Anketell Road Upgrade (Leath Road to Kwinana Freeway)

EPA Referral Supporting Document

Document Records

Revision	Date	Name	
0	29/2/2024	GHD and Main Roads	Authors and Reviewers
0	29/2/2024	Main Roads	Approver

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 221.09 ha, including 96.20 ha of native vegetation, 47.98 ha of non-native vegetation and 76.91 ha of cleared areas.

Main Roads is referring the Proposal to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to support the formal referral of the Proposal. 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 and 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 221.09 ha, including clearing or disturbance of up to 96.20 ha native vegetation and 47.98 ha non-native vegetation.

Proposal element	Location / description	Maximum extent, capacity or range
– Principle Shared Path (PSP) 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 221.09 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 221.09 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.	

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 2021).
Potential Impacts	– Loss of 96.20 ha of native vegetation including: • 64.69 ha of native vegetation in Good or better condition • 41.65 ha of Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain (SCP) Threatened Ecological Community (TEC) • 14.26 ha of Banksia woodlands of the SCP TEC • 15.67 ha of Banksia woodlands of the SCP PEC (Priority 3) • 66.24 ha of Northern Spearwood shrublands and woodlands PEC (Priority 3) • 0.49 ha of Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP PEC • 3.71 ha of vegetation within three Bush Forever Sites • 0.55 ha of vegetation within Class A Conservation Reserve R 53313. – Indirect impacts such as the introduction and spread of dieback or weeds, 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, alteration of fire regimes.
Mitigation	<u>Avoid</u> – Avoid bisection of patches of native vegetation by limiting the Proposal to land adjacent to existing cleared areas of Anketell Road and using the median where practicable. <u>Minimise</u> – Minimise clearing impacts through the detailed design process

Element	Description
	– Develop a Construction Environmental Management Plan (CEMP) that includes 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. <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.
Outcomes	Implementation of the Proposal will result in significant residual impacts due to the loss of native vegetation including significant vegetation: – 41.65 ha of the Tuart woodlands and forests of the SCP TEC – 14.26 ha of the Banksia Woodlands of the SCP TEC – 3.71 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. In considering potential impacts to flora and vegetation, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers the EPA objective for flora and vegetation can be met through the implementation of an appropriate environmental Offset Strategy to counterbalance significant residual impacts.
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 2021).
Potential Impacts	– Loss of 135.50 ha of fauna habitat comprising native (96.20 ha) and non-native/modified (39.30 ha) vegetation – Loss of habitat for significant fauna species including: • 608 suitable DBH trees. Of these, 18 trees contained 25 hollows that were considered of suitable depth and shape for Black Cockatoo breeding. However, these trees have not been confirmed as potential breeding trees by a Black Cockatoo specialist. • 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo

Element	Description
	• 7.24 ha of core foraging habitat and 31.55 ha of secondary foraging habitat for FRTBC • 96.21 ha of core habitat for Quenda • 45.15 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake • 59.10 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider • 221.11 ha of secondary habitat for Peregrine Falcon • 59.10 ha of secondary habitat for Chuditch • 17.27 ha of secondary habitat for Western Brush Wallaby • 36.39 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 bisection of patches of fauna habitat or generation of additional movement barriers, by preferentially using the median for construction of the Proposal. <u>Minimise</u> – Minimise clearing impacts on fauna habitat through the detailed design process – Develop a CEMP that includes 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. <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. 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.
Outcomes	Implementation of the Proposal will result in significant residual impacts due to the loss of fauna habitat including significant fauna habitat: – 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo – 7.24 ha of core foraging habitat and 31.55 ha of secondary foraging habitat for FRTBC. In considering potential impacts to terrestrial fauna, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers the EPA objective for terrestrial fauna can be met through the implementation of an appropriate environmental Offset Strategy to counterbalance significant residual impacts.
Terrestrial Environmental Quality	
EPA Objective	To maintain the quality of land and soils so that environmental values are protected.
Policy and guidance	– Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016d) – Finance Technical Guideline: TG010 Acid Sulfate Soils (Department of Finance 2021) – *Guideline: Assessment and management of contaminated sites* (DWER 2021a)

Element	Description
	– 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.
Mitigation	<u>Avoid</u> – Avoid areas of high risk for Acid Sulphate Soils (ASS). <u>Minimise</u> – Minimise impacts through the detailed design process, including reducing earthworks (fill height/cut depth) in areas of heavy vegetation and installing kerbing rather than table drains – Undertake a Preliminary Site Investigation and Detailed Site Investigation – Implement an ASS and Dewatering Management Plan – Develop a CEMP that includes 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.
Outcomes	Implementation of the Proposal is not expected to result in significant residual impacts to Terrestrial Environmental Quality. In considering potential impacts to Terrestrial Environmental Quality, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers the EPA objective for Terrestrial Environmental Quality will be met.
Inland Waters	
EPA Objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
Policy and guidance	– Environmental Factor Guideline: Inland Waters (EPA 2018) – State Planning Policy 2.9 Water Resources (WAPC 2006) – Water Quality Protection Note 44, Roads Near Sensitive Water Resources (DoW 2006) – 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 9.76 ha of mapped Multiple Use Wetlands through infill, ground disturbance and vegetation clearing – Degradation of drains from alteration to surface water drainage – 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 (particularly The Spectacles wetlands), decreased water quality of the P1 and P2 Jandakot

Element	Description
	Underground Water Pollution Control Area Public Drinking Water Source Area, erosion and sedimentation in surrounding areas from vegetation clearing, bridge construction, earthworks and alteration of surface water drainage, changes to groundwater levels due to abstraction of groundwater for construction purposes which may affect private and public groundwater users, 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	Avoid – Drainage design will integrate Water Sensitive Urban Design principles – All road drainage will be treated prior to discharge into surface water or groundwater – Drainage design will be implemented to maintain hydrological flow regimes and control stormwater run-off. Minimise – Minimise clearing impacts through the detailed design process, including installation of kerbing rather than table drains – Monitoring in accordance with CEMP and any licences – Develop a CEMP that includes management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment, including: • Sediment and erosion • Dewatering controls • Contamination and spills. 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.
Outcomes	The proposal's direct impact on up to 0.22 ha of native vegetation within a Multiple Use Wetland is not expected to result in significant residual impacts to Inland Waters, nor are the temporary impacts associated with dewatering. In considering potential impacts to Inland Waters, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers the EPA objective for Inland Waters will be met.
Social Surroundings	
EPA Objective	To protect social surroundings from significant harm.
Policy and guidance	– Environmental Factor Guideline: Social Surroundings (EPA 2023b) – State Planning Policy 5.4 Road and Rail Noise – Road and Rail Noise Guidelines (DPLH 2019) – Guideline: Dust emissions (DWER 2021b) – 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 of one Aboriginal heritage site during clearing and/or excavation works – Disturbance 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

Element	Description
	– Dust emissions and deposition – Construction noise and vibration impacts to sensitive receptors – Changes to road traffic noise post-construction (compared to pre-construction).
Mitigation	<u>Avoid</u> – Significant heritage areas to be avoided within the DE must be clearly marked prior to the commencement of construction activities. <u>Minimise</u> – Minimise clearing impacts through the detailed design process – Design the Proposal to reduce and minimise impacts on Aboriginal heritage – Detailed design of intersections and connecting roads will reduce points of conflict and ensure maximum sight distance can be achieved for both mainline traffic and traffic on the minor roads – 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 will be managed by continuous monitoring, and defining monitoring targets and stop work procedures – Undertake Aboriginal Heritage surveys and additional consultation with Traditional Owners as required – Develop a CEMP that includes 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.
Outcomes	Implementation of the Proposal is not expected to result in significant residual impacts to Social Surrounds. Proposal impacts to Aboriginal heritage will be managed through consultation with the Gnaala Karla Working Group and AH Act Section 18 approval. Proposal impacts to historic heritage sites will be managed through consultation with the City of Kwinana. Construction dust, noise and vibration is unlikely to cause significant impacts and will be managed through the implementation of a CEMP. 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. Limited sensitive receivers are located within the vicinity of the Proposal. In considering potential impacts to Social Surrounds, and the avoidance and mitigation measures proposed to address those potential impacts of the Proposal and the implementation of the environmental offsets, Main Roads considers the EPA objective for Social Surrounds will be met.

Contents

EXECUTIVE SUMMARY ..... **II**
1 PROPOSAL **1**
1.1 Proposal content 1
1.2 Background and justification 5
1.3 The Westport Program 5
1.4 Proposal alternatives 5
1.5 Local and regional context 6
1.5.1 Climate 6
1.5.2 Landform and soils 6
1.5.3 Regional biogeography 6
1.5.4 Other proposals in the surrounding area 7
2 LEGISLATIVE CONTEXT **10**
2.1 Environmental impact assessment process 10
2.1.1 Environmental Protection Act 1986, Part IV Environmental Impact Assessment 10
2.1.2 Environment Protection and Biodiversity Conservation Act 1999 10
2.2 Other approvals and regulation 10
2.3 Planning approvals 11
2.4 Decision making authorities 11
3 STAKEHOLDER ENGAGEMENT **13**
3.1 Stakeholders 13
3.2 Stakeholder engagement process 16
3.2.1 Communication and Stakeholder Engagement Methodology 17
3.2.2 Proposal Design 17
3.2.3 Targeted Stakeholder Engagement – November and December 2023 – Westport 17
3.2.4 Main Roads' Future engagement (2024 onward) 18
4 OBJECT AND PRINCIPLES OF THE EP ACT **19**
4.1 Principles 19
4.2 Identification of Preliminary Key Environmental Factors 21
5 PRELIMINARY KEY ENVIRONMENTAL FACTORS AND OBJECTIVES **24**
5.1 Environmental factor and objective – flora and vegetation 24
5.1.1 EPA Objective 24
5.1.2 Relevant policy and guidelines 24
5.1.3 Receiving environment 24
5.1.4 Potential environmental impacts 50

5.1.5 Mitigation 50
5.1.6 Assessment and significance of residual impacts 52
5.1.7 Predicted Outcomes 64
5.2 EPA environmental factor and objective – terrestrial fauna 65
5.2.1 EPA Objective 65
5.2.2 Relevant policy and guidelines 65
5.2.3 Receiving environment 65
5.2.4 Potential environmental impacts 85
5.2.5 Mitigation 86
5.2.6 Assessment and significance of residual impact 87
5.2.7 Predicted Outcomes 90
5.3 EPA environmental factor and objective – terrestrial environmental quality 92
5.3.1 EPA Objective 92
5.3.2 Relevant policy and guidelines 92
5.3.3 Receiving environment 92
5.3.4 Potential environmental impacts 101
5.3.5 Mitigation 101
5.3.6 Assessment and significance of residual impact 102
5.3.7 Predicted Outcomes 102
5.4 EPA environmental factor and objective – inland waters 104
5.4.1 EPA Objective 104
5.4.2 Relevant policy and guidelines 104
5.4.3 Receiving environment 104
5.4.4 Potential environmental impacts 110
5.4.5 Mitigation 110
5.4.6 Assessment and significance of residual impact 111
5.4.7 Predicted Outcomes 113
5.5 EPA environmental factor and objective – social surroundings 114
5.5.1 EPA Objective 114
5.5.2 Relevant policy and guidelines 114
5.5.3 Receiving environment 114
5.5.4 Potential environmental impacts 127
5.5.5 Mitigation 127
5.5.6 Assessment and significance of residual impact 129
5.5.7 Predicted Outcomes 133
6 OFFSETS 134
7 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE 135

8 HOLISTIC IMPACT ASSESSMENT 136
9 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT 137
10 ADDITIONAL INFORMATION 140
10.1 Abbreviations and acronyms 140
10.2 References 143
11 APPENDICES 148
Appendix 1: Anketell Rd Upgrade – Consolidated Biological Report (Biota 2024) 149
Appendix 2: Preliminary Site Investigation, Anketell Road and Thomas Road Transport Corridor (West Site) (Senversa 2024) 150

List of Figures

Figure 1-1 Development Envelope 4
Figure 1-2: Large development areas within 5 km of the DE 9
Figure 2-1: Land Use 12
Figure 3-1: Stakeholder engagement in the road planning process 17
Figure 5-1: Biological survey extents 26
Figure 5-2: Vegetation complexes within the DE 28
Figure 5-3: Vegetation types within the DE 34
Figure 5-4: Vegetation condition within the DE 35
Figure 5-5: Threatened Ecological Communities within the DE 40
Figure 5-6: Priority Ecological Communities within the DE 41
Figure 5-7: Introduced flora within the DE 45
Figure 5-8: Significant flora within the DE 46
Figure 5-9: Reserves and Conservation Areas 49
Figure 5-10: Tuart Woodlands and Forests of the SCP TEC and subcomponents – local context 56
Figure 5-11: Banksia Woodlands of the SCP TEC and subcomponents – local context 59
Figure 5-12: Fauna habitat and significant fauna 69
Figure 5-13: Black Cockatoo Habitat Trees 75
Figure 5-14: Black Cockatoo Roosting 76
Figure 5-15: Black Cockatoo Foraging Habitat (Carnaby's Cockatoo) 77
Figure 5-16: Black Cockatoo Foraging Habitat (FRTBC) 78
Figure 5-17: Black Cockatoo Foraging Habitat – Local Context 79
Figure 5-18: Quenda Habitat 83
Figure 5-19: Chuditch Habitat 84
Figure 5-20: Acid Sulphate Soils 99
Figure 5-21: Contaminated Sites 100

Figure 5-22: Hydrology 106
Figure 5-23: Wetlands 109
Figure 5-24: Aboriginal heritage 116
Figure 5-25: Non-Indigenous heritage 119
Figure 5-26: Visualisation of potential change 131

List of Tables

Table 1-1: General proposal content description 1
Table 1-2: Proposal content elements 1
Table 2-1: Summary of other regulatory approvals required 10
Table 2-2: Decision making authorities 11
Table 3-1: Stakeholders 14
Table 3-2: Community Consultation Strategy Summary – Westport 16
Table 4-1: Object and principles of the EP Act 19
Table 4-2: EPA Environmental Factors and Objectives 21
Table 5-1: Summary of flora and vegetation surveys conducted within the DE 25
Table 5-2: Vegetation types and condition within the DE 29
Table 5-3: Tuart woodlands and forests of the SCP TEC patch details 37
Table 5-4: Banksia Woodlands of the SCP TEC patch details 38
Table 5-5: Summary of significant flora recorded within the DE and considered as potentially occurring within the DE 43
Table 5-6: Clearing impacts to vegetation complexes mapped within the DE 53
Table 5-7: Clearing impacts to Tuart woodlands and forests of the SCP TEC patches mapped within the DE 54
Table 5-8: Clearing impacts to Banksia woodlands of the SCP TEC patches mapped within the DE 57
Table 5-9: Predicted significant residual impacts to flora and vegetation 64
Table 5-10: Summary of fauna surveys previously conducted for the Proposal 65
Table 5-11: Fauna habitats within the DE (and their corresponding vegetation units) 66
Table 5-12: Habitat classification in relation to significant fauna likelihood of occurrence assessment for the survey area (adapted from Biota (2024) Table 9.1) 70
Table 5-13: Summary of breeding habitat tree types within the survey area 73
Table 5-14: Vegetation units within the DE scored against foraging Habitat Quality Scoring for Black Cockatoo species (adapted from Biota (2024) Table 7.6) 74
Table 5-15: Predicted significant residual impacts to fauna and habitat 91
Table 5-16: Summary of Terrestrial Environmental Quality surveys conducted in the DE 92
Table 5-17: Contaminated sites within the DE or immediately adjacent to the DE 94
Table 5-18: Contaminates Sites from Basic Summary of Records (extracted from Senversa 2024) 96

Table 5-19: Geomorphic wetlands intersected by the DE (GoWA 2023) 107
Table 5-20: Municipal Heritage Places that intersect the DE (GoWA 2023) 117
Table 5-21: Municipal Heritage Places that are located outside of but within 2 km of the DE (GoWA 2023) 118
Table 5-22: Classification of significance (adapted from GoWA (2022)) 120
Table 5-23: Land zoning and reservation within the DE 125
Table 7-1: MNES within the DE 135
Table 9-1: Cumulative impacts 138
Table 10-1: Acronym and abbreviations list 140

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 221.09 ha, including clearing or disturbance of up to 96.20 ha native vegetation and 47.98 ha non-native vegetation.

Proposal element	Location / description	Maximum extent, capacity or range
– Principle Shared Path (PSP) 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 221.09 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 221.09 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.	

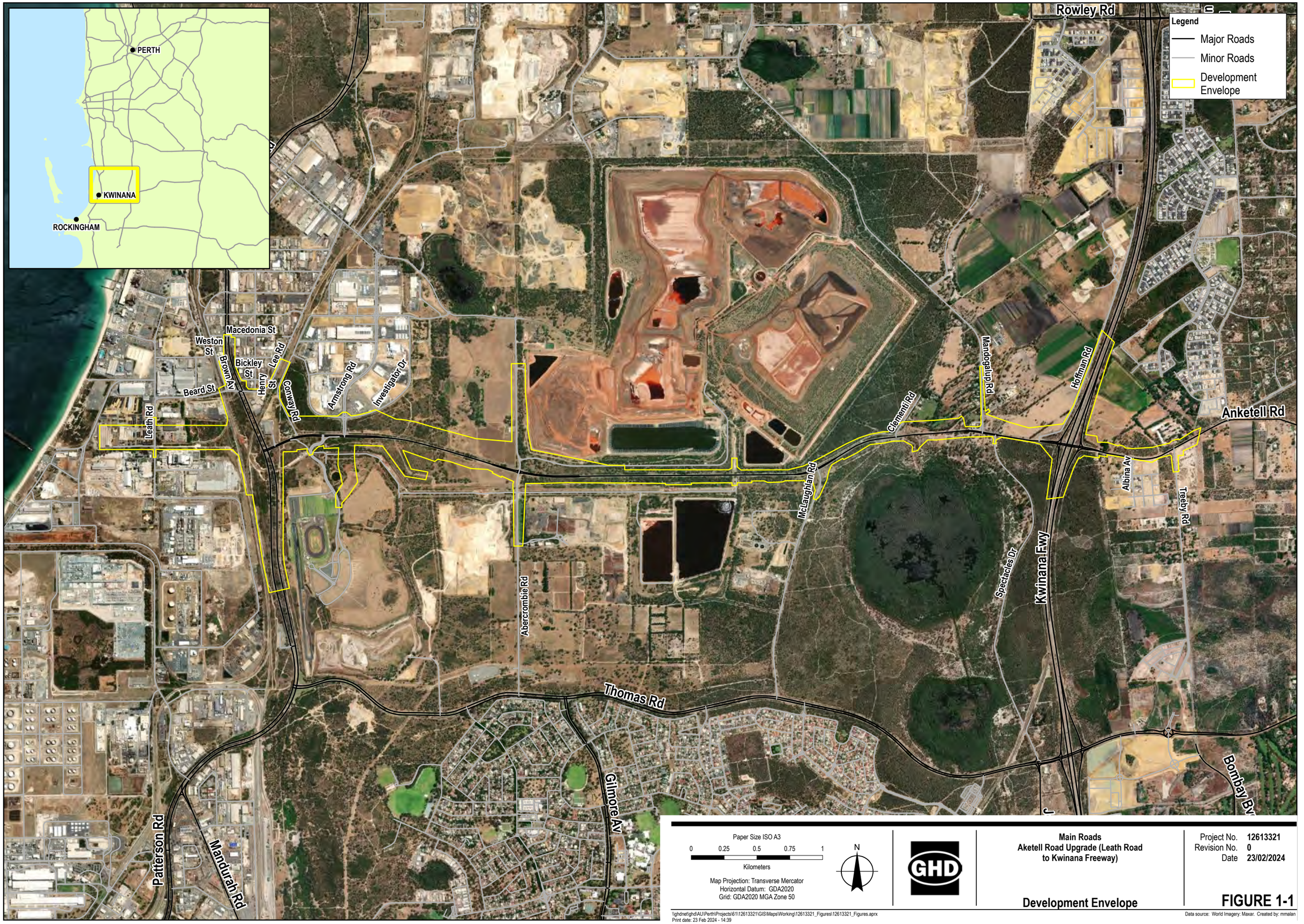
The Proposal aims to upgrade the existing Anketell Road to better connect Kwinana Freeway with the growing strategic KIA and future terminal Westport.

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 221.09 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 2022). The structure of this document aligns with the EPA instructions on how to prepare an Environmental Review Document, where appropriate (EPA 2021b).

Main Roads is referring the Proposal to the Environmental Protection Authority (EPA) for assessment under Section (s) 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to support the formal referral of the Proposal.



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Development Envelope

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 1-1

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:39

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

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 2023 and includes precipitation data (BoM 2023). 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 2023.

Mean maximum temperatures range from 31.6 °C in February to 18.1 °C in July. The mean minimum temperature ranges from 17.2 °C in February to 7.1 °C in July (BoM 2023). The mean annual rainfall is 800.1 mm with an average of 116.68 days of rainfall per year (BoM 2023). 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

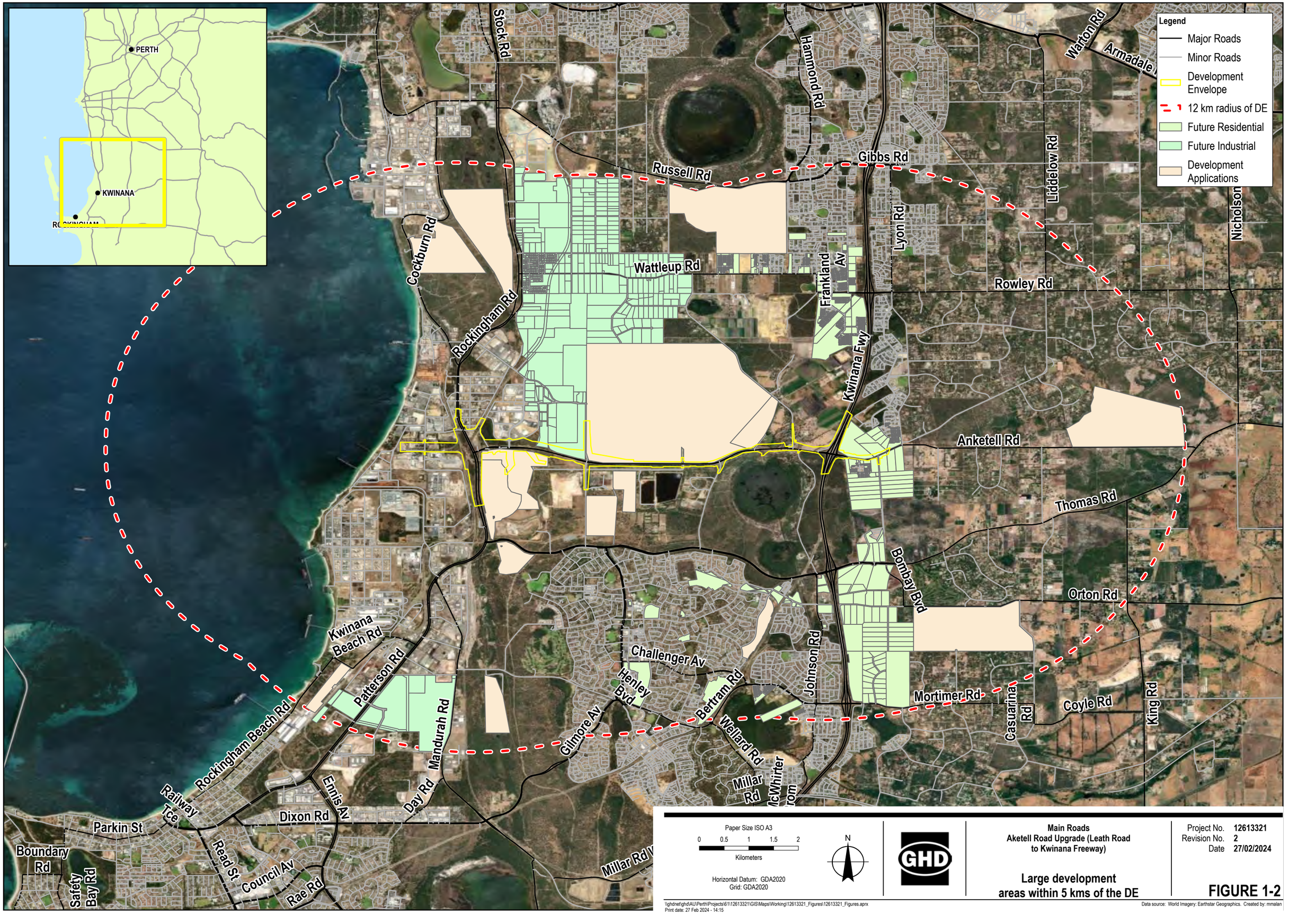
There are other significant activities, developments and land use proposals within 5 km of this Proposal, currently under assessment, or approved but yet to be constructed, that are likely to impact native vegetation and fauna habitat. These include, but are not limited to:

- 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 will be referred to the EPA under s. 38 of the EP Act in parallel to this Proposal referral
- Ammonia Expansion Project (CSBP Proposal) – CSBP 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 Preliminary Environmental Factor
- 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 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
- Various planning proposals, at different stages in the planning process, proposing residential and industrial development. There are a number of large developments within the 5 km buffer of the DE as mapped in Figure 1-2, such as:
    - 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 (2003) was amended in 2023 and referred to the EPA. The level of assessment was determined as Scheme Amendment not to be assessed, with Preliminary Environment Factors including Marine Environmental Quality, Flora and Vegetation, Terrestrial Fauna and Inland Waters
    - 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 recently considered by the EPA prior to public advertising and the EPA decided not to assess. Note also in this area – Lot 2 (No. 10) Rowley Road 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 is subdivision approvals in place to create super-lots for the future district centre
- Zoning in the Metropolitan Region Scheme (MRS) in this area – for example, the Urban zoned land east of the Kwinana Freeway has an approved structure plan in place and is progressively being subdivided by individual owners. Much of the vegetation will be cleared (or will require clearing approval) to enable planning approvals to be implemented.

The above listed Proposals have been used to inform the cumulative impacts of the current Proposal, as summarised in Section 9.



Paper Size ISO A3

0 0.5 1 1.5 2

Kilometers

Horizontal Datum: GDA2020
Grid: GDA2020

N

GHD

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

Large development areas within 5 kms of the DE

Project No. **12613321**
Revision No. **2**
Date **27/02/2024**

FIGURE 1-2

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 27 Feb 2024 - 14:15

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

2 LEGISLATIVE CONTEXT

2.1 Environmental impact assessment process

2.1.1 Environmental Protection Act 1986, Part IV Environmental Impact Assessment

The Proposal is being referred to determine if assessment is required under Part IV of the State EP Act. Part IV Division 1 of the EP Act provides for the referral and assessment of significant or strategic proposals.

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).

The Proposal will be referred to DCCEEW under the EPBC Act due to potential impacts to listed threatened species and communities. The EPBC Act referral will follow the Section 38 referral.

Main Roads does not intend to have this Proposal assessed as an accredited assessment.

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 the Proposal, licence/s will be required from the DWER under the RIWI Act.
DWER	EP Act	Clearing Permit	If the EPA decides not to assess the Proposal, a Native Vegetation Clearing Permit (NVCP) will be obtained prior to clearing any native vegetation, unless an exemption applies under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.
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.

Decision-authority	Legislation or Agreement regulating the activity	Approval required	Whether and how statutory decision-making process can mitigate impacts on the environment
Department of Planning, Lands and Heritage (DPLH)	*Aboriginal Heritage Act 1972* (AH Act)	Section 18	Any disturbance to Aboriginal Heritage sites due to Proposal works, will require Section 18 consent

2.3 Planning approvals

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).

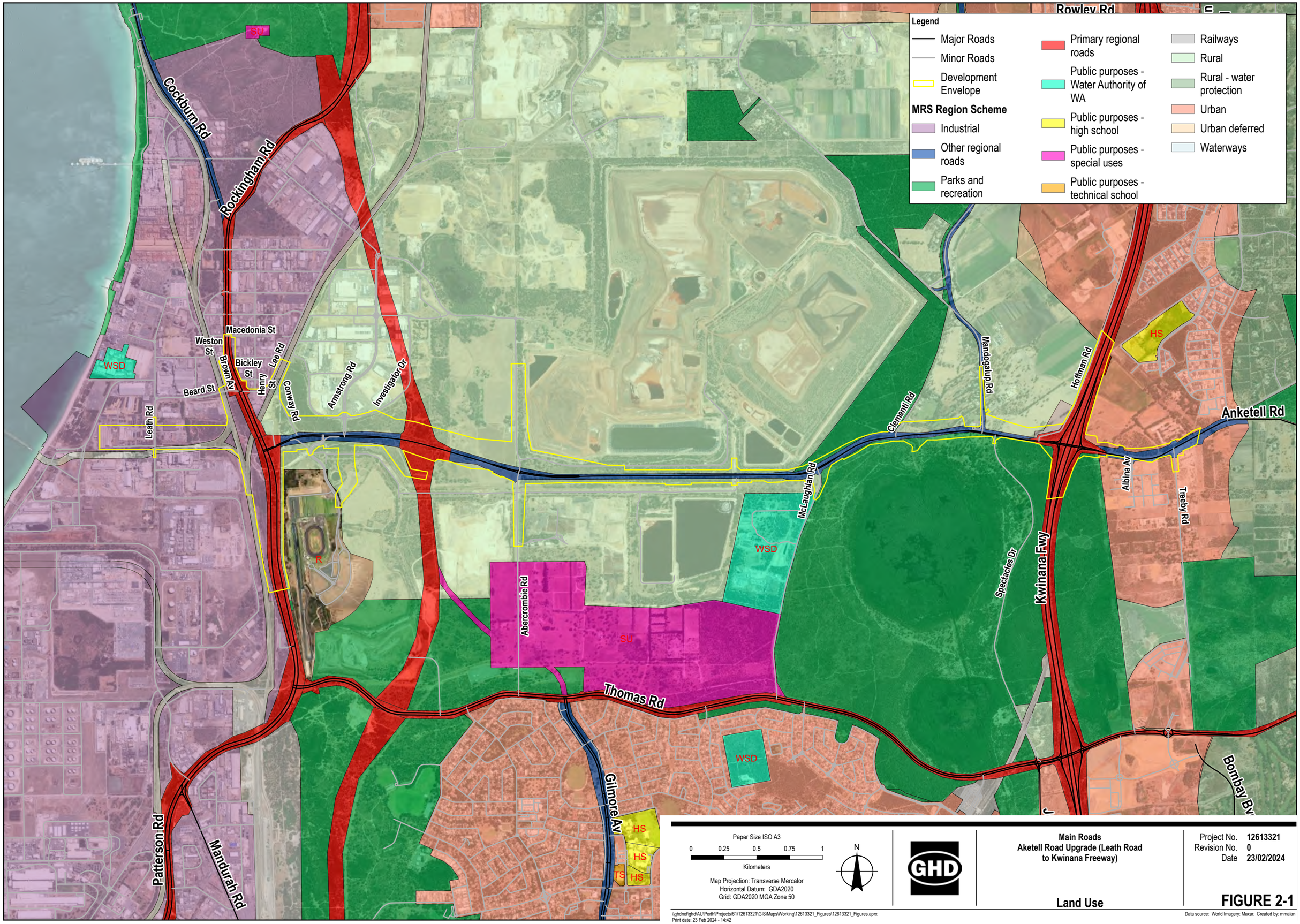
Following completion of the Proposal, all areas outside the existing Primary Regional Roads reservation will be incorporated into Primary Regional Roads, or zoned appropriately, through an omnibus amendment to the MRS pursuant to Section 28 (1) of the LA Act.

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Land Use

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 2-1

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:42

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

3 STAKEHOLDER ENGAGEMENT

Westport has undertaken stakeholder engagement for the greater project, 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.

Specific engagement for the Anketell Road Upgrade Proposal commenced in August 2021, following selection of the future terminal location in Kwinana. Engagement for the Proposal is ongoing, as indicated in Section 3.2.

Engagement to date has included 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 below. 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	Project influence
State Government	Main Roads	Leading project 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
	Western Australian Planning Commission (WAPC)	Program partner Decision maker for land protection and acquisition during the planning process.
	Department of Biodiversity, Conservation and Attractions (DBCA)	Program partner involved in the environmental referral process and land management in the project 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
	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	LGA directly affected by the road corridor
	Shire of Serpentine-Jarrahdale (neighbour)	LGA - project neighbour
	City of Cockburn (neighbour)	LGA - project 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 – City of Melville – City of Rockingham – City of Swan – PEEL Alliance – Shire of Serpentine Jarrahdale – Southwest Group
Business	– Bunbury Dampier 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	External stakeholder groups affected directly or indirectly by the Proposal's development and access changes.
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	External stakeholder groups interested in the Proposal's development and access changes.

Stakeholder group	Stakeholder	Project influence
	– Beeliar Regional Park Community Advisory Committee – BirdLife Australia (member of Westport reference group) – Conservation Council WA – Friends of Kwinana Bushland – Friends of The Spectacles – 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 and the Anketell Road Upgrade Proposal. A summary of community consultation undertaken to inform the Proposal's planning and development 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

Preliminary results from Westport's community survey that ran from September 2023 to January 2024 indicate the Proposal's impacts on the nearby residents are a key area of interest, however this may be more related to the Westport Proposal, rather than the proposal to upgrade Anketell Road. The final report from this survey was being compiled in February 2024.

3.2.1 Communication and Stakeholder Engagement Methodology

Stakeholder and community engagement will be ongoing 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 and inform a business case for the Westport Program
- 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 on them.

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 and future steps including the proposed environmental approval program.

As the Proposal moves through the planning, design and environmental approval process, Main Roads, as the Proposal proponent, will conduct more detailed engagement and communications.

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 Main Roads' Future engagement (2024 onward)

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.

In the first quarter of 2024, Main Roads will lead a stakeholder briefing regarding the Proposal's potential environmental impacts and management strategies.

Main Roads will engage with directly impacted property owners regarding design and environmental approval process during 2024. Further engagement relating to design refinement is proposed when the planning transitions from the business case submission to more detailed planning and development, subject to any statutory requirements including requirements arising from environmental approvals.

It is also noted that the EP Act also provides targeted opportunities for stakeholders and the community to provide submissions at particular stages of the environmental approval process.

A Proposal specific stakeholder engagement plan will be implemented during the planning and development phase of the project.

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. Potential impacts have been identified and described under each key environmental factor. 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. 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.
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.

Decision making authority	Relevant legislation
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) 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	

Decision making authority	Relevant legislation
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 that have been identified as relevant to the Proposal include Flora and Vegetation, Terrestrial Fauna, Terrestrial Environmental Quality, Inland Waters and Social Surroundings.

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
	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

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
	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. This will be done by conducting a Detailed Site Investigation (DSI), including an acid sulfate soils investigation and implementing a Construction Environmental Management Plan (CEMP) to ensure potential TEQ impacts are avoided, mitigated and managed.	No
	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 though unlikely will	No

Theme	Factor	Objective	Relevance to Proposal	Significant Environmental Factor
			be investigated through a wetland and hydrological study to confirm there are no significant impact to inland waters.	
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 impacts to Social Surroundings.	No
	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 2021).

5.1.3 Receiving environment

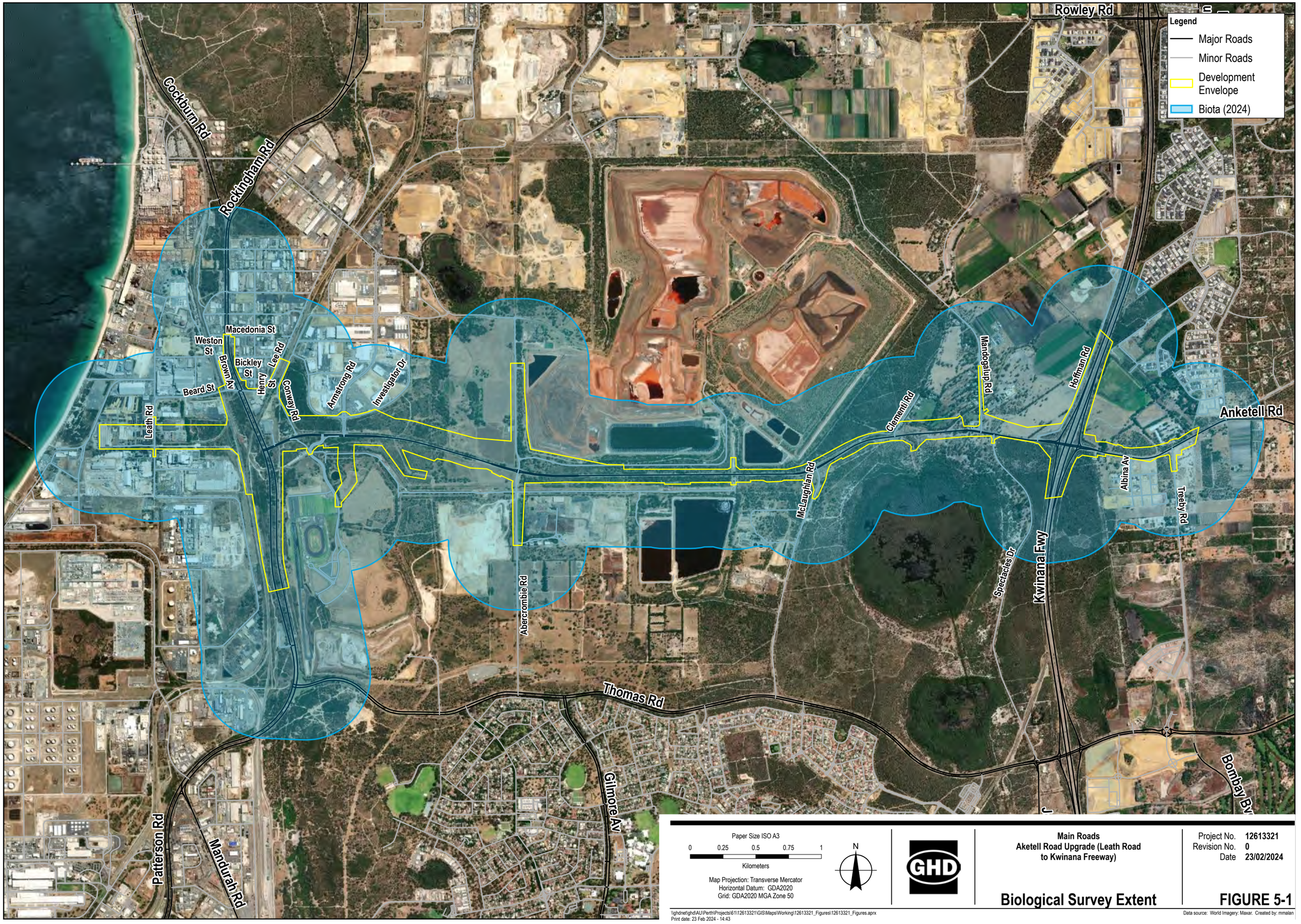
5.1.3.1 Surveys and studies

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 with the extent of the most recent biological survey (Biota 2024) shown on Figure 5-1. The results from the Biota (2024) assessment supersedes the results from Biota (2023, 2022 and 2021) assessment.

Table 5-1: Summary of flora and vegetation surveys conducted within the DE

Survey / Report	Details
Anketell Rd Upgrade – Consolidated Biological Report (Biota 2024) (Appendix 1)	Scope: Consolidation of biological surveys conducted prior to and during 2023, for the proposed Anketell Road Upgrade. The survey drew on relevant previous desktop and field survey results. Previous desktop results and surveys of Anketell Road (Biota 2022) and Westport Freight Road Additional Survey (Biota 2023). This report consolidates the previous 2020-2022 survey results and the winter to spring 2023, including additional surveys within the DE at Rockingham Road and West of Rockingham Road. It provides a comprehensive biological survey report for the entire DE. Survey dates: 26 July 2023 to 9 November 2023, in addition to the surveys completed by Biota (2023 and 2022) Survey area: Anketell Road Upgrade referral boundary, identified by spatial reference D23#1063971. The September 2023 surveys focused on those areas not covered by the Biota (2023) report.
Westport Freight Road Additional Biological Survey (draft) (Biota 2023)	Scope: Single-phase detailed flora and vegetation survey including TEC assessment and targeted flora survey along Thomas and Anketell Roads between Tonkin Highway, Oakford and Rockingham Road, Naval Base. Survey dates: 10 August 2022 to 22 September 2022. Survey area: The survey comprised an 18 km long and 320 m wide survey area (encompassing 132.82 ha of the DE) and a 500 m buffer contextual area (encompassing 66.27 ha of the DE). The remaining 22.01 ha of the DE were not covered by the survey or contextual area.
Anketell Road Planning Study Biological Survey (Biota 2022)	Scope: A detailed flora and vegetation survey and targeted flora survey. The survey assessed the vegetation (native and non-native) values of the DE including the type, condition and extent. Survey dates: between October and November 2020. Survey area: The survey area encompassed the Anketell Road section of the DE and comprised a corridor approximately 13 km long and 300 m wide, centred on Anketell Road extending from the Melville-Mandurah Highway to Thomas Road.
Anketell Road Targeted Orchid Survey (Biota 2021)	Scope: The survey targeted Threatened orchid species *Drakaea elastica* (Glossy-leafed Hammer Orchid) and *Drakaea micrantha* (Dwarf Hammer Orchid). Survey dates: between June and July 2021. Survey area: The survey area encompassed the Anketell Road section of the DE and comprised a corridor approximately 13 km long and 300 m wide, centred on Anketell Road extending from the Melville-Mandurah Highway to Thomas Road.



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Biological Survey Extent

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-1

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:43

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

5.1.3.2 Vegetation

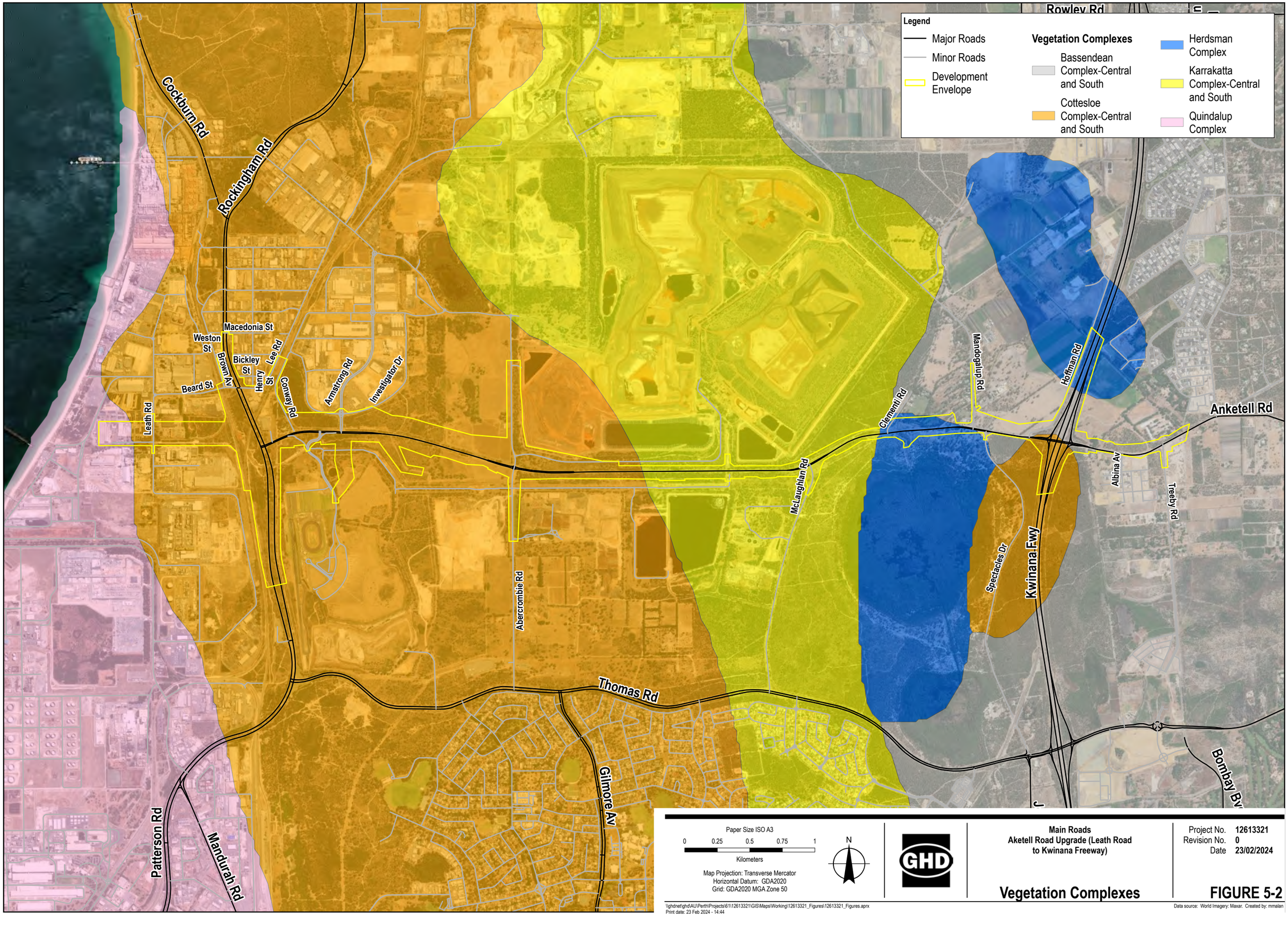
5.1.3.2.1 Broad scale mapping

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 154.64 ha of the DE (east of Leath Road, and south of the Anketell Road/Kwinana Freeway intersection), and intersects 78.01 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 26.40 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 20.39 ha of the DE (west of Clementi Road), and intersects 13.26 ha of native vegetation
- Herdsman Complex – Sedgelands and fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca* species. This complex covers 15 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 4.66 ha of the DE (western corner of the DE, west of Leath Road), and intersects 0.16 ha of native vegetation.


Legend
Major Roads
Minor Roads
Development Envelope
Vegetation Complexes
Bassendean Complex-Central and South
Cottesloe Complex-Central and South
Herdsman Complex
Karrakatta Complex-Central and South
Quindalup Complex
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
Mandogalup Rd
Hoffman Rd
Clementi Rd
Anketell Rd
McLaughlan Rd
Albina Av
Treeby Rd
Spectacles Dr
Kwinana Fwy
Abercrombie Rd
Thomas Rd
Gilmore Av
Bombay Bv
Patterson Rd
Mandurah Rd
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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)
Vegetation Complexes
Project No. 12613321
Revision No. 0
Date 23/02/2024
FIGURE 5-2
\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:44
Data source: World Imagery: Maxar. Created by: mmalan

5.1.3.3.1 Types and condition

The Biota (2024) survey 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 96.20 ha (43.5%) of native vegetation mapped across 20 intact vegetation units, and 47.98 ha (21.7%) of non-native/modified vegetation (Biota 2024). The remainder of the DE is cleared (76.91 ha, 34.8%).

The condition of the native vegetation within the DE ranged from 'Very Good to Excellent' to 'Cleared' (Biota 2024). No patches of vegetation within the DE 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

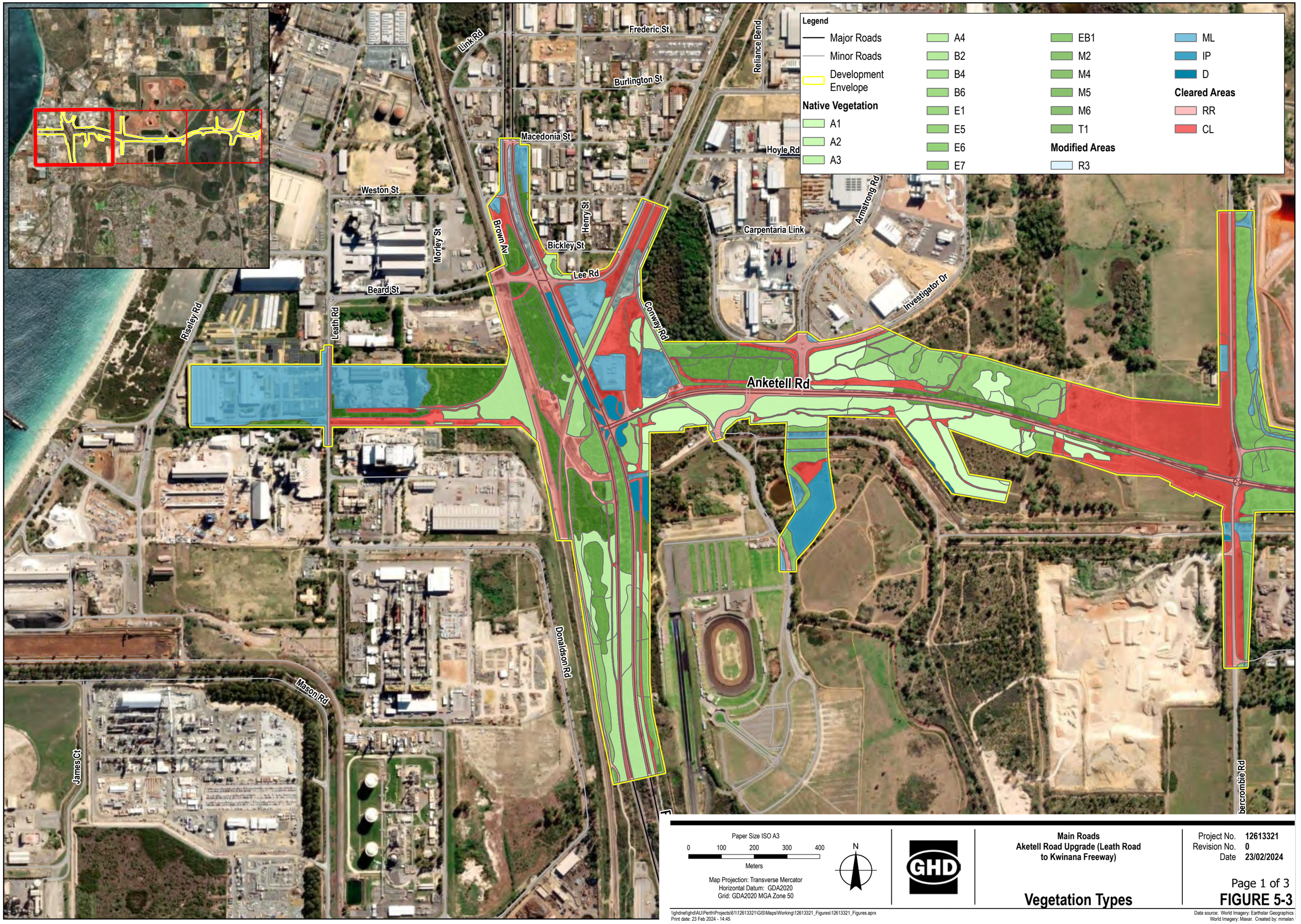
Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
Native Vegetation				
A1	*Acacia rostellifera,* (*A. saligna*) tall shrubland to tall open scrubland over *Xanthorrhoea preissii* very open grass trees over *Hibbertia hypericoides* subsp. *hypericoides, Grevillea vestita* 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	9.41	Good to Very Good	8.45
			Degraded to Good	0.12
			Degraded	0.83
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	5.20	Very Good	3.31
			Good to Very Good	1.65
			Degraded to Good	0.24
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.	3.37	Very Good	0.66
			Good	0.61
			Degraded	2.10
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.	6.29	Good	2.49
			Degraded	1.52
			Cleared	2.28
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	6.93	Very Good to Excellent	1.55
			Good to Very Good	2.14

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
	open shrubland over *Conostylis aculeata* subsp. *aculeata* scattered to very open herbland over **Ehrharta calycina* very open grassland		Good	2.12
			Degraded to Good	0.04
			Degraded	0.99
			Completely Degraded	0.08
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	0.53	Good	0.36
			Degraded to Good	0.17
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	4.22	Very Good	2.55
			Good to Very Good	1.62
			Degraded to Good	0.06
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	3.72	Good	3.72
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	1.87	Good	0.40
			Degraded	1.47
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	31.55	Very Good to Excellent	0.15
			Very Good	4.35
			Good	15.99
			Degraded to Good	6.56
			Degraded	4.49
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,*	0.39	Good	0.39

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
	**Bromus diandrus, *Lagurus ovatus, *Lolium perenne* x *rigidum* very open bunch grassland over **Euphorbia terracina, *Euphorbia peplus* very open herbland			
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	1.30	Degraded	1.30
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	1.35	Very Good	0.76
			Good	0.54
			Degraded to Good	0.06
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	7.24	Very Good to Excellent	3.02
			Good to Very Good	1.26
			Good	1.97
			Degraded	0.99
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 over **Ehrharta longiflora, *Vulpia myuros, *Bromus diandrus, *Avena barbata* scattered grasses	0.92	Degraded	0.61
			Completely Degraded	0.31
M2	*Melaleuca lanceolata* low woodland to low open forest over **Ehrharta calycina, *E. longiflora* open grassland *over *Asparagus asparagoides* scattered herbs	1.81	Very Good	0.01
			Good	0.87
			Degraded to Good	0.94
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, *Asparagus asparagoides, *Trifolium campestre* var. *campestre* very open herbland	2.50	Very Good	1.45
			Good	0.76
			Degraded	0.29

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
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	0.79	Good	0.59
			Degraded	0.20
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	3.20	Very Good	0.97
			Degraded to Good	0.43
			Degraded	1.81
T1	**Leptospermum laevigatum* tall open shrubland over *Acacia saligna, Acacia cyclops, Alyxia buxifolia, Spyridium globulosum* open shrubland over **Cenchrus setaceus* scattered tussock grasses	3.61	Degraded	2.92
			Completely Degraded	0.33
			Cleared	0.36
Total native vegetation (ha)		**96.20**		
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	5.66	Degraded	5.19
			Completely Degraded	0.47
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	1.41	Good	0.23
			Degraded	1.19
ML	Commercial/Residential Mixed Land Use	25.34	Completely Degraded	0.48
			Cleared	24.86
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*	8.68	Good	0.08
			Degraded	3.32
			Completely Degraded	4.54
			Cleared	0.74

Vegetation Unit	Vegetation description	Extent (ha) within the DE	Condition (ha)	
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)	6.89	Completely Degraded Cleared	6.89
Total non-native vegetation (ha)		**47.98**		
Cleared (non-native)				
CL	Cleared	39.97	Cleared	39.97
RR	Roads, rail Infrastructure sand sandtracks	36.94	Cleared	36.94
Total cleared areas (ha)		**76.91**		



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

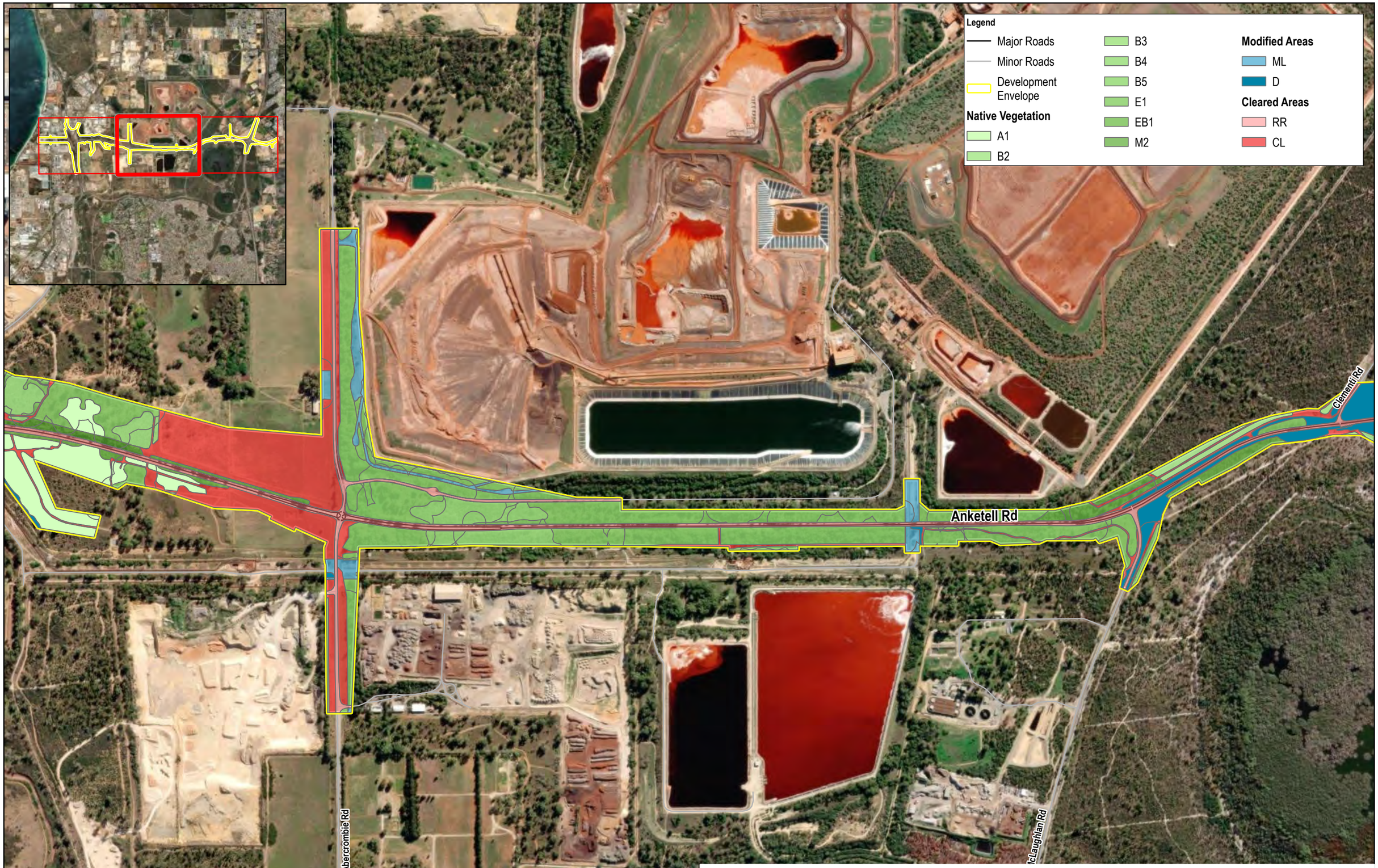
Vegetation Types

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-3

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:45

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

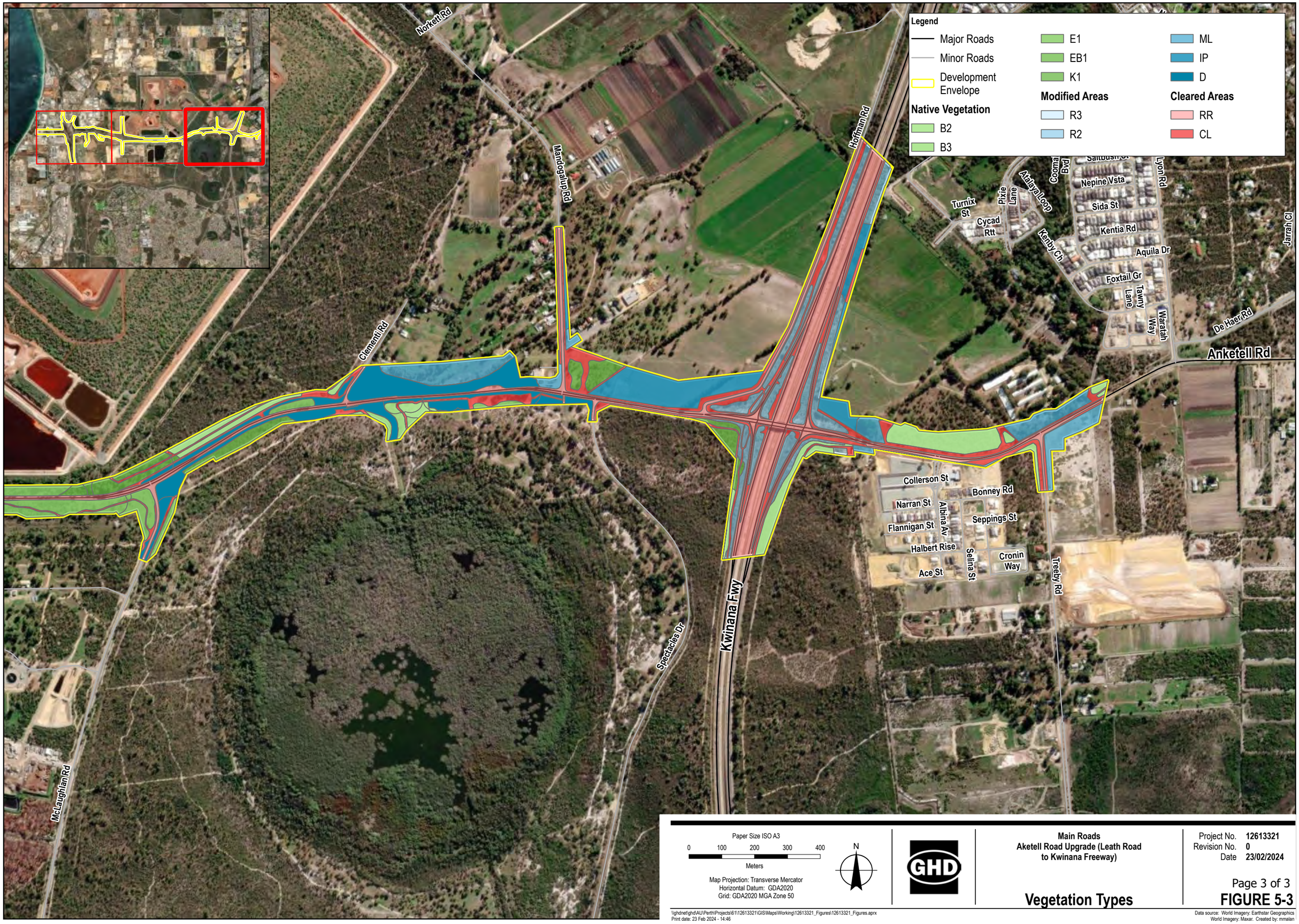
Vegetation Types

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-3

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:46

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



Paper Size ISO A3

0 100 200 300 400

Meters

N

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

GHD

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

Vegetation Types

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-3

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:46

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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Condition

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-4

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:47

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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Condition

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-4

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:47

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

Legend

- Major Roads
- Minor Roads
- Development Envelope

Native Vegetation Condition

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

Norkett Rd
Mandogalup Rd
Clementi Rd
McLaughlan Rd
Spectacles Dr
Hoffman Rd
Kwinana Fwy
Mornington Cr
Darling Ch
Coral Bay
Turnix St
Pixie Lane
Atalaya Loop
Cycad Rtt
Kenby Ch
Nepine Vsta
Sida St
Kentia Rd
Aquila Dr
Foxtail Gr
Tawny Lane
Waratah Way
De Haer Rd
Darrah Cl
Anketell Rd
Collerson St
Bonney Rd
Narran St
Albina Av
Seppings St
Flannigan St
Halbert Rise
Selina St
Cronin Way
Ace St
Treeby 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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Vegetation Condition

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-4

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:47

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

5.1.3.3.2 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 (2024) survey 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 (floristic community type 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 are mapped in Figure 5-5, and PECs are mapped in Figure 5-6.

The DE also contains vegetation associated with wetlands and groundwater dependent vegetation.

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 (TSSC 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. TSSC (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 (TSSC 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 (TSSC 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 (2024) within the DE, occurred within native vegetation types A1, A2, A3, E1, E6, EB1, B2, B3, B4, B5, M1, M2 and M4. Biota (2024) mapped 114.21 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 seven remnant patches with an extent of 41.65 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) (%)	Condition rating	Comments
TT01	8.42	2.14 (25.42)	Very Good to Excellent to Cleared	
TT02	1.03	0.98 (95.15)	Very Good to Excellent to Cleared	
TT03	29.40	6.04 (20.54)	Very Good to Excellent to Cleared	
TT04	6.34	1.00 (15.77)	Good to Very Good to Cleared	
TT05	18.70	11.23 (60.05)	Good to Cleared	
TT06	35.70	17.57 (49.22)	Very Good to Excellent to Cleared	Intersects Bush Forever Site No 268 and 269
TT07	5.74	1.95 (33.97)	Good to Cleared	Intersects Bush Forever Site No 269
TT08	2.36	-	Degraded to Cleared	
TT09	2.75	-	Degraded to Cleared	
TT10	0.74	-	Very Good to Cleared	
TT11	3.03	-	Degraded to Cleared	

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 (TSSC 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 (TSSC 2016b).

Key threats to the Banksia Woodlands of the SCP include land clearing, phytophthora dieback, novel biota, introduced fauna and anthropogenic greenhouse gas emissions (TSSC 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 (2024) within the DE, occurred within native vegetation types A1, A2, E1, EB1, B2, B3 and B4. Biota (2024) mapped 330.2 ha of this TEC in 9 remnant

vegetation patches wholly or partially within the survey contextual area. The DE intersects all nine patches with an extent of 14.26 ha (Table 5-4).

Table 5-4: Banksia Woodlands of the SCP TEC patch details

Patch ID	Size of patch (ha)	Extent within the DE (ha) (%)	Condition rating	Comments
BT01	2.2	0.19 (8.64)	Very Good	
BT02	4.9	2.06 (42.04)	Very Good	
BT03	76.1	1.20 (1.58)	Very Good to Excellent	Intersects Bush Forever Site No 270
BT04	32.7	0.87 (2.66)	Very Good	Intersects Bush Forever Site No 269
BT05	159.6	1.99 (1.25)	Good to Very Good	Intersects Bush Forever Site No 269
BT06	45.4	0.87 (1.92)	Very Good	Intersects Bush Forever Site No 268
BT07	5.6	3.46 (61.71)	Very Good to Excellent	
BT08	3.1	3.02 (97.42)	Very Good to Excellent	
BT09	0.61	0.61 (100)	Good	

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 Threatened Ecological Community '*Melaleuca huegelii – M. systena* shrublands of limestone ridges (floristic community type 26a as originally described in Gibson et al. 1994)' that is on the list of Threatened Ecological Communities, 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 (2024) reports the DE supports a single occurrence of this TEC (1.96 ha) 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 (2024) 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 FCT24 (aff. 29a/30b) and FCT24 (aff. 29a), reflecting the FCTs that were mapped for the surrounding vegetation.

As the FCT analysis did not confirm the presence of this TEC, Main Roads will liaise with DBCA's Species and Communities Branch about this vegetation community and potentially undertake further vegetation community analysis to arrive at a more definitive conclusion about the presence and extent of this TEC. Given this uncertainty, the TEC is not assessed further in this document.

Banksia woodlands of the Swan Coastal Plain PEC

The Banksia woodlands of the SCP PEC is listed as Priority 3 by DBCA and can also be a component of the EPBC Act listed Banksia Woodlands of the SCP TEC. The Banksia woodlands of the SCP PEC mapped by Biota (2024) within the DE, occurred within native vegetation types A2, E1, EB1, B2, B3 and B4 . There is 115.37 ha of this PEC wholly or partially within the survey contextual area, with 15.67 ha within the DE, ranging from Degraded to Good to Very Good to Excellent in condition.

Portions of all 9 patches of the Banksia woodlands of the SCP TEC mapped within the DE are also mapped as the Banksia woodlands of the SCP PEC. There is an additional 4.45 ha of the PEC mapped within the DE that is not associated with areas of the Banksia woodlands of the SCP TEC. The Banksia woodlands of the SCP PEC intersects Bush Forever Site No.s 268, 269 and 270.

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).

The Northern Spearwood shrublands and woodlands PEC mapped by Biota (2024) within the DE, occurred within native vegetation types A1, A2, A3, A4, E1, E5, E7, EB1, B2, B3, B4, B5, B6, M2, M4, M5, M6 and T1. There is 186.00 ha of this PEC wholly or partially within the survey contextual area (Biota 2024), of which 66.24 ha occurs within the DE, ranging from Cleared to Very Good in condition.

Portions of the Banksia woodlands of the SCP TEC are also mapped as the Northern Spearwood shrublands and woodlands PEC. The Northern Spearwood shrublands and woodlands PEC intersect Bush Forever Site No.'s 268 and 269.

Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP PEC

The Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain 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*, *B. 39anksia39e*, *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.

This State-listed PEC is a component of the Commonwealth Tuart Woodlands and Forests TEC, and the patches within the DE and survey contextual area that were representative of the PEC comprised 0.49 ha and 5.36 ha respectively, located north of Anketell Road. This PEC is associated with a part of vegetation type E1 and in Good condition.

Legend

Major Roads

Minor Roads

Development Envelope

Threatened Ecological Communities

Federal TEC Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the Swan Coastal Plain

Federal TEC Banksia Woodlands of the Swan Coastal Plain

Link Rd
Frederic St
Reliance Bend
Bass Lane
Everette Way
Burlington St
McLaren Av
Conway Rd
Bligh Lane
Macedonia St
Hoyle Rd
Weston St
Henry St
Armstrong Rd
Morley St
Brown Av
Carpentaria Link
Bickley St
Lee Rd
Investigator Dr
Beard St
Riseley Rd
Leath Rd
TT01
TT02
BT07
TT03
TT05
BT09
BT08
Anketell Rd
TT04
Donaldson Rd
Mason Rd
James Ct
bercrombie Rd

Paper Size ISO A3

0 100 200 300 400

Meters

N

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

GHD

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

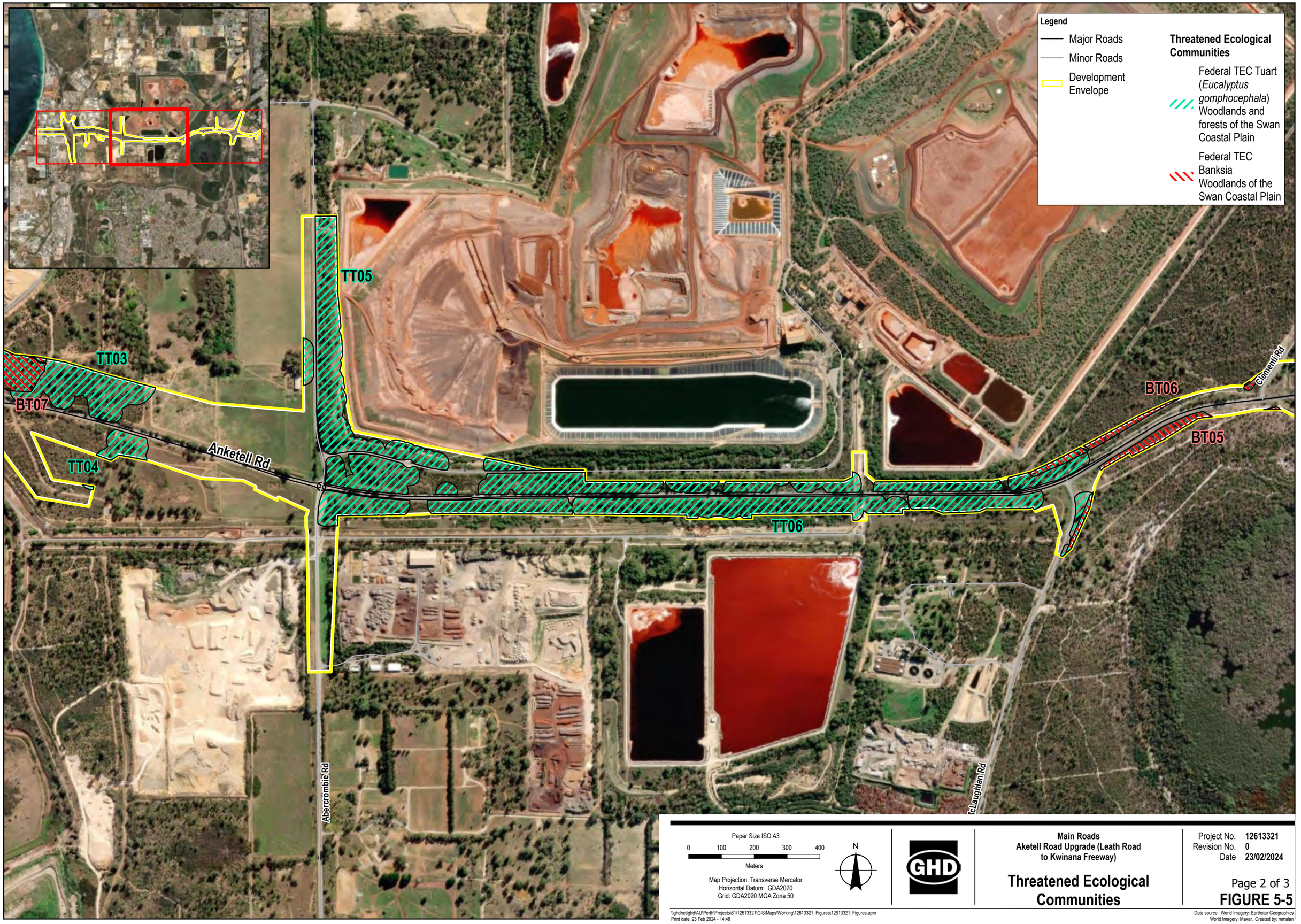
Threatened Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-5

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:48

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

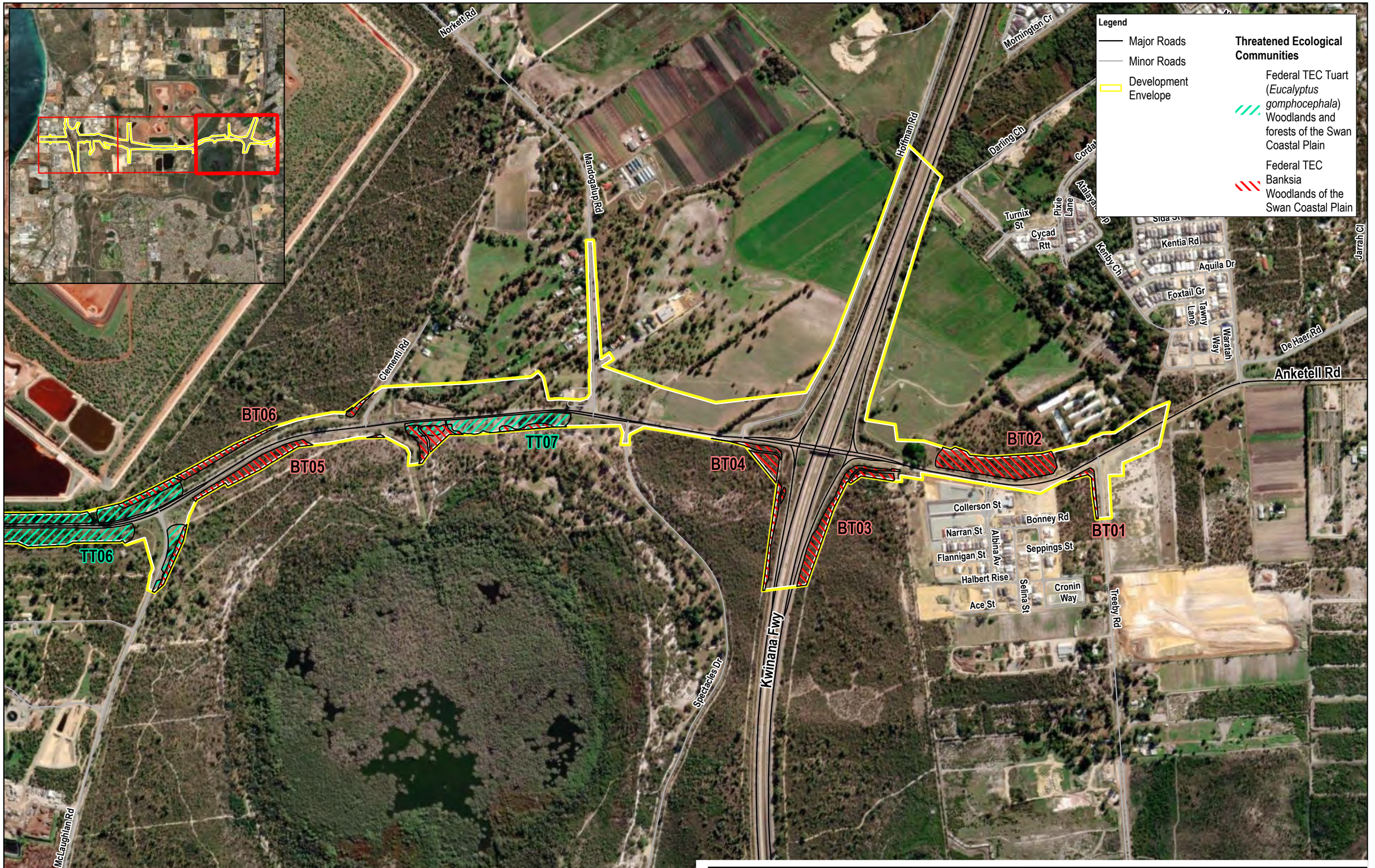
Threatened Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-5

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:48

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Threatened Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-5

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:48

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

Legend

- Major Roads
- Minor Roads
- Development Envelope

Priority Ecological Communities

- Banksia Woodlands of the Swan Coastal Plain (Priority 3)
- Northern Spearwood shrublands and woodlands (Priority 3)
- Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain (Priority 3)

Link Rd
Frederic St
Reliance Bend
Bass Lane
Everette Way
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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

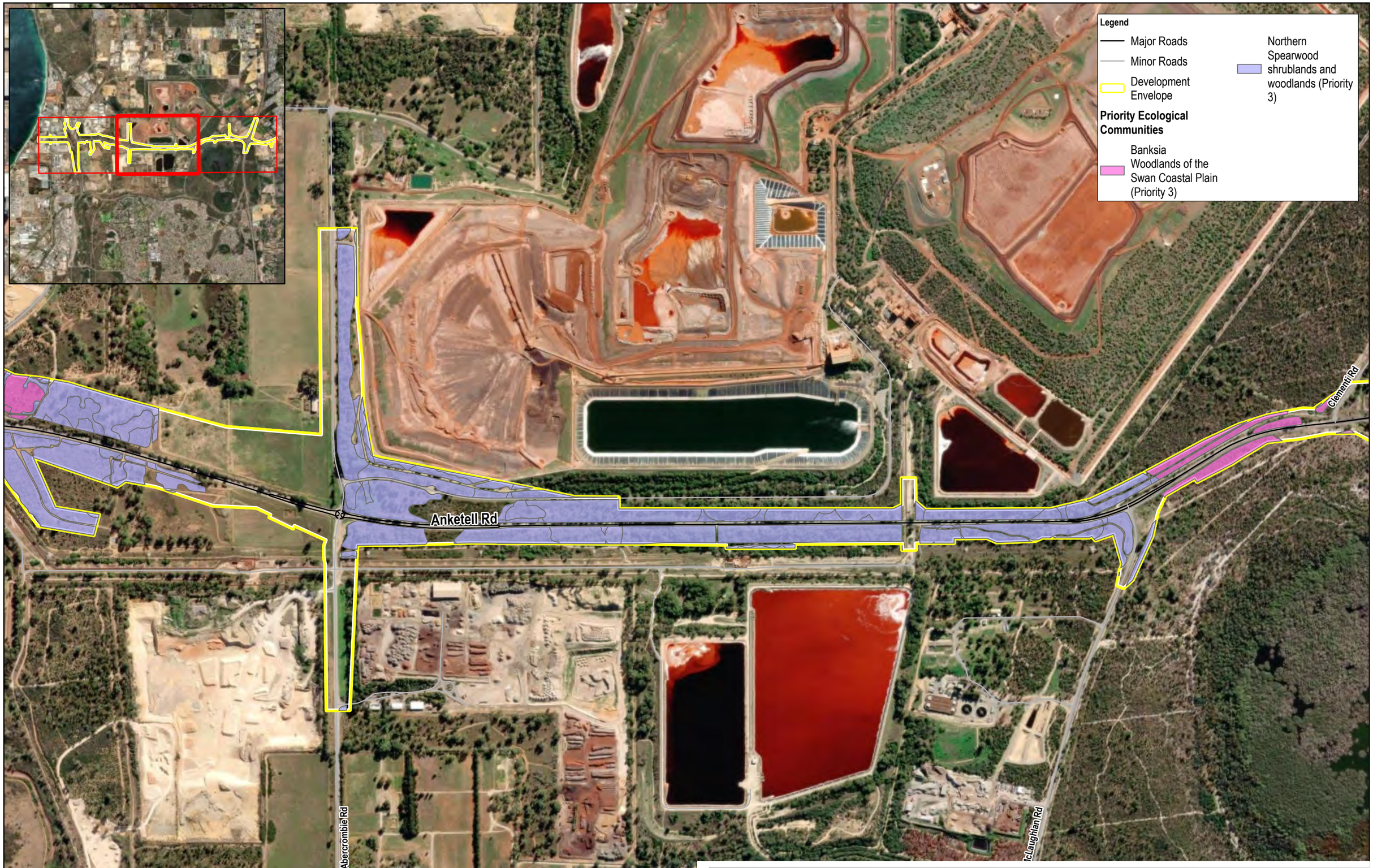
Priority Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-6

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:50

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Priority Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-6

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:50

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

Legend

- Major Roads
- Minor Roads
- Development Envelope

Priority Ecological Communities

- Banksia Woodlands of the Swan Coastal Plain (Priority 3)
- Northern Spearwood shrublands and woodlands (Priority 3)

Norkett Rd
Mandogalup Rd
Clementi Rd
McLaughlan Rd
Spectacles Dr
Kwinana Fwy
Hoffman Rd
Mornington Cr
Darling Ch
Turnix St
Pixie Lane
Atalaya Loop
Cycad Rtt
Kenby Ch
Sida St
Kentia Rd
Aquila Dr
Foxtail Gr
Tawny Lane
Waratah Way
De Haer Rd
Darrah Cl
Anketell Rd
Collerson St
Bonney Rd
Narran St
Albina Av
Seppings St
Flannigan St
Halbert Rise
Selina St
Cronin Way
Ace St
Treeby 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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Priority Ecological Communities

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-6

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:50

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

Dampland, wetland and groundwater dependent vegetation

The Biota (2024) survey 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.

A search of the Groundwater Dependent Ecosystems (GDE) Atlas (BOM 2023) by Senversa (2024) identified the following GDEs within a 1 km radius of the site [accessed on 8 November 2023]:

- Known aquatic and terrestrial GDEs directly south of the site associated with the Spectacle Swamp
- High potential aquatic GDE intersects the site and is associated with the damplands intersecting with site towards Kwinana Freeway. There is a high potential aquatic GDEs associated with Mandogalup Swamp South (North of the site boundary) and Long Swamp (Sumplands) located North of the site boundary. Additional high potential aquatic GDEs associated with damplands exist both to the north and south of the site boundary
- High and Medium terrestrial GDEs in the vicinity of Spectacle Swamp Wetland, south of the site boundary. There are also medium and low potential terrestrial GDEs associated with Mandogalup Swamp South (north of site)
- Low potential aquatic GDE north of the site boundary associated with Long Swamp.

Biota (2024) 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''.

5.1.3.4 Flora

Biota (2024) 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).

5.1.3.4.1 Introduced Species

One hundred and thirty-one (131) introduced flora species were recorded during the Biota (2024) survey across the survey area. 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
- **Zantedeschia aethiopica* (Arum Lily) – DP
- **Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) – DP

- **Morea flaccida* (One-leaf Cape Tulip) – DP.

Locations of the Declared Pests and WoNS are shown in Figure 5-7.

5.1.3.4.2 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 2024). Four native Priority species were identified within the DE (Biota 2024):

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

Two individuals of *Calothamnus quadrifidus* subsp. *Teretifolius* (DBCA: Priority 4) were also recorded by Biota (2024) 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 two 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 single record of *Eryngium pinnatifidum* subsp. Palustre (G.J. Keighery 13459) (Priority 3) was recorded approximately 30 m north of the DE near Clementi Road. A single *Caladenia speciosa* plant was recorded in the survey contextual area from an opportunistic location in the B1 vegetation.

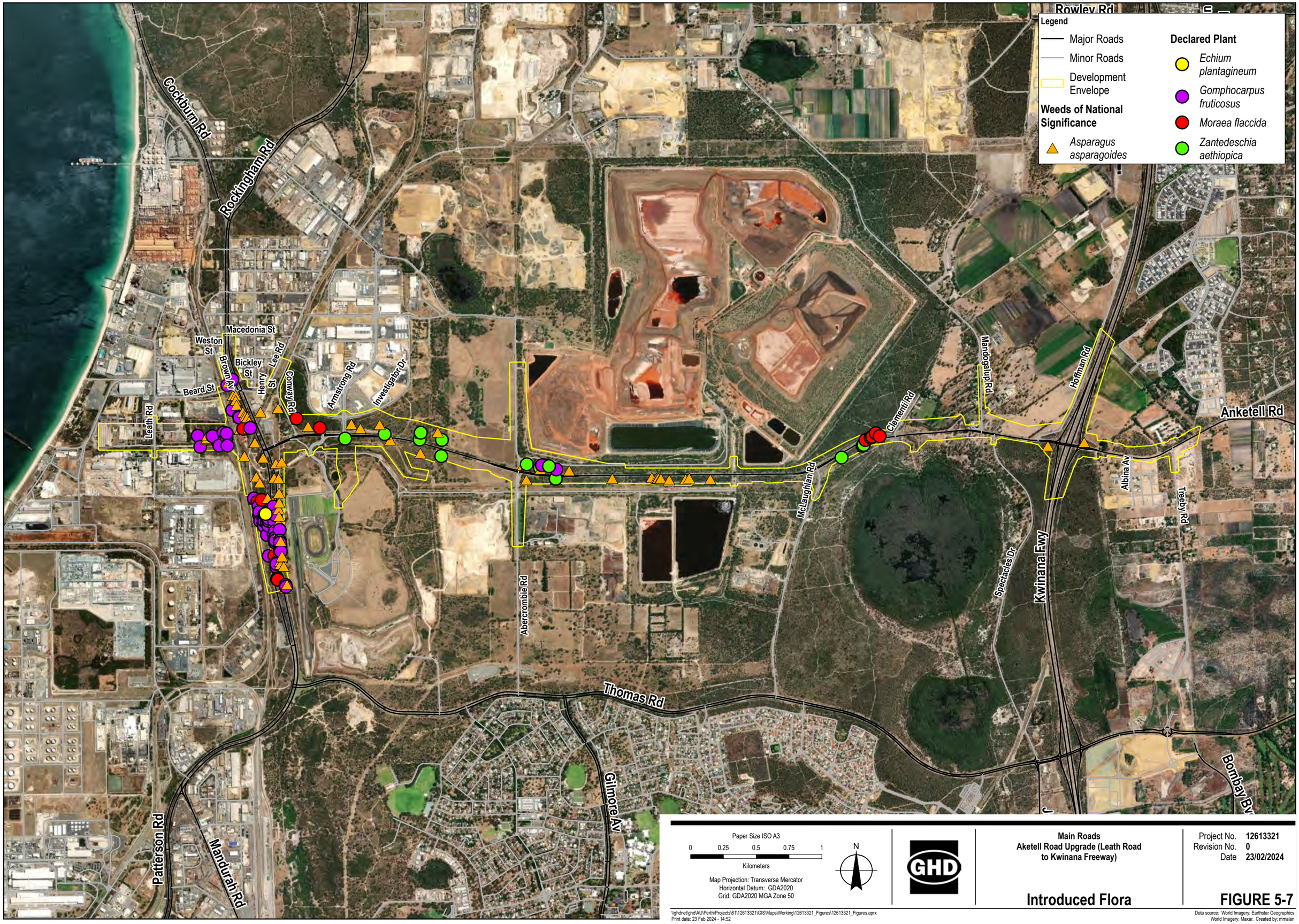
A likelihood of occurrence assessment completed by Biota (2024) post-field survey concluded four Threatened orchid species may potentially occur in the survey area (and DE). The remainder of conservation significant flora taxa were considered unlikely to or would not occur within the survey area (and DE).

A summary of significant species either known to occur or having the potential to occur is presented in Table 5-5 and Figure 5-8 (Biota 2024).

Table 5-5: Summary of significant flora recorded within the DE and considered as potentially occurring within the DE

Taxon	Status	Comments
Poranthera moorokatta	P2	One individual of *Poranthera moorokatta* was recorded from 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 recorded from three quadrats within the DE, from vegetation types M2 and M4 located on a limestone ridge between Rockingham Road and the freight railway. The number of individuals was not recorded due to the unknown status of the collections made at the time of the sampling, however the projective foliage cover of this species within the respective quadrats was between 0.1 % and 9%.

Taxon	Status	Comments
Pimelea calcicola	P3	Nine opportunistic records of this species were made in the DE from vegetation types M6 and E7. It was also recorded from two from quadrats and one opportunistic record in the survey contextual area, within vegetation unit M4.
Eucalyptus foecunda subsp. Foecunda	P4	This species 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. In addition, 38 opportunistic records, comprising a total of 149 individuals were also recorded.
Caladenia huegelii	EPBC Act: EN BC Act: CE	There are previous records within 5 km of the Biota (2024) survey area. No individuals were identified during the Biota surveys (2021, 2024). Despite no observations of this species Biota considers it has the potential to occur within the survey area as underground tubers, due to the lack of recent fire in the area and the ability of the species to remain dormant for up to three years. *Caladenia huegelii* occurs on grey or brown sand, clay loam. There is habitat for the species within the DE.
Diuris purdiei	EPBC Act: EN BC Act:	There are previous records within 1 km of the Biota (2024) survey area. No individuals were identified during the Biota surveys (2021, 2024). Despite no observations of this species Biota considers it has the potential to occur within the survey area as underground tubers, due to the lack of recent fire in the area and the ability of the species to remain dormant for up to three years. *Diuris purdiei* occurs on grey-black sand in a moist environment and winter-wet swamps. There is limited habitat for the species within the DE.
Drakaea elastica	EPBC Act: EN BC Act:	There are previous records within the Biota (2022) contextual area. No individuals were identified during the Biota surveys (2021, 2024). Despite no observations of this species Biota considers it has the potential to occur within the survey area as underground tubers, due to the lack of recent fire in the area and the ability of the species to remain dormant for up to three years. *Drakaea elastica* occurs on white or grey sand, in low-lying situations adjoining winter-wet swamps. There is some suitable habitat within the DE.
Diuris micrantha	EPBC Act: VU BC Act:	There are previous records within 5 km of the Biota (2024) survey area. No individuals were identified during the Biota surveys (2021, 2024). Despite no observations of this species Biota considers it has the potential to occur within the survey area as underground tubers, due to the lack of recent fire in the area and the ability of the species to remain dormant for up to three years. *Diuris micrantha* occurs on brown loamy clay, in winter-wet swamps and in shallow water. There is limited habitat for the species within 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

N

GHD

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

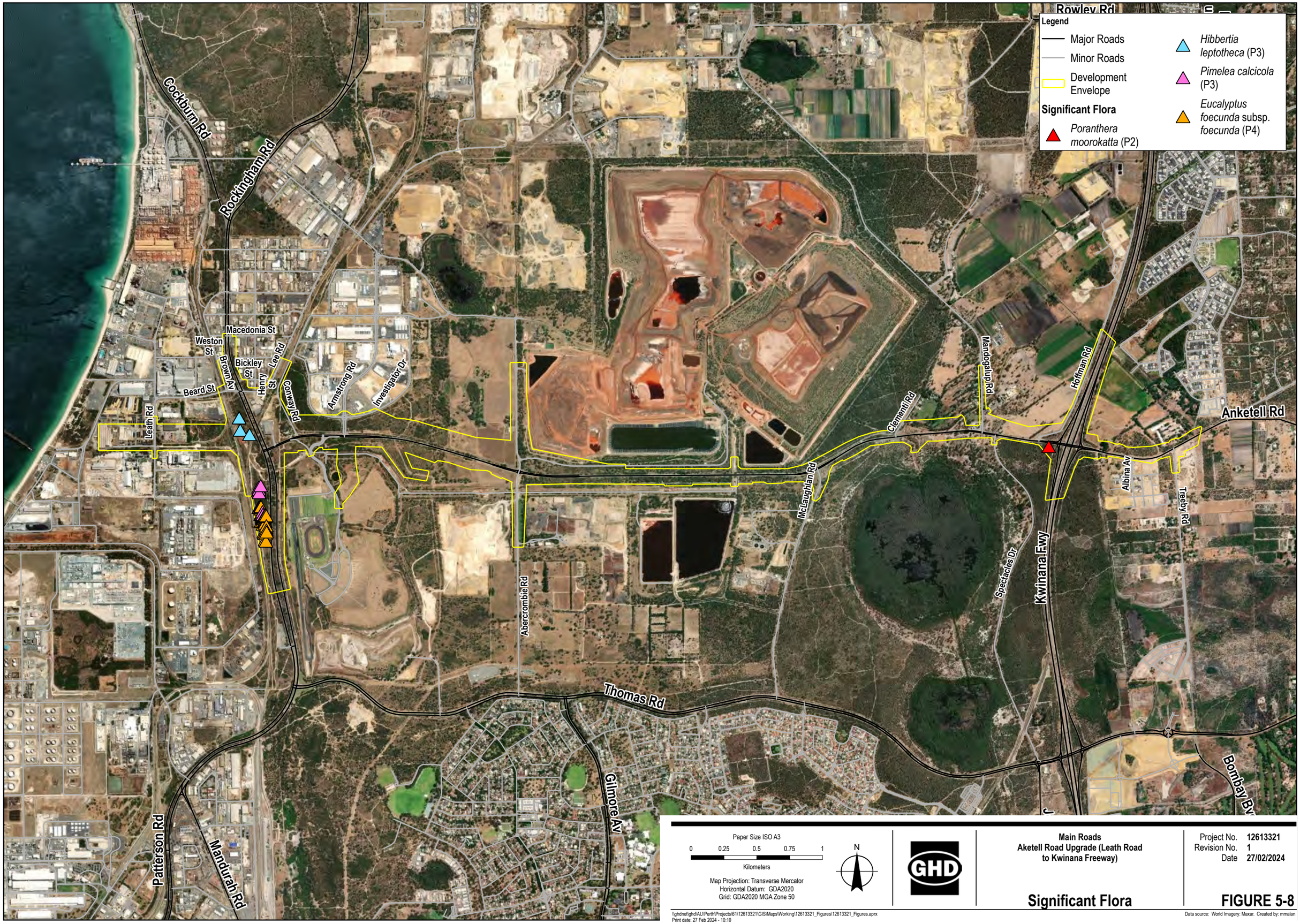
Introduced Flora

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-7

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:52

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Significant Flora

Project No. **12613321**
Revision No. **1**
Date **27/02/2024**

FIGURE 5-8

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 27 Feb 2024 - 10:10

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

5.1.3.5 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 5-9, 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.

5.1.3.5.1 Bush Forever Site 268

Mandogalup Road Bushland, Mandogalup (Bush Forever Site no. 268) is approximately 91 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 1.68 ha of Bush Forever Site no. 268, including 1.28 ha of native vegetation (of which 0.85 ha is in Good condition and 0.43 ha is in Very Good to Excellent condition. The remainder of Bush Forever intersecting the DE is mapped as non-native vegetation (0.05 ha) and existing cleared areas (0.35 ha).

5.1.3.5.2 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 (GoWA 2023). 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 4.72 ha of Bush Forever Site no. 269, including 1.93 ha of native vegetation (ranging from Good to Very Good condition to Degraded to Good condition), 1.72 ha of non-native vegetation and 1.07 ha of existing cleared areas.

5.1.3.5.3 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 (GoWA 2023). 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.

5.1.3.6 Conservation Reserves

The DE intersects one DBCA managed reserve, Class A Conservation Park (R 53313), south of the Kwinana Freeway / Anketell Road interchange (1.03 ha, including 0.55 ha of native vegetation). R 53313 is vested with the Conservation and Parks Commission, classified under WAPC Section 8a Lands within Beeliar Regional Park. 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). The entire extent of Beeliar Regional Park is mapped in Figure 5-9.

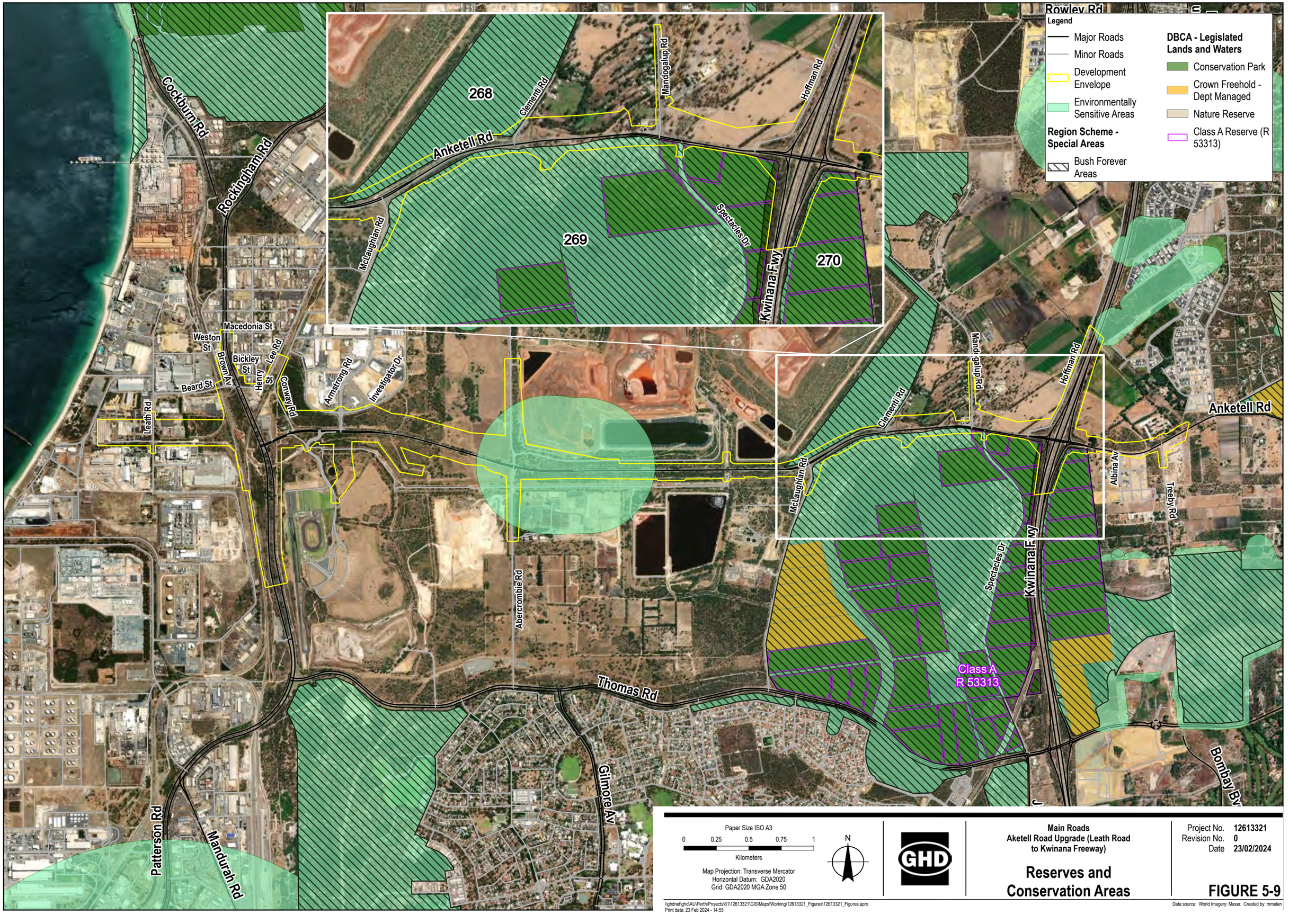
R 53313 occupies 610 ha across four separate areas, including North Lake, Farrington Road bushland, South Lake, parts of Kogolup Lake, portions of The Spectacles and Treeby Lake (Jandakot Regional Park) (Urban Bushland Council WA Inc 2020). Two other DBCA managed lands lie within 500 m of the DE, crown 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.

5.1.3.7 Environmentally Sensitive Areas

Five Environmentally Sensitive Areas (ESAs) intercept the DE (GoWA 2023). These ESAs are associated with TECs, wetlands and Bush Forever sites, and are mapped in Figure 5-9.

5.1.3.8 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 vincity of the DE (South Coast NRM 2023).


Legend
Major Roads
Minor Roads
Development Envelope
Environmentally Sensitive Areas
Region Scheme - Special Areas
Bush Forever Areas
DBCA - Legislated Lands and Waters
Conservation Park
Crown Freehold - Dept Managed
Nature Reserve
Class A Reserve (R 53313)
Rowley Rd
Cockburn Rd
Rockingham Rd
268
269
270
Anketell Rd
Clementi Rd
Mandogalup Rd
Hoffman Rd
McLaughlan Rd
Spectacles Dr
Kwinana Fwy
Macedonia St
Weston St
Brown Av
Bickley St
Henry St
Lee Rd
Conway Rd
Armstrong Rd
Investigator Dr
Beard St
Leath Rd
Albina Av
Treeby Rd
Abercrombie Rd
Thomas Rd
Gilmore Av
Patterson Rd
Mandurah Rd
Class A
R 53313
Bombay Bv
Paper Size ISO A3
0 0.25 0.5 0.75 1
Kilometers
N
Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 50
GHD
Main Roads
Aketell Road Upgrade (Leath Road to Kwinana Freeway)
Reserves and Conservation Areas
Project No. 12613321
Revision No. 0
Date 23/02/2024
FIGURE 5-9
\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:55
Data source: World Imagery: Maxar. Created by: mmalan

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 96.20 ha of native vegetation including:
    - 64.69 ha of vegetation in Good or better condition
    - 41.65 ha of Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP TEC
    - 14.26 ha of Banksia woodlands of the SCP TEC
    - 15.67 ha of Banksia woodlands of the Swan Coastal Plain PEC
    - 66.24 ha of Northern Spearwood shrublands and woodlands (FTC24) PEC
    - 3.71 ha of vegetation within Bush Forever Sites
    - 0.55 ha of vegetation within Class A Conservation Reserve R 53313.
- Loss of significant flora including:
    - One individual of *Poranthera moorokatta* (Priority 2)
    - Multiple individuals of *Hibbertia leptotheca* (Priority 3)
    - 9 individuals of *Pimelea calcicola* (Priority 3)
    - Multiple individuals (greater than 149) 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
    - Alteration of fire regimes and increased fire risk from construction activities.

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.

Avoidance measures considered and incorporated in the Proposal planning include:

- The design solution is located mainly on existing roads. 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, reduced congestion, and ease of access
- The widening of Anketell Road will occur in the median where possible in order to minimise the impacts on adjacent native vegetation
- The DE avoids additional bisection of patches of native vegetation

- All infrastructure associated with the Proposal will be contained within the DE, including road pavements, footpaths, noise walls, stormwater drainage, fencing, and electrical power reticulation
- All laydowns, stockpiles and access tracks will be constructed within existing cleared areas or within the permanent footprint of the works. No native vegetation will be cleared for temporary works outside the permanent footprint
- The detailed design will seek to reduce earthworks (fill height/cut depth) in areas of heavy vegetation.
- Barriers for the protection of high-quality vegetation will be considered during the detailed design stage, to reduce clear zone requirements. Deep cuts, cuts in rock, or cuts behind barriers might be steepened in detailed design however this is dependent on the findings of the geotechnical investigation which has not yet been carried out for the reference design. This may also impact the typical cross section if trapezoidal drains or additional drainage layers are required in sections of cut
- Clearing impacts will be minimised during the detailed design process, by implementing measures such as the use of kerbing where appropriate to alleviate the need for table drains, requiring a larger clearing footprint
- Traffic volumes, traffic mix, and road safety will influence the intersection layouts and carriageway cross section. Intersections and connecting roads will be located to reduce points of conflict and ensure maximum sight distance can be achieved for both mainline traffic and traffic on the minor roads
- Drainage design will seek to maintain existing flow lines/watercourses to avoid impacting existing vegetation. This will be investigated further at detailed design and following detailed hydrological assessment. A drainage plan will be progressed during detailed design
- Implementation of the CEMP that includes management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment. The CEMP will include clearing and access controls, dieback and weed management, sediment and erosion controls, soil management and revegetation and landscaping requirements. The management measures will include:
    - Significant flora individuals within the DE that will not be cleared will be marked and identified as no-go areas, demarcated on relevant drawings and provided to the Construction Contractor Representative
    - All clearing areas and vegetation to be retained will be clearly marked with flagging on site
    - Declared Plants within the DE will be treated according to their Control Codes and advice from DPIRD, with the aim of eradication where possible but as a minimum prevent off site movement
    - WoNS and environmental weeds within DE will be treated according to the weed control management outlined by Weeds Australia (http://weeds.ala.org.au/) with the aim of controlling off-site movement
    - Topsoil containing Declared Pests or WoNS will not be reused in landscaping or revegetation
    - All heavy plant and machinery will be inspected by the contractor prior to entry at the work site and be confirmed to be clean and free of vegetation and soil material

- Dieback will be managed in accordance with the threat abatement plan Phytophthora Dieback Management Manual (DBCA 2020)
- Topsoil from infected or potentially infected dieback areas will be segregated and not used in non-infected areas
- Topsoil within the DE will be harvested, stockpiled and reused in accordance with Main Roads Environmental Guideline Topsoil Management
- If construction dewatering is required, groundwater modelling will be undertaken to estimate the cone of depression and identify, monitor and manage any potential groundwater impacts to native vegetation

- A project specific Landscape and Revegetation Management Plan will specify landscaping within the road reserve will use local native species in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques
- An Offsets Strategy will be implemented to mitigate significant residual impacts on flora and vegetation (Section 6).

5.1.6 Assessment and significance of residual impacts

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 96.20 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 5-6). 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 0.18% for the Cottesloe Complex-Central and South Complex. At the City of Kwinana scale the Proposal will potentially reduce the remaining extent of the mapped Complexes between 0.0% and 2.06% for the Cottesloe Complex-Central and South Complex (Table 5-6). 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 5-6: 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	13.26	12,452 (23.46%)
	City of Kwinana	1,633.94	485.73	29.73		472.47 (28.92%)
Quindalup Complex	SCP	54,574	32,983	60.44	0.16	32,983 (60.44%)
	City of Kwinana	1,289.37	310.40	24.07		310.01 (24.04%)
Cottesloe Complex-Central and South	SCP	45,300	14,571	32.17	78.01	14,493 (31.99%)
	City of Kwinana	3,789.77	1,281.71	33.82		1,204 (31.76%)
Bassendean Complex-Central and South	SCP	87,476	23,533	26.90	3.60	23,529 (26.90%)
	City of Kwinana	4,678.84	1,743.46	37.26		1,740 (37.19%)
Herdsman Complex	SCP	9,665	3,081	31.88	1.17	3,080 (31.87%)
	City of Kwinana	579.45	282.06	48.68		281 (48.48%)

The Proposal will result in clearing of up to 96.20 ha of native vegetation. The remainder of the DE includes of non-native vegetation (47.98 ha) and cleared areas (76.91 ha, 34.79 %). Of native vegetation within the DE:

- 64.69 ha (67.25%) of native vegetation is in Good or better condition
- 28.13 ha (29.24%) of native vegetation is in Degraded or Degraded to Good condition
- 3.38 ha (3.51%) is in Completely Degraded or Cleared condition.

Assessment of the local scale impacts was determined using Department of Primary Industries and Regional Development (DPIRD) Native Vegetation Extent data (DPIRD-005) (GoWA 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 96.20 ha of native vegetation, the clearing of which would result in a reduction of up to 1.85% in the extent of native vegetation within the 5 km buffer, reducing the native vegetation remaining within 5 km of the Proposal to 5,084 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 41.65 ha of the Tuart woodlands and forests of the SCP TEC (EPBC Act: Critically Endangered) mapped as seven patches. Of these, patches TT06 and TT07 occur within/intersect Bush Forever sites.

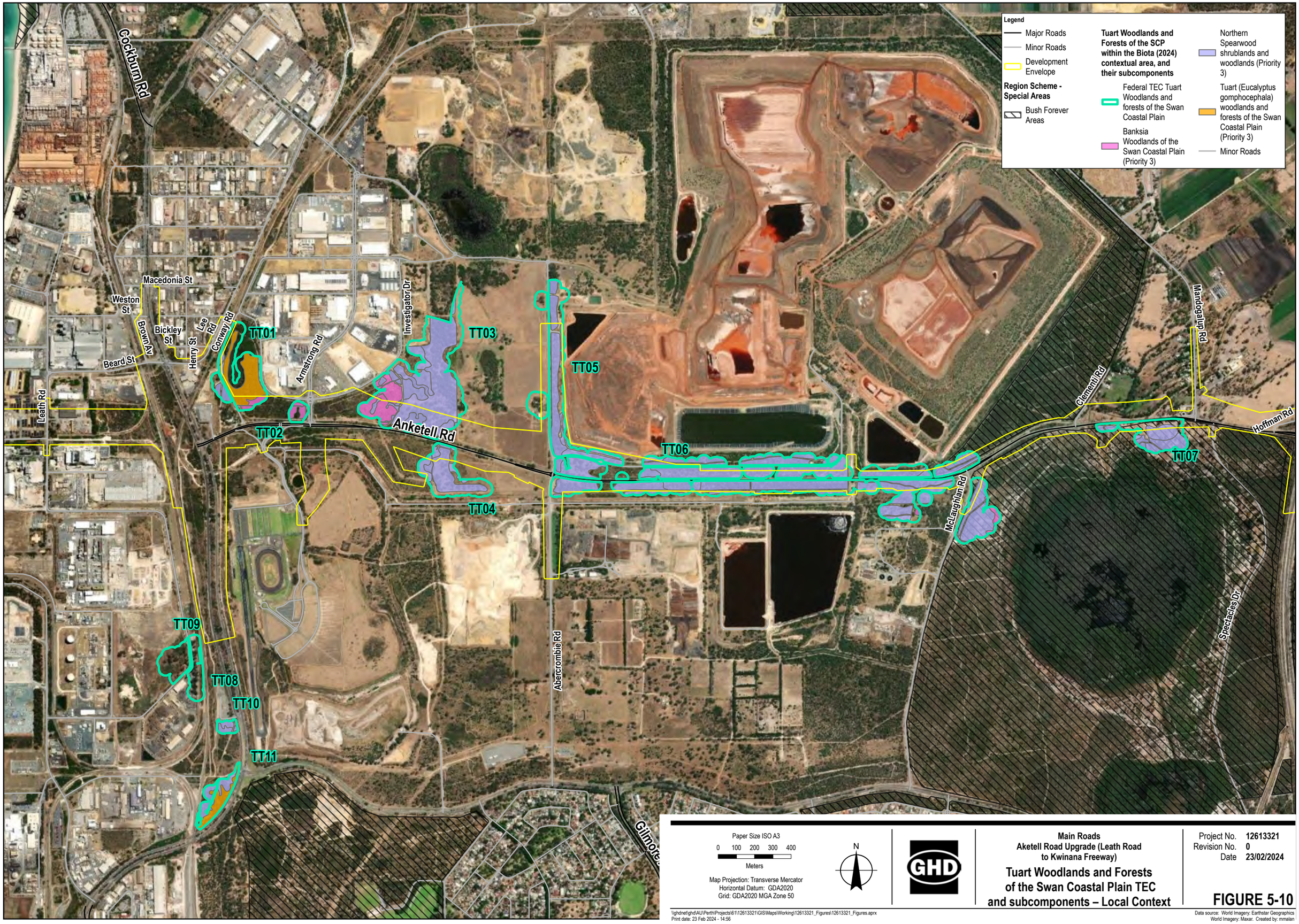
As shown in Table 5-7 and Figure 5-10, clearing will occur on the edges of most patches, except for patch TT02, which will be removed almost entirely. Post clearing, patches TT01, TT03, and TT04 will be greater than 5 ha and therefore meet the size threshold to be representative of the Tuart woodlands and forests of the SCP TEC. Patches TT05 and TT06 will be reduced in size but are still likely to meet the size and condition thresholds to remain a Tuart woodlands and forests of the SCP TEC patch. Patch TT07 will be less than 5 ha and is unlikely to meet size and condition thresholds and therefore will no longer represent Tuart woodlands and forests of the SCP TEC. Patches TT08, TT09, 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 5-7: 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) (%)	Condition rating	Comments
TT01	8.42	2.14 (25.42)	Very Good to Excellent to Cleared	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	1.03	0.98 (95.15)	Very Good to Excellent to Cleared	Majority of patch removed. No longer Tuart woodlands and forests of the SCP TEC patch.
TT03	29.40	6.04 (20.54)	Very Good to Excellent Cleared	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	6.34	1.00 (15.77)	Good to Very Good to Cleared	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	18.70	11.23 (60.05)	Good to Cleared	Clearing southern portion of patch. Patch split and size reduced to <5 ha. Remaining northern patch assessed by Biota (2024) and has moderate condition and meets biotic 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.

Patch ID	Size of patch (ha)	Extent within DE (ha) (%)	Condition rating	Comments
TT06	35.70	17.57 (49.22)	Very Good to Excellent to Cleared	Clearing bisects (fragments) patch. Remaining northern patch likely to meet size and condition thresholds. Remaining southern patch unlikely to meet size and condition thresholds. Part of existing patch remains Tuart woodlands and forests of the SCP TEC patch.
TT07	5.74	1.95 (33.97)	Good to Cleared	Clearing northern edge of patch. Patch size reduced to <5 ha. Remaining patch unlikely to meet size and condition thresholds. No longer Tuart woodlands and forests of the SCP TEC patch.
TT08	2.36	-	Degraded to Cleared	No impacted by Proposal. Will remain Tuart woodlands and forests of the SCP TEC patch.
TT09	2.75	-	Degraded to Cleared	
TT10	0.74	-	Very Good to Cleared	
TT11	3.03	-	Degraded to Cleared	


Legend
Major Roads
Minor Roads
Development Envelope
Region Scheme - Special Areas
Bush Forever Areas
Tuart Woodlands and Forests of the SCP within the Biota (2024) contextual area, and their subcomponents
Federal TEC Tuart Woodlands and forests of the Swan Coastal Plain
Banksia Woodlands of the Swan Coastal Plain (Priority 3)
Northern Spearwood shrublands and woodlands (Priority 3)
Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain (Priority 3)
Minor Roads
Cockburn Rd
Macedonia St
Weston St
Brown Av
Bickley St
Henry St
Lee Rd
Conway Rd
Beard St
Leath Rd
Armstrong Rd
Investigator Dr
Anketell Rd
TT01
TT02
TT03
TT04
TT05
TT06
TT07
TT08
TT09
TT10
TT11
Abercrombie Rd
McLaughlan Rd
Clementi Rd
Mandogalup Rd
Hoffman Rd
Spectacles Dr
Gilmore
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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)
Tuart Woodlands and Forests of the Swan Coastal Plain TEC and subcomponents – Local Context
Project No. 12613321
Revision No. 0
Date 23/02/2024
FIGURE 5-10
\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:56
Data source: World Imagery: Earthstar Geographics
World Imagery: Maxar. Created by: mmalan

Banksia woodlands of the Swan Coastal Plain ecological community TEC

The DE intersects 14.26 ha of the Banksia woodlands of the SCP TEC (EPBC Act: Endangered) mapped as 9 patches. Of these patches, four intersect Bush Forever sites. As shown in Table 5-8, 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 representative of the Banksia woodlands of the SCP TEC. Patch BT01 and BT07 will be reduced in size nearing the 2 ha extent, however, will likely meet condition thresholds to remain a Banksia woodlands of the SCP TEC patch.

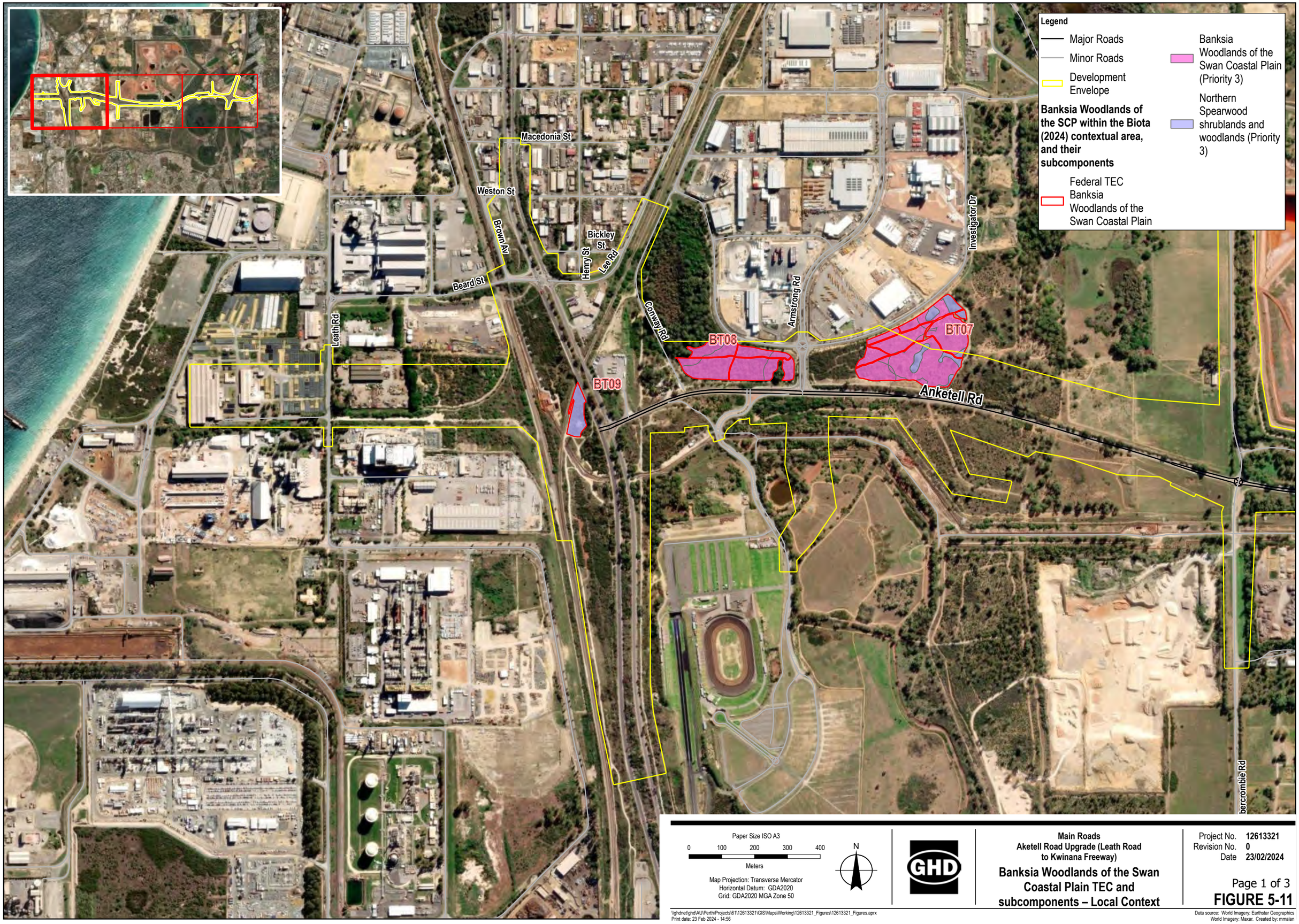
Clearing impacts to the Banksia woodlands of the SCP TEC patches mapped within the DE is detailed in Table 5-8 with the extent of the TEC mapped by Biota (2024) provided in Figure 5-11.

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 5-8: Clearing impacts to Banksia woodlands of the SCP TEC patches mapped within the DE

Patch ID	Size of patch (ha)	Extent within the DE (ha) (%)	Condition rating	Comments
BT01	2.2	0.19 (8.64)	Very Good	Clearing on edge of patch. Patch will meet size threshold and condition thresholds (>2 ha and Good condition) post clearing. Likely to remain Banksia woodlands of the SCP TEC patch.
BT02	4.9	2.06 (42.04)	Very Good	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	1.20 (1.58)	Very Good to Excellent	Intersects Bush Forever Site No. 270. 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	0.87 (2.66)	Very Good	Intersects Bush Forever Site No 269. 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	1.99 (1.25)	Good to Very Good	Intersects Bush Forever Site No 269 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.

Patch ID	Size of patch (ha)	Extent within the DE (ha) (%)	Condition rating	Comments
BT06	45.4	0.87 (1.92)	Very Good	Intersects Bush Forever Site No 268 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.
BT07	5.6	3.46 (61.71)	Very Good to Excellent	Clearing southern portion of patch. Patch likely to meet size threshold and condition thresholds (>2 ha and Good or better condition) post clearing. Likely to remain Banksia woodlands of the SCP TEC patch.
BT08	3.1	3.02 (97.42)	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	0.61 (100)	Good	Clearing patch. No longer Banksia woodlands of the SCP TEC patch.



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

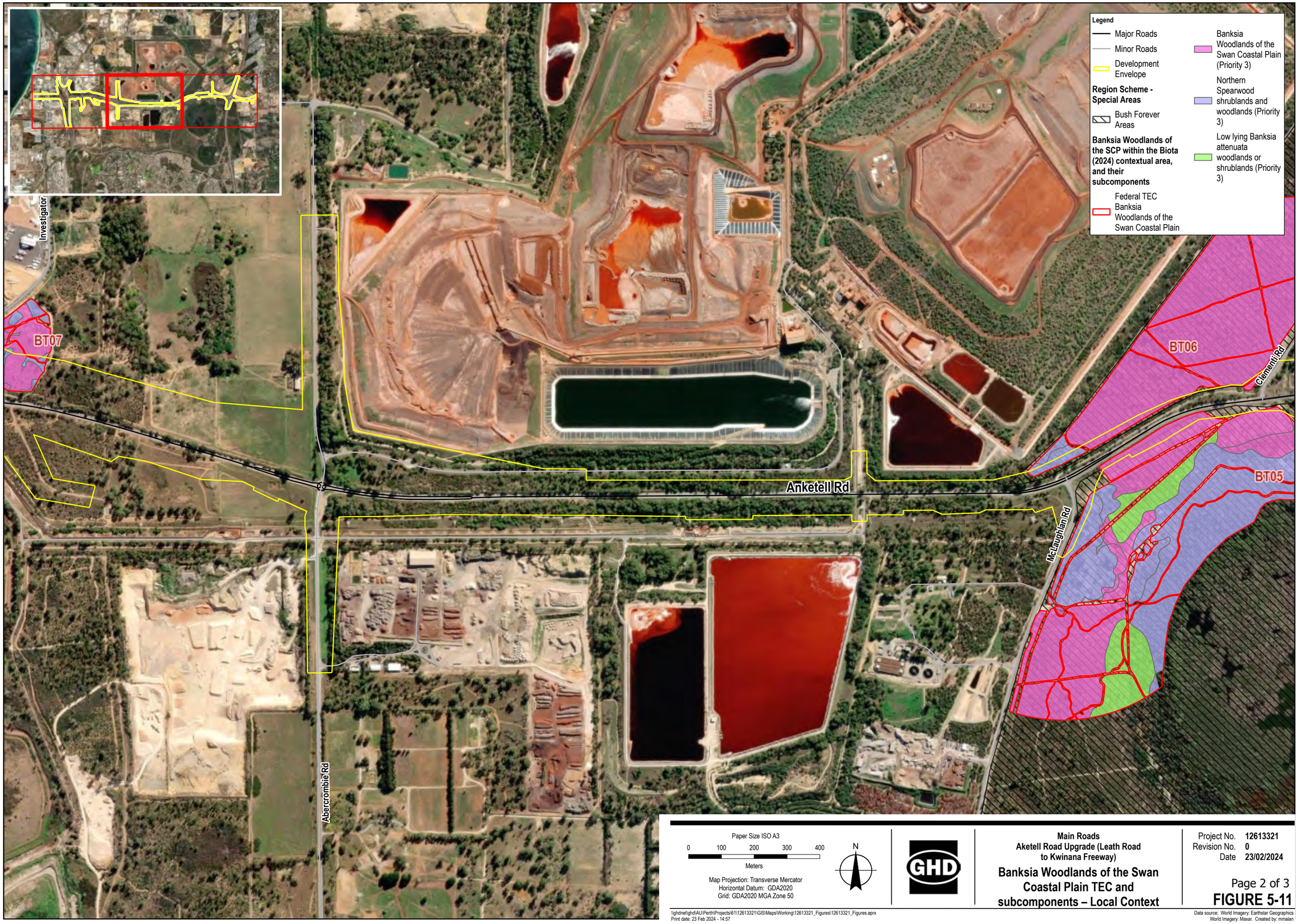
Banksia Woodlands of the Swan Coastal Plain TEC and subcomponents – Local Context

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-11

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:56

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

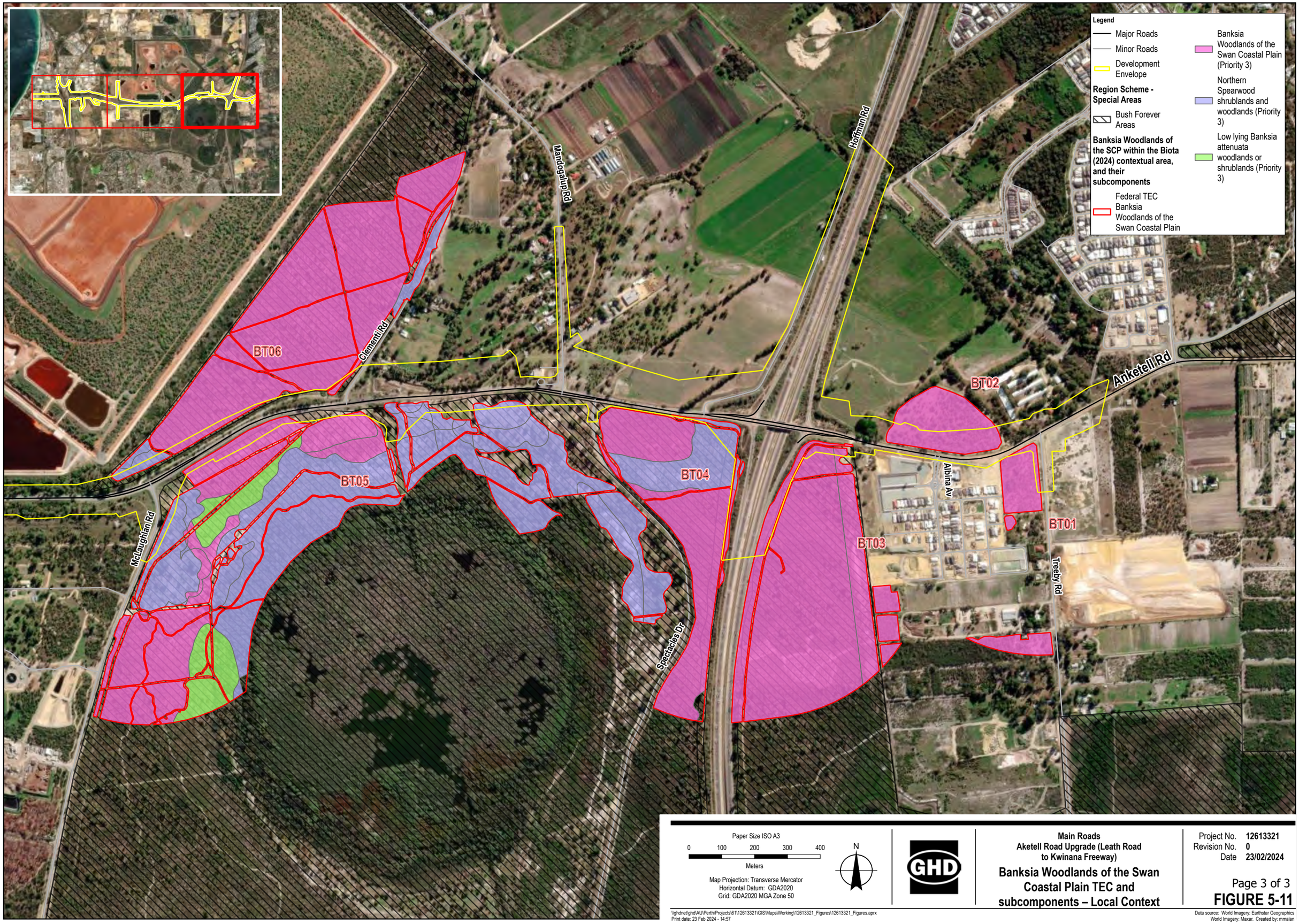
Banksia Woodlands of the Swan Coastal Plain TEC and subcomponents – Local Context

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 3
FIGURE 5-11

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:57

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Banksia Woodlands of the Swan Coastal Plain TEC and subcomponents – Local Context

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-11

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:57

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

Banksia woodlands of the Swan Coastal Plain PEC

The Proposal will result in the clearing of up to 15.67 ha of the Banksia woodlands of the SCP Priority 3 PEC, of which 15.27 ha (97.93%) is in Good or better condition. Approximately 11.17 ha of the PEC is associated with the 9 patches of the Commonwealth listed Banksia woodlands of the SCP TEC. Of the 15.67 ha of the Banksia Woodlands of the SCP PEC, 0.64 ha, 0.42 and 0.57 ha occur within Bush Forever site No.'s 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 66.24 ha of the Northern Spearwood shrublands and woodlands Priority 3 PEC, of which 44.62 ha (68.07%) is in Good or better condition. Approximately 3.08 ha of the PEC is associated with patches of the Commonwealth listed Banksia woodlands of the SCP TEC and 0.64 ha and 1.35 ha occurs within Bush Forever site No.'s 268 and 269 respectively. Clearing of FCT 24 will reduce the local and regional extent of this PEC. However, this impact is also not likely to result in the ecological community being listed as a threatened ecological community, and is also not considered a significant residual impact.

Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP PEC

The Proposal will result in the clearing of up to 0.49 ha of the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain PEC. All of this PEC within the DE is in Good condition and associated with the Commonwealth Tuart woodlands and forests of the SCP TEC. 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 is mapped within the boundary of unnamed MUW (UFI 6538). The Proposal avoids direct impacts on the REW (UFI 6379), which occurs approximately 45 m north east/east of the DE.

The DE also intersects part of Mandogalup Swamp South wetland, a MUW (UFI 6530); however, there is no native vegetation mapped in this area. 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 3.71 ha within Bush Forever sites and 0.55 ha in a Class A Conservation Reserve.

The DE intersects 7.11 ha of Bush Forever sites and the Proposal will clear:

- 1.28 ha of native vegetation in Good or Very Good to Excellent condition along the southern boundary of Bush Forever Site no. 268 (Mandogalup Road Bushland, Mandogalup)

- 1.93 ha of native vegetation ranging from Good to Very Good condition to Degraded to Good 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. Should land within the Conservation Reserve be required for the Proposal, it will need be excised from R 53313.

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 impacts:

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

Biota (2024) recorded single individuals of *P. moorokatta* from from the DE south of Anketell Road adjacent to the Kwinana Freeway. The species was recorded from vegetation type EB1. Based on data extracted from DBCA databases, *P. moorokatta* is recorded from 11 locations including north of Cataby (two collections from a rehabilitated mine site), Chandala Nature Reserve, Banksia Grove, Ellenbrook, Whiteman Park, Perth Airport Estate, Kings Park, Clifton Buffer Reserve in the City of Canning, Forrestdale Lake Restoration Site, Shirley Balla Swamp Reserve and on the slope of the Whicher Scarp. The total population size of *P. moorokatta* is estimated to be 2,565 individuals based on available data. Records show the species has not been previously identified within 5 km of the DE. The Proposal will remove one individual of *P. moorokatta* which represents a loss of approximately 0.04% of the total estimated population of the taxon. The clearing of one individual of the Priority 2 species *P. moorokatta* is unlikely to be significant given the species is known from the SCP across a range north of Cataby to near Bunbury. This impact is not considered a significant residual impact.

Hibbertia leptotheca was recorded from three quadrats within the DE, from vegetation types M2 and M4 located on a limestone ridge between Rockingham Road and the freight railway. The number of individuals was not recorded due to the unknown status of the collections made at the time of the sampling (Biota 2024). This species 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), frequency ranging from a couple to abundant,

and grows in sand over limestone in coastal heaths and thickets, usually dominated by species of Melaleuca and Acacia (Thiele 2019).

There are a total of 31 vouchered records of *Pimelea calcicola* at the WA Herbarium, 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). Nine opportunistic records of this species were made in the DE from vegetation types M6 and E7.

There are a total of 79 vouchered records of *Eucalyptus foecunda subsp. Foecunda* at the WA Herbarium, frequency ranging from infrequent to abundant and dominant, across WA (WA Herbarium 2024). *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. In addition, 38 opportunistic records, comprising a total of 149 individuals were also recorded within the DE.

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 5-7). 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 (2024) survey. 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. Established control methods for all Declared Pests and WoNS recorded within the DE will be outlined in the CEMP. 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. Dieback hygiene measures area will be outlined in the CEMP.

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, although the source of this is yet to be determined, and dewatering is likely to be required to install some road structures such as bridges and underpasses.

Impacts from construction dewatering, including localised groundwater drawdown, will be modelled and managed to ensure no impacts to adjacent native vegetation. Given no significant indirect hydrology impacts have been recorded for similar construction projects on coastal dunes, the Proposal is unlikely to have 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 (TSSC 2016b).

Main Roads will implement standard construction and operational controls to appropriately control the risk of fire in the CEMP. 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

Table 5-9 provides a summary of the Proposal's predicted significant residual impacts on flora and vegetation. Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate, and offset environmental impacts. In considering potential impacts to flora and vegetation, and the avoidance and mitigation measures proposed and the implementation of the environmental offsets, Main Roads considers the EPA objective for flora and vegetation will be met.

Table 5-9: Predicted significant residual impacts to flora and vegetation

Aspect	Summary of predicted significant residual impacts
Significant vegetation	Clearing of up to: – 41.65 ha of the Tuart woodlands and forests of the SCP TEC – 14.26 ha of the Banksia Woodlands of the SCP TEC – 3.71 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.

5.2 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 2021).

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 5-10. The results from the Biota (2024) assessment supersedes the results from Biota (2023 and 2022) assessments. The extent of fauna survey coverage is shown in Figure 5-1.

Table 5-10: Summary of fauna surveys previously conducted for the Proposal

Survey / Report	Details
Anketell Rd Upgrade – Consolidated Biological Report (Biota 2024)	Scope: Consolidation of biological surveys conducted prior to and during 2023, for the proposed Anketell Road Upgrade. The survey drew on relevant previous desktop and field survey results. Previous desktop results and surveys of Anketell Road (Biota 2022) and Westport Freight Road Additional Survey (Biota 2023). This report consolidates the previous 2020-2022 survey results and the winter to spring 2023 survey results, including additional surveys within the DE at Rockingham Road and west of Rockingham Road. It provides a comprehensive biological survey report for the entire DE. Survey dates: September 2023, in addition to the surveys completed by Biota (2023 and 2022).

Survey / Report	Details
	Survey area: Anketell Road Upgrade referral boundary, identified by spatial reference D23#1063971. The September 2023 surveys focused on those areas not covered by the Biota (2023) report.
Westport Freight Road Additional Biological Survey (draft) (Biota, 2023)	Scope: Targeted Black Cockatoo surveys and low intensity fauna survey along Thomas and Anketell Roads between Tonkin Highway, Oakford and Rockingham Road, Naval Base. Survey dates: September 2022. Survey area: The survey comprised an 18 km long and 320 m wide survey area (encompassing 132.82 ha of the DE) and a 500 m buffer contextual area (encompassing 66.27 ha of the DE). The remaining 22.01 ha of the DE were not covered by the survey or contextual area.
Anketell Road Planning Study Biological Survey (Biota, 2022)	Scope: Targeted Black Cockatoo surveys and low intensity significant fauna survey. The survey assessed the fauna habitat values of the DE. Survey dates: between October and November 2020. Survey area: The survey area encompassed the Anketell Road section of the DE and comprised a corridor approximately 13 km long and 300 m wide, centred on Anketell Road extending from the Melville-Mandurah Highway to Thomas Road.

5.2.3.2 Fauna habitat

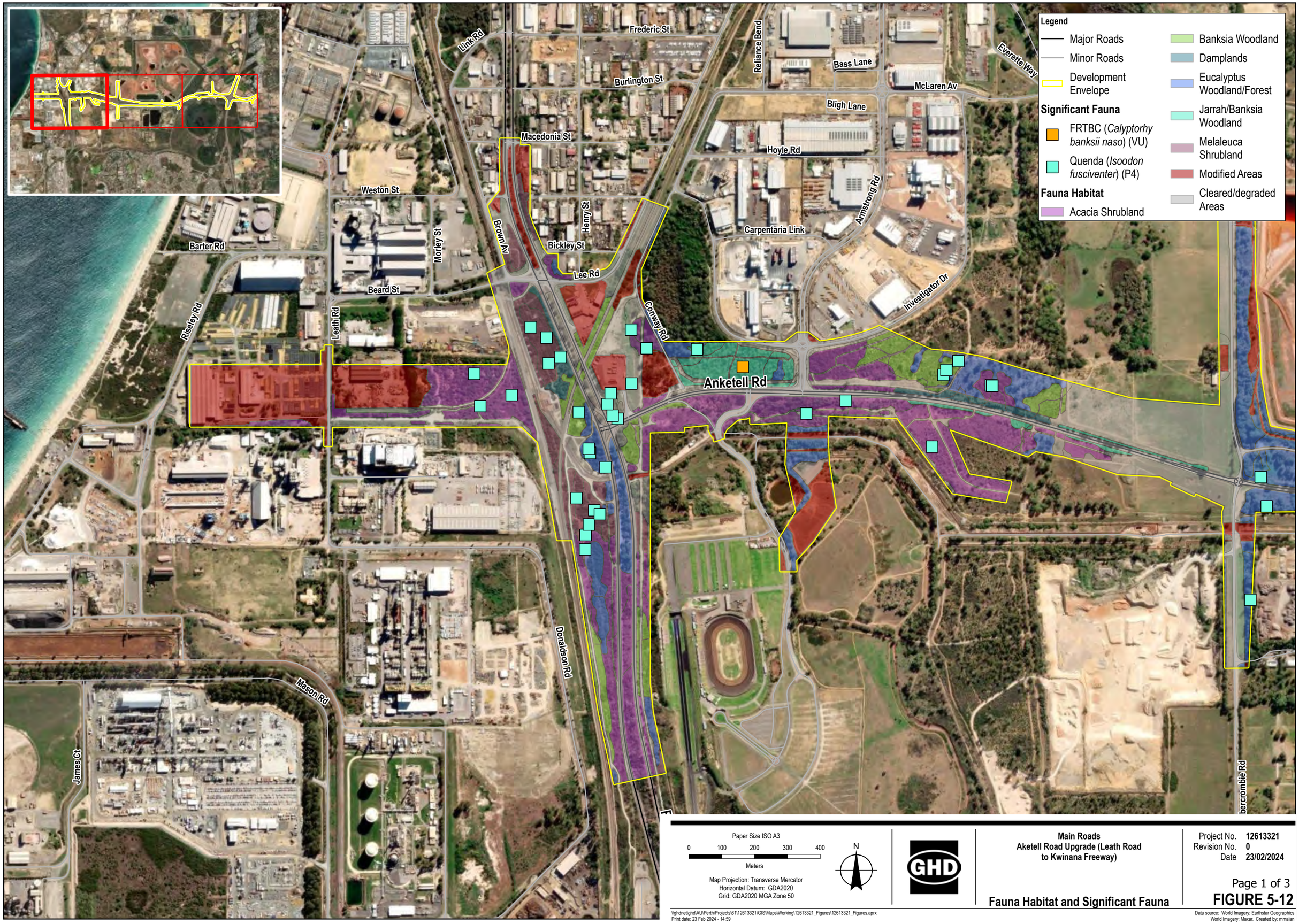
The DE contains seven fauna habitats (135.50 ha or 60.97% of the DE), comprising native (96.20 ha) and non-native/modified (39.30 ha) vegetation. The remainder of the DE comprised cleared and/or degraded areas (86.30 ha; 39.03%) (Biota 2024). A summary of fauna habitat types within the DE is presented in Table 5-11 and shown on Figure 5-12.

Table 5-11: 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.	27.88
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 and Chuditch (transitory basis only). Sandy soils are favourable for fossorial species. *Banksia* species provide foraging habitat for Black Cockatoos.	17.27

Fauna habitat type	Extent (ha) within the DE
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.	2.74
Eucalyptus Woodland/Forest (E1, E5, E6, E7) Landforms: Gentle undulating slopes. Substrate: Loamy sand soils. Vegetation*: Eucalyptus gomphocephala, E. decipens, 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.	34.59
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.	7.24
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.	6.49
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.	33.65
Sub-total fauna habitat	**135.50**

Fauna habitat type	Extent (ha) within the DE
Cleared/degraded areas (CL, D, RR)	85.59
Total	**221.09**



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

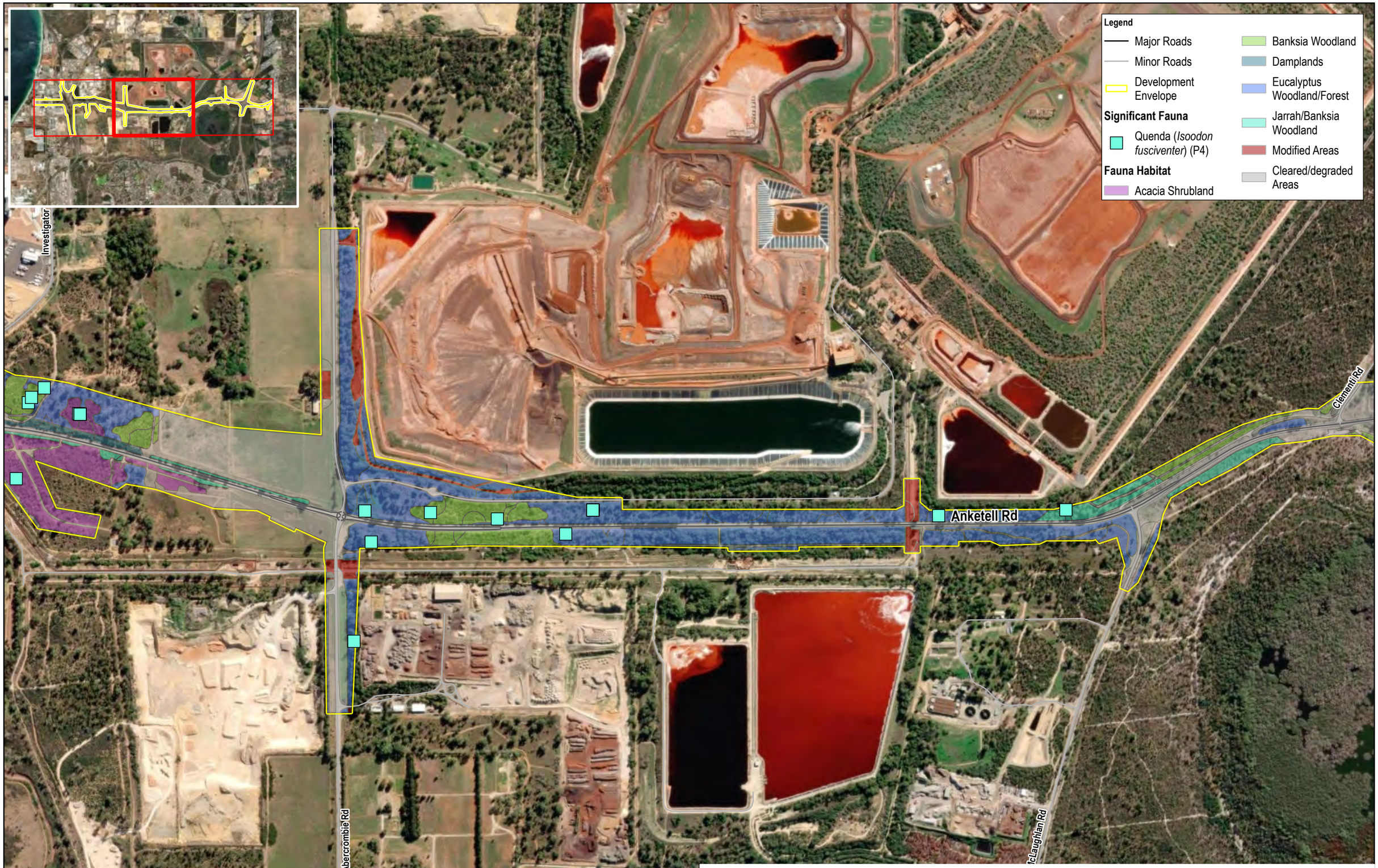
Fauna Habitat and Significant Fauna

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-12

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:59

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Fauna Habitat and Significant Fauna

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 3
FIGURE 5-12

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:59

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

Legend

- Major Roads
- Minor Roads
- Development Envelope

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
Clementi Rd
Hoffman Rd
Mornington Cr
Darling Ch
Turnix St
Cycad Rtt
Pixie Lane
Kenby Ch
Kentia Rd
Aquila Dr
Foxtail Gr
Tawny Lane
Waratah Way
De Haer Rd
Anketell Rd
Jarrah Cl
Collerson St
Bonney Rd
Narran St
Albina Av
Flannigan St
Seppings 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

N

GHD

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

Fauna Habitat and Significant Fauna

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-12

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 14:59

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

5.2.3.3 Fauna diversity

The Biota (2024) survey 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 2024).

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. Fifteen significant fauna species have been recorded within 5 km of the Biota (2024) survey area during previous surveys (Biota 2022, Biota 2023). Biota (2024) also included an assessment of the likelihood of occurrence of a short-tongued bee (*Neopasiphae simplicior*), despite previous records being more than 5 km away from the survey area as little is known about the species ecology and distribution.

Of the 20 significant fauna assessed, four have been recorded in the survey area as part of this survey or previous surveys, two are considered likely to occur in the survey area, and five may occur in the survey area. The remaining 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 the survey by Biota (2024) based on observation or evidence, these were:

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

For significant species potentially occurring, additional consideration of habitat availability and types within the survey area were considered by Biota (2024) 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 (2024), is provided in Table 5-12.

Table 5-12: Habitat classification in relation to significant fauna likelihood of occurrence assessment for the survey area (adapted from Biota (2024) Table 9.1)

Species	EPBC Act Status	Likelihood of Occurrence	Core habitat (Biota 2024)	Secondary habitat (Biota 2024)
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

Species	EPBC Act Status	Likelihood of Occurrence	Core habitat (Biota 2024)	Secondary habitat (Biota 2024)
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
Idiosoma sigillatum Swan Coastal Plain Shield–backed Trapdoor Spider	DBCA: Priority 3	May occur	Banksia Woodland Eucalyptus Woodland/ Forest Jarrah/Banksia Woodland	
Synemon gratiosa Graceful Sunmoth	DBCA: Priority 4	May occur	Acacia Shrubland Banksia Woodland	-
Dasyurus geoffroii Chuditch	EPBC Act: Vulnerable BC Act: Vulnerable	May occur (in transit)	-	Banksia Woodland Eucalyptus Woodland/ Forest Jarrah/Banksia Woodland
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 (2024) survey, no individuals from any of the three Black Cockatoo species were recorded within the survey. 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 Swan Coastal Plain, anywhere north of Rockingham, and in these more northerly areas, records generally occur at the eastern fringe of the Swan Coastal Plain (Johnstone et al. 2010, DAWE 2022). At the latitude of the survey area, Baudin's have rarely been recorded west of Byford (Biota 2024). Given this 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 Swan Coastal Plain (Johnstone et al. 2010, DAWE 2022). No Black Cockatoo breeding activity nor definitive evidence of breeding was observed within the DE during the Biota (2024) survey and the nearest breeding site recorded is more than 13.5 km away on the SCP (Biota 2024).

A total of 608 suitable DBH trees were recorded within the DE and assigned to a Category description. Of these, 18 trees contained 25 hollows that were considered potentially suitable for Black Cockatoo breeding. Hollow containing trees were assessed by Biota (2024) using a pole-mounted camera. No hollows were observed in use by Black Cockatoos during the Biota (2024) survey, nor were signs of use detected in any trees, noting that Black Cockatoos are not known to breed in the area. However, these suitable DBH trees with hollows have not been confirmed as potential breeding trees by a Black Cockatoo specialist.

One Tuart tree within the survey area was assessed as a Category 2 tree; feathers from an unknown species of bird were present within the hollow. Ten trees were assessed as Category 3 trees, that is: trees with suitable DBH with a potentially suitable hollow with no signs of use. The average DBH of trees within this category was 719 mm. Tree species with suitable hollows included Jarrah (n=5), Tuart (n=3), and dead stags (n=2). Four trees supported hollows from ground-level, appeared potentially suitable but could not be assessed further as all were infested by the European Bee. These trees have been precautionarily classified as Category 4, in the event that after the infestation passes, the hollows may become suitable for breeding. Three trees were classified as Category 5 trees as they had suitable DBH and appeared to have suitable hollows from ground level but could not be accessed with the pole-camera to determine suitability or if there were signs as use.

Sixteen trees of suitable DBH had hollows of unsuitable size, depth and/or orientation for black cockatoo breeding. Tree species were Jarrah (n=7), Tuart (n=8) and one unknown eucalypt (stag). An additional 574 trees were of a suitable DBH to form hollows but that did not currently have any hollows present. These

trees were predominantly Jarrah, Tuart and Flooded Gum with a diverse array of trees of other species in much smaller numbers including Marri, Wandoo, Karri and introduced eucalypt species, as well as stags.

Potential Black Cockatoo breeding trees are summarised in Table 5-13 and mapped in Figure 5-13.

Table 5-13: Summary of breeding habitat tree types within the survey area

Category Number	Category description	Number of trees in DE (hollow count)
1	Suitable DBH Tree with Known Nesting Hollows	0
2	Suitable DBH Tree with a potentially suitable hollow with signs of use (not confirmed)	1 (1)
3	Suitable DBH Tree with a suitable hollow with no signs of use (confirmed)	10 (14)
4	Suitable DBH Tree with a marginally unsuitable hollow with no signs of use (confirmed)	4 (6)
5	Suitable DBH Tree with a potential suitable hollow with no signs of use (not confirmed)	3 (4)
6	Suitable DBH Tree with unsuitable hollows (confirmed)	16 (19)
7	Suitable DBH Tree without hollows	574

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 2024).

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 2024). Figure 5-14 presents potential roosting sites and confirmed roosting sites from the Great Cocky Count (Peck et al., 2019). There are 17 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. This represents a roost site for Carnaby's Cockatoo and FRTBC first observed in 2010.

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 2024).

Foraging habitat

Foraging evidence for Carnaby's Cockatoo and FRTBC were recorded from the Biota (2024) and/or previous surveys throughout the DE. Foraging resources for Black Cockatoo species are available within the DE. A Habitat Quality Scoring (HQS) system was used for both Carnaby's Cockatoo and FRTBC, by calculating a site condition score for each vegetation unit described within the Biota (2024) survey area. This HQS has

been scored against secondary foraging habitat extents (of 2 - Low), and against core foraging habitat extents (of 4 - Moderate or greater) within the DE (Table 5-14).

There is 16.11 ha of core and 41.75 ha of secondary foraging habitat within the DE for Carnaby's Cockatoo. There is 7.24 ha of core and 31.55 ha of secondary foraging habitat within the DE for FRTBC.

Table 5-14: Vegetation units within the DE scored against foraging Habitat Quality Scoring for Black Cockatoo species (adapted from Biota (2024) Table 7.6)

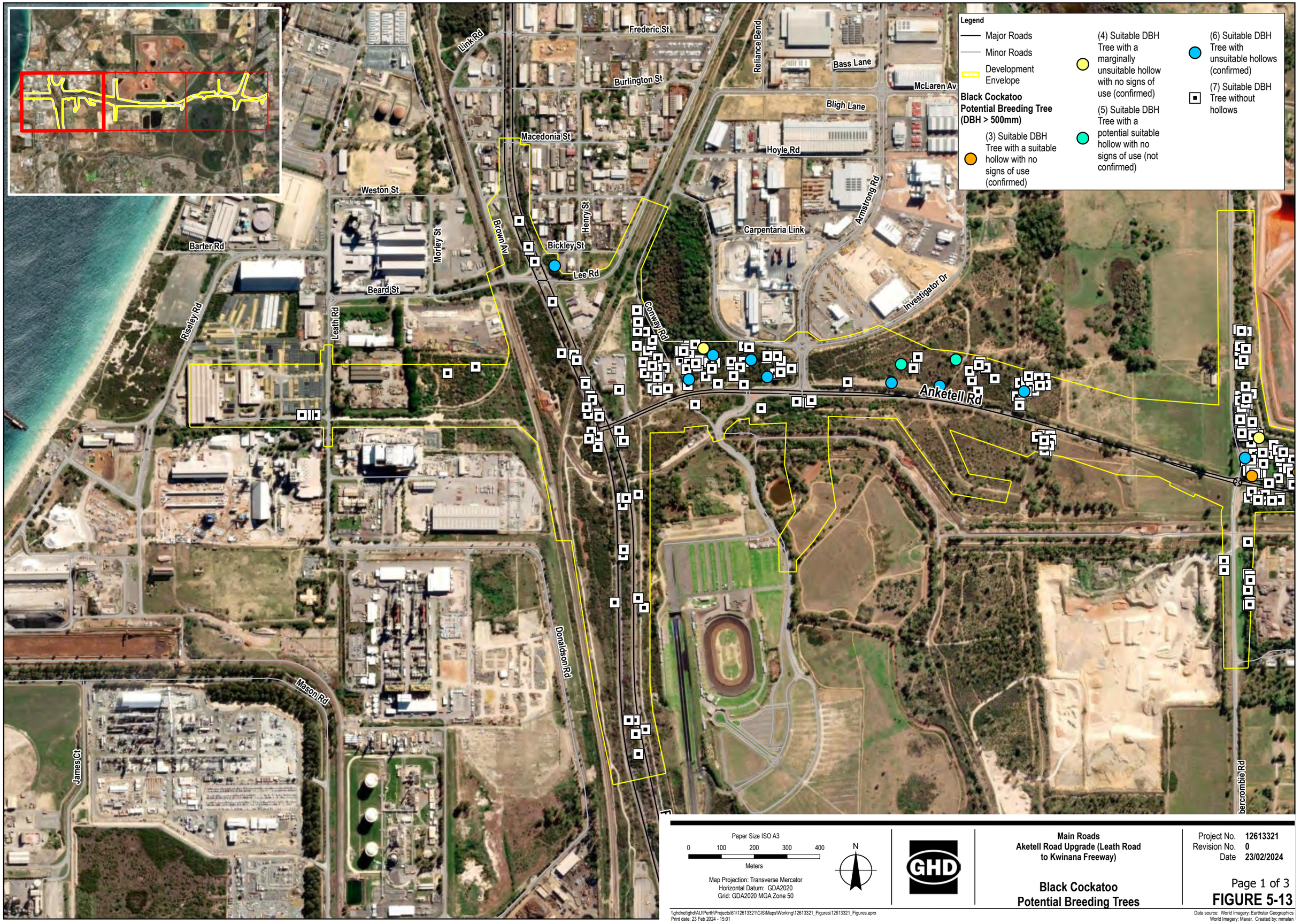
Vegetation Unit	Extent within DE (ha)	Carnaby's Cockatoo	FRTBC
B2	6.93	Core Habitat (4 - Moderate)	
B3	0.53	Core Habitat (4 - Moderate)	
B4	4.22	Secondary Habitat (2 - Low)	
B5	3.72	Secondary Habitat (2 - Low)	
B6	1.87	Secondary Habitat (2 - Low)	
E1	31.55	Secondary Habitat (2 - Low)	Secondary Habitat (2 - Low)
E5	0.39	Secondary Habitat (2 - Low)	
EB1	7.24	Core Habitat (7 - Very High)	Core Habitat (7 - Very High)
R3	1.41	Core Habitat (4 - Moderate)	
Total (ha)		**16.11 ha Core Habitat** **41.75 ha Secondary Habitat**	**7.24 ha Core Habitat** **31.55 ha Secondary Habitat**

Areas of the *Banksia* Woodland habitat, and smaller areas of Jarrah/Banksia woodland habitat, represent potential core foraging habitat for Carnaby's Cockatoo in particular (Biota 2024). Although it is noted the general lack of Marri within the EB1 complex is likely to reduce foraging quality, particularly for Carnaby's Cockatoo for which Jarrah is of much lower foraging preference than Marri, however the additional presence of Banksia contributes to quality. For the FRTBC, Jarrah represents a primary food resource.

The extents of Carnaby's Cockatoo foraging habitat within the DE is shown on Figure 5-15 and the extents of FRTBC foraging habitat within the DE is shown on Figure 5-16.

The Proposal is surrounded by approximately 12,214 ha of potential Black Cockatoo foraging habitat within a 12 km radius of the DE (GoWA 2023), mapped in Figure 5-16. Of the 12,214 ha of potential Black Cockatoo foraging habitat mapped within 12 km of the DE, 6,209 ha (50.83%) lies within reserved lands (in Bush Forever and/or DBCA managed lands).

Additionally, a single site context score for all Black Cockatoo species was calculated by Biota (2024) based on the proximity of known breeding areas or quality foraging resources. A single context score of 3 was reached for both Carnaby's Cockatoo and FRTBC, due to the proximity of quality foraging habitat (greater than a score of 3) within 12 km of the survey site (Biota 2024). The nearest known breeding locality is 6 – 12 km east of the survey area on the Darling Scarp (Biota 2024).



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

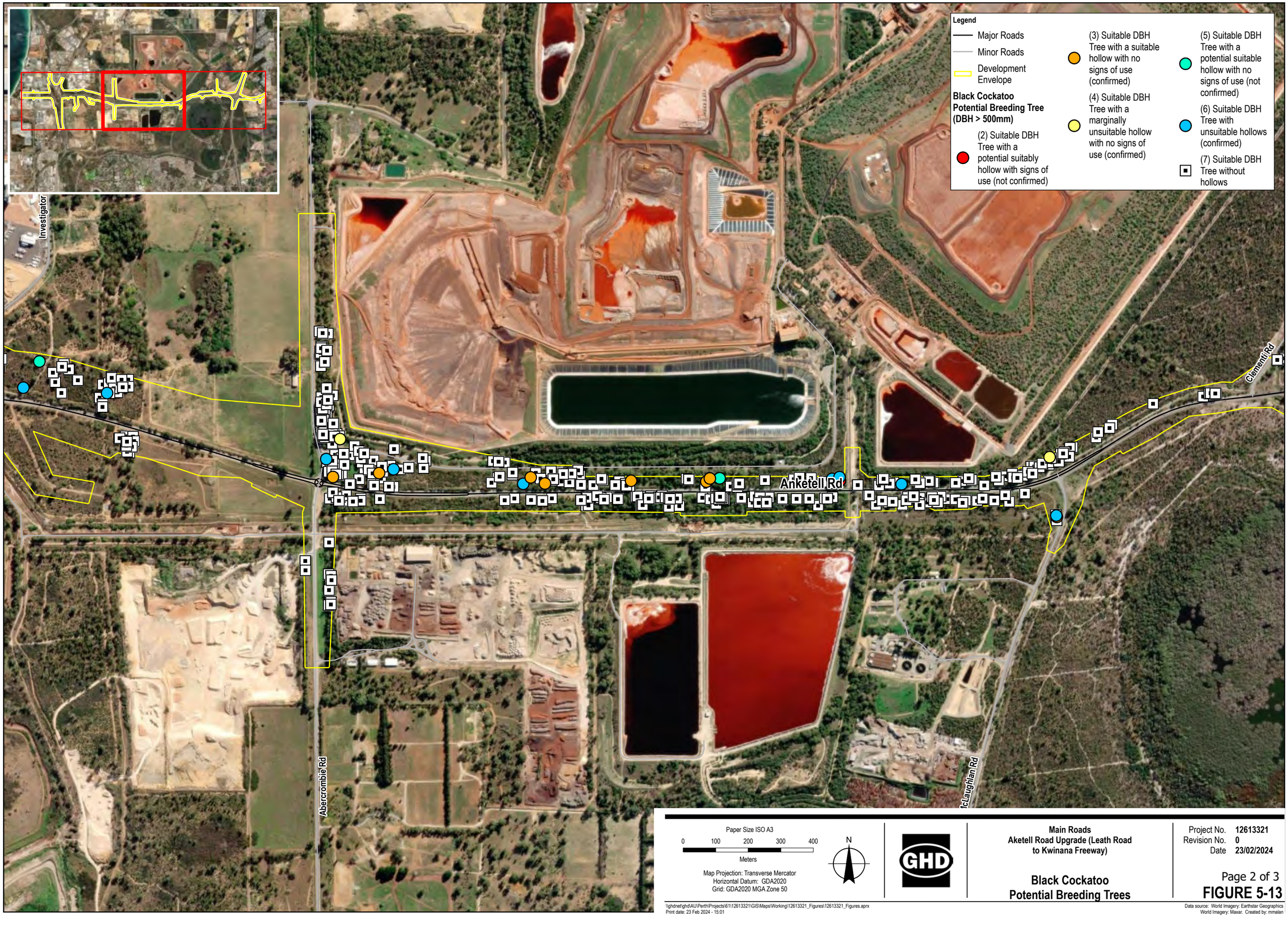
Black Cockatoo Potential Breeding Trees

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-13

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:01

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

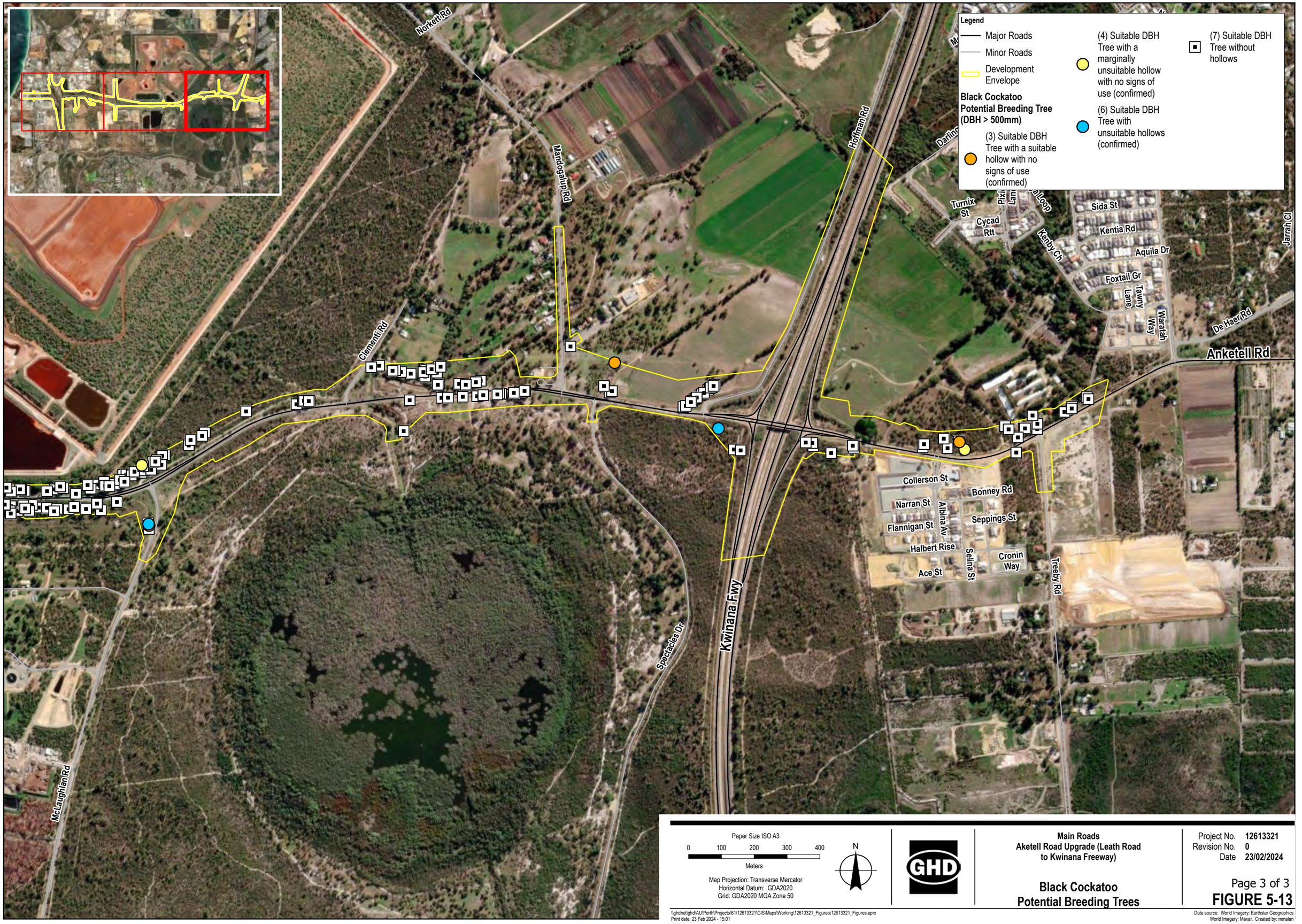
Black Cockatoo Potential Breeding Trees

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 3
FIGURE 5-13

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:01

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

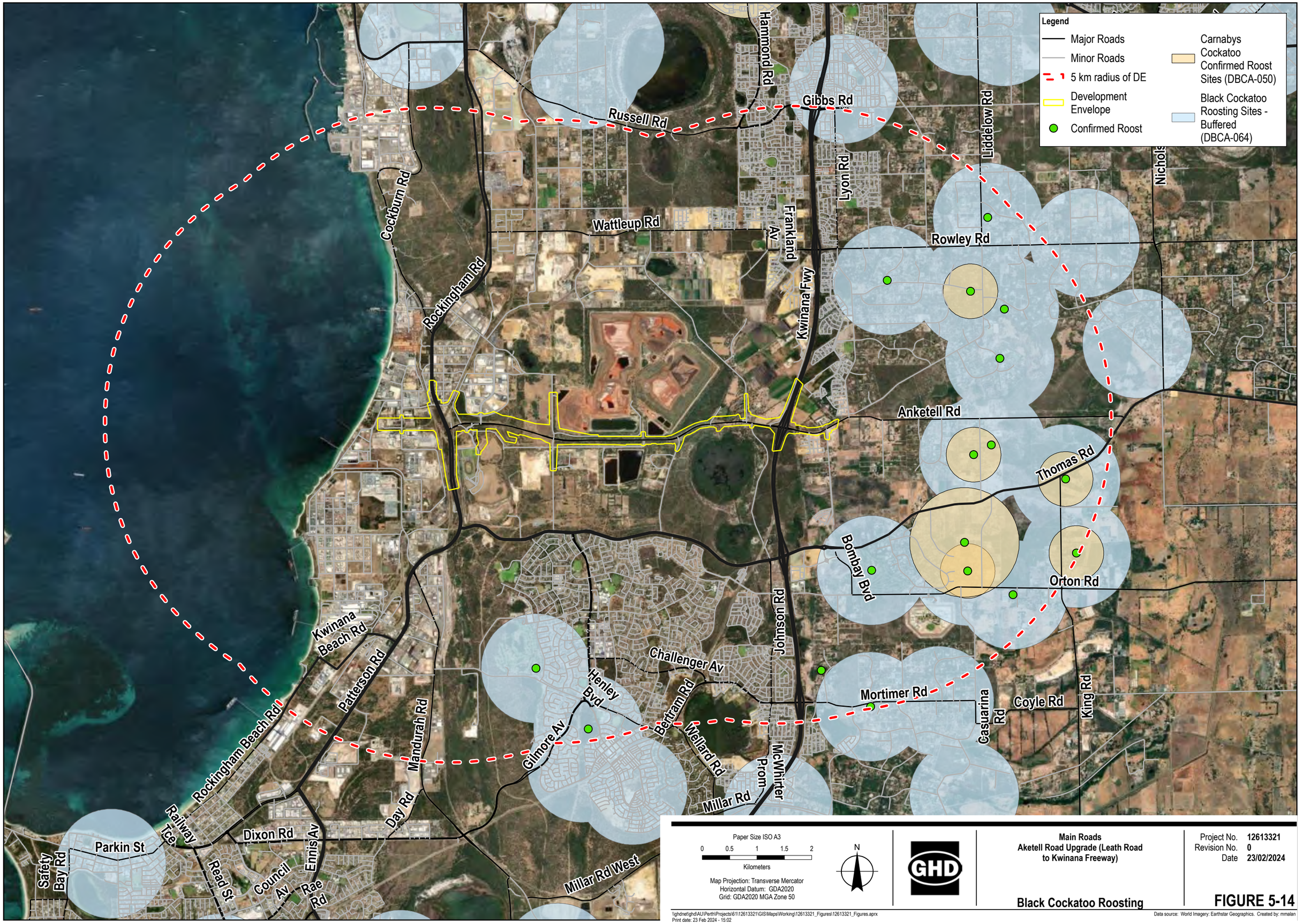
Black Cockatoo Potential Breeding Trees

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-13

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:01

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



Paper Size ISO A3

0 0.5 1 1.5 2

Kilometers

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

N

GHD

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

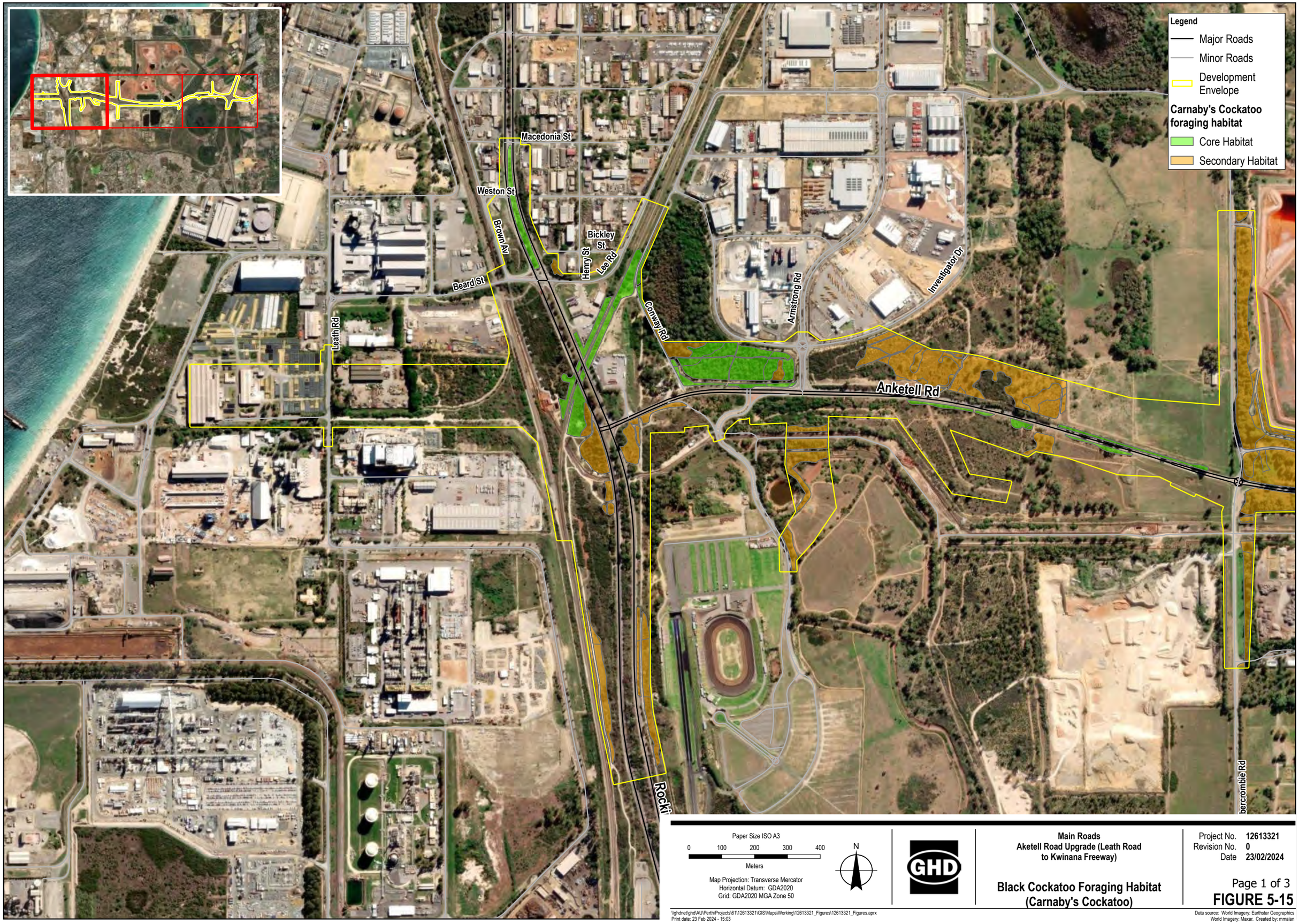
Black Cockatoo Roosting

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-14

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:02

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

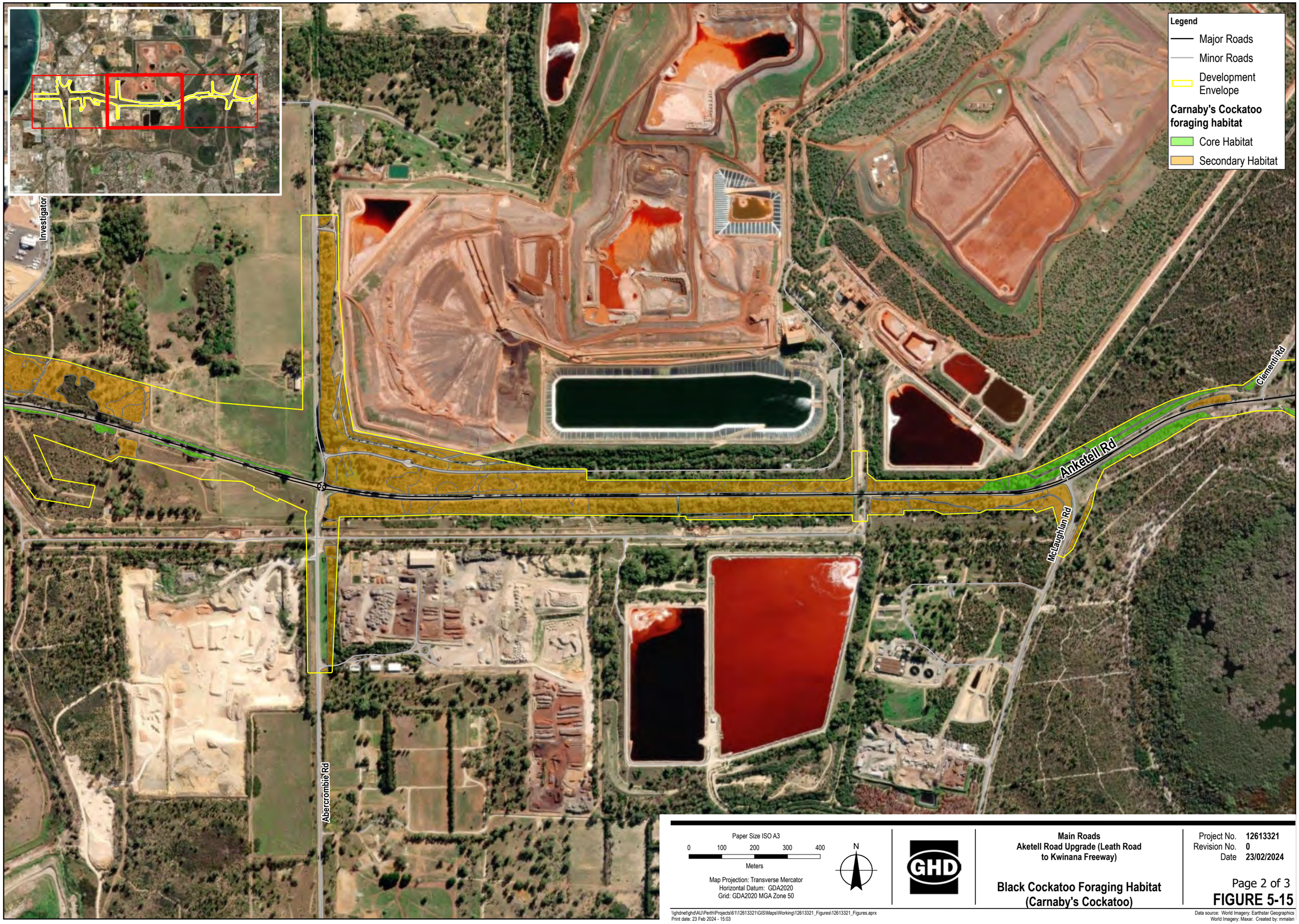
Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-15

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

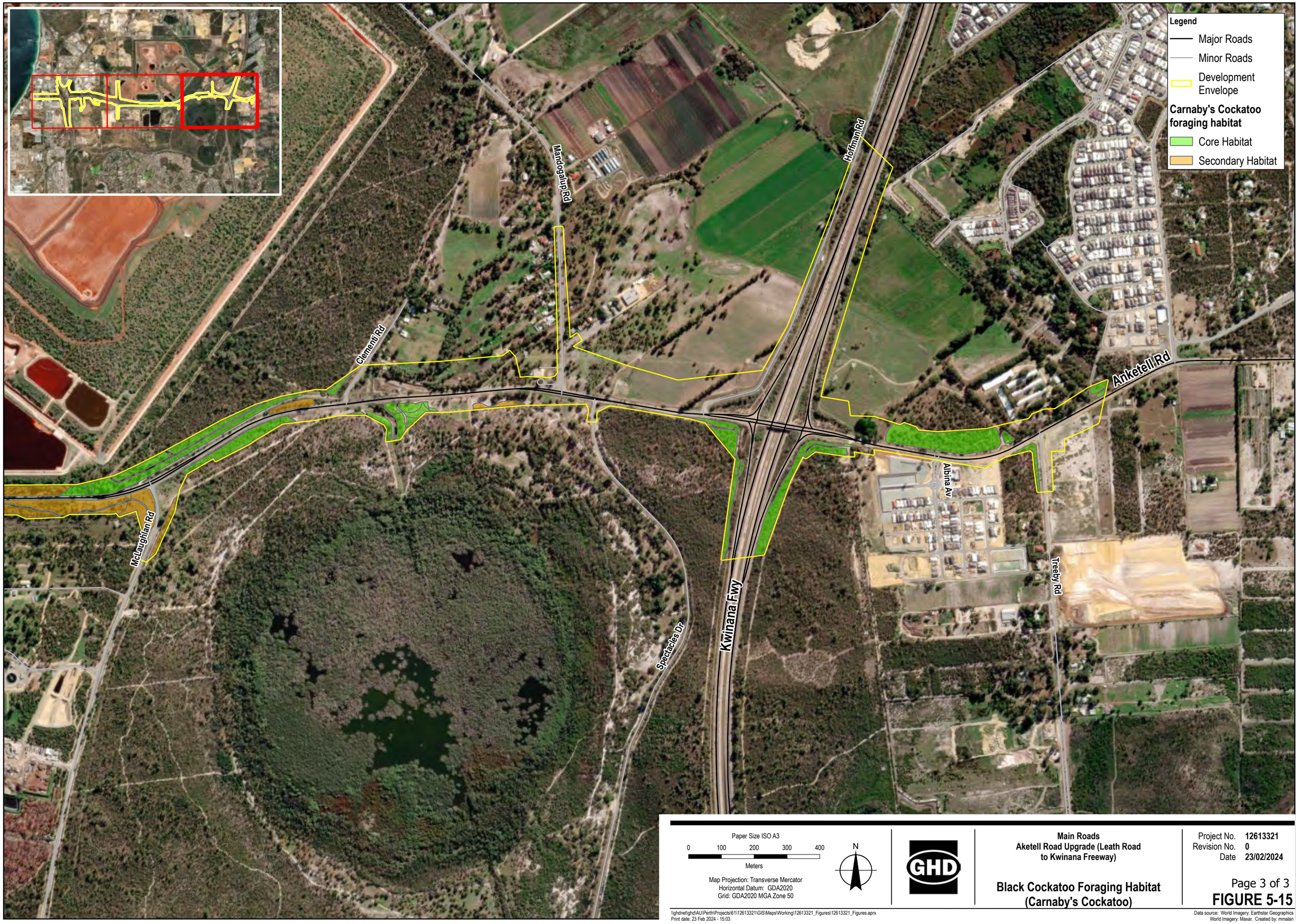
Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-15

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

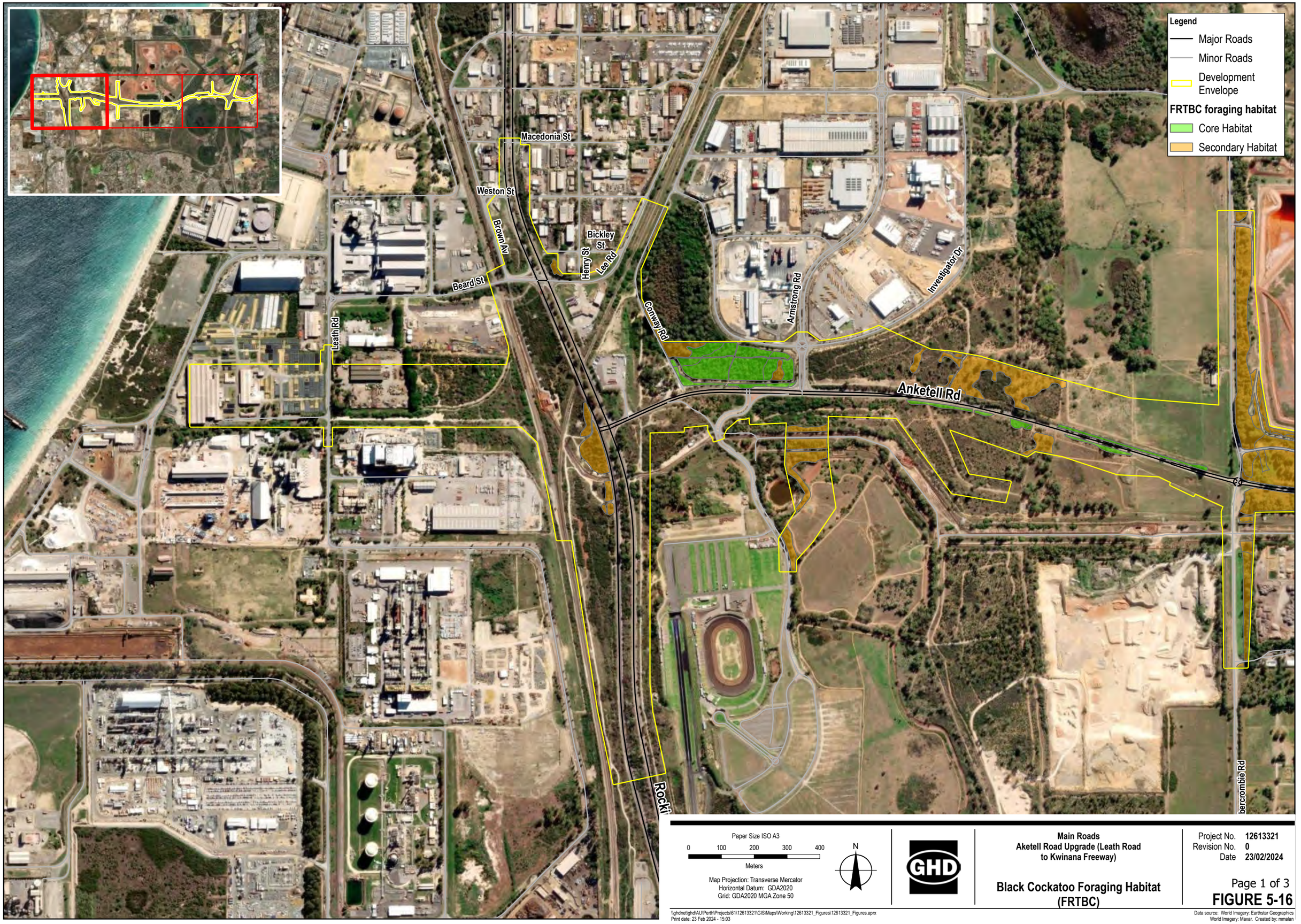
Black Cockatoo Foraging Habitat (Carnaby's Cockatoo)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-15

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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



Paper Size ISO A3

0 100 200 300 400

Meters

N

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

GHD

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

Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-16

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

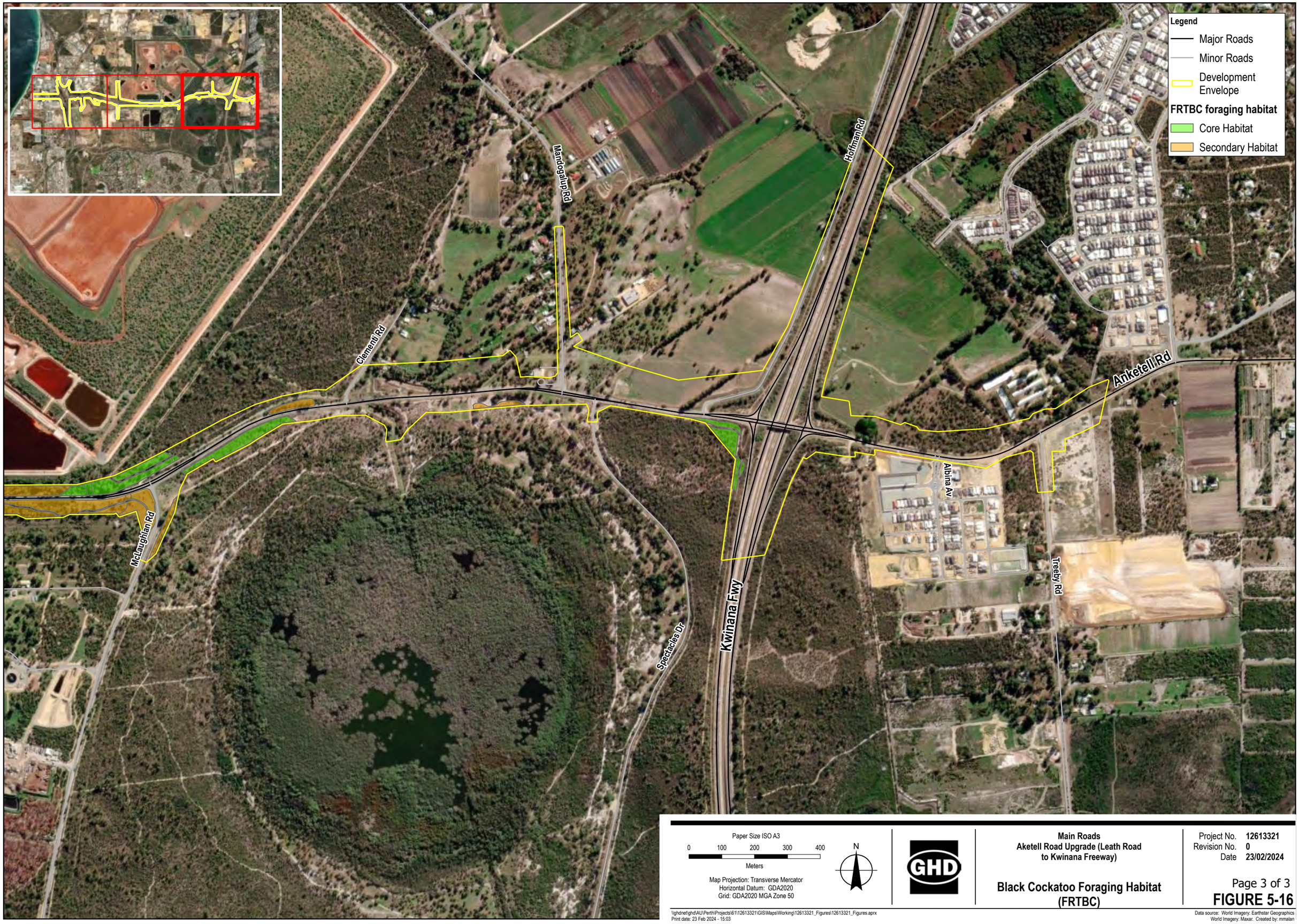
Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-16

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

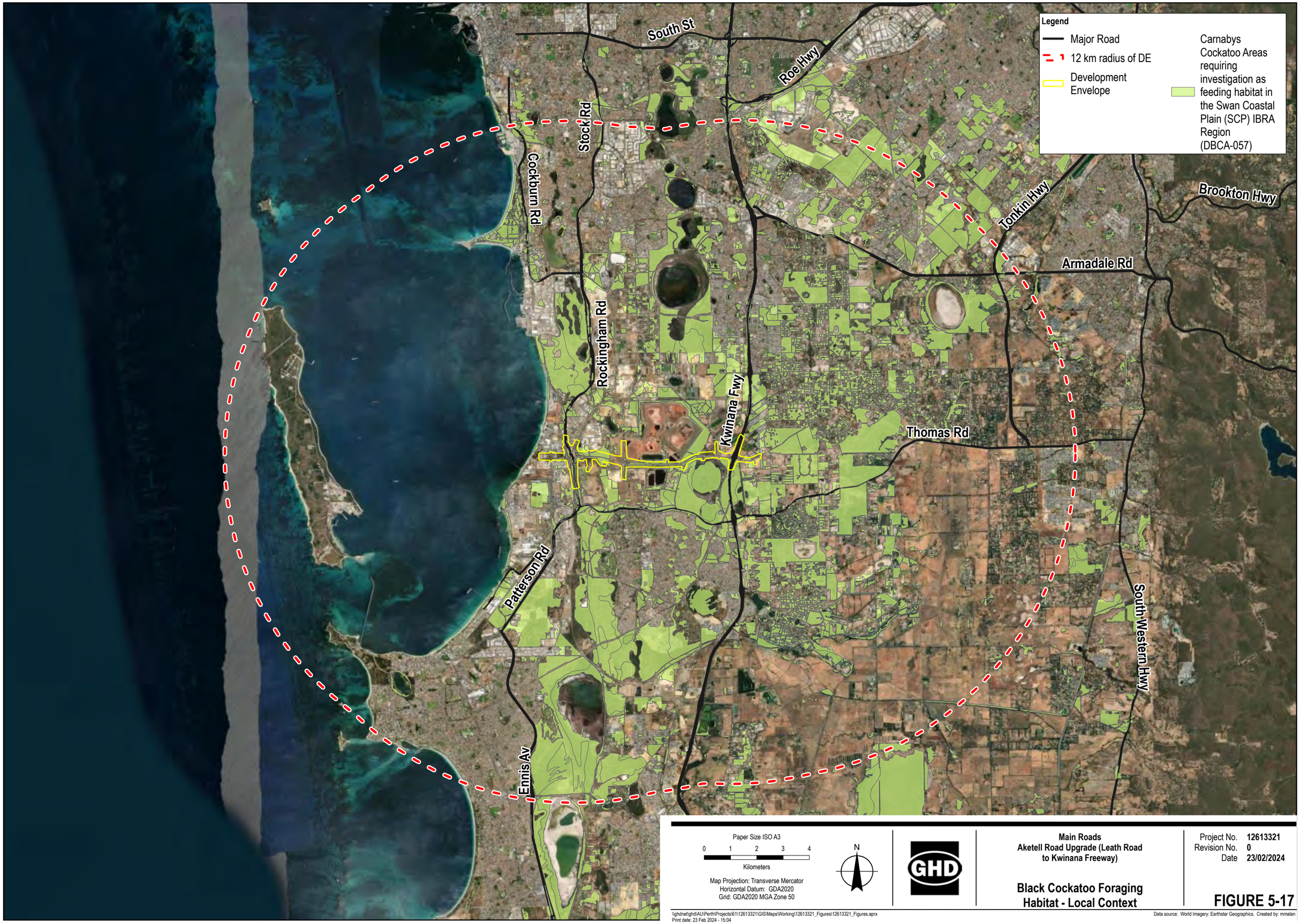
Black Cockatoo Foraging Habitat (FRTBC)

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-16

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:03

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



Paper Size ISO A3

0 1 2 3 4

Kilometers

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

N

GHD

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

Black Cockatoo Foraging Habitat - Local Context

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-17

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:04

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

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 2024). It also favours sandy substrates to allow for digging up food, and often occurs in association with wetland areas (van Dyck and Strahan 2008).

The Quenda were recorded via motion camera, digging, tracks and scats throughout the survey area (Biota 2024). Between 1990 and 2016 there have been numerous records of the species within the Biota (2024) study area and survey area, in addition to the sightings and diggings recorded in the current survey. Although Quenda inhabit a variety of habitats they were primarily recorded in the Beeliar Regional Park, Jandakot Regional Park and Wandi Nature Reserve within Banksia woodland or Jarrah/Banksia woodland.

There is 96.21 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 5-18.

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 2024).

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 2024). There is 45.15 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 2024).

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 45.15 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 2024).

All fauna habitats (221.09) within the DE represent secondary habitat for the Peregrin Falcon.

5.2.3.4.6 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). Burrows have been found on the sandy soils of Banksia woodlands and heathland (Rix et al. 2018).

Swan Coastal Plain Shield-backed Trapdoor Spider may occur in the survey area. The Biota (2024) desktop assessment returned four records from the study area (DBCA and 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 (59.10 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.

5.2.3.4.7 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 2024).

Graceful Sunmoth may occur in the survey area. The desktop returned six records, recorded between 1948 and 2011. The eldest record occurs in the contextual area. There is 45.15 ha of core habitat for the Graceful Sunmoth present in the DE in fauna habitat type Banksia Woodland and Acacia Shrubland. Both known host plant species *Lomandra hermaphrodita* and *L. maritima* were recorded within the survey area.

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).

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 at The Spectacles, located south adjacent the eastern extent of the DE. As such, Biota (2024) 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 The Spectacles. The Chuditch is considered unlikely to occur in the survey area west of freeway due to the prevalence of highly modified and cleared areas between suitable habitat fragments (Biota 2024). 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.

There is 59.10 ha of secondary habitat for the Chuditch present in the DE (Figure 5-19). Eucalypt Woodland/Forest represented particularly favourable habitat for this species while Banksia Woodland and Jarrah/Banksia Woodland represent habitat also (Biota 2024). Whilst the Eucalypt Woodland/Forest habitat with in the DE is geographically constrained and isolated, there is potential for the species to occur on a secondary transitory basis, and it may represent a linkage to larger habitat areas particularly in reserves adjacent the survey area (Biota 2024).

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 Swan Coastal Plain are limited, the species is far more common in the better wooded Jarrah and Warren regions (NatureMap records). 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 during the Anketell Road Biological survey (Biota 2022).

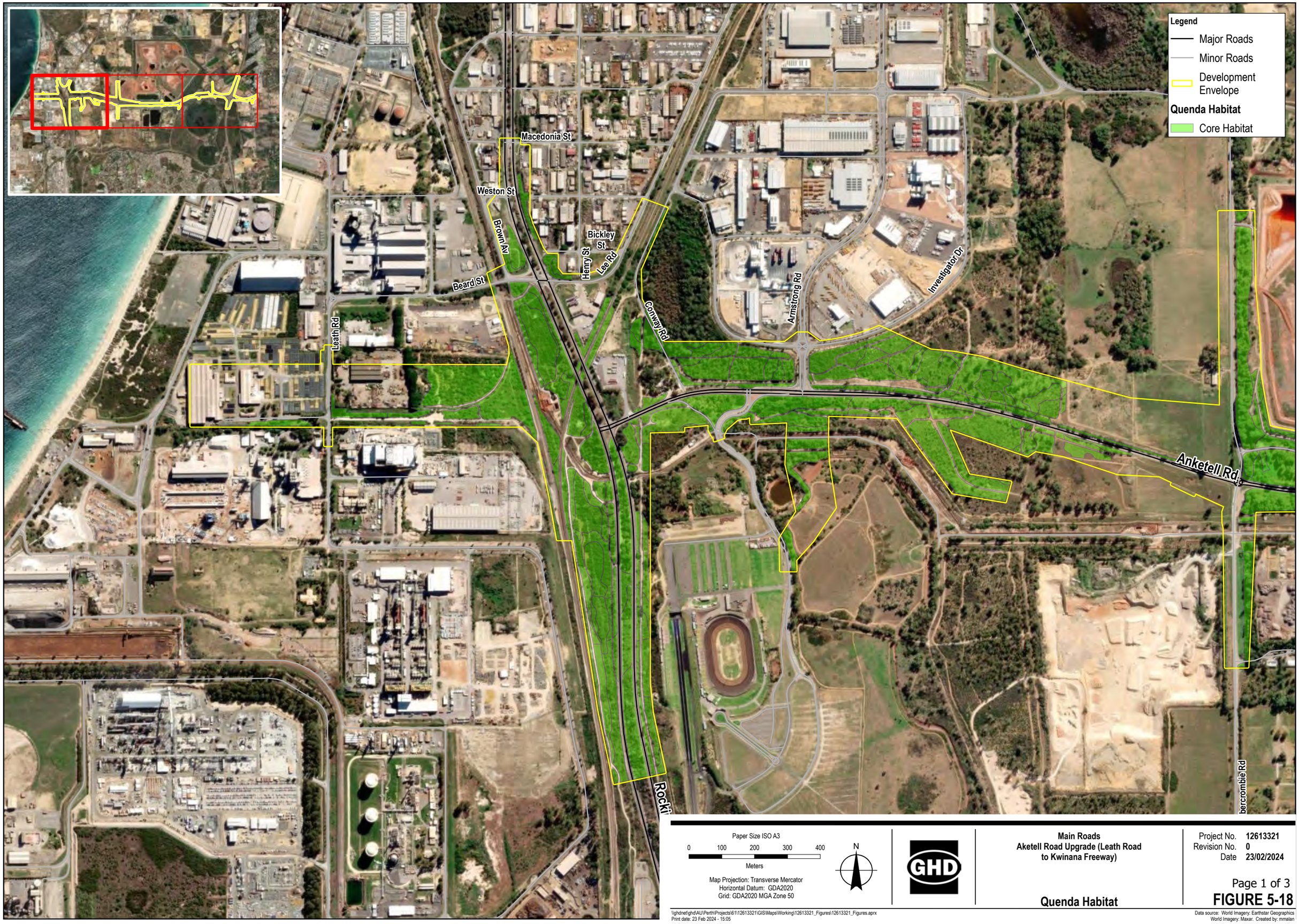
The species may occur in the DE based on the presence of 17.27 ha of suitable secondary Banksia Woodland habitat and a small number of local records. However, given the fragmented nature of the habitat within and surrounding the DE, and the presence of the Kwinana Freeway representing a barrier to the better wooded areas east of the freeway, it is considered unlikely to occur in the 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 The Spectacles reserve.

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 some suitable habitat, particularly adjacent to the DE and the highly mobile nature of the species it is considered to have some potential for occurrence.

The Damplands and Modified areas are secondary habitat, with an extent of 36.39 ha in the DE.



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

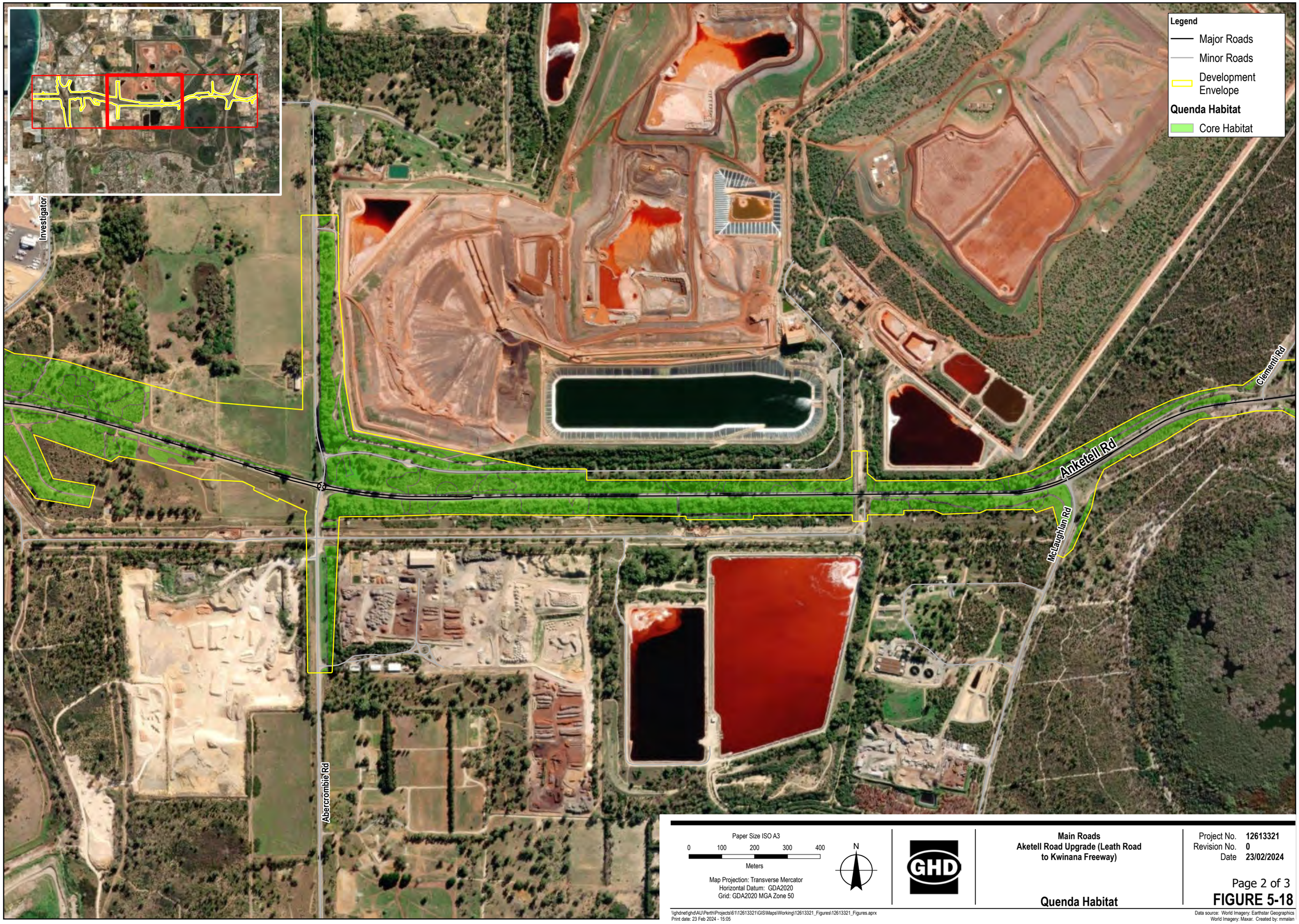
Quenda Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-18

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:05

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Quenda Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 3
FIGURE 5-18

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:05

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

Legend
- Major Roads
- Minor Roads
- Development Envelope

Quenda Habitat
- Core Habitat

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

N

GHD

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

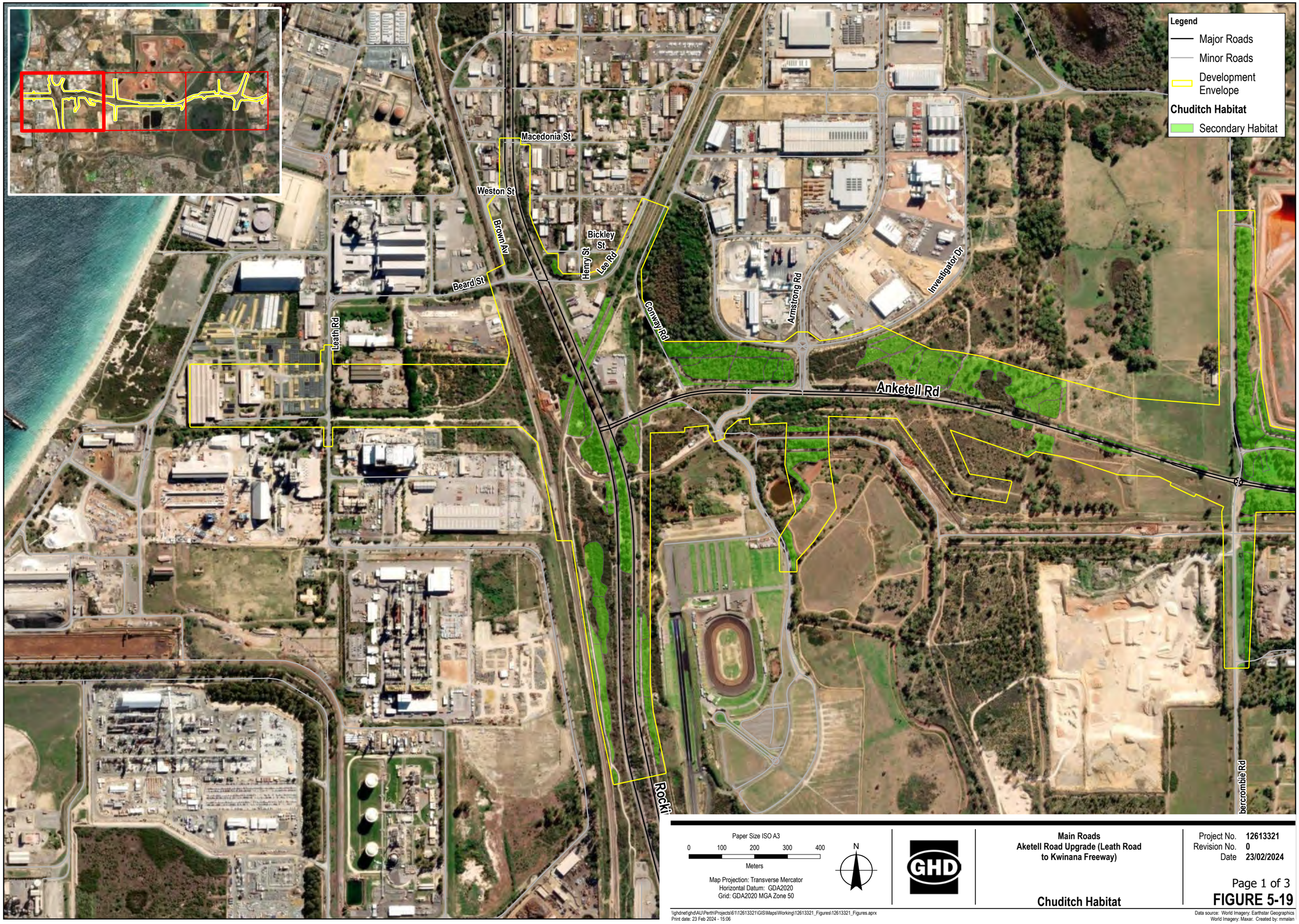
Quenda Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-18

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:05

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



Paper Size ISO A3

0 100 200 300 400

Meters

N

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

GHD

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

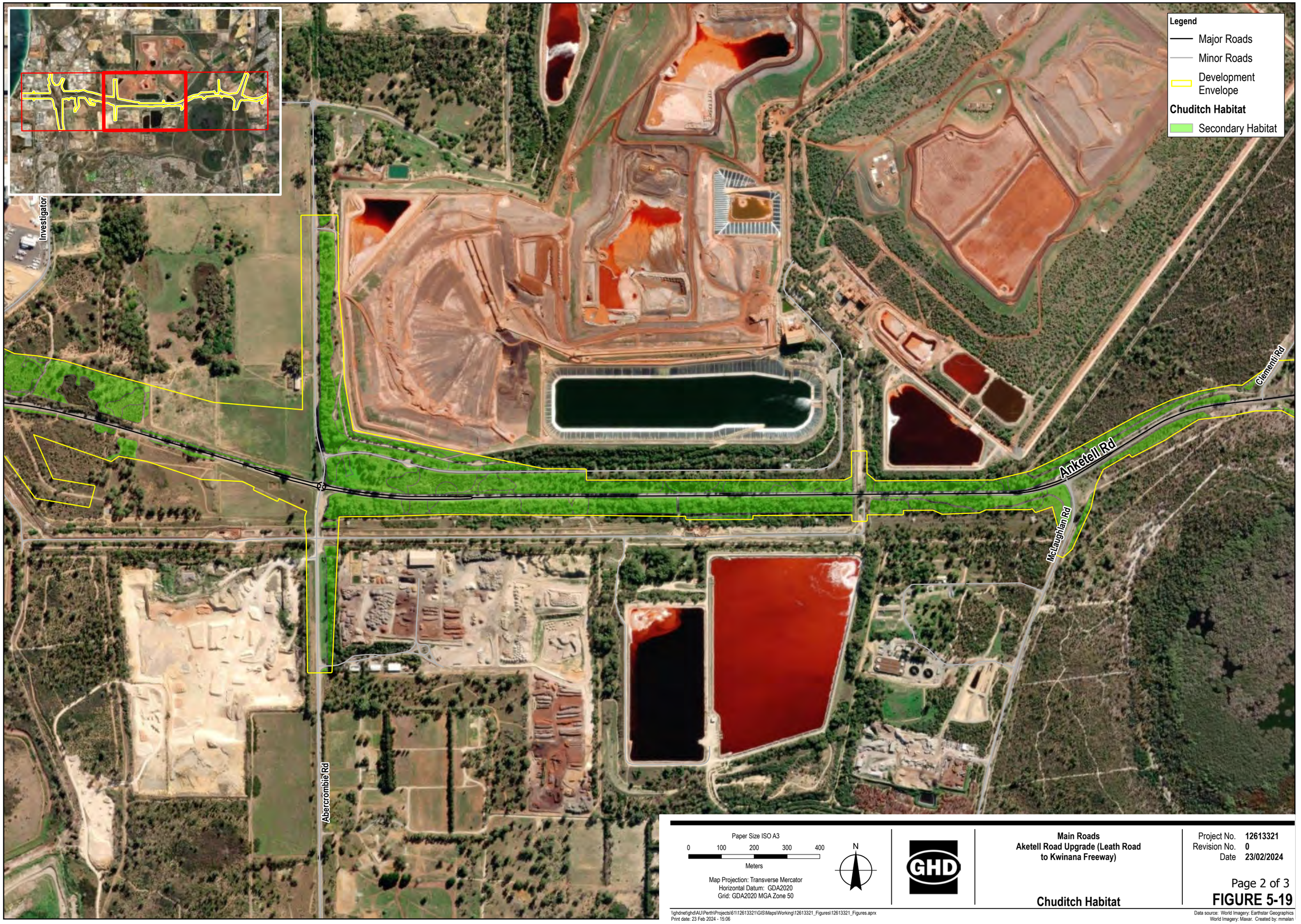
Chuditch Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-19

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:06

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

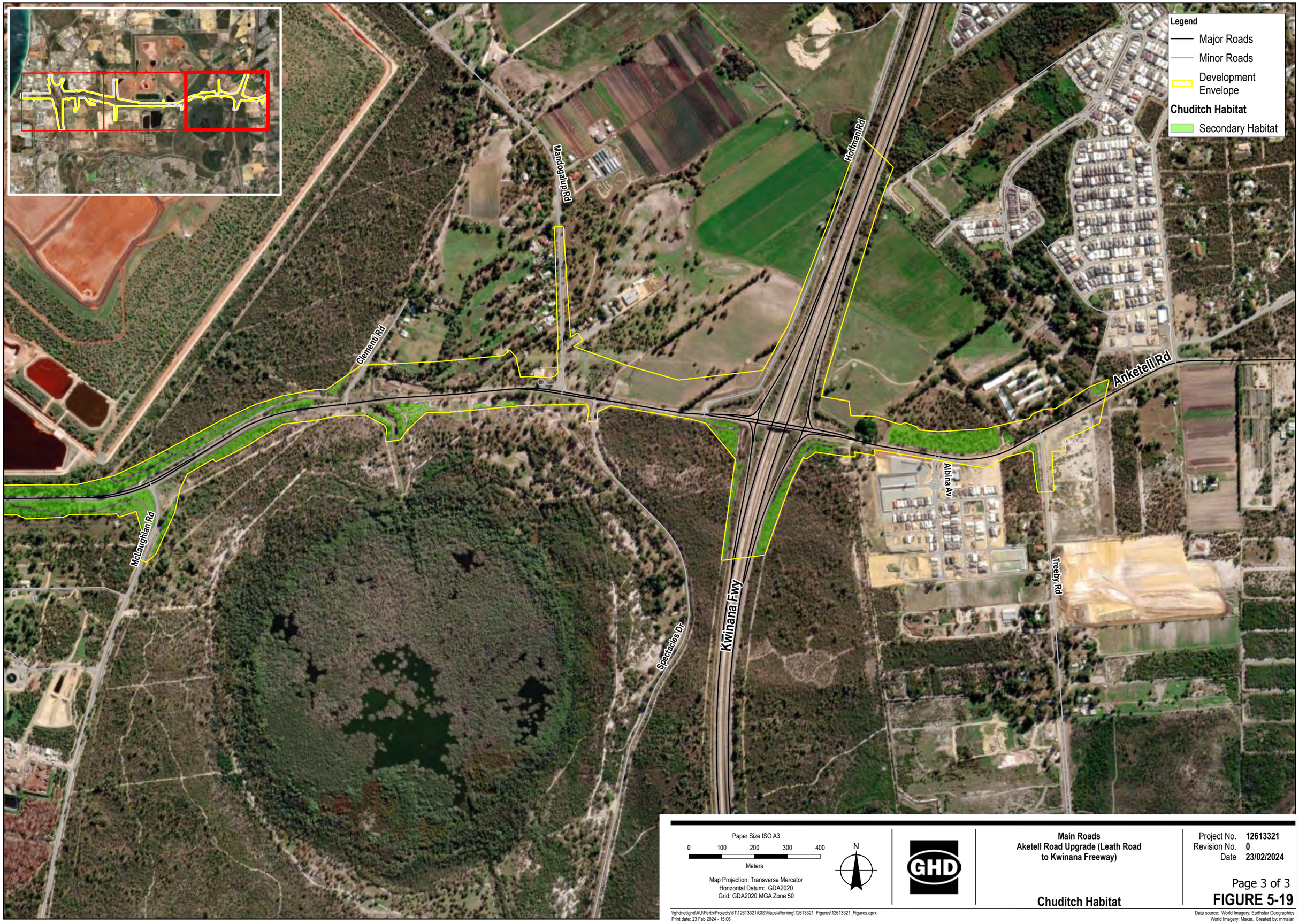
Chuditch Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 3
FIGURE 5-19

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:06

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Chuditch Habitat

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-19

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:06

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

5.2.3.5 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 135.50 ha of fauna habitat, comprising native (96.20 ha) and non-native/modified (39.30 ha) vegetation
- Loss of habitat for significant fauna species including:
    - 608 suitable DBH trees. Of these, 18 trees contained 25 hollows that were considered of suitable depth and shape for Black Cockatoo breeding, noting that breeding is not known to occur within the area
    - 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo
    - 7.24 ha of core foraging habitat and 31.55 ha of secondary foraging habitat for FRTBC
    - 96.21 ha of core habitat for Quenda
    - 45.15 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake
    - 59.10 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider
    - 221.11 ha of secondary habitat for Peregrine Falcon
    - 59.10 ha of secondary habitat for Chuditch
    - 17.27 ha of secondary habitat for Western Brush Wallaby
    - 36.39 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 strike
- 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.

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.

With respect to terrestrial fauna habitat the following avoidance and minimisation measures have been incorporated into the Proposal planning:

- The design solution is located predominantly on existing roads. 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
- The widening of Anketell Road will occur in the median where possible in order to minimise the impacts on adjacent vegetation and fauna habitat
- All infrastructure associated with the Proposal will be contained within the DE, including road pavements, footpaths, noise walls, stormwater drainage, fencing, and electrical power reticulation
- All laydowns, stockpiles and access tracks will be constructed within existing cleared areas or within the permanent footprint of the works. No fauna habitat will be cleared for temporary works outside the permanent footprint
- The detailed design will seek to reduce earthworks (fill height/cut depth) in areas of good quality fauna habitat
- Clearing impacts will be minimised during the detailed design process, by implementing measures such as the use of kerbing where appropriate to alleviate the need for table drains, requiring a larger clearing footprint
- Drainage design will seek to maintain existing flow lines/watercourses to avoid impacting existing fauna habitat. This will be investigated further at detailed design and following detailed hydrological assessment. A drainage plan will be progressed during detailed design
- Identification of movement corridors will be undertaken to determine the number and location of any necessary wildlife underpasses
- Implementation of the CEMP that includes management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment. The CEMP will include clearing and access controls, vehicle movement restrictions, preventing indirect habitat degradation via edge effects, weeds, dieback and rubbish, light and noise measures and revegetation requirements. The management measures will include:
    - All clearing areas and fauna habitat to be retained will be clearly marked with flagging on site
    - Speed limits between 40-80 km p/hr will be applied throughout the construction site for safety purposes which will consequently reduce the risk of fauna strikes during construction
    - A list of local wildlife rescue organisations and carers will be maintained on site during construction to contact in the event of fauna injury

  - A fauna spotter will be present during clearing activities.
  - Construction works will be undertaken in accordance with the Environmental Protection (Noise) Regulations 1997.

- A project specific Landscape and Revegetation Management Plan will specify landscaping within the road reserve will use local native species in accordance with Main Roads Specification 304 (Revegetation and Landscaping) and Main Roads Environmental Guideline Revegetation Planning and Techniques and Vegetation Places within the Road Reserve
- Implementation of an Offsets Strategy to mitigate significant residual impacts on terrestrial fauna (Section 6).

5.2.6 Assessment and significance of residual impact

5.2.6.1 Habitat loss

The Proposal will result in the clearing of up to 135.50 ha of fauna habitat, comprising native (96.20 ha) and non-native/modified (39.30 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. Clearing of up to 135.50 ha of fauna habitat for the Proposal may result in significant impacts on conservation significant terrestrial fauna known or likely to occur within the DE.

5.2.6.1.1 Black Cockatoos

The Proposal will require the clearing of up to 16.11 of core foraging habitat for Carnaby's Cockatoo and 7.24 ha of core foraging habitat for FRTBC, as well as 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo and 31.55 ha of secondary foraging habitat for FRTBC.

The Proposal is surrounded by approximately 12,214 ha of potential Black Cockatoo foraging habitat within 12 km of the DE. Of the 12,214 ha of potential Black Cockatoo foraging habitat mapped within 12 km of the DE, 6,209 ha (50.83%) lies within reserved lands (in Bush Forever and/or DBCA managed lands). An assessment of available Black Cockatoo foraging habitat within 12 km of the Proposal indicates the proposed clearing represents a 0.76% and 0.36% reduction in foraging habitat for Carnaby's Cockatoo and FRTBC, respectively.

Black Cockatoos are highly mobile species and are expected to forage outside the DE amongst foraging resources in the vicinity and are not dependent on a particular patch of foraging habitat within the DE. Furthermore, clearing will occur over linear patches adjacent to existing cleared and disturbed areas along Anketell Road and associated connecting roads, and will not create a gap of 4 km or more between patches of habitat.

The Proposal will result in the loss of up to 608 suitable DBH trees. Of these, 18 trees contained 25 hollows that were considered of suitable depth and shape for Black Cockatoo breeding, however, these trees have not been confirmed as potential breeding trees by a Black Cockatoo specialist. The Proposal will not result in clearing of known breeding trees or hollows. The Proposal occurs approximately 5 km from the closest unconfirmed breeding area for Carnaby's Cockatoo and 11.5 km from the closest confirmed breeding area for Carnaby's Cockatoo (GoWA 2023). While the DE is not considered current breeding habitat for Carnaby's

Cockatoo or FRTBC, it may provide breeding habitat at some point in the future if breeding patterns change.

No known roosting sites were recorded within the DE, nor any evidence of roosting (Biota 2024). The Great Cocky Count (Peck et al., 2019) indicates that the closest roosting site occurs approximately 2.5 km south of the eastern end of the DE in Marri Park Golf Course.

The Proposal's impact to Black Cockatoo foraging habitat is considered to be a significant residual impact. The Proposal's has the potential to impact breeding and roosting habitat, however these potential impacts require further assessment to determine if they are significant residual impacts and, if so, the quantum of such impacts.

5.2.6.1.2 Other conservation significant fauna

Quenda

There is 96.21 ha of core habitat for Quenda within the DE, with 67% in Good or better condition. The Proposal will result in local Quenda habitat loss of Quenda habitat. The species is widespread and is expected to occur in adjacent habitats such as The Spectacles. The Proposal is not expected to have a significant impact on this species. This impact is not considered a significant residual impact.

Perth Lined Slider

There is 45.15 ha of core habitat for the Perth Lined Slider present in the DE. The Proposal will result in local Perth Lined Slider habitat loss, with 70% of the habitat in Good or better condition. Biota (2024) mapped 166 ha of suitable habitat for the Perth Lined Slider within the contextual area, of which 45.15 ha represents a 27.20% loss in habitat extent. 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. This impact is not considered a significant residual impact.

Black-striped Snake

There is 45.15 ha of core habitat for the Black-striped Snake present in the DE, with 70% in Good or better condition. The Proposal will result in local Black-striped Snake habitat loss. Biota (2024) mapped 166 ha of suitable habitat for the Black-striped Snake within the contextual area, of which 45.15 ha represents a 27.20% loss in habitat extent. 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. This impact is not considered a significant residual impact.

Peregrin Falcon

There is 221.11 ha of secondary habitat for the Peregrine Falcon present in the DE. The Proposal will result in local Peregrine Falcon habitat loss. The species is widespread and is expected to occur in adjacent habitats. It is not expected that the Proposal will have a significant impact on this species. This impact is not considered a significant residual impact.

Swan Coastal Plain Shield– backed Trapdoor Spider

The Proposal will result in the local clearing of Swan Coastal Plain Shield– backed Trapdoor Spider habitat, with 59.10 ha of core habitat present in the DE. The Swan Coastal Plain Shield– backed Trapdoor Spider has a large distribution within the regional area and is not constrained to the DE. Additionally, targeted

shearches were completed for the species with no record of presence identified in the DE. The Proposal is not expected to have a significant impact on this species. This impact is not considered a significant residual impact.

Graceful Sunmoth

There is 45.15 ha of core habitat for the Graceful Sunmoth present in the DE. The Graceful Sunmoth occurs on Coastal Banksia Woodland herbland, heathland or shrubland close to the coast. It is not expected that the Proposal will have a significant impact on this species. This impact is not considered a significant residual impact.

Chuditch

Chuditch has a restricted distribution and needs a sizeable area of woodland habitat (>20,000 ha) to persist (Department of Environment and Conservation (DEC) 2012). Chuditch has been recorded The Spectacles (east of the freeway) and nearby Jandakot Regional Park and Wandi Nature Reserve.

The narrow north-south strip on the eastern side of the freeway is the only portion of the DE that may be used by Chuditch to transit through, given it adjoins The Spectacles. However, given this strip occurs immediately adjacent to a freeway, the noise may deter individuals from using this area.

Although habitat also exists in the area north of Anketell Road, east of the freeway, it is considered too small to provide viable Chuditch habitat as it is isolated and doesn't adjoin a larger patch of habitat.

It is not expected that the Proposal will have a significant impact on this species. This impact is not considered a significant residual impact.

Western Brush Wallaby

There is 17.27 ha of secondary habitat for the Western Brush Wallaby present in the DE. The Proposal will result in local Western Brush Wallaby habitat loss, with 84% of Western Brush Wallaby core habitat in Good or better condition. The species is widespread and is expected to occur in adjacent habitats such as The Spectacles. The Proposal is not expected to have a significant impact on this species. This impact is not considered a significant residual impact.

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 (2024) identified the Damplands and Modified areas as secondary habitat for the Glossy Ibis, with an extent of 36.39 ha in the DE. 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. This impact is not considered a significant residual impact.

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 measures identified in the CEMP, such as a requirement for trained fauna handler(s) to be on site during clearing activities. It is unlikely operation of the Proposal will increase the potential for fauna strike, given the existing presence of Anketell Road and other roads. 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

Table 5-15 provides a summary of predicted significant residual impacts of the Proposal on terrestrial fauna. Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset to manage impacts. In considering potential impacts to terrestrial fauna, the mitigation measures proposed to address the Proposal's potential impacts and the implementation of environmental offsets, Main Roads considers the EPA objective for terrestrial fauna will be met.

Table 5-15: Predicted significant residual impacts to fauna and habitat

Aspect	Summary of predicted significant residual impacts
Conservation significant fauna	Clearing of up to: – 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo – 7.24 ha of core foraging habitat and 31.55 ha of secondary foraging habitat for FRTBC.

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

- 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 2021a)
- 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. Table 5-16 provides a brief description of the PSI scope and investigation area. A Detailed Site Investigation (DSI) is planned for Q2 2024.

Table 5-16: 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 2)	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.
MRWA Westport Project – Anketell Road and Thomas Road, Kwinana to Oakford (Golder 2022)	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.

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 (180.48 ha of the DE (81.63%))
- Quindalup South System, described as coastal dunes, of the SCP, with calcareous deep sands and yellow sands (33.90 ha of the DE (15.33%))
- 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 (2.26%))
- Bassendean Sands, described as sand dunes and sandplains with pale deep sand, semi-wet and wet soil (1.71 ha of the DE (0.77%)).

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 (GoWA 2023) indicates the majority of the DE is located within areas mapped as 'Extremely low probability of [ASS] occurrence – 1.5% chance of occurrence in mapping unit with any occurrences in small localised areas' (199.90 ha, 90.41%). ASS mapping is depicted in Figure 5-20.

There is a medium to high risk of ASS being present within 3m of the natural surface in portions of the DE. Areas mapped as a medium / high probability of ASS occurrence are located north of the intersection of Anketell Road / Kwinana Freeway, as well as east of Clementi Road (5.43 ha, 2.46%), and areas mapped as having a low probability of occurrence are located along the eastern extent of the DE (15.77 ha, 7.13%). These areas are associated with mapped wetlands. Areas mapped as extremely low probability of ASS are located along the west of the DE (predominantly west of Clementi Road).

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).

5.3.3.4 Contaminated Sites

The DE intersects 10 mapped contaminated sites and is immediately adjacent to an additional two mapped contaminated sites. Of these, seven are registered as 'Contaminated – remediation required', three are registered as 'Contaminated – restricted use' and two are registered as 'Remediated for restricted use' (GoWA 2023). These sites have been mapped on Figure 5-21 and described in Table 5-17.

In addition, a Basic Summary of Records requested by Main Roads for sites not visible via Contaminated Sites Database has been summarised in Table 5-18. Other government agencies have advised that there may be soil contamination present along Anketell Road (Westport 2020).

Additional potentially contaminating activities that were not apparent in the desktop sections of the PSI (Senversa 2024), but were identified during the site inspection, include the occurrence of fly tipping of various materials and miscellaneous stockpiles across the project area.

From site walkovers and a desktop review, a range of potential environmental concerns were identified broadly 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).

Table 5-17: 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	This lot is the location of the Motorplex site. 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	

Site / Lot Number	Location with respect to the DE	Site classification	Reason for classification	Restrictions
Site No. **15656**, on Lot 435 on Plan 220492	The DE lies adjacent to the western boundary of the site, and intersects the eastern portion of the site. The site runs along the length of the eastern side of Rockingham Road, south of Anketell Road.		– State of soils is unknown.	
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 site lies adjacent to the DE, south-west of Anketell Road and Leath Road intersection.			
Site No. **74385**, on Lot 501 on Plan 72707	The DE intersects the southern and eastern boundary of the site, north-east of the Anketell Road / Abercrombie Road interchange.	Contaminated – remediation required	– Alkali groundwater plumes are present beneath the Source Site (Lot 100 Anketell Road, Hope Valley) 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	– Groundwater abstraction at Lot 100 Anketell Road, Hope Valley is restricted to remediation of contamination and industrial refinery purposes – Land use at Lot 100 Anketell Road, Hope Valley is restricted to non-sensitive commercial/industrial use.

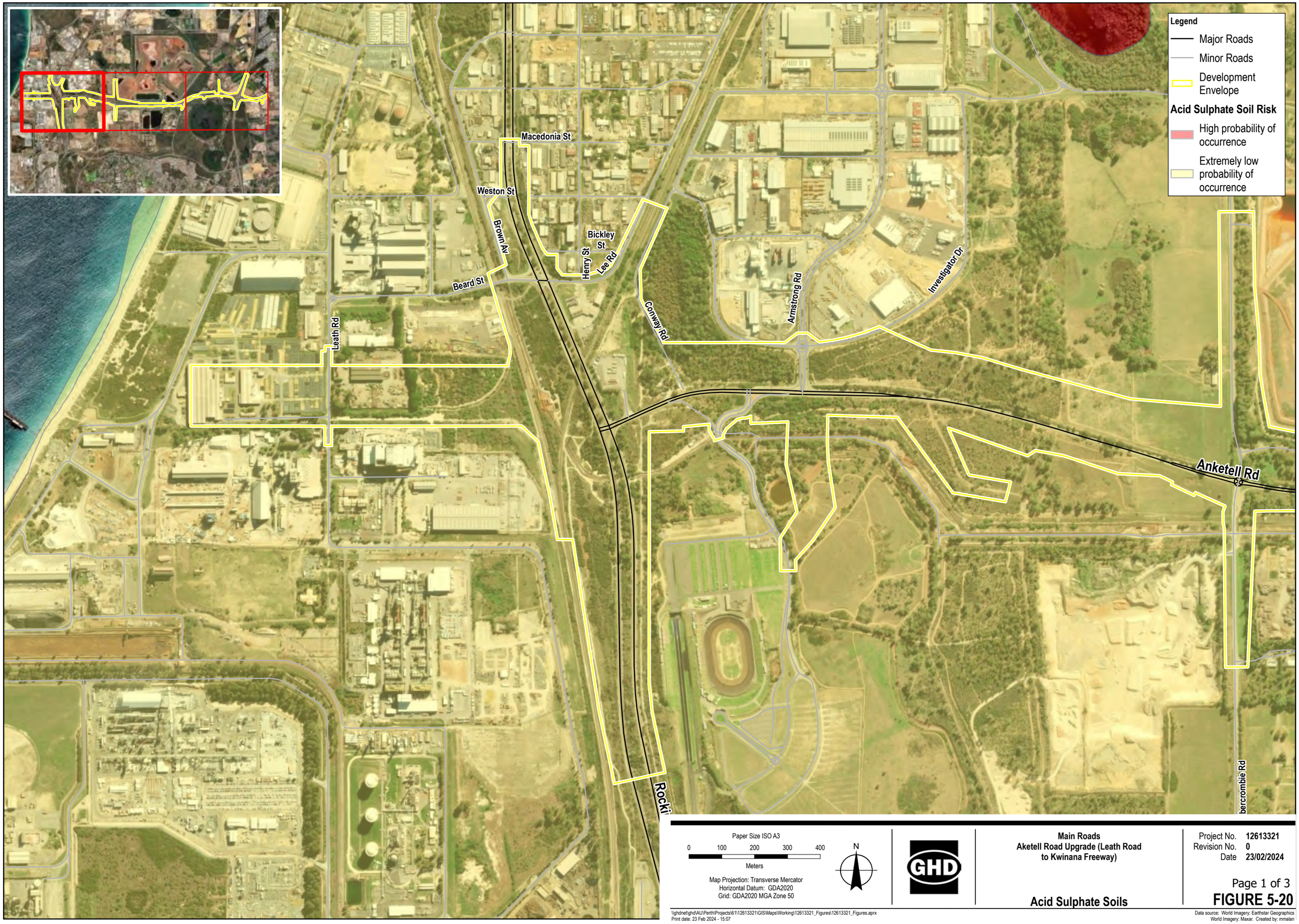
Site / Lot Number	Location with respect to the DE	Site classification	Reason for classification	Restrictions
			works have not yet completed.	
Site No. 2623, on Lot 224 on Plan 3638	The DE intersects the western portion of the site, south-east of the Rockingham Road and Macedonia Street interchange.	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 5-18: Contaminates 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 Diagram 18462	The DE encompasses the entirety of the site, south of the Beard Street / Brown Avenue intersection	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 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	Located on-site, down groundwater gradient. Contamination has not been adequately investigated, nor has the site been sorical ubject to risk assessment in order to understand the nature and extent of contamination onsite.

Site / Lot Number	Location with respect to the DE	Site classification	Summary (Senversa 2024)	Comment (Senversa 2024)
			remediation works has been submitted to DWER.	
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 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.	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 No. 4003, Lot 89 on Plan 217732	The DE intersects the southern corner of the site, north-west of the Anketell	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	Cross gradient to site – unclear as to whether extend of contamination may cross site boundary

Site / Lot Number	Location with respect to the DE	Site classification	Summary (Senversa 2024)	Comment (Senversa 2024)
	Road / Clementi Road intersection		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.	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 BGL.	Down gradient of site.



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Acid Sulphate Soils

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-20

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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

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

Clementi Rd

Anketell 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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Acid Sulphate Soils

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-20

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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

Legend

- Major Roads
- Minor Roads
- Development Envelope

Acid Sulphate Soil Risk

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

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

Paper Size ISO A3

0 100 200 300 400

Meters

N

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

GHD

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

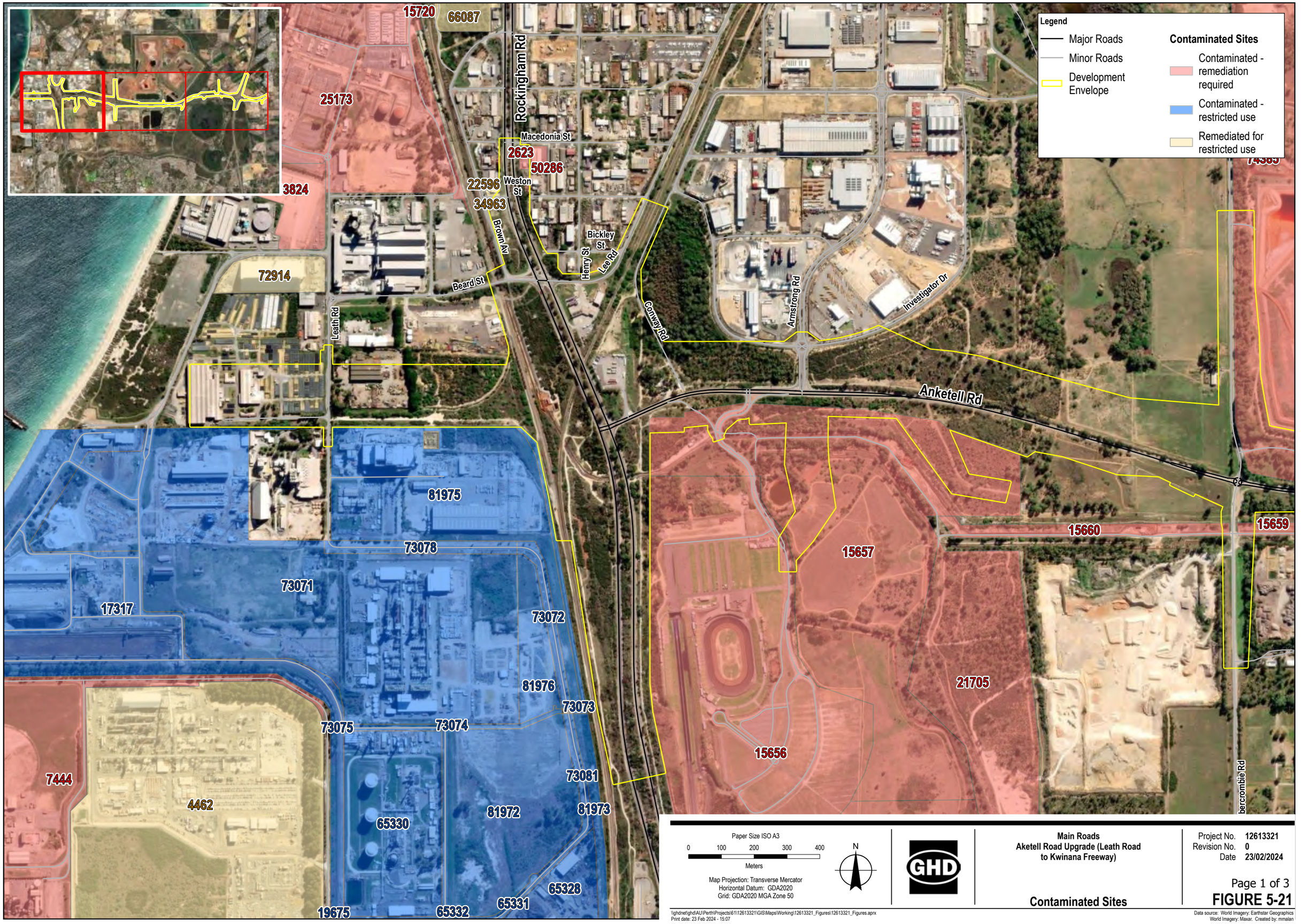
Acid Sulphate Soils

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-20

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

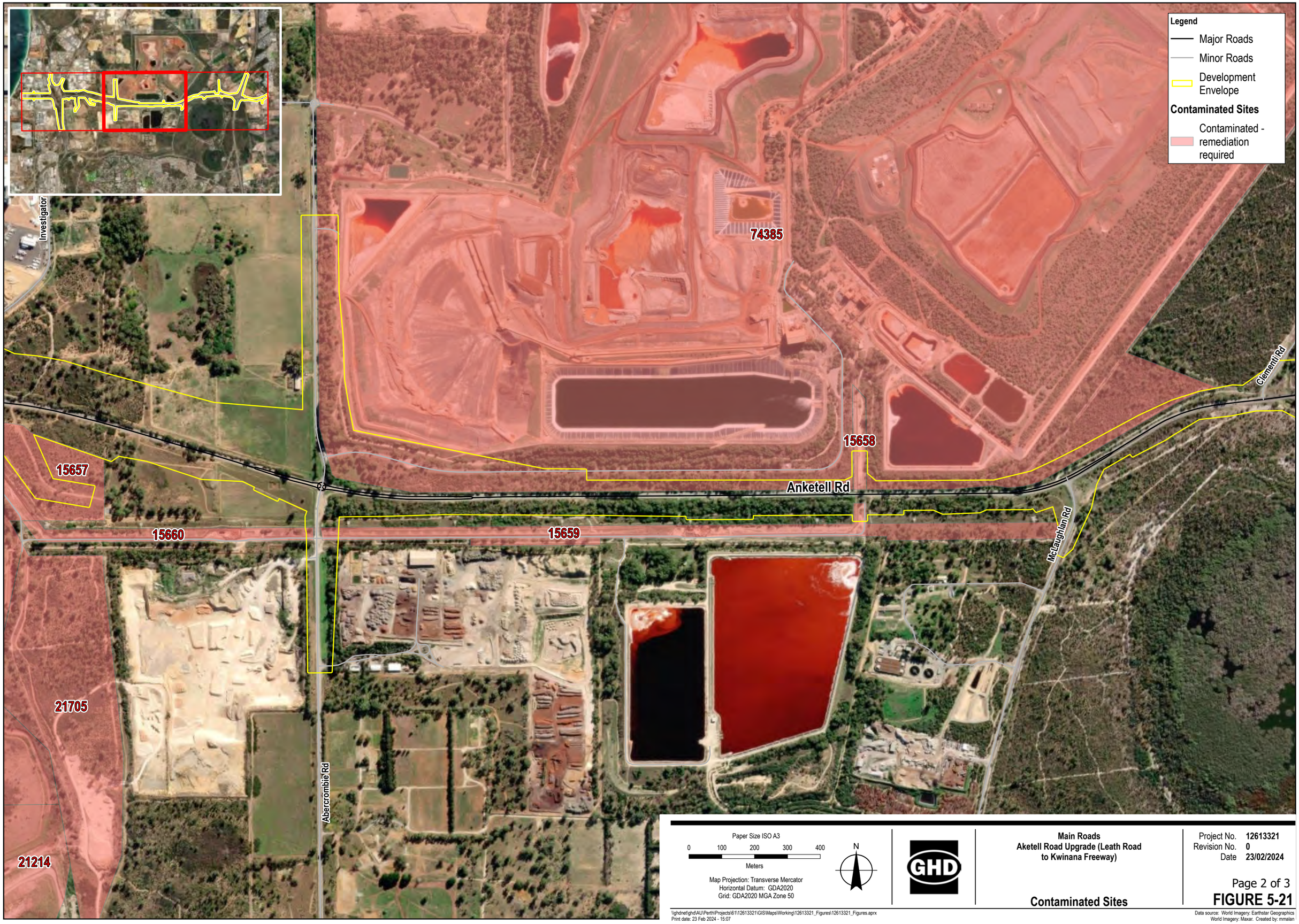
Contaminated Sites

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 1 of 3
FIGURE 5-21

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Contaminated Sites

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-21

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Contaminated Sites

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 3 of 3
FIGURE 5-21

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:07

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

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. In particular, presence of elevated PFAS concentrations in groundwater at the Kwinana end of Anketell Road
- Potential disturbance of ASS due to earthworks, excavation and dewatering

5.3.5 Mitigation

Avoidance and minimisation measures considered and incorporated in the Proposal planning relevant to terrestrial environmental quality include:

- The design solution is located predominantly on existing roads. The positioning of the road infrastructure within the DE will be informed by various constraints (including environment and social) and associated discussions. 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
- The Proposal has been redesigned to avoid excavation in areas of known contamination (e.g. Motorplex site)
- Prior to commencement of works, completion of a PSI and DSI to identify contaminated areas within and adjacent to the DE
- Prior to commencement of works, completion of an ASS investigation to identify moderate and high ASS risk areas within and adjacent to the DE. Proposal specific investigations will be offset by data from existing studies nearby where appropriate
- Preparation and implementation of an ASS and Dewatering Management Plan for works in areas of moderate and high risk for ASS and/or PFAS
- In accordance with the *Contaminated Sites Act 2006* process, prepare and implement a Sampling and Analysis Plan and subsequent Remediation Action Plan to address known soil contamination prior to or as part of construction activities
- Implementation of the CEMP that includes management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment. The CEMP will include chemical and hydrocarbon storage, waste management, spill management, contaminated material handling and management, sediment and erosion controls, soil management, dewatering controls and an unexpected finds protocol
- Development of a groundwater monitoring program, where required to monitor and assess the effectiveness of mitigation measures associated with contamination.

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 based on desktop searches. It is also unknown whether demolition of any buildings potentially containing asbestos is required. The Proposal has the potential to result in impacts to soil quality and/or groundwater quality through disturbance of in situ contaminants. Potential direct and indirect impacts associated with the movement of contaminated soil will be managed during constrcution 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. An ASS Management Plan will be prepared and implemented in accordance with DWER ASS guidelines (DER 2015a and 2015b) to ensure impacts from ASS disturbance are avoided and/or managed. Key management strategies to be implemented will include minimising disturbance of ASS, stockpile management protocols, and treatment of excavated ASS to neutralise acidity.

5.3.7 Predicted Outcomes

Implementation of the Proposal is not expected to result in significant residual impacts to Terrestrial Environmental Quality. Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and

offset to manage environmental impacts. In considering potential impacts to Terrestrial Environmental Quality, and the mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers 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

- Environmental Factor Guideline: Inland Waters (EPA 2018)
- State Planning Policy 2.9 Water Resources (WAPC 2006)
- Water Quality Protection Note 44, Roads Near Sensitive Water Resources (DoW 2006)
- 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

At the time of referral, no surveys, studies or investigations have been completed to characterise surface water or groundwater values within and adjacent to the DE. Main Roads has commission a wetland assessment to identify the environmental values of the wetlands within and near to the DE as well as undertaken surface and groundwater monitoring to provide baseline data to inform potential impact and management measures for inland waters.

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

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 is very slow in the confined aquifers (Leederville and Yarragadee North).

Review of the historical minimum and maximum groundwater contours available on the Perth Groundwater Map infers groundwater at the site flows west towards the ocean 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 Kwinana Wastewater Treatment plant have inferred that mounding caused by the infiltration ponds on-site direct groundwater to flow towards the ponds and The Spectacles wetlands (Senversa 2024). Depth to groundwater across the DE ranges from approximately 5 m to 30 m below ground level (bgl) (DWER 2023).

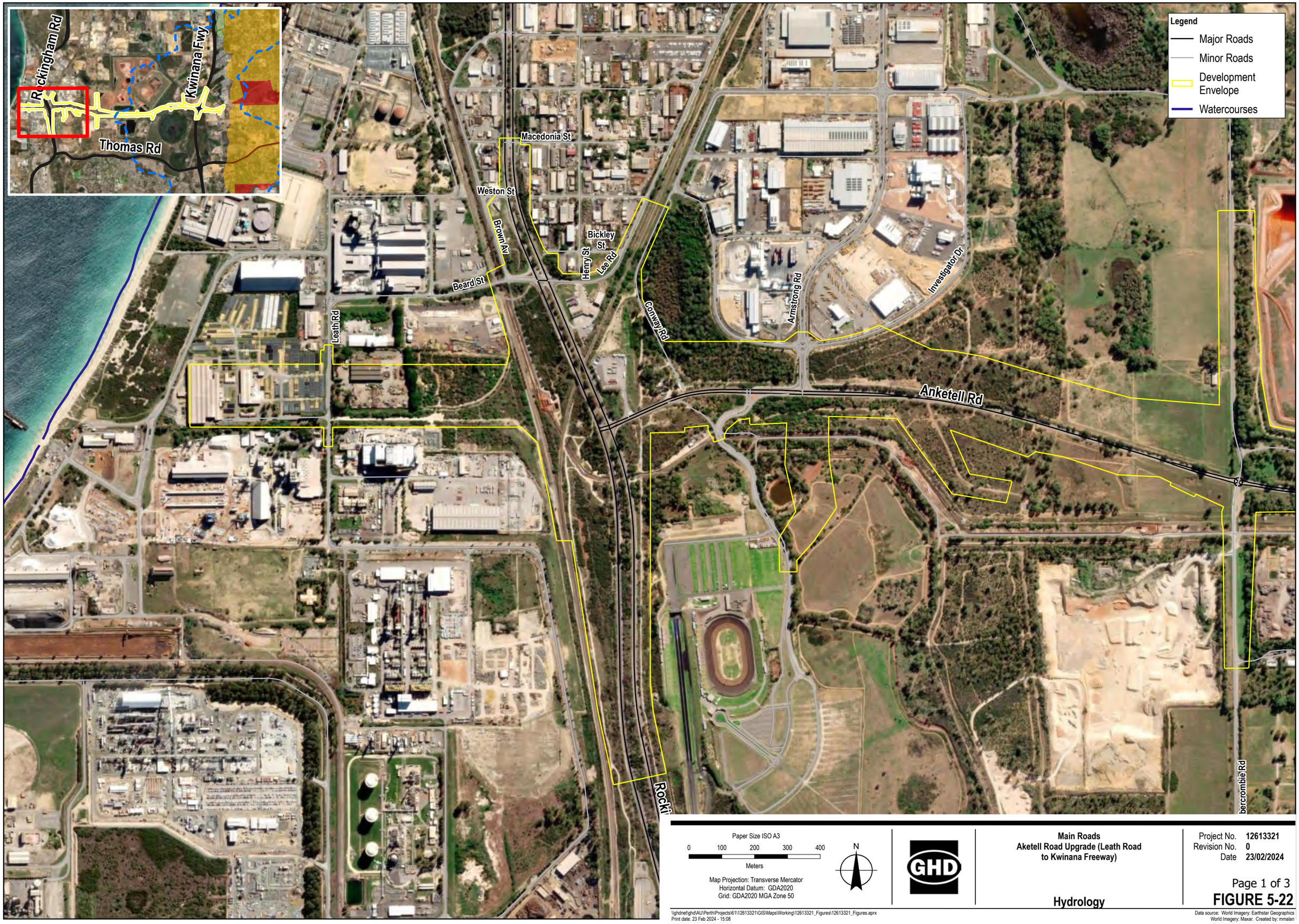
The DE intersects three Groundwater Areas proclaimed under the RIWI Act:

- Cockburn Groundwater Area (170.52 ha (77.13% of DE))
- Jandakot Groundwater Area (30.78 ha (13.92% of DE))
- Serpentine Groundwater Area (19.79 ha (8.95% 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.

5.4.3.3 Surface water

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 5-22). The Peel Main Drain is owned by the Water Corporation and is a tributary of the Serpentine River. It intersects the DE on the western side of Kwinana Highway, between Clementi Road and Mandogalup Road, crossing the DE and running through The Spectacles. The Mandogalup East Drain intersects the north eastern 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 300m north of site at 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, water from Alcoa sump pumps and recovery bores (Golder 2022). Kwinana Wastewater Treatment Plant is located west of The Spectacles with two large ponds visible from satellite imagery, along with smaller evaporation and infiltration ponds/tanks (Senversa 2024).



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Hydrology

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-22

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:08

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

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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

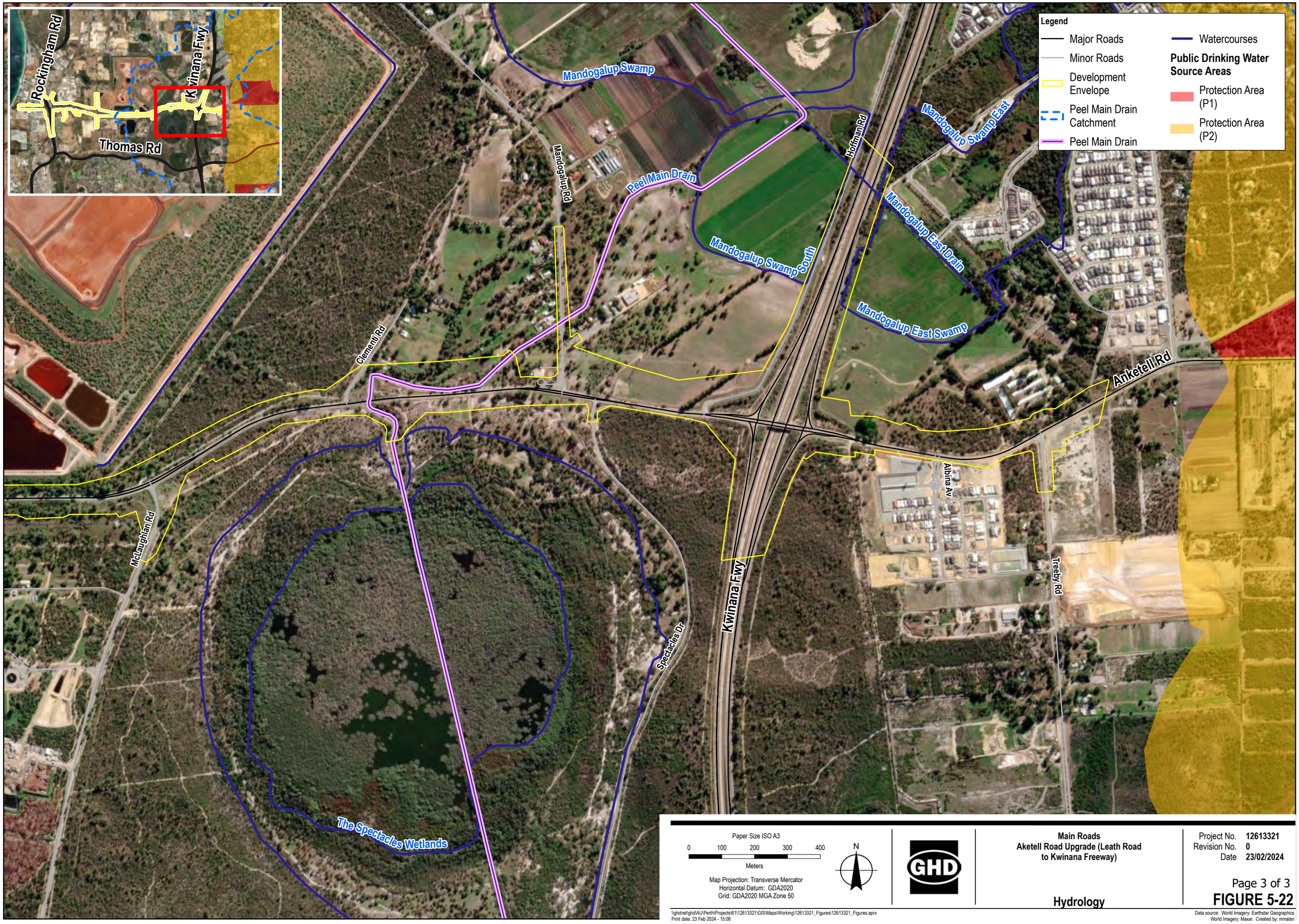
Hydrology

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-22

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:08

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Hydrology

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-22

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:08

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

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 Large Eye Swamp in the north and the Small Eye Swamp in the south. The wetland is also on the City of Kwinana heritage list. Biota (2024) recorded large Tuart and Jarrah trees bordering this wetland within their survey area, that represented some of the most prospective Black Cockatoo roosting habitat in the local area; these trees do not occur within the DE.

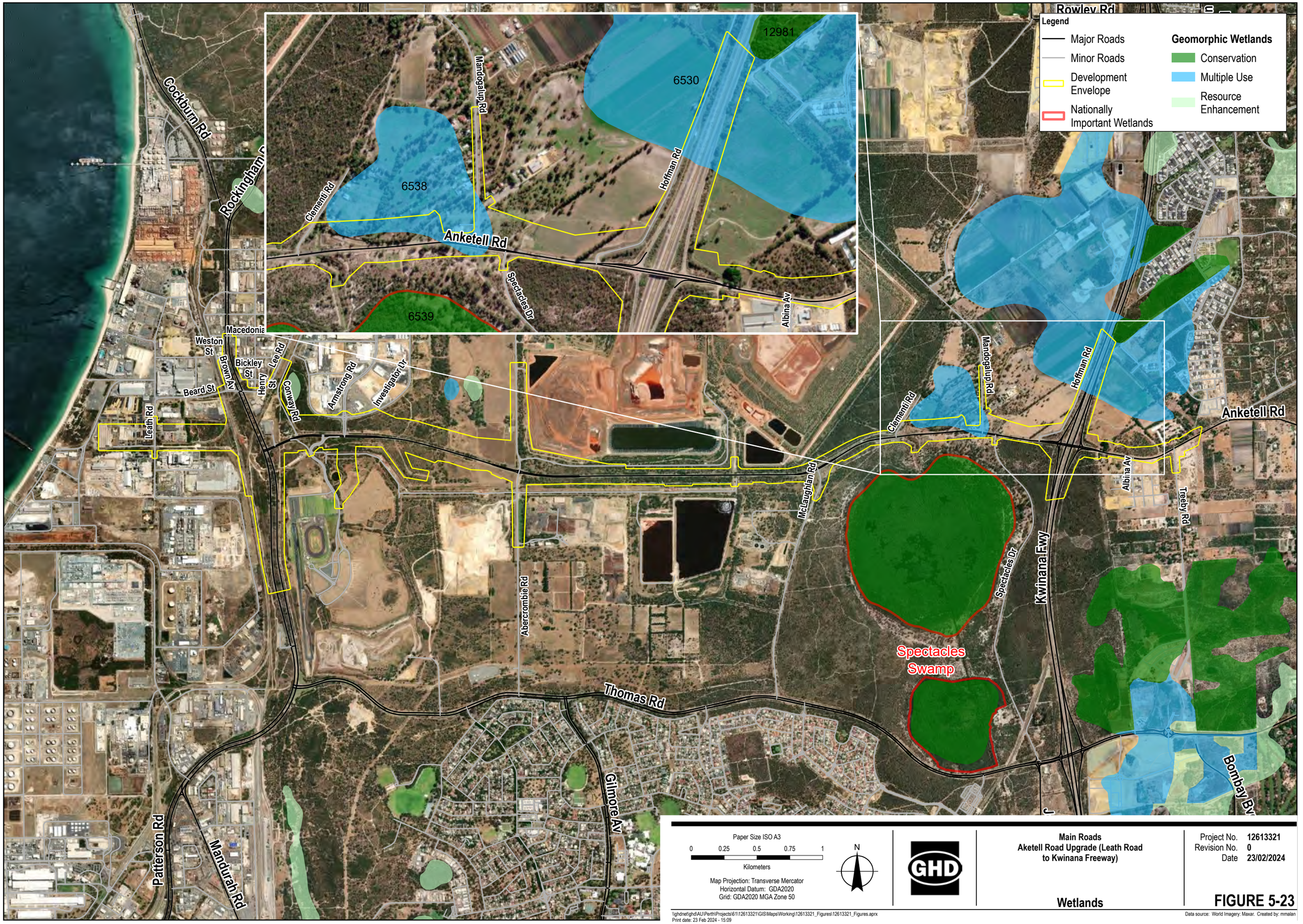
5.4.3.4.2 Geomorphic wetlands

Based on the Geomorphic Wetlands of the SCP mapping, the DE intersects two geomorphic wetlands, detailed in Table 5-19 and mapped on Figure 5-23. A total of 9.76 ha of wetland areas occur within the DE, with 0.22 ha mapped as native vegetation (in Completely Degraded condition), 4.53 ha mapped as modified vegetation, and the remaining 5.00 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 landcare (Hill et al. 1996 and WRC 2001). The DE is also within the 50 m buffer of a REW known as Conway Road Swamp (UFI 6379).

Table 5-19: Geomorphic wetlands intersected by the DE (GoWA 2023)

UFI	Wetland management	Wetland Type	Wetland description	Total extent (ha)	Extent within DE (ha) (% decrease in wetland extent)	Vegetated extent within DE (ha)
6530	Multiple Use	Dampland	This wetland crosses 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.	215.39 ha	5.79 ha (2.69% decrease in mapped wetland extent)	Modified: 1.62 ha Native: 0 ha Cleared: 4.17 ha
6538	Multiple Use	Dampland	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	20.09 ha	3.96 ha (19.71% decrease in mapped	Modified: 2.91 ha Native: 0.22 ha Cleared: 0.83 ha

UFI	Wetland management	Wetland Type	Wetland description	Total extent (ha)	Extent within DE (ha) (% decrease in wetland extent)	Vegetated extent within DE (ha)
			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.		wetland extent)	
Total					**9.76 ha**	**4.53 ha modified** **0.22 ha native** **5.00 ha total**



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Wetlands

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-23

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:09

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

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 9.76 ha of mapped MUWs through infill, ground disturbance and vegetation clearing
- Degradation of drains from alteration to surface water drainage
- Short-term changes to groundwater levels as a result of dewatering during construction.

The Proposal has the potential to indirectly impact inland waters through the following:

- Changes to hydrological regimes of adjacent wetlands from earthworks and alteration of surface water drainage (particularly The Spectacles)
- Erosion and sedimentation in surrounding areas from vegetation clearing, bridge construction, earthworks and alteration of surface water drainage
- Changes to groundwater levels due to abstraction of groundwater for construction purposes which may affect private and public groundwater users
- 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.

With respect to inland waters the following avoidance and minimisation measures have been incorporated into the Proposal planning:

- The design solution is located on existing roads and 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) and associated discussions. 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 environmental and heritage aspects, whilst complying with Main Roads standards for the safety of road users, improved congestion, and ease of access
- The findings and recommendations of a wetlands assessment will inform measures to minimise impacts to Inland Waters
- Consultation with the Water Corporation will be undertaken to ensure the Proposal design in the vicinity of the Drains does not adversely impact the performance of the Water Corporation assets. Drainage design will consider the local drainage network and maintain surface flows associated within Peel Main Drain Catchment, which will be addressed in the design phase of the Proposal

- Drainage design will integrate Water Sensitive Urban Design principles and incorporate the following elements:
    - Stormwater drainage will be designed to maintain existing hydrology through the implementation of best practice consistent with the WA Better Urban Water Management (BUWM) Framework and WA Stormwater Management Manual (WASMM)
    - Construction of basins and/or swales within the DE, to capture, retain and/or infiltrate runoff from a rainfall event
    - Infiltration basins/swales will be planted with native vegetation to assist with nutrient stripping of stormwater during infiltration
    - Where there is no space for conventional basins, installation of gross pollutant traps to capture and retain coarse sediment, litter, vegetation matter, suspended sediment and hydrocarbons carried in the stormwater
    - The new road infrastructure will drain into treatment and infiltration areas designed in accordance with the Better Urban Water Management framework and WA Stormwater Management Manual.
- A licence will be obtained for construction dewatering in accordance with the RIWI Act. Dewatering activities and dewatering effluent will be managed in accordance with license requirements
- Testing of construction de-water, and treatment if necessary, prior to infiltration
- Implementation of the CEMP that includes management objectives, performance criteria, actions and monitoring to minimise risks to the surrounding environment. Management measures relating to sediment and erosion, dewatering controls and contamination and spills.

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 9.76 ha of mapped MUWs, of which 0.22 ha is mapped as native vegetation (in Completely Degraded condition), 4.53 ha is mapped as modified vegetation, and 5.00 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 wetlands, consideration of indirect impacts associated with altered drainage, sedimentation and erosion, and accidental contamination will be important.

The Jandakot drainage and water management plan (DoW 2009) identified Mandogalup Swamp as important regional flood storage, serving as a buffer for The Spectacles wetlands. 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 will consider the local drainage network and maintain surface flows associated with Peel Main Drain Catchment and Mandogalup East Drain. Standard drainage and surface water management measures will be included in the CEMP, and a drainage plan be developed following detailed hydrological assessment. The impact of the Proposal to the Peel Main Drain and Mandogalup East Drain is unlikely to be significant.

5.4.6.3 Dewatering for construction activities

The Proposal includes construction of bridge piers, abutment footings and drainage structures. Dewatering, if required, will cause temporary and localised groundwater drawdown. The Proposal may result in short-term changes to groundwater levels where temporary dewatering is required during construction. However, given Main Roads long history of constructing interchanges on the SCP and that no temporary dewatering-related impacts have been recorded, it is expected that the management measures applied will ensure no significant impact to Inland Waters due to the temporary groundwater drawdown.

If dewatering is required, a licence will be obtained in accordance with the RIWI Act. Dewatering activities and dewatering effluent will be managed in accordance with license requirements. The location of any required abstraction bores will also be determined prior to construction and a licence application for dewatering bores will be submitted to DWER as required.

5.4.6.4 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. 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, changes to hydrological regimes of adjacent wetlands and tributaries are not expected to be significant.

5.4.6.5 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. 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 not expected to be significant.

5.4.6.6 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.

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 wetlands 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

Implementation of the Proposal is unlikely to result in significant residual impacts to Inland Waters due to the loss of wetland areas and potential impacts associated with dewatering.

Construction will result in impacts to Multiple Use Wetlands, but no direct impacts to Conservation Category or Resource Enhancement wetlands. Potential indirect impacts, though unlikely, will be investigated through a wetland and hydrological study to confirm there are no significant impact to inland waters. The Proposal's impacts to surface water and impacts due to erosion and sedimentation and contamination of surface and groundwater are unlikely to be significant.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset to manage environmental impacts. In considering potential impacts to inland waters, and the mitigation measures proposed to address those potential impacts of the Proposal, Main Roads considers 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 2021b)
- 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 Cultural Heritage

5.5.3.1.1 Aboriginal Heritage

The Proposal occurs within the Gnaala Karla Booja Indigenous Land Use Agreement (ILUA) area, made with the Gnaala Karla Booja Traditional Owners under the South West Native Title Settlement. Through the ILUA, the Main Roads Gnaala Karla Booja 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.

Review of the Western Australian Register of Aboriginal Heritage Places and Objects through the Department of Planning, Lands and Heritage (DPLH) Aboriginal Cultural Heritage Inquiry System (ACHIS) has identified that one Aboriginal Heritage Place is situated within the DE: Place ID 3427, Mandogalup Swamp/Spectacles (listed as 'Historic' – previously referred to as 'Stored Data' place type by DPLH). The play type is listed as Mythological, Hunting Place and Water Source and the place intersects two locations at the DE: the northern extent of Kwinana Freeway and east of Treeby Road. Aboriginal Heritage Places that intersect the DE and occur within the vicinity of the Proposal are mapped on Figure 5-24.

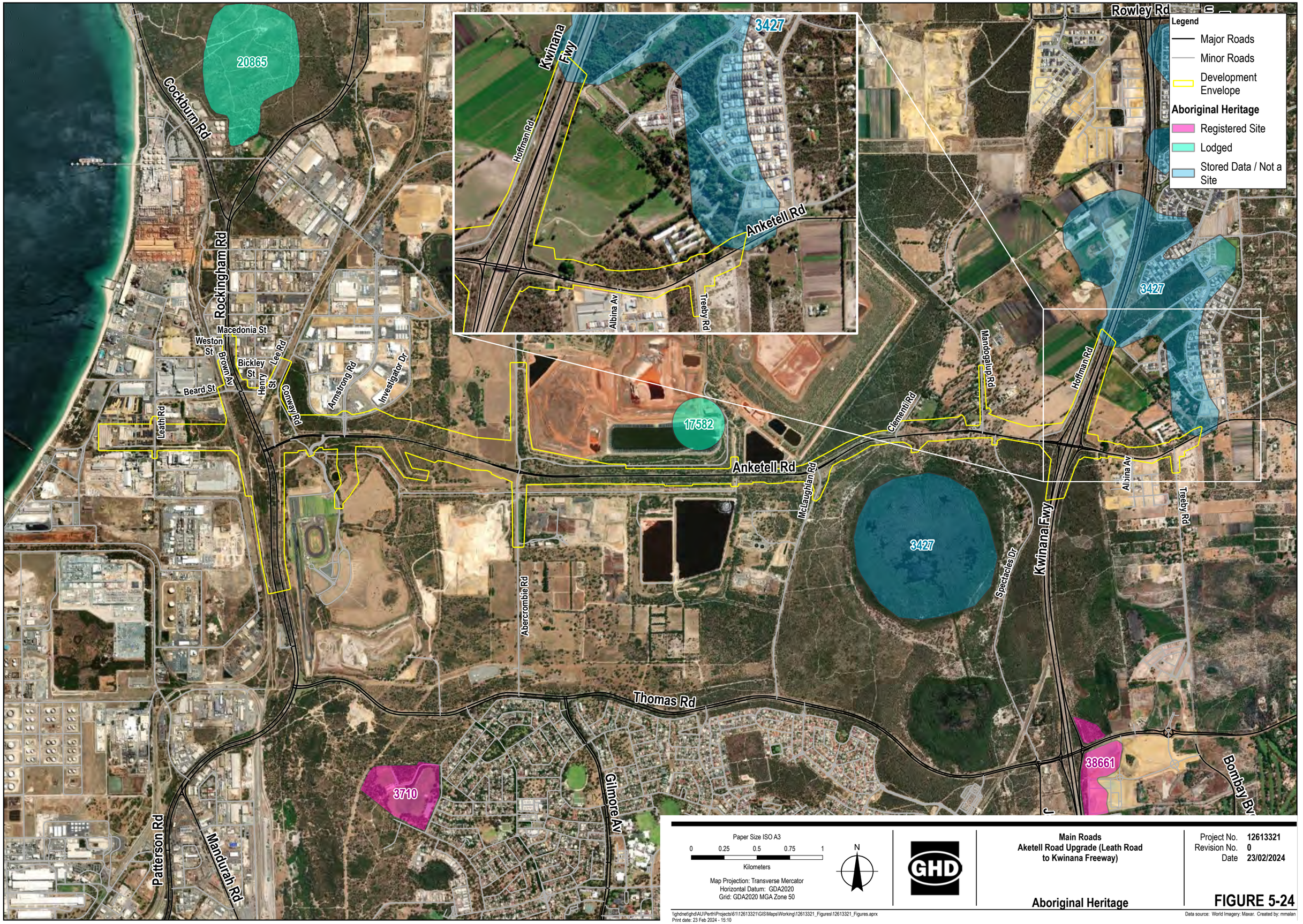
As part of the larger Westport project consultation with key Aboriginal stakeholder groups in the Kwinana area, establishment of an Aboriginal Advisory Group, and development of the *Westport Aboriginal Engagement Strategy* (Westport 2020) by Aboriginal Productions Promotions (APP) organisation have already been undertaken.

Consultation with relevant Elders by APP did not note any additional heritage sites within the Kwinana area, however, the following matters for consideration were raised (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.

Formal Archaeological and Ethnographic Site Identification Aboriginal heritage surveys of the DE are scheduled to be conducted with Gnaala Karla Booja representatives in the first half of 2024. The heritage surveys will be undertaken in accordance with the Main Roads Gnaala Karla Booja Standard Heritage Agreement and will incorporate best practice heritage management, as described in the current Australian Burra Charter Practice Notes (2013).



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Aboriginal Heritage

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-24

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:10

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

5.5.3.1.2 Historic Heritage

There are no World Heritage Properties or National Heritage Places within a 10 km buffer of the DE (DCCEEW 2023). A search of the WA Heritage Register identified seven State Registered Heritage Places within 5 km of the DE (GoWA 2023), of which the closest Place is Kwinana Signal Box (Place Number 112) located approximately 1.1 km south of the western extent of the DE.

A Municipal Inventory is a list of places identified through a Local Heritage Survey that, in the opinion of the LGA, are or may become of cultural heritage significance. Ten places listed on the City of Kwinana Municipal Inventory intersect the DE (Table 5-20) and an additional 19 places occur within 2 km of the DE (Table 5-21). European Heritage Places that intersect the DE and occur within the vicinity of the Proposal are mapped on Figure 5-25.

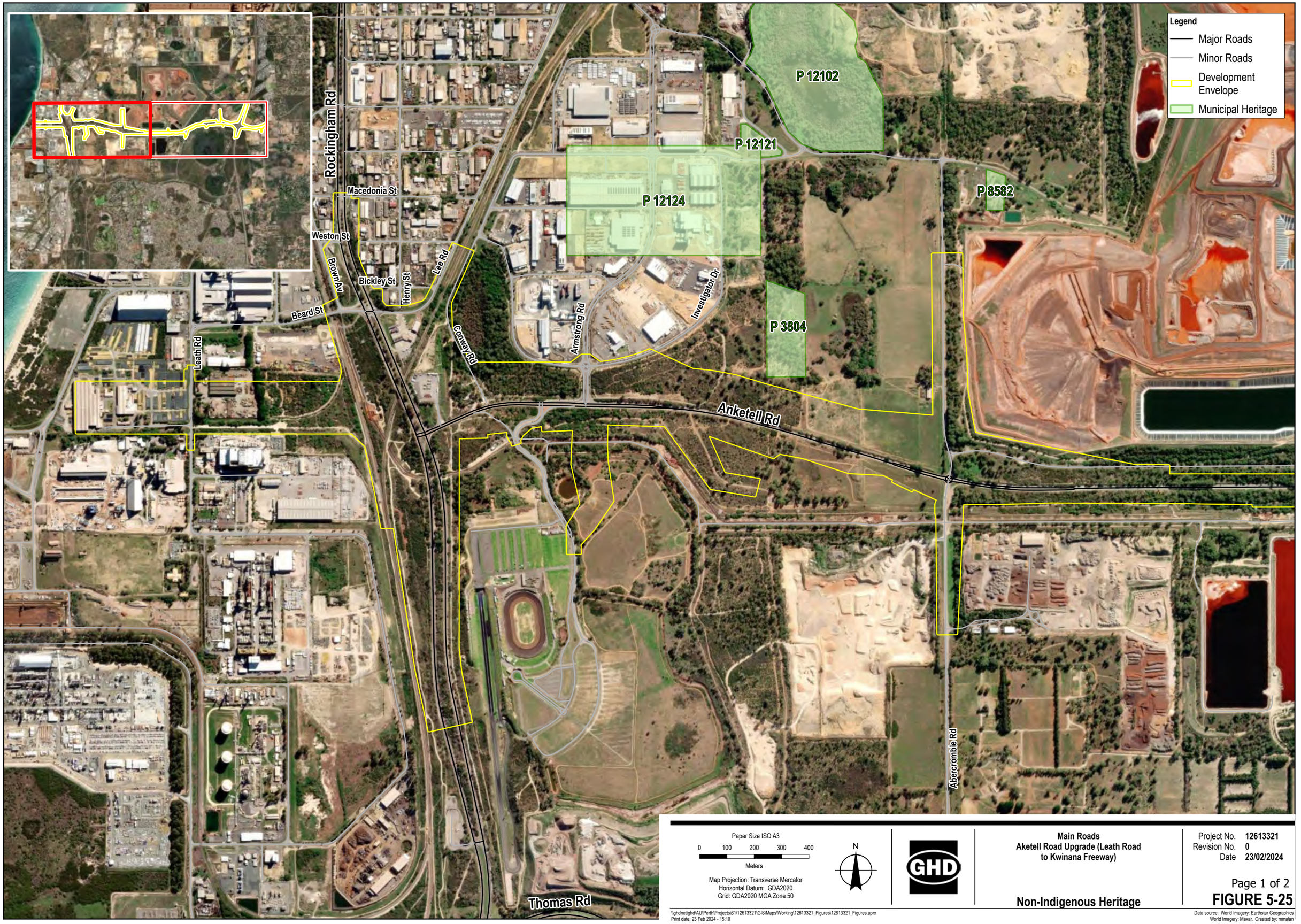
Consultation with the City of Kwinana on the Proposal and DE will be undertaken in early 2024 to establish any heritage-related requirements that the City of Kwinana may have in relation to Municipal Inventory Places that intersect the DE.

Table 5-20: Municipal Heritage Places that intersect the DE (GoWA 2023)

Place No.	Place Name	Site address	LGA	Proposed clearing extent	Total extent (ha)	Extent within DE (ha) (% decrease in site extent)
12115	White Bridge	Anketell Rd, Hope Valley	Kwinana	Entire extent	0.08	0.08 (100%)
12087	Mandogalup Post Office (fmr)	Anketell Rd, Mandogalup	Kwinana	Partial extent	0.33	0.17 (51.52%)
12116	Balmanup Post Office – Site Of	Clementi Rd, Hope Valley	Kwinana	Entire extent	0.24	0.24 (100%)
12100	Hall Reserve - Mandogalup	Cnr Mandogalup & Anketell Rds, Mandogalup	Kwinana	Edges	1.82	0.4 (21.98%)
12098	The Spectacles Wetland	Cnr Thomas/McLaughlan/Anketell Rds, The Spectacles/Postans	Kwinana	Edges	369.96	4.03 (1.09%)
12125	Mandogalup Townsite	Mandogalup	Kwinana	Bisect (fragment)	122.02	8.18 (6.7%)
12092	Soldier Settler Homes, Mandogalup	Mandogalup Rd, Mandogalup	Kwinana	Edges	4.04	0.29 (7.18%)
12114	Jolly's Bridge	Mandogalup Rd, Mandogalup	Kwinana	Partial extent	0.10	0.07 (70%)
12130	7 Mile Site ("Sevvy" to later settlers)	Mandogalup/Johnson/Hope Valley Rds, Mandogalup	Kwinana	Bisect (fragment)	0.87	0.61 (70.11%)
12127	Tramway Reserve - site	Wellard	Kwinana	Bisect (fragment)	50.81	1.07 (2.11%)

Table 5-21: Municipal Heritage Places that are located outside of but within 2 km of the DE (GoWA 2023)

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

N

GHD

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

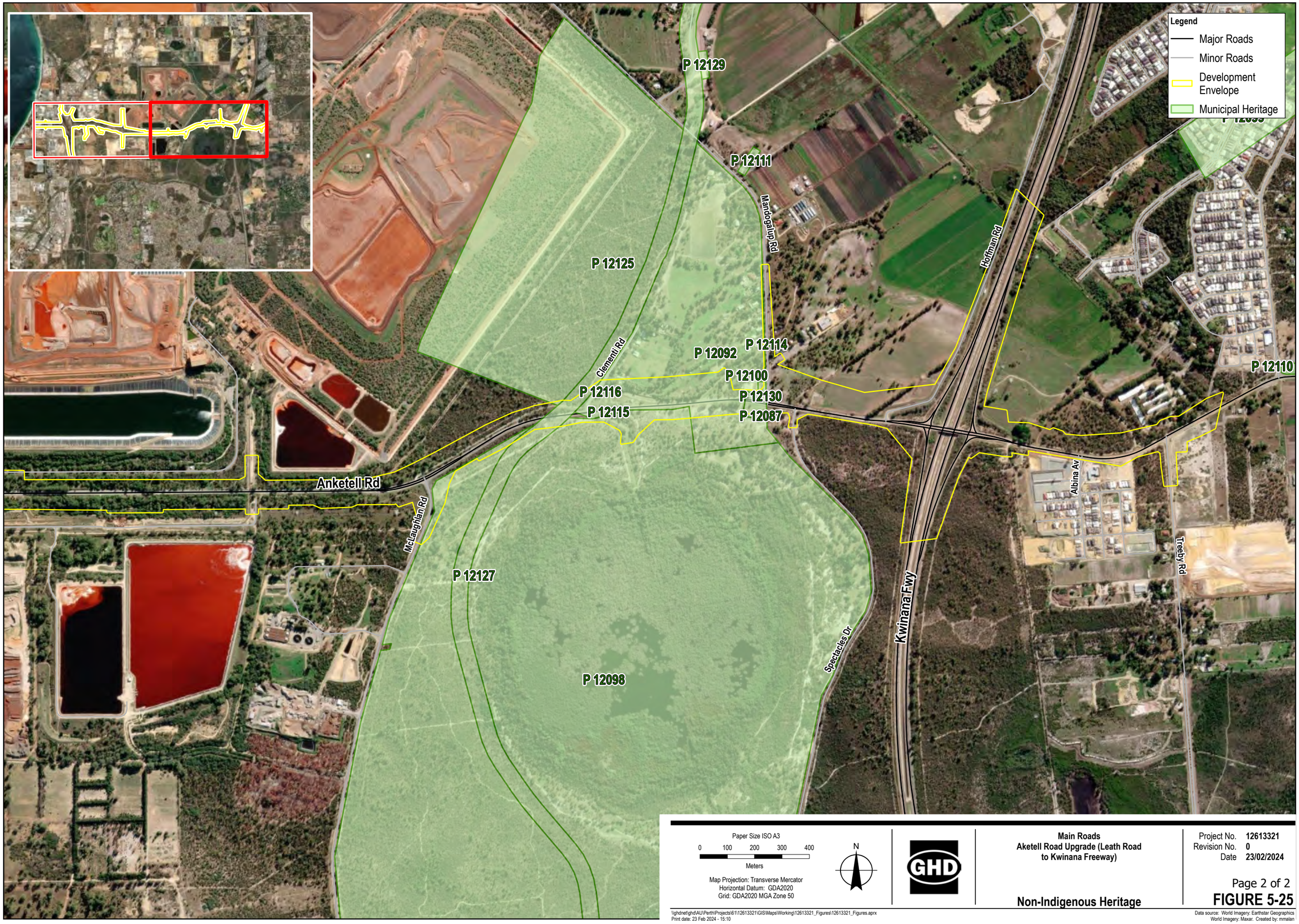
Non-Indigenous Heritage

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

FIGURE 5-25

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:10

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



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
Aketell Road Upgrade (Leath Road to Kwinana Freeway)

Non-Indigenous Heritage

Project No. **12613321**
Revision No. **0**
Date **23/02/2024**

Page 2 of 2
FIGURE 5-25

\\ghdnet\ghd\AU\Perth\Projects\61\12613321\GIS\Maps\Working\12613321_Figures\12613321_Figures.aprx
Print date: 23 Feb 2024 - 15:10

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

Local Heritage Survey Assessment

The Local Heritage Survey assessed Municipal Heritage Places for cultural heritage significance, in terms of aesthetic, historic, scientific, social and spiritual value, and classified said places according to Table 5-22 (GoWA 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 5-22: Classification of significance (adapted from GoWA (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 4.03 ha of the DE within The Spectacles Wetland site, which equates to approximately 1.09% 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 rout 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 1.07 ha of the DE within the Tramway Reserve - site, which equates to approximately 2.11% 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).

5.5.3.1.3 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 5-23). 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%) (GoWA 2023). 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 5-9).

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 5-23: Land zoning and reservation within the DE

MRS description	Area within the DE (ha)	Proportion of the DE (%)
Rural	78.49	35.50
Primary regional roads	52.27	23.64
Other regional roads	38.05	17.21
Industrial	31.21	14.12
Railways	10.74	4.86
Parks and Recreation	6.8	3.08
Urban	3.02	1.37
Parks and recreation - restricted public access	0.38	0.17
Public purposes – Water Authority of WA	0.13	0.06
Total	**221.09**	**100**

5.5.3.2 Visual and social amenity

5.5.3.2.1 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, west of Lyon Road. Residential areas are setback from the current Anketell Road with limited direct visibility of the Proposal area. The existing residential properties are at least 500m from the existing Anketell Road / Kwinana Freeway interchange. The exiting interchange has a bridge structure allowing Anketell Road traffic to pass over Kwinana Freeway. This existing structure is approximately 10m 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 350m south of the DE, and a lookout approximately 500m south of the DE and approximately 1.5km 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.

5.5.3.2.2 Noise and vibration

Existing noise within the DE will be dominated by current traffic noise associated with Anketell Road (classified as 'Other regional roads' in the MRS) and connecting roads.

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).

The closest noise sensitive receivers include residential dwellings (areas zoned urban) located east of the freeway, approximately 100 m north of the DE, west of Lyon Road.

5.5.3.2.3 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.

5.5.4 Potential environmental impacts

The Proposal could potentially result in the following impacts to social surroundings:

- Disturbance of one Aboriginal heritage site during clearing and/ or excavation works
- Disturbance to 10 Municipal heritage sites listed on the Kwinana Municipal Heritage Inventory
- 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. The following avoidance and minimisation measures have been incorporated into the Proposal planning:

- The DE is limited to land adjacent to existing cleared areas of Anketell Highway and the widening of Anketell Road will occur in the median where possible in order to avoid potential amenity impacts to nearby residential properties
- All associated infrastructure for the Proposal will be contained within the DE, including road pavements, footpaths, noise walls, stormwater drainage, fencing, and electrical power reticulation
- 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).
- Construction activities (including materials transport) will be limited between 0700 and 1900 Monday to Saturday, excluding public holidays (standard work hours)

- Traffic volumes, traffic mix, and road safety will influence the intersection layouts and carriageway cross section. Intersections and connecting roads will be located to reduce points of conflict and ensure maximum sight distance can be achieved for both mainline traffic and traffic on the minor roads
- A road traffic noise assessment and noise management plan will be developed, and noise modelling undertaken to identify where noise walls or any other noise mitigation measures are required. Any required noise walls will be located on the road or property boundary as identified from the noise modelling in consultation with the affected resident.
- Vibration impacts will be managed by continuous monitoring, and defining monitoring targets and stop work procedures
- Formal Archaeological and Ethnographic Aboriginal heritage surveys will be undertaken to identify any archaeological and/or ethnographic sites within the DE, as required
- Additional consultation with Traditional Owners representative groups will be undertaken to understand the significance of the area and specific sites to the relevant Traditional Owners, as required
- Aboriginal Heritage sites and places will be avoided where practicable, and will be clearly demarcated on relevant drawings, flagged on site and identified as no-go areas
- Any disturbance of Aboriginal heritage sites/materials will be undertaken in consultation with DPLH and in accordance with the requirements of the *Aboriginal Heritage Act 1972*
- Revegetation and landscaping will be undertaken in accordance with Main Roads guidelines. Main Roads will apply hard and soft surface treatments to areas not required for the road surface or associated infrastructure. Hard landscaping treatments may include paving, concrete, compacted or bound gravel. Soft landscaping treatments may include organic mulch, grass and plantings of seedlings and native plants. Landscaping of medians, verges, and interchanges will be undertaken to:
    - incorporate the road into the surrounds (physically and visually)
    - improve the visual amenity of the road reserve
    - provide a focal point or sense of place
- Revegetation will be undertaken within the road reserve, in areas cleared for construction but not required for ongoing road operation and maintenance, by direct seeding and planting of local native shrub and tree species
- Vegetation cover will be established to help prevent soil erosion and to maintain the stability of the roadside and road formation, improve the biodiversity of the road reserve and provide visual interest
- As the current concept road design progresses into the detailed design phase, impacts to social surroundings will be further considered and minimised through the management objectives, performance criteria, actions and monitoring included in the CEMP. The management measures will include:
    - Ensure compliance with the requirements of the Environmental Protection (Noise) Regulations 1997 and the Aboriginal Heritage Act 1972

- Construction techniques to control dust emissions, impacts to visual amenity, and noise and vibration impacts
- A complaints register and relevant reports (property survey reports, site inspection reports, incident reports, cultural monitoring reports, etc).

5.5.6 Assessment and significance of residual impact

5.5.6.1 Heritage

The DE intersects one Aboriginal heritage site (Place ID 3427), listed as 'Stored Data/Not a Site'. If the Proposal will cause disturbance to areas of heritage significance as identified by the planned Archaeological and Ethnographic Site Identification Aboriginal heritage surveys, Section 18 consent will be obtained via the AH Act. An activity notice and consultation with the Gnaala Karla Working Group will be required as part of the heritage approval process. Ethnographic and archaeological surveys will be required due to the varying accuracy of the existing ethnographic and archaeological surveys within the area. Main Roads will engage with DPLH as required to understand the requirements under the AH Act for Aboriginal Heritage.

The Proposal will not impact on any known registered European heritage places listed on the State Heritage Register. Ten European heritage places listed on the 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, 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 sites 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 for any impact to Municipal Heritage sites. Any structures over 60 years of age that require removal for the Proposal may require 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 the Department of Planning, Lands and Heritage (DPLH) is recommended.

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 5-26).

Figure 5-26: 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 to upgrade Anketell Road may impact on a small number of residents located towards the eastern extent of the DE.

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 is impact 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 will determine if any noise sensitive premises will be adversely impacted by the Proposal. Noise mitigation measures will be implemented based on the recommendations of the assessment.

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.

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.

5.5.7 Predicted Outcomes

Proposal impacts to Aboriginal heritage will be managed through consultation with the Gnaala Karla Working Group and AH Act Section 18 approval. Proposal impacts to historic heritage sites will be managed through consultation with the City of Kwinana. The Proposal will be designed to ensure no significant adverse impacts to Aboriginal or historic heritage.

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 and will be managed through the implementation of a CEMP. 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.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. Impacts to social amenity and visual amenity will be suitably managed with mitigation measures described and the EPA objective for Social Surroundings will be met.

6 OFFSETS

Environmental offsets are conservation actions that provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a proposal (GoWA 2014). Main Roads intend to counterbalance the residual impact of the Proposal through implementation of an environmental offset strategy. The strategy will be prepared in accordance with the WA Government's Environmental Offset Policy (GoWA 2011), WA Environmental Offset Guidelines (GoWA 2014) and the Australian Government's EPBC Act Environmental Offset Policy (DSEWPaC 2012). The offset will be proportionate to the level of impact and significance of the environmental impact.

Main Roads conducts environmental impact assessment on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development and implementation of relevant Management Plans, and finally, an offset proposal.

Main Roads is currently investigating options that will form the basis of an of offsets package to counterbalance potentially significant residual impacts associated with the Proposal. The options under investigation comprise direct and indirect offsets. The offsets package will most likely include both land acquisition and rehabilitation offsets.

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 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 is intending to refer the Proposal to the Commonwealth DCCEEW under the EPBC Act as a result of predicted significant residual impact to MNES. Referral to DCCEEW will be undertaken concurrent to the Section 38 referral. Main Roads does not intend to have this Proposal assessed as an accredited process.

Table 7-1: MNES within the DE

MNES	Impact of Proposal
Listed TECs	Clearing of up to 41.65 ha of Tuart woodlands and forests of the SCP TEC over seven patches. Clearing of up to14.26 ha of Banksia Woodlands of the SCP TEC over 9 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 6), including the clearing of up to: – 608 suitable DBH trees for Black Cockatoos, of which 18 trees contained 25 hollows that were considered of suitable depth and shape for Black Cockatoo breeding – 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo – 7.24 ha of core foraging habitat and 31.55 ha of secondary 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.

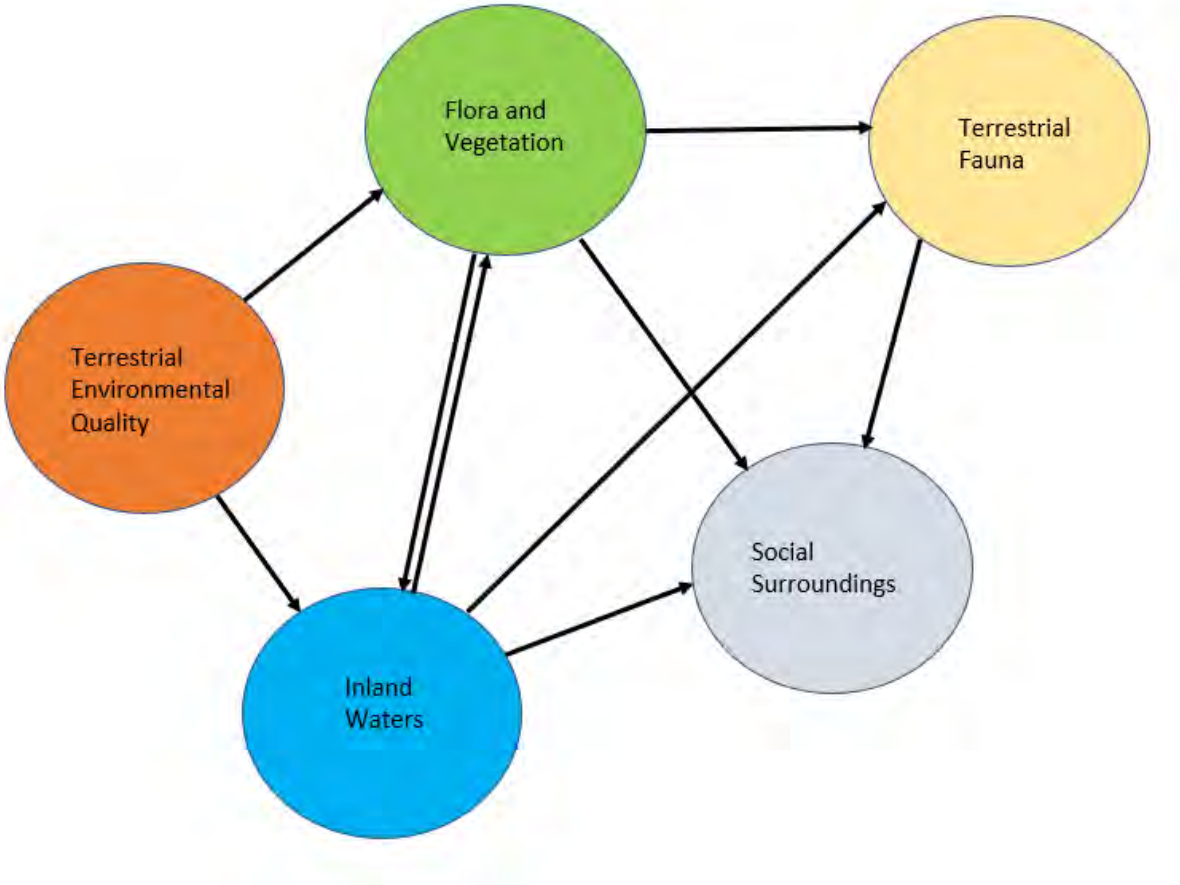
8 HOLISTIC IMPACT ASSESSMENT

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.

Given the high degree of connections and interactions between preliminary environmental factors and values applicable to the Proposal, a holistic impact assessment will be required. This will be undertaken at the future assessment stage.



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 resulting from other proposals in proximity to the current Proposal are summarised in Table 9-1.

Table 9-1: Cumulative impacts

Aspect / Project	Upgrade of Anketell Road from Leath Road to Kwinana Freeway Project Current Proposal	Westport Future Port Project	Ammonia Expansion Project	H2Perth Proposal	Various planning proposals, at different stages in the planning process
Proponent	Main Roads Western Australia	Westport	CSBP Limited	Woodside Energy Technologies Pty Ltd	DevelopmentWA The Western Australian Planning Commission Private companies
Proposed Project commencement	2024	2024	2024	2024	Ongoing
Description	Construction of the first stage of the 13 km Anketell-Thomas Road freight corridor, to connect the future terminal in Kwinana's Outer Harbour with Tonkin Highway.	Construction and operation of a new land-backed port in the KIA.	Construction and operation of a new ammonia plant 'AP3' within the CSBP Kwinana Industrial Complex in the KIA.	Construction and operation of a domestic and export scale hydrogen and ammonia production facility.	Residential and industrial development. The extent of these developments is 3,553.27 ha within the 17,858.16 ha 5 km buffer of the DE.
Location	Anketell road between Leath Road, and Kwinana Freeway.	Within the KIA.	Kwinana Beach Road, Kwinana WA (Lot 20 on Diagram 78086). Within the KIA	Lot 149 on Deposited Plan 68599, Lot 108 on Deposited Plan 400167, and the existing pipeline corridor in Lot 110 and Lot 497. Within the KIA.	Within a 5 km buffer of the DE as mapped in Figure 1-2.
Proposed vegetation clearing (terrestrial)	96.20 ha	approximately 16.7 ha	Less than 1 ha.	0.66 ha.	1,442.46 ha
Significant vegetation and flora	– 41.65 ha of Tuart woodlands and forests of the SCP TEC – 14.26 ha of Banksia woodlands of the SCP TEC – 15.67 ha of Banksia woodlands of the SCP PEC – 66.24 ha of Northern Spearwood shrublands and woodlands (FTC24) PEC – 0.49 ha of Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP PEC – 1 individual of *Poranthera moorokatta* (P2) – Multiple individuals of *Hibbertia leptotheca* (Priority 3) – 9 individuals of *Pimelea calcicola* (Priority 3) – Multiple individuals (greater than 149) of *Eucalyptus foecunda* subsp. *foecunda* (Priority 4)	Based on the results of a desktop assessment for the terrestrial DE: – Three TECs and two other PECs have the potential to occur – One threatened flora species and eight priority flora species may potentially occur	None.	None.	Undetermined.
Vegetation in conservation areas	– 3.71 ha of vegetation within Bush Forever Sites – 0.55 ha of vegetation within Class A Conservation Reserve R 53313	None.	None.	None.	– 772.31 ha of vegetation within Bush Forever Sites – 79.15 ha of Class C Reserve R 39584, 213.63 ha of Class A Reserve R 29241, 122.50 ha of Reserve R 39752, 162.15 ha of DBCA land no. 1892/770
Terrestrial fauna	– 135.50 ha of fauna habitat – 608 suitable DBH trees. Of these, 18 trees contained 25 hollows that were considered of suitable depth and shape for Black Cockatoo breeding	Based on the results of a desktop assessment for the terrestrial DE: – Three threatened, five priority and one 'other protected' vertebrate fauna species may potentially occur	– Less than 1 ha of vegetation potentially suitable for Quenda – Less than 1 ha of vegetation potentially suitable for Black Cockatoo species.	– Approximately 0.14 ha of habitat potentially suitable for Quenda – Approximately 0.5 ha of potentially suitable Black Cockatoo habitat.	Undetermined.

Aspect / Project	Upgrade of Anketell Road from Leath Road to Kwinana Freeway Project Current Proposal	Westport Future Port Project	Ammonia Expansion Project	H2Perth Proposal	Various planning proposals, at different stages in the planning process
	– 16.11 ha of core foraging habitat and 41.75 ha of secondary foraging habitat for Carnaby's Cockatoo – 7.24 ha of core foraging habitat and 31.55 ha of secondary foraging habitat for FRTBC – 96.21 ha of core habitat for Quenda – 45.15 ha of core habitat for Perth Lined Slider, Graceful Sunmoth and Black-striped Snake – 59.10 ha of core habitat for Swan Coastal Plain Shield– backed Trapdoor Spider – 221.11 ha of secondary habitat for Peregrine Falcon – 59.10 ha of secondary habitat for Chuditch – 17.27 ha of secondary habitat for Western Brush Wallaby – 36.39 ha of secondary habitat for Glossy Ibis.	– 13 listed migratory fauna species (all birds) were considered to potentially occur. Preliminary findings from the field survey indicate: – Individuals and secondary evidence (diggings) of quenda were recorded – No other conservation significant vertebrate fauna were recorded – No individuals or secondary evidence of any black cockatoo species were recorded – 99 trees were assessed as potential habitat trees for black cockatoos within the survey area (which is larger than the terrestrial DE and therefore a lower number may apply), with none having hollows present. No evidence of breeding activity was recorded. The survey area is unlikely to support roosting habitat for Carnaby's cockatoo, whilst suitable roosting habitat for forest red-tailed black cockatoos, which have more general habitat preferences, may occur in small portions of the survey area. Based on the shorebirds surveys in November 2023, shorebird numbers recorded were low overall, with four listed migratory species observed: – *Actitis hypoleucos* (common sandpiper) – *Calidris canutus* (red knot) – *Hydroprogne caspi* (Caspian tern) – *Thalasseus bergii* (crested tern).			
Inland waters	Loss of up to 0.22 ha of native vegetation within 9.76 ha of mapped MUWs (UFI 6530, 6538)	None.	None.	None.	Los of up to 116.83 ha of native vegetation within CCW, 23.84 ha of native vegetation within MUW, and 40.87 ha of native vegetation within REW.

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*
AMD	
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

Abbreviation / acronym	Definition
DSR	Detailed Summary of Records
DWER	Department of Water and Environmental Regulation
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
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
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
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

10.2 References

Australian Burra Charter Practice Notes (2013).

ASRIS (2023). Australian Soil Resource Information Viewer, retrieved September 2023, from http://www.asris.csiro.au/index.

Beard, JS (1979). Vegetation Survey of WA: the Vegetation of the Perth Area WA, map and explanatory memoir 1:250,000 series, Applecross, Vegmap Publications.

Beard JS (1990). Plant Life of Western Australia. Perth: Kangaroo Press.

Biota (2021). Anketell Road Targeted Orchid Survey: Winter 2021. Unpublished report prepared for Main Roads, Western Australia.

Biota (2022). Anketell Road Planning Study Biological Survey. Unpublished report prepared for Main Roads, Western Australia.

Biota (2023). Westport Freight Road Additional biological Survey. Unpublished draft report prepared for Main Roads, Western Australia.

Biota (2024). Anketell Rd Upgrade – Consolidated Biological Report. Unpublished report prepared for Main Roads, Western Australia.

Bureau of Meteorology Australia (2023). Climate Averages for Australian Sites – Anketell, Station No. 9258. Available online from: http://www.bom.gov.au/climate/data/index.shtml. Accessed August 2023.

CALM (2006). Beeliar Regional Park Final Management Plan. Prepared for Conservation Commission of Western Australia.

City of Kwinana (2017). Hall Reserve - Mandogalup, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12100.

City of Kwinana (2023a). The Spectacles Wetland, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12098.

City of Kwinana (2023b). Soldier Settler Homes, Mandogalup, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12092.

City of Kwinana (2023c). Mandogalup Post Office (fmr), retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12087.

City of Kwinana (2023d). Tramway Reserve - site, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12127.

City of Kwinana (2023e). White Bridge, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12115.

City of Kwinana (2023f). Jolly's Bridge, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12114.

City of Kwinana (2023g). Mandogalup Townsite, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12125.

City of Kwinana (2023h). Balmanup Post Office – Site of, retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12116.

City of Kwinana (2023i). 7 Mile Site ("Sevvy" to later settlers), retrieved October 2023, from http://inherit.stateheritage.wa.gov.au/public/p/12130.

Commonwealth of Australia (2001). National Objectives and Targets for Biodiversity Conservation 2001 – 2005. Available from: National Objectives and Targets for Biodiversity Conservation 2001-2005 2001–2005 (habitatadvocate.com.au)

DAWE (2022). 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). Commonwealth of Australia, Canberra.

DBCA (2020). Phytophthora Dieback Management Manual, October 2020, Department of Biodiversity, Conservation and Attractions, Perth.

DBCA (2023). Priority Ecological Communities for Western Australia, version 35, Available from: https://www.dbca.wa.gov.au/media/1730/download

DCCEEW (2023). Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results, retrieved September 2023, from http://www.environment.gov.au/epbc/pmst/index.html.

DEC (2011). A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities.

DEC (2012). Chuditch (Dasyurus geoffroii) National Recovery Plan. Wildlife Management Program No. 54, Department of Environment and Conservation. Retrieved from http://www.environment.gov.au/biodiversity/threatened/publications/recovery/chuditch/index.html

DEE (2016a). Tuart (Eucalyptus Gomphocephala) Woodlands and Forests of the Swan Coastal Plain Ecological Community, Draft Conservation Advice Including Draft Listing Advice. October 2017.

DEE (2016b). Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community. Canberra: TSSC, Threatened Species Scientific Committee. July 2023.

DEE (2019). Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/153-conservation-advice.pdf.

DER (2015a). Identification and Investigation of Acid Sulfate Soils (ASS) and Acidic Landscapes, June 2015.

DER (2015b). Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes, June 2015.

DoE (2013a). Survey Guidelines for Australia's Threatened Orchids: Guidelines for Detecting Orchids Listed as "Threatened" Under the Environment Protection and Biodiversity Conservation Act 1999. Draft for public comment, Department of the Environment, Canberra, Australia.

DoE (2013b). Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Canberra, Australian Capital Territory.

Department of Finance (2021). Finance Technical Guideline: TG010 Acid Sulfate Soils.

DoEE (2019). Approved conservation advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community. Australian Government, Canberra, ACT. July 2022.

DPLH (2019). Road and Rail Noise Guidelines.

DPLH (2020). Town of Kwinana Local Planning Scheme No. 3 (Town Centre) - Updated to include AMD 5 GG.

DPLH (2021). Town of Kwinana Local Planning Scheme No. 2 - Updated to include AMD 152 GG.

DSEWPaC (2012). Environment Protection and Biodiversity Act 1999 Environmental Offset Policy.

DoW (2006). Water Quality Protection Note 44, Roads Near Sensitive Water Resources. Department of Water, Government of WA.

DoW (2009). Jandakot Drainage and Water Management Plan. Department of Water, Government of WA.

DWER (2021). Environmental offsets metric: Quantifying environmental offsets in Western Australia.

DWER (2021a). Guideline: Assessment and management of contaminated sites.

DWER (2021b). Guideline: Dust emissions.

DWER (2021). Environmental offsets metric: Quantifying environmental offsets in Western Australia. Available from Environmental offsets metric - Quantifying environmental offsets in WA (www.wa.gov.au)

DWER (2023). Perth Groundwater Map, https://maps.water.wa.gov.au/Groundwater/ Accessed September 2023.

Drake P, Froend R, Franks, P (2011) Linking hydraulic conductivity and photosynthesis to water-source partitioning in trees versus seedlings. Tree Physiology 31: 763-773.

EPA (2013). Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20.

EPA (2016a). Environmental Factor Guideline: Flora and Vegetation, December 2016.

EPA (2016b). Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment, December 2016.

EPA (2016c). Environmental Factor Guideline: Terrestrial Fauna, December 2016

EPA (2016d). Environmental Factor Guideline – Terrestrial Environmental Quality, December 2016.

EPA (2018). Environmental Factor Guideline: Inland Waters, June 2018.

EPA (2020). Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment, July 2020.

EPA (2021a). Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2021 December 2021.

EPA (2021b). Instructions on how to prepare an Environmental Review Document, October 2021.

EPA (2021c). Referral of a proposal under section 38 of the Environmental Protection Act 1986 Instructions, October 2021.

EPA (2022). Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual, October 2021.

EPA (2023a). Statement of Environmental Principles, Factors, Objectives and Aims of EIA, April 2023.

EPA (2023b). Environmental Factor Guideline: Social Surroundings, June 2023.

Franks P, Drake P, Froend R (2007) Anisohydric but isohydrodynamic: seasonally constant plant water potential gradient explained by a stomatal control mechanism incorporating variable plant hydraulic conductance. Plant, Cell and Environment. 30(1) 19-30.

Gibson, N., B. Keighery, G. Keighery, A. Burbidge, and M. Lyons (1994). A floristic survey of the southern Swan Coastal Plain. Department of Conservation and Land Management, Western Australia.

Golder (2022). MRWA Westport Project – Anketell Road and Thomas Road, Kwinana to Oakford.

GoWA (1997). Wetlands Conservation Policy for Western Australia. Prepared by the Department of Conservation and Land Management and Waters and Rivers Commission. Perth, Western Australia.

GoWA (2000a). Bush Forever, Volume 2: Directory of Bush Forever Sites, Department of Environmental Protection, Perth.

GoWA (2000b). Bush Forever, Volume 1: Policies, Principles and Processes, Department of Environmental Protection, Perth.

GoWA (2011). Western Australian Environmental Offsets Policy, September 2011.

GoWA (2014). Western Australian Environmental Offset Guidelines, August 2014.

GoWA (2019). 2018 South West Vegetation Complex Statistics, Current as of March 2019, Perth, Australia, Department of Biodiversity, Conservation and Attractions, retrieved September 2023, from https://catalogue.data.wa.gov.au/dataset/dbca.

GoWA (2022). Guidelines for Local Heritage Surveys.

GoWA (2023). DataWA, retrieved September 2023, from https://data.wa.gov.au/.

Heddle EM, Havel JJ and Loneragan OW (1980). Vegetation Complexes of the Darling System, Western Australia, In: Atlas of natural resources darling system, Western Australia, Department of Conservation and Environment, Perth, WA.

Hill, AL, Semeniuk CA, Semeniuk V and Del Marco A (1996). Wetlands of the Swan Coastal Plain, Wetland Mapping, Classification and Evaluation Volume 2a, Waters and Rivers Commission.

Johnstone RE, Johnstone C and Kirkby T (2010). Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo on the Swan Coastal Plain, Western Australia: Studies on distribution, status, breeding, food movements and historical changes. Report to the Department of Planning, Perth.

Johnstone, RE and Storr, GM (1998). Handbook of Western Australian Birds, Volume 1: Non-passerines (Emu to Dollarbird), Perth, Australia, Western Australian Museum.

Keighery, G., N. Gibson, B. Muir, and B. Keighery (2003). Common and rare limestone communities of the Swan Coastal Plain. Summary Proceedings, Threatened Ecological Communities Symposium. Page Summary Proceedings. Perth.

LandCorp (2007). Hope Valley Wattleup Redevelopment Project Biodiversity Strategy.

Mitchell, D, Williams, K & Desmond, A (2002). SCP 2 (SWA2 — SCP subregion), in Department of Conservation and Land Management (ed). A Biodiversity Audit of WA's 53 Biogeographical Subregions in 2002, pp 724.

Peck A, Barrett G and Williams M (2019). The 2019 Great Cocky Count: A community-based survey for Carnaby's Black-Cockatoo (Calyptorhynchus latirostris), Baudin's Black-Cockatoo (Calyptorhynchus baudinii) and Forest Red-tailed Black-Cockatoo (Calyptorhynchus banksii naso),

BirdLife Australia and Department of Biodiversity, Conservation and Attractions, Floreat, Western Australia.

Perth Biodiversity Project (2004). Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region. Western Australian Local Government Association, Perth.

Pizzey, G., and F. Knight (2007). The Field Guide to the Birds of Australia, 8th edition. Harper Collins Publishers, Sydney.

Rix, M. G., J. A. Huey, S. J. B. Cooper, A. D. Austin, and M. S. Harvey (2018). Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from southwestern Australia. ZooKeys 756:1–121.

Schoknecht N, Tille, P and Purdie, B (2004). Soil-landscape mapping in South-western Australia. Resource Management Technical Report 280. Perth, Western Australia, Department of Agriculture.

Senversa (2024). Preliminary Site Investigation, Anketell Road and Thomas Road Transport Corridor (West Site). Prepared for Main Roads Western Australia.

Sommer, B and Froend, R 2011, Resilience of phreatophytic vegetation to groundwater drawdown: is recovery possible under a drying climate? J Ecohydrology. 4: 67-82.

South Coast NRM 2023, Project Dieback. Accessed November 2023, from https://dieback.net.au/dieback-public-map/.

Thiele, K. R. (2019). The Hibbertia polystachya - H. spicata (Dilleniaceae) species group in Western Australia. Nuytsia 30:291–308.

Urban Bushland Council WA Inc (2020). The Urban Bush Telegraph Winter 2020. July 2020.

van Dyck, S., and R. Strahan (Eds.) (2008). The Mammals of Australia, 3rd edition. Reed New Holland, Sydney.

WA Herbarium (2024). Florabase - the Western Australian Flora [WWW Document]. Department of Biodiversity, Conservation and Attractions. Retrieved from http://florabase.dbca.wa.gov.au/.

WRC (2001). Water and Rivers Commission Position Statement: Wetlands, Water and Rivers Commission, East Perth.

WAPC (2006). Statement of Planning Policy 2.9 Water Resources. Western Australian Gazette, Special Gazette No. 227, 19 December 2006.

Westport (2020). Supporting document to the Westport: Future port recommendations Stage 2 Report. Government of Western Australia, Perth, Western Australia.

Wilson, S., and G. Swan (2017). A Complete Guide to Reptiles of Australia, 5th edition. New Holland.

Woinarski, J. C. Z., A. A. Burbidge, and P. L. Harrison (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing, Victoria.

Woinarksi, J., and A. A. Burbidge (2016). Macropus irma. The IUCN Red List of Threatened Species [WWW Document]. Retrieved from http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T12626A21953231.en.

11 APPENDICES

Appendix	Title
Appendix 1	Westport Freight Road Additional Biological Survey (Biota 2024)
Appendix 2	Preliminary Site Investigation, Anketell Road and Thomas Road Transport Corridor (West Site) (Senversa 2024)

Appendix 1: Anketell Rd Upgrade – Consolidated Biological Report (Biota 2024)

Appendix 2: Preliminary Site Investigation, Anketell Road and Thomas Road Transport Corridor (West Site) (Senversa 2024)