland
Vegetation Condition
Supplementary Environmental Report

Figure:
11.8



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 25 50m
Scale: 1:2,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F12_01
Date: June 2018 | Rev: A | A4

Aurora environmental
ASSESS • ADVISE • APPLY
Author: C. Hewitt | AU Ref: PTA2018-001
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Thornlie to Cockburn Link Project
Conservation Category Wetland (UFI: 7446) at Tom Bateman Reserve
Vegetation Types
Supplementary Environmental Report

Figure:
12.1



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 25 50m
Scale: 1:2,500
MGA94 (Zone 50)

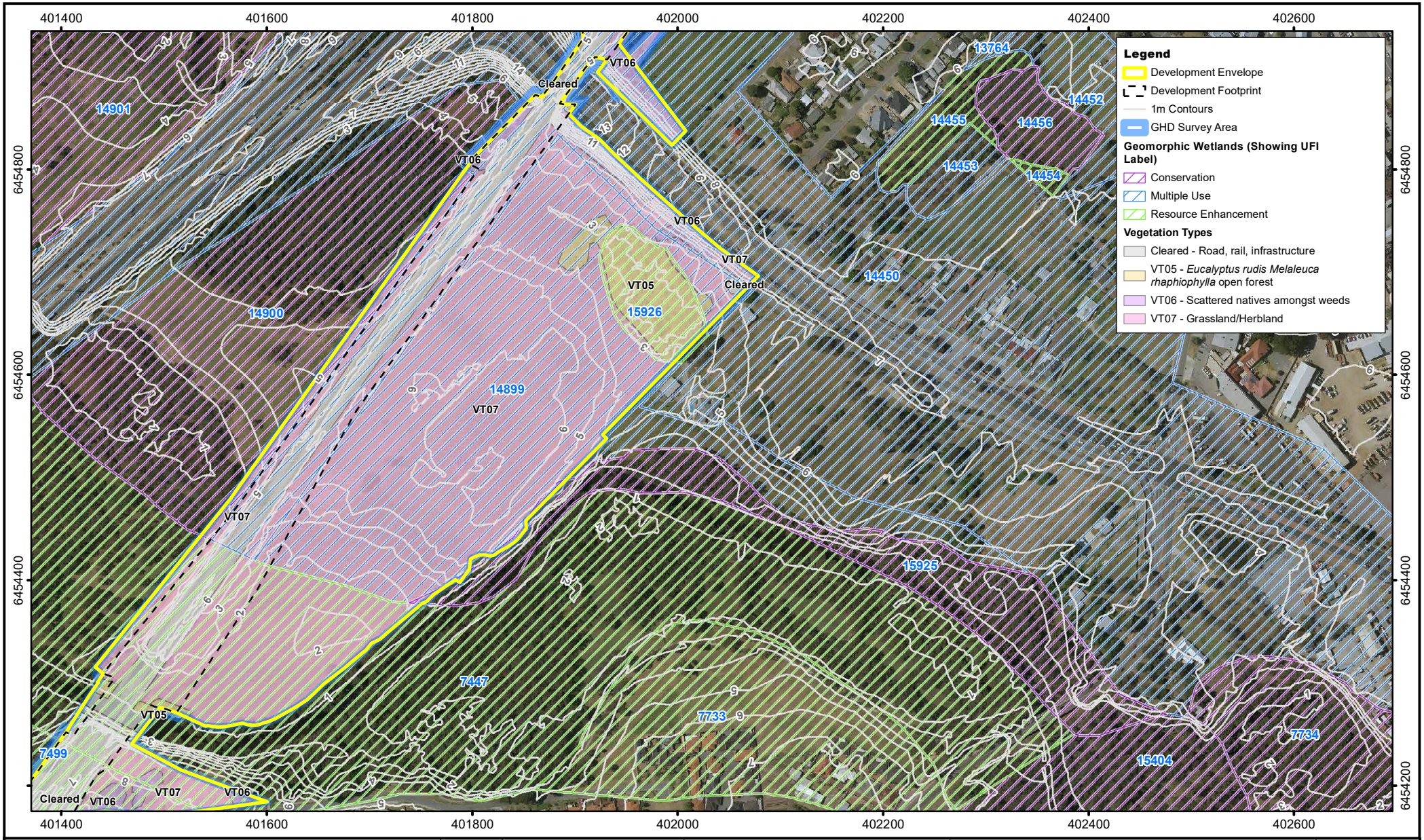
CAD Ref: a2600_SR_F12_02
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project
Conservation Category Wetland (UFI: 7446) at Tom Bateman Reserve Vegetation Condition
Supplementary Environmental Report

Figure:
12.2



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 50 100m
Scale: 1:5,000
MGA94 (Zone 50)

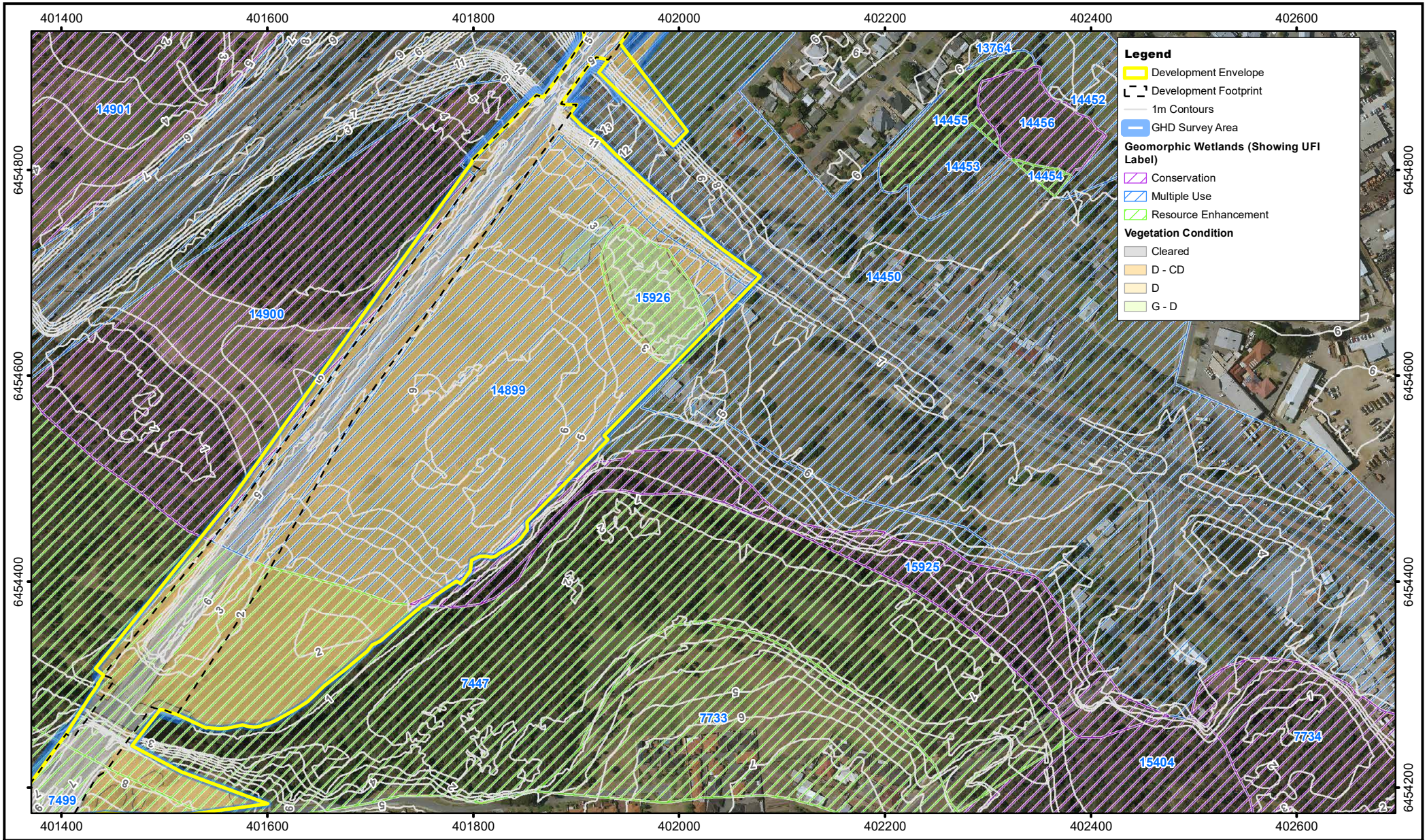
CAD Ref: a2600_SR_F13_01
Date: June 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project
Resource Enhancement Wetlands (UFI: 7747 and UFI: 15926) at Canning River Vegetation Types
Supplementary Environmental Report

Figure:
13.1



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 50 100m
Scale: 1:5,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F13_02
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Thornlie to Cockburn Link Project

Resource Enhancement Wetlands (UFI: 7747 and UFI: 15926) at Canning River Vegetation Condition Supplementary Environmental Report

Figure:

13.2



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 75 150m
Scale: 1:7,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F14_01
Date: June 2018 | Rev: A | A4

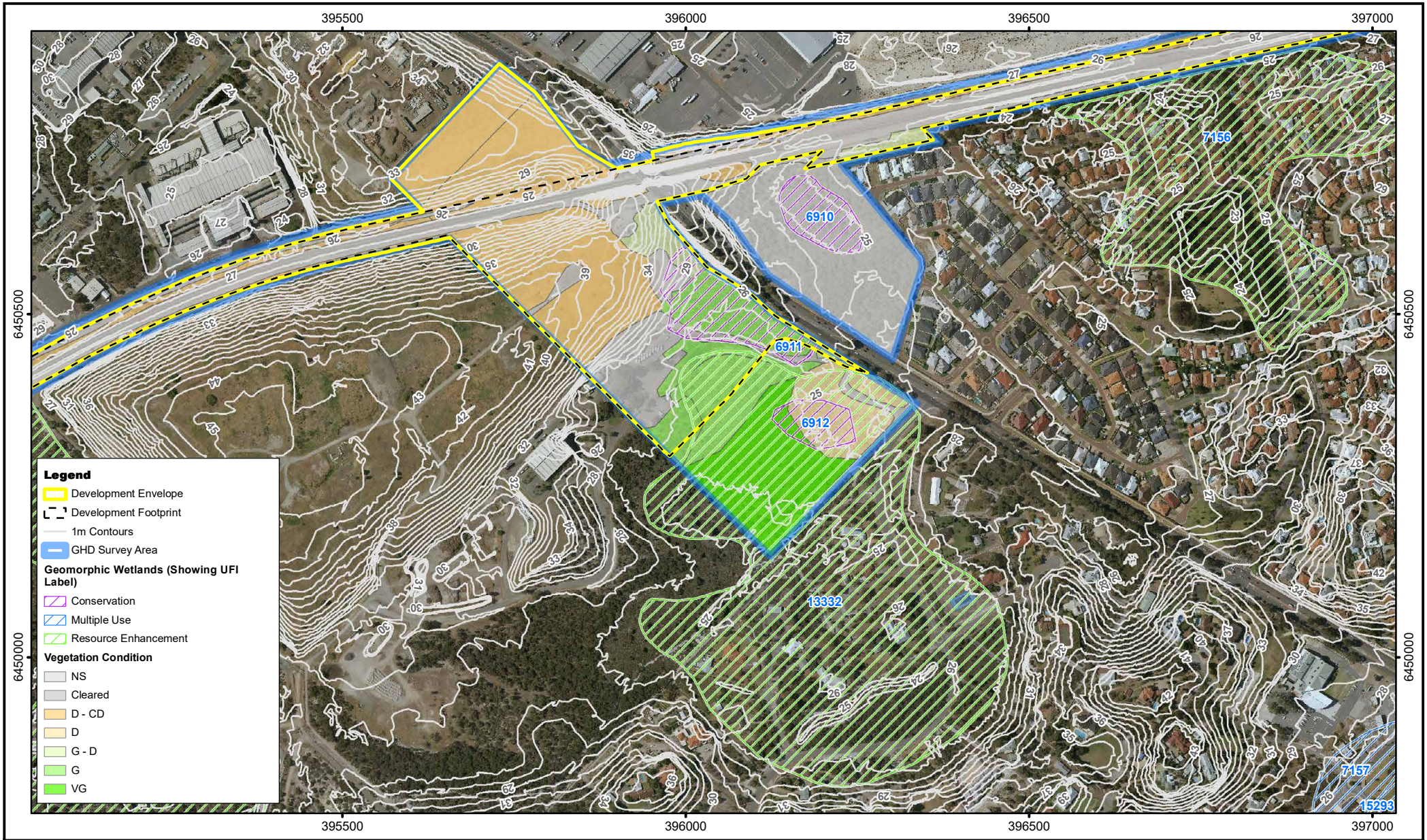
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Thornlie to Cockburn Link Project

Resource Enhancement Wetland (UFI: 13332) 100m South of Canning Vale landfill and recycling facility Vegetation Types Supplementary Environmental Report

Figure:

14.1



Geomorphic Wetlands: DBCA
Cadasta: Landgate
Geology: DMIRS
Contours: DoW
Imagery: Landgate (Nov 2017)

N

0 75 150m
Scale: 1:7,500
MGA94 (Zone 50)

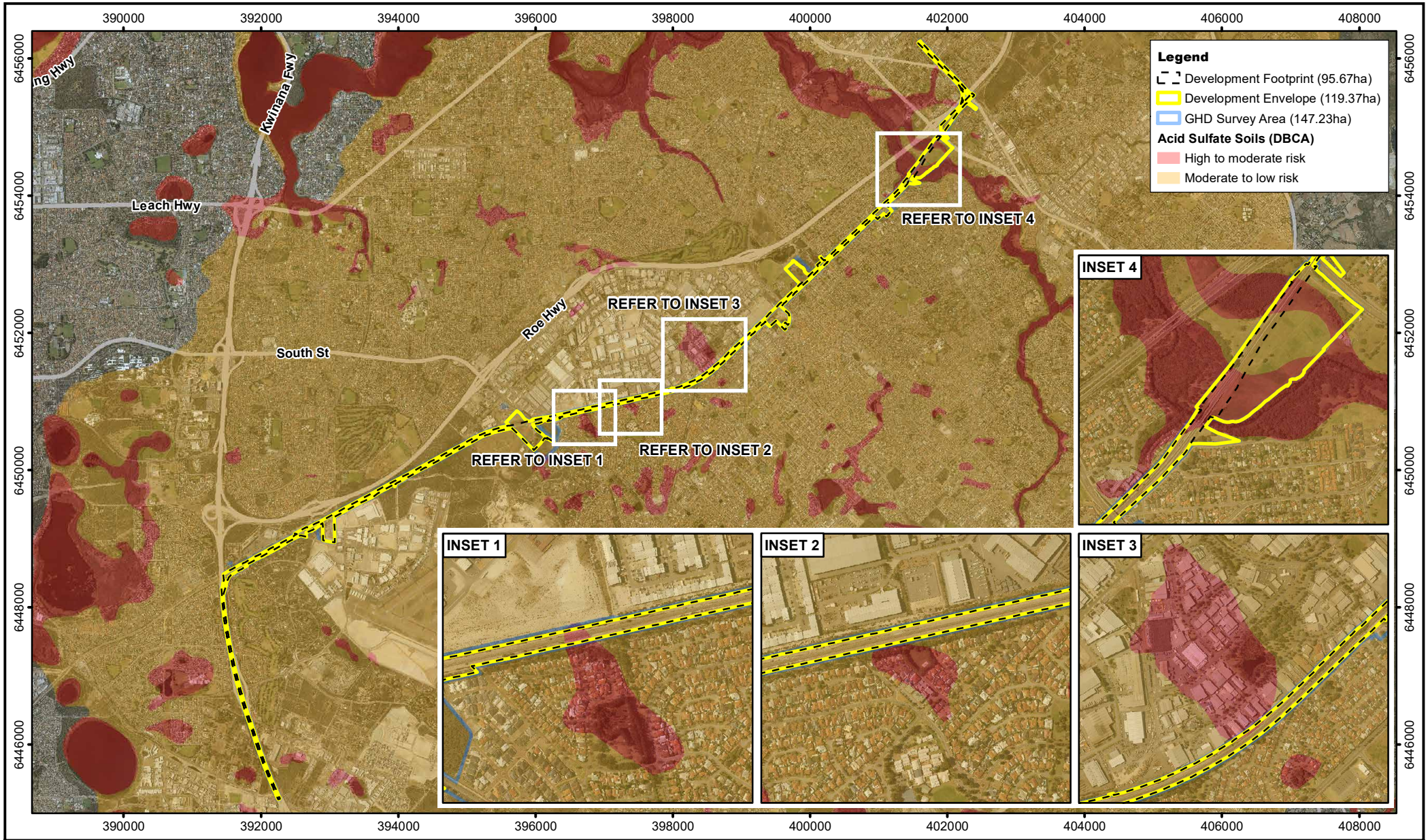
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Thornlie to Cockburn Link Project
Resource Enhancement Wetland (UFI: 13332) 100m South of Canning Vale landfill and recycling facility Vegetation Condition Supplementary Environmental Report

Figure:
14.2



ASS Risk Mapping: DBCA
Imagery: Landgate (Nov 2017)

N

0 0.75 1.5km
Scale: 1:75,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F15
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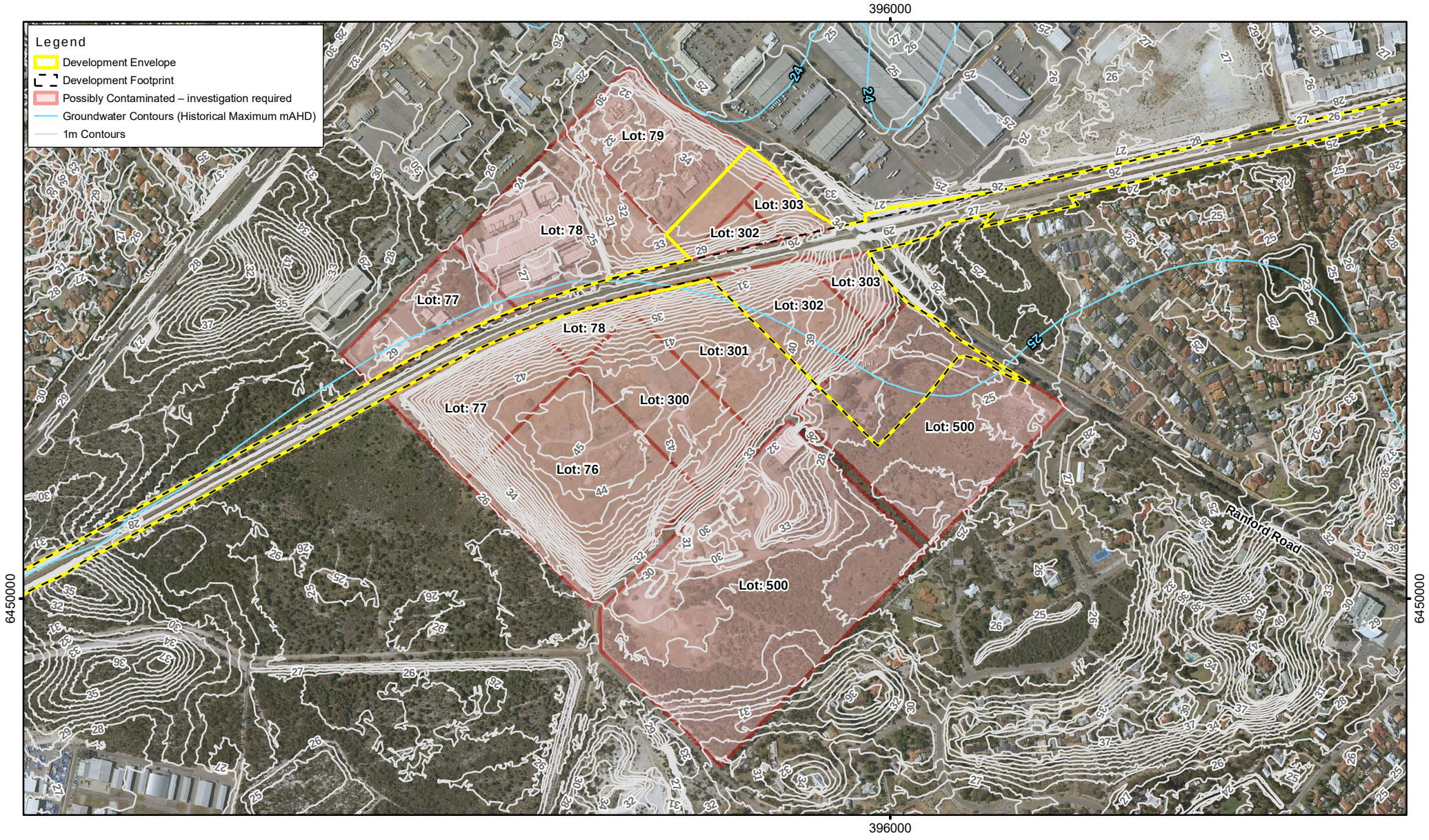
Thornlie to Cockburn Link Project

ASS Risk Mapping

Supplementary Environmental Report

Figure:

15



Contours: DWER
Cadasta: Landgate
Imagery: Landgate (Nov 2017)

N

0 100 200m
Scale: 1:10,000
MGA94 (Zone 50)

CAD Ref: a2600_SR_F16
Date: May 2018 | Rev: A | A4

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Author: C. Hewitt | AU Ref: PTA2018-001
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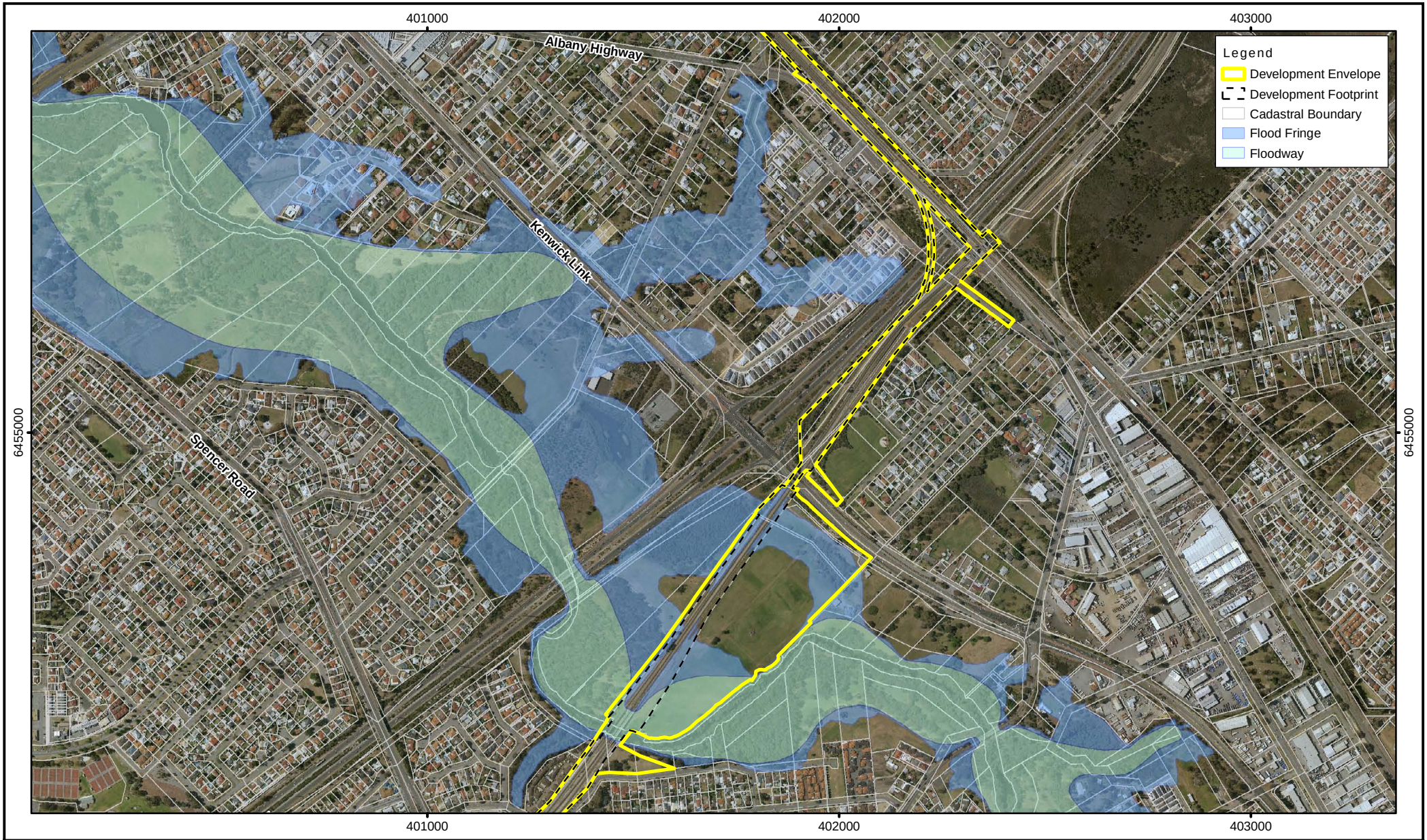
Thornlie to Cockburn Link Project

Former Landfill

Supplementary Environmental Report

Figure:

16



Cadasta: Landgate
Floodplains: DWER
Roads: MRWA
Imagery: Landgate (Nov 2017)

N

0 125 250m

Scale: 1:12,500
MGA94 (Zone 50)

CAD Ref: a2600_SR_F17

Date: May 2018 | Rev: A | A4

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Thornlie to Cockburn Link Project

Canning River Floodplain Mapping

Supplementary Environmental Report

Figure: **17**

APPENDIX 1

Existing Network Maps

APPENDIX 2

Thornlie–Cockburn Link Project Flora and Fauna Survey

APPENDIX 3

Thornlie Extension Environmental Assessment

APPENDIX 4

Lots 302, 303 and 500 Ranford Road, Canning Vale
Preliminary Site Investigation

APPENDIX 5

Ranford Road METRONET Sampling and Analysis Plan
for Detailed Site Investigation

APPENDIX 6

Thornlie – Cockburn Link Noise and Vibration Assessment

APPENDIX 7

Noise and Vibration Management Plan

APPENDIX 8

Aboriginal Heritage Survey

APPENDIX 9

Addendum to Report on Thornlie-Cockburn Link,
Aboriginal Heritage Survey

APPENDIX 10

Section 18 Approval