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Anketell Road Upgrade (Leath Road to Kwinana Freeway)

EPA Environmental Review Document – Revised Referral Supporting Document

Document Records

Revision	Date	Author	Review
RSD Submission	February 2024	GHD and Main Roads	Main Roads
Revised RSD Submission	June 2025	GHD and Main Roads	Main Roads

Invitation to make a submission

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

Main Roads Western Australia proposes to upgrade Anketell Road to an Expressway Standard between Leath Road, within the Kwinana Industrial Area (KIA), and Kwinana Freeway (the Proposal). The Proposal also includes the upgrade of a short section of Anketell Road east of the Kwinana Freeway (to Treeby Road) to connect the Proposal to the existing Anketell Road. The Environmental Review Document (ERD) has been prepared in accordance with the EPA's Procedures Manual. 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 four weeks from Monday 21 July 2025, closing on Monday 18 August 2025.

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 the Environment.

Why write a submission?

The EPA seeks information that will inform its 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 the 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 the names of each participant. 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 environmental outcomes.

What to include in your submission

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

- Your name and address
- Date of your submission
- Whether you want your contact details to be confidential

- A summary of your submission, if it is long
- A list of 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: Monday 18 August 2025

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 EPA Services at the Department of Water and Environmental Regulation on 6364 7000

EXECUTIVE SUMMARY

Main Roads Western Australia (Main Roads) is proposing to upgrade Anketell Road to an Expressway Standard between Leath Road, within the Kwinana Industrial Area (KIA), and Kwinana Freeway (the Proposal). The Proposal also includes the upgrade of a short section of Anketell Road east of the Kwinana Freeway (to Treeby Road) to connect the Proposal to the existing Anketell Road.

The Proposal comprises a total area of 224.83 ha, including 92.22 ha of native vegetation, 50.35 ha of non-native vegetation and 82.26 ha of cleared areas.

Main Roads referred the Proposal to the Environmental Protection Authority (EPA) for assessment under Section (s) 38 of the Environmental Protection Act 1986 (EP Act) in February 2024. The purpose of this revised Referral Supporting Document is to support the formal assessment of the Proposal and address the Notice Requiring Information for Assessment, requested by the EPA under Section 40(2)(a) of the EP Act. A summary of the Proposal and its location and propose extent are provided in Tables ES1 and ES2. A summary of potential impacts, proposed mitigation measures and outcomes for the identified environmental impacts of the Proposal are provided in Table ES3.

Table ES1: Summary of the Proposal

Proposal element	Description
Proposal title	Anketell Road Upgrade (Leath Road to Kwinana Freeway)
Proponent name	Main Roads Western Australia
Short description	Main Roads is proposing to upgrade and widen Anketell Road to an Expressway Standard for approximately 7.5 km between Leath Road and Kwinana Freeway in the City of Kwinana, WA. The Proposal will include grade separated interchanges at six locations, grade separation of road over rail at two locations and other supporting road infrastructure.

Table ES2: Location and proposed extent of physical elements

Proposal element	Location / description	Maximum extent, capacity or range
Physical elements		
The proposal includes the following physical elements: – Approximately 7.5 km of new urban expressway standard, dual carriageway. – Grade separated interchanges at Treeby Road, Kwinana Freeway, Mandogalup Road, Abercrombie Road, Armstrong Road and Rockingham Road. – Grade separations of Rockingham Road and Anketell Road over rail. – New local roads and existing road modifications, including upgrades at Rockingham Road.	Proposal Development Envelope (DE) in Figure 1-1.	The Proposal comprises a total area of 224.83 ha, including clearing or disturbance of up to 92.22 ha native vegetation and 50.35 ha non-native vegetation.

Proposal element	Location / description	Maximum extent, capacity or range
– Drainage basins, drains and other associated infrastructure. – Shared Path (SP) for the full length of the Proposal. – Other road infrastructure, including but not limited to culverts, lighting, fencing, landscaping, road safety barriers and signs. – Utility relocations and works to maintain access to properties.		
Construction Elements		
Construction activities associated with the physical elements are likely to include: – earthworks – laydown – piling – excavation – water abstraction – dewatering – drainage improvements, and – landscaping.	Proposal DE in Figure 1-1.	Construction will occur within the 224.83 ha DE.
Operational Elements		
Main Roads will operate the Proposal using standard management and maintenance practices.	Proposal DE in Figure 1-1.	Operation will occur within the 224.83 ha DE.
Proposal elements with greenhouse gas emissions		
Construction elements		
Scope 1	Land use change – vegetation clearing: 25,364 tCO2-e over 36 months Plant and equipment: 15,783 tCO2-e over 36 months	
Scope 2	None	
Scope 3	All indirect emissions (other than energy/electricity used) that occur in the value chain including both upstream and downstream emissions. This includes embedded energy within construction materials, construction fuel, haulage – 57,911 tCO2-e over 36 months	
Operation elements		
Scope 1	Maintenance over road life – 5,235 tCO2-e	
Scope 2	Electricity use over road life – 3,192 tCO2-e	

Proposal element	Location / description	Maximum extent, capacity or range
Scope 3	All indirect emissions (other than energy/electricity used) that occur in the value chain including both upstream and downstream emissions. This includes emissions associated with the supply of maintenance materials – 10,337 tCO2-e and vehicle user emissions – 2,108,475 tCO2-e over 50 years.	

Table ES3: Summary of potential impacts, proposed mitigation and outcomes

Element	Description
Flora and vegetation	
EPA Objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
Policy and guidance	– Environmental Factor Guideline Flora and Vegetation (EPA 2016a) – Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) – Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20 (EPA 2013) – Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations) – Approved conservation advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (SCP) ecological community (Department of the Environment and Energy (DEE) 2019) – Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the SCP ecological community (DEE 2016b) – Survey Guidelines for Australia's Threatened Orchids: Guidelines for Detecting Orchids Listed as "Threatened" Under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment (DoE 2013a) – WA Environmental Offsets Policy (Government of Western Australia (GoWA) 2011) – WA Environmental Offsets Guidelines (GoWA 2014) – Environmental offsets metric: Quantifying environmental offsets in Western Australia (DWER 2021a).
Potential Impacts	– Loss of 92.22 ha of native vegetation including: • 52.78 ha of native vegetation in Good or better condition • 40.99 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (SCP) Threatened Ecological Community (TEC) (EPBC Act - Federal) • 40.99 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP Priority Ecological Community (PEC, Priority 3) (DBCA listing – State) • 14.56 ha of Banksia Woodlands of the SCP TEC (EPBC Act - Federal) • 14.56 ha of Banksia Woodlands of the SCP PEC (Priority 3) (DBCA listing – State) • 57.12 ha of Northern Spearwood Shrublands and Woodlands PEC (Priority 3) (DBCA listing – State) • 4.00 ha of native vegetation within three Bush Forever Sites (Site no. 268, 269 and 270) • 0.55 ha of vegetation within Class A Conservation Reserve R 53313. – Loss of DBCA-listed Priority flora including: • One individual of *Poranthera moorokatta* (Priority 2) • Fifty-nine individuals of *Hibbertia leptotheca* (Priority 3) • Forty individuals of *Eucalyptus foecunda* subsp. *foecunda* (Priority 4). – The Proposal could also result in the following potential indirect impacts to vegetation and flora: • Introduction and spread of weeds

Element	Description
	• Introduction and/or spread of Phytophthora dieback • Increased edge effects from creating new edges • Changes to vegetation structure and floristic composition in surrounding/adjacent areas through altered surface water drainage patterns and flows and/or altered groundwater levels • Alteration of fire regimes and increased fire risk from construction activities. – The Proposal will also contribute to cumulative impacts to flora and vegetation when considered with other significant proposals and developments at local and regional scales.
Mitigation	<u>Avoid</u> – Narrow medians will be maintained where practicable to reduce clearing of native vegetation. – A compact interchange is proposed at Abercrombie Rd with ramp spacing at approximately 100m (as opposed to 150m) to reduce the footprint through this area. – Placing retaining walls where practicable to reduce clearing impacts. – Drainage basins will be located in disturbed/cleared areas where possible to avoid impacts on environmental values. <u>Minimise</u> – Minimise clearing impacts on flora and vegetation where practicable through the detailed design process. – Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Clearing and access controls • Dieback and weed management • Sediment and erosion controls • Soil management • Dewatering controls. <u>Rehabilitate</u> – Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.
Residual impacts, including assessment of significance	The Proposal involves clearing up to 92.22 ha of native vegetation, which will affect the remaining extents of vegetation complexes; Karrakatta Complex-Central and South, Quindalup Complex, Cottesloe Complex-Central and South, Bassendean Complex-Central and South and Herdsman Complex. The Proposal will reduce the remaining extent of these complexes by 0.00% to 0.17% at the SCP scale and 0.06% to 1.94% at the City of Kwinana scale. Clearing for the proposal will not reduce any complexes below 10% of their pre-clearing extent. The Proposal will result in the clearing of up to 14.56 ha of the Banksia Woodlands of the SCP Priority 3 PEC, of which 11.26 ha (77.34%) is in Good or better condition. Of the 14.56 ha of the Banksia Woodlands of the SCP PEC, 0.66 ha, 2.26 ha and 0.57 ha occurs within Bush Forever Sites no. 268, 269 and 270 respectively. Clearing of Banksia Woodlands of the SCP PEC will reduce the local and regional extent of this PEC. However, as this impact is not likely to result in the ecological community being listed as a TEC, the impact is not considered a significant residual impact, as defined by the WA Environmental Offsets Guideline (WA Government 2014). The Proposal will result in the clearing of up to 57.12 ha of the Northern Spearwood Shrublands and Woodlands Priority 3 PEC, of which 35.74 ha (62.57%) is in Good or better condition. Approximately 2.66 ha of the PEC is associated with patches of the EPBC Act listed Banksia Woodlands of the SCP TEC and 27.55 ha is associated with patches for the EPBC Act listed Tuart Woodlands and Forests of the SCP TEC.

Element	Description
	There is 0.53 ha and 1.38 ha of the Northern Spearwood Shrublands and Woodlands PEC within Bush Forever Sites no. 268 and 269 respectively. Clearing of FCT 24 will reduce the local and regional extent of this PEC. However, as this impact is also not likely to result in the ecological community being listed as a TEC, the impact is not considered a significant residual impact, as defined by the WA Environmental Offsets Guideline (WA Government 2014). The Proposal will result in the clearing of up to 40.99 ha of the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain PEC, of which 20.77 ha (50.65%) is in Good or better condition. There is 0.64 ha and 1.79 ha of this PEC within Bush Forever Sites no. 268 and 269 respectively. Clearing the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain PEC will reduce the local and regional extent of this PEC. However, this impact is not likely to result in the ecological community being listed as a TEC, and is not considered a significant residual impact. The Proposal will result in the clearing of vegetation that grows in association with seasonally inundated soils. There is 0.92 ha of vegetation type K1 within the DE, of which 0.22 ha is mapped within the boundary of unnamed MUW (UFI 6538). The Proposal avoids direct impacts on the Resource Enhancement Wetland (REW) Conway Road Swamp (UFI 6379), which occurs approximately 50 m east of Conway Road and 29 m east and 100 m north of the DE. The DE also intersects part of Mandogalup Swamp South wetland, a MUW (UFI 6530). The Proposal will clear 0.003 ha of vegetation type M1 associated with this MUW. Given the extent and condition of wetland vegetation within the DE, the Proposal's impact on wetland vegetation is not considered a significant residual impact. The Proposal will clear up to 4.25 hectares of native vegetation in conservation areas, including 4.00 hectares within Bush Forever sites and 0.55 hectares in a Class A Conservation Reserve. Areas of native vegetation exist in different conditions across three Bush Forever sites. Despite the Proposal's impacts, significant indirect effects are unlikely due to the existing infrastructure, but the impacts are still considered significant residual impacts according to the WA Environmental Offsets Guideline. Three DBCA listed Priority species will be directly impacted as a result of clearing required for the Proposal. These species are *Poranthera moorokatta* (P2), *Hibbertia leptotheca* (P3) and *Eucalyptus foecunda* subsp. *foecunda* (P4). For each species, the clearing is unlikely to be significant given the known species range is extensive on the SCP. Population loss estimates for each of these species are considered to be an overestimation as frequency data for known records is lacking.
Outcomes	The Proposal's residual impacts to flora and vegetation, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows: – All direct disturbance will occur within the DE – The extent of vegetation values impacted within the DE will not exceed: • 92.22 ha of native vegetation • 40.99 ha of Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the SCP PEC (Priority 3) • 14.56 ha of Banksia Woodlands of the Swan Coastal Plain PEC (Priority 3) • 57.12 ha of Northern Spearwood Shrublands and Woodlands (FCT24) PEC (Priority 3) • 4.00 ha of native vegetation within three Bush Forever Sites (Site no. 268, 269 and 270) • 0.55 ha of vegetation within Class A Conservation Reserve R 53313. – The extent of the following flora values impacted within the DE will not exceed: • One individual of *Poranthera moorokatta* (Priority 2) • 59 individuals of *Hibbertia leptotheca* (Priority 3) • 40 individuals of *Eucalyptus foecunda* subsp. *foecunda* (Priority 4). Main Roads considers implementation of the identified planning, avoidance and mitigation measures and proposed environmental offsets will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for flora and vegetation will be met.

Element	Description
Assessment of offsets	Offsets proposed in the Offset Strategy will counterbalance the Proposal's significant residual impacts to flora and vegetation.
Terrestrial Fauna	
EPA Objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Policy and guidance	– Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c) – Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020) – Referral guideline for 3 WA threatened black Cockatoo Species Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*) (Department of Agriculture, Water and the Environment (DAWE) 2022) – Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Canberra, Australian Capital Territory (Department of Environment (DoE) 2013b). – WA Environmental Offsets Policy (Government of Western Australia (GoWA) 2011) – WA Environmental Offsets Guidelines (GoWA 2014) – Environmental offsets metric: Quantifying environmental offsets in Western Australia (DWER 2021a).
Potential Impacts	– Loss of 133.67 ha of fauna habitat comprising native (92.22 ha) and non-native/modified (41.45 ha) vegetation – Loss of habitat for significant fauna species including: • 592 suitable diameter at breast height (DBH) trees. Of these, 8 trees contained 8 hollows that were considered of suitable depth and shape for Black Cockatoo breeding. • 56.98 ha of foraging habitat for Carnaby's Cockatoo • 38.34 ha of foraging habitat for Forest Red-tailed Black-cockatoo (FRTBC) • 87.58 ha of core habitat for Quenda • 44.57 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake • 56.87 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider • 224.83 ha of secondary habitat for Peregrine Falcon • 16.60 ha of secondary habitat for Western Brush Wallaby • 38.53 ha of secondary habitat for Glossy Ibis. – Direct impacts such as fauna injury/mortality from vehicle strikes. – Indirect impacts from habitat degradation from edge effects, weeds, dieback, rubbish and vehicle tracks, and disturbance of fauna due to light and noise.
Mitigation	<u>Avoid</u> – Avoid additional movement barriers for fauna by limiting the Proposal to land adjacent to the existing cleared areas of Anketell Road – Narrow medians will be maintained where practicable to reduce clearing of fauna habitat. – A compact interchange is proposed at Abercrombie Road with ramp spacing at approximately 100m (as opposed to 150m) to reduce the footprint through this area. – Placing retaining walls where practicable to reduce clearing impacts on terrestrial fauna. – Drainage basins will be located in disturbed/cleared areas where possible to avoid impacts on environmental values. – Identification of movement corridors will be undertaken to determine the number and location of any necessary wildlife underpasses.

Element	Description
	Minimise – Minimise clearing impacts on terrestrial fauna where practicable through the detailed design process – Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Clearing and access controls • Pre-clearance surveys • Inspection of potential Black Cockatoo nesting hollows prior to clearing • Vehicle movement restrictions • Preventing indirect habitat degradation via edge effects, weeds, dieback and rubbish • Noise, light and vibration management. Rehabilitate Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. Development of verge plantings and fauna movement corridors will be included in the detailed design stage. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.
Residual impacts, including assessment of significance	The Proposal will result in the clearing of up to 133.67 ha of fauna habitat, comprising native (92.22 ha) and non-native/modified (41.45 ha) vegetation. Locally the Proposal will result in habitat loss along the existing Anketell Road and other connecting roads. At a regional scale, the clearing of fauna habitat for the Proposal will result in the loss of 0.03% of available native fauna habitat across the SCP. Clearing of up to 133.67 ha of fauna habitat for the Proposal is not considered a significant residual impact when considered at a local or regional scale, but may result in a significant residual impact on conservation significant terrestrial fauna known or likely to occur within the DE. The Proposal will result in the loss of up to 592 suitable DBH trees. Of these, 8 trees contained 8 hollows that were considered of suitable depth and shape for Black Cockatoo breeding. The Proposal will not have a significant impact on breeding habitat for Carnaby's Cockatoo or FRTBC, as no known black cockatoo breeding trees or hollows occur within the DE, nor are black cockatoos known to breed in the local area. Similarly, the Proposal will not have a significant impact on roosting habitat for Black Cockatoos, as no known roost sites are within or adjacent to the DE. The Proposal will require the clearing of up to 56.98 ha of foraging habitat for Carnaby's Cockatoo and 38.34 ha of foraging habitat for FRTBC. The foraging habitat is located along the length of the DE and includes low-moderate to high quality foraging habitat. The Proposal's impact to Carnaby's Cockatoo and FRTBC foraging habitat is considered significant. While the foraging habitat is not located within 12 km of a known breeding site, it represents low-moderate quality foraging habitat for both species and is located within 12 km of known roost sites. Vegetation that provides food resources for Carnaby's Cockatoo is considered habitat critical to its survival (DPaW 2013). Similarly, all Marri, Karri and Jarrah forests, woodlands and remnants in SW WA is considered habitat critical to the FRTBC survival (DEC 2009). The clearing of habitat for both Carnaby's Cockatoo and FRTBC is deemed a significant residual impact. The Proposal will result in the loss of habitat for Quenda, Perth Lined Slider, Black-striped Snake, Peregrin Falcon, Graceful Sunmoth, Swan Coastal Plain Shield–backed Trapdoor Spider, Western Brush Wallaby and Glossy Ibis. It is not expected that the Proposal will have a significant impact on these species. Similarly, no impacts to short-ranged endemic fauna are anticipated from the Proposal.
Outcomes	The Proposal's residual impacts to terrestrial fauna, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows: – No disturbance will occur outside the DE – The extent of fauna habitat values impacted within the DE will not exceed:

Element	Description
	• 133.67 ha of fauna habitat, comprising 92.22 ha of native vegetation and 41.45 ha of non-native/modified vegetation • 592 suitable DBH trees (Black Cockatoo potential breeding trees) and 8 potential suitable hollows • 56.98 ha of foraging habitat for Carnaby's Cockatoo • 38.34 ha of foraging habitat for FRTBC • 87.58ha of core habitat for Quenda • 44.57 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake • 56.87 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider • 224.83 ha of secondary habitat for Peregrine Falcon • 56.87 ha of secondary habitat for Chuditch • 16.60 ha of secondary habitat for Western Brush Wallaby • 38.53 ha of secondary habitat for Glossy Ibis. Main Roads considers implementation of the identified planning, avoidance and mitigation measures and proposed environmental offsets will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for terrestrial fauna will be met.
Assessment of offsets	Offsets proposed in the Offset Strategy will counterbalance the Proposal's significant residual impacts to terrestrial fauna.
Terrestrial Environmental Quality	
EPA Objective	To maintain the quality of land and soils so that environmental values are protected.
Policy and guidance	– ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ 2018) – Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016d) – Finance Technical Guideline: TG010 Acid Sulfate Soils (Department of Finance 2021) – *Guideline: Assessment and management of contaminated sites* (DWER 2021b) – Identification and Investigation of Acid Sulfate Soils (ASS) and Acidic Landscapes (DER 2015a) – Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER 2015b).
Potential Impacts	– Soil and/or groundwater contamination from construction activities associated with waste discharge, storage of chemicals and hydrocarbons, and potential spills – Changes to soil and/or groundwater quality through mobilisation of contaminated materials, including asbestos and per- and polyfluoroalkyl substances (PFAS), associated with earthworks, excavation, demolition and dewatering. – Potential disturbance of ASS due to earthworks, excavation and dewatering. – Potential disturbance of ground at or in proximity to known and suspected contamination. – Potential to abstract contaminated groundwater during dewatering or abstraction of groundwater for construction activities.
Mitigation	<u>Avoid</u> – Avoid excavation where possible in areas of high risk for Acid Sulphate Soils (ASS). – Avoid disturbance of contaminated or potentially contaminated areas where possible. – Narrow medians will be maintained where practicable to reduce the amount of material required for the Proposal and the amount of water required for construction. <u>Minimise</u> – Minimise impacts through the detailed design process, including reducing earthworks (fill height/cut depth) in areas of heavy vegetation – Undertake a Preliminary Site Investigation and Detailed Site Investigation

Element	Description
	– Implement an ASS and Dewatering Management Plan – Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Chemical and hydrocarbon storage • Waste management • Spill management • Contaminated material handling and management • Sediment and erosion controls • Soil management • Dewatering controls • Unexpected finds protocol. – Groundwater abstraction wells will be established away from the Spectacles Wetland and in areas where the risk of mobilising contaminated groundwater is reduced. – Development of a groundwater monitoring program, where required to monitor and assess the effectiveness of mitigation measures associated with ASS and contamination.
Residual impacts, including assessment of significance	The Proposal has the potential to contaminate soils, surface water and groundwater. Controls for managing potential spills and leaks will focus on prevention of spills by minimising volumes stored on site, maintaining storage in accordance with Australian Standard 1940 and storing in bunded areas located away from areas of known environmental values such as wetlands and TECs. Waste will be segregated into various streams, stored in secure areas and/or containers and disposed of in a controlled manner, including at an appropriately licensed facility where required. There are known and suspected contaminated sites within and adjacent to the DE. Proposal planning, avoidance and mitigation measures considered and incorporated will reduce residual impacts of the Proposal to as low as reasonably practicable. Potential direct and indirect impacts associated with the movement of contaminated soil will be managed during construction through early identification of soil contamination, using an unexpected finds Protocol and adhering to requirements in accordance with the *Contaminated Sites Act 2006*. The Proposal has the potential to disturb ASS during excavation activities and/or dewatering. The majority of the Proposal is located within areas mapped as extremely low and low probability of ASS occurrence. It is anticipated, where disturbance of ASS is unavoidable, the risk of impact will be low. An ASS Management Plan will be prepared and implemented in accordance with DWER ASS guidelines to avoid or manage impacts from potential ASS disturbance. After implementation of mitigation measures, the Proposal is unlikely to cause significant residual impacts to terrestrial environmental quality.
Outcomes	The Proposal's Terrestrial Environmental Quality environmental outcome, following implementation of measures to avoid, minimise, reduce and rehabilitate, is as follows: – The Proposal will be designed and constructed in accordance with the requirements of the DWER Assessment and management of contaminated sites (2021b) and DWER ASS guidelines (DER 2015a and 2015b). By implementing these mitigation measures, the Proposal's impacts to Terrestrial Environmental Quality will be reduced and/or minimised, and the EPA objective for Terrestrial Environmental Quality will be met.
Assessment of offsets	Offsets are not relevant to terrestrial environmental quality.
Inland Waters	

Element	Description
EPA Objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
Policy and guidance	– ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ 2018) – Environmental Factor Guideline: Inland Waters (EPA 2018) – State Planning Policy 2.9 Water Resources (WAPC 2006) – Water Quality Protection Note 3, Using water quality protection notes (DWER 2024b) – Water Quality Protection Note 44, Roads Near Sensitive Water Resources (DoW 2006) – Water Quality Protection Note 83, Infrastructure corridors near sensitive water resources (DoW 2007) – Jandakot Drainage and Water Management Plan (DoW 2009) – Wetlands Conservation Policy for Western Australia (GoWA 1997).
Potential Impacts	– Loss of up to 0.22 ha of native vegetation within 9.75 ha of mapped Multiple Use Wetlands through infill, ground disturbance and vegetation clearing – Short-term changes to groundwater levels as a result of dewatering during construction – Indirect impacts such as: • Changes to hydrological regimes of adjacent wetlands from earthworks and alteration of surface water drainage • Changes to recharge and runoff associated with permanent increased area of hard surface and drainage away from the site, potentially causing localised flooding • Erosion and sedimentation in surrounding areas from vegetation clearing, bridge construction, earthworks and alteration of surface water drainage • Changes to groundwater levels and groundwater flow due to abstraction of groundwater for construction purposes which may affect private and public groundwater users • Saline water intrusion or upconing resulting from excessive groundwater extraction • Contamination of surface and/or groundwater from accidental spills of fuels or chemicals during construction, contaminated stormwater runoff during construction and operation, discharge of dewatering effluent and excavation of, and exposure to, ASS.
Mitigation	<u>Avoid</u> – Main Roads has committed to reducing the volume of water abstracted for construction water excluding dust suppression requirements from the 3 proposed bores within the DE by 50% (Total requirement for construction water is estimated to be 430,000KL). The other 50% of the construction water required will be sourced from water trading from existing licences or alternative water sources for example industrial process water or non-potable water. – Flow and water quality to the Spectacles from the Peel Main Drain during construction will be maintained therefore impacts to surface water quality will be avoided. – Drainage design will integrate Water Sensitive Urban Design principles – Drainage design will be implemented to maintain hydrological flow regimes and control stormwater run-off. <u>Minimise</u> – Minimise clearing impacts to inland waters where practicable through the detailed design process, – Monitoring in accordance with standard management controls and any licences – Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Sediment and erosion

Element	Description
	• Dewatering controls • Contamination and spills. <u>Rehabilitate</u> – Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.
Residual impacts, including assessment of significance	Construction of the Proposal will involve the loss of 9.75 ha of mapped MUWs, of which 0.22 ha is mapped as native vegetation (in Completely Degraded condition). Direct impacts from the Proposal will reduce the overall physical extent of degraded MUWs and may reduce their environmental value and function, however, the impact of the Proposal to MUW areas is unlikely to be significant. The Spectacles Wetland occurs approximately 100 m south of the DE. Through careful design of the drainage of the proposed road, Main Roads has committed to maintaining the current drainage network and associated surface water flows. Any activities associated with the Proposal are unlikely to impact surface water flows to the Spectacles Wetland. The Proposal has the potential to impact upon the Peel Main Drain and Mandogalup East Drain through changes/alteration of surface water drainage including surface run-off patterns within and adjacent to the DE. Following implementation of mitigation measures, the impact of the Proposal to the Peel Main Drain and Mandogalup East Drain is unlikely to be significant. The Proposal may result in short-term changes to groundwater levels and groundwater flow where temporary dewatering is required during construction. It is expected that application of management measures will ensure no significant impact to inland waters due to the temporary groundwater drawdown. Proposal activities are not expected to result in changes to surface water flows, affecting the functioning of adjacent wetlands. The existing hydrological regimes are in a largely modified state due to historical clearing and presence of the existing Anketell Road within the DE. Earthworks and clearing within the DE are not expected to be of sufficient scale to cause substantial hydrological changes in the local area. Changes to hydrological regimes of adjacent wetlands and tributaries are considered unlikely to be significant. The Proposal has the potential to indirectly impact on inland water through changes to hydrology, erosion and sedimentation as a result of clearing of vegetation and earthworks. Erosion and sediment controls will be implemented to minimise impacts. Erosion and sedimentation impacts are considered unlikely to be significant. There is potential for contamination of surface water and groundwater during construction of the Proposal. These potential contamination impacts will be effectively managed through the mitigation measures and are considered unlikely to be significant. After implementation of mitigation measures, the Proposal is unlikely to cause significant residual impacts to inland waters.
Outcomes	The Proposal's Inland Waters environmental outcomes, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows: – All ground disturbance will occur within the DE – No direct impacts to Conservation Category or Resource Enhancement wetlands – No more than 0.22 ha of native vegetation associated with a MUW will be impacted – Maintain the existing hydrological regimes during operation – Maintain groundwater and surface water quality during construction and operation – No change to groundwater levels will occur near sensitive receptor wetlands, in the short and long term, and as a result groundwater dependent vegetation will not be impacted

Element	Description
	– No change to surface water flows will occur as effective drainage infrastructure will be constructed. Main Roads considers implementation of the identified planning, avoidance and mitigation measures will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for inland waters will be met.
Assessment of offsets	Offsets are not relevant to inland waters.
Social Surroundings	
EPA Objective	To protect social surroundings from significant harm.
Policy and guidance	– Environmental Factor Guideline: Social Surroundings (EPA 2023b) – Guidelines for Local Heritage Surveys (GoWA 2022) – State Planning Policy 5.4 Road and Rail Noise – Road and Rail Noise Guidelines (DPLH 2019) – Guideline: Dust emissions (DWER 2021c) – A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011). – Town of Kwinana Local Planning Scheme No. 3 (Town Centre) - Updated to include AMD 5 GG (DPLH 2020) – Town of Kwinana Local Planning Scheme No. 2 - Updated to include AMD 152 GG (DPLH 2021).
Potential Impacts	– Disturbance (direct or indirect) of one Historic Aboriginal heritage site (3427) during clearing and/ or excavation works – Disturbance (direct or indirect) of Aboriginal cultural heritage values associated with the physical or biological surroundings – Disturbance of undiscovered subsurface archaeology comprising flaked stone artefacts and burials – Disturbance (direct or indirect) to 10 Municipal heritage sites listed on the Kwinana Municipal Heritage Inventory – Reduced visual amenity due to vegetation clearing and construction activities – Construction waste i.e. litter and debris – Dust emissions and deposition – Construction noise and vibration impacts to sensitive receptors – Reduced visual amenity due to the presence of structures required for the road including elevated road bridges, noise walls or barriers – Changes to road traffic noise post-construction (compared to pre-construction) – Change in land use to Primary Regional Roads.
Mitigation	<u>Avoid</u> – Significant heritage areas to be avoided within the DE must be clearly marked prior to the commencement of construction activities. – Construction works will be undertaken in accordance with the Environmental Protection (Noise) Regulations 1997 and A guideline for managing the impacts of dust and associated contaminants from land development sites. – Construction activities (including materials transport) will be limited between 0700 and 1900 Monday to Saturday, excluding public holidays (standard work hours). – Any disturbance of Aboriginal heritage sites/materials will be undertaken in the presence of Gnaala Karla Booja (GKB) Cultural Monitors, in consultation with the GKB Aboriginal Corporation, South West

Element	Description
	Aboriginal Land and Sea Council (SWALSC) and Department of Planning, Lands and Heritage (DPLH) and in accordance with the requirements of the *Aboriginal Heritage Act 1972* (AH Act). – Two GKB cultural monitors will be present for initial ground disturbance works, as requested by GKB representatives during the Aboriginal Archaeological Survey. – Two GKB monitors will be invited to view the completed works in the vicinity of the Peel Main Drain to ensure the continued flow of water, particularly where the Peel Main Drain passes under the Anketell Road Proposal Area at 'White Bridge' and 'Jolly Bridge', as requested by GKB representatives during the Aboriginal Ethnographic Survey. <u>Minimise</u> – Minimise clearing impacts to social surrounds through the detailed design process – Design the Proposal to reduce and minimise impacts on Aboriginal heritage – Undertake a road traffic noise assessment and develop a noise management plan – Undertake noise modelling to identify noise wall locations and inform noise and vibration management – Vibration impacts during construction will be managed by continuous monitoring, and defining monitoring targets and stop work procedures – The Heritage Potential Zone has high potential for sub surface cultural material and will undergo further archaeological investigation in the form of shovel test pitting to determine presence or absence of subsurface cultural material, prior to commencement of ground disturbing works. If sub-surface cultural material is identified, further archaeological work will be required to adequately characterise the material and place and determine its cultural and scientific significance. – Surface water flow through the Peel Main Drain at completion of the Proposal will be maintained at pre-construction flow levels to mitigate any potential indirect impacts to the Spectacles and the associated heritage values. – Undertake Aboriginal Heritage surveys and additional consultation with Traditional Owners as required. – Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Noise and vibration • Visual Amenity • Dust • Heritage. <u>Rehabilitate</u> – Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.
Residual impacts, including assessment of significance	Main Roads has demonstrated that through Proposal planning, avoidance and mitigation measures have been considered and incorporated to keep residual impacts of the Proposal as low as reasonably practicable. This includes (but is not limited to) following the existing Anketell Road alignment to avoid potential amenity impacts to nearby residential properties and disturbance of Aboriginal heritage and historic heritage places. Proposal impacts to Aboriginal heritage will be managed in consultation with the GKB Aboriginal Corporation and Cultural Advice Committee, SWALSC and DPLH and in compliance of the AH Act. Proposal impacts to historic heritage sites will be managed in consultation with the City of Kwinana, DPLH and if required, the Heritage Council of WA. Main Roads are also proposing management measures to reduce impacts associated with construction waste, dust, noise, vibration and visual amenity. Given the proposal relates to the upgrade of Anketell Road, with few sensitive receivers nearby,

Element	Description
	construction dust, noise and vibration is unlikely to cause significant impacts. Operational noise is anticipated to be mitigated and managed to meet the SPP 5.4 noise regulations. Construction and operation of the Proposal will result in minor impacts to visual amenity and localised changes in the landscape, not considered to be significant.
Outcomes	Implementation of the Proposal is not expected to result in significant residual impacts to Social Surrounds. The Proposal's Social Surrounds environmental outcomes, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows: – All ground disturbance will occur within the DE – The Proposal will be designed and constructed considering the objectives of SPP 5.4 Proposal impacts to Aboriginal heritage and historic heritage will be managed through complementary regulation. Impacts of the proposal to Aboriginal heritage will be managed through consultation with the GKB Group and AH Act Section 18 approval. Proposal impacts to historic heritage sites will be managed through consultation with the City of Kwinana. Main Roads considers implementation of the identified planning, avoidance and mitigation measures will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for Social Surrounds will be met through achievement of the above environmental outcomes and management through complementary regulation.
Assessment of offsets	Offsets are not relevant to Social Surroundings.

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1 PROPOSAL

1.1 Proposal content

Main Roads Western Australia (Main Roads) is proposing to upgrade Anketell Road to an Expressway Standard between Leath Road, within the Kwinana Industrial Area (KIA), and Kwinana Freeway (the Proposal). The Proposal also includes the upgrade of a short section of Anketell Road east of the Kwinana Freeway (to Treeby Road) to connect the Proposal to the existing Anketell Road.

The Proposal links the Western Trade Coast (WTC), including the Kwinana Industrial Area, Rockingham Industry Zone, Australian Marine Complex and Latitude 32 and a proposed future port (Westport), to existing and future Industrial Areas via the upgraded section of Anketell Road and the existing Kwinana Freeway and Roe Highway.

A summary of the Proposal content description and Proposal content elements is included in Table 1.1 and Table 1.2 respectively.

Table 1.1: General proposal content description

Proposal element	Description
Proposal title	Anketell Road Upgrade (Leath Road to Kwinana Freeway)
Proposal name	Main Roads Western Australia
Short description	Main Roads is proposing to upgrade and widen Anketell Road to an Expressway Standard for approximately 7.5 km between Leath Road and Kwinana Freeway in the City of Kwinana, WA. The Proposal will include grade separated interchanges at six locations, grade separation of road over rail at two locations and other supporting road infrastructure.

Table 1.2: Proposal content elements

Proposal element	Location / description	Maximum extent, capacity or range
Physical elements		
The proposal includes the following physical elements: – Approximately 7.5 km of new urban expressway standard, dual carriageway. – Grade separated interchanges at Treeby Road, Kwinana Freeway, Mandogalup Road, Abercrombie Road, Armstrong Road and Rockingham Road. – Grade separations of Rockingham Road and Anketell Road over rail. – New local roads and existing road modifications, including upgrades at Rockingham Road. – Drainage basins, drains and other associated infrastructure.	Proposal Development Envelope (DE) in Figure 1-1.	The Proposal comprises a total area of 224.83 ha, including clearing or disturbance of up to 92.22 ha native vegetation and 50.35 ha non-native vegetation.

Proposal element	Location / description	Maximum extent, capacity or range
– Shared Path (SP) for the full length of the Proposal. – Other road infrastructure and furniture, including but not limited to culverts, lighting, fencing, landscaping, road safety barriers and signs. – Utility relocations and works to maintain access to properties.		
Construction Elements		
Construction activities associated with the physical elements are likely to include: – earthworks – laydown – piling – excavation – water abstraction – dewatering – drainage improvements, and – landscaping.	Proposal DE in Figure 1-1.	Construction will occur within the 224.83 ha DE.
Operational Elements		
Main Roads will operate the Proposal using standard management and maintenance practices.	Proposal DE in Figure 1-1.	Operation will occur within the 224.83 ha DE.
Proposal elements with greenhouse gas emissions		
Construction elements		
Scope 1	Land use change – vegetation clearing: 25,364 tCO2-e over 36 months Plant and equipment: 15,783 tCO2-e over 36 months	
Scope 2	None	
Scope 3	All indirect emissions (other than energy/electricity used) that occur in the value chain including both upstream and downstream emissions. This includes embedded energy within construction materials, construction fuel, haulage – 57,911tCO2-e over 36 months	
Operation elements		
Scope 1	Maintenance over road life – 5,235 tCO2-e	
Scope 2	Electricity use over road life – 3,192 tCO2-e	
Scope 3	All indirect emissions (other than energy/electricity used) that occur in the value chain including both upstream and downstream emissions. This includes emissions associated with the supply of maintenance materials –	

Proposal element	Location / description	Maximum extent, capacity or range
	10,337 tCO2-e and vehicle user emissions – 2,108,475 tCO2-e over 50 years.	

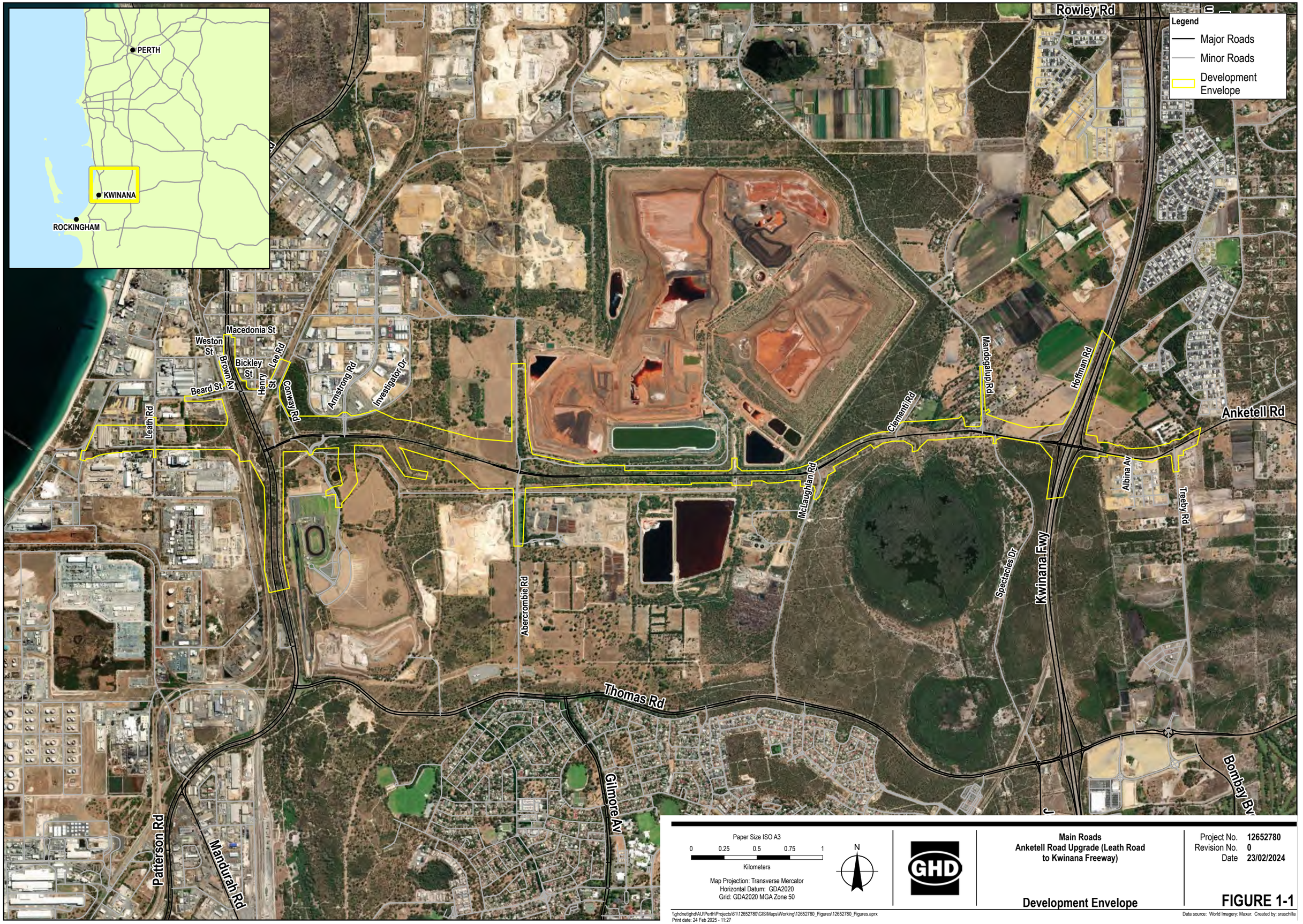
The Proposal aims to upgrade the existing Anketell Road to better connect Kwinana Freeway with the growing strategic KIA and future Westport terminal.

Construction of the Proposal is likely to adopt a mix of earthwork batters (fill and cut) with landscaping and retaining walls. The Proposal will relocate existing infrastructure including electricity, gas and water infrastructure.

The Development Envelope (DE) comprises an area of 224.83 hectares (ha) and represents the boundary surrounding the Proposal within which all development will be contained. The DE also represents the disturbance footprint for the Proposal. The DE varies in width to accommodate intersection upgrades, drainage and vertical profile requirements and encompasses portions of the existing Anketell Road alignment. The Proposal location and DE are shown in Figure 1-1.

This document has been prepared in accordance with Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2021 (EPA 2021a) and Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2024). The structure of this document aligns with the EPA instructions on how to prepare an Environmental Review Document, where appropriate (EPA 2021b).

Main Roads referred the Proposal to the Environmental Protection Authority (EPA) for assessment under Section (s) 38 of the *Environmental Protection Act 1986* (EP Act) in February 2024. The purpose of this revised Referral Supporting Document is to support the formal assessment of the Proposal and address the Notice Requiring Information for Assessment, requested by the EPA under Section 40(2)(a) of the EP Act.



Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Development Envelope

Project No. **12652780**
Revision No. **0**
Date **23/02/2024**

FIGURE 1-1

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1.2 Background and justification

The existing access to the industrial and commercial precincts at Kwinana, Naval Base and Henderson utilise infrastructure that was not designed and built to accommodate the current traffic demand. As such, there are significant operational and road safety issues with the existing network.

Future planning for the WTC includes the development of Henderson (Australian Marine Complex), KIA, Rockingham Industry Zone, the Latitude 32 Industry Zone and the planned transition of container terminal activities from Fremantle to a new purpose-built terminal at Kwinana.

The Town of Kwinana's projected population growth and significant economic development would lead to unsustainable traffic growth on the existing road network.

The Proposal forms a major component of the planned regional road network for the Perth South West corridor and will improve efficiencies and amenity and provide beneficial road safety outcomes.

The main economic drivers of the WTC are bulk commodity trade, engineering and fabrication, advanced manufacturing, metals refining and energy production and the container terminal operations. Each of these industries is reliant on road transport.

The key benefits of the Proposal are:

- Supporting existing and future development associated with the WTC and the Container Terminal with improved freight efficiency, reliable journey times and reduced travel times
- Increasing direct and indirect employment opportunities for the local population during the construction phase
- Improve road user safety on Anketell Road, and the broader road network.

1.3 The Westport Program

The Westport Program is the WA Government's long-term initiative to plan for a new container terminal in the Kwinana Outer Harbour, as well as the road and rail networks servicing the terminal. The upgrade of Anketell Road is a stand alone component of the Westport Program and will be delivered by Main Roads. The Anketell Road Upgrade will be delivered separately to the other components of the Westport Program, including the Westport Future Port Project (Westport Proposal).

1.4 Proposal alternatives

Anketell Road has been identified as an "Other Regional Road" in the Metropolitan Regional Scheme for a significant period of time. This recognises the importance of an efficient road network connection to the areas of Kwinana, Rockingham and Henderson. Anketell Road currently is a single carriageway with one lane in each direction and would not accommodate the volumes of traffic forecast from the developments within Kwinana Industrial Zone, Rockingham and Henderson. An upgrade of Anketell Road is now required.

In 2017, the Westport Taskforce (Westport) was established to provide guidance to the State Government on Perth's long-term freight infrastructure needs. Westport focused on the three existing port precincts at Fremantle, Kwinana and Bunbury. This work included developing a long list of infrastructure options which was assessed through Multi-Criteria Assessment (MCA) by members of Westport and subject matter experts drawn from consultants and Western Australian Government Agencies in May 2019. The assessment resulted in a shortlist of seven options including various Kwinana options with either Anketell Road or Rowley Road serving as the main road freight access.

In May 2019, a second stage MCA assessed the shortlist of seven options in more detail and identified a preferred port location, configuration and supporting road and rail networks. The criteria included complementary land use, social, heritage, environmental, economic and supply chain (which included road and rail). The MCA identified a land-backed port in Kwinana serviced by an upgraded Anketell Road and rail network as the preferred port and supply chain option. Government subsequently endorsed this option. Rowley Road was discounted due to a number of factors including:

- Higher noise impacts on residential land uses compared to Anketell Road
- More significant impact on vegetation and flora compared to Anketell Road
- Rowley Road would have significant impacts on Aboriginal and non-Aboriginal heritage.

Anketell Road will serve as the key freight link between the Kwinana Freeway and the commercial/industrial precincts and the port. The design for Anketell Road accommodates these consolidated functions.

1.5 Local and regional context

1.5.1 Climate

The Proposal is located in the South West Botanical Province of WA (Beard 1990) and experiences a Mediterranean climate with distinctly hot, dry summers and cool, wet winters. The closest current Bureau of Meteorology (BoM) weather station is at Anketell (Station ID: 009258), located approximately 500 m south of the Proposal. Data collected at this station is available from 2002 to 2024 and includes precipitation data (BoM 2025a). Monthly mean maximum and minimum temperatures are recorded at BOM weather station Jandakot Aero (Station ID: 009172). Data collected at this station is available from 1972 to 2024 (BoM 2025b).

Mean maximum temperatures range from 31.7 °C in February to 18.1 °C in July. The mean minimum temperature ranges from 17.2 °C in February to 7.2 °C in July (BoM 2025b). The mean annual rainfall is 792.8 mm with an average of 82.9 days of rainfall per year greater than 1 mm (BoM 2025b). Rainfall is largely received from May to September with 5–6 dry months per year (Beard 1990).

1.5.2 Landform and soils

The Proposal occurs within the Bassendean and Perth Coastal Soil-Landscape Zones of the Swan Province (Schoknecht et al. 2004). The Bassendean Zone consists of Mid-Pleistocene Bassendean sand, fixed dunes inland from coastal dune zone. The Bassendean Zone comprises non-calcareous sands, podsolised soils with low-lying wet areas. The Perth Coastal Zone consists of coastal sand dunes and calcarenite, late Pleistocene to Recent (Quindalup and Spearwood Systems), and calcareous and siliceous sands and calcarenite.

1.5.3 Regional biogeography

The Proposal is located in the South West Botanical Province of WA (Beard 1990) and within the Swan Coastal Plain (SCP) Bioregion and the Perth Sub-region (SWA02) as described by the Interim Biogeographic Regionalisation of Australia (IBRA). The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart Woodlands occur on limestone, Banksia and Jarrah-Banksia Woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

1.5.4 Other proposals in the surrounding area

There are other significant activities, developments and land use proposals within 5 km of this Proposal, currently under assessment, or recently approved that are likely to impact native vegetation and fauna habitat. Other Proposals were identified using the EPA Referred Significant Proposals (DWER-120) dataset (DWER 2025a). Key other proposals include, but are not limited to:

- Outer Harbour Port Development, Kwinana (Westport Proposal) – the Westport Proposal is the State Government's long-term program for a new land-backed port in the KIA. The Westport Proposal overlaps with and is located immediately west of the current Proposal in the KIA and extending into Cockburn Sound. The Westport Proposal was referred to the EPA under s. 38 of the EP Act in March 2024. The level of assessment was determined as Assess – Public Environmental Review in April 2024 with Preliminary Environmental Factors including Benthic Communities and Habitat, Coastal Processes, Marine Environmental Quality, Marine Fauna, Flora and Vegetation, Terrestrial Environmental Quality, Terrestrial Fauna Social, Inland Waters and Social Surroundings.
- H2Perth Proposal – Woodside Energy Technologies Pty Ltd (Woodside) is proposing to construct and operate a domestic and export scale hydrogen and ammonia production facility. The H2Perth Proposal is located primarily within the Rockingham Industrial Zone in the City of Rockingham, with elements also located within the City of Kwinana and on the multi-user Kwinana Bulk Jetty. The H2Perth Proposal is located approximately 4.2 km south of the current Proposal. The H2Perth Proposal was referred to the EPA under s. 38 of the EP Act in May 2023. The level of assessment was determined as Assess – Referral Information with additional information in June 2023 with Preliminary Environmental Factors including Air Quality, Greenhouse Gas Emissions, Social Surroundings, Marine Environmental Quality, Flora and Vegetation, Terrestrial Fauna and Inland Waters.
- Ammonia Expansion Project (CSBP Proposal) – CSBP Limited is proposing to construct and operate a new ammonia plant 'AP3' within the CSBP Kwinana Industrial Complex in the KIA. The CSBP Proposal is located approximately 2.7 km south of the current Proposal. The CSBP Proposal was referred to the EPA under s. 38 of the EP Act in December 2022 with additional information received in July 2023. The EPA Report on assessment was released in November 2023, with Greenhouse Gas Emissions identified as the only Environmental Factor. The Proposal was approved in February 2024 through Ministerial Statement 1217.
- BP Kwinana Renewable Fuel Project (on hold – announcement 3 February 2025) – BP Refinery (Kwinana) Pty Ltd (BP) is proposing to construct and operate a renewable fuels processing facility at the former oil refinery site in the KIA. The Proposal will use an existing disturbed footprint. The BP Kwinana Renewable Fuel Project Proposal was assessed on referral information with Greenhouse Gas Emissions identified as the only Environmental Factor. The Proposal was approved in April 2024 through Ministerial Statement 1218.
- Urban Development of lots 11 and 74 Beenyup Road Banjup – Agile Royal is proposing to develop Lots 11 and 74 Beenyup Road, Banjup for residential development and conservation. The site is located 4.7 km north east of the current Proposal. The Proposal was referred to the EPA under s. 38 of the EP Act in June 2020. The level of assessment was determined as Assess - Additional

Assessment Information (public review) in July 2020 with Preliminary Environmental Factors including Flora and Vegetation, Terrestrial Fauna and Inland Waters. The Environmental Review was advertised for public submissions in late November 2024. The assessment is currently ongoing.

- Lots 2 and 10 Rowley Road Mandogalup – Questdale Holdings Pty Ltd are proposing to extend an existing sand quarry extraction operation on Lots 2 and 10 Rowley Road, Mandogalup. The operation is located approximately 2.2 km north of the current Proposal. The Proposal was referred to the EPA under s. 38 of the EP Act in December 2018. The level of assessment was determined as Assess - Public Environmental Review in March 2019 with Preliminary Environmental Factors including Flora and Vegetation, Terrestrial Fauna and Social Surrounds. The Environmental Review was advertised for public submissions in June-July 2022. The assessment is currently ongoing.
- Perth Seawater Desalination Plant 2 – Water Corporation is proposing to construct the Perth Seawater Desalination Plant 2 (PSDP 2). The PSDP2 Proposal will be located within the KIA extending into the Cockburn Sound, adjacent to the west end of the current Proposal. The PSDP2 Proposal was referred to the EPA under s. 38 of the EP Act in March 2019. The level of assessment was determined as Assess - Additional Assessment Information (public review) in November 2020 with Preliminary Environmental Factors including Benthic Communities and Habitats, Coastal Processes, Marine Environmental Quality, Marine Fauna and Flora and Vegetation. The assessment is currently ongoing.

There are various planning proposals, at different stages in the planning process, proposing residential and industrial development within 5 km of this Proposal. Some of the larger developments sourced from the EPA (Referred Schemes (DWER-119) dataset (DWER 2025b) within 5 km of this Proposal include, but are not limited to:

- Latitude 32, formerly known as the Hope Valley Wattleup Redevelopment Project – The Western Australian Land Authority (DevelopmentWA) manages large-scale Latitude 32 industrial development and redevelopment in the Hope Valley and Wattleup areas. Implementation of Latitude 32 will allow transition of the existing land uses within the area to more compatible uses, integrate existing industry, and provide infrastructure accessibility and strong inter-regional links. The Latitude 32 proposal is located adjacent to the north-eastern section of the current Proposal, north of Anketell Road, extending across and to the east of Kwinana Freeway. The Master Plan was referred to the EPA in 2003 and was assessed at the level of Environmental Review. The Master Plan was approved in November 2004 through Ministerial Statement 667 with conditions relating to Water Management and Biodiversity. The Master Plan was amended in 2023 (Amendment No. 16) and referred to the EPA. The level of assessment was determined as Scheme Amendment Not to be Assessed under Part IV of the EP Act.
- Mandogalup – Improvement Scheme No.1 - The Western Australian Planning Commission has been tasked with planning for suitable land use change within the Improvement Plan No. 47: Mandogalup (IP47) boundary. The IP47 boundary comprises 330 hectares of land, adjacent to the north-eastern section of the current Proposal, north of Anketell Road, extending across and to the east of Kwinana Freeway. The draft Improvement Scheme for the IP47 area was considered by the EPA prior to public advertising and the EPA decided not to assess. The Mandogalup Improvement Scheme No.1 was gazetted in November 2024 and is now the operative planning scheme for the Mandogalup IP47.

area. Note this area includes Lot 2 and 10 Rowley Road (mentioned above) is the subject of a yet to be concluded EPA process to enable vegetation clearing and resource extraction.

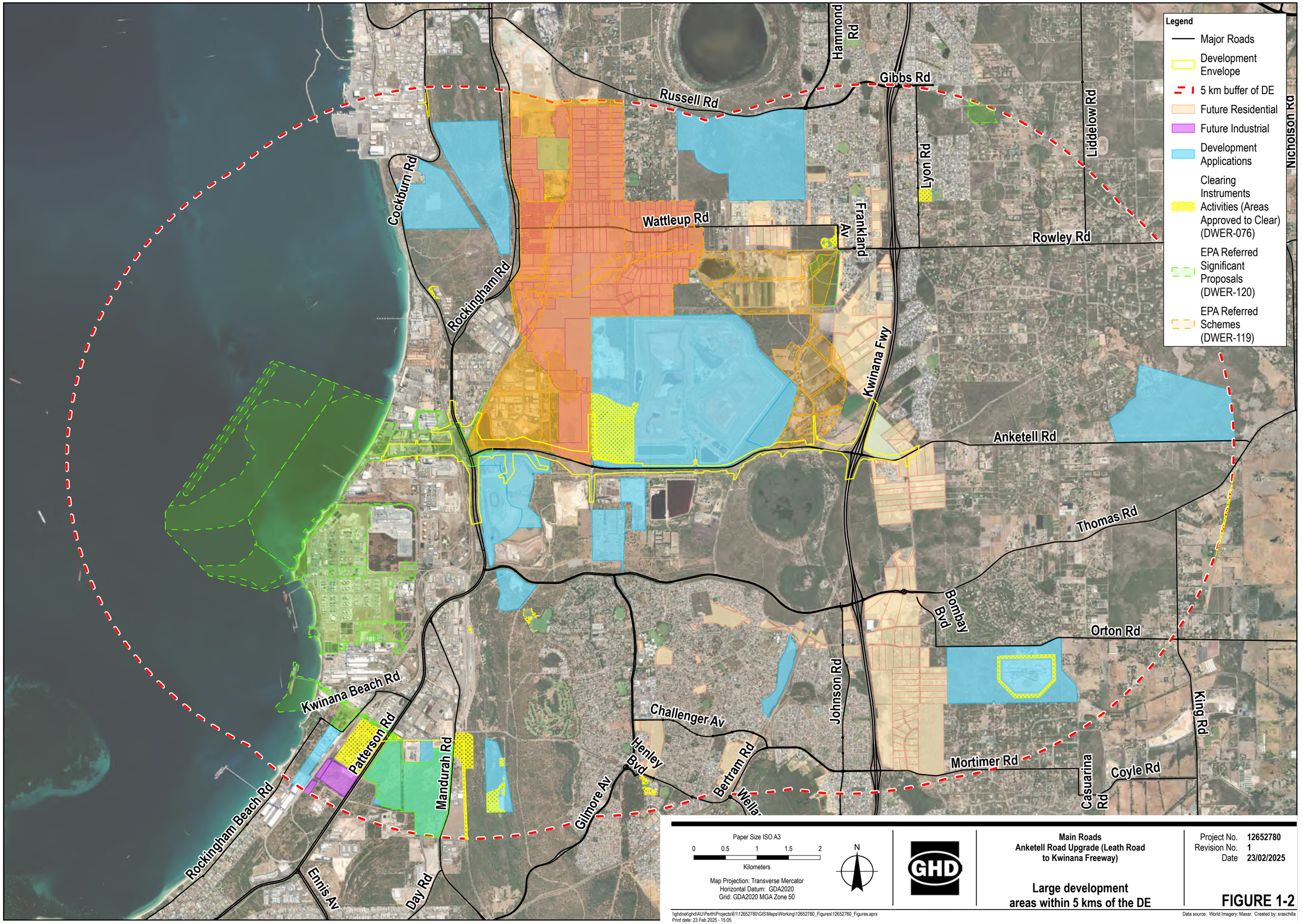
- Wandi District Centre Precinct Structure Plan – Rowe Group prepared the draft Precinct Structure Plan on behalf of the owners of Lots 2 (No. 727) and 313 (No. 651) Anketell Road, Wandi, to facilitate development of the Wandia District Activity Centre. The Precinct Structure Plan covers 39.5 ha and is located at the intersection of Anketell Road and the Kwinana Freeway in Wandi, adjacent to the north-eastern section of the current Proposal, north of Anketell Road, east of Kwinana Freeway. There are subdivision approvals in place to create super-lots for the future district centre.

A review of the Clearing Instruments Activities (Areas Approved to Clear) (DWER-076) dataset (DWER 2025c) indicates there are 22 active clearing permits (status of 'Amended' or 'Granted) within 5 km of the current Proposal.

The Urban Land Development Outlook (ULDO) 2023/2024 is based on an assessment of future land supply at all stages of the planning, zoning, approval, development and redevelopment pipeline. The ULDO output covers Perth to Peel and includes current land development projects as well as areas identified for likely future residential, industrial and commercial land development. The ULDO 2023/2024 draft dataset shows many land parcels within the 5 km buffer of the DE identified as likely future residential, industrial and commercial land development areas. These areas include:

- Likely future residential/commercial areas – numerous small and medium land parcels totalling 685.97 ha scattered throughout the suburbs of Mandogalup, Wandi, Anketell, Orelia, Parmelia, Bertram, Casuarina and Kwinana Town Centre. Of this, approximately 308.96 ha (45.04%) has current conditional approval and a further 60.57 ha (8.83%) will support likely future residential/commercial development within the next 5 years.
- Likely future industrial areas – many large land parcels north of Anketell Road associated with Latitude 32, and three land parcels south of the current proposal within the East Rockingham Industrial Area. Of this, approximately 160.65 ha (19.34%) will support likely future industrial development within the next 5 years, with the remaining 670 ha (80.66%) to support likely future industrial development in the medium (6-10 years) and long term (10+years).

Large future residential, industrial, development applications, other proposals, scheme areas and clearing permit boundaries within 5 km of the proposal have been mapped in Figure 1-2. Key other Proposals and clearing permits have been used to inform the cumulative impacts of the current Proposal, as summarised in Section 9.



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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Large development areas within 5 kms of the DE

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Revision No. **1**
Date **23/02/2025**

FIGURE 1-2

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2 LEGISLATIVE CONTEXT

2.1 Environmental impact assessment process

2.1.1 *Environmental Protection Act 1986*, Part IV Environmental Impact Assessment

The EP Act is the primary legislation governing environmental impact assessment (EIA) in WA. Part IV of the EP Act relates to Environmental Impact Assessment, which is carried out in accordance with the Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2024a).

In accordance with section 3.1.2 of the Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual, the Revised RSD has been prepared with the intent to provide the EPA sufficient information regarding the potential environmental impacts to enable assessment of the Proposal. The Revised RSD has been prepared in accordance with the EPA (2021b) Instructions on how to prepare an Environmental Review Document, including assessment against the EPA's key environmental factors. The EIA is based on conformance with the Notice Requiring Information for Assessment, and various relevant EPA guidance documents.

Main Roads will release the ERD for a public review period of four weeks. The EPA will provide a summary of the submissions on the ERD for Mian Roads to respond to. The EPA will then review the response to the submissions and may publish Main Roads' response to the submissions on the EPA website if appropriate. The EPA then prepares and submits its assessment report and recommendations to the WA Minister for Environment for consideration.

2.1.2 *Environment Protection and Biodiversity Conservation Act 1999*

A proposed action that may have a significant impact on a Matter of National Significance (MNES) requires approval from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In March 2024, the Proposal was referred to DCCEEW under the EPBC Act due to potential impacts to listed threatened species and communities. On 22 August 2024, a delegate of the Federal Minister for the Environment determined that EPBC 2024/09841 (the Proposed Action) was a controlled action pursuant to the EPBC Act, to be assessed by Preliminary Documentation. The relevant Matters of National Environmental Significance (MNES) were listed threatened species and communities (sections 18 and 18A).

This Proposal is not being assessed as an accredited assessment under the bilateral agreement.

2.2 Other approvals and regulation

Following primary environmental approval of the Proposal under part IV of the EP Act, additional regulatory approvals will be required to construct and operate the Proposal. These are summarised in Table 2.1.

Table 2.1: Summary of other regulatory approvals required

Decision-authority	Legislation or Agreement regulating the activity	Approval required	Whether and how statutory decision-making process can mitigate impacts on the environment
DWER	*Rights in Water and Irrigation Act 1914* (RIWI Act)	Licence to take	If groundwater abstraction / dewatering and/or bore/well construction/alteration is required for

Decision-authority	Legislation or Agreement regulating the activity	Approval required	Whether and how statutory decision-making process can mitigate impacts on the environment
			the Proposal, licence/s will be required from the DWER under the RIWI Act.
Western Australian Planning Commission (WAPC)	*Planning and Development Act 2005* (PD Act)	Development Application	Any disturbance to vegetation within the Bush Forever sites due to Proposal works, will require Development Approval under the PD Act to acquire the Bush Forever land.
Department of Biodiversity Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016* (BC Act)	Threatened Flora Authorisation, Authorisation to Take or Disturb Threatened Fauna, Authorisation to Modify a TEC	Conditions of the Authorisations will be adhered to.

2.3 Planning approvals

2.3.1 Development application

The alignment of the Proposal will not be fully located within land currently reserved under the MRS for Primary Roads or Other Regional Roads (Figure 2-1). Areas outside the MRS will likely be subject to a Development Approval through the WAPC. No Development Approval is required for road construction works on land reserved by the MRS for the purpose of Primary Regional Roads or Other Regional Roads.

Land within the proposed alignment will be acquired by Main Roads and dedicated as a road pursuant to Section 28 (1) of the *Land Administration Act 1997* (LA Act).

Following completion of the Proposal, all areas outside the existing Primary Regional Roads reservation will be incorporated into Primary Regional Roads, or zoned appropriately, through an omnibus amendment to the MRS pursuant to Section 28 (1) of the LA Act. The exception is the Class A reserve, which is detailed below.

2.3.2 Class A excision

Reserve 53313 is a Class A Conservation Park vested in the Conservation and Parks Commission with DBCA as the responsible agency (Figure 2-2). The Reserve is comprised of 79 land parcels scattered along a north-south corridor from Farrington Rd in North Lake to Thomas Rd, incorporating a portion of the Spectacles.

Class A Reserves are created under the provisions of the LA Act and under the *Land Act 1933* prior to that. Management of reserves created for conservation purposes are conferred on the DBCA. Amendments to this class of reserve require the consent of the Minister for Environment and an order by the Minister for Lands.

To facilitate the excision of land from the conservation estate, agreement will be sought from DBCA and the Conservation Commission for the excision of a portion of the Reserve, and specifically the land parcel(s) affected. Comments are sought from stakeholder agencies and the Local Government, and a formal submission is made to DPLH for a Crown Subdivision of the subject lot(s). Upon approval from DPLH, a survey will be completed and new boundaries and areas are shown on a Deposited Plan lodged at Landgate.

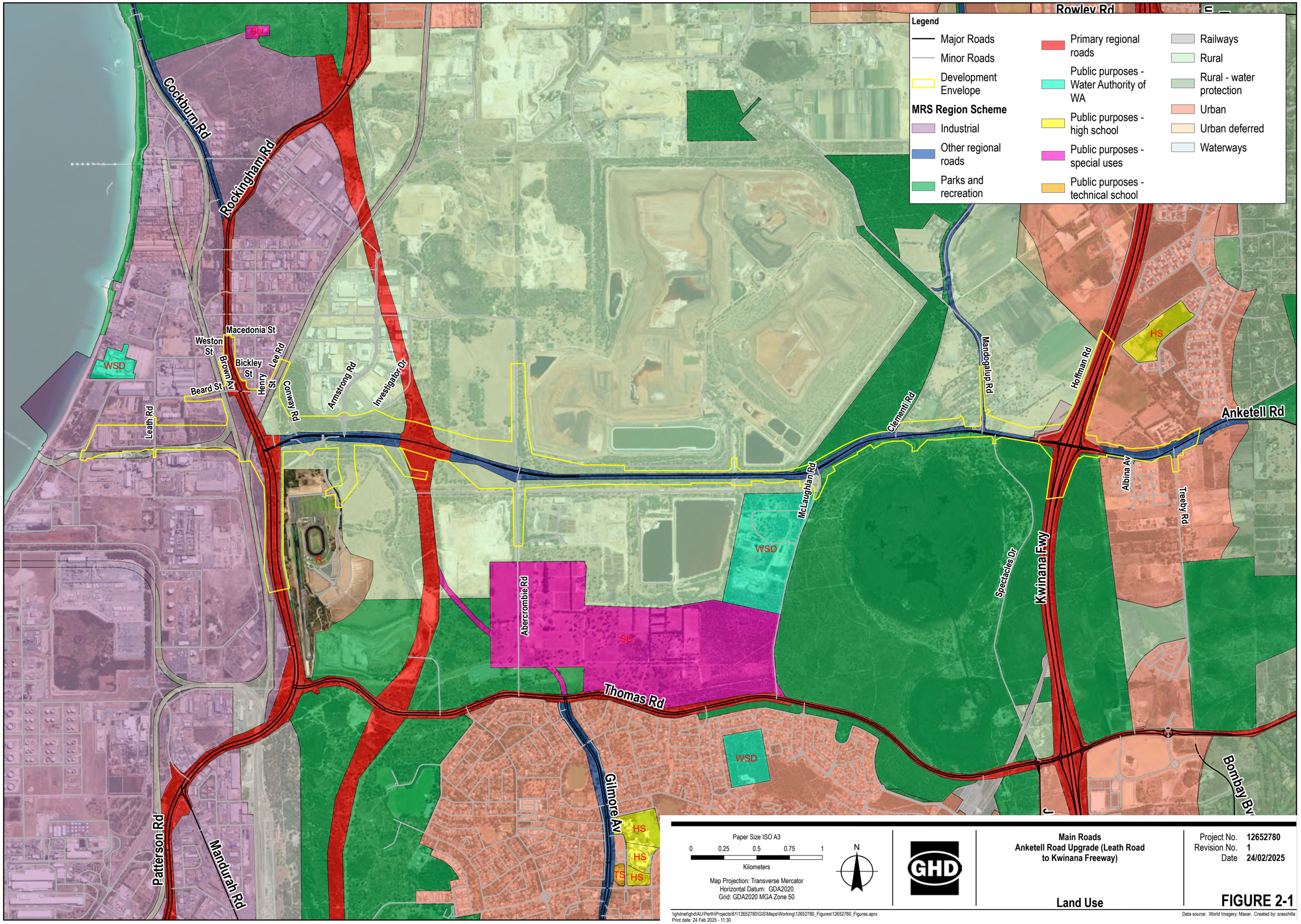
The Minister for the Environment, on the recommendation of the Conservation Commission, will request the Minister for Lands to amend the reserve to excise land from the reserve for the road. The Minister for Lands must advertise the proposed excision in a state newspaper and consider all comments and, no sooner than 30 days later, table it in both houses of Parliament for a period of 14 sitting days. If no Motion to Disallow is raised by a Member of Parliament, the Minister for Lands will, by order, amend the Class A Conservation Reserve. The necessary documents are prepared by DPLH and signed by the Executive Council prior to lodgement at Landgate. The tenure amendments will be recorded in the State property register by the Registrar of Titles.

2.4 Decision making authorities

The authorities listed in Table 2.2 have been identified as decision-making authorities (DMAs) for the Proposal.

Table 2.2: Decision making authorities

Decision making authority	Relevant legislation
Minister for Lands	LA Act
Minister for Planning	PD Act
WAPC	PD Act
Chief Executive Officer of DWER	RIWI Act
Minister for Aboriginal Affairs	AH Act
Minister for the Environment	BC Act


Legend
Major Roads
Minor Roads
Development Envelope
MRS Region Scheme
Industrial
Other regional roads
Parks and recreation
Primary regional roads
Public purposes - Water Authority of WA
Public purposes - high school
Public purposes - special uses
Public purposes - technical school
Railways
Rural
Rural - water protection
Urban
Urban deferred
Waterways
Rowley Rd
Cockburn Rd
Rockingham Rd
Macedonia St
Weston St
Brown Av
Bickley St
Lee Rd
Henry St
Beard St
Conway Rd
Armstrong Rd
Investigator Dr
Leath Rd
Clementi Rd
Mandogalup Rd
Hoffman Rd
Anketell Rd
McLaughlan Rd
Albina Av
Treeby Rd
Spectacles Dr
Kwinana Fwy
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Thomas Rd
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Grid: GDA2020 MGA Zone 50
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GHD
Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)
Land Use
Project No. 12652780
Revision No. 1
Date 24/02/2025
FIGURE 2-1
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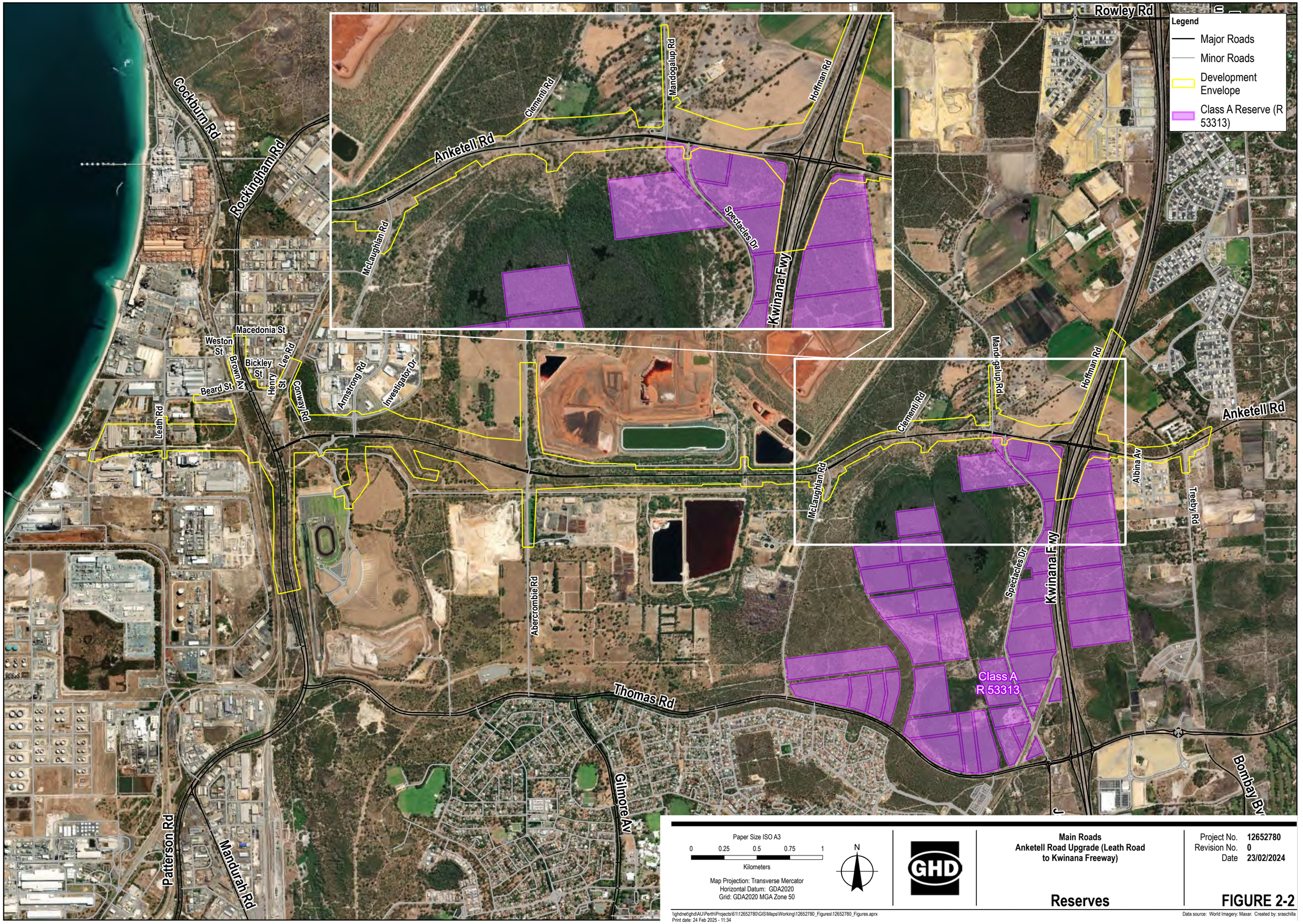

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Reserves

Project No. **12652780**
Revision No. **0**
Date **23/02/2024**

FIGURE 2-2

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3 STAKEHOLDER ENGAGEMENT

Westport has undertaken stakeholder engagement for the greater program, including the Westport Proposal and the Anketell Road Upgrade, since 2018. Westport developed a comprehensive information and engagement plan (Westport 2020) based on inputs from:

- Main Roads
- The Westport Taskforce Reference group comprising community groups, peak bodies, government agencies, universities, and research institutions
- Aboriginal groups and stakeholders
- A Westport Governance Committee
- Organisations not on the Reference group
- The broader community.

Engagement on the long-term Anketell Thomas Road Freight Corridor began in August 2021, following selection of the future terminal location in Kwinana. Specific, targeted engagement for the Anketell Road Upgrade between Leath Road and Kwinana Freeway commenced in late 2023. Community and stakeholder engagement for the Proposal is ongoing, as indicated in Section 3.2.

Engagement to date has included stakeholder and community discussions about the Proposal and associated field surveys and approvals.

3.1 Stakeholders

Stakeholders that have an interest in the planning and development phase of the Proposal are listed in Table 3.1. The stakeholders include all three levels of government, regulators, landowners, residents, business owners and operators, environmental groups, special interest groups, communities, and road users.

Further stakeholders may be identified as the planning progresses from early concept design to detailed design and development.

Table 3.1: Stakeholders

Stakeholder group	Stakeholder	Influence
State Government	Main Roads	Leading concept design development, as well as landowner engagement throughout environmental referral and future planning and development of road corridor.
	Department of Planning, Lands and Heritage (DPLH)	Program partner Managing land protection and acquisition process during planning Landowner in the Proposal area.
	Western Australian Planning Commission (WAPC)	Program partner Decision maker for land protection and acquisition during the planning process. Landowner in the Proposal area.

Stakeholder group	Stakeholder	Influence
	Department of Biodiversity, Conservation and Attractions (DBCA)	Program partner involved in the environmental referral process and land management in the Proposal area
	Department of Water and Environmental Regulation (DWER)	Manage the environmental referral process (State)
	Department of Transport, Public Transport Authority (PTA) and METRONET	Program partners
	Department of Primary Industries and Regional Development	Program partner
	Environmental Protection Authority	Provides advice regarding environmental impact assessments and approvals to the Minister for Environment
	Department of Fire and Emergency Services (DFES)	Manage emergency service operations in the area and provide advice regarding the provision of these services during planning, development and delivery.
	Venues West	Manages the commercial operations / operator of the Motorplex site.
	Member for Kwinana	Premier of Western Australia, Roger Cook, MLA is the key sponsor for the project.
Traditional landowners	Westport's Noongar Advisory Group	Key stakeholder can influence Aboriginal heritage approvals
	South West Land and Sea Council (SWALSC)	Key stakeholder can influence Aboriginal heritage approvals
Federal Government	DCCEEW	Provide approvals under the EPBC Act
Local Government	City of Kwinana	Local Government Authority (LGA) directly affected by the road corridor
	Shire of Serpentine-Jarrahdale (neighbour)	LGA - Proposal neighbour
	City of Cockburn (neighbour)	LGA - Proposal neighbour
	Westport LGA Reference group	Members include: – City of Armadale – City of Belmont – City of Canning – City of Cockburn – City of East Fremantle – City of Kalamunda – City of Kwinana

Stakeholder group	Stakeholder	Influence
		– City of Melville – City of Rockingham – City of Swan – PEEL Alliance – Shire of Serpentine Jarrahdale – Southwest Group
Business	– Bunbury Dampier Natural Gas Pipeline – Motorplex – Alcoa – Wider Kwinana Industrial Area, – Anketell and Wandi commercial centres – Services Authorities (Water Corp, ATCO, Western Power) – Freight and logistics industry – Land Developers – ARC Infrastructure (freight rail operator) – Eclipse Resources – WA Limestone – Latitude 32 Industrial Park (off Armstrong Road) – Lee Road Industrial Precinct	External stakeholder groups affected directly or indirectly by the Proposal's development and access changes. Manage/own land in or adjacent to the Proposal area.
Landowners	Directly impacted landowners/ residents	External stakeholder groups directly impacted by the Proposal's development and access changes.
Community/ interest/ environmental groups	– Wandi Progress Association – Medina Residents Group – Honeywood Residents' Group – Casuarina Wellard Progress Association – Conservation Groups – Mandogalup Volunteer Bush Fire Brigade – Beeliar Regional Park Community Advisory Committee – BirdLife Australia (member of Westport reference group) – Conservation Council WA – Friends of Kwinana Bushland – Friends of The Spectacles	External stakeholder groups interested in the Proposal's development and access changes.

Stakeholder group	Stakeholder	Influence
	– Greening Australia ((member of Westport reference group) – Kwinana in Transition KiT Community Group – Kaarakin Black Cockatoo Conservation Centre – Naragebup - Rockingham Regional Environment Centre – Perth NRM (member of Westport reference group) – Sustainable Built Environment National Research Centre – The Beeliar Group – The Wetlands Centre, Cockburn – The Wilderness Society – Trillion Trees - Rockingham Kwinana – Urban Bushland Council (member of Westport reference group) – WA Wildlife – previously known as Native Ark – WA Naturalists' Club Kwinana Rockingham Mandurah Branch – Wetlands Research Association – Wetlands Conservation Society – Wildflower Society of WA – World Wildlife Fund – Wellard Village People – Medina Residents' Group – Homestead ridge progress association	
General community	Residents, businesses and road users not directly affected by the project but who are neighbours and may have indirect impacts like travel times and methods etc. People who have attended previous project engagement event/ participated in My Say Survey	External stakeholder groups affected by the Proposal's development and access changes.

3.2 Stakeholder engagement process

Westport has developed an engagement strategy to facilitate input from the community and stakeholders for the Westport Proposal, which has also encompassed information about the Anketell Road Upgrade Proposal. A summary of community consultation undertaken to inform the Proposal's planning and development to date is provided in Table 3.2.

Table 3.2: Community Consultation Strategy Summary – Westport

Audience/Stakeholders	Engagement Medium	Timing
All community and stakeholders	Website updates	2021 onwards
Email subscribers	Monthly project newsletter updates	November 2021 onwards
Residents in the City of Kwinana and Shire of Serpentine-Jarrahdale (12,000 letters)	Letterbox drop – Westport Navigate newsletter with project information	March 2021
Shire of Serpentine-Jarrahdale and City of Cockburn, targeting people near Anketell Road	Community pop-up events at shopping centres and local markets	March 2022
All community and stakeholders	Community Survey on the Anketell-Thomas Road Freight Corridor, via My Say Transport.	July 2022
All community and stakeholders	Social media advertising via Department of Transport Facebook page	2022 onwards
Sample of 805 residents from Perth and Peel metropolitan area (including Kwinana and Fremantle)	Biannual community perceptions surveys to determine sentiment / understanding of Westport and preferences for engagement.	March 2022 July 2022 May 2023
Residents in Kwinana and Cockburn	Community pop-up events at local shopping centres to provide project information and answer questions.	September and October 2023
Residents in City of Cockburn, City of Kwinana, City of Rockingham, and Shire of Serpentine-Jarrahdale (110,000 letters)	Letterbox drop – letter and flyer outlining Westport preferred design.	December 2023
All community and stakeholders	Community survey seeking broad feedback on the Westport project, via My Say Transport	September 2023 – January 2024
Horse owners who visit the Naval Base horse beach	Community pop-up events at the Naval Base horse beach to provide project information and answer questions	December 2023
Recreational fishers who access Cockburn Sound	Community pop-up events at various fishing locations to provide project information and answer questions	January – March 2024
Community in Cockburn and surrounding areas	Westport marquee at Coogee Live community event	March 2023

The Westport community survey ran from September 2023 to May 2024, receiving 812 responses, with the most represented areas being the Cities of Rockingham, Cockburn and Kwinana. This survey addressed the Westport Program of works (port, road and rail), which the upgrade of Anketell Road is one component. Respondents listed the environment, the redevelopment of Fremantle Port, and recreation in Cockburn Sound as the top three areas of interest. Road, rail and port design also had significant interest. Specific stakeholder feedback for themes relevant to the Anketell Road upgrade, were:

- Road upgrades:
    - "Forward planning of road upgrades, not waiting for traffic issues to arise following the project completion."
    - "Ensure that the proposed rail and road links can handle the volume of traffic including non-port traffic."
    - "Traffic in Perth is terrible. Westport should be designed in such a way that it improves traffic flow."
- Terrestrial environment:
    - "In the creation of the new port, opportunities should be explored to create green corridors for local fauna."
    - "Care for environment in construction and including impact of rail and road links for the areas surrounding those links. The impact is huge for residential and environment."
    - "There will be significant impacts to the local natural terrestrial and marine environments. How will the planning and subsequent works manage/minimise these impacts, and any environmental offsets should be secured within the local area to ensure that the local community can benefit from these."
- Local traffic:
    - "The most important thing is that transport to and from the port reduces congestion not only for the goods itself but for the people who must transit through the area."
    - "The design of the Anketell-Thomas Road Freight Corridor needs to be carefully considered to minimise the impact on those of us living in the adjacent suburbs."
    - "Minimise the impact of freight transport on residential areas."

3.2.1 Communication and Stakeholder Engagement Methodology

During 2024 Main Roads implemented a targeted, specific Community and Stakeholder Engagement plan to inform the early planning of the Anketell Road Upgrade from Leath Road to Kwinana Freeway. Stakeholder and community engagement is a key input into the planning, development, design and, subject to approvals, construction of the Proposal as shown in Figure 3-1:

- Planning assessment following corridor selection, develop early concept design to confirm corridor alignment, land requirements and proposed access strategy Planning and development – identify issues and constraints, develop a shared understanding of constraints and develop solutions and scope and undertake more refined concept design work including environmental studies for noise, visual amenity etc.
- Procurement – secure a contractor and undertake detailed design

- Construction – inform the community about construction requirements and build understanding of the implications of construction.

Figure 3.1: Stakeholder engagement in the road planning process

3.2.2 Proposal Design

As concept design information has become available, Main Roads has been engaging with directly affected landowners regarding direct land impacts, project investigations and future steps. Special interest groups including local environment groups and local government have also been engaged. A summary of 2024 Main Roads led engagement in regards to the Proposal is in Table 3.3.

Table 3.3: Main Roads Engagement Matrix 2024

Date	Engagement Activity	Objective	Audience	Status
20 March 2024	Environmental Stakeholder Group Briefing	Engage groups to provide project overview – Anketell Road Upgrade – Environmental referral process has begun	Special interest groups – Environmental	Complete
March 2024	EPA (State) Environmental Referral Comment Period	Starts the project environmental referral process	All	Complete
March to June 2024	Impacted landowner direct mail and meetings –	Invite contact to overview the Planning Concept and Planning Control Areas Seek contact information Request meetings with key landowners – Alcoa, Motorplex and private landowners	Landowners	Complete / as required. 6 out of 8 impacted landowners met with by 23/05/2024
10 April 2024	Heritage workshop	Engage Traditional Owners to undertake heritage survey of Anketell Road to inform heritage planning	Aboriginal groups	Complete Walk through survey conducted 13 – 15 May 2024

Date	Engagement Activity	Objective	Audience	Status
May 2024	Ministerial media statement	Announce State and Federal Government funding for planning and project development	All	Complete Link
May 2024	Email update	Advise community and stakeholders of funding for further planning	Email customers subscribed for Westport and Anketell Road Upgrade updates.	Complete
May to Dec 2024	Briefings – MP	Offered via Minister's office Overview and communication activities Opportunity to raise issues and concerns	Local members State and Federal	Ongoing
Ongoing	Main Roads Customer Information Centre Connect database	Create project page Input stakeholder enquiries and contact details Manage customer enquiries	Main Roads	Complete Ongoing
Ongoing	Main Roads website	Create page with high level overview and status information Establish and invite customers to subscribe to electronic mail updates for project	All	Anketell Road Upgrade project page and email subscriber live February 2024
13-24 May 2024	Heritage survey	Traditional Owners undertook heritage survey on site	Aboriginal groups	Complete
28 May 2024	Stakeholder briefing Environmental Referral and Project Overview	Engage Local Government stakeholder Focus on environmental referral processes Opportunity to raise issues and concerns.	City of Kwinana	Complete
21 August 2024	Stakeholder Briefing - Mandogalup Volunteer Bush Fire Brigade	Project update. Overview of project case versus ultimate. Access and property implications discussed.	Mandogalup Volunteer Bush Fire Bridge and City of Kwinana Emergency Response Officers	Complete
4 Oct 2024	Direct mail to wider landowners – Lee Road Industrial Precinct and Latitude 32 – Armstrong Road Precinct	Provide access information to surrounding property owners along the alignment	All	Complete

As the Proposal moves through the planning, design and environmental approval process, Main Roads, as the Proposal proponent, will continue to develop and implement an extensive communications and stakeholder engagement plan.

3.2.3 Targeted Stakeholder Engagement – November and December 2023 – Westport

Stakeholder engagement for the Westport Program increased following the Premier of Western Australia's announcement of the Westport's preferred design on 29 November 2023. This included a letter and flyer sent to 110,000 residents and businesses near the project area in December 2023, to provide information on the preferred design for the port and freight network, including the Proposal (see Table 3.2 above).

3.2.4 Engagement 2024 onward

In addition to direct engagement with adjacent landowners and businesses during 2024, since referral of the Proposal to the EPA, engagement has continued with community webinars and in-person pop-up events:

- 21 March 2024 - Community Webinar 5 - Westport's EPA referral
- 23 March 2024 - Community in-person pop-up at Rockingham Centre
- 18 April 2024 - Community in-person pop-up at Cockburn Gateway
- 18 May 2024 - Community in-person pop-up at Cockburn Power Boats Club
- 23 May 2024 - Community Webinar 'Your Questions Answered'
- 26 May 2024 - Community in-person pop-up at The Local Farmers Market, Honeywood
- 13 June 2024 - Community in-person pop-up at Rockingham Centre, Rockingham
- 27 June 2024 - Community in-person pop-up at Coogee Village, North Coogee
- 18 July 2024 - Community in-person pop-up at Kwinana Marketplace
- 27 July 2024 - Community in-person pop-up at the Local Farmers Market, Cockburn
- 11 August 2024 - Community in-person pop-up at Rockingham Rotary Market
- 6 - 9 September 2024 - Community in-person pop-up at The Club Marine Perth Boat Show
- 15 September 2024 - Community in-person pop-up at the Local Farmers Market Wandi
- 28 September 2024 - Community in-person pop-up at the Local Farmers Market Cockburn
- 16 October 2024 - Community in-person pop-up at the Local Farmers Market Coogee Beach
- 27 October 2024 - Community in-person pop-up at the Rockingham Rotary Market
- 2 November 2024 - Community in-person pop-up at Fremantle Ports Maritime Day
- 17 November 2024 - Community in-person pop-up at Freo Farmers Market
- 19 November 2024 - Westport Community Webinar
- 6 December 2024 - Community in-person pop-up at North Freo Bowlo
- 15 January 2025 - Community in-person pop-up at Kwinana Marketplace.

Main Roads as a program partner, contributes to Westport's governance via the Project's Steering Group and Control Group, a mechanism for integrated management of infrastructure development. Main Roads has commenced selected stakeholder engagement specific to the Proposal's potential environmental impacts and management strategies. This has included ongoing engagement with landowners with regards to potential impacts of contamination and other aspects.

Main Roads will continue to engage with directly impacted property owners, stakeholders and the wider community regarding the Proposal throughout the planning and development phase of the road planning process, subject to any statutory obligations including requirements arising from environmental approvals.

4 OBJECT AND PRINCIPLES OF THE EP ACT

4.1 Principles

Section 4A of the EP Act establishes the objectives and principles of the Act in accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2023a). This section describes how each of the five principles of the EP Act have been applied to the Proposal (Table 4.1).

Table 4.1: Object and principles of the EP Act

Decision making authority	Relevant legislation
1. The precautionary principle Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and b. an assessment of the risk-weighted consequences of various options.	Main Roads has used existing environmental data and commissioned field studies within and adjacent to the DE to assess the environmental values and potential impacts of the Proposal, including: – Flora and vegetation – Terrestrial fauna – Contamination – Noise – Heritage values. Consultation has also been undertaken with stakeholders, with further consultation planned. Information gathered during these studies was used to inform the environmental impact assessment and has reduced the uncertainty surrounding the prediction of impacts for the assessment. Potential impacts have been identified and described under each key environmental factor. Mitigation and management measures have been proposed to ensure impacts are minimised as far as practicable. Main Roads has planned and designed the Proposal to avoid, where possible, serious or irreversible damage to the environment. The design characteristics take engineering, environmental and social investigations and stakeholder consultation into account. This will continue to be considered as the detail design is produced.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal will ensure the health, diversity and productivity of the environment by avoiding as much remnant vegetation and fauna habitat as possible. Similarly, Main Roads has undertaken studies to comprehensively understand ground contamination in the area, surface water flows and groundwater. The project design avoids or minimises impacts to these factors, ensuring environmental values in this area will be maintained for future generations.

Decision making authority	Relevant legislation
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integration should be a fundamental consideration.	Studies have been used to identify and confirm the range and condition of environmental factors within and surrounding the Proposal. There are patches of biological diversity and ecological integrity within and adjacent to the Proposal. Main Roads has sought to preserve as much of the remnant biodiversity as possible by avoiding areas of native vegetation where practicable. Priority has been given to maintaining natural ecological and landscape processes such as surface water flows associated with the Spectacles.
4. Principles relating to improved valuation, pricing, and incentive mechanisms a. Environmental factors should be included in the valuation of assets and services. b. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. c. 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 waste. d. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors have been considered in the planning and design of the Proposal, and there has been (and will continue to be) a strong focus on reducing the direct and indirect impacts of the Proposal. Impacts on flora, vegetation and terrestrial fauna have been assessed and mitigation and management measures proposed. Main Roads accepts that the cost of the Proposal must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Proposal costs. The Proposal will be subject to a sustainability rating, which will assess the environmental, social and economic impacts of the Proposal, including its waste stream and the resources utilised for construction. The Infrastructure Sustainability (IS) rating scheme is designed such that goals are established for a Proposal, then the Proposal is assessed against the achievement of those goals.
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.	Management strategies will be implemented to ensure the generation of waste during the construction phase is minimised. All activities shall be carried out with the principles of cleaner production and waste minimisation. The Proposal will be subject to an IS rating, which will assess the environmental, social and economic impacts of the Proposal, including waste minimisation and discharges resulting from the Proposal. Waste will be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal. The Proposal design includes drainage designed to minimise discharge of contaminated water into the environment. Main Roads is using waste derived materials in road construction where possible to reduce the use of virgin materials and divert waste from landfill. Waste derived materials that could be used (subject to relevant approvals)

Decision making authority	Relevant legislation
	include crushed recycled concrete, crumbed rubber in bitumen and use of non-virgin imported fill.

Description of how the object of the EP Act has been considered:

The object of the EP Act is to protect the environment of the State, having regard to the EP Act principles. The Proposal's predicted outcomes have been considered in relation to the environmental principles and the EPA's environmental objectives for each key environmental factor.

Mitigation of environmental impacts from this Proposal have been assessed through a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design to avoid and minimise impacts; development and implementation of management measures to mitigate and manage environmental impacts during construction and operation. An Offset Strategy will also be developed to mitigate remaining significant residual impacts on relevant environmental factors.

Main Roads considers the measures undertaken to reduce the Proposal's environmental and social impacts and implementation of offsets, will ensure that the object of the EP Act has been considered satisfactorily.

4.2 Identification of Preliminary Key Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a proposal. The EPA has 14 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

Main Roads has assessed the environmental factors relevant to this Proposal, in accordance with the approach in the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2023a) and the EPA's Environmental Factors Guidelines and Environmental Factor Technical Guidance. The relevance of each factor to the Proposal is summarised and the significant environmental factors that require further consideration are identified in Table 4.2.

The preliminary key environmental factors identified as relevant to the Proposal include Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality, Inland Waters and Social Surroundings. These preliminary key environmental factors were confirmed in the EPA Chair's determination to assess this Proposal.

Table 4.2: EPA Environmental Factors and Objectives

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
Sea	Benthic communities and habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	Not relevant, no impacts to benthic habitats.	No
	Coastal processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	Not relevant, no impacts to coastal processes.	No
	Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	Not relevant, no impacts to marine environmental quality.	No

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
	Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	Not relevant, no impacts to marine fauna.	No
Land	Flora and vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction requires native vegetation clearing	Yes
	Landforms	To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.	Distinctive landforms are not present.	No
	Subterranean fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	As discussed in section 1.5.2, the Proposal occurs within calcareous and siliceous sands and calcarenite. Accordingly, the proposal is unlikely to impact upon geological habitats supporting subterranean fauna including calcretes; alluvial formations, paleochannel aquifers; fractured rock aquifers, and karst limestone (stygofauna); karst, channel iron deposits, banded iron formations, alluvium/colluviums in valley-fill areas, and weathered or fractured sandstone (troglofauna).	No
	Terrestrial environmental quality	To maintain the quality of land and soils so that environmental values are protected.	Although a Preliminary Site Investigation (PSI) identified risks associated with existing contamination and acid sulfate soils, these risks will be managed to maintain the quality of land and soils so that environmental values are protected. A Detailed Site Investigation (DSI), including an acid sulfate soils investigation has been undertaken to further the understanding of impacts to terrestrial environment quality. During construction, standard management controls will be implemented to avoid, mitigate and manage potential	No

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
			terrestrial environmental quality impacts.	
	Terrestrial fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in habitat clearing.	Yes
Water	Inland waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	Construction will result in impacts to Multiple Use Wetlands, but no direct impacts to Conservation Category of Resource Enhancement wetlands are expected. Potential indirect impacts have been considered through additional studies of wetland and hydrological regimes. Additional studies confirm that the proposed location of abstraction bores (production and dust suppression) will not impact significantly on the groundwater level at sensitive receptors.	No
Air	Air quality	To maintain air quality and minimise emissions so that environmental values are protected.	Localised air emissions will be generated during construction of the Proposal through plant and vehicles. However, these emissions will be temporary and offset by reduced traffic flow of existing vehicles who avoid the construction works.	No
	Greenhouse gas emissions	To minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable.	Greenhouse gas emissions will be generated during construction and operation of the Proposal. However, the Proposal's Scope 1 or Scope 2 greenhouse gas emissions are not predicted to exceed 100,000 tonnes of CO2-e of in any one year.	No
People	Social surroundings	To protect social surroundings from significant harm.	The Proposal is within a populated area with potential Aboriginal heritage disturbance, noise and amenity issues. However, the Proposal will be controlled to ensure there are no significant	No

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
			impacts to Social Surroundings.	
	Human health	To protect human health from significant harm.	No human health impacts expected. The Proposal will not produce radiation emissions.	No

5 PRELIMINARY KEY ENVIRONMENTAL FACTORS AND OBJECTIVES

5.1 Environmental factor and objective – flora and vegetation

5.1.1 EPA Objective

The EPA's objective for flora and vegetation is *'To protect flora and vegetation so that biological diversity and ecological integrity are maintained'* (EPA 2023a).

5.1.2 Relevant policy and guidelines

- Environmental Factor Guideline Flora and Vegetation (EPA 2016a).
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment. (EPA 2016b)
- Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20 (EPA 2013)
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations)
- Approved conservation advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (SCP) ecological community (Department of the Environment and Energy (DEE) 2019)
- Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the SCP ecological community (DEE 2016b)
- Survey Guidelines for Australia's Threatened Orchids: Guidelines for Detecting Orchids Listed as "Threatened" Under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment (DoE 2013a).
- WA Environmental Offsets Policy (Government of Western Australia (GoWA) 2011)
- WA Environmental Offsets Guidelines (GoWA 2014)
- Environmental offsets metric: Quantifying environmental offsets in Western Australia (DWER 2021a).

5.1.3 Receiving environment

5.1.3.1 Surveys and studies

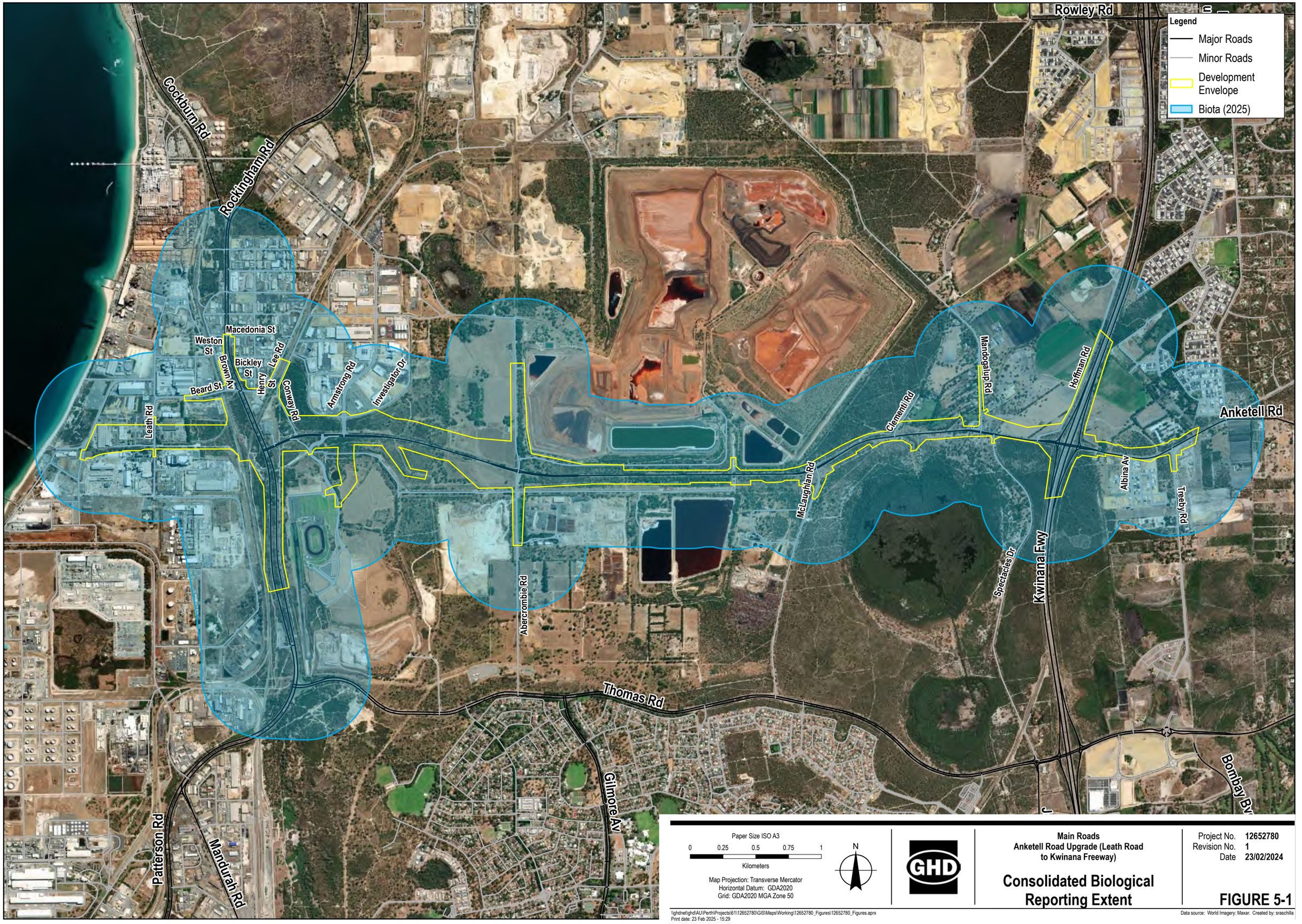
Main Roads has commissioned a number of studies to gain an understanding of the flora and vegetation values within and surrounding the Proposal area. These have included reconnaissance, detailed and targeted vegetation and flora surveys undertaken in accordance with relevant EPA guidance.

Vegetation and flora surveys relevant to the Proposal are outlined in Table 5.1. Biota (2025) has consolidated the results of vegetation and flora surveys relevant to the Proposal into a singular report, as detailed in Table 5.1. The extent of the most recent biological survey is shown on Figure 5-1.

Table 5.1: Summary of flora and vegetation surveys conducted within the DE

Survey / Report	Details
Anketell Rd Upgrade – Consolidated Biological Report (Biota 2025) (Appendix 1)	Scope: Consolidation of biological surveys conducted from 2020 to 2024, for the proposed Anketell Road Upgrade. The report provides a comprehensive biological survey report for the entire DE and immediate surrounds. Detailed flora and vegetation surveys including targeted significant flora searches, fine scale vegetation mapping, TEC assessment and TEC/PEC mapping. The surveys assessed the vegetation (native and non-native) values of the DE including the type, condition and extent through detailed quadrat and relevé sampling. Floristic analyses were completed to validate vegetation unit classification and mapping, and determine the presence and extent of significant vegetation, including TECs and PECs. Significant flora individuals and populations were identified through on-ground targeted systematic searches. Multiple targeted surveys were completed for Threatened orchid species *Caladenia huegelii, Diuris micrantha, Diuris purdiei* and *Drakaea elastica*. Survey dates: 222 person days between October 2020 and October 2024. Survey area: The survey area covers the entirety of the Anketell Road Upgrade referral boundary. The report also covers a Contextual area (500 m buffer around the survey area) and a Study area (5 km buffer around the survey area). Report date: February 2025 **Anketell Road Planning Study Biological Survey (Biota 2022)** Scope: Quadrat sampling and resampling, Spring Flora Targeted Searches and Winter Orchid Targeted Searches. Survey date: 92 total in person days from 22 September 2020 to 25 June 2021 **Westport Freight Road Additional Biological Survey (Biota 2023)** Scope: Quadrat sampling and resampling, Spring Flora Targeted Searches and Winter Orchid Targeted Searches. Survey date: 62 total in person days from 10 August 2022 to 22 September 2022 **Westport Last Mile Area Biological Survey – WSP Commissioned (Biota 2024c)** Scope: Quadrat sampling, Spring Flora Targeted Searches and Winter Orchid Targeted Searches. Survey date: 33 total person days from 26 July 2023 to 16 November 2023 **Anketell Road Additional *Caladenia huegelii* Targeted Survey (Biota 2024d)** Scope: Spring Flora Targeted Searches Survey date: 5 in person days from18 to 22 September 2022 **Rockingham Road Biological Survey (Biota 2024e)** Scope: Quadrat sampling, Spring Flora Targeted Searches and Winter Orchid Targeted Searches. Survey date: 30 total person days from 26 July 2023 to 9 November 2023 **Priority Flora Species Contextual/Additional Searches (Biota 2024a)** Scope: Targeted flora survey for Priority species *Hibbertia leptotheca*, *Pimelea calcicola* and *Eucalyptus foecunda* subsp. *foecunda*. Survey date: Two person days in spring 2024

Survey / Report	Details
Assessment of FCT26a Threatened Ecological Community (Umwelt 2025) (Appendix 2)	Scope: Review the listing of *Melaleuca huegelii – Melaleuca systena* shrublands on limestone ridges TEC and conduct a field survey to verify the occurrence, condition and boundary of the TEC. patch identified by the DBCA listing and by Biota (2025). The report (Umwelt 2025) documents methods and results of the desktop review and field survey. Survey dates: 21st of November 2024 Survey area: Polygon including the location of Floristic Community Type (FCT) 26b as mapped by Biota (2025), as well as the surrounding vegetation. Covers an area of approximately 6.3 ha, including the 1.96 ha of FCT 26b mapped occurrence. Report date: January 2025 (Draft)



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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Consolidated Biological Reporting Extent

Project No. **12652780**
Revision No. **1**
Date **23/02/2024**

FIGURE 5-1

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5.1.3.2 Vegetation

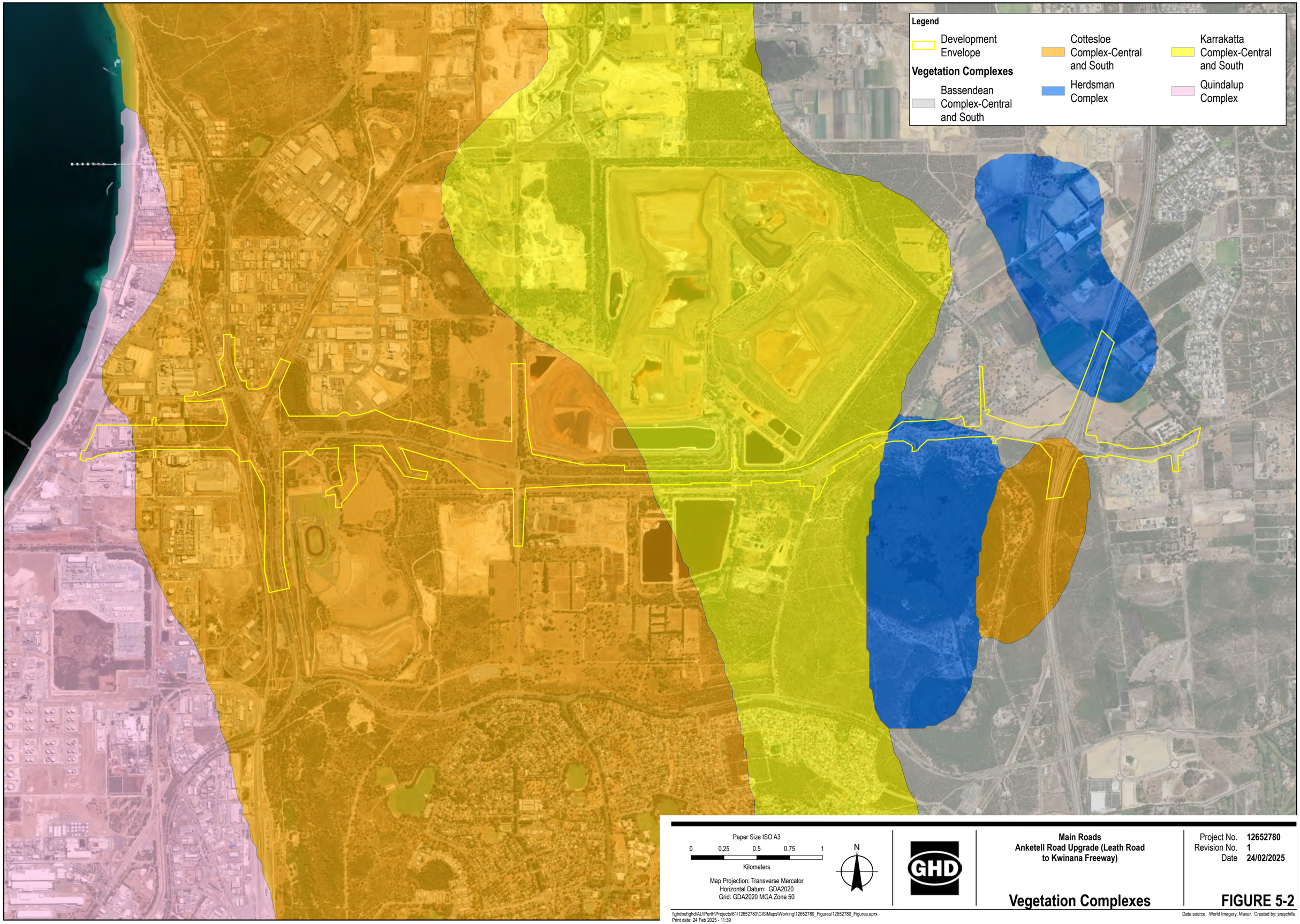
5.1.3.2.1 Broad scale mapping

Broad scale (1:250,000) pre-European vegetation mapping (Beard 1979) indicates the DE intersects five vegetation associations including:

- Medium woodland; tuart & jarrah (association 6)
- Sedgeland; reed swamps, occasionally with heath (association 51)
- Medium woodland; tuart (association 998)
- Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina (association 1001)
- Shrublands; scrub-heath on the SCP (association 3048).

Regional vegetation has been mapped by Heddle et al. (1980) based on major geomorphic units on the SCP. The DE intersects five vegetation complexes (Figure 5-2):

- Cottesloe Complex-Central and South – Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops. This complex covers 155.00 ha of the DE (east of Leath Road, and south of the Anketell Road/Kwinana Freeway intersection), and intersects 73.16 ha of native vegetation
- Bassendean Complex-Central and South – Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - Banksia species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* (Jarrah) to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth. This complex covers 26.38 ha of the DE (eastern extent of the DE, east of Mandogalup Road), and intersects 3.60 ha of native vegetation
- Karrakatta Complex-Central and South – Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - Banksia species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River. This complex covers 21.02 ha of the DE (west of Clementi Road), and intersects 13.49 ha of native vegetation
- Herdsman Complex – Sedgelands and fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca* species. This complex covers 14.99 ha of the DE (between Clementi Road and Mandogalup Road, and the northern extent of Kwinana Freeway), and intersects 1.17 ha of native vegetation
- Quindalup Complex – Coastal dune complex consisting mainly of two alliances, the strand and fore-dune alliance, and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* (Rottnest Teatree) - *Callitris preissii* (Rottnest Island Pine), the closed scrub of *Acacia rostellifera* (Summer-scented Wattle) and the low closed *Agonis flexuosa* (Peppermint) forest of Geographe Bay. This complex covers 7.44 ha of the DE (western corner of the DE, west of Leath Road), and intersects 0.81 ha of native vegetation.



Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Complexes

Project No. **12652780**
Revision No. **1**
Date **24/02/2025**

FIGURE 5-2

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5.1.3.2.2 Types and condition

The Biota (2025) report assessed the vegetation values of the DE including the type, condition, and extent of native vegetation (Table 5.2). The distribution of vegetation types within the DE is shown on Figure 5-3 and vegetation condition on Figure 5-4.

The DE contains 92.22 ha (41.0%) of native vegetation mapped across 21 intact vegetation units, and 50.35 ha (22.4%) of non-native/modified vegetation (Biota 2025). The remainder of the DE is cleared (82.26 ha; 36.6%).

The condition of the native vegetation within the DE ranged from Very Good to Excellent condition to Cleared condition (Biota 2025). No patches of vegetation within the DE were considered to have a Pristine or Excellent condition ranking. Numerous weed species were encountered across the DE.

Table 5.2: Vegetation types and condition within the DE

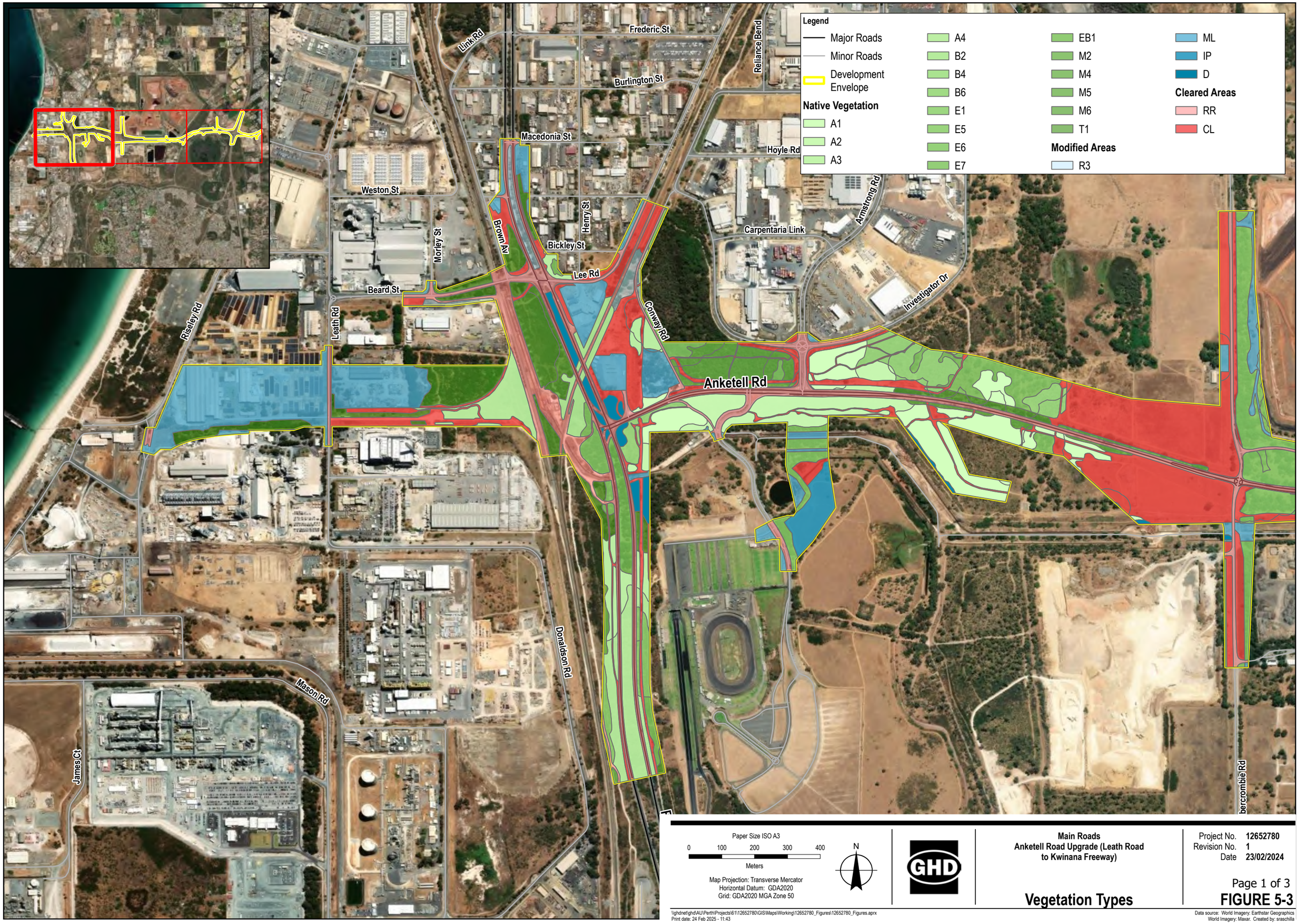
Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
Native Vegetation				
A1	*Acacia rostellifera, (A. saligna*) tall shrubland to tall open scrubland over *Xanthorrhoea preissii* very open grass trees over *Hibbertia hypericoides* subsp. *hypericoides, Grevillea vestita* subsp. *vestita* low open shrubland over *Clematis linearifolia, *Asparagus asparagoides* scattered climbing herbs over **Ehrharta calycina* open grassland over **Euphorbia spp., *Lysimachia arvensis* open herbland	8.927	Very Good	1.409
			Good to Very Good	4.835
			Good	0.390
			Degraded to Good	0.200
			Degraded	2.094
A2	*Banksia attenuata, B. menziesii, Eucalyptus marginata* subsp. marginata isolated low trees over *Acacia rostellifera, (A. pulchella)* tall open scrub over *Xanthorrhoea preissii, Macrozamia riedlei* scattered grass trees and cycads over *Hibbertia hypericoides* subsp. *hypericoides* low open shrubland over scattered *Conostylis aculeata* subsp. *preissii* herbs over **Ehrharta calycina, *Briza maxima, *Bromus diandrus* open grassland	5.390	Very Good	0.549
			Good to Very Good	0.351
			Good	4.213
			Degraded	0.278
A3	*Acacia rostellifera* tall shrubland to tall open scrub over *Xanthorrhoea preissii* scattered grass trees over *Austrostipa* spp. scattered tussock grasses over **Ehrharta longiflora*, **Bromus diandrus* (**Cenchrus setaceus*) open bunch grassland over *Acanthocarpus preissii*, **Euphorbia terracina*, **Sonchus oleraceus* open herbland.	2.400	Very Good	0.527
			Good	0.316
			Degraded	1.557
A4	*Acacia saligna* tall shrubland over *Xanthorrhoea preissii* tall grass trees over **Hyparrhenia hirta* open tussock grassland over **Eragrostis curvula, *Lagurus ovatus* open bunch grassland over **Oxalis pes-caprae, Sixalix atropurpurea* open herbland.	6.280	Good	3.225
			Degraded	0.774
			Completely Degraded	2.281

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
B2	*Banksia menziesii, (B. attenuata)* low woodland over *Kunzea glabrescens* scattered to tall open shrubland over *Xanthorrhoea preissii, (X. brunonis)* open grass trees over *Macrozamia riedlei* scattered cycads over *Hibbertia hypericoides* subsp. *hypericoides, Acacia pulchella* var. *pulchella* low to low open shrubland over *Conostylis aculeata* subsp. *aculeata* scattered to very open herbland over **Ehrharta calycina* very open grassland	6.833	Very Good to Excellent	1.119
			Very Good	0.344
			Good to Very Good	2.163
			Good	2.741
			Degraded	0.389
			Completely Degraded	0.077
B3	*Banksia menziesii, B. ilicifolia, (B. attenuata)* low to low open woodland over *Kunzea glabrescens* tall shrubland over occasional *Xanthorrhoea* spp. *scattered grass trees over Scholtzia involucrata* scattered low shrubs over *Dasypogon bromeliifolius, Phlebocarya ciliata* scattered herbland over **Briza maxima, *Ehrharta calycina, *E. longiflora* very open grassland	0.527	Good	0.359
			Degraded to Good	0.168
B4	*Banksia attenuata* low woodland over *Allocasuarina humilis* scattered shrubs with *Xanthorrhoea preissii (Macrozamia riedlei)* open grass trees and cycads over *Hibbertia hypericoides* subsp. *hypericoides* low open shrubland over *Mesomelaena pseudostygia* scattered sedges over mixed scattered herbs and **Ehrharta calycina, *Bromus diandrus* very open introduced grassland	4.223	Very Good	0.959
			Good to Very Good	0.379
			Good	0.745
			Degraded to Good	0.058
			Degraded	2.056
			Completely Degraded	0.026
B5	*Banksia sessilis* var. *cygnorum (Melaleuca huegelii subsp. huegelii)* tall open shrubland over *Melaleuca systena* scattered shrubs over **Ehrharta longiflora, *E. calycina, *Bromus diandrus, *Avena barbata* bunched grassland over **Trifolium campestre var. campestre, *Euphorbia terracina, *E. peplus, *Sonchus oleraceus* open herbland	3.791	Good	0.741
			Degraded to Completely Degraded	0.532
			Completely Degraded	2.518
B6	*Banksia sessilis* var. *sessilis*, *Acacia saligna, Acacia cyclops* shrubland to tall open shrubland over Acacia truncata scattered low shrubs over **Cenchrus setaceus, Austrostipa flavescens* very open tussock grassland over **Bromus diandrus* very open bunch grassland over **Euphorbia terracina, *Pelargonium capitatum, *Asparagus asparagoides, *Asphodelus fistulosus* very open herbland	1.227	Good	0.919
			Degraded	0.308

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
E1	*Eucalyptus gomphocephala* woodland to open forest with occasional emergent *Eucalyptus marginata* subsp. *marginata* over *Banksia attenuata, B. menziesii* low open woodland over *Acacia rostellifera, (Allocasuarina fraseriana, Kunzea glabrescens)* tall open shrubland over *Xanthorrhoea preissii* very open grass trees over **Ehrharta longiflora, *E. calycina, *Bromus diandrus, *Avena barbata* grassland to closed grassland	30.775	Very Good	4.964
			Good to Very Good	0.031
			Good	12.874
			Degraded to Good	1.639
			Degraded	7.177
			Completely Degraded	4.090
E5	*Eucalyptus decipiens* low open woodland over *Banksia sessilis* var. *sessilis* tall open shrubland *Acacia pulchella* var. *glaberrima, Hardenbergia comptoniana* shrubland over **Ehrharta calycina, *Ehrharta longiflora, *Bromus diandrus, *Lagurus ovatus, *Lolium perenne* x *rigidum* very open bunch grassland over **Euphorbia terracina, *Euphorbia peplus* very open herbland	0.387	Good	0.387
E6	*Eucalyptus gomphocephala* open forest over *Acacia rostellifera* tall open shrubland over *Xanthorrhoea preissii* scattered grass trees over **Ehrharta calycina, *E. longiflora, *Bromus diandrus, *Avena barbata* open bunch grassland over **Euphorbia terracina, *Euphorbia peplus, *Oxalis pes-caprae* open herbland	1.300	Degraded	1.300
E7	*Eucalyptus foecunda* subsp. *foecunda* low woodland over *Spyridium globulosum, Acacia rostellifera* tall shrubland over *Banksia sessilis* var. *sessilis* scattered shrubs over *Hibbertia hypericoides* subsp. *hypericoides* scattered low shrubs over **Ehrharta longiflora, *Briza maxima* very open bunch grassland over **Euphorbia peplus, *Asparagus asparagoides* very open herbland	0.240	Very Good	0.182
			Degraded to Good	0.058
EB1	*Eucalyptus marginata* subsp. *marginata, Banksia menziesii, B. attenuata* low open forest to open forest over *Kunzea glabrescens, Acacia cyclops* tall open shrubland over *Xanthorrhoea preissii, X. brunonis* subsp. *brunonis* open grass trees over *Hibbertia hypericoides subsp. hypericoides, Acacia pulchella* low open shrubland over **Ehrharta calycina* open grassland	7.570	Very Good	2.221
			Good to Very Good	0.190
			Good	2.561
			Degraded	2.541
			Completely Degraded	0.056
K1	*Kunzea glabrescens* tall shrubland to tall open scrub over very scattered *Xanthorrhoea preissii, (X. brunonis)* grass trees over *Melaleuca teretifolia*, *Astartea scoparia*, *Scholtzia involucrata* scattered open shrubland over occasional *Dasypogon bromeliifolius, Phlebocarya ciliata* scattered herbs	0.919	Degraded	0.609
			Completely Degraded	0.311

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
	over **Ehrharta longiflora, *Vulpia myuros, *Bromus diandrus, *Avena barbata* scattered grasses			
M1	*Melaleuca preissiana* low woodland to closed forest over *Astartea scoparia* tall open shrubland to tall open scrub over **Ehrharta longiflora* open grassland.	0.003	Good	0.003
M2	*Melaleuca lanceolata* low woodland to low open forest over **Ehrharta calycina, *E. longiflora* open grassland *over *Asparagus asparagoides* scattered herbs	1.812	Very Good	0.873
			Degraded	0.39
M4	*Melaleuca systena, Melaleuca huegelii* subsp. *huegelii* shrubland over *Xanthorrhoea preissii* scattered grass trees and *Spyridium globulosum, Templetonia retusa, Trymalium ledifolium* var. ledifolium, *Hardenbergia comptoniana, Acacia lasiocarpa* var. lasiocarpa, A. rostellifera*, A. truncata, Grevillea preissii, Hibbertia hypericoides* subsp. *hypericoides, H. aurea* low open shrubland over *Lepidosperma calcicole* scattered sedges over **Lolium perenne, *Avena barbata, *Bromus diandrus, *Lagurus ovatus, *Ehrharta longiflora* bunch grassland over *Opercularia vaginata, Lomandra maritima, Phyllanthus calycinus [Lysiandra calycina], *Asparagus asparagoides, *Trifolium campestre* var. *campestre* very open herbland	2.499	Very Good	2.209
			Completely Degraded	0.290
M5	*Melaleuca huegelii* subsp. *huegelii* tall open scrub over *Acacia rostellifera, Spyridium globulosum* shrubland over *Austrostipa elegantissima, A. flavescens* scattered bunch grasses over **Avena barbata, *Avena barbata, *Bromus diandrus, *Ehrharta longiflora* open bunch grassland over **Asparagus asparagoides, *Euphorbia terracina, *Fumaria capreolata, *Sonchus oleraceus* open herbland	0.539	Good	0.539
M6	*Melaleuca systena, Acacia saligna* tall shrubland over *Spyridium globulosum, Templetonia retusa* open shrubland over *Acacia lasiocarpa* var. *lasiocarpa* low open shrubland over **Cenchrus setaceus* very open tussock grassland over *Lepidosperma calcicola* scattered sedges over **Avena barbata, *Lagurus ovatus* very open bunch grassland over **Romulea rosea* var. *australis* very open herbland	1.605	Completely Degraded	1.605
T1	**Leptospermum laevigatum* tall open shrubland over *Acacia saligna, Acacia cyclops, Alyxia buxifolia, Spyridium globulosum* open shrubland over **Cenchrus setaceus* scattered tussock grasses	4.975	Degraded	3.925
			Completely Degraded	1.050
Total native vegetation (ha)		**92.22 (41.0%)**		
Modified Areas (non-native)				
R2	Occasional *Eucalyptus rudis* subsp. *rudis, Corymbia calophylla* open woodland over **Callistemon citrinus* tall to tall open shrubland over *Calothamnus quadrifidus* subsp. *teretifolius, C. rupestris* shrubland to closed heath over **Ehrharta longiflora* very open grassland over **Euphorbia peplus, *Lotus subbiflorus, *Trifolium campestre* var. *campestre* very open herbland	5.656	Completely Degraded	5.656

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
R3	*Banksia menziesii* scattered low trees over *Jacksonia sternbergiana, Kunzea glabrescens* tall open shrubland over *Adenanthos cygnorum* subsp. *cygnorum* scattered shrubs over *Hibbertia hypericoides* subsp. *hypericoides, Styphelia conostephioides, Scholtzia involucrata* low open shrubland over *Dasypogon bromeliifolius, Phlebocarya ciliata, Lyginia imberbis* scattered perennial herbs with **Ursinia anthemoides* subsp. *anthemoides, *Carpobrotus edulis* very open introduced herbland	1.646	Very Good to Excellent	0.079
			Good	0.151
			Degraded	0.766
			Completely Degraded	0.650
ML	Commercial/Residential Mixed Land Use	27.226	Good	6.518
			Degraded	0.540
			Completely Degraded	20.169
D	Mosaic of highly modified degraded areas. Consists of a high proportion of introduced species, particularly grasses. Common species encountered in these areas were tussock grasslands of **Ehrharta calycina, *Bromus diandrus, *Lolium rigidum, *Cenchrus setaceus* and **Avena barbata,* and introduced herblands of typically **Euphorbia terracina, *Lupinus cosentinii* and **Foeniculum vulgare*	8.897	Good to Very Good	1.808
			Good	0.565
			Degraded to Good	0.356
			Degraded	1.300
			Completely Degraded	4.868
IP	Isolated Trees over Previously Cleared or Pasture. Typically consisted of acreage, exposed sands, previously cleared areas, and pasture with isolated remnant trees (either introduced, naturalised, or native)	6.922	Good to Very Good	0.731
			Degraded to Good	1.961
			Degraded	4.230
Total non-native vegetation (ha)		**50.35 (22.4%)**		
Cleared (non-native)				
CL	Cleared	46.020		
RR	Roads, rail infrastructure, sandtracks	36.241		
Total cleared areas (ha)		**82.26 (36.6%)**		



Paper Size ISO A3

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Types

Project No. **12652780**
Revision No. **1**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-3

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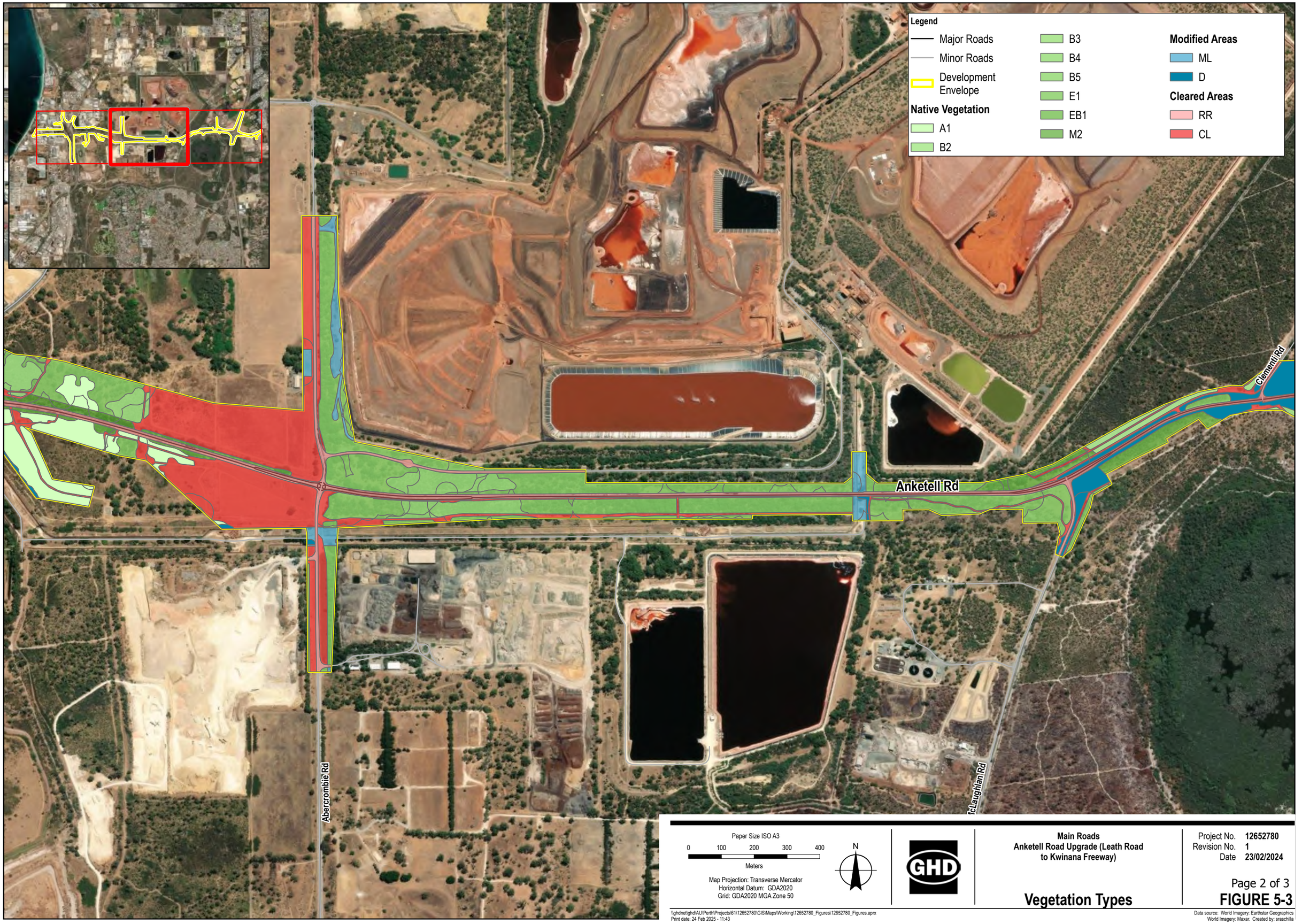

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Map Projection: Transverse Mercator
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Page 2 of 3
FIGURE 5-3

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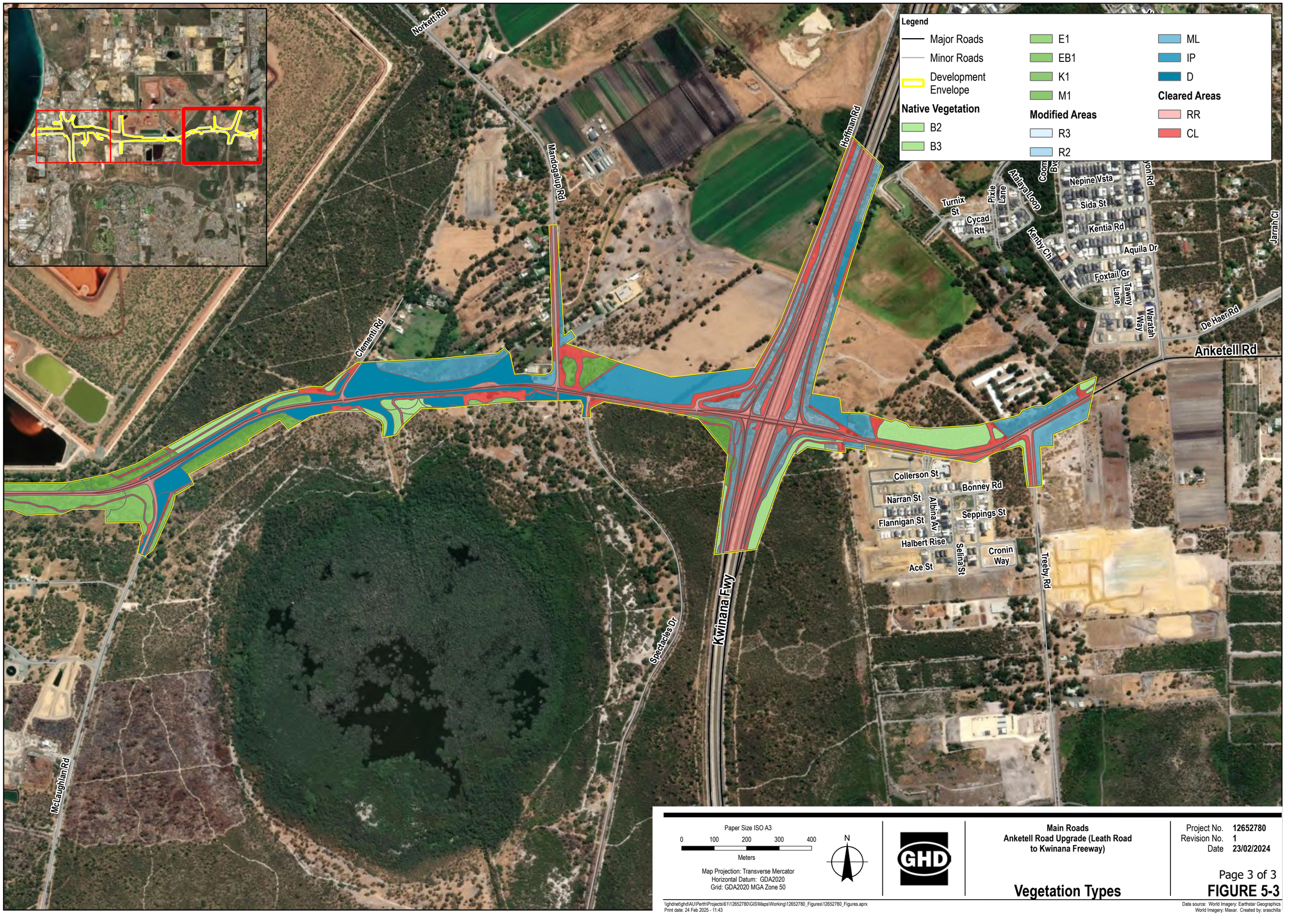

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Main Roads
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Vegetation Types

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FIGURE 5-3

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Data source: World Imagery: Earthstar Geographics
World Imagery: Maxar. Created by: sraschilla

Legend
- Major Roads
- Minor Roads
- Development Envelope

Vegetation Condition
- Very Good
- Good to Very Good
- Good
- Degraded to Good
- Degraded
- Completely Degraded

Link Rd
Frederic St
Reliance Bend
Bass Lane
Everette Way
Hope Valley R
Burlington St
McLaren Av
Bligh Lane
Macedonia St
Hoyle Rd
Weston St
Armstrong Rd
Henry St
Brown Av
Morley St
Carpentaria Link
Bickley St
Lee Rd
Investigator Dr
Beard St
Riseley Rd
Leath Rd
Conway Rd
Anketell Rd
Donaldson Rd
Mason Rd
James Ct
bercrombie Rd

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Condition

Project No. **12652780**
Revision No. **1**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-4

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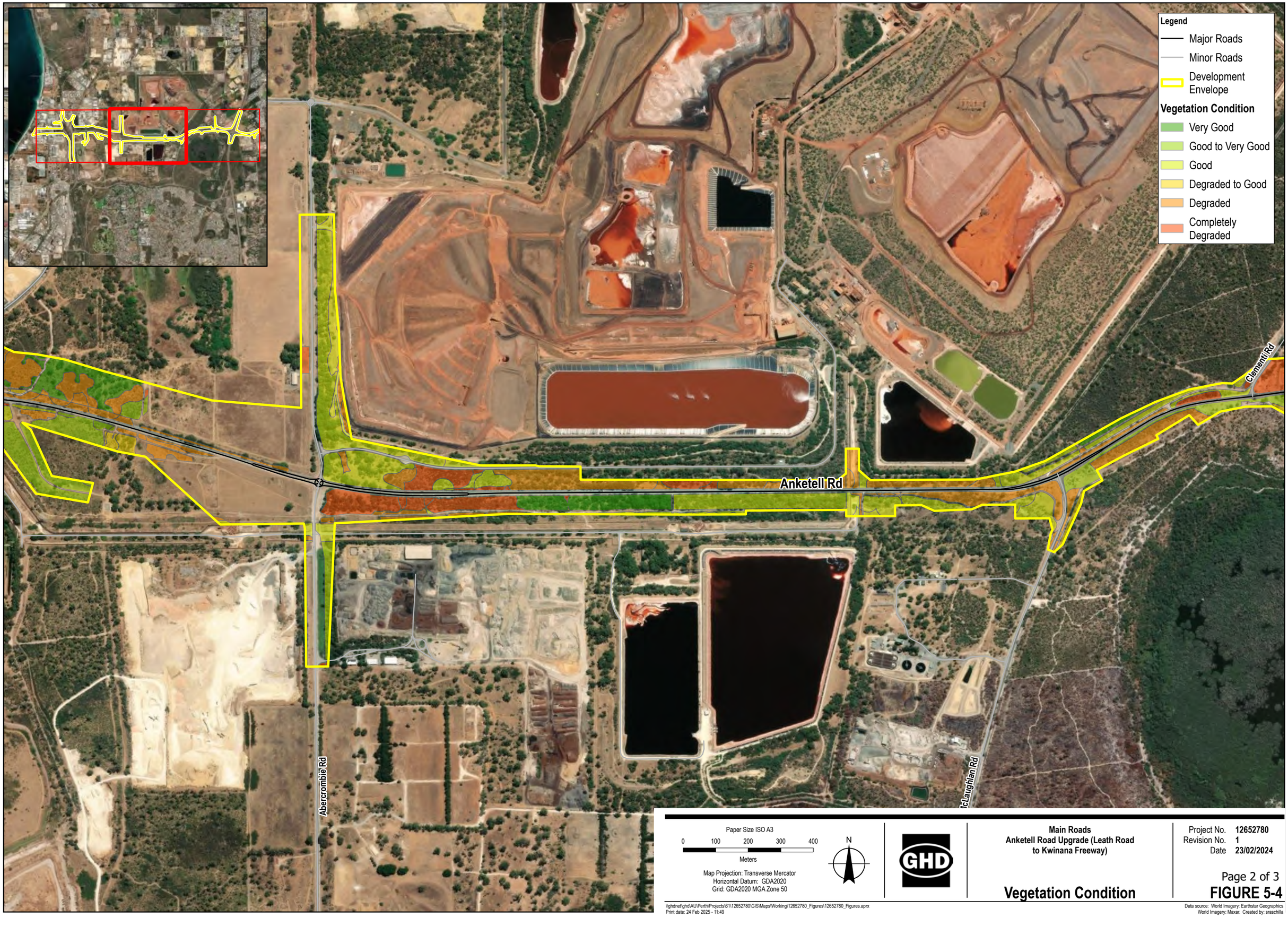

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

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FIGURE 5-4

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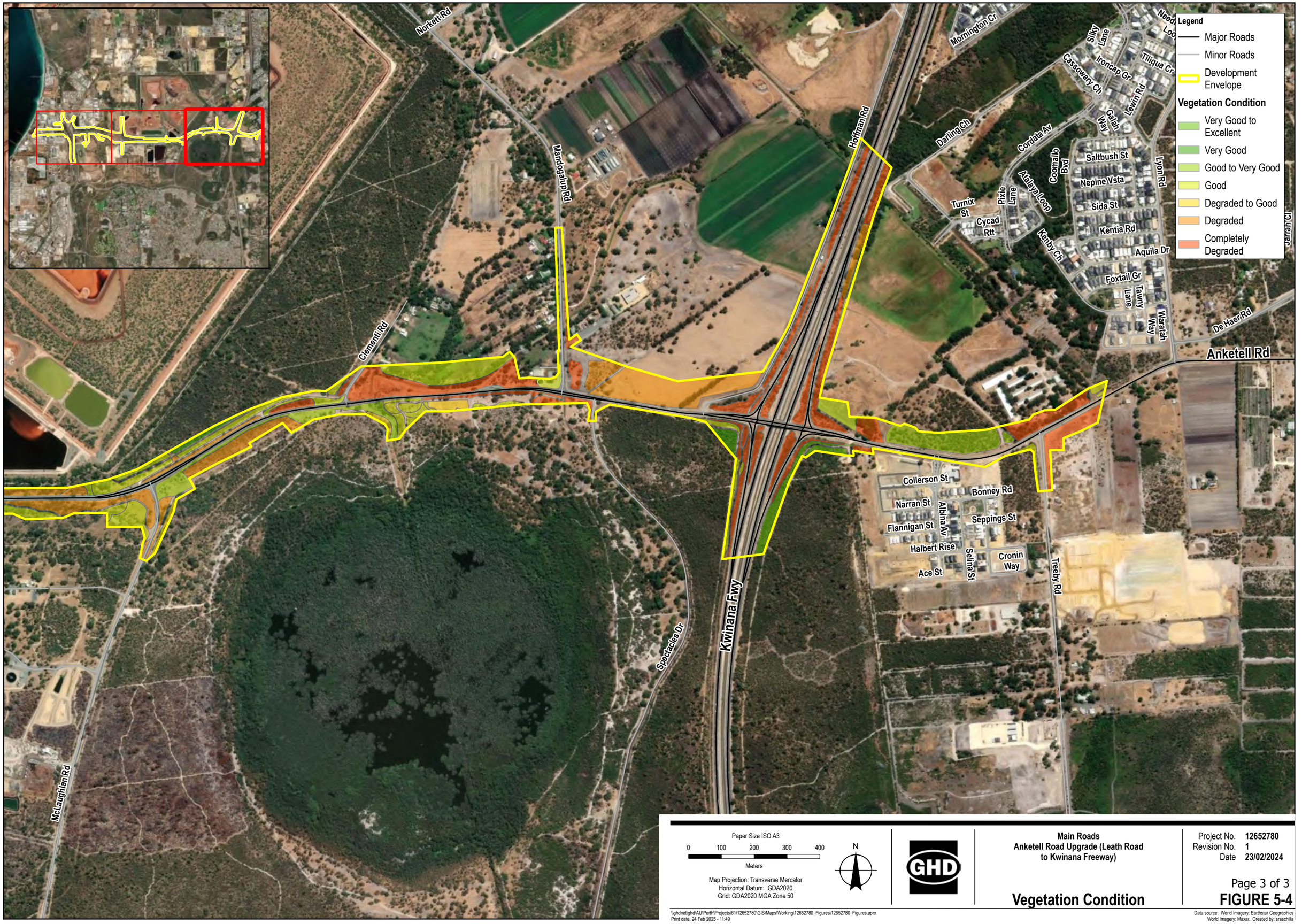

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Meters

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Main Roads
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FIGURE 5-4

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5.1.3.2.3 Significant vegetation

Desktop searches of the EPBC Act Protected Matters Search Tool (PMST) and DBCA Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) Database identified nine TECs and six PECS present or potentially present within a 5 km buffer of the DE. The Biota (2025) report identified three commonwealth TECs, one state TEC and three PECs occurring within the DE:

- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP TEC (EPBC Act: Critically Endangered)
- Banksia Woodlands of the SCP ecological community TEC (EPBC Act: Endangered)
- Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion TEC (EPBC Act: Critically Endangered)
- *Melaleuca huegelii – M. systena* shrublands of limestone ridges (FCT 26a as originally described in Gibson et al. 1994) TEC (BC Act: Critically Endangered)
- Banksia Woodlands of the SCP PEC (DBCA: Priority 3)
- Northern Spearwood Shrublands and Woodlands (FCT 24) PEC (DBCA: Priority 3)
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC (DBCA: Priority 3).

Note that the Tuart Woodlands and Forests of the SCP TEC has a buffer associated with tuart canopy, that overlaps Banksia Woodlands of the SCP TEC extents. TECs/PECs are mapped in Figure 5-5, Figure 5-6 and Figure 5-7.

The DE also contains vegetation associated with wetlands and potential groundwater dependent vegetation (Groundwater Dependent Ecosystem (GDE) type: phreatophytic vegetation) (Biota 2025; Stream 2025).

Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP TEC

The Tuart Woodlands and Forests of the SCP TEC occurs on the SCP in WA, from Jurien, approximately 200 km north of Perth, to the Sabina River, near Busselton, 225 km south of Perth (DEE 2016a). The community is strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. Currently the Tuart Woodlands and Forests of the SCP TEC occurs as a thin strip along the SCP. DEE (2016a) estimates the Tuart Woodlands and Forests of the SCP TEC area of occupancy as 17,070 ha as of 2015.

The primary defining feature of the community is the presence of *Eucalyptus gomphocephala* (Tuart) in the uppermost canopy, although this may co-occur with various other tree species. The ecological community varies in structure, with variable height and canopy closure across its range. The understorey is often relatively open, including many non-woody species from the Asteraceae, Cyperaceae, Restionaceae and Orchidaceae families as well as lilies (DEE 2016a).

Key threats to the Tuart Woodlands and Forests of the SCP TEC include land clearing, phytophthora dieback, novel biota, introduced fauna and flora, and anthropogenic greenhouse gas emissions (DEE 2016a). With many of the occurrences occurring within the greater Perth metropolitan area, the frequency of fires, impact of recreational users, weed invasion and incidence of illegal rubbish dumping are generally increased. These factors can all lead to degradation of vegetation and alteration of structure, species composition or loss of component taxa.

The Tuart Woodlands and Forests of the SCP TEC mapped by Biota (2025) within the DE, occurred within native vegetation types A1, A2, A3, E1, E6, EB1, B2, B3, B4, B5, M1, M2 and M4. Biota (2025) mapped

103.41 ha of this TEC in eleven remnant vegetation patches wholly, partially or immediately adjacent to the survey contextual area. Details on each TEC patch is provided in Table 5.3. The DE intersects eight remnant patches with an extent of 40.99 ha. A further nineteen patches were assessed, but did not meet the diagnostic criteria to be recognised as the TEC.

Table 5.3: Tuart Woodlands and Forests of the SCP TEC patch details

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
TT01	8.4	2.157	25.6	High	
TT02	0.9	0.984	95.5	High-Med	
TT03	29.5	6.032	20.5	High-Med	
TT04	6.3	1.162	18.3	High-Med	
TT05	18.7	11.264	60.3	High-Med	
TT06	35.7	16.850	47.2	High-Med	Intersects Bush Forever Site no. 268 and 269
TT07	5.7	0.591	10.3	Med-Low	Intersects Bush Forever Site no. 269
TT08 & TT09[1]	5.1	1.954	38.2	High-Med	
TT10	0.7	-	-	Med-Low	
TT11	3.0	-	-	High-Med	
Total		**40.99**			

[1] TEC patches were combined post-field assessment, but original patch numbering has been retained.

Banksia woodlands of the SCP TEC

The Banksia Woodlands of the SCP TEC is restricted to the SCP IBRA bioregion and immediately adjacent areas, including the Dandaragan Plateau, from Jurien Bay in the north, to Dunsborough in the south, and northwest on the Whicher and Darling escarpments. The community typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands (DEE 2016b).

A key diagnostic feature of this TEC is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The community is characterised by a high endemism and considerable localised variation in species composition across its range (DEE 2016b).

Key threats to the Banksia Woodlands of the SCP include land clearing, phytophthora dieback, novel biota, introduced fauna and anthropogenic greenhouse gas emissions (DEE 2016b). With many of the occurrences occurring within the greater Perth metropolitan area, the frequency of fires, impact of recreational users, weed invasion and incidence of illegal rubbish dumping are generally increased. These factors can all lead to degradation of vegetation and alteration of structure, species composition or loss of component taxa.

The Banksia Woodlands of the SCP TEC mapped by Biota (2025) within the DE, occurred within native vegetation types A2, E1, EB1, B2, B3 and B4. Biota (2025) mapped 148.60 ha of this TEC in nine remnant

vegetation patches wholly or partially within the survey contextual area. The DE intersects all nine patches with an extent of 14.56 ha (Table 5.4).

Table 5.4: Banksia Woodlands of the SCP TEC patch details

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
BT01	2.2	0.187	8.5	Very Good	
BT02	4.9	2.056	42.0	Good to Excellent	
BT03	76.1	1.198	1.6	Very Good to Excellent	Intersects Bush Forever Site no. 270
BT04	32.7	0.867	2.7	Good to Very Good	Intersects Bush Forever Site no. 269
BT05	159.6	2.490	1.6	Good to Very Good	Intersects Bush Forever Site no. 269
BT06	45.4	0.690	1.5	Good to Excellent	Intersects Bush Forever Site no. 268
BT07	5.6	3.454	61.7	Excellent	
BT08	3.1	3.020	97.4	Very Good to Excellent	
BT09	0.61	0.605	100	Good	
Total		**14.56**			

Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion TEC / *Melaleuca huegelii – Melaleuca systena* shrublands on limestone ridges (Gibson et al. 1994 type 26a)

Effective from 15 November 2023 the State-listed TEC *Melaleuca huegelii – Melaleuca systena* shrublands on limestone ridges was approved and listed as a Critically Endangered Commonwealth TEC under the EPBC Act. At the time of the approved conservation advice listing, this ecological community is synonymous with, and corresponds to, the Critically Endangered WA TEC *Melaleuca huegelii – M. systena* shrublands of limestone ridges (FCT 26a as originally described in Gibson et al. 1994) that is on the list of TECs, under the WA BC Act.

This TEC is largely restricted to massive limestone ridges within Yanchep and Neerabup National Parks. The community typically occurs on skeletal soil on ridge slopes and tops of ridges, and is dominated by *Melaleuca huegelii*, *M. systena* and *M.* aff. *systena* often over scattered limestone heath species such as *Banksia sessilis* and *Grevillea preissii* (Keighery et al. 2003).

Biota (2025) reports a single occurrence of this TEC (1.96 ha) within the DE situated north and south of Anketell Road, east of the Abercrombie Road intersection (existing within the mapped vegetation unit B5). The two small areas were identified to occur prior to the survey (Biota 2022) and were specifically targeted with three sampling quadrats. Biota (2025) states the mapped area is in a relatively Degraded condition and depauperate in understory species. The combined species recorded from the three quadrats included 33 introduced species, with only 13 native taxa recorded. Although the species recorded are typical of the Gibson et al (1994) community type 26a, PATN analysis of the site data against the 11 sites known to represent this TEC sampled on the SCP by Gibson et al (1994) shows very little similarity in terms of

vegetation composition. From the floristic analyses, these quadrats were assigned to FCT 24 (aff. 29a/30b) and FCT 24 (aff. 29a), reflecting the FCTs that were mapped for the surrounding vegetation.

The occurrence of the *Melaleuca huegelii – Melaleuca systena* shrublands on limestone ridges TEC is listed as a registered site for the TEC by DBCA (Luu and English 2005, Occurrence 75). Given the FCT analysis did not confirm the presence of this TEC, Main Roads commissioned Umwelt to undertake further work to verify the occurrence, condition and boundary of this TEC patch.

Umwelt (2025) concluded that the vegetation within a defined "Study Area" (including both the DBCA listed TEC and the 1.96ha area identified by Biota (2025)) does not currently support either the state BC Act listed *Melaleuca huegelii – Melaleuca systena* shrublands of limestone ridges TEC or the EPBC Act listed Honeymyrtle shrubland on limestone ridges of the SCP Bioregion TEC, in its current state. The assessment concluded that certain portions of the "Study Area" may have previously represented the TEC, whilst the remainder of the "Study Area" was unlikely to have ever represented the TEC.

Umwelt (2025) stated "The vegetation of the site is classified as Degraded due to a loss of vegetation structure and species diversity, with the vegetation impacted by previous clearing, grazing and displaying a high cover of aggressive weed species. The site is currently narrow and bounded by Anketell Road, Alcoa's Waste Residue Facility and a power line, significantly influencing its potential to be sustainable in the long term. Historical aerial imagery and available information on the site history indicates that the vegetation may have undergone regrowth and regeneration in the past (aided by restoration effort); however, there is no evidence of recent regeneration, and given the site has had many years to regenerate following the initial disturbance event, it is unlikely to regenerate in future in the absence of intensive ongoing management."

Following the review of Umwelt (2025) and receipt of independent expert advice, DBCA advised the occurrence at Anketell Road would be deleted from the DBCA TEC Database due to the highly degraded condition of the native understory and due to past attempts at revegetation appearing to be unsuccessful.

Based on the Umwelt (2025) study and following correspondence with DBCA it is concluded that the vegetation present within the DE does not support the BC Act listed *Melaleuca huegelii – Melaleuca systena* shrublands of limestone ridges TEC.

Banksia Woodlands of the Swan Coastal Plain PEC

The Banksia Woodlands of the SCP PEC canopy is most commonly dominated or co-dominated by Banksia attenuata and/or B. menziesii. Other Banksia species that can dominate in the community are B. prionotes or B. ilicifolia. It typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; it is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau and can occur in other less common scenarios (DBCA 2023)

The Banksia Woodlands of the SCP PEC is listed as Priority 3 by DBCA and is synonymous with the EPBC Act listed Banksia Woodlands of the SCP TEC. Biota (2025) mapped 148.60 ha of this PEC in nine remnant vegetation patches wholly or partially within the survey contextual area. There is 14.56 ha of the Banksia Woodlands of the SCP PEC within the DE, within native vegetation types A2, E1, EB1, B2, B3 and B4.

Northern Spearwood Shrublands and Woodlands PEC (FCT 24)

The Northern Spearwood Shrublands and Woodlands PEC is listed as Priority 3 by DBCA and can be a component of the Commonwealth Banksia Woodlands of the SCP TEC. FCT 24 is described as heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this group typically include *Banksia sessilis, Calothamnus quadrifidus*, and *Schoenus grandiflorus* (DBCA 2023).

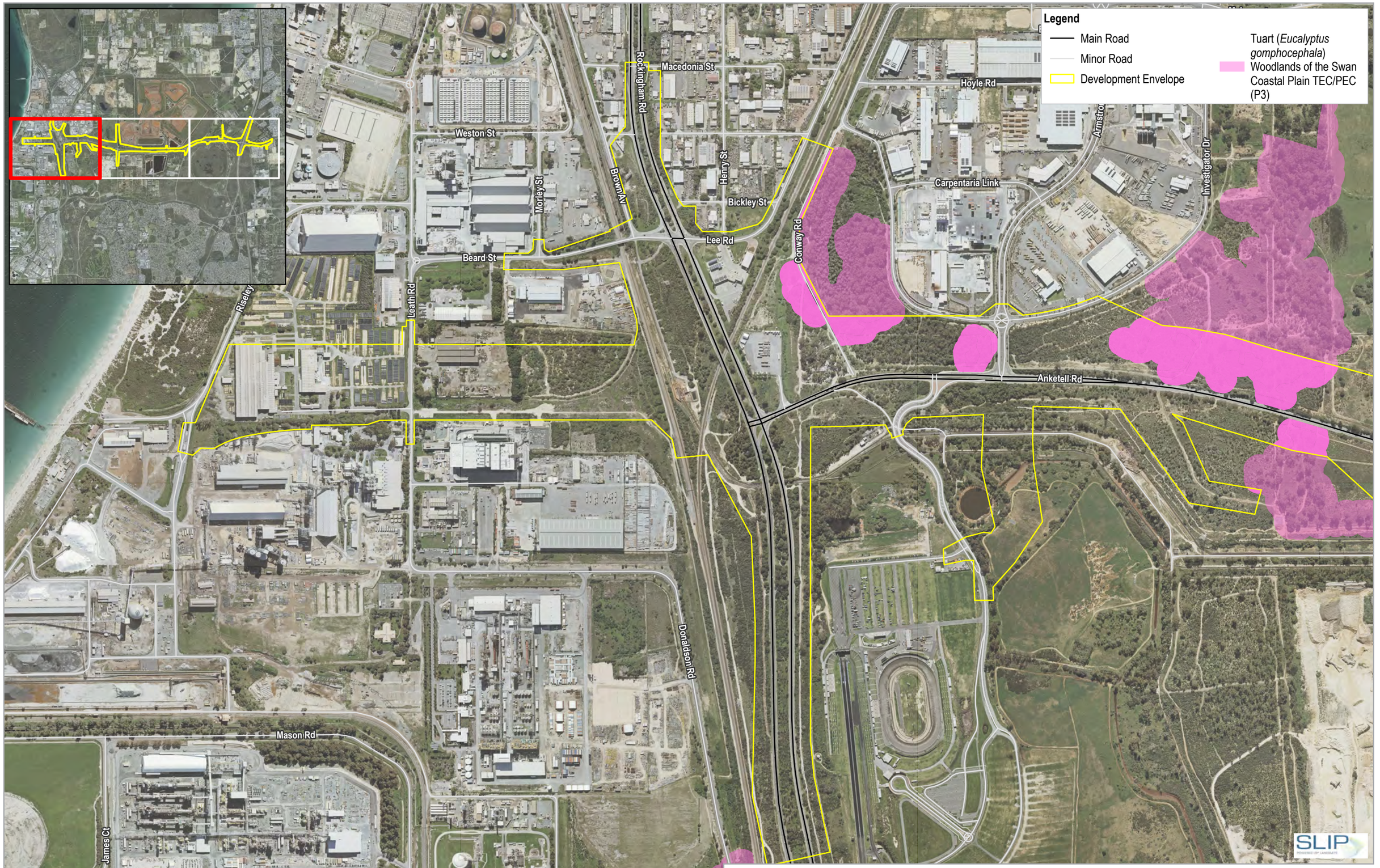
Biota (2025) mapped 185.00 ha of the Northern Spearwood Shrublands and Woodlands PEC in 13 remnant vegetation patches wholly or partially within the survey contextual area. There is 57.12 ha of the Northern Spearwood Shrublands and Woodlands PEC within the DE. This PEC was mapped within native vegetation types A1, A2, A3, A4, E1, E5, E7, EB1, B2, B3, B4, B5, B6, M2, M4, M5, M6 and T1, ranging from Cleared to Very Good condition.

Portions of the Northern Spearwood Shrublands and Woodlands PEC are also mapped as the Banksia Woodlands of the SCP TEC or Tuart Woodlands and Forests of the SCP TEC. The Northern Spearwood Shrublands and Woodlands PEC partially intersects Bush Forever Sites no. 268 and 269.

Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC

The Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC is mostly confined to Quindalup Dunes and Spearwood Dunes but can also occur on the Bassendean dunes and Pinjarra Plain. Tuart is the key upper canopy species although it may cooccur with *Agonis flexuosa*, *Banksia grandis*, *Eucalyptus marginata*; and less commonly, *Corymbia calophylla*, *B. menziesii* and *B. prionotes*. An understorey of native plants is typically present, which may include introduced grasses and herbs.

The Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC is listed as Priority 3 by DBCA and is synonymous with the EPBC Act listed Tuart Woodlands and Forests TEC. Biota (2025) mapped 103.41 ha of this PEC in eleven remnant vegetation patches wholly, partially or immediately adjacent to the survey contextual area. There is 40.99 ha of the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC within the DE, within native vegetation types A1, A2, A3, B2, B3, B4, B5, E1, EB1 and M2.



Paper Size ISO A3

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Meters

Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Tuart (*Eucalyptus gomphocephala*) Woodlands of the Swan Coastal Plain TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-5

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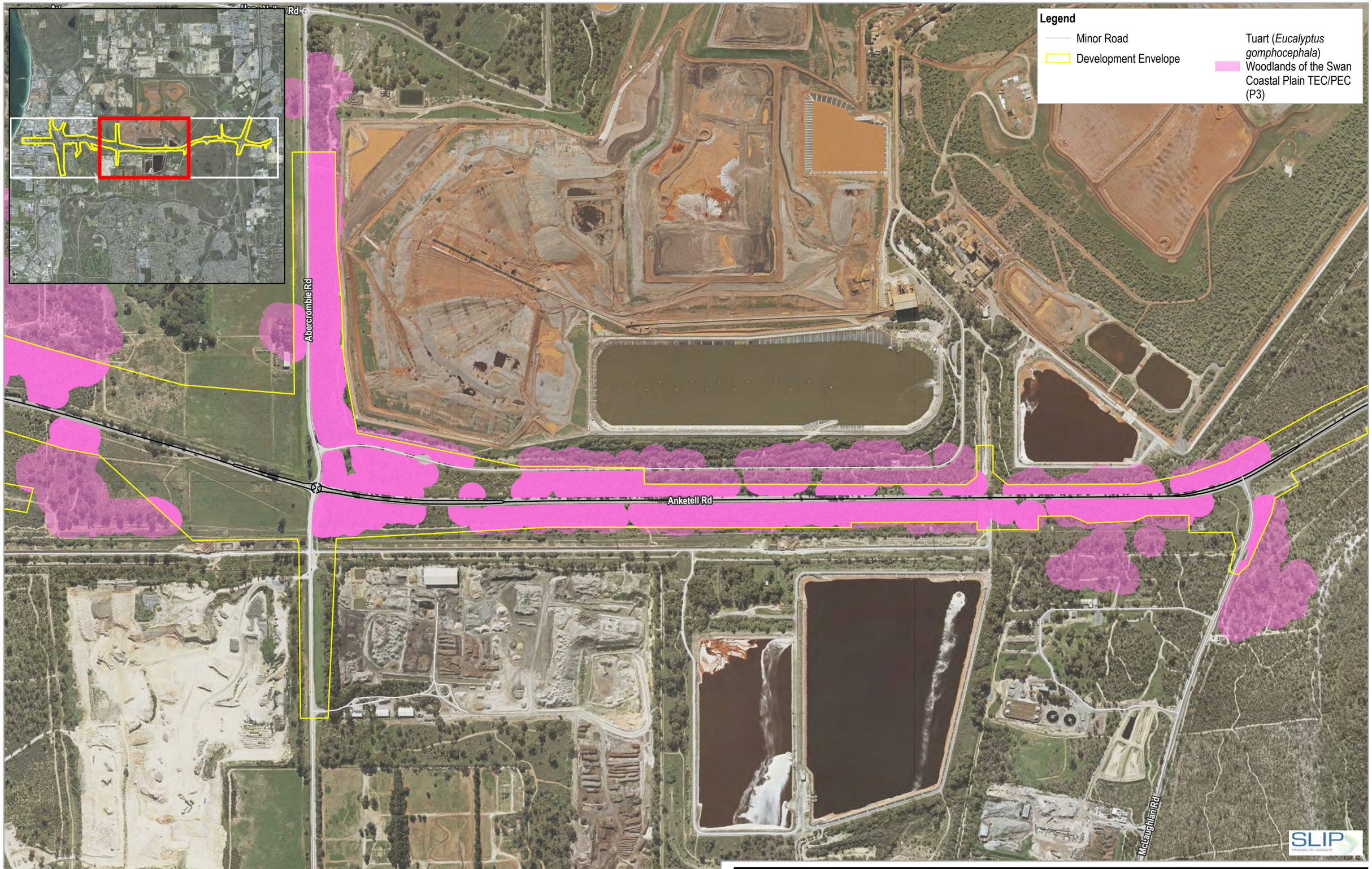

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Tuart (*Eucalyptus gomphocephala*) Woodlands of the Swan Coastal Plain TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-5

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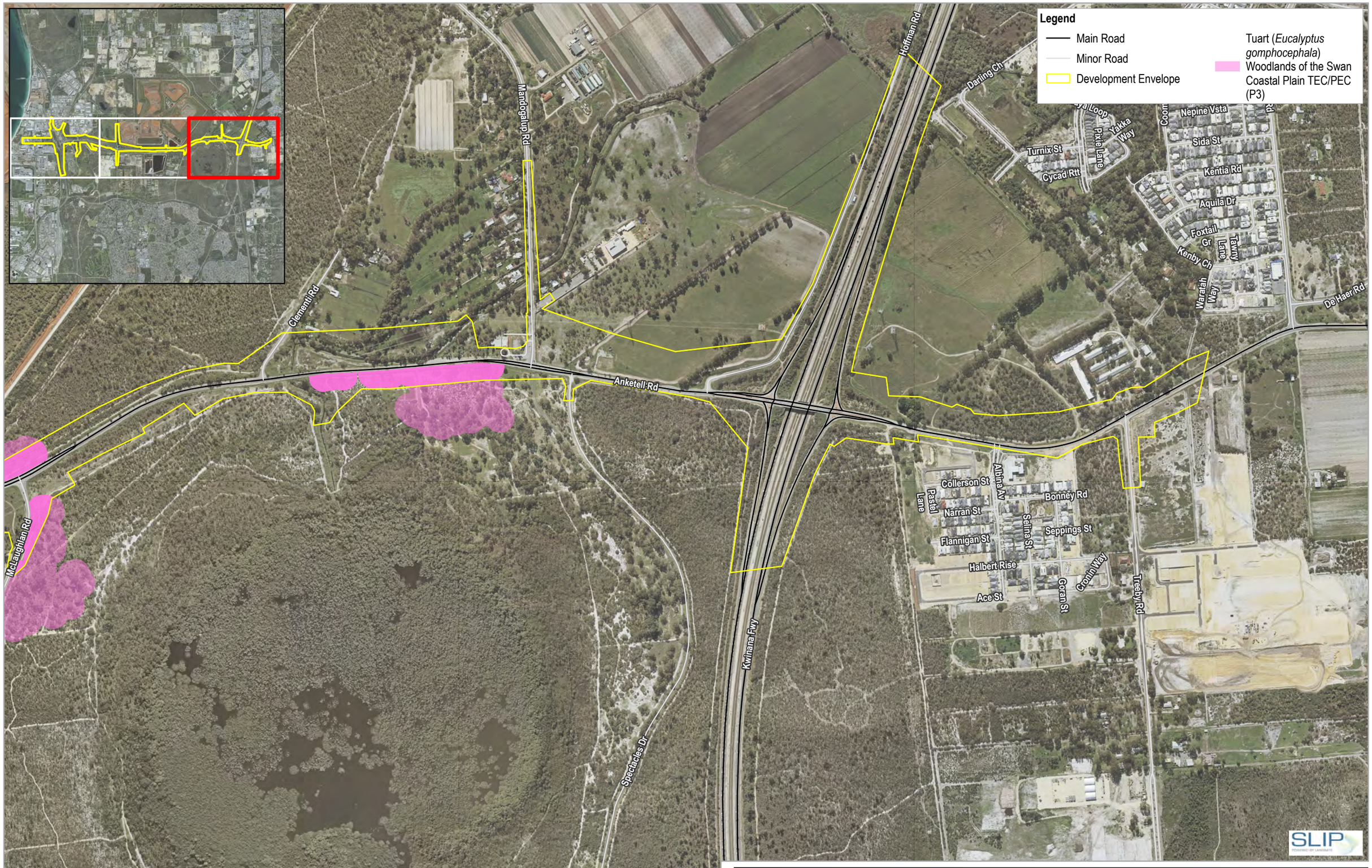

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Tuart (*Eucalyptus gomphocephala*) Woodlands of the Swan Coastal Plain TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-5

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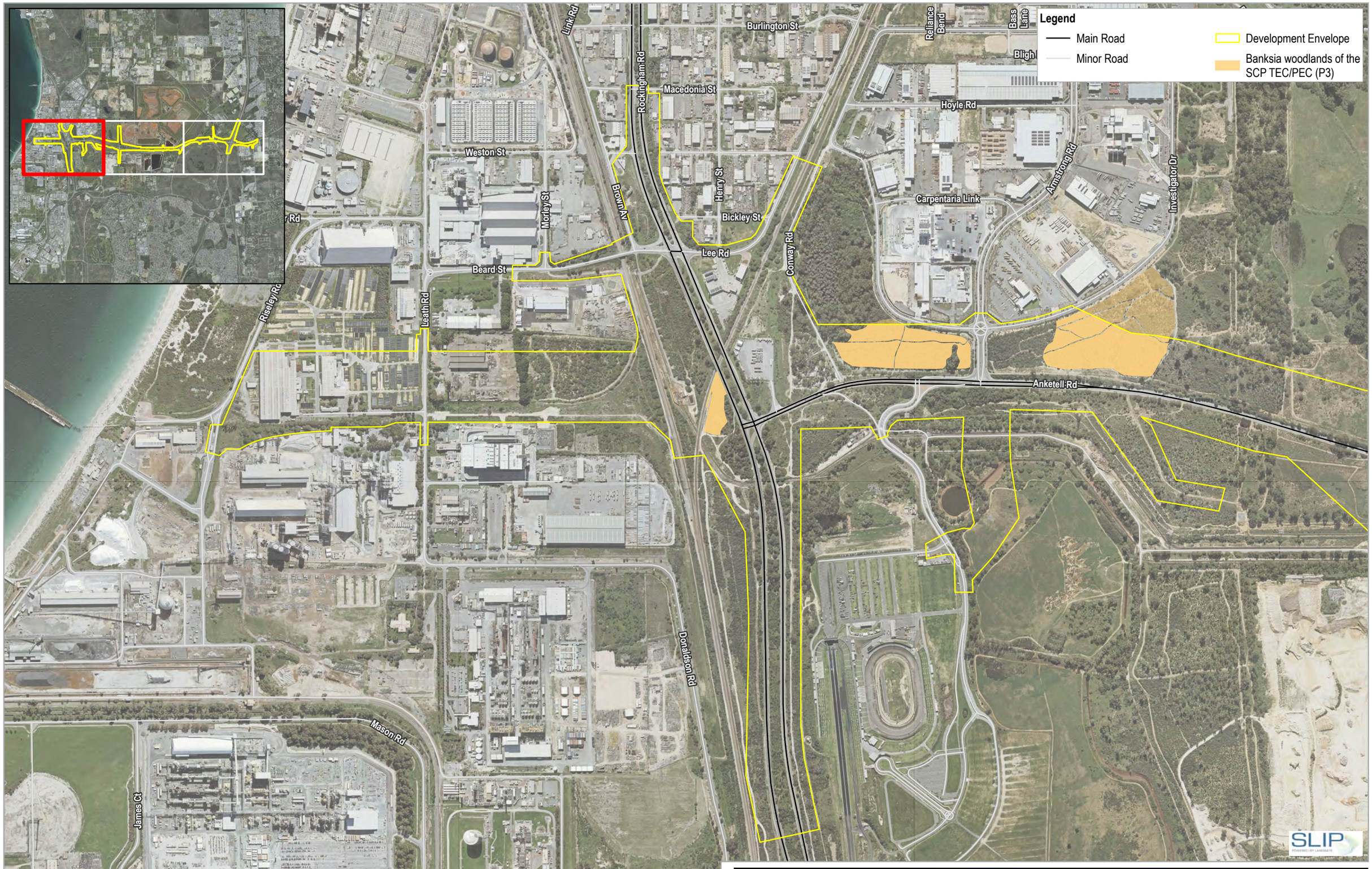

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Banksia woodlands of the SCP TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-6

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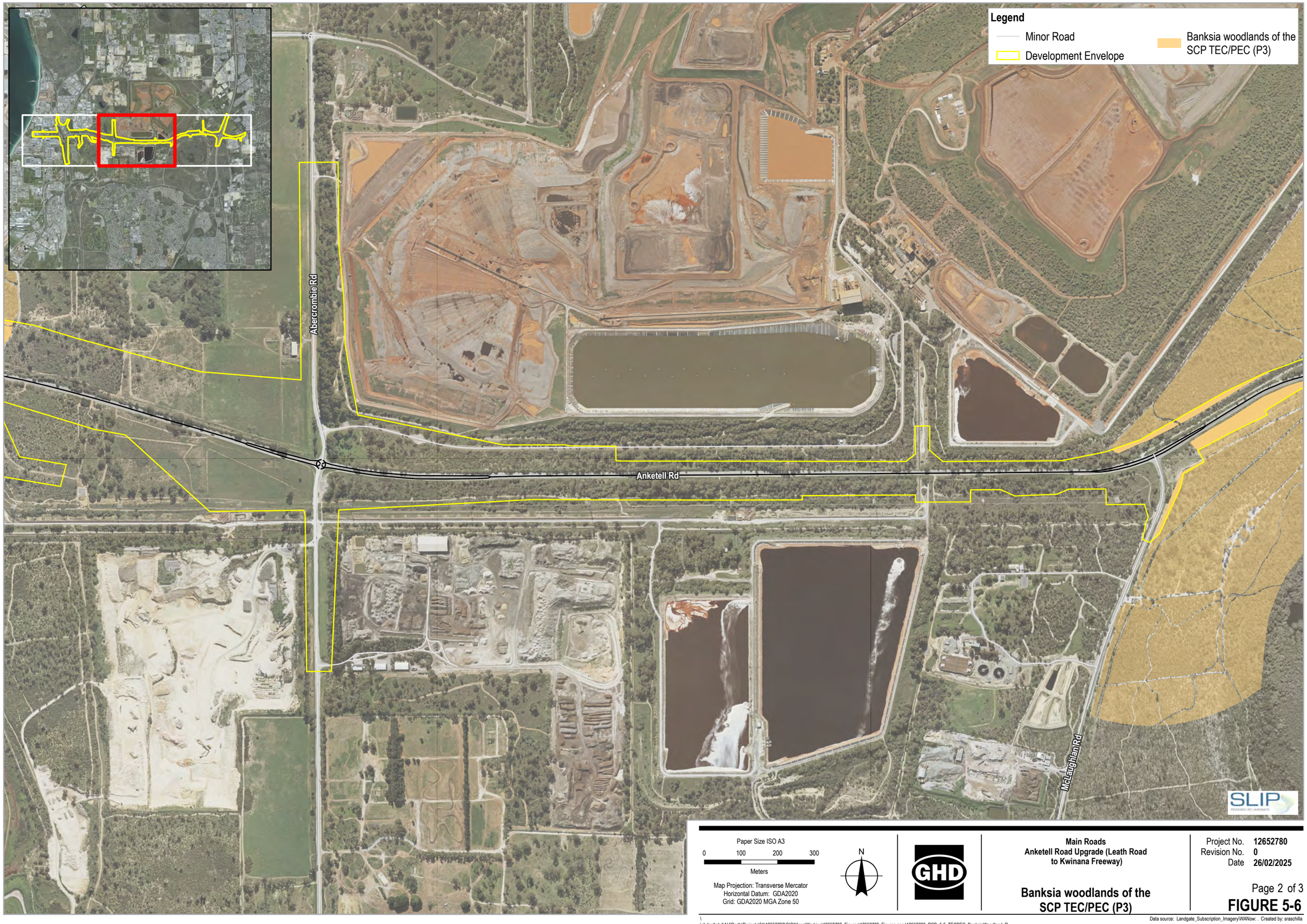

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Banksia woodlands of the SCP TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-6

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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Banksia woodlands of the SCP TEC/PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-6

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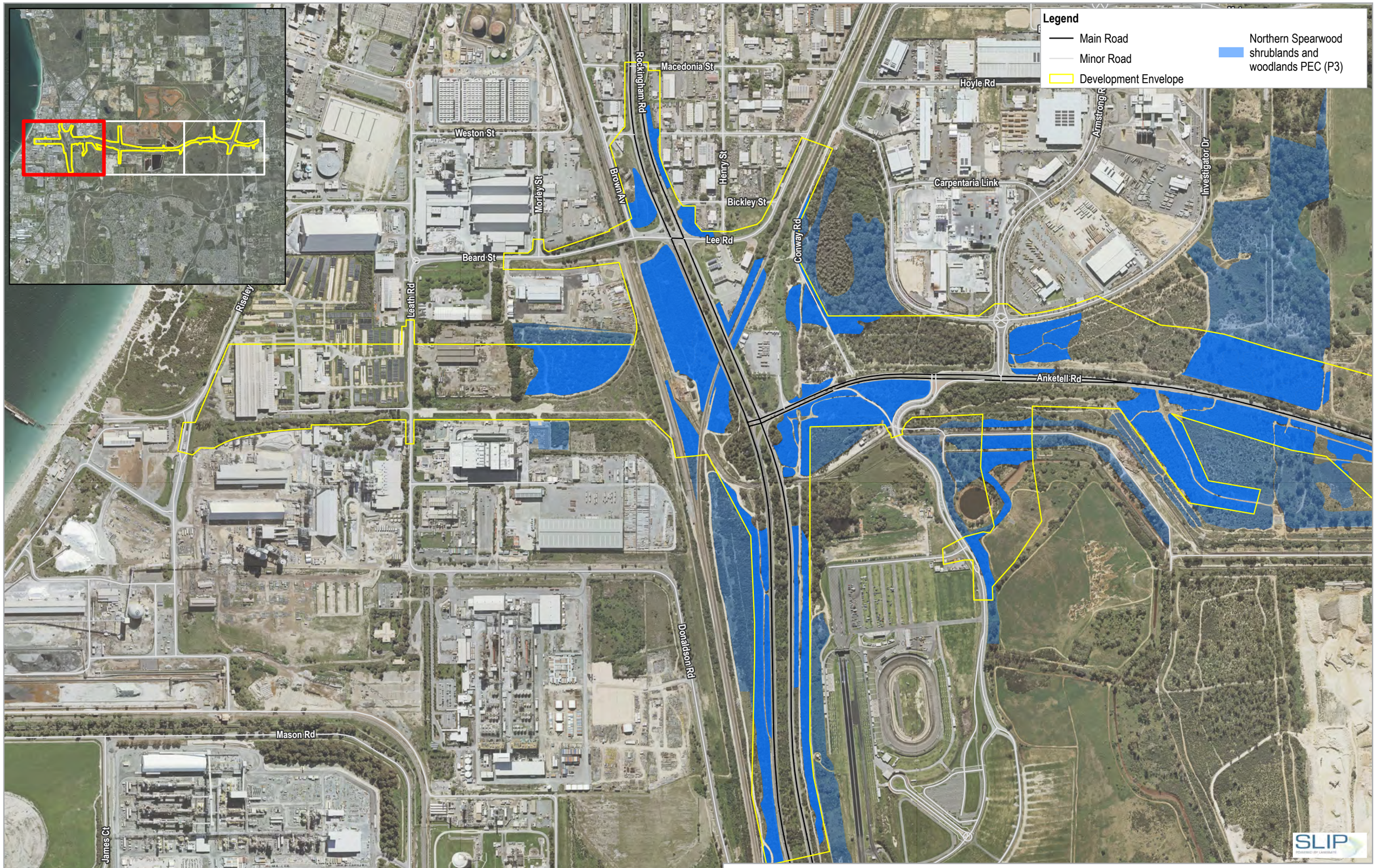

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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Northern Spearwood shrublands and woodlands PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-7

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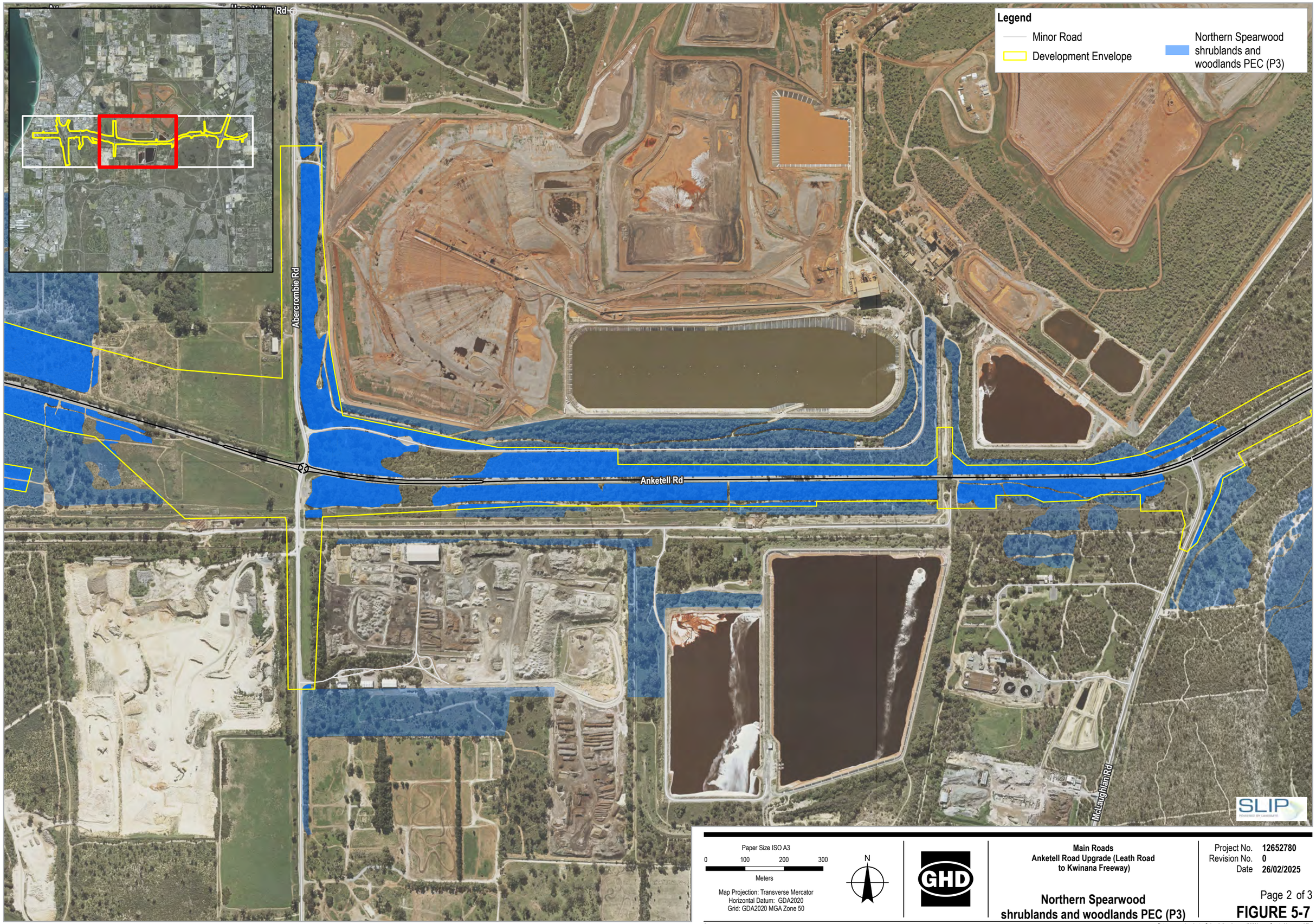

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Map Projection: Transverse Mercator
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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Northern Spearwood shrublands and woodlands PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-7

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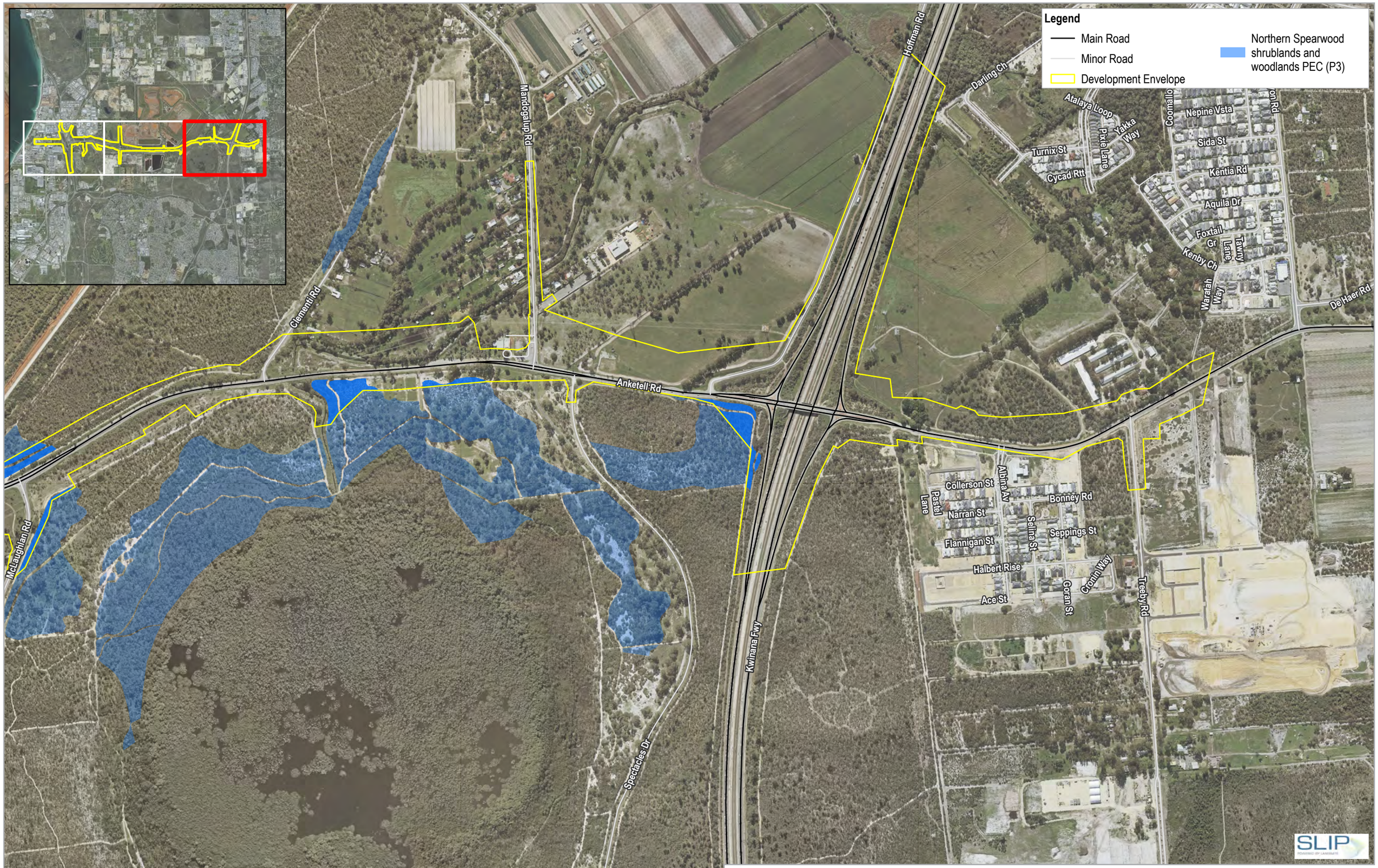

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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Northern Spearwood shrublands and woodlands PEC (P3)

Project No. **12652780**
Revision No. **0**
Date **26/02/2025**

FIGURE 5-7

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Dampland, wetland and groundwater dependent vegetation

The Biota (2025) report described a number of vegetation types that grow in association with seasonally inundated soils. Of those, native vegetation types K1 (*Kunzea* tall shrubland to tall open scrub) and M1 (*Melaleuca preissiana* low woodland over *Astartea*) are mapped within the DE. Vegetation type K1 covers approximately 0.92 ha of the DE and occurs as one patch east of the Anketell Road and Mandogalup Road intersection. This vegetation is associated with an unnamed Multiple Use Wetland (MUW) (UFI 6538) that extends north of the DE, with 0.22 ha of vegetation type K1 mapped within the wetland boundary (based on the Geomorphic wetlands of the SCP dataset). Vegetation type K1 is mapped as Degraded to Completely Degraded. Vegetation type M1 covers 0.003 ha and occurs as one patch east of the Kwinana Freeway at the northern extent of the DE. This vegetation occurs within the mapped boundary of Mandogalup Swamp South (UFI 6530), a MUW that extends north of the DE. Vegetation type M1 is mapped as Good.

Biota (2025) did not report any vegetation types as representing groundwater dependent vegetation. However, Banksia communities are known to be at least partially groundwater dependent if groundwater sources decline to exceed potential root reach or growth rate, or physiological tolerance (Sommer and Froend, 2011). DEE (2019) reports that 'Tuarts have complex physiology related to their access and use of water that varies seasonally, as both surface water and groundwater availability responds strongly to rainfall (Franks et al. 2007). As Tuart trees mature, they develop deep roots and so are able to extract groundwater seasonally. This use of groundwater is described by Drake et al (2011) as 'opportunistic'.

Stream (2025) completed a GDE assessment which identified potential GDE within the DE and Contextual area. Potential GDE included areas with some intact native vegetation and a depth groundwater of <10 m or shallower (Stream 2025). Previous studies on the SCP have identified 10 m as an approximate maximum depth where groundwater dependence of vegetation is likely (e.g., Antao 2015, Froend *et al*. 2004). Stream (2025) identified phreatophytic vegetation within the DE and within the Contextual area. Of the mapped phreatophytic vegetation, high ecological value areas were associated with the presence of PECs including the Banksia Woodlands of the SCP, Tuart Woodlands and Forests of the SCP and Northern Spearwood Shrublands and Woodlands PEC as well as areas with Priority flora records. Phreatophytic vegetation mapping for the DE and surrounds is shown on Figure 4, Appendix 9 in Stream (2025) (Appendix 10).

5.1.3.3 Flora

Biota (2025) recorded 243 native vascular flora taxa representing 53 families and 130 genera in their survey area. The most well-represented families were Fabaceae (29 taxa) and Myrtaceae (27 taxa).

5.1.3.3.1 Introduced Species

One hundred and thirty-one (131) introduced flora species were recorded during the Biota surveys across the survey area (Biota 2025). Of these, five Declared Pests (DP) listed under the BAM Act, including one Weed of National Significance (WoNS), were recorded within the DE:

- **Asparagus asparagoides* (Bridal Creeper) – DP and a WoNS
- **Echium plantagineum* (Paterson's Curse) – DP
- **Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) – DP
- **Morea flaccida* (One-leaf Cape Tulip) – DP
- *Zantedeschia aethiopica (Arum Lily) – DP.

Locations of the Declared Pests and WoNS are shown in Figure 5-8.

5.1.3.3.2 Significant flora

Desktop searches of the EPBC Act PMST (DCCEEW 2023), DBCA Threatened and Priority Flora List (TPFL) and Western Australian Herbarium (WAHerb) databases identified the presence/potential presence of 25 conservation significant flora taxa within 5 km of the DE, comprising 12 taxa listed as Threatened under the EPBC Act and/or BC Act and 13 listed as Priority species by DBCA.

No Threatened species listed under the EPBC Act or BC Act were recorded within the survey area or DE (Biota 2025). Three native Priority species were identified within the DE (Biota 2025):

- *Poranthera moorokatta* – Priority 2 by the DBCA
- *Hibbertia leptotheca* – Priority 3 by the DBCA
- *Eucalyptus foecunda* subsp. *foecunda* – Priority 4 by the DBCA.

A further three Priority flora species were recorded by Biota (2025) during surveys that occur outside, but between 30 m and 470 m from the DE. This included:

- Sixteen individuals of *Pimelea calcicola* (Priority 3) from nine locations southwest of the Rockingham Rd – Anketell Rd intersection outside, but adjacent to the DE. A further 39 individuals were recorded approximately 0.5 km south of the DE, northeast of the Thomas Road – Anketell Rd intersection.
- A single individual of *Eryngium pinnatifidum* subsp. Palustre (G.J. Keighery 13459) (Priority 3) that was recorded approximately 30 m north of the DE near Clementi Road.
- A single individual of *Caladenia speciosa* (Priority 4) that was recorded in the survey contextual area, approximately 470 m from the eastern end of the DE, from an opportunistic location in the B1 vegetation.

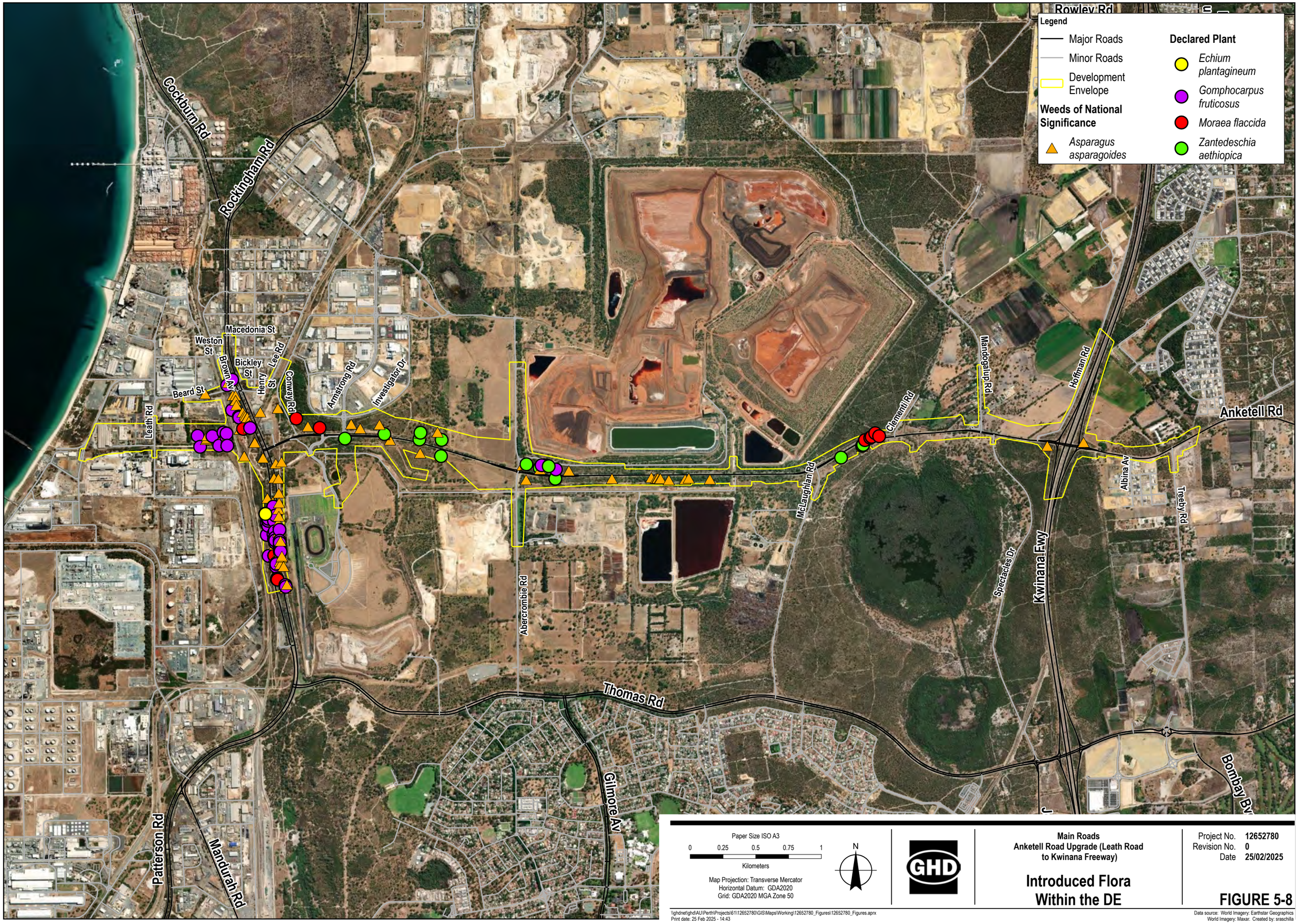
Individuals of *Calothamnus quadrifidus* subsp. *teretifolius* (DBCA-listed Priority 4) were also recorded by Biota (2025) within the DE near Kwinana Freeway. Biota reported that 'This species has been used in revegetation works, resulting in it becoming naturalised in areas of WA. It is likely that the records are a result of revegetation efforts along the borders of the Kwinana Freeway ramps.' All recorded individuals of this taxon are deemed to be planted; these are not considered significant and are not discussed further.

A likelihood of occurrence assessment completed by Biota (2025) based on the desktop study concluded four Threatened orchid species were likely to occur in the survey area based on the location of previous records. Biota (2025) completed extensive targeted searches within the survey area in accordance with the draft Survey Guidelines for Australia's Threatened Orchids (Department of the Environment 2013). Following the searches Biota (2025) concluded it is unlikely that these orchid species are present within the survey area, given the significant spatial and temporal survey effort allocated to their detection across a minimum of three seasons with no individuals identified. Post-survey, the remainder of conservation significant flora taxa identified in the desktop searches were considered unlikely to or would not occur within the survey area (and DE) (Biota 2025).

A summary of significant species known to occur within the DE (Biota 2025) is detailed in Table 5.5 and shown on Figure 5-9.

Table 5.5: Summary of significant flora recorded within the DE

Taxon	Status	Comments
Poranthera moorokatta	P2	One individual of *Poranthera moorokatta* was recorded within the DE south of Anketell Road adjacent to the Kwinana Freeway. The species was recorded from vegetation type EB1.
Hibbertia leptotheca	P3	This species was initially recorded from three quadrats along Anketell Road. Additional targeted surveys recorded 59 individuals from 12 locations within the DE, northwest of the Rockingham Rd – Anketell Rd intersection. These individuals occurred in vegetation types M2 and M4 located on a limestone ridge between Rockingham Road and the freight railway. Twelve individuals from nine locations were recorded southwest of the Rockingham Rd – Anketell Rd intersection outside, but adjacent to the DE. A further seven individuals were recorded within the Biota (2025) contextual area, approximately 430 m northwest of the Rockingham Rd – Link Rd intersection.
Eucalyptus foecunda subsp. *foecunda*	P4	This species was a dominant component of the overstorey stratum for vegetation type E7, which was mapped from a small patch of remnant vegetation in the survey area situated between Rockingham Road and the rail line. Targeted surveys recorded 151 individuals from 39 locations, all located within the singular patch of remnant vegetation. Of these, 40 individuals occur within the DE and 111 individuals occur outside, but adjacent to the DE.



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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Introduced Flora Within the DE

Project No. **12652780**
Revision No. **0**
Date **25/02/2025**

FIGURE 5-8

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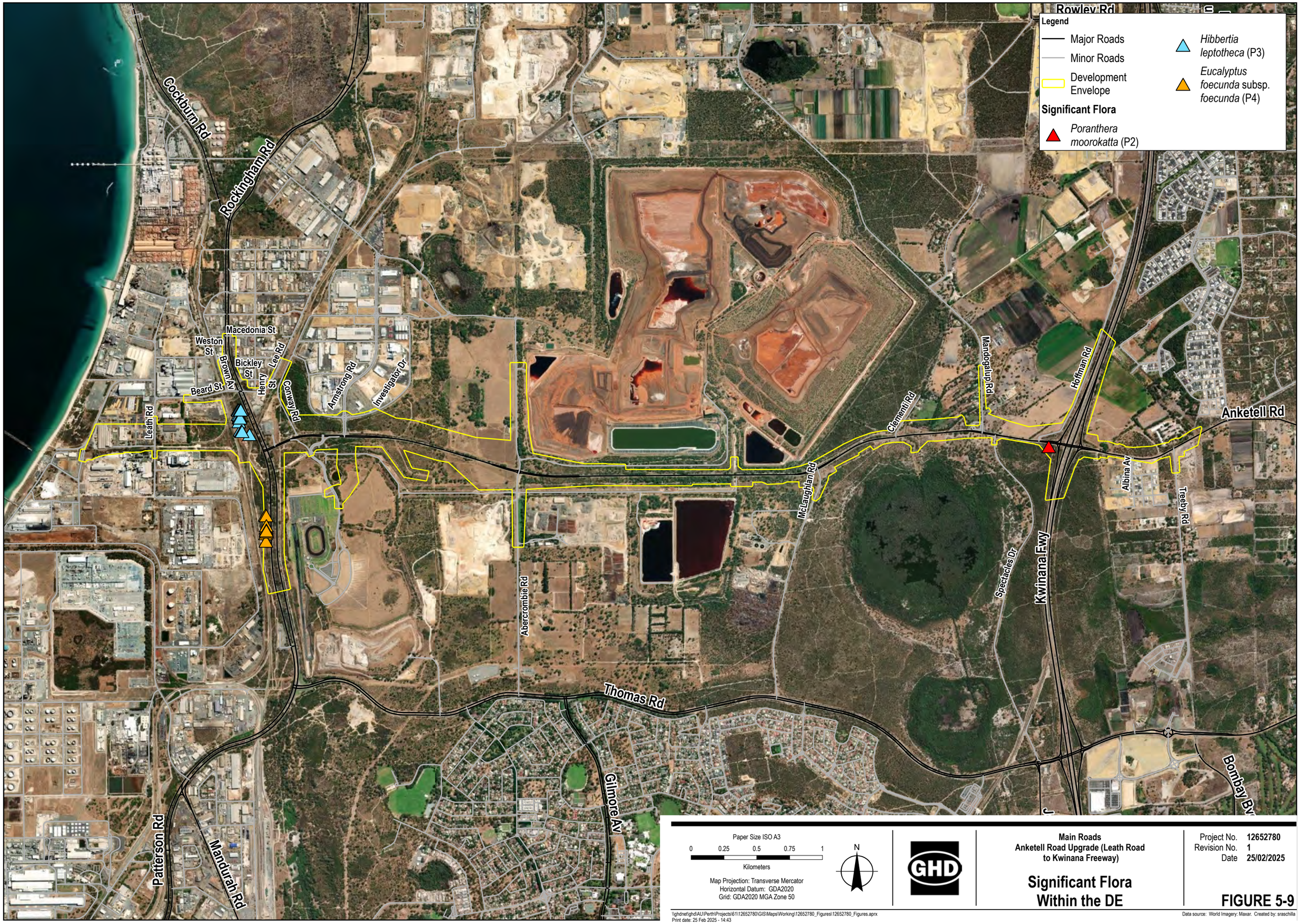

Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Significant Flora Within the DE

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

FIGURE 5-9

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Data source: World Imagery: Maxar. Created by: sraschilla

5.1.3.4 Bush Forever Sites

State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Region* adopted in 2010 recognises the protection and management of significant bushland areas such as Bush Forever in the planning process, as well as integrating environmental, social and economic considerations. Bush Forever identifies regionally significant bushland to be retained and protected wherever possible. As shown on Figure 5-10, the DE intersects three Bush Forever Sites:

- Bush Forever Site no. 268 – Mandogalup Road Bushland, Mandogalup
- Bush Forever Site no. 269 – The Spectacles
- Bush Forever Site no. 270 – Sandy Lake and Adjacent Bushland, Anketell.

5.1.3.4.1 Bush Forever Site 268

Mandogalup Road Bushland, Mandogalup (Bush Forever Site no. 268) is approximately 99.62 ha in size and extends north of Anketell Road, intersecting Mandogalup Road (GoWA 2000a). The site contains upland vegetation and significant fauna and intersects Crown Reserve (C Class) land (GoWA 2000b).

The DE intersects the southern portion of Bush Forever Site no. 268, fringing the north-west corner of Clementi Road and Anketell Road. The DE intersects 1.47 ha of Bush Forever Site no. 268, including 1.08 ha of native vegetation (ranging from Very Good condition to Degraded condition). The remainder of the DE intersecting Bush Forever Site no. 268 is mapped as non-native vegetation (0.05 ha) and existing cleared areas (0.34 ha).

5.1.3.4.2 Bush Forever Site 269

The Spectacles (Bush Forever Site no. 269) covers 348.44 ha and is bounded on the west by McLaughlan Road, on the east by Kwinana Freeway, on the north by Anketell Road and on the south by Thomas Road (GoWA 2000a). The site intersects Crown Reserve (A Class) land and Crown Freehold – Department Managed land (DBCA 2024a). The site contains upland and wetland vegetation and significant flora and fauna (GoWA 2000b). The Spectacles are also listed as Nationally Important Wetland (Spectacles Swamp) and Conservation Category Wetland (CCW).

The DE intersects the northern portion of Bush Forever site no. 269, between McLaughlan Road and the intersection of Anketell Road and Kwinana Freeway. The DE intersects 5.41 ha of Bush Forever Site no. 269, including 2.43 ha of native vegetation (ranging from Very Good condition to Degraded condition), 1.88 ha of non-native vegetation and 1.09 ha of existing cleared areas.

5.1.3.4.3 Bush Forever Site 270

Sandy Lake and Adjacent Bushland, Anketell (Bush Forever Site no. 270) covers 72.11 ha and is located between Thomas Road and Anketell Road along the eastern side of Kwinana Freeway (GoWA 2000a). The site intersects Crown Reserve (C Class) land and Crown Freehold – Department Managed land (DBCA 2024a). The site contains upland and wetland vegetation and significant flora and fauna (GoWA 2000b).

The DE intersects the northern portion of Bush Forever Site no. 270, southeast of the Anketell Road/Kwinana Freeway intersection. The DE intersects 0.71 ha of Bush Forever Site no. 270, of which 0.49 ha comprises native vegetation in Very Good to Excellent condition, 0.08 ha comprises non-native vegetation, and 0.14 ha comprises existing cleared areas.

5.1.3.5 Conservation Reserves and Regional Parks

The DE intersects one DBCA managed reserve, Class A Conservation Park (R 53313), south of the Kwinana Freeway / Anketell Road interchange. The DE intersects 1.03 ha of R 53313 including 0.55 ha of native vegetation. Native vegetation condition within the Class A Conservation Park includes Good (0.03 ha), Very Good (0.35 ha) and Very Good to Excellent (0.17 ha). R 53313 is vested with the Conservation and Parks Commission, classified under WAPC Section 8a Lands within Beeliar Regional Park. R 53313 occupies 610 ha across four separate areas, including North Lake, Farrington Road bushland, South Lake, parts of Kogolup Lake, portions of the Spectacles and Treeby Lake (DBCA 2024a).

Two other DBCA managed lands lie within 500 m of the DE, crown freehold land 1315/701 and 1315/702 (located approximately 375 m south of the DE, east of McLaughlan Road). All DBCA managed land within 500 m of the DE (1315/701, 1315/702 and R 53313) are associated with Bush Forever sites 269 and/or 270.

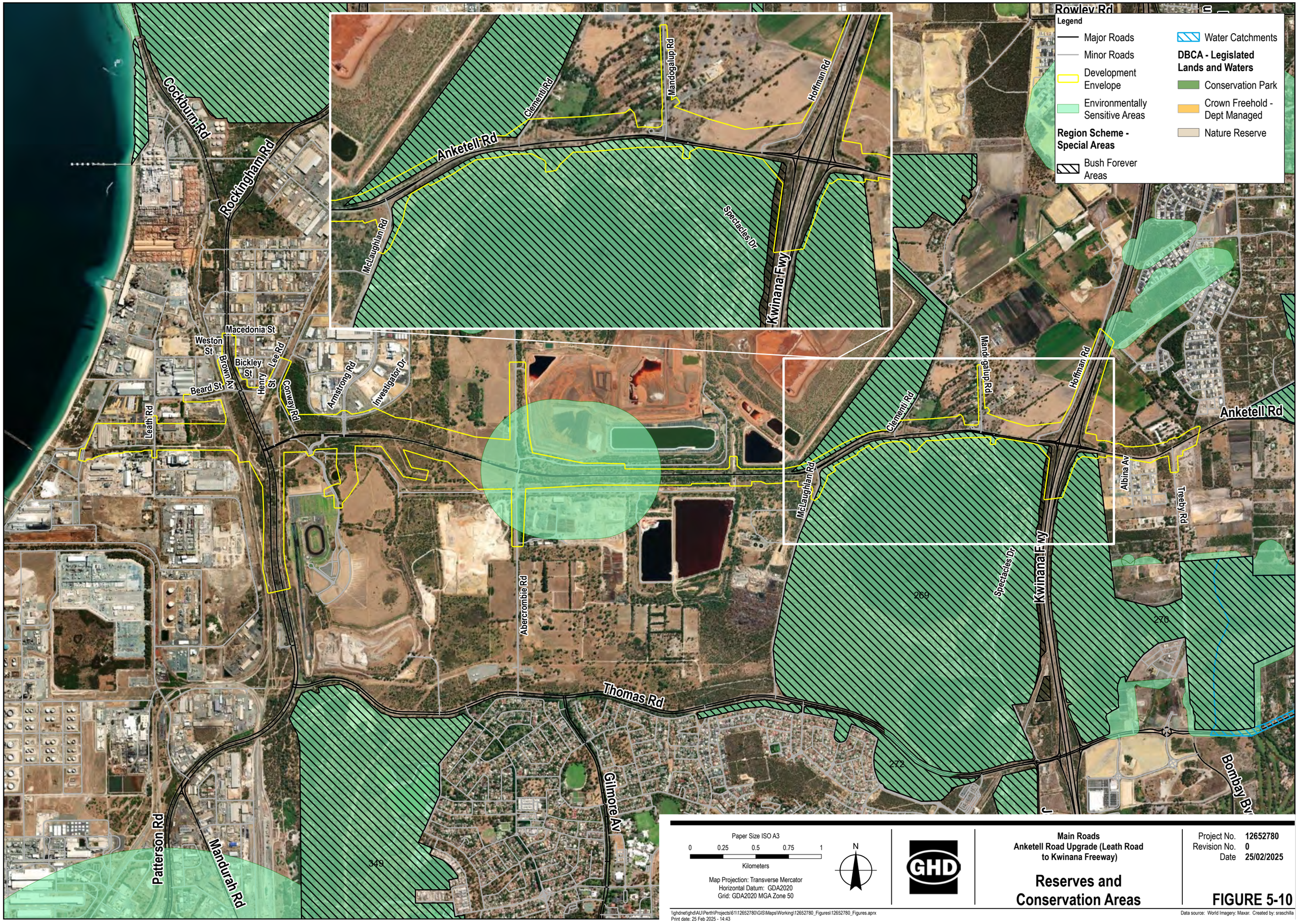
The DE intersects two Regional Parks, Beeliar Regional Park and Jandakot Regional Park. The DE intersects 5.28 ha of Beeliar Regional Park in the vicinity of the Spectacles on the west side of Kwinana Freeway and intersects 0.47 ha of Jandakot Regional Park on the east side of Kwinana Freeway. Beeliar Regional Park encompasses two chains of wetlands and an area of coastal limestone cliff (Henderson foreshore) and has high nature conservation value due to its rich diversity, ecosystem complexity, cultural significance and amenity and recreation value (Department of Conservation and Land Management (CALM) 2006). Jandakot Regional Park comprises a mosaic of land, stretching from the southern end of Jandakot Airport to south of Casuarina Prison. Collectively, the estates of the Park represent a network of land with regionally significant nature conservation, landscape and recreation value (DEC 2010).

5.1.3.6 Environmentally Sensitive Areas

The DE intersects five Environmentally Sensitive Areas (ESAs) (DWER 2021d). These ESAs are associated with TECs, wetlands and Bush Forever sites, and are mapped in Figure 5-10.

5.1.3.7 Phytophthora dieback

The DE is located within a dieback risk area as it receives more than 400 mm of average annual rainfall and is south of the 26˚ parallel. Historic dieback mapping available from Dieback Information Delivery and Management System (DIDMS) indicates areas of Low Confidence Uninfested, Moderate Confidence Uninfested, High Confidence Uninfested and Uninterpretable along Anketell Road in the vicinity of the DE (South Coast NRM 2023). Surveying for dieback is undertaken in the pre-construction phase. Management of dieback infested material, if found, is discussed in Section 5.1.6.4.



Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Reserves and Conservation Areas

Project No. **12652780**
Revision No. **0**
Date **25/02/2025**

FIGURE 5-10

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Data source: World Imagery: Maxar. Created by: srascbilla

5.1.4 Potential environmental impacts

The implementation of the Proposal will result in the loss of flora and vegetation through clearing. Potential direct impacts to flora and vegetation include:

- Loss of 92.22 ha of native vegetation including:
    - 52.78 ha of native vegetation in Good or better condition
    - 40.99 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP TEC
    - 40.99 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC
    - 14.56 ha of Banksia Woodlands of the SCP TEC
    - 14.56 ha of Banksia Woodlands of the SCP PEC
    - 57.12 ha of Northern Spearwood Shrublands and Woodlands (FTC 24) PEC
    - 4.00 ha of vegetation within three Bush Forever Sites (Site no. 268, 269 and 270)
    - 0.55 ha of vegetation within Class A Conservation Reserve R 53313.
- Loss of significant flora including:
    - One individual of *Poranthera moorokatta* (Priority 2)
    - Fifty-nine individuals of *Hibbertia leptotheca* (Priority 3)
    - Forty individuals of *Eucalyptus foecunda* subsp. *foecunda* (Priority 4).
- The Proposal could also result in the following potential indirect impacts to vegetation and flora:
    - Introduction and spread of weeds
    - Introduction and/or spread of *Phytophthora* dieback
    - Increased edge effects from creating new edges
    - Changes to vegetation structure and floristic composition in surrounding/adjacent areas through altered surface water drainage patterns and flows and/or altered groundwater levels
    - Alteration of fire regimes and increased fire risk from construction activities.

The Proposal will also contribute to cumulative impacts to flora and vegetation when considered with other significant proposals and developments at local and regional scales.

5.1.5 Mitigation

The Proposal is being designed to avoid and/or mitigate impacts to flora and vegetation where possible, with a particular focus on significant communities and flora. Table 5.6 outlines mitigation and management measures for the avoidance and minimisation of potential impacts to flora and vegetation.

Table 5.6: Avoidance and minimisation of potential impacts to flora and vegetation

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Avoid	
The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on vegetation. The existing road infrastructure consists of a 10 m wide pavement with previously cleared verges. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social constraints). Existing and future environmental data will be used to determine the environmental values and enable the design to be modified and refined, where practical to avoid and minimise impacts to flora and vegetation, whilst complying with Main Roads standards for the safety of road users, reduced congestion, and ease of access.	Established practice for Main Roads, high certainty
Narrow medians will be maintained where practicable to reduce clearing of native vegetation.	Best practice, high certainty
A compact interchange is proposed at Abercrombie Rd with ramp spacing at approximately 100m (as opposed to 150m) to reduce the footprint through this area.	Best practice, moderate certainty
Placing retaining walls where practicable to reduce clearing impacts.	Best practice, moderate certainty
Drainage basins will be located in disturbed/cleared areas where possible to avoid impacts on environmental values.	Best practice, moderate certainty
Mitigation measures for Spectacles/Banksia woodlands will include: – The Kwinana Freeway interchange upgrades have been positioned to the north of the existing bridge over Kwinana Freeway. This keeps the impacts as far north as possible limiting clearing within the Beeliar Regional Park (the Spectacles Wetland) and Jandakot Regional Park. – Between Spectacles Drive and Kwinana Freeway the west bound carriageway of Anketell Road follows the existing Anketell Road. This minimises the impact on vegetation in this area. – This interchange at Mandogalup Road has been designed to provide access for the existing and future development within the Mandogalup area, while facilitating safe movements along Anketell Road by separating the freight and general traffic. The interchange is located as far north as reasonably possible, this avoids direct impacts on the Spectacles Wetland. – Extensive retaining walls are proposed at the interchange of Anketell Road and Mandogalup Road to mitigate the footprint extents. This reduces the interchange's clearing footprint.	Best practice, high certainty
The Tuart Woodlands of the SCP TEC is predominantly distributed between Abercrombie Road and McLaughlin Road. The following design mitigations have been included to avoid or minimise impacts to this TEC: – The proposal follows the existing Anketell Road alignment, predominantly within the disturbed road corridor. – Narrow medians will be maintained where practicable to reduce clearing of the Tuart Woodlands of the SCP TEC. – Drainage basins will be located in disturbed/cleared areas where possible to avoid impacts on the Tuart Woodlands of the SCP TEC.	Best practice, high certainty
Minimise	

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Minimise clearing impacts on flora and vegetation where practicable through the detailed design process.	Best practice, moderate certainty
Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: – Clearing and access controls – Dieback and weed management – Sediment and erosion controls – Soil management – Dewatering controls.	Established practice for Main Roads, high certainty
An Offsets Strategy will be implemented to mitigate significant residual impacts on flora and vegetation (Section 6).	See Section 6
Rehabilitate	
Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.	Established practice for Main Roads, high certainty

5.1.6 Assessment and significance of residual impacts

Implementation of the identified planning, avoidance and mitigation measures in section 5.1.5 ensures the Proposal's residual impacts are as low as reasonably practicable.

Main Roads will also implement management measures to reduce indirect impacts associated with weeds, dieback, surface water, dewatering and bushfire.

Table 5.7 provides a summary of the Proposal's predicted significant residual impacts on flora and vegetation. The following sections discuss these impacts in more detail.

Table 5.7: Predicted significant residual impacts to flora and vegetation

Aspect	Summary of predicted significant residual impacts
Significant vegetation	Clearing of up to: – 40.99 ha of the Tuart Woodlands and Forests of the SCP TEC – 14.56 ha of the Banksia Woodlands of the SCP TEC – 4.00 ha of native vegetation within three Bush Forever sites, Site no. 268 (Mandogalup Road Bushland, Mandogalup), Site no. 269 (The Spectacles) and Site no. 270 (Sandy Lake and Adjacent Bushland, Anketell) – 0.55 ha of native vegetation within Class A Conservation Reserve R 53313.

5.1.6.1 Loss of flora and vegetation

5.1.6.1.1 Vegetation complexes and types

The Proposal will result in clearing of up to 92.22 ha of native vegetation. Clearing of vegetation will result in changes to the remaining extents of vegetation complexes.

The national objectives and targets for biodiversity conservation Australia have been set to prevent clearance of ecological communities with less than 30% of their pre-European extent, below which species loss appears to accelerate exponentially (Commonwealth of Australia 2001). Given that the DE is located within the constrained SCP area, the retention objective of 10% applies [1].

The Government of Western Australia (GoWA 2019) has assessed vegetation complexes mapped (Heddle et al. 1980) against presumed pre-European extents within the SCP IBRA bioregion and LGA levels (latest update March 2019) (Table 5.8). Complexes within the DE whose current extents remaining are less than 30% of their pre-European extents, either within their IBRA region and/or subregions (GoWA 2019), include Karrakatta Complex-Central and South, Quindalup Complex and Bassendean Complex-Central and South.

At a SCP scale, the Proposal will potentially reduce the remaining extent of the mapped Complexes between 0.00% and 0.17%. At the City of Kwinana scale the Proposal will potentially reduce the remaining extent of the mapped Complexes between 0.06% and 1.94% (Table 5.8). However, the Proposal will not reduce any of the complexes below 10% of the preclearing extent and thus proposed clearing is not considered a significant residual impact to the Vegetation Complexes present.

[1] An important criterion on the SCP (see EPA (2008) Environmental Guidance for Planning and Development Guidance Statement No 33. Environmental Protection Authority, Western Australia, Attachment B2-3 https://www.epa.wa.gov.au/policies-guidance/environmental-guidance-planning-and-development-gs-33).

Table 5.8: Clearing impacts to vegetation complexes mapped within the DE

Vegetation Complex	Scale	Pre-European extent (ha)	Current extent (ha)	% Remaining	Extent within DE containing native vegetation (ha)	Current extent of native vegetation remaining after Proposal clearing	
						ha	%
Karrakatta Complex-Central and South	SCP	53,081	12,465	23.48	13.66	12,451.34	23.46
	City of Kwinana	1,633.94	485.73	29.73		472.07	28.89
Quindalup Complex	SCP	54,574	32,983	60.44	0.81	32,982.19	60.44
	City of Kwinana	1,289.37	310.40	24.07		309.59	24.01
Cottesloe Complex-Central and South	SCP	45,300	14,571	32.17	73.66	14,497.34	32.00
	City of Kwinana	3,789.77	1,281.71	33.82		1,208.05	31.88
Bassendean Complex-Central and South	SCP	87,476	23,533	26.90	3.60	23,529.40	26.90
	City of Kwinana	4,678.84	1,743.46	37.26		1,739.86	37.19
Herdsman Complex	SCP	9,665	3,081	31.88	1.17	3,079.83	31.87
	City of Kwinana	579.45	282.06	48.68		280.89	48.48

The Proposal will result in clearing of up to 92.22 ha of native vegetation. The remainder of the DE includes of non-native vegetation (50.35 ha) and cleared areas (82.26 ha). Of native vegetation within the DE:

- 52.78 ha (57.2%) of native vegetation is in Good or better condition
- 26.60 ha (28.84%) of native vegetation is in Degraded condition or Degraded to Good condition
- 12.84 ha (13.9%) is in Completely Degraded condition.

Assessment of the local scale impacts was determined using Department of Primary Industries and Regional Development (DPIRD) Native Vegetation Extent data (DPIRD-005) (DPIRD 2023) for a 5 km buffer surrounding the Proposal. Within a 5 km buffer (17,926 ha) of the DE, 5,179 ha of native vegetation is present. The DE contains 92.22 ha of native vegetation, the clearing of which would result in a reduction of up to 1.78% in the extent of native vegetation within the 5 km buffer, reducing the native vegetation remaining within 5 km of the Proposal to 5,086.78 ha. The proposed vegetation clearing extent is not considered a significant residual impact when considered at a local or regional scale.

5.1.6.1.2 Significant Ecological Communities

Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP TEC

The DE intersects 40.99 ha of the Tuart Woodlands and Forests of the SCP TEC (EPBC Act: Critically Endangered) mapped as eight patches. Of these, patches TT06 and TT07 occur within/intersect Bush Forever sites.

As shown in Table 5.9 and Figure 5-5, clearing will occur on the edges of most patches, except for patch TT02, which will be entirely removed. Post clearing, patches TT01, TT03, TT04 and TT07 will be greater than 5 ha and therefore meet the size threshold to be representative of the Tuart Woodlands and Forests of the SCP TEC. Patches TT05 and TT06 will be split into smaller patches and therefore part of the existing patch will remain Tuart Woodlands and Forests of the SCP TEC; TT05 will be reduced to a single patch and TT06 will be split into 3 separate patches. Patch TT08 & TT09 will be reduced in size but still meets the size and condition thresholds to remain a Tuart Woodlands and Forests of the SCP TEC patch. Patches TT10 and TT11 are not impacted by the Proposal and will remain Tuart Woodlands and Forests of the SCP TEC.

The Proposal's impact on Tuart Woodlands and Forests of the SCP TEC is considered likely to be a significant residual impact due to the direct impact on a TEC, including important occurrences of this TEC (i.e. within Bush Forever).

Table 5.9: Clearing impacts to Tuart Woodlands and Forests of the SCP TEC patches mapped within the DE

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
TT01	8.4	2.157	25.6	High	Clearing on western edge of patch. Patch will meet size threshold (>5 ha) post clearing. Remains Tuart Woodlands and Forests of the SCP TEC patch.
TT02	0.9	0.984	100	High-Med	Entirety of patch removed. No longer Tuart Woodlands and Forests of the SCP TEC patch.
TT03	29.5	6.032	20.5	High-Med	Clearing on southern edge of patch. Patch will meet size threshold (>5 ha) post clearing. Remains Tuart Woodlands and Forests of the SCP TEC patch.
TT04	6.3	1.162	18.3	High-Med	Clearing on northern edge of patch. Patch will meet size threshold (>5 ha) post clearing. Remains Tuart Woodlands and Forests of the SCP TEC patch.
TT05	18.7	11.264	60.3	High-Med	Clearing southern portion of patch. Patch split and size reduced to <5 ha. Remaining northern patch assessed by Biota (2025) and has medium condition and meets biotic

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
					thresholds. Remaining east part of patch unlikely to meet size and condition thresholds. Part of existing patch remains Tuart Woodlands and Forests of the SCP TEC patch.
TT06	35.7	16.850	47.2	High-Med	Clearing bisects (fragments) patch. Remaining northern patch meets size and condition thresholds (split into 2 patches). Remaining southern patch reduced to 1 patch at eastern end that meets size and condition thresholds. Part of existing patch remains Tuart Woodlands and Forests of the SCP TEC patch.
TT07	5.7	0.591	10.3	Med-Low	Clearing northern edge of patch. Patch will meet size threshold (>5 ha) post clearing. Remains Tuart Woodlands and Forests of the SCP TEC patch.
TT08 & TT09[1]	5.1	1.954	38.2	High-Med	Clearing northern portion of patch. Patch size reduced to <5 ha. Remaining part of patch assessed by Biota (2025) and has medium to high condition and meets biotic thresholds. Remains Tuart Woodlands and Forests of the SCP TEC patch.
TT10	0.7	-	-	Med-Low	Not impacted by Proposal. Will remain Tuart Woodlands and Forests of the SCP TEC patch.
TT11	3.0	-	-	High-Med	Not impacted by Proposal. Will remain Tuart Woodlands and Forests of the SCP TEC patch.
Total		**40.99**			

Banksia Woodlands of the Swan Coastal Plain ecological community TEC

The DE intersects 14.56 ha of the Banksia Woodlands of the SCP TEC (EPBC Act: Endangered) mapped across nine patches. Of these patches, four intersect Bush Forever sites. As shown in Table 5.10, clearing will occur on the edges of most patches, with the exception of patches BT08 and BT09, which will be removed almost entirely. Post clearing, patches BT02, BT03, BT04, BT05, and BT06 will remain greater than 2 ha with vegetation in Good or better condition, and are representative of the Banksia Woodlands of the SCP TEC. Patches BT01 and BT07 will be reduced in size nearing the 2 ha extent, however, will meet condition thresholds based on patch quality reported by Biota (2025) to remain a Banksia Woodlands of the SCP TEC patch.

Clearing impacts to the Banksia Woodlands of the SCP TEC patches mapped within the DE is detailed in Table 5.10 with the extent of the TEC mapped by Biota (2025) provided in Figure 5-6.

Considering the extent of the Banksia Woodlands of the SCP TEC clearing, including important occurrences of this TEC (i.e. within Bush Forever areas), the impact of the Proposal on this TEC is expected to be a significant residual impact.

Table 5.10: Clearing impacts to Banksia Woodlands of the SCP TEC patches mapped within the DE

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
BT01	2.2	0.187	8.5	Very Good	Clearing on edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good condition or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.
BT02	4.9	2.056	42.0	Good to Excellent	Clearing southern portion of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.
BT03	76.1	1.198	1.6	Very Good to Excellent	Clearing on edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.
BT04	32.7	0.867	2.7	Good to Very Good	Clearing on north east edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.
BT05	159.6	2.490	1.6	Good to Very Good	Clearing on northern edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.
BT06	45.4	0.690	1.5	Good to Excellent	Clearing on southern edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remains Banksia Woodlands of the SCP TEC patch.

Patch ID	Size of patch (ha)	Extent within DE (ha)	Extent within DE (%)	Patch quality	Comments
BT07	5.6	3.454	61.7	Excellent	Clearing southern portion of patch. Remaining area meets size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Remain Banksia Woodlands of the SCP TEC patch.
BT08	3.1	3.020	97.4	Very Good to Excellent	Clearing majority of patch. Patch size reduced to <0.5 ha. No longer Banksia Woodlands of the SCP TEC patch.
BT09	0.61	0.605	100	Good	Clearing patch. No longer Banksia Woodlands of the SCP TEC patch.
Total		**14.56**			

Banksia Woodlands of the Swan Coastal Plain PEC

The Proposal will result in the clearing of up to 14.56 ha of the Banksia Woodlands of the SCP Priority 3 PEC, of which 11.26 ha (77.34%) is in Good or better condition. Of the 14.56 ha of the Banksia Woodlands of the SCP PEC, 0.66 ha, 2.26 ha and 0.57 ha occurs within Bush Forever Sites no. 268, 269 and 270 respectively. Clearing of Banksia Woodlands of the SCP PEC will reduce the local and regional extent of this PEC. However, as this impact is not likely to result in the ecological community being listed as a threatened ecological community, the impact is not considered a significant residual impact, as defined by the WA Environmental Offsets Guideline (WA Government 2014).

Northern Spearwood Shrublands and Woodlands PEC (FCT 24)

The Proposal will result in the clearing of up to 57.12 ha of the Northern Spearwood Shrublands and Woodlands Priority 3 PEC, of which 35.74 ha (62.57%) is in Good or better condition. Approximately 3.02 ha of the PEC is associated with patches of the EPBC Act listed Banksia Woodlands of the SCP TEC and 27.55 ha is associated with patches for the EPBC Act listed Tuart Woodlands and Forests of the SCP TEC. There is 0.53 ha and 1.38 ha of the Northern Spearwood Shrublands and Woodlands PEC within Bush Forever Sites no. 268 and 269 respectively. Clearing of FCT 24 will reduce the local and regional extent of this PEC. However, as this impact is also not likely to result in the ecological community being listed as a threatened ecological community, the impact is not considered a significant residual impact, as defined by the WA Environmental Offsets Guideline (WA Government 2014).

Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC

The Proposal will result in the clearing of up to 40.99 ha of the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain PEC, of which 20.77 ha (50.65%) is in Good or better condition. There is 0.64 ha and 1.79 ha of this PEC within Bush Forever Sites no. 268 and 269 respectively. Clearing the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain PEC will

reduce the local and regional extent of this PEC. However, this impact is not likely to result in the ecological community being listed as a threatened ecological community, and is not considered a significant residual impact.

5.1.6.1.3 Dampland, wetland and groundwater dependent vegetation

The Proposal will result in the clearing of vegetation that grows in association with seasonally inundated soils. There is 0.92 ha of vegetation type K1 within the DE, of which 0.22 ha is mapped within the boundary of unnamed MUW (UFI 6538). The Proposal avoids direct impacts on the Resource Enhancement Wetland (REW) Conway Road Swamp (UFI 6379), which occurs approximately 50 m east of Conway Road and 29 m east and 100 m north of the DE (Table 5.26).

The DE also intersects part of Mandogalup Swamp South wetland, a MUW (UFI 6530). The Proposal will clear 0.003 ha of vegetation type M1 associated with this MUW. Given the extent and condition of wetland vegetation within the DE, the Proposal's impact on wetland vegetation is not considered a significant residual impact.

5.1.6.1.4 Vegetation in Bush Forever and Conservation Reserves

The Proposal will require the clearing of up to 4.25 ha of native vegetation in conservation areas, including 4.00 ha within Bush Forever sites and 0.55 ha in a Class A Conservation Reserve.

The DE intersects 7.58 ha of Bush Forever sites comprising 4.00 ha of native vegetation, 0.08 ha of non-native/modified vegetation and 3.50 ha of cleared/degraded areas. The Proposal will clear:

- 1.08 ha of native vegetation ranging from Very Good condition to Degraded condition along the southern boundary of Bush Forever Site no. 268 (Mandogalup Road Bushland, Mandogalup)
- 2.43 ha of native vegetation ranging from Very Good condition to Degraded condition along the northern boundary of Bush Forever Site no. 269 (The Spectacles)
- 0.49 ha of native vegetation in Very Good to Excellent condition within Bush Forever Site no. 270 (Sandy Lake and Adjacent Bushland, Anketell).

As the Proposal involves the upgrade of the existing Anketell Road, it is considered unlikely there will be significant indirect impacts associated with additional fragmentation of any of the Bush Forever sites intersected. The Proposal is unlikely to lead to significant impacts on the Bush Forever sites given the viable size of each existing site and presence of the existing Anketell Road and Kwinana Freeway.

The Proposal also intersects 1.03 ha of Class A Conservation Reserve R 53313, of which 0.55 ha is native vegetation. The Proposal will clear 0.17 ha of B2 vegetation in Very Good to Excellent condition and 0.38 ha of EB1 vegetation in Good condition. Section 2.3.2 describes the regulatory process for excising an area of land from conservation tenure.

These impacts to conservation areas, including conservation reserves and Bush Forever sites, are regarded as significant residual impacts as defined by the WA Environmental Offsets Guideline (WA Government 2014).

5.1.6.1.5 Significant flora

The Proposal will directly impact:

- *Poranthera moorokatta* – Priority 2 by the DBCA

- *Hibbertia leptotheca* – Priority 3 by the DBCA
- *Eucalyptus foecunda* subsp. *foecunda* – Priority 4 by the DBCA.

The Proposal also has the potential to indirectly impact *Pimelea calcicola* (Priority 3). A summary of impacts to these Priority flora species is provided in Table 5.11 and detailed below. The total population size for *Hibbertia leptotheca, Pimelea calcicola and Eucalyptus foecunda* subsp. *foecunda* is likely to be much higher, as numerous population records were calculated as containing only one individual due to a lack of frequency data.

Table 5.11: Summary of potential impacts to Priority flora mapped within the DE

Taxon	Within the DE		Within 50 m of the DE		Within 5 km of the DE		Total estimated population
	No.[1]	%	No.[1]	%	No.[1]	%	
Poranthera moorokatta (P2)	1	<0.1	0	-	0	-	2,565
Hibbertia leptotheca (P3)	59	24.4	12	5.0	11	4.5	242
Pimelea calcicola (P3)	0	-	16	9.6	39	23.5	166
Eucalyptus foecunda subsp. *foecunda* (P4)	40	9.1	111	25.2	1	<0.1	440

1: Number of Individuals - data sources: Biota (2025), TPFL dataset, WAHerb dataset, Barrett (2012)

Poranthera moorokatta

Based on data extracted from DBCA databases, *Poranthera moorokatta* is recorded from 11 locations across Western Australia including north of Cataby (two collections from a rehabilitated mine site), Chandala Nature Reserve, Banksia Grove, Ellenbrook, Perth Airport Estate, Clifton Park Buffer Reserve in the City of Canning, Forrestdale Lake Restoration Site, Shirley Balla Swamp Reserve and on the slope of the Whicher Scarp, as well as within the Conservation Estate at Whiteman Park and Kings Park. *Poranthera moorokatta* is typically found in *Banksia menziesii – Banksia attenuata* woodlands on white silica sands, co-occurring with the more widespread *Poranthera microphylla* (Biota 2025). The total population size of *Poranthera moorokatta* is estimated to be 2,565 individuals based on available data (Barrett 2012) (Table 5.11). Records show the species has not been previously identified within 5 km of the DE. The species is highly under-surveyed due to its size, and it is likely more populations exist within the Perth metro area (Biota 2025).

A single individual of *Poranthera moorokatta* was recorded within the DE. Removal of this individual for the Proposal represents a loss <0.1% of the total estimated population of the taxon. No other individuals were recorded within 50 m of the DE. The clearing of one individual is unlikely to be significant given the species is known from the SCP across a range north of Cataby to near Bunbury. This direct impact is not considered a significant residual impact.

Hibbertia leptotheca

Hibbertia leptotheca is known from 39 coastal and near-coastal locations extending from west of Cataby in the north to Lake Preston in the south (WA Herbarium 2024), with frequency of records ranging from a couple individuals to abundant. The species grows in sand over limestone in coastal heaths and thickets, usually dominated by species of Melaleuca and Acacia (Thiele 2019). The estimated population size in

Western Australia is 82 individuals based on available data (Table 5.11), including approximately 10 individuals located within the Conservation Estate at Yalgorup National Park, Yanchep National Park, Gnangara-Moore River State Forest, Nilgen Nature Reserve and the Swan Canning River Park (Biota 2025).

Hibbertia leptotheca was recorded from two locations within the DE, from vegetation types M2 and M4, located on a limestone ridge between Rockingham Road and the freight railway. A total of 59 individuals were recorded within the DE and 16 individuals were recorded outside, but adjacent to the DE. A further seven individuals were recorded approximately 430 m northwest of the DE (Biota 2025). The proposal will remove 59 individuals which represents a loss of 24.4% of the total estimated population of the taxon. This is likely an overestimation of population loss as numerous population records were calculated as containing only one individual due to a lack of frequency data. This direct impact is not considered a significant residual impact given the species is known from the SCP across a range from Cataby to Lake Preston and subpopulations are protected in the Conservation Estate (Biota 2025). Indirect impacts to individuals located outside, but adjacent to the DE will be mitigated through implementation of mitigation measures outlined in section 5.5.5.

Pimelea calcicola

There are a total of 31 vouchered records of *Pimelea calcicola* at the WA Herbarium, with a frequency ranging from occasional to frequent and very common, between Guilderton and Yalgorup National Park (WA Herbarium 2024). Typical habitat for this species is coastal limestone ridges and sand over limestone (WA Herbarium 2024). The total population size of *Pimelea calcicola* is estimated to be 166 individuals based on available data (Table 5.11), including approximately 30 individuals in the Conservation Estate at Yalgorup National Park, Neerabup National Park, Yanchep National Park and Gnangara-Moore River State Forest (Biota 2025).

The species was not recorded within the DE; however, 16 individuals were recorded adjacent to the DE from vegetation types M6 and E7 and have the potential to be indirectly impacted by the Proposal. No direct impacts to *Pimelea calcicola* are anticipated as a result of the Proposal and as such this impact is not considered a significant residual impact (Biota 2025). Indirect impacts to individuals located outside, but adjacent to the DE will be mitigated through implementation of mitigation measures outlined in section 5.5.5

Eucalyptus foecunda* subsp. *foecunda

There are a total of 79 vouchered records of *Eucalyptus foecunda* subsp. *foecunda* across Western Australia at the WA Herbarium, with frequency ranging from infrequent to abundant and dominant. Typical habitat for this species is coastal limestone ridges and sand over limestone (WA Herbarium 2024). The species is currently recorded between Jurien Bay and Lake Preston from 75 locations. Approximately 91 individuals are located within the Conservation Estate at Leda Nature Reserve, Bold Park, Neerabup National Park, Yalgorup National Park, Yanchep National Park, Wilbinga Conservation Park, Gnangara-Moore River State Forest and Hill River Nature Reserve (Biota 2025).

Eucalyptus foecunda subsp. *foecunda* was a dominant component of the overstorey stratum for vegetation types E7, which was mapped from a small patch of remnant vegetation in the survey area situated between Rockingham Road and the rail line. It was recorded from two quadrats, where it was estimated to have 31% and 28% projected foliage cover, respectively. Targeted surveys recorded 151 individuals from 39 locations, all located within a singular patch of remnant vegetation. Of these, 40 individuals occur within the DE and

111 individuals occur outside, but adjacent to the DE. The proposal will remove 40 individuals which represents a loss of 9.1% of the total estimated population of the taxon. This is likely an overestimation of population loss as numerous population records were calculated as containing only one individual due to a lack of frequency data. Clearing is not considered a significant residual impact given the species is known from the SCP across a range from Jurien Bay to Lake Preston and subpopulations are protected in the Conservation Estate (Biota 2025). Indirect impacts to individuals located outside, but adjacent to the DE will be mitigated through implementation of mitigation measures outlined in section 5.5.5.

5.1.6.2 Fragmentation of native vegetation and flora

As the Proposal relates to the upgrade of an existing road, clearing for the Proposal is unlikely to result in increased fragmentation. Native vegetation is already fragmented by the existing Anketell Road and associated road corridors. Clearing will be limited to the edges of existing disturbed corridors along Anketell Road and associated corridors.

Whilst the Proposal will create some additional fragmentation due to the clearing required to upgrade the road, the Proposal will not bisect any previously undisturbed patches of native vegetation, although it may reduce the remaining extent of two bisected patches of Tuart Woodlands and Forests of the SCP TEC (TT05 and TT06) so part of the remaining patches may no longer meet the size and condition thresholds (see Table 5.9). Noting the impact of clearing the Tuart Woodlands and Forests of the SCP TEC has been assessed separately under section 5.1.6.1.2, the Proposal is unlikely to result in fragmentation that would significantly impact vegetation and flora. This impact is not considered a significant residual impact.

5.1.6.3 Introduction and spread of weeds

As the Proposal relates to the upgrade of an existing road, it is unlikely the Proposal will result in the introduction and/or spread of weeds that could result in a significant impact on vegetation and flora. The Proposal has the potential to introduce and spread weeds through ground disturbing activities such as clearing, increased movement of vehicles or earth-moving machinery and import or reuse of weed infested topsoil. This may result in weeds establishing or spreading from the DE into adjacent areas of native vegetation. Five significant weeds (Declared Pests and/or WoNS) were recorded in the DE during the Biota surveys (Biota 2025). The presence of significant weeds could directly impact the integrity of intact native vegetation.

Main Roads will implement standard operational controls to appropriately control the risk of the introduction or spread of weeds. Access restrictions, weed control, hygiene protocols and monitoring will be implemented during the Proposal to prevent the introduction and spread of weeds within the DE and to adjacent vegetation. The Proposal will incorporate revegetation / landscaping where possible, which will reduce the potential spread of weeds in the DE. Topsoil containing Declared Pests or WoNS will not be reused as part of the Proposal.

The implementation of weed hygiene measures are expected to reduce the Proposal's risk of introduction and spread of weeds. The Proposal is not expected to result in the introduction or spread of weeds that could result in significant impacts on vegetation and flora. This impact is not considered a significant residual impact.

5.1.6.4 Phytophthora dieback

Main Roads will undertake Phytophthora dieback surveys of the DE and adjacent areas to inform hygiene management. The Proposal will incorporate dieback hygiene during construction to reduce the risk of introduction and spread of dieback as well as protect adjacent vegetation that may be uninfested and vulnerable. Standard management controls for dieback hygiene will be implemented.

As the Proposal relates to the upgrade of an existing road, the Proposal is not expected to result in the introduction or spread of dieback that could result in significant impacts on vegetation and flora. This impact is not considered a significant residual impact.

5.1.6.5 Alteration to hydrology

The Proposal has the potential to impact local hydrology and adversely impact adjacent native vegetation. The existing Anketell Road and interchanges have modified surface water flows, and construction of the Proposal may alter these previously modified surface water flows.

The Proposal will incorporate infiltration basins and/or swales to capture, treat and infiltrate surface water runoff. The Proposal will minimise runoff outside the DE that could impact adjacent native vegetation and wetlands. The clearing of vegetation within the DE is not expected to be of sufficient scale to cause substantial hydrological changes in the local area. The infiltration of surface water runoff within the DE will maintain the existing hydrological regimes, predominantly within the Spearwood System (characterised by sand dunes and plains), and the Quindalup South System (characterised by coastal dunes and yellow sands).

The Proposal includes construction of bridge piers, abutment footings and drainage structures, which Main Roads has been constructing on the SCP for decades. The depth to groundwater is approximately 5-30 m below ground level across the DE (DWER 2023). The Proposal will require construction water and dewatering is likely to be required to install some road structures such as bridges and underpasses. The Proposal may result in localised groundwater drawdown from abstraction and short-term changes to groundwater levels from construction dewatering affecting GDEs, including phreatophytic vegetation.

Stream (2025) undertook an assessment to assess the risk of impact on GDEs from potential groundwater drawdown associated with dewatering for the Proposal. The assessment considered two dewatering scenarios including 1) dewatering dry season without recharge and 2) dewatering dry season with recharge. Overall risk of impact to GDEs, including phreatophytic vegetation from dewatering is considered low.

Based on the Stream (2025) assessment and the proposed management measures no significant impact to flora and vegetation due to the temporary groundwater drawdown are expected. This impact is not considered a significant residual impact.

5.1.6.6 Alteration of fire regimes

As the Proposal relates to the upgrade of an existing road, the implementation of the Proposal is unlikely to significantly impact on existing fire regimes. A change in fire regimes is often associated with increased human activity, leading to a degradation of natural ecosystems. Fire is a major determining factor in affecting species composition. It can cause disturbance of vegetation but can also be required for regeneration of some species. The Proposal lies adjacent to areas of native vegetation, including Banksia woodlands, which are susceptible to impacts from high frequency fire regimes (DEE 2016b).

Main Roads will implement standard construction and operational controls to appropriately control the risk of fire. This will include identifying potential ignition sources and/or activities with the potential to lead to fire, and preventable measures. Weed management will reduce the risk of fires caused by the Proposal spreading to nearby vegetation. Fire is considered manageable, and the implementation of the Proposal is unlikely to significantly impact existing fire regimes or increase the likelihood of fires. This impact is not considered a significant residual impact.

5.1.7 Predicted Outcomes

The Proposal's residual impacts to flora and vegetation, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows:

- All direct disturbance will occur within the DE
- The extent of vegetation values impacted within the DE will not exceed:
    - 92.22 ha of native vegetation
    - 40.99 ha of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP PEC (Priority 3)
    - 14.56 ha of Banksia Woodlands of the Swan Coastal Plain PEC (Priority 3)
    - 57.12 ha of Northern Spearwood Shrublands and Woodlands (FCT24) PEC
    - 4.00 ha of native vegetation within three Bush Forever Sites (Site no. 268, 269 and 270)
    - 0.55 ha of vegetation within Class A Conservation Reserve R 53313.
- The extent of the following flora values impacted within the DE will not exceed:
    - One individual of *Poranthera moorokatta* (Priority 2)
    - 59 individuals of *Hibbertia leptotheca* (Priority 3)
    - 40 individuals of *Eucalyptus foecunda* subsp. *foecunda* (Priority 4).

Offsets proposed in section 6 will counterbalance the Proposal's significant residual impacts to flora and vegetation.

Main Roads considers implementation of the identified planning, avoidance and mitigation measures and proposed environmental offsets will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for flora and vegetation will be met.

5.2 EPA environmental factor and objective – terrestrial fauna

5.2.1 EPA Objective

The EPA's objective for terrestrial fauna is '*To protect terrestrial fauna so that biological diversity and ecological integrity are maintained*' (EPA 2023a).

5.2.2 Relevant policy and guidelines

- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c)
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020)
- Referral guideline for 3 WA threatened black Cockatoo Species Carnaby's Cockatoo (*Zanda latirostris*), Baudin's Cockatoo (*Zanda baudinii*) and the Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*) (Department of Agriculture, Water and the Environment (DAWE) 2022)
- Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Canberra, Australian Capital Territory (Department of Environment (DoE) 2013b).
- WA Environmental Offsets Policy (Government of Western Australia (GoWA) 2011)
- WA Environmental Offsets Guidelines (GoWA 2014)
- Environmental offsets metric: Quantifying environmental offsets in Western Australia (DWER 2021a).

5.2.3 Receiving environment

5.2.3.1 Surveys and studies

Main Roads has commissioned a number of surveys to gain an understanding of the terrestrial fauna values within and surrounding the Proposal. These have included basic (Level 1) surveys and targeted assessments undertaken in accordance with relevant Commonwealth and EPA guidance.

Fauna surveys that are within or are relevant to the Proposal have been undertaken in conjunction with flora and vegetation surveys and are outlined in Table 5.12. The results from the Biota (2025) report supersedes the results from Biota (2023 and 2022) assessments. The extent of fauna survey coverage is shown in Figure 5-1.

Table 5.12: Summary of fauna surveys previously conducted for the Proposal

Survey / Report	Details
Anketell Rd Upgrade – Consolidated Biological Report (Biota 2025) (Appendix 1)	Scope: Consolidation of biological surveys conducted prior from 2020 to 2023, for the proposed Anketell Road Upgrade. The report provides a comprehensive biological survey report for the entire DE. Basic fauna surveys including vertebrate survey, targeted Black Cockatoo surveys, targeted significant fauna surveys and SRE invertebrate survey. The surveys described and mapped fauna habitats through on-ground traverses and recorded presence and/or evidence of vertebrate fauna. Targeted surveys for significant fauna included active searches for individuals and secondary evidence, deployment of motion cameras and recording of opportunistic observations. Targeted black cockatoo surveys identified, described and mapped breeding, foraging and roosting habitat

Survey / Report	Details
	as well as presence or evidence of black cockatoos. Targeted searches for SRE invertebrates were conducted via burrow searches, leaf litter raking, rock turning and snail searches. Survey dates: 54 person days between October 2020 and October 2024. Survey area: The survey area covers 220.99 ha and includes the entirety of the Anketell Road Upgrade referral boundary. The report also covers a Contextual area (500 m buffer around the survey area) and a Study area (5 km buffer around the survey area). Report date: January 2025 (draft) **Anketell Road Planning Study Biological Survey (Biota 2022)** Scope: Targeted vertebrate survey, targeted black cockatoo assessment and targeted SRE survey. Survey date: 24 to 25 September 2020, 6 to 14 October 2020 and 11 to 13 November 2020 **Westport Freight Road Additional Biological Survey (Biota 2023)** Scope: Low intensity sampling vertebrate survey, targeted black cockatoo assessment and targeted SRE survey. Survey date: 5 to 8 September 2023 and 27 to 29 September 2023 **Westport Last Mile Area Biological Survey – WSP Commissioned (Biota 2024c)** Scope: Low intensity sampling vertebrate survey, targeted black cockatoo assessment and targeted SRE survey. Survey date: 4 to 7 September 2023 and 13 to 14 September 2023 **Rockingham Road Biological Survey (Biota 2024e)** Scope: Low intensity sampling vertebrate survey, targeted black cockatoo assessment and targeted SRE survey. Survey date: 18 September 2023 and 21 September 2023 **Anketell Road SRE Invertebrate Survey (Biota 2024f)** Scope: Targeted SRE survey Survey date: 24 October 2024
Black Cockatoo Foraging Habitat Quality (GHD 2025) (Appendix 3)	Scope: Main Roads requested GHD Pty Ltd to calculate the value of Carnaby's Cockatoo and FRTBC foraging habitat throughout the Proposal DE using the Bamford Consulting Ecologists (BCE) foraging habitat scoring system. Report date: March 2025
Anketell Road Upgrade Targeted Chuditch Survey (Biota 2024b) (Appendix 4)	Scope: As part of the environmental impact assessment for the project, Biota was commissioned to undertake a targeted survey for the Chuditch (*Dasyurus geoffroii*) in relation to the Anketell Rd Upgrade (Leith Road to Kwinana Freeway). Survey dates: Long-term cameras were deployed in January and February 2024; 04/01/2024 (five sites), 29/01/2024 (five sites) and 19/02/2024 (one site). Cameras remained at sites until 18/06/2024. Survey area: The survey area covers includes the entirety of the Anketell Road Upgrade referral boundary, Report date: November 2024

Survey / Report	Details
Survey of 34 nominated trees in the proposed Anketell Road Upgrade for their nesting value for black cockatoos (Australian Black Cockatoo Specialists 2024) (Appendix 5)	Scope: Main Roads commissioned Australian Black Cockatoo Specialists to assess the nesting value of black cockatoo species in the trees listed in the Biota consolidated report for the Anketell Road Upgrade (Categories 1-6, 34 trees) and perform a cursory assessment of Category 7 trees. A close visual inspection using drones, pole cameras, telephoto lenses, and ladders was conducted for 34 trees. The report details the suitability of these trees for Black Cockatoo nesting. Survey dates: 14 to 15 October 2024 Survey area: Survey of DBH trees identified from the Biota (2025) consolidated report. Report date: October 2024

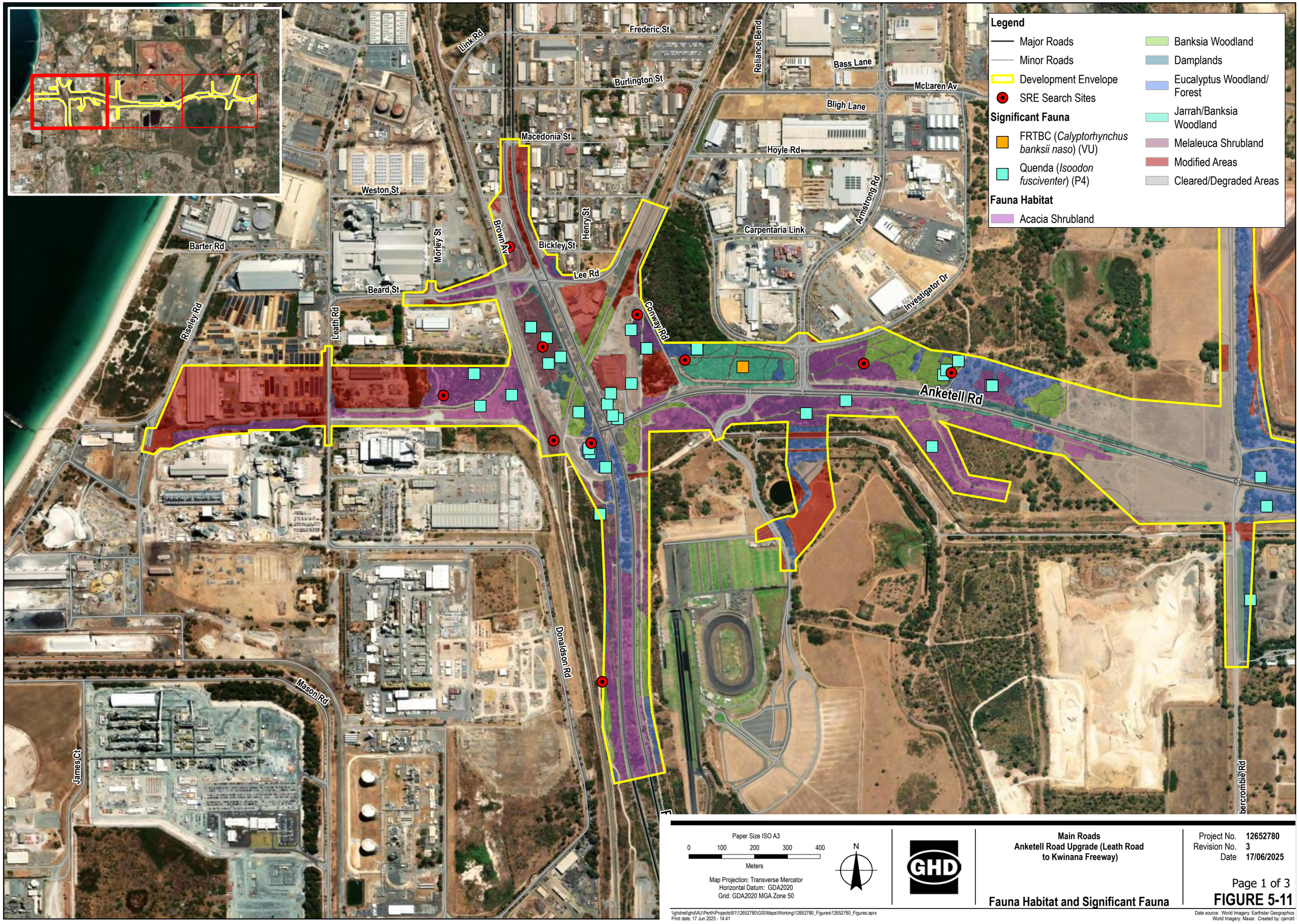
5.2.3.2 Fauna habitat

The DE contains seven fauna habitats (133.67 ha; 59.5% of the DE), comprising native (92.22 ha) and non-native/modified (41.45 ha) vegetation. The remainder of the DE comprised cleared and/or degraded areas (91.16 ha; 40.05%) (Biota 2025). A summary of fauna habitat types within the DE is presented in Table 5.13 and shown on Figure 5-11. SRE search sites in relation to fauna habitat types and the DE is also shown on Figure 5.11.

Table 5.13: Fauna habitats within the DE (and their corresponding vegetation units)

Fauna habitat type	Extent (ha) within the DE
Acacia Shrubland (A1, A2, A3, A4, T1) Landforms: Gentle slopes, coastal dunes. Substrate: Limestone rock, sandy soils. Vegetation: *Acacia rostellifera* shrublands, *A. saligna* shrubland, with mixed *Banksia* spp., *Xanthorrhoea* and *Hibbertia* and isolated *Eucalyptus marginata*. *Gaudium* over *Acacia* shrubland. Values: Habitat for Quenda. Sandy soils may provide habitat for fossorial species. *Banksia* species provide some foraging habitat for Black Cockatoos. Rocky microhabitats present.	27.97
Banksia Woodland (B2, B3, B4, B5, B6) Landforms: Gently sloping plains. Substrate: Sandy soils. Vegetation: *Banksia attenuata, B. menziesii, B. ilicifolia, B. sessilis* with *Adenanthos, Jacksonia, Kunzea, Xanthorrhoea, Hibbertia* and *Conostylis*. Values: Habitat for Quenda, Western Brush Wallaby, Chuditch (transitory basis only) and *Idiosoma sigillatum*. Leaf litter and fallen debris for SRE invertebrate groups. Sandy soils are favourable for fossorial species. *Banksia* species provide foraging habitat for Black Cockatoos.	16.60
Damplands (K1, M1, M2) Substrate: Loamy sand soils. Vegetation: *Melaleuca* low woodlands with *Astartea*, generally surrounded by *Kunzea*. Landforms: Seasonally inundated damplands. Values: Habitat for Quenda and in open areas, Glossy Ibis. Foraging habitat for birds of prey.	2.73

Fauna habitat type	Extent (ha) within the DE
Eucalyptus Woodland/Forest (E1, E5, E6, E7) Landforms: Gentle undulating slopes. Substrate: Loamy sand soils. Vegetation*: Eucalyptus gomphocephala, E. decipiens, E. foecunda, E. marginata* forest over *Banksia* spp., *Acacia rostellifera,* with *Allocasuarina fraseriana* woodland and *Xanthorrhoea preissii* grass trees*.* Values: Habitat for Quenda with Black Cockatoo foraging tree species. Sandy soils may provide habitat for fossorial species. Leaf litter and fallen debris for SRE invertebrate groups.	32.70
Jarrah/Banksia Woodland (EB1) Landforms: Gentle slopes. Substrate: Sandy soils. *Vegetation: Eucalyptus marginata* and *Banksia menziesii/B. attenuata* woodland over *Kunzea, Hibbertia hypericoides* and *Acacia* spp. Shrublands and *Xanthorrhoea brunonis* over scattered herbland/grassland. Values: Habitat for Quenda, Chuditch and Western Brush Wallaby (transitory only) and Black Cockatoo species.	7.57
Melaleuca Shrubland (M4, M5, M6) Substrate: Limestone rock, sandy soils. *Vegetation: Melaleuca systena*, *M. huegelii* over *Xanthorrhoea*, *Spyridium globulosum*, *Templetonia retusa*, and mixed *Acacia spp.* Values: Habitat for Quenda. Sandy soils are favourable for fossorial species. Rocky limestone microhabitats.	4.64
Emergent Flooded Gum and Marri (R2) Vegetation: Modified/Planted *Callistemon* and *Calothamnus* on roadsides. Values: Potential foraging habitat for Black Cockatoo species.	5.66
Modified areas (IP, ML, R3) Substrate: Silt loam, loamy sand. Vegetation: Isolated trees over previously cleared areas or pasture, modified or revegetated areas of mixed *Banksia*, man-made drainages and land modified for farming or residential purposes. Values: Pastures provide potential habitat for Glossy Ibis. Foraging habitat for birds of prey.	35.79
Sub-total fauna habitat	**133.67**
Cleared/degraded areas (CL, D, RR)	91.16
Total	**224.83**



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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Fauna Habitat and Significant Fauna

Project No. **12652780**
Revision No. **3**
Date **17/06/2025**

FIGURE 5-11

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Fauna Habitat and Significant Fauna

Project No. **12652780**
Revision No. **3**
Date **17/06/2025**

FIGURE 5-11

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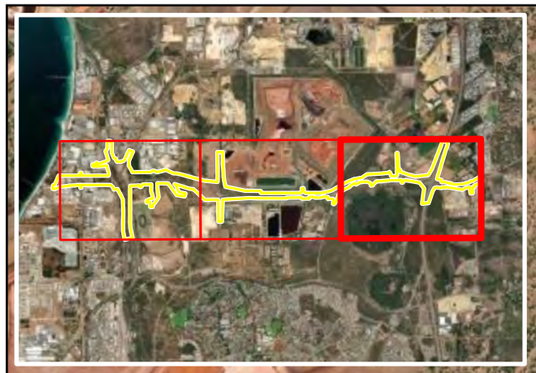

Legend

- Major Roads
- Minor Roads
- Development Envelope
- SRE Search Sites

Significant Fauna

- Quenda (*Isoodon fusciventer*) (P4)

Fauna Habitat

- Banksia Woodland
- Damplands
- Emergent Flooded Gum and Marri, planted eucalypts
- Eucalyptus Woodland/ Forest
- Jarrah/Banksia Woodland
- Modified Areas
- Cleared/Degraded Areas

Norkett Rd
Mandogalup Rd
Hoffman Rd
Mornington
Darling Ch
Turnix St
Cycad Rtt
Sida St
Kentia Rd
Aquila Dr
Kenby Ch
Foxtail Gr
Tawny Lane
Waratah Way
Jarrah Cl
De Haer Rd
Anketell Rd
Clementi Rd
Collerson St
Bonney Rd
Narran St
Albina Av
Seppings St
Flannigan St
Halbert Rise
Selina St
Cronin Way
Ace St
Treeby Rd
Kwinana Fwy
Spectacles Dr
McLaughlan Rd

Paper Size ISO A3

0 100 200 300 400

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Fauna Habitat and Significant Fauna

Project No. **12652780**
Revision No. **3**
Date **17/06/2025**

FIGURE 5-11

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5.2.3.3 Fauna diversity

The Biota (2025) report identified 49 vertebrate fauna species within the survey area during the field survey, including 34 birds, 9 mammals and six reptiles. Of these, 42 fauna species are native with evidence of seven introduced mammals including the Red Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*), Domestic Dog (*Canis familiaris*), Cat (*Felis catus*), House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*) and European Cattle (*Bos primigenius taurus*) recorded during the survey. The assemblage recorded within the survey area is likely to be an adequate representation of fauna values of the survey area (Biota 2025).

5.2.3.4 Significant fauna

Desktop searches identified 19 significant fauna species as present or potentially present within a 5 km buffer of the DE. This included 17 vertebrate species and two invertebrate species. Biota (2025) completed a likelihood of occurrence assessment prior to the field surveys. This assessment also included an additional invertebrate species, the short-tongued bee (*Neopasiphae simplicior*), despite previous records being more than 5 km away from the survey area little is known about the species ecology and distribution. Following the field surveys, the likelihood of occurrence assessment was updated. Post-survey the assessment concluded that four species have been recorded in the survey area as part of the Biota surveys or previous surveys, three species are considered likely to occur in the survey area, and four species may occur in the survey area. The remaining species are considered unlikely to or would not occur in the DE and are not considered further in the sections below.

Two significant fauna species were recorded during Biota surveys (Biota 2025), based on observation or evidence, these were:

- Forest Red-tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii naso*) (Vulnerable) - foraging evidence
- Quenda (*Isoodon fusciventer*) (Priority 4) – direct observation.

For significant species potentially occurring, additional consideration of habitat availability and types within the survey area were considered by Biota (2025) against the definitions below:

- Core: equivalent to "habitat critical to the survival of the species" as per DoE (2013b). This comprised habitat considered to potentially contain roosting, denning or breeding sites, primary foraging areas, or refugia during drought, fire or other stress
- Secondary: habitats which may be used on a transitory, dispersing or occasional basis and for secondary foraging, but does not represent core habitat.

A summary of the listed significant fauna likelihood of occurrence assessment for the DE, categorised according to Core or Secondary potential habitat (adapted from Biota (2025)), is provided in Table 5.14.

Table 5.14: Habitat classification in relation to significant fauna likelihood of occurrence assessment for the survey area (adapted from Biota (2025) Table 9.1)

Species	Conservation Status	Likelihood of Occurrence	Core habitat (Biota 2025)	Secondary habitat (Biota 2025)
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	EPBC Act: Vulnerable BC Act: Vulnerable	Recorded in current survey (foraging evidence)	Jarrah/*Banksia* Woodland	Emergent Flooded Gum and Marri Eucalyptus Woodland/ Forest
Isoodon fusciventer Quenda	DBCA: Priority 4	Recorded in current survey	Acacia shrubland Banksia Woodland Damplands, Eucalyptus Woodland/ Forest Jarrah/Banksia Woodland	-
Zanda latirostris Carnaby's Cockatoo	EPBC Act: Endangered BC Act: Endangered	Previously recorded	Banksia Woodland Jarrah/*Banksia* Woodland	Emergent Flooded Gum and Marri Eucalyptus Woodland/ Forest
Lerista lineata Perth Lined Slider	DBCA: Priority 3	Previously recorded	Acacia Shrubland Banksia Woodland	-
Neelaps calonotos Black-striped Snake	DBCA: Priority 3	Likely to occur	Acacia Shrubland Banksia Woodland	-
Falco peregrinus Peregrine Falcon	DBCA: Specially Protected	Likely to occur (foraging visitor)	-	All habitats
Synemon gratiosa Graceful Sunmoth	DBCA: Priority 4	Likely to occur	Acacia Shrubland Banksia Woodland	-
Idiosoma sigillatum Swan Coastal Plain Shield–backed Trapdoor Spider	DBCA: Priority 3	May occur	Banksia Woodland Eucalyptus Woodland/ Forest Jarrah/Banksia Woodland	
Dasyurus geoffroii Chuditch	EPBC Act: Vulnerable BC Act: Vulnerable	Very unlikely to occur (Biota 2024b)	-	Banksia Woodland Eucalyptus Woodland/ Forest Jarrah/Banksia Woodland

Species	Conservation Status	Likelihood of Occurrence	Core habitat (Biota 2025)	Secondary habitat (Biota 2025)
Notamacropus Irma Western Brush Wallaby	DBCA: Priority 4	May occur (in transit)	-	Banksia Woodland
Plegadis falcinellus Glossy Ibis	EPBC Act: Marine, Migratory BC Act: Migratory	May occur (foraging visitor)	-	Modified Areas Damplands

5.2.3.4.1 Black Cockatoos

During the Biota surveys (Biota 2025), no individuals from any of the three Black Cockatoo species were recorded within the survey area. However, foraging evidence for FRTBC was recorded.

The Proposal is located within the mapped distribution of Carnaby's Cockatoo (Endangered EPBC Act and BC Act) and FRTBC (Vulnerable EPBC Act and BC Act) (DAWE 2022).

Baudin's Cockatoo (*Zanda baudinii*) was identified in the desktop searches, but there are no confirmed records of the species within the study area and the Proposal is outside of the species' currently modelled distribution (DAWE 2022). Baudin's Cockatoos are uncommon on the northern SCP, anywhere north of Rockingham, and in these more northerly areas, records generally occur at the eastern fringe of the SCP (Johnstone et al. 2010, DAWE 2022). At the latitude of the survey area, Baudin's have rarely been recorded west of Byford (Biota 2025). Baudin's Cockatoo was considered unlikely to occur in the survey area by Biota (2025). Given the above justification Baudin's Cockatoo are not considered further in this assessment.

Breeding habitat

Black Cockatoo breeding habitat is considered to consist of a tree species known to support breeding 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 (being greater than 500 mm DBH for most Eucalypts or 300 mm DBH for Wandoo and Salmon Gum) (DAWE 2022).

Whilst Carnaby's Cockatoo are likely to forage within the survey area, they are unlikely to breed within it, with the species current breeding range not extending north of Rockingham or west of the Darling Scarp in more northerly areas of the SCP (Johnstone et al. 2010, DAWE 2022). No Black Cockatoo breeding activity nor definitive evidence of breeding was observed within the DE during the Biota surveys (Biota 2025) and the nearest breeding site recorded is approximately 13.5 km away on the SCP (Biota 2025).

Biota (2025) recorded a total of 590 suitable DBH trees within the DE, which were assigned to a Category description. Of these, 29 trees contained hollow(s) that required further investigation to determine suitability for Black Cockatoo breeding (Categories 2 to 6). No hollows were observed in use by Black Cockatoos during the Biota surveys (Biota 2025), nor were signs of use detected in any trees, noting that Black Cockatoos are not known to breed in the area. Of the 29 trees recorded, tree species included Tuart (n=13), Jarrah (n=13) and three unknown eucalypts (stag). Black Cockatoo tree types recorded by Biota (2025) are summarised in Table 5.15 and mapped in Figure 5-12.

Table 5.15: Summary of breeding habitat tree types within the DE

Category Number	Category description	Number of trees in DE
1	Suitable DBH Tree with Known Nesting Hollows	0
2-6	Suitable DBH Tree with hollow(s) requiring further investigation	29
7	Suitable DBH Tree without hollows	561
Total		**590**

Post Biota surveys, ABCS (2024) completed a follow up assessment of trees assigned to Categories 2-6 by Biota to assess Black Cockatoo nesting value and provide further information on the suitability of hollows. The assessment included performing close visual inspections using a high-resolution 14m camera pole and telephoto lens, capturing high-resolution photographs of each hollow's nesting activity and condition, analysing the photos to assess each hollow's suitability for nesting and recording details of any current usage by both target (Black Cockatoos) and non-target species. ABCS (2024) successfully located all trees within the DE, however, access to three trees was not granted (Tree IDs 187, 188 and 270).

ABCS (2024) concluded that 6 trees each had 1 hollow suitably sized for Black Cockatoos (i.e. 6 trees had 6 hollows suitability sized for Black Cockatoos). The remainder of trees assessed had no suitable Black Cockatoo hollows. Of the three trees that couldn't be accessed, two were assessed as Unknown to contain suitable hollows and one was assessed as Unlikely to contain suitable hollows. ABCS (2024) recorded an additional two suitable DBH trees within the DE during their assessment. Of these additional two trees, one contained one hollow suitable for Black Cockatoos.

Potential Black Cockatoo breeding trees with suitable hollows as assessed by ABCS (2024) are summarised in Table 5.16 and mapped in Figure 5-12.

Table 5.16: Summary of potential breeding trees with suitable hollows within the DE

Tree ID	Species	DBH	Hollow no.	Suitability	Comments (ABCS 2024)
186	Jarrah	610	3	Yes	Fragile dead stag. Top hollow too small, Middle hollow duck eggs, suitable size for black cockatoos, lower hollow some duck down however too shallow. No sign of black cockatoo use.
269	Eucalyptus	960	1	Yes	Duck eggs and down. One suitable black cockatoo hollow.
275	Eucalyptus	1270	1	Yes	Dead stag, one hollow that joins other, one suitable size for black cockatoos.
281	Tuart	1160	2	Yes	Little Corella flushed from upper hollow. Brooding four nestlings, Suitable black cockatoo hollow (one).
459	Tuart	1230	1	Yes	Upper hollow Suitable for black cockatoos, small amount of duck down.
460	Jarrah	1210	1	Yes	Middle hollow suitable size black cockatoo hollow, suspect all join together.

Tree ID	Species	DBH	Hollow no.	Suitability	Comments (ABCS 2024)
270	Jarrah	710	1	Unknown	Unable to get access to land. Unable to get Drone close enough to assess potential hollow.
187	Jarrah	1150	1	Unknown	Unable to get access to land. Drone photos not conclusive. Galah's prospecting in the upper and middle hollows. Bees in lower hollow. Biota (2025) categorised this tree as being a suitable DBH tree with a marginally unsuitable hollow with no signs of use.
188	Jarrah	710	1	Unlikely	No access to area. From the size (DBH of 710) of the tree and hollow entries (burnt) viewed by 500mm lens camera it is unlikely to have suitable black cockatoo hollows.
AI02	Tuart	1001	1	Yes	Chipping on entry most like Corella or Galah. One suitable black cockatoo hollow.

There is a total of 592 suitable DBH trees within the DE, this includes 590 trees recorded by Biota (2025) and two trees recorded by Australian Black Cockatoo Specialists (ABCS) (2024). Of these 592 trees, eight trees contained eight hollows suitable for use by Black Cockatoos, including:

- six trees recorded by Biota (2025) and assessed by ABCS (2024) as containing six hollows suitable for use by Black Cockatoos.
- one tree recorded by Biota (2025) containing one potential hollow, which could not be accessed by ABCS (2024) and was rated as Unknown (Tree ID 270).
- one tree recorded and assessed by ABCS (2024) as containing one hollow suitable for use by Black Cockatoos.

Two trees recorded by Biota (2025) that could not be assessed by ABCS (2024) and were rated as Unknown (Tree ID 187) and Unlikely (Tree ID 188) were not considered to contain suitable hollows and have not been included in the tree and hollow totals above.

Roosting habitat

Roosting habitat refers to habitat which contains known roosting, or potential roosting trees, and roosting locations are generally in close proximity (usually within 2 km) of a permanent water source and in areas of high quality foraging habitat (DAWE 2022). Potential roosting habitat is generally a tall tree or group of trees (typically the tallest), usually close to an important water source (generally within 2 km), and within an area of quality foraging habitat (Biota 2025).

No evidence of roosting was recorded within the DE, nor did the BirdLife Australia database of Great Cocky Count roost data return any roosts within the survey area (Biota 2025). Figure 5-13 presents potential roosting sites and confirmed roosting sites from the Great Cocky Count (Peck et al., 2019). There are 15 identified roost locations within a 5 km radius of the DE, with the closest occurring approximately 2.5 km south of the eastern end of the DE in Marri Park Golf Course. A total of 28 roost sites were returned from the BirdLife Australia data from a 12 km radius of the DE.

The DE does not intersect any areas of permanent water, although the very limited extent of damplands may be used when seasonally inundated. A portion of the survey area intersects the northernmost fringes of the Spectacles Wetland, which represents a significant permanent water source in proximity to the DE. The larger Tuart and Jarrah trees bordering this wetland represent some of the most prospective roosting habitat.

No Roosting habitat has been mapped within the DE (Biota 2025).

Foraging habitat

Foraging evidence for Carnaby's Cockatoo and FRTBC were recorded from the Biota surveys throughout the DE (Biota 2025). Foraging resources for Black Cockatoo species are available within the DE.

Black cockatoo foraging habitat quality was initially rated using DCCEEW's Habitat Scoring System for WA Black Cockatoo foraging (HQS). The HQS system was developed by the DCCEEW with input from WA specialists to calculate the value of offsets for Black Cockatoo species. The system is intended to rate the quality of habitat to be used for the purposes of offsetting residual impacts from development proposals. The HQS system was provided informally by DCCEEW to Main Roads. It was used in conjunction with the results of desktop and field surveys conducted by Biota (2025) to determine the value of foraging habitat for black cockatoos across the survey area for the Proposal.

Considering comments, limitations and other assessment methods post-referral, Main Roads have determined that the Bamford Consulting Ecologists (BCE) foraging habitat scoring system (BCE 2020) is more appropriate for use for the Proposal. The BCE system has four components: site condition, site context and species density (stocking rate) to calculate an overall score out of 10 and a moderation component. The calculated numerical foraging value score reflects the significance of vegetation as foraging habitat for Black Cockatoos (BCE 2020).

The BCE foraging habitat scoring system (BCE 2020) was used to rate the quality of foraging habitat within the DE (GHD 2025). The majority of the DE was rated as having an overall score of 1/10 using the BCE system (GHD 2025). These areas were scored 0 (No foraging value) or 1 (negligible to low foraging value) for site condition as they lacked potential source foods or had <2% cover of known food plants for Carnaby's Cockatoo / <1% cover of known food plants for FRTBC. Areas with an overall score of 1/10 or lower using the BCE system were not considered forging habitat for Carnaby's Cockatoo or FRTBC. It is considered that the foraging habitat scores within the DE have been calculated very conservatively, particularly as it relates to the moderation of scores and the site context scoring.

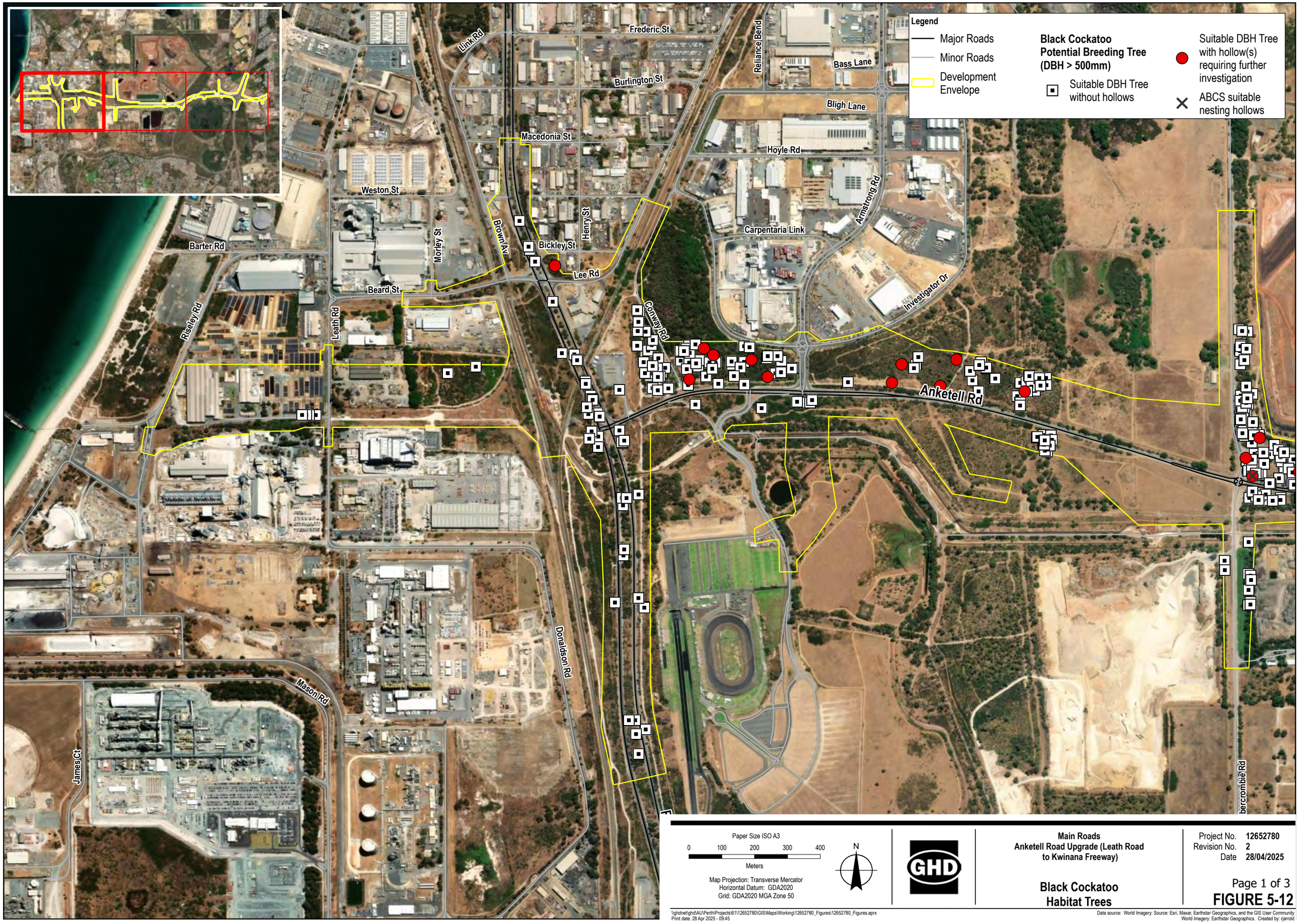
There is 56.98 ha of foraging habitat for Carnaby's Cockatoo and 38.34 ha of foraging habitat for FRTBC within the DE. For Carnaby's Cockatoo nine vegetation units had an overall score of 4/10 to 7/10 (GHD 2025). These included *Banksia* dominated communities or where *Banksia* species were present in the mid-storey with *Eucalyptus* species present in the overstorey. One vegetation unit, EB1 (7.57 ha) had an overall score of 7/10. This unit scored 5 (Moderate to high foraging value) for site condition as it was dominated by *Eucalyptus marginata* subsp. *marginata*, *Banksia menziesii* and *B. attenuata* and was mostly in Good or Very Good condition (GHD 2025).

For FRTBC, two vegetation units had overall scores of 4/10 and 7/10 (GHD 2025). This included E1 that contained occasional *Eucalyptus marginata* subsp. *marginata* in the overstory and EB1 that was dominated by *Eucalyptus marginata* subsp. *marginata* in the overstorey (GHD 2025).

Table 5.17 summarises the Carnaby's Cockatoo and FRTBC foraging habitat within the DE. The extents of Carnaby's Cockatoo foraging habitat within the DE are shown on Figure 5-14 and the extents of FRTBC foraging habitat within the DE is shown on Figure 5-15.

Table 5.17: Black cockatoo foraging habitat quality scores using BCE system (adapted from GHD 2025)

Veg. Unit	Extent within DE (ha)	Carnaby's Cockatoo				FRTBC			
		Site condition	Site context	Species density	Overall score	Site condition	Site context	Species density	Overall score
B2	6.833	4	1	1	6	0	0	0	0
B3	0.527	4	1	1	6	0	0	0	0
B4	4.223	2	1	1	4	0	0	0	0
B5	3.791	2	1	1	4	0	0	0	0
B6	1.227	2	1	1	4	0	0	0	0
E1	30.775	2	1	1	4	2	1	1	4
E5	0.387	2	1	1	4	1	0	0	1
EB1	7.570	5	1	1	7	5	1	1	7
R3	1.646	4	1	0	5	1	0	0	2
Total					**56.98 ha**				**38.34 ha**



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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Habitat Trees

Project No. **12652780**
Revision No. **2**
Date **28/04/2025**

Page 1 of 3
FIGURE 5-12

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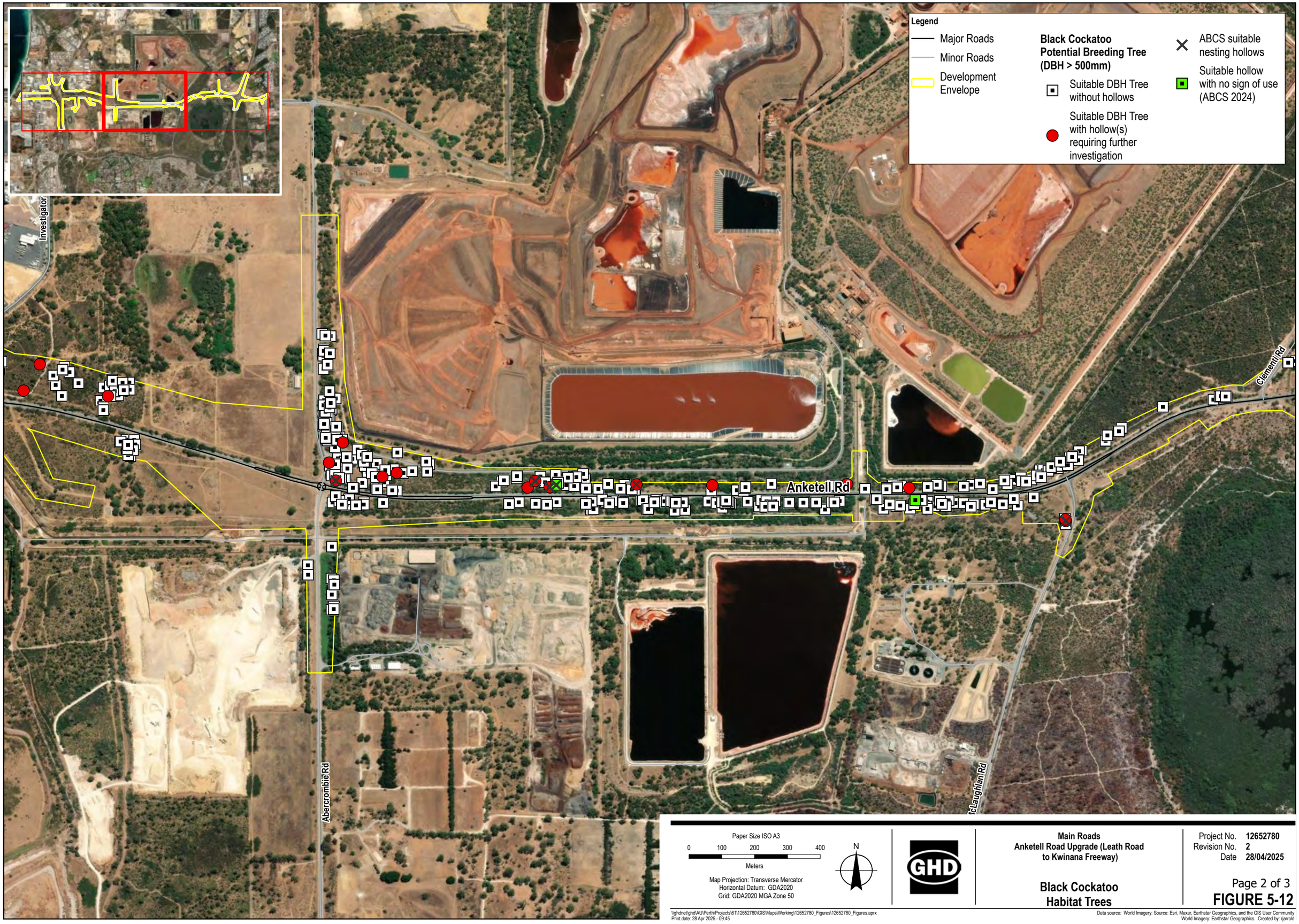

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Habitat Trees

Project No. **12652780**
Revision No. **2**
Date **28/04/2025**

Page 2 of 3
FIGURE 5-12

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World Imagery: Earthstar Geographics. Created by: rjarrold

Legend

- Major Roads
- Minor Roads
- Development Envelope

Black Cockatoo Potential Breeding Tree (DBH > 500mm)

- Suitable DBH Tree without hollows
- Suitable DBH Tree with hollow(s) requiring further investigation
- ABCS suitable nesting hollows
- Suitable hollow with no sign of use (ABCS 2024)

Norkett Rd
Mandogalup Rd
Hoffman Rd
Clementi Rd
Kwinana Fwy
Spectacles Dr
McLaughlan Rd
Anketell Rd
De Haer Rd
Jarrah Cl
Treeby Rd
Bonney Rd
Seppings St
Cronin Way
Collerson St
Narran St
Flannigan St
Halbert Rise
Ace St
Albina Av
Selina St
Nepine Vsta
Sida St
Kentia Rd
Aquila Dr
Foxtail Gr
Tawny Lane
Waratah Way
Kenby Ch
Turnix St
Cycad Rtt
Pixie Lane
Atalaya Loop

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Meters

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Habitat Trees

Project No. **12652780**
Revision No. **2**
Date **28/04/2025**

FIGURE 5-12

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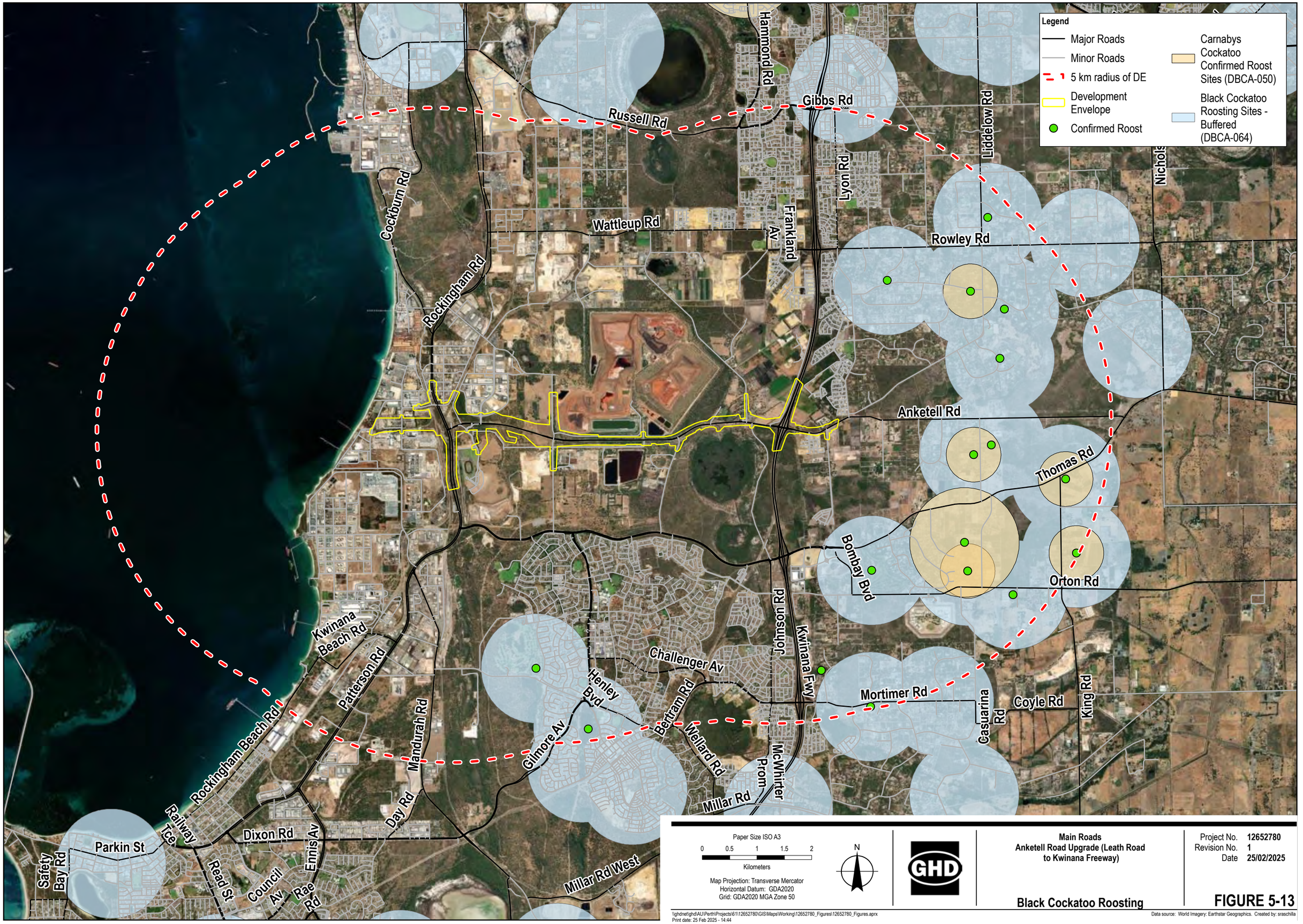

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Roosting

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

FIGURE 5-13

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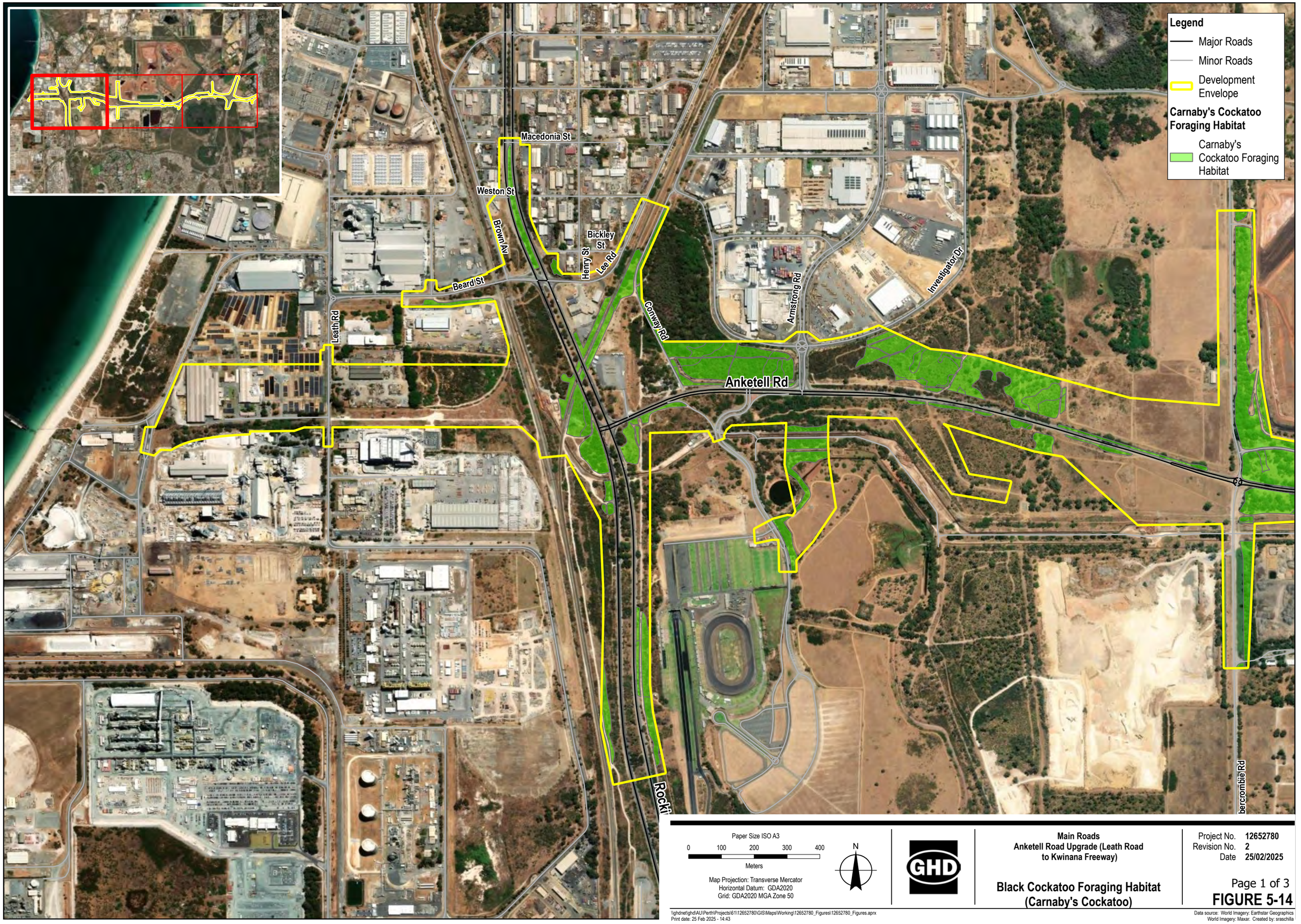

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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

FIGURE 5-14

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

FIGURE 5-14

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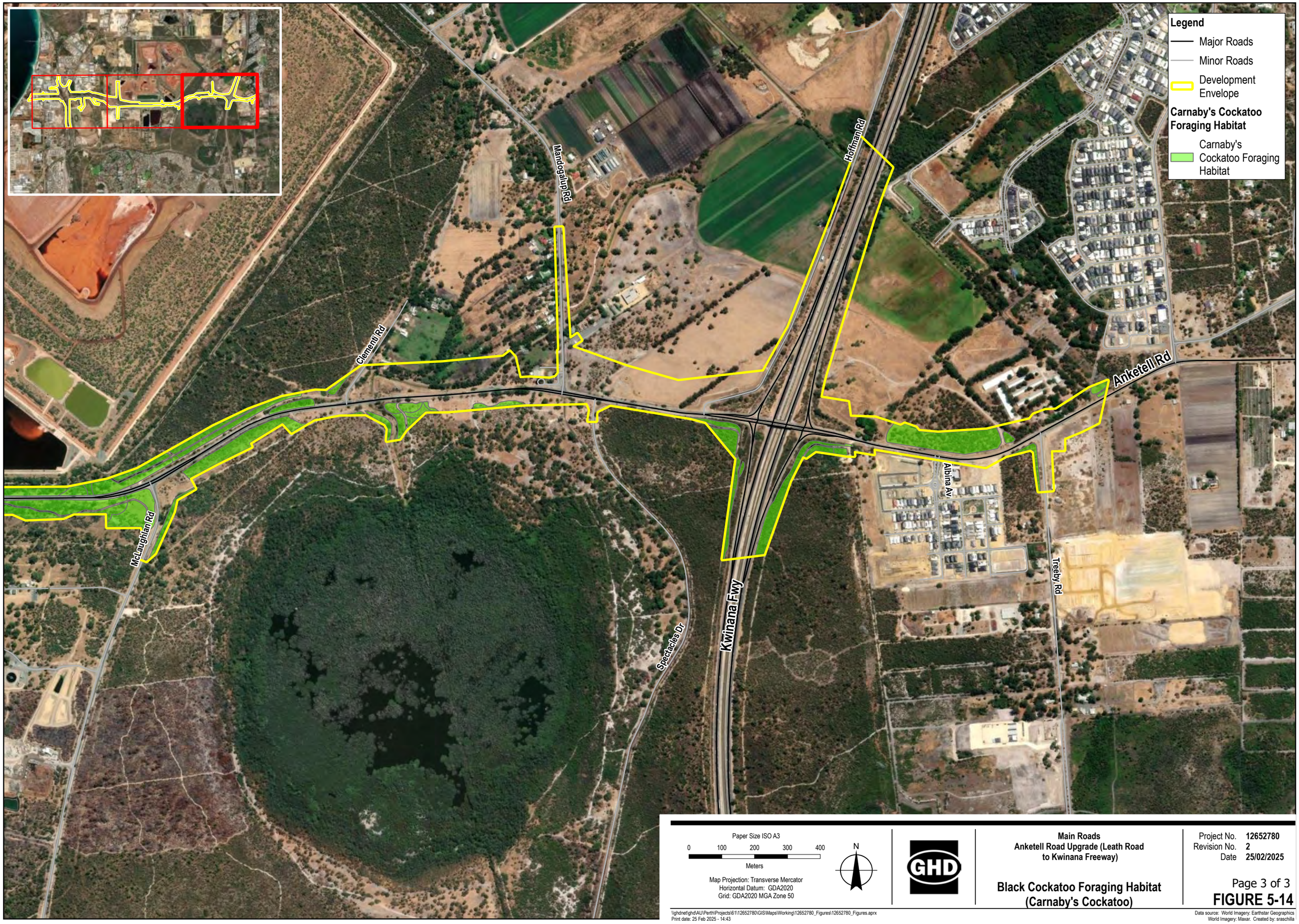

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 3 of 3
FIGURE 5-14

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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 1 of 3
FIGURE 5-15

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 2 of 3
FIGURE 5-15

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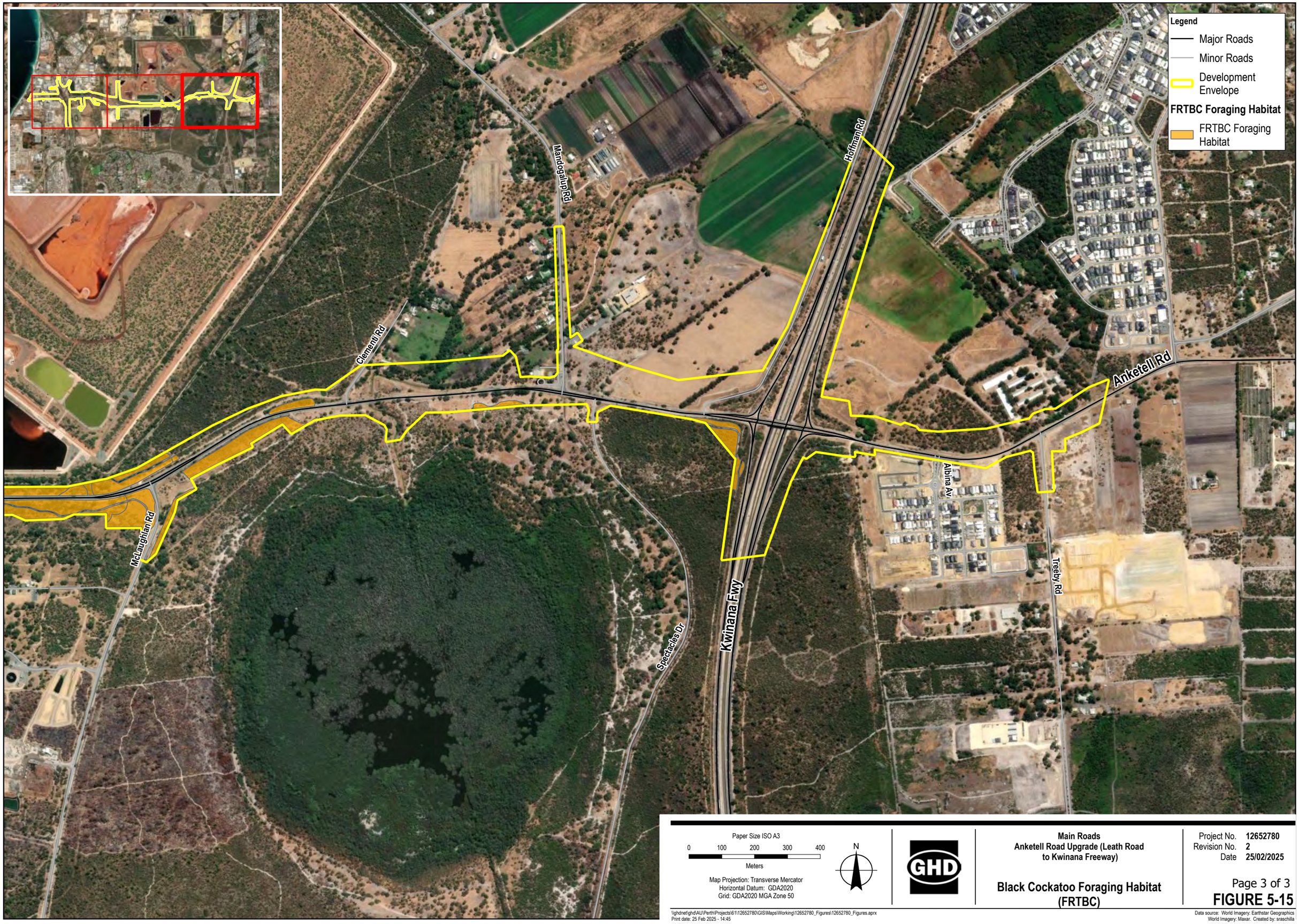

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Map Projection: Transverse Mercator
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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

FIGURE 5-15

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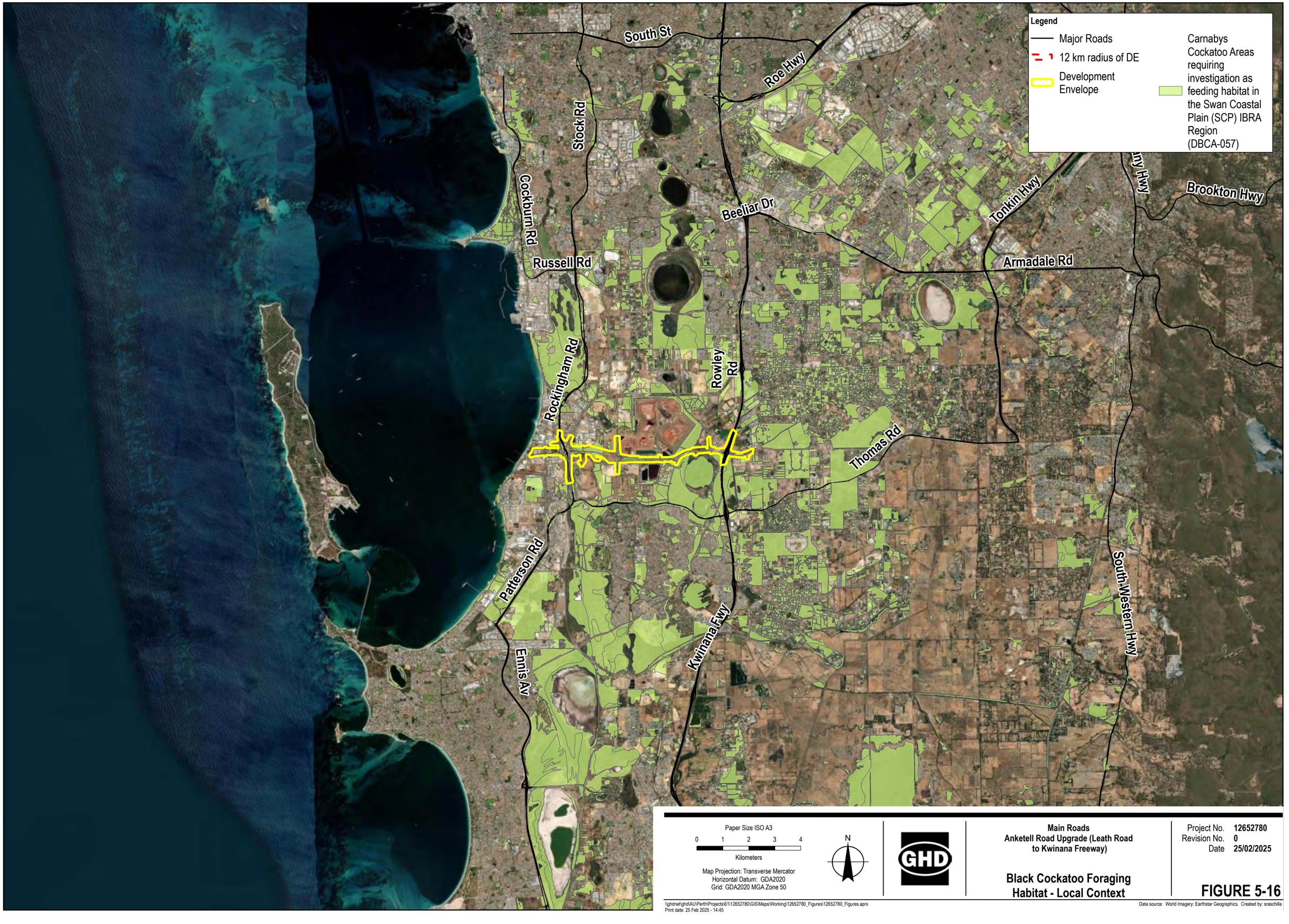

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Black Cockatoo Foraging Habitat - Local Context

Project No. **12652780**
Revision No. **0**
Date **25/02/2025**

FIGURE 5-16

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Data source: World Imagery: Earthstar Geographics. Created by: srascnilla

5.2.3.4.2 Quenda

Quenda occur patchily throughout southwestern Australia from north of Perth to Esperance. The species inhabits a variety of forest, woodland, shrubland and heath communities, but prefer areas of denser vegetation, including wetland fringes and heathland (Biota 2025). It also favours sandy substrates to allow for digging up food and often occurs in association with wetland areas (van Dyck and Strahan 2008).

Quenda were recorded via direct observation, motion cameras and diggings throughout the survey area (Biota 2025). Between 1990 and 2016 there have been numerous records of the species in the locality, in addition to the sightings and diggings recorded in the current survey (Biota 2025). Quenda were recorded from a variety of habitat types including *Banksia* and eucalypt woodlands, *Acacia* shrublands, and *Melaleuca* shrublands.

There is 87.58 ha of core habitat for Quenda present in the DE, including fauna habitat types Acacia shrubland, Banksia Woodland, Damplands, Eucalyptus Woodland/ Forest and Jarrah/Banksia Woodland. The extents of Quenda habitat are mapped in Figure 5-17.

5.2.3.4.3 Perth Lined Slider

The Perth Lined Slider occurs in a small coastal area between Perth and Mandurah, with isolated populations on Rottnest Island, Woodleigh Station in the mid-west coast, and Busselton (Wilson and Swan 2017). Preferred habitat for the species includes sandy coastal heath and shrubland on lower west coast (Biota 2025).

This species has been recorded previously within the DE on two occasions between 2007 and 2014, with two additional records within the survey contextual area (Biota 2025). There is 44.57 ha of core habitat for the Perth Lined Slider present in the DE in fauna habitat type Banksia Woodland and Acacia Shrubland.

5.2.3.4.4 Black-striped Snake

The Black-striped Snake is restricted to the sandy coastal strip of the SCP between Mandurah and Lancelin, with some records existing inland of Gingin, Bullsbrook and Caversham. Preferred habitat for the species includes dunes and sandplains vegetated with heaths and Eucalypt or Banksia woodlands mostly along the SCP (Biota 2025).

Although not recorded in the current survey, there is a historical record of the species in the western end of the contextual area, and the remains of one individual were recorded in a previous survey not far from the survey area (Biota 2021). There is 44.57 ha of core habitat for the Black-striped Snake present in the DE in fauna habitat type Banksia Woodland and Acacia Shrubland.

5.2.3.4.5 Peregrine Falcon

The Peregrine Falcon occurs Australia-wide and inhabits a wide range of habitats, including forests, woodland, wetland and coastal areas, and open country (Pizzey and Knight 2007). Peregrine Falcons are likely to occur as foraging visitors in the survey area. The species has been recorded once approximately 5 km north of the survey in 2005 and on the west coast adjacent to the survey area during the Westport Last Mile Area shorebird survey in January 2024 (Biota 2025).

All fauna habitats (224.83 ha) within the DE represent secondary habitat for the Peregrin Falcon.

5.2.3.4.6 Graceful Sunmoth

The Graceful Sunmoth occurs on Coastal Banksia Woodland herbland, heathland or shrubland close to the coast. Preferred habitat for the species includes sedgelands, heathlands and woodlands, as well as coastal Banksia Woodland herbland, heathland or shrubland close to the coast (Biota 2025).

Graceful Sunmoth is likely to occur in the survey area. The desktop returned six records, recorded between 1948 and 2011. The oldest record occurs in the contextual area. Both known host plant species *Lomandra hermaphrodita* and *L. maritima* were recorded within the survey area. There is 44.57 ha of core habitat for the Graceful Sunmoth present in the DE in fauna habitat type Banksia Woodland and Acacia Shrubland.

5.2.3.4.7 Swan Coastal Plain Shield– backed Trapdoor Spider

The Swan Coastal Plain Shield-backed Trapdoor Spider occurs on the SCP in the southwest of Western Australia, with its range extending from Dalyellup north to Ledge Point, including Rottnest Island and Garden Island, and to the east as far as Boyanup north to Gingin (Rix et al. 2018). Once widespread throughout the Perth region, the species still occurs in remnant habitats such as, Kings Park, Bold Park, and Shenton Park bushland. Burrows have been found on the sandy soils of Banksia woodlands and heathland displaying a 'moustache-like' arrangement of twig-lines (Rix et al. 2018).

Swan Coastal Plain Shield-backed Trapdoor Spider may occur in the survey area. The Biota (2025) desktop assessment returned four records from the study area (DBCA and Atlas of Living Australia (ALA)), the most recent from 1977 and the nearest approximately 0.5 km away from the DE, just outside the survey contextual area. While core habitat is available within the DE (56.87 ha) in the form of Banksia woodland, Eucalyptus Woodland/Forest and Jarrah/Banksia Woodland, the species was not recorded despite targeted searches for their burrows, which are detectable with targeted effort by experienced zoologists.

5.2.3.4.8 Chuditch

The Chuditch formerly occurred over much of the Australian continent, across a wide range of habitats including woodlands, dry sclerophyll forests and desert areas, but is now restricted to south-western Australia (Woinarski et al. 2014). Isolated subpopulations of the species are still present in the Avon Wheatbelt, eastern Goldfields woodlands, and near Fitzgerald River National Park and Ravensthorpe Range (Woinarski et al. 2014).

Contemporary records of the Chuditch on the SCP are rare, but the species has been previously recorded in 2009 at the Wandi Nature Reserve, approximately 2.4 km east-northeast of the DE and in 2013 Beeliar Conservation Park, located south adjacent to the eastern part of the DE. As such, Biota (2025) assessed the Chuditch as having some potential, albeit low, to occur within their survey area at its eastern extent on a transitory basis particularly in areas adjacent to Beeliar Conservation Park. The Chuditch is considered unlikely to occur in the DE west of the freeway due to the prevalence of highly modified and cleared areas between suitable habitat fragments (Biota 2025). It was noted that east of the freeway, due to patches being isolated, Chuditch may only be present within the DE within the vegetation that runs alongside the freeway.

Biota (2024b) completed a targeted survey for the Chuditch to assess the likelihood of occurrence within the DE and whether any occurrence is likely to be as resident individuals utilising core habitat, or transitory use of secondary habitat types. The survey involving the deploying 11 motion-sensor cameras for 4-5 months both within the DE and nearby Jandakot and Beeliar Regional Parks. The cameras were placed in Jarrah woodland habitat where available or otherwise Banksia and Tuart woodlands. The Chuditch was not

recorded during the targeted survey and has not been recorded during previous Biota surveys for the Proposal. Biota (2024b) considers the Chuditch very unlikely to occur within the DE with no evidence of a population occurring even in the larger reserves nearby, Jandakot Regional Park and Beeliar Regional Park.

There is 56.87 ha previously designated as secondary habitat for the Chuditch present in the DE in fauna habitat types Banksia Woodland, Eucalypt Woodland/Forest and Jarrah/Banksia Woodland (Figure 5-18). However, Chuditch is considered highly unlikely to occur within the DE or in reserves nearby. Though Chuditch once occurred in areas now associated with the DE and its surrounds, given it is now unlikely to occur and the lack of connection to existing Chuditch populations, the Banksia Woodland, Eucalypt Woodland/Forest and Jarrah/Banksia Woodland within the DE is now not considered Chuditch habitat.

5.2.3.4.9 Western Brush Wallaby

The Western Brush Wallaby is endemic to the south-west of WA, and inhabits a wide range of habitats, including open forest and woodland, mallee, heathland, low open grasslands and thickets (Woinarksi and Burbidge 2016).

Records of the Western Brush Wallaby from the northern SCP are limited, the species is far more common in the better wooded Jarrah and Warren regions (Biota 2025). There are five historical records of the species occurring within 10 km of the survey area, the nearest is less than 3 km away on the Marri Park Golf Course (1999). Furthermore, the species was recorded on a motion camera approximately 3.5 km east of the survey area boundary, in Jarrah/Banksia woodland habitat by Biota (2022).

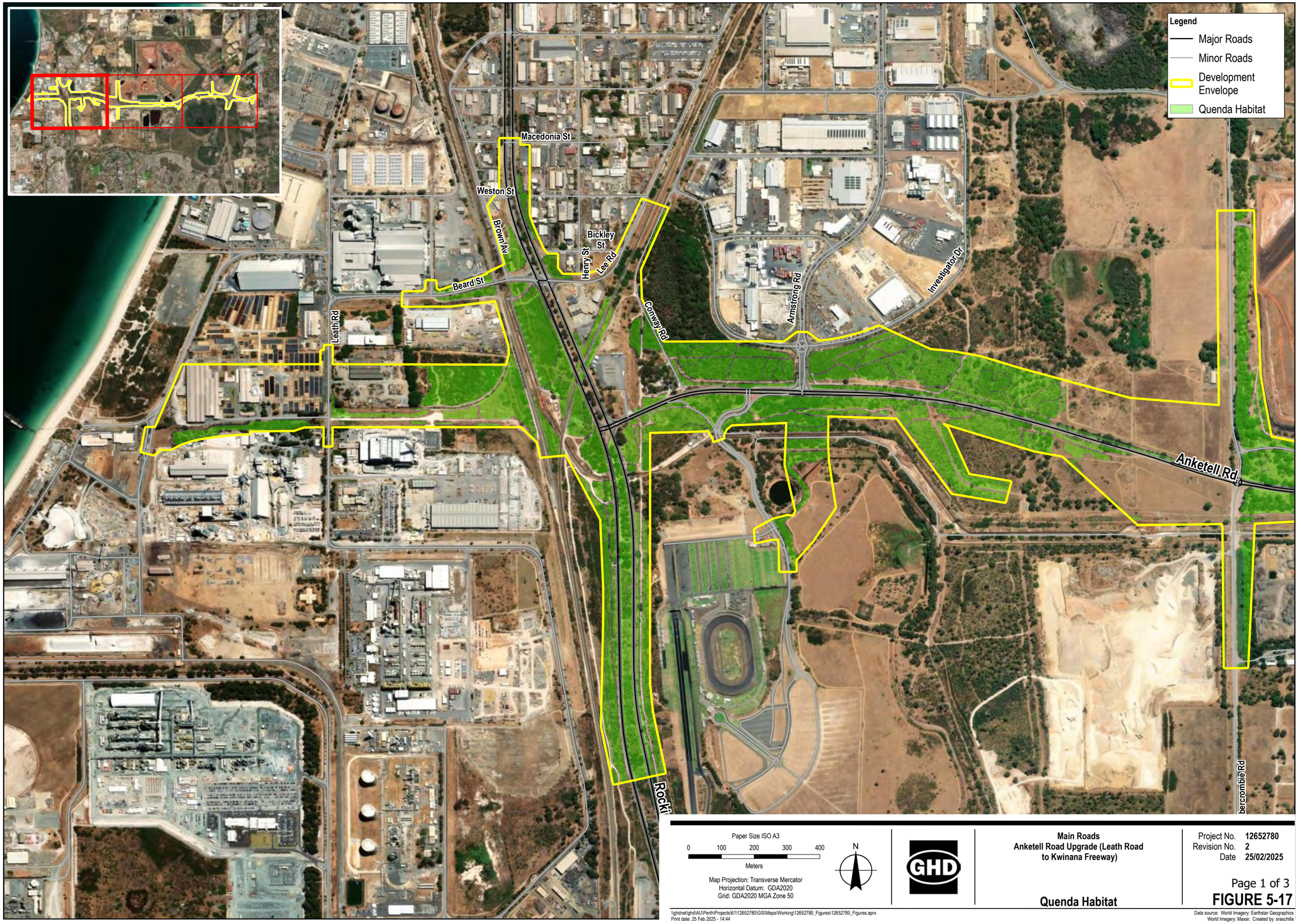
The species may occur in the DE based on the presence of 16.60 ha of suitable secondary Banksia Woodland habitat and a small number of local records. However, given the fragmented nature of the habitat within and surrounding the DE, and the presence of the Kwinana Freeway representing a barrier to the better wooded areas east of the freeway, it is considered unlikely to occur west of the Kwinana Freeway. The species is considered most likely to occur east of the Kwinana Freeway, particularly in the areas nearest to and in Beelar Conservation Park.

5.2.3.4.10 Glossy Ibis

The Glossy Ibis are widely distributed globally, and in Western Australia this species is particularly concentrated in well-watered flatlands of the Kimberley and SCP (Johnstone and Storr 1998). It is a non-breeding visitor to the SCP, where it is generally rare to uncommon but increasing in abundance (Johnstone and Storr 1998).

The Glossy Ibis may occur in the DE. Only two records of the species were returned from within the desktop study area, one within the survey contextual area near the Spectacles, the other south-east of the survey area in a paddock. However, given the presence of suitable habitat, particularly adjacent to the DE and the highly mobile nature of the species it is considered to have some potential for occurrence.

There is 38.53 ha of secondary habitat for the Glossy Ibis present in the DE in fauna habitat types Damplands and Modified areas.



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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Quenda Habitat

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 1 of 3
FIGURE 5-17

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Quenda Habitat

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FIGURE 5-17

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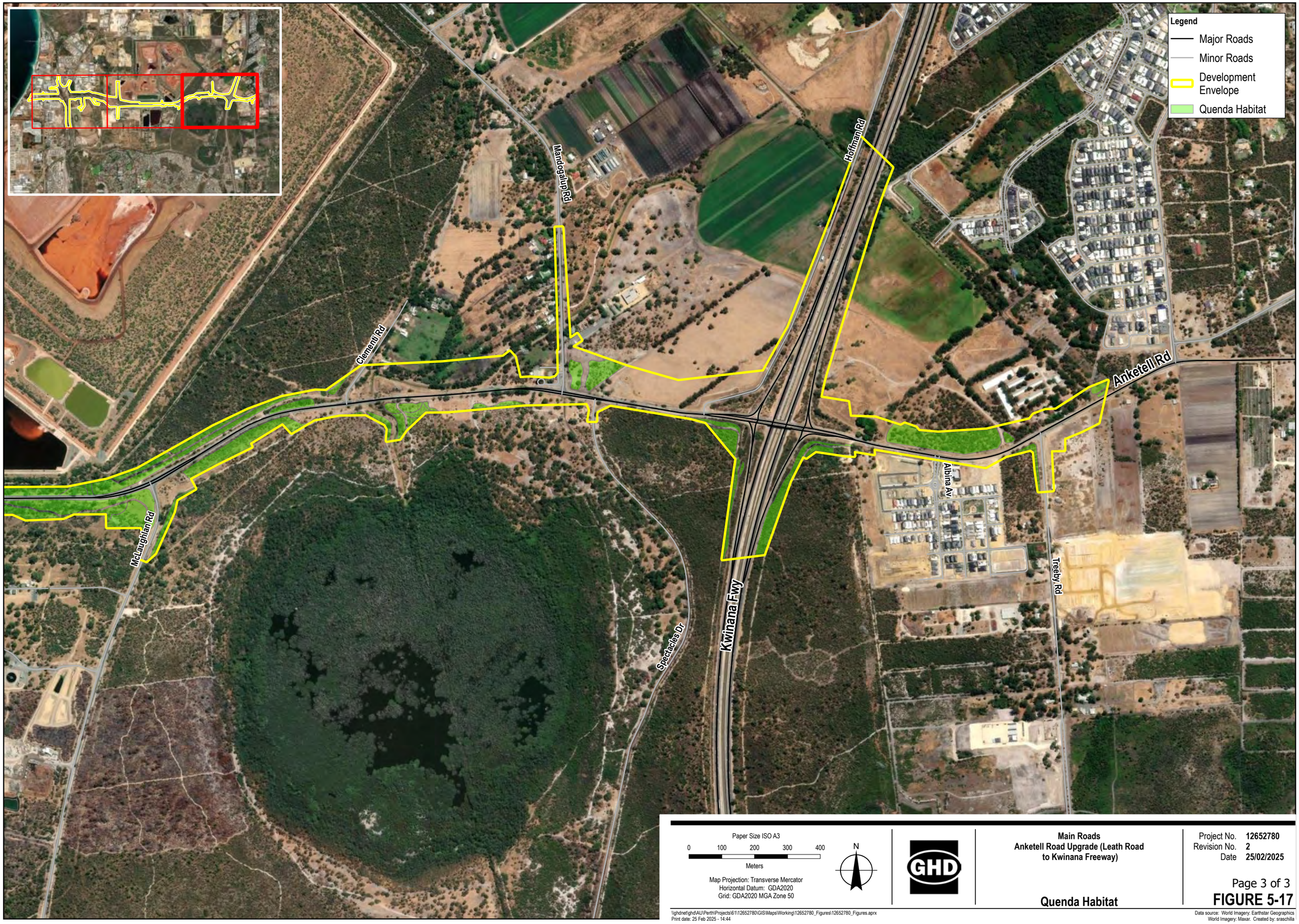

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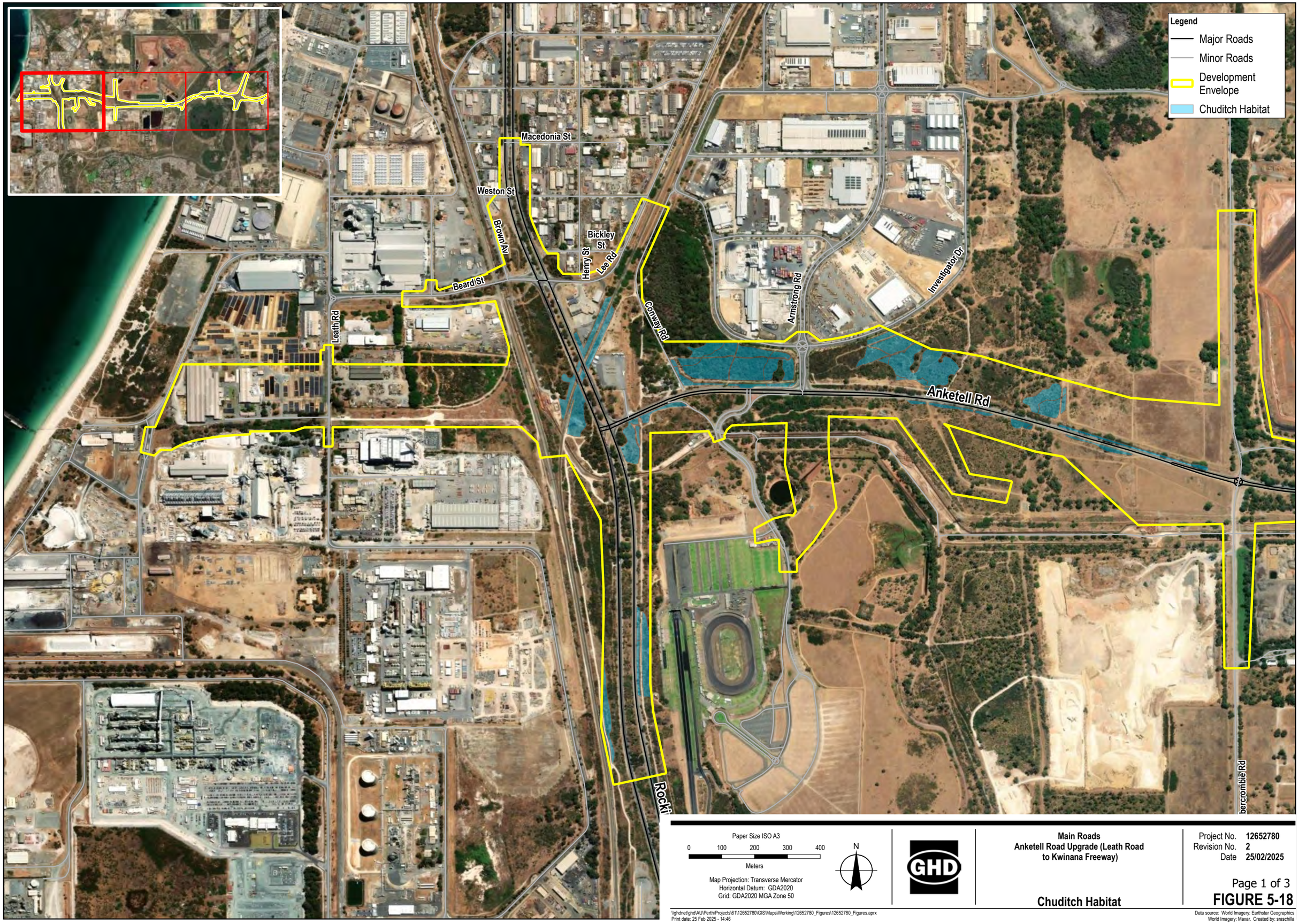

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Chuditch Habitat

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 1 of 3
FIGURE 5-18

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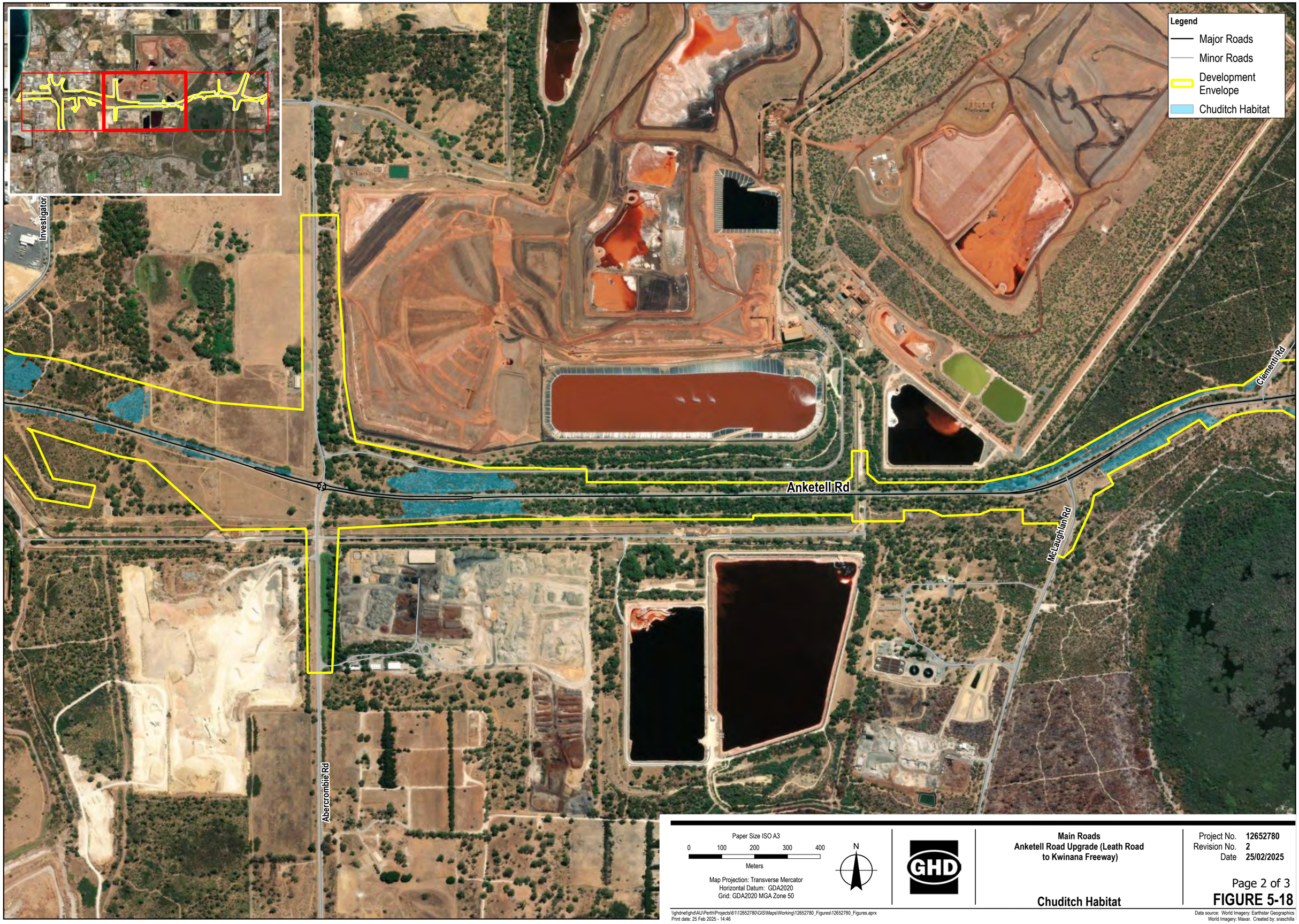

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Chuditch Habitat

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

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FIGURE 5-18

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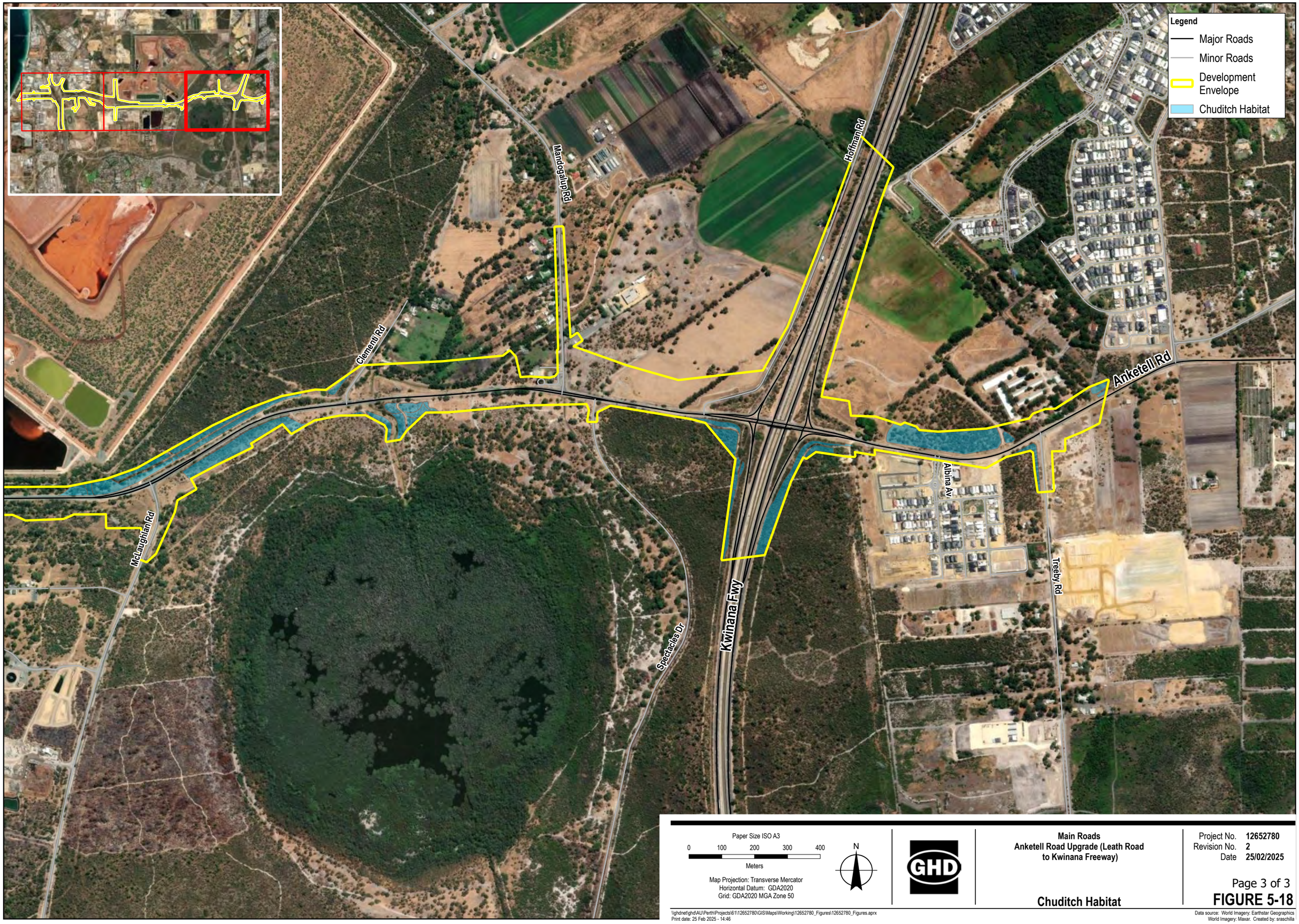

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FIGURE 5-18

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5.2.3.5 Short range endemic fauna

5.2.3.5.1 Habitats

The DE contains seven fauna habitats which provide microhabitats for SREs (Table 5.13 and Figure 5.11). Microhabitats supporting moisture for longer periods are more amenable to the non-burrowing groups prone to short-range endemism such as snails, millipedes, and isopods. These microhabitats include deep leaf litter, under rocks and fallen logs and other debris. Patches of these microhabitats were scattered throughout many of the fauna habitats with the DE (Biota 2025).

Woodland areas in better vegetation condition, particularly the Banksia woodland immediately west and east of Kwinana Freeway, offered many areas of accumulated leaf litter and debris suitable for SRE groups. Rocky habitats were less common and largely present as limestone outcropping within the Acacia Shrubland and Melaleuca Shrubland habitat types at the western coastal end of the DE. None of the known SRE species from the desktop study have a preference for this habitat type, however, many invertebrates from SRE-prone groups, particularly snails and millipedes, are saxicoline (living among rocks) (Biota 2025).

5.2.3.5.2 Species

Biota (2025) undertook a desktop study using the WA Museum (WAM) invertebrate databases and supplementary data sourced from ALA. The study identified 17 confirmed SRE invertebrate species within a 100 km buffer of the survey area. This total comprises eight mygalomorph spiders, four millipedes, three isopods and two annelids. Further examination of distributional records and habitat preferences for these taxa revealed that the vast majority demonstrate distributions localised to the Darling Scarp and are therefore not expected to occur within the survey area on the SCP. Two species were exceptions to this:

- Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*) (See Section 5.2.3.4.7)
- Isopod species *Buddelundia cinerascens* and *Buddelundia inaequalis* (likely represent the same species) - WAM records show both species exhibit a restricted distribution confined to the westerly margin of the SCP and Rottnest Island. Records suggest this species may occupy a range of habitats and microenvironments indicating the species may be widespread within the area (Biota 2025).

A further 88 taxa of unresolved taxonomy were considered to represent potential SREs, comprising: 42 mygalomorph spiders, 18 isopods, 16 millipedes, nine pseudoscorpions and three scorpions. The remaining taxa are either not considered SRE taxa due to demonstrated large distributions or because they lack enough taxonomic resolution to provide an accurate assessment of their status. However, they do belong to groups broadly recognised as prone to short-range endemism.

No known or potential SRE fauna were recorded from within the survey area, contextual area or study area during the Biota surveys (Biota 2025). The majority of invertebrate fauna recorded were readily identifiable in the field as widespread or exotic species (i.e., *Ommatoiulus moreleti*, *Theba pisana*) and so were not collected. Three specimens were collected (one camaenid snail, one buthid scorpion, one isopod) and specialist identifications were sought for these from the WA Museum and Alacran Environmental Science. None of the recorded specimens were found to belong to species that represent potential SRE fauna.

5.2.3.6 Ecological Linkages and Corridors

Ecological linkages are known as non-contiguous natural areas that connect larger natural areas by forming stepping stones that allow the movement over time of fauna between larger natural areas (Perth

Biodiversity Project, 2004). According to the Hope Valley Wattleup Biodiversity Strategy (LandCorp 2007), a Primary Linkage (part of the 'Southern Wetland Ecological Link' for Long Swamp, Hendy Road Swamp (East) and Conway Road Swamp) occurs along Anketell Road east of Rockingham Road. Primary linkages have been identified as those which provide linkages between the eastern and western chain of the Beeliar Regional Park (LandCorp 2007), which occur adjacent to and may intersect the DE.

Fauna most likely to utilise primary and secondary linkages along railway corridors and roads are highly mobile fauna species such as some birds and bats (LandCorp 2007). Landscaping, revegetation and management practices will ensure the protection and maintenance of Ecological Linkages and Corridors as far as practicable.

5.2.4 Potential environmental impacts

The implementation of the Proposal will result in the direct loss of fauna habitat, including:

- Loss of 133.67 ha of fauna habitat, comprising native (92.22 ha) and non-native/modified (41.45 ha) vegetation
- Loss of habitat for significant fauna species including:
    - 592 suitable DBH trees. Of these, 8 trees contained 8 hollows that were considered of suitable depth and shape for Black Cockatoo breeding, noting that breeding is not known to occur within the area
    - 56.98 ha of foraging habitat for Carnaby's Cockatoo
    - 38.34 ha of foraging habitat for FRTBC
    - 87.58 ha of core habitat for Quenda
    - 44.57 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake
    - 56.87 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider
    - 224.83 ha of secondary habitat for Peregrine Falcon
    - 16.60 ha of secondary habitat for Western Brush Wallaby
    - 38.53 ha of secondary habitat for Glossy Ibis.

The Proposal has the potential to indirectly impact on significant fauna and fauna habitat through the following:

- Fauna injury/mortality from vehicle strike as a result of increased road use by vehicles
- Habitat degradation from edge effects, weeds, dieback, rubbish and vehicle tracks
- Disturbance of fauna due to light and noise as a result of construction activities and road use by vehicles.

The Proposal will also contribute to cumulative impacts to fauna habitat availability when considered with other significant proposals and developments at local and regional scales (Section 9.2).

5.2.5 Mitigation

Impacts to terrestrial fauna and associated habitat have been avoided and minimised through mitigation and management measures. Many of the measures considered to avoid and reduce impacts to flora and vegetation are mutually beneficial for terrestrial fauna. Table 5.18 outlines mitigation and management measures for the avoidance and minimisation of potential impacts to terrestrial fauna.

Table 5.18: Avoidance and minimisation of potential impacts to terrestrial fauna

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Avoid	
The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on fauna habitat. The existing road infrastructure consists of a 10 m wide pavement with previously cleared verges. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social constraints). Existing and future environmental data will be used to determine the environmental values and enable the design to be modified and refined, where practical, to avoid and minimise environmental and heritage impacts, whilst complying with Main Roads standards for the safety of road users, improved congestion, and ease of access.	Established practice for Main Roads, high certainty
Avoid additional movement barriers for fauna by limiting the Proposal to land adjacent to the existing cleared areas of Anketell Road	Best practice, high certainty
Narrow medians will be maintained where practicable to reduce clearing of fauna habitat.	Best practice, high certainty
A compact interchange is proposed at Abercrombie Road with ramp spacing at approximately 100m (as opposed to 150m) to reduce the footprint through this area.	Best practice, moderate certainty
Placing retaining walls where practicable to reduce clearing impacts on terrestrial fauna	Best practice, moderate certainty
Drainage basins will be located in disturbed/cleared areas where possible to avoid impacts on environmental values.	Best practice, moderate certainty
Identification of movement corridors will be undertaken to determine the number and location of any necessary wildlife underpasses.	Best practice, high certainty
Mitigation measures for Spectacles/Banksia woodlands will include: – The Kwinana Freeway interchange upgrades have been positioned to the north of the existing bridge over Kwinana Freeway. This keeps the impacts as far north as possible limiting clearing within the Beeliar Regional Park (the Spectacles Wetland) and Jandakot Regional Park. – Between Spectacles Drive and Kwinana Freeway the west bound carriageway of Anketell Road follows the existing Anketell Road. This minimises the impact on habitat in this area. – This interchange at Mandogalup Road has been designed to provide access for the existing and future development within the Mandogalup area, while facilitating safe movements along Anketell Road by separating the freight and general traffic. The interchange is located as far north as reasonably possible, this avoids direct impacts on the Spectacles Wetland. – Extensive retaining walls are proposed at the interchange of Anketell Road and Mandogalup Road to mitigate the footprint extents. This reduces the interchange's clearing footprint.	Best practice, high certainty
Minimise	
Minimise clearing impacts on terrestrial fauna where practicable through the detailed design process.	Best practice, moderate certainty

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: – Clearing and access controls – Pre-clearance surveys – Inspection of potential Black Cockatoo nesting hollows prior to clearing – Vehicle movement restrictions – Preventing indirect habitat degradation via edge effects, weeds, dieback and rubbish – Noise, light and vibration management.	Established practice for Main Roads, high certainty
An Offsets Strategy will be implemented to mitigate significant residual impacts on terrestrial fauna (Section 6).	See Section 6
Rehabilitation	
Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. Development of verge plantings and fauna movement corridors will be included in the detailed design stage. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.	Established practice for Main Roads, high certainty

5.2.6 Assessment and significance of residual impact

Implementation of the identified planning, avoidance and mitigation measures will ensure the Proposal's residual impacts are as low as reasonably practicable.

Main Roads are also proposing management measures to reduce indirect impacts associated with habitat degradation, vehicle strike, noise, light and vibration. Table 5.19 provides a summary of Proposal's predicted significant residual impacts on terrestrial fauna. The following sections discuss these impacts in more detail.

Table 5.19: Predicted significant residual impacts to fauna and habitat

Aspect	Summary of predicted significant residual impacts
Conservation significant fauna	Clearing of up to: – 56.98 ha of foraging habitat for Carnaby's Cockatoo – 38.34 ha of foraging habitat for FRTBC.

5.2.6.1 Habitat loss

The Proposal will result in the clearing of up to 133.67 ha of fauna habitat, comprising native (92.22 ha) and non-native/modified (41.45 ha) vegetation. The habitat present within the DE comprises a mixture of woodlands, shrublands and revegetation/non-native plantings. The DE has already been impacted by the existing Anketell Road and clearing for industrial and recreation developments with 91.16 ha (40.05%) of the DE mapped as cleared and/or degraded areas.

Locally the Proposal will result in habitat loss along the existing Anketell Road and other connecting roads. Contextual mapping completed by Biota (2025) shows a continuation of most habitats into adjacent areas. While the majority of adjacent areas are mapped as Modified Areas and Cleared/degraded areas, high quality fauna habitat occurs within the adjacent/nearby Jandakot and Beeliar Regional Parks. At a regional scale, the clearing of fauna habitat for the Proposal will result in the loss of 0.03% of available native fauna habitat across the SCP (DPIRD 2023). Clearing of up to 133.67 ha of fauna habitat for the Proposal is not considered a significant residual impact when considered at a local or regional scale but may result in a significant residual impact on conservation significant terrestrial fauna known or likely to occur within the DE.

5.2.6.1.1 Black Cockatoos

The Proposal will result in the loss of up to 592 suitable DBH trees. Of these, 8 trees contained 8 hollows that were considered of suitable depth and shape for Black Cockatoo breeding. The Proposal will not result in clearing of known breeding hollows. The suitable DBH trees occur along the length of the DE with approximately 64% recorded from Eucalyptus Woodland/Forest habitat type.

The closest known black cockatoo breeding locations to the Proposal are approximately 13.5 km north in Bibra Lake and 15 km south in Baldivis (Biota 2025, Peck et al 2019). The DE is not considered current breeding habitat for Carnaby's Cockatoo or FRTBC.

No known roosting sites were recorded within the DE, nor any evidence of roosting (Biota 2025). The Great Cocky Count records have been developed over a period of 13 years and therefore the survey provides a robust documentation of roosting sites and activity across Perth (Peck et al., 2019). The closest roosting site

occurs approximately 2.5 km south of the eastern end of the DE in Marri Park Golf Course. This represents a roost site for Carnaby's Cockatoo and FRTBC first observed in 2010. Twenty-eight roost sites were returned from the BirdLife Australia data from a 12 km radius of the DE. These sites are located north, east and south of the DE and includes 10 white-tailed black cockatoo roosts, 10 joint roosts, 6 unconfirmed roosts and two roost sites which have since been cleared. Of the 28 roost sites located within 12 km of the DE, none are located within the boundaries of other Proposals and clearing permits (as identified in Section 9).

The Proposal will require the clearing of up to 56.98 ha of foraging habitat for Carnaby's Cockatoo and 38.34 ha of foraging habitat for FRTBC. The foraging habitat is located along the length of the DE and includes low-moderate to high quality foraging habitat as assessed using the BCE foraging habitat scoring system (BCE 2020) (see Section 5.2.3.4.1). Black Cockatoos are highly mobile species and are expected to forage both within and outside the DE amongst foraging resources in the local area; they are unlikely to be dependent on a particular patch of foraging habitat within the DE. While the DE occurs within a modified landscape, it is adjacent/nearby to Jandakot and Beeliar Regional Parks, which are likely to provide better foraging habitat for both Carnaby's Cockatoo and FRTBC.

The extent of foraging habitat for Carnaby's Cockatoo and FRTBC based upon broad vegetation mapping within 12 km of the DE is shown on Figure 5-16. The 12km buffer is based upon the maximum distance black cockatoos are likely to forage from their nest during the breeding season (DAWE 2022). The Proposal is surrounded by approximately 10,260.71 ha of potential Carnaby's Cockatoo foraging habitat and 10,260.22 ha of potential FRTBC foraging habitat within 12 km of the DE. Of this potential foraging habitat, approximately 6,009 ha (58.57%) lies within reserved lands (in Bush Forever and/or DBCA managed lands). Implementation of other proposals and clearing permits (as identified in Section 9) will result in the combined removal of approximately 224.08 ha of potential Carnaby's Cockatoo foraging habitat and 292.73 ha of potential FRTBC foraging habitat within 12 km of the DE. This represents a 2.18% and 2.85% reduction in potential foraging habitat for Carnaby's Cockatoo and FRTBC, respectively. A review of the current Proposal and other proposals and clearing permits indicates the proposed clearing will not create a gap of 4 km or more between patches of habitat.

The primary threat to Black Cockatoos is the loss and fragmentation of habitat as a result of native vegetation clearing. This includes the loss of nesting trees, loss of foraging habitat (including non-native vegetation), fragmentation of breeding habitat from foraging resources and the mortality of individual birds (DAWE 2022). The introduction or spread of dieback (*Phytophthora cinnamomi*) and other plant diseases can also contribute to the decline of habitat (DAWE 2022).

The Proposal will not have a significant impact on breeding habitat for Carnaby's Cockatoo or FRTBC, as no known black cockatoo breeding trees or hollows occur within the DE, nor are black cockatoos known to breed in the local area. Similarly, the Proposal will not have a significant impact on roosting habitat for Black Cockatoos, as no known roost sites are within or adjacent to the DE. The Proposal's impact to Carnaby's Cockatoo and FRTBC foraging habitat is considered significant. While the foraging habitat is not located within 12 km of a known breeding site, it represents low-moderate quality foraging habitat for both species and is located within 12 km of known roost sites. The clearing of 56.98 ha of foraging habitat for Carnaby's Cockatoo and 38.34 ha of foraging habitat for FRTBC is considered a significant impact.

5.2.6.1.2 Other conservation significant fauna

Quenda

There is 87.58 ha of core habitat for Quenda within the DE, with 61% of the habitat in Good or better condition. Biota (2025) recorded the species throughout the survey area and there are numerous records in the locality The Proposal will result in the loss of Quenda habitat both at a local and regional scales. The species is widespread and is expected to occur in adjacent habitats such as the Spectacles. Biota (2025) mapped approximately 354 ha of suitable habitat for the Quenda within the contextual area. Given the proximity of the DE to larger areas of similar or better quality habitat (e.g. Beeliar and Jandakot Regional Parks), the Proposal is not expected to have a significant impact on this species.

Perth Lined Slider

There is 44.57 ha of core habitat for the Perth Lined Slider present in the DE, with 62% of the habitat in Good or better condition. The Proposal will result in the loss of Perth Lined Slider habitat both at a local and regional scales. Biota (2025) mapped approximately 169 ha of suitable habitat for the Perth Lined Slider within the contextual area. The species has a restricted distribution between Perth and Mandurah, occurring in small pockets of fragmented remnant habitat. It is not expected that the Proposal will have a significant impact on this species.

Black-striped Snake

There is 44.57 ha of core habitat for the Black-striped Snake present in the DE, with 62% in Good or better condition. The Proposal will result in the loss of Black-striped Snake habitat both at local and regional scales. Biota (2025) mapped approximately 169 ha of suitable habitat for the Black-striped Snake within the contextual area. The species has a restricted distribution between Lancelin and Mandurah, occurring in small pockets of fragmented remnant habitat. It is not expected that the Proposal will have a significant impact on this species.

Peregrin Falcon

There is 224.83 ha of secondary habitat for the Peregrine Falcon present in the DE. The Proposal will result in the loss of Peregrine Falcon habitat at both local and regional scales. The species is widespread and is expected to occur in adjacent habitats. Biota (2025) mapped approximately 1,036 ha of suitable habitat for the Peregrin Falcon within the contextual area. It is not expected that the Proposal will have a significant impact on this species.

Graceful Sunmoth

There is 44.57 ha of core habitat for the Graceful Sunmoth present in the DE. The Proposal will result in the loss of Graceful Sunmoth habitat at both local and regional scales. The Graceful Sunmoth occurs on Coastal Banksia Woodland herbland, heathland or shrubland close to the coast. Biota (2025) mapped approximately 169 ha of suitable habitat for the Graceful Sunmoth within the contextual area. It is not expected that the Proposal will have a significant impact on this species.

Swan Coastal Plain Shield–backed Trapdoor Spider

There is 56.87 ha of core habitat for the Swan Coastal Plain Shield–backed Trapdoor Spider present in the DE. The Proposal will result in the loss of Swan Coastal Plain Shield–backed Trapdoor Spider habitat at both

local and regional scales. The Swan Coastal Plain Shield–backed Trapdoor Spider has a large distribution within the regional area and is not constrained to the DE. Biota (2025) mapped approximately 250 ha of suitable habitat for the Swan Coastal Plain Shield–backed Trapdoor Spider within the contextual area. The Proposal is not expected to have a significant impact on this species.

Chuditch

Chuditch have a restricted distribution and need sizeable areas of woodland habitat (>20,000 ha) to persist (DEC 2012). Biota (2025) mapped approximately 250 ha of suitable habitat for the Chuditch within the contextual area. Chuditch has been historically recorded in Beeliar Conservation Park (east of the freeway) and nearby Jandakot Regional Park and Wandi Nature Reserve. Following a targeted survey by Biota (2024b), it is considered very unlikely for Chuditch to occur within the DE. No evidence was recorded of any populations or individuals occurring within the DE or larger nearby reserves including the Jandakot Regional Park and Beeliar Regional Park. Given their unlikely presence within the DE, the Proposal is not expected to impact on Chuditch habitat or have a significant impact on this species.

Western Brush Wallaby

There is 56.87 ha of secondary habitat for the Western Brush Wallaby present in the DE. The Proposal will result in the loss of Western Brush Wallaby habitat at local and regional scales. The species is widespread and is expected to occur in adjacent habitats such as the Spectacles. Biota (2025) mapped approximately 115 ha of suitable habitat for the Western Brush Wallaby within the contextual area. The Proposal is not expected to have a significant impact on this species.

Glossy Ibis

The Glossy Ibis may visit the DE on occasion, particularly with the Spectacles in relatively close proximity to the DE. However, it is highly unlikely to be a resident in the DE. Biota (2025) identified the Damplands and Modified areas as secondary habitat for the Glossy Ibis, with an extent of 38.53 ha in the DE. Biota (2025) mapped approximately 51 ha of Damplands and 664 ha of Modified Areas within the contextual area. As the Glossy Ibis is highly mobile and unlikely to rely on the habitats present in the DE, the Proposal is not expected to have a significant impact on this species.

Short range endemic fauna

No known or potential SRE fauna were recorded from within the survey area, contextual area or study area during the Biota surveys (Biota 2025). Two SRE species may occur in the DE, these include the Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*) (See Section 5.2.3.4.7) and Isopod species *Buddelundia cinerascens* and *Buddelundia inaequalis* (likely represent the same species and records suggest this species may occupy a range of habitats and microenvironments) (Biota 2025). Patches of microhabitats were scattered throughout many of the fauna habitats mapped with the DE. Woodland areas (Banksia Woodland and Eucalyptus Woodland/Forest) offered accumulated leaf litter and debris suitable for SRE groups and Acacia Shrubland and Melaleuca Shrubland habitat types offered rocky habitats. Based on these habitat types there is approximately 81.91 ha of potential SRE habitat in the DE and 285.85 ha in the Contextual area. The findings from the Biota surveys (Biota 2025) indicate that SREs are unlikely to rely on the habitats present in the DE, the Proposal is not expected to have a significant impact on SREs.

5.2.6.2 Habitat fragmentation

As the Proposal involves the upgrade of the existing Anketell Road and other infrastructure, the Proposal will not exacerbate fragmentation of fauna habitat. The Proposal will present a potential barrier to fauna movement; however, Main Roads is conducting further studies to determine measures required to enable fauna movement across the Proposal. The Proposal comprises the upgrade of an existing road. Habitat to the north and south of the DE is fragmented by the existing Anketell Road and previous land uses (e.g. clearing for agriculture and urban and industrial development). Given proposed mitigation measures, the Proposal is not expected to increase existing barriers to fauna movement. Accordingly, the Proposal is unlikely to cause significant impacts to fauna due to impeded fauna movement or fragmentation. This impact is not considered a significant residual impact.

5.2.6.3 Vehicle strike

Construction of the Proposal may result in increased vehicle movements within the DE. Terrestrial fauna may be struck by vehicles and machinery during construction and by vehicles during operation. Direct mortality during construction is anticipated to be low as vehicle access and speeds will be limited in order to manage other potential impacts such as dust emissions. Construction activities will be undertaken in accordance with standard management controls, such as a requirement for trained fauna handler(s) to be on site during clearing activities.

It is unlikely the operation of the Proposal will significantly increase the potential for fauna strike, given the proposal relates to the upgrade of existing roads and the degraded condition of most areas adjacent to the road corridor. The Proposal is not expected to result in significant impacts on terrestrial fauna from strike given existing barrier effects. This impact is not considered a significant residual impact.

5.2.6.4 Habitat degradation

The Proposal involves the upgrade of the existing Anketell Road and other infrastructure. The construction of the Proposal has the potential to cause degradation and modification to the surrounding habitat due to the spread of weeds and/or disease. Increased weed incursion and the introduction of dieback into fauna habitat adjacent to the DE may cause the degradation of fauna habitat values. Weed species and dieback are most likely to be introduced during construction activities. However, the DE already contains a number of weed species and high levels of disturbance. The implementation of hygiene measures will reduce the risk of introduction and spread of weeds and dieback as a result of the Proposal. The Proposal is not expected to result in the introduction or spread of weeds or dieback that could result in significant impacts on terrestrial fauna. This impact is not considered a significant residual impact.

5.2.6.5 Noise, light and vibration

During construction, there will be noise and vibration emissions due to vehicles movements, as well as from operation of equipment and machinery associated with construction activity. Noise and vibration associated with construction of the Proposal have the potential to result in short-term disturbance to fauna on a local scale. It is anticipated management measures implemented in response to social surround (amenity) considerations will also benefit and reduce impacts to fauna. It is unlikely operation of the Proposal will significantly increase noise and vibration impacts above existing noise and vibration levels. The Proposal is not expected to result in in significant impacts on terrestrial fauna from noise light and vibration. This impact is not considered a significant residual impact.

5.2.7 Predicted Outcomes

The Proposal's residual impacts to terrestrial fauna, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows:

- No disturbance will occur outside the DE
- The extent of fauna habitat values impacted within the DE will not exceed:
    - 133.67 ha of fauna habitat, comprising 92.22 ha of native vegetation and 41.45 ha of non-native/modified vegetation
    - 592 suitable DBH trees (Black Cockatoo potential breeding trees) and 8 potential suitable hollows
    - 56.98 ha of foraging habitat for Carnaby's Cockatoo
    - 38.34 ha of foraging habitat for FRTBC
    - 87.58ha of core habitat for Quenda
    - 44.57 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake
    - 56.87 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider
    - 224.83 ha of secondary habitat for Peregrine Falcon
    - 16.60 ha of secondary habitat for Western Brush Wallaby
    - 38.53 ha of secondary habitat for Glossy Ibis.

Offsets proposed in Section 6 will counterbalance the Proposal's significant residual impacts to terrestrial fauna.

Main Roads considers implementation of the identified planning, avoidance and mitigation measures and proposed environmental offsets will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for terrestrial fauna will be met.

5.3 EPA environmental factor and objective – terrestrial environmental quality

5.3.1 EPA Objective

The EPA's objective for terrestrial environmental quality is *'To maintain the quality of land and soils so that environmental values are protected'* (EPA 2023a).

5.3.2 Relevant policy and guidelines

- ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ 2018)
- Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016d)
- Finance Technical Guideline: TG010 Acid Sulfate Soils (Department of Finance 2021)
- Guideline: Assessment and management of contaminated sites (DWER 2021b)
- Identification and Investigation of Acid Sulfate Soils (ASS) and Acidic Landscapes (DER 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER 2015b).

5.3.3 Receiving environment

5.3.3.1 Surveys and studies

Main Roads commissioned a Preliminary Site Investigation (PSI) to gain an understanding of the terrestrial environmental quality within and surrounding the Proposal. This was supplemented with a Detailed Site Investigation (DSI), with interim advice provided to provide key investigation findings ahead of formal reporting. Supplementing these investigations are preliminary geotechnical investigations. Table 5.20 provides a summary of the terrestrial environmental quality surveys conducted within the DE.

Table 5.20: Summary of Terrestrial Environmental Quality surveys conducted in the DE

Survey / Report	Details
Preliminary Site Investigation, Anketell Road and Thomas Transport Corridor (West Site) (Senversa 2024) (Appendix 6)	Scope: A desktop review of the existing Anketell Road alignment, road reserve and select land parcels. Additionally, a site inspection in the form of a meandering walkover was undertaken to inspect the site for visual and/or olfactory lines of evidence of potential contamination (including potential primary and secondary sources), to undertake opportunistic sampling of surficial potential asbestos containing material where encountered, to inspect the site surrounds for potentially contaminating activities, to verify the desktop component of the PSI, targeting areas of likely disturbance by surrounding development and historical roadworks or areas otherwise of interest. Neighbouring properties to the east and west of Kwinana Freeway (comprising rural and residential properties, agricultural land, and industrial properties, as well as the Alcoa pipeline for sodium hydroxide movement and the Spectacles Wetland) were not directly inspected during the PSI. The general walkover was undertaken from publicly accessible vantage points to assess the presence of potentially contaminating land-uses in the surrounding area. However, this area was driven and observed from publicly accessible vantage points Investigation date: 14 August 2023. Investigation area: The site inspection covered the DE, from west of Leath Road through to the Tonkin Highway / Thomas Road intersection.

Survey / Report	Details
MRWA Westport Project – Anketell Road and Thomas Road, Kwinana to Oakford (Golder 2022)	The report has been superseded by Detailed Site Investigation (Senversa 2025). Scope: A preliminary geotechnical investigation for the proposed Westport freight route connecting Kwinana Port to Tonkin Highway via Anketell and Thomas Road. Investigation date: March 2022 Investigation area: The preliminary geotechnical investigation covered Anketell Road and Thomas Road, from Kwinana Port to Tonkin Highway, encompassing the DE.
MRWA Motorplex Site Geotechnical Desktop Study Westport (WSP 2023)	The report has been superseded by Detailed Site Investigation (Senversa 2025). Scope: A desktop review of the existing publicly available data, geotechnical reports provided by MRWA and information gained during a site meeting with Alcoa and a site walkover on 1 June 2023 for the Motorplex site. Investigation date: June 2023 Investigation area: This desktop review primarily focused on the area to the east of the Motorplex access road.
Detailed Site Investigation (Senversa 2025) Appendix 7	Scope: Interim advice from the detailed site investigation (DSI) of the existing Anketell Road alignment, road reserve and select land parcels currently in progress. Soil and groundwater samples were taken and analysed for an analytical suite that included ASS, metals, nutrients, hydrocarbons and pesticides. The interim advice provides an update on key investigation findings to date ahead of formal reporting. A formal DSI report will be prepared upon completion of works which will then replace the interim advice. Groundwater monitoring is still being undertaken and therefore interim advice is subject to change. Investigation date: Soil investigation was undertaken between 17 to 25 October 2024, Groundwater Monitoring Well Installation 18 to 21 November 2024 and groundwater monitoring event 28 to 29 November 2024. Investigation area: The site investigation aligned with the original referred DE, from west of Leath Road through to the east of Kwinana Freeway.

5.3.3.2 Geology and Soils

The majority of the DE overlies Tamala Limestone within the Spearwood Quaternary geomorphic unit of the SCP. The Proposal occurs within the Bassendean and Perth Coastal Soil-Landscape Zones of the Swan Province (Schoknecht et al. 2004), and the DE intersects four soil landscape mapping systems:

- Spearwood System, described as yellow deep sands, pale deep sands and yellow/brown shallow sands (182.11 ha of the DE (81.0%))
- Quindalup South System, described as coastal dunes, of the SCP, with calcareous deep sands and yellow sands (36.02 ha of the DE (16.02%))
- Vasse System, described as poorly drained estuarine flats, of the SCP; tidal flat soil, saline wet soil and pale deep sand; samphire, sedges and paperbark woodland (5.00 ha of the DE (2.22%))
- Bassendean Sands, described as sand dunes and sandplains with pale deep sand, semi-wet and wet soil (1.71 ha of the DE (0.76%)).

5.3.3.3 Acid sulfate soils

Review of the Australian Soil Resources Information System (ASRIS 2023) risk mapping and SCP Acid Sulfate Soils (ASS) risk map (DWER 2017) indicates the majority of the DE is located within areas mapped as extremely low probability of ASS occurrence (203.65 ha, 90.58%) and located along the west of the DE (predominantly west of Clementi Road). Areas mapped as having a low probability of occurrence are located along the eastern extent of the DE (15.76 ha, 7.03%) and areas mapped as having a high probability of ASS occurrence are located north of the intersection of Anketell Road / Kwinana Freeway, the Spectacles, as well as east of Clementi Road (5.43 ha, 2.41%). Higher probability areas of ASS are associated with mapped wetlands. ASS risk mapping is depicted in Figure 5-19.

No indicators of ASS/PASS were observed at the time of inspection such as corrosion of concrete or steel structures or stunted/scalded vegetation (Senversa 2024). Signs of waterlogged soils were observed at the deeply incised drains adjacent to the rural residential properties which was predominantly cleared for grazing (Senversa 2024).

Senversa (2025) undertook soil and groundwater sampling at several locations throughout the DE as shown in Figure 5-20 and Figure 5-21 (refer Section 5.4.3) and provided the key findings in an Interim Advice Notice to Main Roads in advance of the completion of the DSI. The findings from the Interim Advice Notice in relation to ASS include (Senversa 2025):

- Potential ASS was not identified during the soil investigation aside from a single pH_{FOX} exceedance of the ASS investigation levels at location SB031 at a depth of 0.0-0.1 m bgl. Confirmatory Chromium Reduced Sulphur (CRS) laboratory analysis conducted on a deeper sample from the same location (0.5-0.6 m bgl) within the same Bassendean Sand geology did not indicate the presence of ASS, indicating the pH_{FOX} result from the surface sample likely represents organic acidity rather than ASS, common in A Horizon soils.
- Several locations sampled in the mapped high risk ASS area north of the Spectacles Wetland were indicative of ASS during field sampling as they exceeded the pH change investigation level, however laboratory analysis of CRS across several soil horizons within these locations did not confirm the presence of ASS. Interim results indicate the groundwater wells GBH05 and GBH08 located near the Spectacles Wetland, a mapped high risk ASS area, are mildly acidic at 5.61 and 5.79 respectively, potentially indicative of the historical acidification of groundwater.
- Total alkalinity was detected at high concentrations within the western groundwater wells, indicative of a higher potential buffering capacity for mitigation of the effects of ASS impacted groundwater compared to wells located within the eastern high risk ASS areas of the DE.

5.3.3.4 Contaminated Sites

The DE intersects 13 mapped contaminated sites. Of these, seven are registered as 'Contaminated – remediation required', six are registered as 'Contaminated – restricted use' and two are registered as 'Remediated for restricted use' (DWER 2025d). These sites have been mapped on Figure 5-20 and described in Table 5.21.

A Basic Summary of Records requested by Main Roads for sites not visible via Contaminated Sites Database has been summarised in Table 5.22.

The Preliminary Site Investigation identified a range of potential environmental concerns including small scale fly tipping, fuel storage & dispensing, fuel transmission pipelines, agricultural open sump and drains, fire station, wastewater treatment, recycling yard, alumina refinery, landfilling, metal scrapyard (Senversa 2024). Several of these sites are classified under the *Contaminated Sites Act (2003)* as *Possibly contaminated - investigation required* or *Contaminated – remediation required*. The presence of scattered potential asbestos containing materials debris is the only areas of potential environmental concern identified that is associated with the use of the site as a road reserve (Senversa 2024). All other areas of potential environmental concern relate to surrounding industry (Senversa 2024).

Senversa (2025) undertook soil and groundwater sampling at several locations throughout the DE as shown in Figure 5 21 and Figure 5 22 and provided the findings in an Interim Advice Notice to Main Roads in advance of the completion of the DSI. The findings from the Interim Advice Notice in relation to contamination include:

- Concentrations of contaminants of potential concern were not detected above the National Environment Protection Council (NEPC) (2013) National Environment Protection (Assessment of Site Contamination) Measure (NEPM) trigger values at any soil sample locations.
- The concentrations of contaminants of potential concern identified in soil and groundwater are largely considered by to be reflective of the ambient conditions within the wider Kwinana Industrial area and further support the absence of significant source contamination within the DE. No exceedances of the NEPM trigger values were identified at any of the soil sample locations.
- Elevated lead concentrations, compared to the rest of the soil assessments undertaken as part of the DSI were detected in surface samples at SB02 and SB08, along Rockingham Road, however these concentrations were still below trigger levels and possibly associated with nearby road use.
- Polyfluoroalkyl substances (PFAS) concentrations in soil samples were mostly below the laboratory level of detection, with detectable concentrations identified in the western portion of the DE in the surface samples at locations SB025, SB027, SB032 and SB042 with concentrations aligned to ambient background conditions and significantly lower than the PFAS National Environmental Management Plan (NEMP) (HEPA 2020) soil health trigger value.
- Indicative field pH readings and sampling of the groundwater wells MW02 and GBH01 to date are near neutral at 6.94 and 7.09 respectively, indicating the alkaline plume present at the Kwinana Motorplex Site as detailed in the PSI (Senversa 2024) does not appear to have impacted the groundwater in the western portion of the DE.
- Concentrations of contaminants of potential concern in groundwater were generally below the NEPM trigger values, aside from select metals, PFOS and nitrate. Concentration of metals other than iron, including exceedances of ANZECC & ARMCANZ (2000) 99% species protection level ecological trigger levels are considered likely representative of background conditions.
- Concentrations of iron above the DWER (2021) Assessment and management of contaminated sites non-potable use guidelines trigger levels and slightly acidic pH in the eastern portion of the site and potentially indicative of the historical acidification of groundwater from the high risk ASS area of the Spectacles Wetland.

- Groundwater exceedances of PFAS, particularly PFOS concentrations are considered likely representative of ambient background conditions, despite the exceedance of ecological trigger values of PFOS, which are common across the Perth metropolitan region.
- PFAS concentrations in groundwater were within the expected range for an industrial area.
- Nitrate exceedances of the ecological trigger values are likely associated with the nitrate plumes emanating from sites within the Kwinana industrial area or nearby farming areas as detailed in the PSI (Senversa 2024) and can be considered as ambient background concentrations.

Table 5.21: Contaminated sites within the DE or immediately adjacent to the DE

Site / Lot Number	Location with respect to the DE	Site classification	Reason for classification	Restrictions
Site No. **15659**, on Lot 114 on Plan 48295	The DE intersects the northern, eastern and western portion of the site. The site runs along the length of the southern side of Anketell Road, between Abercrombie Road and McLaughlan Road.	Contaminated – remediation required	– Groundwater is contaminated with arsenic, aluminium, molybdenum, fluoride, chloride and elevated alkalinity as a result of liquid mineral processing effluent in sand-clay lined slurry lagoons leaking through to the underlying groundwater and migrating off site (PSI 2023) – A mineral waste pipeline traverses the Source Site, extending to the east along Anketell Road (PSI 2023)	– Groundwater is not suitable for use without treatment – Groundwater abstraction, as part of an on-going groundwater remediation program, is permitted provided all groundwater is sent to an appropriate disposal facility – No soils may be excavated or disturbed without the implementation of a health, safety and environmental management plan – Land use is restricted to commercial/industrial use, which excludes childcare centres, kindergartens, pre-schools and primary schools.
Site No. 15660, on Lot 114 on Plan 48295	The DE intersects the eastern boundary of the site, south-west of the Anketell Road / Abercrombie Road interchange.			
Site No. **15657**, on Lot 51 on Plan 20582	The DE intersects the northern boundary of the site, south-east of the Anketell Road / Rockingham Road interchange.			
Site No.**15658**, on Lot 114 on Plan 48295	The DE intersects the southern portion of the site, north of Anketell Road, adjacent to Site No. 74385.		– Groundwater is contaminated with arsenic, aluminium, molybdenum, fluoride, chloride and elevated alkalinity – State of soils is unknown.	
Site No. **15656**, on Lot 435 on Plan 220492	This lot is the location of the Motorplex site. The DE lies adjacent to the western boundary of the site and intersects the eastern portion of the site. The site runs			

Site / Lot Number	Location with respect to the DE	Site classification	Reason for classification	Restrictions
	along the length of the eastern side of Rockingham Road, south of Anketell Road.			
Site No. **73073**, on Lot 200 on Plan 407762	The DE lies adjacent to the eastern boundary of the site, west of the Kwinana Beach Railway.	Contaminated – restricted use	– Nitrate contamination in groundwater underlying the site – Soils contain widespread industrial slag and cinders that contain heavy metals	– Land use is restricted to commercial/industrial use, which excludes childcare centres, primary schools and other sensitive commercial land uses.
Site No. **81975**, on Lot 2 on Deposited Plan 419343	The DE lies adjacent to the northern boundary of the site, south-east of the Naval Base Railway and Leath Road interchange.			
Site No. 73071, on Lot 201 on Plan 407762	The DE intersects the northern portion of the site, south-west of Anketell Road and Leath Road intersection.			
Site No. 17317, on Lot 11 on Plan 39572	The DE intersects the northern portion of the site, near Riseley Rd, western extent of the DE.			
Site No. 84602, on Lot 251 on Deposited Plan 415974	The DE intersects the northern portion of the site, near Riseley Rd, western extent of the DE.			
Site No. 84604, on Lot 252 on Deposited Plan 415974	The DE intersects the northern portion of the site, near Riseley Rd, western extent of the DE.			
Site No. **74385**, on Lot 501 on Plan 72707	The DE intersects the southern and eastern boundary of the site, north-east of the	Contaminated – remediation required	– Alkali groundwater plumes are present beneath the Source Site (Lot 100 Anketell Road, Hope Valley)	– Groundwater abstraction at Lot 100 Anketell Road, Hope Valley is restricted to remediation of contamination

Site / Lot Number	Location with respect to the DE	Site classification	Reason for classification	Restrictions
	Anketell Road / Abercrombie Road interchange.		as a result of leaking of sodium carbonate and sodium hydroxide from refinery residue storage ponds at the alumina refinery operations site. – Groundwater contamination plumes at the Source Site are being actively managed by means of recovery bores, natural attenuation and periodic monitoring. Remedial works have not yet completed.	and industrial refinery purposes – Land use at Lot 100 Anketell Road, Hope Valley is restricted to non-sensitive commercial/industrial use.
Site No. **2623**, on Lot 224 on Plan 3638	The DE intersects the western portion of the site, south-east of the Rockingham Road and Macedonia Street interchange.	Contaminated – remediation required	– Hydrocarbon contamination has been identified in soils within the south east of the site and groundwater contamination within the superficial aquifer at 10 m depth across the site	– Groundwater abstraction for use is not permitted because of the nature and extent of groundwater contamination – Land use is restricted to its current use as a commercial storage yard until further chemical testing of soil and groundwater and risk assessment is conducted.
Site No. **34963**	The DE intersects the eastern portion of the site, between Rockingham Road and Brown Avenue.	Remediated for restricted use	– Groundwater beneath the site contains hydrocarbons (such as from petrol or diesel).	– Groundwater beneath this site is not suitable for use without treatment for the presence of hydrocarbon contamination – Land use is restricted to commercial/industrial use, or use as a road reserve. The site should not be developed for a more sensitive use without further contamination assessment and/or remediation.
Site No. **22596**, on Lot 2 on Diagram 42807	The site lies adjacent to the DE, north-west of the Rockingham Road / Weston Street intersection.			

Table 5.22: Contaminated Sites from Basic Summary of Records (extracted from Senversa 2024)

Site / Lot Number	Location with respect to the DE	Site classification	Summary (Senversa 2024)	Comment (Senversa 2024)
Site No. 5083, Lot 52 on	The DE encompasses the entirety of the site, south of the Beard	Possibly contaminated - investigation required	Classified in 2010 due to a report of one million litres of saline cooling water to soils and groundwater. The cooling water was alkaline and contained elevated levels of sodium hydroxide and sodium	Located on-site, down groundwater gradient. Contamination has not been adequately investigated, nor has the

Site / Lot Number	Location with respect to the DE	Site classification	Summary (Senversa 2024)	Comment (Senversa 2024)
Diagram 18462	Street / Brown Avenue intersection		carbonate. No soil or groundwater investigations have been carried out. The Site has undergone remediation works involving the partial excavation of impacted soils. Due to safety reasons some impacted soils were retained beneath high voltage electrical infrastructure and pipeline supports within the Site. The resultant excavations were infilled with gypsum and clean fill material. No information on the effectiveness or completeness of the remediation works has been submitted to DWER.	site been subject to risk assessment in order to understand the nature and extent of contamination onsite.
Site No. 86, Lot 22 on Diagram 40237	The DE intersects the southern extent of the site, north of the Naval Base Railway between Leath road and Brown Avenue	Awaiting Classification	Known as Lot 22 Leath Road, Naval Base 6165. A Detailed Summary of Records (DSR) request is recommended for further information on the site.	
Site No. 1858, Lot 103 on Plan 3638	The DE intersects the southern extent of the site, south-west of the Lee Road / Bickley Street intersection	Possibly contaminated - investigation required	Known as 40 Bickley Street, Naval Base 6165. Classified in 2009 due to groundwater contamination with arsenic, aluminium, molybdenum, fluoride, chloride and elevated alkalinity. The contamination is likely a result of disposal of mineral processing waste from the adjacent bauxite/aluminium processing facility.	Potentially down gradient of site, this is an affected site – northeast of source site.
Site No. 3171, Lot 2129 on Plan 173137	The DE intersects the north-eastern corner of the site, south-west of the Anketell Road / McLaughlan Road intersection	Possibly contaminated - investigation required	Known as 119 McLaughlan Road, Postans 6167. Classified in 2016 due to elevated concentrations of nutrients in the groundwater beneath the site. The site, which has been operational since the 1970s is currently licenced under the EP Act 1986 (licence number L6543/1991/10) to operate as a waste water treatment plant. The contamination is likely a result of a spill of raw sewage and re-direction of additional sewage to an unlined bio-solids lagoon. No evidence of successful remedial works targeting the nutrient contamination. Localised remediation works were carried out at the site in 2015 to remove minor amounts of asbestos containing materials (ACM) associated with the	Cross gradient to site. Groundwater modelling has suggested groundwater mounding beneath infiltration ponds on site causes surficial groundwater flow in an easterly direction towards the Spectacles.

Site / Lot Number	Location with respect to the DE	Site classification	Summary (Senversa 2024)	Comment (Senversa 2024)
			decommissioning of redundant infrastructure at the wastewater treatment plant. Based on the information provided, all ACM impacted soils associated with the decommissioning works have been successfully remediated.	
Site No. 4003, Lot 89 on Plan 217732	The DE intersects the southern corner of the site, north-west of the Anketell Road / Clementi Road intersection	Possibly contaminated - investigation required	Known as 103 Mandogalup Road, Mandogalup 6167. Classified in 2009 due to groundwater beneath the north west portion of the site being affected by an alkali groundwater contamination plume from the source site at Lot 100 Anketell Road that operates as an alumina refinery. The affected site has only been partially investigated and further delineation of contamination is required.	Cross gradient to site – unclear as to whether extend of contamination may cross site boundary due to close proximity to source site.
Site No. 1140, Lot 112 on Diagram 88143	The DE intersects the northern, southern and south-eastern extent of the site, west of Abercrombie Road, on either side of Anketell Road	Possibly contaminated - investigation required	Known as 205 Abercrombie Road, Hope Valley 6165. Classified in 2018 due to groundwater beneath the site being affected by an alkaline plume migrating from Lot 501 Anketell Road (moving westwards). The source site is an alumina refinery.	Cross gradient of site.
Site No. 1158, Lot 102 on Plan 3638	The DE intersects the southern extent of the site, north of Lee Road and east of Henry Street	Possibly contaminated - investigation required	Known as 38 Bickley Street, Naval Base 6165. Classified in 2019 due to elevated concentrations of aluminium and arsenic potentially in the groundwater beneath site, extending from a plume from a nearby retired alumina residue storage area to the south of the site. Groundwater impact detected to approximately 44 m below ground level (bgl).	Down gradient of site.

Legend

Major Roads

Minor Roads

Development Envelope

Acid Sulphate Soil Risk

High probability of occurrence

Extremely low probability of occurrence

Macedonia St

Weston St

Brown Av

Bickley St

Henry St

Lee Rd

Beard St

Leath Rd

Conway Rd

Armstrong Rd

Investigator Dr

Anketell Rd

Rocki

bercrombie Rd

Paper Size ISO A3

0 100 200 300 400

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Acid Sulphate Soils

Project No. **12652780**
Revision No. **0**
Date **25/02/2025**

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FIGURE 5-19

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Print date: 25 Feb 2025 - 14:48

Data source: World Imagery: Earthstar Geographics
World Imagery: Maxar. Created by: sraschilla

Legend

- Major Roads
- Minor Roads
- Development Envelope

Acid Sulphate Soil Risk

- High probability of occurrence
- Low probability of occurrence
- Extremely low probability of occurrence

Investigator

Anketell Rd

Clementi Rd

McLaughlan Rd

Abercrombie Rd

Paper Size ISO A3

0 100 200 300 400

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Acid Sulphate Soils

Project No. **12652780**
Revision No. **0**
Date **25/02/2025**

FIGURE 5-19

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Print date: 25 Feb 2025 - 14:48

Data source: World Imagery: Earthstar Geographics
World Imagery: Maxar. Created by: sraschilla

Legend

- Major Roads
- Minor Roads
- Development Envelope

Acid Sulphate Soil Risk

- High probability of occurrence
- Low probability of occurrence
- Extremely low probability of occurrence

Mandogalup Rd
Hoffman Rd
Clementi Rd
Anketell Rd
Albina Av
McLaughlan Rd
Spectacles Dr
Kwinana Fwy
Treeby Rd

Paper Size ISO A3

0 100 200 300 400

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Acid Sulphate Soils

Project No. **12652780**
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FIGURE 5-19

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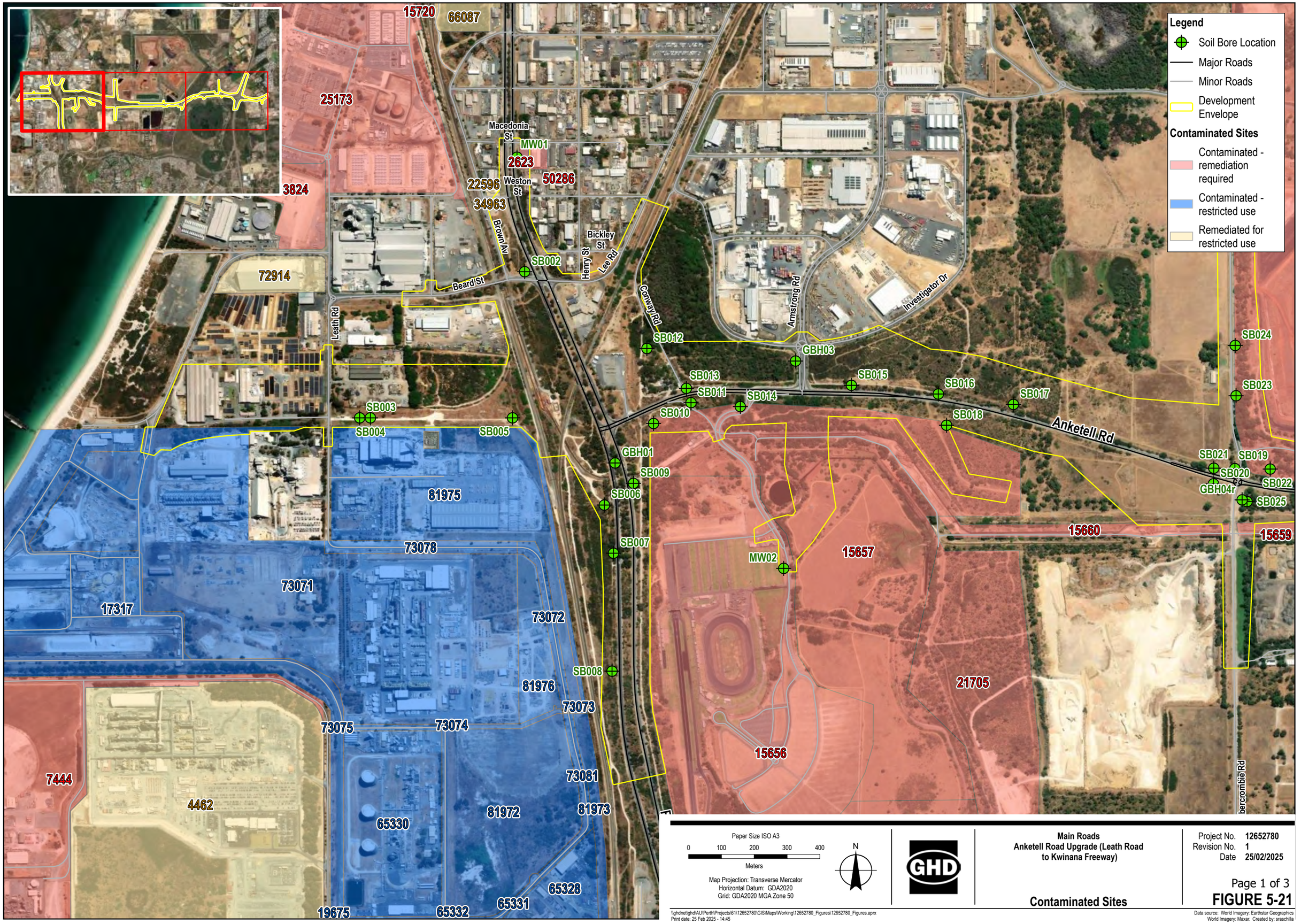

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Map Projection: Transverse Mercator
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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Contaminated Sites

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

Page 1 of 3
FIGURE 5-21

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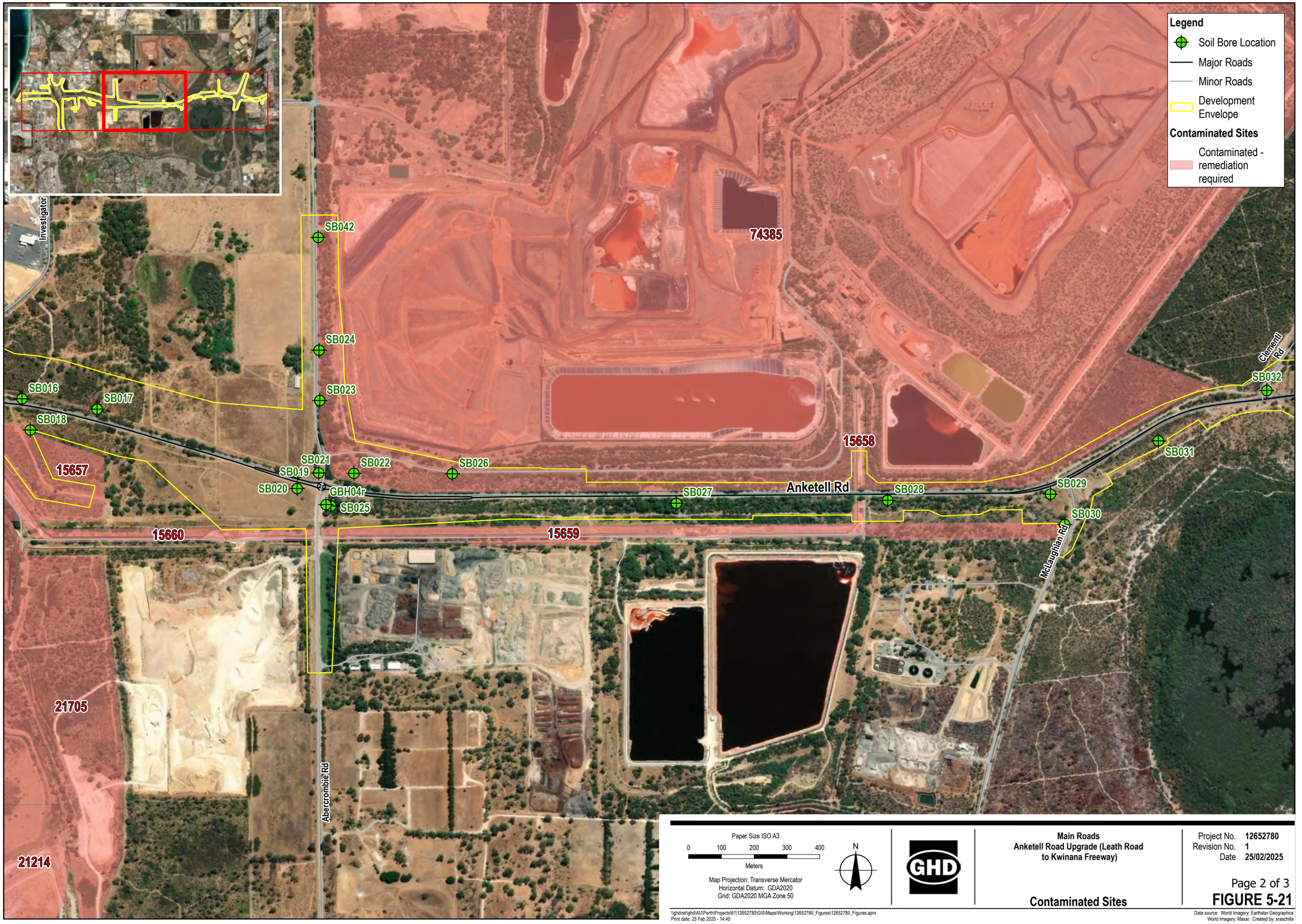

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Meters

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Contaminated Sites

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

FIGURE 5-21

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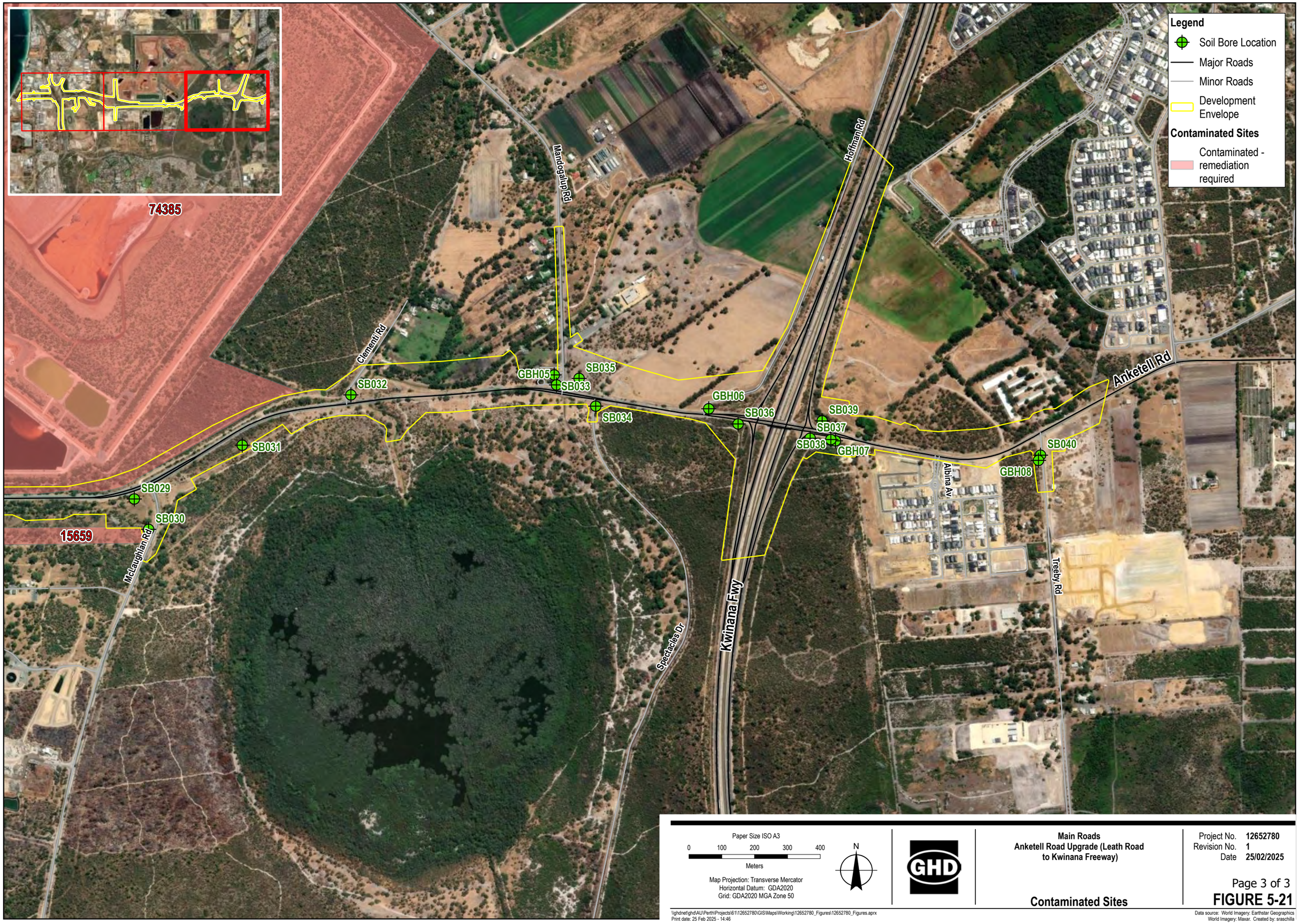

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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Contaminated Sites

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

FIGURE 5-21

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5.3.4 Potential environmental impacts

The implementation of the Proposal may result in potential direct and indirect impacts to terrestrial environmental quality, including:

- Soil and/or groundwater contamination from construction activities associated with waste discharge, storage of chemicals and hydrocarbons, and potential spills
- Changes to soil and/or groundwater quality through mobilisation of contaminated materials, including asbestos and per- and polyfluoroalkyl substances (PFAS), associated with earthworks, excavation, demolition and dewatering.
- Potential disturbance of ASS due to earthworks, excavation and dewatering
- Potential disturbance of ground at or in proximity to known and suspected contamination including:
    - 29.42 ha across seven registered sites classified as 'contaminated – remediation required' including the widening of Anketell Road between Abercrombie Road and McLaughlin Road with the Alcoa residue storage areas to the north, construction of the proposed new access to the Motorplex site over the historical residue storage pond, intersection of Rockingham Road and Macedonia Street.
    - 1.49 ha across four 'contaminated – restricted use' registered sites including the extension of Anketell Road to the Kwinana Bulk Terminal.
    - 0.03 ha across one 'remediated for restricted use' registered site at the intersection of Rockingham Road and Weston Street.
- Potential to abstract contaminated groundwater during dewatering or abstraction of groundwater for construction activities. Further information on the potential impacts to groundwater chemistry are discussed in 5.4.4.

5.3.5 Mitigation

Avoidance and minimisation measures considered and incorporated in the Proposal planning relevant to terrestrial environmental quality are outline in Table 5.23.

Table 5.23: Avoidance and minimisation of potential impacts to terrestrial environmental quality

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Avoid	
The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on terrestrial environmental quality. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social). Existing and future environmental data will be used to determine the environmental values and enable the design to be modified and refined, where practical to avoid and minimise impacts to terrestrial environmental quality, whilst complying with Main Roads standards for the safety of road users, improved congestion, and ease of access.	Established practice for Main Roads, high certainty
Avoid excavation where possible in areas of high risk for ASS.	Best practice, moderate certainty
Avoid disturbance of contaminated or potentially contaminated areas where possible. The project design avoids potential disturbance of contamination including: – Between Abercrombie Road and McLaughlin Road the design is located to the south with sufficient separation to avoid Alcoa residue storage areas. – South of Armstrong Road the proposed new access into the Motorplex site has been designed to avoid excavating the historical residue storage pond.	Best practice, moderate certainty
Narrow medians will be maintained where practicable to reduce the amount of material required for the Proposal and the amount of water required for construction.	Best practice, moderate certainty
Minimise	
Minimise impacts through the detailed design process, including reducing earthworks (fill height/cut depth) in areas of heavy vegetation.	Best practice, moderate certainty
Undertake a Preliminary Site Investigation and Detailed Site Investigation	Established practice for Main Roads, high certainty
Implement an ASS and Dewatering Management Plan	Established practice for Main Roads, high certainty
Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: – Chemical and hydrocarbon storage – Waste management – Spill management – Contaminated material handling and management – Sediment and erosion controls – Soil management	Established practice for Main Roads, high certainty

Mitigation measure	Industry standard, best practice and certainty of effectiveness
– Dewatering controls – Unexpected finds protocol.	
Groundwater abstraction wells will be established away from the Spectacles Wetland and in areas where the risk of mobilising contaminated groundwater is reduced.	Best practice, moderate certainty
Development of a groundwater monitoring program, where required to monitor and assess the effectiveness of mitigation measures associated with ASS and contamination.	Best practice, high certainty

5.3.6 Assessment and significance of residual impact

5.3.6.1 Soil and/or groundwater contamination

The Proposal has the potential to contaminate soils, surface water and groundwater as a result of inappropriate storage and handling of materials, chemical and hydrocarbon leaks and spills, inappropriate waste management and import of contaminated material (e.g. fill). Controls for managing potential spills and leaks will focus on prevention of spills by minimising volumes stored on site and maintaining storage in accordance with Australian Standard 1940 (AS:1940). Chemicals and hydrocarbons will be stored in bunded areas located away from areas of known environmental values such as wetlands and TECs.

The Proposal is expected to generate a variety of waste streams that could result in contamination of soils if not managed and disposed of in a controlled manner. Waste will be segregated into various streams, stored in secure areas and/or containers and disposed of in a controlled manner, including at an appropriately licensed facility where required.

The Proposal may require fill materials that will be imported for use in construction. To prevent contamination from imported materials, all fill materials used for the Proposal will be verified as suitable for specified construction purposes.

5.3.6.2 Changes to soil quality

There are known and suspected contaminated sites within and adjacent to the DE. There may be a need to demolish buildings potentially containing asbestos. Proposal planning, avoidance and mitigation measures considered and incorporated will reduce residual impacts of the Proposal to as low as reasonably practicable. This includes project design to avoid or minimise the potential disturbance of contamination including:

- Avoiding excavation of the historical residue storage pond for the proposed new access to the Motorplex site south of Armstrong Road
- Widening of Anketell Road between Abercrombie Road and McLaughlin Road to the south to provide sufficient separation to avoid the Alcoa residue storage areas. This design solution was achieved through ongoing consultation with Alcoa.
- Compact design with narrow medians, compact interchanges and use of retaining walls to reduce the footprint and associated disturbance and excavations
- Design to minimise excavation below the existing surface
- Dewatering for construction is likely to be required to the east of Kwinana Freeway, outside of known areas of contamination.

Potential direct and indirect impacts associated with the movement of contaminated soil will be managed during construction through early identification of soil contamination, using an unexpected finds Protocol and adhering to requirements in accordance with the *Contaminated Sites Act 2006*.

5.3.6.3 ASS

In anoxic conditions, ASS does not pose a significant risk to the environment, but when ASS are disturbed there is potential for iron sulfides in the soils to react with oxygen and produce sulfuric acid (DER 2015a).

This can acidify the landscape and result in mobilisation of contaminants (commonly iron, aluminium and other metals) that can be transported to waterways, wetlands and groundwater.

The Proposal has the potential to disturb ASS during excavation activities and/or dewatering. The majority of the Proposal is located within areas mapped as extremely low and low probability of ASS occurrence. It is anticipated, where disturbance of ASS is unavoidable, the risk of impact will be low. Dewatering is likely to be required in the area east of Kwinana Freeway, in the locality of the Wandi Nature Reserve and potentially other sites where a shallow water table and swamp deposits occur and may result in oxidation of ASS. As Main Roads have long history of constructing interchanges on the SCP with no recorded temporary dewatering-related impacts, it is expected that the management measures applied will ensure no significant impact to Terrestrial Environment Quality due to the temporary groundwater drawdown during dewatering.

An ASS Management Plan will be prepared and implemented in accordance with DWER ASS guidelines (DER 2015a and 2015b) to avoid or manage impacts from potential ASS disturbance. Key management measures to be implemented will include minimising disturbance of ASS, stockpile management protocols, disposal or treatment of ASS material.

5.3.7 Predicted Outcomes

The Proposal's Terrestrial Environmental Quality environmental outcome, following implementation of measures to avoid, minimise, reduce and rehabilitate, is as follows:

- The Proposal will be designed and constructed in accordance with the requirements of the DWER Assessment and management of contaminated sites (2021b) and DWER ASS guidelines (DER 2015a and 2015b).

By implementing these mitigation measures, the Proposal's impacts to Terrestrial Environmental Quality will be reduced and/or minimised, and the EPA objective for Terrestrial Environmental Quality will be met.

5.4 EPA environmental factor and objective – inland waters

5.4.1 EPA Objective

The EPA's objective for inland water is *'To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA 2023a).

5.4.2 Relevant policy and guidelines

- ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ 2018)
- Environmental Factor Guideline: Inland Waters (EPA 2018)
- State Planning Policy 2.9 Water Resources (WAPC 2006)
- Water Quality Protection Note 3, Using water quality protection notes (DWER 2024b)
- Water Quality Protection Note 44, Roads Near Sensitive Water Resources (DoW 2006)
- Water Quality Protection Note 83, Infrastructure corridors near sensitive water resources (DoW 2007)
- Jandakot Drainage and Water Management Plan (DoW 2009)
- Wetlands Conservation Policy for Western Australia (GoWA 1997).

5.4.3 Receiving environment

5.4.3.1 Surveys and studies

Since referral of the Proposal in February 2024, Main Roads has commissioned a wetland assessment to identify the environmental values of the wetlands within and near to the DE; and surface and groundwater monitoring to provide baseline data to inform potential impact and management measures for inland waters. These studies have been completed to characterise surface water or groundwater values within and adjacent to the DE.

A summary of inland waters studies that have been undertaken for this Proposal are presented in Table 5.24.

Table 5.24: Summary of inland waters surveys undertaken for the Proposal

Survey / Report	Details
Anketell Road Upgrade - Construction Water Sourcing Report (Metis 2024)	Scope: Main Roads engaged Metis Construction Management to evaluates water sources and dewatering for the Anketell Road / Westport Project case concept design. This included an assessment of the potential construction water sourcing, availability and environmental issues with review of constraints and opportunities to provide guidance to the appropriateness of the sources to meet the project objectives. The report details construction water use and potential water sources such as potable water, groundwater, desalination, secondary treated wastewater, reclaimed water and seawater.
Anketell Road Upgrade Project - Preliminary Groundwater Level Assessment (FSG 2024) Appendix 8	Scope: FSG Geotechnics and Foundations (FSG) was engaged by Main Roads to prepare a groundwater assessment for the Anketell Road upgrade to support applications for environmental approvals being sought from the EPA. A preliminary groundwater level assessment based on a desktop study was undertaken to assess the potential groundwater impacts caused by groundwater abstraction and dewatering during project construction. The report presents preliminary groundwater level contours/surfaces and a 3D numerical groundwater flow model with scenarios that cover the DE and surrounding area.

Survey / Report	Details
Anketell Road West Drainage Strategy (BG&E 2024) Appendix 9	Scope: BG&E was engaged by Main Roads to develop the Drainage Strategy for the Anketell Road upgrade. The report outlines how the Drainage Strategy was developed in accordance with Infrastructure Sustainability Council requirements and considers climate change effects such as sea level rise, rising temperatures and changing rainfall. It also details site conditions, existing drainage and various drainage options such as stormwater storage and use, infiltration systems, conveyance systems, detention systems and pollutant systems.
Anketell Road Upgrade Wetland Assessment (Stream 2025) Appendix 10	Scope: Main Roads contracted Stream Environment & Water Pty Ltd (Stream) to carry out an assessment of wetland and hydrological values of the survey area and conduct an assessment of the risks and potential impacts to those values as a result of the proposal. The work included a desktop review of the study area (5km buffer of the DE) for an assessment of wetlands, ecological values and review of available hydrological data and information. A targeted field visit was conducted to collect information to characterise the features, attributes, functions, values and condition of the wetlands and watercourses intersecting the survey area. This assessment was conducted in accordance with the DBCA *methodology for the evaluation of wetlands on the Swan Coastal Plain* and *Wetland Identification and delineation* documentation.

There are a number of Urban Water Management Plans to support long-term resource planning and Local Water Management Strategies that support local land-use planning (local planning scheme amendments or local structure plans) relevant to the DE. These include:

- Drainage and Water Management Plans
    - Anketell North District Water Management Strategy
    - Jandakot Drainage and Water Management Plan - Peel Main Drain Catchment
- District Water Management Strategies:
    - Wandi South District Water Management Strategy
    - Wandi Cell District Water Management Strategy.

5.4.3.2 Groundwater hydrology and hydrogeography

5.4.3.2.1 Regional hydrogeology

The DE occurs above three layers of aquifers, in order from topmost to bottommost layer: the unconfined Superficial Swan aquifer, the confined Leederville aquifer and the confined Yarragadee North aquifer.

The Superficial Swan aquifer receives direct recharge from groundwater infiltration and surface water. The Leederville and Yarragadee North aquifers receive direct recharge where these formations outcrop (not within the location of the Proposal). There is limited interaction between the various aquifers, in terms of water exchange, and groundwater movement and recharge are very slow in the confined aquifers (Leederville and Yarragadee North).

The main regional aquifer of relevance for the Proposal is the Superficial Aquifer comprising Safety Bay Sand, Becher Sand 1, Tamala Sand, Bassendean Sand, Guildford Formation and Tamala Limestone (FSG 2024). This is an unconfined aquifer overlying the Osborne Formation, which in this area is considered an aquitard. The saturated thickness of the Superficial Aquifer beneath the alignment ranges between approximately 20 m to 40 m.

West of Rockingham Road, Becher Sand 2 is known to act as an aquitard, separating the Superficial Aquifer into an Upper Aquifer (above the Becher Sand 2) and a Lower Aquifer (below the Becher Sand 2). There is typically a downward hydraulic gradient between the two aquifers (FSG 2024).

5.4.3.2.2 Local hydrogeology

FSG (2024) undertook a study of groundwater in the contextual area of the Proposal. Data for the study relied on information from the following sources:

- Groundwater level contours from the 1997, 2004 and 2019 Perth Groundwater Atlases
- DWER (2024a) Water Information Reporting (WIR) database, from which monitoring wells from 39 locations in the area with relevant groundwater level information from the Superficial Aquifer were used. Of the 39 well locations, 20 well locations are located around the Kwinana Waste Water Treatment Plant (KWWTP)
- Eighteen project monitoring wells installed in the area of the Proposal.

Locations of groundwater monitoring wells are shown on Figure 5-21.

The 1997 Perth Groundwater Atlas presents the inferred historical maximum groundwater level contours, which range between approximately Reduced Level (RL) 1 m AHD and RL 20 m AHD across the DE. It is noted that the Atlas may consider old wetlands or drains that have been installed/removed and may therefore not be presentative of the current site conditions. The hydraulic gradient (i.e. distances between the 1m contours) changes significantly along the alignment. Where the hydraulic gradients are steeper, the aquifer transmissivity is smaller. Such changes can normally be found at geological changes. The very flat gradient in the western part of the alignment indicates that the Tamala Sand/Limestone has the highest aquifer transmissivity.

The 2004 Perth Groundwater Atlas presents the inferred May 2003 (dry season) groundwater level contours, which range between approximately RL <1 m AHD and RL 18 m AHD across the DE with similar east to west flow directions. It is noted that the Atlas may not always represent the measured May 2003 groundwater level observations accurately due to the adopted interpolation methodology, and this Atlas should therefore be used with caution in this context.

The 2019 Perth Groundwater Map contours represent regionally modelled seasonal maximum groundwater levels, which range between approximately RL <1 m AHD and RL 19 m AHD across the DE with similar east to west flow directions. It is noted that these groundwater contours represent a regional developed groundwater model and do not consider all localised conditions (e.g. it does not appear the Peel Main Drains or the Spectacles have been considered in this area).

These historical groundwater level contours show a consistent range of groundwater levels across the DE. Additionally, review of the groundwater contours infers groundwater at the site has consistently flowed west with eventual discharge to the Indian Ocean (Senversa 2024).

Whilst local groundwater flows in a westerly direction toward the Indian ocean, groundwater investigations at the KWWTP have inferred that mounding caused by the infiltration ponds on-site direct groundwater to flow towards the ponds and the Spectacles (Senversa 2024).

The DE intersects three Groundwater Areas proclaimed under the RIWI Act:

- Cockburn Groundwater Area (174.12 ha (77.44% of DE))

- Jandakot Groundwater Area (30.77 ha (13.69% of DE))
- Serpentine Groundwater Area (19.95 ha (8.87% of DE))

There are no Public Drinking Water Source Areas (PDWSAs) proclaimed under the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or *Country Area Water Supply Act 1947* within the DE. The closest PDWSA is the P1 and P2 Jandakot Underground Water Pollution Control Area PDWSA, located approximately 275 m east of the DE, east of Lyon Road.

5.4.3.2.3 Groundwater quality

Stream (2025) undertook a review of publicly available hydrochemistry data to characterise groundwater quality within the DE. Publicly available data is limited and, as such, characterisation of groundwater quality is also limited.

Three sites previously monitored by DWER (2024a) (sites 61410068, 61419851 and 61470350) for water quality provide non-continuous data for groundwater quality within the DE. Golder (2022) analysed groundwater samples obtained in December 2021 for water aggressivity on steel and concrete structures from nine monitoring bores within the current survey area. Parameters analysed relevant to the Proposal were pH and Total Dissolved Solids (TDS).

The ANZECC & ARMCANZ (2018) guidelines do not provide trigger values for water quality parameters in groundwater. Due to the absence of groundwater reference condition data, and the close proximity of several groundwater dependant wetlands, with above ground ecosystems and surface water expression, the groundwater physical parameters and nutrients were compared to ANZECC & ARMCANZ (2018) guidelines for southwest Australia. Slightly disturbed wetlands and metals were compared to ANZECC & ARMCANZ (2018) guidelines for slightly-moderately disturbed systems.

The findings from the review of groundwater data within the DE, conducted by Stream (2025), include:

- Groundwater pH lightly acidic to slightly basic, ranging from 5.78 – 9.4 pH. Golder (2022) data was above the lower limit pH trigger value of 7.0 pH and five bores (GBH01, GBH04, GBH05, GBH06, GBH08) recorded pH higher than the upper limit trigger value of 8.5 pH for slightly disturbed ecosystems. DWER (2024a) recorded one bore (61410068) as neutral to slightly basic and stable with pH range from 7.2 – 8.0 pH, and one bore (61419851) located in the Spectacles Wetland as slightly acidic to slightly basic with pH range from 5.78 – 8.7 pH and an average of 6.9 pH (from 1995 to 2009), which is marginally below the lower limit pH trigger value of 7.0 pH
- Statewide salinity mapping (DWER 2018) indicates groundwater TDS within the DE ranges from 0 – 1000 mg/L, which is supported by Golder (2022) data with TDS of 24 – 376 mg/L (random distribution from GBH01 to GBH09). DWER (2024a) recorded three bores (61470350, 61410068, 61419851) with an average TDS of 1052 mg/L, 366 mg/L and 1447 mg/L (from 1995 to 2009)
- Dissolved oxygen (DO) in groundwater was low, as typical with groundwater, with one bore (61419851) ranging from 0.1 – 2.2 mg/L (1995 to 2009) and another bore (61410068) ranging from 0.14 – 0.7 mg/L (three readings 2005, 2010, 2018)
- Limited data on groundwater nutrients is available from bores relevant to the survey area. Of the available data, nutrient levels exceeded the ANZECC & ARMCANZ (2018) trigger values. Total Nitrogen (TN) concentrations exceeded the trigger value of 1.5mg/L on all occasions, with the

average TN value of 7.7 mg/L. Total Phosphorus (TP) concentrations exceeded the trigger value of 0.06 mg/L on all occasions, with the average TP value of 0.35 mg/L. Within the survey area, secondary treated wastewater is infiltrated at KWWTP. Water Corporation report that TN and TP from this source is approximately 2.5 times and 10 times respectively the level of native groundwater (Metis 2024)

- Three DWER (2024a) bores (61419851, 61470350 and 61410068) monitored metals between 1995 to 2018, providing non-continuous and sporadic data. Eight metals monitored over that period have trigger values: aluminium, cadmium, copper, lead, manganese, mercury, nickel and zinc. One site (614170350) has data from a singular event in 2018, with records for metals all below the trigger values. Exceedances of trigger values includes:
    - The concentration of Aluminium exceeded the trigger value (0.055mg/L) at site 61419851 on all but one monitoring event from 1995 to 2009
    - The concentration of Lead and Mercury exceeded the trigger values (0.0034mg/L and 0.00006mg/L) on one occasion at site 61410068
    - The concentration of Zinc exceeded the trigger value (0.008mg/L) at site 61419851 on all but one monitoring event from 1995 to 2009 and on one occasion at site 61410068.

Limited groundwater quality data was provided to FSG (2024) for the purpose of the groundwater assessment; however, water quality samples from the Spectacles and some from KWWTP monitoring wells detected *Escherichia coli* (E. coli) in groundwater and surface water. This could be related to the infiltration of the secondary treated wastewater at the KWWTP treatment ponds adjacent to McLaughlan Road.

5.4.3.3 Surface water

5.4.3.3.1 Local hydrology

The DE does not intersect any Surface Water Areas or Irrigation Districts proclaimed under the RIWI Act. The DE intersects two drains and an inundation area (Figure 5-21).

The Peel Main Drain is the main surface water feature that intersects the DE. It is owned by Water Corporation and discharges into the Serpentine River. The Peel Main drain is an artificial, 32 km long, highly modified system constructed to drain the SCP. The drain is derived from year round surface runoff and winter groundwater discharge. It is an ephemeral system drying in summer, with peak stream flow generally between July and September (Marillier et al. 2012, DoW 2009). Despite holding limited ecological value itself, the Peel Main Drain is important in maintaining the hydrological regime of the Spectacles Wetland (Stream 2025).

The Peel Main Drain exists on the western side of Kwinana Highway. After passing through Mandogalup Swamp South, water flows through a culvert under Anketell Road between Mandongalup Road and Clementi Road, entering the Spectacles Wetland, before continuing south, flowing onward to Bollard Bulrush Swamp (Figure 5-21).

The Peel Main Drain catchment area upstream of the survey area is approximately 26 km^2 and largely consists of sand to sandy silt soils associated with Bassendean and Spearwood Dunes and wetland areas (soil units S8, S7, Ms5). At Mandogalup Swamp, outside the DE (Figure 5-21), the drain elevation is 25 mAHD dropping to 4 mAHD over 15 km. Streamflow in the drain is predominantly from surface rainfall

runoff generated in areas of clayey surface geology. The northern reach of the drain has sections where clay is not present which intercepts groundwater during winter, that flows west from Jandakot Mound (Stream 2025).

The Hope Valley gauging station (614013) recorded flow in Peel Main Drain entering the Spectacles Wetland between 1985 – 2001. Average annual flow over that period was 1.6 GL and daily flow shows it is an ephemeral system, drying during summer (Stream 2025).

The Mandogalup East Drain intersects the northeastern part of the DE, crossing the Kwinana Freeway. It joins the Peel Main Drain within Mandogalup Swamp. The Mandogalup Swamp South and East are mapped as an inundation area that intersects the edges of the DE along Kwinana Freeway.

Ponds operated by Alcoa are located 300 m north of the DE at the Kwinana Refinery which are expected to be lined and therefore not have direct contact with the regional aquifer (Golder 2022). There is also a surge pond operated by Alcoa at Kwinana Motorplex which receives stormwater discharge, rainfall runoff and water from Alcoa sump pumps and recovery bores (Golder 2022). KWWTP is located west of the Spectacles adjacent to McLaughlan Road, with two large infiltration ponds totalling approximately 1.5 ha visible from satellite imagery, along with smaller evaporation and infiltration ponds/tanks (Senversa 2024).

The existing drainage along Anketell Road and within the DE is a mixture of unkerbed roads that sheet to the verge/roadside drains to infiltrate, and kerbed roads with localised pit and pipe networks that discharge to nearby infiltration basins (BG&E 2024). Table 5.25 summarises the key drainage characteristics for each road segment in the DE. For further detail see Appendix 9.

Table 5.25: Key drainage characteristics of road segments in the DE (BG&E 2024)

Road segment	Key drainage characteristics
Riseley Road to Rockingham Road	Combination of unused road reserves and industrial properties with on-lot runoff retention.
Rockingham Road / Anketell Road Intersection	Locally kerbed with small pit and pipe networks discharging to infiltration basins.
Anketell Road – Rockingham Road to Armstrong Road	Mix of kerbed and unkerbed sections with various drainage systems including pit and pipe networks and infiltration basins.
Anketell Road – Armstrong Road to Abercrombie Road	Unkerbed sections with roadside table drains and infiltration basins.
Anketell Road / Abercrombie Road	Kerbed roundabout with drainage systems discharging to adjacent verges and basins.
Anketell Road – Abercrombie Road to McLaughlan Road	Unkerbed sections with table drains and infiltration basins.
Anketell Road – McLaughlan Road to Peel Main Drain	Unkerbed with sheet flow to roadside drains and infiltration at low points.
Anketell Road – Peel Main Drain to Mandogalup Road	Flat, unkerbed with sheet flow to verges and infiltration.
Anketell Road - Mandogalup Road to Hoffman Road	Unkerbed with sheet flow to roadside drains.
Anketell Road / Kwinana Freeway	Kerbed with pit and pipe systems discharging to infiltration basins.

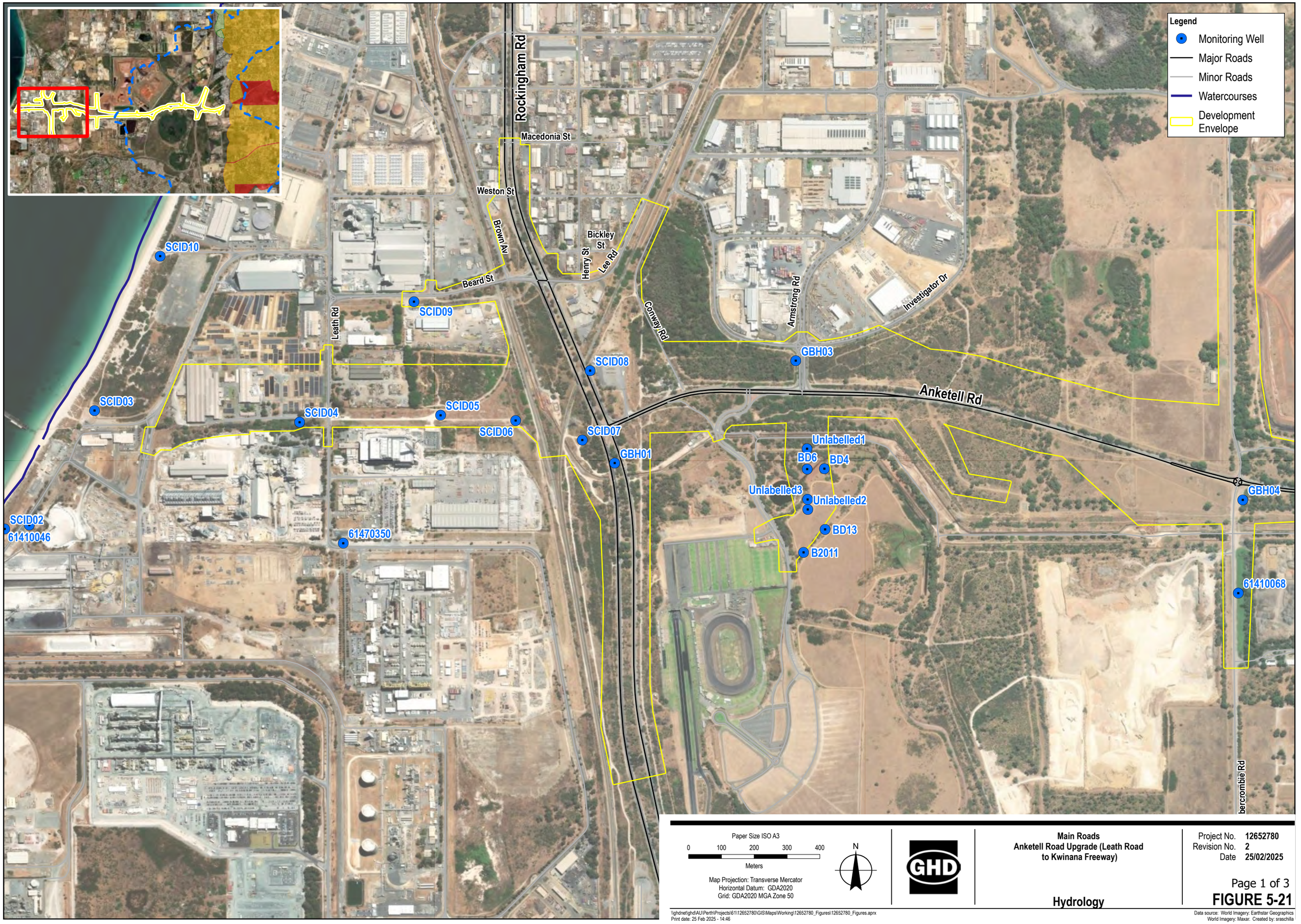
Road segment	Key drainage characteristics
Anketell Road - Kwinana Freeway to Treeby Road	Unkerbed with sheet flow to verges and infiltration.

5.4.3.3.2 Surface water quality

Stream (2025) undertook a review of publicly available hydrochemistry data to characterise surface water quality within the DE. Recent surface water chemistry monitoring data for the Peel Main Drain and the Spectacles Wetland is not publicly available. Water chemistry of the Spectacles North Wetland (monitoring site 6142542) was accessed from DWER (2024a) WIR database, with the most recent water quality data from 2008 to 2010.

The Spectacles North Wetland has surface water quality data for pH, TN, TP and electrical conductivity (EC), with several readings each year from 2008 to 2010. Findings from the Stream (2025) comparison of this monitoring to the ANZECC & ARMCANZ (2018) guidelines for southwest Australia slightly disturbed wetlands include:

- Surface water pH neutral and generally stable. Average 7.3 pH, with a minimum of 6.6 pH and maximum of 8.46 pH. Two records (6.6 and 6.8 Ph) were below the lower ANZECC & ARMCANZ (2018) trigger value of 7.0 pH. No records were above the 8.5 pH upper limit
- EC indicated slightly brackish water with all values excluding one between 1.659 mS/cm to 6.048 mS/cm. These values are above the ANZECC & ARMCANZ trigger value for EC of 0.3-1.5 mS/cm
- Nutrient levels exceeded the ANZECC & ARMCANZ (2018) trigger values. TN concentrations exceeded the trigger value of 1.5mg/L on all but one occasion with the highest TN value of 8mg/L and an average of 4.45mg/L. TP concentrations were above the trigger value of 0.06mg/L on all occasions, ranging between 0.06mg/L to 1.6mg/L. The annual medians were above the Peel-Harvey Water Quality Improvement Plan target of 0.1mg/L (EPA 2008).



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Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Hydrology

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

Page 1 of 3

FIGURE 5-21

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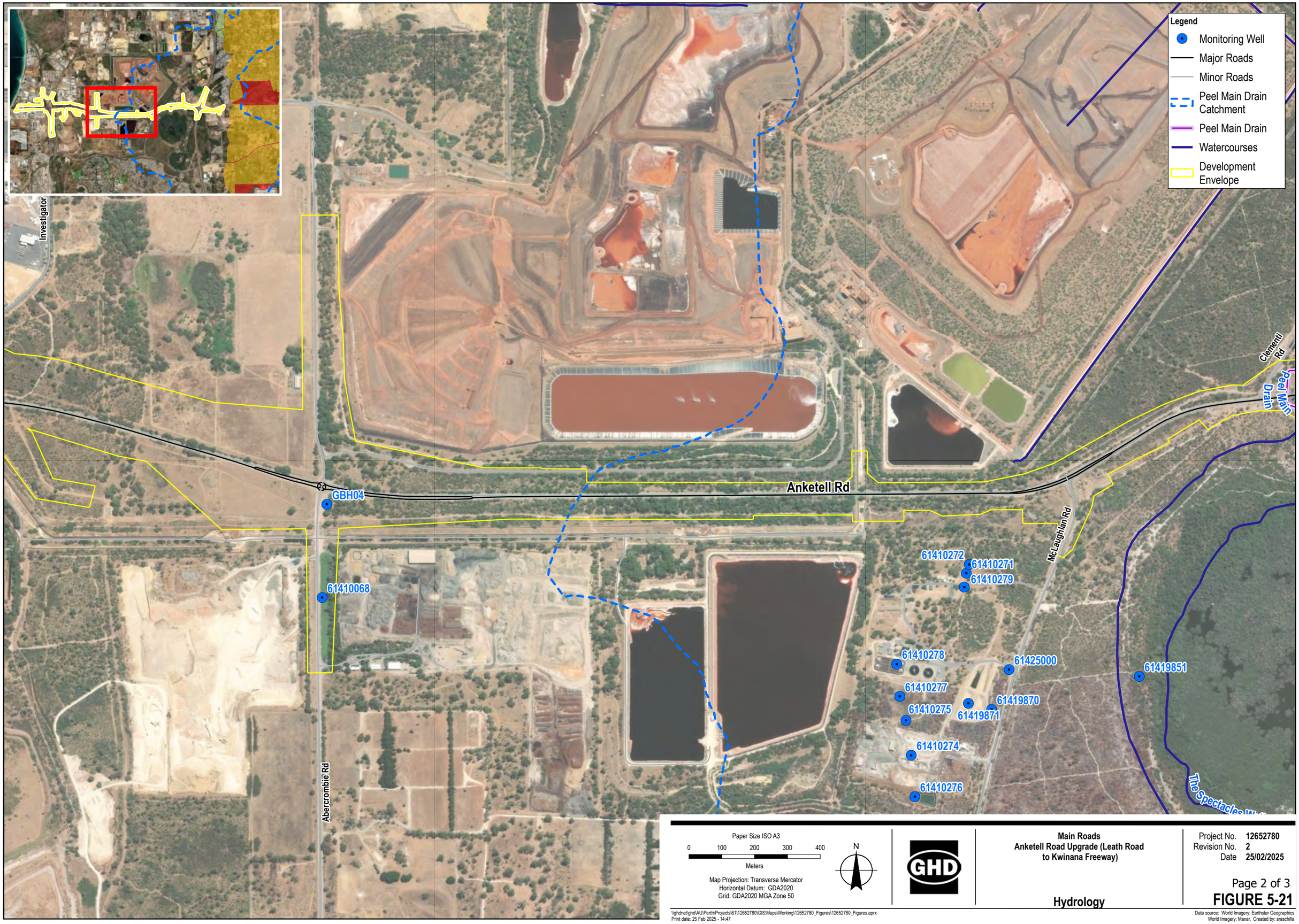

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Map Projection: Transverse Mercator
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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Hydrology

Project No. **12652780**
Revision No. **2**
Date **25/02/2025**

FIGURE 5-21

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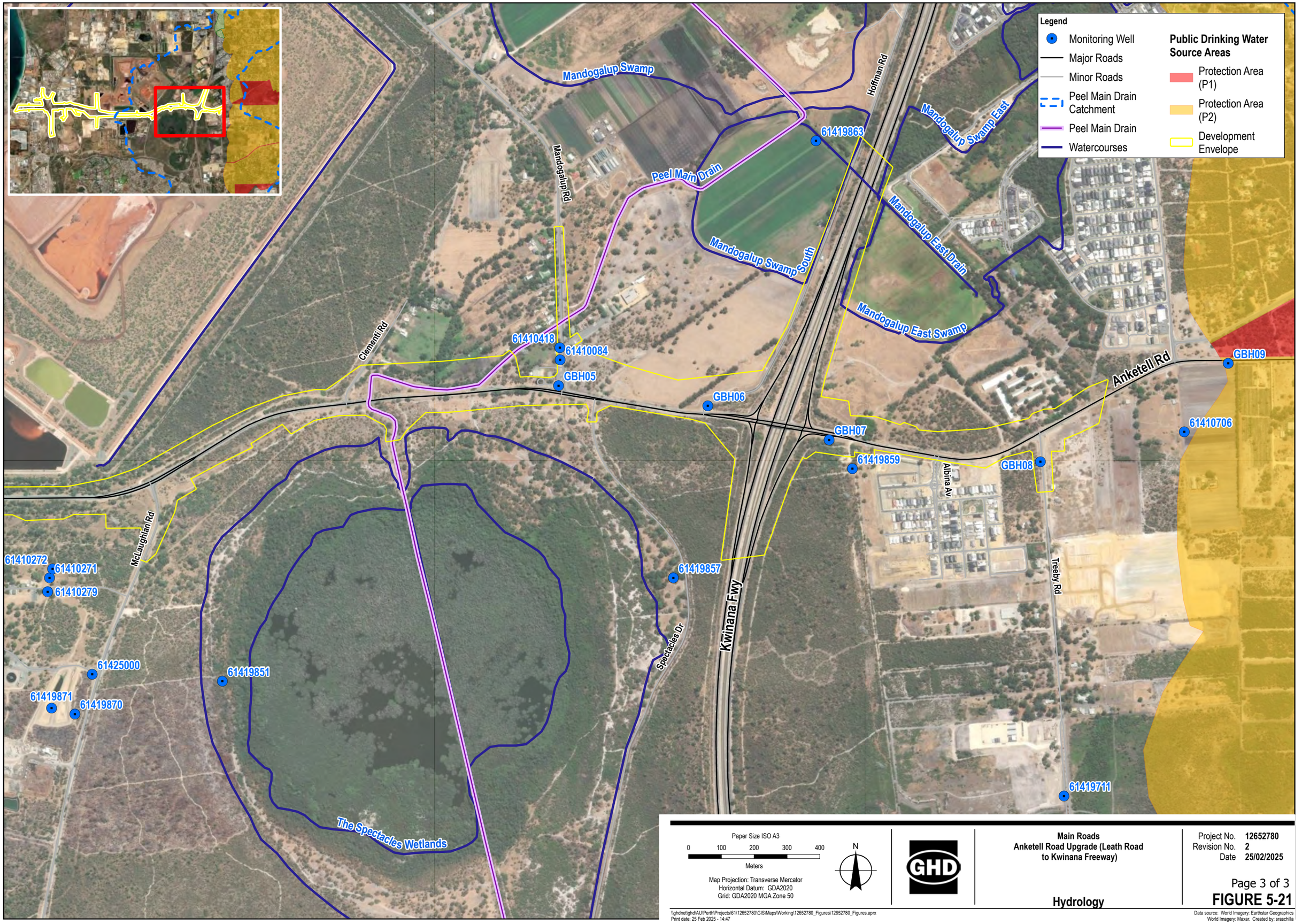

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Map Projection: Transverse Mercator
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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Hydrology

Project No. **12652780**
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Date **25/02/2025**

Page 3 of 3
FIGURE 5-21

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5.4.3.4 Wetlands

5.4.3.4.1 International and nationally important wetlands

No internationally recognised (Ramsar) wetlands or Nationally Important Wetlands intersect the DE. The nearest Ramsar wetland occurs approximately 3.7 km north of the eastern portion of the DE (Forrestdale & Thomsons Lakes), and the nearest Nationally Important Wetland occurs approximately 100 m south of the DE, west of Kwinana Freeway (Spectacles Swamp).

The Spectacles represent the most significant permanent water source in proximity to the DE. The Spectacles is part of Beeliar Regional Park and Bush Forever Site No. 269. It consists of two distinct swamps, the Big Eye Swamp in the north (113.1 ha) and the Small Eye Swamp in the south (28.4 ha). Both spectacles are round sumplands, joined to each other and nearby wetlands by a deep artificial drain. Spectacles Swamp is fed by groundwater and inflow from the Peel Main Drain originating 8 – 10 km northeast and continuing through to the Serpentine River. Inflow and outflow from Peel Main Drain along with minor contributions from rainfall influences water level of the Spectacles Wetland (Marillier *et al.* 2012; DoW 2009). There is substantial flow in the winter months. Water within the wetland is seasonal however near-permanent due to the Peel Main Drain (Stream 2025).

The wetland is also on the City of Kwinana heritage list.

5.4.3.4.2 Geomorphic wetlands

Based on the Geomorphic Wetlands of the SCP mapping (DBCA 2024b), two geomorphic wetlands intersect the DE (UFI 6530 and 6538) and a further five geomorphic wetlands occur within 250 m of the DE (UFI 6379, 6380, 6381, 12981 and 6539), detailed in Table 5.26 and mapped on Figure 5-22.

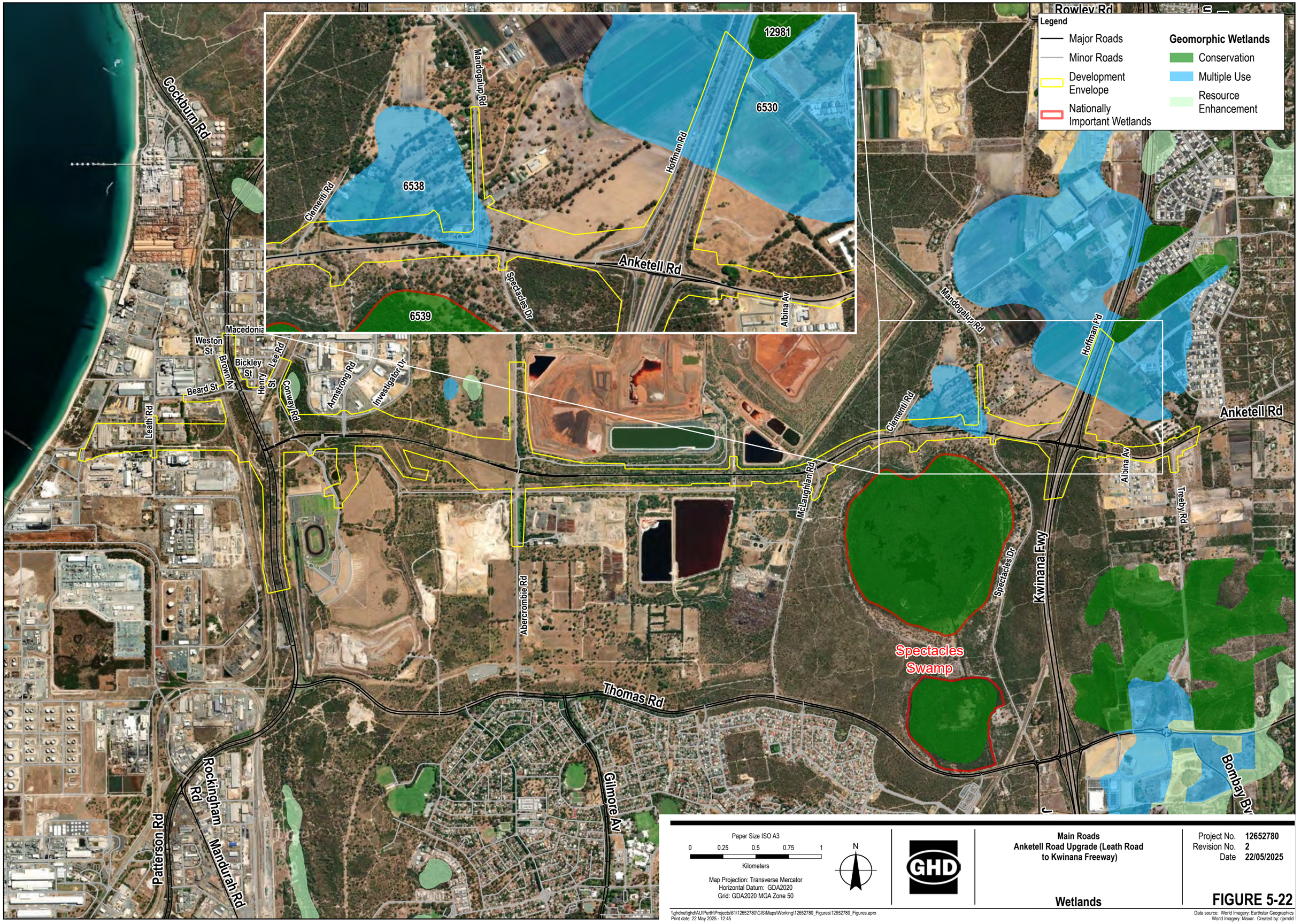
A total of 9.75 ha of mapped wetland areas occurs within the DE, with 0.22 ha mapped as native vegetation (in Completely Degraded condition), 4.54 ha mapped as modified vegetation, and the remaining 4.99 ha mapped as cleared. These wetlands are classified as MUWs, described as wetlands with few remaining important attributes and functions, whose use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through land care (Hill et al. 1996; WRC 2001).

Table 5.26: Geomorphic wetlands within 250 m of DE (DBCA 2024b)

UFI	Wetland name	Wetland management	Wetland Type	Wetland description	Total extent (ha)	Extent within DE (ha)	Decrease in wetland extent (%)	Vegetated extent within DE (ha)
6379	Conway Road Swamp	Resource Enhancement	Damplan d	This wetland is located 50 m east of Conway Road, Hope Valley, and 29 m east and 100 m north of the DE. The wetland contains intact native vegetation (*Melaleuca preissiana* woodland with fringing *Eucalyptus gomphocephala* occasional *Eucalyptus marginata* and *Banksia* spp. woodland) (Biota 2025) predominantly in good or better condition. The wetland is surrounded by native vegetation that extends to the south and east. Vegetation occurring within the wetland includes the listed TEC/PEC Tuart Woodlands and Forests of the SCP ecological community (mapped by Biota 2025) (Stream 2025).	2.12	-	-	-
6380	Unknown	Resource Enhancement	Damplan d	This wetland is located 240 m west of Abercrombie Road and 450 m north of Anketell Road, Hope Valley, approximately 280m north of the DE. It has been mapped as a mix of *Kunzea* tall shrubland to tall open scrub in Degraded condition and cleared (Biota 2025). The wetland is predominately surrounded by cleared areas (Stream 2025).	2.01	-	-	-
6381	Unknown	Multiple Use	Damplan d	This wetland is located 270 m east of Investigator Drive, Hope Valley and approximately 240m north of the survey area. It has been mapped as predominantly cleared (Biota 2025) and aerial photographs show some scattered trees and regrowth. The wetland is surrounded by cleared areas to the east and some native vegetation to the west. Within the 250 m buffer area the western edge of the wetland intersects mapped Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Stream 2025).	1.49	-	-	-
6530		Multiple Use	Damplan d	This wetland is extensive and occurs over multiple land uses. In the vicinity of the Proposal it crosses	215.39	5.79	2.69 (% decrease in	Modified: 1.62 ha

UFI	Wetland name	Wetland management	Wetland Type	Wetland description	Total extent (ha)	Extent within DE (ha)	Decrease in wetland extent (%)	Vegetated extent within DE (ha)
	Mandogalup Swamp South			the Kwinana Freeway north of Anketell Road and has already been highly modified by the existing Kwinana Freeway and surrounding residential development. The DE encompasses a linear strip of the southern extent of the wetland, and areas that have not been cleared are in Degraded to Completely Degraded condition.			mapped wetland extent	Native: 0.003 ha Cleared: 4.16 ha
12981	Mandogalup Swamp South	Conservation	Damplan d	This wetland is located between the Kwinana Freeway and Darling Chase, Wandi, approximately 10 m north of the DE. It contains intact native vegetation (*Kunzea* tall shrubland to tall open scrub and *Melaleuca preissiana* low woodland over *Astartea*) in good condition (Biota 2025).	3.42	-	-	-
6538	Unknown	Multiple Use	Damplan d	This wetland lies north of Anketell Road, north-west of the Mandogalup Road / Anketell Road intersection. The wetland has already been modified by the existing Anketell Road and surrounding residential development. The DE intersects the southern extent of the wetland, and areas that have not been cleared are in Completely Degraded condition.	20.09	3.96	19.71% decrease in mapped wetland extent	Modified: 2.91 ha Native: 0.22 ha Cleared: 0.83 ha
6539	Spectacles North	Conservation	Sumplan d	This wetland is located approximately 500 m southwest of the Anketell Road and Kwinana Freeway intersection and 100 m south of the DE at its closest point. It contains intact native vegetation in a very good to excellent condition, is listed as part of Bush Forever site 260 and Directory of Important Wetlands (WA090) and is part of an ecological linkage (Stream 2025).	132.10	-	-	-
Total						**9.75 ha**		**4.54 ha modified** **0.22 ha native**

UFI	Wetland name	Wetland management	Wetland Type	Wetland description	Total extent (ha)	Extent within DE (ha)	Decrease in wetland extent (%)	Vegetated extent within DE (ha)
								4.99 ha cleared



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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Wetlands

Project No. **12652780**
Revision No. **2**
Date **22/05/2025**

FIGURE 5-22

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Data source: World Imagery: Earthstar Geographics
World Imagery: Maxar. Created by: rjarrold

5.4.3.4.3 Groundwater Dependent Ecosystems

Steam (2025) identified 324.84 ha of potential GDE with the Proposal's contextual area which includes the DE and a 500 m buffer (total area 1,335.84 ha). Potential GDE included areas with some intact native vegetation and a depth groundwater of <10 m or shallower. Of the 324.84 ha, 67.99 ha is mapped as wetland and 256.86 ha as phreatophytic vegetation. The wetland mapped included 56.63 ha rated as high ecological value, 7.27 ha as moderate ecological value and 4.08 ha as low ecological value based the scoring system outline in Stream (2025). Wetland mapping for the DE and surrounds is shown on Figure 4, Appendix 9 in Stream (2025) (Appendix 10).

The Spectacles Wetland North (UFI 6539) and Mandogalup Swamp South (UFI 12981) are groundwater throughflow wetlands with water level controlled by groundwater flowing west from Jandakot Mound, resulting in surface water expression of groundwater at the wetland, typically in winter (Bekele et al. 2019, Marillier et al. 2012). On the up-gradient (east) side of Spectacles wetland, groundwater contours decrease 5 m AHD over 300 m, demonstrating high hydraulic gradient and water level higher or equal to the topographic surface of the wetland (10 m elevation). This results in surface water expression of groundwater as it moves west through the low lying wetland to higher topography and lower aquifer hydraulic gradient on the down-gradient (west) side of the wetland (Marillier et al. 2012) (Stream 2025).

The Spectacles Wetland experiences high rates of evapotranspiration with a maximum water depth usually less than one meter (Bekele et al. 2019). Previous studies indicate that wastewater infiltrated to the Superficial aquifer 500 m west of the wetland creates a small groundwater mound which maintains water level in the wetland (Bekele et al. 2019). Additionally, inflow and outflow from Peel Main Drain influences water level along with minor contributions from rainfall on the wetland surface (Marillier et al. 2012, DoW 2009).

The Conway Road Swamp (UFI 6379) is a Resource Enhancement Category wetland that lies to the northeast of the Anketell Road / Rockingham Road intersection. It occurs in low a lying depression (<10 mAHD surface elevation) within Spearwood Dunes and Tamala limestone, with a groundwater level of 8 – 10 m below surface level (Stream 2025). Stream (2025) reports that it is unlikely or rare that surface expression of groundwater occurs at this wetland even in winter. Stream (2025) notes that vegetation associated with this wetland is likely to be phreatophytic, dependent on the subsurface presence of groundwater.

Phreatophytic vegetation is discussed further in Section 5.1.3.2.3.

Communities of Tumulus Springs (Organic Mounds SCP) TEC

The Communities of Tumulus Springs (Organic Mounds SCP) is listed as a Critically Endangered ecological community under the BC Act and Endangered under the EPBC Act. The TEC is mapped as occurring within geomorphic wetland Mandogalup Swamp South (UFI 6530) (DBCA TEC/PEC). The area of potential TEC occurs approximately 500 m north of the DE (Figure 4, Appendix 9 in Stream 2025, Appendix 10). The occurrence covers approximately 2.6 ha and is surrounded by housing developments and bitumen roads.

The flora and fauna assemblages of the Organic Mounds SCP TEC are reliant on a permanent supply of freshwater and the maintenance of hydrological processes to the mounds (DBCA 2024b). The habitat of the mound springs is characterised by raised areas of peat that with a continuous discharge of groundwater support moist microhabitats and invertebrate fauna assemblages (DBCA 2024b).

5.4.4 Potential environmental impacts

The implementation of the Proposal may result in potential direct impacts to inland waters during construction of the Proposal, including:

- Loss of up to 0.22 ha of native vegetation within 9.75 ha of mapped MUWs through infill, ground disturbance and vegetation clearing
- Short-term changes to groundwater levels as a result of dewatering during construction.

The Proposal has the potential to indirectly impact inland waters, particularly the Spectacles and Conway Road Swamp, through the following:

- Changes to hydrological regimes of adjacent wetlands from earthworks and alteration of surface water drainage
- Changes to recharge and runoff associated with permanent increased area of hard surface and drainage away from the site, potentially causing localised flooding
- Erosion and sedimentation in surrounding areas from vegetation clearing, bridge construction, earthworks and alteration of surface water drainage
- Changes to groundwater levels and groundwater flow due to abstraction of groundwater for construction purposes which may affect private and public groundwater users
- Saline water intrusion or upconing resulting from excessive groundwater extraction
- Contamination of surface and/or groundwater from:
    - Accidental spills of fuels or chemicals during construction
    - Contaminated stormwater runoff during construction and operation
    - Discharge of dewatering effluent
    - Excavation of, and exposure to, ASS.

5.4.5 Mitigation

Impacts to inland waters have been avoided and minimised through mitigation and management measures. Many of the measures considered to avoid and reduce impacts to flora and vegetation, and terrestrial environmental quality, are mutually beneficial for inland waters. Table 5.28 outlines mitigation and management measures for the avoidance and minimisation of potential impacts to inland waters.

Table 5.27: Avoidance and minimisation of potential impacts to inland waters

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Avoid	
The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on inland waters. There is also an offline alignment over some sections. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social). Existing and future environmental data will be used to determine the environmental values and enable the design to be modified and refined, where practical to avoid and minimise impacts to inland waters, whilst complying with Main Roads standards for the safety of road users, improved congestion, and ease of access.	Established practice for Main Roads, high certainty
Main Roads has committed to reducing the volume of water abstracted for construction from the 3 proposed bores within the DE. The estimated abstracted volume (construction water requirement) from the 3 bores in the DE is 485,000 kL. with the remaining construction water required sourced from water trading from existing licences or alternative water sources for example industrial process water or non-potable water.	Best practice, high certainty
Flow and water quality to the Spectacles from the Peel Main Drain during construction will be maintained therefore impacts to surface water quality will be avoided.	Best practice, moderate certainty
Drainage design will integrate Water Sensitive Urban Design principles.	Established practice for Main Roads, high certainty
Drainage design will be implemented to maintain hydrological flow regimes and control stormwater run-off.	Best practice, moderate certainty
Minimise	
Minimise clearing impacts to inlands waters where practicable through the detailed design process.	Best practice, moderate certainty
Monitoring in accordance with standard management controls and any licences.	Best practice, high certainty
Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: – Sediment and erosion – Dewatering controls – Contamination and spills.	Established practice for Main Roads, high certainty
Rehabilitate	
Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.	Established practice for Main Roads, high certainty

5.4.5.1 Preliminary bore locations

The Proposal's total water demand during construction was estimated by Metis (2024) to be approximately 700,000 kL (Table 5.28). Metis (2024) identified numerous possible construction water supply options, of which one was to install production bores within the DE to supply the construction water demand.

Main Roads proposes to abstract 485,000 kL from three groundwater bores within the DE. Main Roads commits to obtaining 215,000kL of earthworks construction water demand from alternative sources such as from existing licenced bores (outside the DE) or from alternative water sources, for example industrial process water or non-potable water.

FSG (2024) modelled the groundwater level drawdown from potential construction water supply bores. The modelling included the above scenario i.e. 485,000 kL sourced from groundwater abstraction at three proposed production bores, shown on Figures 10 and 11 of Appendix 8. Potential bore locations were determined based on modelled groundwater level drawdown (FSG 2024).

Table 5.28: Estimated water demand

Requirement	Amount (kL)
Earthworks	
Moisture conditioning (placement of fill material)	308,000
Dust suppression for earthworks (cut and fill)	122,000
Sub-total earthworks construction	**430,000**
Dust suppression	
Non-earthworks dust suppression	270,000
Total demand	**700,000**

5.4.5.1.1 Bore exclusion zones

Stream (2025) determined exclusion zones to guide the location of production bores if groundwater is identified as the preferred water supply for construction activities. The exclusions zones are distances from high value groundwater dependent wetlands within which production bores should not be constructed, calculated using a drawdown estimate of the Superficial Aquifer. Inputs to the calculation were determined based on predicted water supply requirements for the Proposal, estimated pumping rates and aquifer properties for the Tamala Limestone and Bassendean Sand components.

The total water requirement to construct the project over an estimated two-year timeframe is approximately 430,000 kL. Metis (2024) determined an average flow rate of 9.7 litres per second (over 24-hour period) is required from a production bore to obtain this volume, which is expected to be achieved in limestone. Records from an established water bore at Abercrombie Road show an achieved flow rate of 13 litres per second is achieved, noting that this may be a pump limitation rather than water availability (Metis 2024).

Aquifer parameters for Tamala Limestone and Bassendean Sand were based on values for the area published in Davidson (1995) and estimated aquifer thickness was based on locally derived aquifer cross

sections (Golder 2022). Aquifer values implemented in calculation of exclusion zones are summarised in Table 5.29.

Table 5.29: Aquifer parameters used to calculate cone of depression (Stream, 2025)

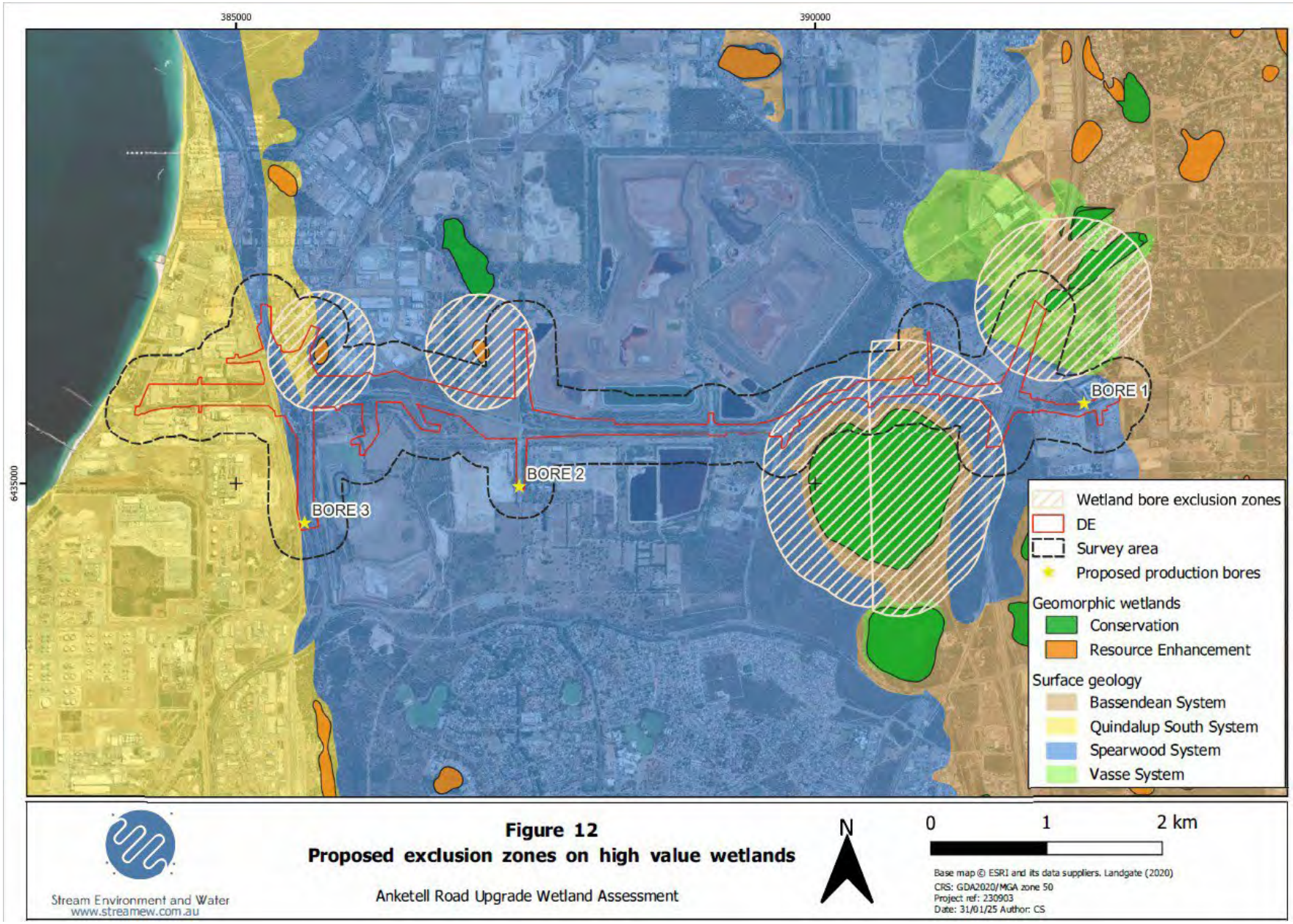
Aquifer material	Hydraulic conductivity (K)*	Estimated saturated thickness	Transmissivity (T) m2/d	Storativity
Bassendean sands	8.2	15	123	0.2
Tamala limestone/Calcarenite	100*	20	2000	0.2

* Davidson (1995) quotes a range in hydraulic conductivity of Tamala Limestone of between 100-1000. A conservative approach was applied by Stream (2025) with the lower K value used in calculations.

The Stream (2025) assessment determined that following 180 days of groundwater abstraction, the following conservative drawdown and radius is expected:

- In Tamala Limestone: just over 10 cm drawdown at 400 m radius and dropping below 10 cm beyond 400 m radius
- In Bassendean Sand: 42 cm drawdown at 400 m radius, dropping to 16 cm at 600 m radius.

For wetlands overlying Tamala Limestone, the calculated drawdown of 10 cm at 400 m (and dropping below 10 cm beyond 400 m) is considered low risk in terms of magnitude and rate of permissible change in groundwater level. Bores should therefore be located at least 400 m from the geomorphic wetland boundary. For bores located in Bassendean Sands, the calculated drawdown of 42 cm at 400m is considered moderate risk in terms of magnitude and severe risk in terms of rate. At 600 m the drawdown is calculated to drop to 16 cm which is considered low risk in terms of magnitude and moderate in terms of rate. Bores should therefore be located at least 600 m from the geomorphic wetland boundary in Bassendean Sands. The calculated exclusion zones are mapped on Figure 12 of Appendix 10 and shown below.


385000
390000
6435000
BORE 1
BORE 2
BORE 3
Wetland bore exclusion zones
DE
Survey area
Proposed production bores
Geomorphic wetlands
Conservation
Resource Enhancement
Surface geology
Bassendean System
Quindalup South System
Spearwood System
Vasse System
Stream Environment and Water
www.streamew.com.au
Figure 12
Proposed exclusion zones on high value wetlands
Anketell Road Upgrade Wetland Assessment
N
0
1
2 km
Base map © ESRI and its data suppliers. Landgate (2020)
CRS: GDA2020/MGA zone 50
Project ref: 230903
Date: 31/01/25 Author: CS

5.4.5.1.2 Risk profile of bore locations

FSG (2024) determined the potential risk of obtaining suitable construction groundwater supply for the Proposal, based on the groundwater modelling results from all modelled groundwater level drawdown scenarios. The DE area was given one of the following three criteria for pumping risk:

- Low Risk: areas considered suitable for groundwater abstraction with low risk of deterioration in abstracted groundwater quality. No to minimal additional investigations likely to be required.
- Moderate Risk: areas considered possibly suitable for groundwater abstraction with moderate risk of deterioration in abstracted groundwater quality. Some additional investigations likely to be required.
- High Risk: areas currently considered unsuitable for groundwater abstraction with high risk of deterioration in abstracted groundwater quality. Significant additional investigations likely to be required.

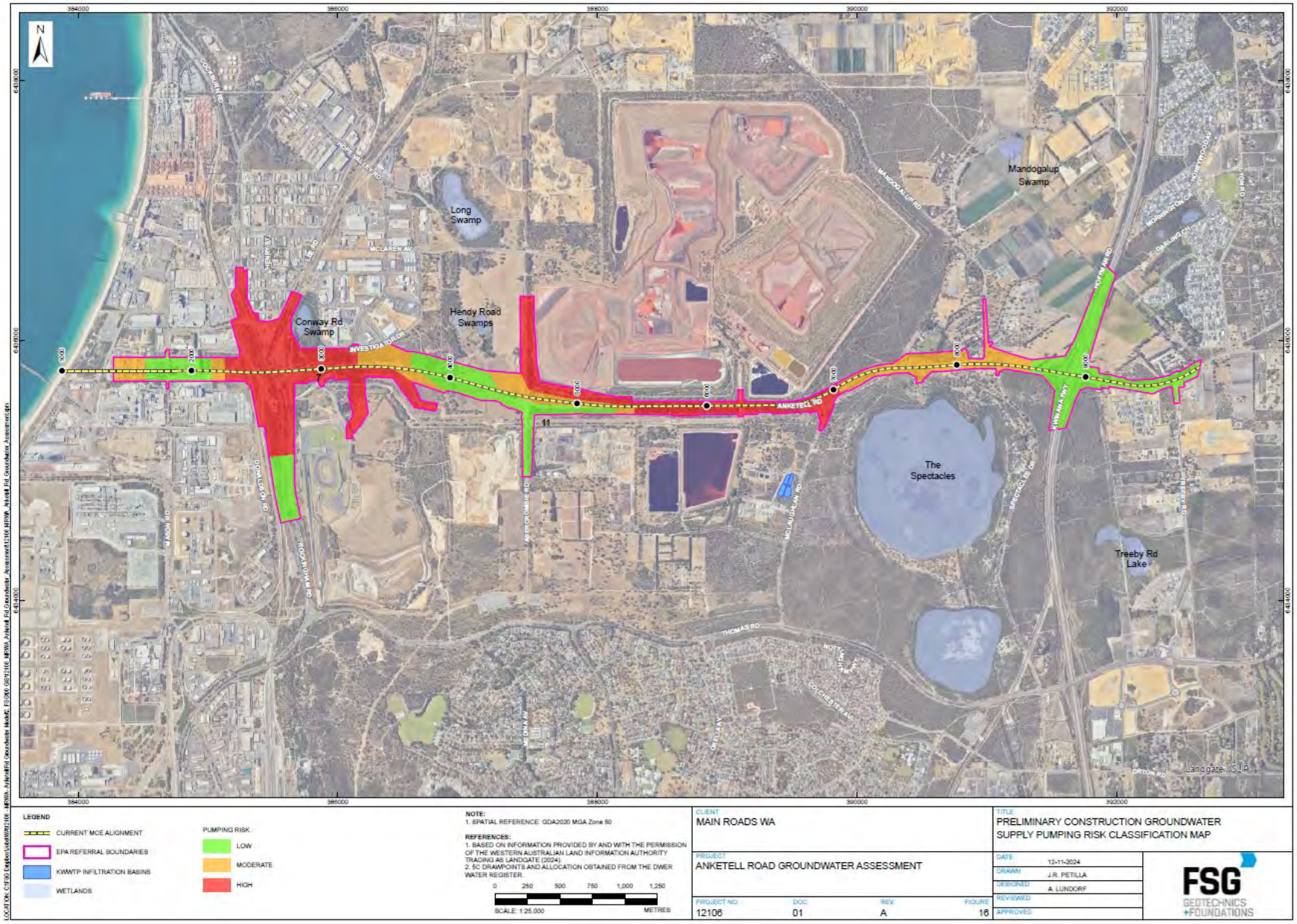
If the risk map was purely based on hydrogeological conditions (i.e. the aquifers capability to provide the required construction water demand), then the entirety of the DE would be classified as a low risk due to the highly transmissive aquifer and the modelled very low drawdown.

Preliminary construction groundwater supply risk within the DE determined by FSG (2024) is mapped on Figure 16 of Appendix 8 and shown below.

FSG (2024) reasoning for the risk classifications within the DE are as follows:

- The moderate risk area west of Rockingham Road is due to potential risk of saline water intrusion or upconing
- The high risk area along Rockingham Road and Anketell Road is due to the potential for known groundwater contamination seeping into the aquifer from the decommissioned Alcoa residue storage facilities south of Anketell Road
- The high risk area along Abercrombie Road and Anketell Road is due to potential contamination risk from the operating Alcoa residual areas. Along Anketell Road northeast of the KWWTP treatment ponds, contamination risk is increased as there is potential for E. coli in abstracted groundwater
- The moderate risk area along Anketell Road north of the Spectacles is predominantly due to the close proximity to the wetland, and there is potential for E. coli in abstracted groundwater.

To minimise potential impacts on high value wetlands, the proposed location of bores was determined through consideration of the exclusion zones developed by Stream (2025) and pumping risk within the DE determined by FSG (2024).


N
Long Swamp
Mandogalup Swamp
Conway Rd Swamp
Hendy Road Swamps
ANKETELL RD
The Spectacles
Treeby Rd Lake
THOMAS RD
Landgate
LEGEND
CURRENT MCE ALIGNMENT
EPA REFERRAL BOUNDARIES
KWWTP INFILTRATION BASINS
WETLANDS
PUMPING RISK
LOW
MODERATE
HIGH
NOTE:
1. SPATIAL REFERENCE: GDA2020 MGA Zone 50
REFERENCES:
1. BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2024).
2. SC DRAWPOINTS AND ALLOCATION OBTAINED FROM THE DWER WATER REGISTER.
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CLIENT
MAIN ROADS WA
PROJECT
ANKETELL ROAD GROUNDWATER ASSESSMENT
PROJECT NO. 12106
DOC. 01
REV. A
FIGURE 16
TITLE
PRELIMINARY CONSTRUCTION GROUNDWATER SUPPLY PUMPING RISK CLASSIFICATION MAP
DATE 12-11-2024
DRAWN J.R. PETILLA
DESIGNED A. LUNDORF
REVIEWED
APPROVED
FSG GEOTECHNICS +FOUNDATIONS

5.4.6 Assessment and significance of residual impact

5.4.6.1 Loss of wetland areas

Construction of the Proposal will involve the loss of 9.75 ha of mapped MUWs, of which 0.22 ha is mapped as native vegetation (in Completely Degraded condition), 4.54 ha is mapped as modified vegetation, and 4.99 ha is mapped as cleared. Direct impacts from the Proposal will reduce the overall physical extent of degraded MUWs and may reduce their environmental value and function (such as loss of habitat and water retention capacity). The impact of the Proposal to MUW areas is unlikely to be significant.

The nearest Ramsar wetland occurs approximately 3.7 km north of the eastern portion of the DE (Forrestdale & Thomsons Lakes). Given the distance to the Proposal from Forrestdale & Thomsons Lakes, and the separation between the Proposal and the wetland by a buffer consisting of major roads and residential areas, any activities associated with the Proposal are unlikely to impact Forrestdale & Thomsons Lakes.

The nearest Nationally Important Wetland occurs approximately 100 m south of the DE, west of Kwinana Freeway (Spectacles Swamp). Given the proximity of the Proposal to the Spectacles Wetland, studies of indirect impacts associated with altered drainage, sedimentation and erosion, and accidental contamination have been undertaken (BG&E 2024). Through careful design of the drainage of the proposed road, Main Roads has committed to maintaining the current drainage network and associated surface water flows. As a result, this will maintain surface flows to the Spectacles Wetland, maintaining the current values of the area. Any activities associated with the Proposal are unlikely to impact surface water flows to the Spectacles Wetland.

The Jandakot drainage and water management plan (DoW 2009) identified Mandogalup Swamp as important regional flood storage, serving as a buffer for the Spectacles Wetland. Modelling identified development of Mandogalup Swamp south (sections of the swamp to the east and west of Kwinana Freeway) does not represent a significant risk to downstream wetlands, nor have a limited impact on storage and fill requirements for proposed developments (DoW 2009).

5.4.6.2 Degradation of drains

The Proposal has the potential to impact upon the Peel Main Drain and Mandogalup East Drain through changes/alteration of surface water drainage including surface run-off patterns within and adjacent to the DE. Drainage design has considered the local drainage network and will maintain surface flows associated with Peel Main Drain Catchment and Mandogalup East Drain. Further, standard drainage and surface water management measures will be implemented. Following implementation of mitigation measures, the impact of the Proposal to the Peel Main Drain and Mandogalup East Drain is unlikely to be significant.

A Drainage Strategy (BG&E 2024) has been developed for the Proposal which outlines management objectives to maintain the hydrological values within and adjacent to the DE. The drainage strategy for the Anketell Road upgrade is to provide infiltration at the source, or as close to the source as possible, using permeable base pits via infiltration basins for the small, frequent rainfall events which addresses the runoff management objectives for the project. The infiltration basins will also be used for flood mitigation and protection of the road infrastructure and surrounding properties in major storm events. The use of swales to disconnect the drainage system for conveyance of runoff to the infiltration basins/flood mitigation measures will be included where possible.

The use of permeable base pits (leaky pits) and infiltration basins for the small frequent rainfall events will maintain the existing hydrology of the Proposal area, where currently impervious surfaces flow onto pervious surfaces to infiltrate into the groundwater. This will minimise the impact on wetlands and groundwater dependant ecosystems through maintaining the existing recharge of groundwater and disbursing the recharge via the permeable base pits.

During major events, the infiltration basins will create some localised mounding of groundwater at the basin locations, however, these are expected to be temporary with the mounding dissipating as the runoff infiltrates.

5.4.6.3 Dewatering for construction activities

The Proposal includes construction of bridge piers, abutment footings and drainage structures. Main Roads have indicated dewatering for construction will likely be required east of the freeway near the Wandi Nature Reserve and potentially at other sites where shallow water table and swamp deposit soils occur. Depending on the location, current groundwater level, depth of excavation required and duration, dewatering will cause temporary and localised groundwater drawdown.

The Proposal may result in short-term changes to groundwater levels and groundwater flow where temporary dewatering is required during construction. This can in turn result in impacts to GDEs, including wetlands, directly through changes in hydrological regimes. Dewatering can also result in changes to groundwater chemistry including those resulting from oxidation of ASS.

Stream (2025) undertook an assessment to assess the risk of impact on GDEs from potential groundwater drawdown associated with dewatering for the Proposal. The assessment considered two dewatering scenarios including 1) dewatering dry season without recharge and 2) dewatering dry season with recharge. Overall risk of impact to GDEs from dewatering is considered low. Drawdown extent is small and bore placement means drawdown (as modelled) generally occurs where the depth the groundwater is relatively deep, reducing the risk of impact to GDEs, and/or environmental values associated with GDEs are limited (Stream 2025). One section of MUW (part of Mandogalup Swamp South, UFI 6530) was scored with a moderate risk of impact under the dewatering scenario one (1). This wetland falls within the 0.5 m drawdown contour with groundwater at or near surface. The overall risk of impact as moderate is considered conservative for this wetland given the vegetation within the wetland is mapped as isolated trees over previously cleared or pasture (Biota 2025; Stream 2025).

Based on the Stream (2025) assessment and the proposed management measures no significant impact to Inland Waters due to the temporary groundwater drawdown are expected.

A Dewatering Management Plan will be developed and implemented that outlines treatment, monitoring and management requirements of the dewatering discharge.

5.4.6.4 Abstraction

The total water requirement for construction of the project over an estimated two-year timeframe is approximately 430,000 kL for earthworks construction and 270,000 kL for additional dust suppression. Whilst a range of water supply options have been investigated (including potable water sourced from water mains, use of reclaimed treated wastewater sourced from KWWTP or Kwinana Water Reclamation Plant and desalinisation of seawater), only abstraction of groundwater has the potential to impact the hydrological values within and adjacent to the DE. Abstraction of groundwater can result in localised groundwater

drawdown which occurs when groundwater is abstracted from an aquifer at a rate faster than it can be replenished, forming a cone of depression in groundwater level (Stream 2025). As indicated in section 5.4.5.1, FSG (2024) modelled the abstraction of 485,00kL. The potential impacts of this modelled abstraction were assessed by Stream (2025).

The high hydraulic conductivity and transmissivity of Tamala Limestone and, to a lesser extent, Bassendean Sand within the DE means a fast rate of lateral groundwater flow to the abstraction sites, potentially reducing groundwater level at sensitive wetlands (Stream 2025). Change in groundwater level has the potential to impact wetlands through alteration of hydrological regimes, reduced water availability and impacts to groundwater chemistry. Three potential bore locations have been chosen with respect to bore exclusion zones (5.4.5.1.1) and risk profiling of bore locations (Section 5.4.5.1.2). The potential for groundwater drawdown to impact Conway Road Swamp, the Spectacles Wetland and Mandogalup Swamp is considered to be low given the proximity to potential bore locations.

Substantial abstraction can also result in changes to groundwater flow, independent of potential change resulting from reduced or increased recharge. As presented by Bekele et al (2019), the groundwater mound created by infiltration of secondary treated wastewater at KWWTP influences groundwater flow west of the Spectacles Wetland and maintains water level at the wetland. Changes to the volume and or location of abstraction bores that currently interact with this mound could potentially alter the groundwater flow dynamics between the KWWTP and Spectacles Wetland (Stream 2025).

There is potential for private and public groundwater users to be impacted by changes to groundwater levels and groundwater flow as a result of abstraction. Stream (2025) reviewed the online Water Register (DWER, 2025e) and identified 36 current 5C groundwater licences issued within the Superficial aquifer across three groundwater areas intersecting the groundwater model boundary. Based on the number and location of drawpoints displayed for a groundwater license, and the risk threshold of 1 m or greater of groundwater drawdown, the risk to existing groundwater users was assessed as low for modelled scenarios of dewatering and abstraction (Figure 17 of Appendix 10).

5.4.6.5 Changes to hydrological regimes of adjacent wetlands

Proposal activities are not expected to result in changes to surface water flows, affecting the functioning of adjacent wetlands. The existing hydrological regimes are in a largely modified state due to historical clearing and presence of the existing Anketell Road within the DE. Construction of additional road and other hard surfaces associated with the proposal has the potential to alter hydrological regimes by reducing infiltration of rainfall (and recharge to groundwater) and/or increasing runoff from rainfall events into surface water features. This can potentially result in impacts to hydrological values, including wetlands within and adjacent to the DE (Table 5.26). The construction of the proposal will increase the area of hard road surface along the 7 km road upgrade and will generate a marginal increase in runoff and recharge; however, the change in recharge is expected to be very small in comparison to overall local recharge area. In addition, majority of soils in the survey area are highly transmissive sands with high infiltration rates. The drainage design for the project will direct rainfall runoff into swale drains and detention basins to infiltrate on site and will result in local recharge similar to the existing regime.

Road runoff and stormwater will be managed with the objective of maintaining local hydrological regimes. Drainage design will integrate Water Sensitive Urban Design principles and incorporate elements such as infiltration basins and swales. Earthworks and clearing within the DE are not expected to be of sufficient scale to cause substantial hydrological changes in the local area. Through the implementation of mitigation

measures and drainage design (BG&E 2024), changes to hydrological regimes of adjacent wetlands and tributaries are considered unlikely to be significant.

5.4.6.6 Erosion and sedimentation

The Proposal has the potential to indirectly impact on inland water through changes to hydrology, erosion and sedimentation as a result of clearing of vegetation and earthworks. Proposal works have the potential to destabilise soils and, if unmanaged, result in erosion of the DE and sedimentation of surrounding drainage infrastructure, vegetation, wetlands and waterways. This could result in impacts to downstream surface water features including the Peel Main Drain. Drainage design will need to consider the local drainage network and maintain surface flows associated within Peel Main Drain Catchment to avoid erosion and sedimentation. Erosion and sediment controls will be implemented to minimise impacts. Through the implementation of mitigation measures, erosion and sedimentation impacts will be effectively managed and are considered unlikely to be significant.

5.4.6.7 Contamination of surface water and groundwater

There is potential for contamination of surface water and groundwater during construction of the Proposal from accidental release of hazardous materials, erosion runoff and from sediments or dust. Unintended releases may occur as a result of runoff during stormwater events and contaminated sediment depositing within adjacent wetlands. There is also a potential risk of accidental spills, such as fuel, during the construction phase of the project from vehicles and construction equipment.

Contaminated surface water and groundwater has the potential to impact adjacent sensitive receptors including neighbouring vegetation, fauna and wetlands. Downstream sensitive receptors include the Spectacles Wetland and Mandogalup Swamp south, as well as other Conservation Category wetlands. These potential contamination impacts will be effectively managed through the mitigation measures and are considered unlikely to be significant.

5.4.7 Predicted Outcomes

The Proposal's Inland Waters environmental outcomes, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows:

- All ground disturbance will occur within the DE
- No direct impacts to Conservation Category or Resource Enhancement wetlands
- No more than 0.22 ha of native vegetation associated with a MUW will be impacted
- Maintain the existing hydrological regimes during operation
- Maintain groundwater and surface water quality during construction and operation
- No change to groundwater levels will occur near sensitive receptor wetlands, in the short and long term, and as a result groundwater dependent vegetation will not be impacted
- No change to surface water flows will occur as effective drainage infrastructure will be constructed

Main Roads considers implementation of the identified planning, avoidance and mitigation measures will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for inland waters will be met.

5.5 EPA environmental factor and objective – social surroundings

5.5.1 EPA Objective

The EPA's objective for social surroundings is *'To protect social surroundings from significant harm'* (EPA 2023a).

5.5.2 Relevant policy and guidelines

- Environmental Factor Guideline: Social Surroundings (EPA 2023b)
- Guidelines for Local Heritage Surveys (GoWA 2022)
- State Planning Policy 5.4 Road and Rail Noise
- Road and Rail Noise Guidelines (DPLH 2019)
- Guideline: Dust emissions (DWER 2021c)
- A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011)
- Town of Kwinana Local Planning Scheme No. 3 (Town Centre) - Updated to include AMD 5 GG (DPLH 2020)
- Town of Kwinana Local Planning Scheme No. 2 - Updated to include AMD 152 GG (DPLH 2021).

5.5.3 Receiving environment

5.5.3.1 Surveys and studies

A summary of the key social surroundings studies that have been undertaken in relation to the Proposal are presented in Table 5.30.

Table 5.30: Summary of social surrounds surveys undertaken for the Proposal

Survey / Report	Details
Transportation Noise Assessment Anketell Road Upgrade (Leath Road to Treeby Road) (Lloyd George Acoustics 2024). Appendix 11	Lloyd George Acoustics undertook a Transportation Noise Assessment for the Proposal. The acoustic criteria relevant to a road upgrade are provided in State Planning Policy No. 5.4 Road and Rail Noise produced by the Western Australian Planning Commission (WAPC), with outdoor noise targets of 60 dB $LA_{eq(Day)}$ and 55 dB $LA_{eq(Night)}$. A model of existing noise levels was developed and calibrated with on-site noise measurements, referred to as the Existing Scenario. The calibrated model was then modified to consider the traffic noise in the future (2051) including the Anketell Road upgrade. The analysis shows that there are no noise sensitive premises that are predicted to receive a future traffic noise level, assuming the 'Build' scenario, that exceed the State Planning Policy No. 5.4 Road and Rail Noise criteria. Therefore, for this project, further consideration of noise mitigation is not required under the Policy.
The Report Of An Aboriginal Archaeological Heritage Survey Of The Anketell Road Proposal Area (Kwinana Freeway To Leath Road) (Archae-aus 2024a).	Archae-aus undertook an Aboriginal Archaeological survey across the Proposal area. The scope of the survey was to conduct Aboriginal Archaeological surveys to Site Identification level, sufficient for Main Roads to make a successful application under section 18 of the *Aboriginal Heritage Act 1972* (AHA) and conduct the surveys in accordance with the Noongar Standard Heritage Agreement (NSHA), with the participation of the Gnaala Karla Booja (GKB) representatives as nominated by the GKB Cultural Advice Committee, through the South West Aboriginal Land and Sea Council (SWALSC).

Survey / Report	Details
Appendix 12	The archaeological survey was conducted in collaboration with nominated Gnaala Karla Booja Traditional Owners. The fieldwork was undertaken over two fieldtrips, from the 13 to 15 May 2024, and a follow up trip on 9 July 2024. No new Aboriginal archaeological sites were identified during the survey.
The Report Of An Ethnographic Aboriginal Heritage Survey Of The Anketell Road Proposal Area (Kwinana Freeway To Leath Road) (Archae-aus 2024b). Appendix 13	Archae-aus undertook an ethnographic site identification survey across the Proposal area. The scope of the survey was to conduct Aboriginal Ethnographic surveys to Site Identification level, sufficient for Main Roads to make a successful application under section 18 of the Aboriginal Heritage Act 1972 (AHA) and conduct the surveys in accordance with the Noongar Standard Heritage Agreement (NSHA), with the participation of the Gnaala Karla Booja representatives as nominated by the GKB Cultural Advice Committee, through the South West Aboriginal Land and Sea Council (SWALSC). The ethnographic survey was conducted in collaboration with nominated Gnaala Karla Booja Traditional Owners. The fieldwork was undertaken on 9 July 2024. A desktop study indicated that one Aboriginal Cultural Heritage Historic Records Place is situated in close proximity to the Survey Area and overlaps two small portions of the Survey Area. This place, DPLH ID 3427 (Mandogalup Swamp/Spectacles), currently holds a 'historic record' status with the Department of Planning, Lands and Heritage (DPLH), indicating that information on the place held by DPLH has previously been assessed against the site assessment criteria of the *Aboriginal Heritage Act 1972* and determined to not meet the assessment criteria to register the place as an Aboriginal Site. The GKB Traditional Owners who took part in the ethnographic survey were adamant that the Spectacles did constitute an Aboriginal Site that should be protected under the AHA. Archae-aus advised that, while not a Site under the AHA, the waters running into DPLH ID 3427 (Mandogalup Swamp/Spectacles) from the north through the Peel Main Drain is important for maintaining the health of the Spectacles and the flow of water should be protected. need to be recognized and understood as a part of the extensive cultural heritage landscape that spans the Perth coastal plain. The GKB Traditional Owners further recommended that two GKB monitors be invited to view the completed works in the vicinity of the Peel Main Drain to ensure the continued flow of water.

5.5.3.2 Aboriginal heritage

The Proposal occurs within the Gnaala Karla Booja (GKB) Indigenous Land Use Agreement (ILUA) area, made with the GKB Traditional Owners under the South West Native Title Settlement. Through the ILUA, the Main Roads GKB Standard Heritage Agreement has come into effect, which is an agreement to ensure that proposed activities are carried out in a manner that protects Aboriginal Heritage Places and Objects to the greatest extent possible.

Spatial analysis was undertaken to identify recorded Aboriginal heritage sites within the DE and within a 5 km buffer. Spatial analysis used the DPLH Aboriginal Cultural Heritage - Register (DPLH-099), Aboriginal Cultural Heritage - Lodged (DPLH-100) and Aboriginal Cultural Heritage – Historic (DPLH-098) datasets. These datasets contain places within Western Australia that have been reported to the Registrar of Aboriginal Sites as possible Aboriginal sites within the meaning of the AH Act and include the following categories:

- Registered Sites – places assessed by the Aboriginal Cultural Heritage Committee (ACHC) as meeting the criteria for section 5 of the AH Act

- Lodged Places – places that are yet to be formally assessed by the ACHC against the criteria under section 5 of the AH Act
- Historic Records Places – places that have been assessed by the ACHC as not meeting the criteria of Section 5 of the AH Act

Archaeological places preserve evidence of past activities by Aboriginal groups or people, such as artefacts and quarries, and are described in Section 5.5.3.2.1. Ethnographic places are places known to Traditional Owners as part of their cultural traditions and typically have mythological, ritual or ceremonial associations. Ethnographic sites are described in Section 5.5.3.2.2.

5.5.3.2.1 Archaeological heritage

Spatial analysis of DPLH datasets did not identify any Aboriginal Heritage Places with archaeological values as occurring within the DE. Within a 5 km study area of the DE, there are 20 Aboriginal Heritage Places with archaeological values. These sites are detailed in Table 5.31 and shown on and Figure 5-23. Of the 20 places, 5 are Registered Sites, 5 are Lodged Places and 10 are Historic Records Places. Of the Registered Sites nearest to the DE, Place 3710 is a previous camp location while Place 38661 is attributed with multiple heritage features: burial, artefacts/scatter, camp, ritual/ceremonial and water source. At a minimum, these Registered Sites are 1.7 km from the DE.

Table 5.31: Aboriginal Heritage Places (Archaeological) within 5 km of the DE (DPLH, 2024)

Place ID	Site name	Status	Type	Distance to DE
3534	Sloans Reserve Artefacts.	Register	Sub surface cultural material; Artefacts / Scatter; Other	4.7 km south
3710	Thomas oval.	Register	Camp	1.8 km south
3711	Sloans reserve.	Register	Camp; Hunting Place	3.8 km south
4357	Wattleup Road Swamp	Register	Artefacts / Scatter	3.4 km north
38661	Thomas Road	Register	Burial; Artefacts / Scatter; Camp; Ritual / Ceremonial; Water Source	1.7 km south
3646	Bellway Sand Quarry, Wellard	Lodged	Artefacts / Scatter	4.8 km south
17582	Hope Valley Trees 1-12	Lodged	Other	0.3 km north
21148	Leda Isolated Finds	Lodged	Other	4.8 km south
35999	Challenger Ave Cave	Lodged	Rock Shelter	4.2 km south
38973	Scarred Tree, 313 Mandurah Road	Lodged	Modified Tree	5 km south
3555	Treeby road lake.	Historic	Artefacts / Scatter; Camp; Other	1.6 km south
3627	Mortimer/Woolcoot, Wellard	Historic	Artefacts / Scatter	5 km south
3647	Gibbs Road, Success	Historic	Artefacts / Scatter	5 km north
3689	East Rockingham Cemetery	Historic	Burial	4.2 km south
3690	Mandurah road trees.	Historic	Camp; Other	4.3 km south
3698	Chalk hill camps.	Historic	Camp	2.8 km south

Place ID	Site name	Status	Type	Distance to DE
4148	Natgas 127	Historic	Artefacts / Scatter	2 km south
4360	Norkett Road	Historic	Artefacts / Scatter	1.7 km north
21330	Thompsons Lake Isolated Artefacts	Historic	Artefacts / Scatter; Other	5 km north
31743	Rockingham Industry Isolated Finds	Historic	Other	5 km south

Archae-aus (2024a) undertook an Aboriginal Archaeological survey of the Proposal area. The fieldwork was undertaken over two fieldtrips, from the 13 to 15 May 2024, and a follow up trip on 9 July 2024. The archaeological survey was conducted in collaboration with a representative group of GKB Traditional Owners nominated by the GKB Cultural Advice Committee, through SWALSC. The survey was undertaken in accordance with the Main Roads GKB Standard Heritage Agreement and incorporated best practice heritage management, as described in the current Australian Burra Charter Practice Notes (2013).

The Archae-aus (2024a) survey identified a number of sample areas within the DE for targeted pedestrian inspection, where desktop review of historical imagery had indicated previous land use and ground disturbance may have been minimal and there is potential for surface cultural material. A total of 13 sample areas within the survey area were identified and inspected using a series of parallel pedestrian transects, with archaeologists and Traditional Owners spaced no more than 30 m apart. Team members visually inspected the terrain for archaeological material. In total, the 13 sample areas covered an area of approximately 47.7 ha.No new Aboriginal archaeological heritage places or isolated artefacts were located during the archaeological assessment of the DE. However, the lack of surface archaeological finds is not an indicator of the absence of sub-surface cultural material. The DE, especially areas adjacent (within 500 m) to the lakes, was considered to have a very high potential for subsurface archaeology comprising flaked stone artefacts and burials. As a result, Archae-aus (2024a) designated the area surrounding the Peel Main Drain as a Heritage Potential Zone (HPZ), see Appendix 12, Map 5.

5.5.3.2.2 Ethnographic heritage

Spatial analysis of DPLH datasets has identified that one Aboriginal heritage place with ethnographic values intersects the DE, shown in Table 5.32 and Figure 5-23. Place ID 3427, named as Mandogalup Swamp/Spectacles, intersects small portions of the DE at two locations: the northern extent of Kwinana Freeway and east of Treeby Road. The place is considered a Historic Records Place with ethnographic values tied to Creation/Dreaming narratives and also identified as a camping, hunting and water source area.

A further four Aboriginal heritage places with ethnographic values occur within 5 km of the DE, shown in Table 5.33, Figure 5-23. One of these sites is Registered Site 18938 (Thomsons Lake), which is located 4.9 km north of the DE. This Registered Site has ethnographic values associated with Creation/Dreaming narratives and was known as an area of plant resources and as a water source. Of the other three places within 5 km of the DE, two are Lodged Places and one is a Historic Records Place. The nearest of these sites is Place 3776 (Indian Ocean), which is 0.3 km west of the DE. The Indian Ocean place has ethnographic value as it is important in its association with a particular local Creation/Dreaming Narrative relating to Cockburn Sound.

Table 5.32: Aboriginal Heritage Places (Ethnographic) that intersect the DE

Place ID	Site name	Status	Type	Description
3427	Mandogalup Swamp/Spectacles	Historic Record	Mythological / Creation / Dreaming Narrative; Hunting Place; Water Source	A waterbody associated with the Waugal. One in a series of wetlands, extending from Wattleup Road in the north to Hope Valley Road in the south. Mandogalup Swamp and the Spectacles Wetland were originally recorded as an ethnographic Aboriginal site in 1991. This area had been a freshwater source, a food resource, camping and hunting site for local Aboriginal people before market gardens intruded into it in the post-World War Two years.

Table 5.33: Aboriginal Heritage Places (Ethnographic) within 5 km of the DE

Place ID	Site name	Status	Type	Distance to DE
18938	Thomsons Lake	Register	Ritual / Ceremonial; Creation / Dreaming Narrative; Historical; Plant Resource; Water Source	5 km north
3290	Thomsons Lake.	Lodged	Hunting Place	4.9 km north
20865	Mount Brown - Booyeeanup	Lodged	Creation / Dreaming Narrative	2 km north
3776	Indian Ocean	Historic Record	Creation / Dreaming Narrative	1.7 km west

Archae-aus (2024b) conducted an ethnographic survey in collaboration with a representative group of GKB Traditional Owners, which took place on 9 July 2024. The ethnographic information provided during the survey was in accordance with Sections 5b and 5c of the AH Act.

As descried in Table 5.32, one Historic Records Place is recorded as occurring within the DE: Place 3427 (Mandogalup Swamp/Spectacles). Despite the historic records listing, the GKB Traditional Owners who took part in the ethnographic survey were adamant that the Spectacles did constitute an Aboriginal Site under the AH Act. Furthermore, they advised that the waters running into the Spectacles from the north through the Peel Main Drain need to be recognised and understood as a part of the extensive cultural heritage landscape that spans the Perth coastal plain.

While not a Registered Site under the AH Act, the water flowing into the Spectacles through the Peel Main Drain is important for maintaining the health of the Spectacles. The survey investigated whether this waterway also constitutes part of the site. Archae-aus (2024b) determined that there is no ethnographic information to date that supports this; however, water is considered culturally significant in accordance with broader Noongar belief and is associated with the biocultural health of the Spectacles Wetland. As discussed in Section 5.5.3.2.1, Archae-aus (2024a) has designated the area surrounding the Peel Main Drain as a Heritage Potential Zone (HPZ).

5.5.3.2.3 Aboriginal cultural values associated with physical or biological surroundings

The DE is located within the GKB ILUA (WI2015/005), which forms part of the broader South West Native Title Settlement (WC1998/058). The GKB ILUA Area covers approximately 34,427 km^2 and stretches broadly

from the south of Perth down the coast near to Busselton. GKB Country incorporates three original Noongar sub-groups: the Pinjarup (also known as Bindjareb), Wiilman, and Kaniyang.

As described in Archae-aus (2024b):

> "*The kaip 'water' and bilya 'rivers' of the South-West Coast drainage basin are fundamental to the economic, social, and spiritual lives of Noongar people. (Note: kaip and bilya may differ slightly between dialect groups, but essentially these are the Noongar words for water and river.) The rivers formed movement corridors and resource-rich landscape features integral to Noongar economy. Rainfall levels which define the Southwest Botanical Province form a distinctive geographic and environmental zone, they also define Noongar country. As defining features of Noongar country, the rivers, lakes, creeks, and all of their tributaries are fundamental to Noongar culture, and thus maintain a special significance. Spiritual life is fundamental to Noongar culture, and it is inextricably linked to the organisation of Noongar society and to the management of Boodjar (Country). The responsibility to look after Boodjar is deeply engrained in Noongar cosmology, which enshrines a set of governing principles for the management of land and water*."

> "*In Nyungar Cosmology, the Waarkal is the Creator, the keeper of the fresh water sources. He gave us life and our trilogy of belief in the boodjar – the land – as our mother and nurturer of the Nyungar moort – family and relations – and our katitjin – knowledge so that we could weave that intricate tapestry known as the "web of life". Nyungar Katitjin is people's knowledge based on cosmological stories from the Dreamtime, known as Nyitting to Nyungar, on which cultural knowledge is founded. Nyitting (or Dreamtime) yarns are cosmological stories about events within and beyond the living memories of the Nyungar people. […] Nyitting literally means 'cold time', and refers to the time of creation*."

Consultation with GKB Traditional Owner representatives revealed the on-going connection with Mandogalup Swamp, The Spectacles, and surrounding bush (Archae-aus 2024b). Key sentiments shared can be summarised in the following themes:

- The area has been and is regularly accessed for cultural teachings, collecting ochre, and teaching about waterways and plant use to current generations. The area has been used for cultural tours, cooking traditional foods like kangaroo and damper.
- The Spectacles area is rich in resources such as freshwater reeds, tree saps, bark, honey from banksias, and other beneficial flora. Memories of wildlife in the area included turtles traveling between waterbodies and the presence of the Ngoorlak (Black Cockatoo).
- The waterbodies (Spectacles north and south lakes) were described as Miyall (eyes of Country) and formed part of a significant trade route. Because of this, it is likely the area was used as a meeting place for Noongar people.
- Traditional practices included the use of dried banksia cones to carry fire between meeting places, Mungite (Banksia grandis) was used as a firestick and sign of welcome, and medicinal pigface was found in the area. Paperbark trees were used for shelter.
- Various traditional food sources from the area included long neck turtles, possum, jilgies (freshwater crayfish), and racehorse goanna.

The GKB Traditional Owners recommend that Historic Records Place ID 3247 (Mandogalup Swamp/Spectacles) be re-assessed for Site Registration, with a new boundary that includes the two

waterbodies known as the Spectacles, as well as the surrounding remnant vegetation which is an intrinsic part of the cultural landscape. This boundary does not intersect with the DE (refer to Appendix 12, Map 10).

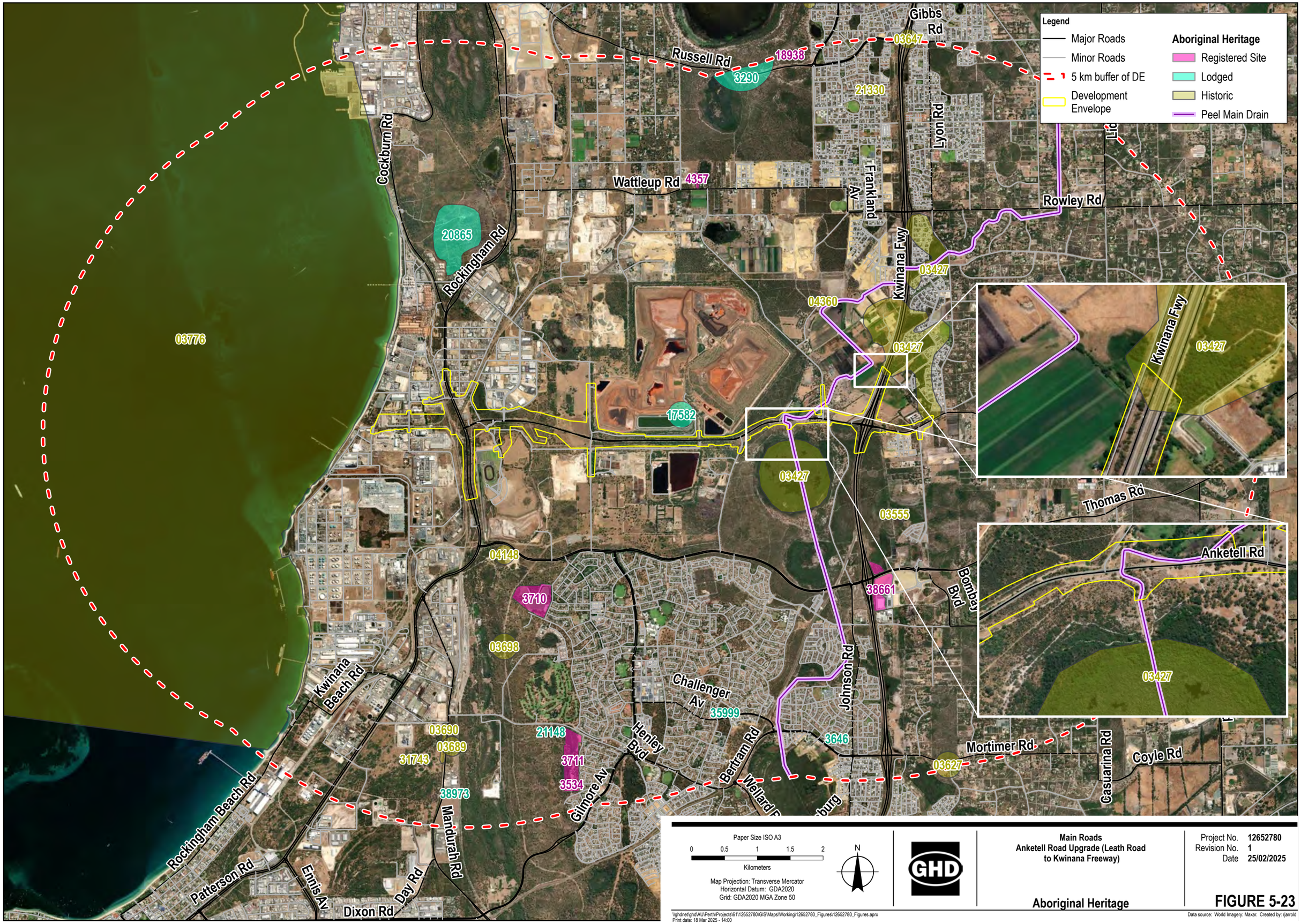
5.5.3.2.4 Traditional Owner Consultation during the EIA process

Consultation with relevant Elders raised the following matters for consideration (Westport 2020):

- Preference for options that use / widen existing roads to access the port
- Concerns about potential spillage of dangerous materials
- Concerns about risks of pollution to beaches, sea life and food sources
- A number of camps in the area (some listed, some used in living memory)
- The chain of hills along the coast, including Mt Brown, are culturally significant
- The Spectacles is an important source of wetlands and part of the Pinjar song line – any encroachment will need to be addressed.

Prior to conducting ethnographic and archaeological heritage surveys, Main Roads engaged with SWALSC and the GKB Aboriginal Corporation in accordance with the Main Roads GKB Standard Heritage Agreement Activity Notice process. This engagement determined the need for further consultation, pre survey meetings and surveys based on the nature of the proposed works.

During the ethnographic survey, no objections were raised to the proposed upgrades to Anketell Road by the GKB representatives and Archae-aus subsequently reported that the GKB Traditional Owners are supportive of the proposed project.
Mitigation measures suggested by GKB Traditional Owner representatives have been considered and included as part of the mitigation measures outlined in Section 5.5.5.



Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

N

GHD

Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Aboriginal Heritage

Project No.	**12652780**
Revision No.	**1**
Date	**25/02/2025**

FIGURE 5-23

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5.5.3.3 Historical Heritage

There are no World Heritage Properties or National Heritage Places within a 10 km buffer of the DE (DCCEEW 2025). A search of the WA State Register of Heritage Places, through the Heritage Council of WA's online inHerit Portal, identified six State Registered Heritage Places within 5 km of the DE (DPLH 2025a), of which the closest Place is Kwinana Signal Box (Place Number 3112) located approximately 1.1 km south of the western extent of the DE, near Rockingham Road.

The Local Heritage Survey (formerly Municipal Inventory) is a list of places identified that, in the opinion of the LGA, are or may become of local historical heritage significance. Ten places listed on the City of Kwinana's Local Heritage Survey intersect the DE (Table 5.34) and an additional 19 places occur within 2 km of the DE (Table 5.35). Historical Heritage Places that intersect the DE and occur within the vicinity of the Proposal are mapped on Figure 5-24.

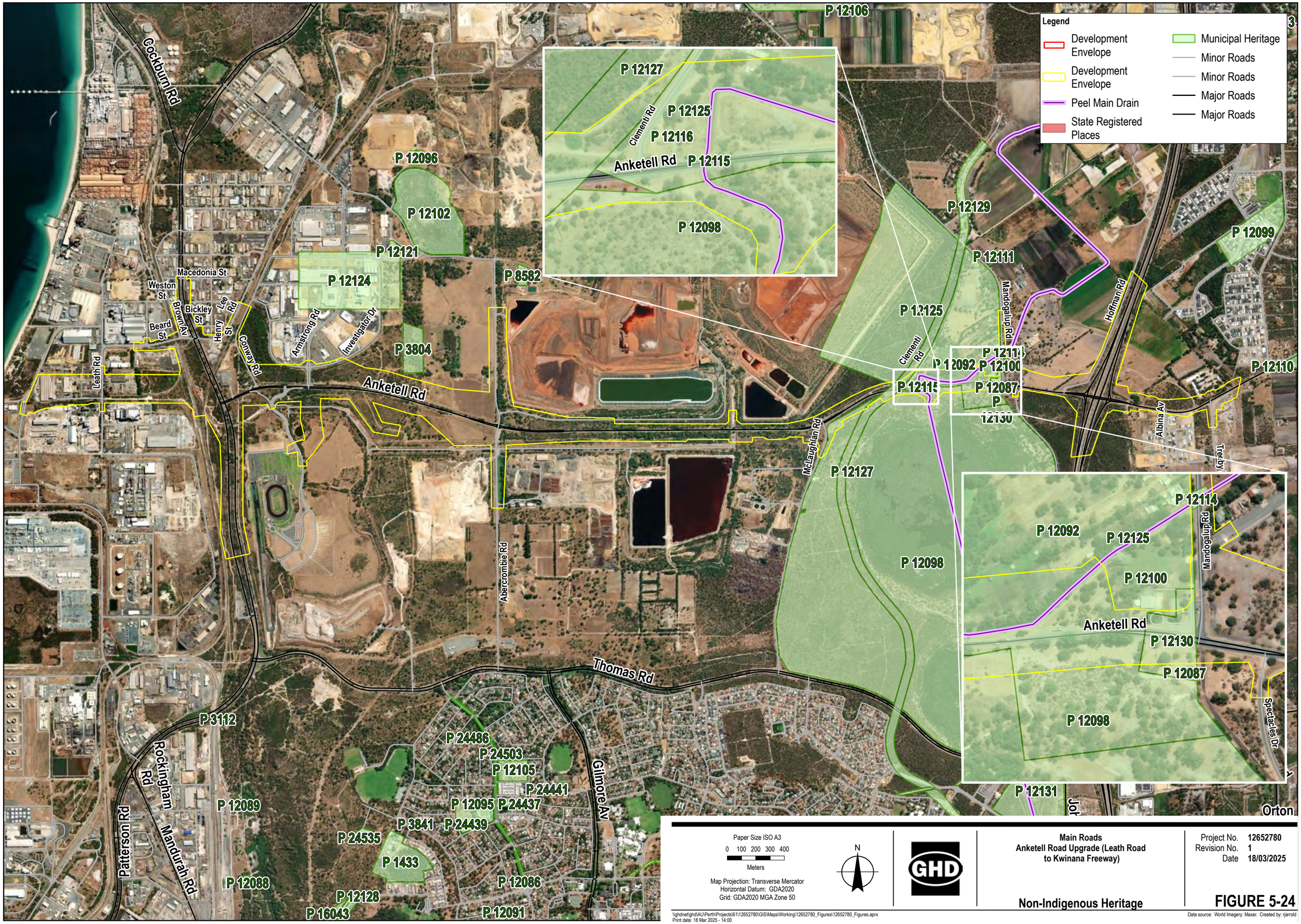
Consultation with the City of Kwinana on the Proposal and DE will be undertaken in early 2025 to establish any heritage-related requirements that the City of Kwinana may have in relation to Local Heritage Survey Places that intersect the DE.

Table 5.34: Municipal Heritage Places that intersect the DE (DPLH 2025a)

Place No.	Place Name	Site address	LGA	Proposed clearing extent
12115	White Bridge	Anketell Rd, Hope Valley	Kwinana	Entire extent
12087	Mandogalup Post Office (fmr)	Anketell Rd, Mandogalup	Kwinana	Partial extent
12116	Balmanup Post Office – Site Of	Clementi Rd, Hope Valley	Kwinana	Entire extent
12100	Hall Reserve - Mandogalup	Cnr Mandogalup & Anketell Rds, Mandogalup	Kwinana	Edges
12098	The Spectacles Wetland	Cnr Thomas/McLaughlan/Anketell Rds, The Spectacles/Postans	Kwinana	Edges
12125	Mandogalup Townsite	Mandogalup	Kwinana	Bisect (fragment)
12092	Soldier Settler Homes, Mandogalup	Mandogalup Rd, Mandogalup	Kwinana	Edges
12114	Jolly's Bridge	Mandogalup Rd, Mandogalup	Kwinana	Partial extent
12130	7 Mile Site ("Sevvy" to later settlers)	Mandogalup/Johnson/Hope Valley Rds, Mandogalup	Kwinana	Bisect (fragment)
12127	Tramway Reserve - site	Wellard	Kwinana	Bisect (fragment)

Table 5.35: Municipal Heritage Places that are located outside of but within 2 km of the DE (DPLH 2025a)

Place No.	Place Name	Site address	LGA
3804	Frederick Postans' Cottage, Hope Valley	41 Hendy Rd, Hope Valley	Kwinana
24503	Anglican Church (fmr)	57 Medina Av, Medina	Kwinana
12089	Pines Cottage	Butcher St, Kwinana Beach	Kwinana
8582	Heritage Farm	Cnr Abercrombie & Hope Valley Rds, Hope Valley	Kwinana
12121	Hope Valley School - site	Cnr Hope Valley Rd & McLaren Av, Hope Valley	Kwinana
12105	Harry McGuigan Park	Cnr Medina Av & Hoyle Rd, Medina	Kwinana
12124	Hope Valley Area Townsite	Hope Valley	Kwinana
12110	Mandogalup School - Site of	Jcn Anketell/Lyon/DeHaer Rds, Wandi	Kwinana
3112	Kwinana Signal Box	Kwinana Railway Marshalling Yards, Kwinana	Kwinana
12096	de San Miguel Home	Lot 339 Hope Valley Rd, Hope Valley	Kwinana
12102	Long Swamp	Lot 339 Hope Valley Rd, Hope Valley	Kwinana
12129	6 Mile Site	Lot 663 Norkett R d, Mandogalup	Kwinana
12111	Mandogalup School - Site of	Lot 665 Mandogalup R d, Mandogalup	Kwinana
12099	Leslies Property - Mandogalup	Lot 674 West of Lyon Rd, Wandi	Kwinana
12113	Barber's Bridge	Lyon Rd, Wandi	Kwinana
24486	Medina Avenue Trees	Medina Av, Medina	Kwinana
12128	Old Armadale-Rockingham Road	Nr Cnr Johnson/Thomas R ds, Casuarina	Kwinana
3841	East Rockingham Heritage Precinct	Rockingham	Rockingham
12104	Wandi Nature Reserve	Wandi Reserve, Wandi	Kwinana



Paper Size ISO A3

0 100 200 300 400

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Non-Indigenous Heritage

Project No. **12652780**
Revision No. **1**
Date **18/03/2025**

FIGURE 5-24

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Data source: World Imagery: Maxar. Created by: rjarrold

Local Heritage Survey Assessment

The Local Heritage Survey assessed Municipal Inventory Places for cultural heritage significance, in terms of aesthetic, historic, scientific, social and spiritual value, and classified said places according to Table 5.36 (Heritage Council 2022). Municipal Heritage Places that intersect the DE are discussed further below, grouped according to their classification level, from highest significance to least significance.

Table 5.36: Classification of significance (adapted from Heritage Council (2022))

Level of significance to the local area	Classification	Description
Exceptional	Category 1 [A]	Essential to the heritage of the locality. Rare or outstanding example.
Considerable	Category 2 [B]	Very important to the heritage of the locality.
Some/moderate	Category 3 [C]	Contributes to the heritage of the locality.
Little	Category 4 [D]	Has elements or values worth noting for community interest but otherwise makes little contribution.

The Spectacles Wetland (Place No. 12098)

The Spectacles Wetland within the Beeliar Regional Park (an area of remnant bushland and wetlands in the area south of Perth) is a large permanent wetland in the Spearwood dunes and consists of two lakes, Large Eye and Small Eye, which are largely covered with paperbarks. It is listed in good condition, with high integrity and high authenticity. The site is classified under grading category A, as 'highest level of protection for places of exceptional cultural heritage significance to the Town of Kwinana. Will also include places on the State Register of Heritage Places' (City of Kwinana 2023a). The City of Kwinana (2023a) considers the site to have exceptional cultural heritage significance due to the following:

- The place has aesthetic value as an attractive and prominent landscape feature which makes a significant contribution to the character of the area
- The place has historic value as it is associated with the Millar's timber line, which passed through the site on its way between Jandakot and Wellard, and made use of the water in the Large Eye to refill the boilers of the steam locomotives. The place is associated with the implementation of the Group/Soldier Settlement Scheme on the Peel Estate in the1920s, which, although generally considered a failure, contributed to the early development of farming and settlement at Mandogalup
- The place has scientific value as part of the Beeliar Regional Park; the place is an important component of one of the most important systems of lakes and wetlands remaining in the Perth metropolitan area. In particular, the wetland is important as a refuge and breeding site for native fauna
- The place has social value for the community as a popular and educational site for bush-walking and bird-watching. The place is valued by the local Aboriginal community, who have an ongoing association with the site and who recognise its significance as a traditional source of abundant food
- The place has research value for its potential to provide information about the life cycles and habitat of native fauna and flora, as well as some potential for archaeological finds relevant to the use of the

place by settlers from the Peel Estate Scheme and for its longer ongoing use as a place occupied and valued by the Whadjuk Noongar
- The Spectacles is a good example of large diverse wetlands. The area is important as a refuge and breeding site for native fauna, supporting breeding populations of scarlet robin, weebill, western thornbill, silvereye, Pacific black duck and rufous night heron. The black gloved wallaby, short nosed bandicoot and skinks, all species of conservation significance, are found around the wetlands.

The DE intersects the northern boundary of this site. There is approximately 4.72 ha of the DE within the Spectacles Wetland site, which equates to approximately 1.27% of the site (369.96 ha).

Soldier Settler Homes, Mandogalup (Place No. 12092)

The place comprises a (discontinuous) row of three single-storey residences, each located on the west side of Mandogalup Road. It is listed in good condition, with high integrity and moderate to high authenticity. The site is classified under grading category B, as 'high level of protection for places of considerable cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023b). The City of Kwinana (2023b) considers the site to have considerable cultural heritage significance due to the following:

- The place has aesthetic value, as the residences combine to produce a recognisable precinct of buildings and contribute to the streetscape of Mandogalup Road, with their simple building forms, weatherboard cladding and corrugated iron roofs
- The place has historic value as the houses are associated with the implementation of the Soldier Settlement Scheme on the Peel Estate in the 1920s, which, although generally considered a failure, contributed to the early development of farming and settlement at Mandogalup
- This group of three cottages demonstrate government planning of rural settlements, through their location together and the style and size of the homes. The differences between the homes demonstrate how the settlers could express their individuality.

The DE intersects the eastern edge and southern corner of this site. There is approximately 0.29 ha of the DE within the Soldier Settler Homes, Mandogalup site, which equates to approximately 7.18% of the site (4.04 ha).

Mandogalup Post Office (fmr) (Place No. 12087)

The site of the former Post Office comprises a number of built and landscape features including a small limestone structure, the remains of a brick chimney, and the limestone base of a former tank stand. It is listed in poor to ruinous condition, with moderate integrity and moderate authenticity. The site is classified under grading category B, as 'high level of protection for places of considerable cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023c). The City of Kwinana (2023c) considers the site to have considerable cultural heritage significance due to the following:

- The place has aesthetic value as the limestone building ruins retain evidence of skilled stonemasonry, and the remaining archaeological material present a historic precinct of the Mandogalup townsite
- The place has historic value as the site of the first Mandogalup post office and store, built in the 1920s, and is associated with the early development of the district

- The place has research value (potential archaeological value) in revealing the way of life of early settlers in an isolated rural community
- The remnant structures on the site are evidence of local business that were central to small regional communities in the Inter War and the period following World War Two.

The DE intersects the northern extent of this site. There is approximately 0.17 ha of the DE within the Mandogalup Post Office (fmr) site, which equates to approximately 51.52% of the site (0.33 ha).

Tramway Reserve (Place No. 12130)

Very little physical evidence remains of the former tramway, however a network of reserves and unallocated crown land extending between the northern border of the municipal area and the old Wellard Townsite reveals the tramway reserve. The Tramway Reserve is currently zoned as Parks and Recreation and is a popular recreation location. Condition is listed as 'Site Only', with low integrity and low authenticity. The site is classified under grading category B, as 'high level of protection for places of considerable cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023d). The City of Kwinana (2023d) considers the site to have considerable cultural heritage significance due to the following:

- The place has historic value as the site of the former tramway which was constructed in the 1900s as a supply route for settlers in the northern section of the Peel Estate
- The place has research value for its potential for the sites to yield archaeological finds relevant to its former use.

The DE bisects the site where it crosses Anketell Road, west of Clementi Road. There is approximately 1.24 ha of the DE within the Tramway Reserve - site, which equates to approximately 2.43% of the site (50.81 ha).

White Bridge (Place No. 12115)

White Bridge comprises a simple road bridge crossing the open drain that extends southwest from Mandogalup. It is listed in good condition, with high integrity and low authenticity. The site is classified under grading category C, to 'retain and conserve, if possible, places of some cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023e). The City of Kwinana (2023e) considers the site to have some cultural heritage significance due to the following:

- The place has historic value as it is associated with the Peel Estate drainage project, which involved draining lowland swamps to open up new tracts of land for farming
- The place has social value as it is a well-known crossing of the main Mandogalup drain, once characterised by its white-painted timber structure, and contributes to the community's sense of place
- The decision to build a drainage scheme to establish agricultural land over existing swamps demonstrates the prevailing view of the Inter War period which prioritised agricultural land over the existing wetlands.

The DE intersects the entirety of this site. There is approximately 0.08 ha of the DE within the White Bridge site, which equates to 100% of the site (0.08 ha).

Jolly's Bridge (Place No. 12114)

Jolly's Bridge comprises a simple road bridge crossing the open drain that extends southwest from Mandogalup. The site is listed in good condition, and classified under grading category C, to 'retain and conserve, if possible, places of some cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023f). The City of Kwinana (2023f) considers the site to have some cultural heritage significance due to the following:

- The place has historic value as it is associated with local resident, Jack Jolly, who was foreman for the Settlement Scheme house building in the 1920s. The place is associated with the Peel Estate drainage project, which involved draining lowland swamps to open up new tracts of land for farming
- The place has social value as it is a well-known crossing of the main Mandogalup drain and contributes to the community's sense of place for its presence in the landscape since the 1920s.

The DE bisects the site where it crosses Mandogalup Road, north of Anketell Road. Only a small sliver of the eastern extent of the site remains. There is approximately 0.07 ha of the DE within Jolly's Bridge site, which equates to approximately 70% of the site (0.10 ha).

Hall Reserve - Mandogalup (Place No. 12100)

The site comprises a public reserve, Mandogalup Pioneer Reserve, located on the northwest corner of the intersection of Mandogalup Road and Anketell Road, commemorating the former location of the Mandogalup Hall and the Mandogalup townsite. The site is classified under grading category C, to 'retain and conserve, if possible, places of some cultural heritage significance to the Town of Kwinana' (City of Kwinana 2017). The City of Kwinana (2017) considers the place to have historic value as the former site of the Mandogalup Hall, constructed in the 1920s as part of the early townsite, and associated with the initial growth and demise of the Mandogalup settlement.

The DE intersects bisects the site where it crosses Anketell Road, west of Mandogalup Road. There is approximately 0.4 ha of the DE within the Hall Reserve - Mandogalup site, which equates to approximately 21.98% of the site (1.82 ha).

Mandogalup Townsite (Place No. 12125)

The site comprises a few residences and the ruins of the Mandogalup Post Office, including the three remaining Soldier Settler homes (namely no.'s 27, 31 and 45 Mandogalup Road) and the corner of the Pioneer Reserve. It is listed in good condition, with low integrity and moderate authenticity. The site is classified under grading category D, described as 'recognition of places which achieve the minimum threshold cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023g). The City of Kwinana (2023g) considers the site to be a Historic Site due to the following:

- The place has aesthetic value, as the remaining soldier settler homes, combined with the hall site and the post office and store ruins, reveal the layout and character of the early buildings that formed the focus of Mandogalup townsite, and combine to represent a historic precinct
- The place has historic value as the site of the Mandogalup townsite, which was established as a Soldier's Settlement in 1921.

The DE intersects the southern extent of the site and the eastern boundary of the site. There is approximately 8.18 ha of the DE within the Mandogalup Townsite site, which equates to approximately 6.7% of the site (122.02 ha).

Balmanup Post Office (Place No. 12116)

The site is a section of cleared crown land, near the intersection of Clementi Road and Anketell Road. There are no visible remains of the former post office building, although it was believed to have been constructed south of Grassy Swamp, a small wetland just north of the Large Eye of the Spectacles. It is listed with low integrity and low authenticity, condition not assessed. The site is classified under grading category D, described as 'recognition of places which achieve the minimum threshold cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023h). The City of Kwinana (2023h) considers the site to be a Historic Site due to the following:

- The place has historic value for its association with the 1920s establishment of the farming community in the region and the subsequent Peel Estate Settlement. The site is valued for its association with the provision of mail services to the community by the state and federal government.

The DE intersects the entirety of this site. There is approximately 0.24 ha of the DE within the Balmanup Post Office – Site of site, which equates to 100% of the site (0.24 ha).

7 Mile Site ("Sevvy" to later settlers) (Place No. 12130)

Documentary evidence indicates the former stopping place known as Seven Mile is located on the western side of Mandogalup Road, opposite the intersection with Anketell Road. This area is currently occupied by the Mandogalup Community Hall and Fire Station. Condition is listed as 'Site Only', with low integrity and low authenticity. The site is classified under grading category D, described as 'recognition of places which achieve the minimum threshold cultural heritage significance to the Town of Kwinana' (City of Kwinana 2023i). The City of Kwinana (2023i) considers the site to be a Historic Site as it has historic value as the stopping place for the light rail travelling between Jandakot and Wellard, and was regularly used by local dairy farmers as a depot for bringing their milk and cream to be picked up by the train. The place is associated with the development of the region through the Peel Estate Agricultural Scheme.

The DE bisects the site where it crosses Anketell Road, west of Mandogalup Road. There is approximately 0.61 ha of the DE within the 7 Mile Site ("Sevvy" to later settlers) site, which equates to approximately 70.11% of the site (0.87 ha).

5.5.3.3.1 Existing land use

The Metropolitan Region Scheme (MRS) divides land into zones and reservations and provides the legal basis for future land use planning throughout the Perth Metropolitan Region. The majority of land within the DE is zoned as 'Rural' under the MRS and reserved as 'Primary regional roads' (the existing Anketell Road) and 'Other regional roads' (Table 5.37). The majority of the DE is located on areas reserved as Freehold Land (35.15%) and Road (28.54%), followed by Easements (20.54%), Crown Land (11.16%), and Reserves (4.63%) (DPLH 2025b). Land use within the DE and in the vicinity of the Proposal is mapped on Figure 2-1. The DE also intersects the northern extent of Reserve Class A Conservation Park R 53313 (Figure 5-10).

The City of Kwinana is covered by two Local Planning Schemes, Local Planning Scheme No. 2 and Local Planning Scheme No. 3. The DE falls within Local Planning Scheme No. 2, intersecting Naval Base Locality, Kwinana Naval Base Locality and Wandi Locality, and zones the DE for the following land uses, in order from highest prevalence to least: Rural B, General Industry, Rural A, Park recreation and drainage, Development, Service commercial and Public purposes.

Table 5.37: Land zoning and reservation within the DE

MRS description	Area within the DE (ha)	Proportion of the DE (%)
Rural	83.24	37.02
Primary regional roads	51.73	23.01
Other regional roads	38.04	16.92
Industrial	30.31	13.48
Railways	10.11	4.49
Parks and Recreation	7.27	3.23
Urban	3.23	1.43
Parks and recreation - restricted public access	0.77	0.34
Public purposes – Water Authority of WA	0.13	0.06
Total	**224.83**	**100**

5.5.3.4 Visual and social amenity

5.5.3.4.1 Visual Amenity

The Proposal is situated within modified landscapes associated with the Kwinana Industrial Area, including the Alcoa Kwinana Refinery, areas of general Industry, commercial services, rural land, primary regional roads, and freight railway corridors. Areas of natural vegetation immediately south of the eastern end of the Proposal include recreation areas within the Spectacles (part of Beeliar and Jandakot Regional Park). Other smaller areas of remnant vegetation occur on the northern side of the Proposal (City of Kwinana Town Planning Scheme No. 2).

A small number of private residences (rural and semi-rural) are located approximately 100 m north of the DE, on Clementi Road. There are also private residences north and south of the DE, on Treeby Road and near Lyon Road east of the Kwinana Freeway. The existing Anketell Road / Kwinana Freeway interchange has a bridge structure allowing Anketell Road traffic to pass over Kwinana Freeway. This existing structure is approximately 10 m above the ground level and the Kwinana Freeway. The existing interchange is landscaped with native vegetation.

Less than two per cent of the DE is zoned urban, with two residential estates being constructed east of Kwinana Freeway and north and south of Anketell Road. There are plans for additional residential dwellings immediately west and north of Kwinana Freeway and Anketell Road (land zoned rural). Current and future sensitive receptors may be affected by visual changes due to the Proposal.

However, given the relatively flat topography of landscape surrounding the DE, viewing distances from residential and recreational receptors are not high. This flat topography also presents potential opportunities to minimise the Proposal's visual impacts through landscaping and visual screening.

Views from most residences are to pastureland intersected by existing local roads and the Kwinana Freeway in the eastern portion of the DE. The existing visual environment is affected by tall transmission tower structure in the vicinity of Kwinana Freeway and Anketell Road. Several houses along Clementi Road have views of natural vegetation to the west of Clementi Road, zoned Parks and Recreation and rural residential.

The Spectacles recreation area has a parking area and walk trail off McLaughlan Road approximately 350 m south of the DE, and a lookout approximately 500 m south of the DE and approximately 1.5 km southwest of the Kwinana Freeway. Given the distance of the Proposal from these recreation areas, it is unlikely that the Proposal's additional permanent structures will be intrusive or even noticeable.

5.5.3.4.2 Noise and vibration

Project setting and sensitive receptors

Existing noise within the DE is be dominated by current traffic noise associated with Anketell Road (classified as 'Other regional roads' in the MRS) and connecting roads. Anketell Road is identified as a Strategic Freight and Major Traffic Route under State Planning Policy 5.4 Road and Rail Noise as it experiences either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume. This road has a trigger distance of 300 metres to be measured from road carriageway edge.

A noise sensitive receiver is defined under State Planning Policy 5.4 Road and Rail Noise as Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, childcare premises, hospital, nursing home, corrective institution or place of worship (DPLH 2019).

For the Proposal, due to the majority of the road alignment passing through industrial land, there are not many noise sensitive premises that would be affected by noise. The closest noise sensitive receivers include residential dwellings (areas zoned urban) located east of the Kwinana freeway, approximately 100 m north of the DE, west of Lyon Road. Currently there is no form of noise mitigation in place for these residential properties.

The existing environment has a high level of traffic noise impacting noise sensitive receivers currently. Traffic noise has been measured east of Kwinana Freeway at 65 dB (L_{Aeq}(Day)), which is 5 dB higher than the outdoor noise criteria in State Planning Policy 5.4 Road and Rail Noise.

Studies and Survey Effort

Noise monitoring and modelling have been undertaken to quantify potential impacts in accordance with State Planning Policy 5.4 Road and Rail Noise by Lloyd George Acoustics (2024).

The noise assessment of the proposed upgrade of Anketell Road included:

- Traffic noise monitoring to assess existing conditions and calibrate the noise model;
- Identification of noise sensitive premises adjacent to the project area;
- Noise modelling to predict future noise conditions;
- Assessment of traffic noise and potential impacts; and

- Recommendations regarding priority areas and suitable treatments for noise mitigation measures.

Noise Monitoring

Noise monitoring was undertaken at two locations in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters (L_{Aeq}(Day) and L_{Aeq}(Night)); and
- Calibrate the noise model for existing conditions.

The instruments used were Acoustic Research Laboratories (ARL) noise data loggers, with the microphone located approximately 1.4 metres above ground level. The loggers recorded various acoustic parameters, with the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} values reported. These loggers comply with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. Table 5.38 provides details at each monitoring location with Figure 5-25 and Figure 5-26 providing their general location. Loggers were located within the road reserve, rather than at residences. Table 5.39 provides a summary of the existing noise monitoring results.

Table 5.38: Noise Logging Details

Location	Serial No.	Set up Date	Collection Date
Anketell Rd – West of Kwinana Fwy	16-707-041	Monday, 11 December 2023	Tuesday, 19 December 2023
Anketell Rd – East of Kwinana Fwy	15-301-468	Monday, 11 December 2023	Tuesday, 19 December 2023

Table 5.39: Summary of Measurement Results

Measurement Location	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Anketell Rd – West of Kwinana Fwy	75	72	73	68
Anketell Rd – East of Kwinana Fwy	67	64	65	60

5.5.3.4.3 Dust

Dust is comprised of particles suspended in the atmosphere and is classified based on particle size. Dust size classifications include total suspended particulates (TSP), which consists of particulate matter less than 50 micrometres (µm), particulate matter less than 10 µm (PM10) and particulate matter less than 2.5 µm (PM2.5) in diameter.

Dust during construction has the potential to cause nuisance impacts on nearby residential, commercial and industrial land uses. It may also constitute a safety hazard to road and rail traffic. High concentration levels of dust may impact upon human health.

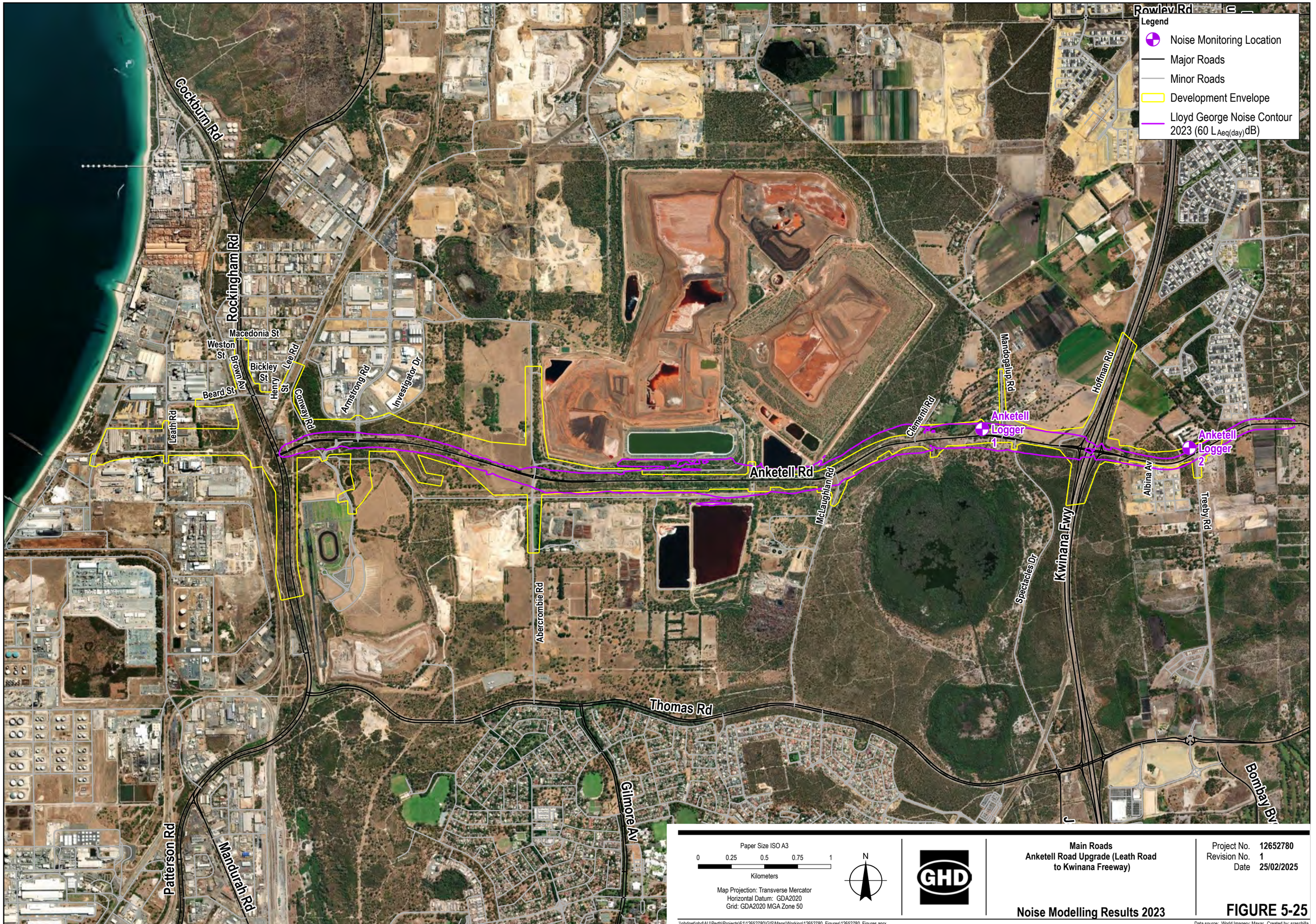
Dust can arise from a range of natural and man-made sources causing various acute and chronic health effects, as well as nuisance and visibility impacts (DEC 2011).

In the case of the Proposal, wind-borne dust may arise from:

- Exposed surfaces such as cleared land
- Sand stockpiles

- Construction activities
- Crushing activities
- Vehicle movements.

The composition of dust particles will depend on the nature of the source material (DEC 2011). Dust generated from the construction of the Proposal will reflect the composition of the soils which underlies the DE.



Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50

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Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)

Noise Modelling Results 2023

Project No. **12652780**
Revision No. **1**
Date **25/02/2025**

FIGURE 5-25

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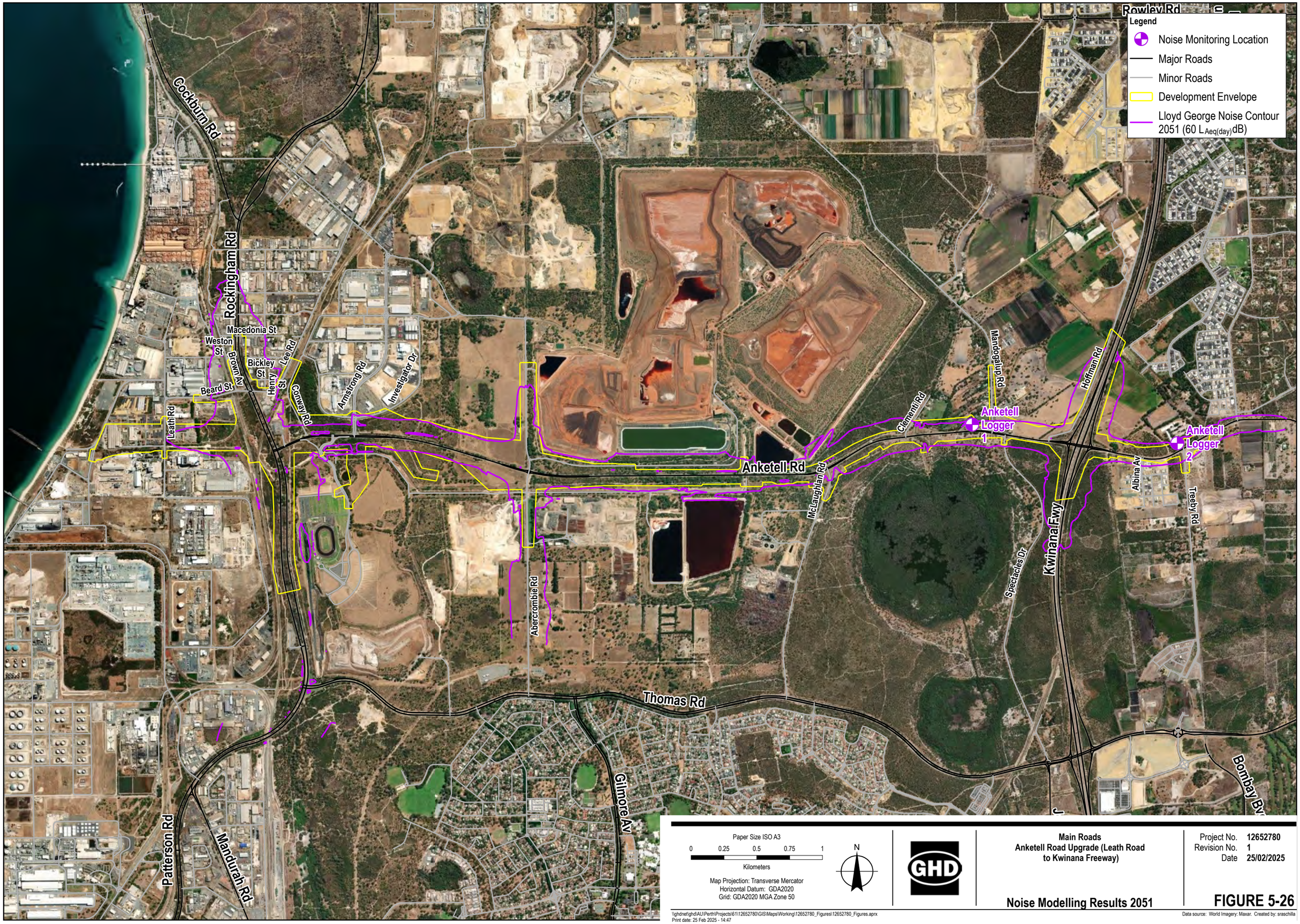
Legend
Noise Monitoring Location
Major Roads
Minor Roads
Development Envelope
Lloyd George Noise Contour 2051 (60 $L_{Aeq(day)}$dB)
Cockburn Rd
Rockingham Rd
Rowley Rd
Anketell Rd
Thomas Rd
Macedonia St
Weston St
Bickley St
Beard St
Henry St
Brown Av
Lee Rd
Conway Rd
Armstrong Rd
Investigator Dr
Leath Rd
Patterson Rd
Mandurah Rd
Abercrombie Rd
McLaughlan Rd
Clementi Rd
Mandogalup Rd
Hoffman Rd
Spectacles Dr
Kwinana Fwy
Albina Av
Treeby Rd
Gilmore Av
Bombay Bv
Anketell Logger 1
Anketell Logger 2
Paper Size ISO A3
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Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50
N
GHD
Main Roads
Anketell Road Upgrade (Leath Road to Kwinana Freeway)
Noise Modelling Results 2051
Project No. 12652780
Revision No. 1
Date 25/02/2025
FIGURE 5-26
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Print date: 25 Feb 2025 - 14:47
Data source: World Imagery: Maxar. Created by: srashilla

5.5.4 Potential environmental impacts

The Proposal could potentially result in the following impacts to social surroundings:

- Disturbance (direct or indirect) of one Historic Records Aboriginal heritage site (3427) during clearing and/ or excavation works
- Disturbance (direct or indirect) of Aboriginal cultural heritage values associated with the physical or biological surroundings
- Disturbance of undiscovered subsurface archaeology with the potential to comprise flaked stone artefacts, other cultural objects and burials/skeletal remains.
- Disturbance (direct or indirect) to 10 Municipal heritage sites listed on the Kwinana Municipal Heritage Inventory (Table 5.34)
- Reduced visual amenity due to:
    - Clearing of native vegetation to enable construction of the Proposal
    - Cut and fill works including temporary impacts associated with excavation activities, soil movement and stockpiling
    - Construction activities associated road construction including temporary buildings and laydown areas
- Construction waste i.e. litter and debris
- Dust emissions and deposition
- Noise and vibration impact to sensitive receivers, from noise emissions and vibration generated by construction activity within the DE (equipment and vehicle operation).

The potential operational impacts that may occur to social surroundings due to the Proposal are:

- Reduced visual amenity due to the presence of structures required for the road including elevated road bridges, noise walls or barriers
- Changes to road traffic noise post-construction (compared to pre-construction)
- Change in land use to Primary Regional Roads.

5.5.5 Mitigation

Impacts to social surroundings have been avoided and minimised through mitigation and management measures. Table 5.40 outlines avoidance and minimisation measures that have been incorporated into the Proposal planning.

Table 5.40: Avoidance and minimisation of potential impacts to social surroundings

Mitigation measure	Industry standard, best practice and certainty of effectiveness
Avoid	
The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on social surrounds. The existing road infrastructure consists of a 10 m wide pavement with previously cleared verges. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social constraints). Existing and future environmental data will be used to determine the environmental and heritage values and enable the design to be modified and refined, where practical to avoid and minimise impacts to social surrounds, whilst complying with Main Roads standards for the safety of road users, reduced congestion, and ease of access.	Established practice for Main Roads, high certainty
Significant heritage areas to be avoided within the DE must be clearly marked prior to the commencement of construction activities.	Established practice for Main Roads, high certainty
Construction works will be undertaken in accordance with the Environmental Protection (Noise) Regulations 1997 and A guideline for managing the impacts of dust and associated contaminants from land development sites (DEC 2011).	Industry standard, high certainty
Construction activities (including materials transport) will be limited between 0700 and 1900 Monday to Saturday, excluding public holidays (standard work hours).	Industry standard, high certainty
Any disturbance of Aboriginal heritage sites/materials will be undertaken in the presence of GKB Cultural Monitors, in consultation with the GKB Aboriginal Corporation, SWALSC and DPLH and in accordance with the requirements of the AH Act	Industry standard, high certainty
Two GKB cultural monitors will be present for initial ground disturbance works, as requested by GKB representatives during the Aboriginal Archaeological Survey.	Best practice, high certainty
Two GKB monitors will be invited to view the completed works in the vicinity of the Peel Main Drain to ensure the continued flow of water, particularly where the Peel Main Drain passes under the Anketell Road Proposal Area at 'White Bridge' and 'Jolly Bridge', as requested by GKB representatives during the Aboriginal Ethnographic Survey.	Best practice, high certainty
Minimise	
Minimise clearing impacts to social surrounds through the detailed design process.	Best practice, moderate certainty
Design the Proposal to reduce and minimise impacts on Aboriginal heritage	Best practice, high certainty
Undertake a road traffic noise assessment and develop a noise management plan.	Established practice for Main Roads, high certainty
Undertake noise modelling to identify noise wall locations and inform noise and vibration management.	Established practice for Main Roads, high certainty
Vibration impacts during construction will be managed by continuous monitoring and defining monitoring targets and stop work procedures.	Best practice, high certainty

Mitigation measure	Industry standard, best practice and certainty of effectiveness
The HPZ (Appendix 12, Map 5) has high potential for sub surface cultural material and will undergo further archaeological investigation in the form of shovel test pitting to determine presence or absence of subsurface cultural material, prior to commencement of ground disturbing works. If sub-surface cultural material is identified, further archaeological work will be required to adequately characterise the material and place and determine its cultural and scientific significance.	Best practice, high certainty
Surface water flow through the Peel Main Drain at completion of the Proposal will be maintained at pre-construction flow levels to mitigate any potential indirect impacts to the Spectacles and the associated heritage values.	Best practice, moderate certainty
Undertake Aboriginal Heritage surveys and additional consultation with Traditional Owners as required.	Best practice, high certainty
Standard management controls will be implemented that include management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: – Noise and vibration – Visual Amenity – Dust – Heritage.	Established practice for Main Roads, high certainty
Rehabilitate	
Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.	Established practice for Main Roads, high certainty

5.5.6 Assessment and significance of residual impact

Main Roads has demonstrated that through Proposal planning, avoidance and mitigation measures have been considered and incorporated to keep residual impacts of the Proposal as low as reasonably practicable. This includes (but is not limited to) following the existing Anketell Road alignment to avoid potential amenity impacts to nearby residential properties and disturbance of Aboriginal heritage and historic heritage places. Proposal impacts to Aboriginal heritage will be managed in consultation with the GKB Aboriginal Corporation and Cultural Advice Committee, SWALSC and DPLH and in compliance of the AH Act. Proposal impacts to historic heritage sites will be managed in consultation with the City of Kwinana, DPLH and if required, the Heritage Council of WA. Main Roads are also proposing management measures to reduce impacts associated with construction waste, dust, noise, vibration and visual amenity. Given the proposal relates to the upgrade of Anketell Road, with few sensitive receivers nearby, construction dust, noise and vibration is unlikely to cause significant impacts. Operational noise is anticipated to be mitigated and managed to meet the SPP 5.4 noise regulations. Construction and operation of the Proposal will result in minor impacts to visual amenity and localised changes in the landscape, not considered to be significant.

5.5.6.1 Heritage

The Proposal will not impact on any known Registered Aboriginal Sites or Lodged Places and therefore consent under Section 18 of the AH Act is not required. If the Proposal will cause disturbance to Registered Aboriginal Sites or places with potential to be a Registered Aboriginal Site, Ministerial consent to impact these places under section 18 of the AH Act, or Authority under the *Aboriginal Heritage Regulations 1974* will first be sought. Consultation with the GKB Aboriginal Corporation will be required as part of the heritage approval process.

The DE intersects one Aboriginal heritage place with ethnographic values (Historic Records Place ID 3427 Mandogalup Swamp/Spectacles). The Proposal will directly impact two small portions of this site (in the vicinity of Mandogalup Swamp), totalling less than 0.5% of the mapped site. The portions of this site within the DE are mapped as modified/planted vegetation, cleared areas (associated with the Kwinana Freeway and Anketell Road) and intact native vegetation in Good condition (Biota 2025). Proposal impacts are restricted to the edge of this mapped site, avoiding waterbody areas associated with Mandogalup Swamp.

Ethnographic and archaeological surveys completed by Archae-aus identified the HPZ in vicinity of the Peel Main Drain will require further archaeological investigation in the form of shovel test pitting to determine the presence of sub-surface archaeological material, prior to the commencement of any ground disturbance. If sub-surface cultural material is identified, further archaeological work will be required to characterise the material and place and determine associated cultural and scientific significance. Main Roads will liaise with DPLH as required to ensure compliance with the AH Act for Aboriginal Heritage.

As indicated in Section 5.5.3.2.2, water is considered culturally significant in accordance with broader Noongar belief and is associated with the biocultural health of the Spectacles Wetland. The outcomes predicted in Inland Water section 5.4.7 will ensure no significant harm to Aboriginal cultural heritage values associated with the Spectacles Wetland or associated hydrological processes.

Archaeological and Ethnographic surveys undertaken with the participation of the Gnaala Karla Booja (GKB) representatives (Archae-aus 2024a,2024b) indicated Aboriginal cultural heritage values are unlikely to be significantly harmed by the proposal.

The Proposal will not impact on any known historical heritage places listed on the State Heritage Register. Ten historical heritage places listed on the City of Kwinana Municipal Heritage Inventory intersect the DE. The Proposal will directly impact the entire extent of White Bridge (Place ID 12115) and Balmanup Post Office – Site of (Place ID 12116), however, the extents of both sites have been previously cleared. The Proposal bisects Tramway Reserve – site (Place ID 12127), Jolly's Bridge (Place ID 12114), Mandogalup Townsite (Place ID 12125) and 7 Mile Site ("Sevvy" to later settlers) (Place ID 12130), however, all four places have been previously disturbed by clearing and construction works. The Proposal intersects the eastern boundary and southern corner of Soldier Settler Homes Mandogalup (Place ID 12092), and does not directly impact the heritage residences No. 27, 31 or 45. Similarly, the Proposal will directly impact the eastern boundary and southern extent of Hall Reserve – Mandogalup (Place ID 12100), but only the bitumen carpark at the site is intersected by the DE. The Proposal will also directly impact the northern boundary of the Spectacles; however, this is only the fringes of the site that already border adjacent roads.

The Proposal is unlikely to impact on the cultural heritage values of the above mentioned sites. However, the Proposal will directly impact approximately half the extent of Mandogalup Post Office (fmr) site (Place ID 12087), and depending on final design, the Proposal may directly impact the remaining built and landscape features of the former Post Office. As such the Proposal may impact on the cultural heritage values of this site.

Consultation will be undertaken with the City of Kwinana and DPLH for any impact to Municipal Heritage sites. Any structures over 60 years of age that require removal for the Proposal may require consultation with DPLH and consideration under the Government Heritage Property Disposal Process (GHPDP). A Property Condition Survey may be required pre and post construction for those sites; consultation with DPLH will be undertaken.

5.5.6.2 Construction activities

There is potential for impacts to aesthetic, economic and social values to occur during construction of the Proposal; however, impacts will be temporary and not expected to be significant. Construction activities will have a finite timeframe and will not create lasting impacts following completion of the construction phase. These impacts include reduced visual amenity as a result of vegetation clearing and construction activities; nuisance from dust, noise, vibration, construction traffic and increased disturbance and nuisance to local residents in general.

The severity and frequency of impacts to social surroundings will be minimised through locating the construction equipment away from residential areas and avoiding the use of residential streets for construction traffic where possible. During construction, there will be an increase in machinery and localised vehicle activity along Anketell Road. Noise disruption will be reduced by undertaking construction activities within regulated hours. Where construction activities are required outside of normal working hours a noise management plan will be lodged for approval with the local council. Due to the proximity of the construction site to residential, recreational and commercial areas, mitigation will be undertaken to minimise the nuisance and inconvenience to residents, businesses and visitors during the construction period.

5.5.6.3 Visual impacts

The proposed upgrade of Anketell Road from a two-lane rural road to a four lane freight route and associated grade separation works is not expected to cause significant visual impact.

The physical presence of the new road formation and elevated structures will result in minor changes to the amenity of some current and future sensitive receptors, noting that less than two per cent of the DE contains land zoned as urban. Although few residents reside within the vicinity of the DE, minor short-term to visual amenity impacts may also result during project construction. Receptors (existing and potential) are located the eastern portion of the DE. Potential impacts are expected to have a limited spatial extent.

The construction of elevated structures has the potential to impact visual amenity, given the Proposal will change the existing visual environment within a viewable area. The Proposal may restrict the view distances of some adjacent land users. These impacts are predicted to be minor given:

- The existing landscape is predominantly modified, rather than natural
- The visual change due to the Proposal is limited in magnitude and spatial extent
- The visibility of these changes from residential and recreational areas is limited due to relatively flat terrain in the vicinity of the Proposal.

Structures such as the road interchange at the intersection of the Kwinana Freeway and the upgraded Anketell Road will be elevated above the surrounding landscape. However, the magnitude of visual change due to such structures is not predicted to be significant given the infrastructure that already exists. Approximately 10m will be added to the height of the existing 10m high Kwinana Freeway / Anketell Road structure taking the structure height to approximately 20m. Visual contrast of these structures will be minimised by landscaping as described in section 5.5.

The visual change experienced at existing residences and recreation areas, such as the Spectacles walkway and viewing platform will be minor given a separation distance of at least 500m (Figure 5-27).

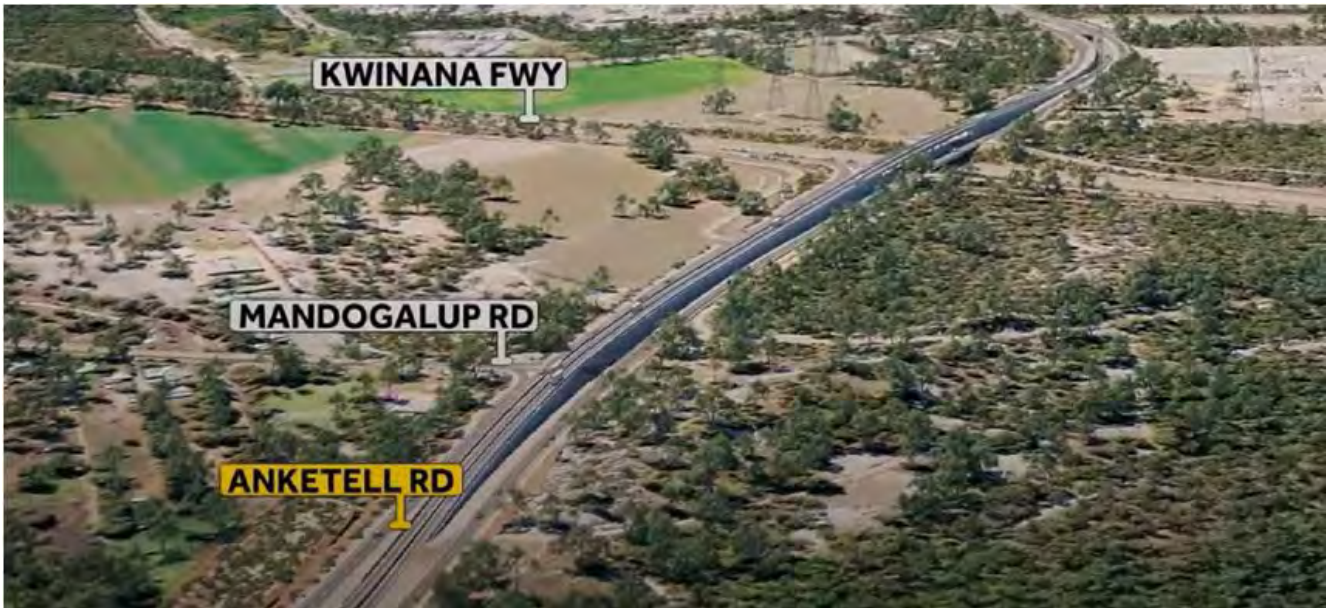

Figure 5.27: Visualisation of potential change

Main Roads designs will include requirements for screen walls wherever the Proposal could reduce the privacy of adjoining residential properties because of increased visibility from vehicles, pedestrians or cyclists or increased impacts from headlight glare. The detailed design will consider all angles of vision to the roadworks, using a viewing height of 2.0 m and a viewing source (on the road) of 2.4 m.

The Proposal may generate public interest due to its location within an urban environment, proximity to the Spectacles and change in traffic flows. Consultation will be undertaken during the detailed design process to address community expectations of visual impact of the Proposal, including new permanent structures. This consultation will include nearby residents and the local community.

Based on the above analysis, the Proposal is not expected to cause significant visual impacts.

5.5.6.4 Noise

The Proposal will generate noise emissions during construction and operation. Construction noise and vibration will be associated with plant, equipment and vehicle use, and earthworks and compaction. Noise generated during the construction of the Proposal is likely to have a temporary nuisance effect on nearby residents. During the day, this impact is likely to be minimal, however, where night works are required, this will have a more significant impact on adjacent noise sensitive receivers. The requirements of the *Environmental Protection (Noise) Regulations 1997* must be met in respect of noise management and construction working hours. Where construction works occur outside normal hours, noise management plans are required and will need to be approved by the City of Kwinana under delegated authority from the DWER.

Given that the Proposal involves significant upgrades, from a two-lane rural road to a four lane freight route, and a small portion of the DE occurs near residents, road traffic noise has the potential to increase at nearby sensitive receivers during road operations.

A traffic noise assessment in accordance with SPP 5.4 has been prepared by Lloyd George Acoustics (2024). Noise mitigation measures will be implemented based on the recommendations of the assessment.

Noise Criteria

The criteria relevant to this project is provided in State Planning Policy No. 5.4 Road and Rail Noise (SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the Road and Rail Noise Guidelines (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

Table 5.41 outlines the noise targets for roads as defined by SPP 5.4.

Table 5.41: Noise targets for roads

Scenario	Outdoor Noise Targets	
	Day (6 am–10 pm)	**Night** (10 pm–6 am)
Road Upgrade	60 dB L_{Aeq}(Day)	55 dB L_{Aeq}(Night)

Noise Modelling

Initially, the noise model is set-up to reflect existing conditions and then calibrated against the existing noise monitoring results. A calibration of -0.5 dB for roads west of the freeway and -1.6 dB for roads east of the freeway was applied to the model and noise contours produced representing the existing road design with 2023 traffic volumes; and the future road design with 2051 traffic volumes.

The results (noise contours) are presented in Figure 5-25 and Figure 5-26. Figure 5-25 representing the 'Existing Scenario (2023)' and Figure 5-26 representing the 'Future Scenario (2051)'.

With reference to SPP 5.4, the Outdoor Noise Target for a Road Upgrade project is 60 dB L_{Aeq}(Day) and 55 dB L_{Aeq}(Night). From the noise contour plot, it can be seen that there are no noise sensitive premises that are predicted to receive a future noise level, assuming the 'Build' scenario, that exceed these criteria. Therefore, no further consideration of noise mitigation is required under the Policy.

Construction Noise

For this project, due to the majority of the road alignment passing through industrial land, there are few sensitive receptors that would be affected by noise. In the areas where noise sensitive receptors are located near to the project, such as between Kwinana Freeway and Lyon Road, provided the work is undertaken during normal working hours (7am – 7pm, Monday to Saturday, excluding public holidays) and using well maintained plant, compliance with the *Environmental Protection Act 1986* and the *Environmental Protection (Noise) Regulations 1997* is likely to be achieved.

If work is required outside normal working hours, and is justifiable, then the noise impacts would generally be assessed through computer modelling to determine the extent of the noise impact and approval sought

from the LGA as a delegated authority by DWER under the *Environmental Protection (Noise) Regulations 1997* and notification sent to those residents likely to be adversely affected.

5.5.6.5 Vibration

The proposal to upgrade Anketell Road may impact on a small number of residents located towards the eastern extent of the DE.

Vibration from construction works may cause impacts on humans and buildings. Humans can experience discomfort from vibration, so construction vibration may have a temporary nuisance effect on nearby residents. Vibration has the potential to cause structural damage to nearby buildings, especially where the ground particle velocity exceeds 5 mm/s.

5 mm/s pcpv is the current vibration limit applied by Main Roads Western Australia to most road construction projects in Western Australia, and is also recommended as the maximum level of vibration in the transportation noise assessment (Lloyd George Acoustics 2024).

Vibration monitoring will be required as part of construction works, with particle velocity not to exceed 5 mm/s at the receiving property. A complaints system will be established and maintained by the contractor. Buildings within 200 m of the project will be subject to a property inspection prior to and following works to ensure there is no damage resulting from the Proposal. Vibration impacts are not expected to be significant.

5.5.6.6 Change in land use

The DE intersects Main Roads road reserve, privately owned (freehold) land and Crown land. Where the DE extends beyond the Main Roads road reserve, land will need to be acquired by Main Roads and transferred to road reserve. Transferring land lying outside Main Roads road reserve will require a change to the Metropolitan Region Scheme (MRS). Where construction works fall within areas zoned under the City of Kwinana Local Planning Scheme No. 2 as contrary to intended development, planning approval from the City of Kwinana must be sought. Should land within Conservation Park Reserve (R3313) be required for the Proposal it will need to be excised from the Reserve (refer to Section 2.3.2).

5.5.7 Predicted Outcomes

The Proposal's Social Surrounds environmental outcomes, following implementation of measures to avoid, minimise, reduce and rehabilitate, are as follows:

- All ground disturbance will occur within the DE
- No known Registered Aboriginal Heritage sites will be impacted
- The Proposal will be designed and constructed considering the objectives of SPP 5.4

Proposal impacts to Aboriginal heritage and historic heritage will be managed through complementary legislation. Engagement completed under the AH Act has resulted in management and mitigation commitments being identified to avoid and minimise impacts to Aboriginal cultural heritage. Proposal impacts to historic heritage sites will be managed through consultation with the City of Kwinana.

Main Roads considers implementation of the identified planning, avoidance and mitigation measures will ensure the Proposal's residual impacts are as low as reasonably practicable, and that the EPA objective for Social Surrounds will be met through achievement of the above environmental outcomes and management through complementary regulation.

6 OFFSETS

6.1 Background

Main Roads has conducted an environmental impact assessment for the Proposal. Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate, and offset environmental impacts. Significant residual impacts from the Proposal remain after the application of the mitigation hierarchy (avoid, minimise, reduce). Main Roads has developed an offset strategy to mitigate the significant residual impacts of the Proposal (Appendix 14). This chapter outlines the key elements of the offset strategy.

The Proposal's offset strategy has been prepared in accordance with the WA Government's Environmental Offset Policy (GoWA 2011), WA Environmental Offset Guidelines (GoWA 2014) and has given regard to EPA's Public Advice Considering Environmental Offsets at a Regional Scale (2024). Main Roads has also consulted with the DBCA regarding offsets that relate to significant residual impacts to matters relevant to the *Conservation and Land Management Act 1984* and the BC Act.

The offset package developed by Main Roads includes a combination of restoration, revegetation and management to offset the significant residual impact of the Proposal. Main Roads notes the challenges faced in attempting to identify offset sites in close proximity to the Proposal in a highly developed area within the SCP.

6.2 Significant residual impacts

A summary of the significant residual impacts for the Proposal that Main Roads is proposing to offset is provided in Table 6.1.

Table 6.1: Summary of residual impacts

Environmental Value	Conservation Significance of Environmental Value	Significant Impact
Banksia Woodland of the SCP PEC	Priority 3 PEC	14.56
Tuart Woodlands and Forest of the SCP PEC	Priority 3 PEC	40.99
Class A Conservation Reserve	Class A Reserve	0.55
Bush Forever Sites (268, 269 and 270)	Bush Forever	4.00
Carnaby's Cockatoo foraging habitat	Threatened species - Endangered	56.98
FRTBC foraging habitat	Threatened species - Vulnerable	38.34

6.3 Principles of the WA Environmental Offsets Policy

The Offset Strategy has been developed to be consistent with the WA Offsets Policy (GoWA 2011). Table 6.2 shows how each of the offset policy principles has been addressed in the Offset Strategy.

Table 6.2: Consideration of the WA Environmental Offset Policy Principles

Offset Principle	Consideration
Environmental offsets will only be considered after avoidance and mitigation options have been pursued.	The potential impacts from the Proposal have been reduced through the refinement of the DE. This reduction has been largely achieved through the additional avoidance and mitigation measures that have been developed for the Proposal. Main Roads will continue to refine the Proposal during design and construction in order to minimise the impacts as far as practicable. However, it is unlikely that any further significant avoidance or minimisation of the impacts will be able to be implemented without affecting the overall intent and objectives of the Proposal and therefore, an environmental offset for the significant residual impacts is warranted.
Environmental offsets are not appropriate for all projects.	Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and (if necessary, where significant residual impacts will result) offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development, and implementation of management measures and finally, an offset proposal. Application of the management hierarchy has been summarised in this Offset Strategy. Environmental offsets are considered appropriate for this Proposal.
Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.	Main Roads has pursued a number of options in developing a package of offsets to counterbalance residual impacts that are relevant and appropriate for the locality and quantum of impact for each environmental value impacted. The options investigated have comprised of areas of direct offsets and revegetation and restoration of land representative of TECs, PECs, Carnaby's Cockatoo and FRTBC foraging habitat, Bush Forever and Class A Reserve. The direct offsets proposed will protect and enhance the same (or similar) environmental values being impacted by the Proposal. The area and condition of offsets within the proposed offset sites is proportionate to that being impacted.
Environmental offsets will be based on sound environmental information and knowledge.	All offset sites have either been surveyed or will be surveyed as part of the implementation of the offset. The quantum of impact has been calculated using data from field surveys or the most current publicly available information in the absence of field survey data.
Environmental offsets will be applied within a framework of adaptive management.	Each offset will have an offset management plan to ensure offset objectives are met and each of these plans addresses monitoring, has contingencies and allows for adaptive management measures.
Environmental offsets will be focussed on longer term strategic outcomes.	All offsets will be implemented for at least 20 years by Main Roads prior to being handed over to the land manager of the site. On-ground management actions for each site will be formalised through a site-specific management plan, where applicable.

Table 6.3: Residual Impact Significance Model

Part IV Environmental Factors	**Vegetation and Flora**			**Terrestrial Fauna**			
Part V Clearing Principles	**Rare flora**	**Threatened ecological communities**	**Remnant vegetation**	**Wetlands & waterways**	**Conservation areas**	**High biological diversity**	**Habitat for fauna**
Residual impact that is environmentally unacceptable or cannot be offset	None	None	None	None	None	None	None
Significant residual impacts that will require an offset **All significant residual impacts to species and ecosystems protected by statute or where the cumulative impact is already at a critical level**	None	– Clearing of up to 14.56 ha of Banksia Woodland of the SCP PEC (P3) – Clearing of up to 40.99 ha of Tuart Woodlands and Forest of the Swan Coastal Plan PEC (P3)		None	– Clearing of up to 0.55 ha of Class A Conservation Reserve (R 53313) – Clearing of up to 4.00 ha of regionally significant vegetation in Bush Forever sites (no. 268, 269 and 270)	None	– Clearing of up to 56.98 ha of Carnaby's Black-Cockatoo foraging habitat (Threatened Species – Endangered) – Clearing of up to 38.34 ha of Forest Red-tailed Black-Cockatoo foraging habitat (Threatened Species – Vulnerable)
Significant residual impacts that may require an offset **Any significant residual impact to potentially threatened species and ecosystems, areas of high environmental value or where the cumulative impact may reach critical levels if not managed**	None	None	None	None	None	None	None
Residual impacts that are not significant	– Clearing of one individual of *Poranthera moorokatta* (P2) – Clearing of up to 59 individuals of *Hibbertia leptotheca* (P3) – Clearing of up to 40 individuals of *Eucalyptus foecunda* subsp. *foecunda* (P4)	– Clearing of up to 57.12 ha of FCT 24 – Northern Spearwood Shrublands and Woodlands PEC (P3)	– Clearing of up to 92.22 ha of native vegetation: • 1.12 ha Very Good to Excellent condition • 14.24 ha Very Good condition • 7.95 ha Good to Very Good condition • 29.47 ha Good condition • 2.12 ha Degraded to Good condition • 24.48 ha Degraded condition • 12.84 ha Completely Degraded condition	– Clearing of up to 4.76 ha of vegetation in multiple use wetlands • Including 0.22 ha of native vegetation	None	None	None

6.4 Offset Package

6.4.1 Summary of Offset Package

Four offset sites are proposed for the Proposal's offset package, and these are summarised below in Table 6.4. This Offset Strategy has determined the starting and predicted future quality score for each of these offsets for each environmental value, through referencing surveys to quantify the residual impacts and offset gains, and ongoing measurable management. Each site is described in further detail below.

Table 6.4: Summary of Offset Package for the Proposal

Offset	Offset Type	Distance from Proposal	Offset Property Area (ha)	Banksia Woodland PEC (14.56 ha x Quality 4.5)	Tuart Woodlands PEC (40.99 ha x Quality 3.3)	SCP 24 PEC (57.12 ha x Quality 3.5)	CBC Habitat (56.98 ha x Quality 4.8)	FRTBC Habitat (38.34 ha x Quality 3.2)	Bush Forever (4 ha @ 1.5:1)	Class A Reserve (0.55 ha @ 3:1)
				ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)
Gabbadah	Restoration	107 km north	404.44	8.1 (22.4%)	5.01 (6.7%)	110.1 (100%)	87.7 (40.4%)			
Lake Mealup	Restoration	51 km south south-west	85.16	29.7 (77.8%)	40.0 (73.2%)		45.0 (20.7%)	45 (33.2%)		
	Revegetation				5.2 (20.2%)		16.7 (28.6%)	16.7 (49.3%)		
St Ronans	Revegetation	84 km north-east	120.75				6.0 (10.3%)	6.0 (17.7%)		
The Spectacles	Management	Adjacent	331.12						6.0 (100%)	1.65 (100%)
Total				**37.8 (100.2%)**	**50.21 (100.1%)**	**110.1 (100%)**	**155.4 (100%)**	**67.7 (100.2%)**	**6.0 (100%)**	**1.65 (100%)**

6.4.2 Gabbadah

Lot 1 Tamarisk Drive, Gabbadah encompasses a total area of 404.44 ha and is located approximately 5 km east of Seabird, within the Shire of Gingin. The offset site lies within the SCP IBRA Region and lies approximately 107 km north of the Proposal. A portion of the property will be used as an environmental offset for the Proposal.

A vegetation assessment conducted for the offset site identified the presence of three P3 PECs (Banksia Woodland of the SCP, Tuart Woodland and Forests of the SCP and Northern Spearwood Shrublands and Woodlands (FCT24)). Overall, the vegetation within the offset site is in 'Very Good' condition, with poorer quality vegetation occurring adjacent to areas subject to previous disturbance (PGV Environmental 2024).

Lot 1 Tamarisk Drive will be acquired and managed by DBCA. Main Roads will fund the acquisition and management for 20 years by DBCA as an environmental offset. The property will become part of DBCA's conservation estate and protected in perpetuity.

Main Roads and DBCA will develop a Memorandum of Understanding (MoU) to finalise the land management agreement, including funding and actions required by both parties. The MoU will be developed and finalised within 12 months of the acquisition of the property. Main Roads will develop a set of monitoring and management activities and targets for the offset site.

The existing environmental values within the offset site pertaining to this Offset Strategy include:

- 8.1 ha of Banksia Woodlands of the SCP PEC (DBCA: Priority 3)
- 5.01 ha of Tuart Woodlands and Forests of the SCP PEC (DBCA: Priority 3)
- 110.1 ha of Northern Spearwood Shrublands and Woodlands (FCT24) PEC (DBCA: Priority 3)
- 87.7 ha of vegetation suitable for restoration as Carnaby's Cockatoo habitat.

6.4.3 Lake Mealup Revegetation and Restoration

The 'Lake Mealup' offset site encompasses revegetation and restoration within Lot 277 Lake Mealup Road North, Birchmont, Shire of Murray. It occurs on the eastern shore of the Peel Inlet, which is part of the Peel-Yalgorup Ramsar System, and is adjacent to the McLarty Nature Reserve (R24739) and Mealup Point Nature Reserve (R2738), both Class A Reserves for the conservation of flora and fauna. The offset site lies within the SCP IBRA Region, approximately 50 km south of the Proposal.

The Lake Mealup offset site will be acquired and managed by DBCA. Main Roads will fund the acquisition, revegetation and management for 20 years as an environmental offset. The property will become part of DBCA's conservation estate and protected in perpetuity.

Main Roads and DBCA will develop a MoU to finalise the land management agreement, including funding and actions required by both parties. The MoU will be developed and finalised within 12 months of the acquisition of the property. Main Roads will develop a set of monitoring and management activities and targets for the offset site.

The existing environmental values (based on Main Roads' site inspection on 14 October 2024) currently within the Lake Mealup offset site pertaining to this Offset Strategy include:

- 45 ha of Banksia Woodlands of the SCP PEC 'Good-Very Good' condition (5)
- 40 ha of Tuart Woodlands and Forests of the SCP PEC 'Very Good' condition (6)

- 45 ha of vegetation suitable for restoration as Carnaby's Cockatoo habitat and FRTBC habitat (offset start score of 6).

The areas of Banksia Woodlands of the SCP PEC and Tuart Woodland and Forests of the SCP PEC overlap at this offset site, hence the sum of their parts is greater than the area of the offset site.

6.4.4 St Ronans Revegetation

The 'St Ronans' offset site encompasses a 6.0 ha portion of Lots 58, 706 and 1437 Great Southern Highway, St Ronans, located approximately 8.5 km west of York. The offset site occurs within the Avon Wheatbelt and the Jarrah Forest IBRA Regions and is approximately 84 km east north-east of the Proposal. Main Roads is proposing to revegetate 6.0 ha within Lot 706 as an environmental offset for Carnaby's Cockatoo and FRTBC. The property has been cleared for agriculture, with some areas of existing revegetation.

Main Roads acquired the property in December 2024 and will own and manage the property as an environmental offset. Main Roads will create a new freehold lot with the designated purpose of "Environmental Offset". The land will be designated as an environmental offset prior to the revegetation reaching completion criteria to protect the site in perpetuity. Main Roads has developed a set of monitoring and management activities and targets for St Ronans Revegetation site.

The existing environmental values currently within the St Ronans revegetation site pertaining to this Offset Strategy include:

- 6.0 ha of cleared land suitable for the establishment of foraging and potential breeding habitat for Carnaby's Cockatoo and FRTBC.

6.4.5 The Spectacles

The Spectacles offset site, which forms part of Bush Forever Site 269 and is managed by DBCA, is located immediately adjacent to the Proposal. The offset site is situated within the SCP IBRA Region and encompasses several adjacent properties. Within this site, 6 ha will serve as an environmental offset for the impacts the Proposal will have on a Bush Forever site, while 1.65 ha will be allocated as an environmental offset for impacts to a Class A Reserve.

The Spectacles offset site lies within land currently managed by DBCA. Main Roads will liaise with DBCA to fund management within the offset site for the next 20 years before management will revert back to DBCA. Main Roads will develop a set of management activities and targets for the offset site.

The existing environmental values within the Spectacles offset site pertaining to this Offset Strategy include:

- 6 ha of Bush Forever Site no. 269 (the Spectacles)
- 1.65 ha of Class A reserve currently vested and managed by the DBCA.

7 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Under the EPBC Act, the Proposal (also referred to as the 'Proposed Action' with respect to EPBC Act matters) will require approval from the Commonwealth Minister if it has, will have, or is likely to have, a significant impact on an MNES. A number of desktop and field surveys have been undertaken for the Proposal in order to assess the presence of MNES which trigger the requirement for referral (Section 5) and have been summarised in Table 7.1.

The Proposed Action is likely to result in significant residual impacts to Tuart Woodlands and Forests of the SCP TEC, Banksia Woodlands of the SCP TEC, Carnaby's Cockatoo and FRTBC. Main Roads has referred the Proposal to the Commonwealth DCCEEW under the EPBC Act (2024/09841) as a result of predicted significant residual impact to MNES. Referral to DCCEEW and subsequent impact assessment is being undertaken concurrent to the EP Act Section 38 referral.

On 22 August 2024, a delegate of the Federal Minister for the Environment determined that EPBC 2024/09841 (the Proposed Action) was a controlled action pursuant to the EPBC Act, to be assessed by Preliminary Documentation. On 22 September 2024, DCCEEW requested additional information to support the Preliminary Documentation. Main Roads has undertaken and commissioned further environmental studies to support this request and prepare the Preliminary Documentation.

Table 7.1: MNES within the DE

MNES	Impact of Proposal
Listed TECs	Clearing of up to 40.99 ha of Tuart Woodlands and Forests of the SCP TEC over eight patches. Clearing of up to 14.56 ha of Banksia Woodlands of the SCP TEC over nine patches. The Proposal may result in indirect impacts to Tuart Woodlands and Forests of the SCP TEC and Banksia Woodlands of the SCP TEC that is adjacent to the DE including: – Fragmenting TEC habitat, rendering the remaining adjacent patch area no longer representative of Tuart Woodlands and Forests of the SCP TEC – Introduction and/or spread of weeds – Introduction and/or spread of *Phytophthora cinnamomi* dieback. – Changes to vegetation structure and floristic composition through altered surface water drainage patterns and flows, and construction dewatering.
Listed Threatened Fauna	Direct clearing of habitat for the following EPBC Act listed fauna species known or likely to occur within the DE (see Section 5.2), including the clearing of up to: – 592 suitable DBH trees for Black Cockatoos, of which 8 trees contained 8 hollows that were considered of suitable depth and shape for Black Cockatoo breeding – 56.98 ha of foraging habitat for Carnaby's Cockatoo – 38.34 ha of foraging habitat for FRTBC. The Proposal has potential to cause indirect impacts to habitat that lies adjacent to the DE. The Proposal may result in indirect impacts including: – Introduction and/or spread of weeds – Introduction and/or spread of *Phytophthora cinnamomi* dieback – Increased risk of vehicle strike.

8 HOLISTIC IMPACT ASSESSMENT

The EIA process needs to consider the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment. This requires consideration of the impacts of the Proposal in a regional context as well as at the local scale.

The environmental surveys and studies undertaken to date for this Proposal have identified values within and adjacent to the DE, and considered the results at both at a local and regional scale. The results of these studies have informed the Proposal impact assessment and development of mitigation measures.

While the Proposal's predicted outcomes have been considered independently in relation to the environmental principles and the EPA's environmental objectives for each preliminary environmental factor, Main Roads recognises the complex linkages between Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality, Inland Waters and Social Surrounds. These complex linkages and connections between parts of the environment have been portrayed in Figure 8-1.

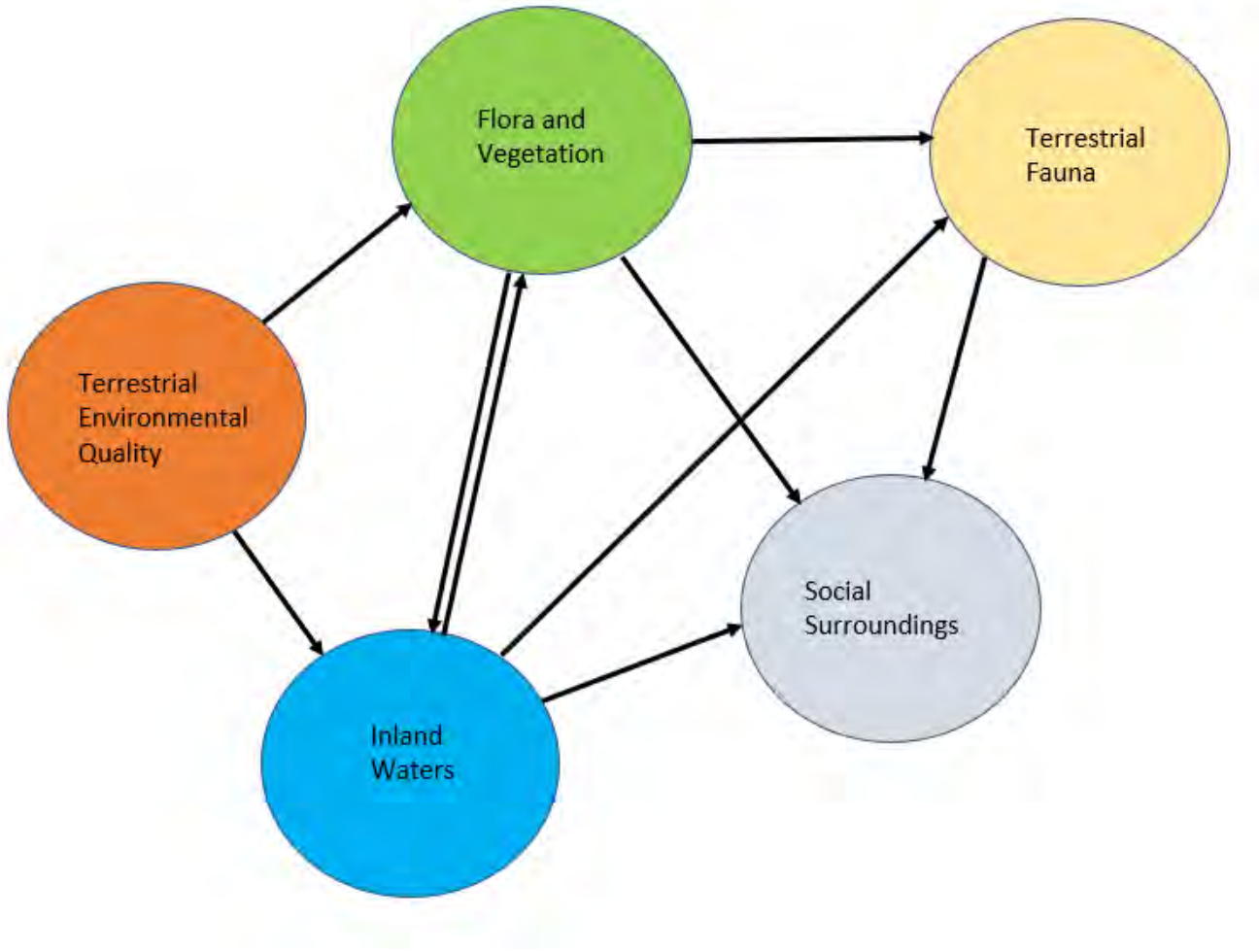

Figure 8.1: Intrinsic interactions between key environmental factors

Table 8.1: Key linkages between environmental factors

Factor	Key linkages to other factors	Mitigation measures
Flora and vegetation	Clearing of vegetation for the construction of the Proposal has the potential to impact: – terrestrial fauna through the removal and alteration of fauna habitat, impacting several significant fauna species – wetlands and inland waters by affecting the hydrology of the area – social surrounds by reducing visual amenity.	– Minimise clearing impacts where practicable through the detailed design process such as: • Narrow medians will be maintained where practicable. • Placing retaining walls where practicable. – An Offsets Strategy will be implemented to mitigate significant residual impacts on flora and vegetation. – Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.
Terrestrial fauna	Clearing of fauna habitat for the Proposal has the potential to alter the ecological integrity of communities within the DE impacting: – flora and vegetation by affecting the quality and composition habitats – social surrounds through alteration of the natural landscape – inland waters through alterations to the associated hydrological regimes and water quality.	– Avoid additional movement barriers for fauna by limiting the Proposal to land adjacent to the existing cleared areas of Anketell Road. – Minimise clearing impacts where practicable through the detailed design process such as: • Narrow medians will be maintained where practicable. • Placing retaining walls where practicable. – An Offsets Strategy will be implemented to mitigate significant residual impacts on terrestrial fauna. – Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.

Factor	Key linkages to other factors	Mitigation measures
Terrestrial environmental quality	Potential direct and indirect impacts of the Proposal on terrestrial environmental quality may also impact: – social surrounds from the disturbance of contaminated land – Flora and vegetation as well as terrestrial fauna from changes to soil and/or groundwater quality through mobilisation of contaminated materials – Inland waters through the movement of contaminated surface water to downstream sensitive receptors including the Spectacles Wetland, Mandogalup Swamp and other Conservation Category wetlands.	– Avoid areas of high risk for ASS. – Avoid disturbance of contaminated or potentially contaminated areas where possible. The project design avoids potential disturbance of contamination as including: • Between Abercrombie Road and McLaughlin Road the design is located to the south with sufficient separation to avoid Alcoa residue storage areas. • South of Armstrong Road the proposed new access into the Motorplex site has been designed to avoid excavating the historical residue storage pond. – Narrow medians will be maintained where practicable to reduce the amount of material required for the Proposal and the amount of water required for construction. – Minimise impacts through the detailed design process, including reducing earthworks (fill height/cut depth) in areas of heavy vegetation. – Groundwater abstraction wells will be established away from the Spectacles Wetland and in areas where the risk of mobilising contaminated groundwater is reduced.
Inland waters	Direct and indirect impacts of the Proposal on inland waters may result in changes to surface water flows during construction and operation which can affect water quality and impact: – flora and vegetation as well as terrestrial fauna through changes to recharge and runoff as well as hydrological regimes of adjacent wetlands – social surrounds through loss of visual amenity and restricted access to recreational areas.	– Main Roads has committed to reducing the volume of water abstracted for construction water excluding dust suppression requirements from the 3 proposed bores within the DE by 50% (Total requirement for construction water is estimated to be 430,000KL). The other 50% of the construction water required will be sourced from water trading from existing licences or alternative water sources for example industrial process water or non-potable water. – Flow and water quality to the Spectacles from the Peel Main Drain during construction will be maintained therefore impacts to surface water quality will be avoided. – Drainage design will integrate Water Sensitive Urban Design principles. – Drainage design will be implemented to maintain hydrological flow regimes and control stormwater run-off. – Monitoring in accordance with standard management controls and any licences.

Factor	Key linkages to other factors	Mitigation measures
Social surrounds	The Proposal's impact on flora and vegetation, terrestrial fauna and inland waters has the potential to impact on social surroundings through the loss of the natural landscape, restricted access to recreational areas and reduced visual amenity.	The design solution follows the existing Anketell Road alignment, predominantly within the disturbed road corridor to avoid and reduce impacts on social surrounds. Aboriginal Heritage sites and places will be avoided where practicable, including Place ID 3247. Where impacts are unavoidable, Main Roads will seek permission to impact the site through DPLH, in agreeance with the relevant GKB Traditional Owners. Surface water flow through the Peel Main Drain at completion of the Proposal will be maintained at pre-construction flow levels to mitigate any potential indirect impacts to the Spectacles and the associated heritage values. Revegetation and landscaping will be undertaken in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques. These requirements will be detailed in the project specific Landscape and Revegetation Management Plan.

9 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

Cumulative environmental impacts are the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable activities (EPA 2021c). Reasonably foreseeable future activities are defined by EPA (2022) as third party (or proponent) activities which are already approved, are in a government approvals process, or are otherwise reasonably likely to proceed:

- For proposals assessed at the level of environmental review – at the time an Environmental Review Document for a proposal is accepted
- For proposals assessed at the level of assessment on referral information – at the time the final referral or required additional information is accepted
- Existing activities that are reasonably expected to be ongoing.

Cumulative effects to the environment result from multiple activities whose direct impacts may be relatively minor, but in combination with other activities can result in significant environmental and social effects.

Cumulative impacts to environmental values resulting from the current Proposal and other proposals in the surrounding area (within 5 km of the DE) and across the SCP were assessed (Table 9.1), focusing on environmental values that are at risk of being impacted by the Proposal, including:

- native vegetation
- native vegetation within mapped vegetation complexes
- Bush Forever and Reserves
- Tuart Woodlands
- Banksia Woodlands
- Carnaby's Cockatoo foraging habitat
- FRTBC foraging habitat.

Datasets from DataWA were used to broadly estimate predicted cumulative impacts both locally (within 5 km of the DE) and across the SCP. Proposals that have the potential to impact the listed environmental values were identified using the EPA Referred Significant Proposals (DWER-120) dataset (DWER 2025a). Only proposals currently under assessment or having recently been approved by the EPA (2022 to current) were included in the assessment. Impacts resulting from clearing permits issued by the DWER were identified using the Clearing Instruments Activities (Areas Approved to Clear) (DWER-076) dataset (DWER 2025c). Clearing permits with a status of 'Amended' or 'Granted' were included in the assessment.

Foreseeable cumulative impacts associated with the current Proposal are summarised in Table 9.1. Key findings associated with flora and vegetation and terrestrial fauna factors are outlined below. In considering cumulative impacts, Main Roads considers that the EPA factor for flora and vegetation and terrestrial fauna will be met.

9.1 Environmental factor – flora and vegetation

- Implementation of the current Proposal as well as other proposals and clearing permits will result in the combined removal of up to approximately 105.96 ha of native vegetation in varying condition locally (within 5 km of the DE) and up to approximately 10,633.48 ha of native vegetation in varying condition across the SCP. This clearing will result in a cumulative reduction of 0.042% of native vegetation locally and 2.29% of native vegetation across the SCP. Impacts to native vegetation from the Proposal is limited to 92.22 ha which represents a reduction of 0.02% across the SCP.
- Clearing associated with the current Proposal as well as other proposals and clearing permits will result in a cumulative reduction of 2.96% or less to all mapped complexes, except for the Bassendean Complex-Central and South complex where a cumulative reduction of 11.94% across the SCP is predicted. Clearing for the current Proposal as well as other proposals and clearing permits will not reduce any of the complexes below 10% of their preclearing extents at a SCP scale.
- The current Proposal as well as other proposals and clearing permits will impact up to approximately 5.80 ha of native vegetation within Bush Forever sites locally and 805.98 ha of native vegetation within Bush Forever sites across the SCP. Locally six Bush Forever sites will potentially be impacted. The current Proposal will impact Bush Forever sites nos. 268, 269 and 270. No other identified proposals will impact these sites. Across the SCP, 84 Bush Forever sites will potentially be impacted. Over half of the potential clearing impacts (approximately 521.15 ha) are predicted to occur within Bush Forever sites no. 320, 356, 380, 398 and 462.
- The Proposal will impact on 0.55 ha of native vegetation within Class A Conservation Reserve R 53313. No other proposals and clearing permits are predicted to impact upon Class A reserves locally (within 5 km of the DE). Across the SCP, the Proposal and other identified proposals will impact upon approximately 1,169.20 ha of native vegetation within Class A reserves, which represents a 1.01% reduction. The majority of the predicted clearing (approximately 827 ha, 70%) will occur within the Gnangara-Moore River State Forest, Watheroo National Park and Myalup State Forest.
- The Proposal will clear up to 40.99 ha of the Tuart Woodlands of the SCP TEC. It is estimated there is approximately 20,834.20 ha of Tuart Woodlands across the SCP, with a large percentage of this likely to represent the Tuart Woodlands of the SCP TEC. The Proposal and other identified proposals will result in the combined removal of approximately 43.05 ha of Tuart Woodlands locally and 286.04 ha across the SCP. This represents a reduction of 0.207% locally and 1.37% at a SCP scale.
- The Proposal will impact 14.56 ha of the Banksia Woodlands of the SCP TEC. Broadly mapped vegetation complexes indicate there is approximately 186,692 ha of native vegetation across the SCP strongly associated with the Banksia Woodlands ecological community. The Proposal and other identified proposals will result in a reduction of Banksia Woodlands by 0.032% locally and 3.23% across the SCP.

9.2 Environmental factor – terrestrial fauna

- The current Proposal will contribute to the loss of black cockatoo habitat on the SCP. This habitat includes black cockatoo potential breeding habitat (suitable DBH trees) and foraging habitat for Carnaby's Cockatoo and FRTBC. It is estimated there is approximately 499,563.41 ha of Carnaby's Cockatoo foraging habitat and 120,468.05 ha of FRTBC foraging habitat across the SCP. Future development across the SCP (proposals and clearing permits) may result in a foreseeable cumulative clearing of up to 9,157.48 ha of native Carnaby's Cockatoo foraging habitat and 4,649.54 ha of native FRTBC foraging habitat. This clearing represents a reduction of approximately 1.83% of native Carnaby's Cockatoo foraging habitat and 3.86% of native FRTBC foraging habitat across the SCP.

- Across the SCP, the Gnangara, Pinjar and Yanchep pine plantations provide Black Cockatoo foraging habitat. The total extent of these plantations was estimated at 23,000 ha, with approximately 16,530 ha (71.9%) having already been cleared. It is anticipated that the remaining 6,470 ha will be removed by 2025/2026 (Curtin University 2022). The current Proposal does not involve the clearing of any pine plantation.
- With consideration to both native and non-native (pine plantation) vegetation, clearing for foreseeable future developments across the SCP may result in the loss of up to 15,627.82 ha of Carnaby's Cockatoo foraging habitat (native and non-native), representing a cumulative reduction of 3.09% (based on an estimated total extent of 506,033.41 ha) of native and non-native Carnaby's Cockatoo foraging habitat across the SCP. The current Proposal will impact only 0.011% of native and non-native Carnaby's Cockatoo foraging habitat across the SCP.

Table 9.1: Foreseeable cumulative impacts associated with the Current Proposal in the surrounding area (within a 5km buffer of the Current Proposal) and across the SCP

Environmental value	Upgrade of Anketell Road from Leath Road to Kwinana Freeway Project Current Proposal	Proposals and DWER clearing permits within 5 km of the DE	Foreseeable cumulative impact within 5 km of the DE	Proposals and DWER clearing permits across the SCP	Foreseeable cumulative impact across the SCP	Estimated total extent across the SCP	% of impact from foreseeable cumulative impacts within 5 km of the DE	% of impact from foreseeable cumulative impacts across the SCP	% of impact from Current Proposal across the SCP
Native vegetation	92.22 ha	105.96 ha	198.18 ha	10,633.48 ha	10,725.70 ha	468,378.68 ha	0.042 %	2.29 %	0.020 %
Native vegetation within Karrakatta Complex-Central and South	13.26 ha	0.21 ha	13.47 ha	338.17 ha	351.43 ha	12,702.70 ha	0.106 %	2.77 %	0.104 %
Native vegetation within Quindalup Complex	0.16 ha	41.63 ha	41.79 ha	433.15 ha	433.31 ha	33,267.37 ha	0.126 %	1.30 %	<0.001 %
Native vegetation within Cottesloe Complex-Central and South	78.01 ha	18.31 ha	96.32 ha	361.08 ha	439.09 ha	14,833.27 ha	0.649 %	2.96 %	0.526 %
Native vegetation within Bassendean Complex-Central and South	3.60 ha	44.95 ha	48.55 ha	2,957.63 ha	2,961.23 ha	24,805.22 ha	0.196 %	11.94 %	0.015 %
Native vegetation within Herdsman Complex	1.17 ha	0 ha	1.17 ha	21.67 ha	22.84 ha	3,283.28 ha	0036 %	0.70 %	0.036 %
Vegetation within Bush Forever	4.00 ha	1.80 ha	5.80 ha	801.98 ha	805.98 ha	51,730.00 ha	0.11 %	1.56 %	0.008 %
Vegetation within Reserves (Class A)	0.55 ha	0 ha	0.55 ha	1,168.65 ha	1,169.20 ha	115,812.34 ha	<0.001 %	1.01 %	<0.001 %
Tuart Woodlands	40.99 ha	2.06 ha	43.05 ha	245.05 ha	286.04 ha	20,834.20 ha	0.207 %	1.37 %	0.197 %
Banksia Woodlands	14.56 ha	44.95 ha	59.51 ha	6,012.59 ha	6,027.15 ha	186,692.58 ha	0.032 %	3.23 %	0.008 %
Native Carnaby's Cockatoo foraging habitat	56.98 ha	71.09 ha	128.07 ha	9,099.96 ha	9,156.94 ha	499,563.41 ha	0.026 %	1.83 %	0.011 %
Native FRTBC foraging habitat	38.34 ha	63.47 ha	101.81 ha	4,610.80 ha	4,649.14 ha	120,468.05 ha	0.085 %	3.86 %	0.032 %
Gnangara pines (non-native Black Cockatoo foraging habitat)	0 ha	0 ha	0 ha	6,470.00 ha	6,470.00 ha	6,470.00 ha	0 %	100.00 %	0 %

10 ADDITIONAL INFORMATION

10.1 Abbreviations and acronyms

Table 10.1: Acronym and abbreviations list

Abbreviation / acronym	Definition
ACHIS	Aboriginal Cultural Heritage Inquiry System
AH Act	*Aboriginal Heritage Act 1972*
APP	Aboriginal Productions Promotions
AS:1940	Australian Standard 1940
ASRIS	Australian Soil Resources Information System
ASS	Acid Sulphate Soils
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BGL	Below ground level
BoM	Bureau of Meteorology
BUWM	Better Urban Water Management
CALM	Department of Conservation and Land Management [now DBCA]
CCW	Conservation Category Wetland
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and the Environment [now DCCEEW]
DBCA	Department of Biodiversity Conservation and Attractions
DBH	Diameter at breast height
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DE	Development Envelope
DEC	Department of Environment and Conservation [now DBCA]
DEE	Department of the Environment and Energy [now DCCEEW]
DER	Department of Environmental Regulation [now DWER]
DIDMS	Dieback Information Delivery and Management System
DMAs	Decision-making authorities
DoE	Department of the Environment [now DCCEEW]
DoW	Department of Water [now DWER]
DP	Declared Pests
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DSEWPaC	Department of Sustainability, Environment, Water, Pollution and Communities [now DCCEEW]
DSI	Detailed Site Investigation
DSR	Detailed Summary of Records
DWER	Department of Water and Environmental Regulation

Abbreviation / acronym	Definition
EC	Electrical conductivity
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESAs	Environmentally Sensitive Areas
FCT	Floristic Community Type
FRTBC	Forest Red-tailed Black Cockatoo
GDV	Groundwater Dependent Vegetation
GoWA	Government of Western Australia
HPZ	Heritage Potential Zone
IBRA	Interim Biogeographic Regionalisation of Australia
ILUA	Indigenous Land Use Agreement
IMTs	Intermodal terminals
IS	Infrastructure Sustainability
KIA	Kwinana Industrial Area
LA Act	*Land Administration Act 1997*
LGA	Local Government Area
Main Roads	Main Roads Western Australia
MCAs	Multi-criteria analyses
MNES	Matter of National Significance
MRS	Metropolitan Region Scheme
MUW	Multiple Use Wetland
NRM	Natural Resource Management
NVCP	Native Vegetation Clearing Permit
PD Act	*Planning and Development Act 2005*
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
PFAS	Per- and polyfluoroalkyl substances
PMST	Protected Matters Search Tool
PSI	Preliminary Site Investigation
PSP	Principle Shared Path
PTA	Public Transport Authority
RAV	Restricted Access Vehicle
REW	Resource Enhancement Wetland
RIWI Act	*Rights in Water and Irrigation Act 1914*
RR	Roads, rail Infrastructure sand sandtracks
RL	Reduced Level
SPP	State Planning Policy

Abbreviation / acronym	Definition
SCP	Swan Coastal Plain
SWTC	Scope of Work and Technical Criteria
TEC	Threatened Ecological Communities
TEU	Twenty-Foot Equivalent Unit
TN	Total Nitrogen
TP	Total Phosphorus
TPFL	Threatened and Priority Flora List
TSP	Total suspended particulates
TSSC	Threatened Species Scientific Committee
WA	Western Australia
WAHerb	Western Australian Herbarium
WAPC	Western Australian Planning Commission
WASMM	WA Stormwater Management Manual
Westport	Westport Taskforce
WoNS	Weed of National Significance
WTC	Western Trade Coast
WRC	Water and Rivers Commission

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11 APPENDICES

Table 11.1: Appendices

Appendix	Title	Reference
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Appendix 3	Black Cockatoo Foraging Habitat Quality	GHD 2025
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