



**Public Transport
Authority**



Byford Rail Extension

Environmental Review Document

EPA Assessment 2261

May 2021

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Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this proposal.

The Public Transport Authority (PTA) proposes to develop the Byford Rail Extension Proposal (The Proposal) as part of the Western Australian Government's METRONET vision.

The Environmental Review Document (ERD) has been prepared in accordance with the EPA's ***Procedures Manual (Part IV Divisions 1 and 2)***.

The ERD is the report by the proponent on their environmental review which describes this proposal and its likely effects on the environment.

The ERD is available for a public review period of **two** weeks from **3 May 2021**, closing on **17 May 2021**.

Information on the proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the proposal to the Minister for Environment.

Why write a submission?

The EPA seeks information that will inform the EPA's consideration of the likely effect of the proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on information in the ERD.

When making comments on specific elements in the ERD:

- Clearly state your point of view and give reasons for your conclusions.
- Reference the source of your information, where applicable.
- Suggest alternatives to improve the outcomes on the environment.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your contact details – name and address.
- Date of your submission
- Whether you want your contact details to be confidential.
- Summary of your submission, if your submission is long.
- List points so that issues raised are clear, preferably by environmental factor.
- Refer each point to the page, section and if possible, paragraph of the ERD.
- Attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: **17 May 2021**

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at <https://consultation.epa.wa.gov.au>.

Alternatively submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup DC WA 6919, or
- delivered to: Environmental Protection Authority, Prime House, 8 Davidson Terrace, Joondalup 6027.

If you have any questions on how to make a submission, please contact the EPA Services at the Department of Water and Environmental Regulation on 6364 7000.

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Definitions and terminology

Acronym / Term	Definition / Full text
AHD	Australian height datum
Annual Exceedance Probability (AEP)	The likelihood of occurrence of a flood of given size or larger occurring in any one year, expressed as a percentage.
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AASS	Actual acid sulfate soils
ASS	Acid sulfate soils
ASSMS	Acid Sulfate Soils Management Strategy
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
Banksia Woodlands TEC	Banksia Woodlands Threatened Ecological Community (TEC) (including Banksia Woodlands Priority Ecological Community (PEC))
BC Act	<i>Biodiversity Conservation Act 2016</i>
bgl	below ground level
Black Cockatoo breeding habitat	Areas containing trees species with the potential to form suitable breeding hollows with a DBH 300 mm for salmon gum and wandoo and 500 mm for other species. High quality breeding habitat generally is less than 2 km from water and has quality foraging habitat within a 6 km radius
Black Cockatoo potential breeding tree	The Revised draft referral guideline for three threatened black cockatoo species (DEE, 2017) defines Black cockatoo potential breeding trees as: "species of trees known to support breeding (see Table 1) within the range of the species which either have a suitable nest hollow OR are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most species of trees, suitable DBH is 500 mm. For salmon gum and wandoo, suitable DBH is 300 mm. Note that any species of tree may develop suitable hollows for breeding."
Suitable nest hollow	Any hollow that appears to be deep enough and with an opening large enough to be used by black cockatoos. Usually this will be a natural hollow, but artificial hollows may also be suitable in some circumstances (for example, where the artificial hollow has been specifically designed for use by black cockatoos) (DEE, 2017).
BoM	Bureau of Meteorology
CCW	Conservation Category Wetland - wetlands which support a high level of attributes and functions
DAWE	Commonwealth Department of Agriculture, Water and the Environment. The Commonwealth agency responsible for administering the EPBC Act. Previously known as the Commonwealth Department of the Environment and Energy (DotEE) and the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA).
DBCA	The Department of Biodiversity, Conservation and Attractions. The State Government agency responsible for the administration of the Conservation and Land Management Act 1985. The former Department of Parks and Wildlife (DPaW).
Development Envelope	The area within which activities associated with the construction and operation of the Proposal can occur.
Direct impacts	Impacts associated with the Proposal that are located within the Footprint.
DITCaRD	Department of Infrastructure, Transport, Cities and Regional Development
DMA	Decision Making Authority
DoC	Department of Communities. The State Government Department responsible for diverse activities include intensive responses such as the protection of children, preventative responses such as housing assistance and disability

Acronym / Term	Definition / Full text
	support, and enabling activities such as urban development and providing community grants.
DoH	Department of Health of Western Australia. State Government Department responsible for administering the <i>Public Health Act 2016</i> .
DPLH	Department of Planning, Lands and Heritage
DWER	The Department of Water and Environmental Regulation. The State Government agency responsible for the administration of the <i>Environmental Protection Act 1986</i> .
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority. The Authority responsible for assessing the environmental impacts of development proposals.
EPASU	Environmental Protection Authority Services Unit
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
Fauna habitat	The natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live (e.g. breed, forage, roost or seek refuge).
FCT	Floristic Community Type
Footprint	The indicative area within which rail infrastructure will be located and construction activities will occur.
FW 95%	Freshwater 95% - water quality trigger value to ensure the protection of 95% of species in freshwater ecosystems under the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality trigger values.
GDE	Groundwater dependent ecosystem
GL	Gigalitre
GWL	Groundwater level
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
Intact native vegetation	Native vegetation in better than Completely Degraded condition as defined under the Technical Guidance - Flora and Vegetation Surveys - Environmental Protection Agency WA (2016).
kL/d	kilolitre per day
km	Kilometre
km ²	square kilometre
LAA	<i>Land Administration Act 1997</i>
m	metre(s)
m AHD	metres Australian height datum
m bgl	metres below ground level
m btoc	metres below top of casing
m/day	metres per day
Management action	Identified actions proposed or undertaken to mitigate the impacts of implementation of a proposal on the environment and achieve the condition environmental objective.
MCA	Multi criteria analysis
MEL	Morley Ellenbrook Line
mg/L	milligrams per litre
MGL	Maximum groundwater level
MO	METRONET Office
MRS	Metropolitan Region Scheme (MRS)
MRWA	Main Roads Western Australia
μS/cm	micro-siemens per centimetre

Acronym / Term	Definition / Full text
MUW	Multiple Use Wetland
mV	millivolt
NHMRC	National Health and Medical Research Council
Noise sensitive receptor	A building, or a part of a building, on the premises that is used for a noise sensitive purpose, in accordance with those premises defined in Schedule 1 Part C of the <i>Environmental Protection (Noise) Regulations 1997</i> .
NRMMC	Natural Resource Management Ministerial Council
°C	degrees Celsius
PASS	Potential acid sulfate soils
PDWSA	Public drinking water source area
PEC	Priority Ecological Community
PER	Public Environmental Review
PMST	Protected Matters Search Tool
Potential indirect impacts	Are potential impacts to key environmental values located within 20 metres of the Footprint. Where the Footprint is located close to or on the boundary of the Development Envelope, potential indirect impacts may occur up to 20 metres outside the Development Envelope boundary.
Proposal	Byford Rail Extension
Proposed Action	Byford Rail Extension
PTA	Public Transport Authority of Western Australia
Q1, Q2, Q3, Q4	Quarter one, quarter two, quarter three, quarter four
REW	Resource Enhancement Wetland
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
SCP	Swan Coastal Plain
SPP	State Planning Policy
SRE	Short range endemic
Study Area	Desktop study area used for context surrounding the development envelope.
TEC	Threatened Ecological Community
The Corridor	Land vested in PTA containing the existing rail corridor between Armadale and Byford
TSSC	Threatened Species Scientific Committee
UWPCA	Underground water pollution control area
WA	Western Australia
WAH	Western Australian Herbarium
WAPC	The Western Australian Planning Commission; or statutory authority of the Government of Western Australia with functions and authority to undertake and regulate land use planning and development established under the <i>Planning and Development Act 2005</i> .
WONS	Weeds of National Significance

Executive summary

The Public Transport Authority of Western Australia (PTA) is proposing to develop the Byford Rail Extension Proposal (The Proposal) as part of the Western Australian Government's METRONET vision. The Proposal will extend the passenger rail network by 8 km from Armadale Station to a proposed new station at Byford. The Proposal will make use of the existing Australind rail corridor and includes the replacement of the current bridge at Wungong Brook, upgrade of Armadale Station, construction of the new Byford Station, replacement of select level crossings with grade separated crossings and establishment of a Principal Shared Path (PSP). **Table 1** and **Table 2** provides a summary of the Proposal and the key Proposal characteristics.

Table 1 Summary of the Proposal

Item	Details
Proposal title	Byford Rail Extension Rail Works
Proponent name	Public Transport Authority of Western Australia
Short description	The Proposal is to construct and operate an 8 km new railway (including dual tracks and associated rail infrastructure), between Armadale and Byford. The Proposal includes modification to the existing Armadale Station and construction of a new Byford station. The Proposal also includes the replacement of a number of existing at-grade line crossings (level crossings) with grade separated crossings, either road over rail or rail over road.

Table 2 Key Proposal characteristics

Element	Location	Proposed extent
Physical elements		
Railway tracks and associated infrastructure	The new 8 km dual railway track extends the existing electrified rail network at Armadale in a southerly direction using the existing Australind rail corridor (the Corridor) to the new Byford Station, north of Abernethy Road, Byford (Figure 1). Rail modifications will also be required as far as Sherwood Station 1.5 km north of Armadale Station.	Disturbance of up to 80.7 ha in the area shown as Disturbance Footprint contained entirely within a 164.6 ha Development Envelope. This includes the clearing of up to 15.99 ha of native vegetation.
Armadale Station (modifications) Modifications to the existing railway station and associated facilities including intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (walking/cycling) facilities.	Located approximately 500 m south of Armadale Road, Armadale (Figure 1).	
Byford Station New railway station and associated facilities including intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (walking/cycling) facilities.	Located approximately 8 km south of the existing Armadale Station, 400 m north of Abernethy Road, Byford (Figure 1).	

Element	Location	Proposed extent
Level Crossings	Located along the Corridor (Figure 1).	
Existing level crossings will be retained, closed or replaced with grade separated crossings, depending on the most appropriate design option. Each crossing will fit entirely within the Development Envelope.		
Wungong Brook Rail Bridge	Rail crossing over Wungong Brook.	Duplication of rail bridge over Wungong Brook.
Construction and access areas	Where practicable the PTA will locate temporary construction areas in areas of existing disturbance. Construction and access areas in and adjacent to the Corridor, entirely within the 164.6 ha Development Envelope.	
Operational elements		
Rail and Bus Services	The passenger railway will operate as an extension to the existing Perth to Armadale line, extending 8 km to Byford (Figure 1). New rail and bus services are proposed for Byford Station.	The passenger railway will operate within the 80.7 ha Disturbance Footprint (Figure 1)

The PTA referred the proposal to the EPA in September 2020. The EPA determined the level of assessment as Public Environmental Review, and noted the following key environmental factors as requiring considering:

- Flora and Vegetation
- Terrestrial Fauna
- Inland Waters
- Social Surroundings
- Other environmental factors, including:
 - Greenhouse Gas Emissions
 - Air Quality
 - Principle of Waste Minimisation.

This Environmental Review Document (ERD) assesses each of the nominated factors, outlines the potential and actual impacts and describes how the PTA has applied the mitigation hierarchy to manage impacts. This assessment considered all requirements of the approved Byford Rail Extension Environmental Scoping Document. **Table 3** provides a summary of the potential impacts, the proposed mitigation measures that will avoid, minimise, and rehabilitate impacts arising from the Proposal, and the predicted outcomes for the environmental factors considered in this ERD.

Table 3 Summary of potential impacts, proposed mitigation and outcomes

Key Environmental Factor - Flora and Vegetation	
EPA objective	<i>To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</i>
Policy and guidance	<ul style="list-style-type: none"> • Environmental Factor Guideline: Flora and Vegetation (EPA 2016a) • Environmental Protection Bulletin 20 – Protection of naturally vegetated areas through planning and development (EPA 2013) • Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems (EPA 2006). Instructions: IBSA Data Packages (EPA 2020a) • Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016d)
Potential impacts	<ul style="list-style-type: none"> • Permanent loss of flora and vegetation generally through clearing • Clearing of significant flora that occur, or have a high likelihood of occurring, within the Development Envelope • Dust deposition on surrounding vegetation • Introduction and/or spread of weeds to surrounding bushland areas • Decline of vegetation from changes to surface water drainage flows and infiltration during rainfall events • Increased edge effects • Introduction and/or distribution of diseases to surrounding bushland areas, including Phytophthora Dieback • Fragmentation of intact native vegetation including impacts on significant ecological communities, and the potential for fragmentation of ecological linkages • Decline of significant ecological communities and groundwater dependent ecosystems from dewatering and groundwater abstraction • Increased risk of bushfire from operation of an electrified railway near areas of vegetation
Mitigation	<p>Avoid</p> <ul style="list-style-type: none"> • Consideration of flora and vegetation values during detailed design to avoid clearing, particularly in areas of significant flora and vegetation • Construction and operational access tracks have been designed to coincide with existing tracks or aligned along cleared areas wherever practicable • Clearing regionally significant bushland associated with Bush Forever has been avoided wherever practicable • Consideration of vegetation values during detailed design to avoid clearing, particularly in areas of significant vegetation • The <i>Diuris purdiei</i> record will be avoided and buffered to prevent ground disturbance at this location • Vegetation clearing and earthworks will be avoided during high winds wherever practicable <p>Minimise</p> <ul style="list-style-type: none"> • Cleared areas will be used for temporary construction requirements, wherever practicable • The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on native vegetation and minimise impacts on TEC SCP 3a and Conservation Category Wetlands

- The Development Envelope and Footprint to be marked on all design drawings as site boundaries
- Manage clearing of vegetation in accordance with the PTA Ground Disturbance Procedure and PTA Environmental Spatial Data Procedure
- No land clearing or ground disturbance work is to be undertaken until a Ground Disturbance Permit has been signed and issued by PTA
- Vehicles and equipment access limited to designated roads/access tracks and cleared areas
- The Proposal Footprint has been narrowed through Bush Forever site no. 264 as far as practicable to minimise impacts on native vegetation
- All significant flora will be mapped and marked on site and avoided where possible during clearing
- Ensure staff and contractors are aware of the location of significant flora and vegetation on site and their responsibility to ensure they are protected
- Implement dust suppression measures outlined in the PTA Ground Disturbance Procedure
- Dust suppression measures will be utilised at locations of high dust risk including internal construction roads, cleared areas, batters and stockpiles
- Dust suppression measures such as application of water and dust suppressants will be implemented where dust generation is visible, except during topsoil stripping
- Vehicle speeds on construction roads will be reduced where necessary to minimise dust emissions
- Manage weeds in accordance with the PTA Ground Disturbance Procedure
- Identify weed management zones aligned with significant weed infestations
- Control the infestations of One-leaf Cape Tulip and Black berry within the Development Envelope in accordance with DPIRD guidelines
- The PTA will develop and Construction Contractor implement a hygiene management process to control access and movement of vehicles and construction personnel to prevent the introduction and spread of weeds into weed free areas
- Require all personnel to complete a site induction that will include hygiene training, including the environmental implications of the introduction and spread of weeds, dieback, and associated obligations
- Movement of topsoil restricted to within the same weed interpretation mapping or Phytophthora dieback interpretation mapping unit
- Source clean fill, gravel and topsoil or other materials from suppliers with appropriate weed and dieback control measures
- Implement biannual weed monitoring and targeted spraying program at the Proposal during operation
- Installation of drainage structures to maintain or improve existing surface water drainage within the DE and incorporate erosion protection measures, where required
- Placement of culverts to maintain existing surface water flows
- Temporary capture of runoff to control discharge of sediment and minimise turbidity of water leaving the Development Envelope
- Construction staging will ensure appropriate surface water management such as culverts and drainage diversions are installed prior to the wet season wherever practicable
- The Proposal has been designed to avoid dissecting areas of native vegetation to limit edge effects by using an existing rail corridor

- Manage dieback to avoid or minimise the spread of pathogen through:
 - Ensuring all vehicles and machinery observe appropriate hygiene measures as identified in the Construction Environmental Management Plan (CEMP)
 - Undertake disturbance activities under dry soil conditions (where possible).
 - No storage of top soil or movement of soil and plant material from the Development Envelope into Lambert Lane Nature Reserve or Fletcher Park.
 - Construction of a green bridge for the access track south of Lambert Lane Nature Reserve
 - Any topsoil known to be dieback infested to be reused in infested areas, buried onsite in a suitable location or disposed of at landfill, in accordance with regulatory requirements
- The PTA will monitor and manage drawdown and surrounding vegetation condition through:
 - Monitoring requirements established under a *Rights in Water and Irrigation Act 1914* (RIWI Act) 5C licence
 - A water operating strategy
 - Implementation of a TEC SCP 3a condition monitoring program to avoid impacts on terrestrial GDEs
- The PTA will develop and implement bushfire management measures in line with the PTA Bushfire Management Strategy and in consultation with City of Armadale and the Shire of Serpentine Jarrahdale, to align any relevant existing local government Bushfire Management Plans
- Require all personnel to complete a site induction that will include information on prevention of fires, including designated smoking areas, no fires permitted in workplace, use of extinguishers, hot works procedures
- Working fire extinguishers to be fitted to all mobile plant equipment
- All fuel stored on site to be in a secure bund with fuel storage to be minimised where possible
- Refuelling of equipment and machinery to be completed in the early morning where possible
- Machinery (chainsaws etc.) not to be placed on the ground where long grass exists following use
- Approved Hot works permit to be in place for all 'hot work' (e.g. grinding/welding)
- The area immediately surrounding 'hot work' to be dampened with water if vegetated and vegetation is not already naturally damp
- The PTA will implement the PTA Bushfire Management Strategy to reduce bushfire risk during Proposal operation. Actions may include:
- Implement regular bushfire hazard reduction through mechanical and chemical fuel load reduction:
 - Maintain strategic firebreaks
 - Ensure controlled access to PTA land
 - Require safe operating procedures for high-risk maintenance activities
 - Adhere to the PTA's current fire emergency response procedures

Rehabilitate

Areas cleared for the Proposal will be revegetated where not required for permanent infrastructure or management access and with consideration for operational safety requirements.

Outcomes

Significant Residual Impacts

Permanent loss of:

- 2.83 ha of *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (SCP 3a) TEC
- 1.54 ha of vegetation associated with Bush Forever sites nos. 264, 266 and 350

Offset

The PTA has proposed an offsets Strategy to counterbalance the significant residual impacts for the Proposal.

Key Environmental Factor – Terrestrial Fauna

EPA objective	<i>To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</i>
Policy and guidance	<ul style="list-style-type: none">• Environmental Factor Guideline – Terrestrial Fauna (EPA 2016c)• Instructions: IBSA Data Packages (EPA 2020a)• Instructions on how to prepare an Environmental Review Document (EPA 2020b)• Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016e)• Technical Guidance: Sampling of short range endemic invertebrate fauna (EPA 2016f)• Technical Guidance: Terrestrial fauna surveys (EPA 2016g)• Technical Report: Carnaby's Black Cockatoo in Environmental Impact Assessment in the Perth and Peel Region (EPA 2019)
Potential impacts	<ul style="list-style-type: none">• Impacts on conservation significant fauna• Fauna deaths and injury resulting from collisions with earth moving equipment, vehicles, and/or trains during construction and operation, or from fauna entering excavated areas• Disturbance of up to 80.7 ha of fauna habitat, due to clearing and construction of infrastructure in the Footprint• Fragmentation of fauna habitat, barriers to fauna movement and/or loss of ecological connectivity• Changes in feral animal abundance and/or movement• Noise and lighting impacts may change fauna movement and behaviour• Degradation of habitat and habitat modification from the introduction and increased spread of weeds and/or disease, soil pathogens, altered surface water flows and edge effects• Increased separation between habitat patches
Mitigation	Avoid <ul style="list-style-type: none">• The Proposal design shall avoid clearing of fauna habitat where possible, with a particular emphasis on avoiding habitat of moderate to better value black cockatoo foraging (VSA 4)• The PTA will further investigate avoiding areas of fauna habitat during the detailed design phase, where practicable• The Footprint has been selected in order to minimise the extent of clearing of fauna habitats and avoid creating a new barrier to fauna movement, by utilising the existing Armadale and Australind rail corridor

- Water sensitive urban design principles will be implemented as part of drainage design
- Fencing will be erected along either side of the railway line to prevent fauna accessing the track. The fencing will be in accordance with PTA standards and will be between 1.8 and 2.4m high
- The railway has been designed to minimise impacts to significant surface water flows, such as at Wungong Brook, as much as practicable
- The PTA will place existing culverts to maintain sufficient surface water flow
- Waterway crossings, including Wungong Brook have been designed to avoid direct impacts to stream beds (through use of span bridges) and minimise impacts to stream bank and riparian zones

Minimise

- The PTA has reduced the Footprint near Lambert Lane (immediately north of Eleventh Road) which contains quality fauna habitat that is utilised by Black Cockatoos.
- The Proposal was designed to place the temporary construction areas within existing cleared or Completely Degraded areas adjacent or near the rail corridor wherever practicable
- The Development Envelope and Footprint to be marked on all design drawings as site boundaries
- Vehicles and equipment access limited to designated roads/access tracks and cleared areas
- Design of the two single span bridges at Wungong Brook to minimise impact to the water course and Carter's Freshwater Mussel habitat
- Translocation of Carter's Freshwater Mussel in areas of habitat that will be directly impacted during construction. Translocation to be linked to water quality monitoring
- Provision of a culvert crossings (between 300 mm and 1500 mm to best accommodate fauna) at natural ground level to facilitate fauna movement between Lambert Lane Nature Reserve and Fletcher Park
- The PTA will ensure that any landscaping or revegetation undertaken will be sufficient distance from the live railway
- Black Cockatoo foraging plants will not be used in close proximity to the rail line to avoid foraging near the rail line and minimise the risk of bird strike
- Speed limited on construction access roads during construction
- Water Sensitive Urban Design (WSUD) will be applied to manage the quality of surface water runoff originating from hard stand areas such as carparks and train stations
- Installation of drainage structures to maintain or improve existing surface water drainage within the Development Envelope and incorporate erosion protection measures, where required
- Construction staging will ensure appropriate surface water management such as culverts and drainage diversions are installed prior to the wet season wherever practicable
- The PTA will manage water flow through temporary capture of runoff, to control discharge of sediment and minimise turbidity of water leaving the Development Envelope, minimising the potential impact to Carter's Freshwater Mussel
- A strategy will be developed and incorporated into the CEMP, which will be implemented by the PTA to ensure groundwater impacts are minimised. This will include:
 - implementing a water quality monitoring program, prior, during, and post construction to measure water quality in areas of Carter's Freshwater Mussel habitat

- mitigation measures such as silt curtains, erosion control, and translocation of individuals that are expected to be impacted.
- Manage weeds and dieback in accordance with the PTA Ground Disturbance Procedure
- Identify weed management zones aligned with significant weed infestations
- Control the infestations of One-leaf Cape Tulip and Black berry within the Development Envelope in accordance with DPIRD guidelines
- PTA to develop and implement a hygiene management process to control access and movement of vehicles and construction personnel to prevent the introduction and spread of weeds and dieback
- Require all personnel to complete a site induction that will include hygiene training, including the environmental implications of the introduction and spread of weeds, dieback and associated obligations
- Movement of topsoil restricted to within the same weed interpretation mapping
- Source clean fill, gravel and topsoil or other materials from suppliers with appropriate weed and dieback control measures
- Implement biannual weed monitoring and targeted spraying program at the Proposal during operation
- Ensure all vehicles and machinery observe appropriate hygiene measures as identified in the Construction Environmental Management Plan (CEMP)
- Movement of topsoil restricted to within the same Phytophthora dieback interpretation mapping unit
- Any topsoil known to be dieback infested to be reused in infested areas, buried onsite in a suitable location or disposed of at landfill, in accordance with regulatory requirements

Rehabilitate

- Areas cleared for the Proposal, that are no longer required for future infrastructure or management access, will be revegetated, with consideration for operational safety requirements
- Topsoil to be managed to reduce the weed seed bank prior to reuse for rehabilitation or landscaping
- Disturbed and cleared habitat and riparian vegetation will be revegetated to improve fauna connectivity and reduce weed infestation

Outcomes

Significant Residual Impacts

Permanent loss of significant fauna habitat comprising:

- 8.65 ha of foraging habitat for Baudin's cockatoo classified entirely as moderate value foraging habitat
- 19.3 ha of foraging habitat for Carnaby's cockatoo comprised of 8.65 ha of moderate value foraging habitat and 10.67 ha of low value foraging habitat
- 61.1 ha of foraging habitat for Forest Red-tailed Black Cockatoo comprised of 8.65 ha of moderate to high value foraging habitat and 52.49 ha of low value foraging habitat
- Loss of up to 139 potential Black Cockatoo breeding trees, 131 (94.4%) with no hollows, and eight (5.8%) with hollows not suitable for black cockatoos

Offset

The PTA will offset the residual impacts of the Proposal at Lowlands Nature Reserve, the established METRONET offset site.

Key Environmental Factor – Inland Waters

EPA objective	<i>To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.</i>
Policy and guidance	Key EPA policy and guidance is: Environmental Factor Guideline: Inland Waters (EPA 2018).
Potential impacts	<ul style="list-style-type: none"> • Temporary abstraction of groundwater for construction and dewatering purposes may result in the: <ul style="list-style-type: none"> – decrease of groundwater availability to existing users and wetlands – interruption of or changes to surface water flows where surface water is dependent on groundwater decrease in the quality of surface water of the storage and seepage of abstracted water • Reinjection of groundwater during construction phase may result in: <ul style="list-style-type: none"> – impacts on groundwater quality – interruption of or changes to surface water where it is dependent on groundwater discharge • Ground disturbance and earthworks required for the construction of rail infrastructure and hardstand areas may result in: <ul style="list-style-type: none"> – impacts on surface water flows or hydrological regimes along riparian areas associated with brooks and drains – deterioration of surface water quality from sedimentation and transport of contaminants – alteration of on surface water quantities flowing into wetlands – impacts on wetlands due to clearing, reducing the size of the functioning wetland – impacts on wetlands from changes to surface water quality – impacts on wetlands from changes to surface water quantity • Where wetlands occur adjacent to the Development Envelope there is potential for indirect impacts resulting from changes to surface and groundwater quality and quantity • Operation and maintenance may cause partial interruption of surface water flows due to the presence of railway infrastructure such as hardstand areas associated with Armadale and Byford stations
Mitigation	<p>Avoid</p> <ul style="list-style-type: none"> • Access into wetlands and Wungong Brook during construction except for areas to be cleared or during construction • Impacts will be avoided by placing the bores at least 50 m away from existing users and sensitive receptors or 100 m where practicable • The railway has been designed to remain above the water table • The railway has been designed to minimise the intersection of significant surface water flows, such as at Wungong Brook, as far as practicable • Where practicable, runoff from disturbed areas will be directed away from existing waterways and wetlands <p>Minimise</p> <ul style="list-style-type: none"> • Investigate opportunities during detailed design and construction planning to further reduce impacts on Conservation Category Wetlands (CCWs) and Multiple Use Wetland (MUWs) • Apply the principles of WSUD at Armadale and Byford stations

- Implement the CEMP during the construction phase to minimise the risk of discharges to nearby wetlands and Wungong Brook
- Maintain existing vegetation along Wungong Brook and around wetlands in as an undisturbed state as possible to provide a buffer against their disturbance
- Implement 20 m buffer zone Wungong Brook and CCWs and REWs during construction. . Access within buffer zones will be restricted to areas within the footprint to allow minimum required access for construction activities.
- The PTA will obtain licenses required for the abstraction of groundwater and the construction of bores. These licenses require a WOS to be developed and implemented to manage impacts
- The PTA will manage abstraction in accordance with the CEMP and WOS to ensure that drawdowns are managed in accordance with prescribed criteria
- The PTA will implement engineering controls and/or reinjection bores or recharge basins where practicable to minimise the extent and severity of drawdown on the receptors nearby
- A WOS will be developed and incorporated into the CEMP, which will be implemented by the PTA to ensure groundwater impacts are minimised
- The WOS will incorporate operating protocols to minimise water use and drawdown on the water table. It will include a monitoring programme to detect whether excessive drawdown is emanating from abstraction sites. It will include triggers and contingency measures to manage unplanned changes Access to Wungong Brook for construction activities will be minimised
- Access to Wungong Brook for construction activities will be minimised through establishment of 20 m buffer zones along the brook. Access within buffer zones will be restricted to areas within the Footprint and allow the minimum required access for construction activities. Additional disturbance will be minimised through restricting vehicle access and location of the laydown areas to outside of the buffer zone
- Drainage through the Armadale and Byford station sites will be diverted if required in order to ensure winter flows are not interrupted by construction activities more than is necessary to control sediment movements
- During the construction phase stormwater will be managed in accordance with the CEMP
- Where practicable, construction across waterways will be undertaken during the dry season
- Surface water quality will be monitored in watercourses intersecting the Development Envelope during construction.
- Surface water quality monitoring will be implemented in Wungong Brook prior to commencement of construction to establish a baseline and continue during construction to inform the implementation of management response. Monitoring will include sites upstream and downstream of the development envelope, with the number of sites and parameters to be monitored to be confirmed with relevant agencies prior to commencement of monitoring. As a minimum monitoring is likely to include turbidity, Total Suspended Solids and Dissolved Oxygen.
- Where required erosion and sediment control will be implemented during construction to minimise impacts on in stream values and habitat. Controls will include (but not be limited to) erosion matting and silt curtains and implementation will be informed by the results of the water quality monitoring program.
- Surface water will be managed in line with WSUD principles
- The Wungong Brook bridges will be designed to ensure flows and velocities do not adversely impact existing waterways, wetlands and nearby properties up to a 1% AEP event

Rehabilitate

- Wungong Brook bed and banks (outside of built infrastructure) will be restored following removal of existing pylon and bridge works.
- Cleared riparian vegetation outside of built infrastructure will be revegetated following construction.
- Rehabilitate disturbance associated with the removal of the existing pylon in Wungong Brook.

Outcomes

Significant Residual Impacts

The PTA considers the residual impacts are not significant where wetlands are mapped as being MUW or highly altered and no longer retaining CCW values. Significant residual impacts of the Proposal to inland waters are the loss of 2.6 ha of CCW.

Offset

Where significant residual impacts to CCWs remain, the PTA will counterbalance these impacts through an offset strategy.

Key Environmental Factor – Social Surroundings

EPA objective

To protect social surroundings from significant harm.

Policy and guidance

Environmental Factor Guideline: Social Surroundings (EPA 2016b)

Potential impacts

Aboriginal Heritage

- Impacts on spiritual and environment/physical values of Site ID 3512 through the installation of a railway bridge across Wungong Brook
- Potential disturbance of unregistered sites or artefacts during vegetation clearing and construction

Noise and Vibration

- Temporary exposure of sensitive receptors in residential areas near the railway and associated infrastructure to construction noise and vibration
- Temporary exposure of users of any recreational areas near the railway and associated infrastructure to construction noise and vibration
- Increased noise from vehicle movements during construction impacting the amenity of landowners and users of nearby recreational areas
- Increased and ongoing exposure to operational noise and vibration for sensitive receptors in residential and recreational areas in close proximity to the railway and associated infrastructure from operation
- Increase in noise levels at sensitive receivers from the cumulative impacts of rail and road operation

Visual Amenity

- Potential to change visual amenity within identified landscape character units due to railway and station construction and associated vegetation clearing, road and/or rail bridges and noise walls or barriers

Bushfire

- Ignition as a result of construction works
- Interruption of Emergency service access due to temporary closure of local road network
- Ignition from train operation and rail maintenance
- Risk to asset and passengers from bushfire adjacent to the Proposal

Mitigation

Avoid

- The Proposal has been designed to avoid recorded Aboriginal Heritage sites wherever practicable and will utilise the existing cleared areas and road reserve where land has already been disturbed and cleared for recent projects
- The design for the rail and PSP bridges over Wungong Brook will not include bridge piers within the water channel

Minimise

- PTA will seek s18 approval for disturbance to registered Aboriginal heritage sites required to be disturbed for the Proposal.
- Disturbance of the Wungong Brook watercourse for the removal of the existing pier will be temporary and managed so as to minimise the impact
- Noongar monitors to be onsite at the nominated locations during initial ground disturbance associated with the Proposal, to identify any potential unknown Aboriginal heritage sites or artefacts
- During construction, cease disturbance activities as soon as possible in the event of finding Aboriginal artefacts/objects and report findings to DPLH, the WA Museum and the WA Police if any skeletal material is found
- The PTA will apply mitigation measures to reduce maximum noise levels. This will also reduce period average noise levels, already lower than the maximum noise levels
- Depending on the level of exceedance, mitigation options for achieving compliance with set noise criteria include the following: combination of noise walls and rail web dampers; noise walls only; and rail web dampers only
- Under ballast matting (UBM) and /or under sleeper pads (USP) with suitable trackform will be used at appropriate locations to ensure Ground Borne Noise (GBN) and Ground Borne Vibration (GBV) meet the standards required
- In addition to engineered mitigation measures, PTA will undertake consultation with community stakeholders prior to final design, where there may be a history of complaints or specific concerns over noise and/or vibration impact. The users of premises with sensitive receptors in very close proximity to the Proposal will be consulted
- Construction noise and vibration impacts will meet the requirements of the *Environmental Protection (Noise) Regulations 1997*, through the implementation of the construction environmental management plan, noise and vibration management plan and out of hours noise management plans
- Noise and vibration mitigation controls shall consider the potential visual impact of noise controls and where practicable minimise the visual impact in consultation with residents of rail-facing properties
- Consultation will be undertaken with residents and the local community on the design of the new Byford Station and Armadale Station upgrade.
- The construction management and operations will include bushfire management measures in line with PTA Bushfire Management Strategy (PTA 2018). This will be prepared in consultation with the City of Armadale and the Shire of Serpentine Jarrahdale and will contribute to any relevant existing local bushfire risk management plans

Outcomes

Residual Impacts

- The Proposal would result in the disturbance of up to 0.30 ha of Aboriginal Site ID 3512 "Wungong Brook" once authorised under an *Aboriginal Heritage Act 1972* (AH Act) Section 18 permit
- With suitable mitigation for noise and vibration it is practicable for the Proposal to comply with the targets listed in State Planning Policy 5.4
- Given the flat terrain of the Proposal and the limited number of rail-facing properties, visual amenity residual impacts are likely to be localised to areas within 30 metres of the Proposal

The PTA does not expect any residual impacts from bushfire risk resulting from the Proposal

Key Environmental Factor – Other Environmental Factors

EPA objective	<p>Greenhouse Gases</p> <p><i>To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.</i></p>
	<p>Air Quality</p> <p><i>To maintain air quality and minimise emissions so that environmental values are protected.</i></p>
	<p>Principle of Waste Minimisation</p> <p><i>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</i></p>
Policy and guidance	<ul style="list-style-type: none"> • Greenhouse Gas Emissions Policy for Major Projects (GoWA 2019) • Western Australian Climate Policy (GoWA 2020) • <i>Environmental Protection Act 1986</i> (GoWA 2020) • <i>Environmental Protection Regulations 1987</i> (GoWA 2020) • <i>Environmental Protection (Rural Landfill) Regulations 2002</i> (GoWA 2002) • <i>Environmental Protection (Unauthorised Discharges) Regulations 2004</i> (GoWA 2004) • <i>Environmental Protection (Controlled Waste) Regulations 2004</i> (GoWA 2020) • <i>Environmental Protection (NEPM UPM) Regulations 2003</i> (GoWA 2003) • <i>Litter Act 1979</i> (GoWA 2020) • <i>Health Act 1911</i> (GoWA 2013) • <i>Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974</i> (GoWA 2020) • <i>Health (Asbestos) Regulations 1992</i> (GoWA 2020) • <i>Waste Avoidance and Resource Recovery Act 2007</i> (GoWA 2021)
Potential impacts	<p>Greenhouse Gases</p> <ul style="list-style-type: none"> • BRE operations will result in minor annual greenhouse gas emissions • Forecasts based on the concept design indicate that the Proposal will: <ul style="list-style-type: none"> – reduce car dependency from year 1 of operation, with an estimated annual fuel emissions reduction of 1,996 tCO₂-e. – produce a Net carbon impact in 2050 of 3,020 tCO₂-e, – achieve Net zero at 2061. <p>Air Quality</p> <ul style="list-style-type: none"> • The Proposal will replace private vehicle journeys by car with rail will result in a decrease in concentrations of particulate matter (PM_{2.5} and PM₁₀) and nitrous oxides including nitrogen dioxide (NO₂) <p>Principle of Waste Minimisation</p> <ul style="list-style-type: none"> • Potential production of waste from construction and operation including: <ul style="list-style-type: none"> – Acid Sulfate Soils – Onsite Soils – Contaminated Sites – Inert Waste – HAZMAT/DGs – Domestic Waste

- Putrescible Waste
- Sewage

Mitigation

Avoid

- The PTA will achieve the requirement of net zero by 2050 through a mandated energy reduction target designed to mitigate the net carbon impact in 2050 of 3,020 tCO₂-e shortfall. This energy reduction target will be achieved during the construction phase of the project and will be third party verified. The specific mitigation measures have not been mandated to allow flexibility in design to achieve the best possible reduction outcome.
- The Proposal has been designed to minimise the need for the excavation and removal of large amounts of material where possible.
- The Proposal will not cause soil or land waste disposal impacts.
- All waste streams will be reused, recycled or disposed to an appropriate off-site waste management facility.

Minimise

- The PTA has integrated the principle of waste minimisation into the Proposal management plans.
- Byford Sustainability Management Plan (SMP) will incorporate the METRONET Resource Recovery Opportunities Review
- The Byford Rail Extension project has also registered for an Infrastructure Sustainability Council of Australia (ISCA) rating and Green Star accreditation for its train stations
- The railway alignment has been designed primarily at grade and with an excess of fill to cut material to minimise the volume of acid sulfate soil (ASS) material potentially excavated
- It is proposed that excess fill material from other local projects (including other METRONET projects) will be imported for this purpose, subject to chemical and geotechnical characterisation to ensure that the material is fit for purpose and poses no contamination risk to the receiving environment
- A preliminary site investigation for contamination, ASS and geotechnical investigations will be undertaken to characterise the local geological characteristics and maximise opportunities for reuse of excavated material by the Proposal
- Preparation of a Construction Resource Efficiency and Waste Management Plan, as well as the contractor needing to prioritise waste minimisation in order to meet the Minimum Rating Targets, Life Cycle Assessment, Sustainable Procurement and Sustainability Performance Reporting requirements of the construction contract
- Life Cycle Assessment report to minimise waste and contribute to a circular economy

Outcomes

Residual Impacts

- The PTA considers the Proposal will meet the three key Climate Policy actions deemed relevant to the Proposal's GHG emissions and scope
- While the Proposal will reduce air emissions generally, carbon monoxide levels are already relatively low in the Perth region and are not likely to be noticeably reduced by the Proposal. The PTA anticipates that the project will result in an overall improvement in local air quality and a reduction in greenhouse gas emissions compared with a 'do nothing approach'
- As a result of mitigation measures proposed to be implemented for the Proposal, waste is not expected to result in a significant impact to the environment

The PTA proposes a range of mitigation measures that will avoid, minimise and rehabilitate impacts arising from the Proposal. Key mitigation measures include:

- Implementation of a Footprint containing all construction and operational activities and infrastructure reducing the project impact area from the referred Development Envelope of 160.1 ha to a Footprint of 80.7 ha
- Consideration of flora, vegetation and fauna values when designing the Footprint within the existing alignment
- Reducing the width of the Proposal's Footprint between Lambert Lane Nature Reserve and Fletcher Park to minimise the impact of the Proposal on the threatened ecological community (TEC) *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (community indicator SCP3a), black cockatoo habitat, Bush Forever and Conservation Category Wetlands
- Relocation of individual Carter's freshwater mussels that will be disturbed by construction activities
- Commitment to construct a single span bridges over Wungong Brook to avoid the need to pile within the Wungong Brook Registered Aboriginal heritage site
- Construction of noise walls to meet the requirements of State Planning Policy 5.4 (Road and Rail Noise)
- Maintenance of existing surface water flows across the Development Envelope so that up- and down- stream impacts are minimised
- Areas cleared for the Proposal, that are no longer required for future infrastructure or management access, will be revegetated, with consideration for operational safety requirements.

The assessment has determined that the proposal will cause the following unavoidable significant residual impacts:

- Permanent loss of significant vegetation, comprising:
 - 2.83 ha of *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (SCP 3a) TEC
 - 1.54 ha of native vegetation associated with Bush Forever sites nos. 264, 266 and 350
- Permanent loss of significant fauna habitat comprising:
 - 8.65 ha of foraging habitat for Baudin's cockatoo classified entirely as moderate value foraging habitat
 - 19.3 ha of foraging habitat for Carnaby's cockatoo comprised of 8.65 ha of moderate value foraging habitat and 10.67 ha of low value foraging habitat
 - 61.1 ha of foraging habitat for Forest Red-tailed Black Cockatoo comprised of 8.65 ha of moderate to high value foraging habitat and 52.49 ha of low value foraging habitat
 - Loss of up to 139 potential Black Cockatoo breeding trees, 131 (94.4%) with no hollows, and eight (5.8%) with hollows not suitable for black cockatoos
- Loss of 2.6 ha of Conservation Category Wetland that retains conservation values.

The PTA will implement an Offset Strategy to counterbalance the Proposal's unavoidable significant residual impacts. The PTA has identified the following offsets:

- On-ground management and revegetation of existing occurrences of SCP3a. The PTA proposes that this strategy will also address the offset requirements for Bush Forever and Conservation Category Wetlands

- On-ground management at the Lowlands Nature Reserve offset site including:
 - 70.01 ha of Carnaby's cockatoo foraging habitat
 - 206.7 ha of forest red-tailed black cockatoo foraging habitat
 - 62.7 ha of Baudin's cockatoo foraging habitat
 - 417 black cockatoo potential breeding trees.

Summary of flora and vegetation values

The PTA commissioned several surveys of the Development Envelope and surrounds. Surveys identified the following key values associated with the flora and vegetation within the Development Envelope:

- One DBCA managed conservation reserve (Lambert Lane Nature Reserve), which supports the TEC SCP3a and is classed as a Conservation Category Wetland
- Fletcher Park, which is vested with the City of Armadale and supports TEC SCP3a and contains CCW
- Three Bush Forever sites
- A regional ecological linkage that runs along Wungong Brook
- Two vegetation complexes: Forrestfield and Guildford
- Six distinct local vegetation units that can be considered native vegetation
- 26.5 ha of native vegetation ranging from Completely Degraded to Excellent condition
- One TEC, SCP 3a *Corymbia calophylla* – *Kingia australis* woodlands on heavy soils
- 3.9 ha of vegetation growing in association with a Conservation Category Wetland
- One Priority 2 flora taxon, *Johnsonia pubescens* subsp. *cygnorum*.

Summary of terrestrial fauna values

The PTA commissioned multiple fauna surveys of the Development Envelope and surrounds. Surveys identified the following key fauna and fauna habitat values associated with the Development Envelope:

- Five Vegetation and substrate associations (VSAs) (i.e., habitat types)
- Evidence of occupation or use by five species of significant fauna:
 - Baudin's cockatoo
 - Carnaby's cockatoo
 - Forest red-tailed black cockatoo
 - Carter's freshwater mussel
 - Quenda.
- 13.5 ha of either moderate or moderate to high quality foraging habitat for each of the three species of black cockatoo
- 336 potential breeding trees, of which 31 have hollows, none suitable for black cockatoos within the Footprint
- A small population of Carter's freshwater mussel at Wungong Brook. Additional populations were recorded outside the Development Envelope
- No habitat suitable for Short Range Endemics fauna.

Summary of inland waters values

The PTA commissioned a wetland study and groundwater investigations of the Development Envelope and surrounding areas. Investigations identified the following key inland waters values associated with the Development Envelope:

- The Development Envelope lies across a number of drainage features flowing from the Darling Scarp onto the Swan Coastal Plain
- The most significant watercourse is Wungong Brook, which is classed as a Conservation Category Wetland and generally flows all year round. Wungong Brook supports populations of Carter's freshwater mussel within, up- and down-stream of the Development Envelope
- Groundwater is generally fed from the Darling Scarp and flows in a general westerly direction
- Almost the entirety of the Development Envelope lies over Multiple Use category palusplain wetland
- Eight Conservation Category Wetlands covering 5.5 ha.

Summary of social surroundings values

The PTA has undertaken consultation with Traditional Owners, modelled predicted noise levels, considered visual impacts and assessed bushfire risk for the Proposal. The PTA has identified the following key values with regards to Social Surroundings within the Development Envelope:

- The Proposal falls entirely within Noongar Boodjar – Beeliar country
- One registered site: Site Number 3512 Wungong Brook
- The Proposal runs adjacent to a range of noise sensitive receptors including:
 - Existing residential properties
 - Residential lots with Local Government Development Application approval
 - Schools
 - Childcare premises
 - Places of worship
- Baseline monitoring indicates that maximum noise level criteria are currently exceeded during the day at monitoring locations. Noise at one monitoring location exceeded night time noise level criteria.
- Vibration was measured to be lower than relevant criteria
- The PTA has identified six landscape character units:
 - Suburban Residential
 - Rural Residential
 - Industrial
 - Commercial
 - Rural
 - Natural
- The predominant landscape type is built with view towards natural areas in some locations
- Key views are those of Darling Scarp
- The majority of the Development Envelope has a Bushfire Hazard level of Moderate.

Matters of National Environmental Significance

The PTA has considered the impact of the Proposal on MNES. A summary of MNES within the Development Envelope is outlined below:

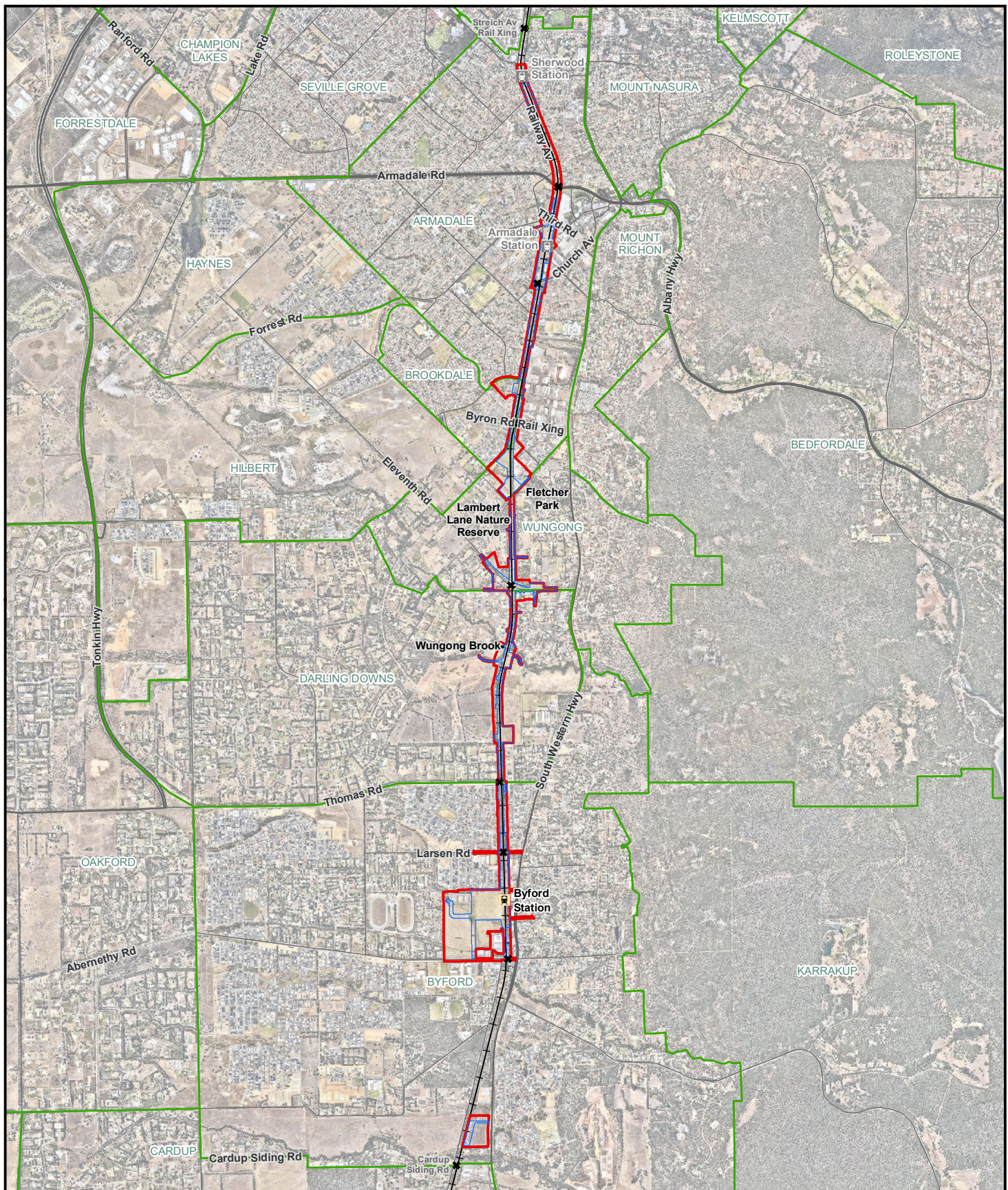
- One TEC: *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils SCP (SCP3a)
- Significant impact assessments have determined that the Proposal will not significantly impact either of two species: *Diuris purdiei* and *Eucalyptus* x *Balanites* (Cadda Road Mallee)
- Four listed fauna:
 - Carnaby's cockatoo
 - Baudin's cockatoo
 - Forest red-tailed black cockatoo
 - Carter's freshwater mussel

Conclusion

The PTA has undertaken extensive investigations into the receiving environment surrounding the Proposal. Based on these investigations, as well as other data available, the PTA has assessed all aspects of the Proposal and identified potential environmental impacts arising from construction and operation of the rail.

The mitigation hierarchy has been applied to avoid, minimise and / or rehabilitate the potential impacts. Some significant, unavoidable residual impacts remain. The PTA has prepared an offset strategy to counterbalance these impacts.

The PTA is confident that it has applied all reasonable mitigation measures and that with mitigation the Proposal satisfies the EPA's objectives for all factors and meets all MNES requirements under the EPBC Act.



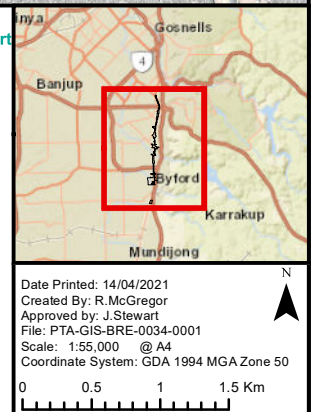
METRONET | Byford Rail Extension
Figure ES1 | The Proposal Overview



Public Transport Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary



1. Scoping checklist

1.1. Flora and vegetation

Reference	Requirement	Details
1.	Identify and characterise the flora and vegetation that may be directly or indirectly impacted by the Proposal, in accordance with Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016d). Surveys should be designed to inform local and regional context. Surveys should also utilise the DAWE Protected Matters Search Tool, where appropriate.	Section 6.4, Figure 10
2.	Demonstrate how surveys are relevant, representative and demonstrate consistency with current EPA policy and guidance. Ensure database searches and taxonomic identifications are up-to-date. All surveys should be appended to the ERD.	Section 6.4.1 Appendix B Byford Rail Extension Flora and Vegetation Assessment Appendix C METRONET – Byford Extension Part One - Flora and Fauna Assessment Appendix D Phytophthora Dieback Occurrence Assessment
3.	Provide a figure depicting survey effort applied in relation to the survey area and Development Envelope, identifying the direct and indirect impact areas.	Figure 10
4.	Determine whether any flora species recorded are significant and provide an analysis of local and regional context (refer to Environmental Factor Guideline – Flora and Vegetation for definition of significant flora).	Section 6.4.10 Figure 11 Figure 14
5.	Determine whether any vegetation identified is significant and provide an analysis of local and regional context.	Section 6.4.8 Figure 11
6.	Provide figures depicting the recorded locations of flora and vegetation in relation to the Development Envelope in accordance with Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016d).	Figure 13 Figure 14
7.	Assess the potential direct and indirect impacts of the construction and operational elements of the Proposal on identified environmental values. Describe and assess the extent of cumulative impacts as appropriate.	Section 6.5 Section 6.6 Figure 15
8.	Provide a quantitative assessment of impact:	
o	For significant flora, this includes:	
	•number of individuals and populations in a local and regional context based on survey data and existing database records, where available	Section 6.4.10 Section 6.6.2
	•numbers and proportions of individuals and populations directly or potentially indirectly impacted, and	Section 6.5 Section 6.6 Table 21 Table 22 Section 8.10 Figure 14

Reference	Requirement	Details
	<ul style="list-style-type: none"> •numbers/proportions/populations currently protected within the conservation estate (where known). 	Section 6.4.2 Section 6.4.10 Figure 14
o	For all vegetation units (noting threatened and priority ecological communities and significant vegetation) this includes:	
	<ul style="list-style-type: none"> •area (in hectares) and proportions directly or potentially indirectly impacted, and •proportions/hectares of the vegetation unit currently protected within the conservation estate (where known). 	Section 6.6 Section 6.4.2 Figure 14
9.	Describe the application of the mitigation hierarchy in the proposal design, construction and operation. Detail actions to be undertaken to avoid, minimise and mitigate impacts from the Proposal including revegetation of areas not required for permanent infrastructure.	Section 6.7 Table 25 Table 26 Section 11.8
10.	Provide management and /or monitoring plans to be implemented pre- and post-construction to demonstrate that residual impacts are not greater than predicted. Management and / or monitoring plans are to be prepared in accordance with EPA instructions and consistent with the Australian Government Environmental Management Plan Guidelines (DofE 2014). Management Plans need to consider all relevant EPBC Act listed threatened flora species and threatened ecological communities where appropriate.	Table 26 Appendix R Byford Rail Extension – Draft Offset Strategy
11.	Demonstrate how the Proposal has had regard to, and is not inconsistent with, relevant recovery plans, conservation advice and threat abatement plans.	Section 6.3 Section 11.3 Table 69
12.	Describe how the Proposal has considered the Australian Government Significant Impact Guidelines 1.1 (DEWHA 2013) for all direct and indirect impacts on matters protected under the EPBC Act.	Section 11
13.	Demonstrate how the EPA's objective for this factor has been addressed.	Section 6.8.1 Section 6.8.3
14.	Determine and quantify any significant residual impacts by applying the:	
o	residual Impact Significance Model (page 11 of the WA Environmental Offsets Guideline) for all direct and indirect impacts, including an explanation of how the information and values within the model have been determined,	Appendix R Byford Rail Extension – Draft Offset Strategy
o	WA Offset Template in the WA Environmental Offsets Guidelines (2014), including the provision of supporting information, and	Section 12.9 Appendix R Byford Rail Extension – Draft Offset Strategy
o	the Australian Government Offsets Assessment Guide (DSEWPAC 2012a) including rationale for the values entered into the guide.	Section 12.9 Appendix R Byford Rail Extension – Draft Offset Strategy
15.	Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines (GoWA 2014). Spatial data defining the area of significant residual	Section 12.4 Section 12.7 Section 12.9

Reference	Requirement	Details
	impacts for each environmental value should also be provided (e.g. vegetation type, vegetation condition, specific flora species habitat).	Section 12.10 Figure 46 Appendix R Byford Rail Extension – Draft Offset Strategy
16.	Where significant residual impacts remain to any EPBC Act listed threatened species or threatened ecological community, propose an appropriate offset package consistent with the Commonwealth Environmental Offsets Assessment Guide (DSEWPAC 2012a) and the EPBC Act Environmental Offsets Policy (DSEWPAC 2012b). Demonstrate how the proposed offset is consistent with each of the principles of the Commonwealth Environmental Offsets Policy in addition to providing a rationale for the values entered into the offset guide. Spatial data defining the area of significant residual impacts for each environmental value should also be provided (e.g. vegetation type, vegetation condition, specific flora species habitat)	Section 12.9 Figure 46 Appendix R Byford Rail Extension – Draft Offset Strategy

1.2. Terrestrial Fauna

Reference	Requirement	Details
17.	In accordance with the requirements of EPA Guidance conduct a desktop study to identify and characterise the terrestrial fauna and fauna habitats to inform local and regional context. Surveys should also utilise the Department of Agriculture Water and the Environment (DAWE) Protected Matters Search Tool, where appropriate.	Section 7.5.1 Figure 17
18	Based on the results of the desktop study:	
o	conduct a Basic (Level 1) survey and fauna habitat assessment,	Appendix C METRONET – Byford Rail Extension Part One – Flora and Fauna Assessment Appendix E Byford Rail Extension Fauna Assessment; Spring 2020
o	conduct a Detailed (Level 2) survey, and	Appendix G Byford Rail Extension Consolidated Terrestrial Fauna Report
o	conduct targeted surveys for significant fauna that may be directly or indirectly impacted including for the three species of Black Cockatoos; Carnaby's cockatoo, Baudin's cockatoo, forest red-tailed cockatoo, and Carter's Freshwater Mussel - <i>Westralunio carteri</i> .	Appendix F Byford Rail Extension Assessment of Possible Black Cockatoo Breeding Hollows Appendix H Byford Railway Extension Targeted Fauna Survey for <i>Westralunio carteri</i> Carter's Freshwater Mussel Appendix I Desktop Review and Impact Assessment of Short Range Endemic and Conservation Significant

Reference	Requirement	Details
		Invertebrates for the Byford Rail Extension
19.	Demonstrate how surveys are relevant, representative and consistent with current EPA policy and guidance and this scoping document.	Section 7.5.1 Table 27
20.	Provide a map of the survey effort applied in relation to the fauna habitats, the survey area, Development Envelope, identifying the direct and indirect impact areas.	Figure 16 Appendix G Consolidated Terrestrial Fauna Report
21.	Identify and describe the fauna assemblages present and likely to be present within the Development Envelope that may be impacted by the Proposal.	Section 7.5.3 Figure 17 Figure 18 Figure 19 Figure 20 Figure 21
22.	Identify and describe the characteristics of the fauna habitats identified by the desktop study and surveys, including a map of their extents in relation to the study area, the Development Envelope and direct and indirect impact areas. Describe significant habitats, including but not limited to: refugia, breeding areas, key foraging habitat, movement corridors and linkages	Section 7.5.2 Section 7.5.4 Figure 17 Figure 18 Figure 19 Figure 20 Figure 21,
23.	Identify significant fauna and describe in detail their known ecology, likelihood of occurrence, habitats and known threats. Map the locations of significant fauna records in relation to the fauna habitats, the study area, the Development Envelope, and direct and indirect impact areas.	Section 7.5.4 Section 11.5 Figure 17 Figure 18 Figure 19 Figure 20 Figure 21
24.	Identify any potential fauna movement corridors within, adjacent to or across the Development Envelope including, but not limited to, areas of intact native vegetation, using appropriate methods. Describe the methods taken.	Section 7.5.2 Table 28 Section 6.8 Figure 17
25.	Identify, describe and quantify the potential impacts (direct, indirect and cumulative) on fauna assemblages, habitats and significant species that may occur following implementation of the Proposal in a local and regional context.	Section 7.6 Section 7.7
26.	In accordance with relevant guidelines set out below, provide figures and maps illustrating fauna habitats, known recorded locations of significant vertebrate species and SRE (and/or other significant) invertebrate fauna in relation to the Development Envelope.	Figure 17 Figure 18 Figure 19 Figure 20 Figure 21 Appendix C AECOM Flora and Fauna Assessment Appendix E Byford Rail Extension Fauna Assessment Appendix F Byford Rail Extension Assessment of

Reference	Requirement	Details
		<p>Possible Black Cockatoo Breed Hollows</p> <p>Appendix G Byford Rail Extension Consolidated Fauna Report</p> <p>Appendix H Byford Rail Extension Targeted Fauna Survey for Carter's Freshwater Mussel</p> <p>Appendix I Desktop Review and Impact Assessment of Short Range Endemic and Conservation Significant Invertebrates for the Byford Rail Extension</p>
27.	Demonstrate that no SRE invertebrate fauna is restricted to the Development Envelope or that such species have been adequately surveyed outside of the Development Envelope.	Appendix I Desktop Review and Impact Assessment of Short Range Endemic and Conservation Significant Invertebrates for the Byford Rail Extension
28.	Provide a table of the extents of each habitat within the Development Envelope and survey extent, and the predicted amount to be directly and indirectly impacted. Consider potential impacts on all State and Commonwealth listed threatened fauna species that are known or likely to occur within and/or adjacent to the Development Envelope.	<p>Table 35</p> <p>Section 7.7</p> <p>Section 11.7</p>
29.	Outline and justify the proposed avoidance and mitigation measures to reduce the potential impacts of the Proposal.	<p>Section 7.8</p> <p>Table 37</p> <p>Table 38</p> <p>Section 11.8</p>
30.	Provide management and /or monitoring plans to be implemented pre- and post-construction to demonstrate that residual impacts are not greater than predicted. Management and / or monitoring plans are to be prepared in accordance with EPA instructions and consistent with the Australian Government Environmental Management Plan Guidelines (DofE 2014). Management and/or monitoring plans are to be presented in accordance with the EPAs Instructions.	<p>Section 7.7</p> <p>Table 37</p> <p>Table 38</p> <p>Appendix R Byford Rail Extension – Draft Offset Strategy</p>
31.	Demonstrate how the Proposal has had regard to, and is not inconsistent with any relevant recovery plans, conservation advice and threat abatement plans.	<p>Section 7.3</p> <p>Section 7.4</p> <p>Section 11.5.1</p> <p>Table 76</p> <p>Section 11.5.2</p> <p>Table 78</p>
32.	Predict the residual impacts on terrestrial fauna after considering and applying the mitigation hierarchy.	Section 7.9.1
33	Determine and quantify any significant residual impacts by applying the:	
o	residual Impact Significance Model (page 11 of the WA Environmental Offsets Guideline) for all direct and indirect	<p>Figure 47</p> <p>Figure 48</p>

Reference	Requirement	Details
	impacts, including an explanation of how the information and values within the model have been determined,	Appendix R Byford Rail Extension – Draft Offset Strategy
o	WA Offset Template in the WA Environmental Offsets Guidelines (2014), including the provision of supporting information, and	Section 12.9 Appendix R Byford Rail Extension – Draft Offset Strategy
o	the Australian Government Offsets Assessment Guide (DSEWPAC 2012a) including rationale for the values entered into the guide.	Section 12.9 Appendix R Byford Rail Extension – Draft Offset Strategy
34.	Where significant residual impacts remain, propose an appropriate offsets package with supporting information to demonstrate consistency with the WA Environmental Offsets Policy and Guidelines. Where residual impacts relate to EPBC Act listed threatened species propose an appropriate offset package consistent with the Commonwealth and WA Environmental Offsets Policy. Spatial data defining the area of significant residual impacts for each environmental value should also be provided (e.g. specific fauna species habitat).	Section 12.6 Section 12.9 Figure 47 Figure 48 Appendix R Byford Rail Extension – Draft Offset Strategy
35.	Propose an appropriate offset package consistent with the Commonwealth Environmental Offsets Policy for the predicted likely significant residual impact to Black Cockatoos. Demonstrate how the proposed offset is consistent with each of the principles of the Commonwealth Environmental Offsets Policy in addition to providing a rationale for the values entered into the offset guide. Spatial data defining the area of significant residual impacts for each environmental value should also be provided (e.g. vegetation type, vegetation condition, specific fauna species habitat).	Section 12.6 Section 12.9 Figure 47 Figure 48 Appendix R Byford Rail Extension – Draft Offset Strategy

1.3. Inland waters

Reference	Requirement	Details
36.	Characterise the local and regional hydrogeological regime and describe recharge and discharge mechanisms and surface water/groundwater interaction.	Section 8.5 Section 8.7 Figure 22, Figure 33 Appendix J Byford Rail Extension: Wetland Assessment Appendix K Draft Metronet Byford Rail Extension Strategic Hydrogeological Assessment Appendix L Byford Rail Extension – Groundwater and Surface Water Level Monitoring
37.	Identify, describe and assess the environmental values and significance of surface and groundwater hydrological characteristics within the Development Envelope and the immediately adjacent area upstream and downstream of the Development Envelope. Describe these values in local and regional contexts. Identify users of the identified values.	Section 8.6 Section 8.7
38.	Identify, describe and assess the wetlands within and in proximity to the Development Envelope. Describe these values in local and regional contexts. Wetland assessments should be undertaken in accordance with 'A methodology for the evaluation of wetlands on the Swan Coastal Plain' (DBCA 2017). This document, in addition to information regarding wetland delineation and identification, can be obtained at https://www.dpaw.wa.gov.au/management/wetlands/publications-and-links . Wetland identification and assessment should utilise the Department of Biodiversity Conservation and Attractions (DBCA) Geomorphic Wetlands Swan Coastal Plain Dataset or any approved update or replacement of this dataset.	Section 8.8.4 Appendix J Byford Rail Extension: Wetland Assessment
39.	Identify, describe, analyse and assess the potential impacts (direct and indirect) as a result of both construction and operation of the proposal on water quantity (excess and deficit) and quality in relation to surface and groundwater, waterways and their floodplains and wetlands within and near the development envelope.	Section 8.9 Section 8.10
40.	Predict the extent, severity and duration of potential impacts to the environmental values identified, including from changes to local and regional surface and groundwater flows and levels (excess and deficit), groundwater drawdown, local surface and groundwater quality and impacts to surface and groundwater users as a result of construction and operation.	Section 8.9 Section 8.10
41.	Identify, describe and assess the potential impacts on Wungong Brook flood levels and upstream and downstream flood levels from the associated bridge/crossing.	Section 8.7.1 Section 8.7.3 Section 8.9 Section 8.10 Figure 31,

Reference	Requirement	Details
		Figure 32, Figure 36
42.	Identify the preferred location of groundwater abstraction zones for water required to implement the proposal.	Section 8.10.1 Figure 35 Figure 36 Figure 37
43.	Demonstrate how the mitigation hierarchy of avoid, minimise, mitigate has been applied during the planning and design stages of the Project.	Section 8.11 Table 49 Table 50
44.	Describe and justify any proposed mitigation to reduce the potential impacts of construction and operation of the Proposal on the identified values.	Section 8.11
45.	Provide management and /or monitoring plans to be implemented pre- and post-construction to demonstrate that residual impacts are not greater than predicted. Management and / or monitoring plans are to be prepared in accordance with the EPA's instructions to demonstrate and ensure the EPA's objective can be met. Plans to include any hydrological and hydrogeological assessments undertaken for dewatering and abstraction.	Section 8.10 Figure 35 Figure 36 Appendix J Byford Rail Extension: Wetland Assessment Appendix K Draft Metronet Byford Rail Extension Strategic Hydrogeological Assessment
46.	Provide maps of and justification for the location and number of any proposed drainage and stormwater infrastructure.	Figure 23 Section 8.10
47.	Discuss the proposed management, monitoring and mitigation to ensure impacts on inland water ecological values are not greater than predicted as a result of implementing the Proposal. This is to include, but not be limited to, consideration of suitable buffers, between the boundary of the Development Envelope and waterways and wetlands.	Section 8.10 Section 8.10.2 Section 8.11 Table 49 Table 50 Appendix J Byford Rail Extension: Wetland Assessment Appendix K Draft METRONET Byford Rail Extension Strategic Hydrogeological Assessment
48.	Demonstrate how best practice Water Sensitive Urban Design principles will be implemented in the design of the infrastructure and in stormwater and drainage components to ensure hydrological regimes and groundwater quality are maintained.	Section 8.10.2 Section 8.11
49.	Identify, describe and quantify the potential residual impacts (direct and indirect) that may occur following implementation of the proposed mitigation measures and determine the significance of the residual impacts on the identified environmental values by applying the residual impact significance model (page 11) and WA Offset template (Appendix 1) in the WA Environmental Offsets Guidelines (2014). Provide spatial data defining the area of any identified significant residual impacts and proposed offsets in relation to the Development Envelope. Where significant residual impacts remain, propose an	Section 12.7.1 Appendix R Byford Rail Extension – Draft Offset Strategy

Reference	Requirement	Details
	appropriate offsets package that is consistent with the WA Environmental Offsets Policy.	

1.4. Social Surroundings

Reference	Requirement	Details
50.	Characterise, describe and analyse the surrounding land use and amenity values in and adjacent to the Development Envelope with a focus on sensitive receptors that may be impacted by noise and vibration or impacts to visual amenity. Include relevant maps to identify the sensitive receptors likely to be affected by these impacts associated with the Proposal.	Section 9.3 Section 9.4 Section 9.5 Section 9.6
51.	Demonstrate how the mitigation hierarchy of avoid, minimise and mitigate has been applied during the planning and design stages of the project to minimise potential impacts on social surroundings.	Section 9.3.3 Section 9.4.5 Section 9.5.3 Section 9.6.3

1.4.1. Aboriginal heritage

Reference	Requirement	Details
52.	Conduct ethnographic and archaeological surveys of the area likely to be impacted by the Proposal in order to identify and characterise any Aboriginal heritage sites and their relevance and importance to Aboriginal People and their culture. Include details of the discussions and considerations of the indirect impacts to registered Aboriginal heritage sites.	Section 9.3.1 Section 9.3.2 Appendix O Report on the Aboriginal Heritage Survey of Byford Rail Extension
53.	Provide a summary of the surveys undertaken, including the survey effort, timing and personnel.	Section 9.2.2 Appendix O Report on the Aboriginal Heritage Survey of Byford Rail Extension
54.	Describe the Aboriginal heritage values recorded within the survey area with supporting maps.	Section 9.3.1 Figure 38, Figure 39
55.	Identify, describe, assess and analyse any potential impacts (direct and indirect) to identified Aboriginal Heritage values that may occur as a result of implementation of the Proposal.	Section 9.3.2
56.	Describe any proposed mitigation measures to avoid or minimise the identified direct and indirect impacts on Aboriginal heritage values that are to be implemented in consultation with Whadjuk and Gnaala Karla Boodja representatives as nominated by the South West Aboriginal Land and Sea Council (SWALSC) under the Noongar Standard Heritage Agreement. Include management actions that will be undertaken to manage the potential for disturbance to unknown sites of Aboriginal heritage significance during construction.	Section 9.3.3 Table 52 Table 53
57.	Include any proposed management and/or monitoring plans for Aboriginal heritage values that will be implemented pre- and post-construction to demonstrate and ensure the EPA's objective can be met.	Table 53

Reference	Requirement	Details
58	Identify and describe the potential residual impacts (direct and indirect) that may occur following implementation of the proposed mitigation measures and determine the significance of the residual impacts on the identified environmental values of Aboriginal heritage	Section 9.3.4

1.4.2. Noise and vibration

Reference	Requirement	Details
59.	Undertake noise and vibration monitoring and modelling as appropriate along the proposed alignment to determine ambient noise levels (including vibrational noise) in areas of noise sensitive receptors. Consideration should be given to construction and operational noise and vibration impacts.	Section 9.4.1 Section 9.4.3 Section 9.4.4 Figure 40 Appendix M Byford Rail Extension Preliminary Assessment - Noise & Vibration
60.	Undertake an initial screening assessment and if required a detailed noise and vibration assessment in accordance with relevant guidelines to predict future noise and vibration levels resulting from the Proposal on sensitive receptors, including recreational values as appropriate.	Section 9.4.1 Section 9.4.2 Section 9.4.3 Appendix M Byford Rail Extension Preliminary Assessment - Noise & Vibration
61.	Assess and analyse noise and vibration impacts along the proposed railway alignment in accordance with 'State Planning Policy 5.4 – Road and Rail Noise' (WAPC, 2019), Australian Standard AS 2670.2-1990 and relevant guidance. Justify the use of any parameters used to monitor and model impacts from noise and vibration along the proposed alignment. Consideration should be given to planned areas of higher density and mixed-use development in close proximity to the proposed stations, including residential dwellings.	Section 9.4.3 Section 9.4.4 Appendix M Byford Rail Extension Preliminary Assessment - Noise & Vibration
62.	Identify relevant noise and vibration mitigation measures for identified sensitive receptors and describe any proposed mitigation to reduce the potential impacts of construction and operation from the Proposal. Provide maps of and justification for the location and number of any proposed mitigation infrastructure.	Section 9.4.5 Table 59 Table 60 Appendix M Byford Rail Extension Preliminary Assessment - Noise & Vibration
63.	Include any proposed management and/or monitoring plans for noise and vibration that will be implemented pre- and post-construction to demonstrate and ensure that the EPA's objectives can be met.	Section 9.4.5 Table 60 Appendix M Byford Rail Extension Preliminary Assessment - Noise & Vibration
64.	Identify and describe the potential residual impacts (direct and indirect) that may occur following implementation of the proposed mitigation measures and determine the significance of the residual impacts of noise and vibration on the identified sensitive receptors.	Section 9.4.6

1.4.3. Visual amenity

Reference	Requirement	Details
65.	Characterise the land use and aesthetic (visual amenity) values along the proposed alignment that have the potential to be impacted by implementation of the proposal.	Section 9.5.1 Figure 41
66.	Identify and describe any potential direct and indirect impacts on identified visual amenity values as a result of implementation of the proposal.	Section 9.5.2
67.	Identify and describe any proposed mitigation measures to avoid or minimise the potential impacts on the identified visual amenity values along the proposed alignment to demonstrate and ensure the EPA's objective can be met.	Section 9.5.3 Table 62 Table 63
68.	Identify and describe the potential residual impacts (direct and indirect) that may occur following implementation of the proposed mitigation measures and determine the significance of the residual impacts on the identified visual amenity values.	Section 0

2. Introduction

2.1. Introduction

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

The Public Transport Authority of Western Australia (PTA) is proposing to develop the Byford Rail Extension Proposal (The Proposal) as part of the Western Australian Government's METRONET vision. The Byford Rail Extension project (BRE) extends the existing electrified passenger rail network 8 km from Armadale Station, 26 km southeast of Perth, to the proposed new Byford Station.

As one of METRONET's priority projects, the Proposal seeks to:

1. Improve connectivity and integrated transport options within Perth's South Eastern corridor
2. Reduce car dependency and congestion and change travel behaviours
3. Encourage investment by supporting the release of additional land for commercial expansion, mixed-use development, and housing diversity
4. Improve east-west connectivity for greater prioritisation of pedestrian and cycling movements, encouraging physical activity between the 'old' and 'new' Byford Town Centres
5. Build a robust civic presence as integrating community uses into the Byford station precinct core.

The northern section of the Proposal is within the City of Armadale. The southern section is within the Shire of Serpentine Jarrahdale. The Proposal is an integral component of Perth's long-term public transport network, providing essential transportation services to the expanding southeastern suburbs and delivering improved sustainability outcomes envisioned by the Western Australian Government's Perth and Peel@3.5million plan (DPLH & WAPC 2018).

2.2. Purpose and scope

The purpose of this ERD is to provide information specified by the Environmental Scoping Document (ESD), including form, content, timing, and procedure required by s40(3) of the EP Act, to allow the EPA to assess the Proposal. The ERD has been prepared in accordance with prescribed structure and instructions, provided by the EPA, on how to prepare an Environmental Review Document (EPA 2020b). It provides information on the Proposal's activities, the potential environmental impacts, an assessment of the significance of those impacts, mitigation and management measures and the proposed Offsets Strategy to counterbalance for significant residual impacts.

The ERD also addresses impacts on Matters of National Environmental Significance, as defined by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These matters will be considered by an accredited assessment under the EP Act.

2.3. Proponent

The proponent for this Proposal is the Public Transport Authority (PTA). All correspondence regarding this Proposal should be forwarded to the key contact in the table below

Table 4 Proponent details

Reference	Details
Name	Paul Monaghan Environmental Manager Infrastructure Planning and Land Services
PTA ABN	61 850 109 576
Postal Address	34 Stirling Street Perth WA 6000
Email	paul.monaghan@pta.wa.gov.au
Telephone	(08) 9326 3927

2.4. Environmental impact assessment process

Consideration of environmental impacts, their management and mitigation is assessed at both Commonwealth and Western Australian level.

2.4.1. Western Australian environmental assessments

Projects or plans that are likely to have a significant effect on the environment require referral to the EPA under Part IV of the Environmental Protection Act 1986. The process of referral, assessment and approval of projects under the Part IV of the Environmental Protection Act 1986 can be grouped into 5 broad stages:

Stage 1 Referral of a proposal to the EPA (s.38)

Stage 2 EPA to decide whether or not to assess a referred proposal (s. 38A to s. 39B)

Stage 3 Assessment of proposals (s. 40 to s. 43A)

Stage 4 EPA report on the assessment of a proposal (s. 44)

Stage 5 Decision on proposal and implementation of proposals (s. 45 to s. 48).

The PTA referred the Proposal to the EPA in September 2020. The EPA determined that the project would impact key environmental factors: Flora and Vegetation, Terrestrial Fauna, Inland Waters and Social Surroundings.

The Environmental Protection Authority (EPA) determined that the Proposal shall be assessed under Part IV of the Environmental Protection Act 1986 (EP Act). The EPA decided to assess the Proposal on 7 October 2020 and set the level of assessment at Public Environmental Review, with a 2-week public review period

This Environmental Review Document (ERD) has been prepared in response to the requirements outlined in the Environmental Scoping Document, issued by EPA in January 2021. It is now published for a period of two weeks, during which time the public is invited to comment on the ERD.

After the public review period, the EPA will conduct its assessment of the Proposal, taking into account the ERD, any submissions received and the PTA's responses to any submissions received. The EPA also considers relevant policies and guidelines and may seek advice from relevant government agencies or other experts.

The EPA will prepare an assessment report recommending whether the Proposal should be implemented and, if recommending approval, any conditions that should apply. The EPA's report will be made public and is subject to appeal. After the appeal period has concluded, the EPA's assessment report will be provided to the Minister for the Environment, who will decide whether the Proposal may be implemented and, if so, the conditions of approval.

2.4.2. Commonwealth environmental assessments

The principle Commonwealth legislation protecting Matters of National Environmental Significance (MNES) is the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth Department of Agriculture, Water and the Environment (DAWE) administers the EPBC Act.

If a significant impact on a MNES may occur from a proposed action, approval from the Commonwealth under the EPBC Act is required. The Proposal has been referred to DAWE (EPBC 2020/8764). The DAWE determined the proposal to be a Controlled Action under the EPBC Act on 12 October 2020. It will be assessed as an accredited assessment under the EP Act.

A controlled action is defined within the EPBC Act as:

"A proposed action that is likely to have a significant impact on: a matter of national environmental significance; the environment of Commonwealth land (even if taken outside Commonwealth land); or the environment anywhere in the world (if the action is undertaken by the Commonwealth)."

The DAWE identified 'listed threatened species and communities' as the relevant Matter of National Significance (MNES) occurring within the development envelope.

Matters of National Environmental Significance are addressed in detail in **Section 11**.

2.4.3. Other approvals, decision making authorities and legislation

Other approvals

Other regulatory processes outside of the EP Act will apply to the Proposal. **Table 5** below summarises the other approvals that may be required under Western Australian Legislation.

Table 5 Other approvals

Potential Activities	Type of approval	Legislation regulating the activity	Decision Making Authority
Railway, stations, related car parks and public transport interchange facilities being developed outside the rail corridor.	Development Applications	<i>Planning and development Act 2005</i>	City of Armadale, City of Serpentine Jarrahdale, City of Armadale and the Western Australian Planning Commission (WAPC)
During construction hazardous materials storage and handling may be required	Dangerous goods licence	<i>Dangerous Goods Safety Act 2004</i>	Department of Mines, Industry Regulation and Safety (DMIRS)
The abstraction of groundwater to provide a construction water supply or for dewatering for construction activities may be required; including but not limited to piling to construct stations, foundations, bridges or to install/relocate services.	5C and 26D Licence.	<i>Rights in Water and Irrigation Act 1914 (RIWI Act).</i>	DWER
Works conducted on Sundays, Public Holidays, and before 7:00 am	Out of hours Noise Management Plan (NMP)	<i>Environmental Protection (Noise) Regulations 1997.</i>	City of Serpentine Jarrahdale and Armadale as required

Decision making Authorities

The PTA is authorised to construct the BRE railway under section 99 of the *Public Works Act 1902* consistent with the alignment authorised by special Act being the *South Western Railway Act 1891* and the *South Western Railway Act, 1891 Amendment Act 1892 No 30 of 1892* (read as one Act).

The authorities listed below are potential Decision-Making Authorities (DMAs) for the proposal. The assessment process may identify further DMAs.

Decision making authority	Relevant legislation
Minister for Environment	<i>Environmental Protection Act 1986</i> – Part IV Divisions 1 and 2 (Environmental Impact Assessment) <i>Biodiversity Conservation Act 2016</i> - Taking of flora and fauna.
Minister for Aboriginal Affairs	<i>Aboriginal Heritage Act 1972</i> – Consent under section 18
Governor's approval is required on recommendation from Minister for Planning	<i>Planning and Development Act 2005</i> – Scheme amendments. (s.50)
Minister for Lands	<i>Land Administration Act 1997</i> (section 182 Entry for feasibility study)
(or appropriate delegate/subdelegate appointed pursuant to sections 150 or 160 LAA)	
Minister for Water	<i>Rights in Water and Irrigation Act 1914</i> – (Licence to take/licence for construction of a well/Permit to interfere with bed and banks)
Public Transport Authority	<i>Public Works Act 1902</i> –s.99 Powers to make railways, railway stations
	Section 82–Authority to enter lands and do surveys.
CEO, Department of Water and Environmental Regulation	<i>Environmental Protection Act 1986</i> - Part V Division 3 (Native vegetation clearing permit/Works approval/Granting of licence) Environmental Protection (Noise) Regulations 1997 (r.13 – out of hours noise management plan)
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety	<i>Dangerous Goods Safety Act 2004</i> – Storage and handling of hazardous materials and Dangerous Goods Licence.
Chairman, Western Australian Planning Commission	<i>Planning and Development Act 2005</i> - Development applications for station precincts which are in a Planning Control Area. (pursuant to part 7, s.117)
Chief Health Officer, Department of Health CEO	<i>Health Act 1911</i> s107(2)(b) Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations) reg 4A. Drains, sanitary conveniences, and any apparatus for the treatment of sewage intended to serve a building that is not a single dwelling or any other building that produces more than 540 litres of sewage per day.
City of Armadale, Shire of Serpentine-Jarrahdale	<i>Building Act 2011</i> - Building application, permit and certificate. <i>Health Act (Underground Water Supply) Regulation 1959</i> – Regulation 11 - Approval required for a well or other underground source of water supply. <i>Environmental Protection (Noise) Regulations 1997</i> – Approval of Noise Management Plan.

3. The Proposal

3.1. Introduction

3.1.1. Basis of impact assessment

The Proposal includes a Development Envelope containing all potential construction and operational activities (**Figure 1**). Within the Development Envelope, a smaller indicative Footprint (the Footprint) is the predicted disturbance area for permanent infrastructure, temporary construction such as laydown areas, construction access, permanent access, and the operating railway.

PTA's draft concept design informs the Proposal and Footprint including proposed disturbance areas (**Figure 1**).

The PTA undertook a preliminary assessment of key environmental values within and surrounding the Byford Rail Extension rail corridor area based on desktop information and historical survey information. The desktop assessment area identified Threatened Ecological Communities within the PTA rail corridor through Lambert Lane Nature Reserve and Fletcher Park and south of Abernethy Road, as well as a number of conservation category wetlands. An internal assessment was undertaken by the PTA on the potential to realign the rail corridor to avoid key environmental values particularly through Lambert Lane Nature Reserve and Fletcher Park. This assessment looked at key environmental values in the wider area surrounding the existing rail reserve. The outcome of this assessment revealed significant key environmental values through many locations surrounding the rail reserve. There were no viable alternatives that could realign the rail between Armadale and Byford that would lead to better environmental outcomes or the avoidance of key environmental values. The Byford Rail Extension is essentially restricted to the existing rail reserve, and the mitigation of impacts through avoidance, minimisation and rehabilitation is limited within the rail corridor where key permanent infrastructure will be installed.

Specific information on land use and project design provided in this chapter (Proposal Description section) is preliminary.

The detailed design process will optimise the concept design to achieve improved outcomes for PTA, other stakeholders, and the environment. Consequently, the rail alignment and Footprint may move within the Development Envelope, to optimise the project design, however, the Footprint will not exceed a spatial extent of 80.7 ha and will not extend beyond the Development Envelope boundary.

Proposal **Table 7** (Summary of the Proposal) as referred, and as modified by an application to change Proposal under s43a, is the definitive statement of the Proposal to be assessed by the Environmental Protection Authority.

The Proposal and associated Footprint provide the basis for impact assessment and for the avoidance and mitigation of impacts.

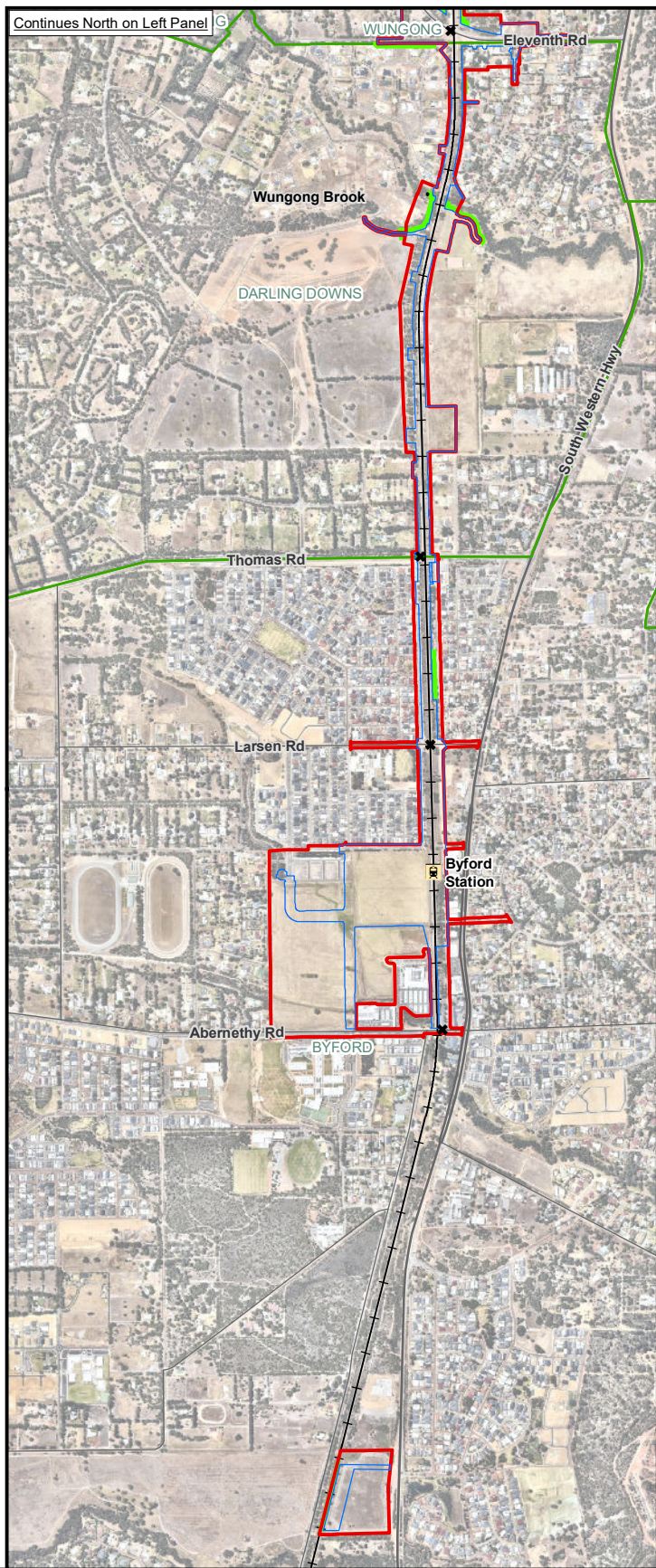
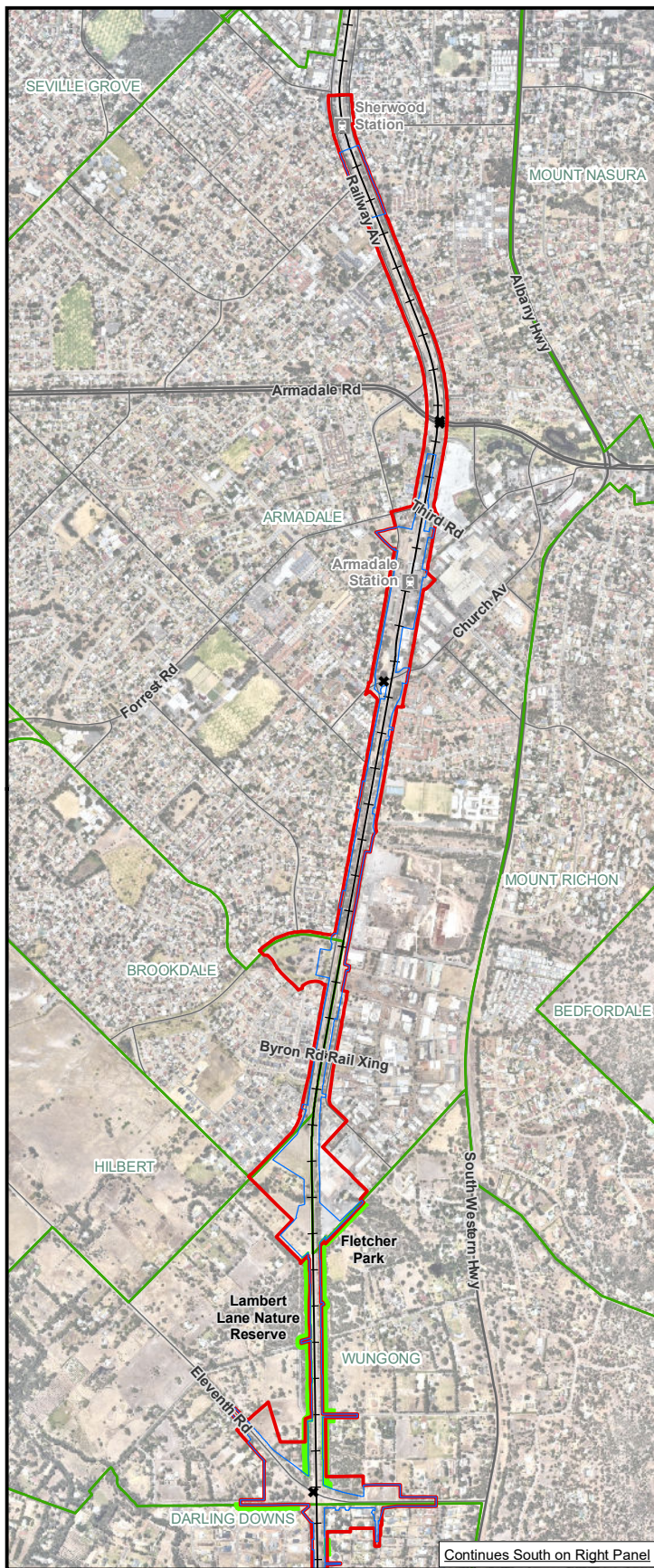
PTA will ensure that all direct impacts, except noise and vibration, will be contained entirely within the Footprint and therefore also within the Development Envelope.

The PTA assessed the Proposal's potential direct impacts by environmental factor (see **Flora and vegetation, Terrestrial fauna, Inland waters, Social surroundings, Other environmental factors** and **MNES** Chapters) by analysing environmental values and assessing impacts occurring within the Footprint.

The EPA's environmental factor guidelines informed PTA's assessment of the Proposal's potential indirect impacts(EPA 2021).

The Proposal's potential indirect impacts were determined to be edge effects associated with the introduction of weeds and/or disease, impacts to fauna habitat and altered hydrology.

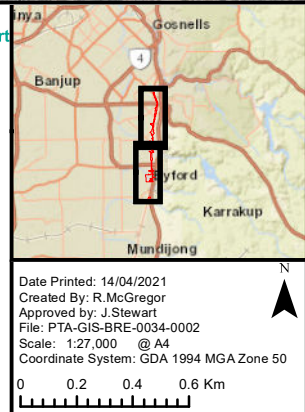
Based on recent experience with rail projects, the PTA's environmental impact assessment process considered such potential indirect impacts to key environmental values (TECs and conservation significant wetlands) within a 20m zone of the direct impacts associated with the Footprint (**Figure 1**).



METRONET | Byford Rail Extension
Figure 1 | The Proposal



- Legend**
- Footprint
 - Development Envelope
 - Potential Indirect Impact Areas
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Existing Railway Station
 - Rail Crossing
 - Locality Boundary



Project land requirements

The Byford Rail Extension Proposal is mainly located within the existing rail reserve currently used for the Australind passenger rail service.

Most of the Proposal will be constructed and operated on existing PTA controlled rail corridor land between Armadale and Byford. PTA will acquire additional land:

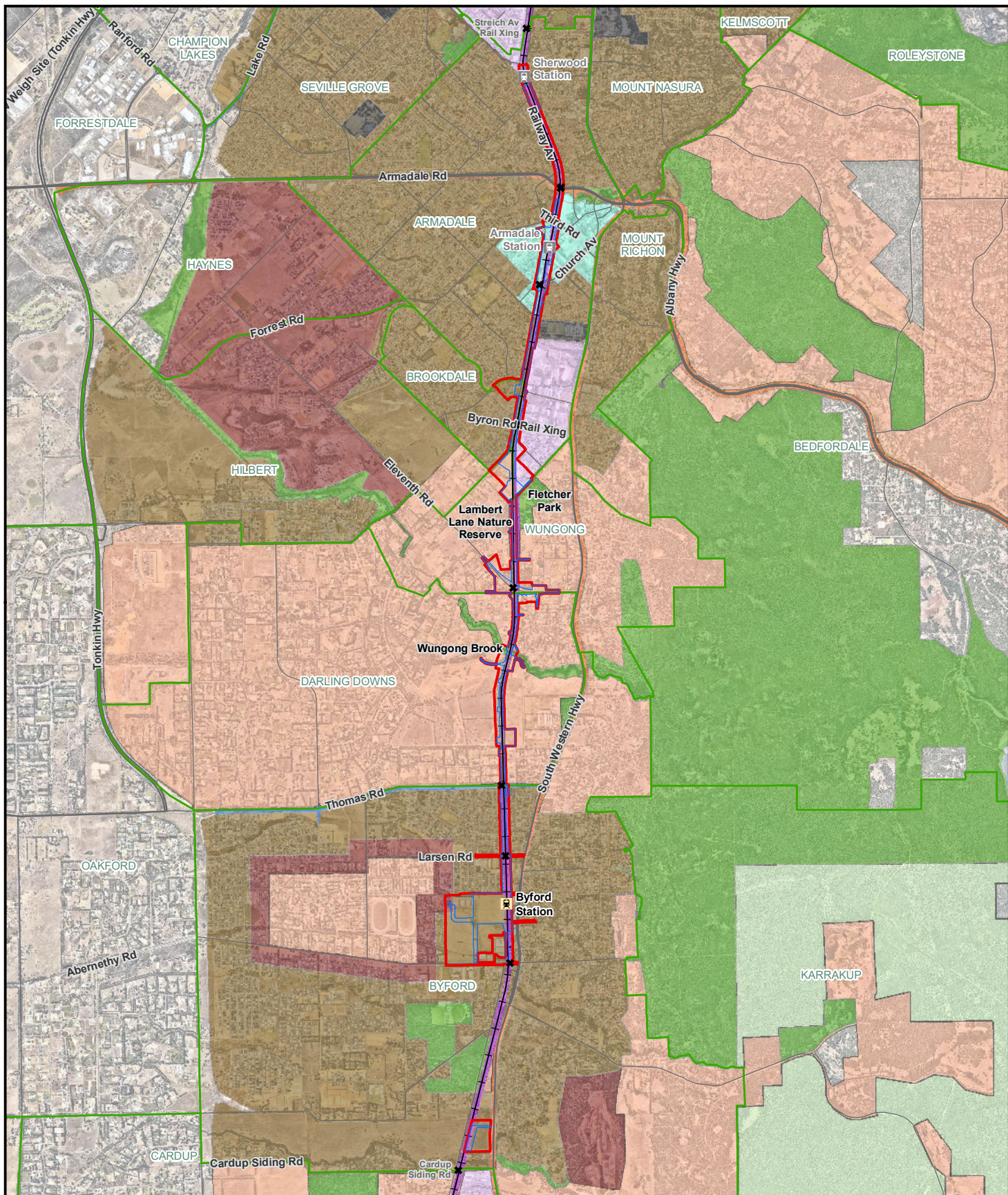
- to construct and operate the Byford Station bus interchange
- for park and ride, kiss and ride facilities and pedestrian access
- for rail drainage basins outside the existing rail corridor.

Urban, rural, and industrial land adjoins the rail corridor. Several primary regional, other regional and local roads intersect the rail line.

The 164.6 ha Development Envelope includes land that is zoned Railways, Rural, Urban, Urban Deferred, Central City Area (near Armadale Station), Parks and Recreations and Public Purpose.

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

- Armadale Station – currently central city area.
- Armadale Station to Byford Station – The Corridor is zoned Railways. The Development Envelope also encompasses and is adjacent to predominantly urban, but also rural zonings. Industrial zoned land is also present between the Corridor and the South-West Highway to the east. The alignment also passes areas designated for conservation and Parks and Recreation.
- Byford Station – currently zoned urban.



METRONET | Byford Rail Extension
Figure 2 | Metropolitan Region Scheme Zoning

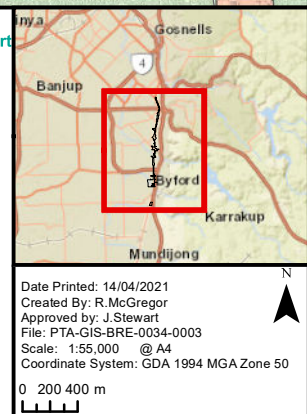


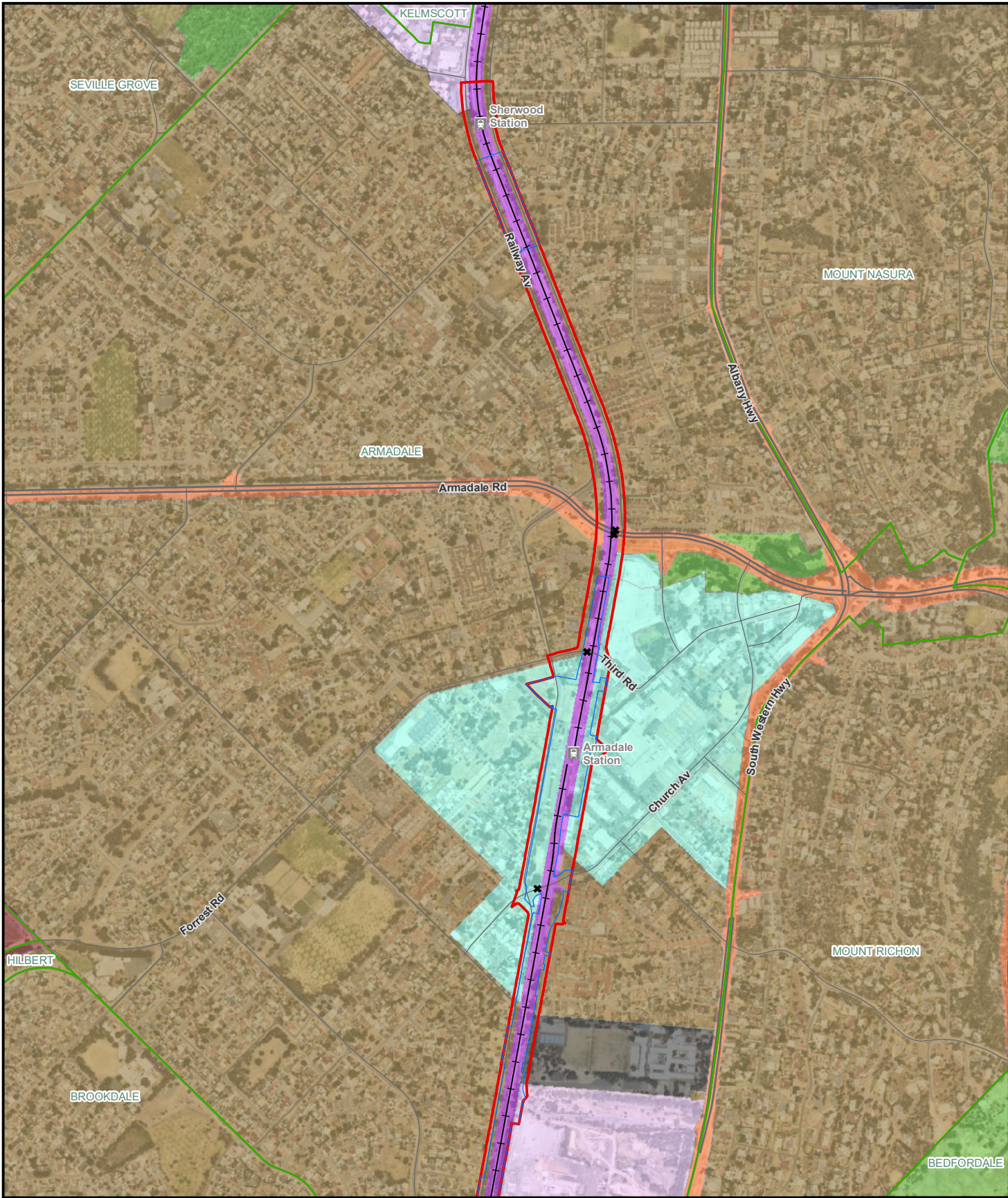
Public Transport
Authority

Legend

Footprint	Zoning Classification	Public purpose
Development Envelope	Central city area	Railways
Indicative Railway Alignment	Industrial	Rural
Proposed Railway Station	Other regional roads	State forests
Existing Railway Station	Parks and recreation	Urban
Rail Crossing	Parks and recreation - restricted public access	Urban deferred
Locality Boundary	Primary regional roads	

A
B
C
D



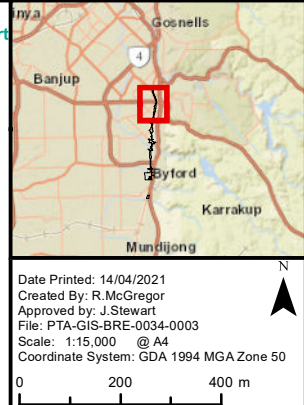


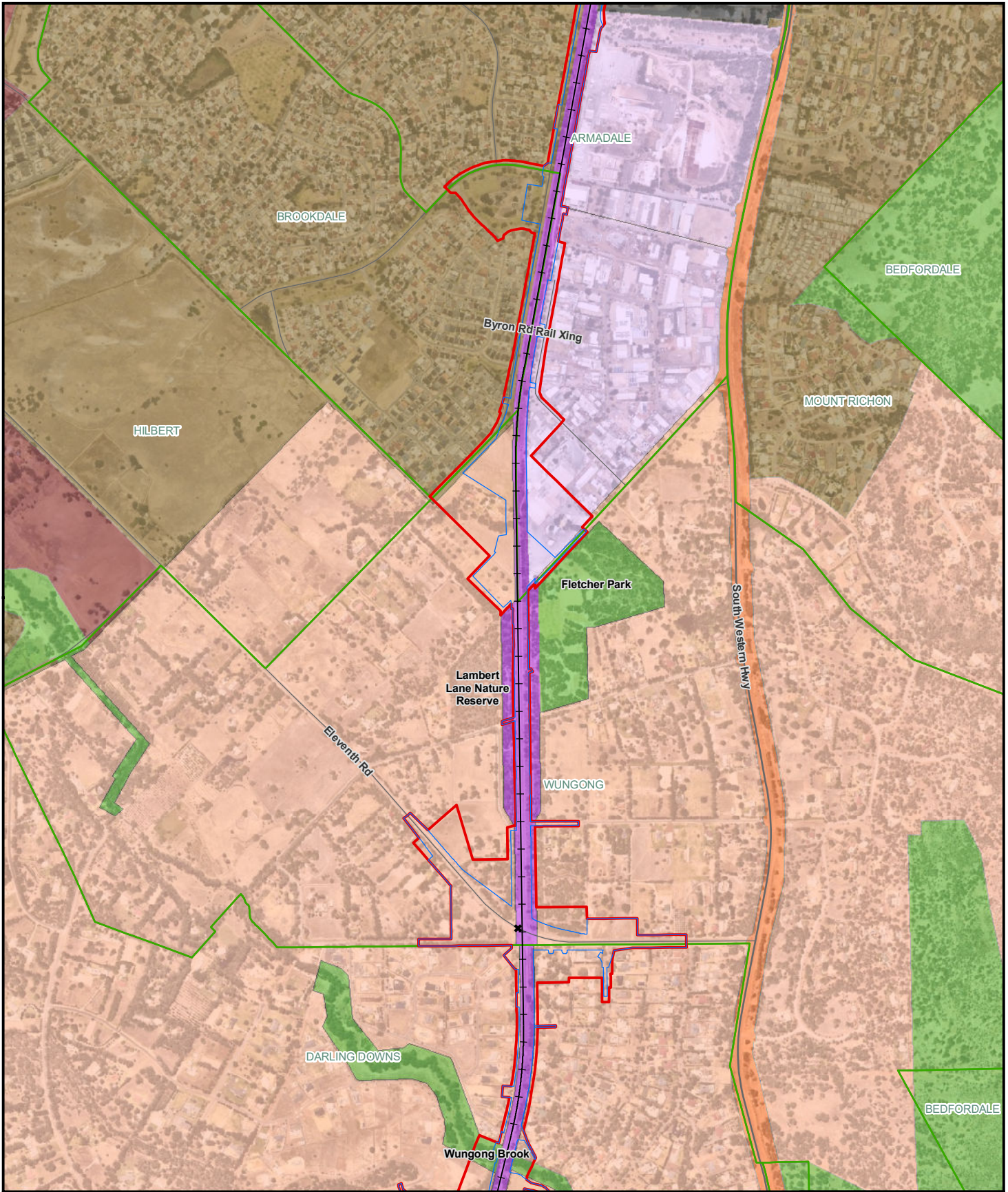
METRONET | Byford Rail Extension
Figure 2A | Metropolitan Region Scheme Zoning



- | | | |
|------------------------------|------------------------------|----------------|
| Legend | Zoning Classification | |
| Footprint | Central city area | Public purpose |
| Development Envelope | Industrial | Railways |
| Indicative Railway Alignment | Parks and recreation | Urban |
| Existing Railway Station | Primary regional roads | Urban deferred |
| Rail Crossing | | |
| Locality Boundary | | |

- | |
|---|
| A |
| B |
| C |
| D |





METRONET | Byford Rail Extension
Figure 2B | Metropolitan Region Scheme Zoning

- Legend**

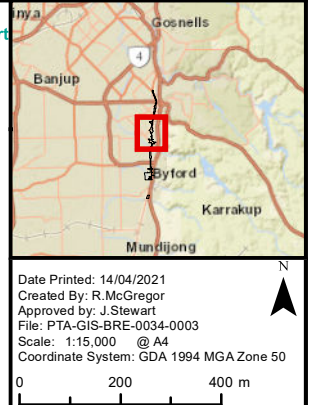
 - Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Rail Crossing
 - Locality Boundary
- Zoning Classification**

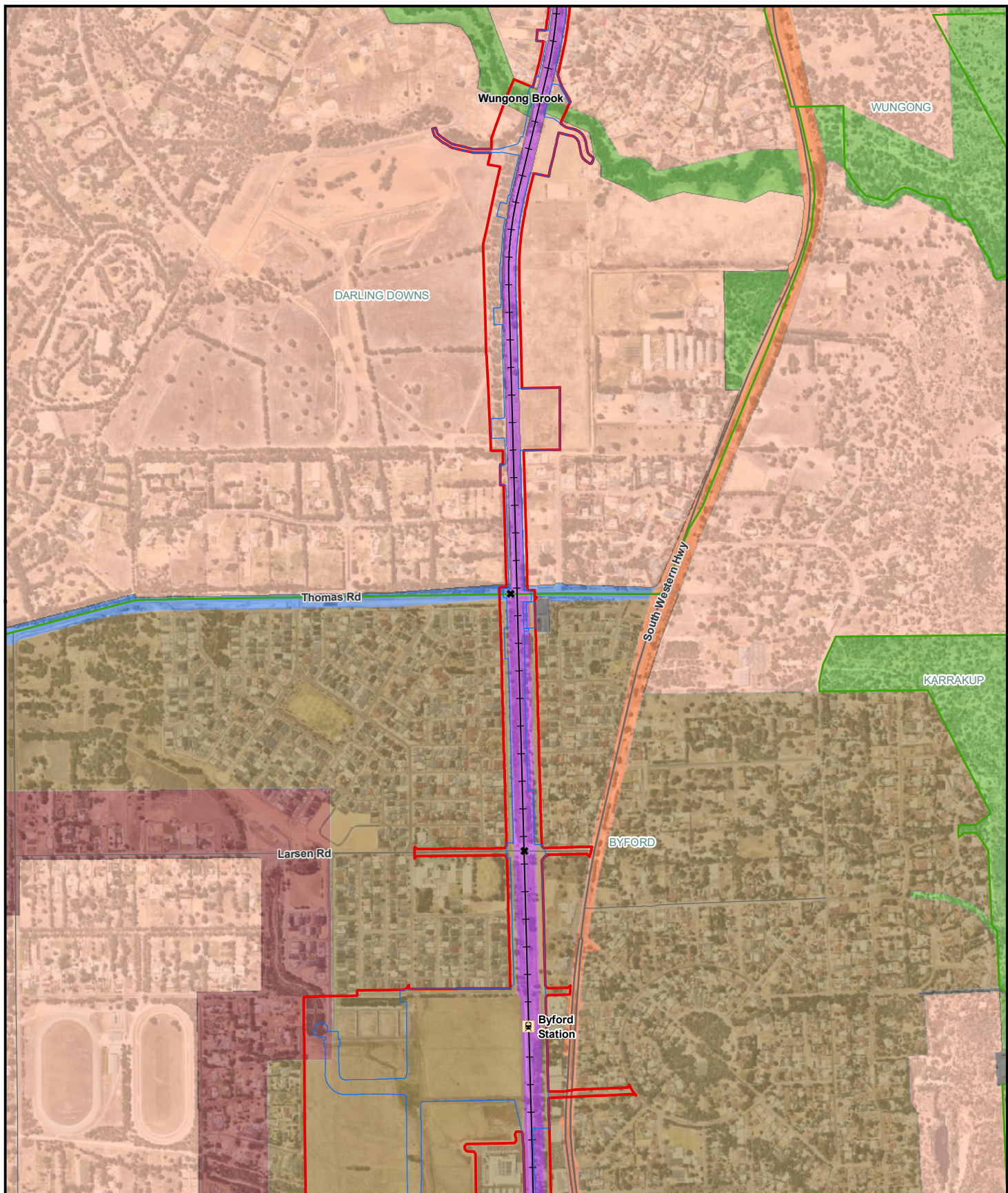
 - Industrial
 - Parks and recreation
 - Primary regional roads
 - Public purpose
 - Rural
 - Urban
 - Urban deferred
- Railways**

 - Railways



- A
- B
- C
- D





METRONET | Byford Rail Extension
Figure 2C | Metropolitan Region Scheme Zoning

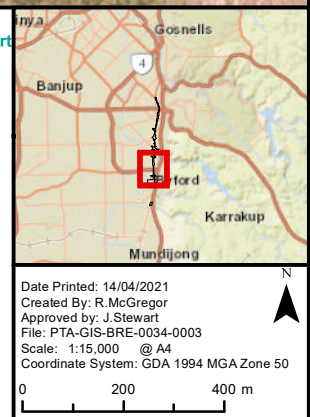


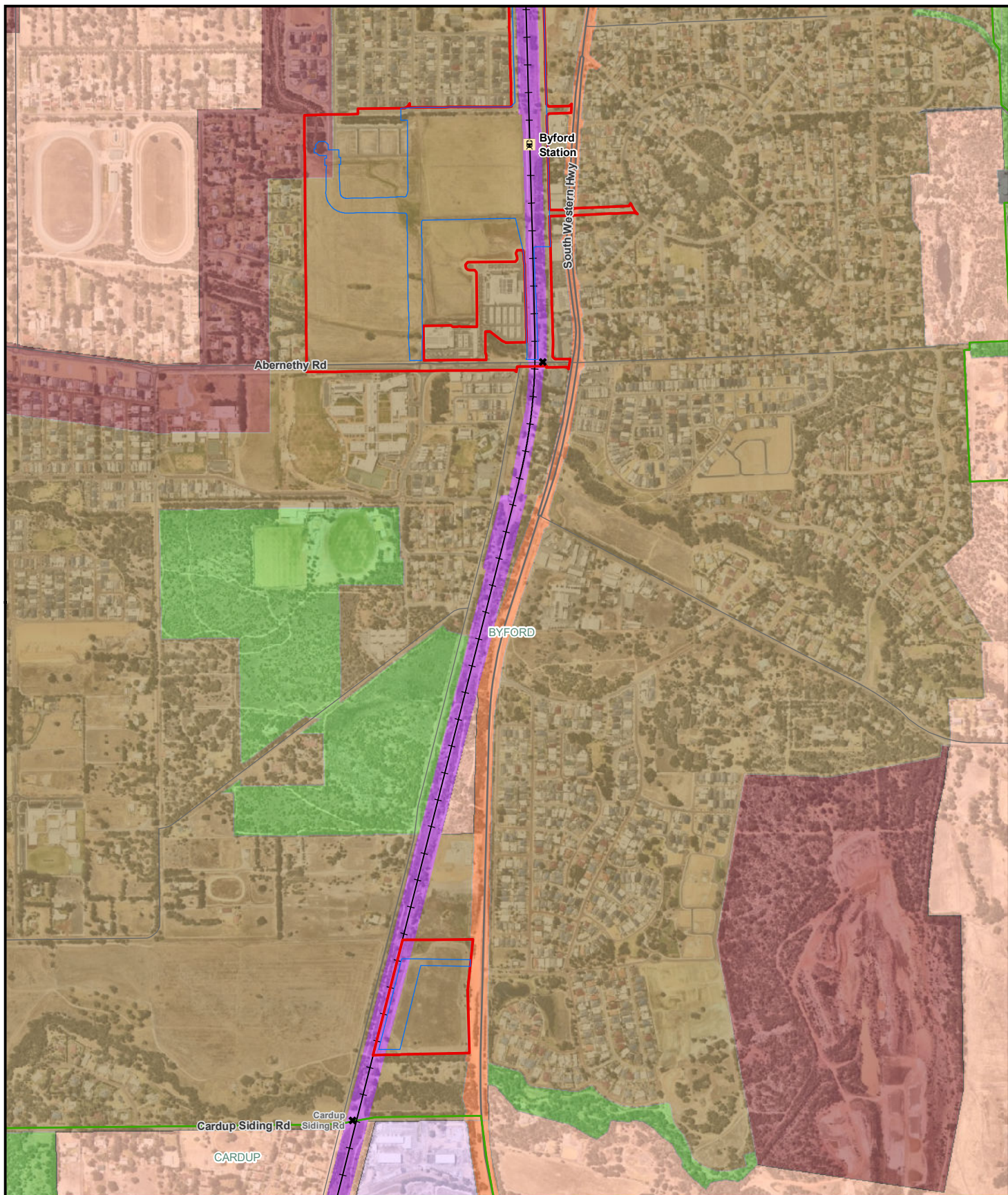
Public Transport
Authority

Legend

Footprint	Zoning Classification	Railways
Development Envelope	Other regional roads	Rural
Indicative Railway Alignment	Parks and recreation	Urban
Proposed Railway Station	Primary regional roads	Urban deferred
Rail Crossing	Public purpose	
Locality Boundary		

A
B
C
D





METRONET | Byford Rail Extension
Figure 2D | Metropolitan Region Scheme Zoning

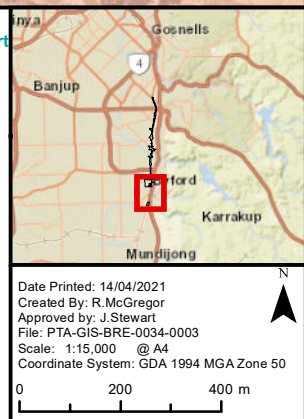


Public Transport
Authority

Legend

Footprint	Zoning Classification	Railways
Development Envelope	Industrial	Rural
Indicative Railway Alignment	Parks and recreation	Urban
Proposed Railway Station	Primary regional roads	Urban deferred
Rail Crossing	Public purpose	
Locality Boundary		

A
B
C
D



The PTA will construct and operate most of the Proposal within the existing PTA controlled rail corridor between Armadale and Byford. The rail corridor intersects three Bush Forever sites and a watercourse. The corridor is zoned Railways under the Perth Metropolitan Regional Scheme (MRS) and is bordered by portions of Urban, Industrial and Rural MRS zoning.

The existing rail corridor is on average 40 metres wide and adequately provides for the construction and operation of the railway related infrastructure. A principal shared pathway (PSP) will run the full length of the rail alignment from Armadale to Abernethy Road, south of Byford Station, along the western side of the rail corridor.

3.2. Planning and Land Use

The BRE project will provide a direct public transport connection between Byford and Armadale, supporting a growing population catchment to the south, facilitating economic growth, and providing greater access to jobs and services. The project strongly aligns with integrated transport policy and land use planning objectives.

Byford is a growing suburb in the south-eastern corridor that has had limited public transport options. Delivery of a new station at Byford provides an opportunity to stimulate the growth of the town centre into a higher intensity mixed-use area that is accessible by public transport.

The indicative railway alignment travels through the following zones (**Figure 2**):

- Armadale Station is within the existing MRS railway reserve. The adjacent landholdings around the station can accommodate medium to higher density mixed use development
- Armadale-Byford rail infrastructure follows the established MRS Railway Reserve
- Byford Station is to be within the existing MRS railway reserve with parts of the bus interchange, park and ride, kiss and ride facilities and pedestrian access on adjacent lots. The surrounding area will accommodate higher intensity land uses and develop into a local activity centre.

3.3. Sustainability

The PTA will implement the Byford Rail Extension project in accordance with the METRONET Sustainability Strategy, developed by the METRONET Office, ensuring the project's delivery in an economically, socially, and environmentally responsible manner.

The strategy sets expectations for transferal of sustainability as a concept into practice across the different phases and components of METRONET and provides guidance to the planning teams, delivery agencies and delivery contractors.

The project is targeting a Silver Infrastructure Sustainability (IS) Rating certification for Design and As-Built under the IS Rating Tool V2.0 of the Infrastructure Sustainability Council of Australia.

The Byford Station is required to register for and target a 4-Star Green Star Design and As Built certification under the Green Star – Railway Stations V1.1 rating tool due to its “Town Centre” precinct typology classification.

The Proposal upgrades the Armadale station platform and access infrastructure, while retaining the existing railway station building. This upgrade will be assessed within the scope of the IS Rating. Any alternative consideration of Armadale Station being totally redesigned and rebuilt, would mean a Strategic Centre precinct typology, requiring the project to register for and target a 5-Star Green Star Design and As-Built certification.

The Green Star certification will ensure the incorporation of Environmentally Sustainable Design (ESD) principles into the station design. Sustainable construction and operation will achieve more efficient resource use, reduced environmental impacts, and greater health and wellbeing benefits for all patrons and staff.

Other key sustainability outcomes targeted for the Byford Rail Extension project include:

- Water-Sensitive Urban Design and other green infrastructure opportunities assessed and integrated with other project strategies like public art and aboriginal engagement to enhance placemaking
- Resilience and Climate Change Vulnerability assessed and adaptation measures provided to eliminate all higher risks
- Whole of Life Cycle Environmental Impacts assessed (LCA) and significant opportunities for more efficient resource use quantified and implemented.

A dedicated sustainability resource will ensure efficient integration of sustainability principles throughout the project up to achievement of the as-built certifications. This will include championing the sustainability management plan and all delivery components to foster a strong innovation culture and improve outcomes through ongoing identification and evaluation of opportunities, tracking of key decisions, implementation and lessons learnt.

The project will report to METRONET on quarterly basis their progress of ongoing sustainability efforts against targeted strategic outcomes.

3.4. Social and Economic Impacts

The BRE project will deliver significant benefits to the community through increased connectivity and capacity to support the fast-growing population of Perth's south-east corridor, as well as contributing to local economic growth through potential investment in Byford and Armadale through commercial expansion, mixed-use development and housing diversity. The BRE project is strongly aligned with the WA government's vision for a well-connected Perth with more transport, housing and employment choices. The project directly addresses several of the key strategies listed in the Perth and Peel @3.5million framework to achieve this vision, including supporting the needs of a growing population by maintaining high levels of liveability; enhancing connectivity and accessibility; and encouraging sustainable development.

The project will provide current and future Byford residents with enhanced connectivity to and from the Perth CBD and south-eastern suburbs with improved travel choices and reduced travel times. High-capacity, high-frequency rail also provides an important opportunity to encourage road users to shift modes to public transport, resulting in fewer cars on the road, fewer kilometres travelled and associated reduction in congestion and vehicle operating costs. It also improves access to jobs, services and amenities. The project is expected to create a large number of construction jobs and wider economic stimulus within the local economy.

Precinct planning around both stations is expected to attract investment and contribute towards Armadale achieving its potential as a strategic centre, which was identified in stakeholder consultations as one of the key study area problems. In Byford, the new station will contribute to activating and intensifying residential and commercial land uses around the new station, providing a viable alternative to driving. New medium-density housing is being built in this area and improved transport connectivity will support and enable growth, whilst reducing car dependency within the community. As community uses are integrated into the Byford station precinct core, the project will support a dynamic civic presence encouraging local economic activity including office, retail, cafes and entertainment. Pathways and cycle ways will connect stations to surrounding residential and employment areas.

Following the confirmed location of the Byford Station in August 2020, there has been various community engagement activities including online project updates, online information sessions, community drop-in sessions and letterbox drops. A BRE Communications and Stakeholder Engagement Plan has been developed to guide the communication and engagement activities throughout the life of the project. Other key stakeholders, such as the Shire of Serpentine-Jarrahdale and City of Armadale, relevant government agencies and utilities, schools and local businesses have been regularly engaged throughout the planning phase of the project.

The project will be delivered in accordance with the overarching METRONET Aboriginal Engagement Strategy (the Gnarla Biddi Strategy) which aims to create business and employment opportunities for Aboriginal people. The Strategy also supports outcomes that align with the METRONET vision including Noongar culture being acknowledged and reflected in the infrastructure designed and built as part of the METRONET Program. This Strategy provides a framework for five engagement streams involving Noongar cultural recognition and input into place-making, Aboriginal procurement and employment, and land access and site management. A number of precinct opportunities have been identified for Byford and Armadale stations, including celebrating the Aboriginal and non-Aboriginal history and values of the area, as well as including Noongar language through place making outcomes. Beyond the project scope, precinct planning and development remains the responsibility of the relevant local government authorities and Development WA.

Public art will play an important role in contributing to the area's identity, bringing a range of social and economic benefits. Following the METRONET Public Art Strategy's guiding principles of place making, site specific, scale and fit, universal accessibility, attractor, sustainable and is well considered and managed, the BRE project will aim to put in place artwork that draws inspiration from Perth's Aboriginal and local culture, history, landscape and place.

The BRE project will also be delivered in accordance with the overarching METRONET Sustainability Strategy, which aims to maximise the project's positive environmental, social and economic outcomes. In addition to all the benefits outlined above, the project is targeting an Infrastructure Sustainability Council of Australia (ISCA) silver rating and a four star Green Star for Byford Station itself.

In summary, the PTA believes a heavy rail public transport transit option to Byford will benefit local communities and the wider region because:

- the population of Byford was approximately 19,465 in 2018 and is expected to reach 47,000 by 2041 (Recent population forecasts place Byford as the second fastest growing suburb in Greater Perth over the next 10 years)
- in the City of Armadale and the Shire of Serpentine Jarrahdale 77% of residents travel to their work place by car – 9% higher than the average for Greater Perth
- public transport journey times currently take up to 40 and 50 minutes from Byford and Mundijong to Armadale respectively – 2x slower than car travel
- it will provide important land use diversification and accessibility for a rapidly growing corridor
- it will increase public transport trips by around 10%
- public transport travel times will be 10 minutes shorter on average
- it will result in public transport user economic benefits, road user economic benefits and other economic benefits.

3.5. Options Analysis

METRONET contracted AECOM to undertake a Multi Criteria Analysis (MCA) for the Proposal, with the results presented in the Byford Rail Extension Long List Options Analysis Report (AECOM 2020a). AECOM applied a multi- disciplinary approach to analyse a "long-list" of potential options against key themes and criteria including potential environmental impacts.

3.5.1. MCA Process

AECOM (2020a) undertook two separate MCAs, which recognised the individual features of the two stations, as well as the alignment of the route itself.

- MCA 1 - Assessment of options and criteria focused solely on the location and type of public transport connection to Byford town centre.
- MCA 2 - Assessment of options and criteria focused on the location of Armadale Station.

A two-part MCA and workshop method was developed, which focussed on the Byford and Armadale areas in isolation.

Byford locality MCA

The options assessed and presented in the Byford MCA 1 workshop included:

1. **Do Minimum As per METRONET BRE Stage 1 Infrastructure Australia submission.** This option included infrastructure upgrades that were already underway or fully committed and funded, such as a new bus route between Armadale, Byford and Mundijong and a small increase in existing bus frequencies.
2. **Bus Rapid Transit.** This option included part segregated / part on-road Bus Rapid Transit via South Western Highway between the existing Armadale Station and Byford Town Centre.
3. **Eight Byford Rail Connection Options.** These options included various potential station locations and configurations, including consideration of both elevated and at-grade stations.

The results of the MCA were tested within a workshop setting, using an interactive voting platform and criteria weightings discussed and agreed with the stakeholders.

Each potential option was assessed and scored against the following key themes and criteria:

- Land Use & Development Potential Urban Form & Sense of Place
 - Planning Context Alignment
 - Land Use Diversity & Intensity
 - Development Potential
 - Connectivity and Urban Structure
- Transport
 - Transport Forecasts
 - Station Walk/Cycle Catchments
- Constructability
 - Station Engineering Compliance / Complexity
- Environment
 - Heritage (Aboriginal & non-Indigenous) Impact
 - Flora / Fauna Impact
 - Flood Risk / Contamination (including wetlands)
- Cost / Operations / Maintenance
 - Capital expenditures (CAPEX) - funds used to acquire, upgrade, and maintain physical assets
 - Operating expenses (OPEX) - the costs incurred for running day-to-day operations.
- Environmental and Heritage Analysis.

For the environmental theme, the criteria focused on potential impacts on Aboriginal & non-Indigenous heritage, flora and fauna, wetlands, flooding and contamination. The constraints assessment used publicly available data to present a comparison of the potential impacts of each option in a workshop format.

The potential Byford station location at Mead Street was determined to involve more extensive issues around wetlands, aboriginal heritage and bush forever sites. The option for the Byford Town Centre and Thomas Road Station locations were shown to have less potential impacts on the suite of environmental values tested. An example of this is shown **Figure 3** and **Figure 4**.

Additional vegetation constraints at Mead Street identified during the MCA included the condition of the vegetation (Very Good) and known presence of TEC.

An EPBC Act Protected Matters Search was conducted for all options assessed during the MCA. Due to the broad buffers applied to this tool, no differentiating matters were identified as being at a greater risk from any option. The initial assessment determined that all options would have the following constraints relating to EPBC Act protected matters:

- Within confirmed Breeding Range of Carnaby's Black Cockatoo
- Within 4 km of Confirmed and Unconfirmed Carnaby's Roosting Sites
- Carnaby's Foraging habitat likely to be present
- Within Known Foraging range for Baudin's Black Cockatoo
- Within Likely occurrence range for Red-tailed Black Cockatoo
- Linkages between remnant patches of bushland habitats.

The "Do minimum" option did not have any environmental constraints and so scored the best on environmental grounds out of the options analysed.

The Byford Town Centre options were also found to provide easier and greater opportunities to deliver residential, dwelling and employment density as well as diversity, to facilitate the development of a successful Transport- oriented development. Given the scoring during the workshop in terms of environmental constraints and other MCA criteria, the Byford Town Centre location was found to be ranked highest.

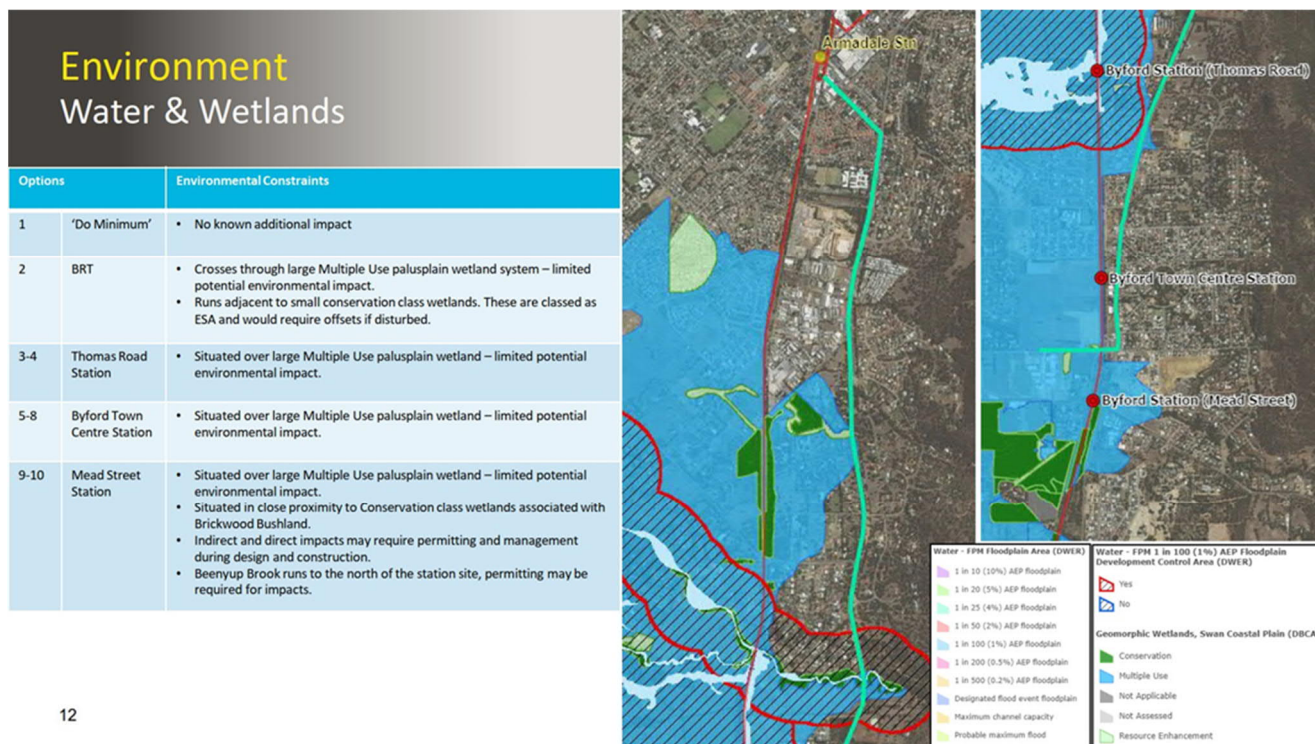


Figure 3 Example of MCA 1 Workshop slide assessing wetland impacts of options (AECOM 2020a)

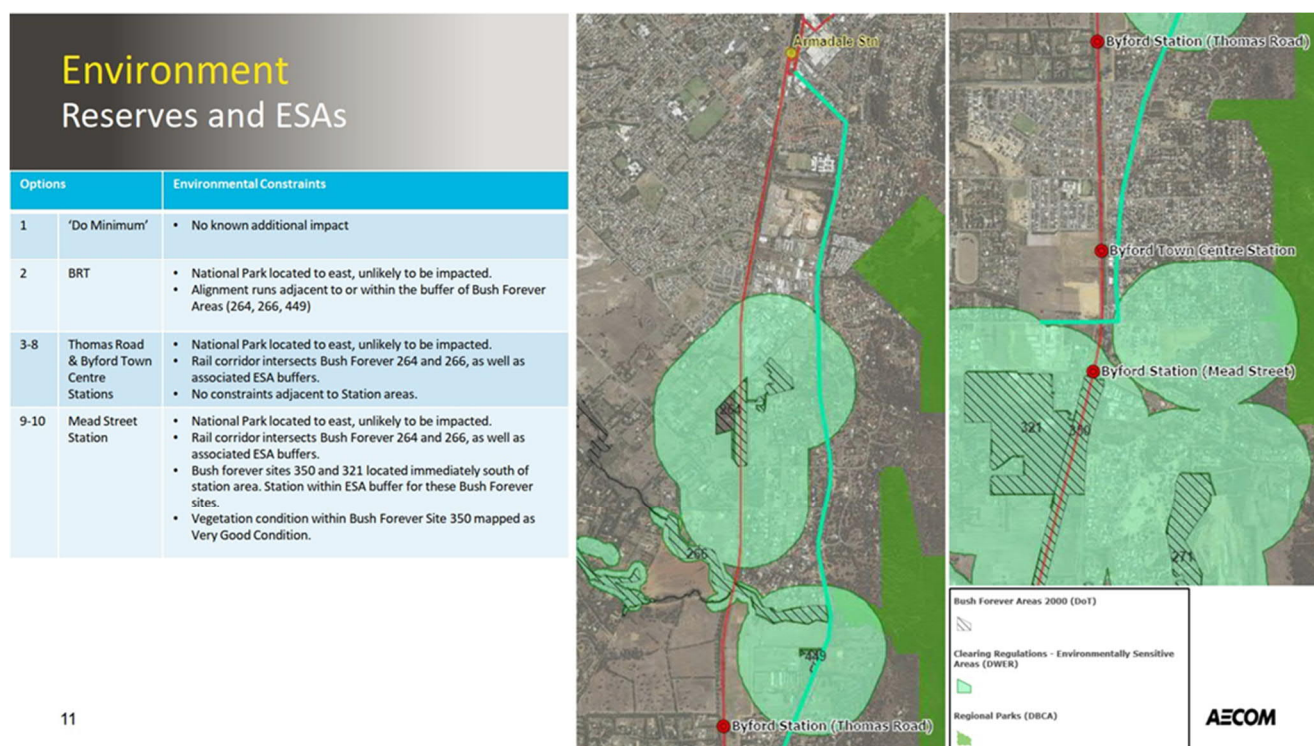


Figure 4 Example of MCA 1 Workshop slide assessing Bush Forever and Reserves (AECOM 2020a)

MCA 2 - Armadale Station

Four options were analysed as part of the MCA 2 - Armadale Station:

- 'Do Minimum' - leaving current facility as is with no upgrades
- Armadale Station (At-Grade)
- Armadale Station (Elevated)
- Armadale Station (Underground)

These options were predominantly relating to changing elevation and engineering design of the current station. Given the works would all relate to the upgrade of an existing facility, there was no differentiation on environmental grounds between the options assessed.

3.5.2. Benefits of selected option

The "do-minimum" option considered during the MCA process did not have any environmental constraints and so scored the highest on environmental grounds. However, this option was scored lowest when taking into consideration the other criteria assessed and the benefits of investing in public transport to support the development of Byford.

To "do- minimum" would mean a non-capital investment approach and assumed a small increase to the existing bus route frequencies and the addition of one new bus route between Armadale, Byford and Mundijong / Whitby. Future development potential at Byford is likely to be comparatively lower in a "do-minimum" scenario when compared with other options (AECOM 2020).

The MCA determined that the key issue with the "do-minimum" option was that proposed density targets would not be able to be met (AECOM 2020a). Transit-oriented development enables multiple housing types and structures to be established. As Byford requires high density residential development to support land use goals, it is likely that this cannot be achieved without public transport investment.

Reduction of air emissions

Although the "do-minimum" option scored highest in terms of environmental constraints assessed as part of the MCA process, the option is based on the increase in bus frequency and number of services as well as upgraded road networks to provide for the transportation needs of the area.

The MCA process included an assessment of the impacts on Road Network Performance, during which it was determined that the rail options scored better than the "do-minimum and BRT" alternatives. **Table 6** below, adapted from AECOM (2020a), shows the results of this analysis.

Table 6 Potential Impacts on Road Network Performance of the MCA options (AECOM 2020a)

Option	Strengths / Constraints
Do Minimum	Volume/Capacity over 1.2 reported on South Western Highway north of Thomas Road. Little bus network to negate this issue, even if South Western Highway were widened as planned but not currently funded by Mains Roads WA. Introduce road congestion if/where number of traffic lanes are reduced to allow for bus lanes or bus priority through intersections.
Byford BRT	Reduce car reliance – propensity to reduce traffic on road network with improved bus services. Ease road congestion on SW Hwy with reduced traffic volumes. Introduce road congestion if/where number of traffic lanes are reduced to allow for bus lanes or bus priority through intersections.
Byford Station Options	Reduce car travel demand hence improve overall road network performance. Reduce congestion on South Western Highway north of Thomas Road, which is forecast to be oversaturated during peak periods under the 2041 'Do Minimum'. Opportunity for rail to perhaps reduce the need for Mains Roads WA to widen South Western Highway as planned. Possibly create localised network congestion around the station during peak periods, with large amount of Park and Ride traffic – however this impact would be negated by the improvements as a result of locating a station in Byford – future design will need to be conscious of this. Thomas Road and Mead Street Stations may provide less opportunity to reduce Park and Ride requirements.

A key benefit of the Proposal is the improvement of air quality by reducing the number of private vehicles on the road network.

A qualitative air quality assessment was commissioned by the PTA for the Yanchep Rail Extension Part 2 (Jacobs 2019) and its assumptions are deemed appropriate to extrapolate and apply to this Proposal. The assessment indicated that replacing private vehicle journeys by car with rail will result in a decrease in concentrations of particulate matter (PM2.5 and PM10) and nitrous oxides including nitrogen dioxide (NO2). Carbon monoxide levels are already relatively low in the Perth region and are not likely to be noticeably reduced by the Proposal.

3.6. Proposal description

The Proposal modifies the existing Armadale station and replaces a number of existing at-grade line crossings (level crossings) with grade-separated crossings: either road over rail or rail over road to maintain local connectivity.

The Proposal's general location is provided in **Figure 1**. The scope and specific features (**Table 7** and **Figure 5**) are:

- Development Envelope extends from Sherwood Station in Armadale to the northern boundary of Abernethy Road Byford
- Reconfigures Armadale Station, providing dedicated metro and Australind platforms to minimise operational conflicts between Australind and metro services
- Minimises impacts on Australind services during construction as much as reasonably practicable. Temporary construction works at Church Avenue and Wungong Brook rail bridges allow the Australind to continue to run. Includes a new Byford Station designed as an end of line station for metro services
- Provides a continuous Principal Shared Path (PSP) predominantly within and along the western boundary of the rail reserve from Abernethy Road, south of Byford Station to Armadale Station
- Creates one new level crossing, connecting to Clara Street, and treats existing road and pedestrian level crossings as indicated below
- Will permanently close two level crossings, Byron Rd and Larsen Rd
- Uses the existing SW Mainline rail corridor. TransWA operates Australind train services between Perth and Bunbury in this corridor.

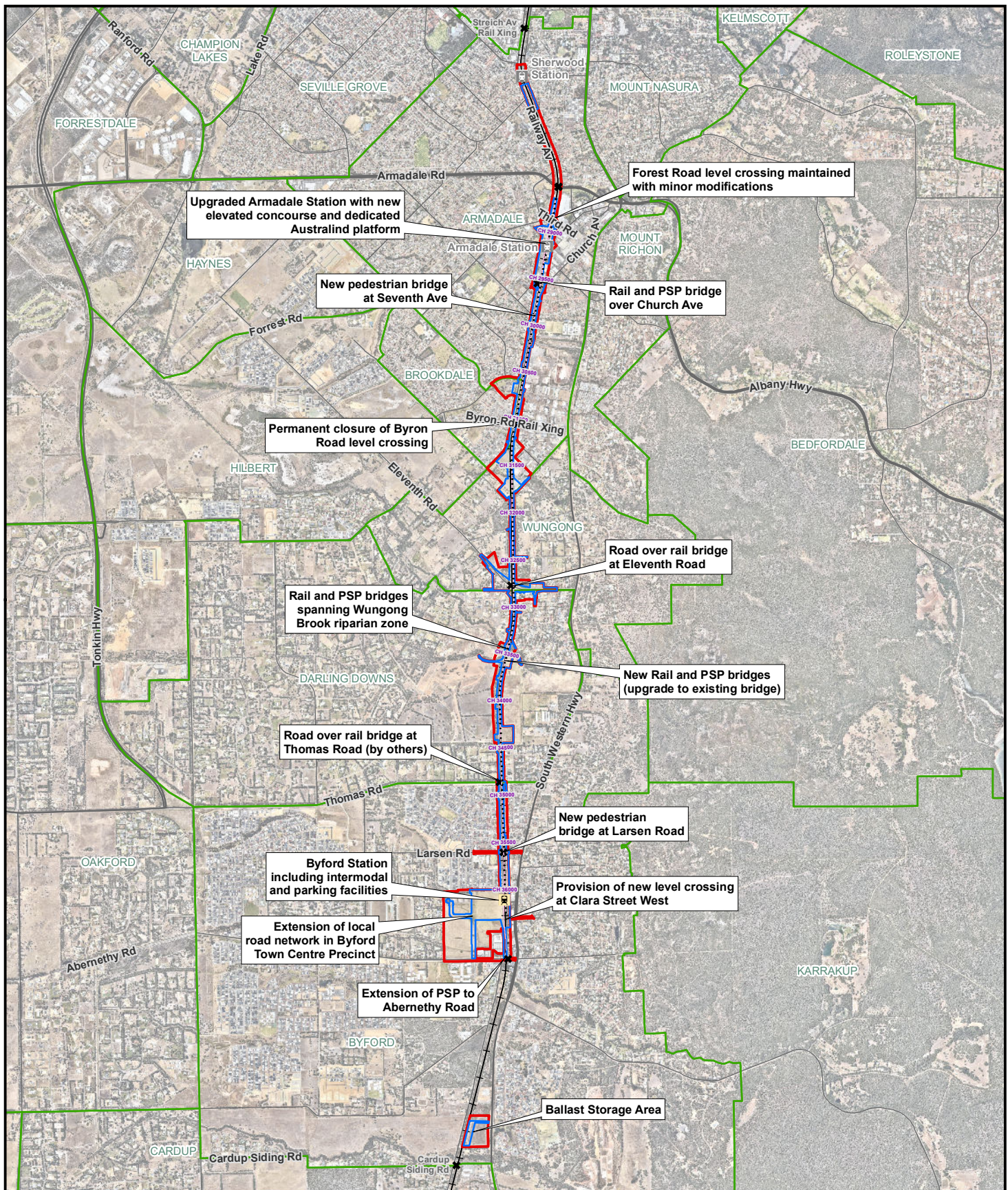
Table 7 **Summary of the Proposal**

Item	Details
Proposal title	Byford Rail Extension Rail Works
Proponent name	Public Transport Authority of Western Australia
Short description	The Proposal is to construct and operate an 8 km new railway (including dual tracks and associated rail infrastructure), between Armadale and Byford. The Proposal includes modification to the existing Armadale Station and construction of a new Byford station. The Proposal also includes the replacement of a number of existing at-grade line crossings (level crossings) with grade separated crossings, either road over rail or rail over road.

Table 8 Key Proposal characteristics

Element	Location	Proposed extent
Physical elements		
Railway tracks and associated infrastructure	The new 8 km dual railway track extends the existing electrified rail network at Armadale in a southerly direction using the existing Australind rail corridor (the Corridor) to the new Byford Station, north of Abernethy Road, Byford (Figure 1). Rail modifications will also be required as far as Sherwood Station 1.5 km north of Armadale Station.	Disturbance of up to 80.7 ha in the area shown as Disturbance Footprint contained entirely within a 164.6 ha Development Envelope. This includes the clearing of up to 15.99 ha of native vegetation.
Armadale Station (modifications) Modifications to the existing railway station and associated facilities including intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (walking/cycling) facilities.	Located approximately 500 m south of Armadale Road, Armadale (Figure 1).	
Byford Station New railway station and associated facilities including intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (walking/cycling) facilities.	Located approximately 8 km south of the existing Armadale Station, 400 m north of Abernethy Road, Byford (Figure 1).	
Level Crossings Existing level crossings will be retained, closed or replaced with grade separated crossings, depending on the most appropriate design option. Each crossing will fit entirely within the Development Envelope.	Located along the Corridor (Figure 1).	
Wungong Brook Rail Bridge	Rail crossing over Wungong Brook.	Duplication of rail bridge over Wungong Brook.
Construction and access areas	Where practicable the PTA will locate temporary construction areas in areas of existing disturbance. Construction and access areas in and adjacent to the Corridor, entirely within the 164.6 ha Development Envelope.	

Element	Location	Proposed extent
Operational elements		
Rail and Bus Services	The passenger railway will operate as an extension to the existing Perth to Armadale line, extending 8 km to Byford (Figure 1). New rail and bus services are proposed for Byford Station.	The passenger railway will operate within the 80.7 ha Disturbance Footprint (Figure 1)

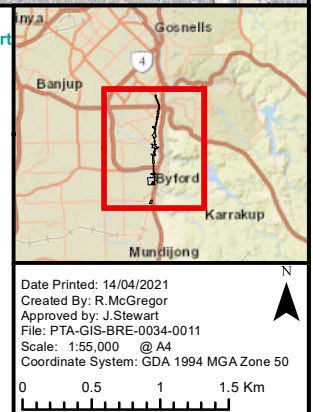


METRONET | Byford Rail Extension
Figure 5 | Project Scope



Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✱ Rail Crossing
- Locality Boundary



3.6.1. Development Envelope and Footprint

The Proposal's 164.6 ha Development Envelope incorporates the existing rail corridor varying in width from 40 m to up to 90 m with an average width of approximately 40 m. The permanent railway and all associated infrastructure are contained entirely within the Proposal's Development Envelope.

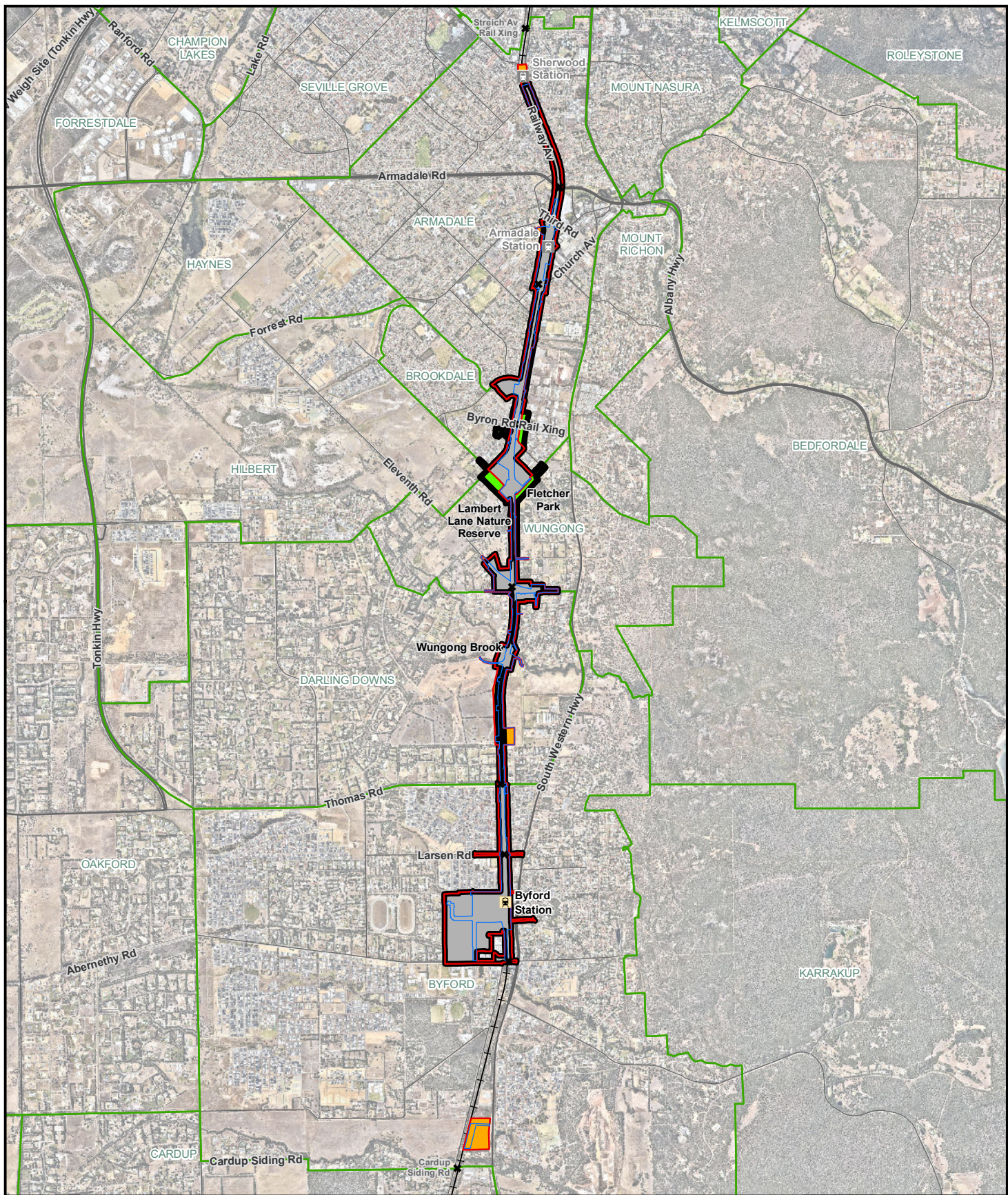
A s43a application associated with this ERD modifies the Development Envelope referred to the EPA on the 7th September 2020, increasing it from 160.1 ha referred (rounded to 160ha in the **Table 7**) by 4.48 ha and creating the Footprint of 80.7 ha. Implementing a Footprint containing all construction and operational activities and infrastructure avoids environmental values and reduces the project impact area from the referred Development Envelope of 160.1 ha to a Footprint of 80.7 ha.

Figure 6 illustrates the changes from the referred Development Envelope to the new Development Envelope and Proposal Footprint. A request to vary a proposal under s156A of the EPBC Act 1999 – Byford Rail Extension (EPBC 2020/8764) similarly modifies the Proposal referred to the Department of Agriculture, Water and the Environment in September 2020.

The Proposal, based on the concept design includes the following specific elements:

- Dual track electrified railway and associated access track, main cable route, drainage, rail formation, rail systems infrastructure including signalling and communications systems
- Earthworks
- Drainage
- Roads
- Parking
- Maintenance access track along the eastern edge of the rail corridor
- Principal Shared Path (PSP)
- Fences / Noise Walls
- Lighting
- New road infrastructure at Eleventh Road
- Drainage basins (anticipating ultimate increase in size to accommodate larger impervious surface in 4-track scenario)
- Lateral access tracks (connecting to proposed rail corridor access track)
- Station precincts including park-n-ride and/or bus interchange facilities
- Temporary laydown areas and site compounds.

Figure 7 illustrates the land elements making up the Proposal and its Footprint.



METRONET | Byford Rail Extension
Figure 6 | Modifications to the Development Envelope



Public Transport
 Authority

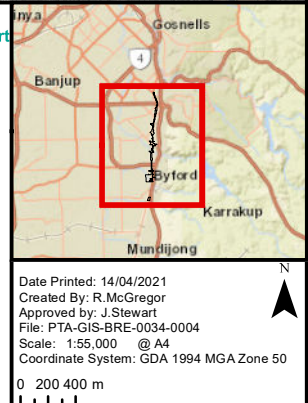
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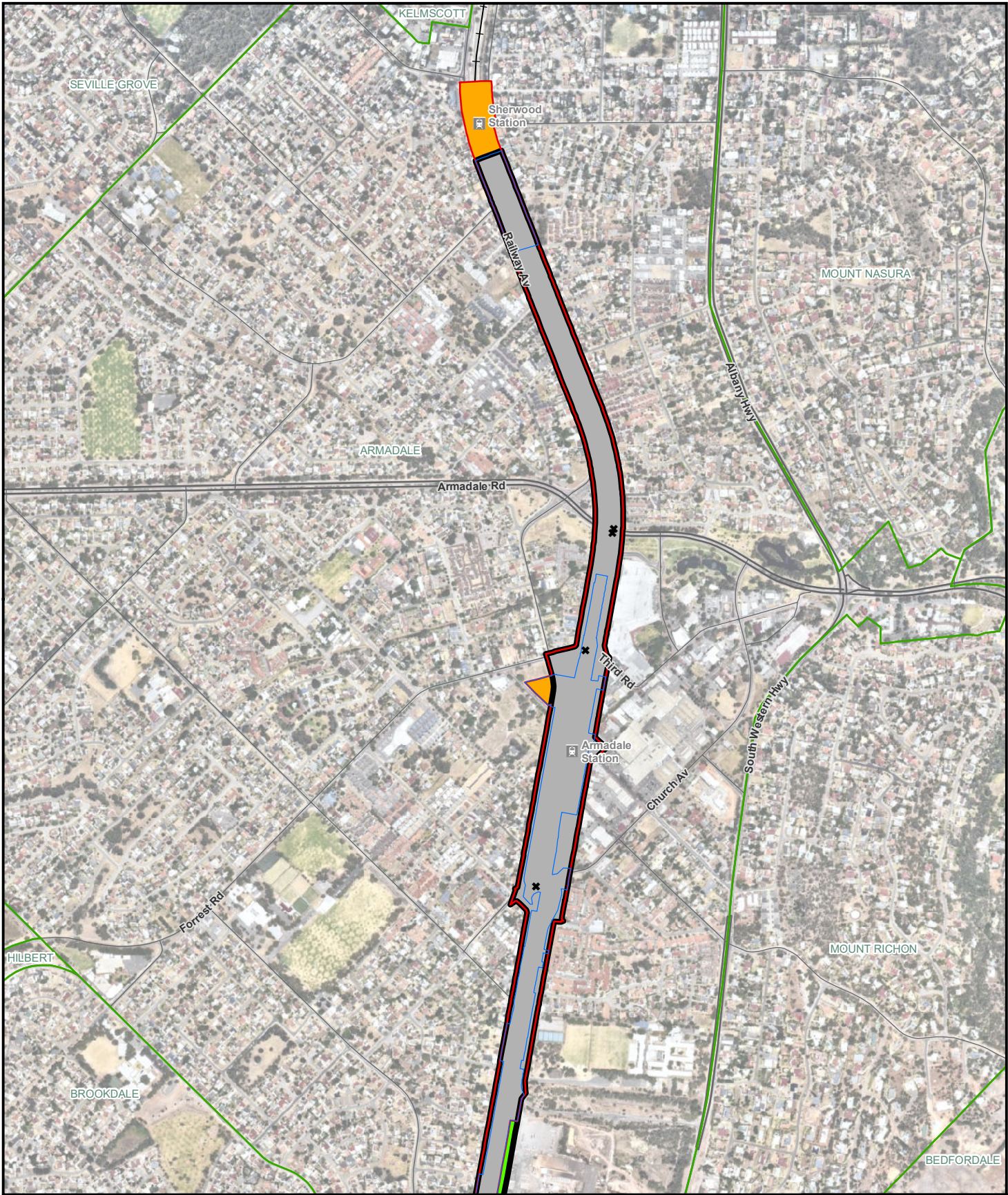
- Footprint
- Development Envelope
- Development Envelope As Referred (PTA, 20200819)
- Indicative Railway Alignment
- ★ Proposed Railway Station
- ★ Existing Railway Station
- ✱ Rail Crossing
- Locality Boundary

Modification Areas

- Areas of Decrease
- Areas of Increase
- Areas of No Change

A
B
C
D





METRONET | Byford Rail Extension
Figure 6A | **Modifications to the Development Envelope**

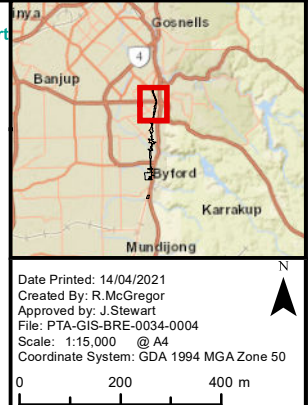
- Legend**

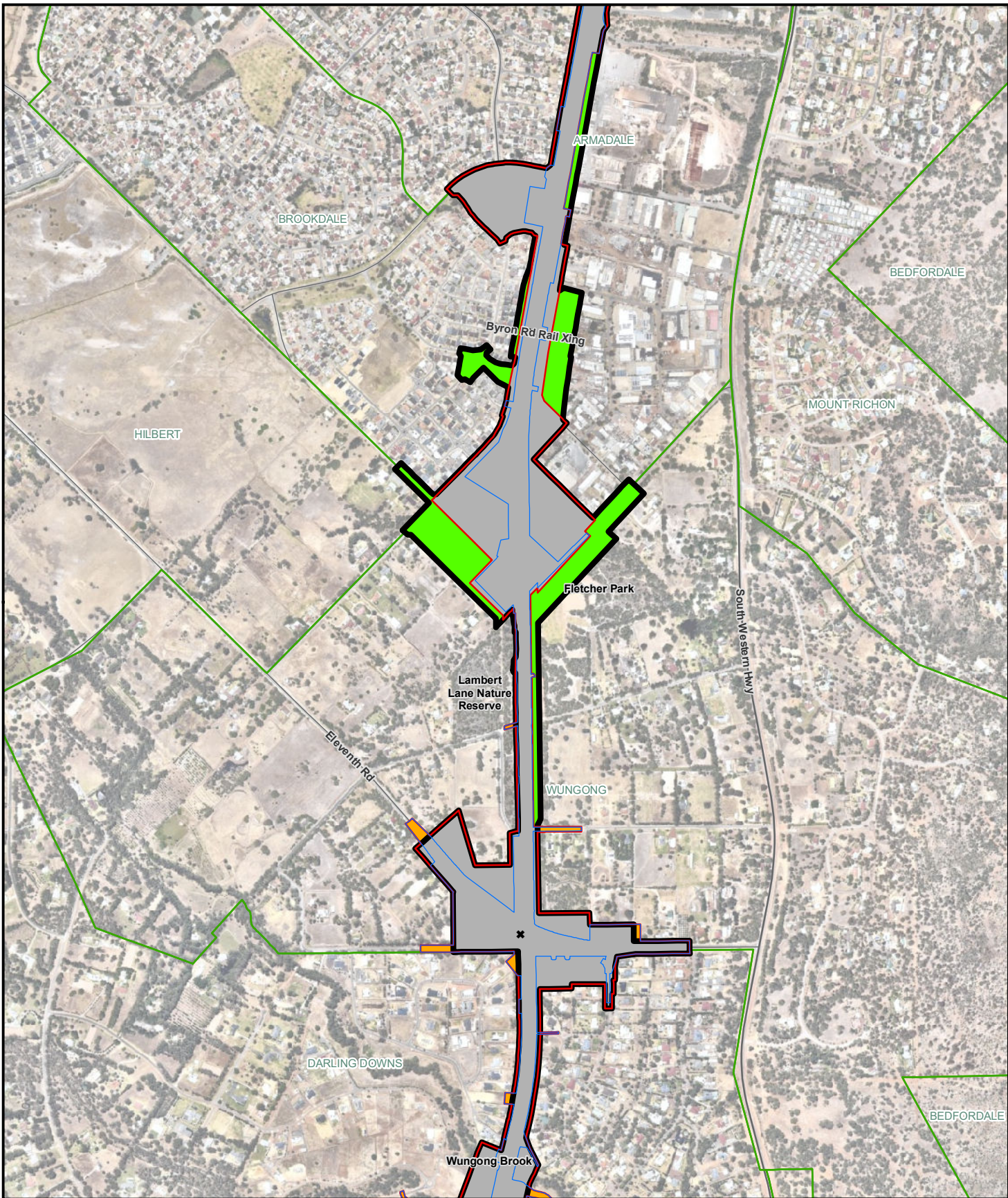
 - Footprint
 - Development Envelope
 - Development Envelope As Referred (PTA, 20200819)
 - Indicative Railway Alignment
 - Existing Railway Station
 - Rail Crossing
 - Locality Boundary
- Modification Areas**

 - Areas of Decrease
 - Areas of Increase
 - Areas of No Change



A
B
C
D





METRONET | Byford Rail Extension
Figure 6B | **Modifications to the Development Envelope**



Public Transport
Authority

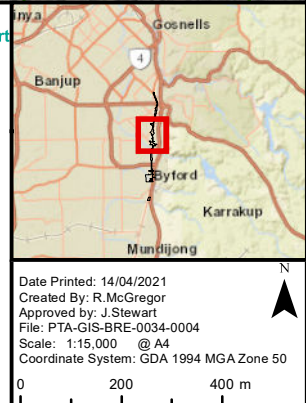
Legend

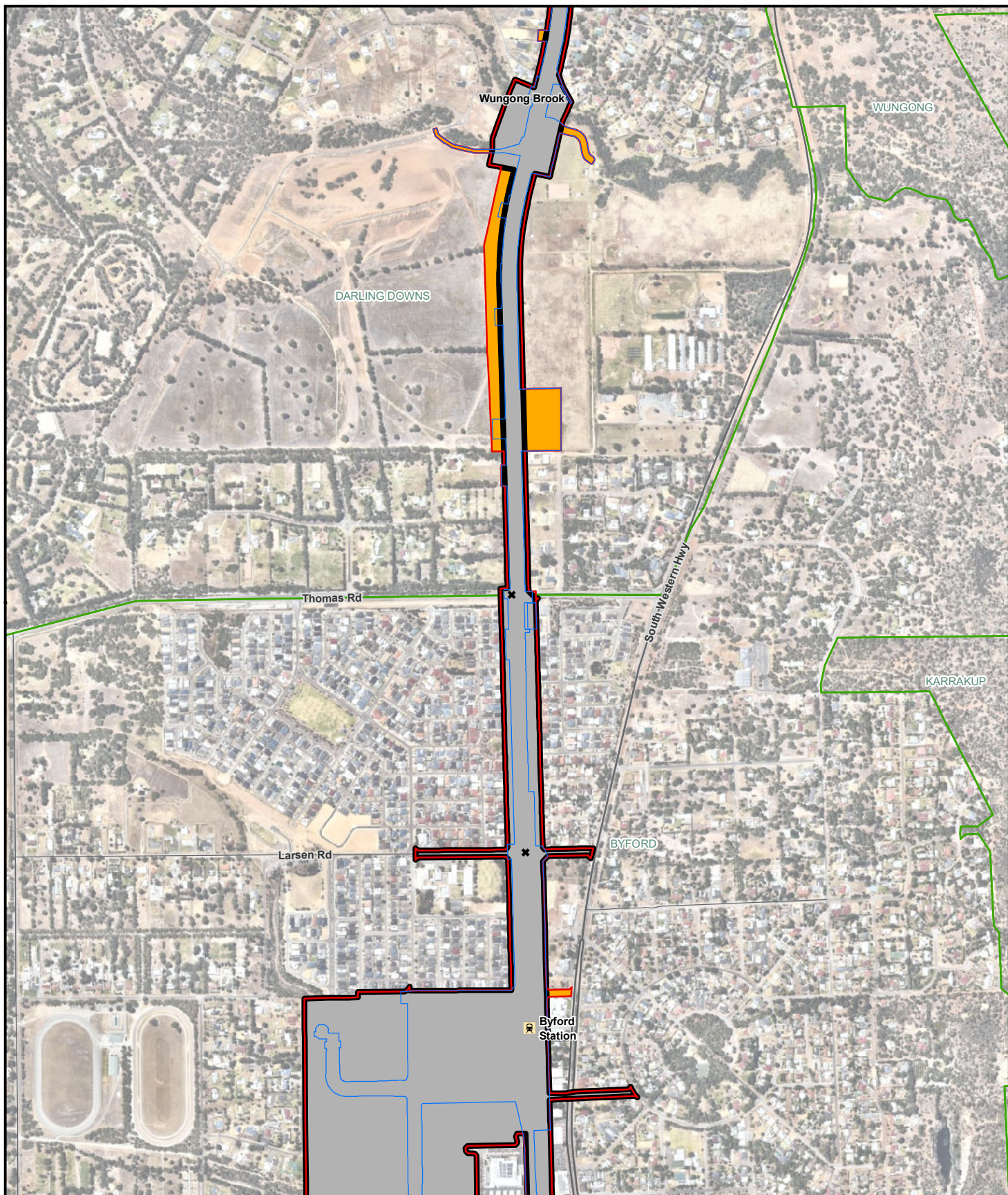
- Footprint
- Development Envelope
- Development Envelope As Referred (PTA, 20200819)
- Indicative Railway Alignment
- ✱ Rail Crossing
- Locality Boundary

Modification Areas

- Areas of Decrease
- Areas of Increase
- Areas of No Change

A
B
C
D





METRONET | Byford Rail Extension
Figure 6C | **Modifications to the Development Envelope**



Public Transport
Authority

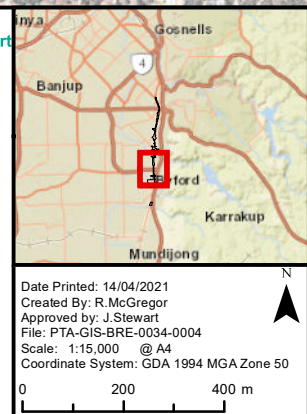
Legend

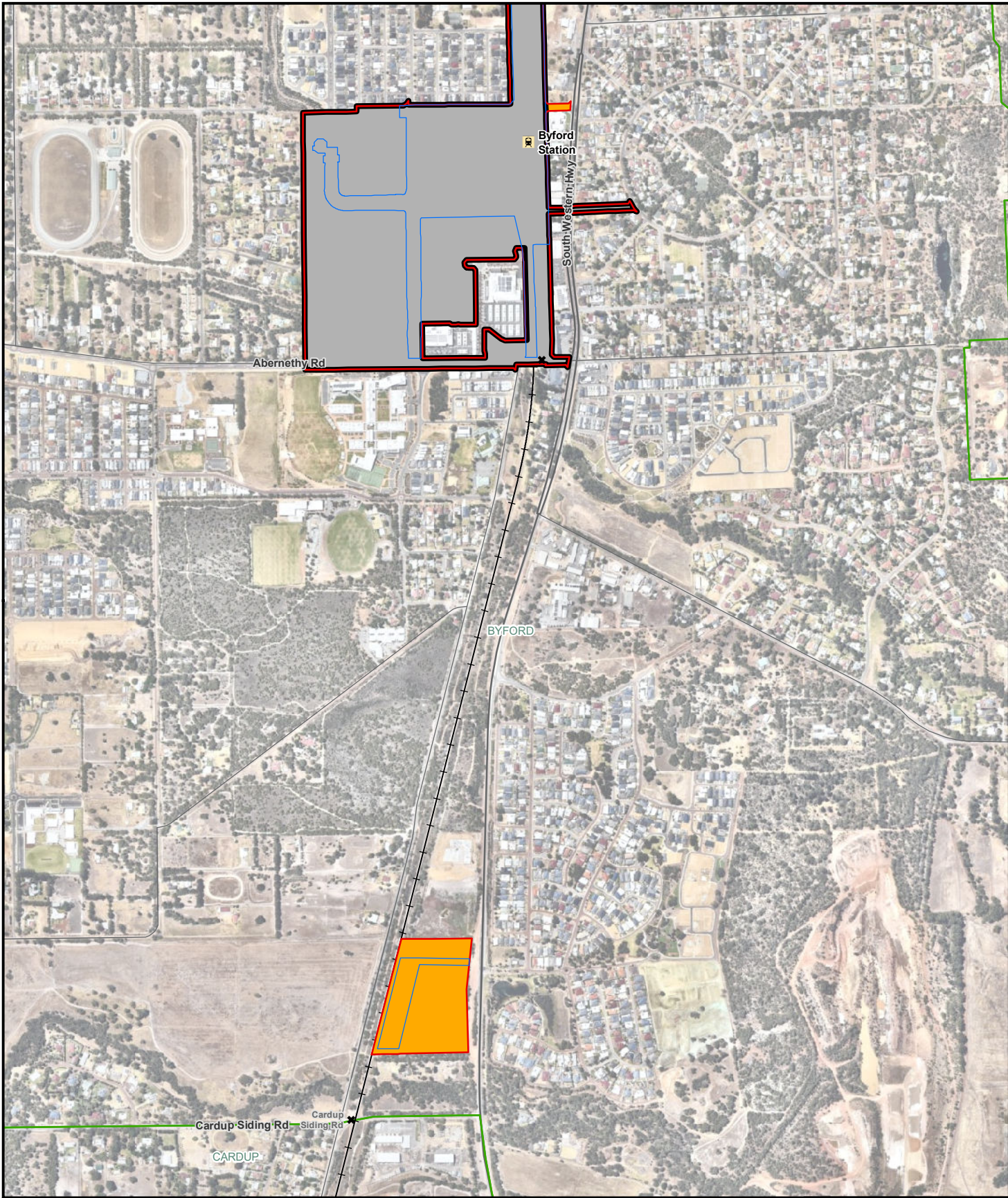
- Footprint
- Development Envelope
- Development Envelope As Referred (PTA, 20200819)
- Indicative Railway Alignment
- Proposed Railway Station
- ✕ Rail Crossing
- Locality Boundary

Modification Areas

- Areas of Increase
- Areas of No Change

A
B
C
D



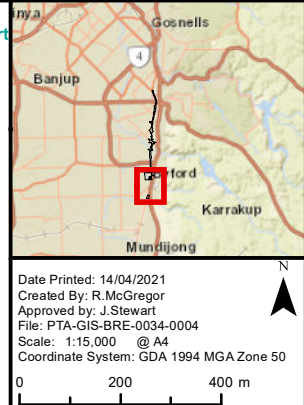


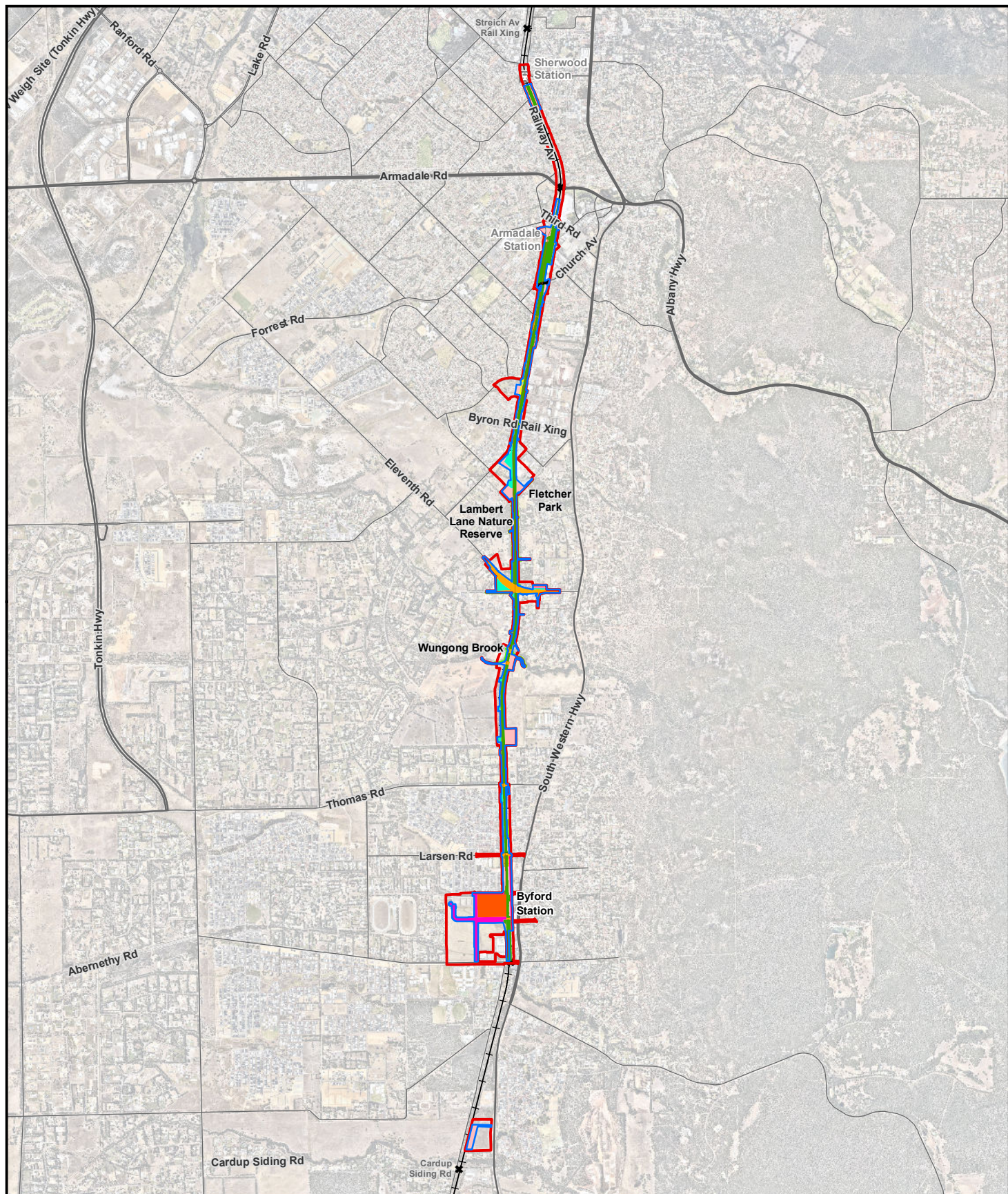
METRONET | Byford Rail Extension
Figure 6D | Modifications to the Development Envelope

- Legend**
- Footprint
 - Development Envelope
 - Development Envelope As Referred (PTA, 20200819)
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Rail Crossing
 - Locality Boundary
- Modification Areas**
- Areas of Increase
 - Areas of No Change



- A
- B
- C
- D





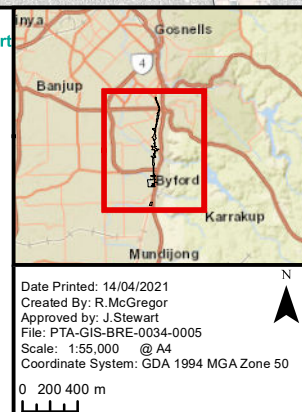
METRONET | Byford Rail Extension
Figure 7 | Indicative Proposal Activities

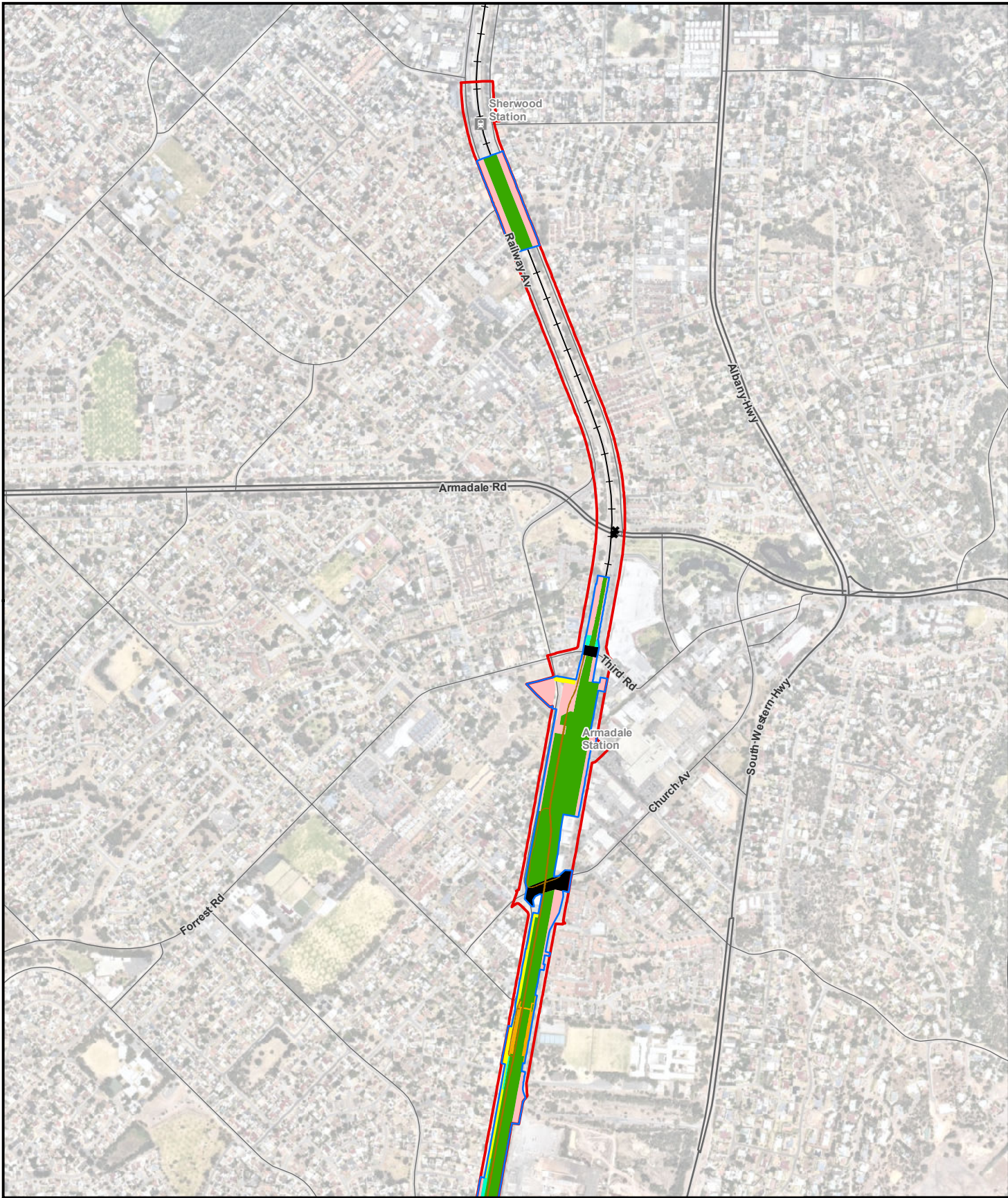


Legend

Footprint	Proposed Land Use	PShP
Development Envelope	Access	Potential Power Sub-Station
Indicative Railway Alignment	Bridge access/Construction	Rail Infrastructure
Proposed Railway Station	Car Park	Relocation of Services
Existing Railway Station	Construction Areas	Road
Rail Crossing	Drainage	
Potential Indirect Impact Areas		

A
B
C
D



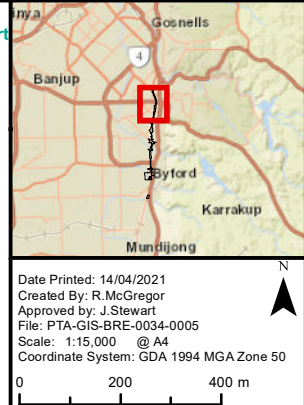


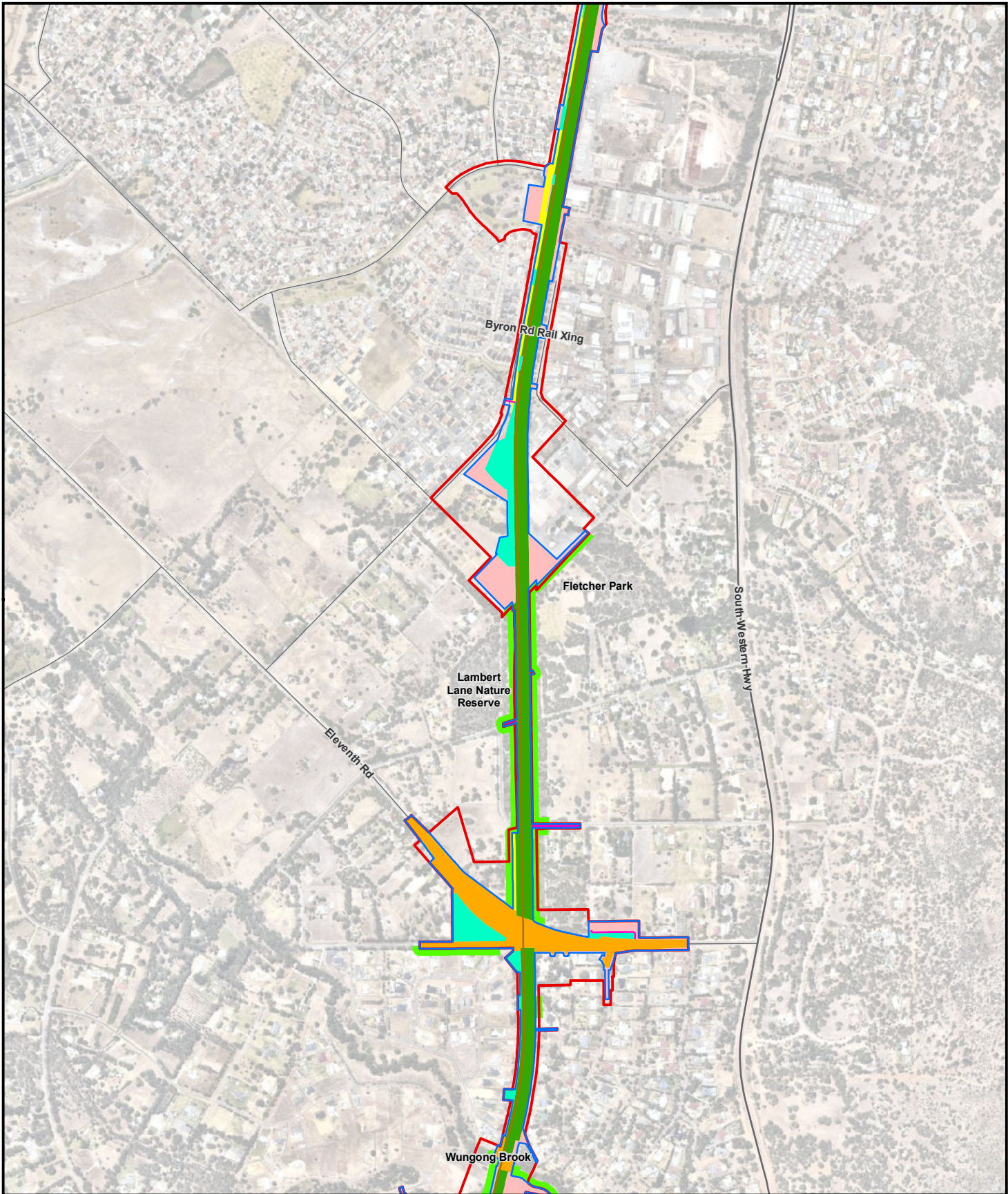
METRONET | Byford Rail Extension
Figure 7A | Indicative Proposal Activities

- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Existing Railway Station
 - Rail Crossing
- Proposed Land Use**
- Bridge access/Construction
 - Construction Areas
 - Drainage
 - PSHP
 - Rail Infrastructure
 - Relocation of Services
 - Road



A
B
C
D





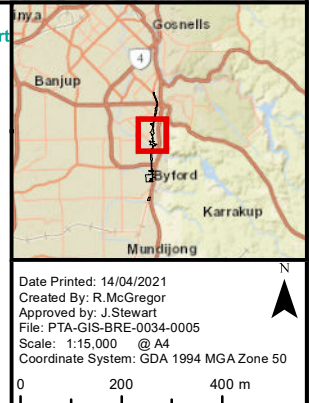
METRONET | Byford Rail Extension
Figure 7B | Indicative Proposal Activities

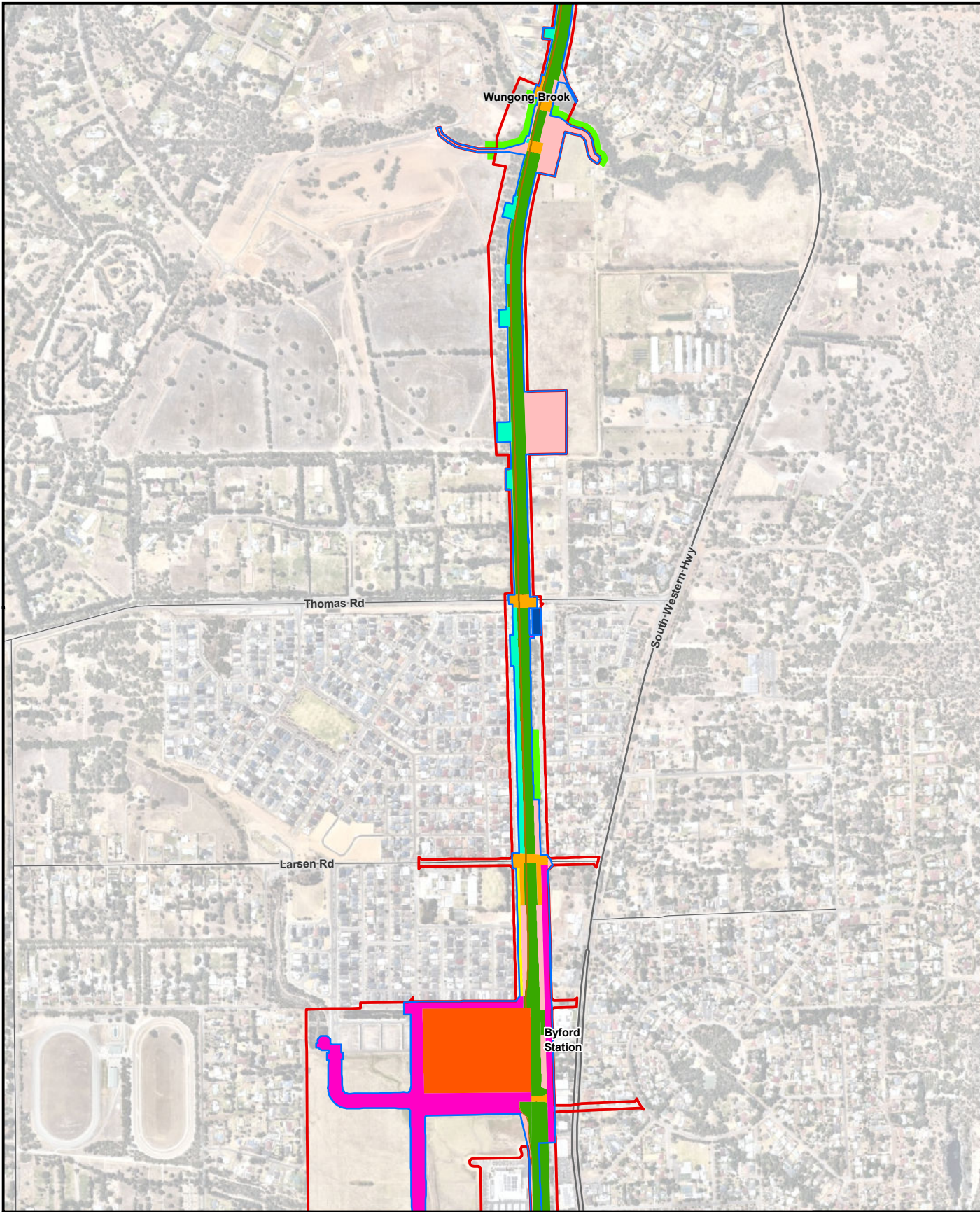


Public Transport
Authority

Legend		
 Footprint	 Access	 Drainage
 Development Envelope	 Bridge access/Construction	 PShP
—+— Indicative Railway Alignment	 Construction Areas	 Rail Infrastructure
✱ Rail Crossing		 Relocation of Services
 Potential Indirect Impact Areas		

A
B
C
D





METRONET | Byford Rail Extension
Figure 7C | Indicative Proposal Activities

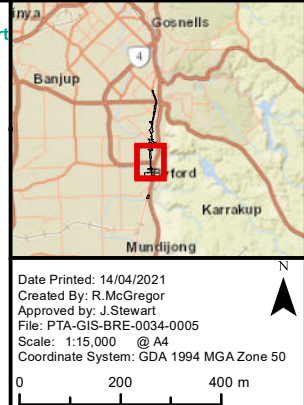
- Legend**

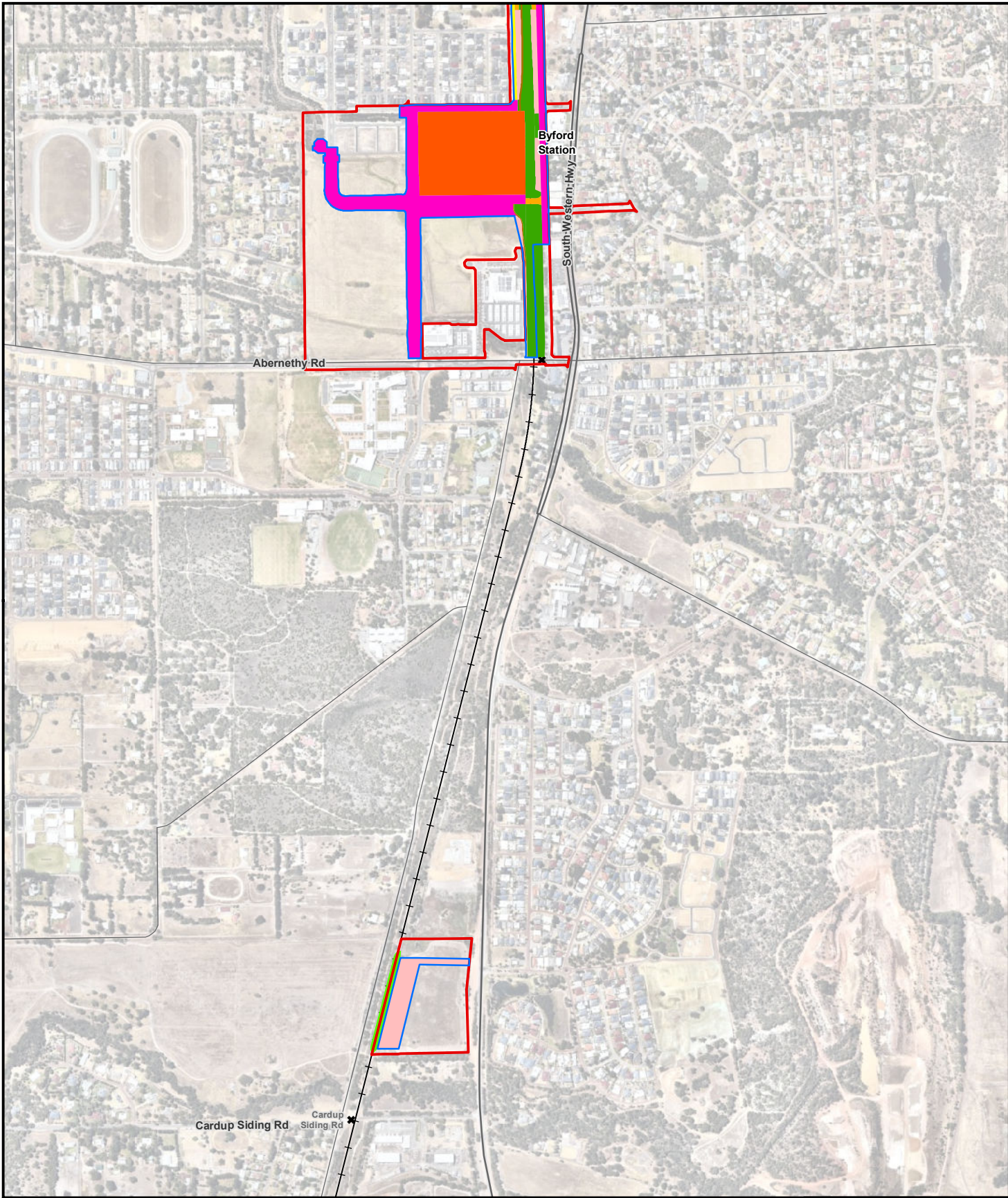
 - Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Rail Crossing
 - Potential Indirect Impact Areas
- Proposed Land Use**

 - Access
 - Bridge access/Construction
 - Car Park
 - Construction Areas
- Drainage
 - PSHP
 - Potential Power Sub-Station
 - Rail Infrastructure
 - Relocation of Services



A
B
C
D



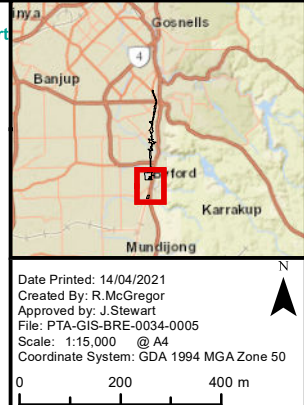


METRONET | Byford Rail Extension
Figure 7D | Indicative Proposal Activities

- | | | |
|---|--|--|
| Legend | Proposed Land Use | |
| Footprint | Access | Construction Areas |
| Development Envelope | Bridge access/Construction | PShP |
| Indicative Railway Alignment | Rail Infrastructure | Relocation of Services |
| + Proposed Railway Station | Car Park | |
| x Rail Crossing | | |
| Potential Indirect Impact Areas | | |



- A
- B
- C
- D



3.6.2. Railway tracks and infrastructure

The Proposal is within the rail corridor used by the non-electrified single narrow gauge South West Mainline connecting Perth to Bunbury. TransWA operates Australind train services between Perth and Bunbury four times daily (two services in each direction) in this rail corridor.

The SW Mainline is located in the centre of the existing corridor and generally follows the proposed alignment of one of the dual tracks of the BRE. However, PTA will temporarily relocate this SW Mainline track to allow two new narrow gauge tracks to be constructed. Future Australind services will run on one of these new tracks.

The PTA will reconstruct the existing rail formation to accommodate new rail horizontal and vertical alignments and to provide an adequate foundation for the tracks.

The Proposal includes a continuous maintenance access track on the eastern side of the corridor, except at the crossing of Wungong Brook. There will be no through maintenance access across Wungong Brook. PTA requirements also dictate provision of gated access to the access track at 1 km intervals.

Most railway tracks and stations will be constructed 'at-grade'. The Proposal requires some minor road realignment to accommodate the construction and operation of the railway infrastructure.

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

3.6.3. Stations

The Proposal includes significant reconstruction of the Armadale Station with a public access concourse over the electrified railway providing connectivity between the Town Centre and the residential areas to the west, with ticketing and vertical transport to the platforms below. The Proposal also extends the bus interchange at Armadale.

A new Byford station and station precinct with Park'n'Ride facilities and a bus interchange will be integrated into the new Town Centre.

The Proposal:

- Reconstructs at ground level most of the existing Armadale station including a public access concourse over the electrified railway, providing connectivity between the Town Centre and the residential areas to the west, with ticketing and vertical transport to the platforms below
- Includes an additional platform at Armadale Station and a new railway station at Byford Town Centre, located approximately 400 m to the north of Abernethy Road level crossing
- Involves vegetation clearing and earthworks necessary to construct the train stations, associated bus interchanges, car parks and buildings.

The stations at Armadale and Byford will have intermodal interchanges for bus services, 'park and ride', 'kiss and ride' and active mode facilities. The Proposal integrates Byford station into precinct planning for the proposed new town centre.

3.6.4. Bridges, culverts and drainage basins

Apart from stations, the Proposal's major structural elements are grade-separated structures for road over rail (2), rail over road bridges (1), pedestrian footbridges (2), bridges over Wungong Brook for the railway and the PSP, and the closure of existing active protection level crossings (2). These structures cross roads, infrastructure and watercourses.

Treatment of existing road and pedestrian level crossings is as Table 9 below

Table 9 Treatment of existing road and pedestrian level crossings

Crossing location	Proposed treatment
Forrest Road	Retain at-grade level crossing, subject to safety review
Church Avenue	Grade separation; rail over road
Seventh Road	Pedestrian bridge over rail
Wungong/Byron Roads	Closure of crossing
Eleventh Road	Grade separation; road over rail
Thomas Road	Grade separation; road over rail (not part of this Proposal, work to be undertaken by Armadale Access Alliance / MRWA)
Larsen Road	Closure of road crossing and provision of pedestrian bridge over rail
Clara Street West	New at-grade level crossing immediately south of Byford station

The Proposal will:

- Remove the existing Wungong Brook Bridge including an existing pier located within the waterway (**Figure 8**)
- Replace existing Wungong Brook Bridge with two single span bridges (rail bridge and PSP bridge) having minimal impact to the water course and associated riparian vegetation
- Replace an existing a five-span open deck bridge structure 150m south of Wungong Brook with a 1.2 x 1.2 m culvert as there is a minimal catchment area associated with this waterway
- Place all culverts to allow sufficient surface water flow
- Locate required drainage basins on the downstream (west) side of the rail corridor.



Figure 8 Existing Bridge 150m south of Wungong Brook

3.6.5. Principal shared path

The Proposal incorporates a Principal Shared Path (PSP) constructed within the existing rail corridor. The PSP connects to the existing PSP network, providing pedestrians and cyclists through access between Armadale Station and Byford Station.

In certain environmentally sensitive areas, the PSP may also provide construction and on ongoing maintenance access to minimise the Proposal's impact.

3.6.6. Temporary construction areas

The Proposal includes temporary construction areas for site offices, crib rooms, welding of sections of rail, and temporary materials and equipment storage. These temporary construction areas will be preferentially located in areas of existing or planned future disturbance.

Construction activities that may occur within the temporary construction areas include:

- Temporary placement of construction materials (rail lengths, sleepers, pipes, stockpiles of materials such as ballast, kerbing, lighting infrastructure, fencing materials, signage, landscaping materials, drainage, etc.).
- Water storage dams, ponds, basins for storage of dewatering effluent, displaced water, stormwater runoff from hardstands and production water. Dams will allow evaporation and /or infiltration of water, unless water quality requires containment.
- Access tracks for machinery and plant to access construction areas and/or future railway reserve. Parking of vehicles and machinery.
- Storage of chemicals and dangerous goods in bunded, suitably sized areas.
- Storage and use of heavy equipment including: trucks, plant piling rigs, front end loaders, excavators, water trucks, graders and static and vibrating rollers, delivery trucks, concrete trucks and pumps, concrete vibrators, cranes and power generators.
- Storage and use of other equipment including portable toilets, site offices, sea containers, concrete wash down bunds and rubbish skip bins.
- Flash butt welding of lengths of rail trucked to the construction site to enable effective rail installation.

The Footprint incorporates a ballast siding on largely disturbed land between Byford and Mundijong.

The Footprint also incorporates construction areas at Wungong Brook, either side of the brook. Movement of heavy equipment across Wungong Brook will be prohibited during construction.

3.6.7. Stormwater drainage infrastructure

The Proposal includes permanent and temporary stormwater infrastructure for construction and ongoing operations. The drainage infrastructure will provide adequate stormwater storage and infiltration to cater for storm events and to prevent adverse impacts to proposed and existing infrastructure. The drainage design incorporates water-sensitive urban design (WSUD) elements and integrates with the existing drainage networks to prevent adverse impacts on infrastructure and environmental values.

3.6.8. Dewatering and groundwater abstraction requirements

The PTA will fully understand the Proposal's abstraction and dewatering requirements on completion of detailed designs.

Investigations conducted indicate:

- the depth to groundwater varies along the Development Envelope and is generally below the Proposal's planned excavation depths
- dewatering is unlikely to be required except potentially for the installation of pile caps at Wungong Brook
- Construction water abstraction (for compaction and dust suppression) is likely to be located at a Byford site and an Eleventh Rd site, however additional abstraction locations may be required.

The PTA or its contractors will obtain the appropriate licences under the *Rights in Water and Irrigation Act 1914* (RIWI Act) from the Department of Water and Environmental Regulation (DWER) for any required dewatering or groundwater abstraction. Appropriate mitigation strategies will also be applied.

3.6.9. Construction method

The contractor will construct the railway by opening multiple fronts to allow activities to occur simultaneously in the following sequence:

1. Remove vegetation and strip topsoil within the Footprint, stockpiling for later reuse in rehabilitation and landscaping, where practicable.
2. Conduct earthworks by excavating soil and rock in areas of 'cut' and placing excess soil in areas of 'fill'. This material is sloped to form stable batters, later stabilised with topsoil, mulch and plants or rock and/or concrete (if they are too steep or subject to erosion). The contractor constructs structures such as train stations, drainage basins, bridges, tunnels, access tracks during the earthworks stage. Underground services are installed and constructed pipework and other infrastructure are relocated as required.
3. Construct and install the railway including the formation (soil and ballast) and railway tracks and station infrastructure including interior construction and fit out. Install electricity, communications and other railway systems cabling. Commission and test of the railway to meet PTA's entry into service process.
4. Landscape including placement of topsoil and mulch and planting, often completed in parallel with the commissioning stage.

Particular features of the BRE construction are as follows.

Australind Rail Services

The TransWA twice-daily service between East Perth and Bunbury may continue during BRE project construction. Staged construction would allow the Australind service to continue by temporarily realigning the SW mainline:

- at the Church Avenue crossing along the western rail reserve boundary (and on the new PSP alignment)
- at Wungong Brook to provide sufficient space to construct the new bridges whilst maintaining Australind services.

The SW mainline realignment follows the future PSP alignment across Wungong Brook. The PSP bridge will support rail loads.

Relocating the SW mainline onto the future PSP alignment reduces net ground disturbance.

Environmentally Sensitive Design

The Proposal minimises environmental and heritage impacts by incorporating:

- A reduced Footprint near Lambert Lane (immediately north of Eleventh Road) reduced impacts to Threatened Ecological Community (TEC) SCP3a
- Culvert crossings (internal dimension between 300 mm and 1500 mm) at natural ground level to facilitate fauna movement between the east and west TEC areas
- Noise and vibration mitigation measures at certain locations
- 20.0m span rail and PSP bridges at Wungong Brook and associated riparian zone to minimise impacts to the Aboriginal Heritage site and Wungong Brook.

ATCO Gas Line

An ATCO gas main runs along the west side, and partly within, the rail corridor (under the proposed PSP) and on adjacent private land. The gas main will be protected or relocated below the proposed PSP alignment. This prevents trains running over an unprotected gas main during the temporary diversion of the SW Main to maintain Australind services. The Footprint makes provision for ground disturbance to either protect or relocate the gas main.

Bridges

The contractor will construct bridges by installing piers and then placing bridge beams or a deck on top. The deck will comprise one or more concrete slabs, typically poured offsite and craned into place.

During construction, laydown areas will be required adjacent to the rail alignment to construct bridge footings and to store bridge beams prior to assembly.

Piled foundations will support the bridge piers. Piling methods will consider noise and vibration impacts due to the proximity of adjacent noise sensitive receptors.

The contractor will transport off site most spoil generated by piling operations, with allowance for reuse if practicable.

Railway earthworks and infrastructure

The railway will be mostly at existing ground level or raised using imported fill with limited cut (excavation below the existing ground level) required to construct the railway.

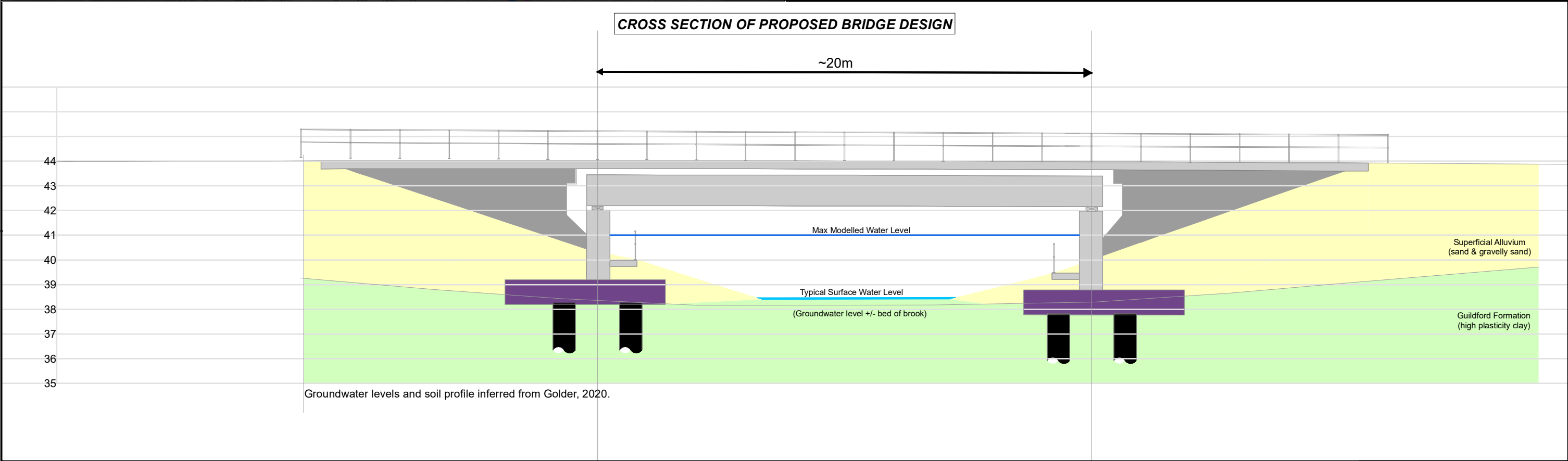
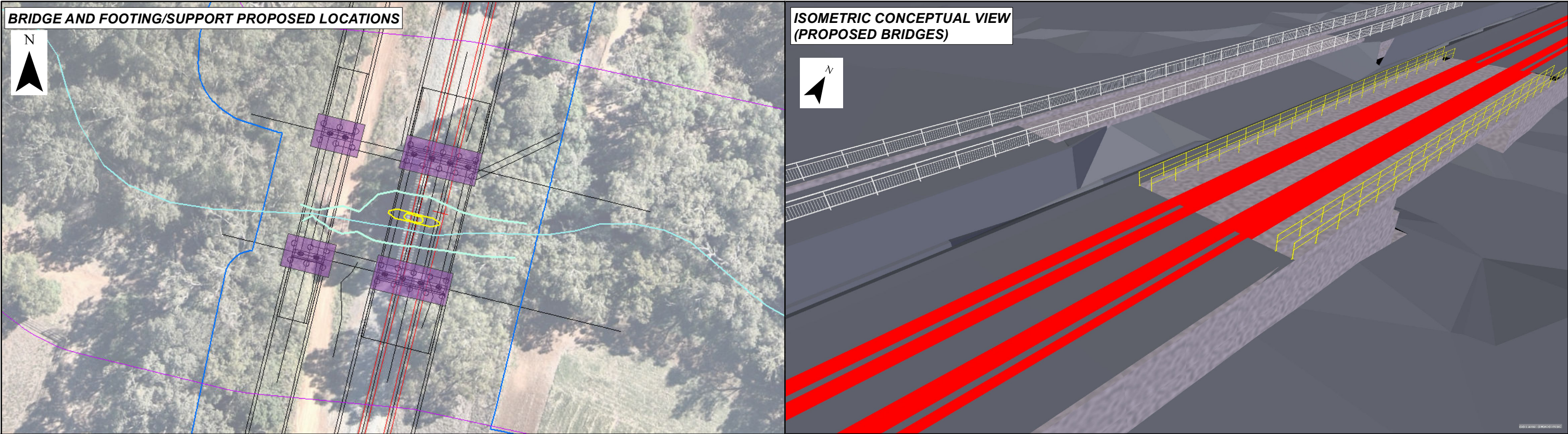
Fill will be predominately for:

- Church Avenue rail over bridge approach ramps.
- Eleventh Road over bridge approach ramps
- Wungong Brook rail bridges approach ramps
- Approach to Byford Station
- Byford Bus Interchange and car parks.

The extent of cut will be relatively minor after topsoil stripping and stockpiling. The contractor will balance cut to fill in localised areas, excavate some suitable fill material from drainage basins and source the remaining fill externally.

Temporary construction areas

Temporary construction areas are necessary during construction to accommodate the contractor's site offices and facilities, storage of materials, laydown areas for preassembly, pads for cranes, access to the linear site for vehicles and construction equipment, and other temporary works. Figure 9 shows temporary construction areas at Wungong Brook.



METRONET | Byford Rail Extension
Figure 9 | Proposed Bridge Structure At Wungong Brook

Legend

Footprint

Aboriginal Heritage Places

Bridge Pile Caps

Pile Foundations

Existing Support Pillar

Indicative Wungong Brook Centreline

Indicative Wungong Brook Bank

Conceptual Design Information (5/11/2020)

Proposed Infrastructure

Proposed Track Alignment

Date Printed: 14/04/2021
Created By: R.McGregor
Approved by: J.Stewart
File: PTA-GIS-BRE-0034-0007
Scale: Not To Scale @ A3
Coordinate System: GDA 1994 MGA Zone 50

Document Path: \\ptovpfsnm01\PLS_GIS\PROJECTS\02_ByfordRail\MAPS_001_200\PTA-GIS-BRE-0034-0007.mxd
Base Data: Nearmap 2019, Landgate 2019, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

4. Stakeholder engagement

4.1. Key stakeholders

The PTA is committed to engaging with stakeholders to ensure consideration of all stakeholders' views during Proposal development. The PTA has consulted about the broader METRONET portfolio of works and specifically about this Proposal with the following key stakeholders.

4.1.1. Commonwealth Government

- Department of Agriculture, Water and the Environment
- Department of Infrastructure, Transport, Cities and Regional Development
- Infrastructure Australia

4.1.2. State Government

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

4.1.3. Local Government

- City of Armadale
- Shire of Serpentine - Jarrahdale

4.1.4. Industry/utilities

- Australian Gas Infrastructure Group (AGIG)
- Dampier Bunbury Pipeline (owner of DBNGP)
- ATCO Gas
- NBN Co
- Optus
- Telstra
- Vocus Group Ltd

- Water Corporation
- Western Power

4.1.5. Other Stakeholders

- South West Aboriginal Land and Sea Council
- Whadjuk Working Party
- Gnaala Karla Booja Working Party
- METRONET Noongar Reference Group
- Conservation Council of Western Australia
- Urban Bushland Council
- Bushcare Environmental Working Group
- Landcare Serpentine-Jarrahdale
- Wildflower Society, Armadale Branch
- Friends of Fletcher Park
- Byford Environmental Group
- Australian Native Nursery
- South East Regional Central for Urban Landcare
- Wildlife Care Western Australia
- Perth Wildlife Rescue Network
- City Heritage Advisory Group
- Local schools
- Local businesses
- Local shopping centres
- Private landowners

4.2. Stakeholder engagement process

The PTA's aim for stakeholder engagement is to increase awareness of the Proposal and provide stakeholders with the opportunity to inform and influence the Proposal's design and management. Ongoing community and stakeholder engagement will occur throughout the Proposal's development so that views are considered and beneficial environmental, social and economic outcomes are achieved.

The PTA will use the knowledge, views and expertise of the community and stakeholders to guide positive environmental outcomes in decision-making. The METRONET website (www.metronet.wa.gov.au) provides a detailed overview of METRONET projects and allows interested stakeholders to inquire and register for project updates. A METRONET engagement hub on the My Say Transport website (<https://www.mysaytransport.wa.gov.au/metronet>) has allowed community input into the Proposal as opportunities arise.

A dedicated PTA communication and engagement team has consulted widely with stakeholders to inform the portfolio of METRONET projects. Key stakeholders were identified as part of the early planning phase of the Proposal (refer Section 4.1 Key stakeholders). A communication database developed by the team that records, informs and manages stakeholder risks and issues. This database documents stakeholder comments, responses or commitments made during the stakeholder engagement process for action by design and delivery teams. The Byford Rail Extension Communications and Stakeholder Engagement Plan was developed to guide community relations and engagement activities for the planning, design, procurement, construction and commissioning phases of the project (METRONET 2020). The objectives of the plan are to:

- Build support for the project by involving the community as early as possible, in the planning, design and delivery phases and communicating project milestones
- Communicate the project vision and benefits to allow for an increased understanding of the project benefits, rationale for key decisions and community opportunities and impacts
- Identify public perceptions of potential risks/impacts/issues associated with the project and use this information to inform project planning
- Establish opportunities for two-way feedback to engage community stakeholders and maximise project outcomes through obtaining local knowledge and expertise
- Provide regular information when and how stakeholders wish to receive it.

Stakeholder engagement has focused on communities located along the Proposal's alignment and in the surrounding area. Methods used to engage community members include door knocking, phone calls, briefings, meetings, community drop-in sessions, formal correspondence, media and digital communications, online information sessions, project surveys, workshops, small group presentations, coffee pop-up sessions and site visits to local areas of interest. Stakeholder relationships and support for the Proposal are dynamic and changeable throughout the term of the Proposal. For this reason, the communication activities, strategies and tools will be adapted as required. Table 10 provides an overview of the stakeholder engagement process, including project stages, strategies and communication tools. Some of the communication activities have been completed while others are proposed or ongoing.

Table 10 Overview of BRE stakeholder engagement process

Project Stage	Core Activities / Strategy	Communication Tools
Project announcement, planning and early design phase (August 2020 – mid-2021)	<ul style="list-style-type: none"> • Desktop research to tailor the community engagement and communication plans • Identify scope of works • Identify relevant stakeholders and issues • Identify project risks, issues and opportunities • Assess level of consultation required • Outline major consultation activities <p>Engagement will be the key focus during the planning and design phase.</p> <p>To involve stakeholders as much as possible during this phase, it is recommended the following occur:</p> <ul style="list-style-type: none"> • Briefing sessions (LGA elected members, executive team and key officers) to provide an overview, timing and identify stakeholder drivers 	<ul style="list-style-type: none"> • Media • METRONET website, project emails and social media • MySayTransport website • EPA website • Publications • Briefings • Images • Information sessions • Internal communications • Shire of Serpentine Jarrahdale channels • City of Armadale channels • Project signage at station location

Project Stage	Core Activities / Strategy	Communication Tools
Project approvals (August 2020 – mid-2021)	<ul style="list-style-type: none"> Information sessions to begin building relationships, establish stakeholder list, provide a project overview to the community, outline timing and begin to understand stakeholder drivers. Identify the interest in establishing a community reference group Meetings with major stakeholders to address any concerns/issues raised including operation of the railway Potential for neighbour's meeting if local residents are interested to work with the project team 	<ul style="list-style-type: none"> Media METRONET website, project emails and social media EPA website Publications Briefings Images / video Internal communications Shire of Serpentine Jarrahdale channels City of Armadale channels
	<ul style="list-style-type: none"> Manage project announcement/public exhibition/display/notification of environmental assessment where required Provide accurate and timely information on the project's objectives and rail crossing options Engage community and stakeholders Manage and document enquiries and concerns in a timely manner Consider and report feedback to the project team for design review, issues management, implementation of agreements/controls 	
Procurement and pre-construction (Mid-2021 – late 2021)	<ul style="list-style-type: none"> Build community understanding and acceptance of the project Provide accurate and timely information on the project's construction activities and impact mitigation Support community safety Manage site establishment and branding Meet PTAs customer service commitments <p>This phase will be managed collaboratively with the delivery agency.</p> <p>Communication and engagement requirements and actions for this and future phases will be further developed when a construction contractor is appointed and the methodology is secured.</p>	<ul style="list-style-type: none"> Media METRONET website, project emails and social media Animations Publications Briefings Images Information sessions Internal communications Community ref group Shire of Serpentine Jarrahdale channels City of Armadale channels
Construction (Late 2021 – late 2023)	<p>During construction, community engagement and progress updates will be managed in collaboration with the lead contractor and the PTA Project Communications Office.</p>	<ul style="list-style-type: none"> METRONET web, project emails and social media Publications PTA, METRONET, and Transperth internal channels Shire of Serpentine Jarrahdale and City of Armadale channels
Transition to operations	Collaborate with Transperth Train Operations on the transition to rail operations.	<ul style="list-style-type: none"> As above

4.3. Stakeholder consultation

The PTA has consulted with stakeholders to understand their views and inform them of environmental matters, the Proposal's impacts and intended management strategies. The PTA has developed a Proposal specific Stakeholder Consultation Register recording stakeholder engagement activities, timelines, outcomes and responses (refer Table 11).

The PTA established the Byford Rail Extension Environmental Stakeholder Reference Group (BREESRG) in August 2020. The objective of the BREESRG is to provide strategic advice, technical input, review the scopes of work for environmental studies and support the development of environmental approvals. The group consists of representatives from PTA, DWER, DBCA and local government who meet monthly to consult on environmental aspects of the Proposal. Technical officers from DWER's Kwinana-Peel regions and DBCA's Swan region and environmental officers from the City of Armadale and the Shire of Serpentine-Jarrahdale advise on technical matters and provide strategic advice on key environmental factors and investigations. The group also provides advice and recommendations on regulator expectations, design elements and environmental management. During these meetings, the PTA provides regular project environmental information, project updates and presentations to the group as new information becomes available. Further details regarding the BREESRG meetings are provided in Table 11.

In October 2020, the PTA engaged with local community groups who are interested in the Proposal. Information about the Proposal and environmental values potentially impacted were provided to members of the City of Armadale's Bushcare and Environmental Working Group (BEWG). The BEWG consists of nine "Friends of Groups" and four nature reserve representatives who have a keen interest in managing and protecting local environmental values within the City of Armadale (refer Table 11). Following this meeting, the City of Armadale and BEWG representatives recommended setting up a site visit.

In November 2020, BREESRG representatives and other interested parties including the DBCA Swan Region Botanist, environmental representatives from the City of Armadale, the PTA and local "Friends of Groups" visited Fletcher Park and Lambert Lane Nature Reserve. Meeting attendee's highlighted areas of environmental value including a Threatened Ecological Community, Threatened species and fauna habitat trees. BREESRG Representatives also pointed out degraded areas requiring environmental management to improve ecological condition.

In December 2020, the PTA met with representatives from the Shire of Serpentine-Jarrahdale and Landcare Serpentine-Jarrahdale, providing information on the Proposal and key environmental values within the Development Envelope. The presentation targeted environmental values of the local area. Attendees provided information drawing on local knowledge and on-ground management activities previously undertaken by members of Landcare Serpentine-Jarrahdale.

Early stakeholder consultation identified key issues with rail station locations (both underground and elevated stations as preferred options), connectivity and access across the rail corridor for all users (fauna, pedestrians and transport modes) and the need to offset significant, residual environmental impacts associated with the Proposal. Local governments and environmental groups highlighted the importance for local and on-ground management offsets. The Offsets chapter provides detailed information about stakeholder consultation that has informed PTA's offsets strategy.

The PTA will continue to engage with the community and local environmental groups as the Proposal is developed. Environmental information and Proposal updates will be given to these groups throughout the environmental assessment phase to address stakeholder concerns where possible. Details of the environmental assessment consultation undertaken and concerns raised will continue to be included in the Stakeholder Consultation Register (refer Table 11). The register has been maintained by the PTA since February 2019 to record all consultation including; dates, type, consultation summary and the outcome or PTA response. A summary of the consultation undertaken is provided in Table 11 below.

Table 11 Stakeholder Consultation Register

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
Early Project Planning				
METRONET Noongar Reference Group	February 2019 - ongoing	Meeting	Input and advice into the METRONET Gnarla Biddi Strategy engagement streams one and two. Input into Project Noongar Cultural Context Document.	Development of the Proposal's Noongar Cultural Context Document (NCCD) and Noongar advice and input into place making and design activities. METRONET Office will continue liaison throughout the Project in collaboration with the PTA.
City of Armadale (CoA)	May 2019	Meeting	CoA presented their business case for undergrounding Armadale Station.	The METRONET Office committed to incorporating the CoA business case into the Proposal assessment.
CoA	May 2019 - ongoing	Meeting	Local Government Reference Group established. City officers involved in options analysis workshops. Elected members briefed to provide progress updates on project.	The CoA supported a grade separated rail solution (initially an underground option and later an elevated rail option). The CoA did not support the potential closure of the Forrest Road level crossing, noting it will significantly impact business in the town centre. The METRONET Office will continue regular meetings and workshops with City officers to discuss planning matters, rail infrastructure and public realm opportunities.
Shire of Serpentine Jarrahdale (SoSJ)	June 2019 - ongoing	Meeting	Local Government Reference Group established. Shire officers involved in options analysis workshops. Elected members briefed to provide progress updates on project.	The SoSJ were positive of the project. SoSJ supported a vehicle and pedestrian crossing south of the new station to enhance connectivity between the two sides of Byford and to encourage access to the new town centre. Shire officers recommended access roads west of the rail to be included in the project. The METRONET Office will continue regular meetings and workshops with Shire officers to discuss planning matters, rail infrastructure and public realm opportunities.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
SoSJ, Main Roads Western Australia (MRWA), Development WA	September 2019	Workshop	Long list multi-criteria assessment workshop on Byford Station	The SoSJ are interested in the impact of the station precinct on the Byford station location. Shire officers noted the importance of Byford as a destination and not solely as an end of line station.
CoA, MRWA, Development WA	December 2019	Workshop	Long list multi-criteria assessment workshop on Armadale Station	The workshop included a detailed discussion on rail level crossings. The CoA advised they preferred underground rail. Issues raised included connectivity and traffic impact assessed with cost, operations and maintenance factors. The development potential with the CoA was discussed.
SoSJ	December 2019	Meeting	Meeting on precinct opportunities around station	The SSJ were supportive of the station location north of Abernathy Road. The Shire's preference was for an elevated station platform to enable connections and permeability across their town centre which is currently divided by the existing rail line.
CoA, SoSJ	February 2020	Meeting	Local Government Reference Group	Both the CoA and SoSJ were positive about the project and want to continue to be actively involved. Both councils noted their own planning to date, and there was considerable discussion and interest in the Infrastructure Australia process.
CoA, SoSJ	May 2020	Meeting	Local Government Reference Group	The CoA and SoSJ were advised that the project is being accelerated and that at-grade stations at both Armadale and Byford are the preferred options to be progressed. The CoA advised the at-grade station outcome was unfavourable. The SoSJ also preferred an elevated rail station solution but remained positive the project is moving ahead.
SoSJ	June 2020	Workshop	Workshop to discuss the wider Byford Station precinct.	The SoSJ's high level design and precinct layout preferences were presented to the METRONET Office.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
DWER, EPA Services	June 2020	Meeting	Initial discussion introducing the Proposal. Presentation on known environmental values, proposed studies and project timeline.	The PTA would arrange a site visit with EPA services to identify the key environmental values within and adjacent to the Proposal. The PTA will continue liaison throughout the Project.
SoSJ	July 2020	Briefing	Project briefing to the Shire's elected members.	The METRONET Office provided an overview of the preferred option, planning to date and next steps to be completed.
DBCA	July 2020	Meeting	Initial discussion introducing the Proposal. Presentation on known environmental values, proposed studies and project timeline.	The PTA will continue liaison throughout the Project. DBCA to provide any available data for nearby DBCA managed land.
Department of Agriculture, Water and the Environment (DAWE)	July 2020	Meeting	Initial discussion introducing the Proposal. Presentation on known environmental values, matters of national environmental significance, proposed studies and project timeline.	The PTA will continue liaison throughout the Project.
DBCA	30 July 2020 - ongoing	Meeting and email	Initial discussion on potential offset sites containing the Threatened Ecological Community (known as floristic community type 3a) (FCT 3).	The PTA reviewed the potential offset sites provided by the DBCA. The PTA will continue discussions with the DBCA on potential offset sites needed for the Proposal.
Development WA	August 2020 - ongoing	Meeting	Local Government Reference Group established. Briefings and design presentations on Armadale Station and surrounding precinct.	Development WA have no major concerns with the Proposal.
Department of Transport (DoT)	August 2020	Meeting	Project update and consultation on Principal Shared Path (PSP) guidelines.	Discussions on the requirements of the DoT policy of grade separating the PSP when the road and rail is separated.
Byford Rail Extension Environmental Stakeholder	5 August 2020	Meeting	Initial meeting of the group. Introductions, objective, project overview, development envelope, environmental factors and studies,	The PTA will continue liaison throughout the development of the proposal to seek input, comments and feedback on environmental matters from stakeholder reference group members.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
Reference Group (BRE ESG)			approvals schedule, community and environmental stakeholders and draft terms of reference.	
Department of Planning, Lands and Heritage (DPLH)	13 August 2020	Meeting and email	Initial discussion regarding the availability of a potential offset for use by the PTA for the Proposal.	The DPLH advised that the site was available and may be allocated to the PTA/METRONET if required. The PTA will continue to liaise with the DPLH as the offset strategy is developed.
Post Project Announcement				
Community / Residents	September 2020	Information Sessions	Project announcement communications and engagement	Following the Minister's media announcement of the Proposal on 24 August 2020, planned public communications will include media and digital communications, a letter box drop, community survey, shopping centre displays, online information session and face-to-face drop-in sessions.
CoA, SoSJ	Ongoing	Briefing	Project updates	Ongoing briefings throughout project definition phase.
Local Businesses	September 2020	Workshop	Briefing/workshop with local business potentially impacted by road layout changes.	Following the Transport Minister's media announcement of the preferred options for the Proposal.
Whadjuk Native Title Group Representatives, Gnaala Karla Booja Native Title Group Representatives and DPLH Registered Knowledge Holders	15 and 16 September 2020 and 7 October 2020	Survey	An Aboriginal consultation and heritage survey was completed by a heritage consultant with representatives from the Whadjuk and Gnaala Karla Booja Native Title Groups and (DPLH) Registered Knowledge Holders.	The group representatives visited the Proposal site and traversed the alignment and key areas of the Proposal. The three Aboriginal heritage groups were supportive of the Proposal. The group representatives recommended the PTA submit an application to disturb a registered heritage site (Site No. 3512 Wungong Brook) under Section 18 of the <i>Aboriginal Heritage Act 1972</i> . The group representatives approved the proposed works and would support the grant of a Section 18 application subject to heritage monitoring. The heritage consultant recommended that Aboriginal heritage monitors were on site when ground disturbing

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
				works are undertaken at Wungong Brook, Byford Station and within a 20 metre radius of a former Aboriginal burial site in Armadale.
LGA, DWER, DBCA	September 2020 - ongoing	Meeting	Follow up meeting with environmental, planning and technical officers to discussions regarding the environmental studies being undertaken and potential offset options.	Ongoing consultation throughout environmental assessment period conducted through BRE ERSG.
Marri Grove Primary School	September - December 2020	Meeting	Two meetings held with the school principle and corporate services manager to discuss the Proposal.	The school are opposed to the closure of Larsen Road level crossing. The school expressed concerns regarding the level crossing closure and the potential for a reduction of students and subsequent loss of staff members.
Armadale Senior High School	September - December 2020	Meeting	Meeting held with the school principle and corporate services manager.	The school discussed the impact to Hobbs Drive during construction and advised Hobbs Drive is a busy road for school drop-offs and pick-ups for both cars and buses.
BRE ERSG	24 September 2020	Meeting	Information regarding local environmental groups provided, Draft Terms of reference, Detailed project overview presentation by BRE Project Coordinator, overview of land access requirements, overview of flora and vegetation and fauna surveys, update on surveys completed and update on environmental approvals schedule, project Q&A session.	Consideration for fauna movement needed. Future horse movement/trails. Information regarding Infrastructure Sustainability Council of Australia (ISCA) and Water Sensitive Urban Design (WSUD) initiatives relevant to the BRE to be provided to the group. Offsets would be needed to offset significant, residual environmental impacts. CoA and SoSJ indicated there is the potential for offset sites (specifically TEC SCP3a) within their respective local government areas.
Department of Fire and Emergency Services (DFES)	October - November 2020	Meeting	Project briefing with a focus on Armadale Station and level crossings.	The DFES have no major concerns with the Proposal.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
EPA Services and EPA Board Members	1 October 2020	Site Visit	Information regarding the Proposal was provided to board members and feedback sought on environmental factors and management.	The Board advised that on-ground revegetation will be needed to offset significant residual environmental impacts. Consultation with Aboriginal heritage groups should also continue and advice from traditional owners should be considered when developing the Proposal. The Board made special mention that Aboriginal heritage requirements should be considered in relation to construction activities in and near Wungong Brook. The Board did not identify any significant environmental issues during the site visit and noted that the Proposal impacts could be managed.
Bushcare and Environmental Working Group (BEWG) Group consists of representatives from Armadale Gosnells Landcare Group, Armadale Settlers Common Working Group, Bungendore Park Environmental Working Group, Environment Centre Working Group, Friends of Forrestdale, Friends of Goolamrup Reserve, Friends of	14 October 2020	Presentation	Introduction to Proposal, key environmental values located within the development envelope, Lambert Lane Nature Reserve, Fletcher Park and Wungong Brook, Threatened Ecological Community, Black Cockatoo Habitat, quenda and regionally significant wetlands. Summary of environmental and heritage surveys to date, approvals strategy and application of mitigation hierarchy.	Concerns regarding biodiversity offsets and the need for local offsets and on-ground revegetation. PTA to continue collaborating with stakeholders once significant, residual impacts are known.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
Lloyd Hughes, Roleybushcare, Wildflower Society (Armadale Branch) and reserve custodians from; Creyk Park, Alice, Gilcoe and Shepherd Reserves.				
BRE ESG	29 October 2020	Meeting	Review of scope of works undertaken for flora and vegetation and fauna. Overview of BRE sustainability initiatives. Discussion on wetland assessment and new DBCA geomorphic wetland mapping dataset.	No gaps or technical omissions with flora and vegetation and fauna scope of works. Concern from LGA regarding fauna movement and access across the rail corridor from semi-rural areas for pedestrians, fauna and horses. PTA confirmed that safety requirements would need to be adhered when installing fencing. Kangaroo gates within the rail fencing were not acceptable due to safety issues. Stakeholders questioned if there were opportunities to change the concept design and whether minor changes would be included including to Water Sensitive Urban Design (WSUD). PTA advised the Proposal was at the concept design phase and detailed planning will include stakeholders and consideration for connectivity to waterways, nature, enhancement of environmental values and social connectivity. Further information would be provided to DWER regarding WSUD.
DBCA	20 November 2020	Meeting	Meeting to discuss proposed offsets and future management.	DBCA advised PTA that an on-ground management and a revegetation offset at Lambert Lane would be supported by DBCA. DBCA advised PTA that an on-ground management and revegetation offset at Fletcher Park would be supported by DBCA. DBCA ran

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
				through/discussed further sites containing FCT SCP 3a that may be considered as offset options. The DBCA would provide the PTA with a list of DBCA preferred potential offset sites, along with indicative management actions and associated costs.
BRE ESG	25 November 2020	Meeting	Review of Proposal scope of works; including wetlands assessment, Carter's Freshwater Mussel and Hydrological studies.	Feedback and questions were discussed on all three scope of works. There were some queries regarding Aboriginal heritage studies and heritage management. Further Aboriginal heritage information would be provided by the PTA to the group.
Environmental Groups	25 November 2020	Site Visit	Site visit to Fletcher Park, Lambert Lane Nature Reserve with three environmental groups, DBCA and PTA.	Questions on potential on-ground offsets.
Larsen Road Childcare Centres (Three Centres)	December 2020	Meeting	Project briefings were undertaken with each childcare centre advising on the possibility that the Larsen Road level crossing will close.	The three childcare centres had no major concerns with the Proposal.
Environmental Groups	2 December 2020	Presentation	Introduce the BRE project to Landcare SJ (Friends of Group).	Project questions. Need for local offsets. On-ground offsets preferred.
City of Armadale	2 December 2020	Meeting	Discussed the use of Fletcher Park and indicative areas as an offset for FCT SCP 3a. Discussed any other potential offset sites containing TEC 3a within the City.	PTA to provide the City with updated information from surveys for Fletcher Park including vegetation, weeds and dieback mapping. City officers advised there are no known examples of the TEC 3a within the City's boundaries. The CoA would provide the PTA with a potential offset site to investigate.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
SoSJ	8 December 2020	Meeting	Discussed the use of Brickwood Reserve as an offset and potential management actions. SoSJ provided a summary of numerous sites that contained TEC 3a or may have unverified instances of TEC 3a.	SoSJ to provide PTA with a list of potential offset sites. The PTA to complete a desktop review of potential offset sites.
DBCA	11 December 2020	Phone call	The PTA and DBCA continued to discuss progress regarding the list of potential sites and removing sites previously discussed.	DBCA to provide PTA with a list of DBCA preferred potential offset sites in priority order, along with indicative management actions and associated costs by late December.
Gnaala Karla Booja Native Title Group Representatives	15 and 16 December 2020	Survey	Two Aboriginal heritage representatives from the Gnaala Karla Booja Native Title Group were tasked with monitoring the geotechnical works near the proposed Byford Station site. The monitoring exercise was coordinated by an Aboriginal Heritage specialist under the supervision of an Aboriginal Liaison Officer.	No Aboriginal cultural materials or skeletal material were uncovered in the course of the works. The Gnaala Karla Booja representatives were satisfied that heritage monitoring was carried out adequately. The group representatives thanked the PTA for the opportunity to participate in the heritage monitoring task.
Urban Bushland Council (UBC)	23 December 2020	Phone call and email	Contact made with the UBC to provide information on the Proposal and seek their input, feedback and concerns associated with the Proposal. An offer was made to meet with representatives from the UBC to discuss and deliver a presentation on the Proposal.	The PTA provided the Section 38 BRE Referral Document to the UBC which would be distributed to the committee members for their review. PTA would follow up with UBC in mid-January 2021.
Armada Shopping Centres (Two Centres)	January 2021	Meeting	Project briefings were undertaken with each shopping centre.	Concerns were raised over the closure of the Forrest Road level crossing, noting it will significantly impact business (especially small business) in the shopping centres.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
Conservation Council of WA (CCWA)	8 January 2021	Phone call and email	Contact was made with the CCWA to provide information on the Proposal and to seek their input, feedback and concerns associated with the Proposal.	An offer was made to meet with representatives from the CCWA to discuss and deliver a presentation on the Proposal. The PTA provided the Section 38 Referral Document to the UBC which would be distributed to the committee members for their review. PTA would follow up with CCWA in late January 2021. The PTA asked whether the CCWA would like to receive further information on the Proposal. No response was received.
UBC	18 January 2021 and 11 February 2021	Phone call and email	Follow up call to confirm whether or not the UBC had input or feedback on the Proposal.	The UBC requested that the referral documents be resent. Further contact was made with the UBC via email on 11 February 2021 to request input on the Proposal. The PTA re-submitted the referral documents to the UBC. The UBC advised they were concerned with native vegetation clearing in the south west region of WA as well as landscape connectivity. The UBC asked if the Wildflower Society (Armadale Branch) had been consulted as the Branch had a lot of expertise in the area. PTA advised the Wildflower Society (Armadale Branch) were consulted through the BEWG. PTA would follow up with the UBC on 3 February 2021 to seek their input. The PTA requested comments and input by close of business 3 March 2021 so that comments may be addressed in the Environmental Review Document. No response was received.

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
CCWA	19 January 2021 and 11 February 2021	Phone call and email	Follow up call to confirm whether or not the CCWA had input or feedback on the Proposal.	The CCWA advised they would review the BRE Referral Documents and respond to the PTA. Further contact was made with the CCWA via email on 11 February 2021 to request input on the Proposal. The PTA requested comments and input by close of business 3 March 2021 so that comments may be addressed in the Environmental Review Document. No response was received.
BRE ESG	28 January 2021	Meeting	PTA provided an update on the status of the environmental approvals, biological surveys completed, overview of community engagement, sustainability, lifecycle and materiality assessment undertaken for the Proposal.	A query was raised regarding whether direct (face-to-face) stakeholder engagement will be undertaken with the CoA. The PTA will engage with the CoA in the near future. The importance of community interest in environmental matters was discussed. The PTA advised that environmental issues or concerns raised by the group are recorded in the project consultation register and project requirements and analysis matrix which are addressed through to project delivery. PTA discussed future opportunities to meet with environmental groups.
Heritage Advisory Group (CoA)	11 February 2021	Phone call	The CoA was contacted regarding European heritage sites located near the Proposal.	No concerns were raised with CoA European heritage sites listed in the Municipal Register that are located near the Proposal location. Two former CoA listed European heritage sites are located near the Forrest Rd level crossing (Fire and Rescue Services and the Armadale RSL Sub-Station) were discussed. Another site, known as Dale Cottages (listed CoA Heritage Site) was also discussed. The CoA noted these sites should be considered as part of rail construction activities near level crossings. The PTA provided information to the CoA regarding the sites, including consideration of potential impacts and management to these sites. The PTA advised that pre and post dilapidation surveys would be undertaken by the

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
City of Armadale	11 February 2021	Phone call	The PTA contacted the CoA to discuss possible offset options in Fletcher Park.	<p>Construction Contractor to manage potential vibration impacts.</p> <p>Discussions on a potential offset site in the CoA for black cockatoo foraging. The City officer advised the PTA that the community felt very strongly about the need for a local offset. The CoA acknowledge that the PTA may not be able to locate an offset with the required environmental values needed within the local government boundary. The CoA would provide comments and possible management actions to the PTA for consideration.</p>
Heritage Advisory Group (CoA)	16 February 2021	Phone call	Provided an update to the CoA regarding heritage, historical and community sites of importance located near the Development Envelope.	<p>The PTA advised that contract requirements would require the construction contractor to undertake dilapidation surveys pre- and post-construction for properties of European heritage, historical and community importance located near construction areas. The construction contractor shall also develop and implement a Construction Noise and Vibration Management Plan (CNVMP) to address noise and vibration issues from the construction process, including any potential impacts to heritage, historical and community sites of importance, including but not limited to the Armadale Fire and Rescue Service, Armadale RSL Sub branch and Dale Cottages.</p>
DAWE, EPA Services	25 February 2021	Meeting	Presentation by the PTA to discuss offset options for the Proposal.	<p>The DAWE advised that land acquisition and management was the preferred offset method. If this is not possible, the DAWE would consider alternative offset options. The DWER advised that offsets should be measureable and reportable showing an outcome and improvements in ecological health.</p>

Stakeholder	Date of Contact	Engagement	Summary	Issue/Outcome/Proponent Response
BRE ESG	4 March 2021	Meeting	Presentation by the PTA to discuss offset options for the Proposal and seek input and feedback on the proposed options.	The group were supportive of the approach taken and offset options proposed by the PTA. A Draft Offsets Strategy would be developed by the PTA for inclusion in the Environmental Review Document. The group thanked the PTA for the offset consultation undertaken to date.

5. Environmental principles and factors

5.1. Environmental Principles

The PTA has considered each of the principles of environmental management in Section 4A of the EP Act while planning the Byford Rail Extension.

5.1.1. The precautionary principle

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In this application of the precautionary principle, decisions should be guided by:

- 1. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and*
- 2. an assessment of the risk-weighted consequences of various options.*

The PTA has ensured that the design of the Proposal, minimises significant residual impacts. PTA has modified the Development Envelope and Footprint to avoid and then to minimise environmental impacts, wherever practicable to do so. As a result of these efforts, no threats of serious or irreversible impacts to the environment remain.

An example of this avoidance is the use of an existing rail alignment, which currently supports the Australind service. This minimises the overall extent of clearing of native vegetation that is required.

PTA undertook extensive options analysis (AECOM 2020) prior to selecting the current alignment as the preferred option. The Multi Criteria Analysis process, which including consideration of environmental values and impacts, considered options ranging from 'do nothing', multi modal and rapid bus transit to the preferred alignment. Further detail relating to the criteria and range of options considered is provided in The Proposal.

PTA has undertaken a range of environmental studies over several years, which provides a high level of scientific certainty regarding the environmental values and the likely impacts associated with the proposal. These studies have focused on a range of environmental factors:

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

The extent of studies undertaken within the Development Envelope and surrounding areas ensures a high level of scientific certainty. Each chapter details the potential environmental impacts, with irreversible impacts identified.

Suitable environmental offsets have been proposed for significant residual impacts, described in the Offsets chapter. The PTA has undertaken consultation with relevant government agencies, including DWER and DBCA, to minimise any uncertainty surrounding any environmental impacts of the Proposal. These discussions have been summarised in the **Stakeholder engagement** chapter, above. Notably, site visits with representatives from DBCA have confirmed the extent of TEC within the Development Envelope.

5.1.2. The principle of intergenerational equality

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The PTA appreciates the importance of sustainable development and maintaining the health, productivity and diversity of the environment for future generations, while meeting the needs of current generations.

Infrastructure Australia has recognised the low density in Perth's south-eastern corridor as contributing to high car dependency. A Project Sustainability Report commissioned by PTA has identified several key sustainability opportunities that can be integrated into the project (WSP 2021b). By better integrating transport and long-term land use planning, the Proposal will encourage more sustainable development and intensify development near activity centres and railway stations through this area, benefiting current and future residents.

At a local scale, the Proposal will result in longer term, higher density urban development around station precincts, making more sustainable and active forms of travel such as walking and cycling more attractive. The implementation of a travel behaviour change program and the provision of feeder bus services to growth areas will reduce reliance on cars and other road transport. This will ultimately lead to lower air pollution emissions (as demonstrated in the Greenhouse Gas assessment under **Other environmental factors**) and less traffic congestion in the local area. On a larger scale, a shift towards the use of mass transit that is facilitated by this Proposal will lead to lower emissions of air pollutants, reduced greenhouse gas emissions and less traffic congestion generally (WSP 2021b). The Proposal will therefore also serve to enhance the health of the environment for future generations.

The information contained in this ERD demonstrates that the Proposal can be implemented to deliver improvements in the health, diversity and productivity of the environment for the benefit of future generations.

5.1.3. The principle of the conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

The PTA has designed the Proposal to make use of previously disturbed land, while avoiding areas of high biological diversity and conserving ecological integrity as much as practicable. The Development Envelope has been modified iteratively in line with an increased understanding of environmental values over time, and where avoidance has not been possible, the extent of the impact has been minimised, as demonstrated in **Figure 7** in **Proposal description**.

The PTA has sourced or undertaken environmental studies relevant to the project area to gain a detailed understanding of the environmental values of the area. These studies have considered the presence of Threatened and Priority flora, fauna and ecological communities, and have described the processes influencing inland waters.

The PTA acknowledges that there are unavoidable impacts on Threatened Ecological Community 3a. Through design modifications, realignment and adjustments to construction methodology, the disturbance through areas of TEC has been minimised as much as practicable, as discussed in section 6.7 - Flora and vegetation Mitigation. Offsets are proposed to compensate for significant residual impacts.

As a result of using existing cleared areas wherever practicable, the Proposal will not substantially reduce the extent of any ecological community, vegetation type or protected species' habitat. PTA acknowledges that the proposal will result in the loss of 2.83 ha of the TEC *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (FCT3a), which will be compensated for in the Offsets package described below. The Proposal will therefore ensure that biological diversity and ecological integrity is conserved

5.1.4. Principles in relation to improved valuation, pricing and incentive mechanisms

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 cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes.

Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.

The PTA acknowledges that environmental factors hold intrinsic value that must be considered during the development of the Proposal.

The PTA recognises that costs will be incurred as a result of environmental activities associated with the Proposal, such as impact avoidance and mitigation, management, monitoring and maintenance, as well as contributions to offsets. In particular, the process of design must weigh the cost and benefit of the proposed alignment in relation to environmental values. An example of this is the decision to redesign the crossing at Eleventh Road as a Road over Rail option and commitment to using retaining walls, which significantly reduces the overall impact of the Proposal on TEC 3a. The cost of constructing retaining walls to reduce the width of the project footprint is justified when weighed against the environmental values of the TEC.

These various costs have been incorporated into the cost benefit analysis of the Proposal.

Environmental costs have been accounted for across the entire lifecycle of the BRE Project, including the operational phase. The PTA will be responsible for funding the Proposal's costs of environmental avoidance, mitigation, management and offsets throughout the complete lifecycle of the BRE Project. All known potential environmental costs related to the Proposal have been considered during the assessment process. This has provided a realistic estimate of initial and ongoing expenditure related to the service, including aspects such as the disposal of waste.

5.1.5. The principle of waste minimisation

All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.

In planning the Proposal, the PTA has been considerate of the principle of waste minimisation, including the destination and use of removed materials.

The PTA will ensure plans are in place to require contractors to take all reasonable and practicable measures to reduce waste generation and dispose of construction wastes appropriately. In general, waste will be minimised during construction by adopting the hierarchy of waste controls: avoid, minimise, reuse, recycle and safe disposal.

The majority of the BRE alignment is proposed to be constructed on fill, which will reduce the overall volume of waste material generated by the proposal. Where excavation is required, the PTA's objective is to reuse suitable fill within the Development Envelope wherever practicable, minimising the creation of waste.

Waste management costs, in both construction and operational phases, have also been accounted for within the Proposal, with a waste minimisation strategy adopted. Materials such as soil for fill will be reused within the BRE where practicable, with appropriate disposal of materials that cannot be reused.

The Proposal is expected to generate waste during the construction and operation phases, despite the application of the waste hierarchy. Strategies for the minimisation and management of these waste products are outlined in **Other environmental factors** as part of a waste minimisation strategy. The PTA anticipates that the measures detailed in this waste minimisation strategy will be adequate to ensure that the disposal and management of wastes do not adversely affect health, amenity or environmental values.

5.2. Other environmental factors

The PTA has commissioned several desktop investigations during the planning stage for the Byford Rail Extension. PTA used the results of these investigations to inform the Referral supporting document submitted to EPA in September 2020 and to determine the key environmental factors relevant to the Proposal.

As a result of these studies, the PTA determined that a number of the EPA's environmental factors were not relevant to the Proposal and were therefore excluded from further consideration. In accordance with the Statement of Environmental Principles, Factors and Objectives (EPA 2020c), the relevant preliminary key environmental factors for the Byford Rail Extension identified by the EPA are:

- Flora and Vegetation
- Terrestrial Fauna
- Inland Waters
- Social Surroundings.

These factors are discussed in detail in the following chapters. Other factors not considered relevant to this proposal are discussed below.

5.2.1. Landforms

The EPA's objective for Landforms is to maintain the variety and integrity of significant physical landforms so that environmental values are protected.

The landforms within the Development Envelope are not considered to be significant, as defined in the Environmental Factor Guideline Landforms (EPA 2018). The nearest landform of note is the Darling Scarp to the east of the Proposal. The Proposal will not impact this landform.

5.2.2. Subterranean Fauna

The EPA's objective for Subterranean fauna is to protect subterranean fauna so that biological diversity and ecological integrity are maintained.

Invertebrate Solutions (2020) undertook a desktop assessment of the likelihood for subterranean fauna to exist within the Development Envelope or to be impacted by the Proposal. The desktop assessment determined that no subterranean fauna species listed under the *Biodiversity Conservation Act 2016 or the EPBC Act* are likely to occur or have known habitat within the Development Envelope. Invertebrate Solutions (2020) found that the Proposal is situated within the Guildford Formation, which is comprised predominantly of clay units of the Swan Coastal Plain. These clay units provide no habitat for subterranean fauna. Invertebrate Solutions (2020) also found that the Development Envelope contains no Threatened or Priority Ecological Communities that relate to subterranean fauna.

5.2.3. Terrestrial Environmental Quality

The EPA's objective for Terrestrial Environmental Quality is to maintain the quality of land and soils so that environmental values are protected.

Golder (2020c) undertook a Preliminary Site Investigation (PSI) within the Development Envelope to characterise the site and provide recommendations for further action. The investigation identified three sites as possibly contaminated and one site awaiting classification. Several sites that are either Remediated for Restricted Use or Decontaminated are located between 100 and 500 m from the Development Envelope. Golder (2020c) inferred all of these sites to be hydraulically down gradient of the Development Envelope.

Golder (2020c) notes that firefighting foam is likely to have been discharged to ground at Armadale Career and Volunteer Fire Station (438 Green Avenue), where there is also evidence of hydrocarbon storage, and that the site is registered as possibly contaminated, further investigation required. Although this site is situated entirely within the Development Envelope, the site is outside of the Footprint and PTA is unlikely to undertake ground excavations adjacent to the site. PTA's ground disturbance procedures will ensure that any excavations within proximity to the site will include requirements to undertake soil and groundwater testing, with appropriate management measures applied if disturbance of contaminated material is required. Appropriate measures will include undertaking laboratory analysis of soil and water samples, determining levels of contaminants of potential concern and developing a remediation and action plan that meets the requirements of DWER for managing contaminated materials under the Contaminated Sites Act 2003.

Golder (2020c) identified a scrap metal yard at 26 Keates Road, Armadale, adjacent to the eastern edge of the Development Envelope. The Department of Environmental Regulation found it to have elevated levels of heavy metals in the soil. Golder (2020c) records the site as Possibly contaminated - further investigation required. PTA does not propose to undertake any works within the boundary of this site and is therefore unlikely to impact any contaminated ground at the site. No excavation is likely to be required for rail works within this section of the Proposal and therefore there is a very low risk that construction activities will encounter contaminated soil or groundwater.

There is a site at 24 Stone Street, Wungong about 80 m from the edge of the Development Envelope that is registered as Possibly contaminated - investigation required. The Footprint extends to within 120 m of its boundary to allow site access and any associated peripheral road improvements to occur. It is unlikely that the site will be disturbed in any way and is therefore not considered likely to be affected by this proposal.

A site at 245 South Western Highway is noted by Golder (2020c) is awaiting classification. The site contains underground storage tanks, with no further information currently available. PTA has aligned the Footprint to avoid the property and it is unlikely that any excavations will occur adjacent to the site for rail works.

PTA considers the Proposal is unlikely to directly disturb any contaminated sites or undertake any excavations or dewatering adjacent to potential or known sites. The PTA therefore considers that Terrestrial Environmental Quality is not a significant Factor.

5.2.4. Air Quality

The EPA's objective for Air Quality is to maintain air quality and minimise emissions so that environmental values are protected.

At a local scale, the Proposal will result in improved air quality due to the reduction in private vehicle use as people use the new railway. It will also result in a reduction in greenhouse gas emissions as the electrically powered trains generate fewer tonnes of carbon dioxide equivalent per passenger kilometre than cars or buses. It is acknowledged that the electricity powering the trains is provided by the South West Integrated Network which is currently dominated by electricity generated by fossil fuel powered plants, however as the proportion of renewable energy generation increases, the tonnes of carbon dioxide equivalent per passenger kilometre travelled by rail will decrease.

The PTA anticipates that the project will result in an overall improvement in local air quality and a reduction in greenhouse gas emissions compared with a 'do nothing approach'.

6. Flora and vegetation

6.1. Introduction

The EP Act defines native vegetation as indigenous aquatic or terrestrial vegetation. For the purposes of environmental impact assessment (EIA), flora is defined as native vascular plants and vegetation is defined as groupings of different flora patterned across the landscape that occur in response to environmental conditions (EPA 2016a).

Vegetation is an important functional component, and often the defining feature, of terrestrial ecosystems. Flora and vegetation may also hold spiritual, cultural, and/or economic values. The EPA recognises that there are inherent links between Flora and Vegetation and other environmental factors (EPA 2016a).

This chapter describes how the Proposal may impact values of the factor, Flora and Vegetation. The assessment addresses the construction and operational activities that could either directly or indirectly impact Flora and Vegetation.

The PTA has proposed mitigation measures where the Proposal was found to impact on Flora and Vegetation values.

The assessment identifies significant residual impacts to Flora and Vegetation resulting from the Proposal including the permanent loss of *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (SCP 3a) TEC, vegetation associated with Bush Forever sites nos. 264, 266 and 350, and vegetation associated with Conservation Category wetlands.

The PTA has proposed an Offsets Strategy to counterbalance the Proposal's significant residual impacts on Flora and Vegetation.

6.2. EPA objective

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

6.3. Policy and guidance

6.3.1. EPA policy and guidance

- Environmental Factor Guideline: Flora and Vegetation (EPA 2016a).
- Environmental Protection Bulletin 20 – Protection of naturally vegetated areas through planning and development (EPA 2013).
- Guidance Statement 6 – Rehabilitation of Terrestrial Ecosystems (EPA 2006). Instructions: IBSA Data Packages (EPA 2020a).
- Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016d).

6.3.2. Other policy and guidance

- Advice on the presence of hybrids in listed ecological communities (TSSC 2011).
- Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016).
- Approved Conservation Advice for Clay Pans of the Swan Coastal Plain (DSEWPaC 2012a).
- Approved Conservation Advice for *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (DotEE 2017a).
- Approved Conservation Advice for *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (DotEE 2017b).
- Approved Conservation Advice for *Tetraria australiensis* (Southern Tetraria) (DEWHA 2008c).
- Approved Conservation Advice for *Diuris purdiei* (Purdie's Donkey-orchid) (DEWHA 2008a).
- Approved Conservation Advice for *Drakaea micrantha* (Dwarf Hammer-orchid) (DEWHA 2008b).
- Conservation Advice *Synaphea* sp. Pinjarra Plain (A.S. George 17182) (TSSC 2018b).
- Conservation Advice *Synaphea* sp. Serpentine (G.R. Brand 103) (TSSC 2018c).
- Commonwealth Listing Advice on Claypans of the Swan Coastal Plain (TSSC 2012).
- *Corymbia calophylla* - *Kingia australis* woodlands on heavy soil (Swan Coastal Plain Community type 3a - Gibson et al. 1994), Interim Recovery Plan 2011-2016 (DEC 2011).
- *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands (Swan Coastal Plain Community type 3c -Gibson et al. 1994), Interim Recovery Plan 2000-2003 (English & Blyth 2000).
- *Eucalyptus balanites* Interim Recovery Plan 2004-2009 (DEC 2004).
- Environmental Management Plan Guidelines (DotE 2014).
- EPBC Act Environmental Offsets Policy (DSEWPaC 2012b).
- How to use the Offsets Assessment Guide (DSEWPaC 2012d).
- National Recovery Plan for the Clay pans of the Swan Coastal Plain Ecological Community (DBCA 2019). Phytophthora Dieback Interpreter's Manual for lands managed by the Department, Forest and Ecosystems Management (DBCA 2020).
- Significant Impact Guidelines 1.1 – Matters of National Environmental Significance, Commonwealth of Australia (DotE 2013).
- Survey guidelines for Australia's threatened orchids: Guidelines for detecting orchids listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999 (DotE 2013).
- *Synaphea* sp. Serpentine (G.R. Brand 103), Interim Recovery Plan 2017-2022 (DPaW 2017).
- Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DotEE 2018).
- Western Australian Environmental Offsets Policy (GoWA 2011).
- Western Australian Environmental Offsets Guidelines (GoWA 2014).
- Western Australian Environmental Offsets Template (EPA 2014).

6.4. Receiving Environment

6.4.1. Surveys and studies

The PTA commissioned a number of project specific studies to gain an understanding of the flora and vegetation within and surrounding the Proposal including:

- two detailed flora and vegetation assessments conforming with EPA Technical Guidance for Flora and Vegetation Surveys (EPA 2016d) and
- targeted flora surveys informed by applicable survey guidelines and conservation advice.

Previous surveys include a Level 2 flora and vegetation survey of rail corridor areas within the Shire of Serpentine Jarrahdale (GHD 2012) and a reconnaissance survey for areas north of Armadale Station (Aurora 2020). GHD (2021a) discusses relevant results from these surveys. Glevan (2021) completed a dieback assessment was conducted in accordance with the DBCA interpreter's manual (DBCA 2020).

The METRONET Office has a dedicated Environmental Stakeholder Reference Group for the Proposal that includes officers from the DWER and DBCA who have provided feedback on the environmental survey scopes. The group ensures the survey scopes meet Commonwealth and State policy, guideline requirements and robust data is provided to support the environmental impact assessment process for the Proposal.

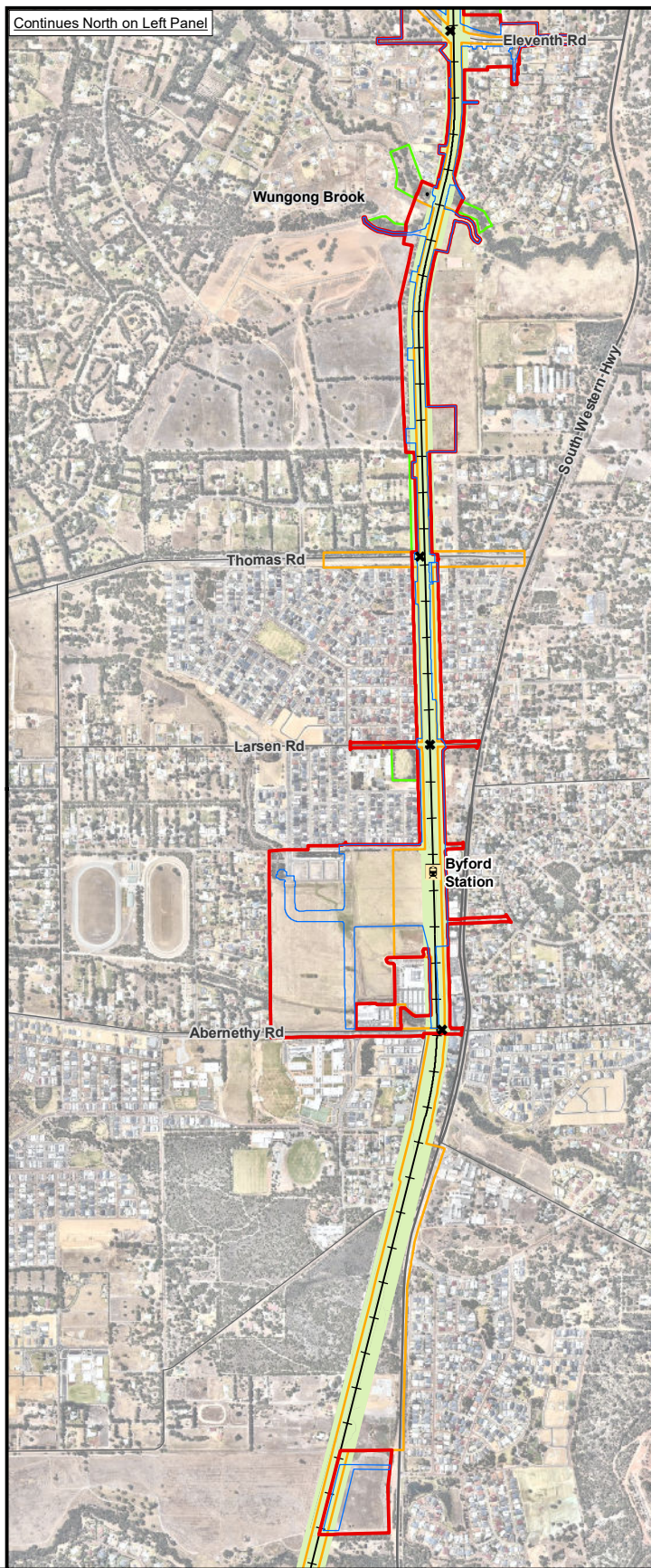
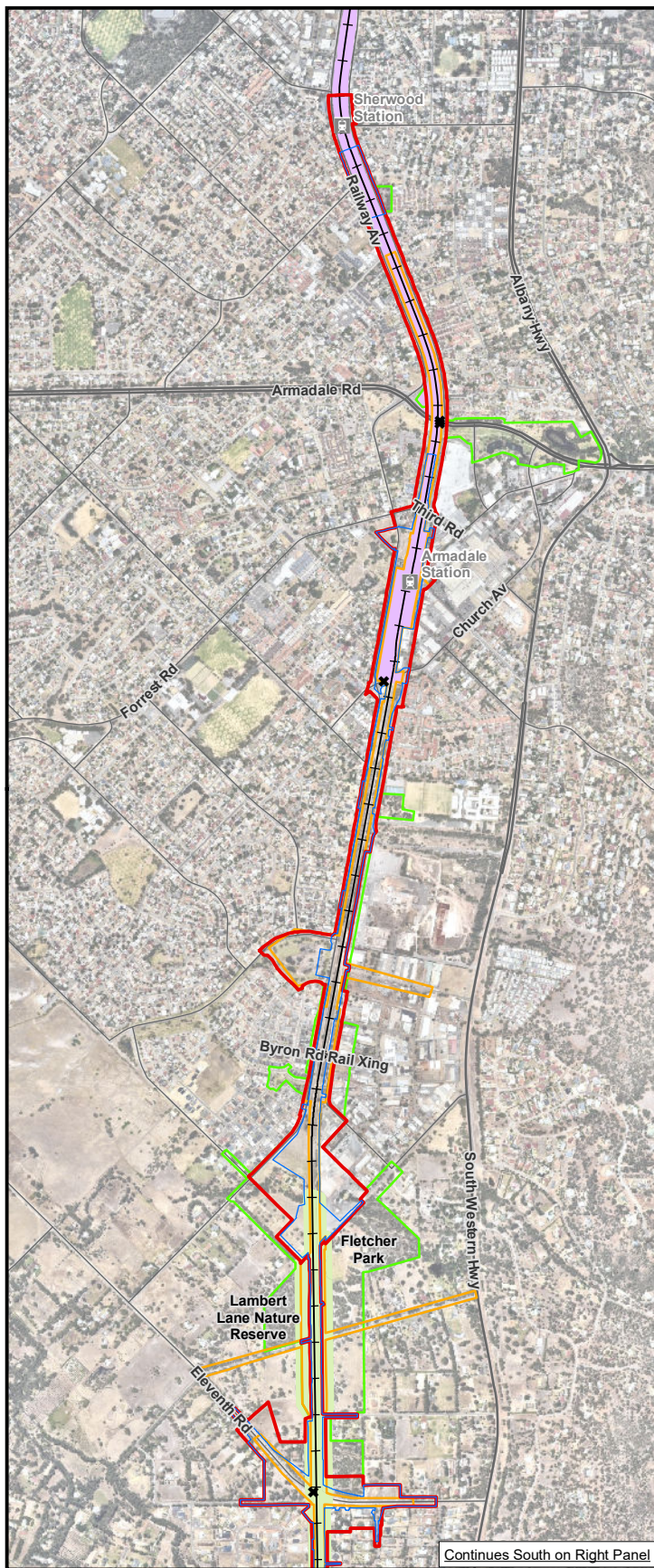
Table 12 outlines key vegetation and flora surveys and dieback assessments relevant to the Proposal. Collectively, the survey areas cover the Development Envelope and adjacent areas. The extent of survey coverage is shown on **Figure 10**.

Table 12 Summary of environmental investigations relevant to flora and vegetation

Study/survey	Details
Report for Rail Reserves in the Shire of Serpentine Jarrahdale, Spring Flora and Vegetation Survey and Fauna and Habitat Assessment (GHD 2012)	<p>Scope: Level 2 vegetation and flora survey along PTA's rail corridor within the Shire of Serpentine Jarrahdale, covering approximately 62 km of corridor and 230 ha. The survey methodology was conducted in accordance with Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004) and included sampling from 16 quadrats and six relevés, vegetation type and condition mapping, and targeted searches for Threatened and Priority flora. Collected quadrat data was compared with regional datasets and the presence of TECs and PECs inferred from this analysis. Survey effort included 10 person days.</p> <p>An IBSA data package was not produced for this scope as it pre-dates IBSA.</p> <p>Survey area: GHD (2012) survey area</p> <p>Relevance to Proposal: The survey covered part of the Development Envelope.</p> <p>Consultant: GHD Pty Ltd</p> <p>Survey dates: 7-11 November 2011</p> <p>Report date: January 2012</p> <p>IBSA reference: IBSA-2021-0165</p>

Study/survey	Details
METRONET – Byford Extension Part One Flora and Fauna Assessment (AECOM 2020b)	<p>Scope: Detailed flora and vegetation of a survey area covering approximately 102 ha that extended along the existing rail corridor from Gladstone Road, Armadale to Cardup Siding Road, Byford. The survey methodology was aligned with EPA Technical Guidance (2016a) and included sampling floristic data from 11 quadrats and eight relevés, vegetation community and condition mapping, and targeted flora and threatened community searches. An FCT analysis was also undertaken to inform the determination of TECs and PECs within the survey area. Survey effort included 4 person days.</p> <p>An IBSA data package was produced as part of this scope.</p> <p>Survey area: AECOM (2019) survey area</p> <p>Relevance to Proposal: The survey covered approximately 60.5 ha (38%) of the Development Envelope and provides baseline information of the flora and vegetation values within the Development Envelope.</p> <p>Consultant: AECOM</p> <p>Survey dates: 8, 9, 16 and 19 November 2019</p> <p>Report date: June 2020</p> <p>IBSA reference: IBSA-2021-0162</p>
Byford Rail Extension, Detailed Flora and Vegetation Survey (GHD 2021a)	<p>Scope: Detailed flora and vegetation of a survey area covering approximately 213 ha that includes the entire Development Envelope and adjacent areas with native vegetation. The survey methodology was aligned with EPA Technical Guidance (2016a) and included sampling floristic data from 16 quadrats and five relevés, vegetation community and condition mapping and targeted flora searches. FCT analyses were also undertaken to inform the determination of TECs and PECs within the survey area. Survey effort included 13 person days.</p> <p>An IBSA data package was produced as part of this scope.</p> <p>Survey area: GHD (2020) survey area, which covered the entire Development Envelope and adjacent areas.</p> <p>Relevance to Proposal: Covers the entire Development Envelope and adjacent areas with native vegetation. Provides baseline information for the flora and vegetation values within the Development Envelope and Context Area.</p> <p>Consultant: GHD Pty Ltd</p> <p>Survey dates: 21-25 October 2020</p> <p>Report date: November 2020</p> <p>IBSA reference: IBSA-2021-0167</p>
Environmental Advice Armadale Train Line Platform & Signalling Upgrade Program (Aurora 2020)	<p>Scope: A flora and vegetation survey of the Armadale Line, including targeted Black Cockatoo habitat assessment, with compilation of a tree inventory for the areas approximately 200 m up-line and down-line of each station along the Armadale Train Line.</p> <p>Survey area: The Armadale Train Line survey area encompassing approximately 150 ha along the 30 km length of the Armadale to Perth rail line and varying survey area width of approximately 50 m.</p> <p>Relevance to Proposal: Covers areas of the DE between Sherwood and Armadale Stations.</p> <p>Consultant: Aurora Environmental</p> <p>Survey dates: 19 September 2016; and over five days between 30 January to 10 February 2020.</p>

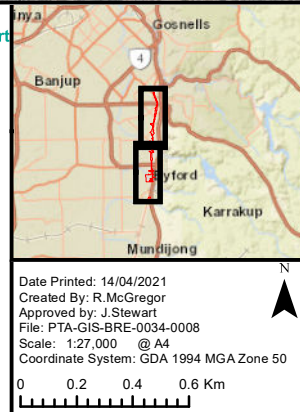
Study/survey	Details
Phytophthora Dieback occurrence assessment (Glevan Consulting 2021)	<p>Report date: June 2020</p> <p>IBSA reference: IBSA-2021-0174</p> <p>Scope: Dieback assessment of a 184.63 ha area, starting at Sherwood Station and extending south for approximately 11.5 km to Byford. The survey methodology was aligned with Chapter 6 of the FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department (DPAW 2015) and included a single soil and tissue sample.</p> <p>Survey area: Glevan (2020) survey area</p> <p>Relevance to Proposal: Covers the entire Development Envelope.</p> <p>Consultant: Glevan Consulting</p> <p>Survey dates: 1 October 2020</p> <p>Report date: February 2021</p>



METRONET | Byford Rail Extension
Figure 10 | **Flora and Vegetation Survey Coverage**



- Legend**
- Footprint
 - Development Envelope
 - +— Indicative Railway Alignment
 - Proposed Railway Station
 - Existing Railway Station
 - ✱ Rail Crossing
 - Survey Extent (GHD 2012)
 - Survey Extent (AECOM 2020)
 - Survey Extent (Aurora, 2020)
 - Survey Extent (GHD 2021)



6.4.2. Conservation reserves

The DBCA, responsible for 31 million hectares of parks, reserves and forests in Western Australia, manages conservation areas to protect plants, animals and ecosystems, connecting people to natural areas, providing safe, environmentally responsible and inspiring experiences for visitors (DBCA 2019).

One DBCA managed reserve, Lambert Lane Nature Reserve (R 42044, Class C), is located adjacent to the Development Envelope and Footprint. Lambert Lane Nature Reserve is located on the west side of the existing rail reserve, north of Eleventh Road in Wungong. The Reserve is 3.62 ha and is vested with the Conservation Commission of WA for the purposes of conservation of flora and fauna. Lambert Lane Nature Reserve contains significant flora taxa and vegetation representative of SCP 3a. Lambert Lane Nature Reserve is included in Bush Forever site no. 264.

No other DBCA managed reserves are located within 500 m of the Development Envelope and Footprint.

Lambert Lane Nature Reserve is part of Greenways 106 and 128 as identified in 'A Strategic Plan for Perth's Greenways' (Alan Tingay & Associates 1998).

6.4.3. Parks and recreation reserves

Fletcher Park (R 14217) is vested with the City of Armadale, Fletcher Park, intersects the Development Envelope (**Figure 11**). The Park is located on the east side of the existing rail reserve and extends from Stone Street to Eleventh Road in Wungong. Fletcher Park is approximately 19 ha in area and is zoned Parks and Recreation in the City of Armadale Town Planning Scheme 4 and zoned Rural under the Metropolitan Region Scheme (MRS). The Park contains significant flora taxa and vegetation representative of SCP 3a. Wallangarra Riding and Pony Club (Inc) leases a portion of Fletcher Park for recreational use by the community (ENV Australia 2010). Fletcher Park is also included in Bush Forever site no. 264.

A small portion of the Development Envelope and Footprint (1.48 ha, 0.90%) lies within Fletcher Park. No regional parks are located within or adjacent to the Development Envelope and Footprint.

6.4.4. Bush Forever

Bush Forever protects regionally significant bushland within the Swan Coastal Plain portion of the Perth metropolitan region. The Government of Western Australia identified Bush Forever sites using conservation value criteria and a target of protecting at least 10% of each vegetation complex that is representative of regional ecosystems and habitats (GoWA 2000). Bush Forever aims to protect a comprehensive representation of all ecological communities originally occurring in the region (GoWA 2000).

Three Bush Forever sites intersect the Development Envelope (**Table 13, Figure 11**):

- Bush Forever site no. 264, Lambert Lane Bushland, Wungong
- Bush Forever site no. 266, Wungong Brook, Byford
- Bush Forever site no. 350, Byford to Serpentine Rail/Road Reserves and Adjacent Bushland.

Bush Forever site no. 264 includes Lambert Lane Nature Reserve, Fletcher Park and areas of the existing rail reserve. The site is recognised as being regionally significant bushland and includes vegetated upland and wetland areas in varying condition, which are representative of the eastern side of the SCP (such as SCP 3a). Bush Forever site no. 264 also contains Conservation Category Wetlands and significant flora and fauna (GoWA 2000). Of the 2.73 ha intersecting the Footprint, 1.29 ha contains native vegetation, including 1.02 ha mapped as TEC SCP 3a, with the remaining 1.44 ha mapped as cleared land.

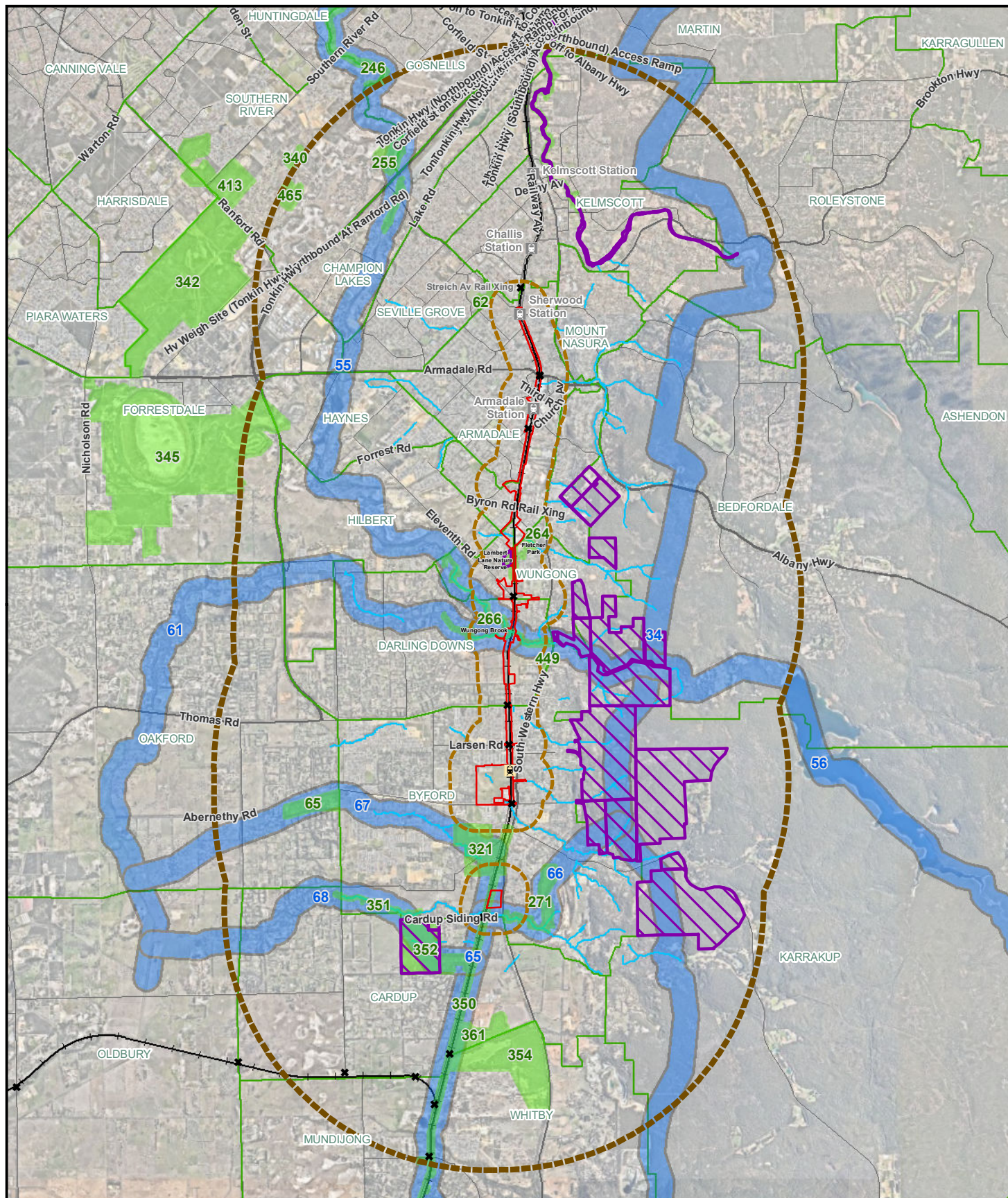
Bush Forever site no. 266 is located approximately 600 m south of Eleventh Road in Wungong and includes parts of Wungong Brook, extending both upstream and downstream of the Development Envelope. The site comprises vegetated wetland areas in varying condition. No significant vegetation or flora was recorded for this site, but the site is part of regional ecological linkages (No. 56 and 61) (GoWA 2000). Of the 0.36 ha intersecting the Footprint, 0.21 ha contains native vegetation with the remaining 0.15 ha mapped as cleared land.

Bush Forever site no. 350 is located in the southern portion of the Development Envelope, extending approximately 8.3 km from Byford to Serpentine and includes areas of the rail reserve. The site comprises vegetated upland, wetland and creek areas in varying condition, which are representative of the eastern side of the SCP. The site contains significant flora, forms part of two regional ecological linkages (No. 65 and 66) and is inferred to contain TECs (GoWA 2000). Of the 1.04 ha intersecting the Footprint, 0.04 ha contains native vegetation with the remaining 1.00 ha mapped as cleared land.

Total impacts from the Proposal to native vegetation within Bush Forever sites is 1.54 ha.

Table 13 Bush Forever Sites in or within 1 km of the Development Envelope

Site No.	Site name	Size (ha)	Extent in Development Envelope	Extent in footprint (ha)	Location relative to proposal
264	Lambert Lane Bushland, Wungong	15.13	3.06	2.73	Site lies either side of the Development and Footprint and incorporates the rail corridor
266	Wungong Brook, Byford	26.21	1.13	0.36	Site intersects the Development and Footprint and extends east and west along Wungong Brook
350	Byford to Serpentine Rail/Road Reserves and Adjacent Bushland	93.13	1.71	1.04	Site intersects the Development Envelope and Footprint and extends approximately north and south within the road and rail reserve.
Total			5.9	4.1	



METRONET | Byford Rail Extension
Figure 11 | Local and Regional Context and Regional Linkages



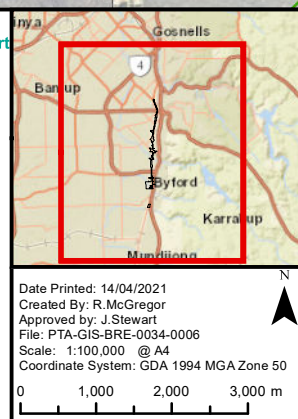
Legend

- Development Envelope
- +— Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✱ Rail Crossing
- Locality Boundary
- Ecological Linkages
(Link ID Labelled)
- Bush Forever (DPLH-019)
(ID Labelled)
- DBCA Legislated Lands and Waters (DBCA-011)

Context Buffers From Development Envelope

- 5000m Buffer
- 500m Buffer

A
B
C
D





METRONET | Byford Rail Extension
Figure 11A | Local and Regional Context and Regional Linkages



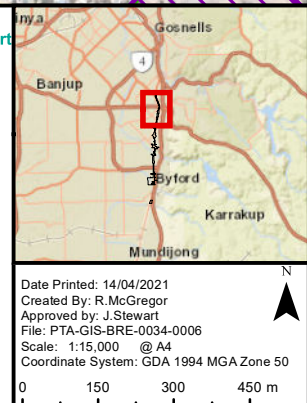
Public Transport
Authority

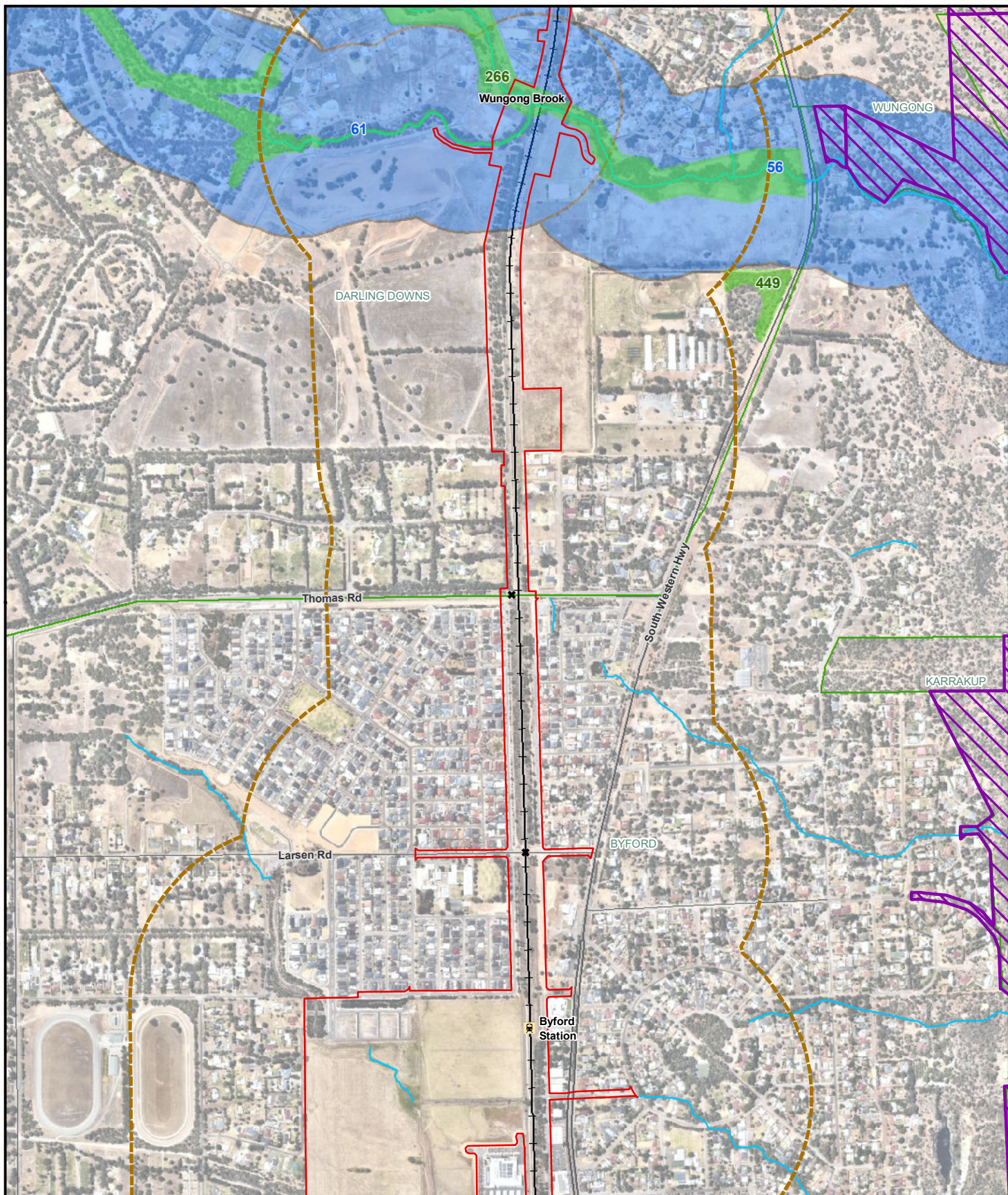
Legend

- Development Envelope
- Indicative Railway Alignment
- Existing Railway Station
- Rail Crossing
- Locality Boundary
- Bush Forever (DPLH-019)
(ID Labelled)
- DBCA Legislated Lands and Waters (DBCA-011)

- Context Buffers From Development Envelope**
- 5000m Buffer
 - 500m Buffer

A
B
C
D





METRONET | Byford Rail Extension
Figure 11C | Local and Regional Context and Regional Linkages



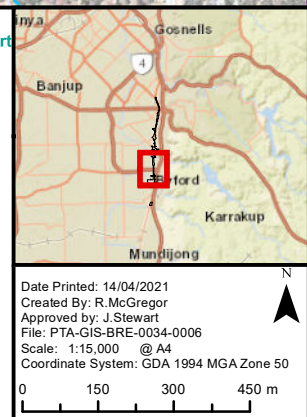
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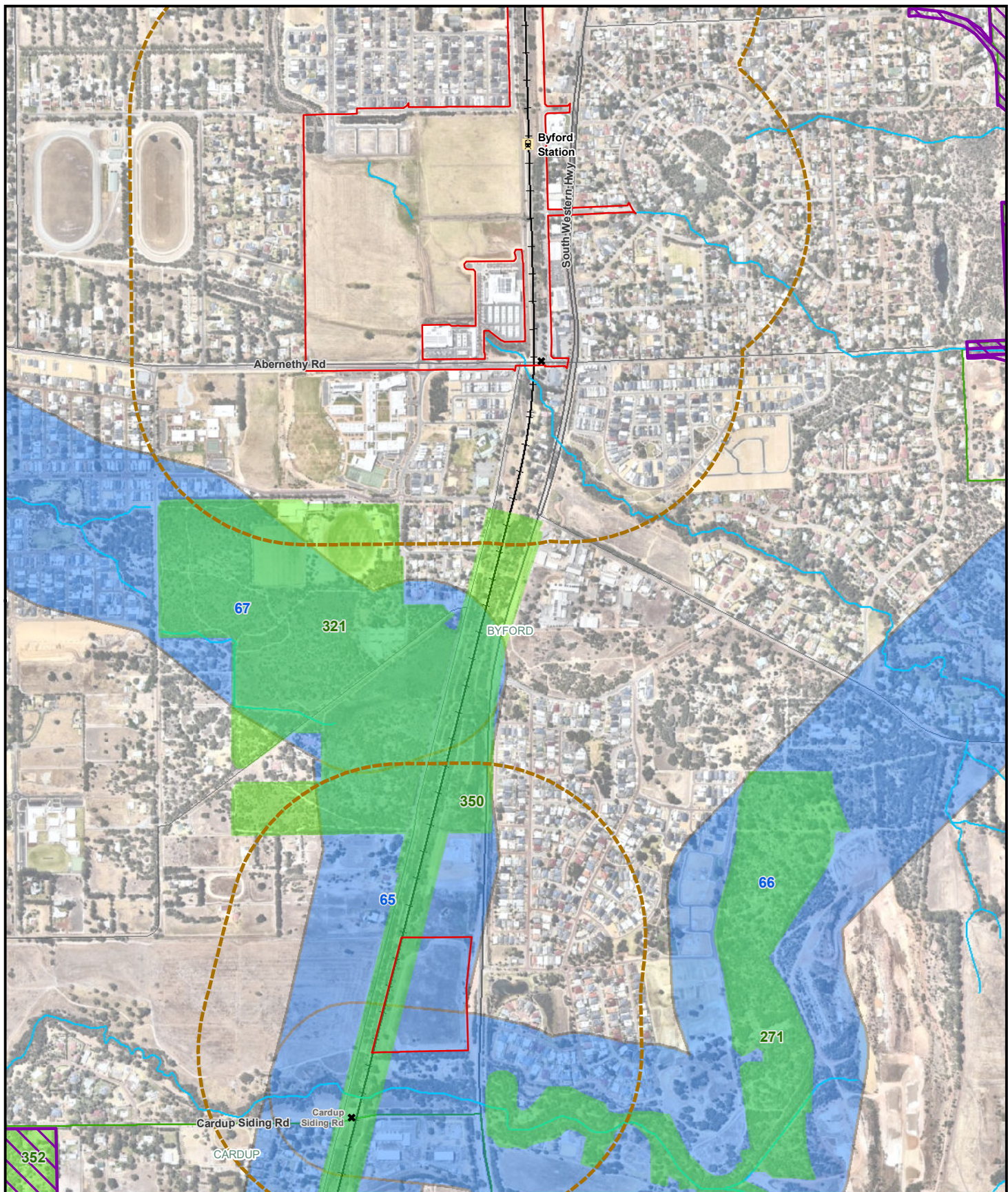
- Development Envelope
- +— Indicative Railway Alignment
- Proposed Railway Station
- ✱ Rail Crossing
- Locality Boundary
- Ecological Linkages
(Link ID Labelled)
- Bush Forever (DPLH-019)
(ID Labelled)
- DBCA Legislated Lands and Waters (DBCA-011)

Context Buffers From Development Envelope

- 5000m Buffer
- 500m Buffer

A
B
C
D





METRONET | Byford Rail Extension
Figure 11D | Local and Regional Context and Regional Linkages



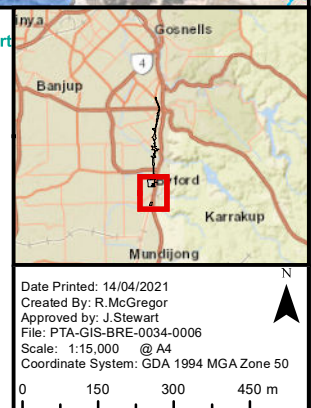
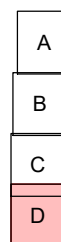
Public Transport
Authority

Legend

- Development Envelope
- + Indicative Railway Alignment
- Proposed Railway Station
- ✱ Rail Crossing
- Locality Boundary
- Ecological Linkages
(Link ID Labelled)
- Bush Forever (DPLH-019)
(ID Labelled)
- DBCA Legislated Lands and Waters (DBCA-011)

Context Buffers From Development Envelope

- 5000m Buffer
- 500m Buffer



6.4.5. Regional vegetation

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

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

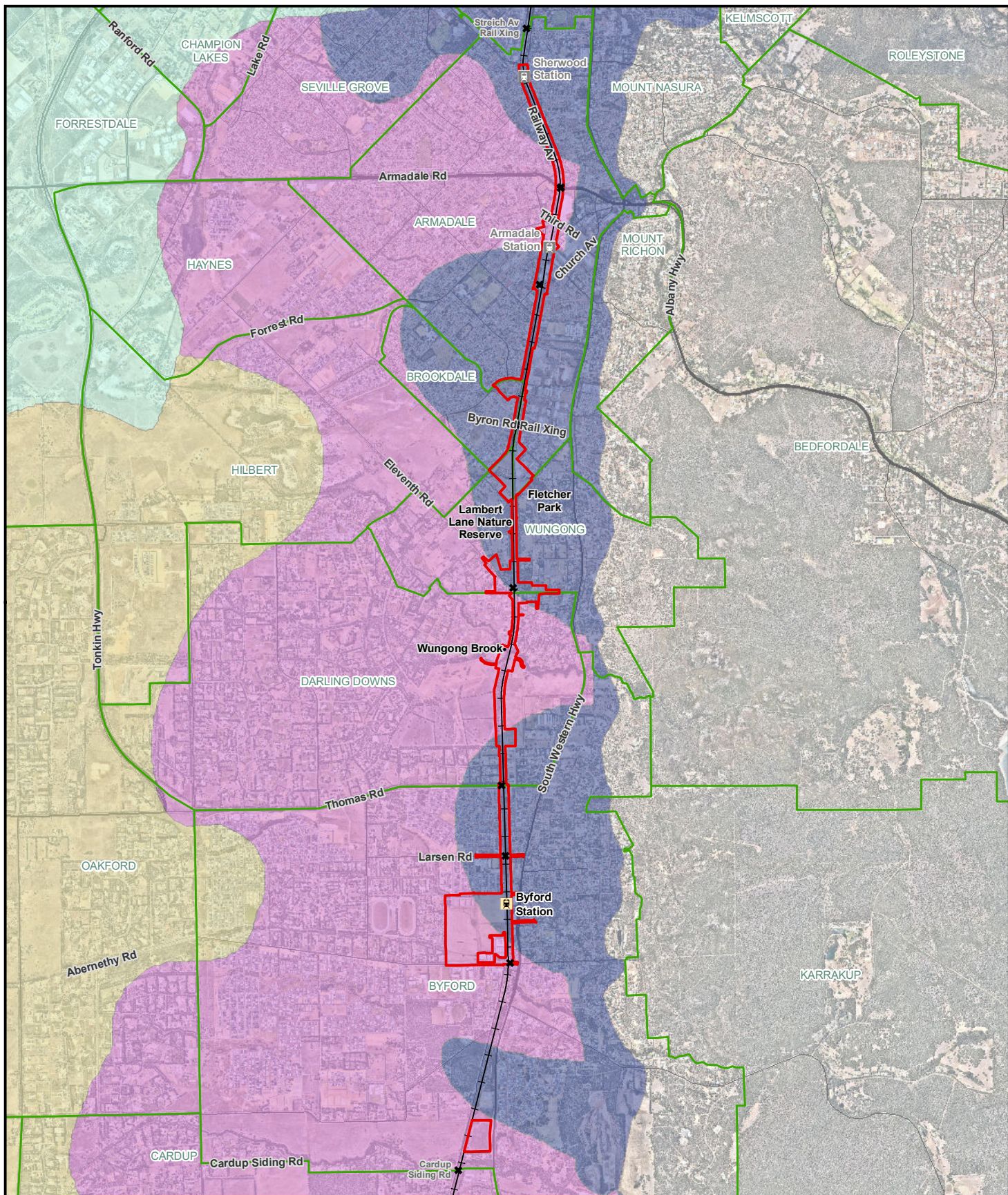
The Northern Jarrah Forrest (JAF01) subregion is approximately 600 m east of the Corridor.

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

- Medium forest; Jarrah-Marri (association 3).
- Medium woodland; Jarrah, Marri & Wandoo (association 968).

Heddle et al. (1980) mapped vegetation complexes at a scale of 1:250,000 based on major geomorphic units on the Swan Coastal Plain. Pitt et al. (2016) extended the vegetation complex mapping of Heddle et al. (1980). The Development Envelope lies within two vegetation complexes:

- Forrestdale Complex: Vegetation ranges from open forest of *Corymbia calophylla* - *Eucalyptus wandoo* – *E. marginata* to open forest of *E. marginata* – *C. calophylla* - *Allocasuarina fraseriana* - *Banksia* species. Fringing woodland of *E. rudis* in the gullies that dissect this landform.
- Guildford Complex: A mixture of open forest to tall open forest of *C. calophylla* – *E. wandoo* – *E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis* - *Melaleuca raphiophylla*.

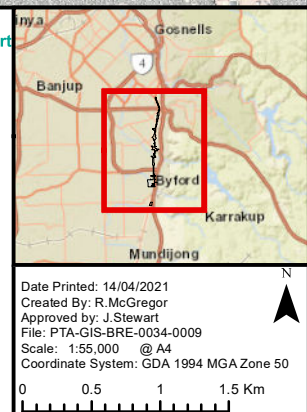


METRONET | Byford Rail Extension
Figure 12 | **Vegetation Complexes**



Legend

- | | |
|--|---|
| Development Envelope | Vegetation Complexes
(Hedde et al. 1980) |
| —+— Indicative Railway Alignment | Beermullah Complex |
| Proposed Railway Station | Forrestdale Complex |
| Existing Railway Station | Guildford Complex |
| ✱ Rail Crossing | Southern River Complex |
| Locality Boundary | |



6.4.6. Local vegetation types

The Development Envelope and Footprint contains remnant native vegetation, natural regrowth and planted vegetation as well as cleared and hardstand areas. The Footprint contains 15.98 ha (19.80%) of native vegetation, 5.66 ha (7.01%) of planted vegetation and 59.05 ha (73.18%) of highly modified/cleared areas (GHD 2021a).

The majority of the Development Envelope and Footprint are highly disturbed/cleared. Where vegetation is present, it occurs in linear strips along the rail corridor and watercourses as well as isolated stands of trees. Of the seven vegetation types mapped within the Development Envelope six occur within the Footprint. The vegetation types include open woodlands on flat to gentle slopes on plains with brown to light grey sandy clay. Other types include open woodlands, woodlands on drainage lines and over scattered trees over native shrubs and/or introduced species. Planted/revegetation of native, non-local natives and introduced species were also mapped within the Development Envelope and Footprint.

Table 14 describes the extents of the vegetation types within the Development Envelope and Footprint and **Figure 13** maps these.

Table 14 Extent of vegetation types within the Development Envelope and Footprint

Code	Description	Extent in Development Envelope (ha)	Extent in Development Envelope (%)	Extent in Footprint (ha)	Extent in Footprint (%)
VT01	<i>Corymbia calophylla</i> and occasionally <i>Eucalyptus marginata</i> and <i>Eucalyptus lane-poolei</i> open woodland. <i>Corymbia calophylla</i> and occasionally <i>Eucalyptus marginata</i> and <i>Eucalyptus lane-poolei</i> open woodland over <i>Kingia australis</i> and <i>Hakea trifurcata</i> open shrubland over <i>Allocasuarina humilis</i> , <i>Xanthorrhoea preissii</i> and <i>Banksia dallanneyi</i> low open shrubland over <i>Mesomelaena tetragona</i> , <i>Mesomelaena stygia</i> subsp. <i>stygia</i> and <i>Schoenus grandiflorus</i> sparse sedgeland over <i>Lechenaultia biloba</i> , <i>*Ursinia anthemoides</i> and <i>Siloxerus multiflorus</i> sparse forbland	3.44	2.09	2.83	3.51
VT03	Mixed woodland of <i>Corymbia calophylla</i> , <i>Eucalyptus rudis</i> and <i>Eucalyptus wandoo</i> woodland on drainage line. Mixed woodland of <i>Corymbia calophylla</i> , <i>Eucalyptus rudis</i> and <i>Eucalyptus wandoo</i> woodland over <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i> and <i>Xanthorrhoea preissii</i> open shrubland over <i>*Ehrharta longiflora</i> and <i>*Briza maxima</i> sparse grassland over <i>*Oxalis pes-caprae</i> , <i>*Freesia alba x leightlinii</i> and <i>*Fumaria capreolata</i> sparse forbland	<0.01	0.00	0.00	0.00
VT04	<i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> woodland on drainage line. <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> open woodland over <i>Xanthorrhoea preissii</i> , <i>Grevillea wilsonii</i> and <i>Banksia dallanneyi</i> open shrubland over <i>*Eragrostis curvula</i> open grassland	1.57	0.95	0.38	0.47

Code	Description	Extent in Development Envelope (ha)	Extent in Development Envelope (%)	Extent in Footprint (ha)	Extent in Footprint (%)
VT06	Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> . <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> scattered trees over <i>Xanthorrhoea preissii</i> and <i>Kingia australis</i> sparse shrubland over introduced grasses and herbs. Some areas contain no overstorey and consist of patches of <i>Xanthorrhoea preissii</i> and/or <i>Kingia australis</i> with occasional scattered native shrubs including <i>Hypocalymma angustifolium</i> and <i>Leschenaultia biloba</i>	12.16	7.39	7.95	9.85
VT08	Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> trees with occasional <i>Eucalyptus wandoo</i> or <i>Eucalyptus rudis</i> in paddocks and grazed areas. Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> trees with occasional <i>Eucalyptus wandoo</i> or <i>Eucalyptus rudis</i> , with some planted non-local native trees, over parkland cleared in paddocks/grazed areas and road reserve	8.35	5.07	4.65	5.76
VT09	<i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> open woodland over introduced grasses and herbs. <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> open woodland over <i>Kingia australis</i> and <i>Xanthorrhoea preissii</i> open shrubland over <i>*Ehrharta calycina</i> and <i>*Ehrharta longiflora</i> grassland over <i>*Watsonia meriana</i> open herbland	0.95	0.58	0.17	0.21
Subtotal native vegetation		26.5	16.1	16.0	19.8
VT07	Planted/revegetation of both native, non-local natives and introduced species. areas with planted shrubs and trees of both native, non-local natives and introduced species. Understorey is generally comprised of introduced herbs and grasses or maintained gardens	12.99	7.89	5.65	7.00
Subtotal planted vegetation		13.0	7.9	5.7	7.0
Cleared	Areas devoid of native vegetation that have been cleared for paddocks, roads, housing and infrastructure	125.12	76.02	59.05	73.18
Total		164.6	100.00	80.7	100.00

6.4.7. Vegetation condition

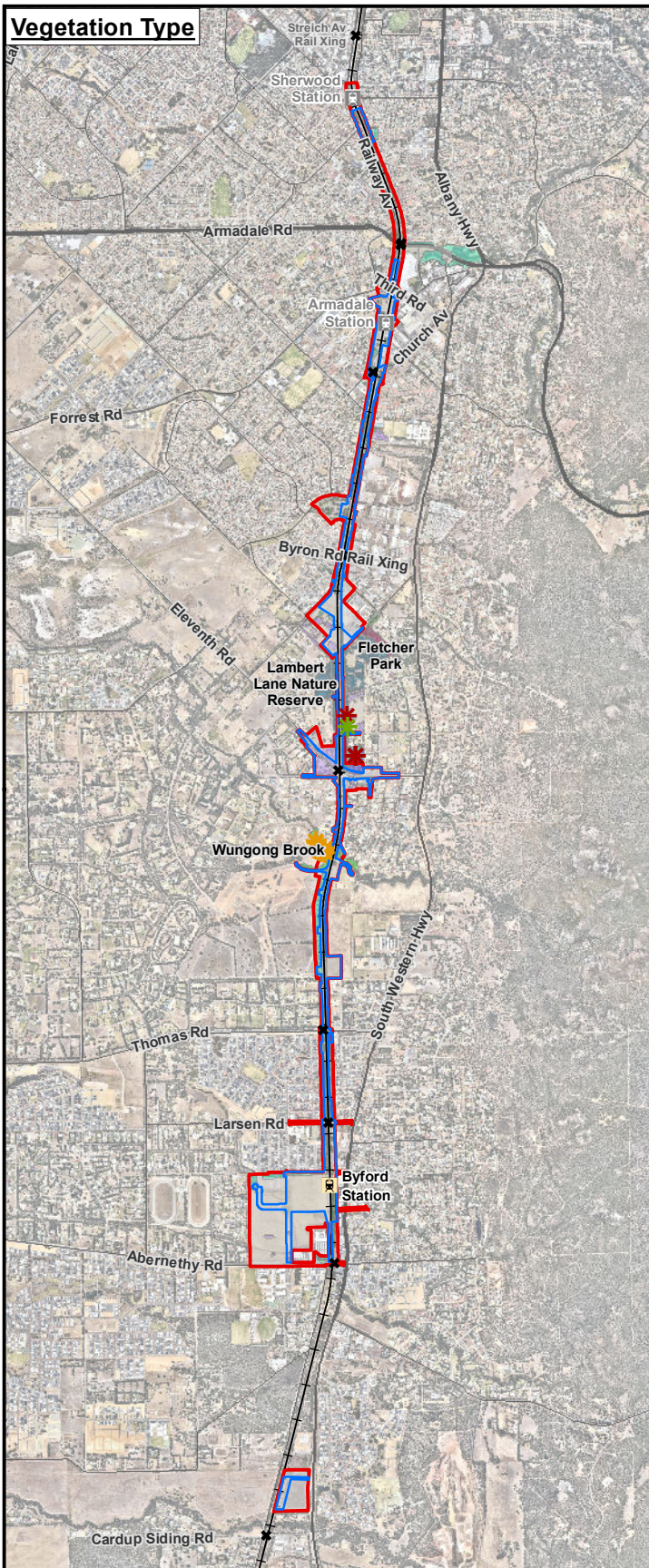
The Development Envelope and Footprint contain vegetation in Excellent to Completely Degraded condition (**Table 15**). Approximately 59.1 ha (73%) of the Footprint is cleared and comprises infrastructure, tracks, paddocks or parklands. Native vegetation represents 19.80% of the Footprint. Of this 5.22 ha (32.7% of the total native vegetation) is in Degraded or better condition with the remaining 10.76 ha (67.3%) in Completely Degraded condition.

Historical clearing, tracks, infrastructure development and aggressive weed species have influenced the structure and composition of the native vegetation within the Development Envelope. Vegetation rated Degraded or Completely Degraded in condition was largely devoid of native species in the mid and ground strata, however retained remnant tree species that formed a structural layer in the upper stratum. Areas in Excellent and Very Good condition are associated with Lambert Lane Nature Reserve and Fletcher Park. Vegetation in these areas are mostly intact, with high floristic diversity and minimal, non-aggressive weed species present.

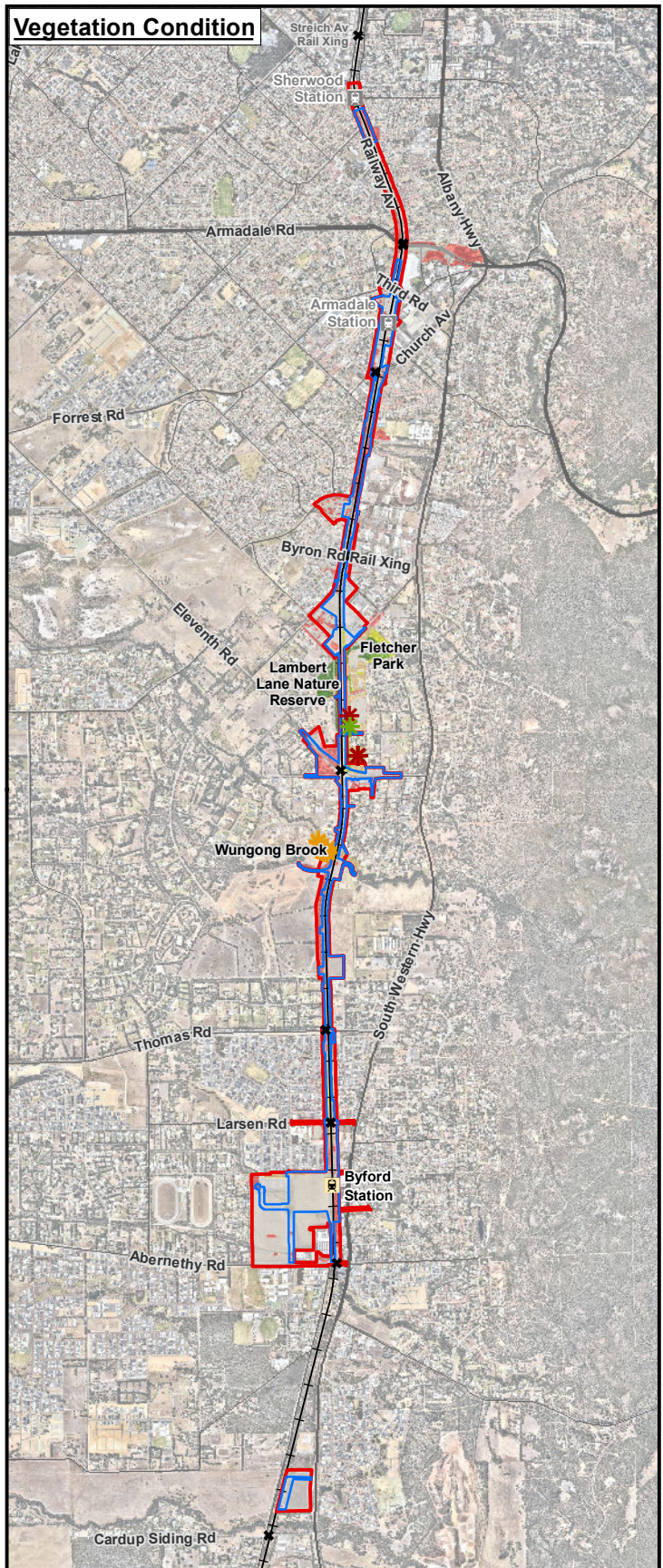
Table 15 Extent of vegetation condition ratings within the Development Envelope and Footprint

Vegetation condition rating	Extent in Development Envelope (ha)	Extent in Development Envelope (%)	Extent in Footprint (ha)	Extent in Footprint (%)
Excellent	0.07	0.04	0.02	0.02
Very Good	0.15	0.09	0.06	0.07
Good	2.48	1.51	2.05	2.54
Degraded	5.39	3.28	3.09	3.83
Completely Degraded	18.37	11.16	10.76	13.33
Subtotal native vegetation	26.5	16.1	16.0	19.8
Degraded	1.19	0.72	0.64	0.79
Completely Degraded	11.80	7.17	5.02	6.22
Subtotal planted vegetation	13.0	7.9	5.7	7.0
No rating - Cleared	125.12	76.03	59.05	73.18
Total	164.6	100.00	80.7	100.00

Vegetation Type



Vegetation Condition



METRONET | Byford Rail Extension
Figure 13 | Vegetation Type and Condition

Legend

- Footprint
- Development Envelope
- Proposed Railway Station
- Existing Railway Station

Taxon (GHD, 2020)

- ✱ *Asparagus asparagoides*
- ✱ *Echium plantagineum*
- ✱ *Rubus ulmifolius*
- ✱ *Zantedeschia aethiopica*

Vegetation Unit (GHD, 2021)

- *Corymbia calophylla* and *Eucalyptus marginata* open woodland over *Xanthorrhoea preissii* (VT05)
- *Corymbia calophylla* and *Eucalyptus marginata* open woodland over introduced grasses and herbs (VT09)
- *Corymbia calophylla* and *Eucalyptus rudis* woodland on drainage line (VT04)
- *Corymbia calophylla* and occasionally *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus lane-poolei* open woodland (VT01)

Mixed woodland of *Corymbia calophylla*, *Eucalyptus rudis* and *Eucalyptus wandoo* woodland on drainage line (VT03)

Planted/revegetation of both native, non-local natives and introduced species (VT07)

Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06)

Scattered *Corymbia calophylla* and *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus rudis* in paddocks and grazed areas (VT08)

Cleared/hardstand

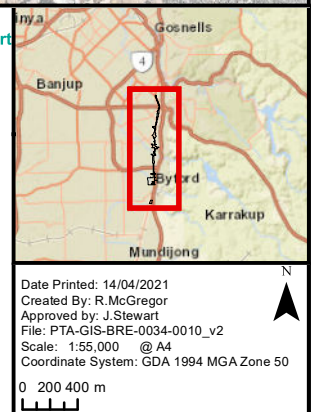
Vegetation Condition (GHD, 2021)

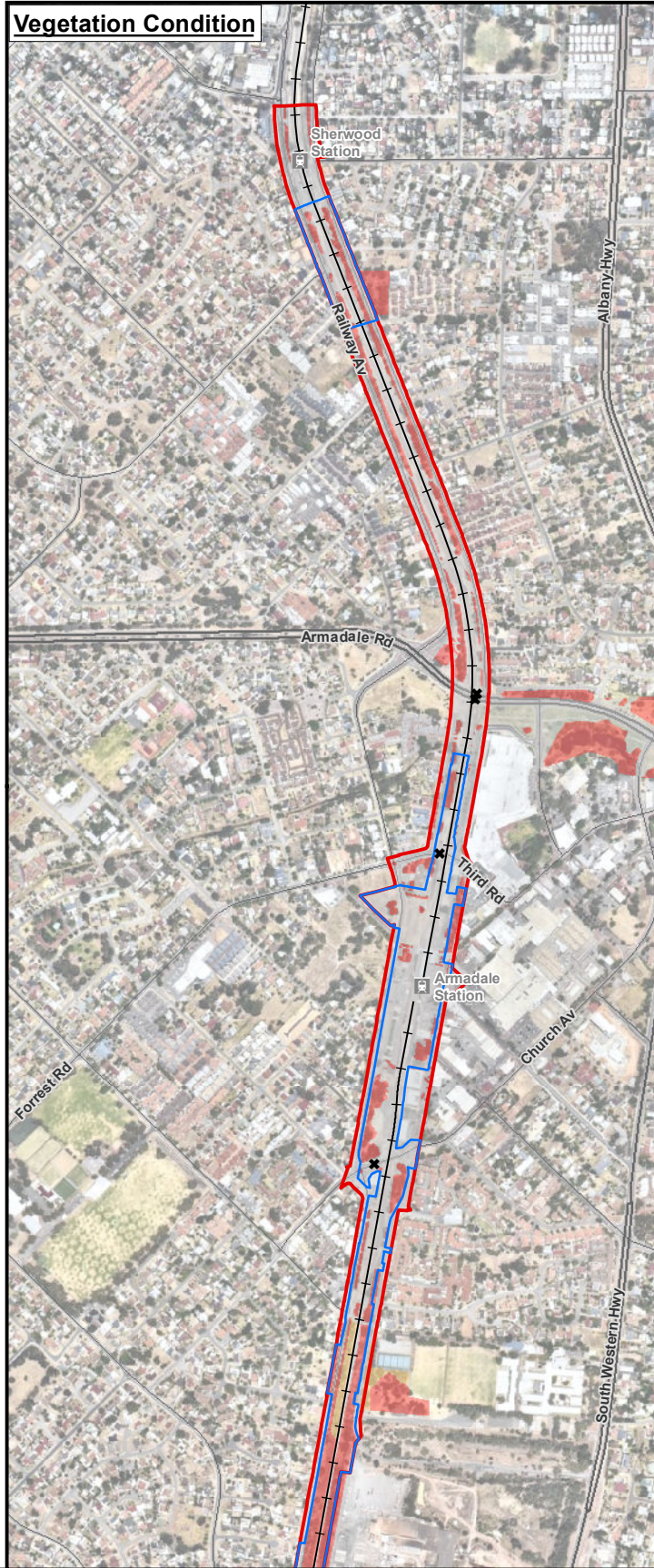
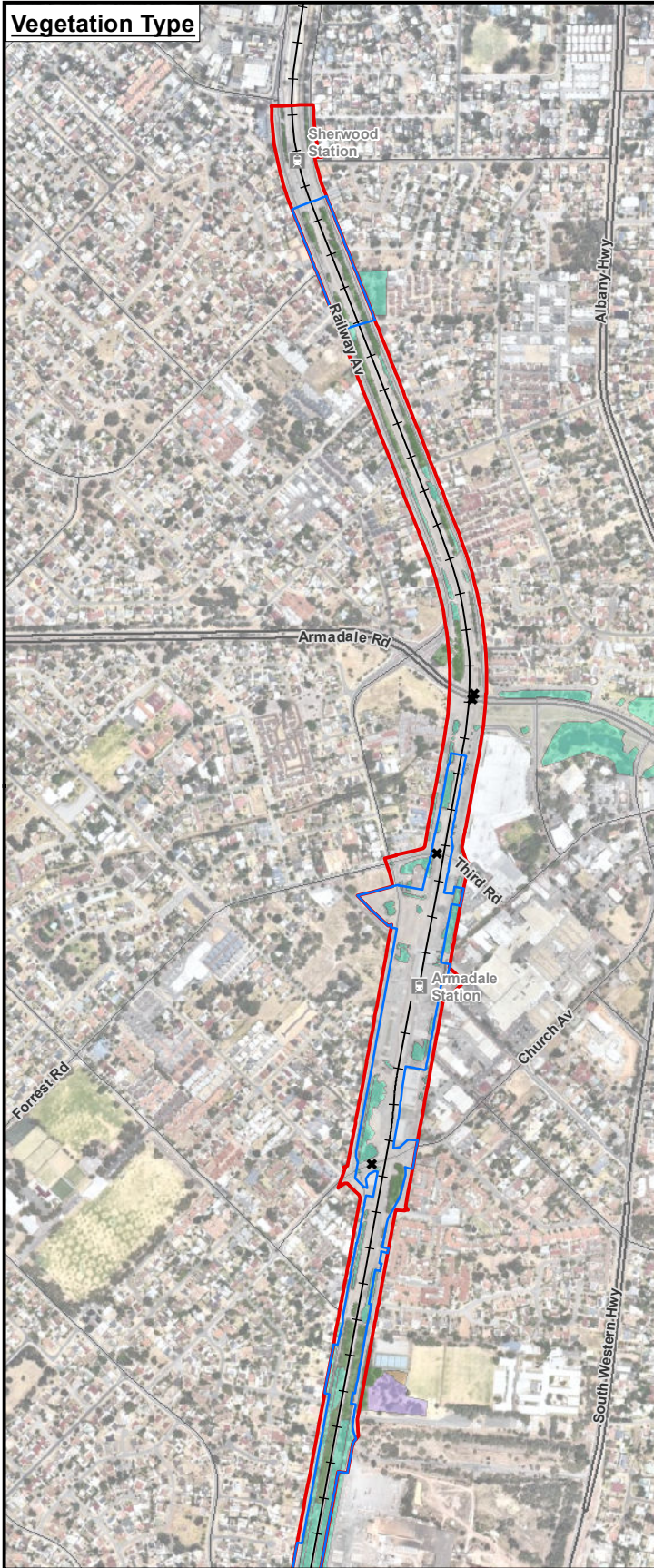
- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared

A
B
C
D



Public Transport
Authority





METRONET | Byford Rail Extension
Figure 13A | Vegetation Type and Condition

Legend

- Footprint
- Development Envelope
- Existing Railway Station
- Taxon (GHD, 2020)**
- ✱ *Asparagus asparagoides*
- ✱ *Echium plantagineum*
- ✱ *Rubus ulmifolius*
- ✱ *Zantedeschia aethiopica*

Vegetation Unit (GHD, 2021)

- Corymbia calophylla* and *Eucalyptus marginata* open woodland over *Xanthorrhoea preissii* (VT05)
- Planted/revegetated of both native, non-local natives and introduced species (VT07)

- Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06)
- Scattered *Corymbia calophylla* and *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus rudis* in paddocks and grazed areas (VT08)
- Cleared/hardstand

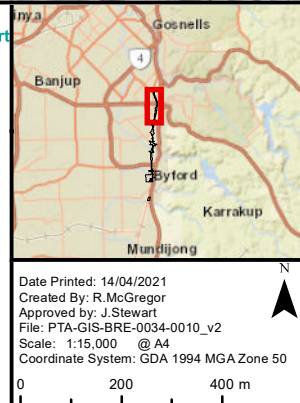
Vegetation Condition (GHD, 2021)

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared

A
B
C
D

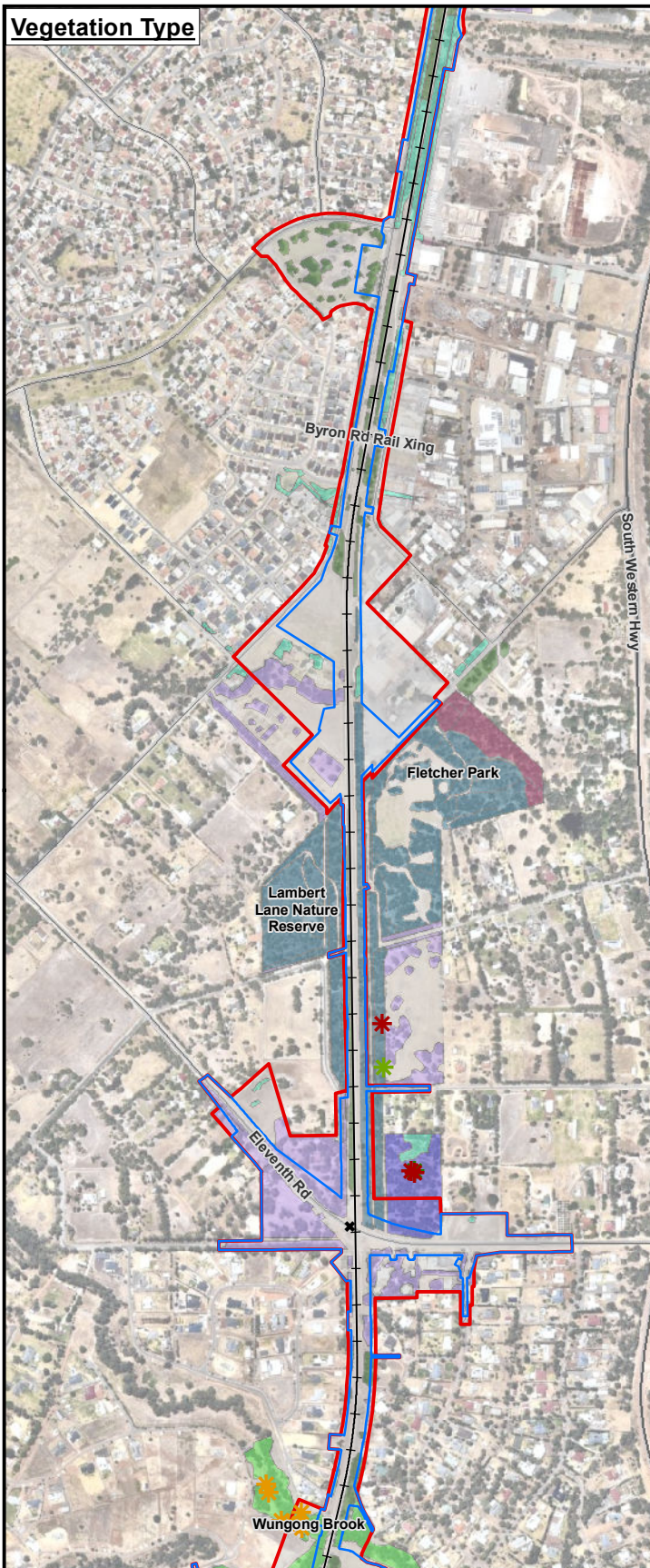


Public Transport
Authority

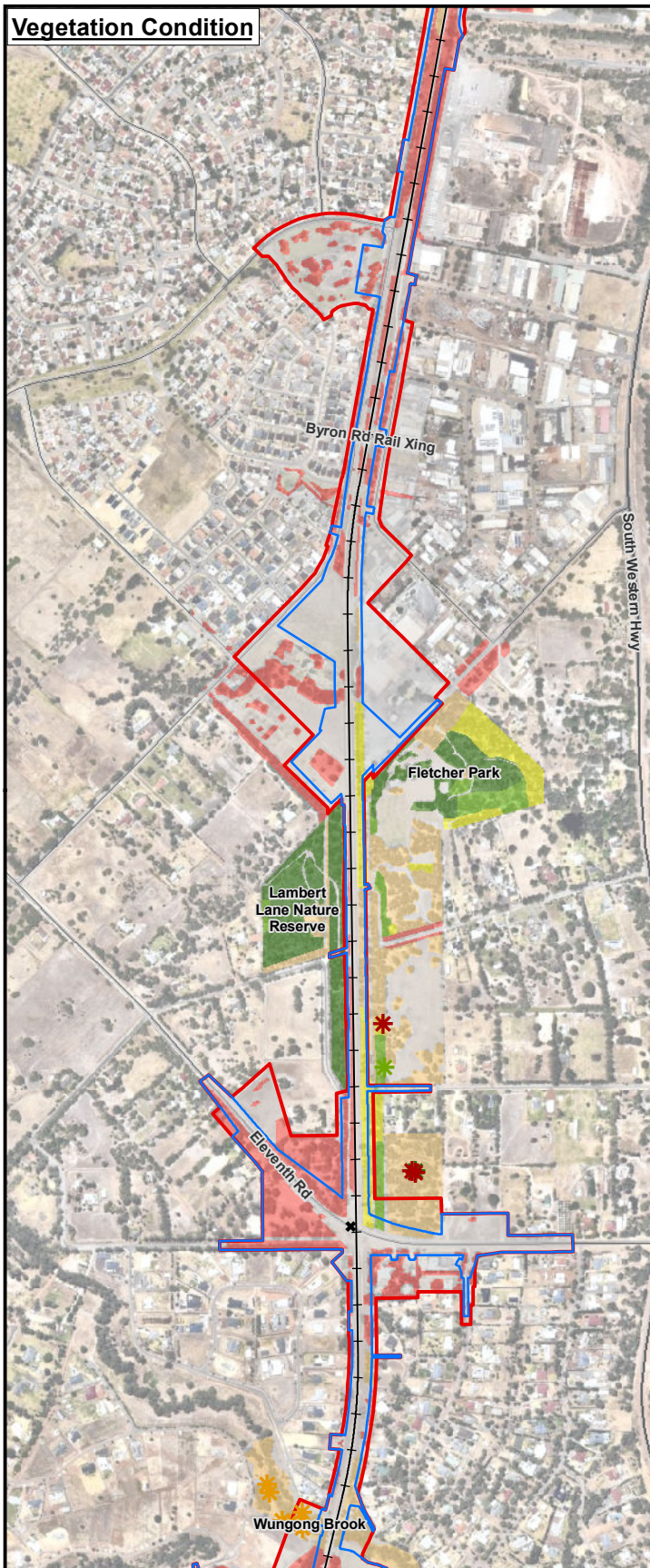


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Scale: 1:15,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50

Vegetation Type



Vegetation Condition



METRONET | Byford Rail Extension
Figure 13B | Vegetation Type and Condition

Legend

- Footprint
- Development Envelope
- Taxon (GHD, 2020)**
- ★ *Asparagus asparagoides*
- ★ *Echium plantagineum*
- ★ *Rubus ulmifolius*
- ★ *Zantedeschia aethiopica*

Vegetation Unit (GHD, 2021)

- *Corymbia calophylla* and *Eucalyptus marginata* open woodland over introduced grasses and herbs (VT09)
- *Corymbia calophylla* and *Eucalyptus rudis* woodland on drainage line (VT04)
- *Corymbia calophylla* and occasionally *Eucalyptus marginata* trees with *Eucalyptus lane-pooli* open woodland (VT01)
- Mixed woodland of *Corymbia calophylla*, *Eucalyptus rudis* and *Eucalyptus wandoo* woodland on drainage line (VT03)

Planted/revegetation of both native, non-local natives and introduced species (VT07)

Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06)

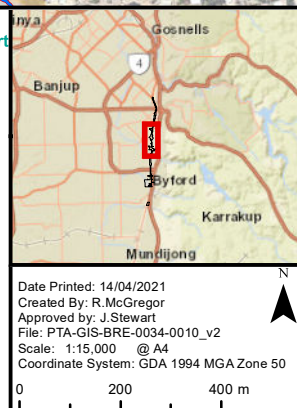
Scattered *Corymbia calophylla* and *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus rudis* in paddocks and grazed areas (VT08)

Cleared/hardstand

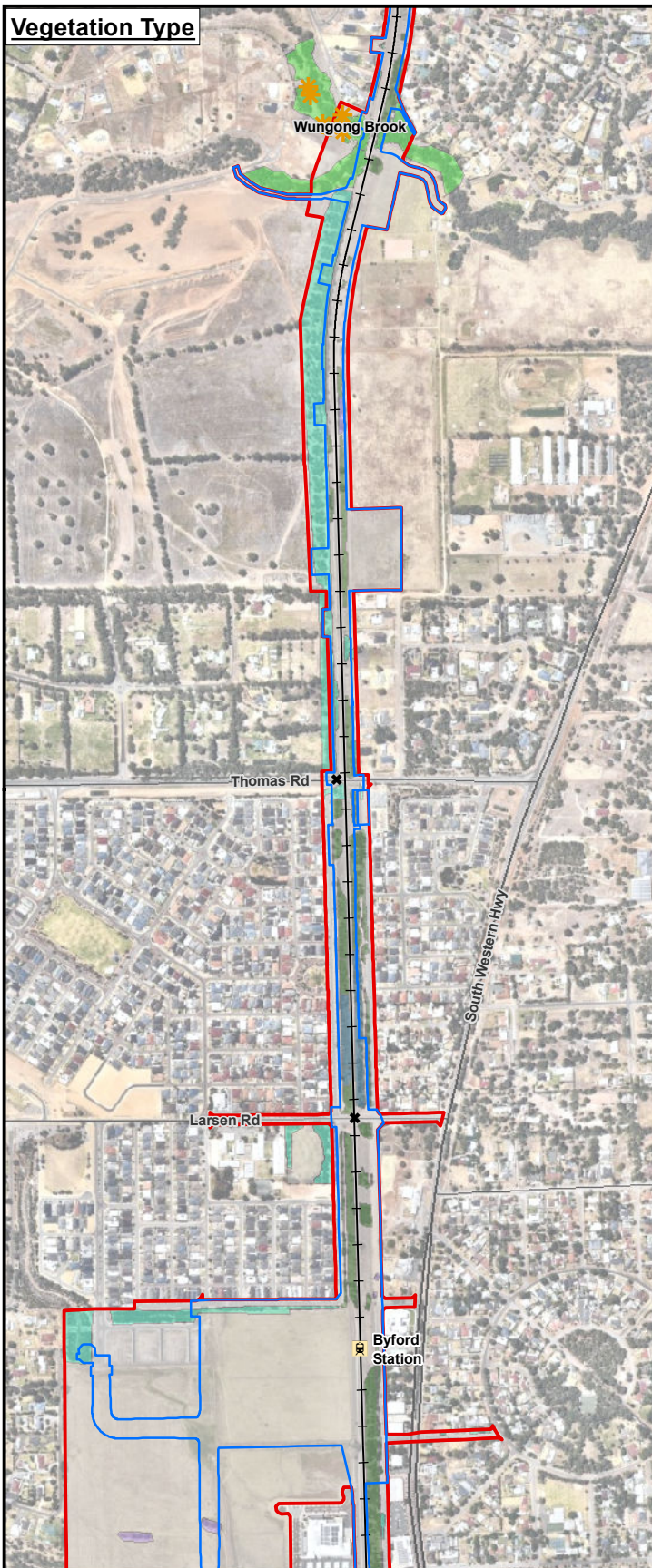
Vegetation Condition (GHD, 2021)

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared

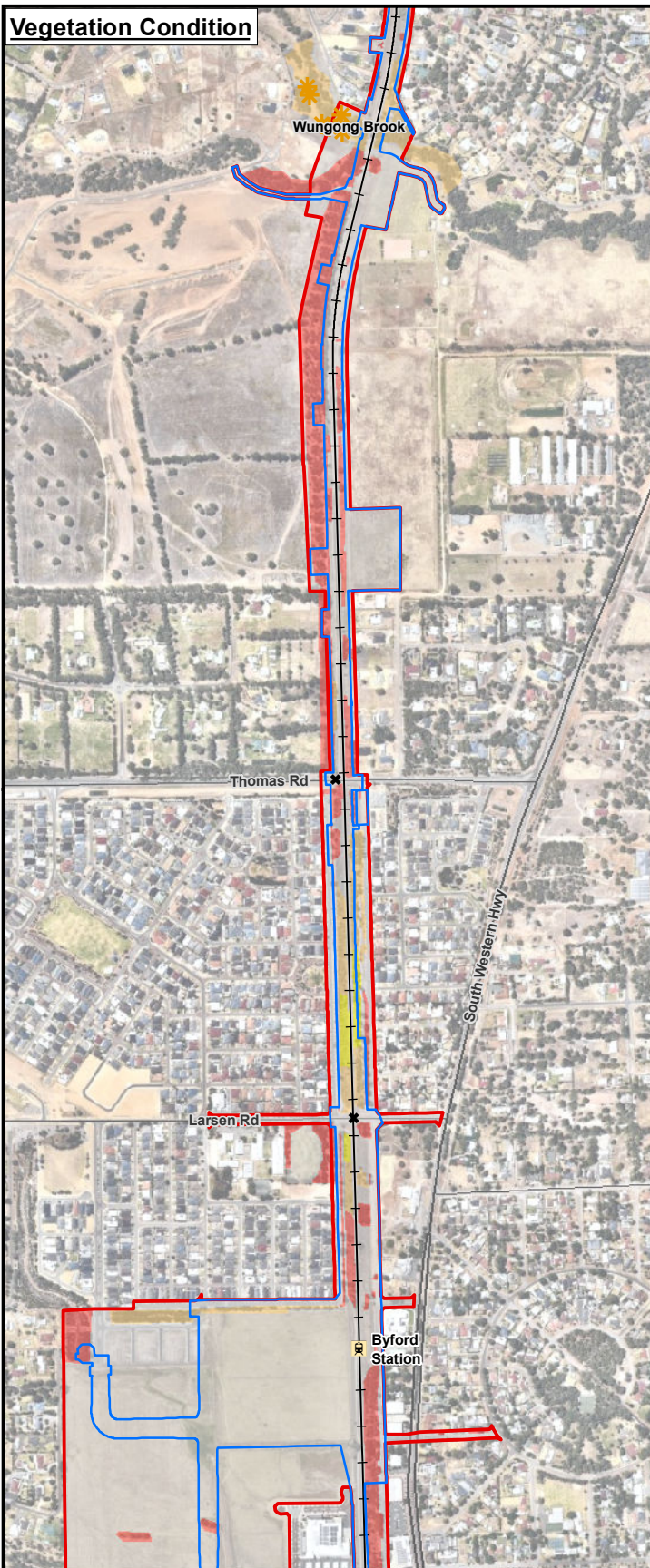
A
B
C
D



Vegetation Type



Vegetation Condition



METRONET | Byford Rail Extension
Figure 13C | Vegetation Type and Condition



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- ✱ Proposed Railway Station
- Taxon (GHD, 2020)**
- ✱ *Asparagus asparagoides*
- ✱ *Echium plantagineum*
- ✱ *Rubus ulmifolius*
- ✱ *Zantedeschia aethiopica*

Vegetation Unit (GHD, 2021)

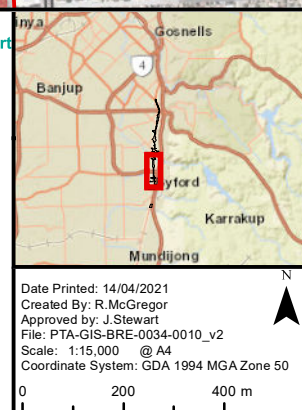
- *Corymbia calophylla* and *Eucalyptus rudis* woodland on drainage line (VT04)
- *Corymbia calophylla* and occasionally *Eucalyptus marginata* and *Eucalyptus lane-pooleri* open woodland (VT01)
- Planted/revegetation of both native, non-local natives and introduced species (VT07)

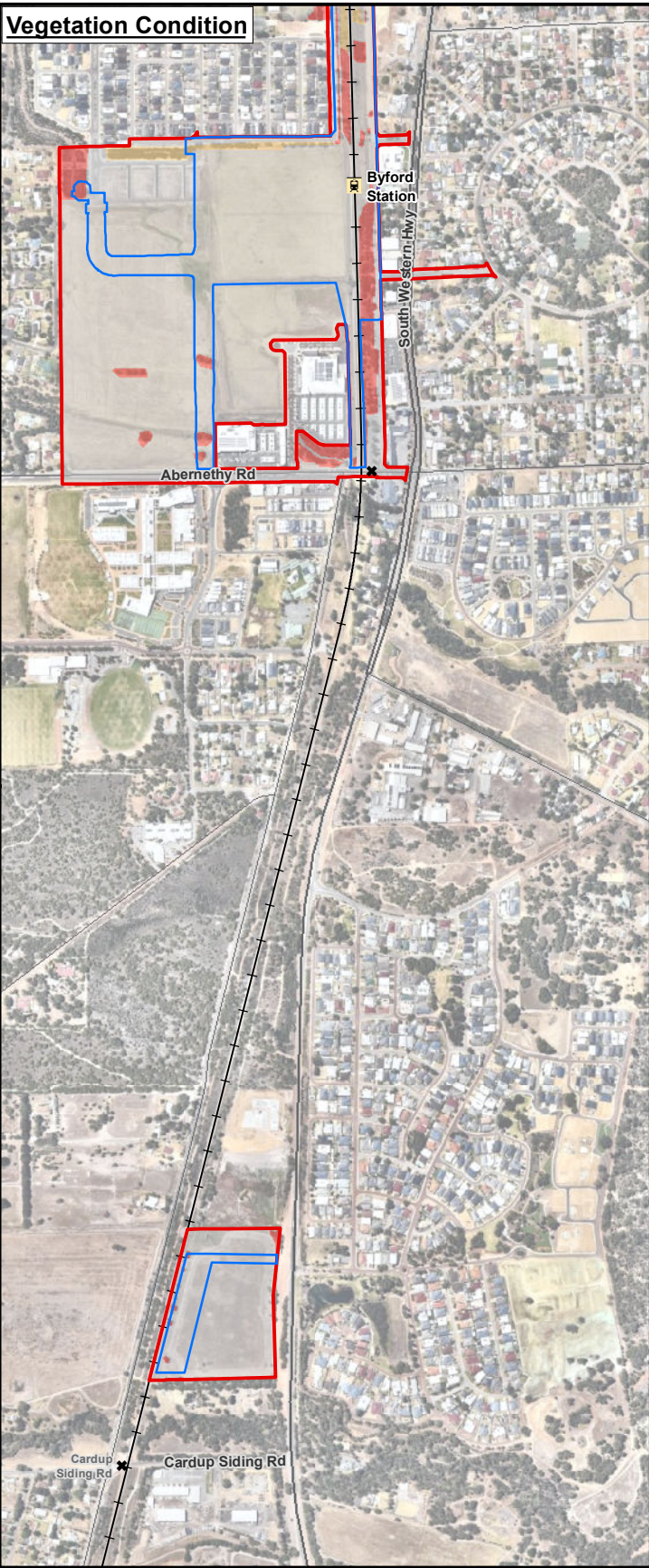
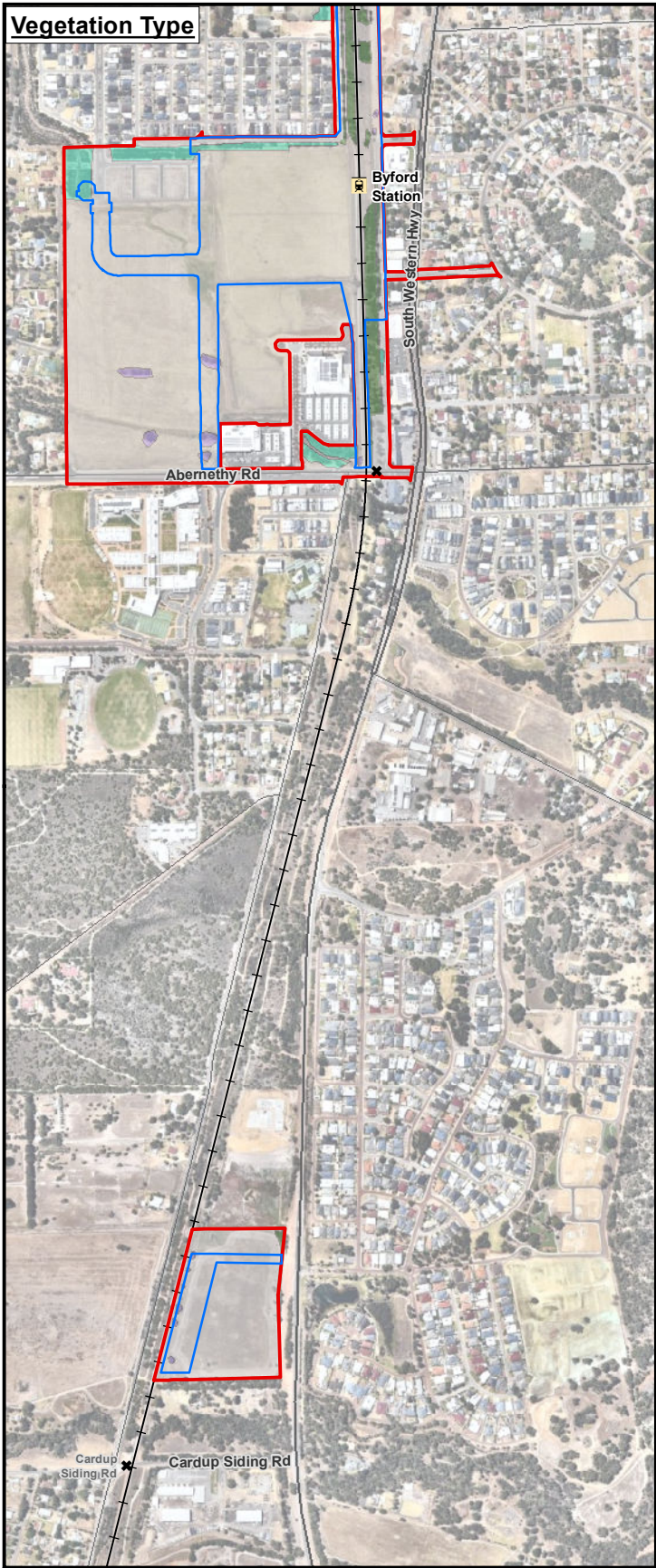
- Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06)
- Scattered *Corymbia calophylla* and *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus rudis* in paddocks and grazed areas (VT08)
- Cleared/hardstand

Vegetation Condition (GHD, 2021)

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared

A
B
C
D





METRONET | Byford Rail Extension
Figure 13D | Vegetation Type and Condition

Legend

- Footprint
- Development Envelope
- Proposed Railway Station

Taxon (GHD, 2020)

- Asparagus asparagoides*
- Echium plantagineum*
- Rubus ulmifolius*
- Zantedeschia aethiopica*

Vegetation Unit (GHD, 2021)

- Planted/revegetation of both native, non-local natives and introduced species (VT07)
- Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06)
- Scattered *Corymbia calophylla* and *Eucalyptus marginata* trees with occasional *Eucalyptus wandoo* or *Eucalyptus rudis* in paddocks and grazed areas (VT08)
- Cleared/hardstand

Vegetation Condition (GHD, 2021)

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- Cleared

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Coordinate System: GDA 1994 MGA Zone 50

6.4.8. Conservation significant vegetation

Desktop searches identified nine TECs and three Priority Ecological Communities and/or their buffers occurring within 5 km of the Development Envelope. Of the communities identified in the desktop assessment, one TEC, SCP 3a was recorded in the Development Envelope and Footprint. The remaining TECs and PECs identified in the desktop assessment do not occur in the Development Envelope or Footprint (**Table 16, Figure 14**).

Table 16 TECs and PECs identified in the desktop assessment

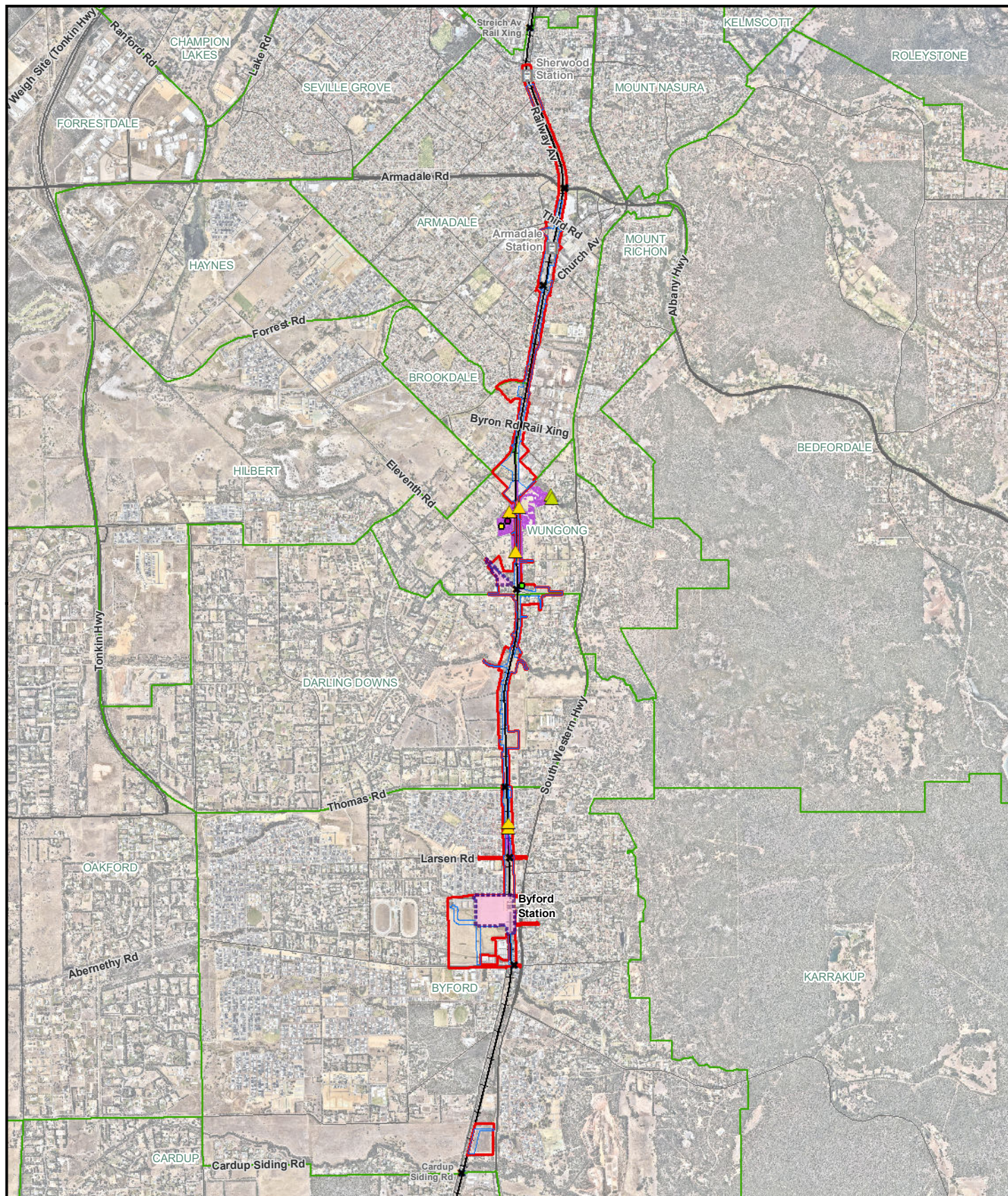
Community name and status	Discussion
<p><i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain (SCP3a) TEC</p> <p>EPBC Act: Endangered BC Act: Critically Endangered</p>	<p>The buffer of this TEC intersects DE and Footprint at Lambert Lane Nature Reserve, Fletcher Park and the southern end of the DE.</p> <p>This TEC is mapped within the DE at Lambert Lane Nature Reserve, Fletcher Park and south of Thomas Road.</p> <p>The TEC occurs within the DE and Footprint.</p>
<p><i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP3b) TEC</p> <p>BC Act: Vulnerable</p>	<p>The buffer of this TEC intersects the DE and Footprint near Cardup Siding Road.</p> <p>The vegetation in the DE mapped within this buffer zone is Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> (VT06) and Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> trees with occasional <i>Eucalyptus wandoo</i> or <i>Eucalyptus rudis</i> in paddocks and grazed areas (VT08). This vegetation is not considered to represent the TEC based on statistical analyses, vegetation condition and comparison of key indicator/dominant species.</p> <p>This TEC does not occur in the DE or Footprint.</p>
<p><i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain (SCP3c)</p> <p>EPBC Act: Endangered BC Act: Critically Endangered</p>	<p>The buffer of this TEC intersects the southern end of the DE and Footprint near Byford.</p> <p>The vegetation in the DE mapped within this buffer zone is Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> (VT06) and Planted/revegetation of both native, non-local natives and introduced species (VT07). This vegetation is not considered to represent the TEC based on statistical analyses, vegetation type and condition.</p> <p>This TEC does not occur in the DE or Footprint</p>
<p>Herb rich shrublands in clay pans (SCP08) TEC ¹</p> <p>EPBC Act: Critically Endangered BC Act: Vulnerable</p>	<p>No buffers of this TEC intersect the DE or Footprint.</p> <p>The vegetation within the DE is not representative of herb rich shrublands and no clay pan areas were recorded. The statistical analyses did not identify any quadrats or vegetation types with affinities to SCP08.</p> <p>This TEC does not occur in the DE or Footprint</p>
<p>Dense shrublands on clay flats (SCP09) TEC ¹</p> <p>EPBC Act: Critically Endangered BC Act: Vulnerable</p>	<p>No buffers of this TEC intersect the DE or Footprint.</p> <p>The vegetation within the DE is not representative of dense shrublands and no clay flats were recorded. The statistical analyses did not identify any quadrats or vegetation types with affinities to SCP09.</p> <p>This TEC does not occur in the DE or Footprint</p>

Community name and status	Discussion
Shrublands on dry clay flats (SCP 10a) ¹ EPBC Act: Critically Endangered BC Act: Endangered	No buffers of this TEC intersect the DE or Footprint. The vegetation within the DE is not representative of shrublands and no clay flats were recorded. The statistical analyses did not identify any quadrats or vegetation types with affinities to SCP10a. This TEC does not occur in the DE or Footprint
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (SCP20b) TEC ² EPBC Act: Endangered BC Act: Endangered	The buffer of this TEC intersects the southern end of the DE and Footprint near Byford and Cardup Siding Road. The vegetation in the DE mapped within this buffer zone is Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> (VT06), Planted/revegetation of both native, non-local natives and introduced species (VT07) and Scattered <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> trees with occasional <i>Eucalyptus wandoo</i> or <i>Eucalyptus rudis</i> in paddocks and grazed areas (VT08). This vegetation is not considered to represent the TEC based on statistical analyses, vegetation type and condition. This TEC does not occur in the DE or Footprint.
<i>Banksia</i> Woodlands of the Swan Coastal Plain TEC and PEC EPBC Act: Endangered DBCA: Priority 3	The buffer of this TEC/PEC intersects the DE and Footprint at Lambert Lane Nature Reserve and Armadale Park. No <i>Banksia</i> overstorey was observed in the DE. There is no vegetation within the DE that meets the key characteristics and condition/size thresholds for this TEC/PEC. Mapping of <i>Banksia</i> woodlands in the metropolitan area is based on Commonwealth's "likely to occur" area and represents broad-scale mapping units. This TEC/PEC does not occur in the DE or Footprint.
Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain ecological community EPBC Act: Critically Endangered DBCA: Priority 3	No buffers of this TEC intersect the DE or Footprint. No Tuart Woodlands were mapped in the DE. There is no vegetation within the DE that meets the key characteristics and condition/size thresholds for this TEC/PEC This TEC does not occur in the DE or Footprint.
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain TEC EPBC Act: Endangered BC Act: Endangered	No buffers of this TEC intersect the DE or Footprint. No Muchea Limestone occurs within the DE and the vegetation within the DE is not representative of this community. This TEC does not occur in the DE or Footprint.
<i>Casuarina obesa</i> association PEC DBCA: Priority 1	No buffers of this PEC intersect the DE or Footprint. No vegetation within the DE is dominated by <i>Casuarina obesa</i> nor representative of this community. This PEC does not occur in the DE or Footprint.
<i>Eucalyptus haematoxylon</i> - <i>E. marginata</i> woodlands on Whicher foothills (SCP1a) PEC DBCA: Priority 3	No buffers of this PEC intersect the DE or Footprint. The DE is not located on the Whicher foothills and no vegetation within the survey area is representative of <i>Eucalyptus haematoxylon</i> - <i>E. marginata</i> woodlands.

Community name and status	Discussion
Low lying <i>Banksia attenuata</i> woodlands or shrublands (SCP21c) PEC ² DBCA: Priority 3	<p>This PEC does not occur in the DE or Footprint.</p> <p>No buffers of this PEC intersect the DE or Footprint.</p> <p>No <i>Banksia</i> overstorey was observed in the survey area and no vegetation within the DE is representative <i>Banksia attenuata</i> woodlands or shrublands.</p> <p>This PEC does not occur in the DE or Footprint.</p>
Clay Pans of the Swan Coastal Plain TEC EPBC Act: Critically Endangered	<p>No buffers of this TEC intersect the DE or Footprint.</p> <p>No clay flats were recorded in the DE. The statistical analyses did not identify any quadrats or vegetation types with affinities to clay plan communities synonymous with the TEC (SCP08, SCP09 and SCP 10a).</p> <p>This TEC does not occur in the DE or Footprint.</p>

¹ A component of the EPBC Act listed Clay Pans of the Swan Coastal Plain TEC.

² Can be a component of the EPBC Act listed Banksia Woodlands of the Swan Coastal Plain TEC.



METRONET | Byford Rail Extension
Figure 14 | Conservation Significant Vegetation and Flora

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary
- Indicative Supply Bores
- Abstraction Areas

Taxon (GHD, 2020)

- ▲ *Eucalyptus x balanites*
- ▲ *Johnsonia pubescens subsp. cygnorum*

Taxon (DBC Database)

- *Johnsonia pubescens subsp. cygnorum*
- *Synaphea sp. Serpentine* (G.R. Brand 103)
- *Diuris purdiei*

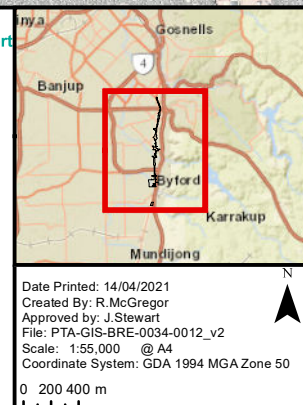
PEC/TEC (GHD, 2020)

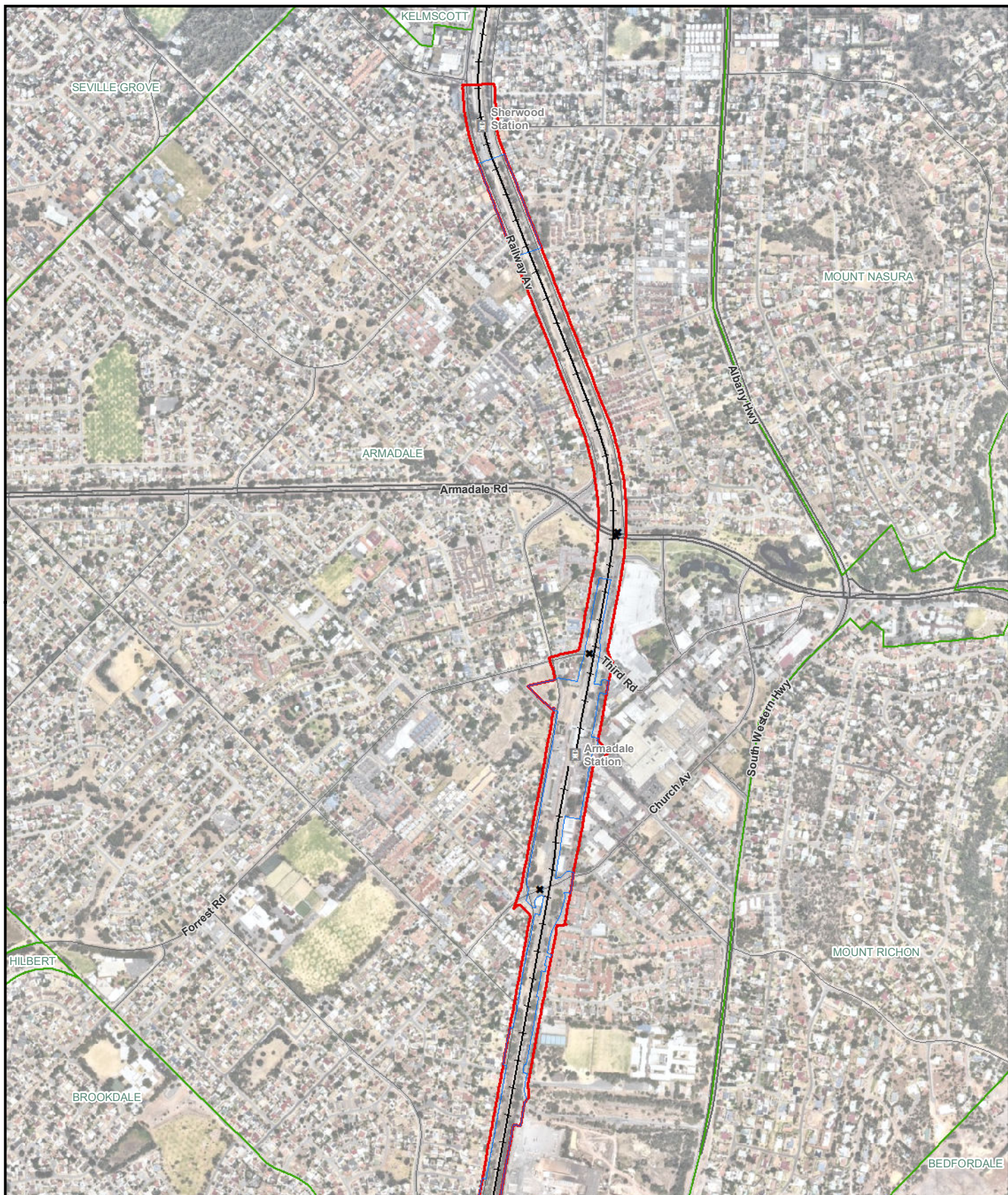
- EPBC and WA TEC *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (FCT3a)



Public Transport Authority

A
B
C
D





METRONET | Byford Rail Extension
Figure 14A | Conservation Significant Vegetation and Flora

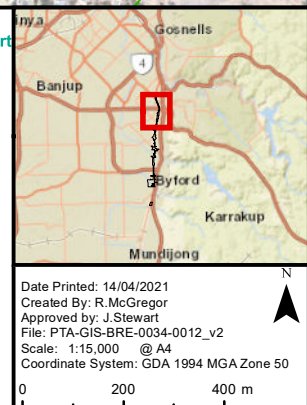


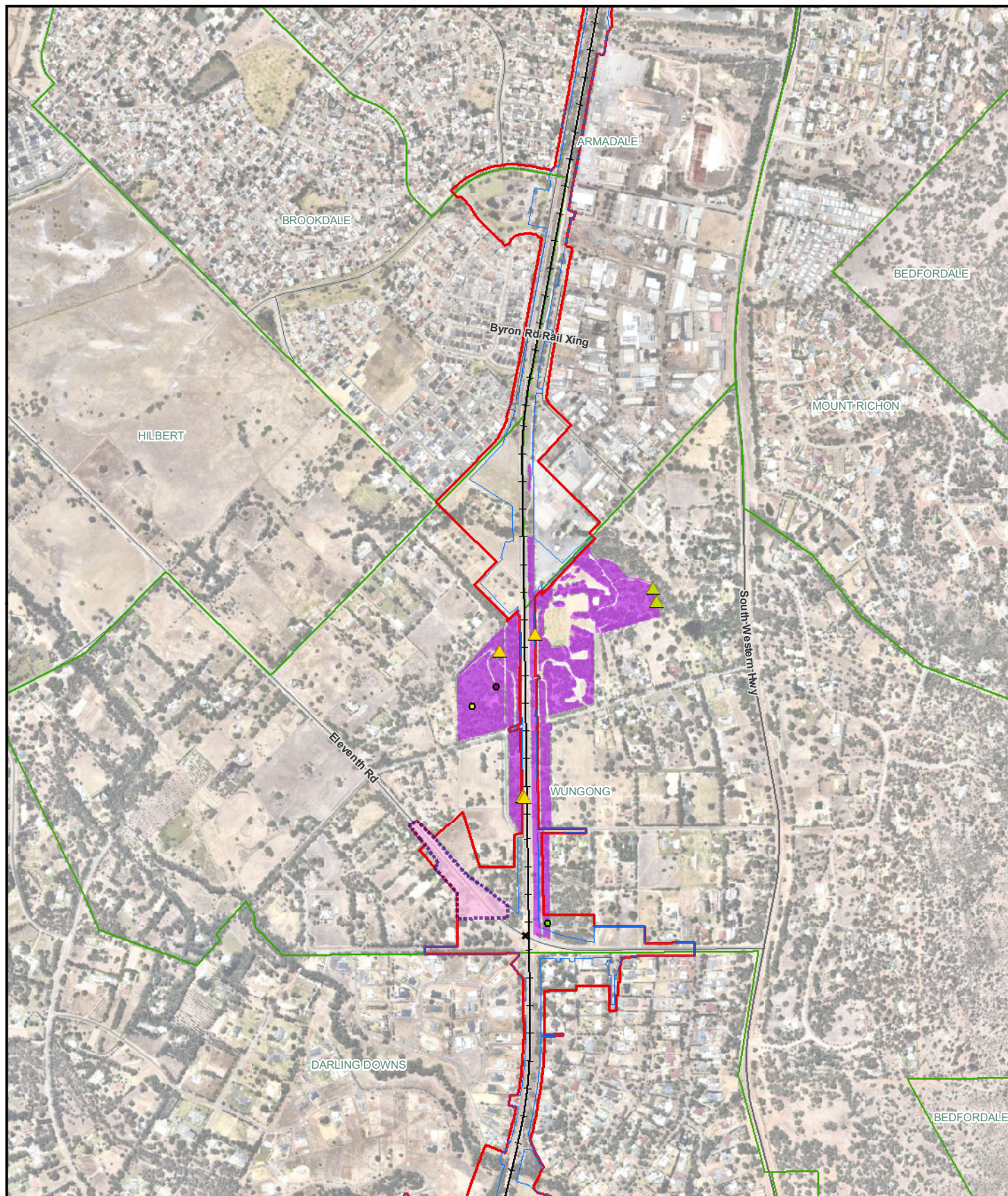
Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Existing Railway Station
- Rail Crossing
- Locality Boundary

A
B
C
D





METRONET | Byford Rail Extension
Figure 14B | Conservation Significant Vegetation and Flora



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Rail Crossing
- Locality Boundary
- Indicative Supply Bores
- Abstraction Areas

Taxon (GHD, 2020)

- ▲ *Eucalyptus x balanites*
- ▲ *Johnsonia pubescens* subsp. *cygnorum*

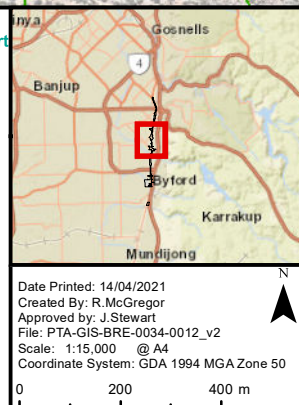
Taxon (DBC/TEC Database)

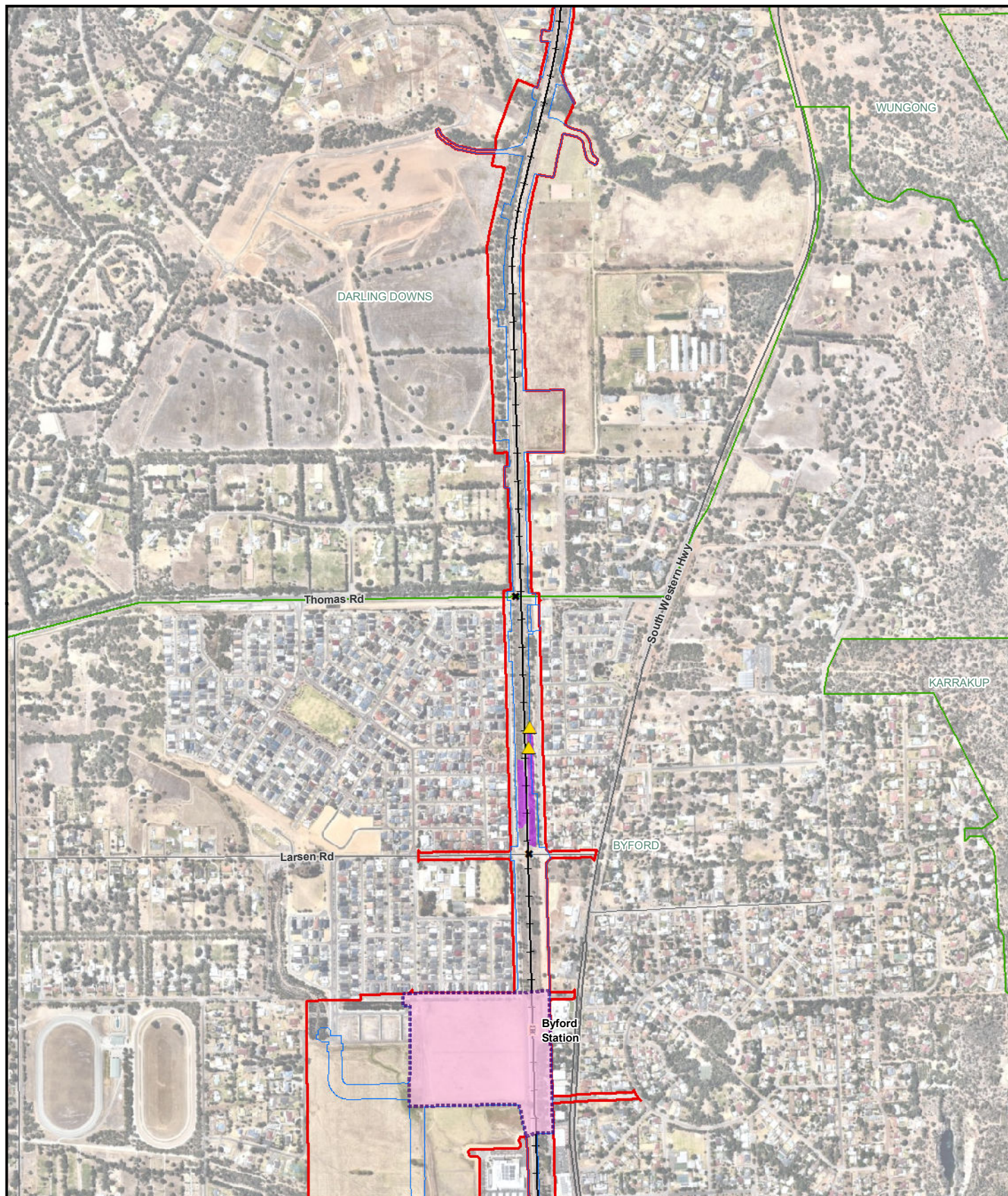
- *Johnsonia pubescens* subsp. *cygnorum*
- *Synaphea* sp. *Serpentine* (G.R. Brand 103)
- *Diuris purdiei*

PEC/TEC (GHD, 2020)

- EPBC and WA TEC *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (FCT3a)

A
B
C
D





METRONET | Byford Rail Extension
Figure 14C | Conservation Significant Vegetation and Flora



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Rail Crossing
- Locality Boundary
- Indicative Supply Bores Abstraction Areas

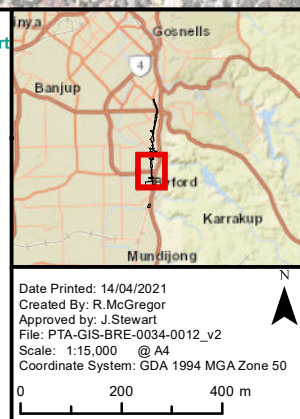
Taxon (GHD, 2020)

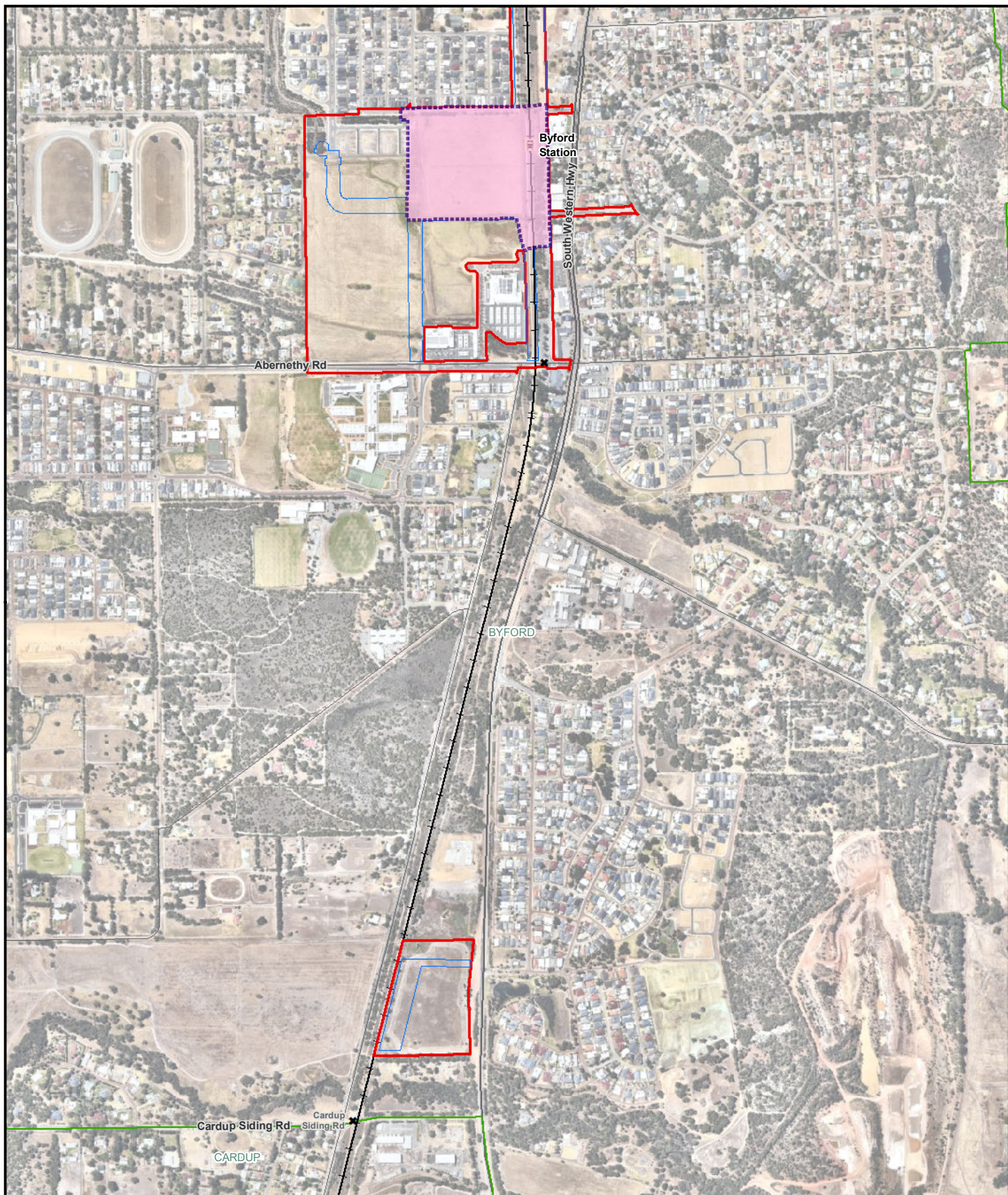
- ▲ *Johnsonia pubescens* subsp. *cygnorum*

PEC/TEC (GHD, 2020)

- EPBC and WA TEC *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (FCT3a)

A
B
C
D





METRONET | Byford Rail Extension
Figure 14D | Conservation Significant Vegetation and Flora

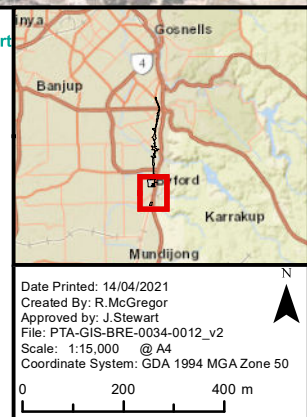


Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Rail Crossing
- Locality Boundary
- Indicative Supply Bores Abstraction Areas

A
B
C
D



Corymbia calophylla - Kingia australis woodlands on heavy soils (SCP3a) (TEC)

SCP 3a is a woodland community located on the heavy soils of the eastern side of the SCP. It is one of three Marri dominated communities, previously some of the most extensive on the eastern side of the SCP. These communities have suffered extensive clearing and now are regionally rare (DEC 2011). Typical and common native taxa in SCP3a include *Corymbia calophylla*; the shrubs *Banksia nivea*, *Philotheca spicata*, *Kingia australis* and *Xanthorrhoea preissii*; herbs, rushes and sedges, *Cyathochaeta avenacea*, *Dampiera linearis*, *Haemodorum laxum*, *Desmocladus fasciculatus*, *Mesomelaena tetragona* and *Tetraria octandra*. The introduced grass *Briza maxima* is also common in the community (DEC 2011). The floristic composition of the TEC depends on the water regimes of the area. This TEC occurs where groundwater is typically within 3 m of the natural ground surface, indicating a dependence on groundwater (DEC 2011).

The Interim Recovery Plan (DEC 2011) and Approved Conservation Advice (DotEE 2017a) indicate that SCP 3a is located between Ruabon (near Capel) and Guildford and is restricted to the SCP and Jarrah Forrest IBRA bioregions. The Interim Recovery Plan (DEC 2011) lists 26 occurrences of TEC SCP 3a from 16 locations covering approximately 145 ha in total area. More recent data obtained from DBCA indicates there is approximately 194 ha of the TEC remaining with mapped occurrences ranging in size from <1 ha to 33.83 ha.

Critical habitat for SCP 3a is described as the heavy soils on which it occurs, the fresh superficial groundwater, and/or surface water that helps sustain flora species in this wetland community, and the catchment for groundwater and surface water (DEC 2011) (DotEE 2017a). The Interim Recovery Plan states important occurrences of this TEC as 'occurrences that provide for representation of the community across its geographic range and that can be managed for conservation and/or with conservation included in their purpose' (English & Blyth 2000). Furthermore, because of its very restricted distribution, no condition thresholds have been applied to ecological community and hence all areas meeting the description of the SCP 3a are habitat areas critical to its survival (DotEE 2017a).

Key threats to SCP 3a include clearing, altered fire regimes, weed invasion, hydrological change, salinisation, grazing and introduction of disease (DEC 2011) (DotEE 2017a). Almost all of the SCP 3a occurrences are very close to or surrounded by highly urbanised areas. The frequency of fires, impact of recreational uses, risk of hydrological impacts, and incidence of illegal rubbish dumping are generally higher in urban areas. These factors can all lead to degradation of plant communities through increasing weed invasion and alteration of structure, species composition or loss of component taxa (DEC 2011) (DotEE 2017a). Salinisation and increased inundation as a consequence of clearing in the catchment may also represent threats to SCP 3a as it occurs in low lying sites in highly cleared areas, and most occurrences experience seasonal waterlogging or inundation (DEC 2011) (DotEE 2017a).

GHD (2021a) mapped SCP 3a at Lambert Lane Nature Reserve, Fletcher Park, and within the rail corridor south of Thomas Road. All three occurrences intersect the Development Envelope and Footprint (**Figure 13**).

Lambert Lane Nature Reserve and Fletcher Park are known to contain TEC SCP 3a and are represented by occurrences 9, 10 and 11 in the Interim recovery Plan (DEC 2011). DEC (2011) reports that these almost contiguous occurrences form a small cluster adjacent to the rail line and cover approximately 12.9 ha. Occurrences 9, 10 and 11 occur within Bush Forever Site no. 264 and extend east into the rail reserve and into Fletcher Park. The Eleventh Road end of the community has been fenced (DEC 2011). DEC (2011) notes that weed invasion, and recreational impacts including illegal access pose the most significant threats to TEC SCP 3a in this area.

Monitoring data collected by Golder (2021a) on behalf of the PTA from November 2020 to January 2021 indicates the water table in the vicinity of TEC SCP 3a in Lambert Lane Nature Reserve and Fletcher Park is approximately 6-8 m below ground level. Monitoring data collected during the same period from near Eleventh Road indicates the water table is approximately 2.2 m below ground level (Golder 2021a). Areas of TEC SCP3a in the vicinity of Lambert Lane Nature Reserve and the northern and central parts of Fletcher Park are considered to have a low reliance on groundwater.

GHD (2021a) also mapped an occurrence of SCP 3a south of Thomas Road. At this location TEC SCP 3a is limited to vegetation on both sides of the railway line in Good to Degraded condition. This occurrence is not listed in the Interim Recovery Plan (DEC 2011) and based on current available data represents a new record of TEC SCP 3a.

A total of 3.44 ha of SCP 3a has been mapped within the Development Envelope, of which 2.83 ha occurs within the Footprint. The majority (2.03 ha, 71.73%) of the TEC SCP 3a within the Footprint is in Good or better condition (**Table 17**).

Table 17 Extent and condition of TEC SCP 3a within the Development Envelope and Footprint

Condition	Extent in Survey Area (ha)	Extent in Development Envelope (ha)	Extent in Footprint (ha)
Excellent	6.78	0.07	0.02
Very Good	1.93	0.15	0.06
Good	3.32	2.38	1.95
Degraded	4.88	0.84	0.80
Total	16.9	3.4	2.8

6.4.9. Terrestrial and Aquatic Groundwater Dependent Ecosystems

Groundwater plays an important role in sustaining aquatic and terrestrial ecosystems. Groundwater dependent ecosystems (GDEs) require access to groundwater on a permanent or intermittent basis to meet all, or some, of their water requirements and maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al. 2011).

GDE's may be described as either terrestrial or aquatic (BoM 2021). Terrestrial GDEs rely on subsurface groundwater. Aquatic GDEs rely on the surface expression of groundwater, this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs (BoM 2021).

The Bureau of Meteorology (BoM 2021) GDE Atlas maps terrestrial GDEs within Lambert Lane Nature Reserve and Fletcher Park, largely aligning with the distribution of TEC SCP 3a. No other vegetation types mapped within the Development Envelope were considered representative of terrestrial GDEs (GHD 2021a).

Aquatic GDEs cover a large portion of the Development Envelope (BoM 2021). Vegetation that grows in association with Wungong Brook represents an aquatic GDE. Vegetation along the Brook is mapped as *Corymbia calophylla* and *Eucalyptus rudis* woodland on drainage line (VT04). There is 1.57 ha of this vegetation within the Development Envelope, of which 0.38 ha occurs within the Footprint. All Aquatic GDE is mapped as Degraded to Completely Degraded.

Approximately 68.63% of the Development Envelope is mapped as geomorphic wetlands, indicating large areas subject to seasonal waterlogging (GoWA 2021). A wetland assessment completed by Stream (Stream 2021a) reported that wetlands within (and surrounding) the Development Envelope have generally been subject to alteration and wetland processes and functions have been disrupted in many areas. However, intact native vegetation and ecosystems retain wetland values.

Broadscale mapping of Geomorphic Wetlands of the SCP indicates there is 20.63 ha of native vegetation mapped within the Development Envelope that grows in association with wetlands. Of this, 12.35 ha occurs within the Footprint, 2.52 ha of which comprise Conservation Category Wetlands. A breakdown of the native vegetation condition by wetland category is provided in **Table 18**.

Table 18 Extent of native vegetation by condition rating and wetland category within the Development Envelope and Footprint

Wetland category	Vegetation category rating	Extent in Development Envelope (ha)	Extent in Footprint (ha)
Conservation	Excellent	0.03	0.02
	Very Good	0.14	0.05
	Good	1.37	1.11
	Degraded	0.84	0.44
	Completely Degraded	1.55	0.90
Subtotal		3.9	2.5
Multiple Use	Excellent	0.04	<0.01
	Very Good	0.01	<0.01
	Good	0.83	0.67
	Degraded	4.06	2.29
	Completely Degraded	11.28	6.86
Subtotal		16.2	9.8
Resource Enhancement	Completely Degraded	0.48	0
Subtotal		0.4	0
Total		20.6	12.4

6.4.10. Flora

Diversity

Desktop searches identified 1,524 flora taxa, representing 130 families and 491 genera as potentially occurring within 5 km of the Development Envelope. This total comprised 1,264 native taxa and 260 introduced taxa (GHD 2021a).

Surveys have recorded 222 species, including 57 introduced and/or planted species (25%) (GHD 2021a). The total number of species recorded by the surveys is approximately the predicted species diversity estimate (based on a bootstrap estimate of species richness generated from the field data, (GHD 2021a). The survey area is representative of the floristic diversity in the local area.

Conservation significant flora

Desktop searches of the EPBC Act Protected Matters Database, NatureMap and DBCA Threatened and Priority Flora List (TPFL) and Western Australian Herbarium (WAHerb) databases identified the presence/potential presence of 76 conservation significant flora taxa within the 5 km of the Development Envelope. This total comprised 28 taxa listed as Threatened under the EPBC Act and/or BC Act and 48 taxa listed as Priority species by the DBCA.

GHD (2021a) recorded two significant flora taxa, including one Threatened taxon, *Eucalyptus x balanites*, and one Priority flora taxon, *Johnsonia pubescens* subsp. *cygnorum*. Of these, only *Johnsonia pubescens* subsp. *cygnorum* (Priority 2) occurs within the Proposal Footprint and Development Envelope.

A likelihood of occurrence assessment carried out after the field survey concluded that two significant flora taxa are known to occur in the area (although only *Johnsonia pubescens* subsp. *cygnorum* (Priority 2) was recorded within the Footprint and Development Envelope), one significant flora taxon is considered possibly occurring (*Diuris purdiei*) and the remaining 73 significant flora taxa are unlikely to occur within the Development Envelope. The known and possible significant flora are discussed below and shown in **Figure 14**.

A discussion is also provided on a spurious record of *Synaphea* sp. Serpentine (G.R. Brand 103) from Lambert Lane Nature Reserve, as well as three Threatened flora species identified by DAWE as possibly being significantly impacted by the Proposal.

***Eucalyptus x balanites* (Endangered)**

Eucalyptus x balanites (Cadda Road Mallee) is a putative hybrid that grows as sprawling tree mallee to 5 m high (WAH 2021). The taxon is endemic to Western Australia and known from two disjunct populations - a population in bushland at Fletcher Park comprising a single individual (Population 2, (DEC 2004)) and a population approximately 208 km north of Perth in the Badgingarra National Park in the Geraldton Sandplains region (Population 1, (DEC 2004)).

GHD (2021a) recorded *Eucalyptus x balanites* from two locations within the north-eastern part of Fletcher Park, with two individuals observed (one at each location). The locations of these records correspond with Population 2 in the Cadda Road Mallee (*Eucalyptus x balanites*) Recovery Plan (DEC 2004), however GHD (2021a) recorded two individuals compared with a single individual noted in the Recovery Plan (DEC 2004).

This taxon is not recorded within the Development Envelope and GHD (2021a) reported that it is unlikely that any further locations or individuals of this taxon occur in the Development Envelope.

***Johnsonia pubescens* subsp. *cygnorum* (Priority 2)**

Johnsonia pubescens subsp. *cygnorum* is a tufted perennial herb to 0.25 m high with white-green flowers observable in September (WAH 2021). The taxon is endemic to Western Australia and is known from 18 records representing approximately 14 populations with a distribution from south of the Swan River to near Pinjarra, a range of approximately 68 km (WAHerb 1998). The estimated total population size of *J. pubescens* subsp. *cygnorum* is 2,201 individuals based on available data (*pers comm*. DBCA 2021). Two populations are located on DBCA managed tenure, within unnamed Nature Reserve (R 51784) and Lambert Lane Nature Reserve (R 42044).

GHD (2021a) recorded three individuals of *Johnsonia pubescens* subsp. *cygnorum* at three locations within the Proposal Footprint. A further two locations with two individuals were recorded within 20 m of the Proposal Footprint. This included one individuals within the Development Envelope south of Thomas Road, and one individual outside, but within 1.5 m of the Development Envelope, in Fletcher Park. Individuals were recorded within *Corymbia calophylla* and occasionally *Eucalyptus marginata* and *Eucalyptus lane-poolei* open woodland (VT01) and Scattered *Corymbia calophylla* and *Eucalyptus marginata* (VT06) vegetation types.

GHD (2021a) reported that it is unlikely that any further locations or individuals of this taxon occur in their survey area (which includes the Development Envelope and Footprint) based on the level of survey effort and timing completed for this Proposal.

***Diuris purdiei* (Endangered)**

Diuris purdiei (Purdie's Donkey-orchid) is a slender, terrestrial orchid growing up to 45 cm tall. Flowering occurs from late September to mid-October, but only after a summer or early autumn fire (Brown et al. 1998). The taxon is endemic to Western Australia and is known from 55 records extending from near Manning Road in Perth, south to near the Whicher Range (DEWHA 2008; DBCA 2019). Due to the difficulty in detecting the species (as it only flowers following fire), current population estimates are unknown, and population sizes are considered indicative only (Government of Western Australia 2015). Where population information is available, numbers of individuals range from 30 to 1000+ individuals at recorded locations (WAH 2021). Based on Government of Western Australia (2015), a conservative total estimated population size is approximately 1,200 individuals.

Diuris purdiei grows on sandy to sandy clay soils in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *Eucalyptus marginata* and *Nuytsia floribunda* (DEWHA 2008a). The main identified threats to *D. purdiei* are habitat loss and invasive species. Extensive clearing has reduced available habitat, and *D. purdiei* is now largely confined to private and Shire land in the Perth metropolitan region (DEWHA 2008). It may also still exist in areas where fire has been absent for long periods, and searches after summer fires may result in the discovery of new populations (Brown et al. 1998).

A previous record in the south of Fletcher Park is present within the Development Envelope within *Corymbia calophylla* and occasionally *Eucalyptus marginata* and *Eucalyptus lane-poolei* open woodland (VT01). This DBCA TPFL record is from 2005 with nine individuals recorded. Targeted searches for this Proposal (traverses) during the flowering period did not record this species (GHD 2021a). *Diuris purdiei* flowers between late September and mid- October, but only in the season after a hot summer or early autumn fire (Brown et al. 1998). There is insufficient evidence to rule out the presence of *Diuris purdiei* within the Development Envelope due to the lack of suitable fire occurrence prior to the survey. It is notable the vegetation structure in the southern portion of Fletcher Park, where *D. purdiei* has been historically recorded, is highly disturbed and modified. The understorey is dominated by grassy weeds, including **Watsonia meriana* and **Moraea flaccida* at this location which may have reduced the ability for the *D. purdiei* population to persist (GHD 2021a).

This record of *Diuris purdiei* is within the Development Envelope, but outside of the Footprint (coming within 18 m at its closest point).

***Synaphea* sp. Serpentine (G.R. Brand 103) (Critically Endangered)**

Synaphea sp. Serpentine (G.R. Brand 103) is a perennial, erect, shrub, growing up to 60 cm tall and 50 cm wide (WAH 2021). The taxon is endemic to Western Australia, with its range is restricted from the west of Byford to the South of Serpentine. The taxon is currently known from six fragmented populations, predominantly along road and rail reserves (DPaW 2017). Flowers are yellow borne on long spikes, flowering in late August to November. The taxon grows in clumps, commonly in grey-brown sandy-loam or clay in seasonally wet areas (DPaW 2017).

A previous record *Synaphea sp. Serpentine* (G.R. Brand 103) from plot Lamb01, located in Lambert Lane Nature Reserve was noted by GHD (2021a). This DBCA WAHerb record is from 1995, but is not contained in the DBCA TPFL database, nor the Interim Recovery Plan for *Synaphea sp. Serpentine* (G.R. Brand 103) (DPaW 2017). GHD (2021a) completed a review of the specimen label details, which indicated the record was from Lambkin Nature Reserve in Serpentine, which is approximately 12.5 km south of the Proposal. This locality aligns with population information provided in the Interim Recovery Plan for *Synaphea sp. Serpentine* (G.R. Brand 103) (DPaW 2017). Furthermore, GHD (2021a) reported that there was *Synaphea sp. Serpentine* (G.R. Brand 103) listed on the Lamb01 plot species list (available from NatureMap (DBCA 2019)).

GHD completed targeted searches (traverses) for *Synaphea* species across their survey area. The searches were completed during the reported flowering period of *Synaphea sp. Serpentine* (G.R. Brand 103) as well as other *Synaphea* species. Multiple collections of *Synaphea* spp. were made from Lambert Lane Nature Reserve, Fletcher Park and across their survey area through targeted searching (traverses) and quadrat and opportunistic sampling. Of these collections *Synaphea gracillima*, *S. petiolaris* subsp. *petiolaris* and *S. acutiloba* were identified through the identification services at the WA Herbarium. No individuals of *Synaphea sp. Serpentine* (G.R. Brand 103) were recorded from the GHD (2021a) survey, despite adequate survey effort.

Based on the above information regarding the likely error of the *Synaphea sp. Serpentine* (G.R. Brand 103) record within Lambert Lane Nature Reserve and the adequate survey effort undertaken, GHD (2021a) concluded that *Synaphea sp. Serpentine* (G.R. Brand 103) was unlikely to occur in their survey area (which includes the Development Envelope and Footprint).

***Synaphea sp. Pinjarra Plain* (A.S George 17182) (Endangered)**

Synaphea sp. Pinjarra Plain (A.S George 17182) is distributed from north of Mudijong to West Coolup, occurring mostly in grey-brown sandy loams and occasionally in brown clay-sand overlain by laterite pebbles (DPaW 2016). The taxon is a perennial, erect, clumped shrub, growing up to 80 cm high. Large yellow flowers are held on long spikes, which flower between late August to November (WAH 2021). The taxon is currently known from 12 populations, predominantly growing on flats or seasonally wet areas along road and rail reserves (WAH 2021; DPaW 2016).

The closest known record of *Synaphea sp. Pinjarra Plain* (A.S George 17182) is 2.5 km south of the proposal (GHD 2021a). GHD completed targeted searches (traverses) for *Synaphea* species across their survey area. The searches were completed during the reported flowering period of *Synaphea sp. Pinjarra Plain* (A.S George 17182) as well as other *Synaphea* species. Multiple collections of *Synaphea* spp. were made from Lambert Lane Nature Reserve, Fletcher Park and across their survey area through targeted searching (traverses) and quadrat and opportunistic sampling. Of these collections *Synaphea gracillima*, *S. petiolaris* subsp. *petiolaris* and *S. acutiloba* were identified through the identification services at the WA Herbarium. No individuals of *Synaphea sp. Pinjarra Plain* (A.S George 17182) were recorded from the GHD (2021a) survey, despite adequate survey effort.

Based on the previous records and the adequate survey effort undertaken GHD (2021a) concluded that *Synaphea sp. Pinjarra Plain* (A.S George 17182) was unlikely to occur in their survey area (which includes the Development Envelope and Footprint).

***Drakaea micrantha* (Vulnerable)**

Drakaea micrantha (Dwarf Hammer Orchid) is a tuberous, terrestrial herb, growing up to 30 cm high. The taxon has silvery-grey heart-shaped leaves, with prominent green veins and red and yellow flowers, which grow 1.2 to 2.5 cm long. Flowering occurs during September to October (WAH 2021). The taxon is endemic to Western Australia, with scattered populations from Perth to Albany. The taxon predominantly grows in white-grey sand in cleared fire breaks and open disturbed patches (Brown et al. 1998). The taxon is associated with the EPBC Act listed TECs *Corymbia calophylla*-*Kingia australis* Woodlands on Heavy Soils of the Swan Coastal Plain and *Corymbia calophylla*-*Xanthorrhoea preissii* Woodlands and Shrublands of the Swan Coastal Plain (DEWHA 2008).

No recent records of *Drakaea micrantha* were identified within the study area (GHD 2021a). The preferred habitat for the taxon is typically *Banksia* woodland or *Kunzea glabrescens* thickets, which were not recorded during the surveys (GHD 2021a, AECOM 2020), nor occur within the Development Envelope. The targeted search efforts were undertaken during the flowering period and did not locate any individuals of the taxon (GHD 2021a).

Due to the lack of suitable habitat and adequate search effort during the survey, GHD (2021a) concluded that *Drakaea micrantha* was unlikely to occur in their survey area (which includes the Development Envelope and Footprint).

***Tetraria australiensis* (Vulnerable)**

Tetraria australiensis (Southern Tetraria) is a rhizomatous, tufted perennial, grass-like or herb, growing up to one metre high (WAH 2021). Flowering occurs from November to December, but only after a fire (TSSC 2008). The taxon is endemic to WA and occurs over a range between Perth and to near Busselton (DBCA 2019). The taxon grows in grey sand over clay, preferring winter-wet swampy depressions and drainage lines. The taxon has also been recorded in open forest or Marri woodland (TSSC 2008).

The closest recent record of *Tetraria australiensis* is located 4.7 km south of the proposal (from Brickwood Reserve) (GHD 2021a). Potentially suitable habitat (VT01) occurs within the Development Envelope. The targeted search efforts did not record the taxon. The survey was undertaken during the flowering period for the taxon, and despite requiring a fire event for flowering to occur, no uncertain *Tetraria* collections were made within the survey area (GHD 2021a). The Development Envelope lacks winter-wet, swampy depressions, or rises surrounding swamps. The drainage lines in the Development Envelope are modified and contain aggressive weeds species.

GHD (2021a) determined that *Tetraria australiensis* is unlikely to occur in the survey area (which includes the Development Envelope and Footprint). This is due to the lack of preferred habitat for the taxon and suitable targeted search effort undertaken.

Introduced flora

GHD (2021a) recorded fifty-seven introduced species, with three taxa listed as Declared Plants under the BAM Act and/or as Weeds of National Significance (WoNS). Two Declared Plants occur within the Development Envelope, **Rubus ulmifolius* (Black berry) and **Moraea flaccida* (One-leaf Cape Tulip). Forty-three (43) individuals of Black berry occur within the Development Envelope along Wungong Brook. These individuals are part of a larger population of the species that extends west along the Brook beyond the Development Envelope. Approximately ten individuals of One-leaf Cape Tulip occur within the Development Envelope within the rail corridor south of Thomas Road.

The records of One-leaf Cape Tulip occur within the Footprint.

The remaining introduced species present within the Development Envelope are considered environmental weeds and all have been previously recorded on the SCP (GHD 2021a). The majority of these species include weedy grasses and daisies. However, more aggressive weed species such as **Watsonia meriana* were also recorded (GHD 2021a). These species have the potential to invade adjacent native vegetation and cause further degradation.

6.4.11. Dieback

Dieback is a destructive plant disease caused by the pathogen *Phytophthora cinnamomi* (Dieback) and other *Phytophthora* species, which kills susceptible plants by attacking their root systems. Dieback is found throughout southern Western Australia in areas with susceptible plant species that receive rainfall in excess of 400 mm/year (Dieback Working Group 2014).

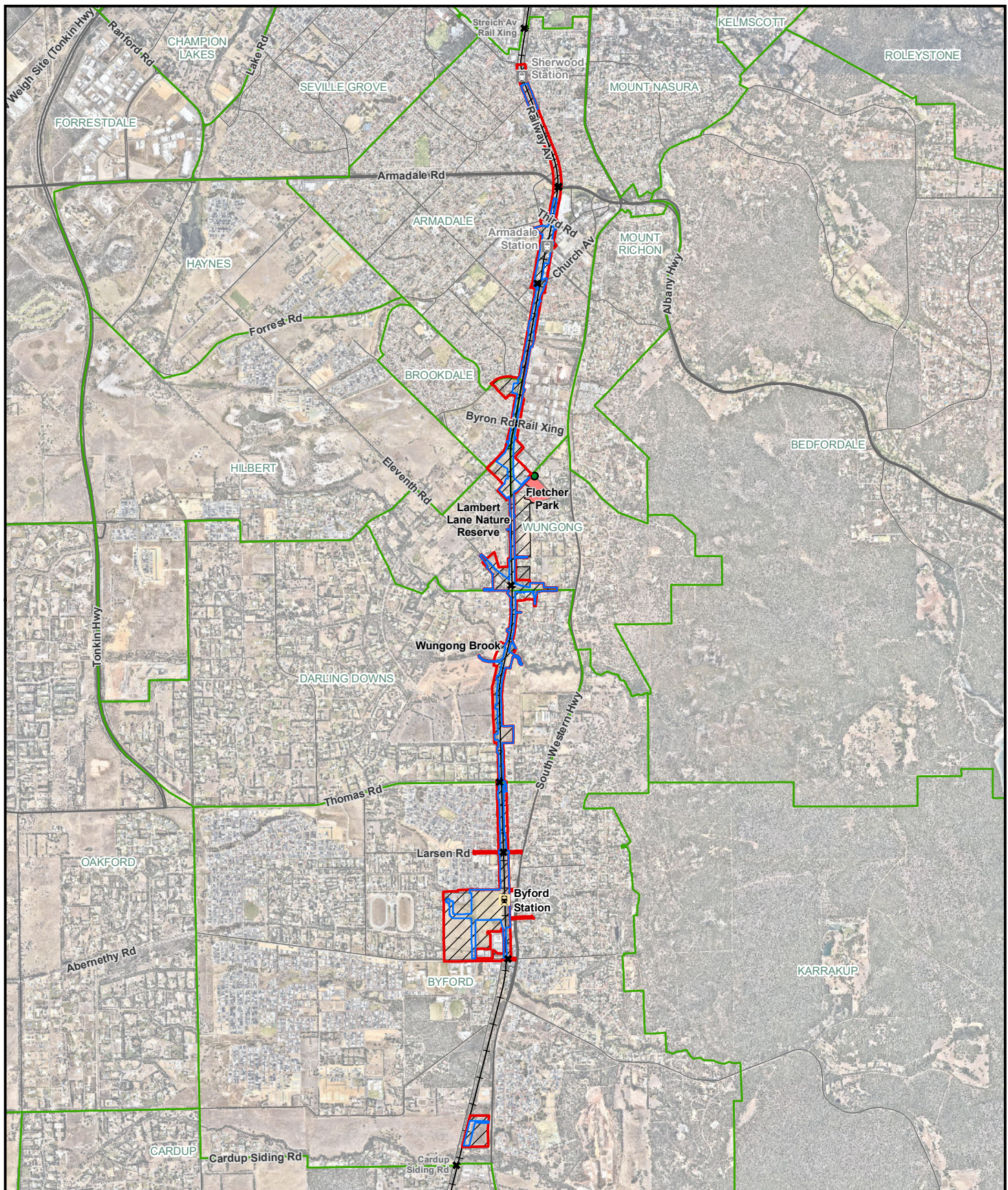
Glevan Consulting (Glevan 2021) conducted a dieback survey assessment for the Proposal. A desktop assessment indicated that Dieback has not been previously recovered within the Development Envelope. Glevan (2021) did not observe Dieback infestations within the Development Envelope. The entirety of the Development Envelope was categorised as Excluded due to degraded condition or being devoid of vegetation (**Figure 15**).

Glevan (2021) notes that there are sections of uninterpretable and potentially uninfested vegetation in the Byford section of the rail corridor. These sections are however, narrow, fragmented and degraded, and mapped as excluded. These sections are also not contiguous with any larger areas of protectable vegetation. Glevan (2021) also notes that due to the presence of several water-gaining sites it is likely that the pathogen is present at some sites within the excluded area.

The assessment identified an infested area adjacent to the Development Envelope in the north-eastern part of Fletcher Park. This area contains a creekline and has been mapped as infested during a previous dieback assessment of Fletcher Park by Dieback Treatment Services (Glevan 2021).

The vegetation along the eastern boundary of Lambert Lane Nature Reserve (adjacent to the Development Envelope) is known to be infested at the northern end of the reserve. The remainder of the vegetation on the boundary of the Reserve is degraded or lacking reliable Indicator Species and the disease status was unclear (Glevan 2021).

There are no protectable areas within the Development Envelope or Footprint. However, Glevan (2021) notes there are areas of high conservation value (such as Lambert Lane Nature Reserve and Fletcher Park) outside of the Development Envelope.



METRONET | Byford Rail Extension
Figure 15 | **Phytophthora Dieback Occurrence Mapping**

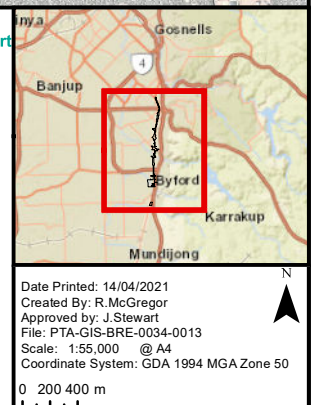


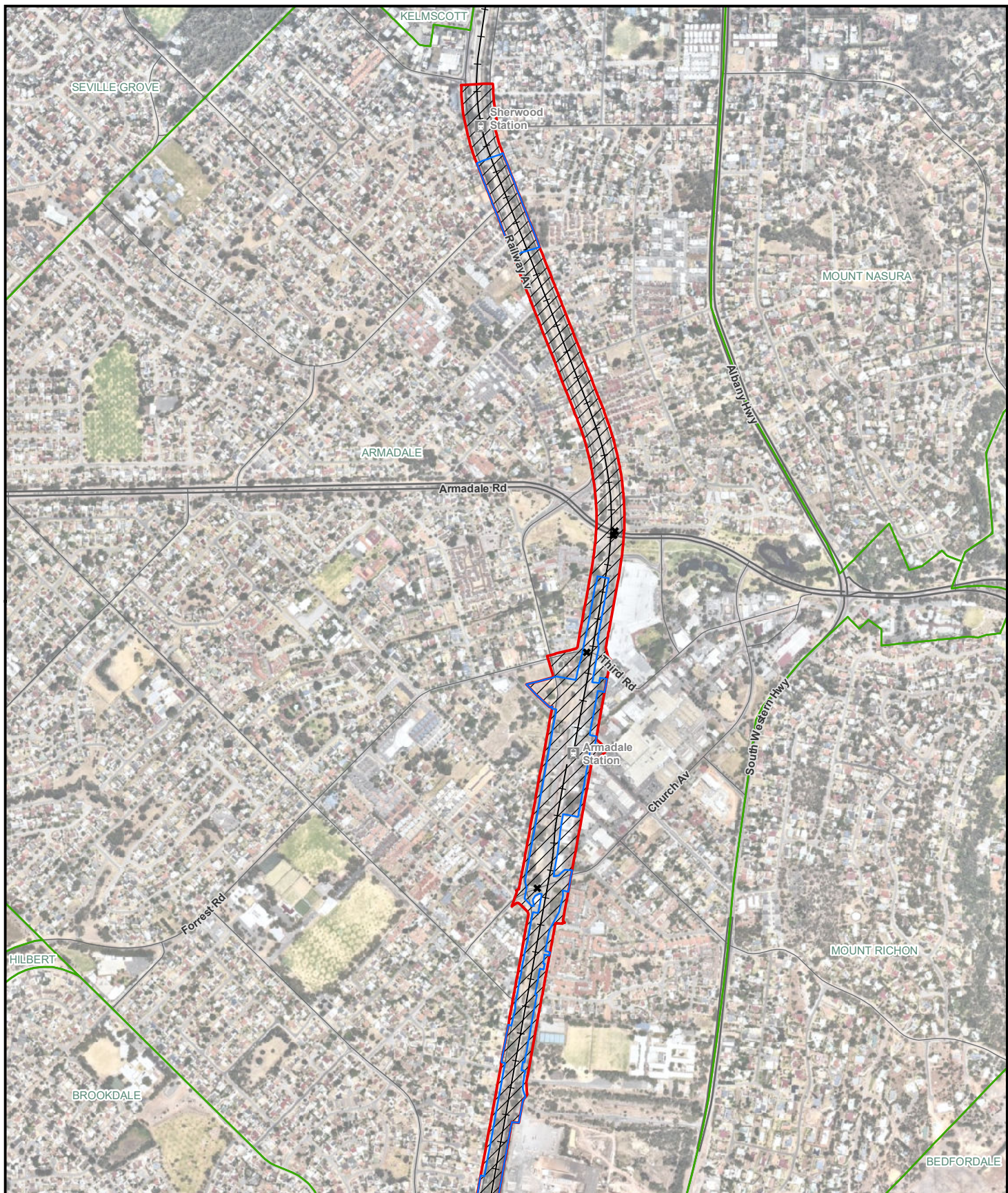
Public Transport
Authority

Legend

- | | |
|------------------------------|--------------------------------------|
| Footprint | Dieback Samples (Glevan, 2020) |
| Development Envelope | Dieback Status (Glevan, 2020) |
| Indicative Railway Alignment | Excluded |
| Proposed Railway Station | Infested |
| Existing Railway Station | |
| Rail Crossing | |
| Locality Boundary | |

A
B
C
D





METRONET | Byford Rail Extension
Figure 15A | **Phytophthora Dieback Occurrence Mapping**

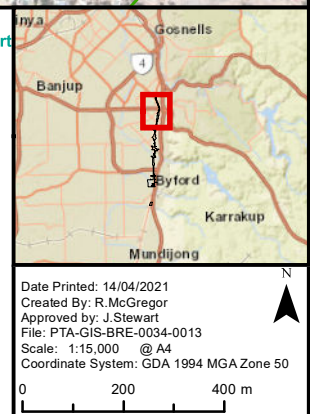


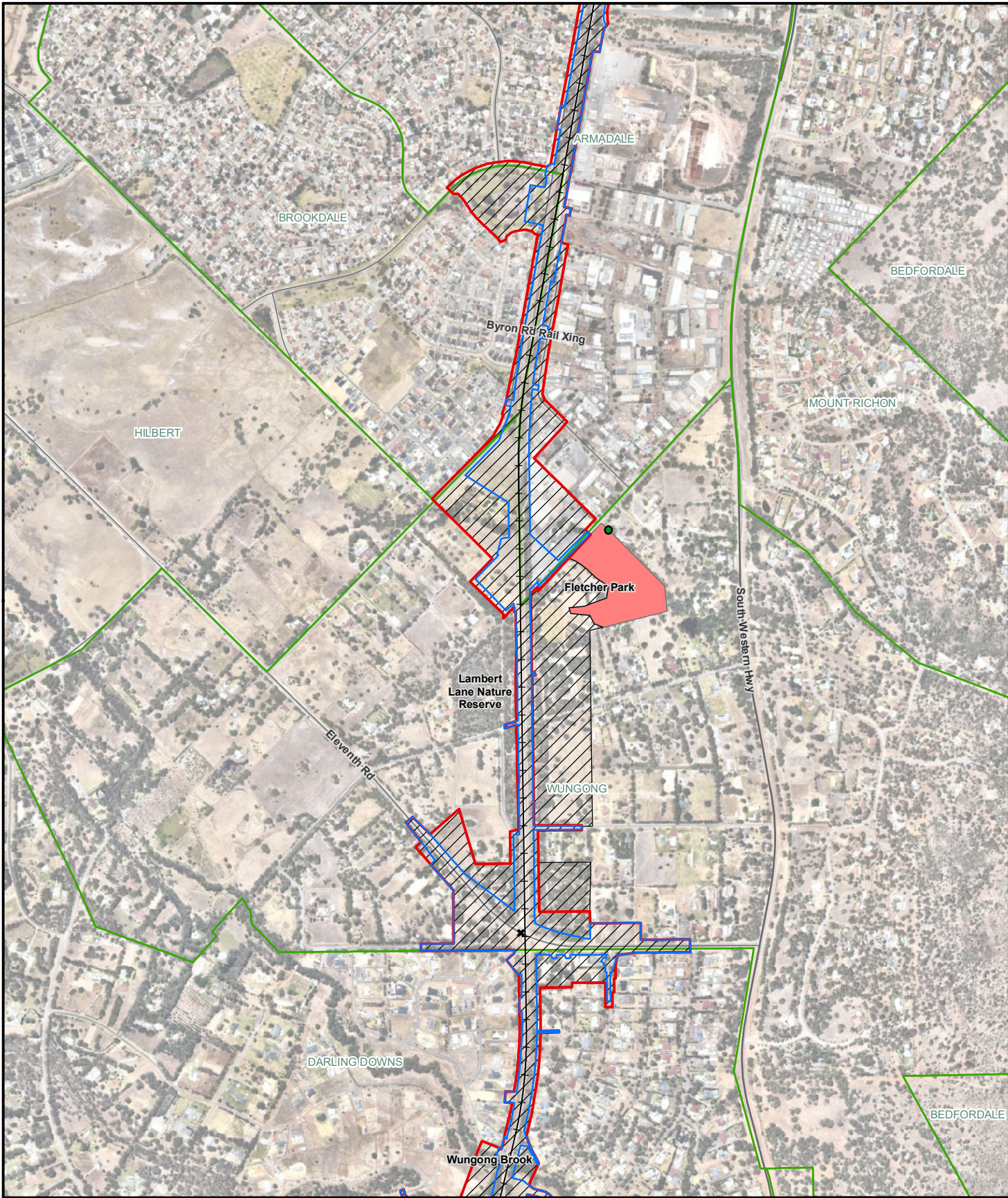
Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Existing Railway Station
- Rail Crossing
- Locality Boundary
- Dieback Status (Gleavan, 2020)**
- Excluded

A
B
C
D



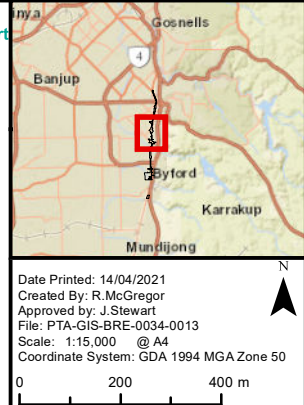


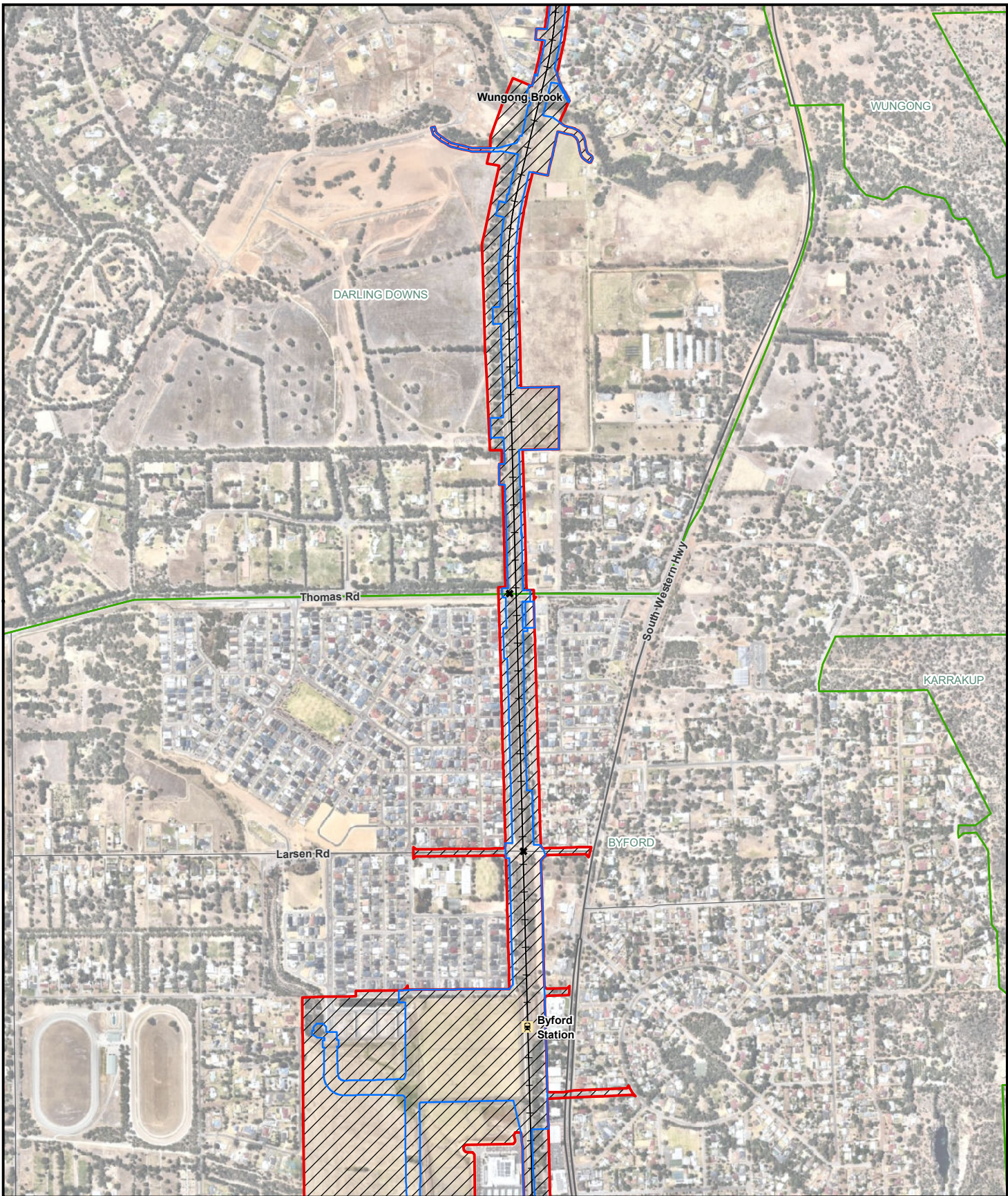
METRONET | Byford Rail Extension
Figure 15B | **Phytophthora Dieback Occurrence Mapping**



- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Rail Crossing
 - Locality Boundary
 - Dieback Samples (Glevan, 2020)
 - Dieback Status (Glevan, 2020)**
 - Excluded
 - Infested

A
B
C
D



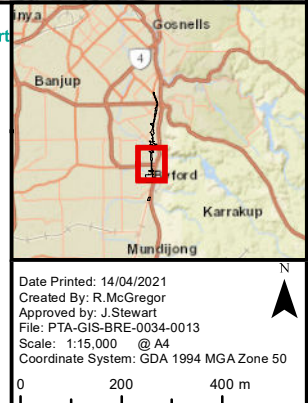


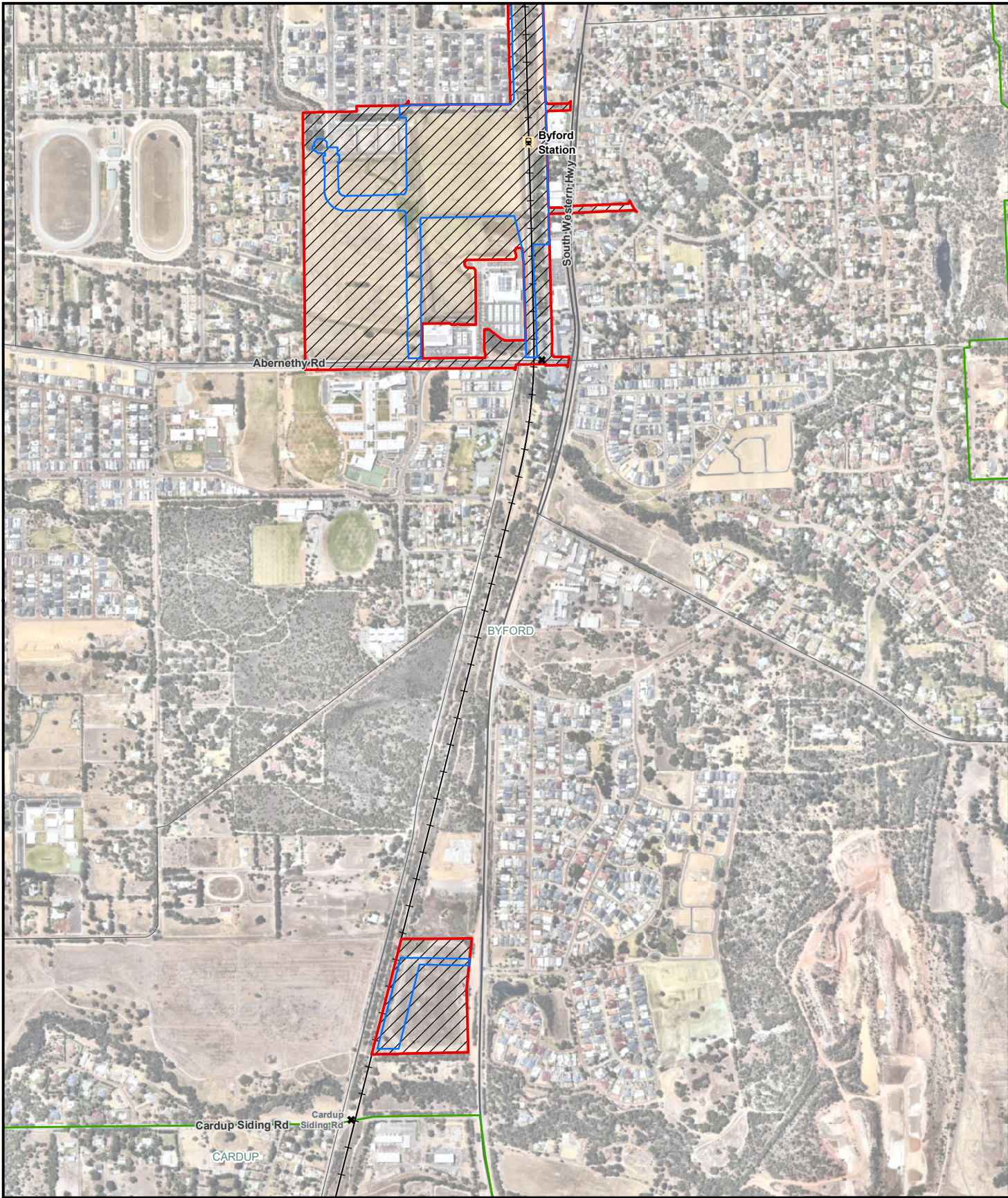
METRONET | Byford Rail Extension
Figure 15C | **Phytophthora Dieback Occurrence Mapping**



- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Proposed Railway Station
 - ✱ Rail Crossing
 - Locality Boundary
- Dieback Status (Gleavan, 2020)**
- Excluded

A
B
C
D



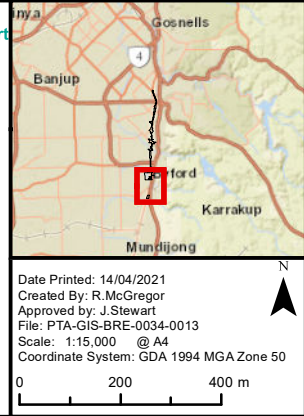


METRONET | Byford Rail Extension
Figure 15D | **Phytophthora Dieback Occurrence Mapping**



- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Rail Crossing
 - Locality Boundary
 - Dieback Status (Gleavan, 2020)**
 - Excluded

A
B
C
D



6.5. Potential impacts

6.5.1. Direct

The implementation of the Proposal will result in direct impacts on flora and vegetation values within the Development Envelope. The potential direct impacts on flora and vegetation from construction and operation of the Proposal include:

- permanent loss of flora and vegetation generally through clearing
- clearing of conservation significant flora and vegetation that occur, or have a high likelihood of occurring, within the Development Envelope.

6.5.2. Indirect

The Proposal's construction and operational activities may also indirectly impact flora and vegetation values. The potential indirect impacts on flora and vegetation include:

- dust deposition on surrounding vegetation
- introduction and/or spread of weeds to surrounding bushland areas
- decline of vegetation from changes to surface water drainage flows and infiltration during rainfall events
- increased edge effects
- introduction and/or distribution of diseases to surrounding bushland areas, including Phytophthora Dieback
- fragmentation of intact native vegetation including impacts on significant ecological communities, and the potential for fragmentation of ecological linkages.
- decline of significant ecological communities and groundwater dependent ecosystems from dewatering and groundwater abstraction
- increased risk of bushfire from operation of an electrified railway near areas of vegetation.

The PTA considers potential indirect impacts to key environmental values to occur within a 20 m zone of the Footprint (see Section 3.1.1). Approximately 55% of the potential indirect impact zone lies within the Development Envelope.

6.5.3. Cumulative

The implementation of the Proposal will also contribute to cumulative impacts on flora and vegetation values. The potential cumulative impacts on flora and vegetation include the permanent loss of flora and vegetation in the local and regional areas, including the loss of significant flora and vegetation discussed further in section 6.6.8.

6.6. Assessment of Impacts

6.6.1. Permanent loss of native vegetation through clearing

Impacts on regional vegetation

The Proposal will result in clearing of up to 15.98 ha of native vegetation. Native vegetation clearing will result in changes to the remaining extents of the Forrestfield and Guildford vegetation complexes at local and regional scales (**Table 19**). On the SCP the Forrestfield and Guildford complexes have 12.29% and 5.09% of their pre-European extents remaining respectively at the regional scale. Less than 2% of the current extents for both complexes are within conservation areas (e.g. DBCA managed lands). Following implementation of the Proposal, the current extent remaining of the Forrestfield complex would reduce by 1.66 ha to 2,801.70 ha (12.28% of its pre-European extent) on the SCP. Following implementation of the Proposal, the current extent remaining of the Guildford complex would reduce by 0.07 ha to 4,607.84 ha (5.09% of its pre-European extent) on the SCP.

At a local scale, the Forrestfield complex has 4.63% of its pre-European extent remaining within the City of Armadale and the Guildford complex has 4.25% its pre-European extent remaining within the Shire of Serpentine Jarrahdale. After Proposal implementation, the current extent remaining of the Forrestfield complex within the City of Armadale would decrease by 1.66 ha to 88.04 ha (4.45% of its pre-European extent). After Proposal implementation, the current extent remaining of the Guildford complex within the Shire of Serpentine Jarrahdale would decrease by 0.07 ha to 552.18 ha (4.25% of its pre-European extent).

The Forrestfield and Guildford complexes have limited remaining extents at all scales. The complexes are already below, or close to the now rescinded 10% target the EPA used as a guide for retention of vegetation complexes within constrained areas of the SCP (EPA 2008). The Proposal would result in further small reductions (1.66 ha or less) in the already limited extents of these complexes, reducing their current extents by 0.18% or less at all scales. Proposal impacts on the Forrestfield and Guildford complexes are mostly restricted to areas in Fletcher Park and along Wungong Brook. At these locations, native vegetation occurs directly adjacent to the existing rail reserve. While the Proposal has been designed to avoid areas of native vegetation where possible, vegetation clearing in Fletcher Park and along Wungong Brook is unavoidable. The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on native vegetation. Given the mitigation measures implemented and the small reductions in the remaining extents of the Forrestfield and Guildford vegetation complexes, Proposal clearing within the Forrestfield and Guildford complexes at local and regional scales is not considered significant.

Table 19 Impacts to vegetation complexes mapped in the Development Envelope and Footprint

Vegetation complex	Scale	Pre-European extent (ha)	Current extent remaining (ha) (%)	Extent in DE (ha) (%)	Extent in Footprint (ha) (%)	Current extent remaining after Proposal implementation (ha) (%)
Forrestfield	Swan Coastal Plain	22,812.92	2,803.36 (12.29%)	3.49 (0.12%)	1.66 (0.06%)	2,801.70 (12.28%)
	City of Armadale	1,937.18	89.70 (4.63%)	3.49 (3.89%)	1.66 (1.85%)	88.04 (4.45%)
	Shire of Serpentine Jarrahdale	4,514.76	411.02 (9.10%)	-	-	411.02 (9.10%)
Guildford	Swan Coastal Plain	90,513.13	4,607.91 (5.09%)	0.85 (0.02%)	0.07 (<0.01%)	4,607.84 (5.09%)
	City of Armadale	1,436.09	25.65 (1.79%)	-	-	25.65 (1.79%)
	Shire of Serpentine Jarrahdale	12,986.67	552.25 (4.25%)	0.85 (0.15%)	0.07 (0.01%)	552.18 (4.25%)

Impacts on local vegetation types

The Proposal will result in the permanent loss of up to 16.0 ha of native vegetation ranging from Excellent to Completely Degraded condition (**Table 20**). The native vegetation within the Footprint comprises six vegetation types. The remaining areas within the Footprint contain non-native (planted) vegetation or are existing cleared/hardstand areas. Of the six native vegetation types within the Footprint, *Corymbia calophylla* and occasionally *Eucalyptus marginata* and *Eucalyptus lane-poolei* open woodland (VT01) represents the *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils, SCP (SCP 3a) TEC (discussed below). *Corymbia calophylla* and *Eucalyptus rudis* woodland on drainage line (VT04) represents aquatic groundwater dependent vegetation.

Direct impact on native vegetation in Excellent to Degraded condition from Proposal clearing has been limited to 5.23 ha. This represents approximately 32.7% of the native vegetation within the Footprint and approximately 6.5% of the total Footprint area. The Proposal has been designed to avoid impacts to native vegetation in Good or better condition where possible through utilising the existing rail reserve and reducing the Footprint width within Lambert Lane Nature Reserve and Fletcher Park to as far as practicable.

Locally, there is approximately 5,315 ha of remnant vegetation mapped within 5 km of the Development Envelope (GoWA 2021). Approximately 83% of this remnant vegetation is located within the Jarrah Forest IBRA bioregion with the remaining 17% located on the SCP. Proposed clearing represents approximately 1.75% of this remnant vegetation mapped on the SCP.

Table 20 Impacts to native vegetation types mapped within the Development Envelope and Footprint

Vegetation type	Condition rating	Extent in Development Envelope (ha)	Extent in Footprint (ha)
VT01	Excellent	0.07	0.02
	Very Good	0.15	0.06
	Good	2.38	1.95
	Degraded	0.84	0.80
VT03	Degraded	<0.01	0.00
VT04	Degraded	0.93	0.25
	Completely Degraded	0.64	0.13
VT06	Good	0.10	0.10
	Degraded	2.62	1.84
	Completely Degraded	9.44	6.01
VT08	Degraded	0.05	0.03
	Completely Degraded	8.29	4.62
VT09	Degraded	0.95	0.17
Sub total	Excellent	0.07	0.02
	Very Good	0.15	0.06
	Good	2.48	2.05
	Degraded	5.40	3.10
	Completely Degraded	18.37	10.76
Total		26.5	16.0

Impacts on significant vegetation

Significant vegetation that will be directly impacted from construction and operation of the Proposal include TEC SCP 3a, Groundwater Dependent Ecosystems and native vegetation in conservation areas. No other significant vegetation will be directly impacted from the Proposal.

TEC SCP 3a

The Footprint contains 16.0 ha of native vegetation, of which 2.83 ha is mapped as TEC SCP 3a. The Proposal will impact three occurrences of this TEC, at Lambert Lane Nature Reserve (0.02 ha), Fletcher Park (1.89 ha), and within the rail corridor south of Thomas Road (0.92 ha) (**Figure 13**).

The PTA has designed the Proposal to avoid areas of TEC SCP 3a where possible and minimise impacts to this community through narrowing the Proposal Footprint width as far as practicable, particularly through Lambert Lane Nature Reserve / Fletcher Park areas. The Interim Recovery Plan (DEC 2011) states TEC SCP 3a in Lambert Lane Nature Reserve and Fletcher Park are represented by occurrences 9, 10 and 11 covering approximately 12.9 ha. However, the GHD (2021a) survey mapped approximately 15.83 ha at this location. The existing railway line already intersects the patch of TEC SCP 3a at Lambert Lane Nature Reserve and Fletcher Park. Clearing within the Proposal Footprint will be limited to the edges of TEC SCP 3a mapped within Fletcher Park and will mostly avoid TEC SCP 3a mapped at Lambert Lane Nature Reserve. Based on the GHD mapped extent of TEC SCP 3a at Lambert Lane Nature Reserve and Fletcher Park, the Proposal will clear up to 1.91 ha (approximately 12%) of TEC SCP 3a at this location.

The GHD (2021a) survey also mapped an occurrence of TEC SCP 3a south of Thomas Road. TEC SCP 3a is limited to vegetation on both sides of the railway line at this location. This occurrence is not listed in the Interim Recovery Plan (DEC 2011) and covers 1.08 ha (GHD 2021a). As this TEC SCP 3a occurrence is within the existing rail corridor, direct impact is unavoidable. Proposed clearing would impact on 0.92 ha (approximately 85%) of TEC SCP 3a at this location. The remaining TEC SCP 3a at this location after Proposal implementation will include a thin strip on the eastern side of the railway line (within the rail reserve) covering approximately 0.16 ha.

In total, the Proposal would clear up to 2.83 ha of TEC SCP 3a (Table 17). There is a further 3.0 ha of TEC SCP 3a adjacent to the Proposal Footprint, within the indirect impact zone (Table 17). While this 3.0 ha of TEC SCP 3a will not be directly impacted by clearing, there is potential for indirect impacts as a result of Proposal. Potential indirect impacts to TEC SCP 3a are discussed under subsequent sections.

Recent data obtained from the DBCA indicates there is approximately 194 ha of TEC SCP 3a across its range (*pers. comm.* DBCA). The clearing of up to 2.83 ha of TEC SCP 3a would result in a reduction of approximately 1.45% of the current extent of the TEC.

Offsets have been proposed to address these impacts to TEC SCP3a in Section 12.5 and in the Offsets Strategy (Appendix R)

Groundwater dependent vegetation

The Development Envelope contains native vegetation (aquatic GDE) associated with Wungong Brook (**Figure 13**). Clearing would result in the loss of approximately 0.4 ha of native vegetation along this Brook (**Table 21**). Native vegetation along Wungong Brook was mapped as Degraded (0.25 ha) and Completely Degraded (0.13 ha) in condition. Clearing of riparian vegetation associated with Wungong Brook would contribute to localised degradation of the Brook through loss of vegetation cover.

There is a further 1.1 ha of native vegetation associated with Wungong Brook, adjacent to the Proposal Footprint, within the indirect impact zone (**Table 21**). This vegetation will not be directly impacted by clearing, but there is potential for indirect impacts as a result of Proposal. While potential indirect impacts to vegetation are discussed under subsequent sections, the vegetation along Wungong Brook was in Degraded to Completely Degraded condition with individuals of Blackberry (a Declared weed) present.

Given the current state of groundwater dependent vegetation along Wungong Brook, direct and indirect impacts as a result of the Proposal are not considered significant.

The Development Envelope contains native vegetation associated with geomorphic wetlands based on the broad scale Geomorphic Wetlands of the SCP mapping (DBCA 2020). Clearing for the Proposal would result in the loss of native vegetation in Conservation, Multiple Use and Resource Enhancement Category wetlands. There are 2.52 ha of native vegetation mapped within Conservation Category wetlands. The majority of this (2.3 ha) is located within wetlands (UFI 12150, 12184 and 14179) where an amendment of the management category (from Conservation to Multiple Use) was recommended in the report on the wetland assessment commissioned for this Proposal (Stream 2021a). In line with the EPA's approach to Inland Waters, the Inland Waters section addresses the impact of the Proposal on geomorphic wetlands.

Loss of vegetation in conservation areas

The Proposal intersects three Bush Forever sites over an area of 4.1 ha, of which 1.54 ha is mapped as native vegetation. The existing rail corridor already intersects all three Bush Forever sites. Impacts to sites nos. 266 and 350 are limited to native vegetation in Degraded or Completely Degraded condition. The Proposal would impact on 0.20 ha of native vegetation in site no. 266 and on 0.04 ha of native vegetation in site no. 350, which equates to less than 1.4% of the total area of sites nos. 266 and 350 (**Table 21**).

The Proposal would clear up to 1.29 ha of native vegetation within Bush Forever site no. 264 (**Table 21**). Of the 1.29 ha, 1.02 ha is mapped as TEC SCP 3a ranging from Excellent to Degraded in condition (impacts to this are TEC are discussed above). Approximately 18% of site no. 264 intersects the Development Envelope; this includes the existing rail line.

There is a further 2.4 ha of native vegetation mapped within Bush Forever sites nos. 264, 266 and 350, adjacent to the Proposal Footprint, within the indirect impact zone (**Table 21**). This vegetation will not be directly impacted by clearing, but there is potential for indirect impacts as a result of Proposal. Potential indirect impacts to Bush Forever areas include introduction and spread of weeds, dieback and edge effects. Potential indirect impacts to native vegetation within Bush Forever sites nos. 264, 266 and 350 are discussed under subsequent sections.

Summary

The PTA have implemented mitigation measures to reduce direct impacts on significant vegetation, particularly TEC SCP 3a as far as reasonably practicable. This has included considering the location and extent of significant vegetation during design and Footprint selection to avoid and/or minimise impacts. As noted above, the Proposal Footprint has been narrowed in width as far as practicable, through Lambert Lane Nature Reserve / Fletcher Park areas to reduce impacts on TEC SCP 3a and Bush Forever site no. 264. The narrowed Footprint contains the required infrastructure and minimum constructability corridor for the Proposal.

Given the extent of TEC SCP 3a and the area of clearing proposed, the impact of the Proposal on this TEC may be considered significant. This is due to the direct impact of clearing a TEC, which is already limited in extent, including important occurrences of this TEC that are managed for conservation and/or with conservation included in their purpose, such as within Bush Forever sites. Management measures including the provision of environmental offsets have been proposed to address potential impacts to TEC SCP 3a from the Proposal (refer to Mitigation section).

While all three Bush Forever sites are already fragmented by the existing rail corridor, Proposal impacts on Bush Forever sites may be considered significant, as they will result in a reduction in native vegetation and overall site size at each site. Management measures including the provision of environmental offsets have been proposed to address potential impacts to Bush Forever sites from the Proposal (refer to Mitigation section 6.7 and Offsets section 12.7).

Table 21 Impacts to significant vegetation from the Proposal

Significant vegetation	Condition / Site no.	Direct Impact Footprint (ha)	Indirect Impact Zone (ha)	Total (ha)
TEC SCP 3a	Excellent	0.02	1.15	1.17
	Very Good	0.06	0.29	0.35
	Good	1.95	0.77	2.72
	Degraded	0.80	0.74	1.54
	Total	2.8	3.0	5.8
Aquatic GDE*	Degraded	0.25	0.47	0.72
	Completely Degraded	0.13	0.60	0.73
	Total	0.4	1.1	1.5
Conservation Category Wetlands	Excellent	0.02	0.95	0.97
	Very Good	0.05	0.27	0.32
	Good	1.11	0.61	1.72
	Degraded	0.44	0.84	1.28
	Completely Degraded	0.90	0.59	1.49
	Total	2.5	3.3	5.8
Bush Forever	Site No. 264	1.29	2.01	3.3
	Site No. 266	0.21	0.32	0.52
	Site No. 350	0.04	0.03	0.07
	Total	1.54	2.4	3.9

6.6.2. Clearing of significant flora

Johnsonia pubescens subsp. cygnorum

There are three individuals of *Johnsonia pubescens* subsp. *cygnorum* within the Proposal Footprint. A further two individuals are located within the indirect impact zone.

Johnsonia pubescens subsp. *cygnorum* is found over a range of 68 km in WA (where it is endemic), from Como in the Perth metropolitan area to Pinjarra in the south (DBCA 2019). The taxon is known from 18 records representing approximately 14 populations. The estimated total population size of *J. pubescens* subsp. *cygnorum* is 2,201 individuals based on available data (pers. comm. DBCA 2021).

The Proposal will remove up to three individuals of *J. pubescens* subsp. *cygnorum* (**Table 22**). The removal of three individuals represents an approximate 0.13% loss of the total estimated population of the taxon. The direct impact of the Proposal on *J. pubescens* subsp. *cygnorum* is therefore unlikely to be significant.

The Proposal has the potential to indirectly impact on an additional two individuals of *J. pubescens* subsp. *cygnorum* located adjacent to the Proposal Footprint (within the indirect impact zone) (**Table 22**). The PTA proposes to peg and flag these individuals prior to any ground disturbance to ensure all staff and contractors are aware of their locations. All clearing lines will be inspected prior and post- clearing to ensure no direct or indirect impacts. Other potential indirect impacts to *J. pubescens* subsp. *cygnorum* are discussed under subsequent sections.

Diuris purdiei

A previous record of *Diuris purdiei* is located within the Development Envelope (and indirect impact zone), at the southern end of Fletcher Park.

Diuris purdiei is known from 55 records extending from Perth south to near the Whicher Range (DEWHA 2008). The species only flowers in the season after a hot summer or early autumn fire (Brown, Marchant & Thomson- Dans 1998).). Based on Government of Western Australia (2015), a conservative total estimated population size is approximately 1,200 individuals.

The survey (GHD 2021a) did not record *Diuris purdiei*. In the absence of a suitable fire event preceding the survey, the previous record was unable to be confirmed, but is assumed present for the purpose of this impact assessment. The DBCA TPFL record is from 2005 with nine individuals recorded. While the record is within the Development Envelope, it is outside the Footprint (18 m at its closest point).

The Proposal has the potential to indirectly impact on the estimated nine individuals of *Diuris purdiei* located within the indirect impact zone (**Table 22**). The PTA commits to avoiding and buffering the record site to prevent ground disturbance at this location. Management measures have been proposed to address potential impacts to significant flora including *Diuris purdiei* from the Proposal (refer to Mitigation section). The Proposal is thus not expected to directly impact *Diuris purdiei*.

Table 22 Impacts to significant flora from the Proposal

Taxon	Status	No of individuals		
		Direct Impact Footprint	Indirect Impact Zone	Total estimated population
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	Priority 2	3	2	2,201
<i>Diuris purdiei</i>	Endangered	-	9	1,200

6.6.3. Impacts from dust, weeds, change to surface water drainage flow patterns and infiltration during rainfall events and/or edge effects

Dust

The Proposal will generate dust during construction activities, typically related to the movement of vehicles, earth moving and placement of ballast. Dust deposition on foliage has the potential to affect the ability of plants to photosynthesise, or control water loss through transpiration. The indirect impacts on flora and vegetation from dust deposition is difficult to quantify in isolation. Dust accumulation on vegetation can be cyclical with dust loads increasing during dry conditions and decreasing following rainfall. New foliage growth and rehabilitation or paving of disturbed areas will reduce the effects of dust after construction.

Dust suppression measures will be implemented during construction to minimise dust accumulation on adjacent vegetation. Management measures will include the use of water trucks to minimise wind-borne dust from exposed surfaces, restricted vehicle movements and speeds throughout the Development Envelope and use of hydromulch or similar soil stabiliser on stockpiles. The Proposal is not expected to result in a measurable change to vegetation health from dust accumulation in adjacent areas.

Dust levels are not likely to be significant during the Proposal's operational phase, as vehicle movements will be limited to periodical and occasional maintenance activities and electrified train movements do not generate significant dust.

No significant dust impacts are likely with the implementation of the Proposal's dust suppression measures.

Introduction and spread of weeds

The Proposal has the potential to introduce new weed species to the Development Envelope and/or cause the spread of existing weeds. Inadequate site hygiene measures and poor management of imported fill can both lead to the spread of weeds throughout the Development Envelope. Many weed species are disturbance specialists, and infestation risk increases during ground disturbing activities.

Individuals of Declared Pest One-leaf Cape Tulip occur within the Footprint and individuals of Declared Pest Blackberry occur within the Development Envelope. One-leaf Cape Tulip has the potential to spread along the rail corridor south of Thomas Road and Blackberry has the potential to further spread along Wungong Brook as well as to other areas within and adjacent to the Development Envelope through ground disturbing activities and movement of vehicles, plant and people.

The PTA will implement controls throughout the Development Envelope and indirect impact zone to reduce the potential introduction and/ or spread of weeds. Key mitigation measures will include:

- Identify weed management zones aligned with significant weed infestations
- Control the infestation of One-leaf Cape Tulip and Black berry in accordance with DPIRD guidelines
- Regular inspections and monitoring for weeds
- Implement weed control through targeted chemical control programs
- Weekly visual inspections and spot checks for evidence of unauthorised access, compliance with hygiene requirements and presence of weeds in rehabilitated areas.

Proposal works may also result in the introduction and spread of weeds into adjacent vegetated areas (e.g. within the indirect impact zone) such as Lambert Lane Nature Reserve and Fletcher Park, which contain significant vegetation, TEC SCP 3a in Excellent to Degraded condition. Both Lambert Lane Nature Reserve and Fletcher Park are already subject to potential weed introduction and spread. Lambert Lane Nature Reserve is managed by the DBCA with weed invasion and recreational impacts including illegal access noted as significant threats to the Reserve. Fletcher Park is publicly accessible and potential weed introduction and spread may occur from recreational activities such as walking and horse riding. To reduce potential weed introduction and spread into the indirect impact zone, in areas that are known to support TEC SCP 3a, the PTA will implement additional mitigation measures including:

- Controlled access in the vicinity of Lambert Lane Nature Reserve and Fletcher Park to reduce and restrict movement of vehicles, plant and people. This may include installation of temporary fencing, barriers and/or signage
- No storage of topsoil known to contain weeds and/or weed seeds
- Appropriate 'clean on entry and exit' hygiene measures.

To reduce potential weed introduction and spread into the indirect impact zone during operation of the Proposal, the PTA will undertake maintenance conforming with the PTA Bushfire Management Strategy which includes regular control of weeds within the rail reserve.

With the implementation of weed hygiene measures, the Proposal is not likely to result in the introduction or spread of weeds that could result in significant impacts on vegetation and flora. With respect to TEC SCP 3a in adjacent areas of Lambert Lane Nature Reserve and Fletcher Park, potential indirect impacts from the introduction and spread of weeds are expected to be limited to the construction phase of the Proposal. The management measure proposed are expected to limit weed introduction and spread into adjacent areas of TEC SCP 3a, particularly into Lambert Lane Nature Reserve where an existing access track runs along the boundary of the Development Envelope creating a buffer. Risks of indirect impacts resulting from weed introduction and spread are low and any impacts occurring are expected to be of limited severity on adjacent vegetation including TEC SCP 3a.

Changes to surface water drainage flow patterns and infiltration during rainfall events

The Proposal has the potential to cause indirect impacts on vegetation and flora adjacent to the Development Envelope, including areas of TEC SCP 3a by altering drainage flow patterns and infiltration during rainfall events. The removal of vegetation and earthworks within the Development Envelope has the potential to alter surface hydrology, altering rainfall runoff and recharge patterns and impact on adjacent vegetation. Large portions of the Development Envelope and surrounding areas are surrounded by existing cleared and hardstand areas reducing the likelihood of impacts on adjacent vegetation. Areas of TEC SCP 3a and significant flora adjacent to the Development Envelope are already subject to altered drainage flow patterns and infiltration from the presence of access tracks and the existing railway line.

The PTA will implement drainage management during construction to minimise impacts to adjacent vegetation and flora. Management measures will include the installation of temporary drainage diversions as required, temporary capture of runoff to control discharge of sediment and minimise turbidity of water leaving the Development Envelope and the placement of culverts to maintain existing flows. During construction these activities will be managed in accordance with the Construction and Environmental Management Plan (CEMP) that will incorporate DWER guidance such as: *Infrastructure corridors near sensitive water resources, and Stormwater management at industrial sites*. The infiltration of surface water runoff within the Development Envelope will maintain the existing hydrological regime within the Pinjarra Plain, which is characterised by clayey soils and poor drainage. Furthermore, detailed design will incorporate drainage and stormwater design including water sensitive urban design initiatives to minimise surface water flow impacts during Proposal operation.

Given the Development Envelope's location in a highly modified environment and implementation of management measures during construction, the Proposal is not likely to result in changes to surface water drainage that could result in significant impacts on vegetation and flora. This includes significant vegetation, TEC SCP 3a and significant flora *Johnsonia pubescens* subsp. *cygnorum* and *Diuris purdiei*. The management measure proposed are expected to limit changes to surface water drainage and infiltration and will minimise indirect impacts on adjacent areas of TEC SCP 3a resulting in no to limited impact severity on TEC SCP 3a.

Edge effects

The condition of remnant native vegetation adjacent to the Development Envelope could potentially decline if appropriate weed, dieback, bushfire and surface water drainage management measures are not implemented. The Development Envelope is located adjacent to conservation areas including Lambert Lane Nature Reserve and Fletcher Park, which contain areas of native vegetation, including significant vegetation TEC SCP 3a in Excellent and Very Good condition and significant flora *Johnsonia pubescens* subsp. *cygnorum* and *Diuris purdiei*.

The Proposal is located within an existing rail reserve, partially cleared and serviced by access tracks along the majority of its length. The corridor will be widened in parts but the length of the interface between the Proposal and adjacent vegetation (area of potential edge effects) will not significantly increase. The implementation of appropriate management measures during both the construction and operation phases to minimise the risk of introducing weeds, dieback, dust and fire (refer to discussions under respective headings) will ensure edge effects are not significantly increased. Indirect impacts resulting from edge effects are expected to be limited to the construction phase and are not expected to change from current levels.

6.6.4. Introduction and/or distribution of diseases including Phytophthora Dieback

Glevan (2021) mapped the entire Development Envelope as 'not assessable' for dieback, being either degraded or devoid of native vegetation. No mapped areas were designated as 'protectable'. Glevan (2021) notes that there are sections of 'uninterpretable' and potentially 'uninfested' vegetation within the Development Envelope, as well as 'infested' areas due to the presence of several water-gaining sites. The disease has been recorded nearby in conservation areas including Lambert Lane Nature Reserve (along its eastern boundary at the northern end) and Fletcher Park (north eastern corner) (Glevan 2021).

There is the potential for dieback to be introduced to the Development Envelope from construction activities, through the movement of soil adhering to vehicles, plant and machinery, as well as via personnel. Dieback can also be introduced via imported fill material extracted from a dieback infested area. Over time, indirect impacts can occur from dieback migrating off site along waterways and via members of the public carrying infected dirt on shoes into previously dieback free areas. Proposal works also could potentially introduce and spread dieback into adjacent vegetated areas (e.g. within the indirect impact zone) which contain significant vegetation such as TEC SCP 3a and significant flora *Johnsonia pubescens* subsp. *cygnorum* and *Diuris purdiei*. No hygiene boundaries or Clean on Entry (COE) points were proposed by Glevan (2021), but hygiene measures were proposed to manage the risks of dieback movement within the Development Envelope and surrounding areas.

Glevan (2021) reported the potential for the disease to be introduced or spread into Lambert Lane Nature Reserve during Proposal activities appears to be low. This is due to the presence of a buffer (a vehicle access track) that runs along the edge of the Development Envelope separating it from vegetated areas of the Reserve. The implementation of the Proposal's Dieback hygiene measures are likely to reduce the risk of introduction or spread of Dieback. Key management measures include:

- Demarcation of infested and uninfested areas
- Access control (vehicles, soil and equipment)
- Implementing vehicle and plant hygiene protocols
- Undertaking disturbance activities under dry soil conditions (where possible)
- No storage of top soil or movement of soil and plant material from the Development Envelope into Lambert Lane Nature Reserve or Fletcher Park.

With respect to Lambert Lane Nature Reserve, Glevan (2021) recommends construction of a 'green bridge' along the access track south of Lambert Lane. Use of dieback free material such as crushed limestone or quarried blue metal ballast of approximately 50 mm to 100 mm thickness is recommended to create a green bridge (Glevan 2021). This 'green bridge' will lower the risk of dieback spread into Lambert Lane Nature Reserve, reducing potential indirect impacts on vegetation in conservation areas including TEC SCP 3a.

The Proposal is not likely to result in the introduction or spread of Dieback that could result in significant indirect impacts on vegetation and flora. With respect to TEC SCP 3a in adjacent areas of Lambert Lane Nature Reserve and Fletcher potential indirect impacts from the spread of dieback are expected to be limited to the construction phase of the Proposal. The management measure proposed are expected to limit dieback spread into adjacent areas of TEC SCP 3a, particularly into Lambert Lane Nature Reserve. Indirect impacts as a result of dieback spread are expected to be of no to limited severity on adjacent vegetation including TEC SCP 3a.

6.6.5. Fragmentation of native vegetation

Clearing for construction of the Proposal is unlikely to result in fragmentation of suitable habitat or occurrences of significant flora and vegetation. Fragmentation may affect the survival of individual populations of significant flora or the function of vegetation communities, particularly significant vegetation. The existing rail reserve already fragments native vegetation and significant flora populations in the local area. While the Proposal will contribute to further fragmentation in the local area, by slightly increasing the distance between already separated populations and communities, the Proposal will not bisect any additional patches of native vegetation to create two or more smaller patches, including within Lambert Lane Nature Reserve and Fletcher Park. The Proposal is thus considered unlikely to result in fragmentation that would significantly impact vegetation and flora.

6.6.6. Decline of significant ecological communities and groundwater dependent ecosystems from dewatering and groundwater abstraction

Impacts caused by dewatering and groundwater abstraction could potentially result in the decline of significant ecological communities and GDE adjacent to the Development Envelope. The TEC SCP 3a areas within the Development Envelope are identified as terrestrial GDE. No other terrestrial GDEs are mapped within or adjacent to the Development Envelope.

Groundwater abstraction

Temporary abstraction of groundwater will be required to supply water for construction purposes. Bores installed into the Leederville or Yarragadee aquifers will provide this water supply. Construction water supply bores are planned in two areas, in the vicinity of Eleventh Road and Byford Station. Indicative sites for the bores are shown on Figure 35 (in Inland Waters). The bores will intersect groundwater-bearing intervals in the Leederville and Yarragadee aquifers. The bores near Eleventh Road will draw from the Leederville Aquifer and the bores near Byford Station will draw from the Yarragadee Aquifer, both averaged over the nine-month construction period (see section 8.10.1). The final number and location of these water supply bores will be determined once the Proposal's designs are finalised. Key considerations for their final locations and pumping rate will be the yield of the local aquifer and distance from sensitive receptors, such as significant vegetation, TEC SCP 3a.

TEC SCP 3a occurrence located south of Thomas Road is situated approximately 600 m from the Byford Station area at its closest point. Approximate depth to groundwater in the vicinity of this TEC occurrence is estimated to be 6-8 m below ground level (Golder 2021a). Post-clearing there will be approximately 0.16 ha of TEC SCP 3a, remaining as a thin strip on the eastern side of the railway line (within the rail reserve). TEC SCP 3a occurrences in Lambert Lane Nature Reserve and Fletcher Park extend within the rail corridor to near Eleventh Road. Monitoring data collected by Golder (2021a) on behalf of the PTA from November 2020 to January 2021 indicates the water table in the vicinity of TEC SCP 3a in Lambert Lane Nature Reserve and Fletcher Park is approximately 6-8 m below ground level. Monitoring data collected during the same period from near Eleventh Road indicates the water table is approximately 2.2 m below ground level (Golder 2021a). Areas of TEC SCP3a in the vicinity of Lambert Lane Nature Reserve and the northern and central parts of Fletcher Park are considered to have a low reliance on groundwater.

Golder (2021a) concluded drawdown risks could be minimised by maintaining a minimum distance of 50 m between the Proposal's bores and GDEs (including TEC SCP 3a). This was based on the analysis indicating a 0.2 m drawdown at 50 m and no drawdown impacts at a distance of 100 m (Golder 2021a). Applying the precautionary principal, as far as is practicable, the PTA will adopt a minimum separation of 100 m to ensure there are no drawdown impacts to occurrences of TEC SCP 3a within Lambert Lane Nature Reserve and Fletcher Park, and south of Thomas Road. Additional controls to minimise impacts include adjusting the rate and duration of abstraction to allow drawdown during pumping cycles to recover.

Indirect impacts from groundwater abstraction for construction of the Proposal on TEC SCP 3a occurrences (post-clearing) are not anticipated (Table 21). This is due to the separation distance of at least 50 m, and as far as practicable 100 m between the proposed construction water supply bores and TEC 3a occurrences. Furthermore, the PTA recognises that abstraction cannot be undertaken until a RIWI Act licence and Water Operating Strategy (if required) are approved by the DWER. The Water Operating Strategy must include identification of all sensitive receptors, management measures to avoid or minimise impact, a monitoring programme to demonstrate this is the case and contingency measures to ensure any unforeseen impacts are identified and appropriate actions are taken to prevent inadvertent impacts. Based on TEC SCP 3a low reliance on groundwater across the Development Envelope, proposed separation distances for abstraction bores and management measures which will be developed as part of a Water Operating Strategy, no indirect impacts on TEC SCP 3a from groundwater abstraction are anticipated, and therefore impact severity is considered negligible.

Dewatering

Temporary dewatering of up to 1.5 m may be required during the construction of pile caps for the new Wungong Brook bridge (Agonis 2021). The Agonis assessment indicates dewatering is not required anywhere else within the Development Envelope. The preliminary hydrological assessment (Golder 2021) estimated dewatering rates at the Wungong Brook bridge crossing to be less than 5 L/sec, based on the stratigraphy and permeability values obtained from the PTAs monitoring bores. Pumping for dewatering will continue as long as construction in the excavation continues. This is expected to occur over a period of several months. Analyses by Golder indicate drawdown is estimated to be less than 0.2 m or one tenth of the normal seasonal water table fluctuation between 40 and 50 m from the dewatered site. Drawdown outside of this area is expected to be indistinguishable from natural water table fluctuations. Given the small amount of dewatering required and proximity to perennial flows along Wungong Brook, the water table will recover within several months after dewatering stops.

Vegetation that grows in association with Wungong Brook represents an aquatic GDE. Vegetation along the Brook is described as *Corymbia calophylla* and *Eucalyptus rudis* woodland on a drainage line (VT04). There is 0.38 ha of this vegetation within the Footprint (to be cleared) and a further 0.40 ha in Degraded and Completely Degraded condition within 50 m of the Wungong Brook bridge site (Table 23). It is noted that the 50 m buffer of the Wungong Brook bridge site is wholly within the Development Envelope.

Based on groundwater depth tolerances specified within Froend and Loomes (2006), *Eucalyptus rudis* has a water depth tolerance range (absolute) of 1.03 m (maximum) and -6.44 m (minimum) and *Corymbia calophylla* has a water depth tolerance range (absolute) of -0.45 m (maximum) and -8.83 m (minimum). It is estimated the maximum extent of significant vegetation that may be impacted from dewatering for construction of pile caps for the new Wungong Brook bridge is 0.4 ha of aquatic GDE (*Corymbia calophylla* and *Eucalyptus rudis* woodland on a drainage line (VT04)) in Degraded to Completely Degraded condition (Table 23).

TEC SCP 3a occurrences are located in Lambert Lane Nature Reserve and Fletcher Park, and south of Thomas Road. These occurrences are approximately 700 m and 1.7 km from the Wungong Brook bridge site respectively. Based on the analyses by Golder on groundwater drawdown predicted vertical and horizontal extents, no indirect impacts from dewatering for construction of pile caps for the new Wungong Brook bridge on TEC SCP 3a occurrences are anticipated (Table 23).

The actual dewatering rates and volumes required for dewatering will be determined once the design and construction methods have been finalised. However, a preliminary hydrological assessment concluded that drawdown will not extend beyond 50 m of the bridge site and will largely remain within the Development Envelope (Golder 2021).

Given the location and the small amount of dewatering required, the estimated water table recovery time and the small extent of significant vegetation (Degraded to Completely Degraded aquatic GDE only) these impacts are unlikely to be considered significant.

Dewatering will cause temporary and localised groundwater drawdown, but is not expected to cause significant or long term, irreversible impacts on adjacent native vegetation GDE based on reported groundwater depth tolerances of dominant species along Wungong Brook. Furthermore, dewatering will be undertaken in accordance with a Water Operating Strategy (WOS), if required, as part of the licence and the CEMP to ensure significant impacts do not occur. Indirect impacts to significant vegetation (aquatic GDE). Based on the above reasoning, small maximum extent of significant vegetation (aquatic GDE) that may be impacted and management measures which will be developed as part of a Water Operating Strategy, minor indirect impacts on from groundwater dewatering are anticipated, and therefore impact severity is considered low.

Table 23 Indirect impacts to significant vegetation from groundwater abstraction and dewatering from the Proposal

Significant vegetation	Condition	Extent within 50 m of construction bore or dewatering (ha)
Groundwater abstraction		
TEC SCP 3a	Excellent to Degraded	-
Dewatering		
TEC SCP 3a	Excellent to Degraded	-
Aquatic GDE	Degraded	0.02
	Completely Degraded	0.40
	Total	0.4

6.6.7. Increased risk of bushfire

Bushfire potential depends on many factors, with the type and extent of vegetation, location and timing of rainfall being critically important for determining the potential fuel levels. An increase in human activity can pose a heightened risk of fire due to the potential increase in ignition sources. Clearing activities by their nature occur where fuel loads exist, meaning that they have the potential to trigger a fire. Other construction activities such as hot works (welding and grinding) are a potential ignition source for bushfire. Ignition from train operation and rail maintenance also have the potential to cause bushfires.

The Development Envelope is located in a built up area surrounded by a mix of residential, industrial, isolated stands of native and planted vegetation, and parks and reserves such as Lambert Lane Nature Reserve and Fletcher Park. Any bushfires within vegetated areas will impact on vegetation condition and may contribute to a decline in vegetation condition over time depending on fire frequency, intensity and extent.

The PTA will implement construction and operational controls including adherence to fire safety regulations to control the risk of fire. Construction contractors will be required to identify potential ignition sources and/or activities with the potential to cause fires, fire prevention and management measures in an EMP. The PTA Bushfire Management Strategy outlines the approach to bushfire risk reduction across PTA owned, managed or leased land. The PTA will implement regular bushfire hazard reduction measures, maintain strategic firebreaks and ensure controlled access to PTA land to manage the risk of bushfire as a result of the Proposal.

The risk of fire due to the Proposal is considered manageable through the implementation management measures outlined in the construction contractors EMP and the PTA Bushfire Management Strategy. The Proposal is unlikely to increase the likelihood of bushfire that would significantly impact vegetation and flora.

6.6.8. Cumulative Impacts

There are several other foreseeable activities, developments and land use proposals in the vicinity of the Proposal. These include:

- Thomas Road Bridge over Rail, Main Roads Western Australia – located adjacent to the Proposal on Thomas Road
- Tonkin Highway Extension (Thomas Rd to South West Highway), Main Roads Western Australia – located approximately 3.2 km west of the Proposal extending south and east
- Soldiers Road Principal Shared Path, Shire of Serpentine Jarrahdale – extending south of the Proposal.

These proposals have been used to inform the cumulative impacts of the Proposal.

A summary of the impacts of the other proposals in close proximity to the Proposal are provided in Table 24. A comparison of impacts to flora and vegetation from the implementation of the current Proposal to impacts from other proposals indicates the following:

- Implementation of the Proposal as well as other proposals will result in the loss of vegetation and flora. The vegetation types (and broad vegetation associations and complexes) recorded within the Proposal Footprint are not restricted to the local area, however, have limited remaining extents at all scales (see Table 15) due to the extensive clearing on the SCP. Whilst similar vegetation may be impacted from other nearby proposals, the extents of native vegetation clearing are relatively low (23 ha or less).
- The Tonkin Highway Extension (Thomas Rd to South West Highway) proposal also recorded TEC SCP 3a (*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils, SCP). The proposal will directly impact on 0.13 ha of this TEC. Based on recent data obtained from the DBCA (DBCA, pers. comm.) the current Proposal will result in a reduction of approximately 1.45% of the current extent of the TEC (see Section 6.6.1). The Tonkin Highway Extension (Thomas Rd to South West Highway) proposal will impact on a further 0.07% of the current extent of this TEC.
- There is no overlap in significant flora species recorded between the proposals, therefore no further impacts on *Johnsonia pubescens* subsp. *cygnorum* (Priority 2) or potential indirect impacts on *Diuris purdiei* (Endangered) are anticipated.
- The Soldiers Road Principal Shared Path proposal is likely to impact on Bush Forever site no. 350, Byford to Serpentine Rail/Road Reserves and adjacent bushland. It is unclear the extent of impact on this site as the clearing permit application states the Shire of Serpentine Jarrahdale intend to utilise the current access track for the PTA rail, however, permission is required. Based on the clearing permit application, the Soldiers

Road Principal Shared Path proposal and the current proposal will likely impact on the same areas of Bush Forever site no. 350 and potentially an area of TEC SCP 3a (*Corymbia calophylla* – *Kingia australis* woodlands on heavy soils, SCP).

- Due to the distance between the proposals, cumulative indirect impacts such as dust, introduction and spread of weeds and dieback, changes to surface hydrology, edge effects, groundwater abstraction and dewatering and risk of bushfire are not considered amplified or significant. While the Thomas Road Bridge over Rail proposal is adjacent to the current Proposal, there are very limited flora and vegetation values associated with this Proposal.

Table 24 Cumulative impacts to flora and vegetation values of the Proposal

Aspect / Project	Thomas Road Bridge over Rail	Tonkin Highway Extension (Thomas Rd to South West Highway)	Soldiers Road Principal Shared Path
Proponent	Main Roads Western Australia	Main Roads Western Australia	Shire of Serpentine Jarrahdale
Description	Thomas Road will be elevated to pass over the rail corridor with two lanes in each direction.	Extension of Tonkin Highway an additional 14 km to South Western Highway.	The Soldiers Road Principal Shared Path is a community project that will link the towns of Byford and Mundijong with a formal path.
Location	Shire of Serpentine Jarrahdale The bridge will be constructed slightly to the north of the existing Thomas Road alignment, between South Western Highway and Wungong South Road.	Shire of Serpentine Jarrahdale Thomas Road, Oakford to South Western Highway, south-east of Mundijong	Shire of Serpentine Jarrahdale Soldiers Road reserve and rail reserve between Byford and Mundijong. The Shire intend to utilise the current access track for the PTA rail, however, permission is required (based on the clearing permit application).
IBRA Bioregion	SCP	SCP	SCP
Proposed vegetation clearing	1.03 ha of native vegetation in highly disturbed condition.	20.6 ha of native vegetation	1.33 ha of native vegetation
Significant vegetation affected	None.	<ul style="list-style-type: none"> • 0.13 ha of <i>Corymbia calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils, SCP (SCP3a) TEC (Endangered) • 2.09 ha of <i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the SCP (SCP3c) TEC (Endangered) 	<i>Banksia</i> Woodlands of the SCP (Endangered TEC/Priority 3 PEC) TEC SCP 3a (<i>Corymbia calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils, SCP)

Aspect / Project	Thomas Road Bridge over Rail	Tonkin Highway Extension (Thomas Rd to South West Highway)	Soldiers Road Principal Shared Path
Significant flora affected	None.	<ul style="list-style-type: none"> 3 individuals of <i>Synaphea</i> sp. Serpentine (Critically Endangered) 165 individuals of <i>Tetraria australiensis</i> (Vulnerable) 	None.
Bush Forever	None.	6.6 ha in Bush Forever areas	Likely to be within Bush Forever site No. 350, Byford to Serpentine Rail/Road Reserves and Adjacent Bushland.

6.7. Mitigation

The PTA will apply the mitigation hierarchy to avoid, minimise, mitigate and rehabilitate potential direct, indirect and cumulative impacts to flora and vegetation during design and development of the Proposal (**Table 25** and **Table 26**).

Table 25 Mitigation measures for impacts to flora and vegetation

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	Assessment of impacts	Preliminary Mitigation Hierarchy
Permanent loss of up to 16 ha of native vegetation	<p>The Proposal will result in the clearing of up to 16 ha of native vegetation including 5.23 ha of native vegetation in Degraded or better condition, within an 80.7 ha Footprint. Native vegetation comprises approximately 20% of the Footprint. Clearing includes 0.04 ha of vegetation in Excellent condition.</p> <p>Proposed clearing represents approximately 1.75% of remnant vegetation mapped on the SCP within 5 km of the Proposal. The loss of native vegetation for the Proposal is therefore not considered significant.</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> • Consideration of flora and vegetation values during detailed design to avoid clearing, particularly in areas of significant flora and vegetation. • Construction and operational access tracks have been designed to coincide with existing tracks or aligned along cleared areas wherever practicable. <p><i>Minimise</i></p> <ul style="list-style-type: none"> • Cleared areas will be used for temporary construction requirements, wherever practicable. • The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on native vegetation. • The Development Envelope and Footprint to be marked on all design drawings as site boundaries. • Manage clearing of vegetation in accordance with the PTA Ground Disturbance Procedure and PTA Environmental Spatial Data Procedure. • No land clearing or ground disturbance work is to be undertaken until a Ground Disturbance Permit has been signed and issued by PTA. • Vehicles and equipment access limited to designated roads/access tracks and cleared areas. <p><i>Rehabilitate</i></p> <ul style="list-style-type: none"> • Areas cleared for the Proposal will be revegetated where not required for permanent infrastructure or management access and with consideration for operational safety requirements.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	Assessment of impacts	Preliminary Mitigation Hierarchy
Loss of ecological values protected in Bush Forever sites nos. 264, 266, 350	<p>The Proposal will result in the reduction of the total extent of the three Bush Forever sites by 4.1 ha, of which 1.54 ha is mapped as native vegetation.</p> <p>Impacts on 1.54 ha of the Bush Forever sites are considered significant and have been included in the Offset Strategy.</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> Clearing regionally significant bushland associated with Bush Forever has been avoided wherever practicable. <p><i>Minimise</i></p> <ul style="list-style-type: none"> The Proposal Footprint has been narrowed through Bush Forever site no. 264 as far as practicable to minimise impacts on native vegetation.
Permanent loss of up to 2.83 ha of <i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, SCP (SCP 3a) TEC	<p>The Proposal will impact three occurrences of TEC SCP 3a, at Lambert Lane Nature Reserve (0.02 ha), Fletcher Park (1.89 ha), and within the rail corridor south of Thomas Road (0.92 ha).</p> <p>Despite the avoidance and minimisation measures proposed, the loss of up to 2.83 ha of TEC SCP 3a is considered a significant impact, which has been included in the Offset Strategy.</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> Consideration of vegetation values during detailed design to avoid clearing, particularly in areas of significant vegetation. <p><i>Minimise</i></p> <ul style="list-style-type: none"> The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on TEC SCP 3a.
Permanent loss of aquatic GDE	<p>The Proposal will result in the permanent loss of 0.38 ha of aquatic GDE associated with Wungong Brook. The small area of clearing and degraded conditions of this vegetation is not considered a significant impact.</p> <p>The Proposal will also clear up to 2.5 ha of native vegetation mapped within Conservation Category wetlands.</p> <p>In line with the EPA's approach to Inland Waters, the Inland Waters section addresses the impact of the Proposal on geomorphic wetlands.</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> Consideration of vegetation values during detailed design to avoid clearing, particularly in areas of significant vegetation. <p><i>Minimise</i></p> <ul style="list-style-type: none"> The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on Conservation Category Wetlands.
Loss of conservation significant flora	<p>Targeted surveys identified 3 individuals of <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i> (Priority 2) within the Footprint, totalling four individuals within the Development Envelope and a further one</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> The <i>Diuris purdiei</i> record will be avoided and buffered to prevent ground disturbance at this location.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	<p>Assessment of impacts</p> <p>individual located adjacent to the Development Envelope. A previous record of <i>Diuris purdiei</i> (Threatened) is located within the Development Envelope, at the southern end of Fletcher Park.</p> <p>The Proposal is not considered to have a significant impact on <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i> or <i>Diuris purdiei</i>.</p>	<p>Preliminary Mitigation Hierarchy</p> <p><i>Minimise</i></p> <ul style="list-style-type: none"> All significant flora will be mapped and marked on site and avoided where possible during clearing. Ensure staff and contractors are aware of the location of significant flora and vegetation on site and their responsibility to ensure they are protected.
Indirect impacts from dust	<p>Vegetation condition has the potential to decline adjacent to the alignment and/or Footprint where due to dust deposition on foliage as a result of the Proposal.</p> <p>With the implementation of appropriate dust suppression measures, this impact is not considered to be significant.</p>	<p><i>Avoid</i></p> <ul style="list-style-type: none"> Vegetation clearing and earthworks will be avoided during high winds wherever practicable. <p><i>Minimise</i></p> <ul style="list-style-type: none"> Implement dust suppression measures outlined in the PTA Ground Disturbance Procedure. Dust suppression measures will be utilised at locations of high dust risk including internal construction roads, cleared areas, batters and stockpiles. Dust suppression measures such as application of water and dust suppressants will be implemented where dust generation is visible, except during topsoil stripping. Vehicle speeds on construction roads will be reduced where necessary to minimise dust emissions. Vehicles will remain within designated roads and park only in allocated areas.
Introduction and spread of weeds during construction	<p>There is a risk of the introduction and spread of weeds within areas of native vegetation in and adjacent to the Development Envelope. Appropriate management measures will be implemented to control access, ground disturbance and soil movement to minimise the spread of weeds into these areas.</p>	<p><i>Minimise</i></p> <ul style="list-style-type: none"> Manage weeds in accordance with the PTA Dieback and Weed Control Management Procedure. Identify weed management zones aligned with significant weed infestations.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	Assessment of impacts	Preliminary Mitigation Hierarchy
	<p>Wungong Brook is mapped as Degraded to Completely Degraded with one Declared Pest species (Black berry) recorded. The Proposal has the potential to spread this Declared Plant into along Wungong Brook.</p> <p>With the implementation of appropriate management measures, it is considered unlikely that this will result in a significant impact.</p>	<ul style="list-style-type: none"> Control the infestations of One-leaf Cape Tulip and Black berry within the Development Envelope in accordance with DPIRD guidelines. Construction Contractor to develop and implement a hygiene management process to control access and movement of vehicles and construction personnel to prevent the introduction and spread of weeds into weed free areas. Require all personnel to complete a site induction that will include hygiene training, including the environmental implications of the introduction and spread of weeds and associated obligations. Movement of topsoil restricted to within the same weed interpretation mapping so that topsoil from poorer quality weed interpretive areas aren't used in higher quality weed interpretive areas.. Controlled access in the vicinity of Lambert Lane Nature Reserve and Fletcher Park to reduce and restrict movement of vehicles, plant and people. This may include installation of temporary fencing, barriers and/or signage. No storage of topsoil known to contain weeds and/or weed seeds near Lambert Lane Nature Reserve and Fletcher Park. Source clean fill, gravel and topsoil or other materials from suppliers with appropriate weed control measures. Implement biannual weed monitoring and targeted spraying program at the Proposal during operation.
Changes to surface water drainage flow patterns and infiltration during rainfall events	<p>The Proposal has the potential to cause indirect impacts on vegetation adjacent to the Development Envelope by altering drainage flow patterns and infiltration during rainfall events. Large portions of the Development Envelope are surrounded by existing cleared and hardstand areas reducing the likelihood of impacts on adjacent vegetation.</p> <p>Given the Development Envelope's location in a highly modified environment and implementation of</p>	<p><i>Minimise</i></p> <ul style="list-style-type: none"> Installation of drainage structures to maintain or improve existing surface water drainage within the DE and incorporate erosion protection measures, where required. Placement of culverts to maintain existing surface water flows. Temporary capture of runoff to control discharge of sediment and minimise turbidity of water leaving the Development Envelope

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	Assessment of impacts management measures during construction, the Proposal is not likely to result in changes to surface water drainage that could result in significant impacts on vegetation and flora.	Preliminary Mitigation Hierarchy <ul style="list-style-type: none"> Construction staging will ensure appropriate surface water management such as culverts and drainage diversions are installed prior to the wet season wherever practicable.
Indirect edge effects during construction	<p>The condition of remnant native vegetation adjacent to the Development Envelope could potentially decline if appropriate weed, dieback, bushfire and surface water drainage management measures are not implemented. The Development Envelope is located adjacent to conservation areas including Lambert Lane Nature Reserve and Fletcher Park, which contain areas of native vegetation in Excellent and Very Good condition.</p> <p>The implementation of appropriate management measures to minimise the risk of introducing weeds, dieback, dust and fire will ensure edge effects are not significantly increased.</p>	<p><i>Minimise</i></p> <ul style="list-style-type: none"> The Proposal has been designed to avoid dissecting areas of native vegetation to limit edge effects by using an existing rail corridor.
Introduction and spread of dieback during construction	<p>There is the potential for dieback to be introduced to the Development Envelope from Proposal construction activities, through the movement of soil adhering to vehicles, plant and machinery, as well as via personnel. Dieback can also be introduced via imported fill material extracted from a dieback infested area. Over time, indirect impacts can occur from dieback migrating off site along waterways and via members of the public carrying infected dirt on shoes into previously dieback free areas.</p> <p>The implementation of the Proposal's Dieback hygiene measures are likely to reduce the risk of introduction or spread of Dieback. The Proposal is not likely to result in the introduction or spread of</p>	<p><i>Minimise</i></p> <ul style="list-style-type: none"> Manage dieback in accordance with the PTA Dieback and Weed Control Management Procedure. Construction Contractor to develop and implement a hygiene management process to control access and movement of vehicles and construction personnel. Ensure all vehicles and machinery observe appropriate hygiene measures as identified in the CEMP. Require all personnel to complete a site induction that will include hygiene training with regards to dieback, the environmental implications of the introduction and spread of dieback and obligations. Movement of topsoil restricted to within the same Phytophthora dieback interpretation mapping unit.

EPA Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.		
Potential impacts	Assessment of impacts	Preliminary Mitigation Hierarchy
	Dieback that could result in significant indirect impacts on vegetation and flora	<ul style="list-style-type: none"> Source clean fill, limestone, gravel and topsoil or other materials from suppliers with appropriate weed and dieback control measures Any topsoil known to be dieback infested to be reused in infested areas, buried onsite in a suitable location or disposed of at landfill, in accordance with regulatory requirements. Undertake disturbance activities under dry soil conditions (where possible). No storage of top soil or movement of soil and plant material from the Development Envelope into Lambert Lane Nature Reserve or Fletcher Park. Construction of a green bridge near Lambert Lane Nature Reserve.
Groundwater drawdown from dewatering and abstraction during construction	<p>Construction of the Proposal will require periods of groundwater abstraction and dewatering. Abstraction will be required to source a construction water supply, and dewatering will occur at Wungong Brook where the groundwater levels need to be reduced in order to construct the new Wungong Brook bridge</p> <p>With these management measures in place, indirect impacts on terrestrial (TEC SCP 3a) and aquatic GDEs are likely to be minimal.</p>	<p><i>Minimise</i></p> <ul style="list-style-type: none"> The PTA will monitor and manage drawdown and surrounding vegetation condition through: <ul style="list-style-type: none"> Monitoring requirements established under a RIWI Act 5C licence A water operating strategy, where required. Implementation of a TEC SCP 3a condition monitoring program to avoid impacts on terrestrial GDEs Adopt a minimum separation distance of at least 50 m, and as far as practicable 100 m, between the proposed construction water supply bores and TEC 3a occurrences.
Increased risk of bushfire	Construction and operation of the Proposal has the potential to increase bushfire risk. The Development Envelope is located in a built-up area surrounded by a mix of residential, industrial, isolated stands of native and planted vegetation, and parks and reserves such as Lambert Lane Nature Reserve and Fletcher Park. Any bushfires within vegetated areas will impact on vegetation	<p><i>Minimise</i></p> <ul style="list-style-type: none"> The Contractor will develop and implement bushfire management measures in line with the PTA Bushfire Management Strategy and in consultation with City of Armadale and the Shire of Serpentine Jarrahdale, to align any relevant existing local government Bushfire Management Plans. Require all personnel to complete a site induction that will include information on prevention of fires, including designated smoking areas,

EPA Objective:	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	
Potential impacts	<p>Assessment of impacts</p> <p>condition and may contribute to a decline in vegetation condition over time depending on fire frequency, intensity and extent.</p> <p>The risk of fire due to the Proposal is considered manageable through the implementation management measures. The Proposal is unlikely to increase the likelihood of bushfire that would significantly impact vegetation and flora.</p>	<p>Preliminary Mitigation Hierarchy</p> <p>no fires permitted in workplace, use of extinguishers, hot works procedures</p> <ul style="list-style-type: none"> • Working fire extinguishers to be fitted to all mobile plant equipment • All fuel stored on site to be in a secure bund with fuel storage to be minimised where possible • Refuelling of equipment and machinery to be completed in the early morning where possible • Machinery (chainsaws etc.) not to be placed on the ground where long grass exists following use • Approved Hot works permit to be in place for all 'hot work' (e.g. grinding / welding) • The area immediately surrounding 'hot work' to be dampened with water if vegetated and vegetation is not already naturally damp • The PTA will implement the PTA Bushfire Management Strategy to reduce bushfire risk during Proposal operation. Actions may include: <ul style="list-style-type: none"> – Implement regular bushfire hazard reduction through mechanical and chemical fuel load reduction – Maintain strategic firebreaks – Ensure controlled access to PTA land – Require safe operating procedures for high-risk maintenance activities – Adhere to the PTA's current fire emergency response procedures.

Table 26 Management Table

Mitigation / Management Action	Objective / Outcome	Timing	Location
<ul style="list-style-type: none"> Consideration of flora and vegetation values during detailed design to avoid clearing, particularly in areas of significant flora and vegetation. The Proposal Footprint has been narrowed through Lambert Lane Nature Reserve and Fletcher Park as far as practicable to minimise impacts on native vegetation. 	Minimise clearing of native vegetation for the Proposal	Detailed design	Development Envelope
<ul style="list-style-type: none"> Manage clearing of vegetation in accordance with the PTA Ground Disturbance Procedure and PTA Environmental Spatial Data Procedure. Vehicles and equipment access limited to designated roads/access tracks and cleared areas. Cleared areas will be utilised for laydown and temporary construction where practicable. 	Avoid unapproved clearing of native vegetation outside the Development Envelope	During construction	Development Envelope
<ul style="list-style-type: none"> Implement dust suppression measures outlined in the PTA Ground Disturbance Procedure, particularly at locations of high dust risk including internal construction roads, cleared areas, batters and stockpiles. Vegetation clearing and exposed surfaces will be kept to a minimum wherever practicable. Vegetation clearing and earthworks will be avoided during high winds wherever practicable 	Minimise dust generated from the Proposal	During construction	Development Envelope
<ul style="list-style-type: none"> Manage weeds in accordance with the PTA Dieback and Weed Control Management Procedure Identify weed management zones aligned with significant weed infestations. Control the infestation of Black berry and One-leaf Cape Tulip within the Development Envelope in accordance with DPIRD guidelines. Movement of topsoil restricted to within the same weed interpretation mapping so that topsoil from poorer quality weed 	Minimise the introduction and/or spread of weeds within the Development Envelope and into areas of adjacent vegetation	During construction	Development Envelope

Mitigation / Management Action	Objective / Outcome	Timing	Location
<p>interpretive areas aren't used in higher quality weed interpretive areas.</p> <ul style="list-style-type: none"> Source clean fill, gravel and topsoil or other materials from suppliers with appropriate weed control measures. Controlled access in the vicinity of Lambert Lane Nature Reserve and Fletcher Park to reduce and restrict movement of vehicles, plant and people. This may include installation of temporary fencing, barriers and/or signage. No storage of topsoil known to contain weeds and/or weed seeds near Lambert Lane Nature Reserve and Fletcher Park. 			
<ul style="list-style-type: none"> Implement biannual weed monitoring and targeted spraying program at the Proposal during operation. 	Minimise the introduction and/or spread of weeds within the Development Envelope and into areas of adjacent vegetation	During operation	Development Envelope
<ul style="list-style-type: none"> Manage dieback in accordance with the PTA Dieback and Weed Control Management Procedure. Develop and implement a hygiene management process to control access and movement of vehicles and construction personnel. Ensure all vehicles and machinery observe appropriate 'clean on entry and exit' hygiene measures as identified in the Construction Contractor CEMP. Movement of topsoil restricted to within the same Phytophthora dieback interpretation mapping unit. Source clean fill, limestone, gravel and topsoil or other materials from suppliers with appropriate weed and dieback control measures Any topsoil known to be dieback infested to be reused in infested areas, buried onsite in a suitable location, or disposed of at landfill, in accordance with regulatory requirements. Undertake disturbance activities under dry soil conditions (where possible). 	Minimise the introduction and/or spread of Phytophthora dieback within the Development Envelope and into areas of adjacent vegetation	During construction	Development Envelope and adjacent areas

Mitigation / Management Action	Objective / Outcome	Timing	Location
<ul style="list-style-type: none"> No storage of top soil or movement of soil and plant material from the Development Envelope into Lambert Lane Nature Reserve or Fletcher Park. Construction of a green bridge near Lambert Lane Nature Reserve. 			
<ul style="list-style-type: none"> Implement standard construction management measures for surface water and stormwater to maintain the hydrological conditions as far as practicable, in accordance with management measures outlined in Inland Waters. Installation of drainage structures to maintain or improve existing surface water drainage within the DE and incorporate erosion protection measures, where required. Temporary capture of runoff to control discharge of sediment and minimise turbidity of water leaving the Development Envelope 	Avoid impacts on native vegetation from changes to surface water drainage flow patterns and infiltration within the Development Envelope and in areas of adjacent vegetation.	During construction	Development Envelope and adjacent areas
<ul style="list-style-type: none"> Placement of culverts to maintain existing surface water flows. 	Avoid impacts on native vegetation from changes to surface water drainage flow patterns and infiltration within the Development Envelope and in areas of adjacent vegetation.	During operations	Development Envelope and adjacent areas
<ul style="list-style-type: none"> The impact of dewatering and abstraction on TEC SCP 3a and GDEs will be managed in accordance with management measures outlined in Inland Waters Implement vegetation condition monitoring during construction to monitor health of adjacent TEC SCP 3a and GDEs. Adopt a minimum separation distance of at least 50 m, and as far as practicable 100 m, between the proposed construction water supply bores and TEC 3a occurrences. 	Avoid dewatering and groundwater abstraction impacts on vegetation significant ecological communities and GDE with the Development Envelope and in adjacent areas.	During construction	Development Envelope and adjacent areas
<ul style="list-style-type: none"> PTA will develop and implement bushfire management measures in line with the PTA Bushfire Management Strategy and in consultation with City of Armadale and the Shire of 	Minimise risk of bushfire	During construction	Development Envelope

Mitigation / Management Action	Objective / Outcome	Timing	Location
<p>Serpentine Jarrahdale, to align any relevant existing local government Bushfire Management Plans.</p> <ul style="list-style-type: none"> Working fire extinguishers to be fitted to all mobile plant and equipment Approved Hot works permit to be in place for all 'hot work' (e.g. grinding / welding) The area immediately surrounding 'hot work' to be dampened with water if vegetated and vegetation is not already naturally damp. The PTA or its contractor will implement the PTA Bushfire Management Strategy to reduce bushfire risk during Proposal operation 	Minimise risk of bushfire	During operation	Development Envelope

6.8. Predicted Outcome

6.8.1. Residual impacts

With the implementation of the mitigation and management measures described in Table 25, the Proposal will result in the following residual impacts to flora and vegetation:

Permanent loss of up to 16.0 ha of native vegetation including:

- 5.22 ha of native vegetation in Degraded or better condition
- 2.83 ha of *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (SCP 3a) TEC
- 1.54 ha of vegetation associated with Bush Forever sites nos. 264, 266 and 350
- 2.52 ha of vegetation associated with Conservation Category wetlands
- Up to three individuals of *Johnsonia pubescens* subsp. *cygnorum* (Priority 2).

The PTA has demonstrated that, through the implementation of proposed management measures outlined in the Assessment of Impacts and Mitigation sections, it has kept residual impacts of the Proposal as low as reasonably practicable. This is demonstrated through consideration of flora and vegetation values during Proposal design, narrowing of the Proposal Footprint as far as practicable through Lambert Lane Nature Reserve and Fletcher Park, avoiding and buffering a Threatened flora record (*Diuris purdiei*) and proposing best practice management measures to reduce indirect impacts associated with dust, weeds, dieback, surface water, dewatering and bushfire. With the exception of impacts to TEC SCP 3a, regionally significant bushland within Bush Forever sites and vegetation associated with Conservation Category Wetlands, the PTA considers the Proposal's impacts are not considered to be significant.

The loss of up to 16.0 ha of native vegetation within the Footprint is a limited impact when considered in the context of its condition (5.23 ha in Degraded or better condition and 10.76 ha in Completely Degraded condition) and the remaining extent of surrounding vegetation within 5 km buffer of the Proposal (1.75% of remnant vegetation mapped on the SCP). However, this 16.0 ha, contains vegetation representative of TEC SCP 3a, vegetation associated with Bush Forever sites nos. 264, 266 and 350 and Conservation Category wetlands.

Proposed impacts to these values are considered significant, and these significant residual impacts will be managed in accordance with an Offsets Strategy.

The loss of three individuals of *Johnsonia pubescens* subsp. *cygnorum* (Priority 2) is not significant in the context of its known population extent, which equates to 0.13%. The PTA can manage potential impacts on the location of a historical record of *Diuris purdiei* (Endangered) during Proposal construction, through buffering the record and avoiding ground disturbing activities in adjacent areas.

6.8.2. Significant residual impacts

An assessment of the significance of the residual impacts concluded that significant residual impacts from the Proposal are the permanent loss of:

- 2.83 ha of *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils (SCP 3a) TEC
- 1.54 ha of vegetation associated with Bush Forever sites nos. 264, 266 and 350
- 2.52 ha of vegetation associated with Conservation Category Wetlands.

The PTA has proposed an offsets Strategy to counterbalance the significant residual impacts for the Proposal.

6.8.3. Predicted outcome

The key flora and vegetation values identified in the Development Envelope include remnant native vegetation and the presence of significant vegetation and flora.

The final design of the Proposal will include measures to avoid and minimise impacts on flora and vegetation.

The PTA operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. In considering potential impacts to flora and vegetation, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal and the implementation of the environmental offsets, the PTA considers the EPA objective for flora and vegetation will be met. Details of the environmental offsets are in Sections 12.5 and 12.7 of this document, and Appendix R (Draft Offset Strategy).

7. Terrestrial fauna

7.1. Introduction

The EP Act defines terrestrial fauna as animals living on land or using land (including aquatic systems) for all or part of their lives. It includes vertebrate and invertebrate groups (EPA 2016c).

Fauna habitat includes the natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live. The EPA recognises that there are inherent links between Terrestrial Fauna and other environmental factors (EPA 2016c).

This chapter describes how the Proposal may impact values of the factor, Terrestrial Fauna. The assessment addresses the construction and operational activities that could directly or indirectly impact Terrestrial Fauna.

Avoidance and mitigation measures have been applied where the Proposal was found to impact Terrestrial Fauna values.

The assessment identifies significant residual impacts to Terrestrial Fauna resulting from the Proposal including:

- 8.65 ha of foraging habitat for Baudin's Black Cockatoo classified entirely as moderate value foraging habitat
- 19.3 ha of foraging habitat for Carnaby's Cockatoo comprised of 8.65 ha of moderate value foraging habitat and 10.67 ha of low value foraging habitat
- 61.1 ha of foraging habitat for Forest Red-tailed Black Cockatoo comprised of 8.65 ha of moderate to high value foraging habitat and 52.49 ha of low value foraging habitat
- Loss of up to 139 potential Black Cockatoo breeding trees, 131 (94.2%) with no hollows, and eight (5.8%) hollow bearing trees not currently suitable for black cockatoos.

The significant residual impacts to Terrestrial Fauna from the Proposal will be counterbalanced by an offset at Lowlands Nature Reserve, the established METRONET offset site (Section 12.6.4). Further details regarding offset measures for residual impacts to Terrestrial Fauna are described in the Offsets Chapter.

7.2. EPA objectives

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

7.3. EPA policy and guidance

- Environmental Factor Guideline – Terrestrial Fauna (EPA 2016c).
- Instructions: IBSA Data Packages (EPA 2020a).
- Instructions on how to prepare an Environmental Review Document (EPA 2020b).
- Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016e).
- Technical Guidance: Sampling of short range endemic invertebrate fauna (EPA 2016f).
- Technical Guidance: Terrestrial fauna surveys (EPA 2016g).
- Technical Report: Carnaby's Black Cockatoo in Environmental Impact Assessment in the Perth and Peel Region (EPA 2019).

7.4. Other Policy and Guidance

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (DPaW 2013).
- Chuditch (*Dasyurus geoffroi*) Recovery Plan (DEC 2012).
- Conservation Advice for *Westralunio carteri* Carter's freshwater mussel (TSSC 2018).
- Draft Revised Referral Guideline for Three Threatened Black Cockatoo Species: Carnaby's Cockatoo, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo (DotEE 2017).
- Environmental Management Plan Guidelines (DotE 2014).
- *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPaC2012).
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2010).
- Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (DEC 2008).
- National Recovery Plan for the Woylie (*Bettongia penicillata ogilbyi*): Wildlife Management Program No. 51 (DEC 2012).
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act (DSEWPaC 2011).
- Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the EPBC Act (DSEWPaC 2011).
- Threat Abatement Plan for Competition and Land Degradation by Rabbits (DotEE 2016).
- Threat Abatement Plan for Disease in Natural Ecosystems caused by *Phytophthora cinnamomi* (DotEE 2018).
- Threat Abatement Plan for Predation by Feral Cats (DotE 2015).
- Threat Abatement Plan for Predation by the European Red Fox (DEWHA 2008).
- Western Australian Environmental Offsets Guidelines (GoWA 2014).
- Western Australian Environmental Offsets Policy (GoWA 2011).
- Western Australian Environmental Offsets Template (EPA 2014).

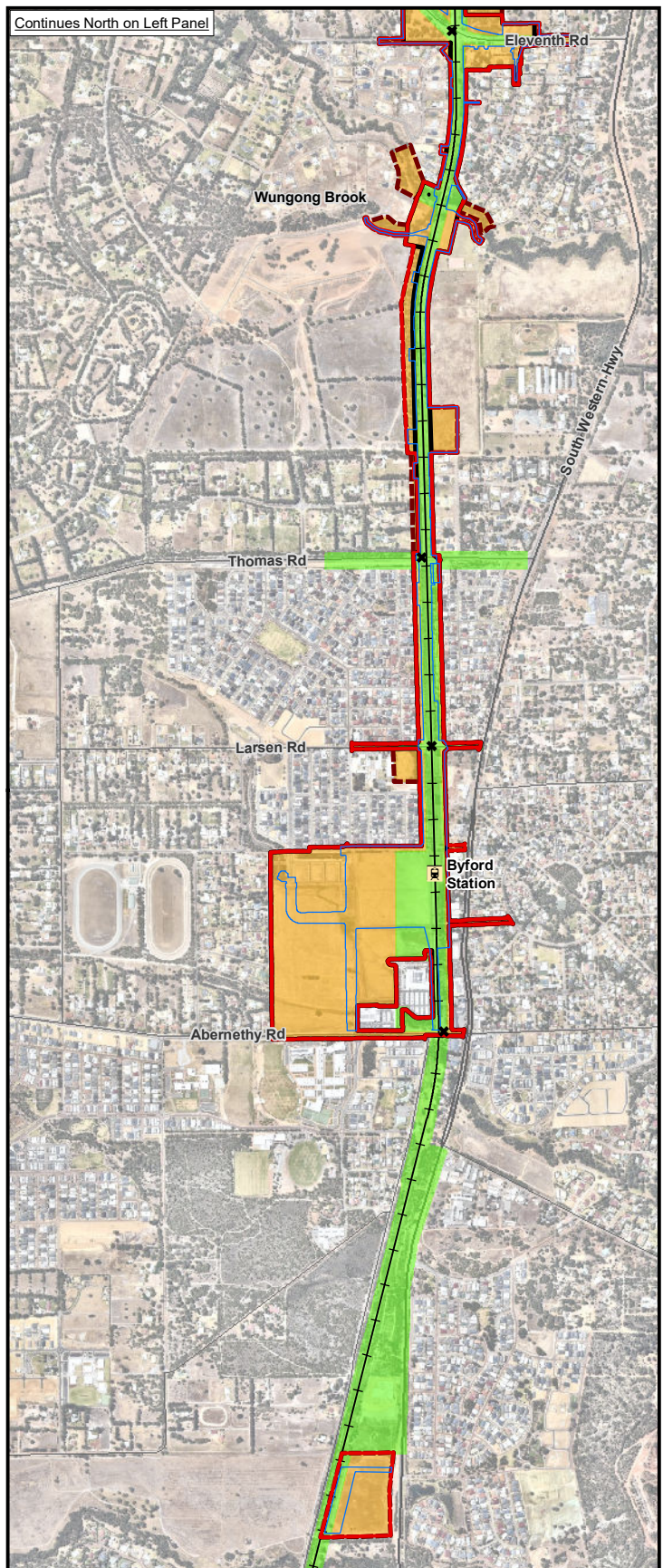
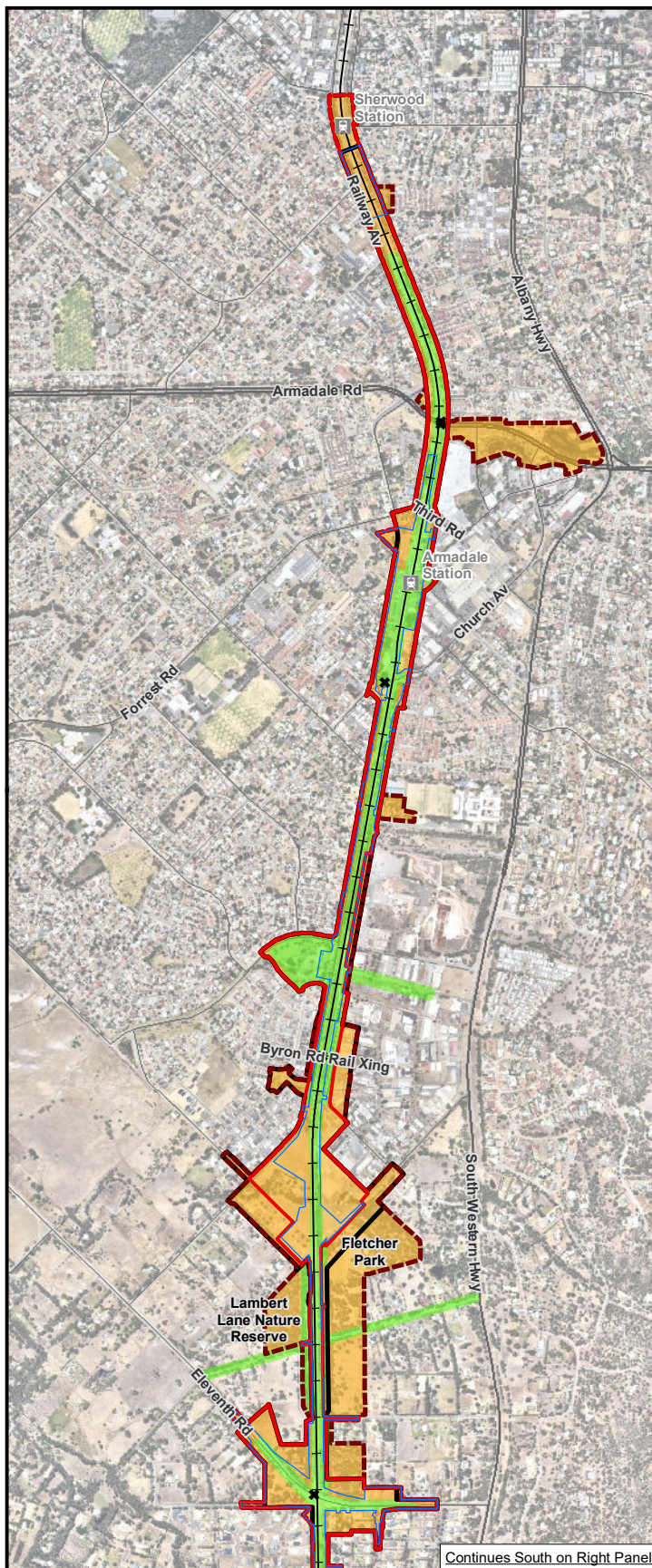
7.5. Receiving environment

7.5.1. Surveys and Studies

PTA has commissioned several project specific studies to gain an understanding of the terrestrial fauna values within and surrounding the Proposal. These include two reconnaissance assessments (Level 1 and basic) undertaken in accordance with EPA Technical Guidance (EPA 2016g; EPA 2020) and targeted surveys and assessments undertaken with reference to relevant survey guidelines and conservation advice. A consolidated terrestrial fauna report (GHD 2021b, 2021c) discusses results from these surveys. PTA has also commissioned a desktop short range endemic and conservation significant invertebrate assessment (Invertebrate Solutions 2020) for the Proposal.

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

Table 27 outlines key terrestrial fauna surveys relevant to the proposal and **Figure 16** shows the extent of survey coverage.



METRONET | Byford Rail Extension
Figure 16 | Terrestrial Fauna and Black Cockatoo Survey Coverage



- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Existing Railway Station
 - ✕ Rail Crossing
 - Carter's Mussel Assessment Survey Boundary (SEW, 2020)
 - Short Range Endemic (SRE) Survey Extent (Invertebrate Solutions, 2020)
 - Level 1 Fauna Survey and Black Cockatoo Survey (AECOM, 2020)
 - Fauna Survey Coverage (Bamfords, 2020)

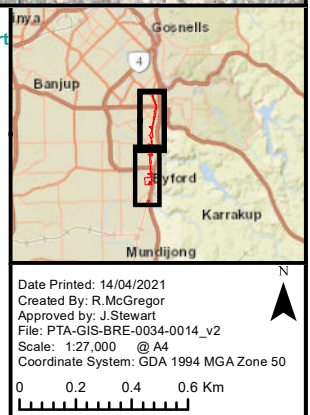


Table 27 Summary of environmental investigations relevant to fauna

Study/survey	Details
Byford Rail Extension Assessment of Possible Black Cockatoo Breeding Hollows (Kirkby 2021)	<p>Scope: Conduct a detailed assessment of potential Black Cockatoo breeding hollows recorded from previous surveys undertaken by AECOM (2020b) and Bamford Consulting (2021) for the Byford Rail Extension. Potential breeding hollows were inspected from ground level for signs of usage and hollows for suitability in relation to size, height from ground, and angle of hollow. Hollows were then raked with a pole to check for the presence of a female Black Cockatoo which may be incubating an egg or brooding a chick. Any hollow that appeared suitable for Black Cockatoos was then inspected with a pole camera, where safe to do so.</p> <p>Survey area: Development Envelope. Consultant: Tony Kirkby.</p> <p>Survey Dates: October - November 2020 (During the breeding season of Carnaby's and Baudin's Cockatoo, and local breeding of Forest Red-tailed Black Cockatoo).</p> <p>Report Date: January 2021.</p> <p>IBSA Submission: IBSA-2021-0166</p>
Byford Rail Extension Consolidated Fauna Assessment 2021 (GHD 2021b)	<p>Scope: Consolidate the results of the AECOM (2020b) and Bamford Consulting (2021) terrestrial vertebrate fauna surveys commissioned by the PTA for the Proposal. The consolidated terrestrial fauna report has been prepared to meet the conditions of the Environmental Scoping Document, that requires if multiple surveys have been undertaken to support the BRE assessment, a consolidated report should be provided, including integrating results of the surveys.</p> <p>Consultant: GHD.</p> <p>Survey Dates: Not applicable – culmination of results from AECOM (2020b) and Bamford Consulting (2021).</p> <p>Report Date: March 2021.</p> <p>IBSA Submission: No IBSA submission. All biological data contained in report is derived from fauna surveys reports listed, that have been uploaded to the IBSA website</p>
Byford Rail Extension Fauna Spring 2020 (Bamford Consulting 2021)	<p>Scope: A Basic fauna survey and targeted Black Cockatoo survey to identify fauna assemblage values and investigate the status of Black Cockatoos within the survey area, including their presence and extent, as well as the condition of foraging, breeding and roosting habitat within the Bamford Consulting survey area. The Basic fauna survey involved developing descriptions of the environments that provide habitat for fauna, identifying fauna species and significant environments present, the ecological processes upon which fauna may depend, general patterns of biodiversity, and threats that are currently impacting fauna values. The surveys were conducted in accordance with Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment in Western Australia (EPA 2020b) and the EPBC Act Referral Guidelines for Black Cockatoos (DSWEPaC 2012).</p> <p>Survey area: Bamford Consulting (2020) survey area.</p> <p>Relevance to Proposal: The survey covered a 149.2 ha area, and provides baseline information of the terrestrial fauna and Black Cockatoo values within a portion of the Development Envelope, including areas not previously assessed by AECOM (2020b).</p> <p>Consultant: Bamford Consulting.</p> <p>Survey Dates: 10-14 October 2020, with a follow up site visit on 27 January 2021.</p>

Study/survey	Details
Byford Railway Extension Targeted Fauna Survey for <i>Westralunio carteri</i> Carter's Freshwater Mussel (Stream 2021b)	<p>Report Date: 2021.</p> <p>IBSA Submission: IBSA-2021-0176</p> <p>Scope: Targeted fauna survey for Carter's Freshwater Mussel at watercourses that intersect the Development Envelope, as well as adjacent areas with potential habitat for the species. The survey included 12 habitat assessments across six watercourses, one drain and two lakes, as well as targeted searches for the species, which incorporated the establishment of transects in three watercourses/lakes to determine the distribution, density and size of the target species.</p> <p>Survey area: Stream (2021b) survey area.</p> <p>Consultant: Stream Environment and Water Pty Ltd (Stream).</p> <p>Survey Dates: 14-16 September 2020 and 29-30 October 2020.</p> <p>Report Date: January 2021.</p> <p>IBSA Submission: IBSA-2021-0163</p>
Desktop Review and Impact Assessment of Short Range Endemic and Conservation Significant Invertebrates for the Byford Rail Extension Project, Western Australia (Invertebrate Solutions 2021)	<p>Scope: Desktop assessment for short range endemic (SRE) species, examining presence and suitable habitat within an approximate 1,560 square kilometre rectangle, centred on the Development Envelope. The assessment involved determining the likelihood that SRE invertebrate species are present within habitats in the Development Envelope, followed by a site inspection to confirm overall habitat values and further inform the likelihood of occurrence of individual species. An impact assessment to determine the potential direct and indirect impacts of the Proposal on SRE invertebrate fauna was also completed. The assessment was conducted with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016f).</p> <p>Survey area: Invertebrate Solutions (2020) survey area.</p> <p>Relevance to Proposal: The survey covered approximately 1,560 square kilometres, inclusive of the Development Envelope, and provides baseline information of the SRE invertebrate values within the Development Envelope and its surrounds.</p> <p>Consultant: Invertebrate Solutions.</p> <p>Survey Dates: August 2020.</p> <p>Report Date: February 2021.</p>
METRONET – Byford Extension Part One Flora and Fauna Assessment (AECOM 2020b)	<p>Scope: A Level 1 fauna survey and targeted Black Cockatoo survey were concurrently undertaken across an approximate 102 ha survey area, that extended along the existing rail corridor from Gladstone Road, Armadale to Cardup Sliding road, Byford. The Level 1 Fauna survey included fauna habitat mapping, assessment of the potential presence of conservation significant fauna species and recording fauna species via direct and indirect evidence. The survey was conducted in accordance with EPA Technical Guidance (EPA 2016g). The targeted Black Cockatoo survey quantified breeding and potential breeding trees within the AECOM survey area, identified roosting habitat trees and determined the quality of foraging habitat within the AECOM survey area. The survey was undertaken in accordance with the EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (DSEWPaC 2012) and the Draft Revised Referral Guideline for Three Black Cockatoo Species (DotEE 2017). Survey effort included 4 person days. An IBSA data package was produced as part of this scope.</p> <p>Survey area: AECOM (2020b) survey area.</p> <p>Consultant: AECOM.</p> <p>Survey Dates: 8,9,16,29 November.</p>

Study/survey	Details
	Report Date: June 2020.
	IBSA Submission: IBSA-2021-0162

7.5.2. Fauna Habitats

The Proposal lies on the Swan Coastal Plain (SCP), a region with a history of extensive clearing for agriculture and development for housing and industry. The Proposal lies in IBRA subregion Swan Coastal Plain 2 (SWA02) and falls within the Bioregion Group classification "extensively cleared for agriculture" and is within an area of major urban development with a high degree of species loss (EPA 2004).

While extensively cleared and developed, the surrounds of the Development Envelope include some remnants of native vegetation including:

- Bush Forever site no. 264, Lambert Lane Bushland, Wungong
- Bush Forever site no. 266, Wungong Brook, Byford
- Bush Forever site no. 350, Byford to Serpentine Rail/Road Reserves and Adjacent Bushland.

Bush Forever site no. 264 includes Lambert Lane Nature Reserve, Fletcher Park and areas of the existing rail reserve. The site is recognised as being regionally significant bushland and includes vegetated upland and wetland areas in varying condition, which are representative of the eastern side of the SCP (such as SCP 3a). Bush Forever site no. 264 also contains Conservation Category Wetlands and significant flora and fauna (GoWA 2000). Of the 2.73 ha intersecting the Footprint, 1.29 ha contains native vegetation, with the remaining 1.44 ha mapped as cleared land.

Lambert Lane Nature Reserve and Fletcher Park provide habitat linkages across the Swan Coastal Plain and the Development Envelope. These areas on the surrounds of the Development Envelope are likely to provide good or better condition habitat for fauna (**Figure 17**), than the mosaic of habitats within the established rail reserve.

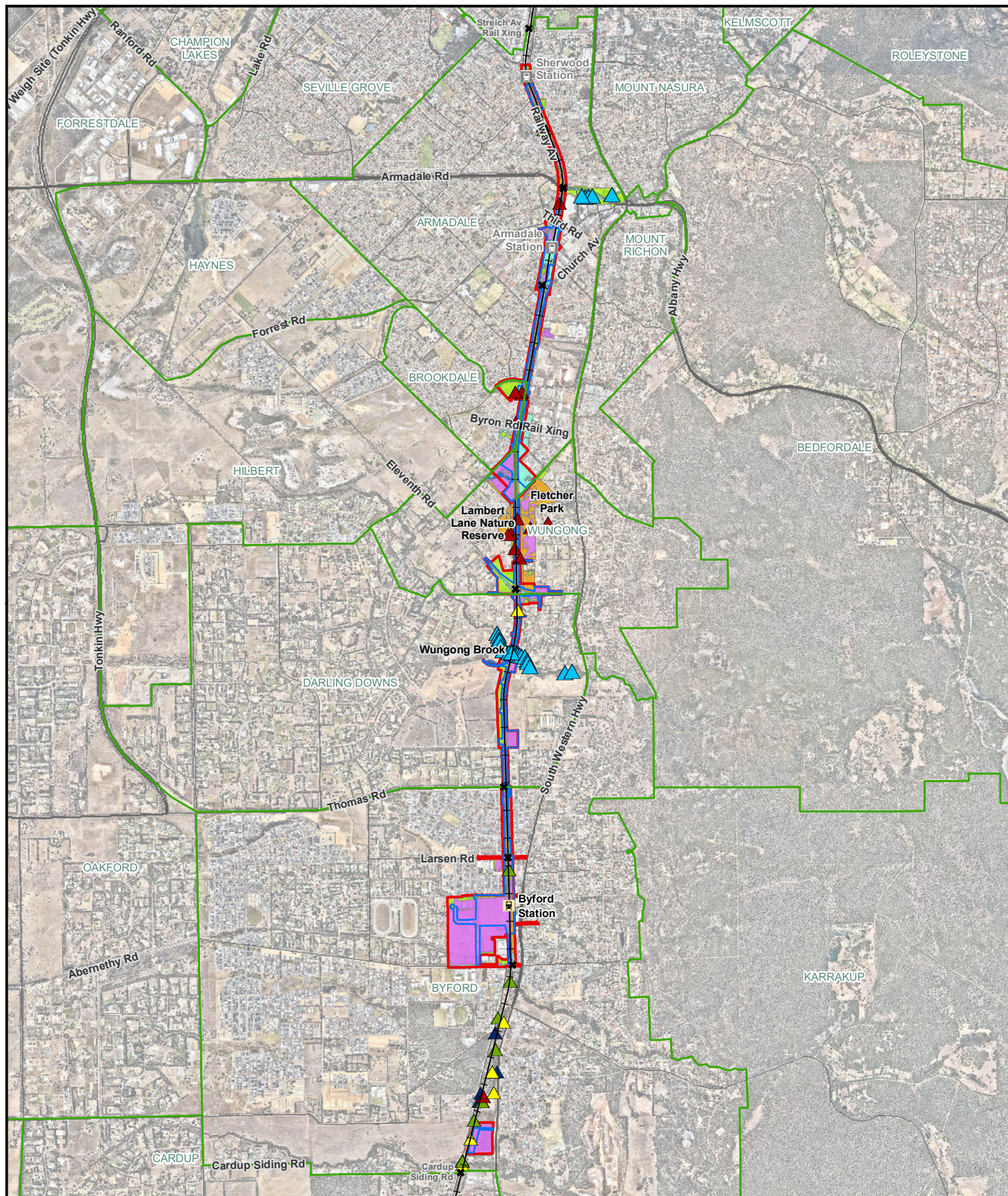
Table 28 demonstrates the habitat linkages within the Development Envelope and its surrounds.

Vegetation and substrate associations (VSAs) of the landscape were used to define fauna habitats within the Development Envelope. The Development Envelope contains a complex mosaic of VSAs, reflecting a natural variation due to a transitional landform being superimposed with anthropogenic impacts.

Five VSAs were identified within the Development Envelope that provide habitat for fauna species (Bamford Consulting 2021). These VSAs are fragmented within the Development Envelope and mainly consist of grassland and paddocks with scattered trees (79.4 ha), Light industrial areas and hard surfaces (44.5 ha) and urban parks and gardens (24.8 ha) that offer low value fauna habitat due to being highly modified or previously disturbed or cleared. Eucalypt woodland to forest and watercourses make up the minority of the Development Envelope (<10%) and offer higher value habitat to fauna, with eucalypt woodland to forest covering an area of 13.5 ha and watercourses covering 2.4 ha of the Development Envelope.

Fauna are dynamic, and it is not possible to assign a simple fauna value to each VSA. For this reason, species lists are not provided for each VSA. Instead, emphasis is placed on whether the VSA provides habitat for resident species, occasional visitors, or its functional role in providing connectivity for fauna.

Table 29 describes the extent of the VSAs within the Development Envelope and Footprint and **Figure 17** illustrates the VSAs.



METRONET | Byford Rail Extension
Figure 17 | Terrestrial Fauna Habitat



Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary

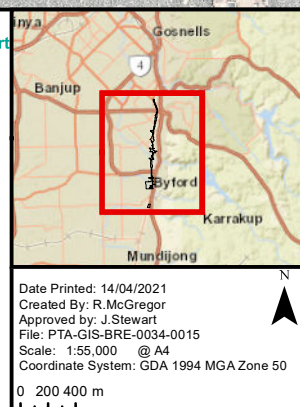
Fauna Sightings (2020)

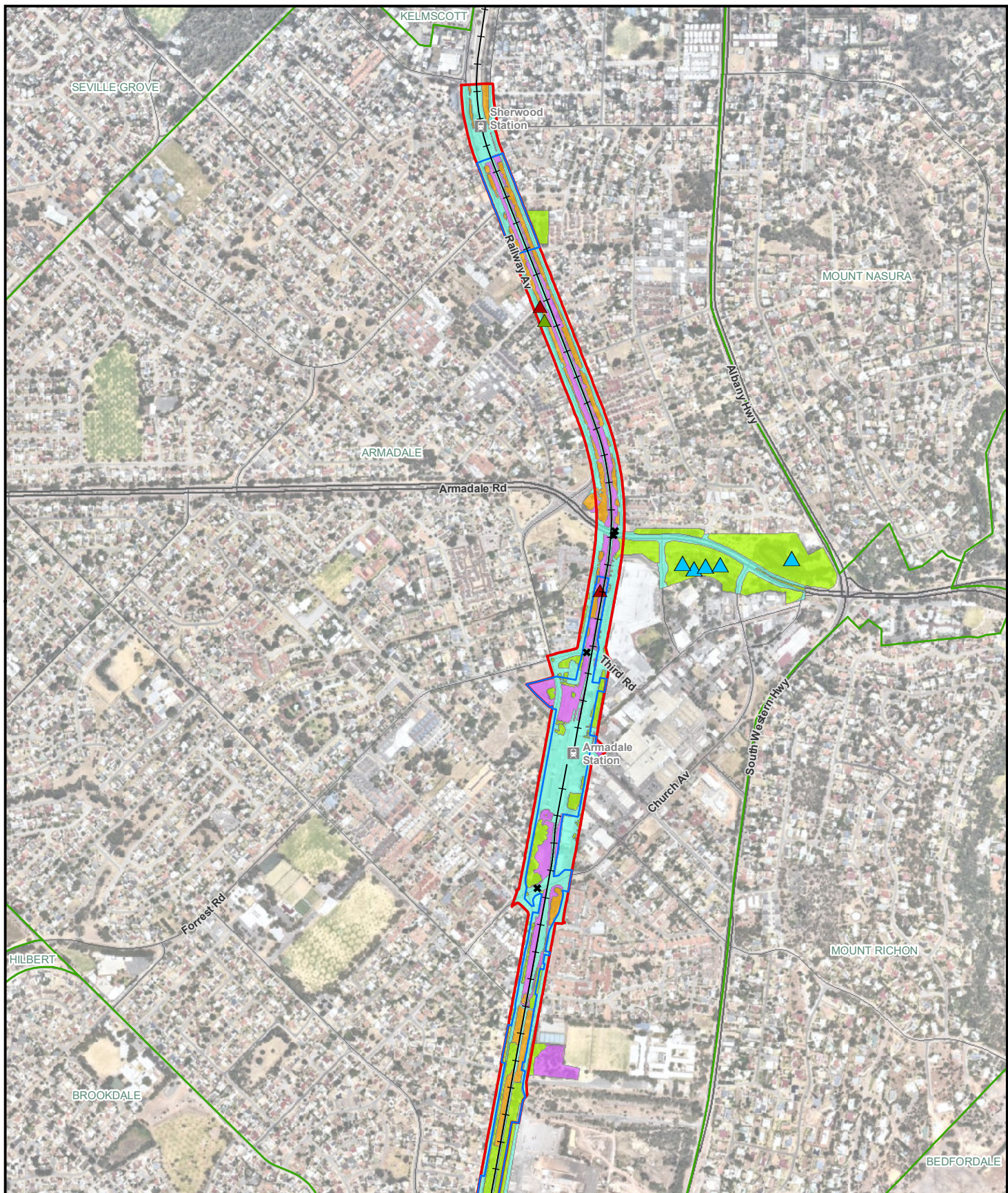
- ▲ *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii* (Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris* (Carnaby's Cockatoo)
- ▲ *Isodon obesulus* (Southern Brown Bandicoot)
- ▲ *Westralunio carteri* (Carter's Freshwater Mussel)

Fauna Habitat (GHD, 2020)

- VSA1 - Grassland/paddock with scattered trees
- VSA2 - Urban parks and gardens
- VSA3 - Light industrial areas and hard surfaces
- VSA4 - Eucalypt woodland to forest
- VSA5 - Watercourses

- A
- B
- C
- D





METRONET | Byford Rail Extension
Figure 17A | Terrestrial Fauna Habitat



Public Transport
Authority

Legend

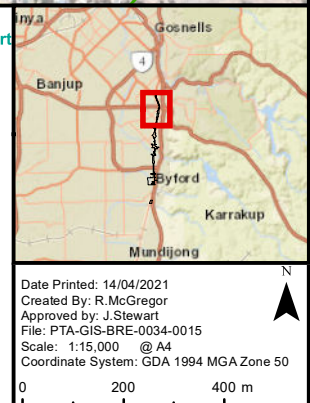
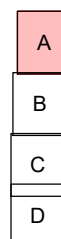
- Footprint
- Development Envelope
- +— Indicative Railway Alignment
- Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary

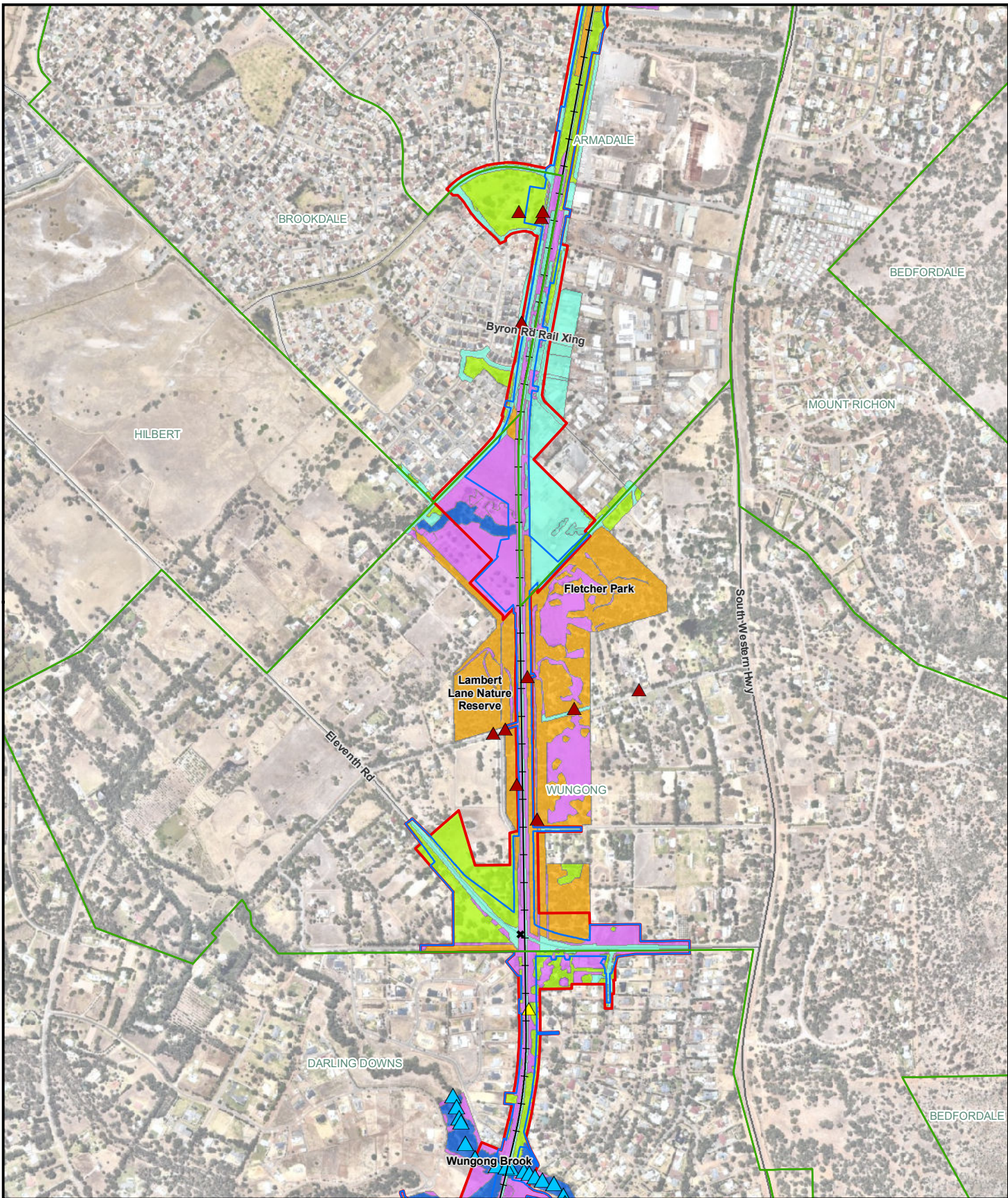
Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso*
(Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii*
(Baudin's Cockatoo)
- ▲ *Westralunio carteri*
(Carter's Freshwater Mussel)

Fauna Habitat (GHD, 2020)

- VSA1 - Grassland/paddock with scattered trees
- VSA2 - Urban parks and gardens
- VSA3 - Light industrial areas and hard surfaces
- VSA4 - Eucalypt woodland to forest





METRONET | Byford Rail Extension
Figure 17B | Terrestrial Fauna Habitat



Public Transport
Authority

Legend

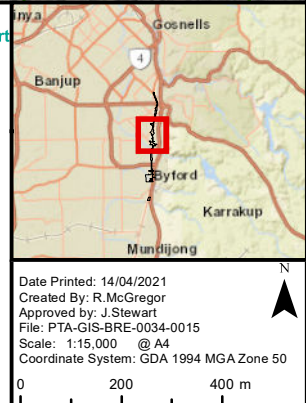
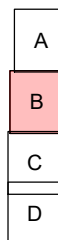
- Footprint
- Development Envelope
- Indicative Railway Alignment
- Rail Crossing
- Locality Boundary

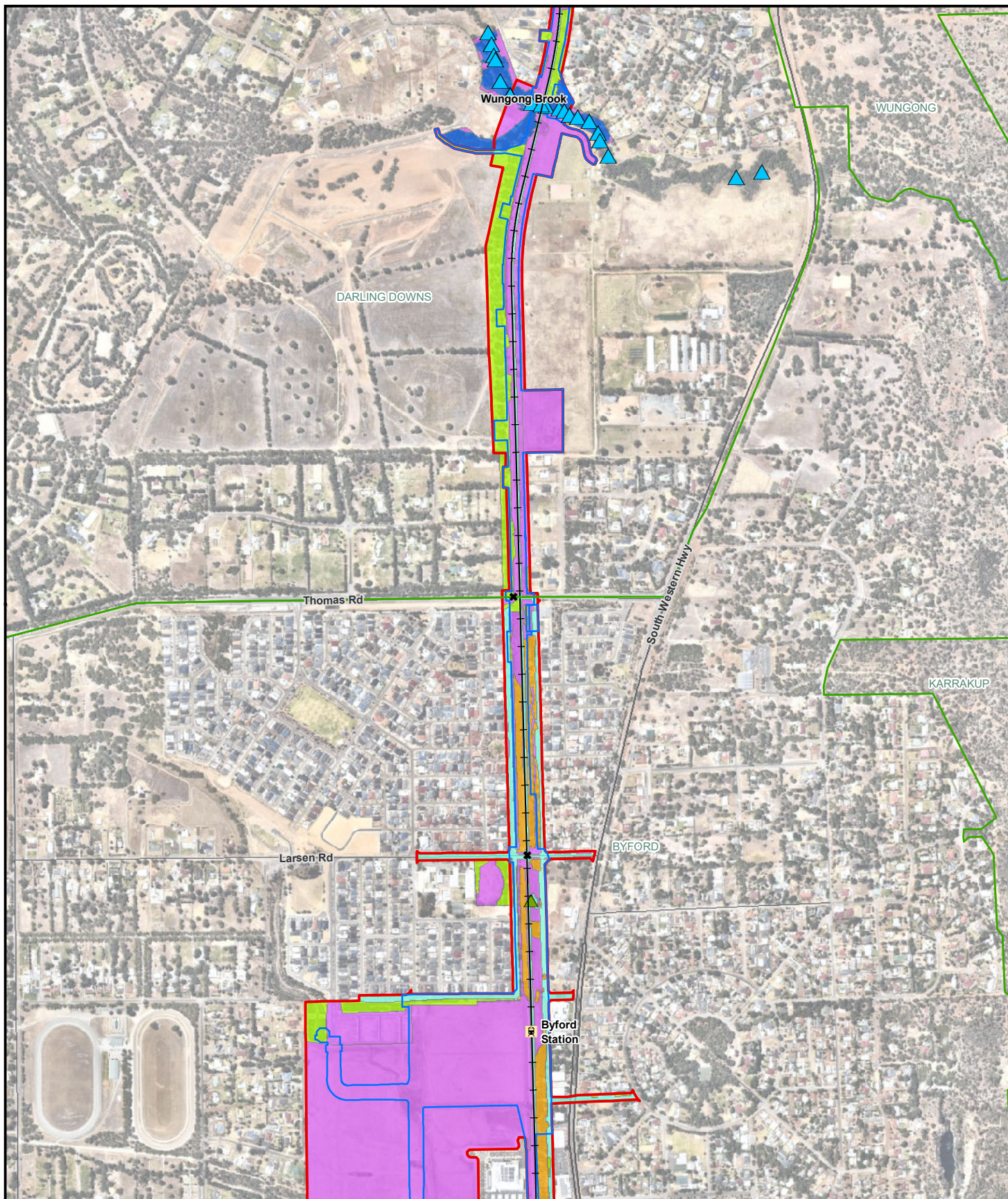
Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso*
(Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus latirostris*
(Carnaby's Cockatoo)
- ▲ *Westralunio carteri*
(Carter's Freshwater Mussel)

Fauna Habitat (GHD, 2020)

- VSA1 - Grassland/paddock with scattered trees
- VSA2 - Urban parks and gardens
- VSA3 - Light industrial areas and hard surfaces
- VSA4 - Eucalypt woodland to forest
- VSA5 - Watercourses





METRONET | Byford Rail Extension
Figure 17C | Terrestrial Fauna Habitat



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Rail Crossing
- Locality Boundary

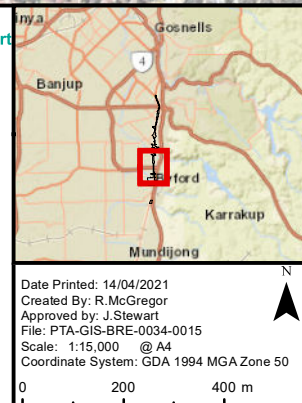
Fauna Sightings (2020)

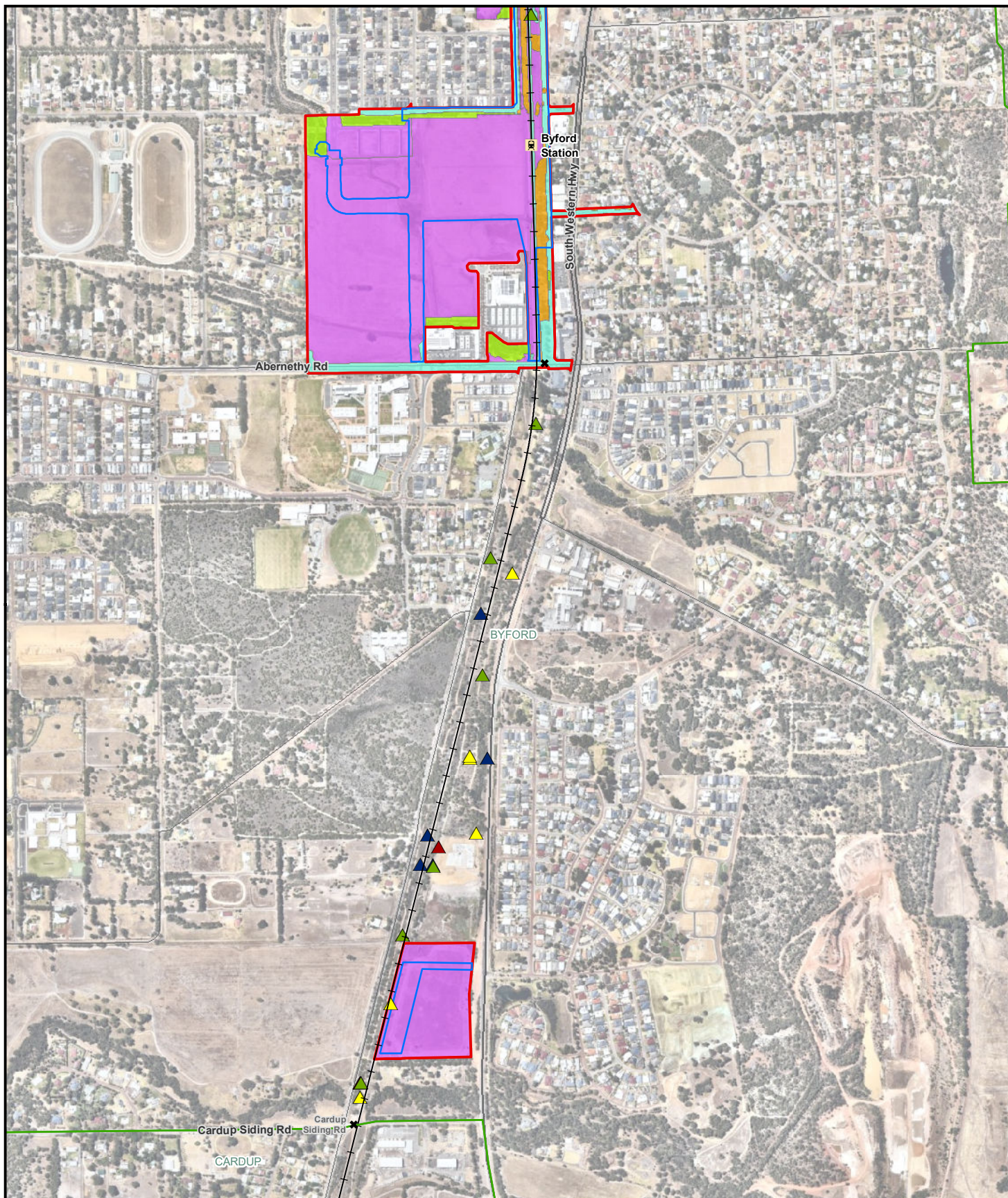
- ▲ *Calyptorhynchus baudinii*
(Baudin's Cockatoo)
- ▲ *Westralunio carteri*
(Carter's Freshwater Mussel)

Fauna Habitat (GHD, 2020)

- VSA1 - Grassland/paddock with scattered trees
- VSA2 - Urban parks and gardens
- VSA3 - Light industrial areas and hard surfaces
- VSA4 - Eucalypt woodland to forest
- VSA5 - Watercourses

A
B
C
D





METRONET | Byford Rail Extension
Figure 17D | Terrestrial Fauna Habitat



Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- + Proposed Railway Station
- x Rail Crossing
- Locality Boundary

Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso*
(Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii*
(Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris*
(Carnaby's Cockatoo)
- ▲ *Isodon obesulus* (Southern Brown Bandicoot)

Fauna Habitat (GHD, 2020)

- VSA1 - Grassland/paddock with scattered trees
- VSA2 - Urban parks and gardens
- VSA3 - Light industrial areas and hard surfaces
- VSA4 - Eucalypt woodland to forest

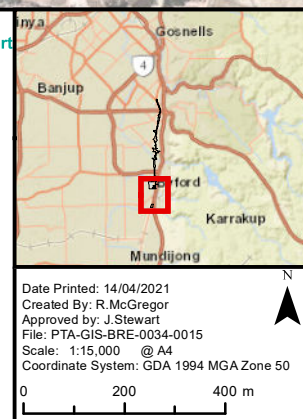
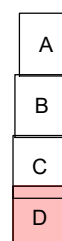


Table 28 Fauna Habitat Linkages within the Development Envelope

Location	Description	Fauna Habitat Value
Reserves and parkland along Armadale Road	A complex of parks, mostly with lawn with planted eastern states eucalypts trees around artificial wetlands	Presence of wetlands and mature trees providing a range of habitats for fauna. Glauert's Froglet calls and Quenda have been recorded within this complex of parks, and Carter's Freshwater Mussel was recorded within Sanctuary and Wright Lake. The corridor has the potential to support the Glossy Ibis occasionally, as well as introduced fish species
Fletcher Park, Lambert Lane Nature Reserve and adjacent property to south	More or less intact vegetation. Fletcher Park is comprised of a transitional eucalypt woodland of escarpment foothills with Marri, Jarrah and Wandoo (or another smooth-barked eucalypts), Flooded Gum along the drainage line and areas of sandy soil with Nuytsia. Lambert Lane Nature Reserve is woodland (mostly Marri) and heath on sand and gravelly loam and sand. The adjacent property is mostly regrowth Marri over mixed shrubs on sand and sandy loam	Provide a large area of native vegetation with some linkage to north, south, east and west, with a broad range of habitats present. High quality foraging habitat for Black Cockatoos, with potential breeding trees and one possible nest hollow (recently used) recorded
Eleventh Road	Two properties that contain substantial retention of original overstorey, predominantly Marri	Abundant foraging signs of Forest Red-tailed Black-Cockatoo
Wungong Brook	Lined with large Marri and Flooded Gum, with some remnant riparian vegetation but largely over-run with weeds. Brook was running and had abundant woody debris. Not especially good foraging habitat for BC as only a few Marri	A major corridor for fauna movement, notable for the presence of Red-winged Fairy-wrens (a locally significant species very unusual off the escarpment) and Quenda and Brushtail Possum
West of rail alignment from Byford Station	Lines of trees alongside rail alignment, including large Marri and Flooded Gum trees, and a line of large planted eastern states eucalypts trees that are poor quality vegetation. Understorey in poor condition	A major corridor through otherwise cleared landscape, despite the poor condition. Trees are likely to be of low foraging and breeding value for Black Cockatoos
Properties between rail alignment and light industry	These properties back onto a brickworks or similar, with native and planted eucalyptus trees	Provides a corridor for fauna movement with some vegetation that may have foraging value for Black Cockatoos
Development Envelope	Road verges	Important reservoirs for fauna and their movement
Rail alignment	Remnant trees and dense, usually weedy understorey	Provides habitat and a corridor for fauna movement, and may be important in facilitating movement of species such as Quenda

Table 29 Vegetation and substrate associations within the development envelope and footprint

VSA	Description	Value for Fauna	Extent in Development Envelope (ha)(%)	Extent in Footprint (ha)(%)
VSA 1. Grassland /paddock with scattered trees	Paddocks, grazed areas, grasslands/parklands with scattered trees both native (mostly Marri and Jarrah with some Wandoo, Flooded Gum and some eastern state species e.g. Lemon-scented Gum and Sugar Gum) and non-native tree species. A few areas, notably in the south near Byford Station, were grassland with very few trees.	Depauperate fauna assemblage, however, may provide occasional foraging flora species for Black Cockatoos. The VSA may provide linkages and value for fauna movements within the Development Envelope and the broader region. However, not all areas of this VSA within the Development Envelope will provide the same habitat values to fauna.	79.42 (48.3%)	41.82 (51.8%)
VSA 2. Urban parks and gardens	Houses with gardens made up of native and non-native plants. Parks with trees and no understorey.	Depauperate fauna assemblage, however, may provide occasional foraging flora species for Black Cockatoos. The VSA may provide linkages and value for fauna movements within the Development Envelope and the broader region. However, not all areas of this VSA within the Development Envelope will provide the same habitat values to fauna.	24.75 (15.0%)	10.23 (12.7%)
VSA 3. Light industrial areas and hard surfaces	Commercial properties that have little vegetation with few, if any, trees or bushes. Includes roads and gravel surfaces.	Negligible. However, some built structures will provide shelter and roosting/nesting sites for bird and bat species, and isolated trees and shrubs can support a few transient fauna species.	44.52 (27.1%)	19.55 (24.2%)
VSA 4. Eucalypt woodland to forest	<i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> open woodland over introduced grasses and herbs, or over <i>Xanthorrhoea</i> sp., small plantations of pine trees or eastern states Eucalyptus sp. Includes small areas of shrubland generally with scattered trees. Trees mostly small, probably reflecting a history of logging.	Likely to support the richest fauna assemblage in the Development Envelope, in particular a high proportion of resident species. The VSA also provides the highest density of forging and potential nesting habitat for Black Cockatoos.	13.53 (8.2%)	8.65 (10.7%)

VSA	Description	Value for Fauna	Extent in Development Envelope (ha)(%)	Extent in Footprint (ha)(%)
VSA 5. Watercourses	Mixed woodland of <i>Eucalyptus grandis</i> , <i>Eucalyptus wandoo</i> and some <i>Corymbia calophylla</i> along creeks and drainage lines. Within the Development Envelope, the VSA is primarily represented by Wungong Brook, some small drainage lines in Fletcher Park, and adjacent sites to the west.	Supports, or may support, species associated with aquatic and riparian environments (Carter's Freshwater Mussel, freshwater fish, frogs for part of their life cycle, Rakali, aquatic invertebrates), and provides a corridor for fauna movements. Foraging value for Black Cockatoos is not high, except where <i>Corymbia calophylla</i> is present.	2.36 (1.4%)	0.44 (0.5%)
Total			164.59	80.69

7.5.3. Faunal Assemblages

Desktop searches of the EPBC Act PMST, NatureMap and the DBCA Threatened and Priority Fauna database identified the presence/potential presence of 32 conservation significant fauna within the consolidated fauna assessment area (GHD 2021b). Combining the results of the AECOM (2020b) and Bamford Consulting (2021) desktop searches identified the presence/potential presence of 75 conservation significant fauna within the consolidated fauna assessment area. This included:

- 22 species listed as Threatened under the EPBC Act and/or BC Act
- 25 bird species listed as Migratory only under the EPBC Act and/or BC Act
- Two species listed as Specially Protected species under the BC Act
- 26 species listed as Priority by DBCA.

Conservation significant fauna are discussed in detail within the Significant Fauna section.

As outlined in the BRE Consolidated Terrestrial Fauna Report (GHD 2021b), the field assessments conducted by AECOM (2020b) and Bamford Consulting (2021) confirmed the presence of 67 vertebrate species, including one introduced fish species, one amphibian, five reptile species, 53 bird species (two of which are introduced) and seven mammal species, of which five are introduced. The fauna composition and assemblage of the Development Envelope is discussed in detail below.

Avifauna

The desktop assessment identified 167 bird species that were expected to occur within the Development Envelope and its surrounds. Of these 167 species, 72 are considered irregular visitors or vagrants, 36 as migrants or regular visitors, and 59 are expected to be residents (Bamford Consulting 2021).

The field surveys commissioned for this Proposal recorded 53 species. Of those recorded, 39 (73.6%) have been classified as resident species, nine (17%) as regular visitors and five (9.4%) as irregular visitors (Bamford Consulting 2021). Three conservation significant bird species were recorded within the Development Envelope, this consisted of the three Western Australian Black cockatoo species. 12 species recorded within the Development Envelope and the immediate surrounds were classified by Bamford Consulting (2021) as locally significant because of their pattern of distribution. These species include:

- Common Bronzewing *Phaps chalcoptera*
- Gilbert's Honeyeater *Melithreptus chloropsis*
- New Holland Honeyeater *Phylidonyris novaehollandiae*
- Rainbow Bee-eater *Merops ornatus*
- Red-winged Fairy-wren *Malurus elegans*
- Scarlet Robin *Petroica boodang*
- Splendid Fairy-wren *Malurus splendens*
- Weebill *Smicromis brevirostris*
- Western Thornbill *Acanthiza inornata*
- Western Wattlebird *Anthochaera lunulata*
- White-Browed Scrubwren *Sericornis frontalis*
- Yellow-rumped Thornbill *Acanthiza chrysorrhoa*

Two introduced bird species were recorded within the Development Envelope or its immediate surrounds through the commissioned surveys. This included the Rainbow Lorikeet (*Trichoglossus haematodus*) and Rock Dove (*Columba livia*).

All three Western Australian Black Cockatoo species were recorded within the Development Envelope during the commissioned surveys. The results are discussed in greater detail in the Significant Fauna section.

The majority of the bird species were observed in the larger areas of native vegetation within the Development Envelope, particularly Fletcher Park, Lambert Lane Nature Reserve, and along the corridor of native vegetation present in the northern parts of the Development Envelope (Sherwood Station to Armadale Road).

In contrast, species that favoured disturbed landscapes, such as the Australian Magpie *Cracticus tibicen*, Australian Raven *Corvus coronoides*, and Galah *Eolophus roseicapilla* were generally only observed in urban and industrial areas, parkland, and cleared paddocks.

Watercourses such as Wungong Brook provide little habitat for waterbirds within the Development Envelope. Instead, waterbirds are considered more likely to utilise artificial wetlands near the town centre and paddocks that flood in winter that may provide seasonal habitat.

Mammals

Desktop assessments identified 18 native mammal species, nine of which are small insectivorous bats, as potentially occurring within the Development Envelope and its surrounds (AECOM 2020b; Bamford Consulting 2021). The desktop assessment identified five conservation significant mammal species that may potentially occur within the Development Envelope (Bamford Consulting 2021). These species included:

- Brush-tailed Phascogale *Phascogale tapoatafa* (Listed as Conservation Dependant Fauna under the BC Act)
- Chuditch *Dasyurus geoffroii* (Listed as Vulnerable under the EPBC Act and BC Act)
- Quenda *Isodon fusciventer* (listed as P4 by DBCA)
- Rakali *Hydromys chrysogaster* (listed as P4 by DBCA)
- Western False Pipistrelle *Falsistrellus mackenziei* (listed as P4 by DBCA)

Conservation significant mammal species are discussed in further detail within the Significant Fauna section.

Field surveys confirmed the presence of two native species within the Development Envelope or the immediate surrounds either by direct observations or indirectly through scats and diggings:

- Brushtail Possum *Trichosurus vulpecula*
- Quenda *Isodon fusciventer* (listed as P4 by DBCA)

Residents along Eleventh Road (within the Development Envelope) reported the occasional presence of Western Grey Kangaroos. However, surveys did not observe the species, and its distinctive scats were not found in the Development Envelope.

AECOM (2020b) and Bamford Consulting (2021) both recorded direct and indirect sightings of Quenda on many occasions within the Development Envelope and its surrounds. Records included a direct sighting of a roadkill individual approximately 100 m west of Albany Highway, and diggings in Fletcher Park and Wungong Brook.

AECOM (2020b) also observed scats, diggings, and individuals several times throughout the rail corridor within the Development Envelope. Bamford Consulting (2021) recorded scats of the Brushtail Possum on a fallen tree along Wungong Brook.

Field surveys also recorded five introduced and naturalised exotic mammal species within the Development Envelope and its surrounds. Generally, these species were recorded sporadically and were observed directly, or indirectly through tracks, scats, or burrows. All introduced species recorded are declared under the Biosecurity and Agriculture Management Act 2007 (BAM Act). The species and their legal status under the BAM Act include:

- Cat *Felis catus* - Permitted – s11
- Dog *Canis familiaris* - the domestic dog is Permitted – s11; the feral dog is Declared Pest - s22(2) (C3 Exempt)
- Fox *Vulpes vulpes* - Declared Pest – s22(2) (C3 Prohibited).
- Horse *Equus caballus* - Permitted - s11
- Rabbit *Oryctolagus cuniculus* - Declared Pest – s22(2) (C3 Prohibited)

Amphibians

Desktop assessments identified ten species, representing a typical assemblage of amphibians across the Swan Coastal Plain, as likely to occur in the Development Envelope (AECOM 2020b, Bamford Consulting 2021). None of the species identified are listed as conservation significant species or introduced species to Western Australia. These ten species include:

- Banjo Frog *Limnodynastes dorsalis*
- Glauert's Froglet / Clicking Froglet *Crinia glauerti*
- Gunther's Toadlet *Pseudophryne guentheri*
- Humming Frog *Neobatrachus pelobatoides*
- Lea's Froglet *Geocrinia leai*
- Moaning Frog *Heleioporus eyrei*
- Motorbike Frog *Litoria moorei*
- Quacking Froglet *Crinia georgiana*
- Sign-bearing Froglet *Crinia insignifera*
- Slender Tree Frog *Litoria adelaidensis*

Surveys recorded only one species of frog out of the ten identified as potentially occurring within the Development Envelope and its surrounds. *Crinia glauerti*, commonly known as the Glauert's Froglet or Clicking Froglet, was recorded at multiple locations throughout the Development Envelope. The species' calls were heard along Wungong Brook, at the stream located opposite to the intersection of Ninth Road and Wungong Road, and also around wetlands in the park adjacent to the Armadale town centre (Bamford Consulting 2021). Further to this, the species was also heard several times in drainage lines throughout the AECOM survey area.

The Development Envelope lacks large seasonal wetlands that are favoured by many frog species. However, seasonal watercourses and artificial wetlands such as garden ponds or brooks may support some species by providing important habitat for breeding within the Development Envelope (Bamford Consulting 2021).

Freshwater Fish

Desktop assessments (AECOM 2020b; Bamford Consulting 2021) identified five fish species, including one conservation significant species, as potentially occurring within the Development Envelope and its surrounds:

- Freshwater Cobbler *Tandanus bostocki*
- Mosquitofish *Gambusia holbrooki* (Introduced Species)
- Pouched Lamprey *Geotria australis* (listed as P3 by the DBCA)
- Western Galaxias *Galaxias occidentalis*
- Western Pygmy-perch *Nannoperca vittata*

Field surveys recorded only one of the species of freshwater fish identified in the desktop assessment. Bamford Consulting (2021) observed the introduced Mosquitofish *Gambusia holbrooki* in Wungong Brook during the field survey. The Mosquitofish is extremely invasive and known to compete with native species and predate on fish and frog eggs, fish larvae and insects (DWER 2021). Other lakes near the City of Armadale town centre may also support introduced fish species (Bamford Consulting 2021).

Permanent and near-permanent wetlands/watercourses may provide habitat for native freshwater fish species within the Development Envelope. Wungong Brook may be utilised by the Priority 3 Pouched Lamprey *Geotria australis* for breeding and migration (Bamford Consulting 2021). Field surveys did not observe other minor and ephemeral watercourses flowing through Fletcher Park and adjacent properties west of the rail alignment as supporting additional freshwater species (Bamford Consulting 2021).

Reptiles

The reptile assemblage within the Development Envelope appears rich, with 41 species identified through desktop

and field assessment. However, not all species may be present, with some included as a precaution because they are known from the general area (Bamford Consulting 2021).

AECOM (2020b) and Bamford Consulting (2021) recorded five reptile species within the Development Envelope:

- Bobtail goanna *Tiliqua rugosa*
- Buchanan's Snake-eyed Skink *Cryptoblepharus buchananii*
- Common Dwarf Skink *Menetia greyii*
- Dugite *Pseudonaja affinis*
- King's Skink *Egernia kingii*

Reptiles can persist in fragmented and degraded landscapes, although the larger areas of intact native vegetation within the Development Envelope, such as Fletcher Park and Lambert Lane Nature Reserve, are likely to be richest in reptile species. Narrow corridors comprised of weedy vegetation will also be able to support some reptile species and may provide an important role in population connectivity (Bamford Consulting 2021).

Field surveys undertaken by AECOM (2020b) and Bamford Consulting (2021) identified no conservation significant reptile species within the Development Envelope.

Short Range Endemics

Short range endemic (SRE) invertebrates are species that have restricted distributions, typically isolated in specific habitats or bioregions. Invertebrate Solutions (2020) undertook a desktop review targeting SRE invertebrates within the Development Envelope and its surrounds.

The desktop assessment and review confirmed seven SRE species to be present within the nominated survey area (an approximate 1,560 km² area centred on the Proposal). These species included three mygalomorph spiders (primitive group of spiders including trapdoor and funnel web), two land snails, one tree cricket and one native bee.

In addition to the above confirmed species, six SRE species were identified as likely to occur within the survey area. These species included three slater species (*Buddelundia cinerascens*, *B. inaequalis* and *B. opaca*), two mygalomorph spiders (*Synochele michalseni*, Teyl 'MYG249') and one millipede species (*Dinocambala ingens*).

The three slater species (*Buddelundia cinerascens*, *B. inaequalis* and *B. opaca*) were the only species identified as likely to have habitat present in the survey area. Invertebrate Solutions (2020) classified all confirmed and likely SRE species identified as occurring within the survey area as having a Low likelihood of occurring within the Development Envelope.

Conservation significant invertebrates are species of invertebrates listed under State or Commonwealth legislation or as Priority fauna by the DBCA. Invertebrate Solutions (2020) identified 11 conservation significant invertebrates in the desktop assessment, including four SRE species and an additional seven widespread, non-SRE species:

- A Native Bee *Neopasiphae simplicior* (listed as Critically Endangered under the EPBC Act and Endangered under the BC Act)
- A Short-tongued Bee *Leioproctus contrarius* (listed as P3 by the DBCA)
- A Short-tongued Bee *Leioproctus douglasiellus* (listed as Critically Endangered under the EPBC Act and Endangered under the BC Act)
- A Short-tongued Bee (Southwest) *Leioproctus Glossurocolletes bilobatus* (listed as P2 by the DBCA) (SRE)
- Douglas' Broad-headed Bee *Hesperocolletes douglasi* (listed as Critically Endangered under the EPBC Act and BC Act)
- Graceful Sunmoth *Synemon gratiosa* (listed as P4 by the DBCA)
- Grey Vernal Katydid (Southwest) *Kawaniphila pachomai* (listed as P1 by the DBCA)
- Inornate Trapdoor Spider *Euoplos inornatus* (listed as P3 by the DBCA) (SRE)
- Stylet Bush Cricket / Stylet Throsco (Jandakot) *Throscodectes xiphos* (listed as P1 by the DBCA) (SRE)
- Swan Coastal Plain Shield-backed Trapdoor Spider *Idiosoma sigillatum* (listed as P3 by the DBCA) (SRE)
- Woollybush Bee *Hylaeus globuliferus* (listed as P3 by the DBCA)

Invertebrate Solutions (2020) concluded that all 11 conservation significant invertebrate species have a Low or Very Low likelihood of occurrence, with no likely habitat present for any of the species within the Development Envelope. This is because these areas lack the understorey required to support conservation significant invertebrates and provide low to Nil SRE or conservation significant invertebrate habitat.

7.5.4. Conservation Significant Fauna

Field surveys recorded five vertebrate species of conservation significance within the Development Envelope (Figure 17):

- Baudin's Cockatoo *Calyptorhynchus baudinii* (listed as Endangered under the EPBC Act and the BC Act) (AECOM 2020b; Bamford Consulting 2021)
- Carnaby's Cockatoo *Calyptorhynchus latirostris* (listed as Endangered under the EPBC Act and the BC Act) (AECOM 2020b)
- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii* (listed as Vulnerable under the EPBC Act and the BC Act) (AECOM 2020b; Bamford Consulting 2021)
- Carter's Freshwater Mussel *Westralunio carteri* (listed as Vulnerable under the EPBC Act and the BC Act) (Stream 2021b)
- Quenda *Isodon fusciventer* (listed as P4 by DBCA) (AECOM 2020b; Bamford Consulting 2021)

In addition to the species that have been recorded within the Development Envelope in recent field surveys, 18 conservation significant species were identified as having the potential to occur within the Development Envelope. These species were assessed based on previous terrestrial fauna surveys and database searches.

Table 30 outlines the recorded and potentially occurring conservation significant fauna within the Development Envelope.

Table 30 Expected conservation significant fauna present in the development envelope

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Australian Painted Snipe <i>Rostratula australis</i>	E	EN	The Australian Painted Snipe is a stocky wading bird approximately 240-300 mm in length, with a long pinkish bill (DSEWPac 2013). This species is a rare summer visitor to the south-west of Western Australia and favours flooded grasslands, which are not a feature of the Development Envelope. The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DSEWPac 2013).	Potential: Vagrant. The Australian Painted Snipe is rarely observed in the South West region of WA, and favours flooded grasslands, which are not a feature identified in the Development Envelope (Bamford Consulting 2021).
Barking Owl <i>Ninox connivens connivens</i>		P3	The Barking Owl is a medium-sized hawk-owl. Hawk-owls lack the definite heart-shaped face of the tyto-owls (Birdlife Australia 2021). Adult Barking Owls are grey-brown above, with white spots on the wings, and whitish below, heavily streaked with grey-brown. The head is almost entirely grey- brown, and the eyes are large and yellow. Barking Owls are nocturnal birds, although they may sometimes be seen hunting during the day (Birdlife Australia 2021). Barking Owls are found in open woodlands and the edges of forests, often adjacent to farmland. They are less likely to use the interior of forested habitat. They are usually found in habitats that are dominated by Eucalyptus species, and prefer woodlands and forests with a high density of large trees and particularly sites with hollows, however, there are occasional records from suburban areas, including a Barking Owl in Thornlie along the Canning River in 2005 (B. Metcalf pers. comm.). The subspecies <i>Ninox connivens connivens</i> occurs in eastern, south-eastern and south-western Australia (Birdlife Australia 2021).	Potential: Irregular Visitor. Considered to be an irregular visitor to the Development Envelope as it lacks extensive areas of tall forest. Within the Development Envelope the species may utilise large trees along Wungong Brook and the Fletcher Park area for roosting (Bamford Consulting 2021).

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Baudin's Cockatoo <i>Calyptorhynchus baudinii</i>	E	EN	Baudin's cockatoo is endemic to south-west Western Australia (Western Australian Museum 2017). Habitat critical to the survival of this species includes forests of Karri Eucalyptus diversicolor, Jarrah <i>E. marginata</i> and Marri <i>Corymbia calophylla</i> , in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May, and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well, east to Clackline, Wundowie, the lower Darkin River, Boyagin Rock, Wandering, Williams, Kojonup and the King River. As well as west to the eastern strip of the Swan Coastal Plain, including West Midland in the north, through Armadale and Byford, and south towards the coastline to the east of Albany. Breeding has been recorded to the south-west of the area bounded by Leschenault, Collie and Albany (DSEWPaC 2012), Serpentine (hills area), east to Kojonup, and near Albany (Kirkby & Johnstone 2008).	Recorded: Regular Visitor. Direct observations and foraging evidence recorded throughout the AECOM survey area (AECOM 2020b). Feeding residue from Baudin's Black Cockatoo recorded at Fletcher Park and along Eleventh Road (Bamford Consulting 2021).
Blue-billed duck <i>Oxyura australis</i>		P4	The Blue-billed Duck is endemic to south eastern and south western Australia. It prefers deep water in large permanent wetlands and swamps with aquatic vegetation. This species of duck is fully aquatic and rarely comes onto land (Office of Environment and Heritage 2017)	Potential: Irregular Visitor. The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and seasonally flooded paddocks (Bamford Consulting 2021).

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Brush-tailed <i>Phascogale</i> <i>Phascogale</i> <i>tapoatafa</i>		CD	The range of this species has reduced significantly and is now known from Perth and south to Albany (DEC 2012). The southern sub-species (<i>P. t. tapoatafa</i>) has been observed in dry sclerophyll forests and open woodlands with hollow-bearing trees and sparse ground cover (DEC 2012).	Potential: Vagrant. There is insufficient continuous habitat to support a population within the Development Envelope. The species occurs nearby (such as in Bungendore Park) and individuals disperse widely, especially males during breeding and young animals after breeding. Most likely to occur in the Fletcher Park/Lambert Lane Reserve area, which provides connectivity with Bungendore Park, and is the largest area of native vegetation within the Development Envelope (Bamford Consulting 2021).
Carnaby's Cockatoo <i>Calyptorhynchus</i> <i>latirostris</i>	E	EN	Carnaby's Cockatoo is a white-tailed black cockatoo endemic to, and widespread in the south-west of Western Australia. The species nests in hollows in eucalypt trees, particularly Salmon Gum (<i>Eucalyptus salmonophloia</i>) and Wandoo (<i>E. Wandoo</i>), with nests also recorded in York Gum (<i>E. loxophleba</i>), Flooded Gum (<i>E. rudis</i>), Tuart (<i>E. gomphocephala</i>) and Marri (<i>Corymbia calophylla</i>) (Kirkby, Johnstone and Johnstone 2010). Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick (Kirkby, Johnstone and Johnstone 2010). Foraging habitat, including Banksia woodlands, is considered to be habitat critical to the survival of the species (Kirkby, Johnstone and Johnstone 2010).	Recorded: Regular Migrant. Direct observations and foraging evidence recorded throughout the AECOM survey area (AECOM 2020b)

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Carter's Freshwater Mussel <i>Westralunio carteri</i>	V	VU	The only reasonably large bivalve in freshwaters of south-west Western Australia. The species occurs from Gingin Brook in the north to the Kent, Goodga and Waychinicup Rivers in the south, and is restricted to freshwater streams, rivers, reservoirs and lakes, that are generally within 50-100km of the coast (Klunzinger et al. 2015). The species prefers perennial stream, riverine and wetland habitats, with stable sediments and low salinity, living partially and fully buried in sand and finer sediment (Klunzinger 2012).	Recorded: Resident. One watercourse and two lakes within the Stream survey area were found to provide suitable habitat for Carter's Freshwater Mussel: Wungong Brook, Sanctuary Lake and Wright Lake. The species was recorded at all three locations during targeted searches (Stream 2021b).
Chuditch <i>Dasyurus geoffroii</i>	V	VU	<p>The species previously occurred throughout arid and semi arid Australia, but is now restricted to south-west Western Australia. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (DEC 2012). The majority of records are found in the contiguous Jarrah forests of the south west of Western Australia, and is effectively extinct on the coastal plain but with occasional records of dispersing individuals (DEC 2012, Bamford Consulting 2021).</p> <p>Occurs in areas dominated by schlerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008) and requires adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive.</p> <p>The Chuditch requires a large home range (>1000ha for a male) and therefore requires large areas of more or less continuous native vegetation to support a stable population (Bamford Consulting 2021). There is insufficient continuous habitat to support a population in the Development Envelope and adjacent habitat areas. They are expected to be vagrants because they occur nearby (such as in Bungendore</p>	<p>Potential: Vagrant. The species occurs nearby (such as in Bungendore Park) and individuals disperse widely, especially males during breeding and young animals after breeding. Most likely to occur in the Fletcher Park/Lambert Lane Reserve area, which provides connectivity with Bungendore Park, and is the largest area of native vegetation within the Bamford Consulting survey area (Bamford Consulting 2021).</p>

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Coastal Plains Skink <i>Ctenotus ora</i>		P3	<p>Park) and individuals disperse widely, especially males during breeding and young animals after breeding. Only marginal habitat may be available in Eucalypt woodlands.</p> <p>The Coastal Plains Skink occurs on the Swan Coastal Plain from south of Perth to the vicinity of Busselton, an area that has experienced extensive clearing. The species appears to have a preference for sandy substrates with low vegetation and open Eucalyptus woodland over Banksia species (Keogh & Kay 2012).</p>	<p>Potential: Resident.</p> <p>Much of the Development Envelope may be too degraded for the species, however, suitable habitat may be present within the Fletcher Park/Lambert Lane Nature Reserve area.</p>
Common Greenshank <i>Tringa nebularia</i>	Migratory		<p>The Common Greenshank is a largely built wader, that is found in inland wetlands and sheltered coastal habitats (DAWE 2021). In Western Australia it occurs around most of the coast from Cape Arid in the south, to Carnarvon in the north-west during the non-breeding season (DAWE 2021).</p>	<p>Potential: Vagrant.</p> <p>The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and seasonally flooded paddocks (Bamford Consulting 2021).</p>
Common Sandpiper <i>Actitis hypoleucos</i>	Migratory		<p>The Common Sandpiper is widespread and found in small numbers throughout Australia, along all coastlines and in many inland areas (DAWE 2021). The species visits Australia during the non-breeding season and can be found in areas of national importance such as Nuytsland Nature Reserve and Roebuck Bay, within Western Australia (Watkins 1993). The Common Sandpiper utilises a wide range of coastal and inland wetlands and has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties (DAWE 2021).</p>	<p>Potential: Vagrant.</p> <p>The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and seasonally flooded paddocks (Bamford Consulting 2021).</p>

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Forest Red- tailed Black Cockatoo <i>Calyptrorhynchus banksii naso</i>	V	VU	The Forest Red-tailed Black Cockatoo is endemic to the south- west humid and sub-humid zones of Western Australia (Mawson and Johnstone 1997). The species inhabits the dense jarrah (<i>Eucalyptus marginata</i>), karri (<i>E. diversicolor</i>) and marri (<i>Corymbia calophylla</i>) forests receiving more than 600 mm average rainfall annually (Rowley, Saunders & Smith 1985, Ingram & Saunders 1995, Chapman 2008), mainly in the hilly interior (Sarti, Johnstone & Kirkby 2013), with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar.	Recorded: Regular Visitor. Direct observations and foraging evidence recorded throughout the AECOM survey area (AECOM 2020b). Recorded along the rail corridor around Sherwood Station (up to 10 birds), in the southern extension of Fletcher Park (3 birds), in Lambert Lane Nature Reserve (4 birds) and on several properties along Eleventh Road (up to 5 birds). Residue from feeding on Marri was widespread within the Development Envelope (Bamford Consulting 2021).
Fork-tailed Swift <i>Apus pacificus</i>	Migratory		The Fork-tailed Swift is a non-breeding visitor to Australia that is almost exclusively aerial, and rarely seen roosting on land (DAWE 2021). The species often occur over cliffs, beaches, and islands, and sometimes well out to sea. They are also found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, and urban areas and cities (DAWE 2021).	Potential: Vagrant. Flocks may pass over the Development Envelope briefly at intervals of a year or more. The species is not reliant on ecosystems within the Development Envelope (Bamford Consulting 2021).
Glossy Ibis <i>Plegadis falcinellus</i>	Migratory		The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats. This species is a non-breeding visitor to south-west Western Australia (Pizzey & Knight 2007).	Potential: Irregular Visitor. The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and seasonally flooded

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
Marsh Sandpiper <i>Tringa stagnatilis</i>	Migratory		The Marsh Sandpiper breeds from Austria to Mongolia, moving to Australia for summer, and is found on coastal and inland wetlands (DAWE 2021, Pizzey & Knight 2007). This species occupies wetlands of varying salinity, including swamps, estuaries, saltmarshes and sewage farms. In Western Australia they prefer freshwater to marine environments with scattered records found primarily near the coast (DAWE 2021, Pizzey & Knight 2007).	paddocks (Bamford Consulting 2021). Potential: Irregular Visitor. The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and seasonally flooded paddocks (Bamford Consulting 2021).
Masked Owl <i>Tyto novaehollandiae subps. novaehollandiae</i>		P3	The Masked Owl occupies a variety of habitats including forests, open woodlands, farmlands with large trees, paperbark woodlands and caves. This species generally occurs in coastal mainland Australia and though widespread, it is typically locally uncommon (Pizzey & Knight 2007).	Potential: Irregular Visitor. The Development Envelope is likely of low habitat importance to the species due to the lack of extensive areas of tall forest. There is potential for the species to utilise habitat within the Development Envelope, in particular, large trees along Wungong Brook and the Fletcher Park area for roosting (Bamford Consulting 2021).
Peregrine Falcon <i>Falco peregrinus</i>		OS	A well-known falcon, the Peregrine inhabits a vast array of environments in Australia. Usually uncommon and migratory (Pizzey & Knight 2007). This species lays its eggs in recesses off cliff faces, or in tree hollows (Debus 2019). In the Perth region, several pairs have been observed nesting on ledges of tall buildings, and one pair has been observed nesting in the large horizontal hollow, of a dead Marri in Whiteman Park (M. Bamford pers. obs.).	Potential: Resident. The Development Envelope is most likely part of the foraging range of a pair. The species may breed in the Development Envelope due to the presence of large trees with large hollows, although the species was not

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
				observed either by AECOM (2020b) or Bamford Consulting (2021).
Pouched Lamprey <i>Geotria australis</i>		P3	The species has been recorded in many of the rivers of the south-west coast from Perth to Albany, including the Swan and Canning river (DWER 2021). However, records are sporadic. The Pouched Lamprey inhabits marine environments as an adult, although breeds in freshwater streams. The species favours permanent and near-permanent streams, generally with low temperatures, intact riparian vegetation and surrounding forest to maintain water quality (Bamford Consulting 2021).	Potential: Regular Visitor. The Pouched Lamprey may now be extinct in the Swan-Canning system. Although if present in the Development Envelope, the species would likely only occur in Wungong Brook, a near-permanent watercourse that retains much of its riparian vegetation (Bamford Consulting 2021).
Quenda <i>Isoodon fusciventer</i>		P4	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. The species can also be found where tall weeds provide dense cover (Bamford Consulting 2021). Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan 2008).	Recorded: Resident. Scat, diggings and individuals were observed several times throughout the AECOM survey area, which consisted of the rail corridor where much of the vegetation consists of weeds under remnant trees. Direct and indirect sightings were also recorded in 2021 (Bamford Consulting 2021).
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	Migratory		The Sharp-tailed Sandpiper spend the non-breeding season in Australia. In Western Australia, they are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of the Pilbara Region, and to south-west and east Kimberley Division (DAWE 2021). In Australasia, the species prefers muddy edges of shallow coastal or inland wetlands with inundated or	Potential: Vagrant. The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
			emergent sedges, or other low vegetation. The Sharp-tailed Sandpiper is also known to inhabit saltworks, flooded paddocks, sewage farms and other ephemeral wetlands, but will leave when they dry (DAWE 2021).	seasonally flooded paddocks (Bamford Consulting 2021).
Rakali <i>Hydromys chrysogaster</i>		P4	The Rakali, or Water Rat has a fragmented distribution in Western Australia, where the population in the South West appears to be isolated (Bamford Consulting 2021). The species occurs in the vicinity of permanent bodies of fresh or brackish water. Dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008). The species has been found in waterways and large wetlands around Perth, including along the Canning River and tributaries (Trocini et al. 2015). The nearest record of the species to the Development Envelope is Neerigen Brook, which links to wetlands near the intersection of Armadale Road and Albany Highway (Bamford Consulting 2021).	Potential: Regular Visitor. The Rakali is considered to be a regular visitor to the Development Envelope, but is likely only along Neerigan Brook in the north (part of wetlands near the Armadale Road and Albany Highway intersection) and Wungong Brook (Bamford Consulting 2021).
Western False Pipistrelle		P4	The species occurs largely across the tall South-West forests and adjacent coastal plain, roosting in hollows in old trees branches and stumps, in colonies from five to 30 bats (Australian Museum 2020). In the Perth region the Western False Pipistrelle has been recorded near Thomson's Lake in the early 1990s, and it was caught near Mialla Lagoon (north of Bunbury) on the Coastal Plain in 1982. However there are no records in more recent surveys and its status on the escarpment east of Perth is uncertain (BCE records 2010).	Potential: Irregular Visitor. Given its uncertain status east of the Development Envelope, the species is most likely to be an irregular visitor to the area (Bamford Consulting 2021)
Wood Sandpiper <i>Tringa glareola</i>	Migratory		The Wood Sandpiper is a summer migrant to Australia where it is more common in the north, although a casual visitor to southern parts. It occupies wetland margins, saltmarshes and sewage ponds (Pizzey & Knight 2007).	Potential: Vagrant. The Development Envelope is likely of low habitat importance to the species, with the potential for irregular visits to large wetlands alongside Armadale Road, and

Species	Status EPBC Act	Status BC Act /DBCA	Distribution and Habitat	Likelihood of Occurrence
---------	-----------------------	---------------------------	--------------------------	-----------------------------

seasonally flooded paddocks (Bamford Consulting 2021).

Black Cockatoo Species

PTA has undertaken targeted Black Cockatoo surveys and investigations to identify potential breeding, roosting and foraging habitat for the three threatened Black Cockatoo species in Western Australia. Ecological values for Black Cockatoos within the Development Envelope were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for Black Cockatoos (DSEWPAC 2012).

The Baudin's Cockatoo *Calyptorhynchus baudinii* (Endangered under the EPBC Act and the BC Act), Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under the EPBC Act and the BC Act), and the forest red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (Vulnerable under the EPBC Act and the BC Act) were all recorded within the Development Envelope during recent field surveys (AECOM 2020b; Bamford Consulting 2021). **Figure 18** shows the locations of the Black Cockatoo sightings.

The Baudin's Cockatoo were observed on several occasions by AECOM (2020b), including flying north over the AECOM survey area (8 birds), flying south over the AECOM survey area (12 birds), and a flock of Baudin's Cockatoos heard to the southwest of the rail corridor (AECOM 2020b). AECOM (2020b) also observed five Baudin's Black Cockatoos in introduced Eucalyptus sp. in the Development Envelope. Bamford Consulting (2021) recorded feeding residue (chewings) from the species at Fletcher Park and along Eleventh Road.

AECOM (2020b) directly observed Carnaby's Cockatoo on two occasions with six Carnaby's Cockatoos recorded flying southeast, and a flock of approximately 40 birds observed flying south over the AECOM survey area.

AECOM (2020b) observed the Forest Red-tailed Black Cockatoo frequently during field assessments including sightings of the species flying over the survey area and observed along the rail corridor around Sherwood Station (up to 10 birds). AECOM also recorded the species in the southern extension of Fletcher Park (three birds), in Lambert Lane Nature Reserve (four birds) and on several properties along Eleventh Road (up to five birds).

Residue from Forest Red-tailed Black Cockatoos feeding on Marri was widespread across the Development Envelope (Bamford Consulting 2021).

Foraging habitat

PTA has assessed the foraging habitat within the Development Envelope for suitability for the three Black Cockatoo species. This included determining the foraging value of each VSA within the Development Envelope by examining vegetation characteristics, context, and species density (Bamford Consulting 2021).

VSA 4 Eucalypt Woodland to Forest covers 13.5 ha of the Development Envelope that and provides the best value foraging habitat for all three species (**Table 31**). This VSA contains Marri, which Carnaby's Black cockatoo regularly feed on. All other VSAs provide Low to Negligible/No value for the three Black Cockatoo species.

Table 32 describes foraging habitat value for each VSA.

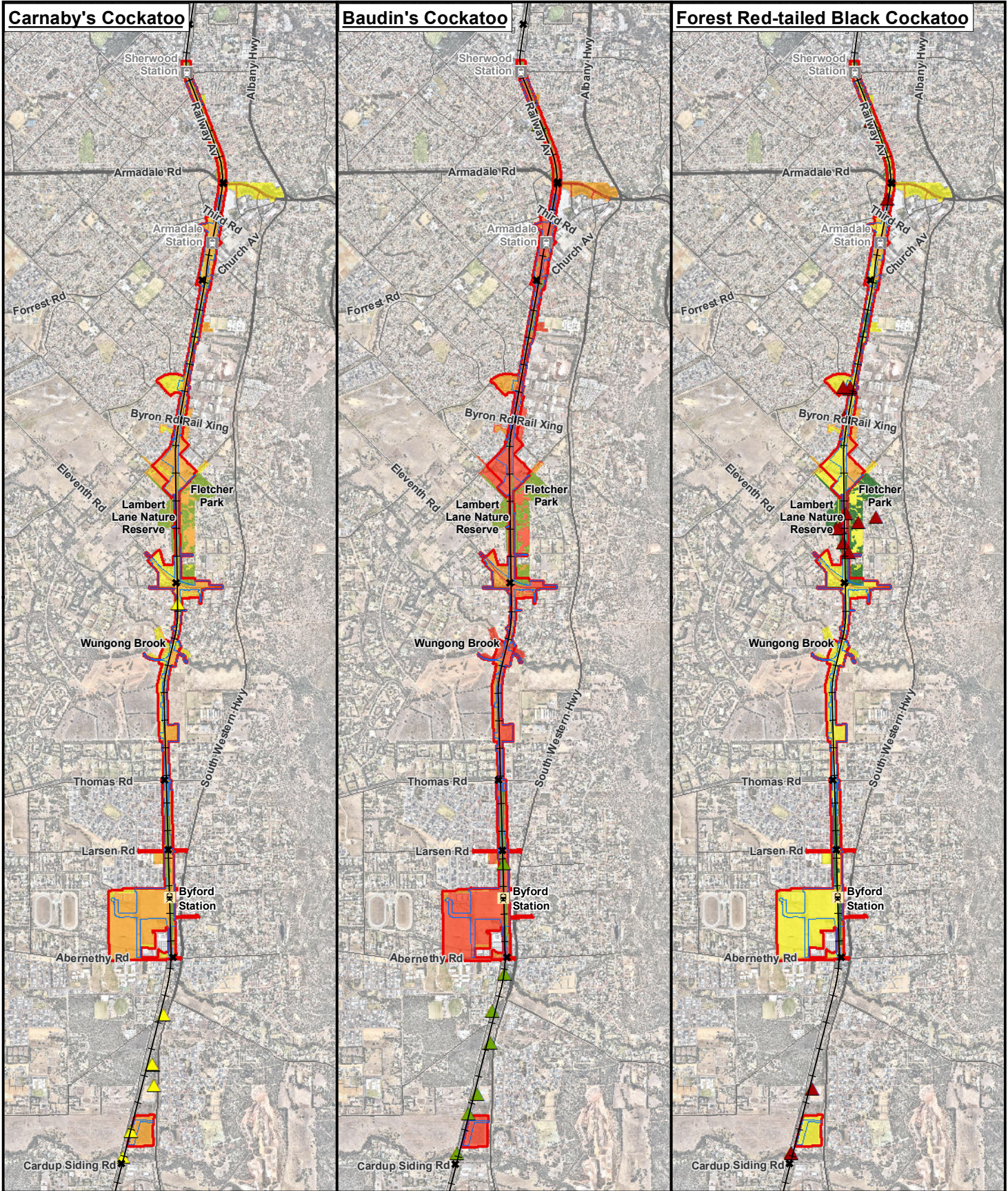
Table 31 Black cockatoo foraging values of vegetation and substrate associations within the development envelope

VSA	Extent in DE (ha)(%)	Footprint Extent (ha)(%)	Baudin's Black Cockatoo	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo
VSA 1. Grassland/paddock with scattered trees	79.42 (48.3%)	41.82 (51.8%)	None	Negligible	Low
VSA 2. Urban parks and gardens	24.75 (15.0%)	10.23 (12.7%)	Negligible	Low	Low
VSA 3. Light industrial areas and hard surfaces	44.52 (27.1%)	19.55 (24.2%)	None	Negligible	Negligible
VSA 4. Eucalypt woodland to forest	13.53 (8.2%)	8.65 (10.7%)	Moderate	Moderate	Moderate to High
VSA 5. Watercourses	2.36 (1.4%)	0.44 (0.5%)	None	Low	Low

The quality of foraging habitat reflects the availability of food sources, proximity to reliable water sources, connectivity to other suitable habitat, presence of breeding habitat and proximity to confirmed roost and breeding sites. Across the Development Envelope there are large amounts of negligible value foraging habitat for all three Black Cockatoo species (**Table 31**). This is particularly evident across VSA 3. Light industrial areas and hard surfaces. VSA 3 includes previously cleared areas such as existing roads, hardstands and buildings, areas that provide very little to no foraging value for Black Cockatoo species (*pers. comm.* M. Bamford). For this reason, negligible value foraging habitat recorded within the Development Envelope and Footprint are not considered when assessing the extent of foraging habitat for Black Cockatoo species

The Development Envelope contains the highest quality foraging habitat for the Forest Red-tailed Black Cockatoo. **Figure 18** and **Table 32** present the quality of foraging habitat across the Development Envelope and Footprint for all three Black Cockatoo species.

There is an estimated 31,754 ha of regional foraging habitat for Black Cockatoos within 12 km of the Development Envelope, of which 26,914 ha is forest on the Darling Escarpment (Bamford Consulting 2021). **Figure 19** illustrates regional Black Cockatoo foraging habitat.



METRONET | Byford Rail Extension
Figure 18 | Black Cockatoo Foraging Habitat

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✕ Rail Crossing

Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii* (Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris* (Carnaby's Cockatoo)

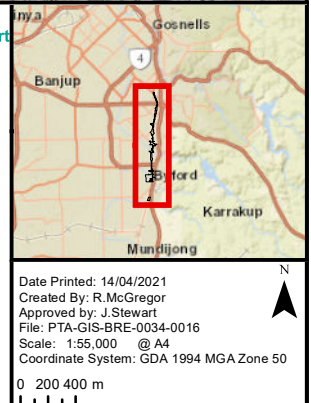
Foraging Value (GHD, 2020)

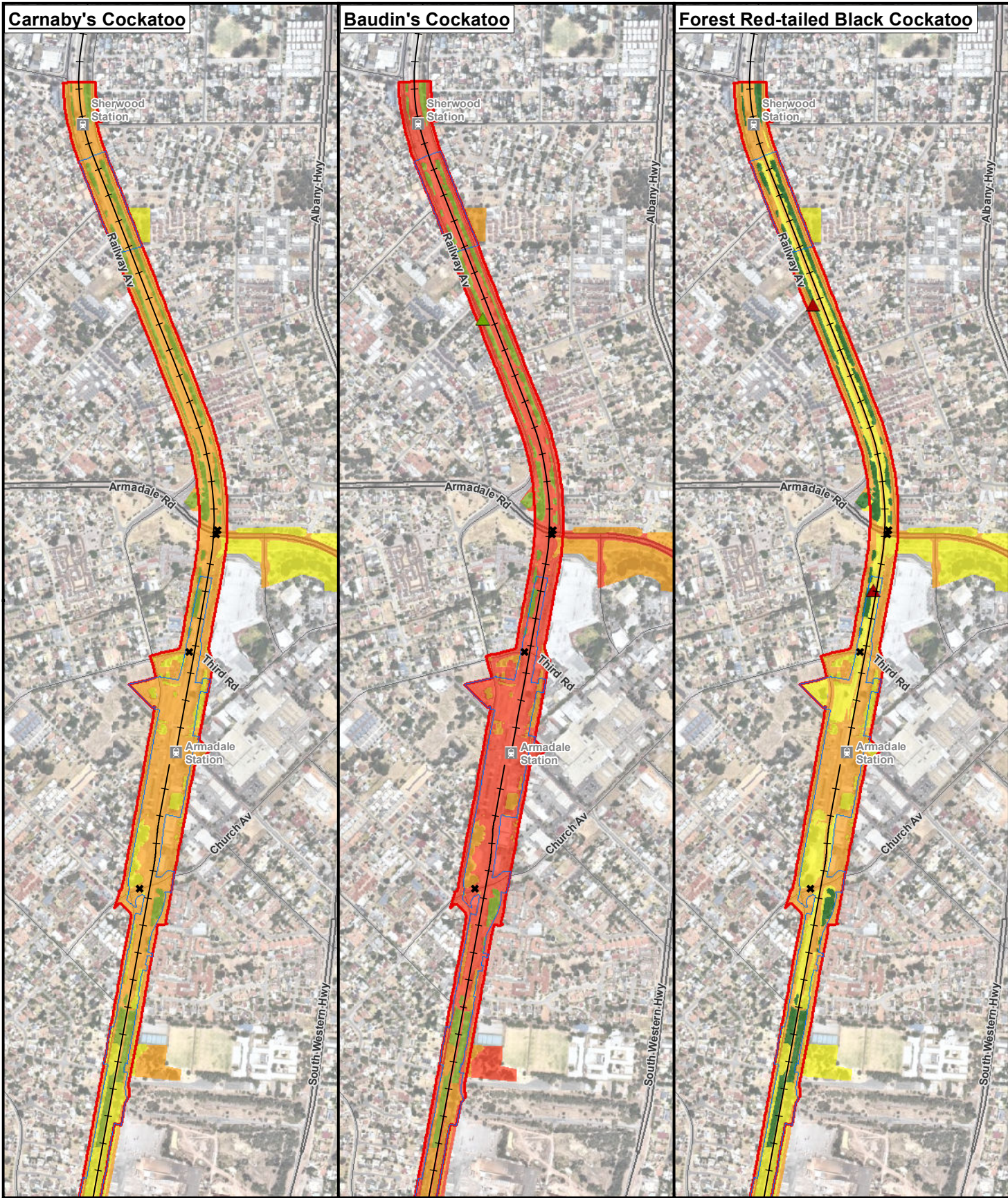
- Moderate to High
- Moderate
- Low
- Negligible
- None



Public Transport
Authority

A
B
C
D





METRONET | Byford Rail Extension
Figure 18A | Black Cockatoo Foraging Habitat

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Existing Railway Station
- Rail Crossing

Fauna Sightings (2020)

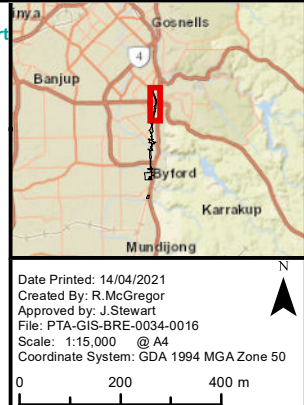
- Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- Calyptorhynchus baudinii* (Baudin's Cockatoo)
- Calyptorhynchus latirostris* (Carnaby's Cockatoo)

Foraging Value (GHD, 2020)

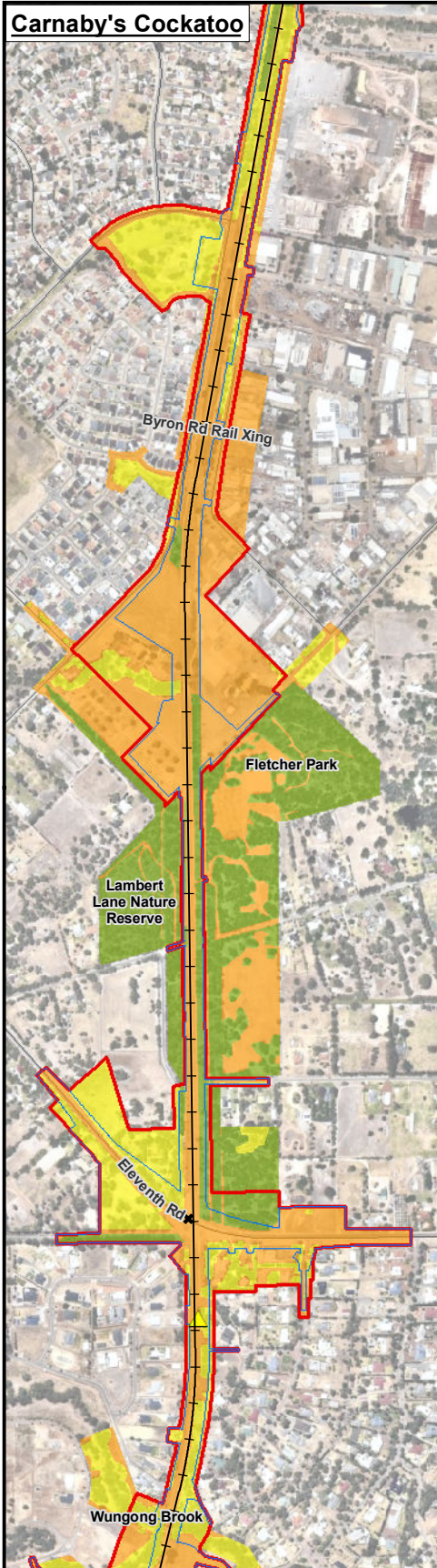
- Moderate to High
- Moderate
- Low
- Negligible
- None



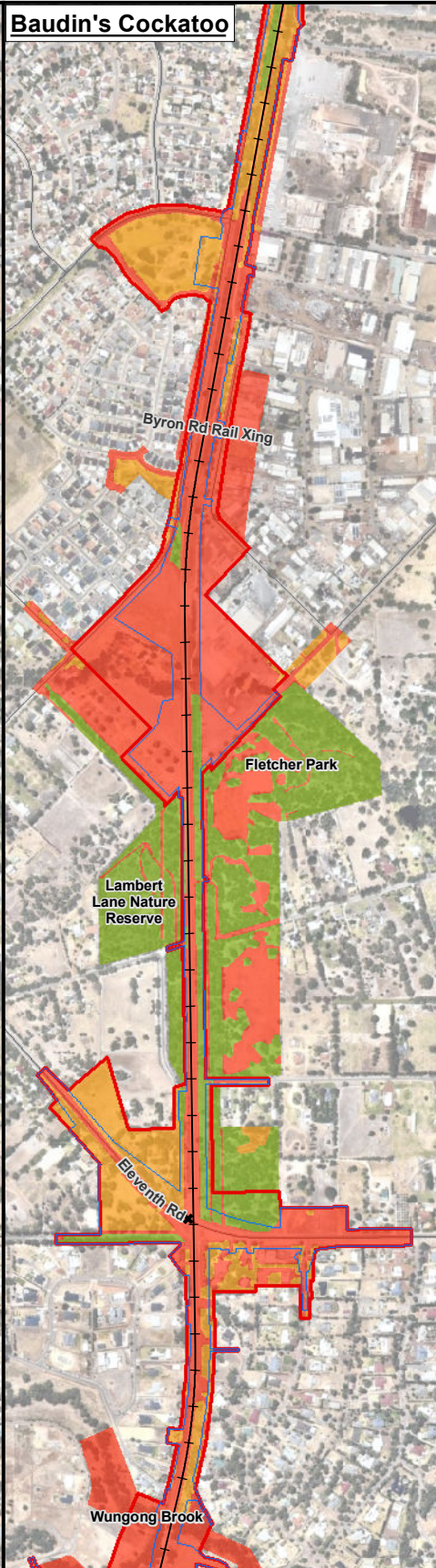
A
B
C
D



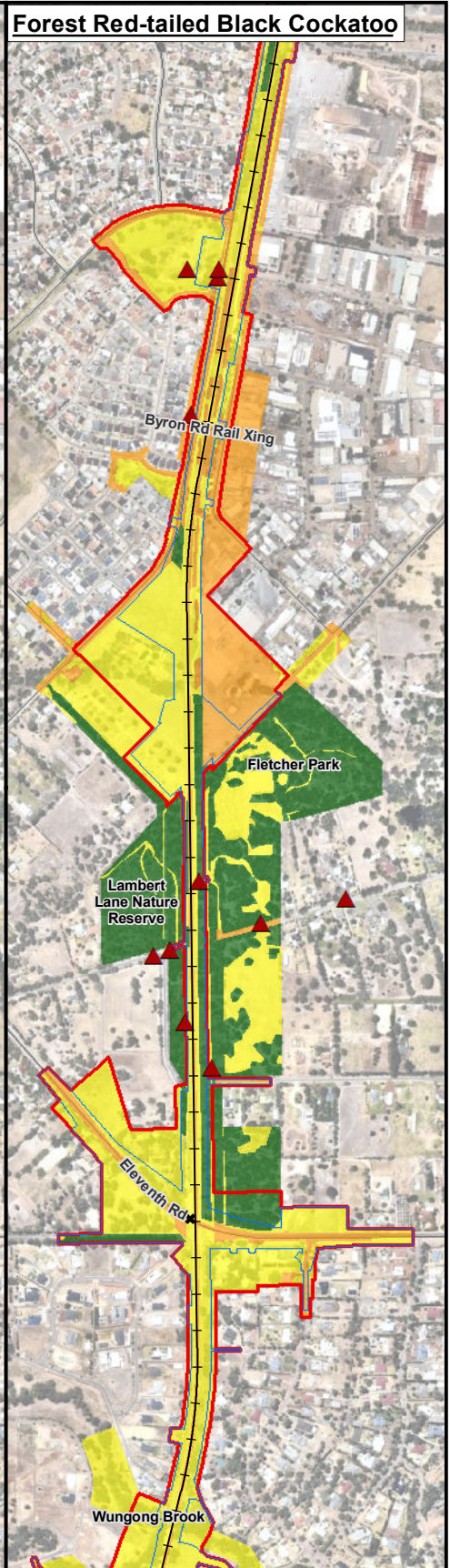
Carnaby's Cockatoo



Baudin's Cockatoo



Forest Red-tailed Black Cockatoo



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Figure 18B | Black Cockatoo Foraging Habitat



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- ✱ Rail Crossing

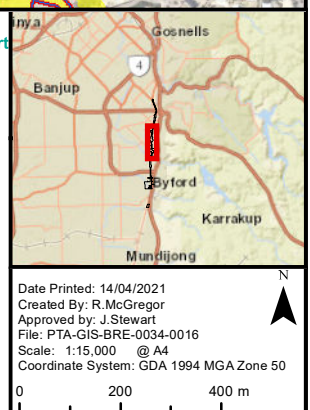
Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso*
(Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii*
(Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris*
(Carnaby's Cockatoo)

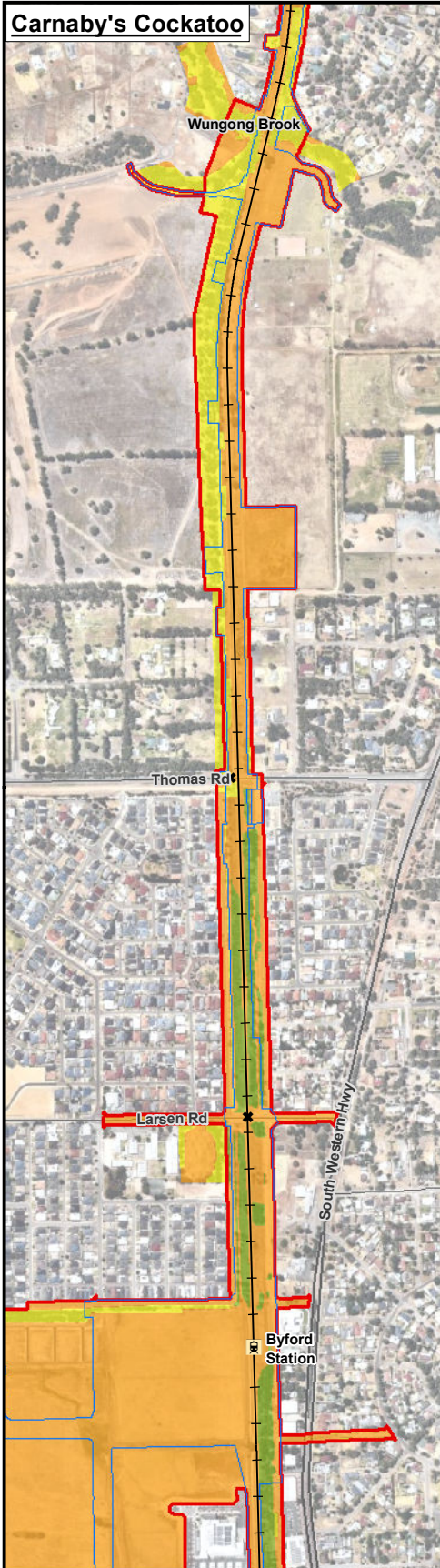
Foraging Value (GHD, 2020)

- Moderate to High
- Moderate
- Low
- Negligible
- None

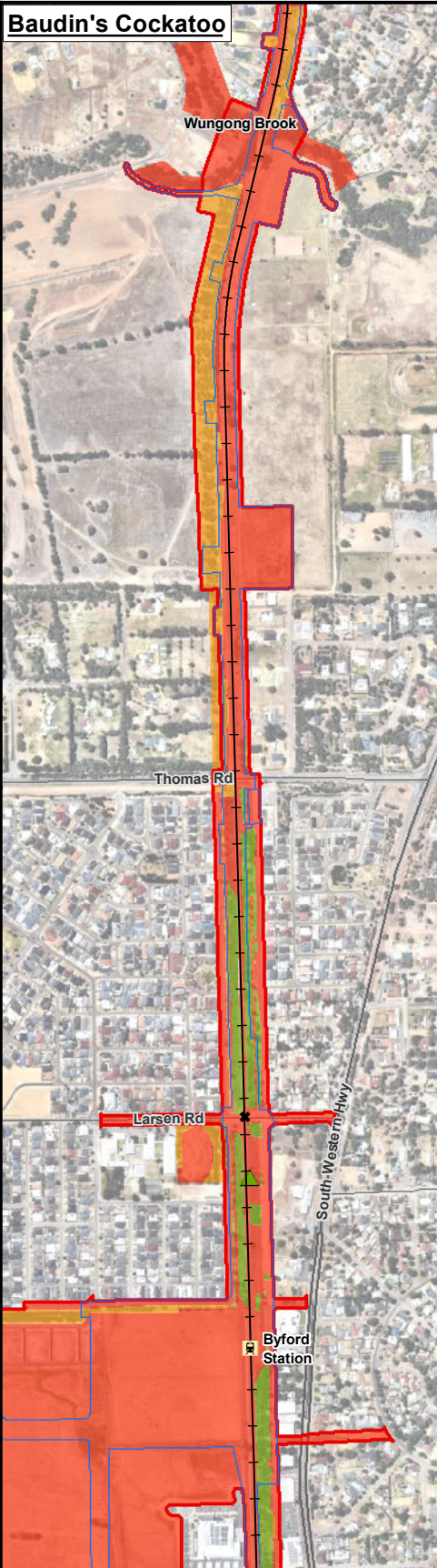
A
B
C
D



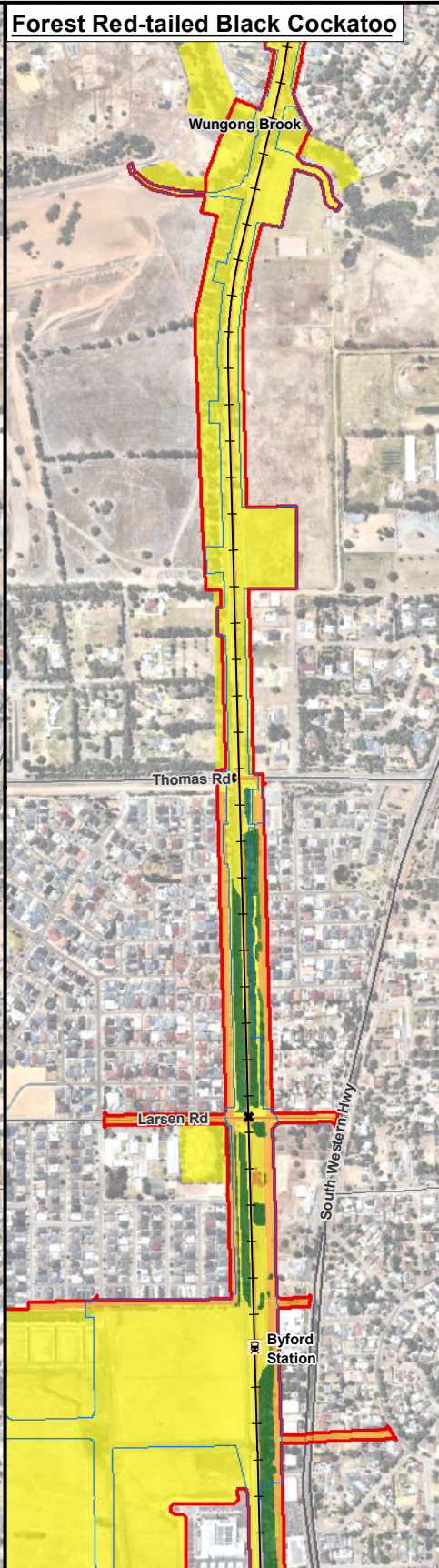
Carnaby's Cockatoo



Baudin's Cockatoo



Forest Red-tailed Black Cockatoo



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Figure 18C | Black Cockatoo Foraging Habitat



Public Transport
Authority

Legend

- Footprint
- Development Envelope
- +— Indicative Railway Alignment
- Proposed Railway Station
- ✕ Rail Crossing

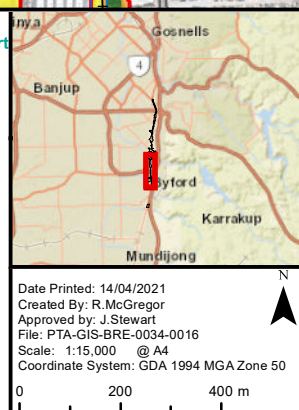
Fauna Sightings (2020)

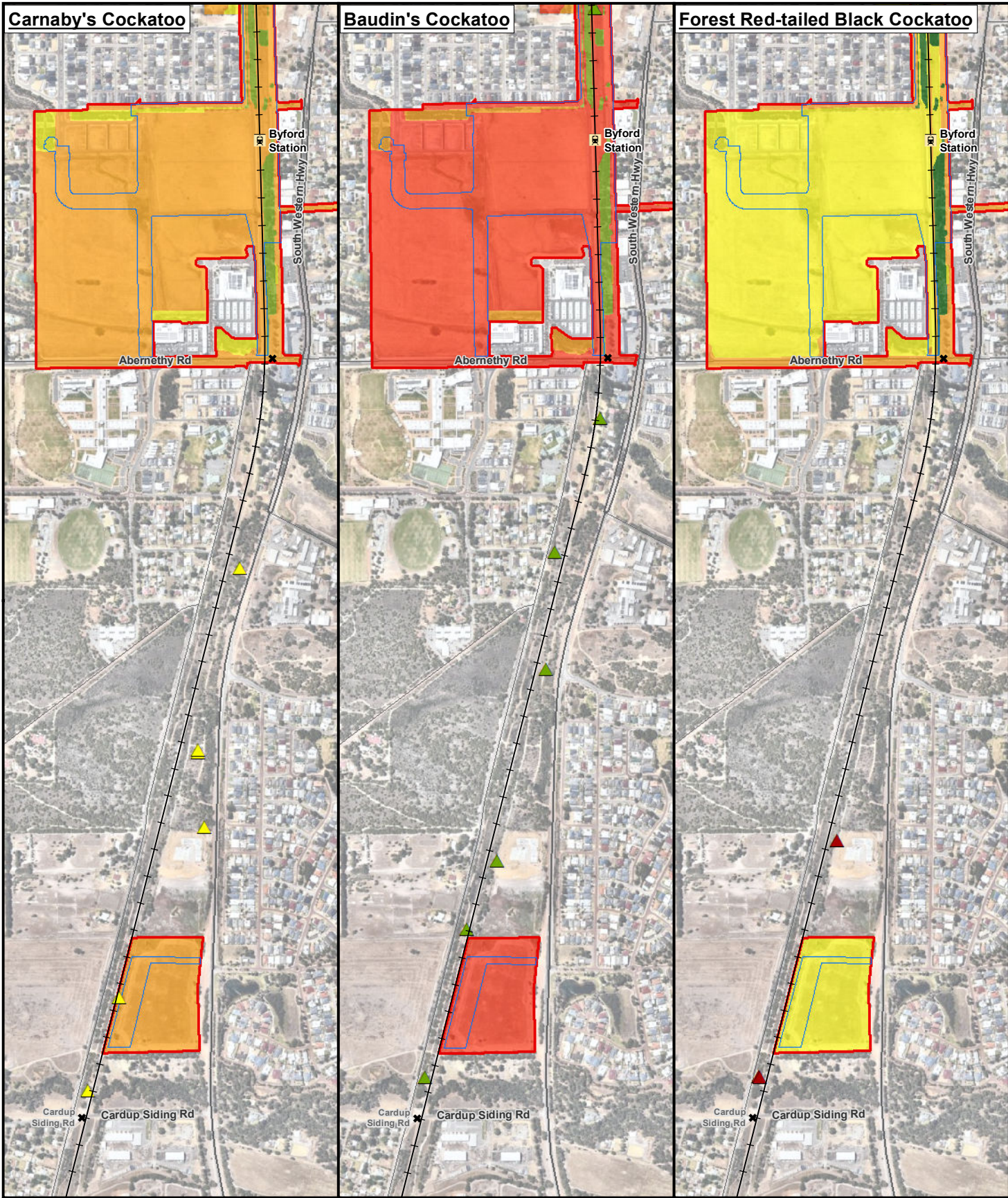
- ▲ *Calyptorhynchus banksii naso*
(Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii*
(Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris*
(Carnaby's Cockatoo)

Foraging Value (GHD, 2020)

- Moderate to High
- Moderate
- Low
- Negligible
- None

A
B
C
D





METRONET | Byford Rail Extension
Figure 18D | Black Cockatoo Foraging Habitat

Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Rail Crossing

Fauna Sightings (2020)

- ▲ *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- ▲ *Calyptorhynchus baudinii* (Baudin's Cockatoo)
- ▲ *Calyptorhynchus latirostris* (Carnaby's Cockatoo)

Foraging Value (GHD, 2020)

- Moderate to High
- Moderate
- Low
- Negligible
- None

Scale

0 200 400 m

Inset Map

Metadata

Date Printed: 14/04/2021
 Created By: R. McGregor
 Approved By: J. Stewart
 File: PTA-GIS-BRE-0034-0016
 Scale: 1:15,000 @ A4
 Coordinate System: GDA 1994 MGA Zone 50

Table 32 Black cockatoo foraging habitat value within the development envelope and footprint

Habitat Value	Baudin's Black Cockatoo Development Envelope Extent (ha) (%)	Baudin's Black Cockatoo Footprint Extent (ha) (%)	Carnaby's Black Cockatoo Development Envelope Extent (ha) (%)	Carnaby's Black Cockatoo Footprint Extent (ha) (%)	Forest Red-tailed Black Cockatoo Development Envelope Extent (ha) (%)	Forest Red-tailed Black Cockatoo Footprint Extent (ha) (%)
Moderate to High	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	13.53 (8%)	8.65 (5%)
Moderate	13.53 (8%)	8.65 (5%)	13.53 (8%)	8.65 (5%)	0.00 (0%)	0.00 (0%)
Low	0.00 (0%)	0.00 (0%)	27.11 (16%)	10.67 (6%)	106.53 (64%)	52.49 (31%)
Total Foraging Habitat	13.53 (8%)	8.65 (5%)	40.64 (24%)	19.32 (11%)	120.06 (73%)	61.14 (37%)

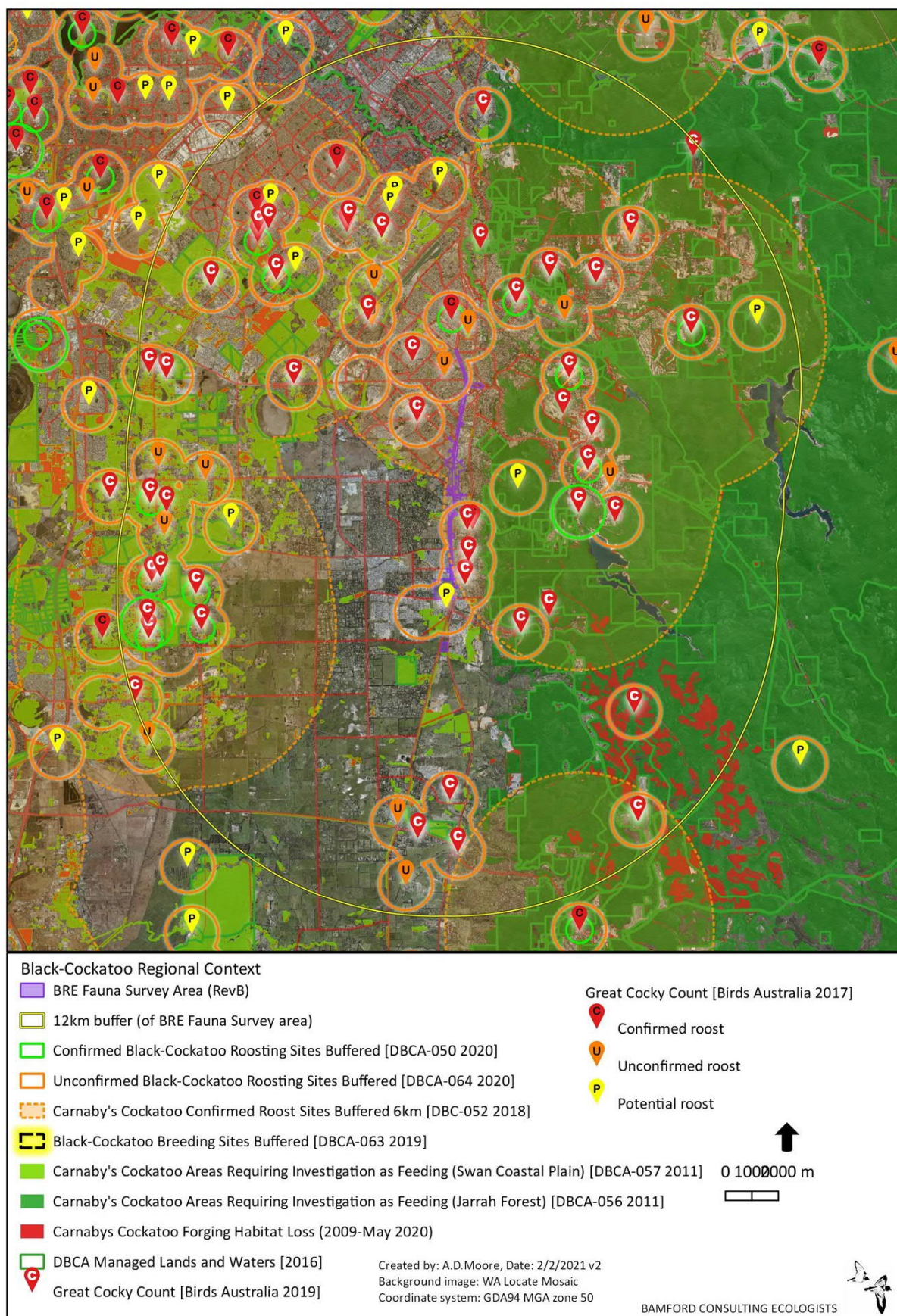


Figure 19 Regional Black Cockatoo Foraging, Roosting and Breeding Habitat

Breeding habitat

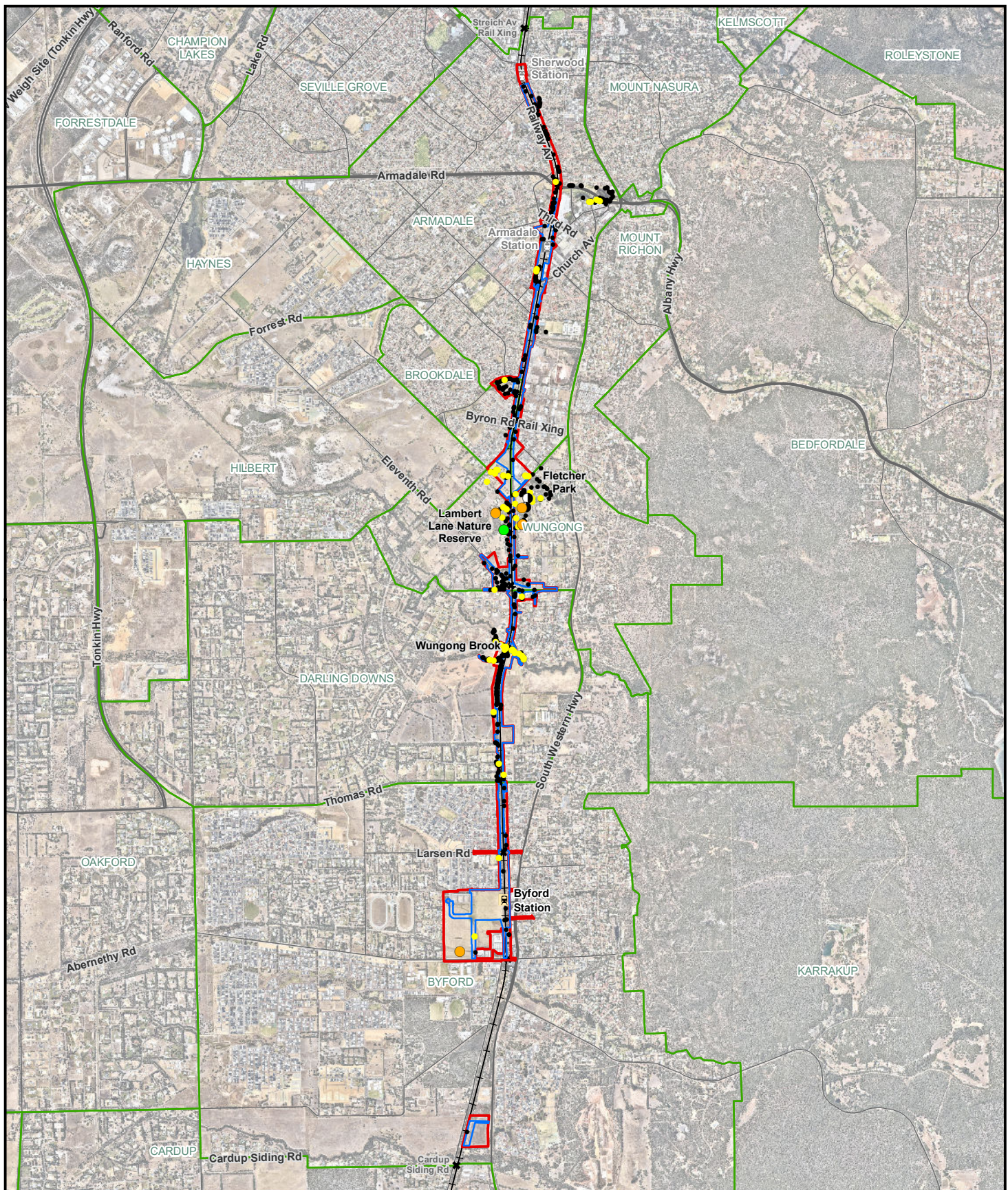
The assessment of Black Cockatoo breeding habitat focused on quantifying breeding and potential breeding trees within the Development Envelope. Potential breeding trees are generally considered to be hollow-forming species of trees known to support breeding, with a Diameter at Breast Height (DBH) equal to or greater than 500 mm, or 300 mm for Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*) (DotEE 2017).

Surveys recorded 336 potential breeding trees within the Development Envelope. Of these, 31 were observed to have a hollow present and 305 had no hollow present. The majority (119) of potential breeding trees within the Development Envelope are Marri (*Corymbia calophylla*), of which four had hollows present (Figure 20).

The Footprint contains 139 potential breeding trees with two Marri (*Corymbia calophylla*) four Flooded Gum (*Eucalyptus rudis*), and one Jarrah (*E. marginata*) and one Wandoo (*E. wandoo*) tree observed with hollows present. None of the eight potential breeding trees with hollows in the Footprint contain hollows that are currently suitable for black cockatoo nesting. The details of the potential breeding trees contained within the Development Envelope and Footprint are provided in **Table 33** and illustrated in **Figure 20**.

Table 33 Potential breeding trees within the development envelope and footprint

Category	Hollow not Present / Hollow Present DE	Hollow not Present / Hollow Present Footprint
<i>Corymbia calophylla</i>	115 / 4	70 / 2
<i>Corymbia citriodora</i>	69 / 5	18 / 0
<i>Eucalyptus globulus</i>	3 / 0	1 / 0
<i>Eucalyptus gomphocephala</i>	1 / 0	0 / 0
<i>Eucalyptus marginata</i>	1 / 1	1 / 1
<i>Eucalyptus rudis</i>	49 / 15	20 / 4
<i>Eucalyptus sp.</i>	25 / 1	9 / 0
<i>Eucalyptus wandoo</i>	7 / 4	2 / 1
Introduced	31 / 1	10 / 0
<i>Pinus radiata</i>	3 / 0	0 / 0
Unidentified	1 / 0	0 / 0
Total	305 / 31	131 / 8



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Figure 20 | Black Cockatoo Potential Breeding Trees and Suitable Roosting Habitat

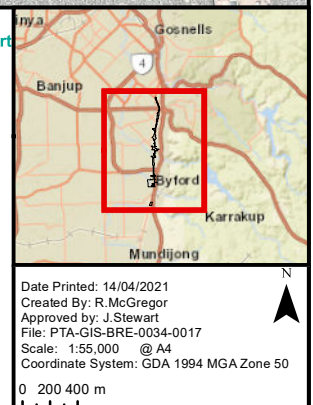


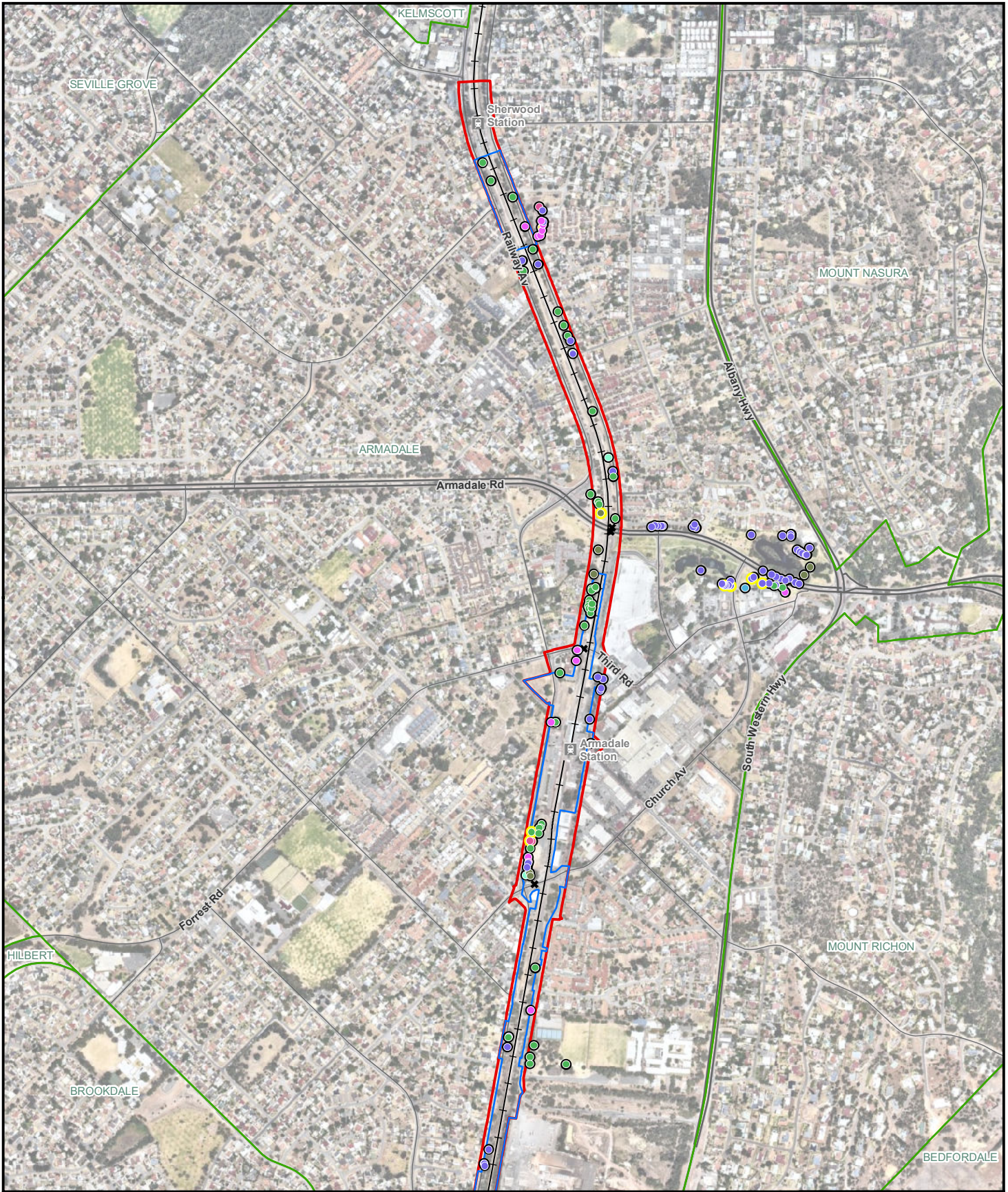
Public Transport
 Authority

Legend

- | | |
|-------------------------------|-----------------------------------|
| Footprint | Hollow Present (GHD, 2020) |
| Development Envelope | Yes |
| Indicative Railway Alignment | No |
| Proposed Railway Station | |
| Existing Railway Station | |
| Rail Crossing | |
| Active Nest (GHD, 2020) | |
| Suitable Hollow (GHD, 2020) | |
| Artificial Hollow (GHD, 2020) | |

A
B
C
D





METRONET | Byford Rail Extension
Figure 20A | Black Cockatoo Potential Breeding Trees and Suitable Roosting Habitat



Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Existing Railway Station
- Rail Crossing

Hollow Present (GHD, 2020)

- Yes
- No

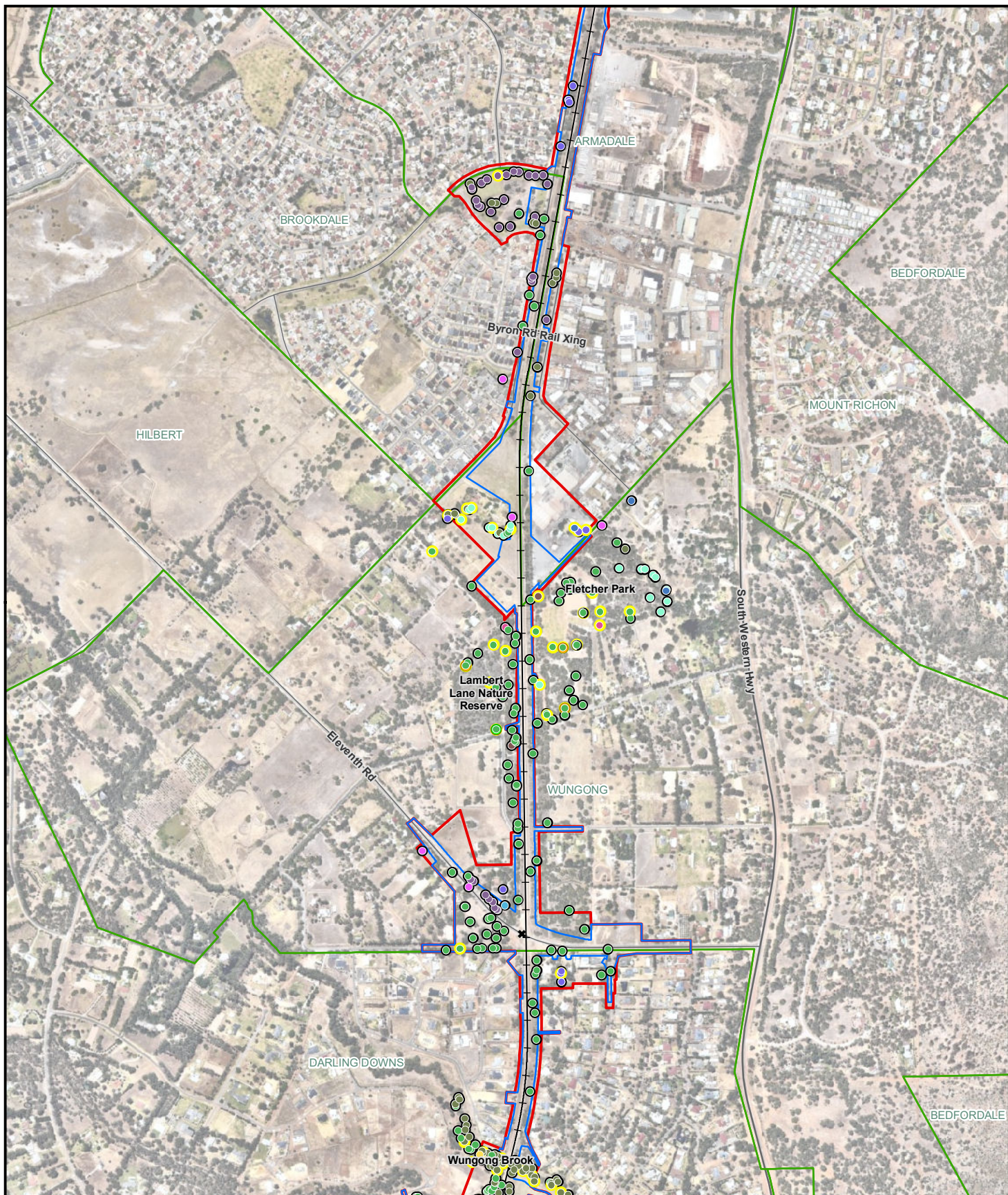
Trees (GHD, 2020)

- Corymbia calophylla
- Corymbia citridora
- Eucalyptus globulus
- Eucalyptus gomphocephala
- Eucalyptus marginata
- Eucalyptus rudis
- Eucalyptus sp.
- Eucalyptus wandoo

Inset map showing the location of the study area within the Perth region, with labels for Gosnells, Banjup, Byford, Mundijong, and Karrakup. A red box highlights the study area.

Date Printed: 14/04/2021
Created By: R. McGregor
Approved by: J. Stewart
File: PTA-GIS-BRE-0034-0017
Scale: 1:15,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50

0 200 400 m



METRONET | Byford Rail Extension
Figure 20B | Black Cockatoo Potential Breeding Trees and Suitable Roosting Habitat



Public Transport
Authority

Legend

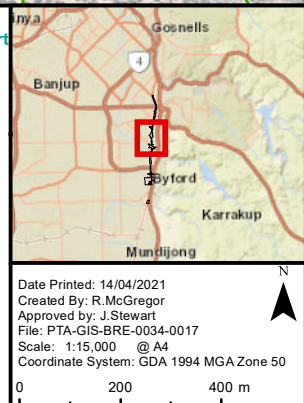
- Footprint
- Development Envelope
- +— Indicative Railway Alignment
- ✕ Rail Crossing
- Active Nest (GHD, 2020)
- Suitable Hollow (GHD, 2020)
- Artificial Hollow (GHD, 2020)

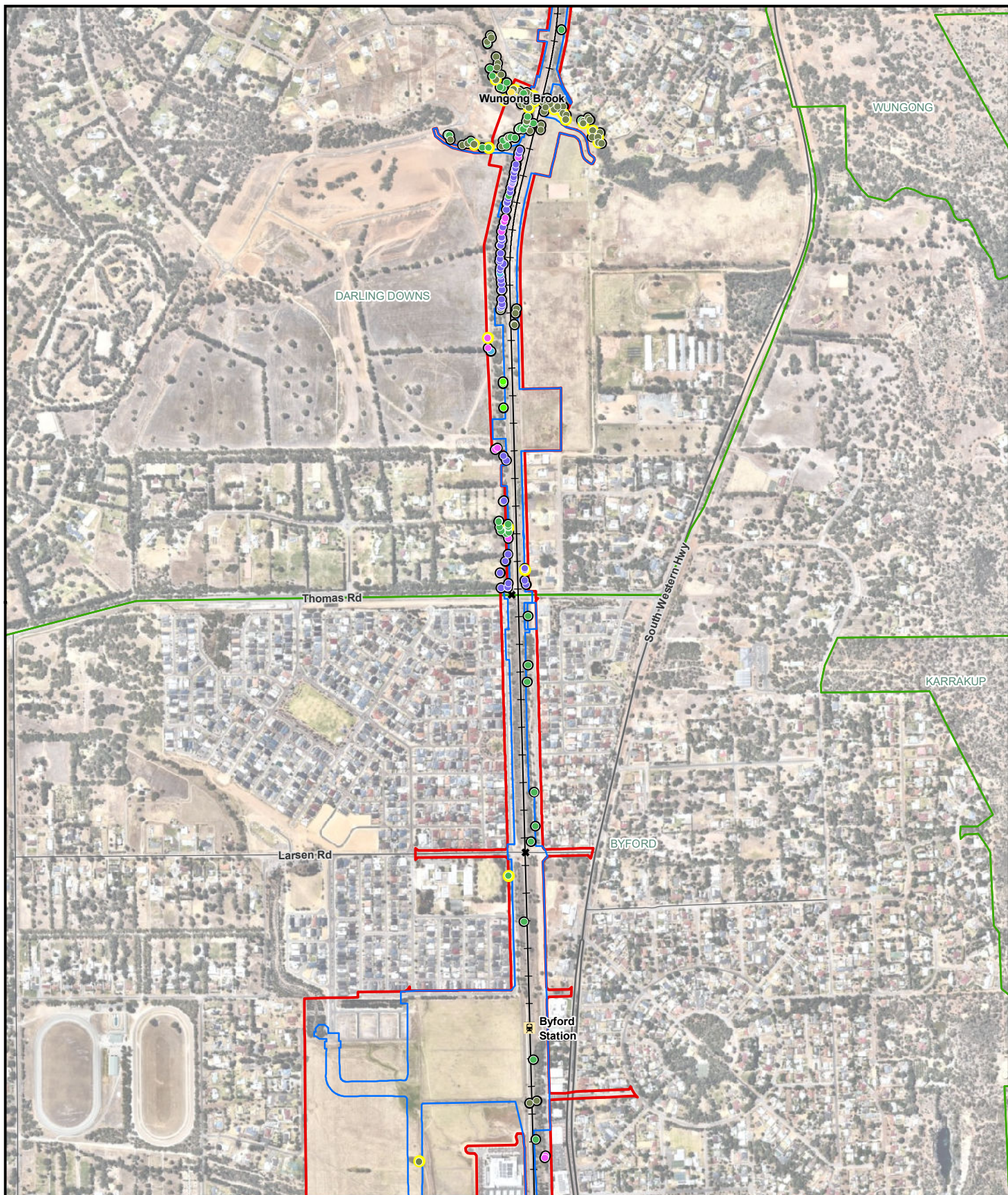
- Hollow Present (GHD, 2020)
- No

Trees (GHD, 2020)

- Corymbia calophylla
- Corymbia citridora
- Eucalyptus globulus
- Eucalyptus gomphocephala
- Eucalyptus marginata
- Eucalyptus rudis
- Eucalyptus sp.
- Eucalyptus wandoo
- Introduced
- Stag
- unid.

A
B
C
D





METRONET | Byford Rail Extension
Figure 20C | Black Cockatoo Potential Breeding Trees and Suitable Roosting Habitat



Public Transport
Authority

Legend

Footprint

Development Envelope

Indicative Railway Alignment

Proposed Railway Station

Rail Crossing

Hollow Present (GHD, 2020)

Yes

No

Trees (GHD, 2020)

Corymbia calophylla

Corymbia citridora

Eucalyptus globulus

Eucalyptus gomphocephala

Eucalyptus rudis

Eucalyptus sp.

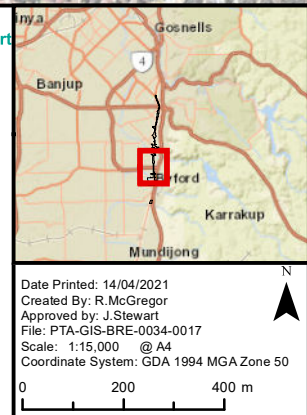
Pinus radiata

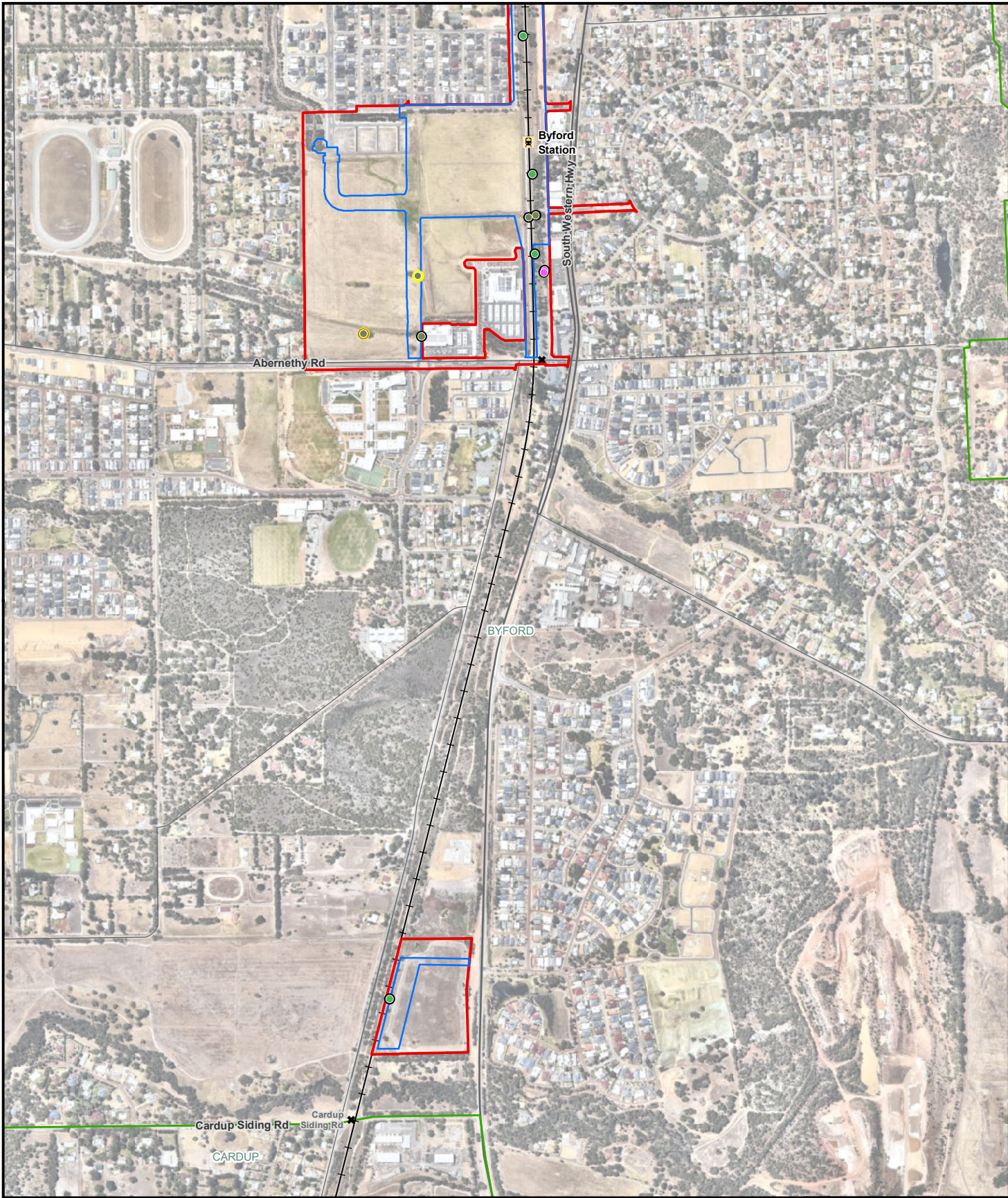
A

B

C

D



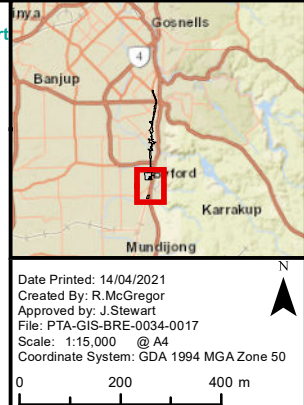


METRONET | Byford Rail Extension
Figure 20D | Black Cockatoo Potential Breeding Trees and Suitable Roosting Habitat



- Legend**
- Footprint
 - Development Envelope
 - Indicative Railway Alignment
 - Proposed Railway Station
 - Rail Crossing
 - Suitable Hollow (GHD, 2020)
 - Hollow Present (GHD, 2020)
 - Yes
 - No
 - Trees (GHD, 2020)
 - Corymbia calophylla
 - Eucalyptus rudis
 - Eucalyptus sp.

A
B
C
D

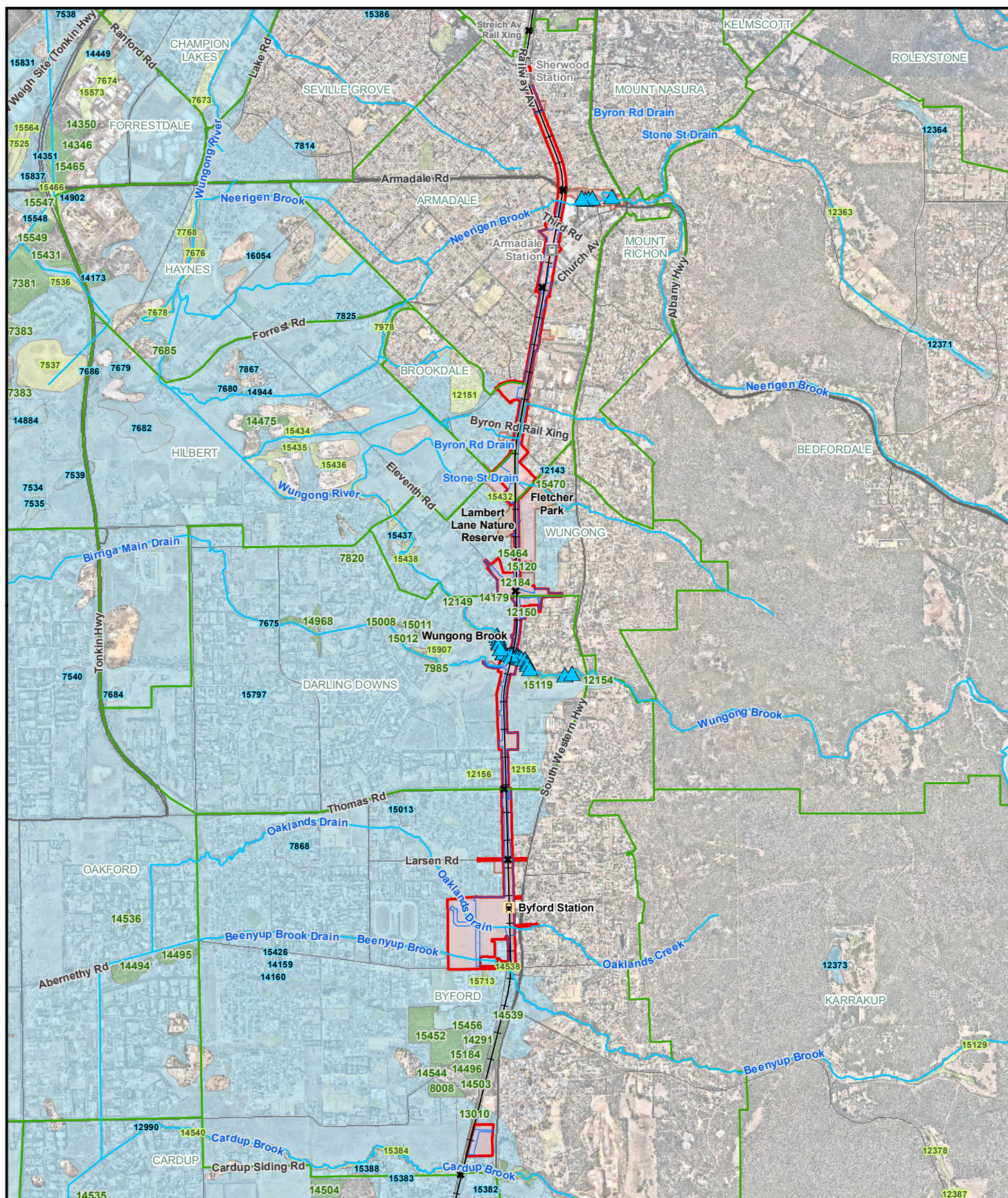


Roosting habitat

AECOM (2020b) undertook an assessment of roosting sites through field surveys and analysis of roosting locations using data from the Great Cocky Count, managed by Birdlife Australia. No roosting sites were identified within the Development Envelope by AECOM (2020b) or Bamford Consulting (2021) and none have been previously recorded within the Development Envelope (**Figure 19**). However, Birdlife Australia has recorded three confirmed roosting locations within approximately 500 m of the Development Envelope, two of which are confirmed as forest red-tailed Black Cockatoo roost sites. These roosting sites are located towards the south-east of the Development Envelope and appear to be in remnant trees within suburbia (**Figure 19**).

Carter's Freshwater Mussel

Stream (2021b) recorded Carter's Freshwater Mussel (*Westralunio carteri*) within the Development Envelope at Wungong Brook. The species was recorded in Wungong Brook in variable, but generally low densities, ranging from one to 12 mussels per m² (mean density 2.6 mussels/m²). The presence and range of size classes observed within the brook indicates a healthy and self-sustaining population. Stream (2021b) also recorded the species in the nearby Sanctuary Lake and Wright Lake. Stream (2021b) noted that it is likely that the species occurs at low- moderate densities within Wright Lake (mean density 4.4 mussels/m²) and at low densities within Sanctuary Lake, based on the suitability of the habitat present. **Figure 21** illustrates the locations of Carter's Freshwater Mussel within the Development Envelope and the Stream (2021b) survey area.



METRONET | Byford Rail Extension
Figure 21 | Carter's Freshwater Mussel Location



Legend

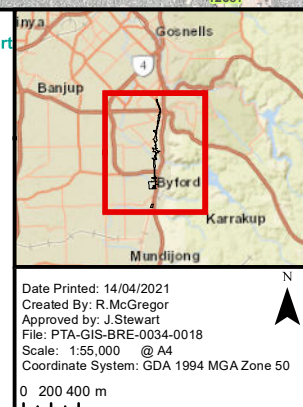
- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary

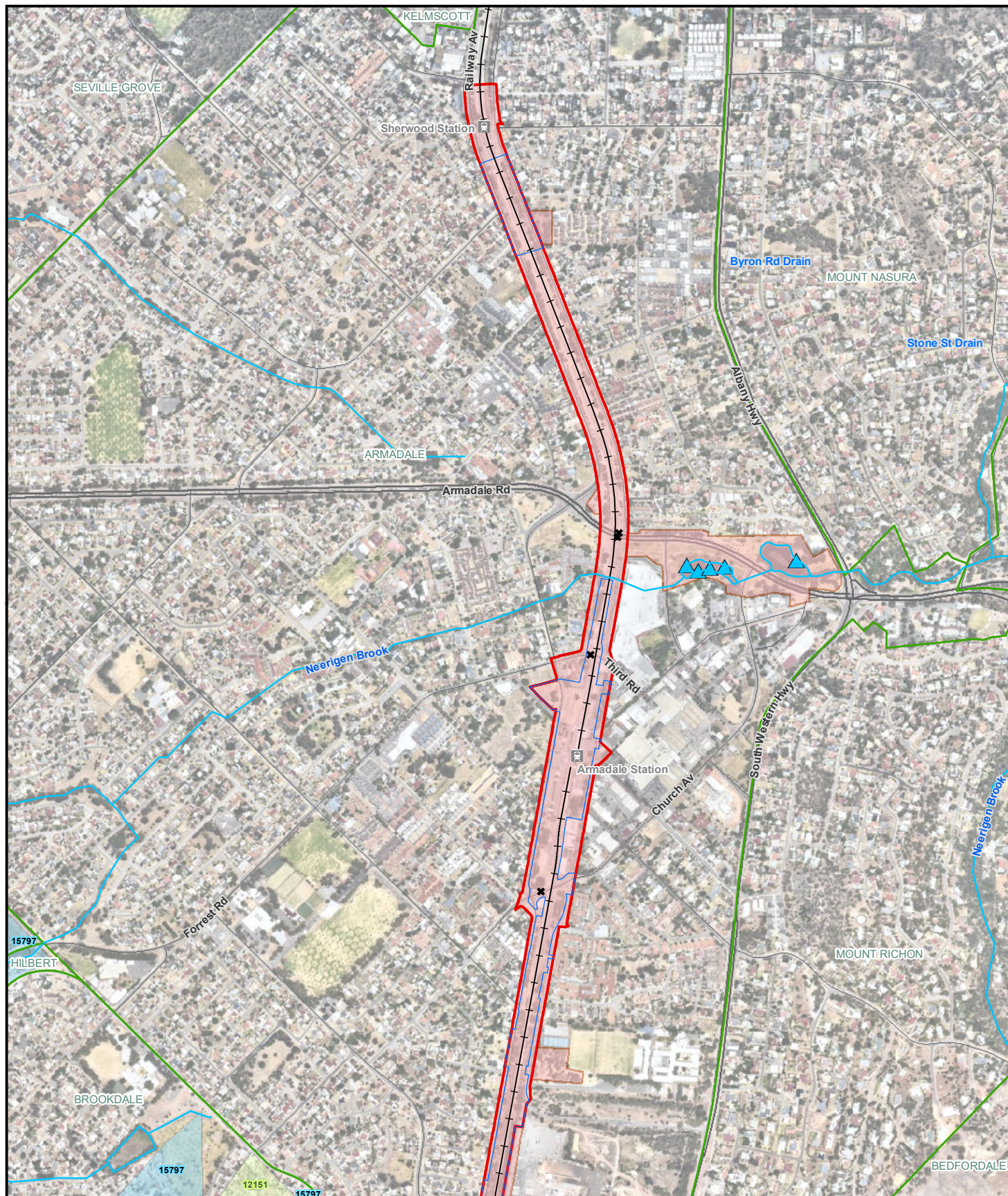
Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019)

- Conservation
- Multiple Use
- Resource Enhancement

- ▲ *Westralunio carteri* (Carter's Freshwater Mussel) (SEW, 2020)
- Carter's Freshwater Mussel Assessment Survey Boundary (SEW, 2020)

- A
- B
- C
- D





METRONET | Byford Rail Extension
Figure 21A | Carter's Freshwater Mussel Location



Public Transport
Authority

Legend

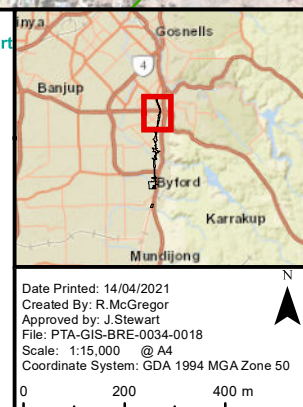
- Footprint
- Development Envelope
- Indicative Railway Alignment
- S Existing Railway Station
- ✕ Rail Crossing
- Locality Boundary

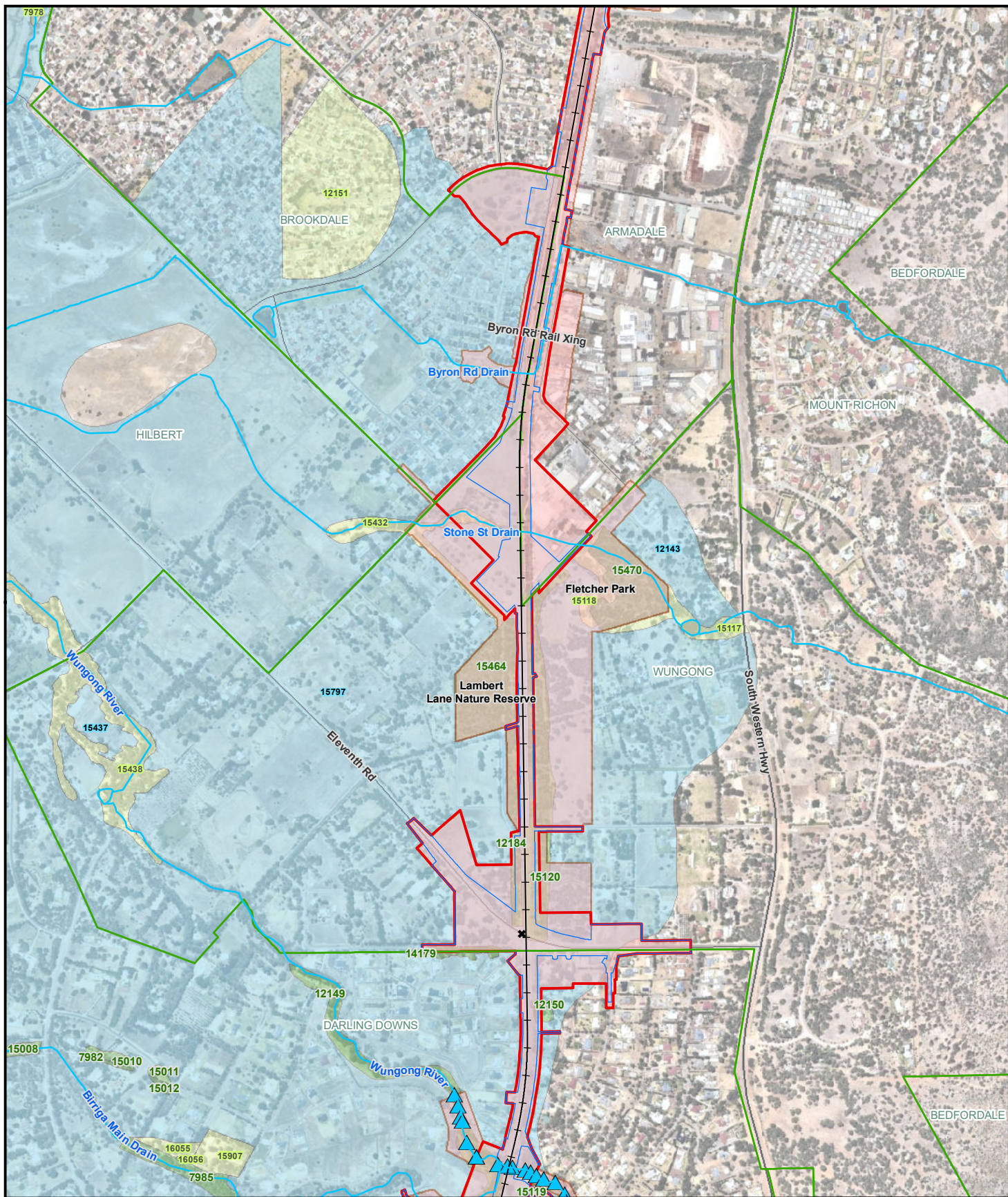
Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019)

- Multiple Use
- Resource Enhancement

- Westralunio carteri* (Carter's Freshwater Mussel) (SEW, 2020)
- Carter's Freshwater Mussel Assessment Survey Boundary (SEW, 2020)

A
B
C
D





METRONET | Byford Rail Extension
Figure 21B | Carter's Freshwater Mussel Location



Public Transport
Authority

Legend

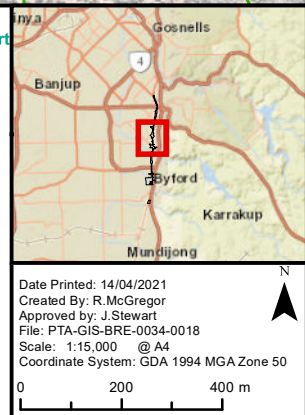
- Footprint
- Development Envelope
- Indicative Railway Alignment
- ✱ Rail Crossing
- Locality Boundary

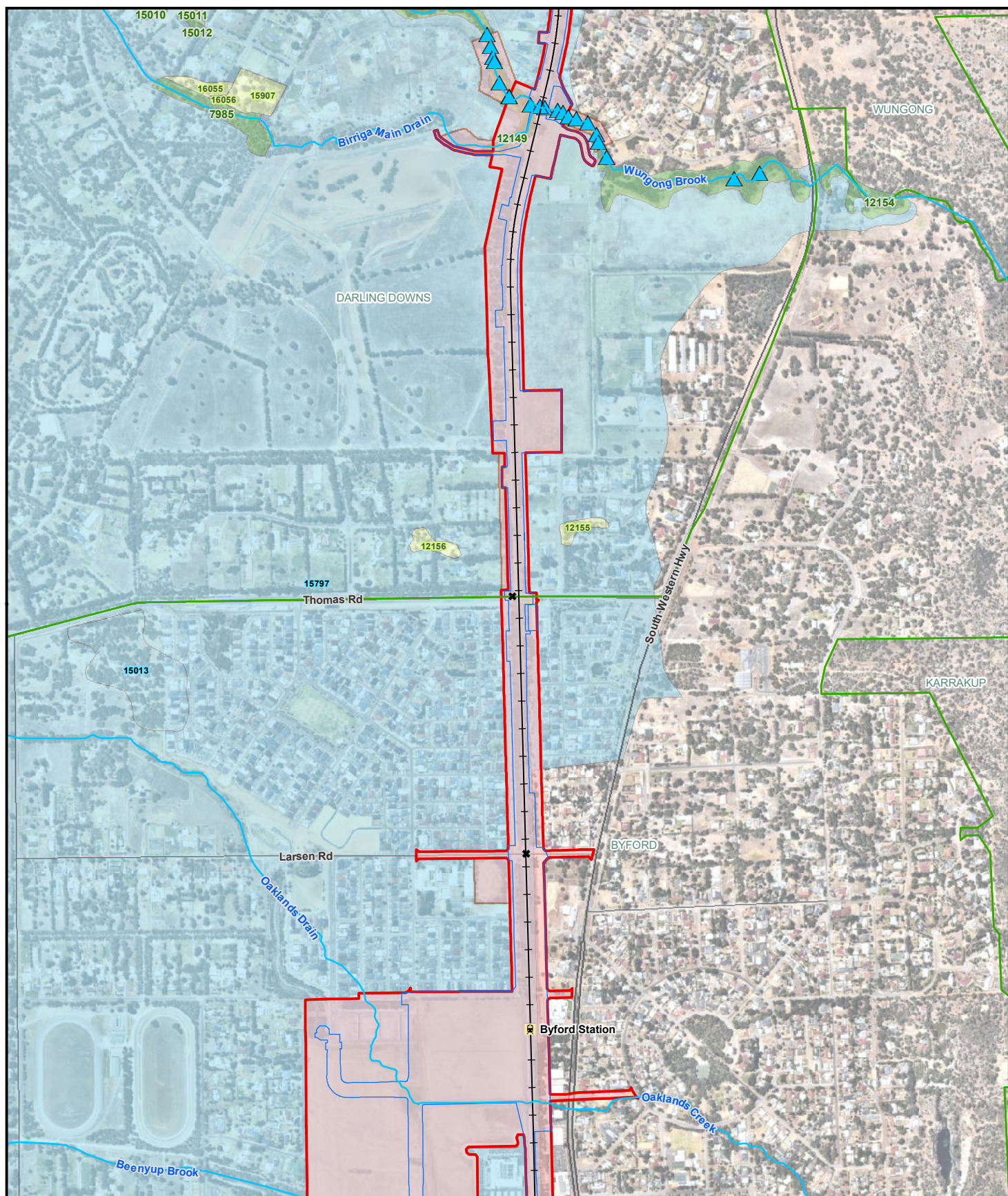
Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019)

- Conservation
- Multiple Use
- Resource Enhancement

- ▲ *Westralunio carteri* (Carter's Freshwater Mussel) (SEW, 2020)
- Carter's Freshwater Mussel Assessment Survey Boundary (SEW, 2020)

- A
- B
- C
- D





METRONET | Byford Rail Extension
Figure 21C | Carter's Freshwater Mussel Location



Public Transport
Authority

Legend

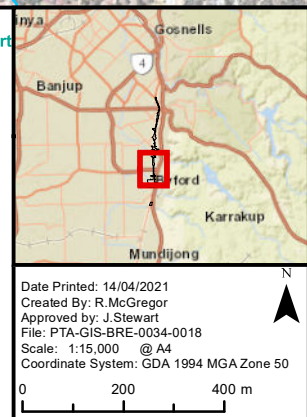
- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- ✕ Rail Crossing
- Locality Boundary

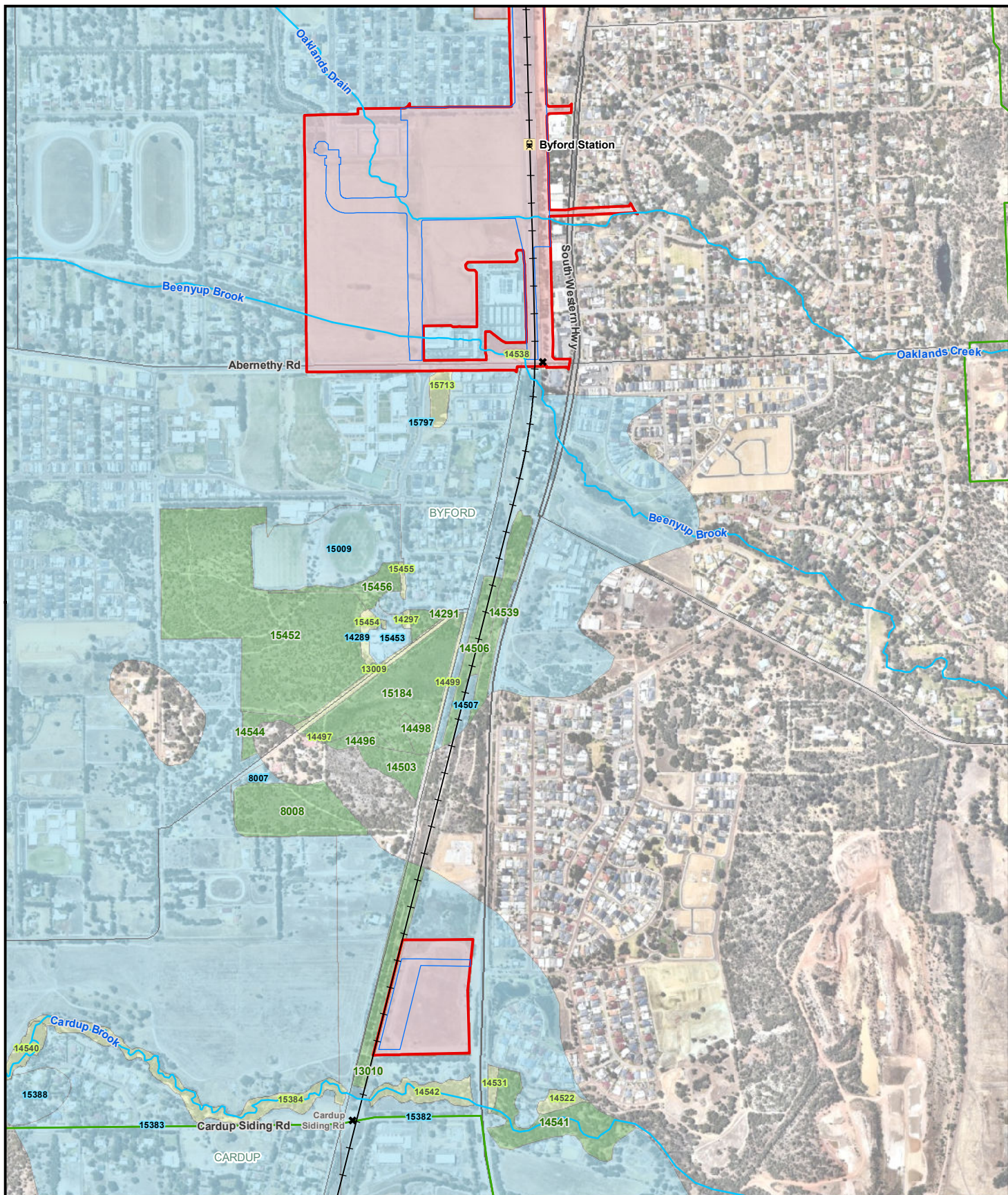
Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019)

- Conservation
- Multiple Use
- Resource Enhancement

- ▲ *Westralunio carteri* (Carter's Freshwater Mussel) (SEW, 2020)
- Carter's Freshwater Mussel Assessment Survey Boundary (SEW, 2020)

A
B
C
D





METRONET | Byford Rail Extension
Figure 21D | Carter's Freshwater Mussel Location



Public Transport Authority

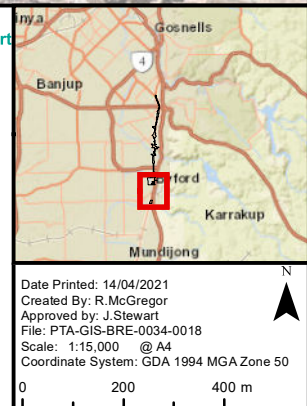
Legend

- Footprint
- Development Envelope
- Indicative Railway Alignment
- Proposed Railway Station
- Rail Crossing
- Locality Boundary

Geomorphic Wetlands of the Swan Coastal Plain (DBCA-019)

- Conservation
- Multiple Use
- Resource Enhancement
- Carter's Freshwater Mussel
- Assessment Survey Boundary (SEW, 2020)

A
B
C
D



7.6. Potential impacts on terrestrial fauna

7.6.1. Direct Impacts

Implementation of the Proposal will result in direct impacts on terrestrial fauna values. The potential direct impacts on terrestrial fauna by construction and operation include:

- Impacts on conservation significant fauna
- Fauna deaths and injury resulting from collisions with earth moving equipment, vehicles, and/or trains during construction and operation, or from fauna entering excavated areas
- Impacts to 80.7 ha of fauna habitat in varying condition, due to clearing and construction of infrastructure in the Footprint
- Fragmentation of fauna habitat, barriers to fauna movement and/or loss of ecological connectivity.

7.6.2. Indirect Impacts

Construction and operation of the Proposal may also indirectly impact terrestrial fauna values. The potential indirect impacts on terrestrial fauna include:

- Changes in feral animal abundance and/or movement
- Short term noise and lighting impacts may change fauna movement and behaviour
- Degradation of habitat and habitat modification from the introduction and increased spread of weeds and/or disease, soil pathogens, altered surface water flows and edge effects
- Increased separation between habitat patches

7.6.3. Cumulative Impacts

The implementation of the Proposal will also contribute to cumulative impacts on terrestrial fauna values including to fauna assemblages, habitats and conservation significant fauna. The cumulative impacts are assessed in Table 36.

7.7. Assessment of impacts on terrestrial fauna

7.7.1. Direct Impacts

Impact on Conservation Significant Fauna

Black Cockatoo Species

Across the Development Envelope and Footprint there are large amounts of negligible value foraging habitat for all three Black Cockatoo species (**Table 31**). This is particularly evident across VSA 3. Light industrial areas and hard surfaces. VSA 3 includes previously cleared areas such as existing roads, hardstands and buildings, areas that provide very little to no foraging value for Black Cockatoo species (*pers comm.* M. Bamford). For this reason, negligible value foraging habitat recorded within the Development Envelope and Footprint are not considered when assessing the impacts of the Proposal on Black Cockatoo species.

The Footprint contains:

- 8.65 ha of foraging habitat for Baudin's Black Cockatoo classified entirely as moderate value foraging habitat
- 19.3 ha of foraging habitat for Carnaby's Cockatoo comprised of 8.65 ha of moderate value foraging habitat and 10.67 ha of low value foraging habitat
- 61.1 ha of foraging habitat for Forest Red-tailed Black Cockatoo comprised of 8.65 ha of moderate to high value foraging habitat and 52.49 ha of low value foraging habitat

The loss of 61.1 ha of foraging habitat overlaps with 19.3 ha of Carnaby's Black Cockatoo foraging habitat and 8.65 ha of Baudin's Black Cockatoo habitat. The loss up to 61.1 ha of foraging habitat represents 37% of the Development Envelope.

There is an estimated 31,754 ha of regional foraging habitat for Black Cockatoos within 12 km of the Development Envelope, of which 26,914 ha is forest on the Darling Escarpment (Bamford Consulting 2021). The proposed clearing equates to a 0.2% reduction in regional foraging habitat for Black Cockatoo species.

336 potential Black Cockatoo breeding trees have been recorded within the Development Envelope. Of these, 139 (41.4%) may be removed within the Footprint. The 139 potential breeding trees within the Footprint are comprised of 131 (94.2%) potential breeding trees with no hollows, and eight (5.8%) hollow bearing trees not currently suitable for black cockatoos (**Table 34**).

No recorded breeding trees were observed within the Development Envelope (**Table 34**), however, Kirkby (2021) recorded one potential active breeding tree near Lambert Lane, approximately 30 m west of the Footprint (**Figure 20**). Light, noise and other construction activities may impact Black Cockatoo breeding.

Carnaby's and Baudin's Cockatoos roost in or near riparian environments or near other permanent water sources, generally within any tall trees, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts and introduced pines. The Forest Red-tailed Black Cockatoo prefers roosting within any tall trees along the edges of forests, but particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced eucalypt trees (DotEE 2017).

There are no known roost sites located within the Footprint. Birdlife Australia has recorded three confirmed roosting locations within approximately 500 m of the Development Envelope, two of which are confirmed as a Forest Red-tailed Black Cockatoo roost sites. These roosting sites are located towards the south-east of the Development Envelope and appear to be located in remnant trees within suburbia (**Figure 19**). The Proposal will not have a significant impact on roosting habitat for Black Cockatoos, as no known roost sites are within the Footprint. Noise and light associated with construction are at a sufficient distance to not cause impacts. Noise, light and other impacts associated with the Proposal will be managed in accordance with a CEMP to minimise the extent of impact.

Primary threats to Black Cockatoo include habitat loss and degradation, including loss and degradation of foraging and roosting habitat, and isolation of mature, hollow-bearing trees necessary for breeding (DSEWPAC 2012).

Furthermore, the introduction or spread of dieback (*Phytophthora cinnamomi*) and other plant diseases can contribute to the decline of habitat (DSEWPAC 2012). Interactions with humans, for example through vehicle or train strike can also cause death or injury to individuals.

Baudin's Black Cockatoo

Clearing for the Proposal is expected to remove up to 8.65 ha of moderate value foraging habitat for Baudin's Black Cockatoo within an 80.7 ha Footprint. This moderate value foraging habitat is associated with VSA 4. eucalypt woodlands and forest. Baudin's Cockatoo primarily forage on Marri *Corymbia calophylla* (seeds, flowers, nectar and grubs) (DSEWPAC 2012), the dominant tree species within VSA 4 (**Table 29**). Sightings of the species were observed on several occasions within the Development Envelope and feeding residue (chewings) from the species were recorded at nearby Fletcher Park and along Eleventh Road.

Although the generalised distribution of Baudin's Cockatoo is known, detailed information on the present distribution and habitat that is critical to the species survival is unknown (DEC 2008). Therefore, the recovery plan for Baudin's Black Cockatoo describes habitat critical to it's survival as areas that are currently occupied by the cockatoos (DEC 2008). As the Development Envelope and Footprint comprise areas currently occupied by the cockatoos, the Footprint meets the definition of habitat critical to survival for the species (DEC 2008).

The breeding population of Baudin's Black Cockatoo is largely disjunct with most birds breeding in the deep south- west and small isolated breeding population near the northern limit of its range (Johnstone & Kirkby 2017). A few nests of Baudin's Cockatoo have been recorded in recent years throughout the northern Jarrah forest of Western Australia, two in the Wungong Dam Catchment, approximately 5 km east of the Development Envelope. Further to this, 336 potential breeding trees were also recorded within the Development Envelope, with 139 potential breeding trees located within the footprint (Bamford Consulting 2021). However, no evidence of breeding was recorded during the commissioned surveys. While breeding, black cockatoos will generally forage within a 6–12 km radius of their nesting site and maintaining the availability of foraging habitat is especially important in the breeding range, with breaks of more than 4 km have been shown to prevent breeding birds reaching resources (DSEWPAC 2012). Clearing of up to 8.65 ha of foraging habitat within the Development Envelope may therefore impact the amount of food available to breeding birds and can affect chick survival rates (DSEWPAC 2012). However, as the Development Envelope is in close proximity to a number of wetlands, reserves and Bush Forever sites that contain habitat similar, if not better quality to that within the Footprint (AECOM 2020b; Bamford Consulting 2021), it is not expected that clearing create a gap of more than 4km between patches of foraging habitat for Baudin's Black Cockatoo, as the linear nature of the Development Envelope has a maximum width of 500 m.

Evaluation of the Proposal against the EPBC Act 1999: Referral Guidelines for three threatened Black Cockatoo species (DSEWPAC 2012) determines that the impacts on Baudin's Black Cockatoo is significant as:

- Clearing of VSA 4. eucalypt woodland and forest, which may be utilised as foraging habitat by the Baudin's Black Cockatoo
- Clearing of up to 8.65 ha of moderate quality foraging habitat
- Clearing of up to 139 potential breeding trees.

No night roosting sites were recorded within the Development Envelope and the Proposal will not result in the clearing or degradation of a known roosting site.

Carnaby's Black Cockatoo

A total of 19.3 ha of foraging habitat for the Carnaby's Cockatoo will be cleared as a result of the Proposal. This includes habitat described as VSA 4. Eucalypt woodlands and forest, where the species will feed regularly on Marri *Corymbia calophylla* (Bamford Consulting 2021). The loss of eucalypt woodlands that provide breeding hollows is critical habitat for Carnaby's Cockatoo (DPaW 2013) and may be utilised as breeding or foraging habitat for the species (AECOM 2020b).

Breeding was not observed within the Development Envelope during commissioned surveys, with the exception of a potential active breeding trees approximately 30 m west of the Footprint. The loss of habitat within 6-12 km of a breeding site is important to maintain to ensure availability of food for breeding birds, which may impact productivity and survival of young (DSEWPAC 2012). Loss of this breeding habitat is a known threat to the survival of Carnaby's Cockatoo (DPaW 2013).

The Proposal was assessed against the EPBC Act 1999: Referral Guidelines for three threatened Black Cockatoo species (DSEWPAC 2012) to determine if the impact on Carnaby's Black Cockatoo species is significant.

The removal of up to 19.3 ha of foraging habitat, including parts of VSA 4. eucalypt woodlands and forest, which has the potential to be utilised as breeding, in conjunction with up to 139 potential breeding trees across the Footprint, will be of significance, as clearing will result in loss, degradation and fragmentation of foraging habitat around known breeding sites and potential breeding sites (DSEWPAC 2012) and cause the loss and isolation of mature hollow bearing trees that have the potential to be utilised by the species.

No night roosting sites were recorded within the Development Envelope. The Proposal will not result in the clearing or degradation of a known roosting site. Furthermore, it is not expected the Proposal will create a gap of more than 4km between patches of foraging habitat for Carnaby's Black Cockatoo, as the Development Envelope is in close proximity to a number of wetlands, reserves and Bush Forever sites that contain habitat similar, if not better quality to that within the Footprint (AECOM 2020b; Bamford Consulting 2021).

Forest Red-tailed Black Cockatoo

Across the Footprint, up to 61.1 ha of foraging habitat for the Forest Red-tailed Black Cockatoo is expected to be cleared. This includes 8.65 ha of moderate to high quality foraging habitat associated with VSA 4. Eucalypt woodlands and forest where the species was observed during the commissioned surveys and likely breeding in the area, with two probable nests recorded by Bamford Consulting (2021) during field investigations and 139 potential breeding trees observed across the Footprint. Two confirmed roosting sites for the Forest Red-tailed Black Cockatoo are also located within approximately 500 m of the Development Envelope.

Although the generalised distribution of the Forest Red-tailed Black Cockatoo is known, detailed information habitat critical to survival is unknown (DEC 2008). Therefore, Habitat critical to survival of Forest Red-tailed Black Cockatoo comprises of areas that are currently occupied by the cockatoos (DEC 2008). As the Development Envelope and Footprint comprise areas currently occupied by the cockatoos, provides some natural vegetation in which the cockatoos nest, feed and roost, and provides natural vegetation through which the cockatoos can move from one occupied area to another, the Footprint meets the definition of habitat critical to survival for the species (DEC 2008).

The Proposal was assessed against the EPBC Act 1999: Referral Guidelines for three threatened Black Cockatoo species (DSEWPAC 2012) to determine if the impact on Carnaby's Black Cockatoo species is significant.

The Proposal will remove up to 61.1 ha of quality foraging habitat for the Forest Red-tailed Black Cockatoo including parts of VSA 4. eucalypt woodlands and forest, which has the potential to be utilised as breeding, in conjunction with up to 139 potential breeding trees across the Footprint. Clearing can result in loss, degradation and fragmentation of foraging habitat around known breeding sites and potential breeding sites (DSEWPAC 2012) and cause the loss and isolation of mature hollow bearing trees that have the potential to be utilised by the species.

Table 34 Black cockatoo potential breeding trees

Potential Breeding Trees	Development Envelope	Footprint
Recorded Breeding Trees	0	0
Potential Breeding Trees with Hollows	31	8
Potential Breeding Trees with no Hollows	305	131
Total Black Cockatoo potential breeding trees	336	139

Quenda

The Quenda is considered a resident in the consolidated fauna assessment area and is probably widespread (GHD 2021b). AECOM (2020b) recorded the species throughout the AECOM survey area in November 2019. Several records of the Quenda were made by Bamford Consulting (2021) including a roadkill on Armadale Road near Albany Highway, and foraging holes in Fletcher Park, the southern extension of Fletcher Park, Lambert Lane Nature Reserve and along Wungong Brook just east of the rail. The direct sightings of Quenda were south of the Byford station (Figure 17) and the intact fauna habitat adjacent to the Development Envelope (Lambert Lane Nature Reserve and Fletcher Park) may be important for Quenda (Bamford Consulting 2021). Culverts will be installed to allow east-west Quenda movement in the vicinity of Lambert Lane and Fletcher Park. Given the proximity of the Development Envelope to larger areas of similar or better quality habitat, the Proposal is not likely to significantly impact the species.

Carter's Freshwater Mussel

Wungong Brook provides suitable habitat for the Carter's Freshwater Mussel, and is likely to be providing a refuge for the species (Stream 2021b). The densities of mussels within Wungong Brook were consistent with other surveys reported for south west watercourses (e.g. 1-15 per m² Klunzinger et al. 2012). Mean densities were very similar either side of the rail corridor (upstream mean density of 2.6/m²; downstream mean density of 2.5/m²). Mussels were recorded within the Development Envelope, however at low density (0.6/m²).

The relatively low densities within the Development Envelope, were considered to be a consequence of lower habitat suitability in this section of the brook (compared to upstream and downstream areas) which was without riparian vegetation and had been subject to historical disturbance (i.e. presence of gravel and concrete from existing bridge footings).

Threatening processes to the species include salinity, water pollutants and sedimentation (Klunzinger et al. 2015; TSSC 2018; University of Western Australia). The design of bridges over Wungong Brook will avoid direct disturbance to the stream bed through use of span bridges. However, some direct impacts will occur as a result of removal of existing bridge pylon (within the stream channel). Removal of existing bridge pylon will result in temporary direct impacts to a part of a known population of Carter's Freshwater Mussel surrounding the bridge location. Any such access to the brook will be entirely within the Footprint. All other construction activities (such as laydown areas) will avoid access to the brook by the provision of a 20m buffer.

Construction of new bridges as proposed may require clearing of riparian vegetation and vehicle movements adjacent to the brook. This may temporarily affect water and habitat quality in downstream receiving environments through erosion, siltation and sedimentation, processes that can impact on the Carter's Freshwater Mussel population. The PTA will implement mitigation measures to minimise erosion and stabilise the disturbed ground to minimise sedimentation. The PTA will implement these measures through a Construction Environmental Management Plan (CEMP) during the construction phase of the project. The CEMP will follow DWER guidance such as: Infrastructure corridors near sensitive water resources.

The works are not expected to modify drainage flows.

Temporary dewatering to a depth of up to 1.5 m may be required during the construction of pile caps (adjacent to Wungong Brook) for the new Wungong Brook bridge (Agonis 2021). The abstraction of groundwater for dewatering will be subject to approval under the RIWI Act. It is expected that drawdown should not extend beyond 50 m of the bridge site and remain predominantly within the Development Envelope, at rates less than 5 L/sec (Golder 2021). Calculations by Golder (pers. comm. K Mundle 5/2/2021) indicate drawdown is estimated to be less than 0.2 m or one tenth of the normal seasonal water table.

Stream (2021b) provided recommendations including the following measures to be implemented to avoid impacts to existing populations within the Development Envelope and its surrounds. The measures will be implemented in accordance with relevant guidelines and best management practices in consultation with the Department of Biodiversity, Conservation and Attractions (DBCA) and other relevant agencies.

- Relocation of susceptible populations in habitat that will be directly impacted in accordance with Environmental Management Plan Guidelines (DotE 2014) and best management practices
- Erosion controls such as silt curtains and anti-erosion matting on banks to minimise the risk of impact to habitat outside the area of direct impact
- Monitoring of water quality (in particular turbidity, Total Suspended Solids and Dissolved Oxygen) prior to and during construction within Wungong Brook upstream and downstream of the Development Envelope
- If water quality monitoring during the construction phase indicates that mussel habitats are being impacted, then the extent of impacts should be established, and appropriate responses implemented. Potential responses include implementation of erosion controls and translocation of mussels from the area of impacts.

Translocation should be either upstream or downstream where known suitable habitat exists and at a distance that would avoid the impacts of turbidity, sedimentation or other impacts from bridge construction. Mussels can be successfully translocated from areas where impacts are expected to occur, and returned following disturbance as shown by previous studies completed (Lymbery, Klunzinger & Beatty 2011; Allen et al. 2012). Given the proposed management, PTA believes there will not be a significant impact to the local Mussel population.

The Stream (2021b) survey recorded mussels across a range of size classes which indicated that the population in Wungong Brook is likely to be self-sustaining and was distributed upstream and downstream of the Development Envelope. There are also additional records of the species from additional sites in the catchment (Stream 2021b). With the implementation of the management and mitigation measures proposed a significant on Carter's Freshwater Mussel is unlikely.

Two highly modified artificial lakes near the Development Envelope, Wright Lake and Sanctuary Lake, provide suitable habitat for Carter's Freshwater Mussel. Erosion, siltation and sedimentation are unlikely to indirectly impact these populations as the sites are upstream from any proposed works.

Short Range Endemic and Conservation Significant Invertebrates

The Development Envelope is largely cleared of native vegetation with minor occurrences of individual trees or clusters of trees along the edge of existing rail corridor. High quality habitat for SREs require at least three microhabitat factors such as SE facing slopes, moisture, rocky areas, habitat isolates, deep leaf litter, mountainous areas, deep gullies or gorges, riparian vegetation, or habitats known to contain SRE species (Invertebrate Solutions 2020). The Development Envelope lacks these requirements and the understorey required to support conservation significant invertebrates and therefore provides low to Nil SRE or conservation significant invertebrate habitat (Invertebrate Solutions 2020).

Vegetation clearing will directly remove up to 1.6 ha of moderate value habitat comprising of riparian vegetation along Wungong Brook in association with the construction of the bridges, and up to 14 ha of degraded vegetation considered to be low SRE habitat (Invertebrate Solutions 2020). This moderate value habitat is represented within the adjoining Lambert Lane Nature Reserve.

At a regional scale, SRE and conservation significant invertebrate habitat across the SCP is largely described as low value or Nil, with higher value habitat on the Darling Scarp due to the presence of sheltered gullies, rocky granite outcrops and other potential habitat isolates (Invertebrate Solutions 2020). Therefore, due to the low likelihood of SRE and conservation significant invertebrates occurring within the Development Envelope, in conjunction with the minimal amounts of low and moderate value habitat, vegetation clearing is considered unlikely to directly impact SRE species.

Clearing of native vegetation may indirectly impact SRE and conservation significant invertebrate species by restricting genetic flow of species with already limited dispersal capabilities. However, due to the linear nature of the Footprint, in conjunction with the limited amounts of potential SRE habitat that is unconnected to other urban bushland, the impact is considered negligible.

Local weed incursion may also impact SRE and conservation significant invertebrate species that rely on microhabitats within the landscape (Invertebrate Solutions 2020). Furthermore, increasing sedimentation, alteration of surface hydrology and contamination of surface and groundwater during construction and operation may impact upon SRE species and their potential habitat. These indirect impacts can be managed through appropriate stormwater design.

The Proposal is not expected to have any significant direct, indirect or cumulative impacts on SRE species or conservation significant invertebrates, at either a local or regional scale. This is due to the narrow linear nature of Footprint, the very limited potential SRE habitat within the Footprint and its surrounds, and the low likelihood of SRE species occurring within the Development Envelope.

Fauna Injury and Mortality

Vehicle strike during construction and operation of the railway has the potential to kill or injure terrestrial fauna. Direct mortality during construction is likely to be low as vehicle speeds will be limited to manage dust emissions and in line with safe methods of work.

PTA will select plants used for revegetation in close proximity to the rail line that do not encourage Black Cockatoo species or other birds from foraging close to the rail line. Rail drainage design will avoid pooling water which may attract fauna.