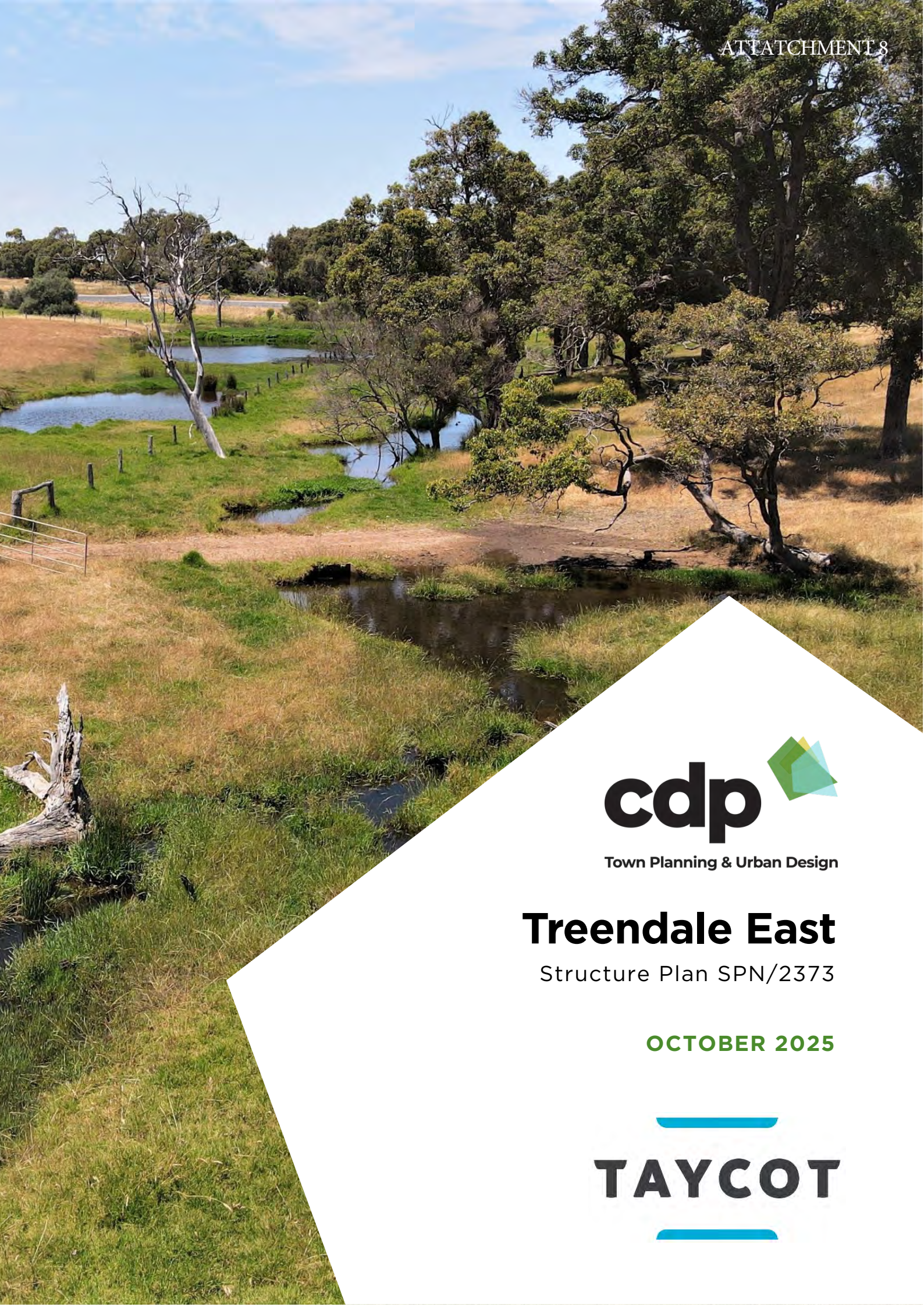
ATTATCHMENT 8



cdp

Town Planning & Urban Design

Treendale East

Structure Plan SPN/2373

OCTOBER 2025

TAYCOT

Treendale East

Structure Plan SPN/2373

OCTOBER 2025

Prepared by. CDP Town Planning & Urban Design
2/464 Murray Street
PERTH WA 6000

p. +61 8 6333 1888
e. info@cdpaus.com.au
w. www.cdpaus.com.au

Prepared for. TAYCOT
1/149 Victoria Street
BUNBURY WA 6230

p. +61 8 9791 5511
e. travis@taycot.com.au
w. www@taycot.com.au

In Collaboration with.

WML Consulting Engineers
Civil Engineering

Emerge Associates
Environment, Landscape, Hydrology, Bushfire

Transcore
Traffic & Transport

Thompsons
Surveying

RPS Australia
Retail & Market Sustainability Assessment

Lloyd George Acoustics
Road Acoustics

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4.1	Minor change to Table 1-2	DM	DM	11.09.2025
4.2	Update LWMS date section 5 & Part 3	DM	DM	30.10.2025

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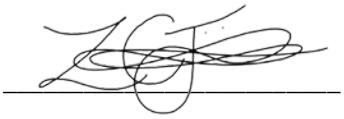
Endorsement

This Structure Plan is prepared under the provisions of the Shire of Harvey Local Planning Scheme No. 2.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON

19 November 2025

Signed for and on behalf of the Western Australian Planning Commission



An officer of the Commission duly authorised by the Commission pursuant to section 24 of the *Planning and Development Act 2005* for that purpose, in the presence of:



Witness

05 December 2025 Date

05 December 2035 Date of Expiry

Table of Amendments

No.	Summary	Date approved by WAPC

Executive Summary

The *Treendale East Local Structure Plan* (**Structure Plan**) has been prepared to support subdivision and development of Lots 151, 152, and 50 on the north-east corner of Forrest Highway and Raymond Road, Roelands, within the Shire of Harvey.

Purpose

This Structure Plan provides an overarching planning framework to guide and facilitate the development of 188.5 hectares of land on Lots 151 on Deposited Plan 418088, Lot 152 on DP418089, and 50 on DP421006.

The Structure Plan provides for an integrated and coordinated approach to provision of an appropriate mix of residential land uses, supporting commercial and community purposes development, and infrastructure to create a strong and vibrant new community in Bunbury's northern corridor

Vision

The vision for Treendale East is to develop a future-ready contemporary and sustainable residential community within the Greater Bunbury area that has a distinctive identity and sense of place in response to its physical and social context.

Treendale East will provide a well-treed, pedestrian and cycle-friendly environment for residents and visitors, with the regenerated Treendale Gully as a visual and activity focal point for passive recreation and interpretation of Wardandi cultural heritage. Engagement with Wardandi elders will inform the detailed design of the waterway and foreshore remediation.

In devising a vision and preliminary design concept for Treendale East, the project team has engaged with multiple subject matter experts and service delivery agencies including the Shire of Harvey, to understand how genuinely sustainable buildings and public realm can be implemented. Ongoing engagement, goodwill, and cooperation between the developer and stakeholders will be required to achieve the genuinely innovative and successful outcomes sought.

Design Approach

The approach to design has involved a rigorous multidisciplinary process with continuous reflection upon the purpose of the Structure Plan and improving sustainability outcomes. Design principles and considerations which have informed the design approach include:

- Public open space allocation, including retention of quality remnant vegetation and community creation.
- Urban structure and place making.
- Movement systems and connectivity.
- Innovative built form.
- Landform and environment.
- Cultural heritage.

Project Overview

The Treendale East development will provide an anticipated 2,200 dwellings, which will ultimately house a new community of around 5,720 residents within a variety of lot product and dwelling types and generous public open space and streetscapes.

In addition to approximately 1,500 dwellings within the 'Domain' precinct, the Structure Plan will provide approximately 700 dwellings and compatible land uses within a 'Village' precinct, along with a Neighbourhood Centre Precinct and a Primary School with co-located Senior Playing Field. The

development will focus on high quality public realm and a public open space system linked to the significant landscape feature of Treendale Gully, a tributary of the Collie River and a registered Aboriginal Heritage site.

Summary Table

Item	Data	Reference (Section No.)
Total Structure Plan Area	188.50 ha	1.2.2, pg. 1
Area of each land use proposed: • 'Domain' Residential • 'Village' Residential • Neighbourhood Centre • Primary School • Public Open Space (Gross) • Drainage • Public Purpose/Service Infrastructure	 101.418 ha 29.869 ha 2.893 ha 4.0 ha 43.867 ha 1.776ha 0.160 ha	4.6, pg. 48
Total Estimated Lot Yield Comprising: ▪ Domain Precinct ▪ Village Precinct	2,200 (1,500) (700)	4.7.1, pg. 49
Estimated Number of Dwellings	2,200	
Estimated Residential Site Density ▪ Per Gross Urban Zone ▪ Per Site Hectare	 11.67 Dwellings 21.734 Dwellings	 4.7.1, pg. 49 4.7.2, pg. 50
Estimated Population (Permanent Residents) @ 2.6/dw	5,720	4.7.1, pg 49
Number of High Schools	0	4.12.1, pg 63
Number of Primary Schools	1	4.12.2, pg 63
Estimated Commercial Floor Space (retail)	4,000m^2 NLA	4.13.1, pg 65
Estimated Open Space and Percentage of Total Site (Number/Area/Percentage): ▪ Regional Open Space ▪ District Open Space ▪ Neighbourhood Parks ▪ Local Parks ▪ Conservation Bushland ▪ Riparian Corridor ▪ Landscape / Acoustic Buffer	 0 / 0 / 0.0% 1 / 4.11ha / 2.74% 1 / 5.590ha / 3.73% 6 / 4.054ha / 2.71% 1 / 12.07ha / 8.06% 4 / 15.826ha / 10.56% 5 / 6.936ha / 4.63%	4.11, pg 63
Estimated percentage of natural area (% of gross area)	48.38ha / 32.3%	4.11, pg 63 4.5.5, 4.5.6, pg 47

Key Abbreviations

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ASS	Acid Sulphate Soils
AS	Australian Standard
BGL	Below Ground Level
BMP	Bushfire Management Plan
BORR	Bunbury Outer Ring Road (now named Wilman Wadandi Highway)
BRA	Bio-Retention Areas
CBD	Central Business District
CCW	Conservation Category Wetland
DPLH	Department of Planning, Lands & Heritage
DWER	Department of Water & Environmental Regulation
DWMS	District Water Management Strategy
EPA	Environmental Protection Authority
GBRS	Greater Bunbury Region Scheme
LDP	Local Development Plan
LILO	Left In, Left Out
LWMS	Local Water Management Strategy
LPP	Local Planning Policy
MUW	Multiple Use Wetland
OP	Operational Policy (formerly Development Control Policy)
PCA	Planning Control Area
REW	Resource Enhancement Wetland
SPP	State Planning Policy
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission

Contents

Endorsement ii

Table of Amendments iii

Executive Summary iv

Key Abbreviations vi

Part One - Implementation 1

1. Structure Plan Area 1

2. Operation 1

3. Purpose 1

4. Staging 1

5. Subdivision & Development Requirements 2

5.1 Structure Plan Map 2

5.2 Land Use Permissibility 2

5.3 Neighbourhood Centre Zone 2

5.3.1 Objectives 2

5.3.2 Density Code 2

5.3.3 Retail Floorspace 2

5.4 Residential (Village) Zone 2

5.4.1 Objectives 2

5.4.2 Density Code 2

5.4.3 Residential (Village) Zone Additional Uses 2

5.5 Residential Zone 3

5.5.1 Dwelling Targets 3

5.5.2 Density Targets 3

5.5.3 Density Plans 4

5.6 Public Open Space 4

5.7 Road Reserves 4

5.8 Other Reserves 5

5.9 Other requirements 5

5.9.1 Bushfire Protection 5

5.9.2 Noise Management 5

5.9.3 High Pressure Gas Pipeline 5

5.9.4 Protection or management of environmental or landscape features 5

5.9.5 Infrastructure Arrangements 6

5.9.6 Development Contributions 6

5.9.7 Water Resource Management ... 6

6. Local Development Plans ... 6

6.1 Prescribed Requirements ... 6

6.2 WAPC Planning Bulletin 112/2016 ... 8

7. Additional Details ... 9

Part Two Explanatory Section ... 1

1. Planning Background ... 1

1.1 Introduction & Purpose ... 1

1.2 Land Description ... 1

1.2.1 Location ... 1

1.2.2 Area, Land Use & Ownership ... 1

1.3 Planning Framework ... 4

1.3.1 Zoning & Reservations ... 4

1.3.2 Strategic Plans & Policies ... 4

1.4 Pre-Lodgement Consultation ... 14

2. Site Characteristics & Context ... 17

2.1 Context ... 17

2.1.1 Surrounding Land Uses ... 17

2.1.2 Movement Network ... 17

2.1.3 Existing Retail & Commercial ... 18

2.1.4 Employment Land ... 18

2.1.5 Education Facilities ... 20

2.1.6 Open Space & Reserves ... 20

2.1.7 Service Infrastructure ... 20

2.1.8 Natural & Manmade Drainage ... 22

2.1.9 Residential Land Supply ... 22

2.2 Biodiversity & Natural Area Assets ... 23

2.2.1 Flora ... 23

2.2.2 Reserves & Conservation Areas ... 24

2.2.3 Fauna ... 24

2.3 Landform & Soils ... 25

2.3.1 Topography ... 25

2.3.2 Soils ... 25

2.3.3 Geotechnical ... 25

2.3.4 Acid Sulphate Soils ... 26

2.3.5 Views ... 26

2.4 Surface & Groundwater 26
2.4.1 Surface Water 26
2.4.2 Groundwater 27
2.4.3 Wetlands 27
2.4.4 Flooding & Inundation Risk 27
2.5 Bushfire Hazard 27
2.6 Heritage 27
2.6.1 Aboriginal Heritage 27
2.6.2 Non-Indigenous Heritage 28
2.7 Noise Impact 28
3. Opportunities & Constraints 30
4. Structure Plan Proposals 32
4.1 Structure Plan Objectives 32
4.2 Design Philosophy 32
4.3 Urban Design Response 35
4.3.1 Domain Precinct 37
4.3.2 Village Precinct 38
4.4 Streets 39
4.4.1 Green Streets 39
4.4.2 Quiet Streets 40
4.5 Landscape Strategy 46
4.5.1 Linear Open Space 46
4.5.2 Neighbourhood & Local Parks 46
4.5.3 Playing Fields 46
4.5.4 Civic 47
4.5.5 Conservation Public Open Space 47
4.5.6 Foreshore Public Open Space (Riparian Corridors) 47
4.5.7 Buffer 48
4.5.8 Streetscapes 48
4.6 Land Uses 48
4.6.1 Land Use Permissibility 49
4.7 Dwelling Forecasts 49
4.7.1 Bunbury-Geographe Sub-Regional Strategy 49
4.7.2 Liveable Neighbourhoods 50
4.8 Residential Densities 50
4.8.1 Residential R25 and R30 51

4.8.2 Residential R40 51
4.8.3 Residential R50 and R60 51
4.8.4 Residential R80 51
4.9 Local Development Plans 52
4.9.1 RMD Codes 52
4.9.2 Prescribed Requirements 52
4.9.3 Neighbourhood Centre Zoned Land 52
4.9.4 Village Precinct 53
4.9.5 Quiet Street Culs-de-sac 53
4.10 Movement Network 54
4.10.1 Proposed Road Network 54
4.10.2 Public Transport 56
4.10.3 Pedestrians & Cyclists 56
4.11 Public Open Space 63
4.12 Education & Community Facilities 63
4.12.1 High Schools 63
4.12.2 Primary School 63
4.12.3 Community Facilities 64
4.13 Activity Centres 65
4.13.1 Overview 65
4.13.2 Neighbourhood Activity Centre 65
4.14 Water Management 66
4.14.1 Water Management Strategy 66
4.15 Infrastructure Servicing & Staging 68
4.15.1 Earthworks 68
4.15.2 Drainage 68
4.15.3 Sewer 68
4.15.4 Water 68
4.15.5 Power 69
4.15.6 Gas 69
4.15.7 Telecommunications 69
4.15.8 Primary Road Infrastructure Funding 69
4.15.9 Staging and Implementation 69
4.16 Development Contribution Arrangements 70
5. Technical Appendices Index 71

Technical Appendices

Appendix 1. Bushfire Management Plan

Appendix 2. Transport Impact Assessment

Appendix 3. Environmental Assessment & Management Strategy

Appendix 4. Water Management Strategy

Appendix 5. Landscape & Irrigation Strategy

Appendix 6. Engineering Servicing Report

Appendix 7. Geotechnical Investigation

Appendix 8. Acoustic Assessment

Appendix 9. Retail & Market Sustainability Assessment

Appendix 10. Alignment with SPP 4.2 Activity Centres

Appendix 11. Certificates of Title

Appendix 12. PB112/2016 Medium Density Single Houses

Plans

Plan 1. Structure Plan Map 10
Plan 2. Public Open Space Plan 11

Part One Figures

Figure 1 - 1. Integrator Arterials & Neighbourhood Connectors 12
Figure 1 - 2. Neighbourhood Connector B, Access Streets A, C & D 13
Figure 1 - 3. Access Street D alternatives, Laneways 14

Part Two Figures

Figure 1. Location 2
Figure 2. Aerial Photograph & Land Ownership 3
Figure 3. GBRS Zoning 5
Figure 4. Shire of Harvey LPS 2 Zoning 6
Figure 5. Bunbury-Geographe Sub-regional Strategy Map 15
Figure 6. Shire of Harvey Local Planning Strategy Map - Roelands 16
Figure 7. District Context 19
Figure 8. School Catchments Plan 21
Figure 9. Noise Level Contours 29
Figure 10. Concept Masterplan 36
Figure 11. Green Street Concept 40
Figure 12. Quiet Streets Overview 43
Figure 13. Quiet Street 'Choker Green' 44
Figure 14. Quiet Street 'Choker' 44
Figure 15. Quiet Street ‘Choker’ 20 metre wide reserve 45
Figure 16. Quiet Street 'Cul-de-sac' 45

Figure 17. Structure Plan Road Hierarchy....57
Figure 18. Higher Order Road Network Cross-Section....58
Figure 19. Middle Order Road Network Cross-Sections....59
Figure 20. Lower Order Road Network Cross-Sections & Key Interfaces....60
Figure 21. Public Open Space Provision....61
Figure 22. Primary School & Senior Playing Field....64
Figure 23. Indicative Neighbourhood Centre Concept....67

Part One Tables

Table 1 - 1. Retail Floorspace....2
Table 1 - 2. Density Locational Criteria....3
Table 1 - 3. Road Hierarchy....5
Table 1 - 4. Other Reserves....5
Table 1 - 5. Information to be Submitted with an Application....9
Table 1 - 6. Studies to be Required as a Condition of Subdivision or Development Approval....9

Part Two Tables

Table 1. Title Details....1
Table 2. Planning Framework....7
Table 3. Pre-Lodgement Consultation....14
Table 4. Unmodified Soil Classes....26
Table 5. Land Use Composition....48
Table 6. Comparative Directions 2031 Targets....50
Table 7. Public Open Space Summary....62

Part One
Implementation

TREENDALE EAST STRUCTURE PLAN



Part One - Implementation

1. Structure Plan Area

This Structure Plan applies to parts of Lots 151, 152, and 50 on Deposited Plans 418088, 410889, and 421006 respectively, being the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map (**Plan 1**).

The Structure Plan is identified as the **Treendale East Local Structure Plan**.

2. Operation

This Structure Plan comes into effect on the date shown on the cover and for a period of ten years.

The Structure Plan is to be given due regard when considering development or subdivision applications. Other instruments informing implementation of the Structure Plan include State Planning Policies (**SPPs**) the Greater Bunbury Region Scheme (**GBRS**) and policies, the Shire of Harvey's operative Local Planning Scheme (**LPS**) and local planning policies (**LPPs**).

3. Purpose

The Structure Plan provides for an integrated and coordinated approach to provision of an appropriate mix of residential land uses, supporting commercial and community purposes development, and infrastructure to create a strong and vibrant new community in Bunbury's northern corridor.

4. Staging

The development of the Structure Plan Area will be implemented in stages. The exact timing, location and composition of the future stages will be dependent on market demand and detailed design; however it is projected to be a 15 – 20 year project based on 100 lots sold per annum.

Staging will commence in the south-central and south-western portions of the estate fronting Raymond Road so to utilise existing services and road infrastructure. A Display Village, Sales Office and 'first release' residential land (i.e. 100 – 150 lots) is expected to be within the first stage. Subsequent stages will be constructed from south to north, spanning west then east, for efficient incremental advancement of road and service infrastructure.

A comprehensive program for provision of traffic intersections with Raymond Road and Forrest Highway will be prepared as part of ongoing detailed planning and design of service infrastructure. The early construction of the Forrest Highway (left-in/left-out) access will be influenced by peak traffic demands at the Raymond Road main intersection. The eastern-most left-in/left-out access off Raymond Road will be retained to service an existing farming property, and to offer interim secondary access for fire and emergency services.

Staging of the Neighbourhood Centre zone will be subject to the development's commercial catchment viability. Some aspects of the Neighbourhood Centre zone may see early development without prejudicing the site's overall built form and social objectives. The same may apply to the Residential (Village) zone whereby early demand for tourism, lifestyle, or other complementary land uses may see development of this precinct concurrent with the initial residential stages within the Domain precinct. The progress of the Village is not reliant on advancement of the residential Domain precinct other than construction of the Raymond Road main entry.

Development of the primary school is subject to local demand, that is, more than 1,000 residential lots pursuant to Department of Education policy frameworks. It is expected that the District parkland (playing field) will be developed ahead of the primary school.

5. Subdivision & Development Requirements

5.1 Structure Plan Map

Plan 1 designates proposed zones and reserves in the Structure Plan area in accordance with Schedule 1, cl. 16(1A) of the Regulations which guides decision making for subdivision and development in Treendale East.

5.2 Land Use Permissibility

Land use permissibility within the Structure Plan area is to be in accordance with the corresponding zone or reserve under the operative Shire of Harvey Local Planning Scheme ('the Scheme') unless otherwise varied under the Structure Plan zones below.

5.3 Neighbourhood Centre Zone

5.3.1 Objectives

The Objectives for this zone are in accordance with the Scheme.

5.3.2 Density Code

A density code of R80 shall apply to any residential dwellings within the Neighbourhood Centre Zone.

5.3.3 Retail Floorspace

Retail floorspace or Nett Lettable Area (NLA) within the Structure Plan Area will generally be in accordance with **Table 1 - 1.**

The maximum NLA included in **Table 1 - 1** may be exceeded through a Local Development Plan for the entire centre where the requirements of *State Planning Policy 4.2 – Activity Centres* are met to the satisfaction of the WAPC and the Shire of Harvey.

Table 1 - 1. Retail Floorspace

Land Use	Maximum Nett Lettable Area (NLA)
Neighbourhood Centre	4,000m^2

5.4 Residential (Village) Zone

5.4.1 Objectives

The objectives for this zone are in accordance with the Scheme.

5.4.2 Density Code

A density code of R30 shall apply to any residential dwellings within the Residential (Village) Zone.

5.4.3 Residential (Village) Zone Additional Uses

Additional uses may be considered within the Residential (Village) zone to support its land use objectives and the intent for the Village Precinct to be developed potentially for retirement living, tourism, short-term accommodation options and associated communal facilities and infrastructure.

Any additional land uses for the Village Precinct shall be limited to communal facilities and tourism related uses generally incidental to the predominant land use so as not to compete with the retail function of the neighbourhood centre.

Additional land uses will be further considered upon preparation of a local development plan for the precinct. As a guide the following potential additional uses could to be considered, including potential floor space limits:

- Café/Restaurant
- Convenience Store
- Tourist Development
- Club Premises
- Warehouse/Storage (recreational vehicles)

5.5 Residential Zone

5.5.1 Dwelling Targets

The subdivision of land zoned Residential should aim to achieve a density of approximately 15 dwellings per gross urban hectare in accordance with State strategic targets.

5.5.2 Density Targets

Residential density will be within ranges of R25 – R80. The allocation of a specific residential density code to a lot shall be consistent with the residential density range identified on the Structure Plan map and the locational criteria specified in **Table 1 - 2.**

Table 1 - 2. Density Locational Criteria

Density Code	Locational Criteria
R25 (R-MD)	The base residential density code shall be R25 within areas coded R25-R40 unless an R30 or R40 residential density code is applied in accordance with the locational criteria set out below.
R30 (R-MD)	An R30 residential density may function as the base code within areas coded R25-R40 where: i. a desired streetscape outcome is proposed at the time of detailed subdivision design.
R40 (R-MD)	An R40 residential density code may be applied within areas coded R25-R40 where a lot is: i. located at the end of a street block and/or with rear laneway access; or ii. located adjacent to or opposite (that is, separated by no more than a constructed and dedicated public road) public open space; or ii. located within 100 metres (walking distance) of public open space, community nodes, and/or key distributor roads; or iv. located adjacent to a Quiet Street mid-block cul-de-sac.
R50 (R-MD)	An R50 residential density code may function as the base code within areas coded R40-R60 where: i. a desired streetscape outcome is proposed at the time of detailed subdivision design.
R60 (R-MD)	An R60 residential density code may only be applied within areas coded R40-R60 where a lot is: i. located at the end of a street block with direct frontage to two intersecting roads, and/or with rear laneway access; or

Density Code	Locational Criteria
	ii. located adjacent to or opposite (that is, separated by no more than a constructed and dedicated public road) public open space; or iii. located abutting a key public transport node or route.

5.5.3 Density Plans

a) A residential density code plan is to be submitted to the WAPC at the time of subdivision, unless exempt from this requirement by clause **5.5.3 d)** of this Structure Plan. This plan is to identify the residential density code applicable to each proposed lot, in accordance with the locational criteria set out in **Table 1 - 2**.

b) The residential density code plan is to include a summary of the proposed dwelling yield and demonstrate how the targets, as specified in Sections **5.5.1** of this Part and **4.7** of Part Two, are progressively being achieved.

c) The WAPC is to determine the residential density code plan together with the related subdivision application. If approved, the residential density code plan will then form part of the Structure Plan and shall be used to assess and determine any future applications for development approval.

d) A residential density code plan is not required if the purpose of the subdivision application is to:

i. amalgamate lots;

ii. create a lot or lots for the purposes of facilitating the provision of access, services, or infrastructure;

iii. create a lot or lots which cannot be developed for residential purpose; or

iv. create residential lots in accordance with a previously approved residential density code plan.

e) As each stage of subdivision is finalised and a deposited plan depicting the lot(s) is submitted to the WAPC for its endorsement, a consolidated residential density code plan is to be prepared and forwarded to the local government and WAPC, and this shall supersede each previous residential density code plan(s).

5.6 Public Open Space

a) The Structure Plan (**Plan 1**) nominates a provisional area of 43.867 hectares as creditable Public Open Space. The proposed Public Open Space meets the minimum 10% requirement as outlined in **Plan 2** and Part Two (Explanatory Section) of this report. The function of each space is identified on **Plan 2**.

b) A progressive Public Open Space schedule is to be provided at the time of subdivision for determination by the WAPC with advice from the Shire of Harvey.

5.7 Road Reserves

The proposed hierarchy of roads is depicted on **Plan 1** and summarised in **Table 1 - 3.**

Indicative cross-sections are provided in **Figure 1 - 1**, **Figure 1 - 2**, and **Figure 1 - 3**.

Table 1 - 3. Road Hierarchy

Road type	Indicative Reserve widths
Integrator Arterial B	30.0 – 31.5 metres
Neighbourhood Connector A	31.5 metres
Neighbourhood Connector B	19.5 – 26 metres
Access Street A	21 – 26 metres
Access Streets C & D	13.0 – 20.0 metres
Laneways	6 metres

5.8 Other Reserves

a) **Plan 1** indicates the other reserves proposed, summarised in **Table 1 - 4**.

Table 1 - 4. Other Reserves

Reserve	Description
Foreshore	Comprises two riparian corridors within a 15.43ha total land area. These sites will be subject to a Foreshore Management and/or Revegetation Plan.
Primary School	1 site of 4.0ha co-located with a District Public Open Space (playing fields). Potential to reduce to 3.5ha subject to development of 'Village' Residential not increasing demand.
Public Purpose – Water Corporation	2 pump station sites, 1,000m^2 and 600m^2 respectively.

5.9 Other requirements

5.9.1 Bushfire Protection

Residential lots identified within the Bushfire Prone Area as designated under the Department of Fire and Emergency Services Mapping of Bushfire Prone Areas and indicated on **Plan 1** will require a Bushfire Attack Level assessment to be undertaken at subdivision stage.

5.9.2 Noise Management

A detailed Noise Management Plan is to be prepared and implemented in accordance with *State Planning Policy 5.4 - Road and Rail Noise* and the associated implementation guidelines for lots identified as affected by noise from Forrest Highway, the Bunbury Outer Ring Road (Wilman Wadandi Highway), and Raymond Road.

5.9.3 High Pressure Gas Pipeline

Applications for subdivision or development approval abutting or involving works within a high-pressure gas pipeline corridor are to be accompanied by a pipeline risk management plan.

5.9.4 Protection or management of environmental or landscape features

a) The riparian corridor is to be subject to a Foreshore Management and/or Revegetation Plan.

b) Following Shire of Harvey approval of the foreshore management and/or revegetation plan, in consultation with relevant environmental agencies (as applicable), a Bushfire Attack Level

Contour Plan is to be prepared that reflects the outcomes required by the plan and determines any bushfire risks and potential impacts on the adjoining residential zoned land.

5.9.5 Infrastructure Arrangements

Road Infrastructure

Main Roads WA will require the proponent to enter into a Deed of Agreement, in consultation with the WAPC and Shire of Harvey regarding the timing and staging of development access to Raymond Road and Forrest Highway and associated developer contributions towards road infrastructure improvements including:

a) Four-way roundabout intersection of Raymond Road, southern estate entry and Ranson Drive.

b) Left-in/Left-out intersection of Forrest Highway and (north-western) estate entry road.

c) Three-way T-intersection of Raymond Road and Forrest Highway.

d) In relation to the Forrest Highway Left-in/Left-out intersection, Main Roads WA is undertaking additional traffic modelling related to the Bunbury Outer Ring Road and associated intersections for further consideration by the subdivider which may have a bearing on final intersection design requirements.

Utility Upgrades

The delivery of sewer pump stations, in accordance with Water Corporation catchment planning requirements, are to be installed in the following locations:

a) Adjacent to POS 15;

b) Adjacent to POS 2; and if required

c) Within the Village Precinct (subject to detailed design).

5.9.6 Development Contributions

A development contribution plan is not required as the whole of the Structure Plan area is to be developed by a single entity.

A private deed of agreement between the proponent and Shire, to contribute towards required community infrastructure, may be considered in addition to Local, State or Federal funding arrangements.

5.9.7 Water Resource Management

Management of water resources is to comply with the requirements of an approved Local Water Management Strategy.

6. Local Development Plans

6.1 Prescribed Requirements

Local development plan(s) are to be prepared as a condition of subdivision in the following situations:

a) Lots designated as **Neighbourhood Centre** zone to address the following:

   i. The creation of a main street environment that encourages pedestrian movement through provision of footpaths, carriageway treatments, continuous shade tree canopy on both sides, good lighting of the public realm, and embayed parking.

ii. Provision of a plaza/civic space, as appropriate to the neighbourhood scale, adjacent to the main street.

iii. Built form that suitably addresses and frames surrounding streets by providing:

- a minimum two-storey height with nil or minimal setback to the street boundary.
- Active frontages with no blank facades and having windows and entrances accessible or visible from the street or public realm and use of glazing to provide visual engagement with the street.
- Weather protection in the form of continuous awnings and/or colonnades along public frontages.
- Visual interest through the use of building articulation, a mixture of appropriate materials, and architectural features to emphasise street corners where applicable.

iv. Car parking provided on-street with any additional parking areas located behind buildings and not visible from the main street.

v. Landscaping and/or other treatments to address the visual and acoustic interface with any adjoining residential areas.

b) Lots designated as **Residential (Village)**

Lot/s created for development other than for conventional freehold subdivision, to address:

i. Proposed land uses.

Retail land use is permissible within the following parameters:

- No more than two individual café/restaurant establishments with a combined size of no greater than 225m^2 NLA and situated no closer than 200 metres to the nearest Neighbourhood Centre cadastral boundary.
- No more than one individual convenience store establishment, which is not to exceed 150m^2 NLA, or 300m^2 NLA if combined with a café and situated no closer than 200 metres to the nearest Neighbourhood Centre cadastral boundary.

ii. Provision of a sewer pumping station in an appropriate location.

iii. Public, emergency, and service vehicle access and circulation.

iv. Continuous public pedestrian and cycle network.

v. Interface of developments with adjoining public realm/common property (as relevant) including the riparian corridors.

vi. Built form bulk and scale.

vii. Key built form design parameters to ensure visual cohesiveness.

viii. Any other relevant matters such as bushfire and acoustic requirements, as considered necessary by the local government or other provisions of this Structure Plan.

c) Lots affected by noise which exceeds the noise target defined by S*tate Planning Policy 5.4 Road and Rail Noise*, to address quiet house design in accordance with the Acoustic Assessment prepared under this Structure Plan.

d) Lots immediately adjacent to public open space, to address:

i. Built form orientation;

ii. The provision of visually permeable uniform fencing.

iii. Window openings from habitable rooms to overlook public open space and the street as applicable.

e) Any other lots identified under a Plan of Subdivision that fulfil the objectives of the *Framework for Local Development Plans* pursuant to Part 6 of Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

f) Lots with frontage to the head of a proposed 'Quiet Street' mid-block cul-de-sac, to:

i. Require that development addresses the adjacent pocket park (located between two culs-de-sac) through building orientation and visually permeable fencing and pedestrian access.

ii. Define the location of crossover/s.

iii. Specify whether a single dwelling is permitted.

iv. Specify the maximum building height if necessary to ensure compatibility with neighbouring single residential lots.

v. Outline any other requirement considered necessary by the local authority, depending on the specific circumstances of each proposed cul-de-sac.

6.2 WAPC Planning Bulletin 112/2016

A Local Development Plan is not required to vary 'Deemed to Comply' provisions of the Residential Design Codes where such variations are adopted under relevant Shire Policy or consistent with WAPC Planning Bulletin 112/2016 *Medium-density single house development standards – Structure Plan Areas.*

7. Additional Details

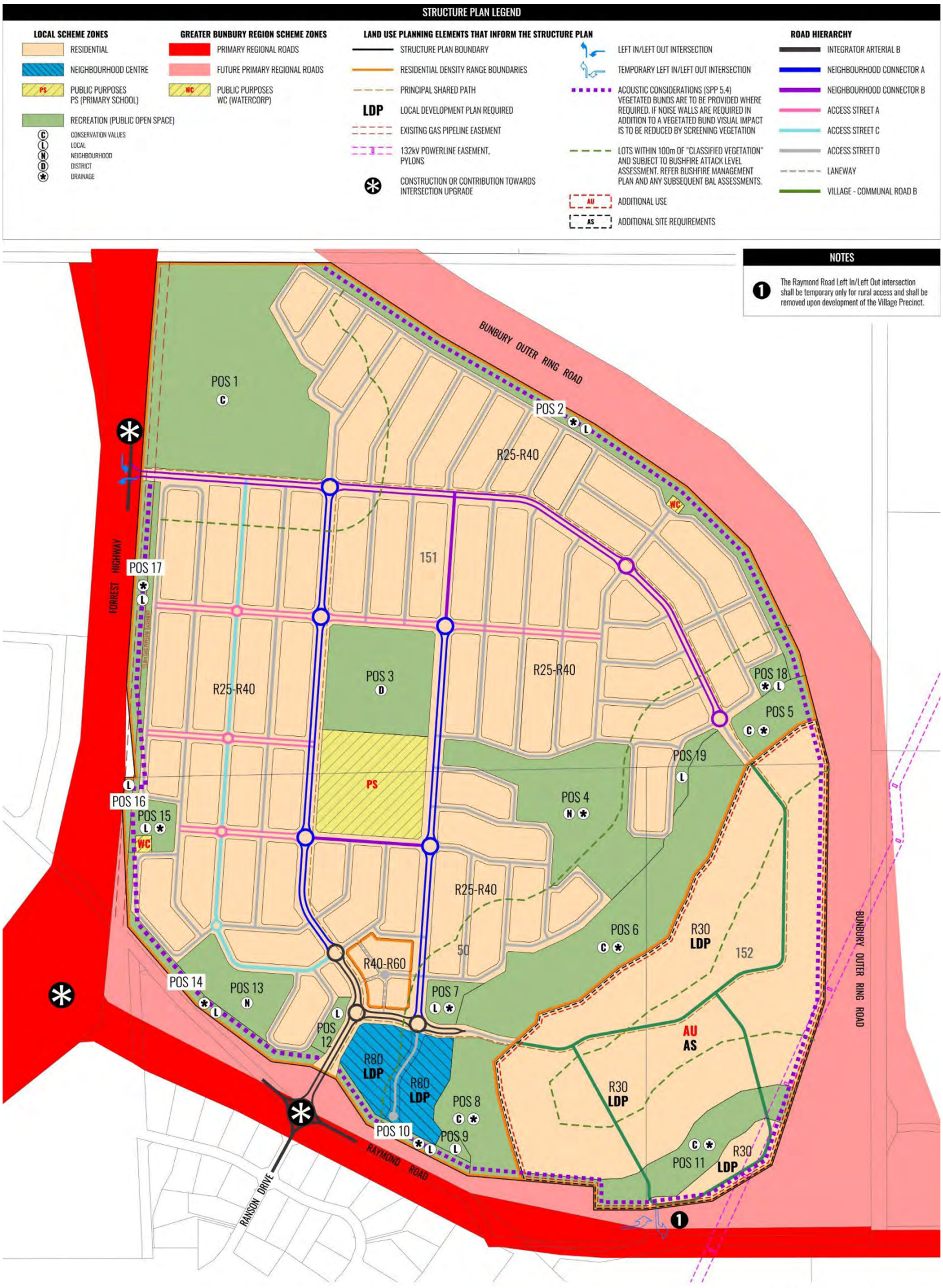
The additional information required and the stage at which it is to be provided is summarised in **Table 1 - 5.** Studies or plans that will be required as a condition of subdivision or development approval are identified in **Table 1 - 6**.

Table 1 - 5. Information to be Submitted with an Application

Additional Information/purpose	Approval Stage	Responsible Agency
Density Plans	Subdivision application	WAPC Shire of Harvey
Public Open Space Schedule	Subdivision application	WAPC Shire of Harvey
Detailed Noise Management Plan	Subdivision application	Shire of Harvey
Bushfire Management Plan	Subdivision application, or development application for identified lots.	Shire of Harvey Department of Fire & Emergency Services
Preliminary Site Investigation for potential contamination	Subdivision application	WAPC

Table 1 - 6. Studies to be Required as a Condition of Subdivision or Development Approval

Additional Information	Responsible Agency
Detailed Noise Management Plan	Shire of Harvey in consultation with Main Roads WA
Bushfire Attack Level Assessment	Shire of Harvey
Urban Water Management Plan	Shire of Harvey
Foreshore and Revegetation Management Plan	Shire of Harvey
Asset Management Plan, including intervention and inspection frequency requirements for all vegetation retained within Public Open Space	Shire of Harvey
Dust Management Plan	Shire of Harvey
Local Development Plan	Shire of Harvey
Green Street strategy for each stage of subdivision	Shire of Harvey
Mosquito and Midge Management Plan	Shire of Harvey
Gas Pipeline Risk Management Plan, as required	ATCO
Notification on Title of Mosquito Risk	WAPC
Deed of agreement for contributions to road infrastructure improvements	Main Roads WA
Construction Environmental Management Plan	Department of Biodiversity, Conservation and Attractions

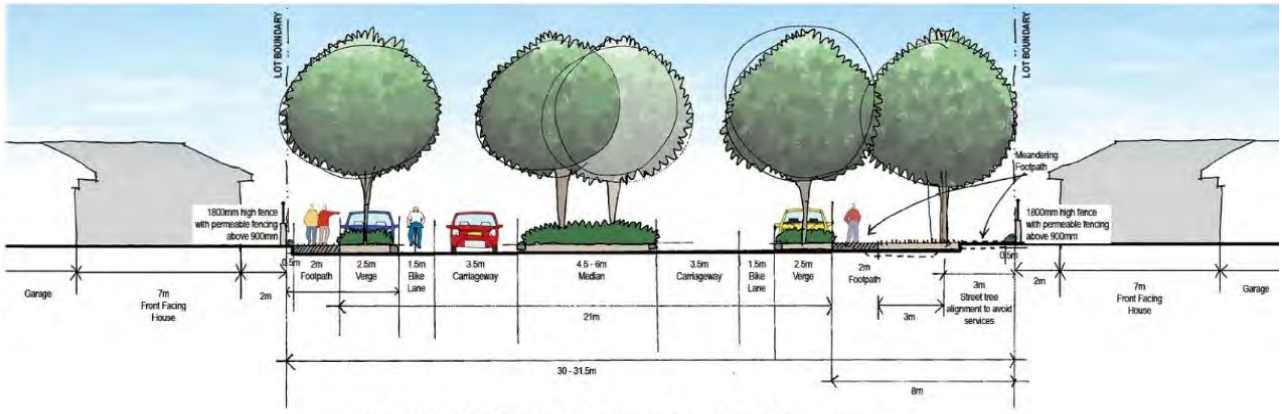


TREENDALE EAST STRUCTURE PLAN

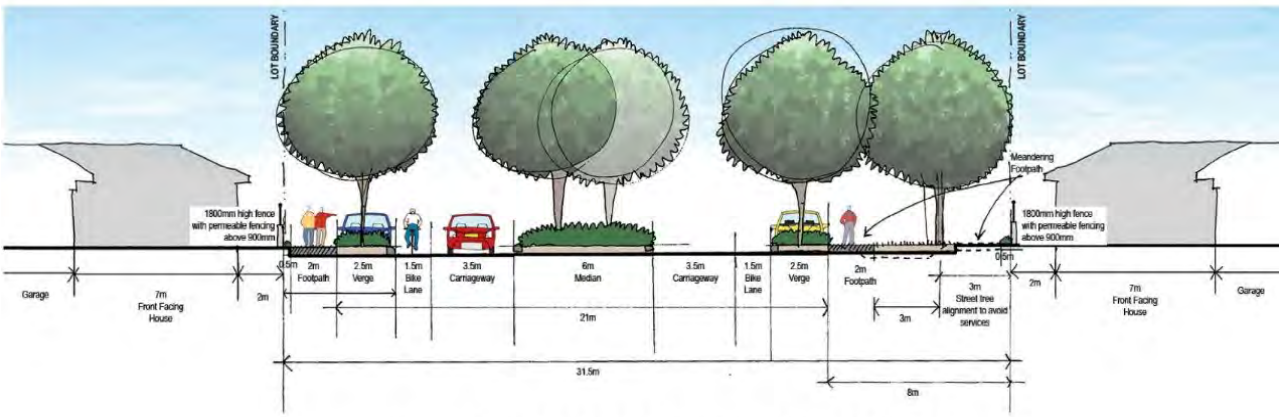
Plan 1



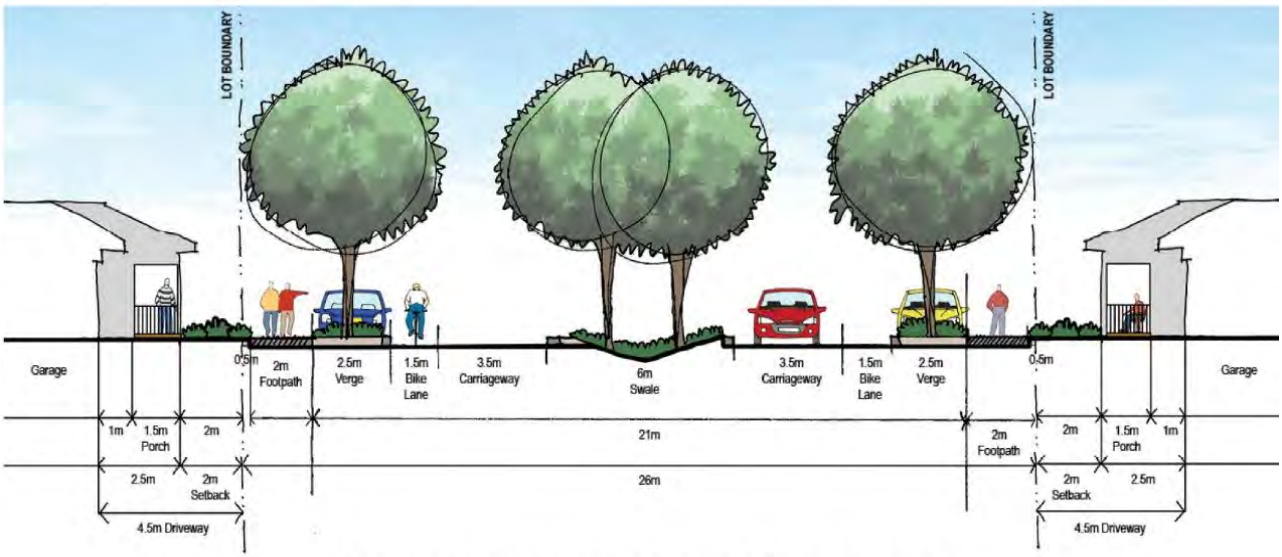
Plan 2. Public Open Space Plan



INTEGRATOR ARTERIAL B (30 - 31.5m)

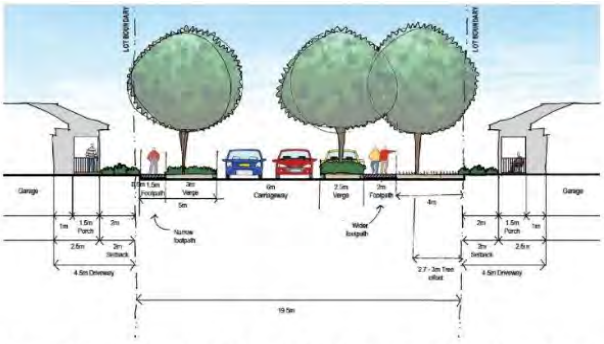


NEIGHBOURHOOD CONNECTOR A (31.5m)
NEIGHBOURHOOD CONNECTOR B (31.5m) - WIDER MEDIAN AND VERGE TREATMENTS

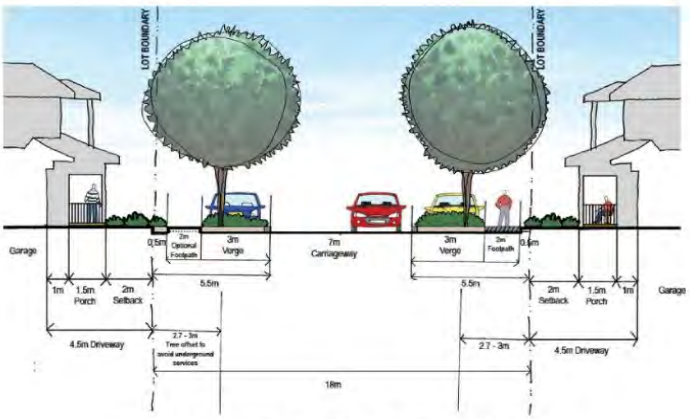


NEIGHBOURHOOD CONNECTOR B (26m)
ACCESS STREET A (26m) - WIDER MEDIAN AND VERGE TREATMENTS

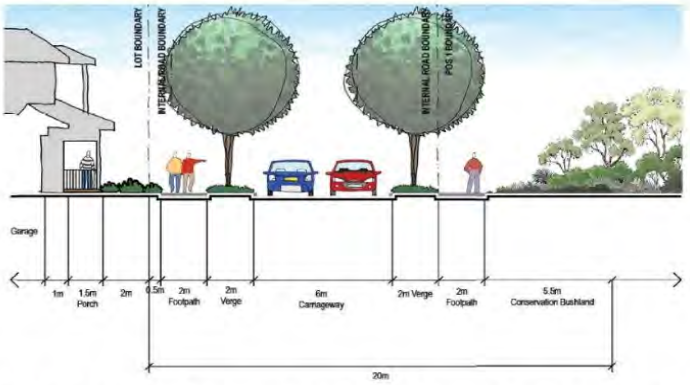
Figure 1 - 1. Integrator Arterials & Neighbourhood Connectors



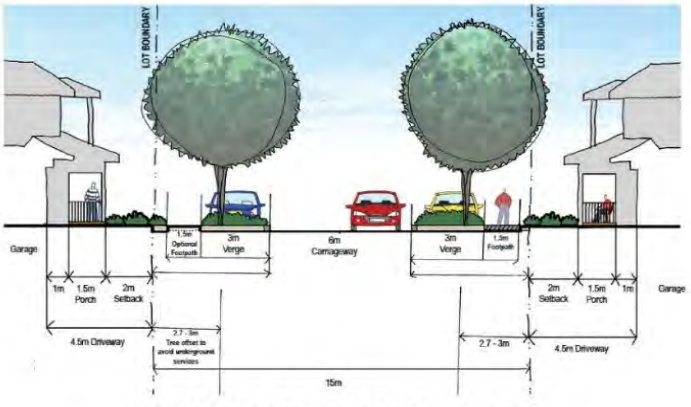
NEIGHBOURHOOD CONNECTOR B (19.5m)
ACCESS STREET D (26m) - WIDER MEDIAN AND VERGE TREATMENTS



ACCESS STREET C - (18m)

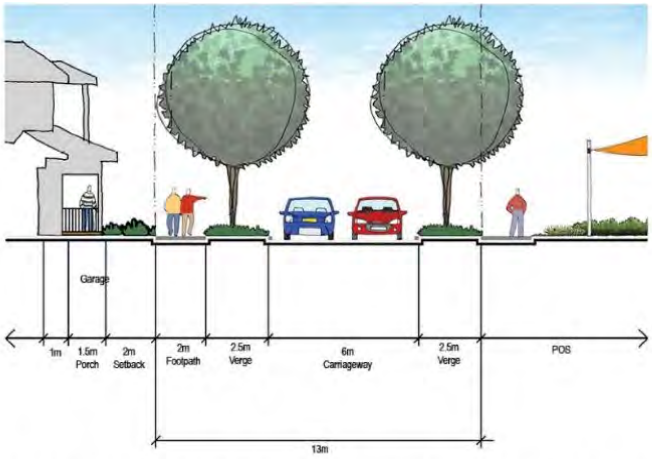


ACCESS STREET D - ADJACENT BUSHLAND (20m)

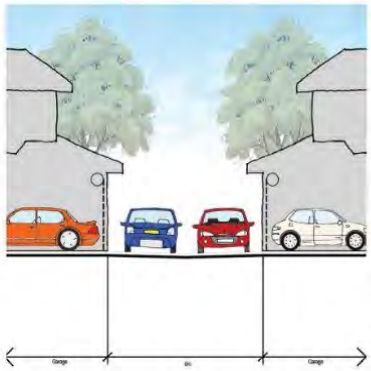


ACCESS STREET D - (15m)

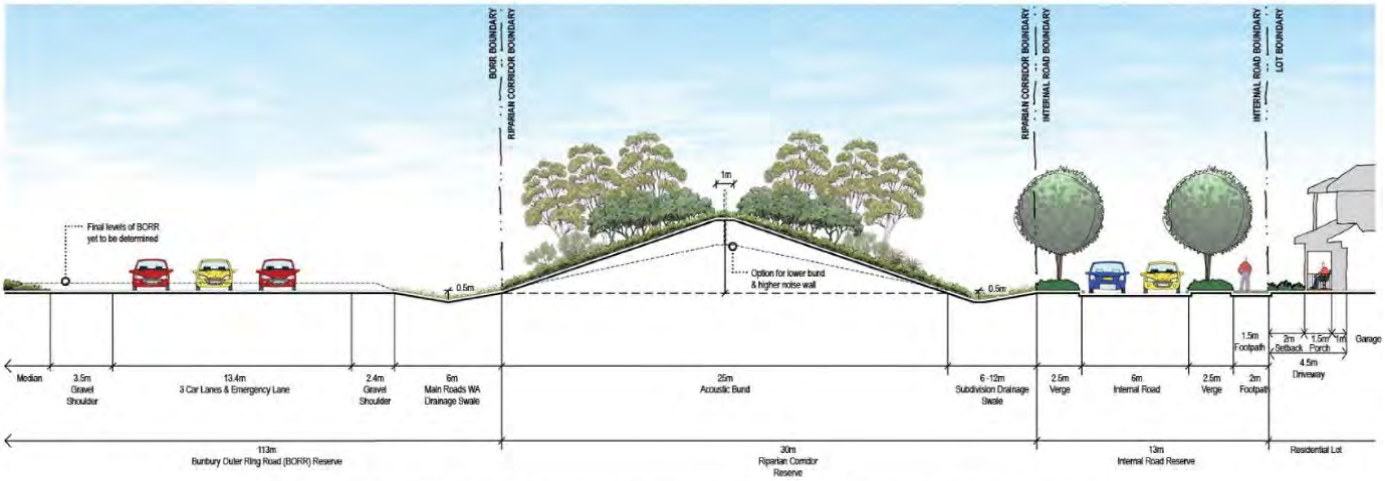
Figure 1 - 2. Neighbourhood Connector B, Access Streets A, C & D



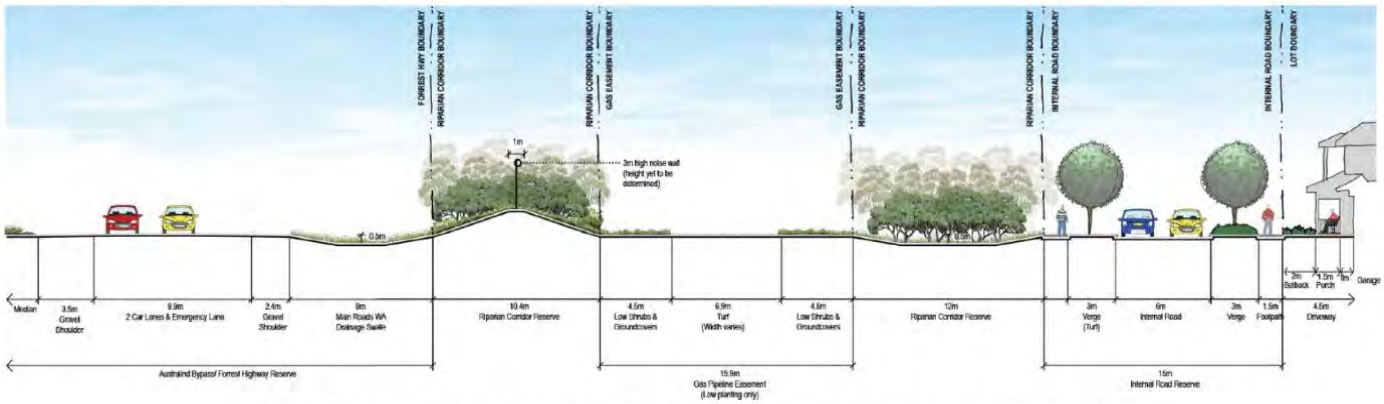
ACCESS STREET D - ADJACENT POS (13m)



LANEWAY (6m)



ACCESS STREET D - ADJACENT BIORETENTION SWALE/
LANDSCAPED BUFFER & BORR (13m)

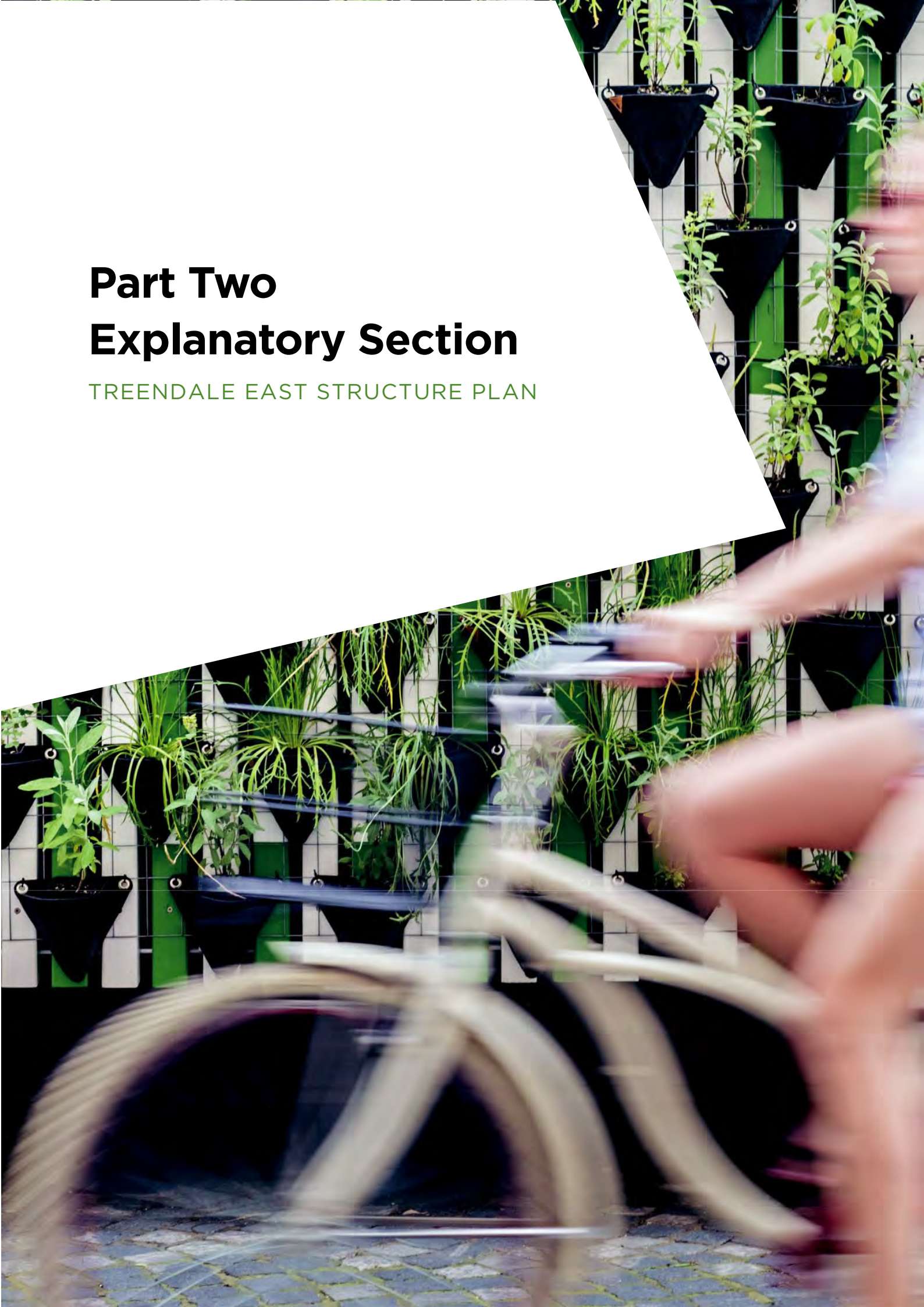


ACCESS STREET D - ADJACENT GAS PIPELINE EASEMENT
& AUSTRALIND BYPASS/FORREST HWY (15m)

Figure 1 - 3. Access Street D alternatives, Laneways

Part Two
Explanatory Section

TREENDALE EAST STRUCTURE PLAN



Part Two
Explanatory Section

1. Planning Background

1.1 Introduction & Purpose

This Structure Plan has been prepared to guide subdivision and development of the future urban area for residential and supporting land uses to create a liveable, sustainable, and distinctive precinct.

This Part of the document describes the characteristics of the Structure Plan Area, its physical, economic, and socio-cultural context (**Sections 2** and **3**), identifies the opportunities arising from those characteristics (**Section 3**), and outlines the intended design and planning responses (**Section 4**).

Part Three – Appendices refers to specialist consultant reports prepared to guide the provisions under Part One and Part Two of the Structure Plan. These specialist reports were prepared at a point in time, so should any inconsistencies in mapping or commentary be identified, Parts One and Two prevail.

1.2 Land Description

1.2.1 Location

The land is in the locality of Roelands, approximately 11.5 kilometres north-east of the Bunbury Central Business District and less than one kilometre east of the Treendale District Activity Centre. **Figure 1** refers.

1.2.2 Area, Land Use & Ownership

The land comprising the Structure Plan Area totals 188.5 hectares over three lots.

Ownership and title details are summarised in **Table 1**. Copies of Certificates of Title are provided in **Appendix 12**. Lot 151 has been severed by the resumption of land required for the Bunbury Outer Ring Road reservation and is only partly included within the Structure Plan Area. **Figure 2** refers. The current land use is farming. The land is comprised of open ground covered with short grass with isolated clusters of tall trees, mostly near drainage channels and at the intersection of the three lots.

The north-west corner of Lot 151 is covered with dense trees and bushes. A mix of shallow hills and flat, level areas make up the southern half of the site on Lots 152 and 50, while Lot 151 is generally flat. Natural and manmade drainage channels run through isolated sections of each lot. Stockpiled materials from some of the man-made drainage channels form large windrows that run parallel to the channel.

A shed near the centre of Lot 50, and two derelict corrugated iron outbuildings in the south-east of Lot 151 are the only buildings on site.

Table 1. Title Details

Lot	Title	Ownership	Area (ha)
151 on DP418088	2996/4	G T Pearson; Pearson Nominees Pty Ltd	120.74 (97.55 within SP Area)
152 on DP418089	2995/604	E E Taylor	26.30
50 on DP421006	4022/561	R L Taylor	64.64



Figure 1. Location



Figure 2. Aerial Photograph & Land Ownership

1.3 Planning Framework

1.3.1 Zoning & Reservations

Greater Bunbury Region Scheme

The Structure Plan Area is zoned 'Urban' in the GBRS.

A Planning Control Area (**PCA**) relating to the Bunbury Outer Ring Road (**BORR**) corridor borders the Structure Plan Area and severs Lot 151.

The GBRS 'Priority Agriculture' policy or its associated buffer that affects a portion of the Structure Plan Area will be modified once the Structure Plan has been endorsed. Refer to **Figure 3**.

Shire of Harvey Local Planning Scheme No. 2

The Structure Plan Area is currently zoned 'Urban Development' in Shire of Harvey Local Planning Scheme No. 2 (**LPS 2**). Refer to **Figure 4**.

The purpose of the 'Urban Development' zone as defined by LPS 2 is:

(a) To provide an intention of future land use and a basis for more detailed structure planning in accordance with the provisions of this Scheme.

(b) To provide for the progressive and planned development of future urban areas for residential purposes and for commercial and other uses normally associated with residential development.

(c) To provide for a range of residential densities to encourage a variety of residential accommodation.

(d) To provide an intermediate transitional zone following the lifting of an urban deferred zoning within a region planning scheme.

1.3.2 Strategic Plans & Policies

Regional and sub-regional planning strategies provide guidance for the preparation and implementation of statutory planning schemes and policies.

State Planning Policies (SPPs) are prepared under Part 3 of the *Planning & Development Act 2005* and are the highest level of planning policy control and guidance.

Local Planning Policies (LPPs) are prepared under the local planning scheme deemed provisions, as set out in the *Planning & Development (Local Planning Schemes) Regulations 2015*.

All policies are 'due regard' documents to be considered in planning decision making.

Operational Policies (OPs), also known as Development Control Policies (DCs), are WAPC policies that provide guidance on specific aspects of subdivision and development.

Table 2 (page 7) summarises the planning framework and applicable planning strategies, SPPs, LPPs, and OPs, with comments regarding Structure Plan responses.

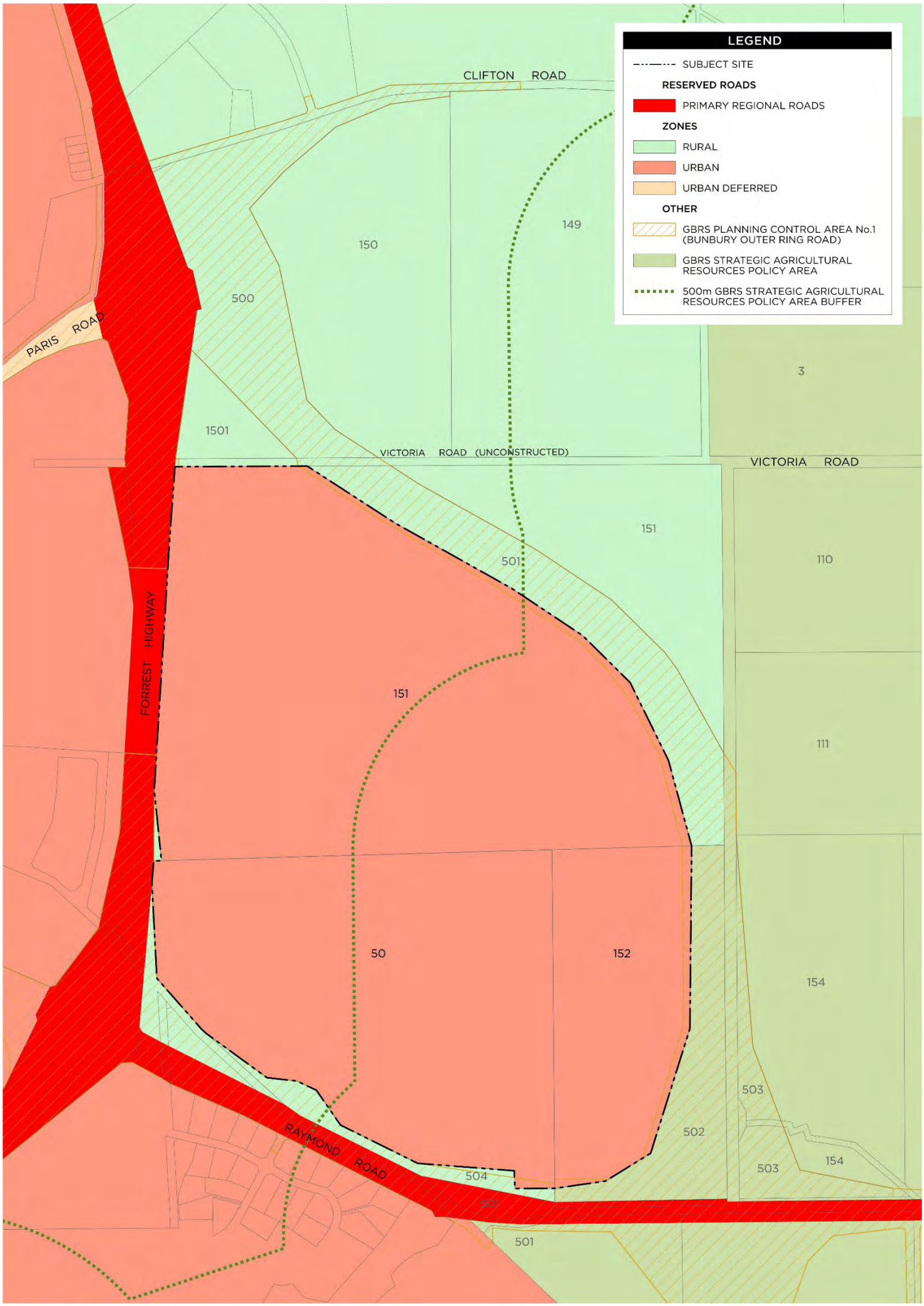


Figure 3. GBRS Zoning

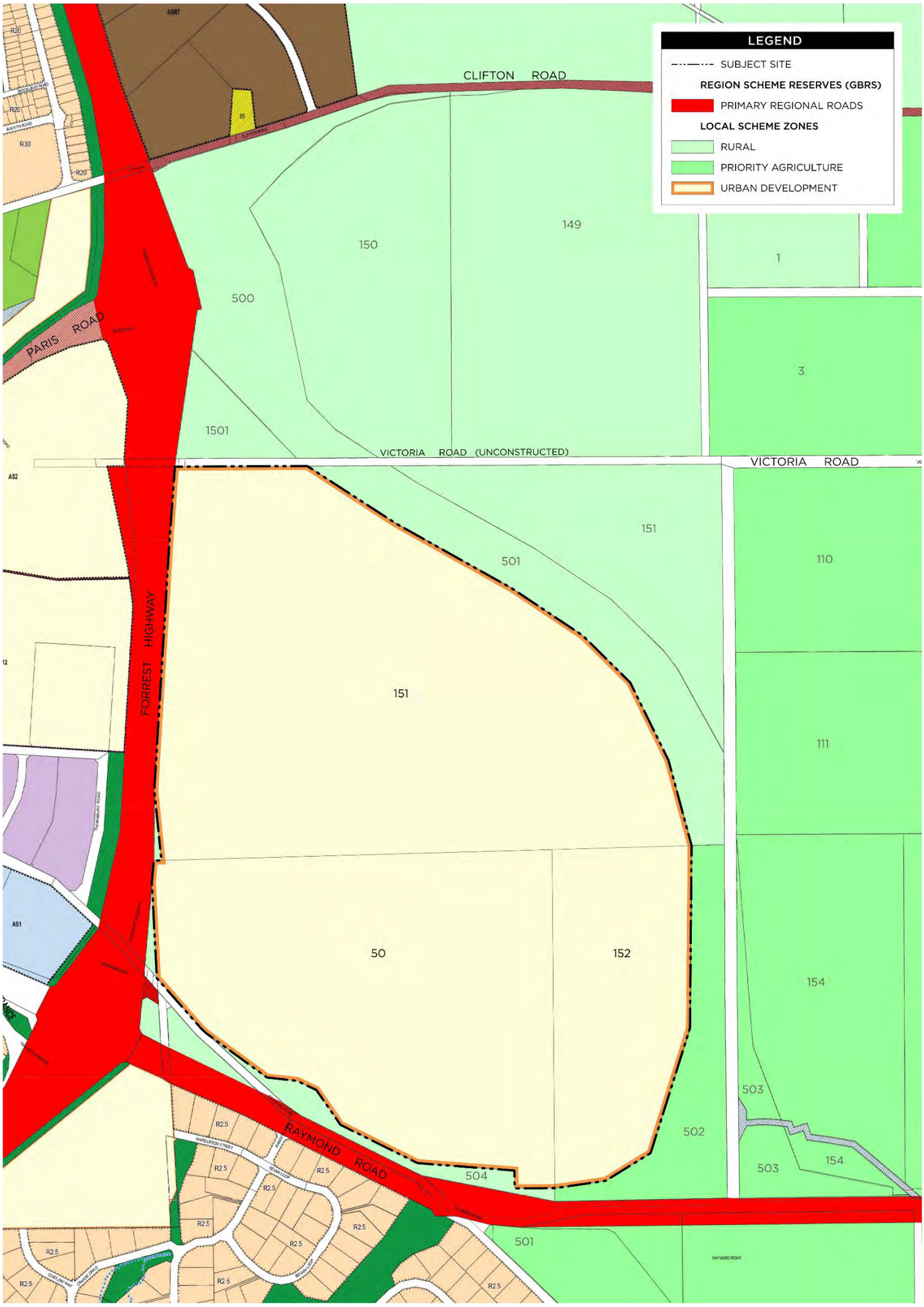


Figure 4. Shire of Harvey LPS 2 Zoning

Table 2. Planning Framework

Planning Document	Key Provisions/Triggers	Structure Plan Response
Strategies		
Greater Bunbury Strategy 2013	This regional strategy provided for the growth of Greater Bunbury to accommodate a population of 150,000 residents. It identified expansion areas for urban (Wanju) and industrial (Waterloo) purposes. Treendale East was identified as an area to be investigated for urban expansion after Wanju had been substantially developed. The District Structure Plan for the Wanju urban expansion area was endorsed by the WAPC in October 2016 and GBRS Amendment 0059/41 rezoned the land from 'Rural' to 'Urban Deferred'.	Urbanisation of Treendale East is consistent with the intent of the *Greater Bunbury Strategy*. Development of Wanju has been delayed, and Treendale East will now be completed well ahead of Wanju.
Bunbury-Geographe Sub-Regional Strategy (January 2022)	Providing further detail than the *Greater Bunbury Strategy* and following confirmation of the alignment of the Bunbury Outer Ring Road (BORR), the *Bunbury-Geographe Sub-Regional Strategy* (SRS) designates the subject land as an Urban Expansion Area, noting that it represents a logical 'rounding off' of the urban footprint west of the BORR. Refer to **Figure 5**. In 2023 WAPC supported rezoning of the land from 'Rural' to 'Urban Deferred' after being satisfied with the outcome of investigations on the following matters, as required by the SRS: • Biodiversity value protection • Bushfire risk • Drainage • Landscape value protection • Protection of significant environmental values • Utility services capacity • Water source impact (ground and surface water) • Regional road access • Road and rail noise • Basic raw material demand • Geotechnical factors • Aboriginal heritage. Urban Deferment was lifted in July 2025.	Urbanisation of Treendale East is consistent with the intent of the *Bunbury-Geographe Sub-Regional Strategy*. • Protects areas of existing biodiversity value and promotes improved biodiversity in previously degraded areas • Responds to bushfire risk through urban structure and landscape management • Directs overland flow to perimeter drains and improves the environmental qualities and values of Water Corporation drains • Minimises the need for bulk earthworks • Encourages lightweight construction methods to reduce demand for sand fill to create Grade A sites • Supports and encourages fit-for-purpose technology to deliver local services • Encourages investigation of alternative models of utility service delivery • Encourages waterwise and climate resilient public open space • Sensitively conserves and interprets Aboriginal heritage, including and beyond the Registered Site.

Planning Document	Key Provisions/Triggers	Structure Plan Response
	Sets out principles supported by strategic directions under various themes.	
Shire of Harvey Local Planning Strategy 2020	Endorsed by the WAPC in April 2020, the local planning strategy provides the basis for Local Planning Scheme No. 2. The strategy identifies Treendale East as a long-term urban investigation area and proposed to identify it in LPS No. 2 within a 'Special Control Area' as a 'Development Investigation Area' noting that the land was then still zoned 'Rural' under the GBRS. Refer to **Figure 6**. This would allow planning for urban development to proceed, but no development could take place until the land is appropriately zoned in the GBRS.	Urbanisation of Treendale East is consistent with the intent of the *Local Planning Strategy*. It is likely that the Strategy will be updated to reflect the more recent proposals contained in the *Bunbury-Geographe Sub-Regional Strategy*. The land has since been zoned 'Urban Development' in LPS 2.
State Planning Policies		
SPP 2.0 Environment & Natural Resources Policy	SPP 2.0 Aims to integrate environmental considerations into planning decisions and avoid unacceptable environmental damage. It requires planning decisions to consider (as relevant): • Water Resources • Air Quality • Soil and Land Quality • Biodiversity • Agricultural Land and Rangelands • Minerals, Petroleum and Basic Raw Materials • Marine Resources and Aquaculture • Landscapes • Greenhouse Gas Emissions and Energy Efficiency	The Structure Plan addresses the relevant considerations as outlined in SPP 2.0. These include: • Response to natural water systems including surface and ground water • Landscaped buffer between major perimeter roads and significant tree planting to maintain healthy air quality • Designation and landscaping of public open space to retain and enhance biodiversity assets • Response to and minimal interference with natural landform • Promotion of environmentally friendly design, materials, and processes.
Draft SPP 2.9 Planning for Water Advertised in 2021. Proposed to streamline and simplify the current water-related policy framework. Covers matters currently addressed by the following pertinent policies: • SPP 2.7 Public Drinking Water Source Policy • SPP 2.9 Water Resources • SPP 3.4 Natural Hazards &	The proposed development is proximate to natural and modified water assets. Draft SPP 2.9 aims to: • maintain or enhance water quality and hydrological regimes to protect public health and support healthy ecosystems • ensure adequate foreshore areas and wetland buffers to	• Scheme water will be utilised for in-house purposes. • A non-potable scheme service will be used for irrigation. • Water conservation measures will be applied. • Water sensitive urban design will assist in reducing water demand. • Stormwater management will maintain the existing

Planning Document	Key Provisions/Triggers	Structure Plan Response
Disasters • Better Urban Water Management • Government Sewerage Policy Until its gazettal, the existing policy provisions continue to apply.	protect values • protect and, where appropriate, promote associated Aboriginal and historic cultural heritage values • maintain and enhance appropriate access to water resources • enhance and protect associated amenity and sense of place • manage flood prone land • protect public drinking water sources • reduce water use and maximise sustainable supply • respond to climate change • manage wastewater for environmental and public health outcomes.	hydrology of the site. • Groundwater management will include shaping the shallow and low permeability clay layer towards the existing waterways, subsoil drains to control localised perched groundwater, and the use of fill to maintain sufficient clearance to groundwater. • Groundwater quality will be managed through the appropriate treatment of surface runoff prior to infiltration, landscape management practices, and the treatment of subsoil drain discharge within surface-based vegetated treatment structures.
SPP 3.0 Urban Growth & Settlement	Applicable to proposed rezoning to allow urban development, SPP 3.0 aims to: • promote a sustainable and well-planned pattern of settlement • build on existing communities and infrastructure • manage growth and development of urban areas • promote sustainable and liveable neighbourhoods • co-ordinate development and the provision of infrastructure.	The 'Urban' zoning of Treendale East represents urban growth within a logical boundary close to established urban areas and infrastructure, as noted in the *Bunbury-Geographe Sub-Regional Strategy*.
SPP 3.4 Natural Hazards & Disasters	SPP 3.4 aims to minimise the adverse impacts of natural disasters on communities, the economy, and the environment by considering them in all planning documents. As a minimum, structure plans should have regard to natural elements that create hazards including— • Climate • Geology • Soils • Vegetation cover • Slopes • Landforms • Hydrology. Of most relevance to Treendale East are policy provisions	• A Bushfire Management Plan has been prepared (refer to **Section 2.5**). • Flood risk and drainage is addressed by the water management strategy (refer to **Section 2.4.4**). • Climate change mitigation is assisted by promotion of sustainable development, conservation of areas of remnant native vegetation, rehabilitation of riparian corridors, and new street tree planting to improve tree canopy cover.

Planning Document	Key Provisions/Triggers	Structure Plan Response
	relating to bushfire and flooding risk, and climate change.	
SPP 3.7 – Planning in Bushfire Prone Areas	SPP 3.7 seeks to implement effective risk-based development to preserve life and reduce the impact of bushfire on property and infrastructure. It requires structure plans to include a bushfire risk assessment and where relevant a Bushfire management plan outlining how bushfire protection measures can be achieved. The policy applies as parts of Structure Plan Area are mapped as bushfire prone.	• A Bushfire Management Plan has been prepared outlining how bushfire risk is to be managed (see **Section 2.5**). • A conservative approach to the impact of likely revegetation of parts of the riparian corridors, the details and extent of which will be refined at later stages of planning.
SPP 4.2 – Activity Centres	A Neighbourhood Activity Centre is proposed. SPP 4.2 Seeks to: • Locate people and the employment, goods and services they need close to each other within activity centres. • Promote activity centres as the focus of integrated and well-designed medium and high-density residential and mixed use development. • Plan for the sustainable growth and development of activity centres ensuring development intensity is appropriate to a centre's position in the activity centre hierarchy. • Manage the hierarchy of activity centres to ensure efficient and equitable access by the community to employment opportunities, housing choice and a broad range of goods and services. • Ensure activity centres are accessible and wellserved by a range of transport options with a priority on walking, cycling and public transport use. • Ensure the urban form of activity centres enables the primary focus of activity to be on the street, in the public realm and connected to public open spaces. • For Neighbourhood Centres,	• The location of the Neighbourhood Centre will provide it will good exposure and accessibility for residents of Treendale East and other users. • A Local Development Plan will be prepared to ensure that development within the precinct defined by the Neighbourhood Centre can achieve required size, diversity, and density targets.

Planning Document	Key Provisions/Triggers	Structure Plan Response
	a target residential density of R25 or above applies within a 200-metre walkable catchment.	
SPP 5.4 – Road and Rail Noise	Parts of Treendale East are within trigger distance of Strategic freight and major traffic route (Australind Bypass, BORR) and other significant freight/traffic route (Raymond Road) as defined by SPP 5.4.	• Urban design of the Structure Plan Area minimises exposure of sensitive land use to road noise. • An Acoustic Assessment has been prepared. • LDPs will be prepared where required to ensure acoustic design for dwellings within the defined trigger distances for noise exposure.
Design WA • *SPP 7.0 Design of the Built Environment* • *SPP 7.1 Neighbourhood Design* (future replacement for *Liveable Neighbourhoods* draft not yet released) • *SPP 7.2 Precinct Design* • *SPP 7.3 Residential Design Codes* Volume 1	The Design WA suite of policy documents aims to ensure that all new built development is well designed and place-responsive, addressing the Ten Principles of good design: • Context and character • Landscape quality • Built form and scale • Functionality and build quality • Sustainability • Amenity • Legibility • Safety • Community • Aesthetics	• The Structure Plan responds to the design principles to the extent relevant at this stage of planning and design. • The Structure Plan objectives are fully aligned with the principles of good design. • The urban structure of Treendale East is designed in accordance with the principles of neighbourhood design set out in *Liveable Neighbourhoods* and is explicitly focussed on achieving a highly sustainable environment that is supportive of community formation and cohesion. • An LDP for the Neighbourhood Centre will be prepared in accordance with the requirements of SPP 7.2 prior to its development.
Region Scheme Policies		
GBRS Priority Agricultural Land Policy	• Lot 152 is currently within the Policy Area and Lots 151 & 50 are affected by the 500m buffer.	An amendment to GBRS will remove Treendale East from the policy area and will change buffer area extent. Treendale East will be separated from the policy area by the BORR.
Local Planning Policies		
LPP 6.7.3 Sustainable building materials and construction practices	Applies to **all land and development** within the Shire. Policy objectives: • Ensure urban form and development contribute to the sustainable use and development of land (economic, social and	• Sustainability is a key platform for Treendale East and opportunities for alternatives to traditional brick constructions will be actively explored in the delivery of built form.

Planning Document	Key Provisions/Triggers	Structure Plan Response
	environmental), promote efficient resource use and minimise energy use and waste. • Facilitate a strong, vibrant, diversified and sustainable local and regional economy with a range of business and employment opportunities. • Ensure the use and development of land does not result in significant adverse impacts on the physical and social environment and public health.	
Operational Policies (formerly Development Control Policies)		
OP 1.5 Bicycle Planning	Design of local movement network.	Accommodates safe cycling routes in design of movement and open space networks.
OP 1.6 Planning to support transit use & development	Design of local movement network	Accommodates public transport routes.
OP 1.7 General Road Planning *(Proposed to be updated by draft OP 1.12 – Planning Proposals Adjoining Regional Roads in Western Australia)*	Design of local movement network	Provides roads according to hierarchy as agreed with Shire of Harvey.
Draft OP 1.12 – Planning Proposals Adjoining Regional Roads in Western Australia Intended to update OP1.7 and OP 5.1)	Provides guidance on vehicular access from adjoining lots, road reserve widening, road upgrading, scenic route considerations, infrastructure contributions and corner lot truncations. Vehicle access arrangements will need to be determined in consultation with Main Roads WA, DPLH and/or local government.	No access to the BORR is contemplated and access to Raymond Road and Forrest Highway will be negotiated and designed with MRWA and the Shire of Harvey.
OP 2.2 Residential Subdivision	Residential development	Provides for subdivision that can comply with requirements.
OP 2.3 Public Open Space in Residential Areas	Residential subdivision	Provides at least 10% public open space.
OP 2.4 School Sites	Residential subdivision generating population	1 x primary school site provided following consultation with Dept of Education.
OP 2.6 Residential Road Planning	Design of local movement network	A permeable street network suitable for intended traffic volumes and types will be provided to the standards agreed with the Shire of Harvey.

Planning Document	Key Provisions/Triggers	Structure Plan Response
Draft OP 4.3 High Pressure Gas Pipelines 2016 (Although still in draft, it replaces PB 87)	Western part of the site is within the ATCO trigger distance.	No high-density development as defined by *AS4645.1 Gas Distribution Networks* is proposed within the trigger distance.
OP 5.1 Regional Roads (Vehicular Access) (Proposed to be updated by draft OP 1.12 – Planning Proposals Adjoining Regional Roads in Western Australia)	Site bound on all sides by existing and proposed GBRS road reserves (including Planning Control Area for BORR)	No access to the BORR is contemplated and access to Raymond Road and Forrest Highway will be negotiated and designed with MRWA and the Shire of Harvey.
Liveable Neighbourhoods Currently under review and will be replaced by a future *SPP 7.2 Neighbourhood Design*	This policy guides planning and development of greenfield site like Treendale East, covering all important elements of neighbourhood design: • Community design • Movement network • Lot layout • Public parkland • Urban water management • Utilities • Activity centres and employment • Schools	The Structure Plan meets *Liveable Neighbourhoods* requirements.
Whole of Government Policies		
Government Sewerage Policy In due course will be incorporated into new *SPP 2.9 Planning for Water*	Policy mapping identifies the Structure Plan Area within two 'sewage sensitive areas': • Estuary catchments on the Swan and Scott coastal plains (whole site); and • Within 1 km of significant wetlands (Lots 152 & 153).	Treendale East will be provided with deep sewer.
Other		
Aboriginal Heritage Amendments to the *Aboriginal Heritage Act 1972* are anticipated and may affect the project.	Treendale Gully/Water Corporation drain on south-east part of site is part of Registered Site 16713 – Collie River Waugal under the *Aboriginal Heritage Act 1972*. Treendale East is within the much wider Gnaala Karla Booja Indigenous Land Use Agreement (ILUA) Area under the Commonwealth *Native Title Act*.	• Being privately owned (alienated) land, Native Title Act requirements do not apply to development at Treendale East. • Work in and around the Registered Site will require prior approval and collaboration with local Aboriginal keyholders. Early engagement is intended.

1.4 Pre-Lodgement Consultation

Various agency stakeholders were consulted during the preparation of this Structure Plan, as summarised in **Table 3**.

Table 3. Pre-Lodgement Consultation

Agency/Consultant Body	Subject	Section Ref.
Department of Education	Requirements for public schools.	**2.1.5**
ATCO Australia	High Pressure Gas Pipeline HP104.	**2.1.7**
Main Roads Western Australia	Advancement of Bunbury Outer Ring Road, land acquisition, and access to Forrest Hwy and Raymond Road.	**4.10.1**
Western Power	High voltage transmission line relocation.	**4.15.5**
Department of Planning, Lands, and Heritage	General liaison in preparation of Structure and GBRS rezoning applications. Design workshops and liaison on general design provisions since project inception.	**Various**
Shire of Harvey		
Harvey Water		

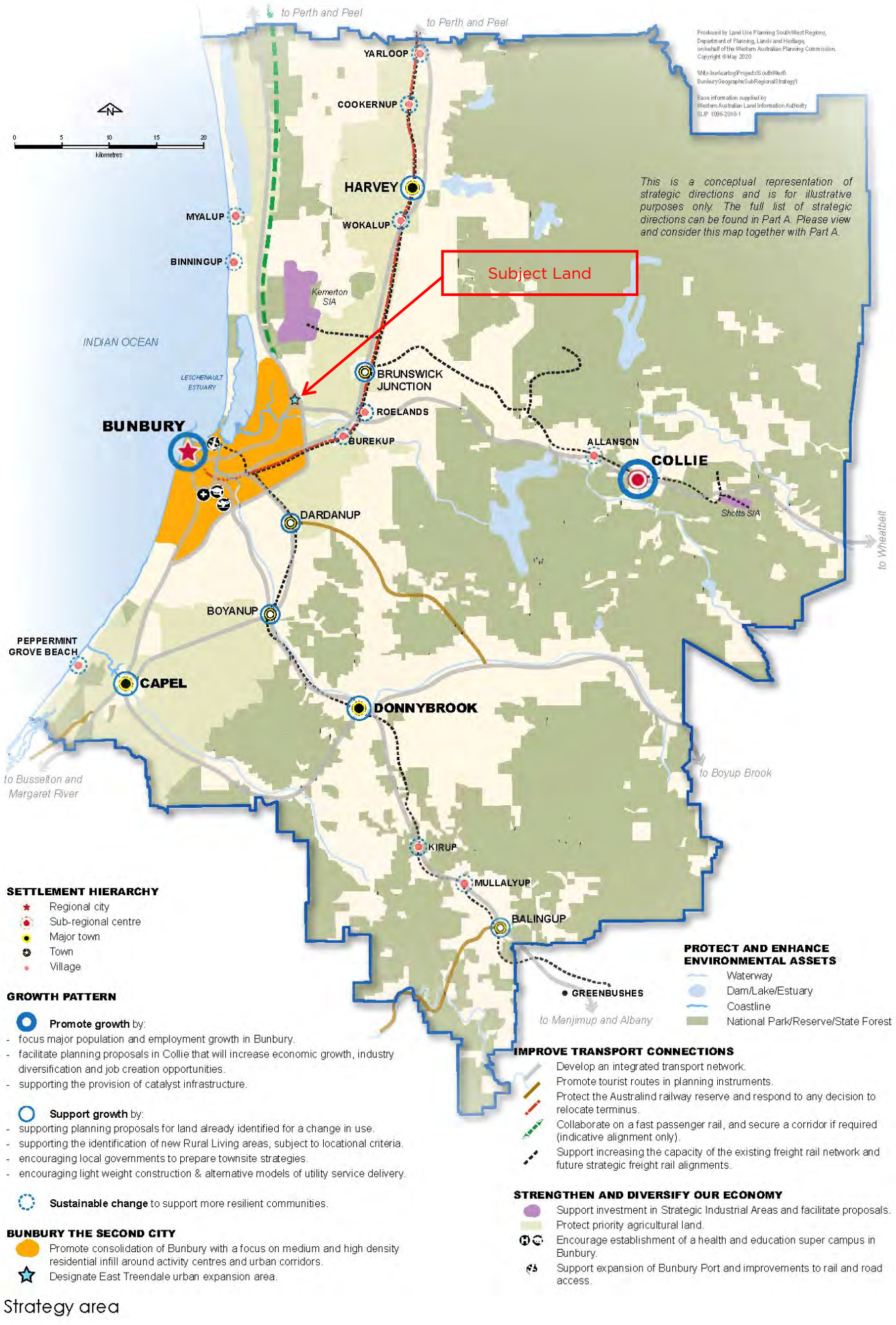


Figure 5. Bunbury-Geographe Sub-regional Strategy Map

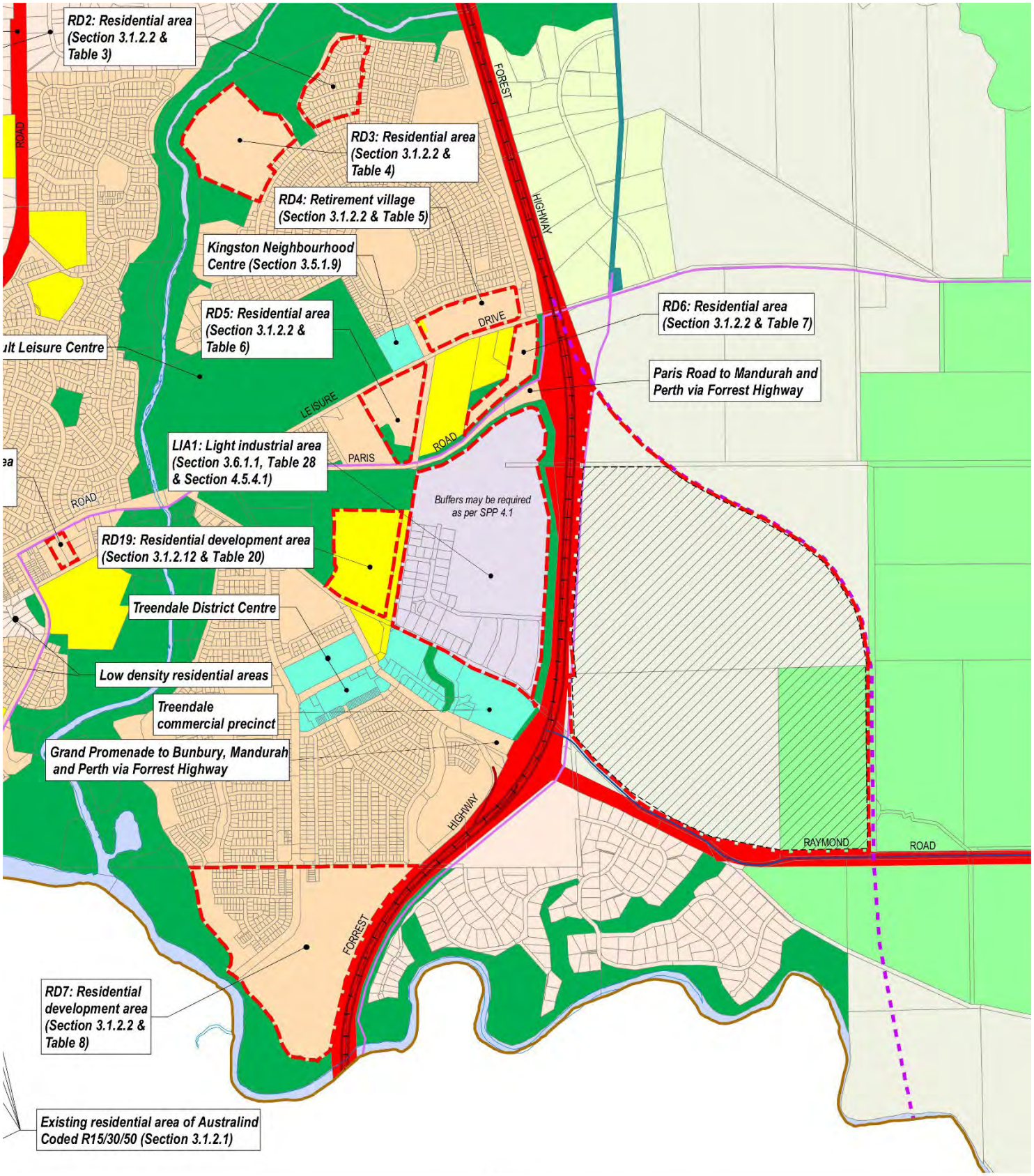


Figure 6. Shire of Harvey Local Planning Strategy Map - Roelands

2. Site Characteristics & Context

2.1 Context

The district context of Treendale East and its relationship to major transport corridors, employment and service centres is illustrated in **Figure 7**.

2.1.1 Surrounding Land Uses

Currently, land north of Raymond Road and east of Forrest Highway around the Structure Plan Area is cleared agricultural land with isolated pockets of remnant vegetation. South of Raymond Road and north of the Collie River foreshore is a Special Residential subdivision comprising lots just over 4,000m^2 (minimum one acre).

West of Forrest Highway, directly opposite the Structure Plan Area, the Australind Industrial Park is gradually being developed north from Ditchingham Place.

The Treendale District Centre is located approximately 1.2 kilometres west of the Structure Plan Area, on The Promenade in the developing Treendale residential area, which extends generally south of Grand Entrance/Ditchingham Place. The intersection of Grand Entrance and Forrest Highway is located approximately 300 metres south of the intersection of Raymond Road and Forrest Highway.

2.1.2 Movement Network

Bunbury Outer Ring Road

When complete, the Bunbury Outer Ring Road (BORR) will connect Forrest Highway to the Bussell Highway. The BORR alignment defines eastern boundary of the Structure Plan Area. The BORR has been officially named the Wilman Wadandi Highway.

The BORR is being constructed as a dual carriageway with four lanes. It is defined as a 'Strategic Freight or Major Traffic Route' and the requirements of *SPP 5.4 Road & Rail Noise* apply.

Associated with construction of the BORR are major interchanges at Forrest Highway/Paris Road and Raymond Road.

No direct access onto the BORR will be permitted.

Construction of this section of the BORR commenced in 2021, and was opened in December 2024 (after much of the work on preparation of this Structure Plan was completed).

Forrest Highway

Forrest Highway defines the western boundary of the Structure Plan Area. The road reserve has been widened to allow for works associated with construction of a major interchange with the BORR just north of the Structure Plan Area, which will provide a connection between Clifton Road and Paris Road, Australind.

Forrest Highway is defined as a 'Strategic Freight or Major Traffic Route' and the requirements of *SPP 5.4 Road & Rail Noise* apply.

A new Left in/Left out connection from Forrest Road into the Structure Plan Area is proposed. This will be necessary to:

- Provide a second entry/exit point for both emergency services and general traffic.
- Provide connectivity into the estate from the north, and to the south from within northern parts of the estate.
- Ensure facilitate efficient internal traffic flow and circulation.

Raymond Road

Raymond Road defines the southern boundary of the Structure Plan Area and is defined as an 'Other Significant Freight/ Traffic Route' for the purposes of *SPP 5.4 Road & Rail Noise*.

Raymond Road will bridge the BORR in the south-east corner of the Structure Plan

Area, and a major all-movements interchange will be built at this intersection.

The BORR and Raymond Road interchange is elevated above the natural ground level alongside the Structure Plan Area and will include construction of a noise wall along the northbound exit ramp.

Planning for the BORR currently includes a single access point from Raymond Road into the Structure Plan Area.

Current MRWA plans indicate a left-in, left-out configuration but to provide efficient access for the proposed new community in Treendale East a full-movement intersection will be necessary. The land already taken for upgrading of Raymond Road has sufficient dimensions to accommodate a roundabout. A four-way intersection with Ranson Drive, which presently has a T-intersection with Raymond Road, would allow residents in the subdivision south of Raymond Road to access the proposed Neighbourhood Centre as well as allowing all users to travel both east and west along Raymond Road.

2.1.3 Existing Retail & Commercial

The Treendale District Centre is located west of Forrest Highway, about 1 kilometre from Treendale East. It is the subject of the *Treendale District Centre Structure Plan 2008*, which indicates 20,000m^2 NLA retail at full build-out, and a further 16,500m^2 of ancillary uses such as office medical, mixed use, food and entertainment, and community. Eaton Fair Activity Centre is located about 5 kilometres to the south-west.

Development of the Treendale District Centre is partly progressed. The Eaton Fair Activity Centre Plan was amended in May 2020 to provide for 32,400m^2 of additional commercial floor space.

It is relevant to note that Treendale East was not included within the main trade area for the Treendale District Centre as the land was not then formally slated for urban development.

Treendale District Centre is likely to be the preferred destination for residents of Treendale East for higher-order retail and service needs.

The draft *Bunbury Geographe Regional Land Supply Assessment* concluded that there is likely to be sufficient commercial floor space to serve the sub-region's needs in the medium to long term. Therefore, commercial space within Treendale East will be required only to serve local needs and/or specialist (destination) uses, such as tourist uses.

2.1.4 Employment Land

The Structure Plan Area is proximate to major existing and proposed industrial areas and is 11.5 kilometres from the Bunbury CBD.

The Kemerton Strategic Industrial Area is located about 5.5 kilometres north of the Structure Plan Area and the Waterloo Industrial Park will be developed about 4.5 kilometres south.

These developments along with other smaller industrial and commercial areas will generate a significant number of direct and indirect employment opportunities and economic growth in the Greater Bunbury area. Treendale East is ideally located to accommodate housing for the required workforce.

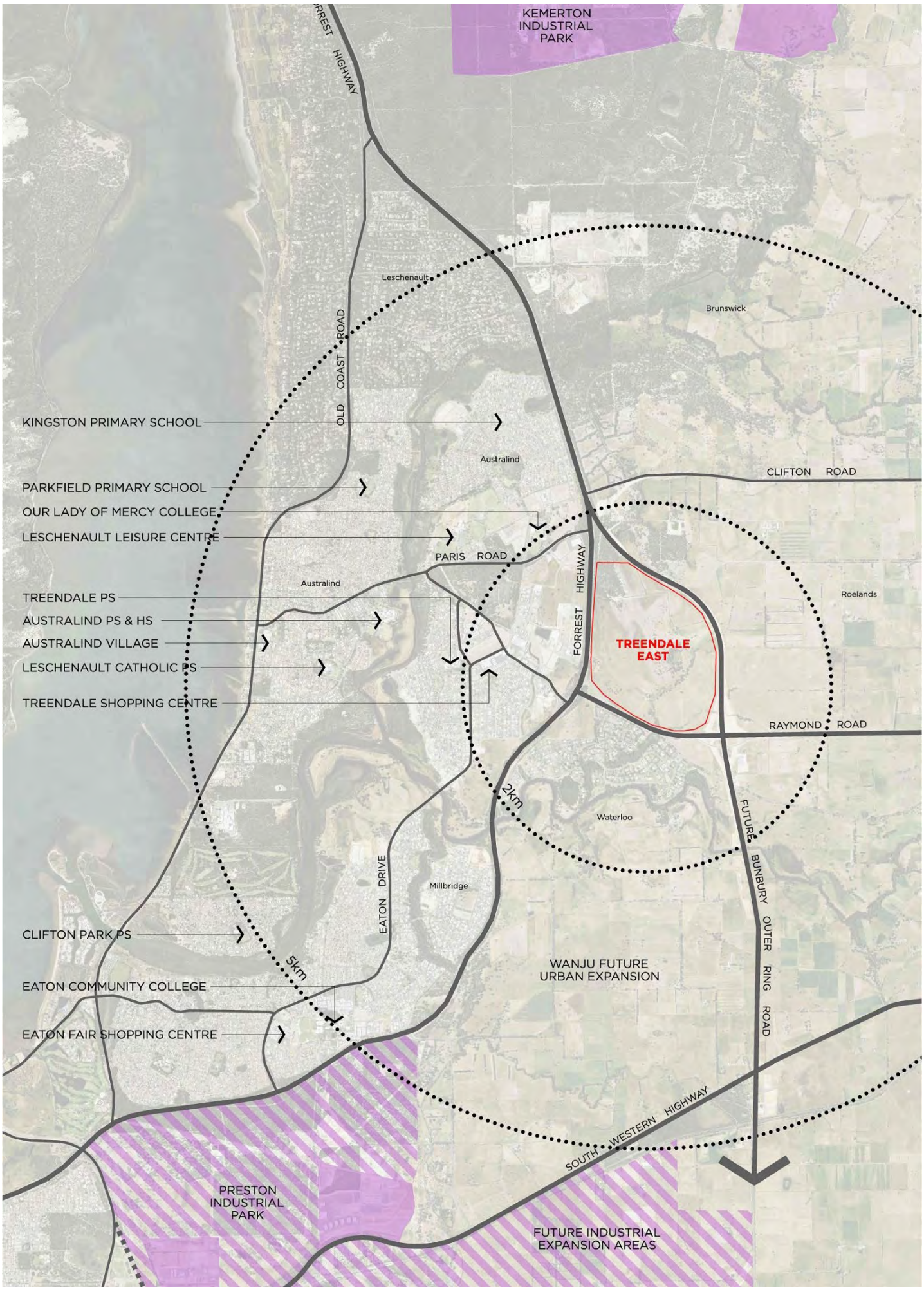


Figure 7. District Context

2.1.5 *Education Facilities*

The Structure Plan Area is within the intake area of Australind Senior High School and Harvey Senior High School. The public Eaton Community College is located approximately five kilometres south-west.

During consultation, the Department of Education (**DoE**) advised that provision of a high school within the Structure Plan Area is not required as the forecast population may not be able to achieve a viable number of secondary school students.

Several future public secondary schools have been identified in the approved Wanju District Structure Plan, south of the Collie River. **Figure 8** is a plan showing secondary school catchments.

The DoE advised that the student yield generated from within the Structure Plan Area is expected to be accommodated within a standard primary school site.

The DoE further advised that the school site is not to be located close to land capable of accommodating commercial uses that could have potential adverse impacts on the health, safety, amenity, and wellbeing of students.

The Department advised that for a primary school site, a maximum of half a hectare of the proposed playing field is permitted to encroach into the school site area, allowing for an effective developable area of three hectares for school buildings and facilities.

2.1.6 *Open Space & Reserves*

Regional open space is located along the northern Collie River foreshore between Forrest Highway and close to the BORR alignment. West of Forrest Highway, Wardandi Flora Reserve is regional open space situated at the intersection of Paris Road and Ditchingham Place.

The major recreation facility for the district is the Leschenault Leisure Centre, located off Paris Road, approximately 1.2 kilometres north-west of the Structure Plan Area.

2.1.7 *Service Infrastructure*

The site is well placed for service utility provision, with power, water, and communications services readily available. Some headworks extensions will be required but no logistical reasons have been identified as to why the site cannot be serviced with the required essential services.

Water Corporation's ESInet system identifies an existing 200 P-12 main in Raymond Road and a 250 P-12 within the undeveloped road Vittoria Road reserve to the north. As of October 2021, the Structure Plan Area was not yet included in Water Corporation's sewer catchment planning.

A supply chain network (Harvey Water) is also delineated within a section of the eastern boundary, which is currently used to deliver non-potable water to the site.

Telecommunications P100 pit and pipe infrastructure is currently located along the south side of Treendale Road.

Installation of NBN fibre has commenced in Grand Entrance within the existing Treendale Estate on the west side of Forrest Highway.

Gas Pipeline Easement

The Structure Plan Area is affected along its western side by the ATCO High Pressure Gas Pipeline Trigger Distance as defined by *WAPC Draft Operational Policy 4.3*. In accordance with the policy provisions, ATCO was consulted during preparation of this Structure Plan to obtain advice on what (if any) risk mitigation measures are required to ensure that no increased risk to the integrity of the HP104 pipeline and the safety of people will arise because of the proposed development.

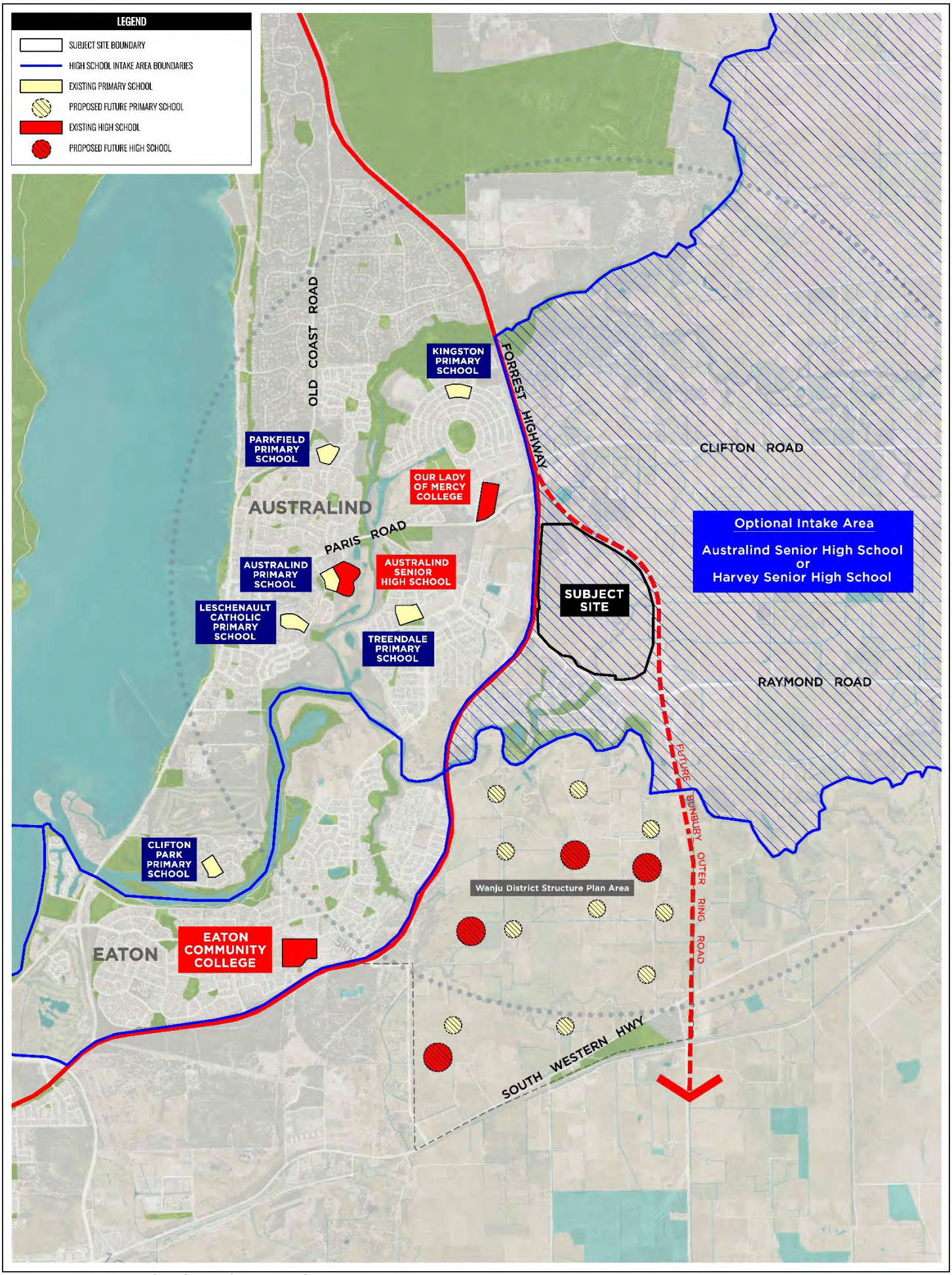


Figure 8. School Catchments Plan

ATCO advised that:

- High density residential areas must be located at least 120 metres away from the High Pressure pipeline corridor. High density is defined by *AS4645.1 Gas Distribution Networks* which includes areas where buildings of four or more storeys are prevalent, major shopping centres, schools, hospitals, aged care facilities, major sporting and cultural facilities. Public infrastructure in direct proximity of the high-density community use area is also deemed to be part of the high-density community use area.
- Sensitive land use (e.g., schools, aged care facilities) must be located at least 120 metres away from the High Pressure pipeline corridor.
- Future construction and any proposed access roads across the ATCO HP gas mains (including proposed roads and road upgrades) need to be managed in accordance with ATCO requirements.
- ATCO Gas must be notified of any works within 15 metres of this gas infrastructure before those works begin.

Powerline Easement

An existing high voltage (132kV) powerline crosses the south-eastern part of the Structure Plan Area. A formal easement has not been created but future development in proximity to the powerlines will have to comply with Western Power clearance requirements.

2.1.8 Natural & Manmade Drainage

The Structure Plan Area is currently traversed by manmade and modified natural drainage channels, including Treendale Gully which is a minor tributary of the Collie River and partly within Registered Aboriginal Heritage Site 16713 (see **2.6.1**).

Treendale Gully is a Water Corporation asset known as the Treendale Main Drain (Drain No. 642), as is the Treendale Branch Drain (Drain No. 633) which intersects with Treendale Gully at a culvert within the Raymond Road reserve which then directs flow towards the Collie River.

The land defined by these Water Corporation drains and the Raymond Road and BORR reserves has a central ridge line which runs from the north-east towards the south-west with a high point of approximately 15 metres and a low point of approximately 7 metres near the culvert.

Servicing of this land requires crossing Treendale Gully.

Treendale Gully is shown in **Image 1.**



Image 1. Treendale Gully

2.1.9 Residential Land Supply

The *Bunbury-Geographe Sub-regional Strategy* recognises the aspiration for the population of the sub-region to grow towards 200,000 over the next 20-30 years. The strategy is informed by the *Bunbury-Geographe Regional Land Supply Assessment 2021*[1] which included an analysis on the adequacy of residential land and dwelling supply. Using an average household occupancy rate of 2.6 people, it concluded that whilst there is a theoretical supply adequate to support a population of

[1] Bunbury-Geographe Regional Land Supply Assessment. DPLH – Draft for Stakeholder Review. April 2021

200,000, 25% of that is located in hinterland settlements where the feasibility of land development is inhibited by various factors. For this reason and in line with the preference to focus major population in the Greater Bunbury metropolitan area ('Bunbury Significant Urban Area'), the identification of Treendale East as an urban expansion area to ensure sufficient residential land to cater for the target population was supported.

2.2 Biodiversity & Natural Area Assets

The Environmental Assessment and Management Strategy (**EAMS**) prepared by Emerge Associates is included as **Appendix 3**. The EAMS used various information sources, including several surveys undertaken for Main Roads WA in relation to development of the BORR.

2.2.1 Flora

Vegetation Condition

The majority of the site comprises pasture grass/weeds and scattered remnant trees. Remnant intact native vegetation within the site is generally concentrated in the north. BORR related surveys assessed vegetation condition within the patch of intact vegetation in the northern portion of the site as being in 'good' to 'completely degraded' condition. Where associated with areas containing trees over pasture grasses, most of the Structure Plan Area would be considered to be 'degraded to completely degraded'. Where associated with pasture grass/paddock areas it would be considered to be in 'completely degraded' condition.

Significant Flora

Based on the October 2021 site visit undertaken by Emerge Associates it is considered unlikely that any occurrences of threatened or priority flora species would be found within the site.

The vegetation and flora study completed for the BORR identified the 'Priority 4' *Acacia semitrullata* within the northern portion of the site. No other threatened or priority flora species were identified within the portions of the site surveyed (which contained the areas of intact vegetation), and none are likely to occur in the portions of the site not included in these surveys given the high degree of disturbance.

Threatened & Priority Ecological Communities

Based on completed survey work, portions of the intact native vegetation within the northern portion of the Structure Plan Area have been identified as the federally listed 'Banksia Woodlands of the Swan Coastal Plain' TEC (Banksia Woodlands TEC), based on meeting patch size and vegetation condition requirements. At State level this same vegetation would be considered the 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region Priority 3 PEC'.

No other vegetation within the site would be considered wither a TEC or PEC based on the extent of disturbance within the site.

Environmentally Sensitive Areas

There are no mapped Environmentally Sensitive Areas (ESA) within the site. The closest ESA is south of Raymond Road, related to riparian vegetation associated with Treendale Gully/Collie River.

Mitigation & Management

Implementation of the Structure Plan is likely to have minimal impact on the flora and vegetation values within the site.

The area of intact remnant vegetation in the northern portion of the site will be fully retained and protected within recreation (conservation value) POS.

Riparian vegetation associated with the waterways in the south-eastern portion of the site will be retained and protected within recreation (conservation value) POS. Road crossings of the waterways can be located to minimise the removal of existing remnant trees.

Areas of other POS are strategically located to maximise the retention of remnant paddock trees.

At future stages of land use planning mitigation measures will be adopted that will minimise impacts to flora and vegetation values during construction and operation. These are detailed in **Appendix 3**.

2.2.2 Reserves & Conservation Areas

There are no DBCA managed reserves within the Structure Plan Area.

Land adjoining the northern boundary of the Structure Plan Area, contiguous with the intact remnant vegetation described in section 2.2.1, has been purchased by Main Roads as an environmental offset for construction of the BORR. A proposed Conservation POS within the Structure Plan Area will provide an effective extension of this offset by conserving this TEC.

2.2.3 Fauna

Fauna Habitat

Areas of intact native vegetation in the northern portion of the site provide the best quality habitat for fauna species.

Surveys undertaken for the BORR identified the following habitat within the site:

- Marri/Eucalyptus woodland, mix of *Corymbia calophylla* and *Eucalyptus marginata* dominated overstorey over mixed native understorey and/or paddock grasses.
- Peppermint woodland, largely uniform stands of *Agonis flexuosa* over paddock grasses.
- Dampland with Melaleuca shrubland and/or woodland, associated with waterway features in the south-eastern portion of the site and included trees over heavily grazed grasses.
- Artificial wetland, associated with man-made drainage channels used to create artificial wetlands.
- Highly modified/cleared.

Conservation-Significant Species

The following species of conservation significance were identified as potentially occurring within the vicinity of the site and potentially subject to impact if available habitat was impacted:

- Western ringtail possum (*Pseudocheirus occidentalis*) (state and federally listed). Western ringtail possums were identified as occurring within the intact 'Marri/ Eucalypt Woodland' and 'Peppermint Woodland' habitat types within the northern portion of the site.
- Three black cockatoo species, namely: Baudin's black cockatoo (*Zanda baudinii*) (state and federally listed); Carnaby`s black cockatoo (*Zanda latirostris*) (state and federally listed) and Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (state and federally listed). Foraging and potential breeding habitat for the three black cockatoo species, including evidence of use, has been identified within the northern and southern portions of the site. This included the 'Marri/ Eucalypt Woodland' and 'Peppermint Woodland' habitat types, and the 'Dampland with Melaleuca shrubland and/or woodland' in the southern portion of the site. It is possible that paddock trees in the unsurveyed portions of the site could also provide foraging and potential breeding habitat
- Carter's freshwater mussel (*Westralunio carteri*) (state and federally listed). Due to elevated levels of salinity, it is considered unlikely that this species will be present in either the agricultural drains or waterways within the site.
- South-western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) (state listed). Based on the fauna habitat within the site, the south-western brush-tailed phascogale, if present, is likely to be largely limited to the 'Marri/Eucalypt Woodland' habitat type within the northern portion of the site

- Quenda (*Isoodon fusciventer*) (state priority species). The quenda, if present, is likely to be limited to the 'Marri/Eucalypt Woodland' habitat type within the northern portion of the site where more intact native understorey is present.

Ecological Linkages

No regional ecological linkages have been mapped within the site. 'Green links' formed by a combination of POS and street planting are proposed by the Structure Plan and may assist in re-establishing or maintaining corridors for some species.

Mitigation & Management

Implementation of the Structure Plan is likely to have minimal impact on the fauna and fauna habitat values within the site.

- The area of intact remnant vegetation in the northern portion of the site will be fully retained and protected within recreation (conservation value) POS. This includes the areas of higher quality habitat for the three black cockatoo species and western ringtail possum.
- Riparian vegetation (associated with black cockatoo foraging and potential breeding habitat) associated with the waterways in the south-eastern portion of the site will be retained and protected within recreation (conservation value) POS. Road crossings of the waterways can be located to minimise the removal of existing remnant trees, and the central corridor will be revegetated, enhancing currently degraded/lower quality fauna habitat values.
- Areas of other POS will be strategically located to maximise the retention of remnant paddock trees.

2.3 Landform & Soils

WML Consultants (WML) undertook a preliminary geotechnical and acid sulphate soil (ASS) investigation. Refer to **Appendix 7.**

The assessment classified the soil based on *AS 2870:2011 - Residential Slabs and Footings* which requires an estimation of the expected surface movement due to the wetting and drying of a foundation. Their report is included as **Appendix 7** and key findings are summarised in the following paragraphs.

2.3.1 Topography

The Structure Plan Area is gently undulating with a high point defining a ridge running generally north-west to south-east in the northern part.

The lowest points are associated with the minor tributaries of the Collie River that operate as main drainage channels in the southern part (see **2.4.3** and **2.1.8**). These two channels form small valleys that separate the land between them from the northern part of the Structure Plan Area.

West of the ridgeline the site's aspect is generally towards the south-west although viewed from Forrest Highway, which is slightly elevated above the Structure Plan Area, the land appears to be flat and low-lying.

2.3.2 Soils

According to the 1:50,000 Geological Map of Bunbury-Burekup, the site comprises three different general soil types. Most of the site is comprised of "Guildford formation: mainly alluvial sandy clay" and "Bassendean sand: low rounded dunes" to probable depths of 20 metres and 15 metres respectively. A smaller area of "Alluvium – older river terraces" is present towards the southeast of the site.

2.3.3 Geotechnical

WML Consultants undertook fieldwork across four days between 30 March to the 6 April 2021. This comprised:

- 72 machine excavated test pits, to depths of 1.3 - 2.0 metres

- 72 Penetrometer tests to a target depth of 1.0 metre or refusal adjacent to each test pit
- Collection of soil samples from test pits for geotechnical laboratory testing
- Sampling of soil at 500 mm intervals for ASS field testing.

Using *AS 2870:2011 Residential Slab & Footings Classifications*, WML divided the Structure Plan Area into three zones based on soil profile, as shown in **Table 4**.

Table 4. Unmodified Soil Classes

Zone	Profile	Class
1	Sands with silt often above coffee rock	P
2	Sands above clays	M
3	Sandy clay above clay	H

Zone 1 'Sand' occurs mainly across the central north, Zone 2 'sand above clay' towards the western and south-western boundary, and along the north-east, and Zone 3 'clay' in the south-eastern corner.

2.3.4 Acid Sulphate Soils

Acid Sulphate Soils (ASS) refers to naturally occurring soils and sediment containing iron sulphide (iron pyrite). ASS are typically present in waterlogged anoxic conditions and in this state do not present any risk. When oxidised, as may happen with ground disturbing works, ASS produce sulphuric acid which can pose risks to the surrounding environment, infrastructure, and human health.

WML Consultants preliminary geotechnical investigation tested 79 field samples for evidence of ASS. None of the criteria indicating the presence of Actual ASS were met, however testing against criteria for Potential ASS found indicators in 21 samples from nine test pits.

Further testing will be necessary to determine whether development in accordance with the Structure Plan risks disturbing ASS.

2.3.5 Views

The land is generally flat and low-lying and there are no significant views available internally or externally. The BORR is elevated well above existing ground levels and will require a considered landscape design response to mitigate its visual impact.

2.4 Surface & Groundwater

Surface and groundwater have been addressed in detail by Emerge Associates in the Environmental Assessment and Management Strategy (**Appendix 3**) and the Water Management Strategy (**Appendix 4**).

2.4.1 Surface Water

The Structure Plan Area is within the lower Collie River catchment.

Multiple major drains, waterways and earth dams are located within the site. Two incised waterways occur within the south-eastern portion of the site, one of which runs from north-east to south-west (Treendale main drain, also known as Treendale Gully), and the other from east to west (Treendale branch drain). These intersect at the southern boundary of the site near Raymond Road and flow south-west into a CCW (UFI 1748) and eventually into to the Collie River approximately 1 km downstream.

The two waterways have limited riparian vegetation (largely remnant trees over grass) and are within a well incised corridor which is up to 60 metres wide is some sections.

A foreshore reserve along the waterways will be provided within POS areas 5, 6, 8 and 11, based on a biophysical assessment by Emerge Associates, discussed further in **4.5.6**.

Several other surface water flow paths and modified agricultural drains occur within the central and northern portions of the site and convey surface water to the west and south-east.

A water management strategy prepared by Emerge Associates provides further detail (see **4.14** and **Appendix 4**).

2.4.2 Groundwater

Aquifers beneath the site are comprised of the Superficial Swan (an unconfined aquifer); the Leederville (a confined aquifer); and the Yarragadee south (a confined aquifer).

Eight groundwater monitoring bores were installed across the site in May 2021 and monitored for a six-month period, to capture the 2021 seasonal peak. maximum groundwater levels beneath the site are variable, and heavily influenced by localised soil profiles. The generally high groundwater levels are associated with the unconfined aquifer.

Groundwater quality sampling across all monitoring bores indicate elevated total nitrogen concentrations across most bores in comparison to the National Water Quality Management Strategy guideline values for lowland rivers. However, the results are not unexpected based on the historical and current agricultural land uses within the site and broader district.

2.4.3 Wetlands

No Ramsar or listed 'important wetlands' are located on or within a kilometre of the site.

A number of multiple use wetlands (MUW) (UFI 1733, 1734 and 1748) are present across majority of the site and these are generally associated with existing cleared areas.

A conservation category wetland (CCW) (UFI 15223) is located more than 100 metres south of the site.

2.4.4 Flooding & Inundation Risk

Much of the site is classified as Multiple Use Wetland (MUW). The western side of the site adjacent to Forrest Highway is known to be inundated during winter, with water ponding above the ground surface following rainfall (see **Image 2**).

The maximum groundwater level (MGL) measured beneath the site in 2021 varied from approximately 0 mBGL to 6.5 mBGL. Most of the levels recorded likely reflect shallow soil profiles and not a permanent superficial aquifer given the low permeability of soils observed.



Image 2. The subject land in winter, looking north

2.5 Bushfire Hazard

Parts of the Structure Plan Area have been identified as bushfire prone due to the presence of remnant vegetation. In accordance with the requirements of *SPP 3.7 Planning for Bushfire Prone Areas*, a Bushfire Management Plan for the Structure Plan was prepared by Emerge Associates and is included in **Appendix 1**.

2.6 Heritage

2.6.1 Aboriginal Heritage

The Structure Plan Area is located on the traditional lands of the Wardandi people of the Noongar nation. Within the south-east part of Structure Plan Area, Treendale Gully is part of Site 16713 (Collie River Waugal) which is Registered under the *Aboriginal Heritage Act 1972.*

Any disturbance to the site is likely to require Section 18 approval (and consultation with Aboriginal people), however would not necessarily prevent development occurring within the boundary of the site.

It is intended that meaningful engagement with Aboriginal stakeholders will commence

early so that good heritage outcomes can be achieved. It is noted that heritage surveys were conducted on behalf of Main Roads WA as part of planning for the BORR.

As well as having cultural significance to Noongar people, Treendale Gully is an important visual landscape feature of the site.

Aboriginal heritage is addressed in more detail in **Appendix 3.**

2.6.2 Non-Indigenous Heritage

No part of the Structure Plan Area is identified as a Heritage place under the Local Planning Scheme or the *Heritage Act 2018*. The former farming land use is represented by an old farm shed on Lot 151 still in reasonable condition, which may be investigated to determine its suitability and viability for adaptive reuse within the development (see **Image 3**).



Image 3. Old farm shed

2.7 Noise Impact

The Structure Plan Area is surrounded by significant transportation routes that trigger the requirements of *SPP 5.4 Road and Rail Noise* (see **1.3.2**). Lloyd George Acoustics prepared a transportation noise impact assessment for Treendale East using the same methodology as for the BORR project, with which the company is also involved. The report is provided as **Appendix 8**.

SPP 5.4 applies only to noise sensitive areas being residential (the Domain), the Village and short stay accommodation, with no mitigation required to public open space or commercial parts of the Structure Plan area.

Figure 9 is a copy of Figure 5-1 from the noise impact report and shows that Noise exposure levels of A, B, and C can be expected across portions of the land because of the cumulative impacts of proposed road levels, surface treatments, and speed limits associated with the BORR, Raymond Road, and Forrest Highway. Unless the noisier surface treatments proposed on Forrest Highway and the BORR are modified to reduce the expected noise impacts (noting that the BORR in this area was designed prior to designation of the land for urban purposes), the development will have to incorporate noise mitigation measures such as additional noise walls and/or Quiet House design requirements.

Within the Domain Precinct, the proposed 4 metre high bund along the BORR interface reduces the extent of noise impacts. Within the Village precinct, future detailed design will address potential noise impacts on the proposed land uses. Noise walls or bunding may be appropriate.

Bunds will be vegetated. Noise walls alone are discouraged in this area so if noise walls are required in any location in addition to a vegetated bund, the visual impact of the wall is to be mitigated by screening planting.

The modelling is based on the undeveloped site. At subdivision design stage a more detailed assessment which considers finished subdivision levels and buildings within Treendale East will refine the noise contours and identify which lots will require Quiet House design, and the package of mitigation measures applicable.

The proposed school site will not require noise mitigation as it is located outside the impacted areas.

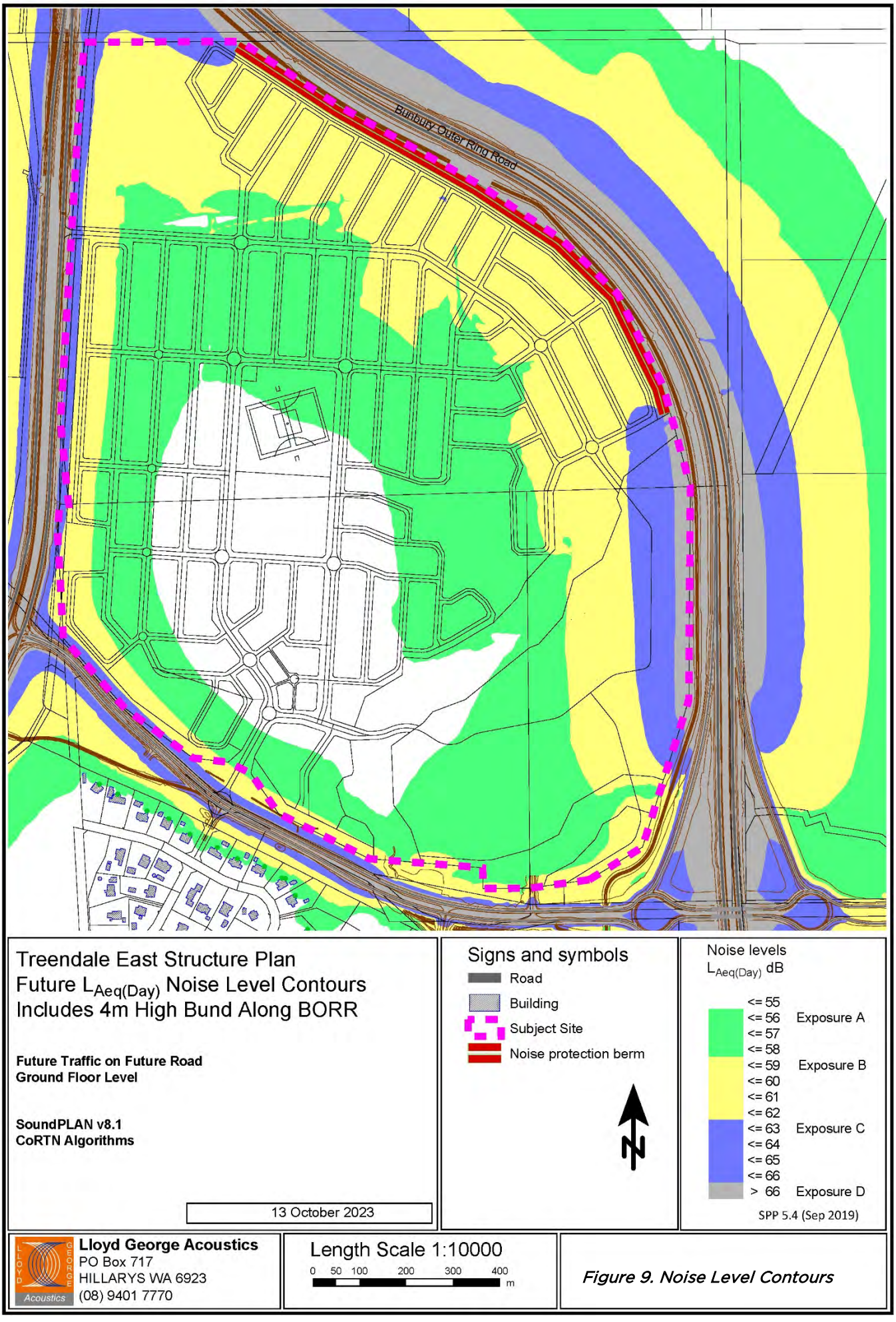


Figure 9. Noise Level Contours

3. Opportunities & Constraints

The key spatial opportunities and constraints that arise from character and context analysis are mapped in **Figure 10**.

The most significant constraints that influence the design response are:

1. Number and location of permitted intersections with Forrest Highway and Raymond Road.
2. Existing and future Primary Regional Roads that carry high volumes of traffic including heavy freight vehicles encircle the Structure Plan Area and in some sections are elevated well above existing ground levels.
3. Drainage requirements, including the significant presence of Treendale Gully and associated topography.
4. Remnant vegetation, in particular remnant native trees with potential foraging and roosting habitat for endangered fauna.
5. Wetland and buffer, and adjacent area of intact native vegetation with potential Western Ringtail Possum habitat, located in the northern part of the Structure Plan Area.
6. Powerline easement affects south-east corner of the Structure Plan Area.
7. Part of Treendale Gully is a Registered site under the *Aboriginal Heritage Act 1972*.

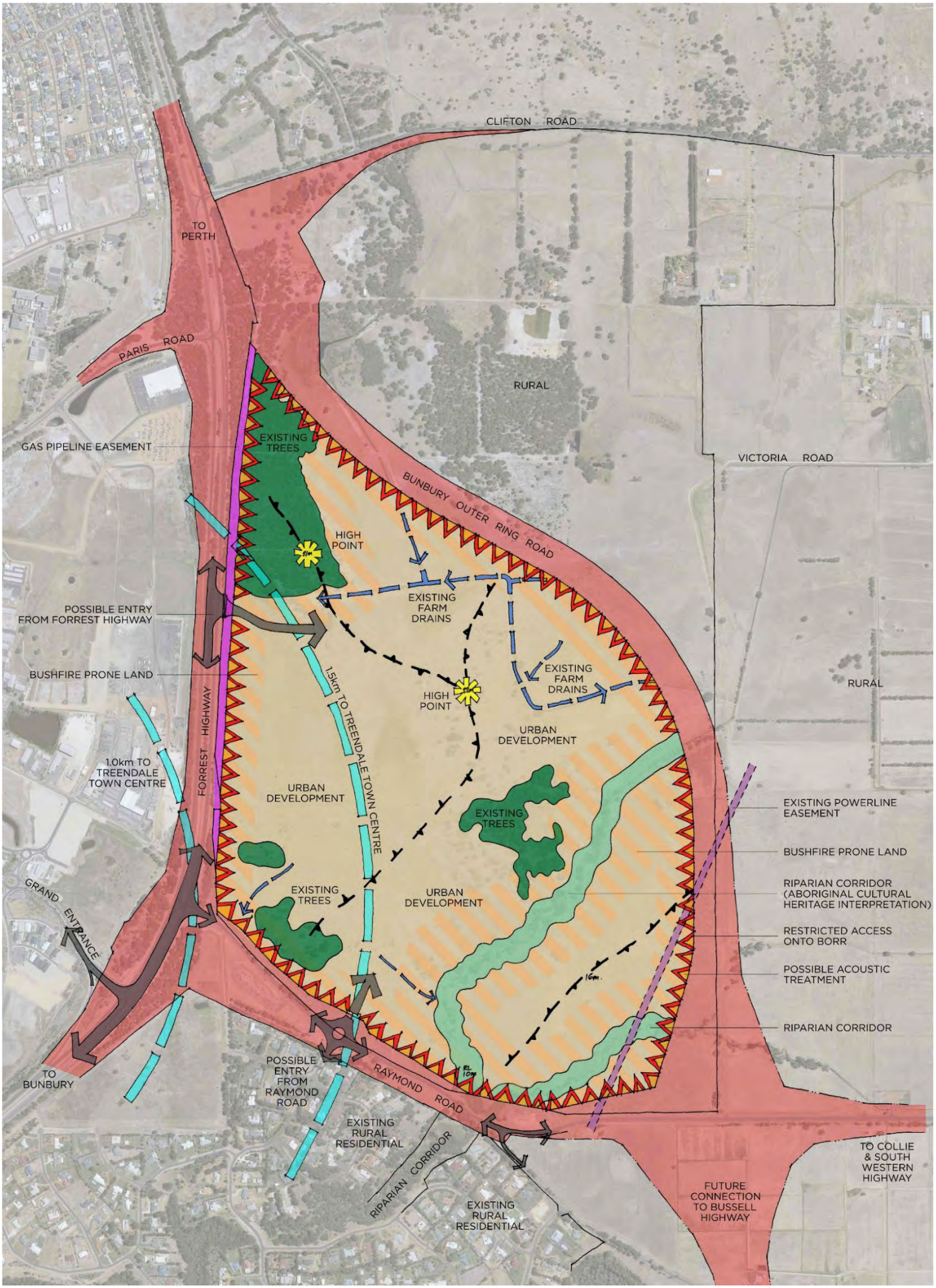


Figure 10. Opportunities & Constraints

4. Structure Plan Proposals

4.1 Structure Plan Objectives

Responding to the site characteristics and context, this Structure Plan aims to provide clear guidance for the planning and development of a quality new urban community at Treendale East that:

- Has a distinctive identity and sense of place.
- Has a comfortable, human scale.
- Fosters positive social interaction and a sense of community.
- Provides an attractive and safe public realm that encourages walking and cycling for local trips.
- Provides residents with quality outdoor public spaces and access to nature.
- Is well connected to the wider Bunbury region via an efficient movement network and public transport.
- Includes an accessible and attractive neighbourhood centre as a focus for retail, commercial, and community activity.
- Includes a range of land and building tenure options that meets the needs of a mix of residents and businesses.
- Maximises the use of recycled and/or recyclable, locally sourced materials in construction of both public realm and buildings (supporting the circular economy).
- Maximises the use of 'alternative' and 'light weight' building techniques for buildings and infrastructure.
- Maximises the use of low energy, high-efficiency service infrastructure (eg: street lighting, drainage, landscaping).
- Reduces water use through application of water sensitive urban design techniques and water efficient appliances.
- Protects and rehabilitates key environmental assets such as remnant vegetation, wetlands, and waterways through the application of biodiversity sensitive urban design principles.
- Retains natural topography and requires minimal or no imported fill.
- Maximises the opportunities for passive design responses to address potential external impacts such as noise, vibration, bushfire, and flooding.
- Respects and interprets local Aboriginal heritage in a culturally appropriate way.

4.2 Design Philosophy

The design concept underlying the Structure Plan is predicated on the belief that urban development should be not just functional and viable but should also create a positive legacy for the future. In the context of Treendale East, this includes promoting 'restorative development' that creates balance between the built and natural environments by regenerating natural systems within an urban context.

The design concept has been prepared in response to the site characteristics and context, having regard to the Ten Principles of Good Design as set out in *SPP 7.0 - Design of the Built Environment*. The principles and the design response to each are summarised in the following paragraphs.

1. Context and character

Good design responds to and enhances the distinctive characteristics of a local area, contributing to a sense of place.

It is intended that Treendale East will have a distinctive and uniquely 'South West' sense of place. The elements of this uniqueness will be refined progressively throughout the planning and implementation process, and will be reflected in the design, materials and plant selection, and colour palette of the public realm landscape and buildings, especially buildings in key locations and commercial and community buildings.

The concept and landscape strategy will be informed by local Wardandi Noongar cultural input.

In response to the major roads that will border the estate, the concept is largely inwardly focussed, with landscaped perimeter batters to minimise the visual and sound impacts of traffic.

The design aims to minimise bulk earthworks to retain as many of the remaining natural features as possible, including remnant vegetation and waterways.

Built form is intended to sit lightly on the site to reduce the need for sand fill to create 'A' class sites and consequential significant modification of the natural landform.

2. Landscape quality

Good design recognises that together landscape and buildings operate as an integrated and sustainable system, within a broader ecological context.

The landscape strategy for Treendale East is to create a high-quality public realm that integrates as many of the remnant trees as practicable and restores biodiversity to the site through the creation of contiguous green-and-blue links and the use of suitable species to support indigenous flora and fauna.

Retention of the main area of uncleared natural vegetation in the north of the Structure Plan Area as conservation open space, contiguous with similar quality vegetation on adjacent land will support the protection of Western Ringtail Possum habitat.

Use of 'Green Streets' (refer **4.4**) will introduce urban tree canopy to provide shade and usable spaces integrated with suitably located water sensitive design features such as rain gardens.

3. Built form and scale

Good design ensures that the massing and height of development is appropriate to its setting and successfully negotiates between existing built form and the intended future character of the local area.

Future buildings will be primarily one and two storeys in height, with greater height possible within and adjacent to the neighbourhood centre, which will be the subject of a Local Development Plan including key design controls.

It is intended that buildings adjacent to the riparian corridors will respond to landform by stepping down or extending over slopes, using alternative construction methods as appropriate to minimise the need for earthworks.

Using sales contract conditions, the developers intend to require all building plans to obtain pre-approval from the estate architect prior to lodgement for formal development approvals and/or building permits.

4. Functionality and build quality

Good design meets the needs of users efficiently and effectively, balancing functional requirements to perform well and deliver optimum benefit over the full lifecycle.

The design and construction of the public built environment is to use quality, ethically sourced materials that are durable, easy to maintain, and ultimately recyclable.

Materials recovered during site preparation will be retained for reuse on site or recycled, as appropriate.

Buildings exposed to bushfire risk and/or transport noise impacts will be designed to standards necessary to mitigate those risks to an acceptable standard.

5. Sustainability

Good design optimises the sustainability of the built environment, delivering positive environmental, social, and economic outcomes.

A desire to leave a positive legacy is a major driver for the development at Treendale

East and inherent to this is the principle of environmental, social, and economic sustainability.

Water sensitive and biodiversity sensitive design principles have been employed in the design of the Structure Plan.

The proposed street network has been carefully designed to optimise solar orientation of lots and aid efficient stormwater drainage.

The design enables the integration of renewable energy including community storage of excess energy and the provision of public electric vehicle charge points, with the ability to easily incorporate further sustainability initiatives if required or desired.

The intention for the 'island' Village precinct is for a strata-titled mixed-use development that features integrated sustainable buildings, public realm, and utility infrastructure. This tenure will allow greater flexibility to incorporate and manage shared infrastructure.

6. Amenity

Good design provides successful places that offer a variety of uses and activities while optimising internal and external amenity for occupants, visitors, and neighbours, providing environments that are comfortable, productive and healthy.

The public realm, incorporating the implementation of 'Green Streets' (**4.4**), will provide a safe, engaging, and attractive environment for community life. Design for universal access will maximise ease and comfort of use for all residents and visitors.

A variety of public open spaces linked by safe pedestrian paths will provide residents with options within easy walking and cycling distance.

The neighbourhood centre will provide a focus for retail, hospitality, and support services. The aim is for buildings within the neighbourhood centre to exhibit excellent, place-sensitive architecture and materiality that will be an attraction in their own right, as well as providing for the day-to-day needs of residents.

7. Legibility

Good design results in buildings and places that are legible, with clear connections and easily identifiable elements to help people find their way around.

The legibility of the highly permeable street network and public realm will be enhanced by a clear hierarchy integral to the 'Green Streets' design (see **4.4)**.

Landscape design will incorporate elements that aid legibility (wayfinding) and sense of place including, where appropriate, interpretation of Wardandi culture developed in collaboration with Wardandi people. Items such as choice of surface textures, colours, plants, and other sensory elements will provide an additional layer of legibility.

8. Safety

Good design optimises safety and security, minimising the risk of personal harm and supporting safe behaviour and use.

A safe and secure environment for all users will be provided through incorporation of 'Crime Prevention through Environmental Design' principles. This will include, inter alia, good spatial definition, clear lines of sight, good environmental lighting, and passive surveillance of the public realm by the location and orientation of buildings.

The design will be informed by research into the user experiences of people of different genders and cultural backgrounds to encourage legitimate use of public space by a wide range of people.

9. Community

Good design responds to local community needs as well as the wider social context, providing environments that support a diverse range of people and facilitate social interaction.

A range of dwelling types will provide for the needs of different household types, lifestyles, and age groups.

Development of a strong sense of community will be encouraged through the design and activation of the public realm and neighbourhood centre, as well as community development initiatives in the early stages of establishment.

Initial concepts for the 'Village' include community buildings that will encourage community interaction and public spirit amongst residents.

10. Aesthetics

Good design is the product of a skilled, judicious design process that results in attractive and inviting buildings and places that engage the senses.

At estate development level the public realm will be carefully designed to provide an environment that is both functional and aesthetically pleasing. Materials and street furniture such as seating, lighting, shelters, and paving will be carefully selected to achieve a locally distinctive, cohesive, and place-appropriate aesthetic, complemented by planting suited to both its location and purpose.

4.3 Urban Design Response

The urban design response to the opportunities and constraints presented by the site's context and characteristics and informed by the design philosophy is illustrated in the indicative development concept in **Figure 10**.

The concept:

- Makes a feature of the riparian corridors to provide internal views and amenity by remediating them as 'living streams' whilst remaining respectful to inherent Aboriginal cultural heritage values.
- Includes a strata-titled 'Village Precinct' on elevated land south-east of Treendale Gully, enabling introduction of community/micro-grid infrastructure.
- Co-locates the neighbourhood retail centre with sites for tourism-related commercial development overlooking Treendale Gully at the main southern entry to the development.
- Orients streets to allow for stormwater to drain towards to perimeter of the Structure Plan Area where drainage corridors will form a green pedestrian link connecting areas of public open space.
- Centrally locates the Primary School and adjacent active public open space.
- Retains the main area of remnant vegetation within Conservation public open space, adjacent to retained native vegetation on neighbouring land to the north.
- Maximises the number of lots with northerly orientation to optimise potential for passive solar design.

The Structure Plan provides for an urban structure which enables sub-precincts to be developed at the landowner's discretion. There are several ways sub-precincts may be developed, including but not exclusive to:

- the prevailing design of the general streetscape (i.e., variation in road reserve widths and verge and median treatments, materials used within the road reserves and verges, landscaping, retaining and fencing);
- the prevailing built form (ie. number of storeys, lot widths, front and rear loaded, setbacks etc); and
- the prevailing Public Open Space design and its usability, function, and configuration of POS areas.

The housing typologies envisaged in the Structure Plan Area will include primarily conventional single and double-storey front-loaded houses, with cottages and terrace housing in higher density development areas.

All design measures will be further explored as part of the subdivision design phase, estate branding, covenants and guidelines, and Local Development Plan preparation.



Figure 10. Concept Masterplan

4.3.1 Domain Precinct

The larger part of the Structure Plan area is referred to as 'The Domain' and will comprise mainly single houses on green title lots, although there will also be opportunities for grouped housing and even low-scale apartments if feasible. Detailed subdivision design at each stage will identify the actual lot sizes and thereby the type of housing that can be accommodated.

The Domain will be characterised by attractive, tree lined streets that encourage active forms of transport and provide opportunities for informal play and meetings – enhancing community formation and connections. Implementation of key street design concepts (described in **4.4** and **4.4.2**) and wider than normal road reserves in some locations will assist in achieving this outcome.

It is intended to partner with local builders who are keen to embrace new ways of building attractive, sustainable, and affordable housing, making Treendale East a showcase for better ways of implementing urban development.

Image 4 is an indicative representation of how a 'quiet street' could work within The Domain (see section **4.4.2**) and is not intended to represent an actual proposal for Treendale East.



Image 4. The Domain will feature low speed, landscaped streets as shared spaces

4.3.2 Village Precinct



Image 5. Communal facilities & landscaping



Image 6. Retention of trees & pedestrian links



Image 7. Narrow, low speed streets



Image 8. Oriented to the riparian corridor

In response to the constraints defined in **2.1.8** it is proposed that the large (approx. 30 hectares) site located in the south-east of the Structure Plan Area be set aside for development that responds to the land's challenging natural topography and distinctive characteristics.

It is intended that the two proposed creek crossings to access this precinct will be a physical and symbolic transition between the more urban public realm and built form of the Domain Precinct and a more relaxed and communal environment within the Village Precinct.

Opportunities for a variety of compatible land uses will be explored within the precinct, including retirement living, tourism accommodation, co-operative/non-conventional housing typologies, and short-term accommodation options. The intention is to create a unique residential and/or tourist accommodation environment that promotes a high level of community interaction in an environment that includes a range of communal facilities and infrastructure such as a community hub with residents' clubhouse. Limited, small-scale food and beverage and/or convenience store uses could be included that would provide amenity and a focus for community and take advantage of the north-facing aspect of the site adjacent to the creek, which will provide an appealing outlook.

Development within the Village Precinct will be visible from the north side of the creek (ie: the Domain Precinct) and access to the creek crossings will be via the Domain's road network. Hence the physical and visual interaction with the rest of Treendale East will be an important consideration for future detailed landscape and architectural design.

Development of the precinct may take place as a single project, but more probably it will be undertaken as multiple smaller projects that together achieve the desired outcome. For this reason, it is proposed that the creation of individual development sites

should be subject to a Shire approved Local Development Plan/s and/or developer-driven Design Guidelines that define key design parameters related to character, built form, the shared movement network, the disposition of key land use elements (eg: any café/restaurant use) and interface with the riparian corridor (eg: uniform fencing, pedestrian access points, public accessways).

The proposed Residential zone and R30 density coding serve to signal broadly the sorts of land uses and the general scale of development that could be contemplated within the Village, and to provide guidance for infrastructure planning. Conventional R30 subdivision and development is not contemplated, however would remain an option if the preferred alternative development proves to be unfeasible. A Local Development Plan would not be required in that case.

The images[2] represent developments with qualities similar to those anticipated within the Village but are indicative only.

4.4 Streets

As urban layouts increasingly respond to requirements for housing lots that maximise solar orientation and for permeability in the movement network by becoming more grid-like, opportunities are sought to provide visual variety and amenity in the streetscape. By making walking and cycling a more pleasurable experience through better amenity, residents will be encouraged to use passive modes of transportation for shorter trips and in so doing will be healthier and more likely to build resilient communities.

The developer of Treendale East intends to provide wider road reserves than the standard *Liveable Neighbourhoods* minimums to provide better amenity and useable space within road verges, a concept referred to as 'Green Streets'. Green Streets are intended to make better use of road reserves by providing more space for tree planting, on-street parking, footpaths, pocket parks, cycle lanes, etc, depending on the primary function of each street.

4.4.1 Green Streets

The concept of 'Green Streets' is intended to provide better quality public realm by providing shallower lots and wider road reserves. In Treendale East the concept will be applied to key roads, as described in Section **4.5.8**.

The principles of Green Streets are to:

- Prioritise pedestrian, cycle, and public space.
- Optimise trees/canopy cover to improve health and wellbeing for users, whilst creating shelter and a sense of enclosure for users.
- Have the potential to co-locate transport modes, including pedestrian, bicycle, and vehicle paths (ie. shared space/zone).
- Provide dual use paths on both sides of the street, subject to location of cycle lanes (e.g. on-street, as a separate lane, or shared with other modes).
- Calm traffic (e.g. meandering carriageway, alternate paving treatment, bollards, shared space/zone, narrowed carriageway, chicanes, one-way, etc).
- Allow the option to provide utility services within one standard width verge, allowing flexibility for tree planting within opposite verge.
- Provide for a widened verge to allow for high level of landscaped amenity (e.g. double row of trees, public space, etc) and the opportunity for reduced setbacks.

[2] All images sourced 15/03/2022. Image 4 https://www.nlv.com.au/villages/hillview/; Images 5 & 6 https://www.lifestylesa.com.au/retirement-villages/golden-grove; Image 7 http://www.wcfcaz.org/aged-care-retirement-villages-in-perth.html.

- Provide flexibility to accommodate either front or rear loaded lot product with crossovers for front-loaded lots consolidated or grouped to free up verge space.
- Provide most on-street parking on secondary streets that have a more utilitarian nature, allowing the green street to prioritise pedestrian and/or cycle movement.
- Ensure the interface between the street and buildings supports pedestrian amenity and safety.
- Provide universal access.
- **Figure 11** illustrates the general concept of Green Streets as compared to traditional streets. The detail of how the concept will be applied across Treendale East will be refined at subdivision design stage in consultation with the Shire of Harvey and WAPC.

4.4.2 *Quiet Streets*

Within the Green Street concept, 'Quiet Streets' are focussed on creating usable, low-speed pedestrian friendly spaces within road reserves.

The Quiet Streets concept will:

- Focus on lower order *Access Streets*, where volumes are low, or where through traffic will be discouraged, but in most instances will still offer a thoroughfare for refuse and emergency vehicles.
- Maintain permeability for pedestrians and cyclists to connect to local and neighbourhood activity nodes.
- Provide opportunities for pocket parks and safe informal play spaces within road reserves.
- Allow additional tree planting/ canopy cover within road reserves.
- Be 'reversible', allowing straightforward adaptation of streets to modify traffic flow if it is ever required. The road reserves will already exist.

Traditional Street



Green Street



Figure 11. Green Street Concept

Figure 12 is an overview of how the 'Quiet Streets' concepts could be implemented on different low-order streets to reduce through traffic and provide a greater variety of informal outdoor recreation spaces and more tree canopy. It also provides examples of how higher density housing product could be incorporated.

A series of vignettes showing possible variants is provided from **Figure 13** to **Figure 16.**

A Modern Cul-de-sac

One of the potential iterations of Quiet Streets is the cul-de-sac.

One Quiet Streets cul-de-sac variant would be to create larger development lots suitable for higher density housing such as villas, townhouses, or low rise apartments between two parallel access streets, accessed from the head of each cul-de-sac. Alternatively, these lots could be confined to a single road and extend between both cul-de-sac heads on that road.

The cul-de-sac variant could also be implemented without higher density development.

Consistency with Liveable Neighbourhoods

The Quiet Street cul-de-sac is consistent with the principles of both the 2009 and draft 2015 versions of *Liveable Neighbourhoods* in that they:

- Would only occur on Access D streets, therefore not impacting the permeability of the estate for vehicular movement.
- Would be no longer than 120 metres long, as the intended street blocks for Treendale East do not typically exceed 220 metres.
- Would typically not serve more than twenty dwellings.
- Permit ongoing pedestrian and cyclist through-traffic.
- Are linked by a small park overlooked by dwellings.
- Are reversible (ie: road reserve is continuous between both culs-de-sac).

Local Development Plan Required

A local development plan for lots with frontage to the head of a cul-de-sac will be required that will:

- Require that development addresses the adjacent pocket park (located between the culs-de-sac) through building orientation and visually permeable fencing and pedestrian access.
- Define the location of crossover/s.
- Specify whether a single dwelling is permitted.
- Specify the maximum building height if necessary to ensure compatibility with neighbouring single residential lots.
- Outline any other requirement considered necessary by the local authority, depending on the specific circumstances of each proposed cul-de-sac.

Figure 13 illustrates how through traffic could be deterred and slowed down. A visually and texturally different surface treatment would narrow the carriageway to a single lane, creating a meandering path for a short distance. Trees would provide shade, and hard surfaces would be used to create safe, informal play spaces within the road reserve. Dwellings facing this section of road would still have vehicle access.

Figure 14 similarly shows how traffic calming and pocket parks could be achieved using a combination of soft and hard landscaping.

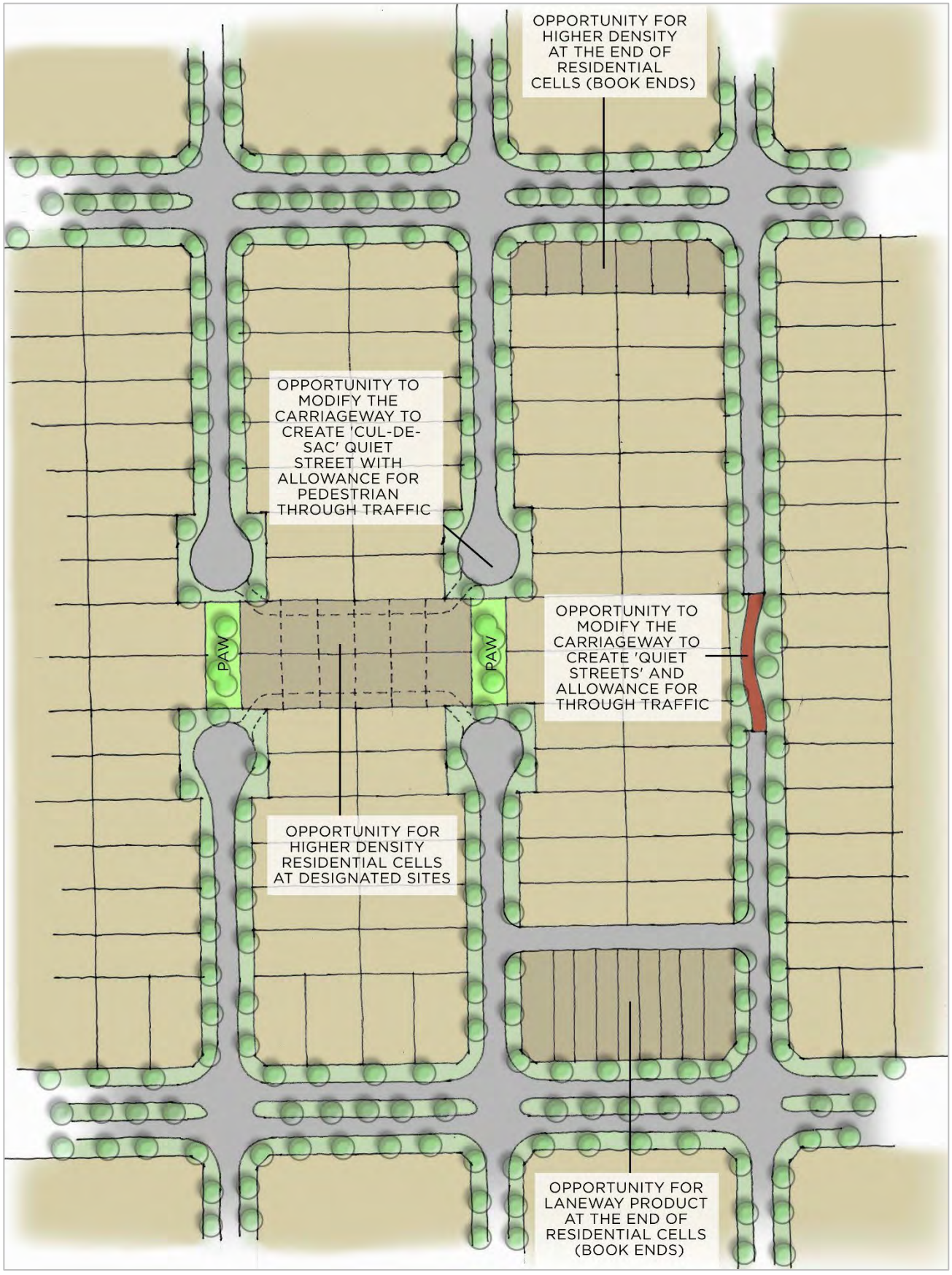
Figure 15 is a variant of the concept shown in Figure 13 applied to a wider (20 metre) road reserve.

Figure 16 shows how two culs-de-sac could be formed mid-block within the road reserve. No through traffic would be possible but pedestrians and cyclists would be able to pass easily between them via a

pocket park/informal play space connecting each end.

The cul-de-sac option could be used to insert higher-density housing mid-block adjacent to the amenity provided by the pocket park. In this option, the road reserve itself could be narrowed between each cul-de-sac head to provide larger lots to accommodate grouped housing.

Figure 12. Quiet Streets Overview



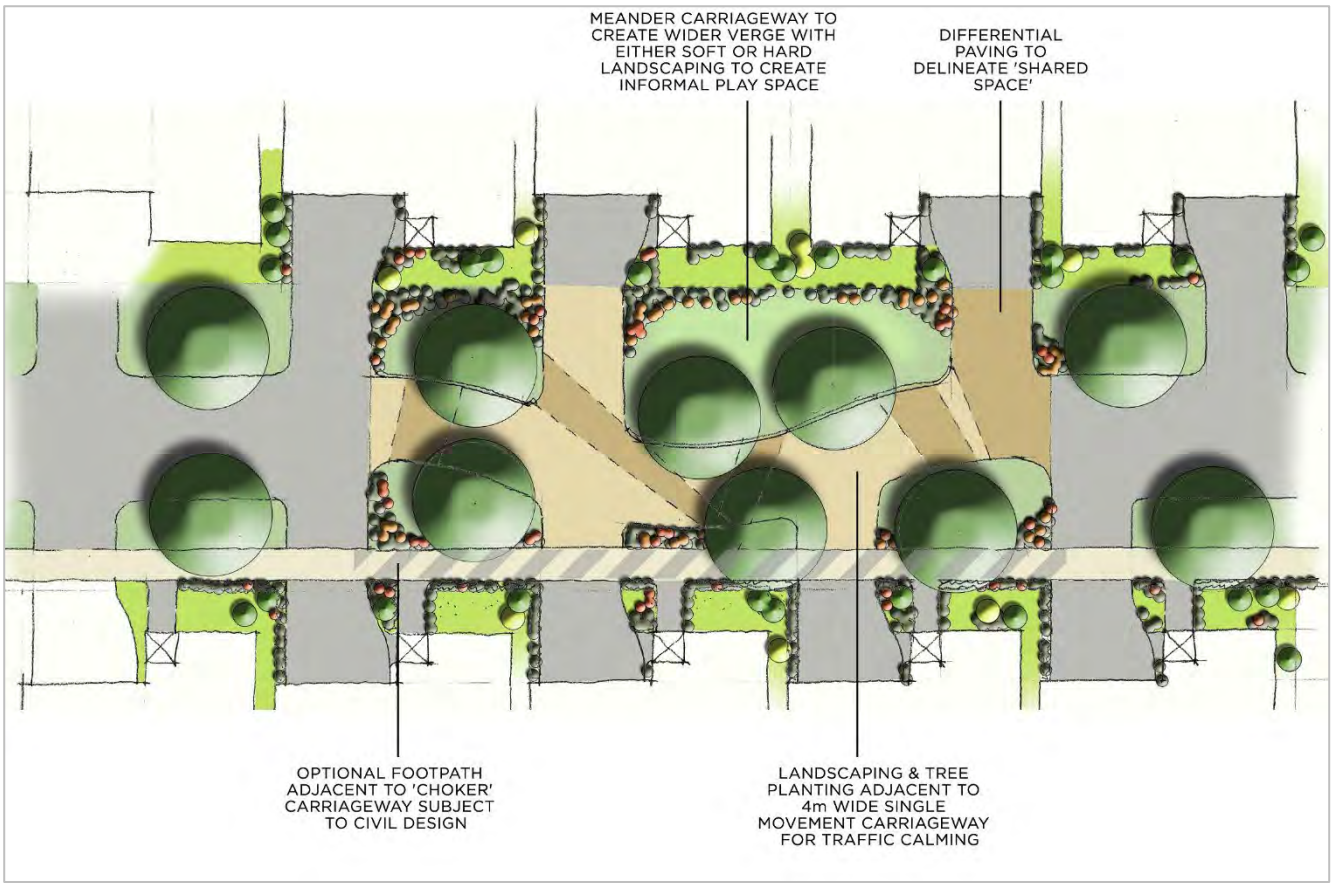


Figure 13. Quiet Street 'Choker Green'

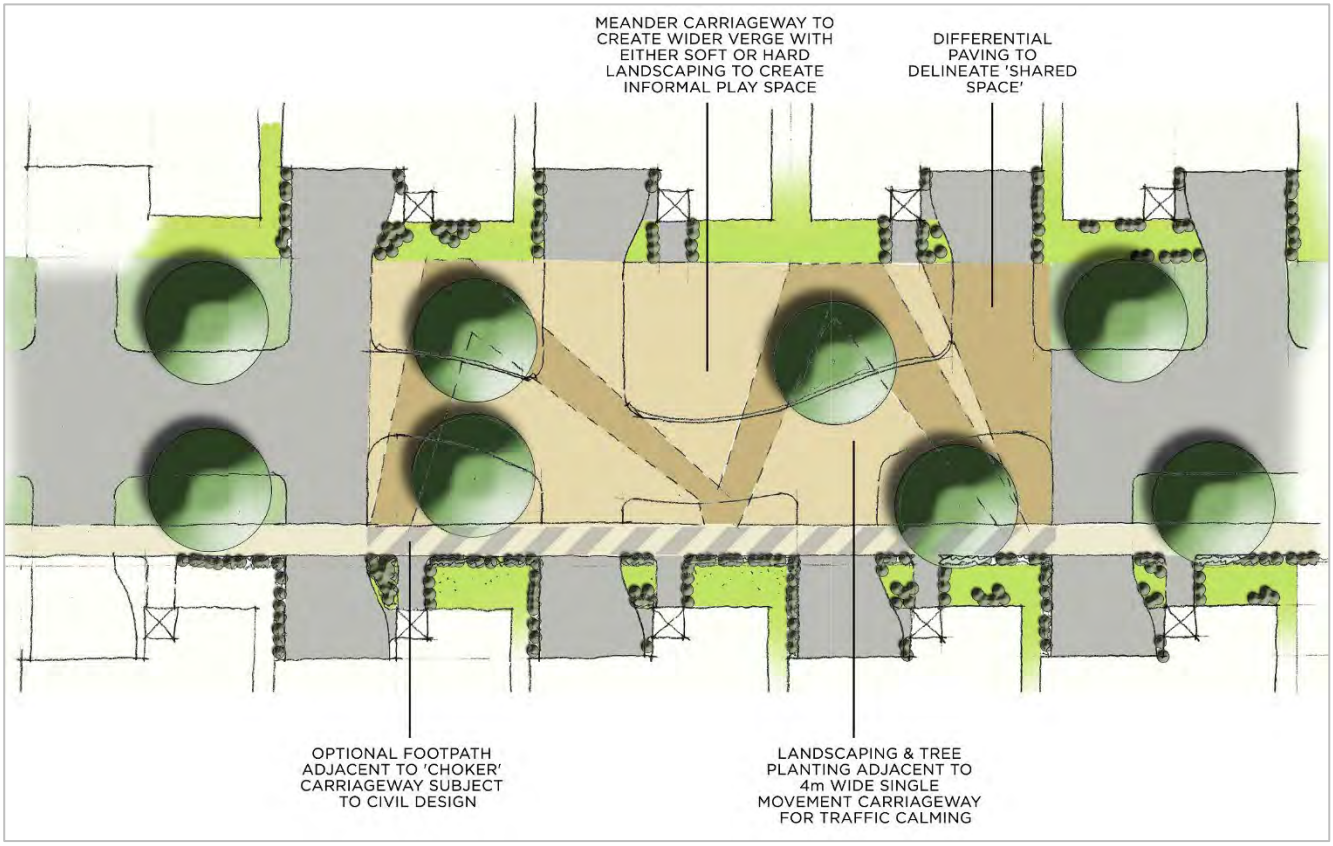


Figure 14. Quiet Street 'Choker'

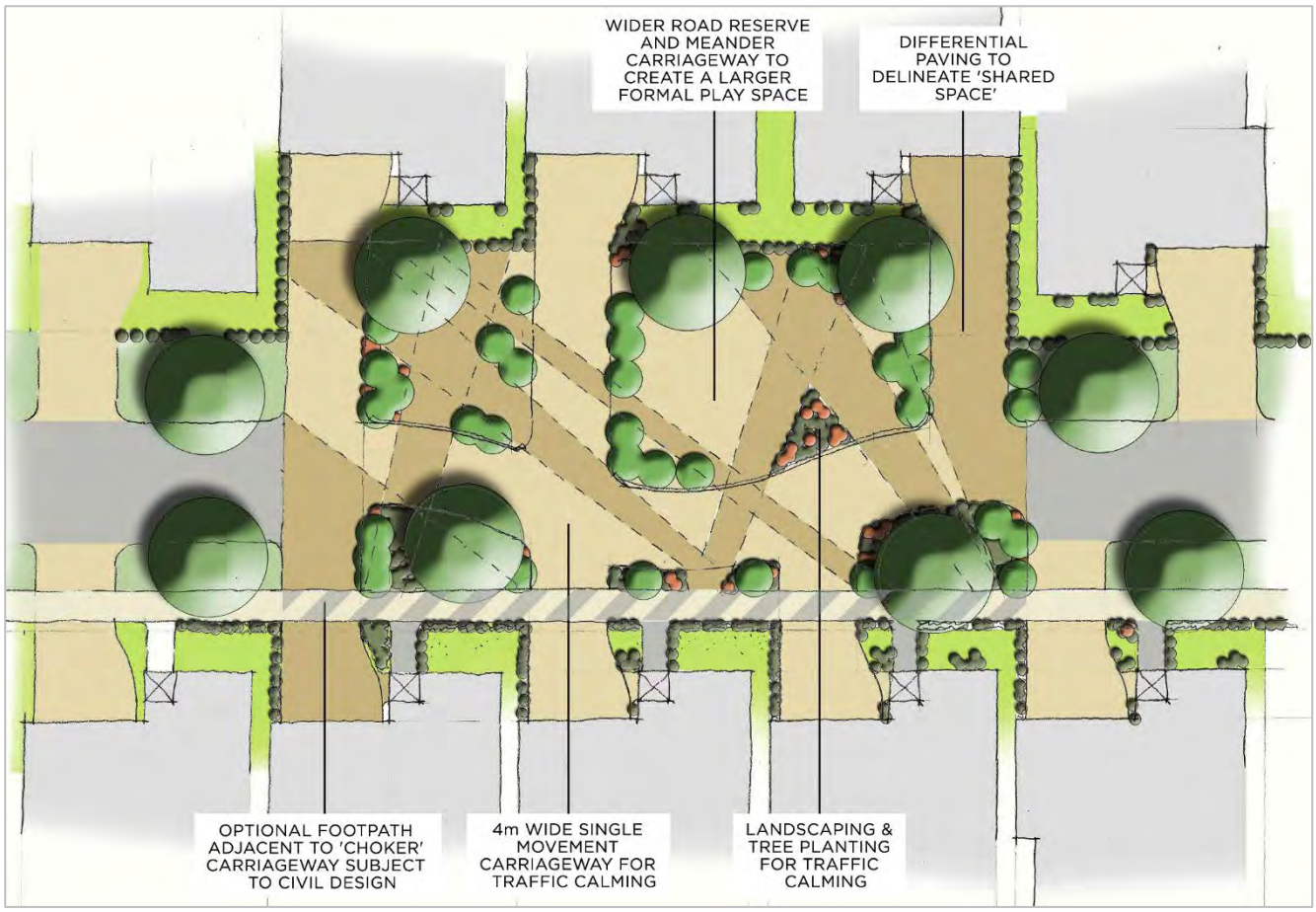


Figure 15. Quiet Street 'Choker' 20 metre wide reserve

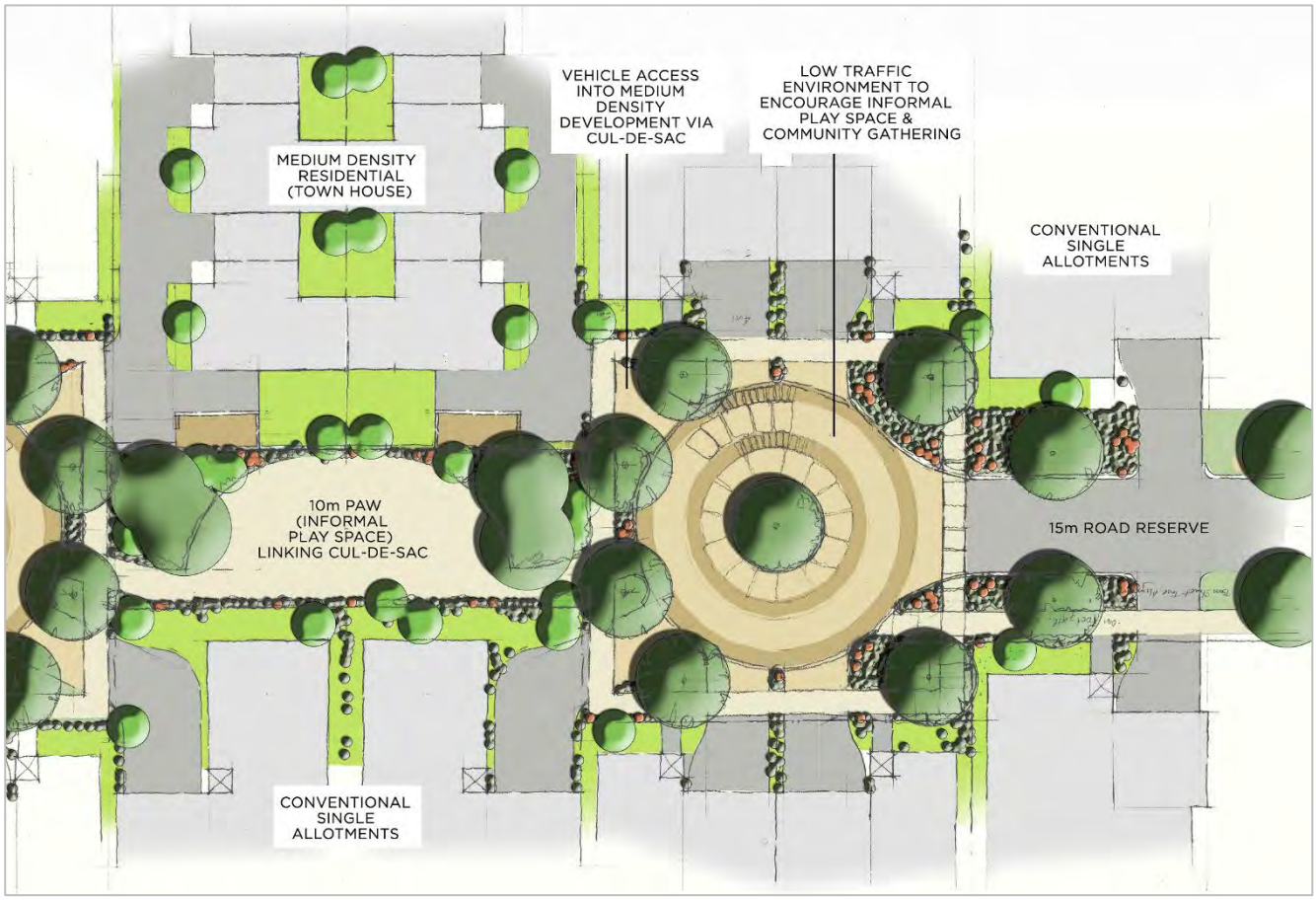


Figure 16. Quiet Street 'Cul-de-sac'

4.5 Landscape Strategy

The development of the site provides the opportunity for the rural character and natural landscape features of the existing locale to be interpreted and sensibly enhanced within practical limits.

Emerge Associates prepared a Landscape and Irrigation Strategy (included in **Appendix 5**) based on the following principles:

- The village environment and the elements that define the site as a place, is an avenue that is to be explored and referenced in the design of the landscape.
- Incorporate ecological corridors/buffers into the POS network and adopt a programme of revegetation and rehabilitation.
- Establish a highly legible and pedestrian/bicycle friendly system via the linear POS network.
- Retain existing stands of scattered and isolated Eucalyptus and Melaleuca trees within POS or wider road reserves.
- Balance the social and recreational requirements of future residents with the ecological and engineering constraints imposed by the site.
- Provide a variety of appropriate outdoor public space for recreational and social opportunities.
- Link the neighbourhood centre with POS, schools, and community infrastructure via a legible network of walking and bicycle paths.
- Incorporate waterway treatment drains within the open space network and widened road reserves to mitigate post development drainage flows, and ensure riparian corridors are sensitively designed to allow for multiple public uses.
- Consistency with Shire of Harvey Playspace Strategy and Signage and Infrastructure Style Guide as relevant.

4.5.1 Linear Open Space

A series of linear open spaces address the requirements of retaining site topography and the principle of protecting existing trees and ecological linkages. The design intent of these spaces is to enhance existing vegetation and incorporate existing stands of isolated trees and drainage alignments. Through respecting the existing topography in these areas, the linear POS will provide a necessary drainage function as well as visual amenity. Some of the linear open spaces align with existing drainage corridors, which are to be integrated and enhanced to provide important ecological function.

4.5.2 Neighbourhood & Local Parks

The landscape treatment of these spaces will generally be informal and characterised by revegetation and native parkland plantings to encourage passive recreation uses. Localised areas of turf catering for informal active recreation may also feature. The central neighbourhood park is likely to consist of retained remnant trees with a centrally built feature playground. Path networks will link to the adjoining residential streets and to the linear POS network.

Drainage areas may be required and where provided, will comprise landscaped basins serving a recreational and amenity function. Drainage swales catering for events greater than a 1-in-5 year rainfall event will have turf to facilitate multiple use and easy maintenance.

Closer to the neighbourhood centre there will be more hardscape and a more urban feel.

4.5.3 Playing Fields

Playing Fields serve a critical role in providing vegetation and large open turfed spaces capable of servicing a diverse range of passive and recreational activities. These large open spaces serve as a landmark and destination as they provide amenities such as large kick about areas, shelters, shade

sales, barbecues, nature play, and exercise nodes.

The landscape treatment of these spaces will provide distinct active/passive zones amongst activities and age groups. Planting will typically be used to provide shade for resting and play areas and perimeter planting will provide a visual buffer between road and path networks.

The playing field is located adjacent to the future primary school, providing an opportunity to co-locate amenities capable of servicing the local school, residents, and the wider community (refer to **Figure 22** on page **64**). Areas may be set aside for multi-purpose fields, hardcourts, amenity block, carparking, and a pavilion/clubroom building for spectators. Its capacity to allow for organised sporting and large-scale community events will contribute towards nurturing social interaction and promoting local connections within the community.

4.5.4 Civic

The civic focus will be the neighbourhood activity centre which may include (inter alia) retail, commercial, short stay accommodation, and a microbrewery. Public open space and streetscapes in proximity to this area will be predominantly hard paved to provide an urban landmark for community gatherings and events.

Key pedestrian and cycle networks will converge on this space.

4.5.5 Conservation Public Open Space

The area containing the greatest density of remnant vegetation, which is also potential habitat for endangered Western Ringtail Possum and Black Cockatoo species (refer to **2.2** and **Appendix 3**), will be dedicated as Conservation Public Open Space.

Located in the north-west of the Structure Plan Area, this 12.07 hectare land parcel is contiguous with land already set aside for conservation purposes by Main Roads WA as part of the BORR project. The combined size of these conservation areas will increase the viability of the land as habitat.

Measures to support the site will typically include weed control, rehabilitation, and path/trail networks with educational signage to help maintain and enhance ecological values.

4.5.6 Foreshore Public Open Space (Riparian Corridors)

Proposed foreshore areas will be defined over the two waterways in the south-eastern portion of the site, based on a biophysical assessment by Emerge Associates (refer to **Appendix 4**). Delineation of the foreshore reserve takes into consideration the extent of extant riparian vegetation adjacent to the waterways, slopes adjacent to waterways exceeding 10%, 1% AEP flood modelling (generally – refer to **Appendix 4**), the requirements for emergency and management access, and earthworks and slope integration.

Rehabilitation of these riparian corridors will include revegetation and sensitive landscaping to provide public use as well as drainage functions.

The combined foreshore open space totals approximately 15.43 hectares.

In addition to important drainage and environmental functions, the public open space functions of the corridor will be aesthetic, recreational, and cultural.

Aesthetically, the waterways are a significant and unique landscape element within the Structure Plan Area. The corridor will provide a beautiful outlook for adjacent development, which will be designed and built in such a way as to have minimal impact on the natural landform whilst providing passive surveillance of the public open space.

Recreationally, the linear form of this public open space lends itself to providing a walking, cycling, and/or jogging trail (bidi)

connected to the perimeter drainage/public open space.

Culturally, the riparian corridor will reflect and interpret Aboriginal cultural heritage in a respectful manner, developed and implemented in collaboration with local Elders, thereby helping to promote cross cultural understanding, reconciliation, and community building.

4.5.7 Buffer

In addition to providing a drainage function and ecological and pedestrian links, a key role of the buffer POS will be to provide a noise and visual buffer between the community and the major perimeter roads through the inclusion of vegetated bunds or similar. See cross sections in **Figure 20**.

4.5.8 Streetscapes

Streetscapes will incorporate treatments in response to the street hierarchy. The street network aims to establish tree canopy that will provide a shady, leafy, and green matrix extending across the estate.

Landscape works within road reserves will incorporate tree planting and other vegetation in accordance with the accepted traffic standards.

It is intended that stormwater runoff from residential roads will be contained upstream mainly in a series of bio-retention swales distributed along road reserves and the linear open space network, for later conveyed to existing waterways.

It is anticipated that within the POS, predominantly native trees will be used. Within streetscapes species selection may also include species that reference historic and cultural influences in the area. These may include deciduous exotic species historically used around rural homesteads on selected routes to provide landmarks and promote legibility.

Indicative street cross sections are illustrated in **Figure 18** to **Figure 20** in **4.10.1**.

4.6 Land Uses

The Structure Plan Area will be largely residential, with a neighbourhood activity centre including a core retail area and entertainment and tourism uses such as a micro-brewery and short-term accommodation.

Other uses will include a primary school, district and local public open space, drainage, and conservation public open space.

Residential development is intended to provide a range of dwelling types to suit the needs and lifestyles of the local population. Treendale East will include primarily housing lots to accommodate single and grouped dwellings with standard freehold and strata tenure options.

The 'Village' has been earmarked as a survey strata subdivision to accommodate a range of housing types, communal facilities and infrastructure, and potentially support services offering a showcase for alternative 'green' construction and servicing techniques.

The Structure Plan map (**Plan 1**) indicates zones corresponding with LPS 2. Land use permissibility will be guided by LPS 2.

Table 5 summarises the proposed broad land uses, and the proportion of the total area dedicated to each.

Table 5. Land Use Composition

Land Use	Area (ha)
Domain Residential (nett)	101.418
Village Residential	29.869
Neighbourhood Centre *Commercial floorspace*	2.893 *0.400*
Primary School	4.0
POS (Total) District Neighbourhood Local Conservation (Bush/Riparian) Landscape/Acoustic Buffer	48.867 4.105 5.593 4.004 27.866 6.817
Drainage (dedicated)	1.776

Land Use	Area (ha)
Infrastructure *Sewer Pump Station (2)*	0.160
Total	**188.50**

4.6.1 Land Use Permissibility

The zones and land use permissibility nominated by section **5.2 of Part One** of this Structure Plan.

Land use permissibility will generally be consistent with that in the proposed future zones shown on the Structure Plan map, which are consistent with zones in LPS 2. In some cases, however, land uses other than those permitted within the designated in the LPS 2 zone may be contemplated to achieve the specific objectives for Treendale East.

Within the Neighbourhood Activity Centre, proposed uses such as Shops, Restaurant/Café, Hotel or Tavern, Small Bar, Brewery, Offices, Consulting Rooms, Holiday Accommodation, Medical Centre, and Motel are all uses that can be contemplated within the Neighbourhood Centre zone.

The Village Precinct is proposed to primarily be a 'Residential' zone, however additional uses are proposed within the 'Residential (Village)' zone to support the intent for the Village Precinct to be developed potentially for retirement living, tourism, short-term accommodation options and associated communal facilities and infrastructure.

For example, it is proposed to make use of land adjacent to the powerlines and the BORR for a caravan and trailer parking/storage facility, but the applicable land use classification ('warehouse/storage') is not permitted use in the proposed zone. Small scale commercial use such as a Restaurant/Café may also be appropriate to support the tourism/lifestyle objectives of the precinct.

Any additional land uses for the Village Precinct would be limited to communal facilities and tourism related uses generally incidental to the predominant land use, so as not to compete with the retail function of the neighbourhood centre.

Additional land uses will be further considered upon preparation of a local development plan for the precinct. As a guide, the following potential additional uses could be considered, including potential floor space limits to prevent them from competing with the Neighbourhood Centre:

- Café/Restaurant
- Convenience Store
- Tourist Development
- Club Premises
- Warehouse/Storage (recreational vehicles)

Following finalisation of this Structure Plan and 'normalisation' of the zoning within the operative Local Planning Scheme, the Additional Uses and Additional Site Requirements (size limitations for café/restaurant) would be designated on the Scheme Map and referenced in the appropriate schedules of the Scheme Text.

4.7 Dwelling Forecasts

4.7.1 Bunbury-Geographe Sub-Regional Strategy

The BGSRS seeks to provide for the growth of the sub-region's population from approximately 106,000 to 200,000, by identifying sufficient residential and employment land to cater for this target population.

In considering the adequacy of residential land supply, the *Bunbury-Geographe Regional Land Supply Assessment* quantified a supply of approximately 41,340 additional dwellings to be achieved through greenfield and major infill. Based on an average household size of 2.6 persons, this could support an additional 107,480 residents in the sub-region, which would be sufficient to accommodate the target population growth.

Major population and employment growth is focussed on Bunbury. The Treendale East Structure Plan Area is designated as an 'Urban Expansion Area' on the north-eastern periphery of the Bunbury metropolitan area (**Figure 5** refers).

Dwelling targets for development areas are not provided by the GBSRS although a consolidated urban form is promoted for Bunbury through urban infill and higher densities around activity centres and other areas identified in a local planning strategy.

To establish general dwelling targets for Treendale East, the *Directions 2031 and Perth and Peel @ 3.5million* target has been used as a guide. **Table 6** refers.

Table 6. Comparative Directions 2031 Targets

Directions 2031 Scenarios	Projected Dwellings
'Business as Usual' @ **10 dwellings** per *gross urban zone*	1,885
'Connected City' @ **15 dwellings** per *gross urban zone*	2,827

Based on the concept plan (**Figure 10**), the 188.5 hectares gross urban site area is projected to yield in the order of **2,200 dwellings** (equivalent to about 12 dwellings per gross urban zone), which places it within the target range prescribed by the State Government. This will accommodate a population of approximately **5,720 people**, at a rate of 2.6 persons per household.

The dwelling yield estimate would be closer to the higher target of 15 dwellings if not for the extensive conservation areas provided as part of 34.74 hectares of 'surplus' creditable Public Open Space (ie: above the 10% minimum) which reduces the developable area. If instead of being set aside as public green space these surplus areas were to be developed for residential purposes, they would contribute approximately 474 additional dwellings (or approximately 2,674 in total) which would achieve 14 dwellings per gross urban zone hectare.

The dwelling forecast is indicative only and will be subject to the individual subdivision stages and more intensive development of the Village Precinct. Detailed drainage and environmental constraints, including retention of good quality remnant native vegetation in POS areas will also impact final dwelling yields. Preferred lot mix and market demand at the time of land release will also influence final dwelling yields.

4.7.2 Liveable Neighbourhoods

Based on the *Liveable Neighbourhoods* 'site hectare' definition, the 'Domain Precinct' (see **4.3.1**) will achieve a nett subdivisible residential area of 62.765 ha.

With a projected yield of 1,500 dwellings, 24 dwellings per site hectare overall will be achieved.

The projected densities will fulfil the *Liveable Neighbourhoods* targets of average 22 dwellings per site hectare for the overall 'Domain Precinct', and 20 – 30 dwellings per site hectare target for development within 400 metres of the Neighbourhood Activity Centre.

The 'Village Precinct' will contribute to higher density projections, acknowledging the residential population is planned to be a combination of permanent (strata-title homes and lifestyle /over 55s) and short-term accommodation (i.e. tourism related).

Whilst land and dwelling tenure is subject to market-lead proposals, as guided by a Local Development Plan and/or Development Application(s), the proponents project a yield of 700 dwellings over this 28.3 ha site. This will equate to *Liveable Neighbourhoods* density targets of at least 30 dwellings per site hectare for the 'Village Precinct'.

4.8 Residential Densities

Density code ranges are proposed to maximise opportunities for diversity in lot product and housing types and enables the Structure Plan design to evolve to suit market demand at the time of staging release.

All images in this section are indicative only and are intended to be representative of the densities discussed. They do not represent development specifically proposed within Treendale East.

The ranges proposed are:

- 'Domain Precinct' R25 – R40
- 'Village Precinct' R30
- Neighbourhood Centre R80

A specific density coding will be allocated to residential lots at the time of subdivision application. The specific density coding will be determined based on the lots complying with one or more of the following design criteria.

4.8.1 *Residential R25 and R30*

The R25 base density coding will be the prevailing density in the Structure Plan area, generally supporting the delivery of conventional front-loaded product of 350m^2 or greater.

Where a particular streetscape outcome or product mix is desired, the R30 base density may apply.

Notwithstanding the locational criteria for R40 coding (**4.8.2**), lots coded R25 and R30 may also be eligible for locations within 100 metres walking distance of public open space on a case-by-case basis.



4.8.2 *Residential R40*

The density coding will generally apply to those lots:

- within 100 metres walking distance of public open space and key distributor roads including public transport stops
- lots at the head of a Quiet Street mid-block culs-de-sac (**4.4.2**) and having a combined site area of 1,000m^2 or greater
- within 100 metres of the proposed Neighbourhood Activity Centre.



R40 Design Rationale

Lots within a 100 metres walkable catchment of public open space or other areas of public amenity are eligible for R40 coding.

Higher densities within the walkable catchment of amenity nodes, including bus stops, is also encouraged to promote greater use of these services.

4.8.3 *Residential R50 and R60*

To promote diversity of lot product, housing typologies, and tenure, the Structure Plan allows for R50 and R60 density coding subject to meeting one of the following criteria (in addition to R40 criteria outlined in **4.8.2**):

- a particular streetscape outcome is sought; or
- lots with a laneway abutting the rear boundary; or
- lots:
  - located at the end of a street block; or with direct frontage to two intersecting roads (corner lots); or
  - within designated medium-high density development sites.

4.8.4 *Residential R80*

The Neighbourhood Centre has been designated as R80 to promote mixed-use development.



R40 – R60 Design Rationale

This density coding for laneway-accessed lot product will enhance streetscapes by mandating vehicle parking at the rear of the site.

The higher density coding for nominated development sites also encourages higher density and product diversity. These sites will be identified at the subdivision design phase and in locations that will not compromise the amenity of previously constructed lower density subdivision stages and may include lots situated at the heads of Quiet Street mid-block culs-de-sac.

Development of higher density lots should be co-ordinated to promote development by a single landowner or partnership and achieve a cohesive design outcome.

The preference is for most higher density development to be located at the 'bookends' of residential cells to assist in achieving:

- better built form outcomes (eg: balconies fronting the dedicated street rather than communal driveways internal to the development);
- reduced impacts on adjoining properties (minimises potential overshadowing and visual privacy constraints compared to 'mid-cell' developments); and
- ability to locate parking in grouped and multiple dwellings at the rear of lots, allowing better street presentation.

In other circumstances, higher density development may require preparation of a Local Development Plan to control interface issues.

4.9 Local Development Plans

4.9.1 RMD Codes

WAPC's *Planning Bulletin 112/2016 Medium-density single house development standards – Structure Plan Areas* is included as **Appendix 12**.

PB 112/2016 provides standard built form provisions for single houses in R25 – R60 coded areas. These will apply until they are superseded by amendments to the R-Codes.

RMD provisions avoid need for Deemed to Comply provisions via Local Development Plans (**LDPs**) to vary the R-Codes for single houses in medium and high-density coded areas.

4.9.2 Prescribed Requirements

Notwithstanding the RMD variations mentioned in **4.9.1**, there will be other circumstances that will require the preparation of LDPs as follows:

- Lots affected by noise from Bunbury Outer Ring Road, Forrest Highway and Raymond Road, as identified by an acoustic assessment (see **Appendix 8**).
- Lots with rear-loaded (laneway) vehicle access.
- Lots with direct boundary frontage (primary or secondary) to an area of Public Open Space.

Preparation of LDPs for lots with these attributes will ensure consistency in built form, fencing and general streetscape.

4.9.3 Neighbourhood Centre Zoned Land

To ensure a well-designed and integrated town centre, lots within a Neighbourhood Centre zone will require preparation of an LDP that addresses the following design elements:

- The creation of a main street environment that encourages pedestrian movement through carriageway treatments, continuous tree canopy on both sides for shade, good lighting of the

public realm, and embayed on-street parking.

- Provision of a plaza/civic space, appropriate to the neighbourhood scale, adjacent to the main street.
- Built form that appropriately addresses and frames surrounding streets and public realm by providing:
  - nil setbacks (including two storeys or equivalent height parapet walls) or minimal setbacks to the street boundary;
  - active frontages with windows and building entrances accessible and/or visible from the public realm, maximum use of glazing to provide visual engagement with the street, and no blank façades.
  - pedestrian weather protection in the form of continuous awnings and/or colonnades along public frontages.
  - visually interesting buildings that address all publicly visible frontages and incorporate contextually appropriate architectural features and materials and address corners where applicable.
- Car parking that is provided on-street and off-street parking areas located behind buildings so as not to visually dominate the streetscape or interrupt pedestrian traffic flow.
- Appropriate interface with adjoining residential areas through the use of landscaping and/or other design measures to avoid negative visual, acoustic or other negative impacts on residential amenity.

4.9.4 Village Precinct

An LDP or LDPs will be required prior to development and/or subdivision of the Village Precinct, other than for conventional residential subdivision, to address:

- Proposed land uses.
- Public, emergency, and service vehicle access and circulation.
- Continuous public pedestrian and cycle network.
- Interface of developments with adjoining public realm/common property (as relevant) including the riparian corridors.
- Built form bulk and scale.
- Key built form design parameters to ensure visual cohesiveness.
- Any other relevant matters such as bushfire and acoustic requirements.

If a single development application that adequately embeds these requirements is proposed and covers the entire Village Precinct, the local government may determine that an LDP is not required and that the development approval provides sufficient certainty of an acceptable outcome. If after exploring the alternatives, a conventional R-30 subdivision is ultimately proposed, only lots meeting other criteria identified in this Structure Plan will require an LDP.

4.9.5 Quiet Street Culs-de-sac

An LDP for lots with frontage to the head of a mid-block cul-de-sac will be required as a condition of subdivision. The LDP will:

- Require that development addresses the adjacent pocket park (located between the culs-de-sac) through building orientation and visually permeable fencing and pedestrian access.
- Define the location of crossover/s.
- Specify whether a single dwelling is permitted.
- Specify the maximum building height if necessary to ensure compatibility with neighbouring single residential lots.
- Outline any other requirement considered necessary by the local authority, depending on the specific circumstances of each proposed cul-de-sac.

4.10 Movement Network

4.10.1 Proposed Road Network

The proposed hierarchy of roads is depicted in **Figure 17**, with indicative cross-sections provided in **Figure 18**, **Figure 19**, and **Figure 20**.

The hierarchy is informed by the requirements of *Liveable Neighbourhoods* Element 2 – Movement Network with technical guidance under the Transcore Transport Impact Assessment (**Appendix 2**) and Emerge Associates Landscape and Irrigation Strategy (**Appendix 5**).

Generally, the road network is defined by *Integrator Arterial B* and *Neighbourhood Connector* roads running from development access points on Raymond Road and Forrest Highway respectively. These are then connected via a north/south central avenue road and complemented by boulevard streets with central medians used for drainage conveyance and landscaping, and lower category avenue and access streets.

The roads have generous road reserve widths to allow for a focus on landscaping and pedestrian/cyclist connectivity ('Green Streets' as described in **4.4**). In some instances, wider-than-standard *Liveable Neighbourhoods* road reservations are presented in this Structure Plan so that the 'Green Streets' concept can be implemented. Development of residential stages will provide opportunity to review reservations to correspond to final traffic volumes and detailed subdivision/public realm design.

Primary Distributors

External to the Structure Plan Area, Forrest Highway, Raymond Road, and the Bunbury Outer Ring Road are a major influence on the movement network within Treendale East.

Access to the development is proposed from Raymond Road and the Forrest Highway. Approval for these intersections and treatments will be required from Main Roads WA (MRWA).

No direct access will be permitted onto the BORR. The existing Raymond Road Left in/Left out intersection is to be temporary only for ongoing rural access until development of the Village precinct, after which it will be removed.

The intersection proposed for Raymond Road is a roundabout located centrally to existing roads - Raymond Road and Ranson Drive. The proposed Forrest Highway Intersection is intended to be secondary intersection and will be a left-in left-out treatment.

Integrator Arterial B

These roads will have up to a 30.0 – 31.5 metre reserve, serving as the major entry points with controlled intersections to the external *Primary Distributors* and will provide attractive landscaped central medians.

Direct driveway access for residential properties will be restricted based on projected traffic volumes exceeding 5,000 vehicles per day (vpd).

Neighbourhood Connector A

These roads will have up to a 31.5 metre reserve connecting the Structure Plan's main entry roads off Raymond Road and Forrest Highway. Projected traffic volumes up to 4,300 vpd allows for a wider verge on one side that can accommodate a double row of tree planting.

Neighbourhood Connector B

The *Neighbourhood Connector B* typology will have a 19.5 - 26 metre reserve range allowing for intermittent on-street parking on each side and full movement intersections. The wider reserve offers a central median for additional landscaping, drainage and way finding of higher order roads.

Access Street A

Access Street A typologies will have up to a 26.0 metre reserve, allowing for a landscaped median that may incorporate a drainage function. To this end they are applied to east-west routes to direct stormwater towards the peripheral drains.

Access Streets C & D

Five types of *Access Streets C and D* (yield roads) are possible, according to the local situation. The reserve widths are 20.0 metres, 19.5 metres, 15.0 metres, or 13.0 – 15.0 metres.

The 20 metre width will apply where a wider verge on one side of the road is proposed to provide embayed on-street parking in suitable locations.

The 19.5 metre reserve will allow for a wider verge incorporating a double row of street tree planting and embayed on-street carparking on one side.

Roads with the 15.0 metre reserve will be standard low volume, low speed access streets with a 6 metre wide carriageway and street tree planting within the verge.

Reserves of between 13.0 and 15.0 metres may be used where a narrower verge adjacent to public open space can be supported.

Modern Culs-de-sac

Modern culs-de-sac are a concept described in section **4.4.2** of this Part, and if applied would be a sub-set of the Access Streets D category of road. Unlike old-style culs-de-sac that are literal dead ends for both vehicles and pedestrians, this concept would be applied 'head-to-head' within the Access Street road reserve, with each cul-de-sac head being connected to the next by a generously proportioned and well landscaped pocket park that would allow safe pedestrian and cycle movement between them. In this way, the modified grid favoured by *Liveable Neighbourhoods* to maximise permeability and legibility is retained whilst creating distinctive and desirable places that encourage interaction between neighbours and help build a genuine sense of community.

Modern culs-de-sac would be low-volume, low-speed traffic environments that would encourage households outdoors to use the streets as shared spaces.

Laneways

Laneways, having a width of 6.0 metres, will be used for rear loaded development fronting the *Integrator Arterial B* or throughout the development where directly fronting Public Open Space, or supporting higher density built form.

Village Road Network

The Village Precinct design philosophy is to create a movement network that encourages walking, cycling and the use of public transport. The indicative design ensures a shared and safe movement network with spaces created for pedestrians and cyclists as well as motor vehicles. The movement network within the Village would support three types of roads, described as Village Communal Roads to differentiate them from other Structure Plan roads.

Village Communal Roads

Village Communal Roads will be provided within the proposed strata-titled Village Precinct. The main vehicle route connecting to the wider Treendale East road network (Village Communal Road B) will be 12.0 metres wide. This reserve will accommodate tree planting and possibly footpaths within the verge. The entrance into the precinct is likely to be treated as a landscaped boulevard as it crosses the riparian corridor.

Subject to detailed design, wider roads may be considered.

In other parts of the precinct, tree planting will take place within building setbacks.

4.10.2 Public Transport

Provision is made for a bus route along the central north-south aligned *Neighbourhood Connector* road, accessing and egressing the main entry points off Forrest Hwy and Raymond Road (**Figure 17** refers).

Subject to agreement with the Public Transport Authority, this service may be an extension of an existing route between the Bunbury CBD and the northern suburban corridor; or a new service specifically for the Treendale East growth area.

4.10.3 Pedestrians & Cyclists

Pedestrian dual use paths will be provided on the major road links and through the POS foreshores and landscape buffers.

A safe and attractive pedestrian cycle route is an important element to achieve the vision for Treendale East.

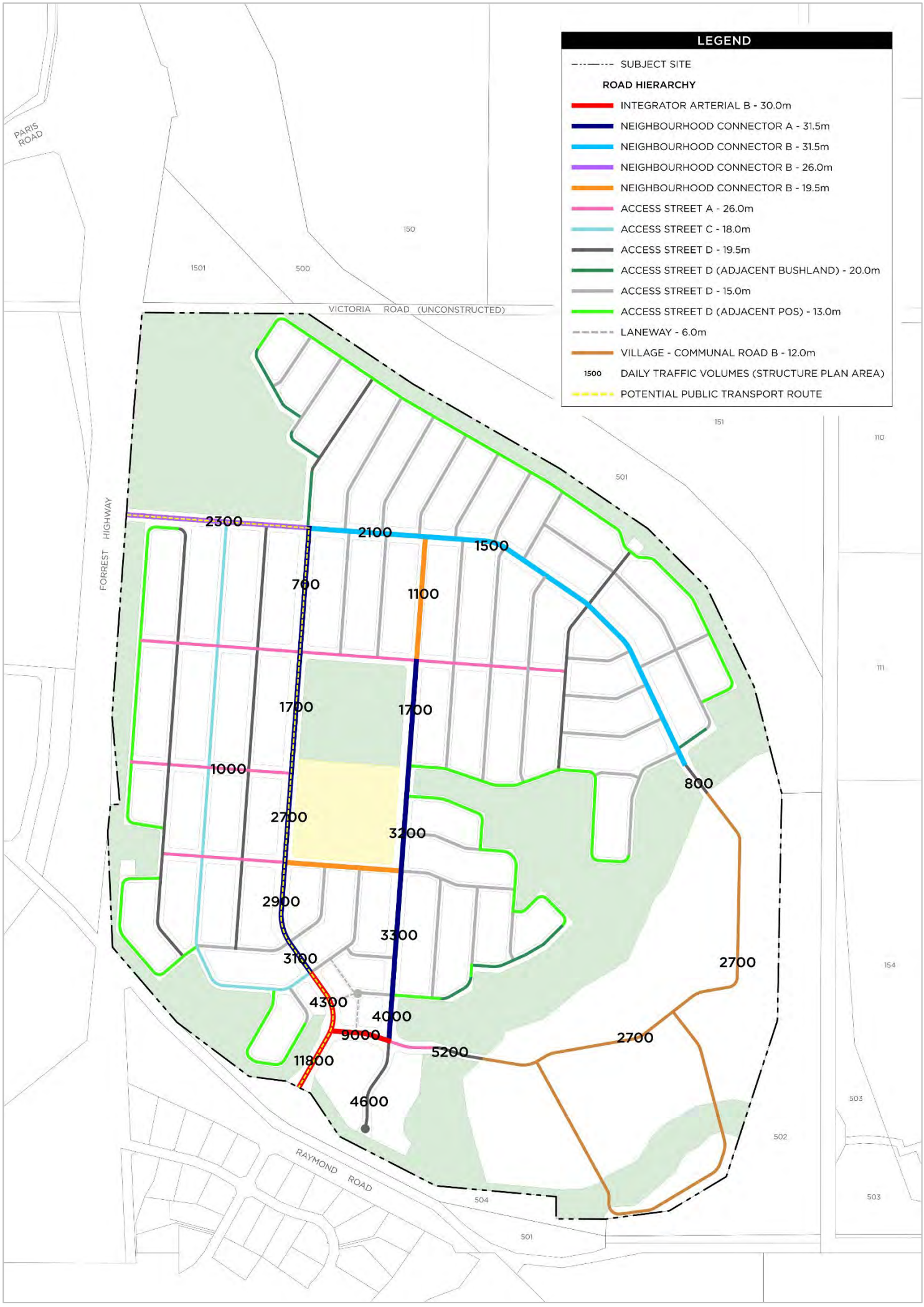
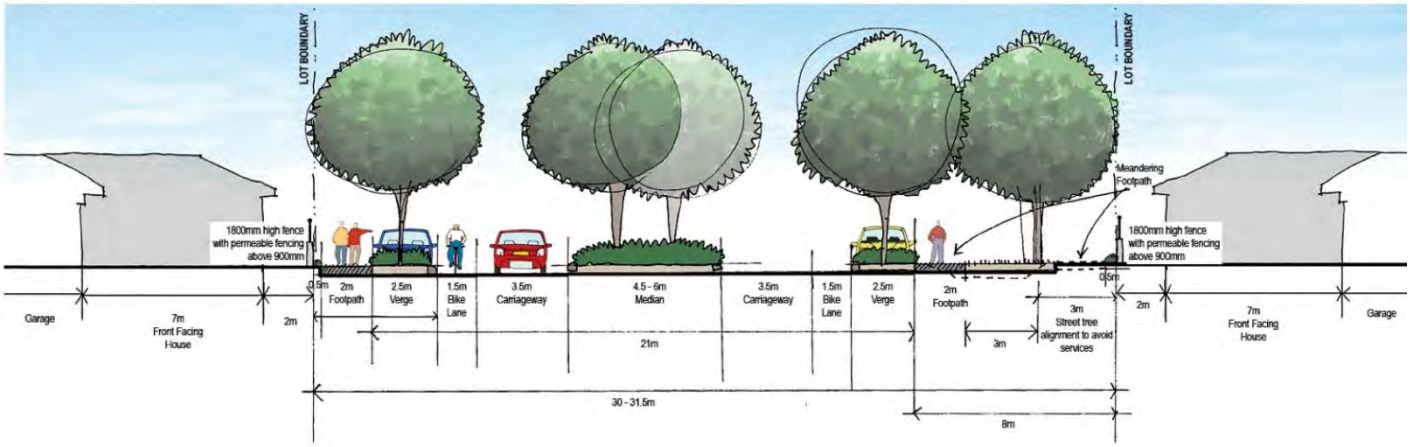
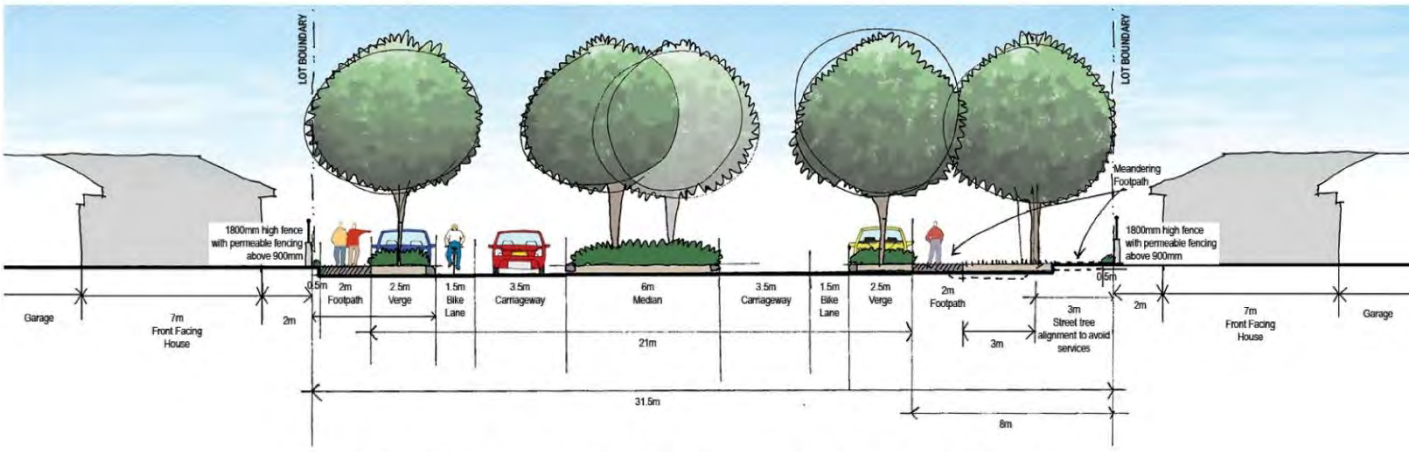


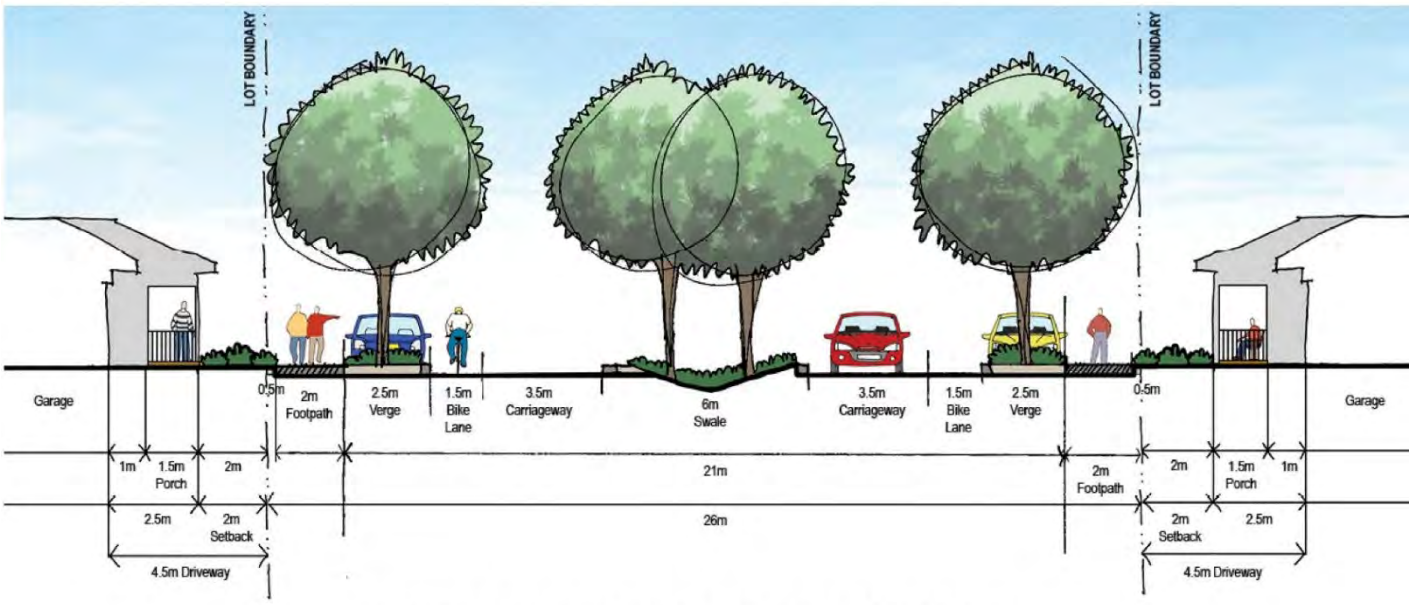
Figure 17. Structure Plan Road Hierarchy



INTEGRATOR ARTERIAL B (30 - 31.5m)

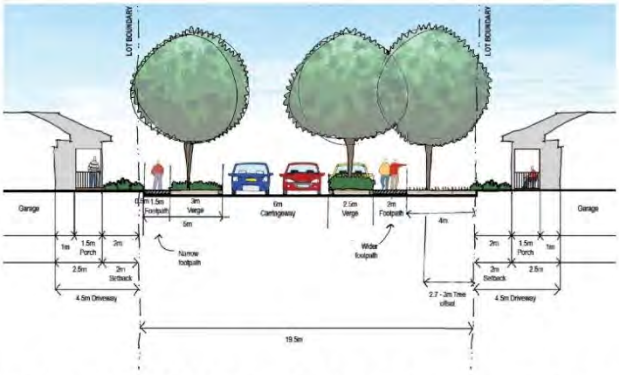


NEIGHBOURHOOD CONNECTOR A (31.5m)
NEIGHBOURHOOD CONNECTOR B (31.5m) - WIDER MEDIAN AND VERGE TREATMENTS

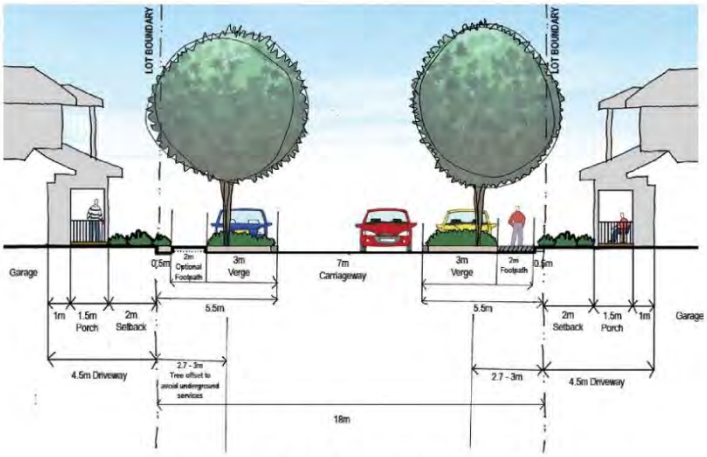


NEIGHBOURHOOD CONNECTOR B (26m)
ACCESS STREET A (26m) - WIDER MEDIAN AND VERGE TREATMENTS

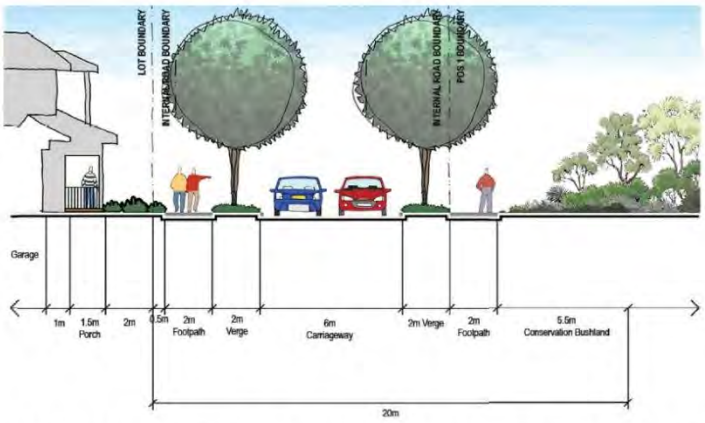
Figure 18. Higher Order Road Network Cross-Section



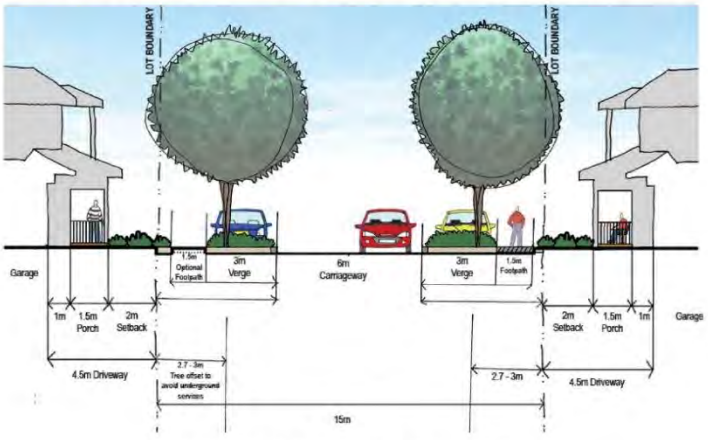
NEIGHBOURHOOD CONNECTOR B (19.5m)
ACCESS STREET D (26m) - WIDER MEDIAN AND VERGE TREATMENTS



ACCESS STREET C - (18m)

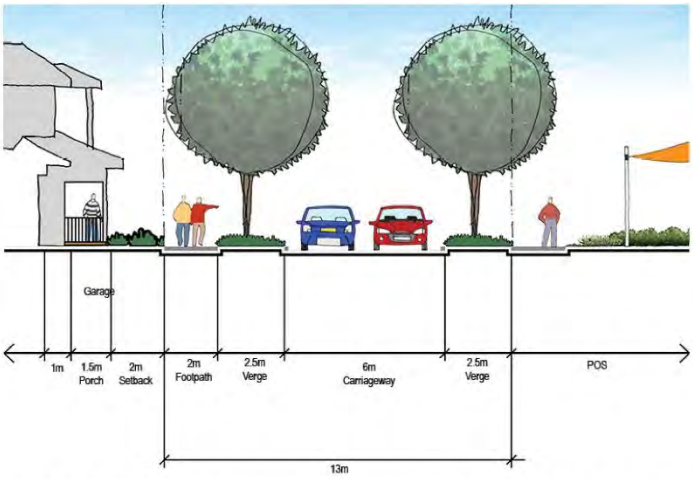


ACCESS STREET D - ADJACENT BUSHLAND (20m)

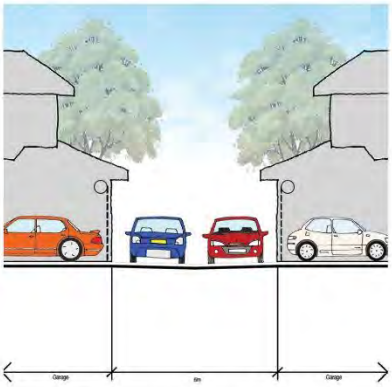


ACCESS STREET D - (15m)

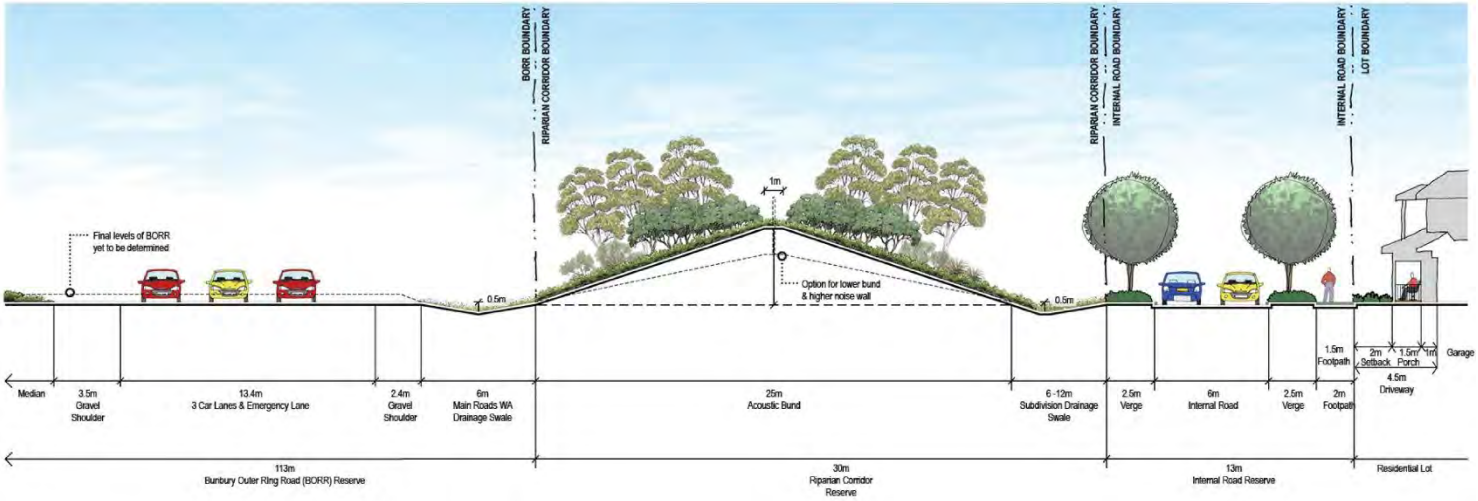
Figure 19. Middle Order Road Network Cross-Sections



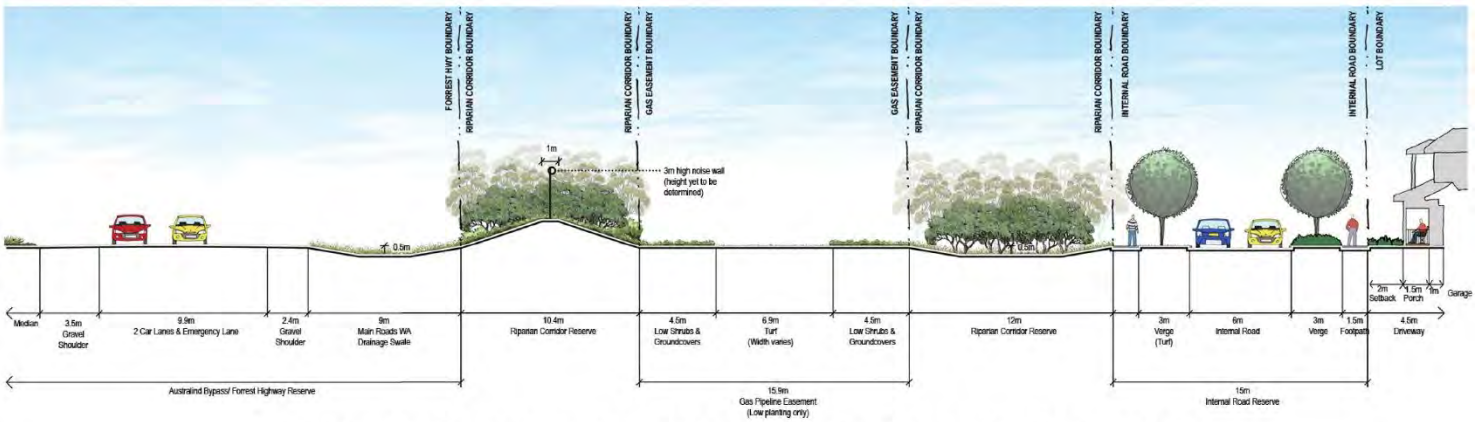
ACCESS STREET D - ADJACENT POS (13m)



LANEWAY (6m)



ACCESS STREET D - ADJACENT BIORETENTION SWALE/ LANDSCAPED BUFFER & BORR (13m)



ACCESS STREET D - ADJACENT GAS PIPELINE EASEMENT & AUSTRALIND BYPASS/FORREST HWY (15m)

Figure 20. Lower Order Road Network Cross-Sections & Key Interfaces



Figure 21. Public Open Space Provision

Table 7. Public Open Space Summary

GROSS SITE AREA (Hectares) (A)			188.500
Minus GBRS (Non-Urban) Deductions			
Total GBRS (Non-Urban) Deductions (B)			0.000
Gross Urban Zone Are (C=A-B)			188.500
Minus Non-Residential Deductions (Hectares)			
	Primary School	4.000	
	Village Precinct (NB. Communal Open Space TBA)	29.869	
	Neighbourhood Centre - West Site	1.476	
	Neighbourhood Centre - East Site	1.417	
	Sewer Pump Station Sites	0.160	
	Dedicated drainage reserve	1.776	
Total Non-Residential Deductions			**38.698**
Gross Subdivisible Area			**149.802**
Minimum Public Open Space Contribution Required		**10%**	**14.9802**
2%	Maximum Restricted Public Open Space Permitted	2.996	
8%	Minimum Unrestricted Public Open Space Required	11.984	

DRAINAGE PROVISION & CREDITABLE OPEN SPACE - BREAKDOWN

		Non-Credited (ha)	Restricted (ha)	Unrestricted (drainage) (ha)	Total Unrestricted
POS Reference	Gross Area	(Deduction) First 15mm Drainage Area	Flood Storage Area (First 15mm - 20% AEP)	Flood Storage Area (20% - 1% AEP)	Combined (ha)
1	12.0700	-	-	-	12.070
2	3.8240	0.7601	0.9261	0.9691	2.138
3	4.1050	-	-	-	4.105
4	5.7390	0.1496	0.3044	0.0041	5.285
5	1.4100	-	-	-	1.410
6	8.0390	-	-	-	8.039
7	0.5948	0.0757	0.0853	0.0007	0.434
8	2.7760	-	-	-	2.776
9	0.1960	-	-	-	0.196
10	0.8155	0.0460	0.0586	-	0.711
11	3.2010	-	-		3.201
12	0.3392	-	-	-	0.339
13	1.9892	0.0654	0.3166	0.3166	1.607
14	1.3407	0.1701	0.2169	0.2356	0.954
15	0.7589	0.0610	0.2005	0.0027	0.497
16	0.2370	0.0301	0.0383	0.0416	0.169
17	1.9760	0.2508	0.3197	0.3472	1.406
18	0.4000	-	0.3683	0.3756	0.032
19	0.3796	-	-	-	0.380
Total	**50.1909**	**1.6104**	**2.833**	**1.978**	**45.748**
			POS Above 10% Contribution		**30.770**

4.11 Public Open Space

The Structure Plan proposes a total of 19 areas of 'green space', inclusive of remnant vegetation areas and the two riparian corridors; all of which are to be credited in full or part as Public Open Space (POS). The POS typologies are detailed in the Landscape Strategy section of this report.

The POS contribution for the Structure Plan Area is summarised in **Table 7**. The contribution complies with the minimum 10% creditable POS requirement in accordance with *Liveable Neighbourhoods* guidance and WAPC's Development Control (DC) Policy 2.3 *Public Open Space in Residential Areas*.

The initial POS contribution well exceeds the minimum 10% creditable required, with a 30.770 hectare 'surplus'. The large conservation area (POS 1) and the riparian corridors (POS 5, 6, 8 and 11) contribute up to 27.9 hectares of this 'surplus'. These will benefit the community by providing extensive areas of functional POS. The final extent of functional spaces creditable as POS will be subject to detailed landscaping and civil designs as part of subdivision staging.

The extensive pedestrian 'Green-Street' spaces should also be acknowledged. These spaces are not credited as POS because they are generally captured within road reservations, however they will be highly utilised spaces for passive recreation (e.g. walking, jogging, social engagement) and provide important links between community nodes and POS areas.

This POS contribution will be progressively reviewed throughout the more detailed subdivision and engineering design stages, as drainage provision, earthworks and nett residential development cells are further adjusted.

4.12 Education & Community Facilities

4.12.1 High Schools

Based on advice from the Department of Education, no high school is proposed within the Structure Plan Area.

The expectation is that due to its proximity, the future secondary student population of Treendale East would enrol at Australind Senior High School (SHS) or one of several planned High Schools in the Wanju District Structure Plan Area (see indicative schools catchment map in **Figure 8** on page **21**).

The Department of Education has advised that it will monitor the student enrolment demand on Australind SHS and if required, identify the suitable number and location of future public secondary school site/s having regard to the potential residential growth in the broader locality. Access to the high school from Treendale East will require good road, pedestrian/cyclist, and public transport connections across Forrest Highway.

4.12.2 Primary School

A dwelling yield of 1,500 dwellings is the accepted threshold for a single primary school. The Domain precinct is expected to yield 1,500 permanent dwellings, making the Structure Plan area self-sufficient for one school. The Village Precinct could yield up to another 700 dwellings, however it is not expected that the demographic profile of residents within the Village would require an additional or larger primary school.

At the request of the Department of Education, a centrally located primary school site of 4.0 hectares is provided, adjacent to the proposed central public open space (POS 3), which will allow for shared use of playing fields. If as expected, development of the Village Precinct does not generate additional demand for a primary school, there should be an opportunity for the required school site to be reduced to 3.5 hectares, with a commensurate increase in the size of POS 3.

The designated primary school site is relatively flat, requiring minimal site works. The school/POS street block is bounded by roads that will facilitate safe and convenient access, sufficient on-street carparking bays for drop-off and pick-up, and integrated pedestrian and bicycle paths

Figure 22 shows indicatively how a primary school site could interact with the adjacent POS to provide a senior playing field and clubrooms (subject to agreement and detailed design).

4.12.3 Community Facilities

No requirement for dedicated community facility site/s has been identified within the Structure Plan Area.

Initial concept planning for the Village Precinct suggested resident clubhouse(s) could be used for community purposes but are likely to be part of an integrated strata or independent living style of development rather than public purpose facilities. These sites will be further defined by the localised planning of the Village Precinct via a Local Development Plan and/or Development Applications.



Figure 22. Primary School & Senior Playing Field

4.13 Activity Centres

4.13.1 Overview

Historically, Greater Bunbury has had above average retail supply given its role as a regional centre for hinterland towns and coastal towns further south and east. There are six significant retail centres that have at least one major supermarket in the Bunbury area. In addition, there is a stand-alone Spudshed supermarket in Australind.

Trade areas can vary significantly based on a range of factors including centre size, role, competition, and travel times including an understanding of future infrastructure (new roads and public transport) which may make it easier to travel to the site, as well as physical and manmade barriers (major roads, parklands, rivers, railway lines) which may make it harder to access the centre. Future residential areas should also be considered.

RPS Consultants in 2018 prepared the *Treendale East Retail and Market Sustainability Assessment* (**Appendix 9** refers), based on development of a 380-hectare land parcel. The findings of that report suggested that a Neighbourhood Centre of up to 5,400 m^2 NLA could be accommodated based on a 3,000-dwelling development at Treendale East.

In response to the final alignment of the BORR the structure plan boundary has been adjusted from that assumed in the RPS report, resulting in a lower dwelling yield of 2,200 and a population of 5,720 people.

4.13.2 Neighbourhood Activity Centre

Appendix 10 provides a rationale against *SPP 4.2 Activity Centres (2023*) for a proposed Neighbourhood Centre (NAC) comprising a retail Nett Lettable Area of up to 4,000m^2. SPP 4.2 identifies the catchment population for a Neighbourhood Centre as between 2,000 and 15,000. 5,720 people will comfortably support a Neighbourhood Centre.

The 2.75-hectare NAC is proposed adjacent to the southern estate entry from Raymond Road. It will be a major focal point for the community of Treendale East and inviting for visitors and passing traffic.

The NAC will provide for the daily and weekly shopping needs of residents. In keeping with the aims of the development and to the extent possible, a preference for locally sourced produce and services over typical generic supermarkets and chains is recommended.

The NAC is also envisaged to include tourism related land uses such as a micro-brewery, tavern, restaurant, short-term accommodation and/or similar hospitality related land use, located on the banks of Treendale Gully where it can take advantage of the attractive outlook. Such a development would be expected to be publicly accessible, culturally appropriate, architecturally significant, and site responsive.

Built form within the NAC is intended to be attractive, distinctive, and memorable, creating a landmark at the main entrance into the estate.

No Activity Centre Structure Plan is required for a Neighbourhood Centre, but a Local Development Plan will define the key parameters for development and subdivision.

The intention is for the core retail functions to be located on the western part of the NAC and tourism/hospitality uses such as a microbrewery and short-term accommodation to be located on the eastern part, built to respond to the topography and amenity of the adjacent riparian corridor public open space.

Additional commercial and tourism/hospitality related activities may be considered in the eastern side of Treendale Gully (within the Village Precinct) subject to the agreed mix of land uses within the Village Precinct (as defined by an LDP – see

section **4.9.4** on page **53**) and any need for additional to cater to demand.

The principal vehicle access will be from the east-west Integrator B road to the north of the site.

Figure 23 illustrates how the Neighbourhood Centre could be arranged, providing frontage to the main street and entry road, and providing possible food and beverage and/or short-term accommodation overlooking the amenity of the riparian corridor. Note that this illustration is based on a superseded version of the local road layout so is indicative only. The final layout will be subject to the future LDP and development approval.

4.14 Water Management

4.14.1 Water Management Strategy

The Water Management Strategy (WMS) prepared by Emerge Associates is provided in **Appendix 4**.

The Water Management Strategy (WMS) has been developed in accordance with *Better Urban Water Management* (WAPC 2008) and provides a level of detail sufficient to address both District and Local Urban Water Management requirements.

It provides a framework to assist in establishing a stormwater management approach based on site-specific investigations that are consistent with relevant State and Local Government legislation, policies, and guidelines. It also provided guidance to the general stormwater management principles for the area and to guide the future urban water management plan (see **4.15.2**).

Stormwater Management

The principle behind the stormwater management strategy described in the WMS is to maintain the existing hydrology of the site by ensuring that the post-development peak flow and discharge locations are consistent with the existing environment. This will be achieved by ensuring runoff up to the 1% AEP event is detained within the development, before discharging off site at a flow rate that mimics the existing hydrology.

WSUD measures proposed across the site include tree pits, raingardens, treatment swales, conveyance swales, bioretention areas, and inline storage and treatment within the existing riparian corridor. The significant storage available in the incised waterway corridors will be utilised to provide flood detention, avoiding the need for large flood detention structures within POS areas.

Groundwater Management

Groundwater management will include shaping of the shallow and low permeability clay layer towards the existing waterways, subsoil drains (over a portion of the site) to control rise of localised perched groundwater above the low permeability clays and the use of imported fill to maintain sufficient clearance to groundwater.

Groundwater quality will be managed through the appropriate treatment of surface runoff prior to infiltration to groundwater (ie. via WSUD measures), landscape management practices (ie. minimising fertiliser use) and the treatment of subsoil drain discharge within surface-based vegetated treatment structures.

Irrigation Water

The irrigation demand for the development has been approximated in the WMS, based on the likely proportion of open space and verges that will be irrigated. A range of WSUD techniques will be employed to ensure that irrigation water requirements are minimised and effectively applied.



Figure 23. Indicative Neighbourhood Centre Concept

The source and volume of non-potable water available for irrigation, along with the requirements of relevant State and local government policies and guidelines will influence the final volumes required. For planning purposes, the LZWMS has estimated the initial annual volume required to irrigate landscaped areas at 176,228 kL.

Non-potable water is one element of design that could lend itself to innovation, which will be explored as the project progresses.

4.15 Infrastructure Servicing & Staging

At a conceptual level there are workable solutions for all servicing and infrastructure needs for the Structure Plan Area.

Solutions for all civil infrastructure can be achieved by standard industry required methodologies however, a strong focus will be placed on achieving desired outcomes using sustainable technologies and environmentally friendly construction products available at the time of development.

An Engineering Servicing Report prepared by WML Consulting Engineers is provided in **Appendix 6**.

4.15.1 Earthworks

The western portion of the site will require significant imported fill due to the high groundwater levels perched on the clay. The central raised area of the site consists of good quality clean sand. Some minimal cutting is proposed through this area to generate some fill for the wetter portions of the site.

The intention is to maintain the undulation of the site and to tie finished levels into the natural ground levels at the POS and drainage foreshore locations.

4.15.2 Drainage

The basis for the drainage design is to direct flows to swale drains located around the perimeter of the site. The swale drains will convey stormwater south to the Water Corporation drainage lines.

The perimeter swales are multi-purpose, conveying stormwater, providing storage, allowing free draining outlets for subsoil drainage, and providing a buffer to the Forrest Highway and BORR.

Bioretention will be incorporated into central median swale drainage and on-street rain gardens as required. On the wetter western portion of the site the intention is to incorporate individual lot subsoil drainage to control groundwater mounding beneath lots and to reduce the requirements for fill.

4.15.3 Sewer

Due to the undulating nature of the site two sewer pumpstations will be required, to maintain minimum depth requirements for gravity mains. The ultimate pumped discharge point will be on the western side of Forrest Hwy, with the specific position to be confirmed with Water Corporation. This will require the sewer to connect under Forrest Highway into the existing Water Corporation infrastructure in Treendale.

4.15.4 Water

It is likely that a link will need to be created between the two existing water mains in Raymond Road and Vittoria Road reserve via a north/south 250mm diameter main. Smaller mains will then service the development off this central line. Final details will be subject to planning to be completed by Water Corporation.

Preliminary discussions with Harvey Water have indicated that water for irrigation could be supplied from its

drainage assets. The intention would be to irrigate the site and provide a secondary supply via a non-potable pipe network within the estate. This will be subject to commercial arrangements and detailed design.

4.15.5 Power

Western Power planning tools indicate that sufficient capacity is available to accommodate the estate from both the Picton Zone and Marriot Road substations.

The development requires a high voltage ring to be created to meet servicing requirements.

Multiple transformers will be required progressively as staged development progresses.

The 132kV transmission line running along the eastern side of the Structure Plan Area is proposed to be realigned to suite the BORR, which will reduce its impact on the subdivision. An electromagnetic interference earth potential rise (EPR)/low frequency induction (LFI) study will be required for installation of any metallic objects including streetlights, houses, fire valves, drains, etc. within the easement area.

4.15.6 Gas

Reticulated gas can be provided and whether it will be supplied to lots or not will be determined at a later stage of project development, taking into account a range of factors including potential impacts on carbon footprint.

4.15.7 Telecommunications

Telecommunication services can be provided with standard pit and pipe infrastructure from the intersection of Treendale Road and Raymond Road.

The Structure Plan Area is within 1 kilometre of the existing NBN network and an extension under Forrest Highway would enable Treendale East to be serviced. If development commences beyond one kilometre a back haul charge may be required.

4.15.8 Primary Road Infrastructure Funding

Subject to agreement with Main Roads WA, in consultation with WAPC and Shire of Harvey, the proponent is to arrange funding contribution towards, or construction of (as works in kind), primary regional road intersections, including:

a) Four-way roundabout intersection of Raymond Road, (southern) Estate entry and Ranson Drive.

b) Left-in/Left-out intersection of Forrest Highway and (north-western) Estate entry road.

c) Three-way T-intersection of Raymond Road and Forrest Highway.

4.15.9 Staging and Implementation

The development of the Structure Plan Area will be implemented in stages. The exact timing, location and composition of the future stages will be dependent on market demand and detailed design; however it is projected to be a 15 – 20 year project based on 100 lots sold per annum.

Staging will commence in the south-central and south-western portions of the estate fronting Raymond Road so as to utilise existing services and road infrastructure. A Display Village, Sales Office and 'first release' residential land (i.e. 100 – 150 lots) is expected to be within the first stage. Subsequent stages will be constructed from south to north, spanning west then east, for efficient incremental advancement of road and service infrastructure.

A comprehensive program for provision of traffic intersections with Raymond Road and Forrest Highway will be prepared as part of ongoing detailed

planning and design of service infrastructure. The early construction of the Forrest Highway (left-in/left-out) access will be influenced by peak traffic demands at the Raymond Road main intersection.

The existing eastern-most left-in/left-out access off Raymond Road is to be retained until such time as construction of new subdivisional roads allows for alternative access to the Village Precinct, which is currently cut off from the balance of the Structure Plan area by Treendale Creek. As the land will continue to be used for farming until development takes place, access to this part of the site must be retained. When alternative road access is available, the existing entry will be closed.

Staging of the Neighbourhood Centre zone will be subject to the development's commercial catchment viability. Some aspects of the Neighbourhood Centre zone may see early development without prejudicing the site's overall built form and social objectives. The same rationale may apply to the Residential (Village Precinct) whereby early demand for tourism, lifestyle, or other complementary land uses may see development of this precinct concurrent with the initial residential stages.

The progress of the Village precinct is not reliant on advancement of the residential (Domain) precinct other than construction of the Raymond Road main entry.

Development of the primary school is subject to local demand, namely more than 1,000 residential lots, pursuant to Department of Education policy frameworks. It is expected that the District parkland (playing field) will be developed ahead of the primary school.

4.16 Development Contribution Arrangements

The land comprising the Structure Plan Area is to be developed by a single entity so there is no requirement for a Development Contribution Plan (DCP).

Based on the concept plan (**Figure 22**), there is ample space for a community building with function space and clubhouse/changerooms for local junior or senior sports club(s). The nexus for such a facility is subject to a Shire of Harvey prepared community facilities plan for Treendale East and the broader Shire.

The proponent may consider a private deed of agreement with the Shire to contribute towards this community infrastructure; this potentially complimented by Local, State or Federal funding.

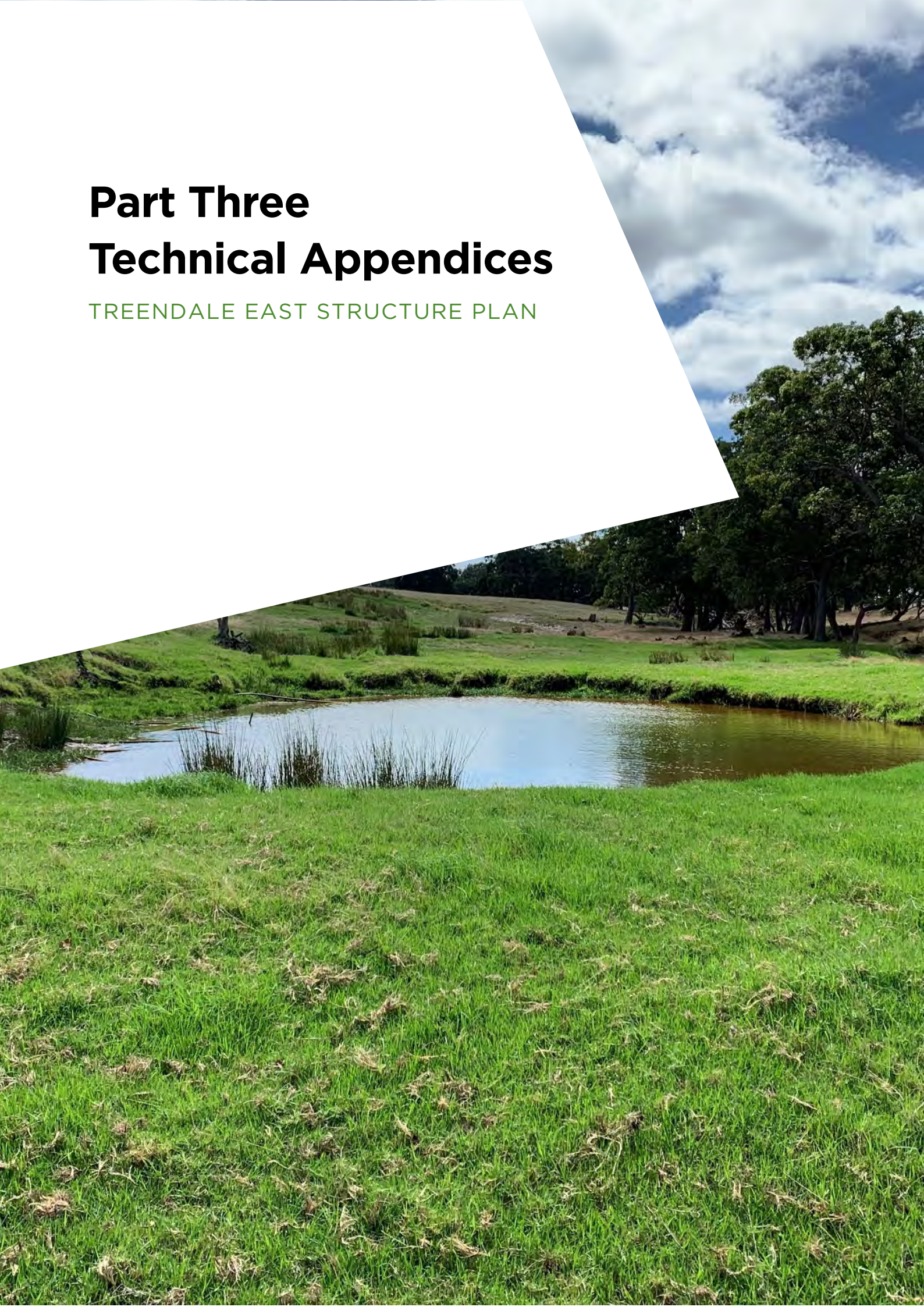
5. Technical Appendices Index

The following technical reports and supporting Government and Certificates of Title information are appended to this Structure Plan.

No.	Document Title	Author & Date
1	Bushfire Management Plan Lots 151, 152 and 153 Raymond Road, Roelands	Emerge Associates April 2025
2	Treendale East Structure Plan Transport Impact Assessment	Transcore May 2025
3	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands	Emerge Associates April 2025
4	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands	Emerge Associates October 2025
5	Treendale East for Taycot Development Local Structure Plan – Landscape and Irrigation Strategy	Emerge Associates April 2025
6	Treendale East Structure Plan Engineering Services Report	WML Consulting Engineers May 2025
7	Treendale East Estate Urban Development Preliminary Geotechnical Investigation	WML Consulting Engineers May 2021
8	Acoustic Assessment	Lloyd George September 2023
9	Treendale East Retail and Market Sustainability Assessment	RPS Australia May 2018
10	Treendale East Structure Plan (SPN2372) SPP4.2 Alignment	CDP Town Planning & Urban Design October 2024
11	Certificates of Title – Subject Landholdings	Landgate February 2022
12	Planning Bulletin 112/2016 – Medium Density Single Houses	Western Australian Planning Commission 2016

Part Three
Technical Appendices

TREENDALE EAST STRUCTURE PLAN



Appendix 1.
Bushfire Management Plan

Appendix 2.
Transport Impact Assessment

Appendix 3. Environmental Assessment & Management Strategy

Appendix 4.
Water Management Strategy

Appendix 5.
Landscape & Irrigation Strategy

Appendix 6.
Engineering Servicing Report

Appendix 7.
Geotechnical Investigation

Appendix 8.
Acoustic Assessment

Appendix 9. Retail & Market Sustainability Assessment

Appendix 10. Alignment with SPP 4.2 Activity Centres

Appendix 11. Certificates of Title

Appendix 12. PB112/2016 Medium Density Single Houses



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Town Planning & Urban Design

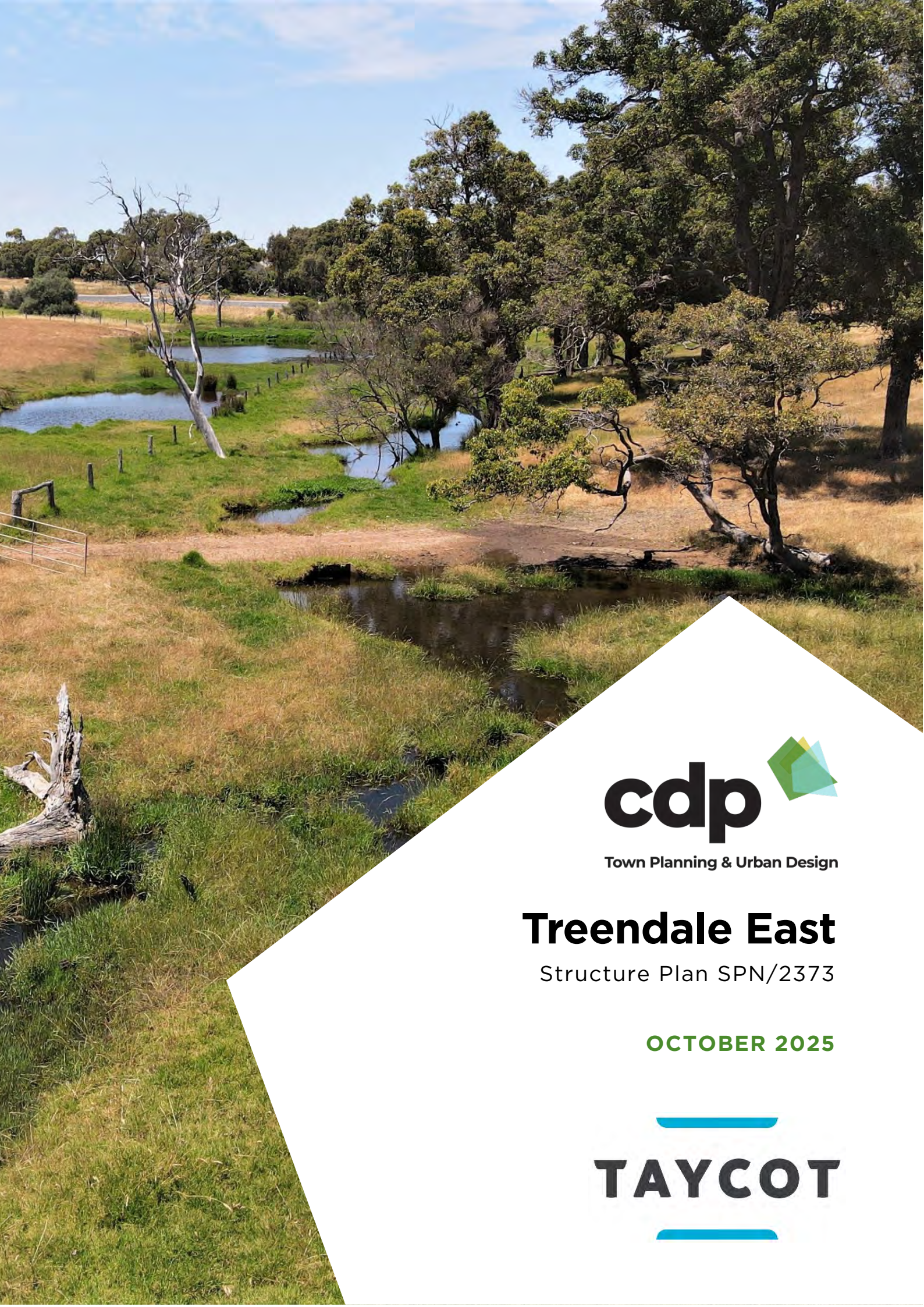
p. 08 6333 1888

e. info@cdpaus.com.au

a. 2/464 Murray St,
Perth WA 6000

PO Box 8002
Cloisters Square 6850

cdpaus.com.au



cdp

Town Planning & Urban Design

Treendale East

Structure Plan SPN/2373

OCTOBER 2025

TAYCOT

Treendale East

Structure Plan SPN/2373

OCTOBER 2025

Prepared by. CDP Town Planning & Urban Design
2/464 Murray Street
PERTH WA 6000

p. +61 8 6333 1888
e. info@cdpaus.com.au
w. www.cdpaus.com.au

Prepared for. TAYCOT
1/149 Victoria Street
BUNBURY WA 6230

p. +61 8 9791 5511
e. travis@taycot.com.au
w. www@taycot.com.au

In Collaboration with.

WML Consulting Engineers
Civil Engineering

Emerge Associates
Environment, Landscape, Hydrology, Bushfire

Transcore
Traffic & Transport

Thompsons
Surveying

RPS Australia
Retail & Market Sustainability Assessment

Lloyd George Acoustics
Road Acoustics

DOCUMENT STATUS

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4.1	Minor change to Table 1-2	DM	DM	11.09.2025
4.2	Update LWMS date section 5 & Part 3	DM	DM	30.10.2025

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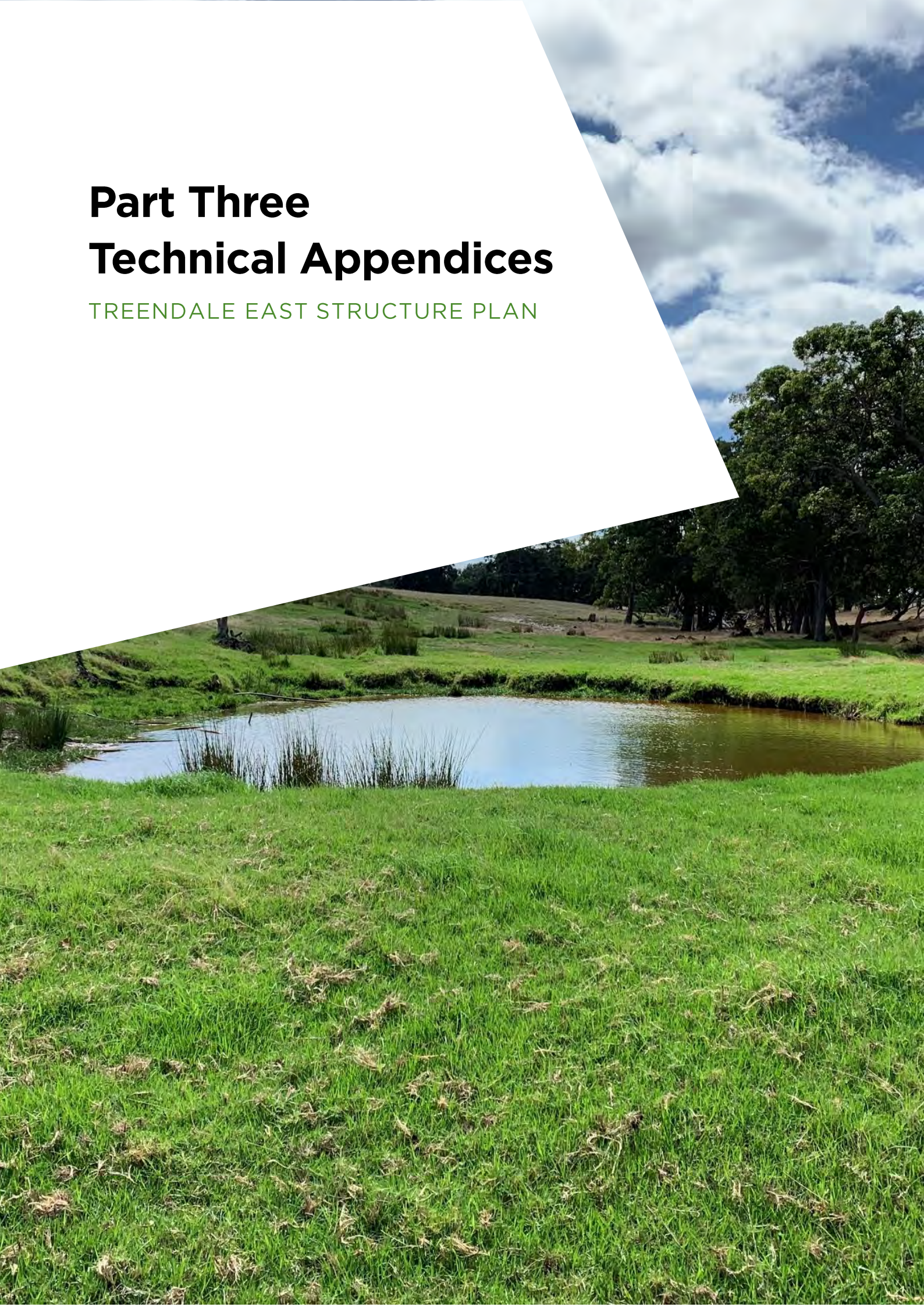
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Appendix 1.
Bushfire Management Plan

Bushfire Management Plan

Lots 151, 152 and 153 Raymond Road, Roelands

Project No: EP21-022(06)

Prepared for Treendale East Landowner Group
April 2025



Document Control

Doc name:	Bushfire Management Plan Lots 151, 152 and 153 Raymond Road, Roelands				
Doc no.:	**EP21-022(06)—007b BFM**				
Version	**Date**	**Author**		**Reviewer**	
1	January 2022	Brodie Mastrangelo	BFM	Kirsten Knox	KK
				Dana Elphinstone	DAE
	Report issued for client review.				
A	March 2022	Kirsten Knox	KK	Dana Elphinstone	DAE
	Minor updates following client review, update to address Version 1.4 of Guidelines for Planning in Bushfire Prone Areas				
B	April 2025	Kirsten Knox	KK	Anthony Rowe	AJR
	Inclusion of updated structure plan and minor text updates to address amended structure plan and ensure text alignment with the structure plan and other supporting documents. No update to the version of the bushfire guidelines the BMP was prepared under has been made.				

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This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2018 is to “prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes” (Standards Australia 2018). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

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Executive Summary

The Treendale East Landowner Group (the proponent) is proposing to rezone Lots 151, 152 and 153 Raymond Road, Roelands (herein referred to as the 'site') to support residential development. The site is currently zoned 'rural' under the Greater Bunbury Region Scheme and 'general farming' and 'intensive farming' under the Shire of Harvey District Planning Scheme. It is bounded by the future Bunbury Outer Ring Road (BORR) corridor to the north and east, Raymond Road and Meadow Landing Estate to the south and Forrest Highway and Treendale residential and light industrial estates to the west.

Portions of the site are currently identified as a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2021). The identification of the site within an area declared as bushfire prone necessitates a further assessment of the determined bushfire risk affecting the site (in accordance with *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959)) and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021).

The purpose of SPP 3.7 and its policy intent is to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure through effective risk-based land use planning. Importantly, it is a risk-based approach requiring a method to identify and evaluate the hazards and provide the treatments to ameliorate these hazards to an acceptable level. SPP 3.7 requires that the determining authority give consideration to the precautionary principle (clause 6.11 in SPP 3.7) and they must be satisfied that the potential for significant adverse impacts can be adequately reduced or managed.

This bushfire management plan (BMP) examines the various responses to the identified bushfire risk (following development) that will make the ultimate use of the land suitable for its intended purpose and achieve compliance with the policy intent. The policy intent can be met by demonstrating compliance with the policy objectives, and policy measures informed by the bushfire protection criteria in the Guidelines and satisfaction of its four elements. Each element in the bushfire protection criteria can be met by utilising an acceptable solution or a performance principle. As part of this, a bushfire attack level (BAL) assessment has been undertaken to determine the associated bushfire risk, the applicable BAL ratings (if any), and the building siting and construction response that will achieve compliance with the bushfire protection criteria and satisfy the precautionary principle.

The existing vegetation within the site and 150 m of the site has been classified in accordance with AS 3959, which has then informed a bushfire hazard level (BHL) assessment. This bushfire hazard level assessment indicates that the majority of the site is subject to a 'moderate' bushfire hazard as it is largely cleared paddock areas. As part of assessing the long-term bushfire risk to the site, vegetation classifications have been detailed for the post-development scenario in order to inform a bushfire attack level (BAL) assessment. The following bushfire hazards were identified as applicable to the site following residential development:

- Forest (Class A) vegetation, associated with existing remnant vegetation within the north-western portion of the site that will be retained and protected, as well as a 10 m -wide revegetated corridor (shown as Plot 11 in this BMP) along the waterways, measured 5 m either side from top of bank (as part of the riparian corridor). Existing forest vegetation within the Forrest Highway reserve west of the site is assumed to remain.
- Scrub (Class D) vegetation, associated with public open space (POS) corridors adjacent to the perimeter of the site, which will be planted to support management of visual amenity (as well as movement of drainage). While it is expected that management of these areas is likely, it is assumed these areas will be planted to achieve a scrub (Class D) classification. Outside the site, it has been assumed that the non-pavement areas of Bunbury Outer Ring Road to the east of the site will be revegetated to achieve scrub classification, while existing scrub vegetation within the Forrest Highway reserve west of the site is assumed to remain.
- Grassland (Class G) vegetation, associated with existing paddock areas to the south and north of the site. In addition, the portion of the riparian corridor within the south-eastern portion of the site not subject to revegetation as forest, is assumed to achieve grassland. While these grassland areas are expected to be managed to support recreation activities, these areas are assumed to achieve a grassland (Class G) classification to provide flexibility for design and to accommodate seasonal variability in maintenance regime.

Overall, the outcomes of this BMP demonstrate that as development progresses, it will be possible for the intent of the bushfire protection criteria outlined in the Guidelines to be satisfied. This includes:

- **Element 1 Location:** The area of the site to be developed as residential lots is subject to a moderate bushfire hazard level. The proposed development is at a higher order strategic planning stage, and the site will, overall, include sufficient area subject to BAL-29 or lower in the post-development scenario (i.e. following implementation of clearing/vegetation modification) to accommodate future residential development. The majority of the site will be subject to BAL-LOW upon completion of development.
- **Element 2 Siting and Design:** The concept plan supporting the scheme amendment shows indicative development cells that are subject to change as part of refinement of the design through the subsequent planning stages. As outlined above, areas of unmanaged vegetation or revegetation have been assumed as part of the post-development scenario to provide a conservative assessment of bushfire risk. The site includes small portions of residential land subject to BAL-40 and BAL-FZ, however there is sufficient area to accommodate habitable buildings within BAL-29 or below using in-lot setbacks. Separation from bushfire hazards to enable future habitable buildings to achieve a BAL rating of BAL-29 or less can be achieved through the provision of perimeter public roads, low threat landscaping within POS, in-lot setbacks and the use of asset protection zones (APZs).
- **Element 3 Vehicular Access:** Appropriate vehicle access can be provided, with the site having direct access to Raymond Road (likely via a roundabout) which connects to South Western Highway to the east and Forrest Highway to the west. In the future, Raymond Road will also connect to the Bunbury Outer Ring Road. A second connection to Forrest Highway is provided in the north-western portion of the site, and will provide left-in/left-out movements, which will enable access to Treendale and Bunbury in the south, or turning opportunities to move north. A

single cul-de-sac road has been included as part of the concept masterplan. It is less than 200 m in length and can meet the acceptable solution. It will provide access to the proposed neighbourhood centre (and associated parking areas). Due to the proximity of the centre to Raymond Road (and traffic/access considerations) and required drainage corridors, a through road connection is not possible.

- **Element 4 Water:** the proposed future residential development will be serviced by a reticulated water network.

The management/mitigation measures to be implemented through the proposed scheme amendment and future development of the site, as discussed in this BMP, demonstrate that the acceptable solutions and/or intent of each element can be met. Accordingly, having regard to clause 6.11 of SPP 3.7, the precautionary principle has been satisfied.

Table of Contents

1 Introduction 9

1.1 Background 9
1.2 Aim of this report 10
1.3 Statutory policy and framework 11
1.4 Description of the proposed development 11
1.5 Description of land characteristics 12

2 Environmental Considerations 13

2.1 Native vegetation – modification and clearing 15
2.2 Revegetation and landscape plans 15
2.2.1 Within the site 15
2.2.2 Surrounding the site 16

3 Bushfire Assessment Results 17

3.1 Bushfire hazard level (BHL) and bushfire attack level (BAL) assessment 17
3.1.1 Assessment inputs 17
3.1.2 Assessment outputs 29
3.1.2.1 Assumptions 29
3.1.2.2 BHL assessment 30
3.1.2.3 BAL assessment 30

4 Identification of Bushfire Hazard Issues 33

5 Assessment Against the Bushfire Protection Criteria 34

5.1 Additional management strategies 38
5.1.1 Future approval considerations 38
5.1.2 Landscape management 38
5.1.3 Within the site 38
5.1.4 Shire of Harvey annual firebreak notice 39
5.1.5 Vulnerable or high-risk land uses 39
5.1.6 Public education and preparedness 40

6 Responsibilities for Implementation and Management of Bushfire Measures 41

7 Applicant Declaration 43

7.1 Accreditation 43
7.2 Declaration 43

8 References 44

8.1 General references 44
8.2 Online references 45

List of Tables

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) 13
Table 2: Vegetation classification and/or exclusions, effective slope and future management 19
Table 3: Summary of the assumed vegetation classification and associated effective slope within the site and 150 m in accordance with Table 2.5 (AS3959) 29
Table 4: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment 31
Table 5: Assessment against the bushfire protection criteria from the Guidelines 34
Table 6: Responsibilities for the implementation of this BMP 41

List of Plates

Plate 1: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021). 10
Plate 2: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007) 18
Plate 3: Excerpt of Table 6 from The Guidelines (DPLH & WAPC 2021) 37

Figures

Figure 1: Site Location and Topographic Contours
Figure 2: Pre-development Vegetation Classifications
Figure 3: Bushfire Hazard Levels
Figure 4: Post-development Vegetation Classifications and Effective Slope
Figure 5: Bushfire Attack Level Contour Plan
Figure 6: Spatial Representation of Bushfire Management Strategies

Appendices

Appendix A

Structure plan (CDP 2025)

Appendix B

Additional photographs

List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
BORR	Bunbury Outer Ring Road
Developable land	*Position Statement: Planning in bushfire prone areas - Demonstrating Elements 1: Location and Element 2: Siting and design* (DPLH 2019) has outlined that 'developable land' is "*land that can accommodate a habitable dwelling and would not generally include areas of BAL-40 and/or BAL-FZ, areas within the local government setback and areas subject to environmental constraints*".
ESA	Environmentally Sensitive Area
FDI	Fire Danger Index
FSAR	Fire Service Access Route
FZ	Flame Zone
GBRS	Greater Bunbury Region Scheme
Habitable building	As defined in Planning and Development (Local Planning Schemes) Regulations 2015, a 'habitable building' is *"a permanent or temporary structure on land that –* *(a) is fully or partially enclosed; and* *(b) has at least one wall of solid material and a roof of solid material; and* *(c) is used for a purpose that involves the use of the interior of the structure by people for living, working, studying or being entertained"*
LPS	Local Planning Scheme
NASH	National Association for Steel-framed Housing Standard
PEC	Priority Ecological Community
SES	State Emergency Service
SLIP	Shared Location Information Platform
TEC	Threatened Ecological Community

Table A2: Abbreviations – Organisations

Organisations	
DBCA	Department of Biodiversity Conservation and Attractions
DFES	Department of Fire and Emergency Services
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environment Regulation
EPA	Environmental Protection Authority
OBRM	Office of Bushfire Risk Management
WAPC	Western Australian Planning Commission
WASAT	Western Australian State Administrative Tribunal

Table A3: Abbreviations – Legislation and policies

Legislation	
AS 3959	Australian Standard 3959-2018 Construction of buildings in bushfire prone areas
Guidelines	Guidelines for Planning in Bushfire Prone Areas version 1.4 (DPLH & WAPC 2021)
SPP 3.7	*State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)

1 Introduction

1.1 Background

The Treendale East Landowner Group (the proponent) is proposing to rezone Lots 151, 152 and 153 Raymond Road, Roelands (herein referred to as the 'site') to support future residential development. The site is identified strategically for urban and residential development as part the *Bunbury-Geographe sub-regional strategy* (DPLH 2020). It is bounded by the future Bunbury Outer Ring Road (BORR) corridor to the north and east, Raymond Road and Meadow Landing Estate to the south and Forrest Highway and Treendale residential/light industrial estates to the west.

A portion of the site is currently identified as a 'bushfire prone area' within the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2021) and is shown in **Plate 1** below. The identification of the site within an area declared as bushfire prone necessitates a further assessment of the determined bushfire risk affecting the site and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015).

The purpose of SPP 3.7 and its policy intent is to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure through effective risk-based land use planning. Importantly, it is a risk-based approach requiring a methodical approach to identify and evaluate the hazards and provide the treatments to ameliorate these hazards to an acceptable level. SPP 3.7 requires that the determining authority give consideration to the precautionary principle (clause 6.11 in SPP 3.7) and they must be satisfied that the potential for significant adverse impacts can be adequately reduced or managed.

> *SPP 3.7 does not require that there be no increase at all in the threat of bushfire to people property or infrastructure. Rather, as is seen in clause 2 of SPP 3.7, the intention of the policy is to 'implement effective, risk¬based land use planning and development to preserve life and* ***reduce the impact of bushfire on property and infrastructure'****.* (emphasis added) [1]

[1] Harmanis Holdings No. 2 Pty Ltd and Western Australian Planning Commission [2019] WASAT 43 (Harmanis).

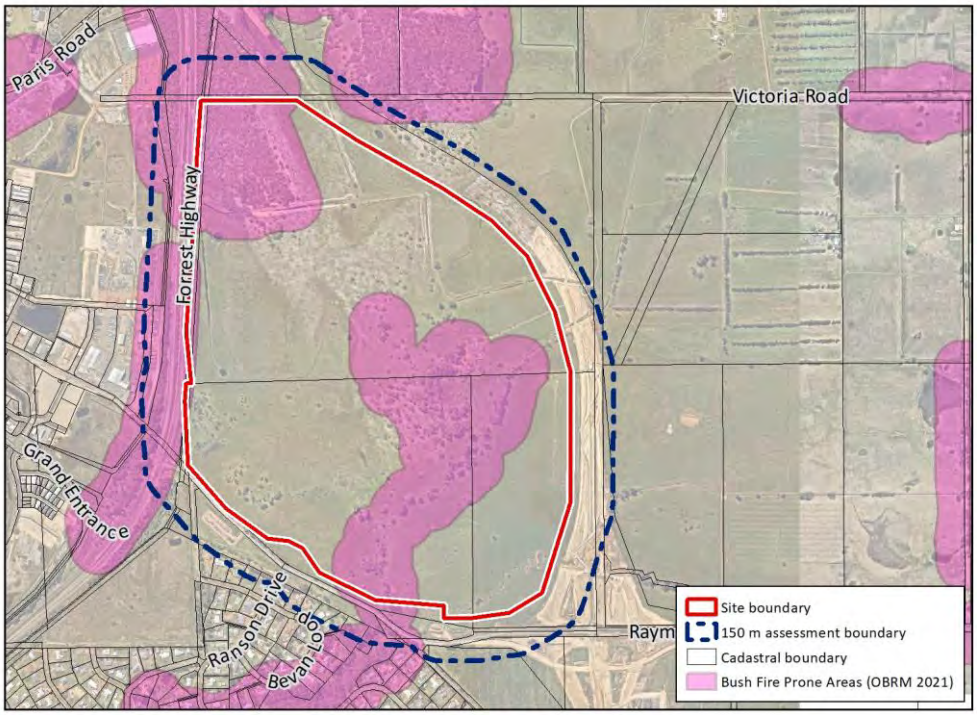


Plate 1: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021).

1.2 Aim of this report

The aim of this BMP is to assess bushfire hazards within the site and nearby areas and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed and demonstrate satisfaction of clause 6.11 of SPP 3.7 (the precautionary principle). This BMP has been prepared to support the rezoning and structure planning of the site and addresses the requirements of SPP 3.7 (WAPC 2015), the *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021) and *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2018). The document provides an assessment of the general bushfire management strategies to be considered as part of the future residential development within the site and includes:

- Overview of the proposed development (see **Section 1.4**).
- An assessment of the existing classified vegetation in the vicinity of the site (within 150 m) and consideration of bushfire hazards that will exist in the post-development scenario (**Section 3**).
- Commentary on how future development can achieve the bushfire protection criteria outlined within the Guidelines (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 6**).

1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan:

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- *Planning and Development Act 2005* and associated regulations
- *Building Act 2011* and associated regulations
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.4* (DPLH & WAPC 2021)
- *Australian Standard AS 3959 – 2018 Construction of buildings in bushfire prone areas* (Standards Australia 2018).

1.4 Description of the proposed development

The site is currently zoned 'rural' under the Greater Bunbury Region Scheme and 'general farming' and 'intensive farming' under the Shire of Harvey District Planning Scheme. The site is proposed to be rezoned to 'urban' and developed for residential purposes, with the structure plan and a concept master plan (CDP 2021) provided in **Appendix** A. The development is proposed to include greenfield residential development, as well as strata titled development. The proposed development within the site will include:

- Lots of various sizes, meeting residential density codes of R25 to R80.
- A strata titled village development cell, within the south-east.
- Interconnected road network, including perimeter roads and external connections to Forrest Highway and Raymond Road.
- Public open space (POS) areas, supporting managed vegetation and retention of existing trees available for future residents to use for passive and active recreation.
- Primary school, and associated shared sports fields.
- Neighbourhood activity centre.
- Riparian corridors, which will include revegetation of the immediate streamlines (5 m wither side of the waterway, measured from the top of bank, and 10 m in total) within the south-eastern portion of the site, whilst the remainder of the corridor will be used for recreation.
- Conservation areas, associated with the retention and protection of existing vegetation within the north-western portion of the site.

1.5 Description of land characteristics

The natural topographical contours indicate that the site, undulates between an elevation of approximately 5 m Australian Height Datum (m AHD) in the south-eastern portion of the site (associated with a waterway) to 20 m AHD in the north-eastern portion of the site, as shown in **Figure 1**.

The site is characterised by largely cleared areas composed of paddock grasses that have been used for livestock grazing, with areas of retained trees. Two incised waterways occur in the south-eastern portion of the site and drain to a low point south of the site, connecting eventually to Collie River. Aside from the south-eastern portion of the site, the site is relatively flat with depressions occurring in the west and man-made drains occurring in the north and northeast.

From a broader context perspective, to the north and east of the site land uses are largely rural-based and characterised by cleared paddocks used for livestock grazing and crop production; while to the south and west, land uses are more urbanised and associated with urban/residential development as well as light industrial land uses. The Dampier to Bunbury Natural Gas Pipeline is located within the western portion of the site, adjacent to the boundary. The land uses surrounding the site (within 150 m) include:

- Remnant vegetation, the Bunbury Outer Ring Road (BORR) corridor and farmland to the north.
- The BORR corridor and farmland, to the east.
- Raymond Road and Meadow Landing Estate to the south.
- Forrest Highway and Treendale residential and light industrial estates to the west.

2 Environmental Considerations

In accordance with the *Bushfire Management Plan – BAL Contour Assessment* template prepared by the Department of Planning, Lands and Heritage (DPLH), this BMP has considered whether there are any environmental values that may require specific consideration through either protection, retention or revegetation. To support this, a review of publicly available databases, as well as site specific information (where available), has been undertaken, with particular reference to the Shared Location Information Platform (SLIP) databases.

The site predominantly consists of cleared pasture with paddock trees and area of remnant native vegetation in the northern portion of the site. The environmental values within and surrounding the site have been summarised in **Table 1** and are based on the publicly available environmental data, the environmental surveys that were undertaken to support the BORR and included the site (Main Roads Western Australia 2018; Biota Environmental Sciences 2019; BORR Team 2019; WRM 2019; BORR Team 2020a; BORR Team 2020b) and site assessment undertaken by Emerge Associates (as environmental consultants, to support the preparation of the Environmental Assessment Management Strategy).

Key environmental considerations for future development of the site and management of bushfire risk include the remnant native vegetation within the northern portion of the site, and the waterways within the south-eastern portion of the site and treatment of these waterways.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe the value that may be impacted
Conservation category wetlands and buffers (DBCA-019)	No	The majority of the site is mapped as a 'Multiple Use' wetland, and is described as a palusplain which is seasonally waterlogged. No other wetland values have been identified within the site. A conservation category wetland is mapped 180 m south of the site. No buffer extends into the site.
RAMSAR wetlands (DBCA-010)	No	Not applicable. No RAMSAR wetlands are located within or adjacent to the site.
Waterways (Hydrography Linear (Hierarchy) (DWER-031))	Yes	No waterways, as mapped by DWER, occur within the site. However, Water Corporation's Treendale Main Drain and Treendale Gully, a tributary of the Collie River, occur within the south-eastern portion of the site. The Collie River, which is a major non-perennial watercourse, occurs 570 m south of the site.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe the value that may be impacted
Threatened and priority flora (DBCA-036)	No	Detailed flora and vegetation surveys have been undertaken in the areas of the site containing intact remnant native vegetation, namely in the northern portion. No threatened flora species were identified in this area, but one priority 4 species (*Acacia semitrullata*) was located. The vegetation in the north-western portion of the site is proposed to be retained and protected in the long-term. Due to the cleared and degraded nature of the remainder of the site, it is highly unlikely threatened or priority flora species will occur in these areas.
Threatened and priority fauna (DBCA-037)	No	Detailed fauna assessments undertaken to support the BORR have been undertaken with the areas of the site containing intact remnant native vegetation, namely in the north-west. Habitat for threatened fauna, including western ringtail possum and the three black cockatoo species were identified within this area. Paddock trees across the site are also likely to be possible habitat for black cockatoo species, particularly where associated with larger Eucalypt or Corymbia species. The vegetation in the north-western portion of the site is proposed to be retained and protected in the long-term.
Threatened ecological communities (TEC) (DBCA-038)	Potentially occurring within the site.	Detailed flora and vegetation surveys have been undertaken in the areas of the site containing intact remnant native vegetation, namely in the northern portion of the site. The federally listed Banksia Woodland of the Swan Coastal Plain threatened ecological community (TEC) was identified in association with this vegetation. As outlined, this vegetation is proposed to be retained and protected as part of future development. Due to the cleared and degraded nature of the remainder of the site, it is highly unlikely that threatened or priority ecological communities will occur in these areas.
Department of Biodiversity Conservation and Attractions (DBCA) controlled lands or waters (DBCA-011)	No	Not applicable. No DBCA controlled lands or waters exist within or adjacent to the site.
Clearing regulations – Environmentally Sensitive Areas (DWER-046)	No	The site is not mapped as an environmentally sensitive area (ESA). The nearest ESA is located 130 m to the south and appears to be associated with the Collie River and its related vegetation.
Conservation Covenants Western Australia (DPIRD-023)	No	Not applicable.
Aboriginal heritage (DAA-001)	Yes	A registered Aboriginal Heritage Place (Place No. 16713, 'Collie River Waugal') is mapped within the south-eastern portion of the site (see **Figure 1**) associated with the waterway which is a tributary of the Collie River), extending south into adjacent landholdings towards the Collie River. The waterway (and associated Aboriginal heritage values) is proposed to be retained within a riparian corridor, and will include revegetation to protect and enhance the existing values.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued).

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe the value that may be impacted
Non-indigenous heritage (SHO-003)	No	No non-indigenous heritage sites were identified within the site. A non-indigenous heritage site (Place No. 26394, 'Shenton's Cottage') occurs approximately 400 m to the south of the site.

2.1 Native vegetation – modification and clearing

Within the site

With regard to bushfire management, native vegetation clearing within the site may be required to enable the relevant siting and access requirements of the Guidelines to be achieved and would be associated with clearing to establish:

- Future lots, including public copen space and the riparian corridors
- Asset protection zones (APZs)
- Public roads
- Firebreaks, particularly associated with the proposed conservation public open space in the northern portion of the site.

Where clearing of native vegetation is undertaken in accordance with a subdivision approval under the *Planning and Development Act 2005*, it is exempt from requiring a clearing permit under Schedule 6 of the *Environmental Protection Act 1986* (EP Act).

2.2 Revegetation and landscape plans

2.2.1 Within the site

Proposed revegetation/unmanaged vegetation

Vegetation within the site that is likely to result in a bushfire hazard (and considered as part of the assessment further below) include:

- The conservation POS in the northern portion of the site (see **Appendix A** for location). Existing remnant native vegetation in this area is assumed to be retained and protected.
- The riparian corridors associated with the waterways within the south-eastern portion of the site (see **Appendix A** for location). A 5 m-wide area either side of the waterways (measured from top of bank) is assumed to be revegetated to achieve a forest classification, to assist with protecting the waterway and supporting management of water quality. The remainder of the corridor is likely to be managed and low threat, however to provide flexibility for ongoing maintenance, existing grass/paddock areas will be assumed to be unmanaged and a hazard.
- The drainage corridors, around the perimeter of the site and associated with conveying stormwater and groundwater (see **Appendix A** for location) and to provide visual amenity

screening. These corridors may be managed and low threat, however to provide flexibility for ongoing maintenance and based on planting to support screening, is assumed to achieve a scrub classification and remain a hazard.

Managed vegetation

The other POS areas (not associated with the waterways, conservation POS or corridors adjacent to the perimeter of the site) will be used for active and passive recreation by the future community, and have been assumed to be managed to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. The specific design and approach will be detailed as part of subsequent stages of the planning and development process, but is likely to include activities such as:

- Low pruning of trees, removing branches within 1.5 m of the ground surface.
- Regular mowing/slashing of grass.
- Regular removal of built-up dead material and weeds
- Re-application of surface cover, such as mulch or other alternatives.

2.2.2 Surrounding the site

Clearing of existing vegetation to the north and east of the site is currently being undertaken to support the construction of the BORR. It is not known whether the verges of the BORR will be revegetated. To provide a conservative assessment of bushfire risk that may apply to the site following construction of the BORR, it has been assumed that revegetation will occur and result in scrub (Class D) vegetation being located adjacent to the site. This is based on revegetation that has been undertaken in nearby areas by Main Roads Western Australia.

3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered in the specific context of the Guidelines (DPLH & WAPC 2021) and AS 3959. The Guidelines require the identification of classified vegetation (using AS 3959) within 150 m of the development site. BAL ratings are then calculated based on the classified vegetation within 100 m of the site, to determine the likely bushfire impacts upon a building in accordance with AS 3959. The objective of AS 3959 is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack on a building or object. It also prescribes simple national construction responses that can resist the determined radiant heat level at a given distance from the fire and are based on six Bushfire Attack Level (BAL) ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-Flame Zone (BAL-FZ).

In Western Australia, the building construction requirements outlined within AS 3959 only apply to Class 1, 2, 3 and (associated) 10a buildings.

3.1 Bushfire hazard level (BHL) and bushfire attack level (BAL) assessment

To support the proposed scheme amendment and structure planning process, the following has been undertaken and are discussed further below:

- Bushfire hazard levels (BHL) within and nearby to the site have been determined in accordance with Appendix Two of the Guidelines and based on the vegetation classification detailed in **Table 2**.
- In accordance with Appendix Five of the Guidelines, a method 1 BAL assessment has been undertaken to demonstrated that the proposed development areas can achieve BAL-29 or less, based on the vegetation classifications and effective slope detailed in **Table 2**.

3.1.1 Assessment inputs

Assessing bushfire hazards takes into account the vegetation classifications and exclusions within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959 and the Guidelines. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types. For example, fuel layers in a typical forest environment can be broken down into five segments as illustrated in **Plate 2** below. These defined fuel layers are considered when determining the classification of vegetation and associated BAL contours. The BMP considers vegetation within the site and nearby areas based on current conditions, observed through the site visit (termed 'pre-development'), and changes to that vegetation that will occur as a result of implementing the proposed development (termed 'post-development').

Not all vegetation is a classified bushfire risk. Vegetation and ground covers that are exempt from classification as a potential hazard is identified as a low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

a) Any vegetation that is more than 100 m from the site.

b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other, or of other areas of vegetation being classified.
d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.
f) Vegetation regarded as a low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

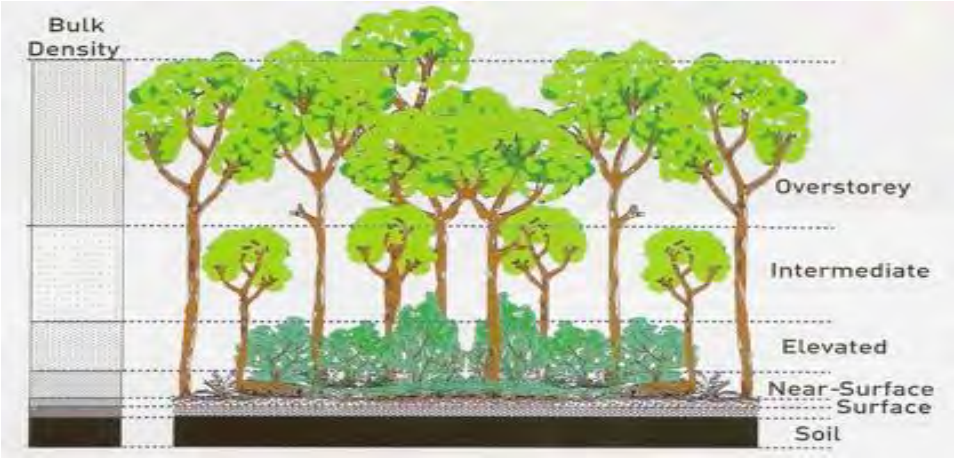


Plate 2: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

An assessment of existing vegetation and effective slope within the site and surrounding 150 m was undertaken on the 13th of September 2021, in accordance with AS 3959 and the Guidelines.

Table 2 below outlines:

- The pre-development AS 3959 vegetation classifications (and associated photo locations showing the existing vegetation conditions). The vegetation classifications and photo locations are shown on **Figure 2**, with additional photos not shown in **Table 2** provided in **Appendix B**. Existing bushfire hazard levels (based on vegetation identified in **Figure 2**) are shown in **Figure 3**.
- The post-development vegetation classifications are shown in **Figure 4** and are based on the assumptions detailed in **Section 3.1.1**.
- The effective slope for each area of classified vegetation present in the post-development scenario, which is also shown in **Figure 4**.

Table 2: Vegetation classification and/or exclusions, effective slope and future management

Plot number (based on pre-development scenario, see Figure 2)	**1 and 2**
Pre-development vegetation classification (see Figure 2)	Forest (Class A) Areas of forest vegetation have been identified within the site associated with the areas of intact native vegetation in north-western portion of the site, and dense stands of trees within the central-east portion of the site (which include trees of variable height, leading to multiple fuel layers).
Post-development vegetation classification (see Figure 4)	Forest (Class A) and low threat vegetation (exclusion clause 2.2.3.2 (f)) The forest vegetation within the north-western portion of the site will be largely retained and protected within a proposed conservation POS area (Plot 1). This area will remain a bushfire risk in the long-term. Other areas of forest vegetation (Plot 2) will be converted to low threat and managed POS (Plot 10), to be used for recreation by the future community. The waterways associated with the riparian corridors in the south-eastern portion of the site (Plot 11) are assumed to be revegetated with forest vegetation, and will extend 5 m either side of the existing top of bank. This is proposed to balance minimising bushfire risk, whilst also enable the protection and enhancement of the existing waterways, which are currently mostly degraded.
Effective slope (see Figure 4)	Flat/upslope (Plot 1); downslope >0 – 5 degrees (Plot 11); and not applicable (Plot 10).
Relevant photo points	2, 3, 4, 5 and 9 (see **Appendix B** for photos not included below).
Site photos	



Photo ID: 2
Forest vegetation within the north of the site (Plot 1), looking northwest.



Photo ID: 3
Forest vegetation within the north of the site (Plot 1), looking west-southwest.

Continued below.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on pre-development scenario, see Figure 2)	1 and 2 (continued)
Site photos (continued)	



Photo ID: 4
Forest vegetation within the north of the site (Plot 1), looking west.



Photo ID: 5
Forest vegetation within the northern portion of the site (Plot 1), looking north-northwest.

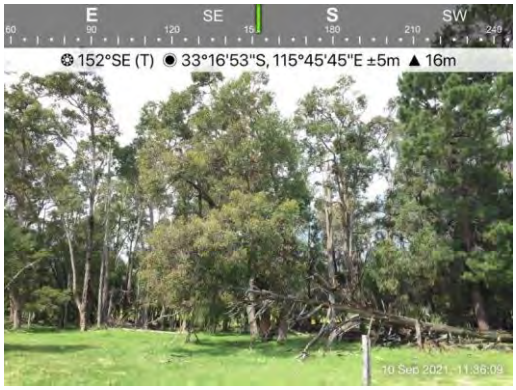


Photo ID:9
Forest vegetation within the central portion of the site, looking south-southeast.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on pre-development scenario, see Figure 2)	**3 – 5**
Pre-development vegetation classification (see Figure 2)	Forest (Class A), I Areas of forest vegetation have been identified to the north, west and south, associated with areas of intact native vegetation with multiple fuel layers and a canopy over 10 m in height; or planted vegetation associated with Forrest Highway or Raymond Road, which has multiple fuel layers and a treen canopy greater than 10 m in height.
Post-development vegetation classification (see Figure 4)	Forest (Class A) The existing forest vegetation is assumed to remain unchanged where it occurs in areas surrounding the site and will continue to be a bushfire risk to the site.
Effective slope (see Figure 4)	Flat/upslope (Plot 3 -5).
Relevant photo points	1, 7, 8, 10, 11, 12, 15, 42 and 43 (see **Appendix B** for photos not included below)
Site photos	



Photo ID: 1
Forest vegetation immediately north of the site, looking north-northwest.



Photo ID: 7
Forest vegetation to the southwest of the site within the Forrest Highway road reserve, looking southeast.



Photo ID: 8
Forest vegetation to the southwest of the site within the Forrest Highway road reserve, looking south.



Photo ID: 10
Forest vegetation to the south of the site, looking west-northwest.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on post-development scenario, see Figure 2)	**6**
Pre-development vegetation classification (see Figure 2)	Scrub (Class D) Scrub vegetation 2-6 m in height with a continuous vertical and horizontal fuel profile, predominantly associated with pockets of melaleuca species (paperbark/tea tree) in lower lying wetland areas to the west of the site.
Post-development vegetation classification (see Figure 4)	Scrub (Class D) Existing scrub vegetation (Plot 6) is assumed to remain unchanged where it occurs in areas surrounding the site. Within the site, the drainage corridors adjacent to the perimeter of the site have been assumed to be planted to achieve a scrub classification (Plot 12). While these areas could be managed, to provide flexibility for the level of maintenance required, and given these corridors may also provide visual amenity screening to the adjacent BORR, Forrest Highway and Raymond Road, these areas have been identified as unmanaged and therefore a bushfire risk.
Effective slope (see Figure 4)	Flat/upslope (Plot 6).
Relevant photo points	17, 18 and 19
Site photos	



Photo ID: 17
Scrub vegetation west of the site within the Forrest Highway median strip, looking north-northeast.



Photo ID: 18
Scrub vegetation immediately west of the site within the Forrest Highway verge, looking north-northeast.



Photo ID: 19 (adjacent)
Grassland vegetation to the west of the site within the Treendale light industrial area and the Forrest Highway verge, looking west. Planting in background appears to be for screening, and species likely to achieve 'scrub' at full growth.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on post-development scenario, see Figure 2)	**7**
Pre-development vegetation classification (see Figure 2)	Grassland (Class G) The majority of the site is cleared and associated with paddock grasses that are currently used for livestock grazing. This vegetation is not required to be managed under the Shire of Harvey firebreak notice and accordingly has been identified as a hazard. Grass/weed height varies from less than 100 mm to greater than 100 mm at the time of inspection.
Post-development vegetation classification (see Figure 4)	Scrub (Class D) (Plot 12); Grassland (Class G) (Plot 7); and non-vegetated/low threat (exclusion clause 2.2.3.2 (e)/(f)) (Plot 9 and 10) To provide flexibility for ongoing maintenance, it is assumed that the existing grassland areas within the riparian corridors (Plot 7) will remain in the long term. It is likely that outside of the proposed revegetation (discussed further above), the corridor is likely to be managed and low threat, however to a conservative assessment of risk, existing grass/paddock areas will be assumed to be unmanaged and a hazard. The drainage corridors around the perimeter of the site, associated with conveying stormwater and groundwater and visual amenity screening are likely to be managed and low threat, however to provide flexibility for ongoing maintenance and based on planting to support screening, is assumed to achieve a 'scrub' classification (Plot 12). The majority of the site is proposed to be cleared or modified and managed to a low threat state as part of the future development, which will ultimately include non-vegetated areas (Plot 9) (i.e. footpaths, roads, driveways, buildings) and low threat vegetation (Plot 10) (i.e. managed parks, residential gardens, manicured lawn, managed road reserves).
Effective slope (see Figure 4)	Flat/upslope (Plot 12); downslope –0 - 5 degrees (Plot 7); and not applicable (Plot 9 and 10).
Relevant photo points	6, 13, 14, 16, 20, 21, 22, 23, 24, 25, 26, 32, 33 and 34 (see **Appendix B** for photos not included below)
Site photos	



Photo ID: 6
Trees (that are not more than 10 % of the canopy cover over the assessment area) over paddock grasses and associated with the waterway, looking north



Photo ID: 13
Grassland vegetaation within the central portion of the site (less than 10 % canopy cover), looking west-northwest.

Continued below

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

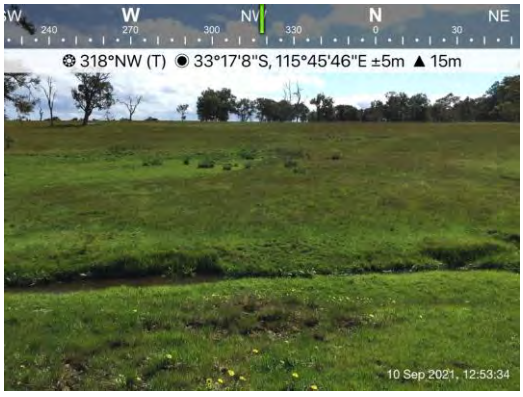
Plot number (based on pre-development scenario, see Figure 2)	7 (continued)
Site photos (continued)	
 **Photo ID: 14** Grassland vegetation within the south-western portion of the site associated with the waterway, looking north-northwest.	 **Photo ID: 16** *Grassland vegetation within the site (canopy cover less than 10%), looking south.*
 **Photo ID: 21** Grassland vegetation within the northwestern portion of the site (with scattered trees/shrubs), looking west.	 **Photo ID: 22** Grassland vegetation with sporadic tussock grasses less than 1 m in height within the northern-central portion of the site, , looking northeast.
 **Photo ID: 26** Grassland vegetation within the central eastern portion of the site, looking northwest.	 **Photo ID: 32** Grassland vegetation within the southern portion of the site, looking south.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on post-development scenario, see Figure 2)	**8**
Pre-development vegetation classification (see Figure 2)	Grassland (Class G) Grassland vegetation is associated with areas containing paddock grasses that are not required to be managed under the Shire of Harvey firebreak notice and, with no clear ongoing management regime. Grass/weed height varies from less than 100 mm to greater than 100 mm at the time of inspection.
Post-development vegetation classification (see Figure 4)	Scrub (Class D) (Plot 13) and Grassland (Class G) (Plot 8) Existing grassland vegetation (Plot 8) outside the site is assumed to remain unchanged and will continue to be a bushfire hazard to the site. Clearing of existing vegetation to the north and east of the site is currently being undertaken to support the construction of the BORR. It is not known whether the verges of the BORR will be revegetated. To provide a conservative assessment of bushfire risk that may apply to the site following construction of the BORR, it has been assumed that revegetation will occur and result in scrub (Class D) vegetation (Plot 13) being located adjacent to the site. This is based on revegetation that has been undertaken in nearby areas by Main Roads Western Australia.
Effective slope (see Figure 4)	Flat/upslope (Plot 8); flat/upslope (Plot 13)
Relevant photo points	27, 28, 29 and 31
Site photos	



Photo ID: 27
Grassland vegetation north of the site, looking north.



Photo ID: 28
Grassland vegetation to the east of the site associated with the future BORR corridor, looking southeast.

Continued below

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on pre-development scenario, see Figure 2)	8 (continued)
Site photos (continued)	



Photo ID: 29
Grassland vegetation to the south of the site, looking east-southeast.



Photo ID: 31
Grassland vegetation to the south of the site, looking southwest.

Table 2: Vegetation classification and/or exclusions, effective slope and future management (continued)

Plot number (based on post-development scenario, see Figure 2)	9
Pre-development vegetation classification (see Figure 2)	Non-vegetated areas (clause 2.2.3.2 (e) exclusion). Non-vegetated areas have been identified surrounding the site and include existing major roads (Forrest Highway, Raymond Road), carpark areas, existing residential and industrial areas and also construction areas associated with the BORR.
Post-development vegetation classification (see Figure 4)	Non-vegetated areas (clause 2.2.3.2 (e) exclusion). All non-vegetated areas surrounding the site are assumed to remain in a non-vegetated state, apart from areas of revegetation assumed for the BORR which is currently under construction. The majority of the site is proposed to be cleared or modified and managed to a low threat state as part of the future development, which will ultimately include non-vegetated areas (Plot 9) (i.e. footpaths, roads, driveways, buildings) and low threat vegetation (Plot 10) (i.e. managed parks, residential gardens, manicured lawn, managed road reserves).
Effective slope (Figure 4)	Not applicable (Plot 9 and 10).
Relevant photo points	35, 36, 37, 38, 39, 40 and 41
Site photos	



Photo ID: 36
Existing non-vegetated area west of the site associated with the Treendale light industrial area, looking northwest.



Photo ID: 38
Construction areas associted with the BORR, looking east-southeast.



Photo ID: 40
Existing non-vegetated area south of the site associated with Meadow Landing Estate, looking south



Photo ID: 41
Existing non-vegetated carpark south of the site, looking northwest.

3.1.2 Assessment outputs

3.1.2.1 Assumptions

The BAL assessment for the site has been undertaken in accordance with Method 1 of AS 3959 to determine the maximum heat flux to which future dwellings within the site are likely to be exposed.

The vegetation classification and effective slope applicable to vegetation within or nearby to the site in the post-development scenario have been summarised in **Table 3** below. Overall, the BAL assessment criteria assumed includes:

- **Designated FDI**: 80
- **Vegetation classification**: forest (Class A), scrub (Class D) and grassland (Class G), see **Figure 4** and summarised in **Table 3**.
- **Effective slope beneath classified vegetation**: flat/upslope and downslope >0 – 5°, as summarised in **Table 3**.
- **Setback distances**: as per Table 2.5 in AS 3959 with the relevant distances used to inform the BAL contour plan summarised in **Table 4** with the BAL contour provided in **Figure 5**.

Table 3: Summary of the assumed vegetation classification and associated effective slope within the site and 150 m in accordance with Table 2.5 (AS3959)

Plot Number	Effective Slope	Vegetation Class
Plot 1	Flat/Upslope	Class A – Forest
Plot 2	Flat/Upslope	Class A – Forest
Plot 3	Flat/Upslope	Class A – Forest
Plot 4	Flat/Upslope	Class A – Forest
Plot 5	Flat/Upslope	Class A – Forest
Plot 6	Flat/Upslope	Class D – Scrub
Plot 7	Downslope >0-5	Class G – Grassland
Plot 8	Flat/Upslope	Class G – Grassland
Plot 9	N/A	Exclusion 2.2.3.2(e)
Plot 10	N/A	Exclusion 2.2.3.2(f)
Plot 11	Downslope >0-5	Class A – Forest
Plot 12	Flat/Upslope	Class–D - Scrub
Plot 13	Flat/Upslope	Class–D - Scrub

In addition to the above, the following key assumptions have informed this assessment:

- Remnant native vegetation associated with the conservation POS in the northern portion of the site (see **Appendix A** for location) will be retained and protected.
- The riparian corridors associated with the waterways within the south-eastern portion of the site (see **Appendix A** for location) will have a 5 m-wide area either side of the waterway, measured from the top of bank, revegetated to achieve a forest classification. The remainder

of the corridor is likely to be managed and low threat, however to provide flexibility for future design and ongoing maintenance (e.g. no maintenance), existing grass/paddock areas will be assumed to be unmanaged and a grassland hazard.

- The drainage corridors, around the perimeter of the site and associated with conveying stormwater and groundwater (see **Appendix A** for location) and likely to provide screening for visual amenity may be managed and low threat, however to provide flexibility for ongoing maintenance and based on planting to support screening, is assumed to achieve a scrub classification.
- Areas of standard public open space will be installed by the developer and maintained in the long-term by the Shire of Harvey to achieve low threat in accordance with clause 2.2.3.2 (f) of AS 3959. These areas will be subject to regular maintenance, to maintain low fuel loads.
- Public roads will be installed by the developer to the minimum standards required under Appendix Four of the Guidelines and verges will be maintained in a low threat state to achieve exclusion under clauses 2.2.3.2 (f).
- Areas of low threat vegetation outside of the site (and not under the proponent's control) will continue to be managed and/or considered to achieve low threat (in accordance with Section 2.2.3.2 of AS 3959) based on the existing maintenance regimes, and/or as per the Shire of Harvey's annual firebreak notice.
- Classified vegetation that has been identified outside of the site has been assumed to remain in its current state (unless stated otherwise), and will, therefore, remain a bushfire hazard to development within the site.
- Areas of the BORR immediately adjacent to the site and not associated with road pavement, is assumed to be revegetated to achieve a scrub classification. This is based on revegetation that has been undertaken in nearby areas by Main Roads Western Australia

3.1.2.2 BHL assessment

A BHL assessment has been prepared for the site and surrounding 150 m based on the existing conditions (see **Figure 2**), with the hazard ratings determined in accordance with Appendix Two of the Guidelines and shown in **Figure 3**.

The outcomes of the assessment indicate that the site and surrounding 150 m assessment area include predominantly moderate bushfire hazards, associated with existing unmanaged grassland, with patches of scrub and forest vegetation (largely associated with road reserves and intact vegetation to the north) identified as an extreme hazard. The majority of the vegetation within the site will be modified and following development, large portions of the site will be subject to a low bushfire hazard.

3.1.2.3 BAL assessment

The BAL contour assessment completed for the site indicates that that the majority of the areas proposed for residential development (and therefore future habitable buildings) can achieve BAL-29 or less based on the proposed concept master plan, as shown in **Figure 5**. Small portions of residential land are subject to BAL-40 and BAL-FZ, however there is sufficient area to accommodate habitable buildings within BAL-29 or below using in-lot setbacks and can be addressed as part of the future planning process.

Table 4 provides a summary of the setback distances necessary from classified vegetation to achieve the indicated BAL ratings, with the BAL contour plan (**Figure 5**) being a visual representation of these distances. The setback distances are based on the post-development classified vegetation and effective slope (shown in **Figure 4**) and are taken from Table 2.5 of AS 3959.

Table 4: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment

Plot number	Vegetation classification (see Figure 2)	Effective slope (see Figure 4)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 5)
Plot 1, 3, 4 and 5	Forest (Class A)	Flat/upslope (0°)	< 16 m	BAL-FZ
			16 - < 21 m	BAL-40
			21 - < 31 m	BAL-29
			31 - < 42 m	BAL-19
			42 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 11	Forest (Class A)	Downslope >0 – 5°	< 20 m	BAL-FZ
			20 - < 27 m	BAL-40
			27 - < 37 m	BAL-29
			37 - < 50 m	BAL-19
			50 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 6, 12 and 13	Scrub (Class D)	Flat/upslope (0°)	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 13 m	BAL-29
			13 - < 19 m	BAL-19
			19 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 8	Grassland (Class G)	Flat/upslope (0°)	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

Table 4: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment (continued)

Plot number	Vegetation classification (see Figure 2)	Effective slope (see Figure 4)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 5)
Plot 7	Grassland (Class G)	Downslope >0 – 5°	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 14 m	BAL-29
			14 - < 20 m	BAL-19
			20 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

4 Identification of Bushfire Hazard Issues

From a bushfire hazard management perspective, the key issues that are likely to require management and/or consideration as part of future development within the site include:

- Provision of appropriate separation distances from permanent bushfire hazards to ensure a BAL rating of BAL-29 or less can be achieved for future habitable buildings. This includes allowances for setbacks adjacent to the conservation POS area, the riparian corridors (forest and grassland hazards) in the south-eastern portion of the site and also along the southern, western and eastern perimeters of the site to account for proposed retention of vegetation, revegetation/no management and visual screening planting respectively.
- Uncertainty regarding future vegetation condition associated with the BORR development, which is currently paddock grasses and would be considered grassland vegetation, or is non-vegetated, associated with active construction of the road that is underway.
- Ensuring that any landscaped areas within the site are appropriately designed and managed to achieve a low threat standard in accordance with AS 3959 on an ongoing basis.
- Provision of appropriate vehicular access to ensure that when development within the site is fully constructed, egress to at least two different destinations will be available to future residents and emergency personnel. This may include the use of temporary cul-de-sacs and/or emergency access ways (EAWs) as part of internal staging of the subdivision, until the full road network associated with the development is constructed.
- Provision of appropriate water supply dedicated to firefighting purposes (i.e. reticulated water hydrants or static water supply) and associated infrastructure, including hardstands, turnaround areas and hydrants/standpipes as required.

These issues are considered further in **Section 5.**

5 Assessment Against the Bushfire Protection Criteria

This BMP provides an outline of the mitigation strategies that will ensure that as subdivision development progresses within the site, an acceptable solution can be adopted for each of the bushfire protection criteria detailed within Appendix Four of the Guidelines. The bushfire protection criteria identified in the Guidelines and applicable/addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply.

As part of future development, it is likely that an 'acceptable solution' will be able to address the intent of all four bushfire protection criteria as part of future subdivision of the site. A summary of how this can be achieved and an associated compliance statement for each has been provided in **Table 5.**

Table 5: Assessment against the bushfire protection criteria from the Guidelines

Bushfire protection criteria	Proposed bushfire management strategies
Element 1: Location	
A1.1 Development location	Element 1 (through *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design* (DPLH 2019b)) is an applicable consideration for intensification of land use as part of strategic planning, to determine the appropriate allocation of land for various land uses. In this instance, the rezoning of the site from 'rural' under the Greater Bunbury Region Scheme and 'general farming' and 'intensive farming' under the Shire of Harvey District Planning Scheme is intended to provide opportunities for future residential development of the site. This is in accordance with the *Bunbury-Geographe sub-regional strategy* (DPLH 2020) which aims to consolidate urban areas and future expansion in the areas generally bounded by the BORR. The majority of the site is identified as a moderate hazard associated with the cleared paddocks identified as grassland vegetation. The site addresses Clause 6.2 (b) of SPP 3.7, which requires development to have a moderate hazard level rating, either before or as part of implementing the proposed development. The majority of future residential areas will be in areas of low hazard once development is progressed and will be able to achieve BAL-29 or less. Small portions of residential land are subject to BAL-40 and BAL-FZ based on the concept masterplan, however there is sufficient area to accommodate habitable buildings within BAL-29 or below using in-lot setbacks and can be addressed as part of the future planning process. Consideration of achieving BAL-29 or less for development is addressed under Element 2 further below. Therefore, the proposal complies with **A1.1**.

Table 5: Assessment against the bushfire protection criteria from the Guidelines (continued)

Bushfire protection criteria	Proposed bushfire management strategies
Element 2: Siting and design	
A2.1 Asset Protection Zone	All proposed lots that are intended to support habitable buildings are able to achieve an asset protection zone (APZ) with sufficient separation from classified vegetation to achieve BAL-29 or below. Separation from permanent bushfire hazards is provided within the structure plan through the management of future lots, and the strategic placement of public open space, public roads, and the proposed design of interfaces between areas of bushfire hazard and development. Overall, the site is suitably sized to accommodate the minimum separation distances (outlined in **Table 4** and shown in **Figure 5**) required to achieve BAL-29 or less at future habitable buildings/developable land[2]. As part of future detailed planning, consideration should be given to any identified bushfire hazards, and the spatial provisions to enable appropriate setbacks (which form the basis for the APZ) to be accommodated, including the provision of public roads, public open space, and in-lot setbacks (if required). Therefore, the proposal complies with **A2.1**. Where proposed to be constructed and within a designated bushfire prone area, future Class 1, 2, 3 and 10a buildings in an area subject to a BAL rating of BAL-12.5 or higher will need to satisfy higher construction standards in accordance with the National Construction Code (NCC) (i.e. AS 3959 or the National Association for Steel-framed Housing (NASH) Standard). It is recommended that as part of the staged development within the site and to minimise the impacts of temporary (grassland) hazards on proposed lots, the proponent should manage a minimum 50 m-wide area immediately surrounding each subdivision stage (where within their broader landholding) to a low threat standard. This would include permanently removing the grass vegetation and/or regularly throughout any year mowing/slashing the grass to 100 mm in height or less. This would be maintained by the proponent until urban development progresses.
Element 3: Vehicular access	
A3.1 Public roads	Surrounding public roads (i.e. Forrest Highway, Raymond Road) and all new internal public roads can and will be able to comply with the minimum standards outlined in Appendix Four of the Guidelines (DPLH & WAPC 2021), which includes a minimum 6 m-wide trafficable surface (refer to **Plate 3** below). Therefore, the proposal complies with **A3.1**.

[2] *Position Statement: Planning in bushfire prone areas - Demonstrating Elements 1: Location and Element 2: Siting and design* (DPLH 2019) has outlined that 'developable land' is "*land that can accommodate a habitable dwelling and would not generally include areas of BAL-40 and/or BAL-FZ, areas within the local government setback and areas subject to environmental constraints*".

Table 5: Assessment against the bushfire protection criteria from the Guidelines (continued)

Bushfire protection criteria	Proposed bushfire management strategies
Element 3: Vehicular access (continued)	
A3.2a Multiple access routes.	The site has direct frontage to Forrest Highway to the west and Raymond Road to the south providing opportunities to accommodate egress to different destinations as part of the future development and proposed through the structure plan and concept plan provided in **Appendix A**. The site will connect to Raymond Road via a roundabout (or similar), while the connection to Forrest Highway will provide for left in/left out movements, with connections generally shown in **Figure 6**. Forrest Highway and Raymond Road are major regional connections, providing egress to the north, south, east and west. Existing areas of urban development, including the Treendale district centre, are located to the south and west. The proposed development complies with **A3.2a**. As part of future planning, future residential development should provide for an interconnected road network which can connect with the existing public road network, ensuring two access routes to at least two different destinations is available to future occupants at all times. The specific layout for future internal roads and connections to the existing surrounding public roads will be determined as part of future planning stages however given the existing public road network surrounding the site, future development can comply with the requirements of the Guidelines.
A3.2b Emergency access way	As outlined above, the design of the future road layout within the site will be refined as part of future planning stages. Given the development will be able to provide egress to at least two different destinations (in line with Acceptable Solution A3.2a), it is unlikely an emergency access way (EAWs) will be required. Therefore, no EAWs are proposed and **A3.2b** is not applicable. If any emergency access ways (including temporary EAWs as part of staged development) are proposed they will need to comply with the minimum technical requirements outlined in Appendix Four of the Guidelines.
A3.3 Through-roads	As part of the future development of the site, while no through roads should be avoided where possible within designated bushfire prone areas, no through roads can be accommodated provided the proponent is able to justify why no alternative exists and/or meet the acceptable solution. Any no through roads (including temporary no through roads proposed as part of staged development) will need to meet the minimum technical requirements for public roads and will require a turning head, in accordance with Appendix Four of the Guidelines, and in particular should be no longer than 200 m and/or may require an emergency access way connecting to the public road network. A single no through road has been included as part of the concept masterplan (see **Appendix A**) and will provide access to the proposed neighbourhood centre (and associated parking areas), shown in **Figure 6**. It is less than 200 m in length and can meet the acceptable solution. Due to the proximity of the neighbourhood centre to Raymond Road (and traffic/access considerations) and required drainage corridors along the perimeter of the site to maintain existing hydrological function, a through road connection is not possible. The proposal is compliant with **A3.3** given the no through road is less than 200 m in length. If development is staged, temporary no-through roads must comply with A3.3.
A3.4a Perimeter roads	The current concept plan (see **Appendix** A) indicates internal perimeter roads will be provided around all areas identified as a possible bushfire hazard to future habitable buildings and the site will also be bound by major public roads, namely Forrest Highway, Bunbury Outer Ring Road and Raymond Road on all boundaries). The proposed development complies with **A3.4a**.

Table 5: Assessment against the bushfire protection criteria from the Guidelines (continued)

Bushfire protection criteria	Proposed bushfire management strategies
Element 3: Vehicular access (continued)	
A3.4b Fire service access route	As outlined above, the future road layout within the site will be designed as part of future planning stages. However, given the development will be able to provide egress to two different destinations (in line with Acceptable Solution A3.1), and the site is bounded by existing public roads that will provide firefighter access around the perimeter of the site (see **Figure 6**), it is unlikely that any fire service access routes (FSARs) will be required. If any FSARs are proposed in the future, they will need to comply with the requirements of the Guidelines (or as agreed with the Shire of Harvey).
A3.5 Battle-axe access legs	None proposed at this stage. As part of the future development of the site, while battle-axe access legs should be avoided where possible within designated bushfire prone areas, if proposed as part of future development, their inclusion will need to be justified and will need to address the minimum standards outlined in Appendix Four of the Guidelines which includes technical requirements in Table 6 (reproduced in **Plate 3**).
A3.6 Private driveway longer than 50 metres	None proposed at this stage based on the density of residential development. If private driveways longer than 50 m are proposed they will need to comply with the requirements of the Guidelines, including Table 6 of the Guidelines.
Element 4: Water	
A4.1 Identification of future water supply	The proposed development is located in an area with a reticulated water supply, including through the northern portion of the site and adjacent to Raymond Road. This will be expanded into the site as future subdivision occurs, as outlined in the water management and servicing reports supporting the structure plan (Emerge Associates 2022). The proposal complies with **A4.1**.
A4.2 Provision of water for fire fighting purposes	Not applicable at this stage in the process. The site will be serviced by a network of reticulated water hydrants as per the relevant water supply authority requirements (Water Corporation/Harvey Water) (or as otherwise determined by a bushfire consultant and relevant approval authority).

Table 6: Vehicular access technical requirements

TECHNICAL REQUIREMENTS	1 Public roads	2 Emergency access way[1]	3 Fire service access route[1]	4 Battle-axe and private driveways[2]
Minimum trafficable surface (metres)	In accordance with A3.1	6	6	4
Minimum horizontal clearance (metres)	N/A	6	6	6
Minimum vertical clearance (metres)	4.5			
Minimum weight capacity (tonnes)	15			
Maximum grade unsealed road[3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum grade sealed road[3]		1:7 (14.3%)		
Maximum average grade sealed road		1:10 (10%)		
Minimum inner radius of road curves (metres)		8.5		

Notes:
[1] To have crossfalls between 3 and 6%.
[2] Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision.
[3] Dips must have no more than a 1 in 8 (12.5% -7.1 degree) entry and exit angle.

Plate 3: Excerpt of Table 6 from The Guidelines (DPLH & WAPC 2021)

5.1 Additional management strategies

5.1.1 Future approval considerations

A BAL contour assessment has been prepared for the site to demonstrate that best practice management strategies can be adopted through future planning and implementation stages to ameliorate the bushfire hazards (i.e. habitable buildings can be located in areas of BAL-29 or less) that would otherwise impact upon its future development.

A BMP will be required to support future subdivision for the site, to detail how the proposed development layout has or will address the bushfire protection criteria based on the recommendations outlined within this BMP, as well as to determine the likely BAL ratings applicable to the future habitable buildings.

5.1.2 Landscape management

5.1.3 Within the site

Proposed revegetation/unmanaged vegetation

Vegetation within the site that is likely to result in a bushfire hazard (and considered as part of the assessment further below) include:

- The conservation POS in the north-western portion of the site (see **Appendix A** for location). Existing remnant native vegetation in this area is assumed to be retained and protected. No management of this vegetation has been assumed.
- The riparian corridors associated with the waterways within the south-eastern portion of the site (see **Appendix A** for location). A 5 m-wide area either side of the waterway (measured from the top of bank) is assumed to be revegetated to achieve a forest classification, to aid with protecting the waterway and supporting management of water quality. The remainder of the corridor is likely to be managed and low threat, however to provide flexibility for design and ongoing maintenance (e.g. no maintenance), existing grass/paddock areas will be assumed to be unmanaged and a hazard. No management of vegetation within the riparian corridor is assumed, and includes consideration of likely revegetation to forest along the physical waterway itself.
- The drainage corridors, around the perimeter of the site are associated with conveying stormwater and groundwater (see **Appendix A** for location) and also to provide visual amenity screening. These corridors may be managed and low threat, however to provide flexibility for ongoing maintenance and based on planting to support screening, is assumed to achieve a scrub classification and remain a hazard. No management of the vegetation in these corridors has been assumed.

Managed vegetation

The other POS areas (not associated with the waterways, conservation POS or corridors adjacent to the perimeter of the site) will be used for active and passive recreation by the future community, and have been assumed to be managed to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. The design and construction of public open space areas is generally a condition of subdivision

approval, and the detailed design of the public open space areas within the site will be determined in collaboration with the Shire of Harvey as part of the standard development process and is assumed to be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959, and in line with Shire of Harvey requirements. Management may include:

- Clearing/modification of vegetation
- Irrigation of grass and garden beds (where required)
- Regular maintenance including removal of weeds and dead material
- Low pruning of trees
- Application of ground covers such as mulch or non-flammable materials
- Regularly mowing/slashing of grass to less than 100mm in height

The proponent will be responsible for the initial maintenance of POS areas, and following handover the Shire of Harvey will be responsible for the long-term maintenance of the public open space areas to a low threat standard.

Within public road reserves

The proposed road reserves will be designed and maintained to achieve a low threat state in accordance with Clauses 2.2.3.2 (e) and (f) of AS 3959, as shown in **Figure 4** and will be the responsibility of the proponent initially until handover to the Shire of Harvey.

5.1.4 Shire of Harvey annual firebreak notice

The Shire of Harvey releases a firebreak notice annually (or as required) to provide a framework for bushfire management within the Shire. The Shire of Harvey is able to enforce this order in accordance with Section 33(1) of the *Bush Fires Act 1954* and landowners will need to ensure compliance with the fire break notice, as published, or any directions provided by the Shire of Harvey.

Following development for residential purposes, all lots will be required under the firebreak notice to:

- Have a firebreak of at least 2 m wide with a 4 m high vertical axis that is maintained within 6 m of the inside of all external boundaries of the land; or
- Cleared hardstand areas and reticulated grassed areas maintained in a green state may be considered acceptable as an adequate firebreak

In addition, all lots subject to an approved bushfire management plan through subdivision will be required to comply with this plan, which is likely to require all future residential/commercial areas to be managed to achieve low threat vegetation and excludable under clause 2.2.3.2 of AS 3959.

5.1.5 Vulnerable or high-risk land uses

Currently, no high-risk land uses, as defined under SPP 3.7, are proposed within the site as part of the subdivision. A vulnerable land use in the form of a primary school is proposed in the central portion of the site.

Where high-risk or vulnerable land uses are proposed in the future, these will need to address the requirements of policy measure 6.6 of SPP 3.7, including the assessment of bushfire risk and/or the preparation of an emergency evacuation plan (for vulnerable land uses) or risk management plan (for high-risk land uses) where subject to a BAL rating greater than BAL-LOW. This will be dealt with as part of future detailed planning stages. The location of the site in an area of largely moderate bushfire hazard (which will transition to low with residential development) and connection to the public road network, including Forrest Highway and Raymond Road, means key considerations such as separation from bushfire hazards and emergency access will be able to be addressed. However, the school is indicatively subject to BAL-LOW and will not require any additional bushfire assessment at the time of development application.

5.1.6 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES website (https://www.dfes.wa.gov.au/bushfire/prepare/) provides a range of materials to help the community prepare for and survive the bushfire season.

The Shire of Harvey provides bushfire safety advice to residents available from their website. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high-risk areas in addition that that provided in this BMP.

In the case of a bushfire in the area, advice would be provided to residents and businesses by DFES, the DBCA and/or the Shire of Harvey on any specific recommendations with regard to responding to the bushfire, including evacuation if required.

6 Responsibilities for Implementation and Management of Bushfire Measures

Subject to the approval of the proposed scheme amendment and structure plan, development within the site for residential purposes will be implemented through the preparation of future subdivision application(s).

Table 6 outlines the future responsibilities of the proponent (developer) and the Shire of Harvey associated with implementing the proposed scheme amendment and structure plan, with reference to future mitigation measures to be accommodated as part of subdivision (in particular, consideration of spatial layout requirements). These responsibilities will need to be considered as part of the subsequent planning process.

Additional bushfire mitigation responsibilities will be required at subdivision for the residential development of the site, including responsibilities for future lot owners.

Table 6: Responsibilities for the implementation of this BMP

Management action	Timing
Developer	
Provide a copy of this BMP to the relevant decision makers to support the proposed scheme amendment and structure plan.	To support the scheme amendment and structure plan approval process.
Following approval of the scheme amendment, prepare a BMP (as required) in accordance with SPP 3.7, the Guidelines (as updated) and AS 3959 to support future subdivision within portions of the site that are designated as bushfire prone areas under the *Map of Bush Fire Prone Areas*. This should be based on the proposed spatial layout of the development. Where the assumptions and outcomes of this BMP are met through subdivision design, the decision-maker may rely on this BMP for subdivision approval at their discretion.	To support future subdivision.
Where applicable, as part of the subdivision process, make spatial provisions for: • A suitable public road network that provides egress to at least two different destinations and meets the technical requirements of Table 6 within Appendix Four of the Guidelines (or as updated), or as otherwise determined by a bushfire consultant and relevant approval authority. • Where possible, avoid no through roads and battle-axe access legs as part of the spatial layout. If these are proposed as part of future development, they will need to be justified from a planning/development perspective and consistent with the minimum requirements outlined in Appendix Four of the Guidelines (or as updated), or as otherwise determined by a bushfire consultant and relevant approval authority. • Ensure future habitable buildings are able to be located in an area subject to BAL-29 or less. The minimum separation distances between habitable buildings and classified vegetation to achieve BAL-29 should be in accordance with **Table 4** in this BMP or as specified in subsequent BAL assessments. These separation distances can be accommodated through locating public roads and/or managed public open space between the habitable building and classified vegetation and/or ensuring proposed residential lots are adequately sized to ensure BAL-29 is not exceeded at the future dwelling (and use of in-lot setbacks). • A water supply dedicated to firefighting purposes in the form of a reticulated network of water hydrants	To support future structure planning and/or subdivision.
Comply with the Shire of Harvey annual firebreak notice.	Ongoing, as required

Table 6: Responsibilities for the implementation of this BMP (continued)

Management action	Timing
Shire of Harvey	
Monitoring vegetation fuel loads in public reserves and liaising with relevant stakeholders to maintain fuel loads at minimal fuel levels, where required/applicable.	Ongoing, as required
Maintaining public road reserves under their management to appropriate standards, where required/applicable.	Ongoing, as required
Monitoring compliance with the Shire of Harvey annual firebreak notice and enforcing requirements as required.	Ongoing, as required

7 Applicant Declaration

7.1 Accreditation

This assessment report has been prepared by Emerge Associates who have a number of team members who have undertaken Bushfire Planning and Design (BPAD) Level 1 and Level 2 training and are Fire Protection Association of Australia (FPAA) accredited practitioners. Emerge Associates has been providing bushfire risk management advice for more than 10 years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry.

Anthony Rowe is a Fire Protection Association of Australia (FPAA) Level 3 Bushfire Planning and Design (BPAD) accredited practitioner (BPAD no. 36690) in accordance with clause 6.12 of the Guidelines.

7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:



Name: Anthony Rowe

Company: Envision Bushfire Protection/Emerge Associates

Date: 04/04/2025

BPAD Accreditation: Level 3 BPAD No. 36690

8 References

8.1 General references

Biota Environmental Sciences 2019, *Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment*, Main Roads Western Australia, Revision 0.

BORR Team 2019, *Bunbury Outer Ring Road Northern and Central Section Environmental Referral Supporting Document*, Main Roads Western Australia, Revision 2.

BORR Team 2020a, *Bunbury Outer Ring Road Northern and Central Sections Response to EPA Notice of Decision to Assess: Additional Information Requirements*, Main Roads Western Australia, BORR-01-RP-EN-0009, Revision 1.

BORR Team 2020b, *Bunbury Outer Ring Road Northern and Central Sections Vegetation and Flora Study* Main Roads Western Australia, BORR-01-RP-EN-0002, Revision 1.

Department of Planning, Lands and Heritage (DPLH) 2019, *Position Statement: Planning in bushfire prone areas - Demonstrating Element 1: Location and Element 2: Siting and design*, Western Australian Planning Commission.

Department of Planning, Lands and Heritage, (DPLH) 2022, *Bunbury-Geographe sub-regional strategy*, Western Australian Planning Commission, Perth.

Department of Planning, Lands and Heritage, and Western Australian Planning Commission, (DPLH & WAPC) 2021, *Guidelines for Planning in Bushfire Prone Areas Version 1.4*, Perth, Western Australia.

Emerge Associates 2022, *Water Management Strategy Treendale East*, EP21-022(04), Version A.

Main Roads Western Australia 2018, *Bunbury Outer Ring Road Northern Section Alignment Selection Report*.

Standards Australia 2018, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney.

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Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia. December 2017.

Wetland Research & Management (WRM) 2019, *BORR Northern & Central: Conservation Signficant Aquatic Fauna Survey*, Main Roads Western Australia. Version 2.

8.2 Online references

Landgate 2019, *Locate V5,* viewed September 2021, <https://maps.slip.wa.gov.au/landgate/locate/>

Office of Bushfire, Risk Management (OBRM) 2021, Map of Bushfire Prone Areas, Landgate, Shared Location Information Platform (SLIP) Locate V5, <https://maps.slip.wa.gov.au/landgate/bushfireprone/>.

Figures

Figure 1: Site Location and Topographic Contours

Figure 2: Pre-development Vegetation Classifications

Figure 3: Bushfire Hazard Levels

Figure 4: Post-development Vegetation Classifications and Effective Slope

Figure 5: Bushfire Attack Level Contour Plan

Figure 6: Spatial Representation of Bushfire Management Strategies

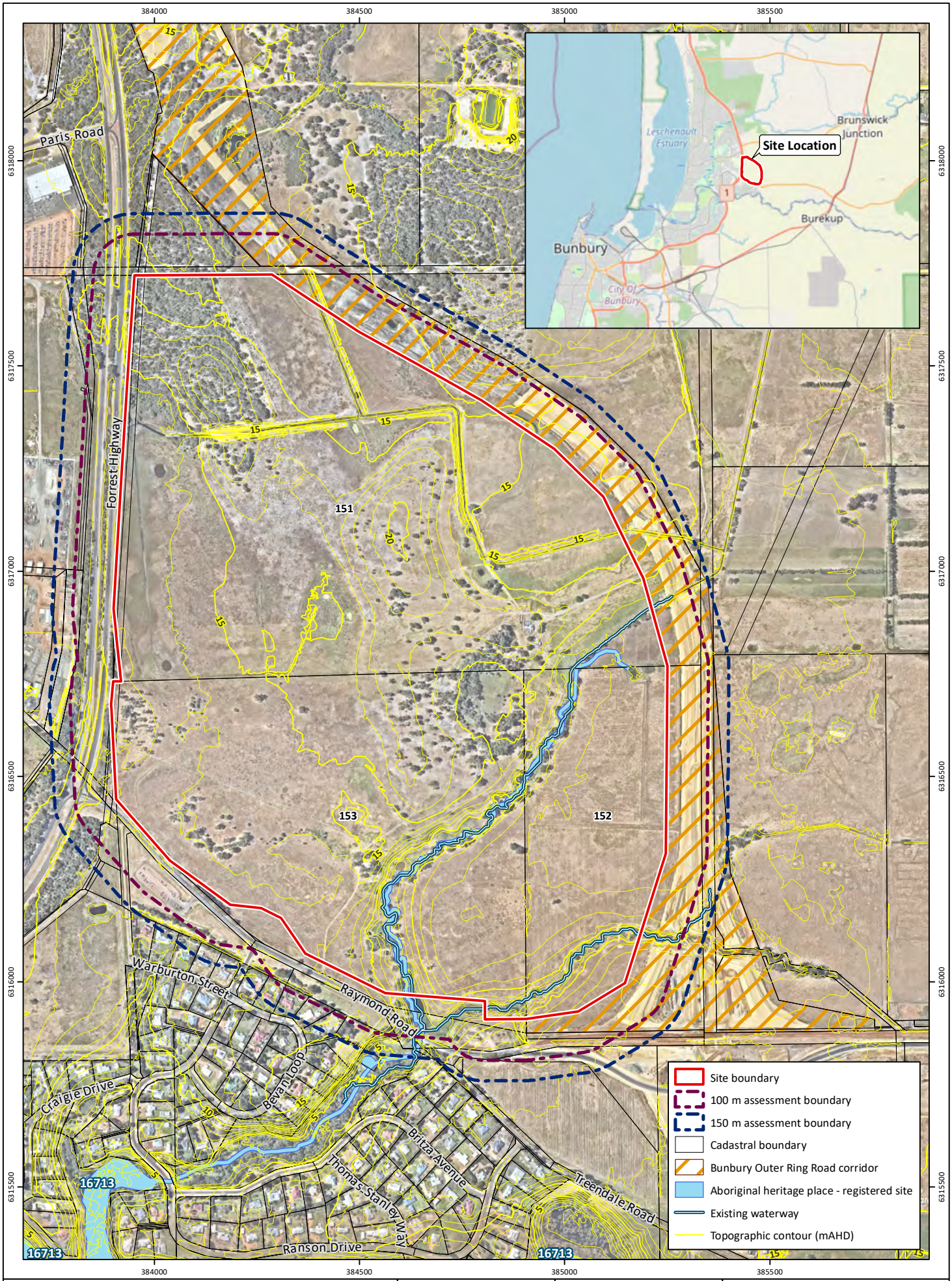


Figure 1: **Site Location and Topographic Contours**

Project: Bushfire Management Plan
Lots 151, 152 and 153 Raymond Road, Roelands
Client: Treendale East Landowner Group

Plan Number: EP21-022(06)--F21
Drawn: GAR
Date: 04/10/2021
Checked: BFM
Approved: KK
Date: 18/01/2022

N

0 100 200 300
Metres
Scale: 1:12,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.
©Landgate (2021). Nearmap Imagery date: 15/12/2021

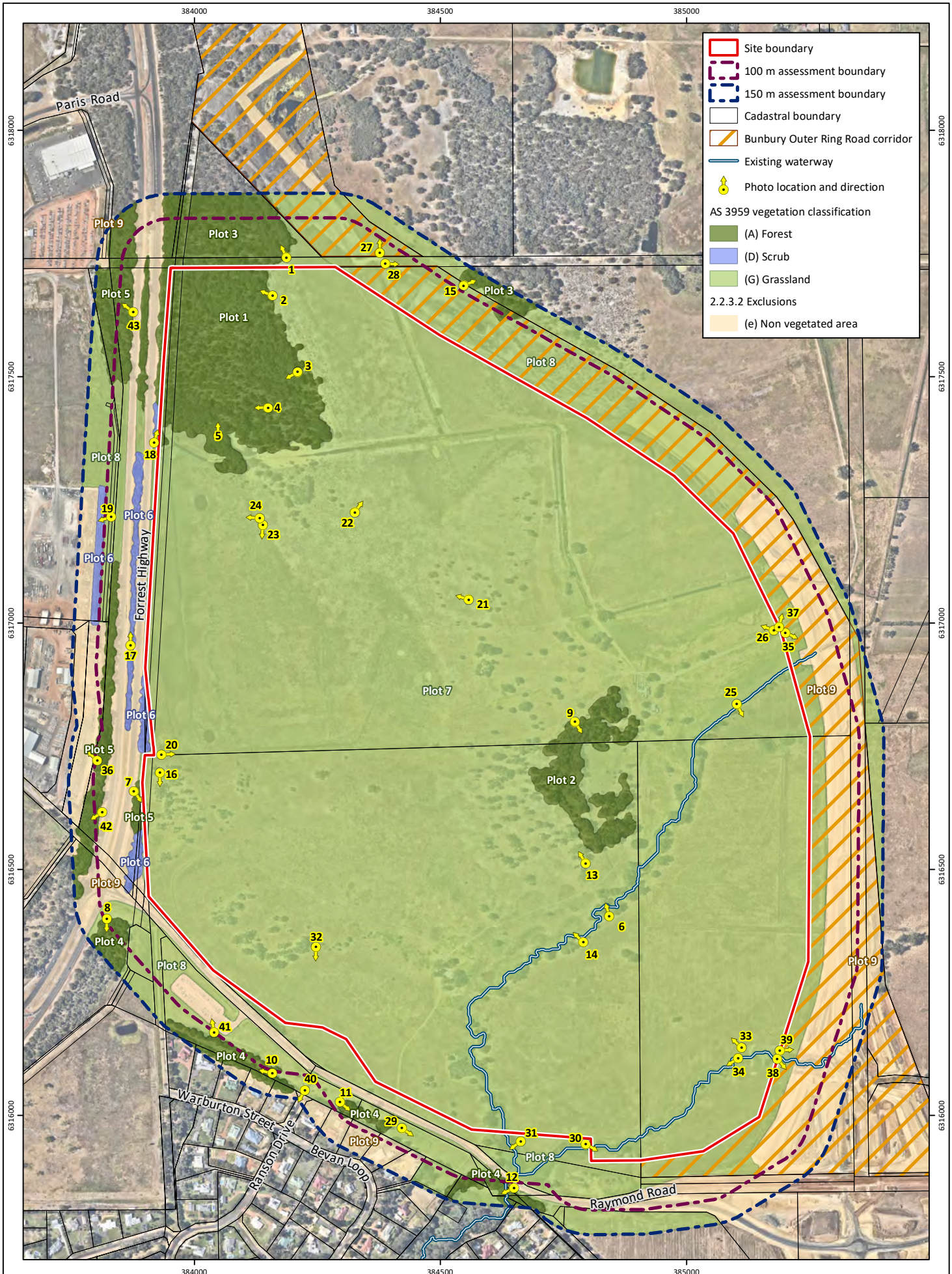


Figure 2: Pre-Development Vegetation Classifications

Project:	Bushfire Management Plan Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(06)--F22

Drawn:	GAR
Date:	04/10/2021
Checked:	BFM
Approved:	KK
Date:	18/01/2022

N

0 100 200 300
Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.
©Landgate (2021). Nearmap Imagery date: 15/12/2021

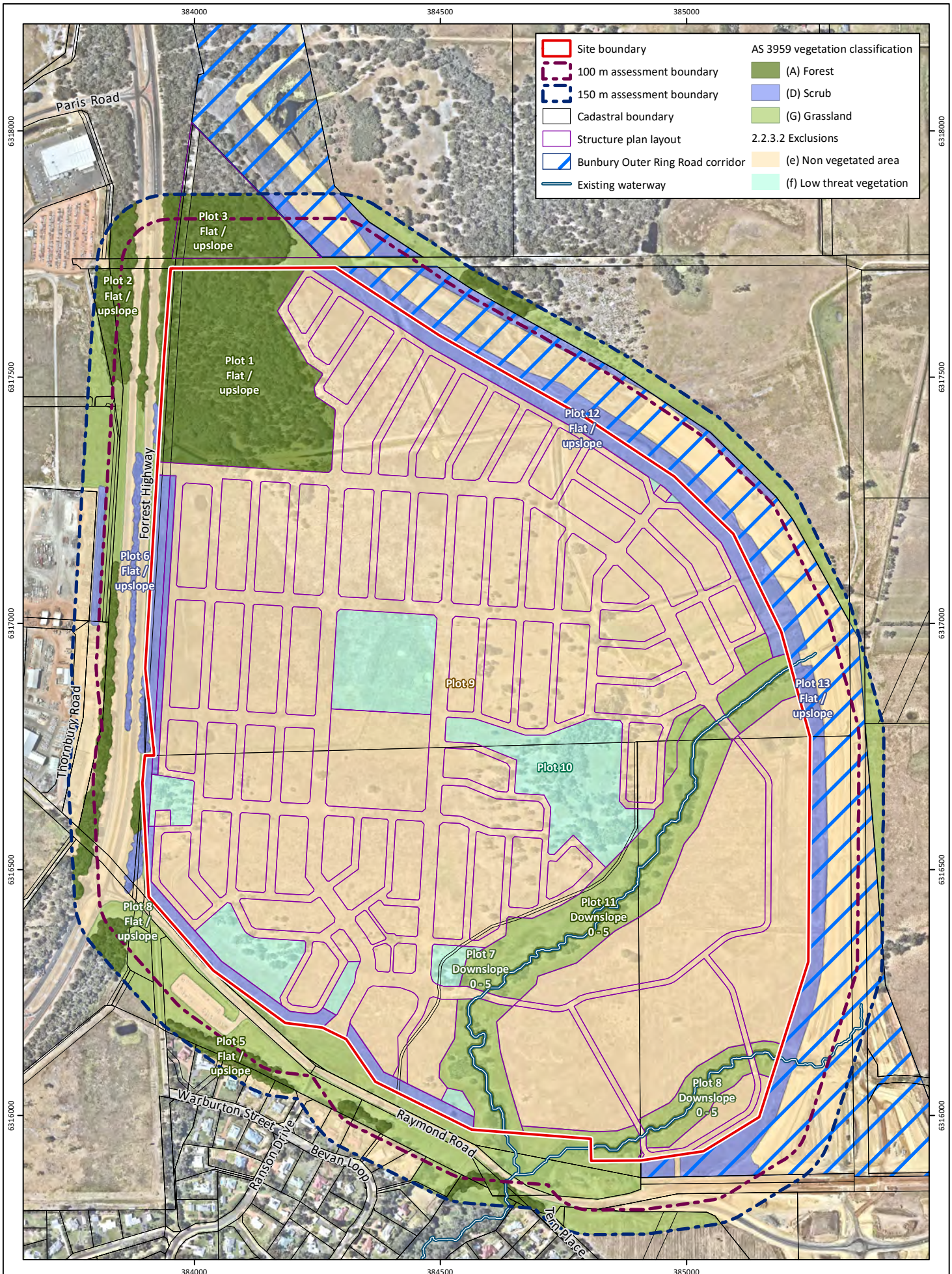


Figure 4: **Post-Development Vegetation Classifications and Effective Slope**

Project: Bushfire Management Plan
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(06)--F23a

Drawn:	CTH
Date:	27/03/2025
Checked:	KK
Approved:	KK
Date:	08/04/2025

N

0 100 200 300
Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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©Landgate (2025). Nearmap Imagery date: 15/12/2022

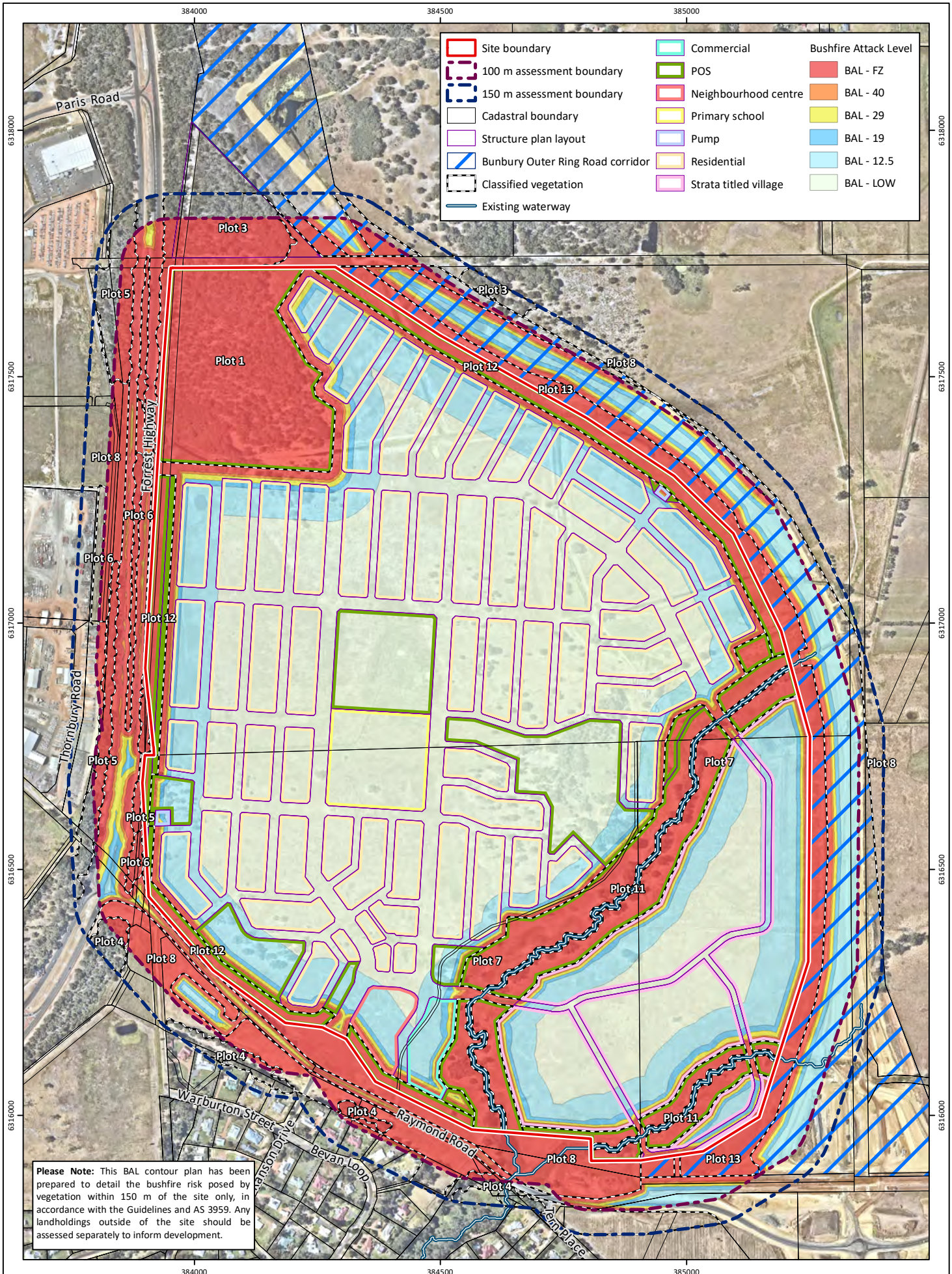


Figure 5: Bushfire Attack Level Contour Plan

Project: Bushfire Management Plan
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(06)--F24b

Drawn:	CTH
Date:	27/03/2025
Checked:	KK
Approved:	KK
Date:	08/04/2025

N

0 100 200 300
Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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©Landgate (2025). Nearmap Imagery date: 15/12/2021

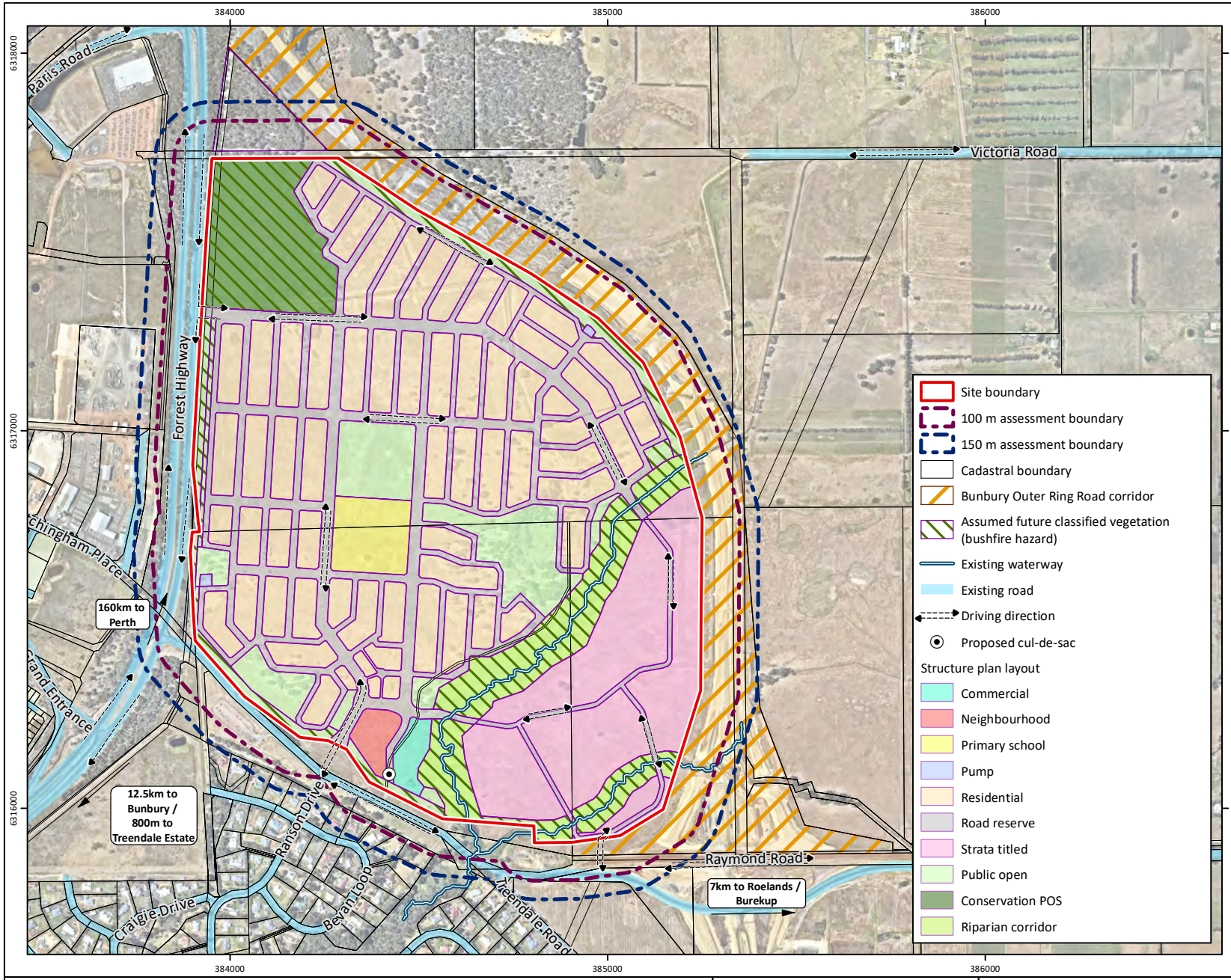


Figure 6: Spatial Representation of Bushfire Management Strategies

Project: Bushfire Management Plan
Lots 151, 152 and 153 Raymond Road, Roelands
Client: Treendale East Landowner Group

Plan Number:
EP21-022(06)--F25a
Drawn: CTH
Date: 27/03/2025
Checked: KK
Approved: KK
Date: 08//04/2025

N

0 200 400 600
Metres
Scale: 1:15,000@A4
GDA 1994 MGA Zone 50

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2020). Nearmap Imagery date: 15/12/2021

Asset protection zones
• All habitable buildings should achieve BAL-29 or less. Asset protection zones will be required around future habitable buildings to achieve BAL-29 or lower. These may be installed within areas of managed POS/road reserves or within lots (i.e. as carparks, driveways, manicured lawn etc).

Building construction requirements
• Where designated bushfire prone, future Class 1, 2, 3 and associated 10a buildings will need to be constructed in accordance with BAL ratings determined in accordance with AS 3959.

Areas of bushfire hazard
A number of areas within the site and nearby are currently grassland and present a 'moderate' risk to future development within the site. To prepare this BMP, it has been assumed, to provide a conservative assessment of bushfire risk, that the following hazards will exist in the long-term (shown as 'assumed future classified vegetation'):
• The existing vegetation within the Conservation POS will be protected and maintained in its current condition. Some revegetation may occur, however this would not change the existing forest (Class A) classification.
• POS corridors adjacent to the perimeter of the site will be planted to support management of visual amenity (as well as movement of drainage). While it is expected that management of these areas is likely, it is assumed these areas will be planted to achieve a scrub (Class D) classification.
• The riparian corridors will be partially revegetated directly adjacent to the streamline (5 m either side) to achieve a forest (Class A) classification as part of protecting the waterway from erosion, and managing water quality. The remainder of the corridor is expected to be managed to support recreation activities, however is assumed to achieve a grassland (Class G) classification to provide flexibility for design and to accommodate seasonal variability in maintenance regimes.
• The outer corridors of the Bunbury Outer Ring Road (not subject to road pavement) will be revegetated to achieve a scrub (Class D) classification.

Landscaping
• All future POS (unless otherwise stated above) and future residential gardens will be managed in a low threat state in accordance with section 2.2.3.2 of AS 3959.

Access
• All future development will be able to achieve two access routes upon completion of development.

Water supply
• The future development will be serviced by a network of reticulated water hydrants.

Appendix A

Structure plan (CDP 2025)

STRUCTURE PLAN LEGEND

LOCAL SCHEME ZONES

- RESIDENTIAL
- NEIGHBOURHOOD CENTRE
- PS — PUBLIC PURPOSES PS (PRIMARY SCHOOL)
- RECREATION (PUBLIC OPEN SPACE)
  - (C) CONSERVATION VALUES
  - (L) LOCAL
  - (N) NEIGHBOURHOOD
  - (D) DISTRICT
  - (*) DRAINAGE

GREATER BUNBURY REGION SCHEME ZONES

- PRIMARY REGIONAL ROADS
- FUTURE PRIMARY REGIONAL ROADS
- WC — PUBLIC PURPOSES WC (WATERCORP)

LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN

- STRUCTURE PLAN BOUNDARY
- RESIDENTIAL DENSITY RANGE BOUNDARIES
- PRINCIPAL SHARED PATH
- LDP — LOCAL DEVELOPMENT PLAN REQUIRED
- EXISITNG GAS PIPELINE EASEMENT
- 132kV POWERLINE EASEMENT, PYLONS
- CONSTRUCTION OR CONTRIBUTION TOWARDS INTERSECTION UPGRADE
- LEFT IN/LEFT OUT INTERSECTION
- TEMPORARY LEFT IN/LEFT OUT INTERSECTION
- ACOUSTIC CONSIDERATIONS (SPP 5.4) VEGETATED BUNDS ARE TO BE PROVIDED WHERE REQUIRED. IF NOISE WALLS ARE REQUIRED IN ADDITION TO A VEGETATED BUND VISUAL IMPACT IS TO BE REDUCED BY SCREENING VEGETATION
- LOTS WITHIN 100m OF "CLASSIFIED VEGETATION" AND SUBJECT TO BUSHFIRE ATTACK LEVEL ASSESSMENT. REFER BUSHFIRE MANAGEMENT PLAN AND ANY SUBSEQUENT BAL ASSESSMENTS.
- AU — ADDITIONAL USE
- AS — ADDITIONAL SITE REQUIREMENTS

ROAD HIERARCHY

- INTEGRATOR ARTERIAL B
- NEIGHBOURHOOD CONNECTOR A
- NEIGHBOURHOOD CONNECTOR B
- ACCESS STREET A
- ACCESS STREET C
- ACCESS STREET D
- LANEWAY
- VILLAGE - COMMUNAL ROAD B

NOTES

1. The Raymond Road Left In/Left Out intersection shall be temporary only for rural access and shall be removed upon development of the Village Precinct.

BUNBURY OUTER RING ROAD
FORREST HIGHWAY
RAYMOND ROAD
RANSON DRIVE
POS 1 (C)
POS 2 (*, L)
POS 3 (D)
POS 4 (N, *)
POS 5 (C, *)
POS 6 (C, *)
POS 7 (L, *)
POS 8 (C, *)
POS 9 (L, L)
POS 10 (*, L)
POS 11 (C, *)
POS 12
POS 13 (N)
POS 14 (*, L)
POS 15 (L, *)
POS 16 (L)
POS 17 (*, L)
POS 18 (*, L)
POS 19 (L)
PS
WC
R25-R80
R80 LDP
R30 LDP
AU AS
151
152
50

NORTH

Not to Scale @ A3
0 50 100 150m

Date: 08/04/2025 **Plan:** TAYTE-2-002F

TREENDALE EAST STRUCTURE PLAN

Plan 1

LEGEND

TREENDALE EAST SUBJECT SITE

LAND USES

RESIDENTIAL
STRATA TITLED VILLAGE
NEIGHBOURHOOD ACTIVITY CENTRE
SCHOOLS
SEWER PUMP STATION
PUBLIC OPEN SPACE & DRAINAGE
GAS PIPELINE EASEMENT
132kV POWERLINE EASEMENT

ROAD HIERARCHY

INTEGRATOR ARTERIAL B - 30.0m
NEIGHBOURHOOD CONNECTOR A - 31.5m
NEIGHBOURHOOD CONNECTOR B - 31.5m
NEIGHBOURHOOD CONNECTOR B - 26.0m
NEIGHBOURHOOD CONNECTOR B - 19.5m
ACCESS STREET A - 26.0m
ACCESS STREET C - 18.0m
ACCESS STREET D - 19.5m
ACCESS STREET D (ADJACENT BUSHLAND) - 20.0m
ACCESS STREET D - 15.0m
ACCESS STREET D (ADJACENT POS) - 13.0m
LANEWAY - 6.0m
VILLAGE - COMMUNAL ROAD B - 12.0m

EXISTING ROAD RESERVE
BUNBURY OUTER RING ROAD
FORREST HIGHWAY
RAYMOND ROAD
RANSON DRIVE
BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1
12.070ha
POS 2
3.824ha
POS 17
1.376ha
POS 16
2370m²
POS 15
7589m²
PUMP
1000m²
PUMP
500m²
PUBLIC OPEN SPACE 3
4.105ha
PROPOSED PRIMARY SCHOOL
4.0ha
PUBLIC OPEN SPACE 4
5.739ha
POS 18
4000m²
PUBLIC OPEN SPACE 5
1.410ha
POS 19
3796m²
PUBLIC OPEN SPACE 6
8.039ha
PUBLIC OPEN SPACE 13
1.989ha
POS 14
1.341ha
POS 12
3392m²
POS 7
5948m²
POS 10
8155m²
POS 9
1960m²
NEIGHBOURHOOD ACTIVITY CENTRE
1.476ha
COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)
1.417ha
PUBLIC OPEN SPACE 8
2.776ha
PUBLIC OPEN SPACE 11
3.201ha
STRATA TITLED VILLAGE
28.285ha
STRATA TITLED VILLAGE
1.584ha
151
152
153
132kV POWERLINE EASEMENT
15.9m GAS PIPELINE EASEMENT

CELL STRUCTURE PLAN

Treendale East

A Taycot Development Project

DRAFT

NORTH
Scale 1:3000 @ A1
0 30 60 90m
PLAN: TAYTE-P114
DATE: 03/04/2025
PROJECTION: PCG 2020
DATUM: AHD
REVISION: K
DRAWN: JP
PLANNER: DM
CHECK: DM

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

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Appendix B

Additional photographs

Table B1: Additional photo points organised by plot, as shown within Figure 2

Plots 3 - 5	
AS 3959 classification (Figure 2): Forest (Class A)	
 **Photo ID: 11** Forest vegetation to the south of the site, looking east-southeast.	 **Photo ID: 12** Forest vegetation to the south of the site, looking southwest.
 **Photo ID: 15** Forest vegetation to the northeast of the site, immediately adjacent to the future BORR corridor, looking east-northeast.	 **Photo ID: 42** Forest vegetation within the Forrest Highway road reserve, looking south.
 **Photo ID: 43** Forest vegetation within the Forrest Highway road reserve, looking north.	.

Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

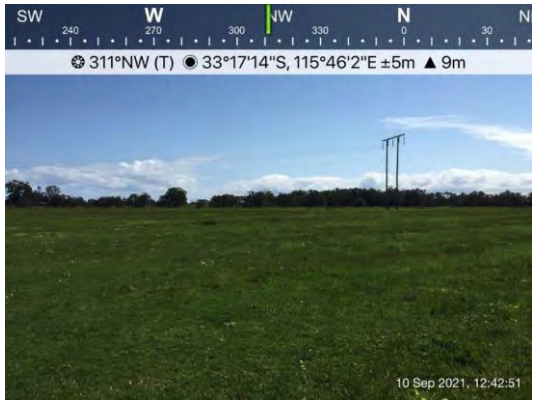
Plot 7	
AS 3959 classification (Figure 2): Grassland (Class G)	
 **Photo ID: 23** Grassland vegetation within the site (with scattered tussock grass), looking south.	 **Photo ID: 24** Grassland vegetation within the northwestern portion of the site (with scattered tussock grass), looking west.
 **Photo ID: 25** Grassland vegetation within the eastern portion of the site, looking southeast.	 **Photo ID: 33** Grassland vegetation within the southeastern portion of the site, looking northwest.
 **Photo ID: 34** Grassland vegetation within the eastern portion of the site (showing the southern waterway), looking west.	

Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

Plot 9	
AS 3959 classification (Figure 2): Exclusion (clause 2.2.3.2 (e))	
 **Photo ID: 35** Existing cleared ares of the BORR corridor, looking southeast.	 **Photo ID: 37** Existing cleared ares of the BORR corridor, looking north-northeast.
 **Photo ID: 39** Existing cleared ares of the BORR corridor, looking south-southeast.	

Appendix 2.
Transport Impact Assessment

transcore
20 years anniversary

transport planning
traffic engineering
modelling

Treendale East Structure Plan

Transport Impact Assessment

PREPARED FOR:
Treendale East Land Owners Group

May 2025

Document history and status

Author	Revision	Approved by	Date approved	Revision type
R White	r01	B Bordbar	15/02/2022	
R White	r01a	B Bordbar	25/03/2022	Final
R White	r01b	B Bordbar	6/05/2025	Revised

File name: t21262-rw-r01b.docx

Author: Robin White

Project manager: Behnam Bordbar

Client: Treendale East Land Owners Group

Project: Treendale East Structure Plan

Document revision: r01b

Project number: t21.262

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TABLE OF CONTENTS

1 INTRODUCTION 1

2 PROPOSED STRUCTURE PLAN 2

3 EXISTING SITUATION 3

3.1 Existing Land Use 3
3.2 Existing Road Network 3
3.3 Existing Traffic Volumes 4
3.4 Heavy Vehicle Routes 8
3.5 Public Transport 8
3.6 Pedestrian and Cyclist Facilities 9
3.7 Changes to Surrounding Road Network 10

4 PROPOSED TRANSPORT NETWORK 12

4.1 Road Hierarchy 12
4.2 Intersection Controls 14
4.3 Public Transport 16
4.4 Pedestrian and Cyclist Facilities 16

5 ANALYSIS OF THE TRANSPORT NETWORK 18

5.1 Assessment Period 18
5.2 Traffic Generation and Distribution 18
5.3 Traffic Flow Forecasts 19
5.4 Roads and Intersections 21
5.5 Intersection Analysis 22
5.6 Access to Frontage Properties 23

6 CONCLUSIONS 25

APPENDIX A: PROPOSED STRUCTURE PLAN

APPENDIX B: TRAFFIC GENERATION CALCULATIONS

APPENDIX C: SIDRA INTERSECTION ANALYSIS

REPORT FIGURES

Figure 1: Site location 1
Figure 2: Existing road hierarchy 3
Figure 3: Forrest Hwy / Paris Rd peak hour traffic flows (April 2018) 5
Figure 4: Forrest Hwy / Raymond Rd peak hour traffic flows (April 2018) 6
Figure 5: Forrest Hwy / Grand Entrance peak hour traffic flows (April 2018) 6
Figure 6: Forrest Hwy / Raymond Rd peak hour traffic flows (BORR opening – 12 Dec 2024) 7
Figure 7: Restricted Access Vehicles Network 8
Figure 8: Existing bus routes 9
Figure 9: Bunbury Outer Ring Road east of Australind 10
Figure 10: Proposed BORR / Paris Road / Clifton Road interchange (viewed from the north) 11
Figure 11: Proposed road hierarchy 12
Figure 12: Intersection controls 15
Figure 13: Proposed path network 17
Figure 14: 2041 traffic flows 21

REPORT TABLES

Table 1: Existing Traffic Volumes 7
Table 2: Traffic Generation 18
Table 3: External Trip Distribution 19

1 Introduction

This Transport Impact Assessment has been prepared by Transcore on behalf of the Treendale East Land Owners Group with regard to the proposed Treendale East Structure Plan east of Australind in the Shire of Harvey.

The proposed Structure Plan will require rezoning of the subject site from rural to allow residential development plus a neighbourhood activity centre and a primary school.

The subject site is located on the eastern side of the existing Forrest Highway (Australind Bypass), north of Raymond Road and west of the future Bunbury Outer Ring Road alignment, as shown in **Figure 1.** This figure shows zones, reservations and planning control areas (yellow hatched areas) in the Greater Bunbury Region Scheme overlaid on a current aerial photo.

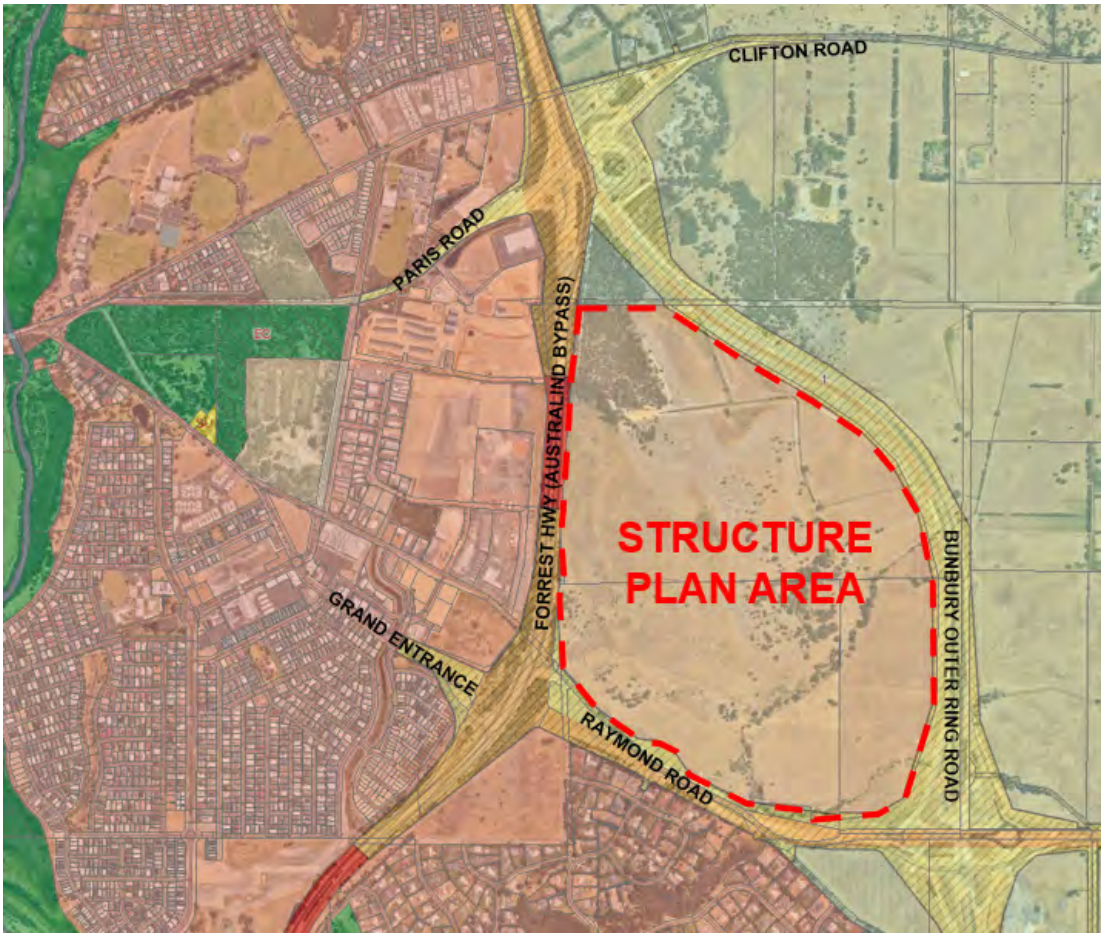


Figure 1: Site location

Accordingly, this report mainly focusses on the proposed road network in and around the proposed Structure Plan area. This revised report addresses modifications requested by the Western Australian Planning Commission.

2 Proposed Structure Plan

The proposed Structure Plan for this site is included at **Appendix A**.

The anticipated land uses that would be accommodated within the proposed Structure Plan area include the following:

- Residential zoned land (approximately 1500 dwellings)
- Strata titled village (approximately 700 dwellings)
- Primary school (standard pattern 540 students)
- Neighbourhood activity centre / shopping centre (approx. 4,000m^2 NLA)
- Commercial (short stay accommodation) (approximately 20 rooms)
- Commercial (micro-brewery) (assume 200 persons capacity)

It should be noted that a range of potential land uses are identified for the neighbourhood activity centre in the planning report for this proposed structure plan. The commercial uses listed above are used in this TIA report as representative of that range of potential uses, purely for the purpose of traffic analysis.

The main access point for the Structure Plan area will be located at the existing Raymond Rd / Ranson Drive intersection, which will be upgraded as a 4-way roundabout on Raymond Road.

The Structure Plan area is also proposed to have a left in / left out intersection on Forrest Highway on the western side of the site. This secondary access point will assist traffic circulation within the Structure Plan area and provide essential emergency access routes in case of bushfire in this area.

3 Existing Situation

3.1 Existing Land Use

Existing land uses within the subject site are rural with existing driveway access from Raymond Road.

3.2 Existing Road Network

The existing road network and its classification in the Main Roads WA functional road hierarchy is illustrated in Figure 2.

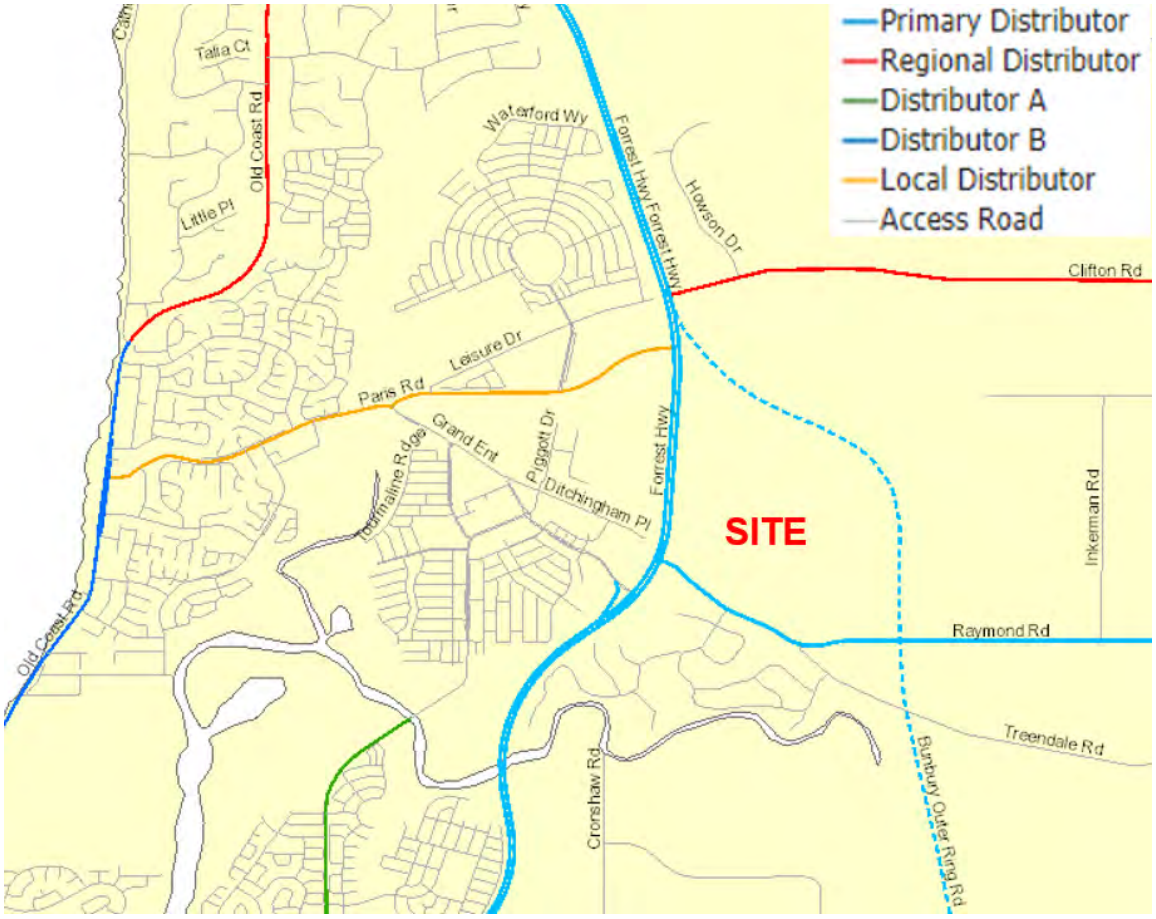


Figure 2: Existing road hierarchy

The **Forrest Highway** alignment west of the structure plan area was initially constructed as the Australind Bypass before construction of the Forrest Highway connection to Kwinana Freeway in the Perth metropolitan region.

Forrest Highway is covered by a Primary Regional Roads Reservation in the Greater Bunbury Region Scheme, as shown in Figure 1. It is classified as a Primary Distributor

in the Main Roads WA functional road hierarchy. It is constructed as a dual carriageway rural highway (two lanes each way) with a wide central median. In the vicinity of the subject site, it has a posted speed limit of 100km/h reducing to 80km/h through key intersections including Raymond Road, Grand Entrance and Paris Road.

Raymond Road is classified as a Primary Distributor in the Main Roads WA functional road hierarchy. In the vicinity of the subject site, it has a posted speed limit of 80km/h.

Raymond Road is constructed as a two-lane rural road adjacent to the subject site with 3.5m traffic lanes and sealed shoulder widths of approximately 1.0 to 1.5m. It has additional road widening to facilitate right turns at three intersections on the southern side (Ranson Drive, Treendale Road and a car park access west of Ranson Drive.

Those three T-intersections on Raymond Road all operate with Give Way sign control on the southern leg of the intersection.

The existing Forrest Hwy / Raymond Rd T-intersection has separate left and right turn approach lanes and Stop sign control on the Raymond Road approach and left and right turn deceleration lanes on Forrest Highway. The right turn movement from Raymond Road to Forrest Highway has an acceleration lane in the Forrest Highway median for this turning traffic to accelerate and merge with northbound traffic on Forrest Highway.

The Forrest Hwy / Grand Entrance T-intersection (approximately 300m south of Raymond Road) operates under traffic signal control. It can be described as a partially signalised intersection as both right turns and the northbound through movement on Forrest Highway are controlled by traffic signals but the southbound through movement on Forrest Highway is not stopped by traffic signals. Instead, the double right turn lanes out from Grand Entrance have an acceleration lane in the Forrest Highway median for this right turn traffic to merge into one lane in the median, then accelerate and merge with southbound traffic on Forrest Highway.

3.3 Existing Traffic Volumes

Existing traffic count information has been sourced from the Main Roads WA online Traffic Map facility.

A 7-day video survey was undertaken for Main Roads WA at a number of intersections along Forrest Highway in April 2018 over the Easter holiday weekend. This included the Forrest Hwy / Paris Rd, Forrest Hwy / Raymond Rd and Forrest Hwy / Grand Entrance intersections. As the Good Friday traffic flows would not represent a typical Friday situation, Main Roads WA have published 4-day average weekday figures from this count. It recorded average weekday traffic flows on each leg of these intersections as follows:

- 17,013vpd (13%HV) Forrest Hwy north of Paris Rd
- 5,662vpd (3%HV) Paris Rd west of Forrest Hwy
- 17,931vpd (12%HV) Forrest Hwy south of Paris Rd

- 4,822vpd (6%HV) Raymond Rd east of Forrest Hwy
- 19,967vpd (10%HV) Forrest Hwy north of Grand Entrance
- 7,794vpd (6%HV) Grand Entrance west of Forrest Hwy
- 19,904vpd (12%HV) Forrest Hwy south of Grand Entrance

The 4-day average weekday AM and PM peak hour traffic flows from those surveys are shown in Figure 3, Figure 4 and Figure 5.

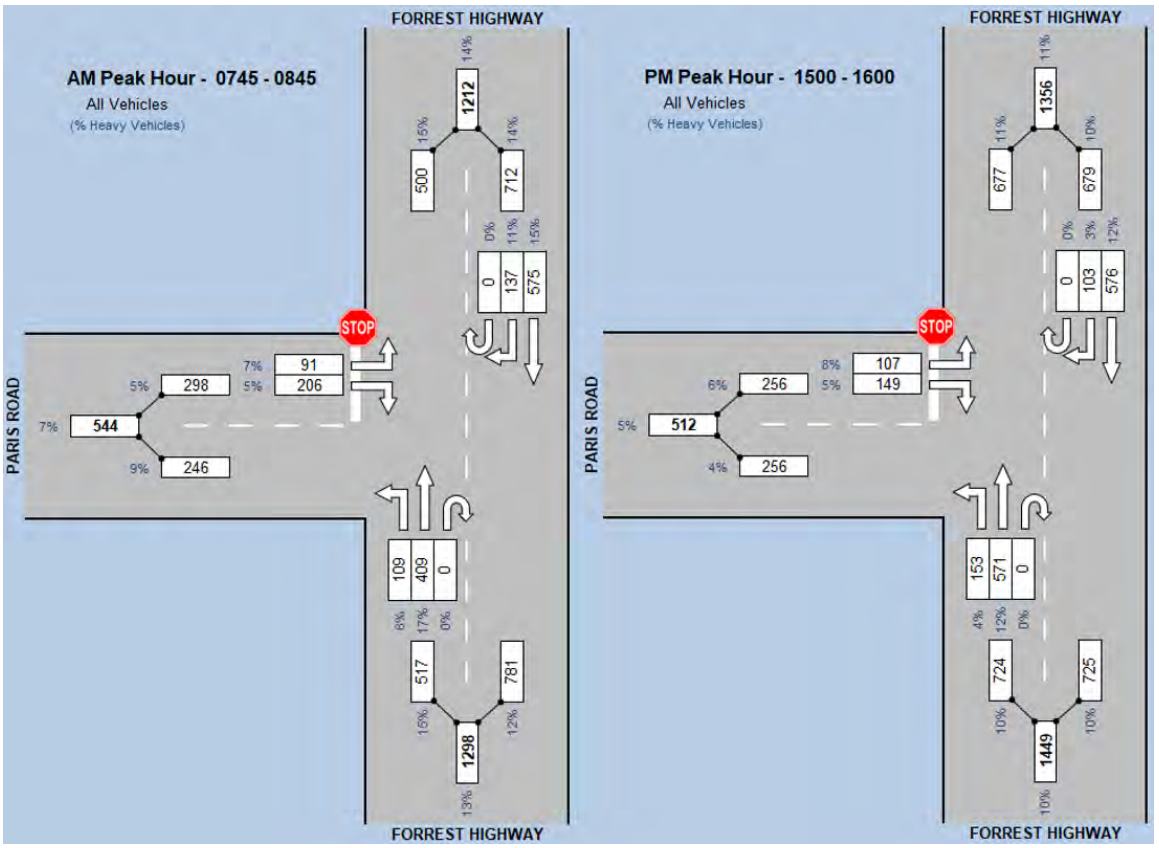


Figure 3: Forrest Hwy / Paris Rd peak hour traffic flows (April 2018)

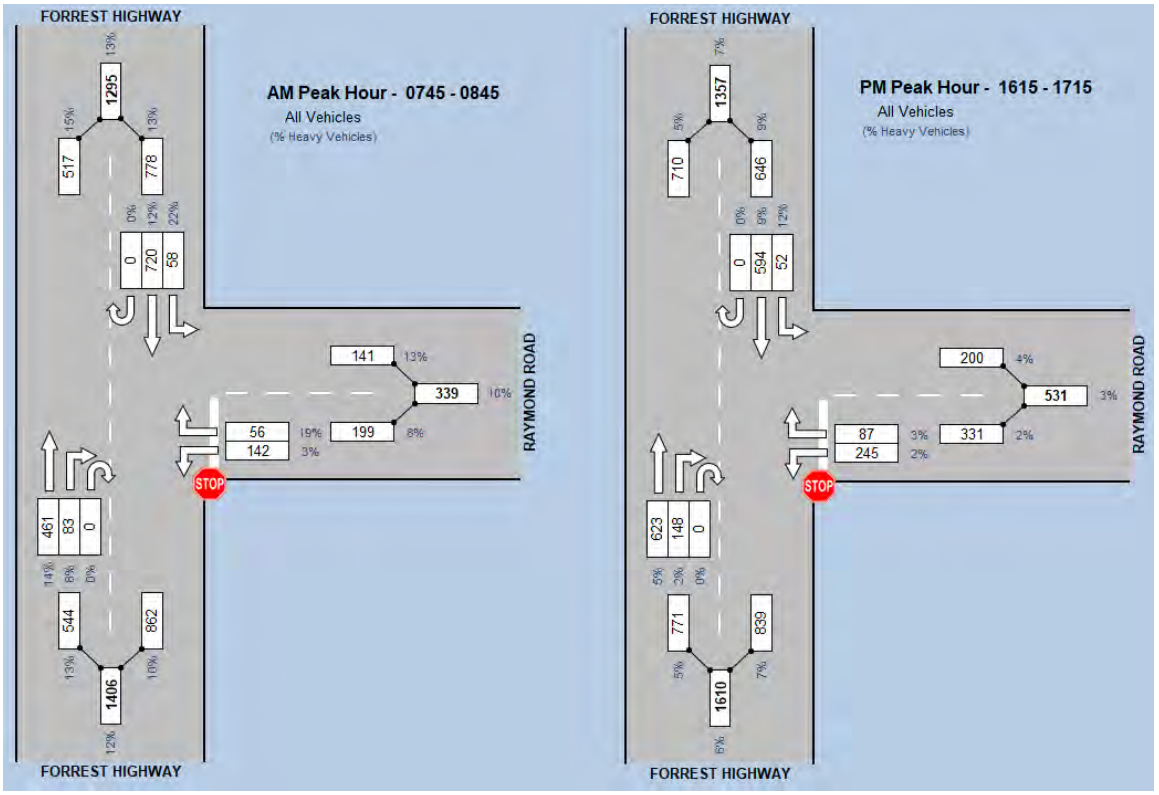


Figure 4: Forrest Hwy / Raymond Rd peak hour traffic flows (April 2018)

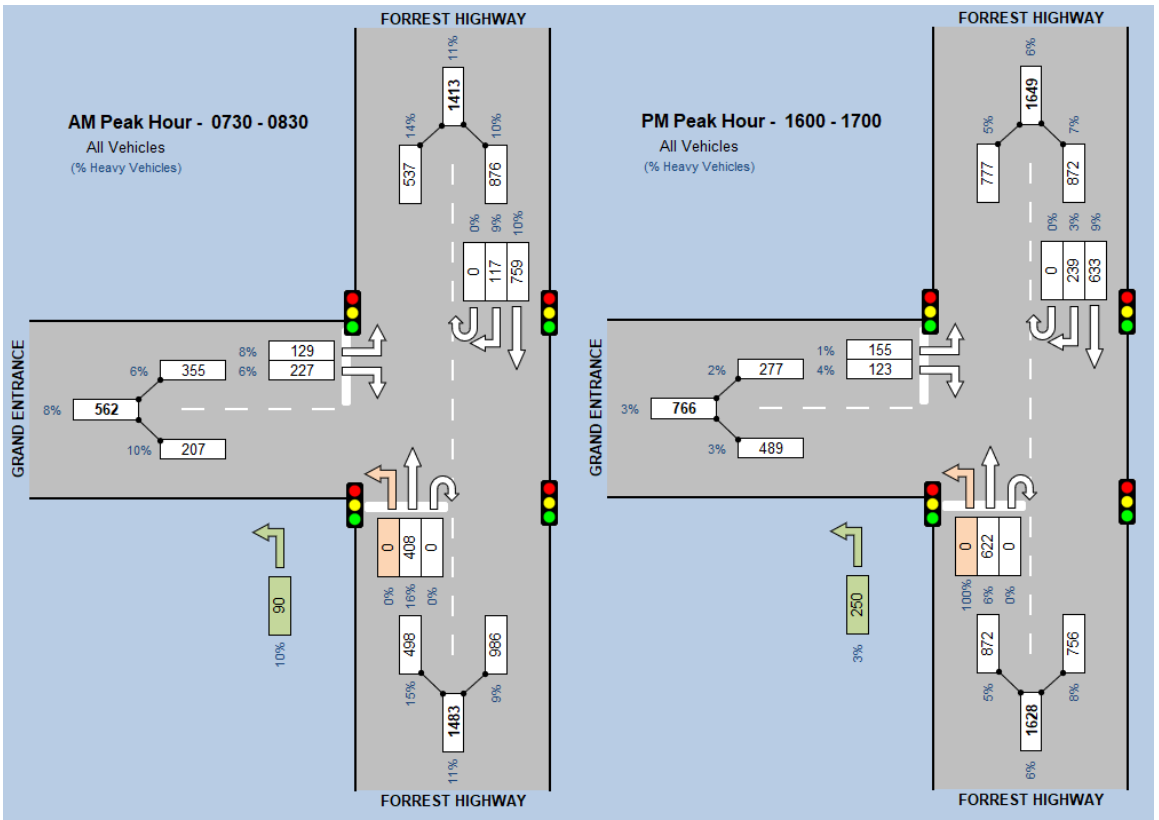


Figure 5: Forrest Hwy / Grand Entrance peak hour traffic flows (April 2018)

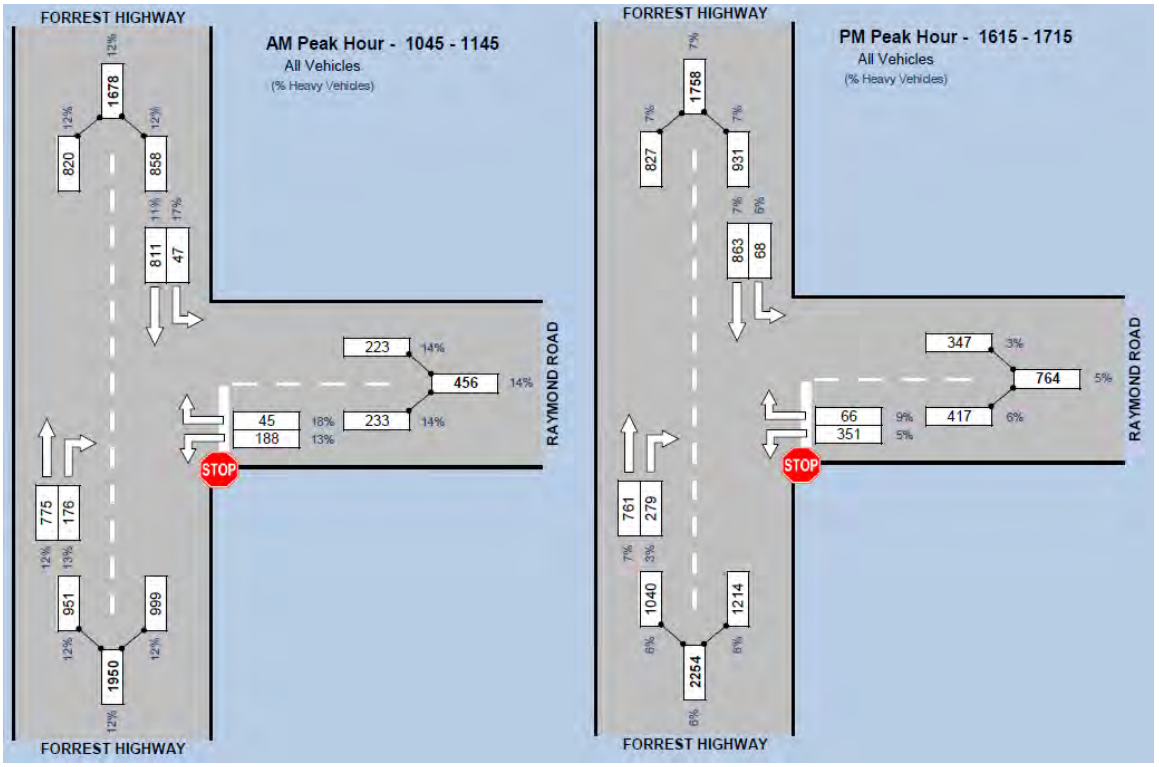


Figure 6: Forrest Hwy / Raymond Rd peak hour traffic flows (BORR opening – 12 Dec 2024)

Other recent traffic counts in this area are summarised in Table 1.

Table 1: Existing Traffic Volumes

Road Name	Location	AWT (HV)	AM Peak	PM Peak	Date
Forrest Hwy	North of Raymond Rd	22,950 (11%)	1,678vph 1045-1145	1,758vph 1615-1715	12 Dec 2024
Forrest Hwy	South of Raymond Rd	27,429 (11%)	1,950vph 1045-1145	2,254vph 1615-1715	12 Dec 2024
Raymond Rd	East of Forrest Hwy	7,583 (10%)	456vph 1045-1145	764vph 1615-1715	12 Dec 2024
Raymond Rd	West of Treendale Rd W	7,416 (15.8%)	557vph 0745-0845	714vph 1630-1730	2024/25

3.4 Heavy Vehicle Routes

Restricted Access Vehicle (RAV) Network routes are designated for access by large heavy vehicle combinations that require special permits for each trip. Main Roads WA manages the RAV Networks and the permits for trucks to use them. Figure 7 shows the roads that are permitted for use by RAV Networks 3, (light blue), 4 (dark blue), and 7 (light purple) vehicles in this area.

RAV Networks 2, 3 and 4 permit access by a number of vehicle combinations up to 27.5m long and RAV Networks 5, 6 and 7 (which includes Forrest Highway and Raymond Road) extend this to vehicles up to 36.5m long including double road trains.

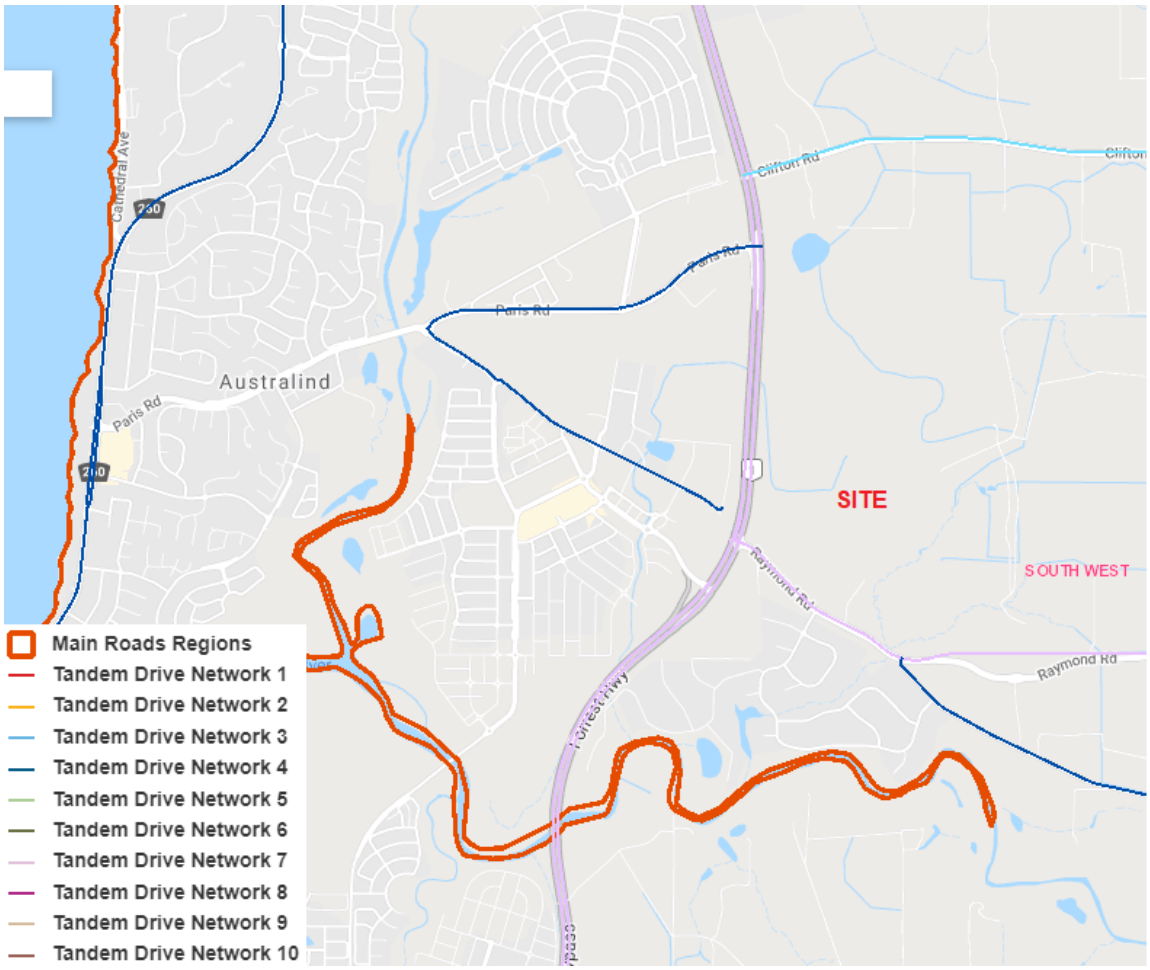


Figure 7: Restricted Access Vehicles Network

3.5 Public Transport

Existing bus route 845 from Bunbury bus station to Australind runs on The Boulevard and Grand Entrance approximately 1.3km west of the subject site, as shown in Figure 8. It generally provides an hourly service during the day on weekdays with higher

frequency during weekday morning and evening peak periods, and two-hourly on Saturdays, Sundays and public holidays.

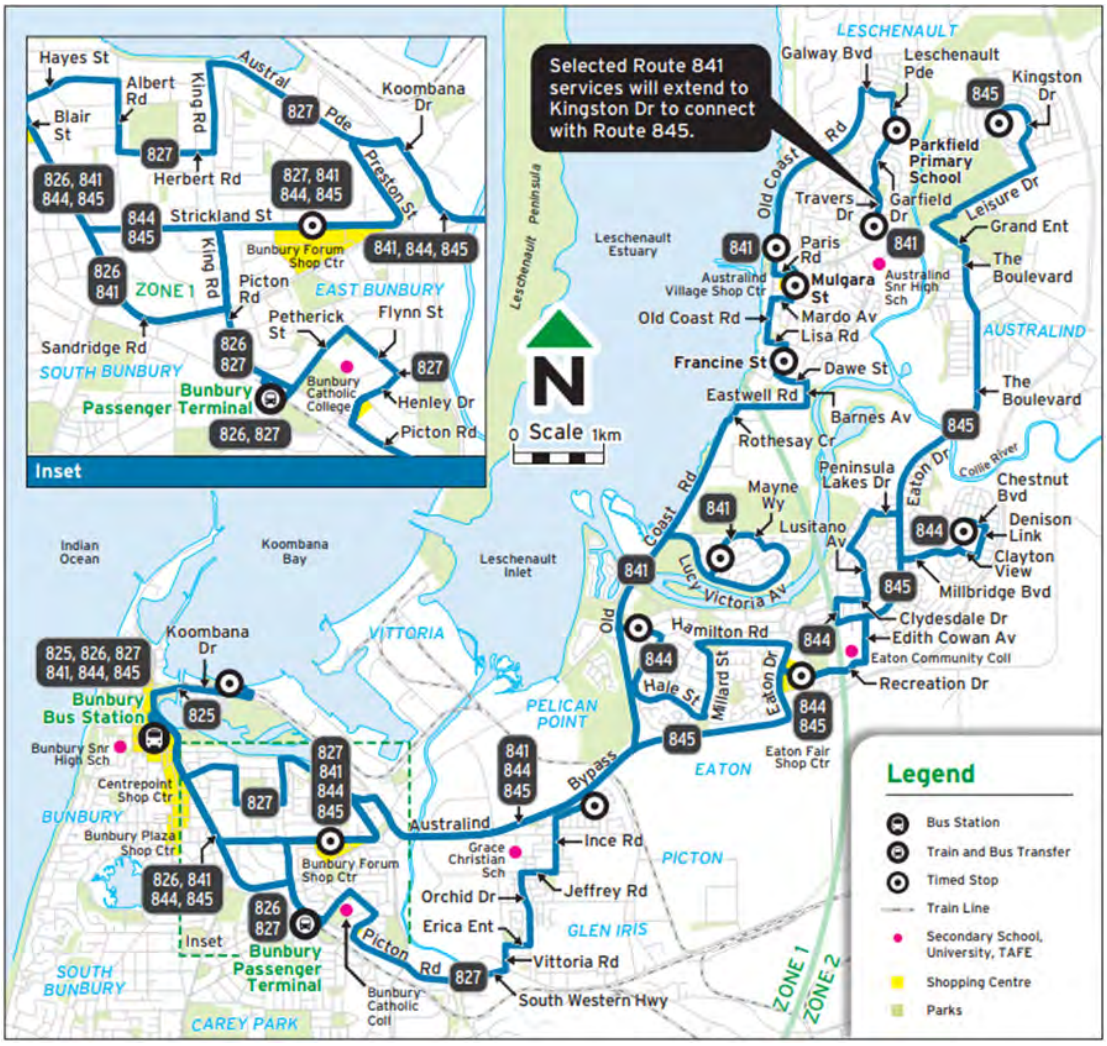


Figure 8: Existing bus routes

3.6 Pedestrian and Cyclist Facilities

The shoulders on Raymond Road include 1.0 to 1.5m wide seal width on both sides and the traffic islands on Raymond Road at the Forrest Highway intersection would assist pedestrians crossing the road. There are no other pedestrian or cyclist facilities on Raymond Road in this vicinity.

The hard shoulders of Forrest Highway can be used by cyclists and the design of the Forrest Hwy / Paris Rd and Forrest Hwy / Grand Entrance intersections includes cycle lanes on Forrest Hwy and Grand Entrance and across the seagull islands in the Forrest Highway median.

3.7 Changes to Surrounding Road Network

The *Greater Bunbury Region Scheme* (GBRS) includes a Primary Regional Roads Reservation over the Australind Bypass (Forrest Highway), as shown in Figure 1. This includes diamond shaped widening for future grade-separated interchanges as part of the long-term planning for the highway.

However, current planning for the Bunbury Outer Ring Road (BORR) represents a significant change from the road network planning shown in the GBRS. The road reserve for the planned BORR is currently protected by the Planning Control Area shown as yellow hatched areas on Figure 1. The planned configuration of the northern section of the BORR (east of Australind) is illustrated in Figure 9 and a detailed image of the planned BORR / Paris Rd / Clifton Rd interchange is shown in Figure 10.



Figure 9: Bunbury Outer Ring Road east of Australind



Figure 10: Proposed BORR / Paris Road / Clifton Road interchange (viewed from the north)

The northern section of the BORR (now named the Wilman Wadandi Highway) was officially opened on 15 December 2024.

4 Proposed Transport Network

4.1 Road Hierarchy

The proposed hierarchy of roads that is actually proposed in the structure plan report is depicted in Figure 11. Refer to the *Treendale East Structure Plan – Landscape and Irrigation Strategy* report by Emerge Associates for the proposed landscaped road cross-sections corresponding to the road widths indicated on Figure 11.

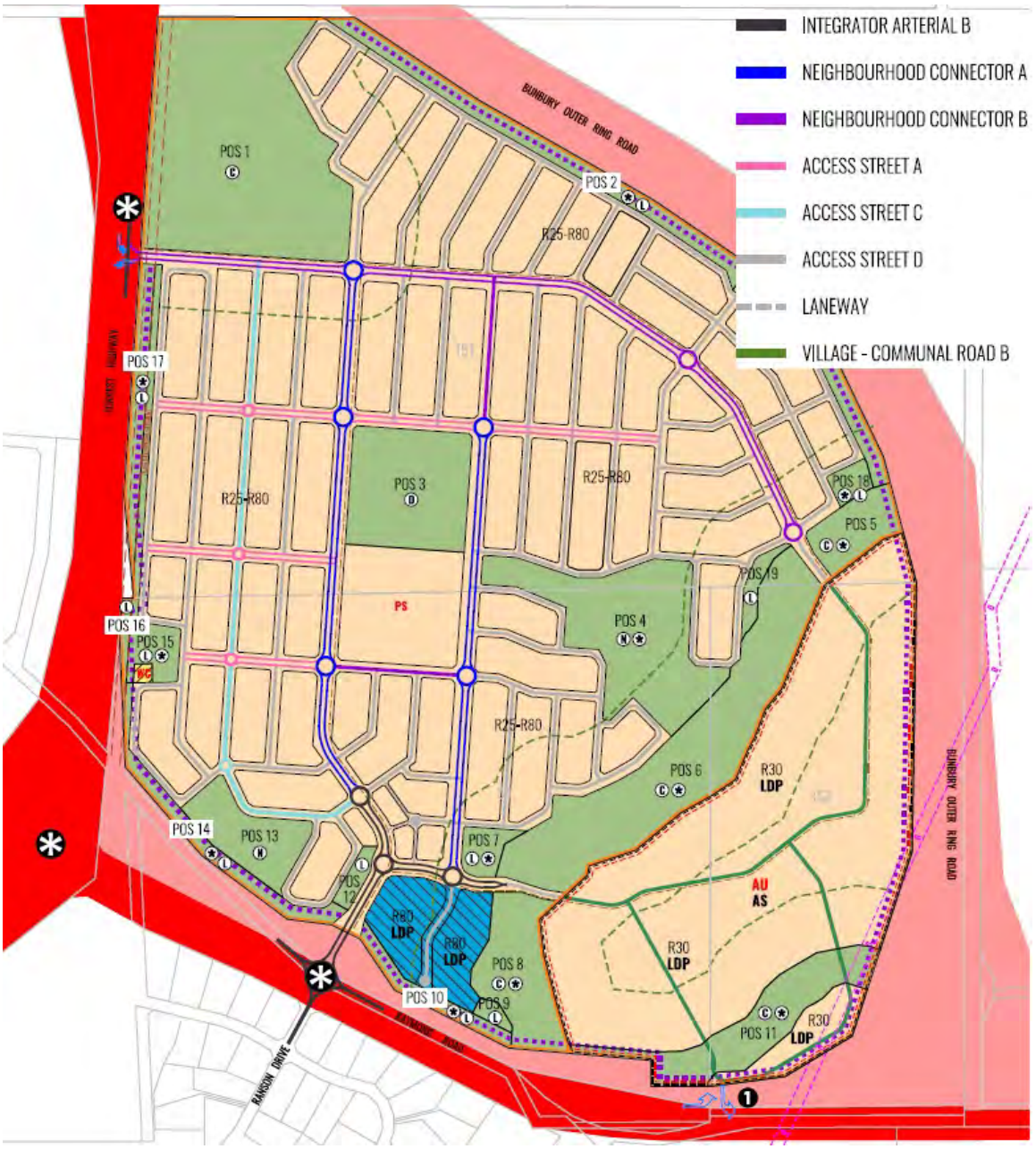


Figure 11: Proposed road hierarchy

The roads have generous road reserve widths to allow for a focus on landscaping and pedestrian/cyclist connectivity. In many instances wider than standard *Liveable Neighbourhoods* road reservations are proposed in this Structure Plan.

Integrator Arterials
Integrator B roads are suitable for traffic flows up to 15,000vpd and can accommodate traffic flows up to 20,000vpd with suitable intersection treatments. Only the main entry road on the western and northern sides of the neighbourhood activity centre would warrant this road standard.

Neighbourhood Connectors
Neighbourhood Connector A roads are suitable for up to 7,000vpd and will form the main north south spine on the western side of the primary school (also part of the road on the eastern side of the primary school) and the secondary entry road eastwards from the existing Forrest Hwy.

The spine road southwards into the neighbourhood activity centre / commercial precinct is tentatively shown as a Neighbourhood Connector A but this will depend upon driveway locations for the neighbourhood activity centre. If all access is from this internal road the traffic flows would warrant Neighbourhood Connector A road standard but if there are activity centre driveways on the northern and/or western roads the traffic flows on this internal road would be significantly reduced and Neighbourhood Connector B standard would be sufficient.

Neighbourhood Connector B roads are suitable for traffic flows up to 3,000vpd but some degree of flexibility with this upper limit should be considered appropriate in localised situations.

Access Streets
Access Street type A includes a central median that is typically designed as a drainage swale in Liveable Neighbourhoods. Use of this type of street is proposed on several east west roads in the structure plan area and will result in a number of minor 4-way intersections deliberately being restricted to left in / left out only. This is discussed further in section 4.2.

Most access streets in this structure plan area will be an Access Street D classification. This standard Access Street is a 6m wide carriageway in a 15m road reserve and is suitable for traffic flows up to 1,000vpd.

A few roads are indicated as Access Street C where they carry more than 1,000vpd or form a longer secondary access route through the structure plan area that doesn't warrant being classified as a neighbourhood connector.

On access streets abutting public open space (POS) the Liveable Neighbourhoods policy allows the verge width to be reduced if desired, as there is minimal requirement to accommodate services in the verge. The proposed structure plan indicates minimum 13m road reserve on access streets abutting POS, although some of these roads abutting bushland are planned as 20m wide road reserves instead to assist with separation required for bushfire management. (Refer to the separate Bushfire Management report for further information on this issue.)

Laneways
A minimum width of 6.0 metres (in accordance with Liveable Neighbourhoods) is proposed for the laneways shown on the structure plan to accommodate two-way movement and rubbish collection. Visitor car parking should be constructed in the road reserve adjacent to proposed lots serviced by laneways.

Village-Communal Roads
The southeast portion of the structure plan area is proposed as a strata-titled village. Details of the roads in this area are not yet known and would be subject to more detailed investigation at subdivision stage.

4.2 Intersection Controls

The proposed intersection controls within and around the LSP area are indicated in Figure 12.

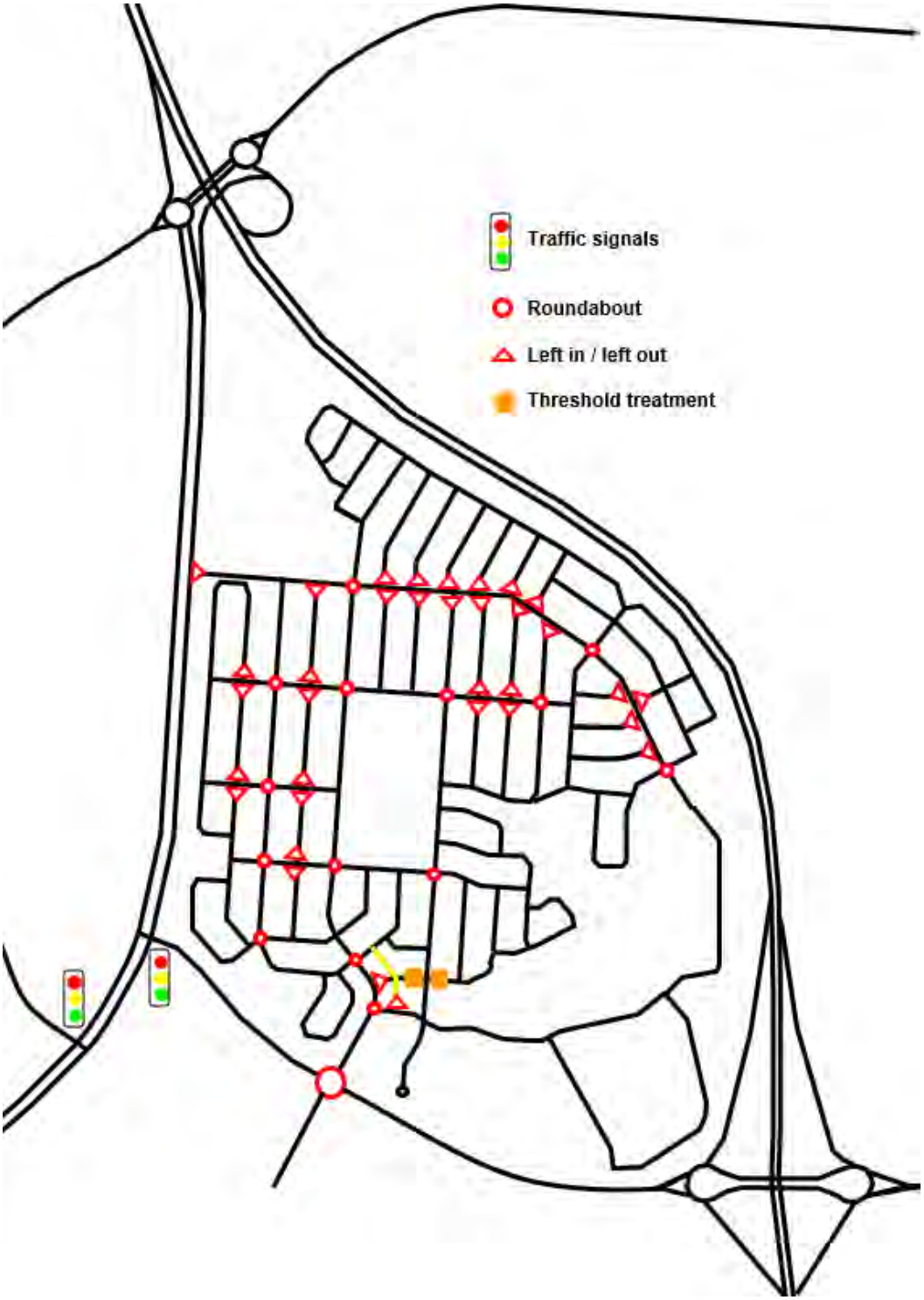


Figure 12: Intersection controls

Grade-separated interchanges have been constructed on the BORR at Raymond Rd southeast of the structure plan area and at Paris Rd / Clifton Rd north of the structure plan area.

Based on traffic analysis in section 5.5 it is anticipated that the existing Forrest Hwy / Raymond Road intersection will ultimately require traffic signals.

The main access point for the Structure Plan area will be located at the existing Raymond Rd / Ranson Drive intersection, which will be upgraded as a 4-way roundabout on Raymond Road.

The Structure Plan area is also proposed to have a left in / left out intersection on Forrest Highway on the western side of the site.

Within the structure plan area, the internal road network will create a significant number of 4-way intersections. Key intersections are proposed to be constructed as 4-way roundabouts, which will assist with speed management as well as facilitating all turn movements at these intersections.

Many of the other minor 4-way intersections will be restricted to left in / left out on the side road by a continuous median on the major roads, which are planned as Neighbourhood Connector A or Access Street A standard for that purpose. This will eliminate right turns and crossing movements from the side roads and will have a significant benefit in terms of speed management along those long, minor access streets.

One 4-way intersection is identified for threshold treatments on the side roads instead, as it is not considered to warrant a roundabout (as one side road is only a short-cul-de-sac) nor restriction to left in / left out only.

4.3 Public Transport

Existing bus services in this area are described in section 3.5 of this report.

The internal Neighbourhood Connector road loop and main entry road from Raymond Road will provide a suitable road alignment for a future bus route within the structure plan area when required in future, for example for a feeder bus service from the Treendale district centre via Raymond Road and Grand Entrance.

4.4 Pedestrian and Cyclist Facilities

Figure 13 outlines the proposed pedestrian and cyclist path network for the structure plan area.

Paths will be provided on at least one side of all roads. There would be paths on both sides of the Integrator B roads and all Neighbourhood Connector roads.

Laneway lots would be required to have footpath access to the visitor parking bays provided for them in the road reserve.

On-road cycling facilities are included on Integrator B and Neighbourhood Connector A roads (refer), which includes the main entry road, the north south spine road west of the primary school and the east west spine road connecting to Forrest Highway on the western side of the structure plan area.



Figure 13: Proposed path network

5 Analysis of the Transport Network

5.1 Assessment Period

The traffic assessment undertaken for the subject site is based on full development of the structure plan area consistent with a 2041 timeframe.

5.2 Traffic Generation and Distribution

Traffic generation rates used in this assessment have been derived from various sources including the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines* (2016), the NSW *Guide to Transport Impact Assessment* (2024) and the ITE Trip Generation Manual (11th edition, 2021).

Total trip generation calculated for the indicative land use components assumed in the structure plan area is summarised in Table 2. Further details of the traffic generation calculations and data sources are provided in Appendix B. As noted in Section 2, the commercial land uses in the neighbourhood activity centre are representative of a wider potential range of uses listed in the planning report. (Specific land uses and quantities need to be nominated for the purpose of traffic calculations.)

Table 2: Traffic Generation

Land Use	Size	Units	Week day (vpd)	AM peak hour (vph)	PM peak hour (vph)
Residential	2200	dwellings	17600	1760	1760
Shopping centre	4000	m^2 NLA	4107	205	411
Microbrewery	200	seats	874	0	78
Short-stay accommodation	20	rooms	67	7	8
Primary School	540	students	1080	540	540
Total			**23728**	**2512**	**2797**

The catchment areas of the primary school and shopping centre, in particular, would primarily just be within this structure plan area, and a smaller proportion of the trips generated by the other commercial land uses would also come from this local catchment area and those trips would be to and from dwellings in this structure plan

area. Overall, approximately one third of the total traffic generation in Table 2 would be the two ends of internal trips (home-school-home, home-shops-home, etc.) and it is anticipated the total traffic generation on the external road network would be approximately 15,000vpd.

Future trip distribution used for this assessment has utilised as a starting point the external trip distribution modelled for the Lot 561 Paris Rd, Australind Local Structure Plan Transport Impact Assessment previously prepared by Transcore, which was based on analysis of existing traffic patterns from existing traffic count information and relative size of other urban areas in each direction. The trip distribution has been adjusted for this Treendale East Structure Plan to take into account its location relative to other urban areas that would become destinations for trips generated by the new residential development in this structure plan area.

The overall trip distribution for new trips to/from the structure plan area assumed for this transport assessment is summarised in Table 3.

Table 3: External Trip Distribution

Approach route	Percentage
Forrest Highway north	9%
Paris Road west	9%
Grand Entrance west	50%
Forrest Highway south	20%
Ranson Drive south	1%
BORR south	9%
Raymond Road east	1%
Clifton Road east	1%

5.3 Traffic Flow Forecasts

For this Transport Impact Assessment, information provided by Main Roads WA included daily (weekday) traffic projections for 2021 and 2041 from the BORR project. Appropriate manual adjustments have been made to those 2041 base traffic

flows by Transcore[1] to calibrate the modelled traffic flows against existing traffic patterns.

Daily traffic flows in 2041 with full development of the proposed structure plan area are shown in Figure 14. Traffic flows generated by the structure plan area are shown on key roads within the structure plan area and on the surrounding road network. Traffic volumes shown within the structure plan area are total traffic volumes as there will not be any significant amount of external through traffic passing through the structure plan area. Total daily traffic flows in 2041 on the external road network are indicated in brackets on this figure.

[1] Refer Transcore email to MRWA dated 28 October 2021 (RE: General Inquiry – Traffic Volume Modelling), which set out proposed adjustments to modelled future traffic flows.

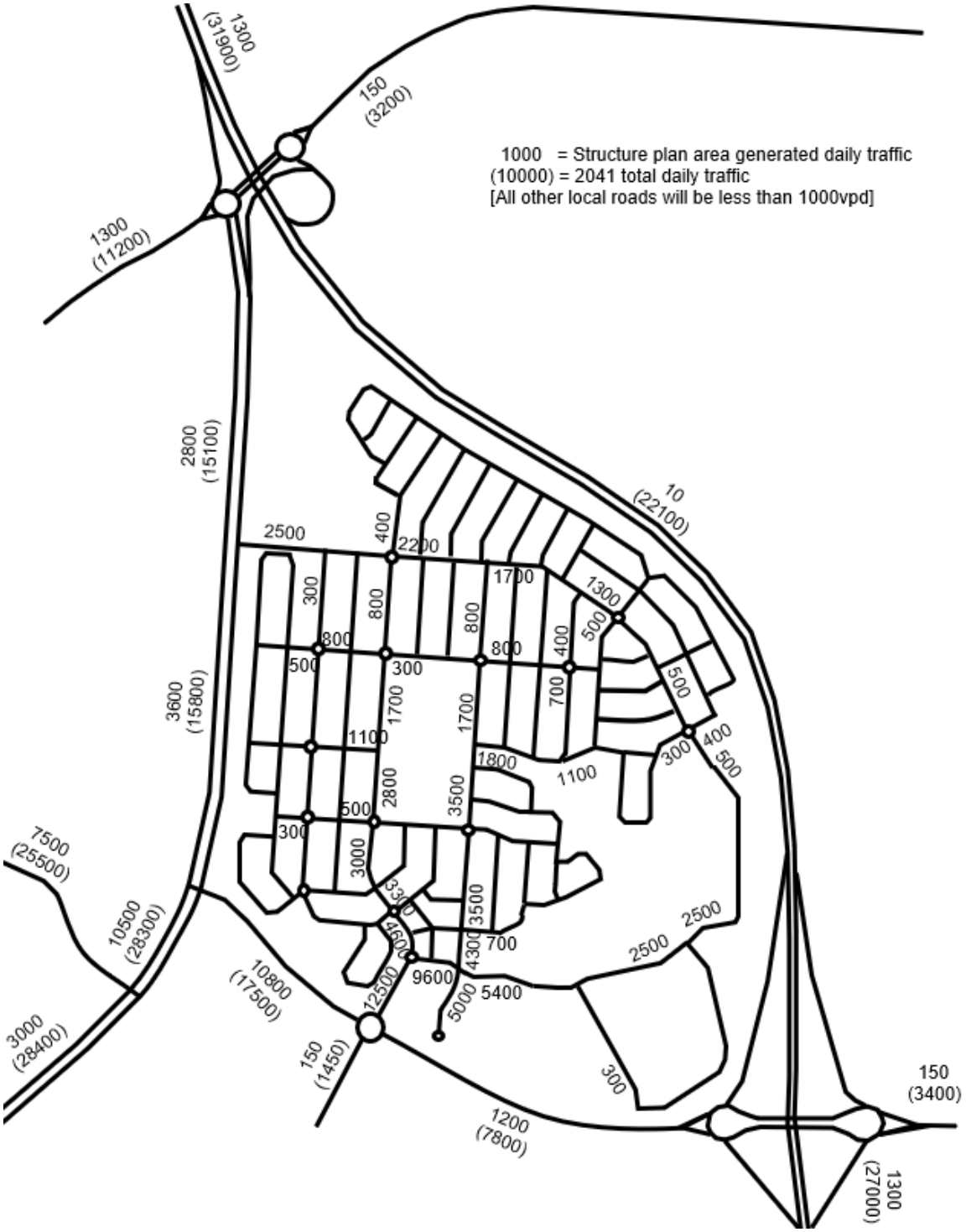


Figure 14: 2041 traffic flows

5.4 Roads and Intersections

The anticipated future road network in and around the subject site has been detailed in section 4 of this transport impact assessment, including discussion of the proposed road hierarchy in section 4.1 and intersection controls in section 4.2.

The key intersections for the proposed structure plan are the three intersections providing access on Raymond Road and on Forrest Highway, and the Forrest Hwy / Raymond Rd intersection itself. As noted in section 4.2 and in Figure 12, the anticipated intersection controls for those four intersections for 2041 full development traffic flows are as follows:

- Forrest Hwy / Raymond Rd intersection will ultimately require traffic signals;
- Raymond Rd / Ranson Dr / main entry road 4-way roundabout; and
- Forrest Rd / western entry road left in / left out T-intersection.

5.5 Intersection Analysis

Intersection capacity analysis has been undertaken for the four key intersections on Raymond Road and Forrest Highway providing access to the proposed structure plan area.

- Forrest Hwy / Raymond Rd signalised T-intersection;
- Raymond Rd / Ranson Dr / main entry road 4-way roundabout; and
- Forrest Rd / western entry road left in / left out T-intersection.

Analysis has been undertaken for 2041 AM and PM peak hour flows that correspond to the 2041 daily traffic flows shown in Figure 14. Structure plan area generated traffic flows for the AM and PM peak hours have been calculated using the peak hour traffic generation rates and peak hour directional splits documented in Appendix B.

External traffic flows have been calculated from 2041 daily traffic flows by applying existing AM and PM peak hour proportion of daily flow and directional splits from the existing traffic counts documented in section 3.3. All of the existing traffic counts available show slightly different timing of AM and PM peak hours, so the peak hours at the busiest intersection (Forrest Hwy / Grand Entrance) from the detailed 2018 intersection traffic counts were adopted for this analysis. These AM and PM peak hours are nominally 0730-0830 and 1600-1700, respectively.

Based on current Main Roads WA requirements this analysis includes division of heavy vehicles into four separate types of vehicles (Austroads classes 2-5, 6-9, 10 and 11) so that the performance characteristics of the significant numbers of 19m semi-trailers, 27.5m B-doubles and 36.5m double road trains on the regional road network are specifically taken into consideration. Existing percentages of heavy vehicles for each of these categories have been obtained from existing MRWA traffic counts and applied to the future through traffic flows modelled on Forrest Highway and Raymond Road. This may tend to overestimate future heavy vehicle percentages on these roads as the BORR would be expected to take some of the existing heavy vehicle traffic off these sections of Forrest Highway and Raymond Road, but this approach has been adopted (in the absence of detailed heavy vehicle traffic projections) to ensure a robust analysis is undertaken.

Diagrams showing the resultant 2041 AM and PM peak hour traffic flows used as input for the traffic analysis at the four intersections are included in Appendix C for

each of these intersections. Note that the intersection analysis uses a default peak hour factor of 0.95 (in accordance with MRWA guidelines) which results in the traffic volumes that are actually analysed being approximately 5% higher than these input peak hour traffic volumes, which further ensures the robustness of the intersection analysis.

Capacity analysis of these intersections has been undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix C and satisfactory intersection performance is shown for each of the intersections shown in Appendix C.

Note that it the modelled future layout of the Forrest Hwy / Raymond Rd intersection assumes that only the two right turn movements and the southbound through movement on Forrest Highway (that is crossed by those right turns) would be controlled by traffic signals, similar to the existing situation at the Forrest Hwy / Grand Entrance intersection. The existing right turn acceleration lane and merge in the Forrest Highway median would remain for northbound movements. The SIDRA analysis indicates the right turn movement from Forrest Highway to Raymond Road should be upgraded to two right turn lanes for the modelled 2041 peak hour traffic flows.

The SIDRA analysis of the Raymond Rd / Ranson Dr / main entry road 4-way roundabout indicates that a single lane roundabout would have sufficient capacity for the modelled 2041 peak hour traffic flows.

5.6 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that *"Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5,000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access."*

There will not be any direct driveway access from any development within the structure plan area onto the BORR, Forrest Highway or Raymond Road.

The only roads within the structure plan area anticipated to have traffic volumes greater than 5,000vpd are the section of the main entry road abutting the western side of the neighbourhood activity centre and the east west road abutting the northern side of the neighbourhood activity centre and commercial precinct. Driveway access to the neighbourhood activity centre and commercial precinct would connect to car parks where vehicles are able to turn around to enter the road travelling forward, so driveway access for these land uses is consistent with that WAPC policy requirement.

A short section of residential development frontage along the northern side of that east west road (opposite the neighbourhood activity centre) would need to be designed in accordance with that WAPC policy requirement. Part of this area is already envisaged to be accessed via rear laneways, so it would only require a minor adjustment to ensure appropriate access solutions are incorporated along the rest of this road frontage.

All of the other roads in the structure plan area are expected to carry less than 5,000vpd, so no other restrictions on vehicular access are required.

6 Conclusions

This transport impact assessment relates to the proposed Treendale East Structure Plan east of Australind in the Shire of Harvey. The site is located on the eastern side of the existing Forrest Highway (Australind Bypass), north of Raymond Road and bounded to the east by the future Bunbury Outer Ring Road, which is currently under construction.

The proposed Structure Plan will require rezoning of the subject site from rural to allow residential development (approximately 1500 residential lots and a strata-titled village of approximately 700 dwellings) plus a neighbourhood activity centre (shopping centre and commercial development) and a primary school.

Total traffic generation of the proposed land uses within the structure plan would be approximately 23,700vpd but about one third of those would be the two ends of internal trips (home-school-home, home-shops-home, etc.), so it is anticipated the total traffic generation on the external road network would be approximately 15,000vpd.

The main access point for the Structure Plan area will be located at the existing Raymond Rd / Ranson Drive intersection, which will be upgraded as a 4-way roundabout on Raymond Road.

The Structure Plan area is also proposed to have a left in / left out intersection on Forrest Highway on the western side of the site. This secondary access point will assist traffic circulation within the Structure Plan area and provide essential emergency access routes in case of bushfire in this area.

Intersection capacity analysis has been undertaken for the two intersections providing access on Raymond Road and on Forrest Highway, and the Forrest Hwy / Raymond Rd intersection itself, for future traffic flows in 2041 with full development of this structure plan area and completion of the Bunbury Outer Ring Road.

The intersection analysis indicates that the Forrest Hwy / Raymond Rd intersection will ultimately require traffic signals and double right turn lanes for the right turn from Forrest Highway into Raymond Road to accommodate the modelled future traffic flows.

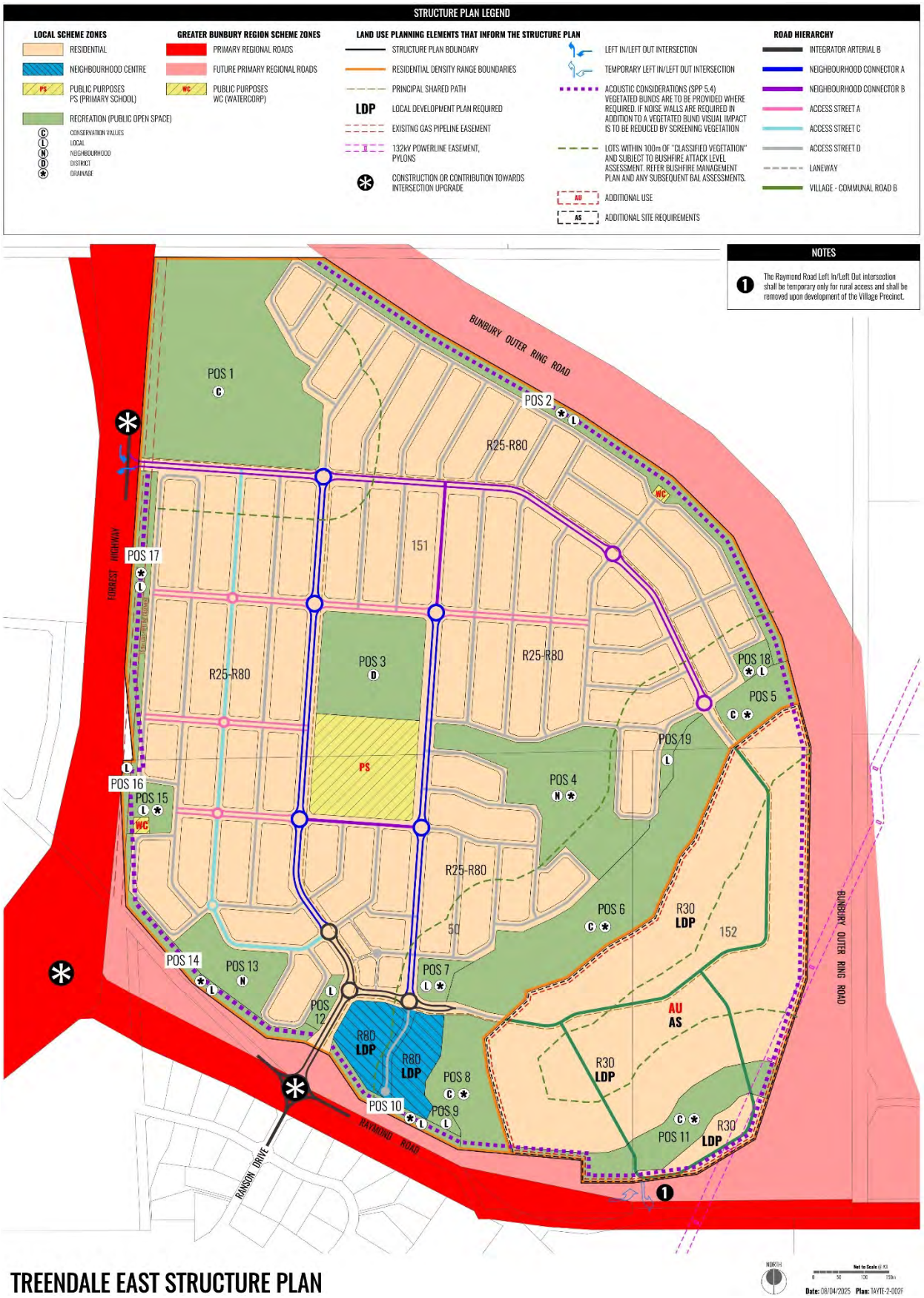
With this intersection upgrade the analysis undertaken confirms that these proposed access arrangements would all operate satisfactorily with those future, full development, traffic flows.

Accordingly, it is concluded that the proposed access arrangements are appropriate to service the proposed urban zoning and development of the proposed Treendale East Structure Plan.

Appendix A

PROPOSED STRUCTURE PLAN

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STRUCTURE PLAN LEGEND
LOCAL SCHEME ZONES
RESIDENTIAL
NEIGHBOURHOOD CENTRE
PS
PUBLIC PURPOSES
PS (PRIMARY SCHOOL)
RECREATION (PUBLIC OPEN SPACE)
C CONSERVATION VALUES
L LOCAL
N NEIGHBOURHOOD
D DISTRICT
DRAINAGE
GREATER BUNBURY REGION SCHEME ZONES
PRIMARY REGIONAL ROADS
FUTURE PRIMARY REGIONAL ROADS
WC
PUBLIC PURPOSES
WC (WATERCORP)
LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN
STRUCTURE PLAN BOUNDARY
RESIDENTIAL DENSITY RANGE BOUNDARIES
PRINCIPAL SHARED PATH
LDP
LOCAL DEVELOPMENT PLAN REQUIRED
EXISITNG GAS PIPELINE EASEMENT
132kV POWERLINE EASEMENT, PYLONS
CONSTRUCTION OR CONTRIBUTION TOWARDS INTERSECTION UPGRADE
LEFT IN/LEFT OUT INTERSECTION
TEMPORARY LEFT IN/LEFT OUT INTERSECTION
ACOUSTIC CONSIDERATIONS (SPP 5.4) VEGETATED BUNDS ARE TO BE PROVIDED WHERE REQUIRED. IF NOISE WALLS ARE REQUIRED IN ADDITION TO A VEGETATED BUND VISUAL IMPACT IS TO BE REDUCED BY SCREENING VEGETATION
LOTS WITHIN 100m OF "CLASSIFIED VEGETATION" AND SUBJECT TO BUSHFIRE ATTACK LEVEL ASSESSMENT. REFER BUSHFIRE MANAGEMENT PLAN AND ANY SUBSEQUENT BAL ASSESSMENTS.
AU
ADDITIONAL USE
AS
ADDITIONAL SITE REQUIREMENTS
ROAD HIERARCHY
INTEGRATOR ARTERIAL B
NEIGHBOURHOOD CONNECTOR A
NEIGHBOURHOOD CONNECTOR B
ACCESS STREET A
ACCESS STREET C
ACCESS STREET D
LANEWAY
VILLAGE - COMMUNAL ROAD B
NOTES
1 The Raymond Road Left In/Left Out intersection shall be temporary only for rural access and shall be removed upon development of the Village Precinct.
BUNBURY OUTER RING ROAD
FORREST HIGHWAY
POS 1
POS 2
POS 3
POS 4
POS 5
POS 6
POS 7
POS 8
POS 9
POS 10
POS 11
POS 12
POS 13
POS 14
POS 15
POS 16
POS 17
POS 18
POS 19
R25-R80
R30
R80
LDP
PS
WC
AU
AS
151
152
50
RAYMOND ROAD
RANSON DRIVE
TREENDALE EAST STRUCTURE PLAN
NORTH
Date: 08/04/2025 Plan: TAYTE-2-002F

Appendix B

TRAFFIC GENERATION CALCULATIONS

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Table B1: Traffic Generation Calculations and Sources of Information

Land Use	Size	Units	Trip rates			Trip rate Units	Trip rate Source	Directional split		VPD	Vehicles per hour					
			Weekday	AM peak	PM peak			AM in %	PM in %	Weekday	AM in	AM out	AM total	PM in	PM out	PM total
Residential	2200	dwellings	8	0.8	0.8	vph/du	WAPC TIA Guidelines	25%	62.5%	17600	440	1320	1760	1100	660	1760
Shopping centre	4000	m^2 NLA	0.695A+1327	5%xVPD	10%xVPD	vph/100m^2	NSW Guide to TIA & ITE	62%	48%	4107	127	78	205	197	214	411
Microbrewery	200	seats	4.37	0	0.39	vph/seat	ITE 11th Ed, Land Use 932	50%	57%	874	0	0	0	44	34	78
Motel	20	rooms	3.35	0.35	0.38	vph/room	ITE 11th Ed, Land Use 320	37%	54%	67	3	4	7	4	4	8
Primary school	540	students	2.0	1.0	1.0	vph/student	WAPC TIA Guidelines	54%	46%	1080	292	248	540	248	292	540
Total										23728	862	1650	2512	1593	1204	2797

Note: Microbrewery trip rates are based on ITE High Turnover (Sit-Down) Restaurant, but opening hours assumed 10am to 10pm 7 days per week.
Note: ITE 11th Ed = Trip Generation Manual, 11th Edition (Institute of Transportation Engineers, 2021)
Note: NSW Guide to Transport Impact Assessment (2024) replaces previous NSW guides.

Appendix C

SIDRA INTERSECTION ANALYSIS

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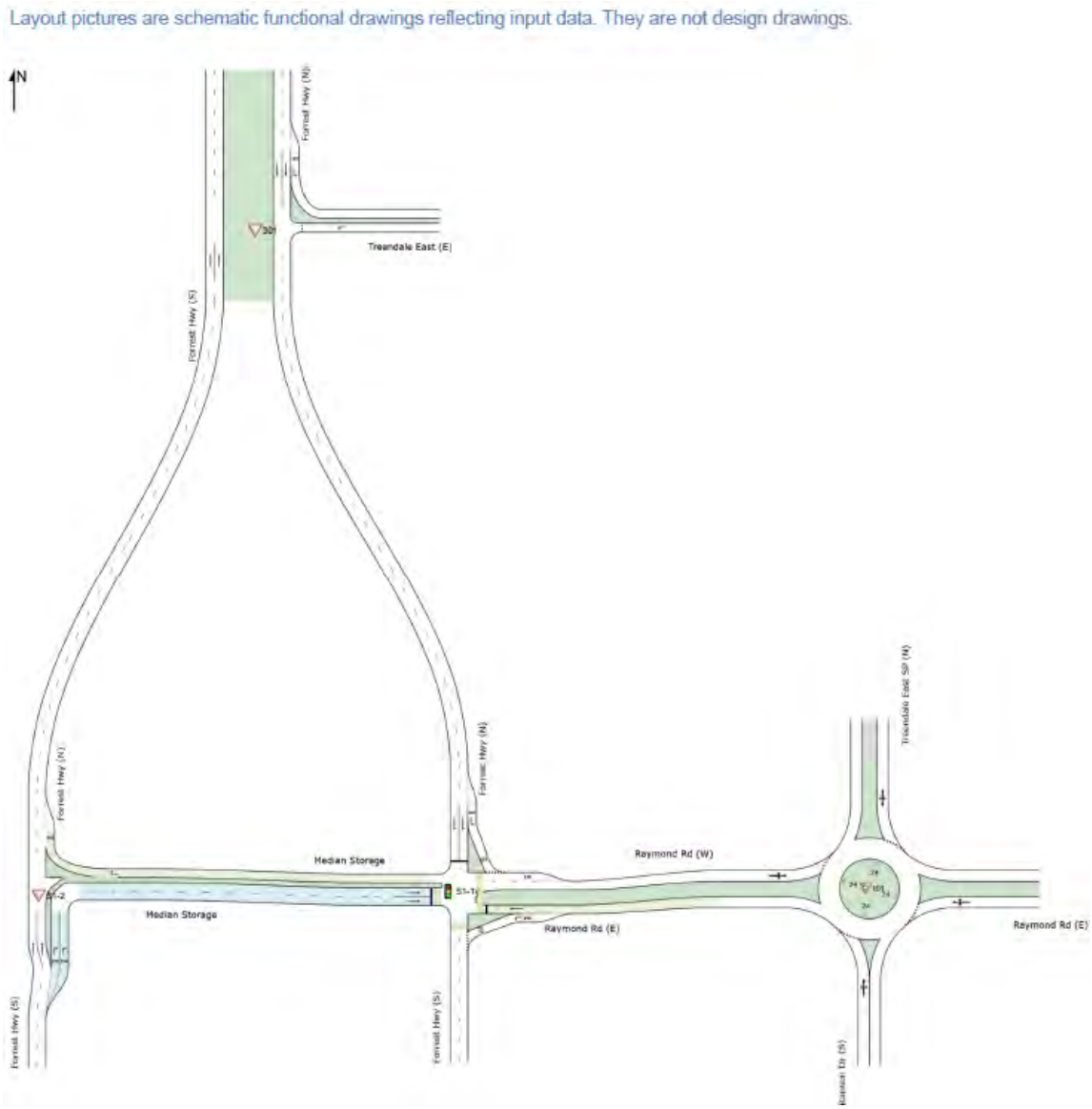


Figure C1. Future Forrest Hwy and Raymond Rd access arrangements analysed in SIDRA Network

Table C1a. SIDRA results – Forrest Hwy / Raymond Rd partially signalised T-intersection – 2041 weekday AM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Raymond Rd (E)															
1	L2	All MCs	715	9.2	715	9.2	0.878	29.6	LOS C	24.0	201.3	0.97	0.98	1.20	42.0
2	T1	All MCs	227	5.5	227	5.5	*0.863	40.1	LOS D	9.0	71.6	1.00	1.00	1.41	31.0
Approach			942	8.3	942	8.3	0.878	32.1	LOS C	24.0	201.3	0.97	0.98	1.25	39.6
North: Forrest Hwy (N)															
3	L2	All MCs	58	14.6	58	14.6	0.058	12.0	LOS B	0.6	5.2	0.42	0.68	0.42	63.0
4	T1	All MCs	863	12.5	863	12.5	*0.818	29.7	LOS C	15.7	139.1	0.98	0.96	1.18	51.4
Approach			921	12.6	921	12.6	0.818	28.6	LOS C	15.7	139.1	0.95	0.94	1.13	51.8
West: Median Storage															
5	T1	All MCs	507	12.4	507	12.4	*0.835	33.8	LOS C	3.7	32.6	0.99	0.92	1.19	3.5
Approach			507	12.4	507	12.4	0.835	33.8	LOS C	3.7	32.6	0.99	0.92	1.19	3.5
All Vehicles			2371	10.9	2371	10.9	0.878	31.1	LOS C	24.0	201.3	0.97	0.95	1.19	41.3

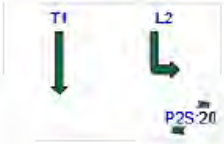
Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Forrest Hwy (S)															
2	T1	All MCs	415	16.0	415	16.0	0.129	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	All MCs	507	12.4	507	12.4	0.159	7.0	LOS A	7.2	63.1	0.00	0.65	0.00	53.6
Approach			922	14.0	922	14.0	0.159	3.9	NA	7.2	63.1	0.00	0.36	0.00	63.0
East: Median Storage															
1	R2	All MCs	227	5.5	227	5.5	0.130	3.2	LOS A	0.0	0.0	0.00	0.53	0.00	29.4
Approach			227	5.5	227	5.5	0.130	3.2	NA	0.0	0.0	0.00	0.53	0.00	29.4
All Vehicles			1149	12.3	1149	12.3	0.159	3.7	NA	7.2	63.1	0.00	0.39	0.00	61.1

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Forrest Hwy (S)											
P4	Full	21	29.3	LOS C	0.0	0.0	0.92	0.92	44.7	20.0	0.45
East: Raymond Rd (E)											
P1	Full	21	29.3	LOS C	0.0	0.0	0.92	0.92	44.7	20.0	0.45
West: Median Storage											
P32	Stage 2	21	8.3	LOS A	0.0	0.0	0.49	0.49	23.6	20.0	0.85
All Pedestrians		63	22.3	LOS C	0.0	0.0	0.77	0.77	37.7	20.0	0.53

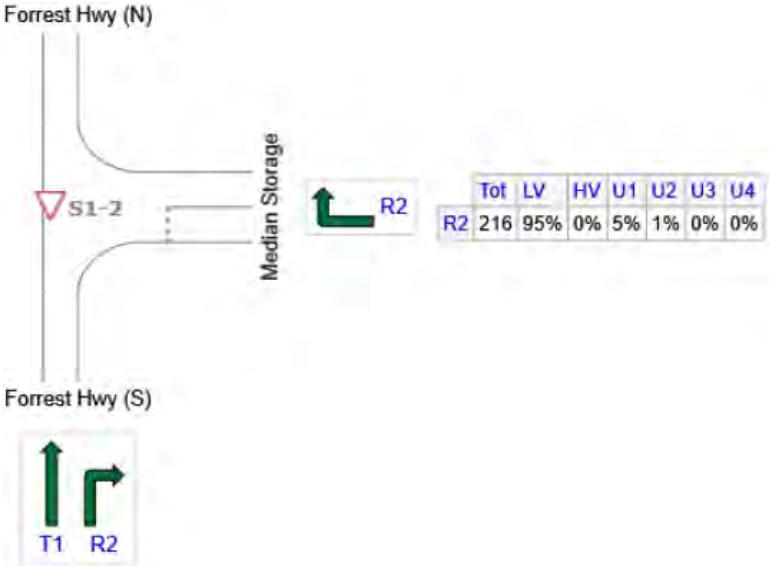
	T1	L2
Tot	820	55
LV	88%	85%
HV	0%	0%
U1	9%	11%
U2	2%	1%
U3	0%	0%
U4	1%	2%





U4	U3	U2	U1	HV	LV	Tot	
1%	0%	1%	10%	0%	88%	482	T1

	Tot	LV	HV	U1	U2	U3	U4
T1	218	95%	0%	5%	1%	0%	0%
L2	579	91%	0%	7%	1%	0%	1%



	Tot	LV	HV	U1	U2	U3	U4
R2	216	95%	0%	5%	1%	0%	0%

	T1	R2
Tot	394	482
LV	84%	88%
HV	0%	0%
U1	12%	10%
U2	2%	1%
U3	1%	0%
U4	2%	1%

Table C1b. SIDRA results – Forrest Hwy / Raymond Rd partially signalised T-intersection – 2041 weekday PM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Raymond Rd (E)															
1	L2	All MCs	647	13.1	647	13.1	0.690	13.6	LOS B	12.2	108.8	0.68	0.81	0.68	52.9
2	T1	All MCs	151	7.7	151	7.7	*0.747	41.5	LOS D	6.3	51.7	1.00	0.89	1.20	30.3
Approach			798	12.1	798	12.1	0.747	18.9	LOS B	12.2	108.8	0.74	0.82	0.78	48.2
North: Forrest Hwy (N)															
3	L2	All MCs	78	8.4	78	8.4	0.091	16.5	LOS B	1.2	9.9	0.51	0.70	0.51	59.4
4	T1	All MCs	569	13.4	569	13.4	*0.722	32.9	LOS C	11.0	98.5	0.98	0.87	1.06	49.5
Approach			647	12.8	647	12.8	0.722	30.9	LOS C	11.0	98.5	0.92	0.85	1.00	50.3
West: Median Storage															
5	T1	All MCs	927	9.0	927	9.0	*0.835	29.6	LOS C	3.9	32.6	0.95	0.89	1.04	4.0
Approach			927	9.0	927	9.0	0.835	29.6	LOS C	3.9	32.6	0.95	0.89	1.04	4.0
All Vehicles			2373	11.1	2373	11.1	0.835	26.4	LOS C	12.2	108.8	0.87	0.85	0.94	39.5

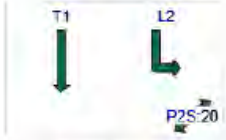
Vehicle Movement Performance

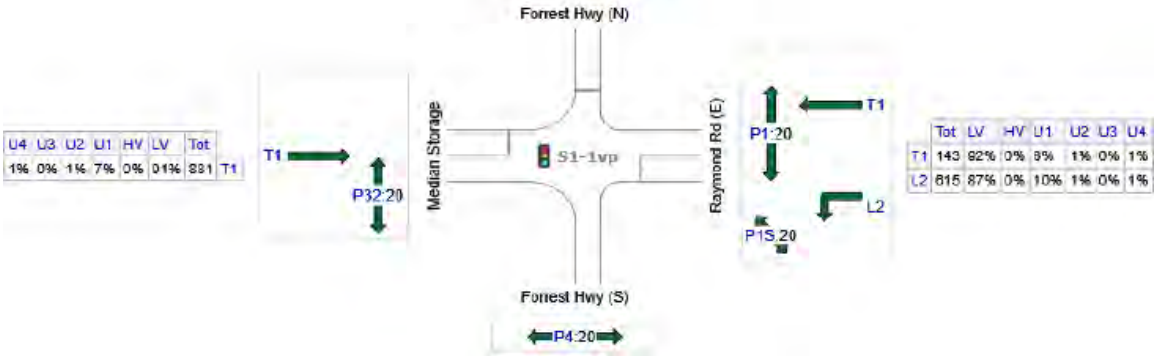
Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Forrest Hwy (S)															
2	T1	All MCs	580	16.0	580	16.0	0.180	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	All MCs	927	9.0	927	9.0	0.278	6.9	LOS A	17.3	144.7	0.00	0.65	0.00	53.6
Approach			1507	11.7	1507	11.7	0.278	4.3	NA	17.3	144.7	0.00	0.40	0.00	61.4
East: Median Storage															
1	R2	All MCs	151	7.7	151	7.7	0.089	3.4	LOS A	0.0	0.0	0.00	0.53	0.00	29.4
Approach			151	7.7	151	7.7	0.089	3.4	NA	0.0	0.0	0.00	0.53	0.00	29.4
All Vehicles			1658	11.3	1658	11.3	0.278	4.2	NA	17.3	144.7	0.00	0.41	0.00	60.7

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Forrest Hwy (S)											
P4	Full	21	34.3	LOS D	0.0	0.0	0.93	0.93	49.6	20.0	0.40
East: Raymond Rd (E)											
P1	Full	21	34.3	LOS D	0.0	0.0	0.93	0.93	49.6	20.0	0.40
West: Median Storage											
P32	Stage 2	21	14.4	LOS B	0.0	0.0	0.60	0.60	29.8	20.0	0.67
All Pedestrians		63	27.6	LOS C	0.0	0.0	0.82	0.82	43.0	20.0	0.46

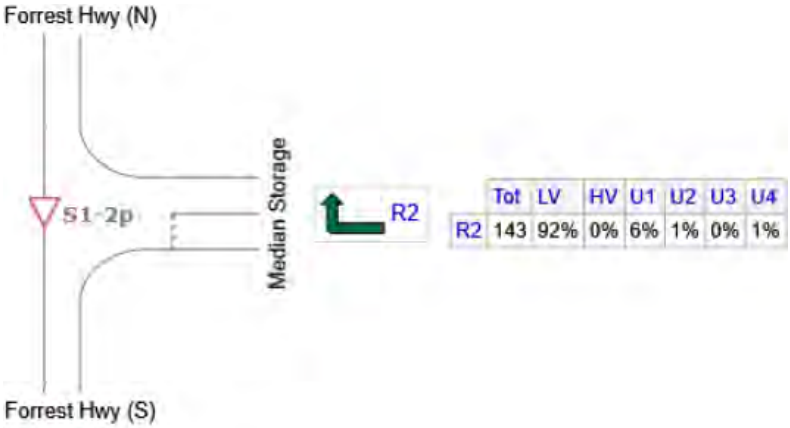
	T1	L2
Tot	541	74
LV	87%	92%
HV	0%	0%
U1	10%	7%
U2	2%	1%
U3	1%	0%
U4	1%	1%





U4	U3	U2	U1	HV	LV	Tot	
1%	0%	1%	7%	0%	91%	881	T1

	Tot	LV	HV	U1	U2	U3	U4
T1	143	92%	0%	6%	1%	0%	1%
L2	615	87%	0%	10%	1%	0%	1%



	Tot	LV	HV	U1	U2	U3	U4
R2	143	92%	0%	6%	1%	0%	1%

	T1	R2
Tot	551	881
LV	84%	91%
HV	0%	0%
U1	12%	7%
U2	2%	1%
U3	1%	0%
U4	2%	1%

Table C2a. SIDRA results – Raymond Rd / Ransom Dr / Treendale East access road roundabout – 2041 weekday AM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Ranson Dr (S)															
1	L2	All MCs	37	3.3	37	3.3	0.135	9.3	LOS A	0.9	6.9	0.86	0.76	0.86	25.9
2	T1	All MCs	3	3.3	3	3.3	0.135	9.1	LOS A	0.9	6.9	0.86	0.76	0.86	33.6
3	R2	All MCs	36	3.3	36	3.3	0.135	14.1	LOS B	0.9	6.9	0.86	0.76	0.86	52.8
Approach			76	3.3	76	3.3	0.135	11.6	LOS B	0.9	6.9	0.86	0.76	0.86	44.9
East: Raymond Rd (E)															
4	L2	All MCs	12	3.3	12	3.3	0.452	11.2	LOS B	3.4	32.4	0.87	0.81	0.96	56.1
5	T1	All MCs	224	21.9	224	21.9	0.452	13.2	LOS B	3.4	32.4	0.87	0.81	0.96	58.5
6	R2	All MCs	39	3.0	39	3.0	0.452	16.8	LOS B	3.4	32.4	0.87	0.81	0.96	55.1
Approach			275	18.4	275	18.4	0.452	13.6	LOS B	3.4	32.4	0.87	0.81	0.96	57.8
North: Treendale East SP (N)															
7	L2	All MCs	107	3.3	107	3.3	0.696	6.9	LOS A	8.4	64.2	0.79	0.69	0.87	53.9
8	T1	All MCs	11	3.3	11	3.3	0.696	6.7	LOS A	8.4	64.2	0.79	0.69	0.87	34.7
9	R2	All MCs	682	3.3	682	3.3	0.696	11.6	LOS B	8.4	64.2	0.79	0.69	0.87	30.3
Approach			800	3.3	800	3.3	0.696	10.9	LOS B	8.4	64.2	0.79	0.69	0.87	36.8
West: Raymond Rd (W)															
10	L2	All MCs	294	3.3	294	3.3	0.414	6.0	LOS A	2.5	22.0	0.23	0.53	0.23	57.5
11	T1	All MCs	239	21.9	239	21.9	0.414	7.0	LOS A	2.5	22.0	0.23	0.53	0.23	60.1
12	R2	All MCs	32	3.3	32	3.3	0.414	11.6	LOS B	2.5	22.0	0.23	0.53	0.23	57.3
Approach			564	11.2	564	11.2	0.414	6.7	LOS A	2.5	22.0	0.23	0.53	0.23	58.9
All Vehicles			1715	8.3	1715	8.3	0.696	10.0	LOS B	8.4	64.2	0.62	0.66	0.68	50.7

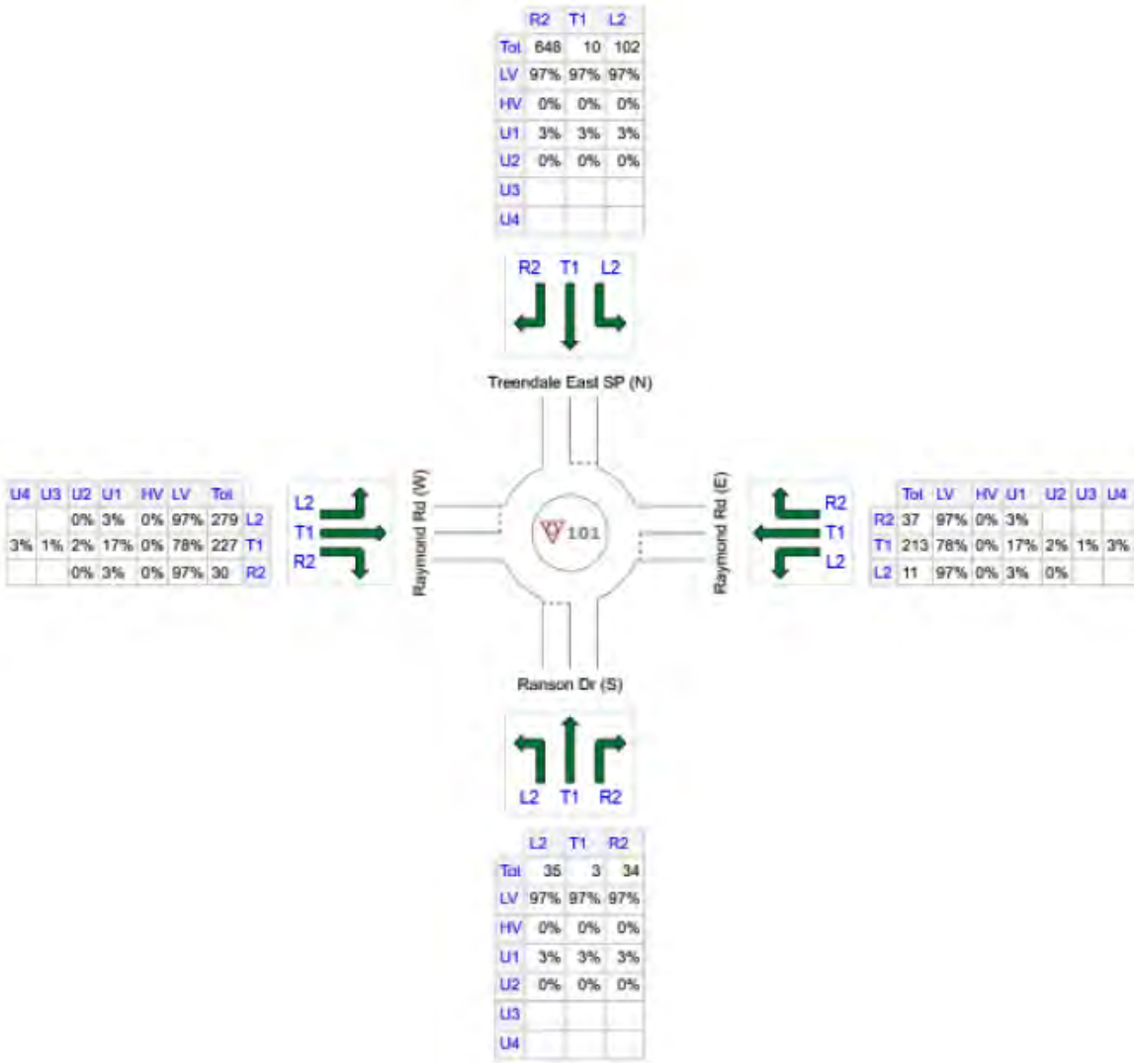

R2 T1 L2
Tot 648 10 102
LV 97% 97% 97%
HV 0% 0% 0%
U1 3% 3% 3%
U2 0% 0% 0%
U3
U4
R2 T1 L2
Treendale East SP (N)
U4 U3 U2 U1 HV LV Tot
0% 3% 0% 97% 279 L2
3% 1% 2% 17% 0% 78% 227 T1
0% 3% 0% 97% 30 R2
L2
T1
R2
Raymond Rd (W)
101
Raymond Rd (E)
R2
T1
L2
Tot LV HV U1 U2 U3 U4
R2 37 97% 0% 3%
T1 213 78% 0% 17% 2% 1% 3%
L2 11 97% 0% 3% 0%
Ranson Dr (S)
L2 T1 R2
L2 T1 R2
Tot 35 3 34
LV 97% 97% 97%
HV 0% 0% 0%
U1 3% 3% 3%
U2 0% 0% 0%
U3
U4

Table C2b. SIDRA results – Raymond Rd / Ransom Dr / Treendale East access road roundabout – 2041 weekday PM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Ranson Dr (S)															
1	L2	All MCs	41	3.3	41	3.3	0.104	8.2	LOS A	0.6	4.9	0.78	0.72	0.78	28.0
2	T1	All MCs	9	3.3	9	3.3	0.104	8.0	LOS A	0.6	4.9	0.78	0.72	0.78	35.4
3	R2	All MCs	18	3.3	18	3.3	0.104	12.9	LOS B	0.6	4.9	0.78	0.72	0.78	54.7
Approach			68	3.3	68	3.3	0.104	9.4	LOS A	0.6	4.9	0.78	0.72	0.78	41.8
East: Raymond Rd (E)															
4	L2	All MCs	29	3.3	29	3.3	0.538	9.5	LOS A	4.3	40.4	0.76	0.74	0.85	57.4
5	T1	All MCs	328	21.9	328	21.9	0.538	11.2	LOS B	4.3	40.4	0.76	0.74	0.85	60.3
6	R2	All MCs	97	3.0	97	3.0	0.538	15.1	LOS B	4.3	40.4	0.76	0.74	0.85	56.4
Approach			455	16.7	455	16.7	0.538	11.9	LOS B	4.3	40.4	0.76	0.74	0.85	59.1
North: Treendale East SP (N)															
7	L2	All MCs	61	3.3	61	3.3	0.448	4.7	LOS A	3.4	25.8	0.61	0.61	0.61	55.1
8	T1	All MCs	6	3.3	6	3.3	0.448	4.5	LOS A	3.4	25.8	0.61	0.61	0.61	36.2
9	R2	All MCs	428	3.3	428	3.3	0.448	9.4	LOS A	3.4	25.8	0.61	0.61	0.61	32.1
Approach			496	3.3	496	3.3	0.448	8.8	LOS A	3.4	25.8	0.61	0.61	0.61	38.1
West: Raymond Rd (W)															
10	L2	All MCs	729	3.3	729	3.3	0.749	6.8	LOS A	8.8	72.2	0.50	0.57	0.50	56.3
11	T1	All MCs	239	21.9	239	21.9	0.749	8.0	LOS A	8.8	72.2	0.50	0.57	0.50	59.4
12	R2	All MCs	36	3.3	36	3.3	0.749	12.4	LOS B	8.8	72.2	0.50	0.57	0.50	56.0
Approach			1004	7.7	1004	7.7	0.749	7.3	LOS A	8.8	72.2	0.50	0.57	0.50	57.3
All Vehicles			2023	8.5	2023	8.5	0.749	8.8	LOS A	8.8	72.2	0.59	0.63	0.62	54.3

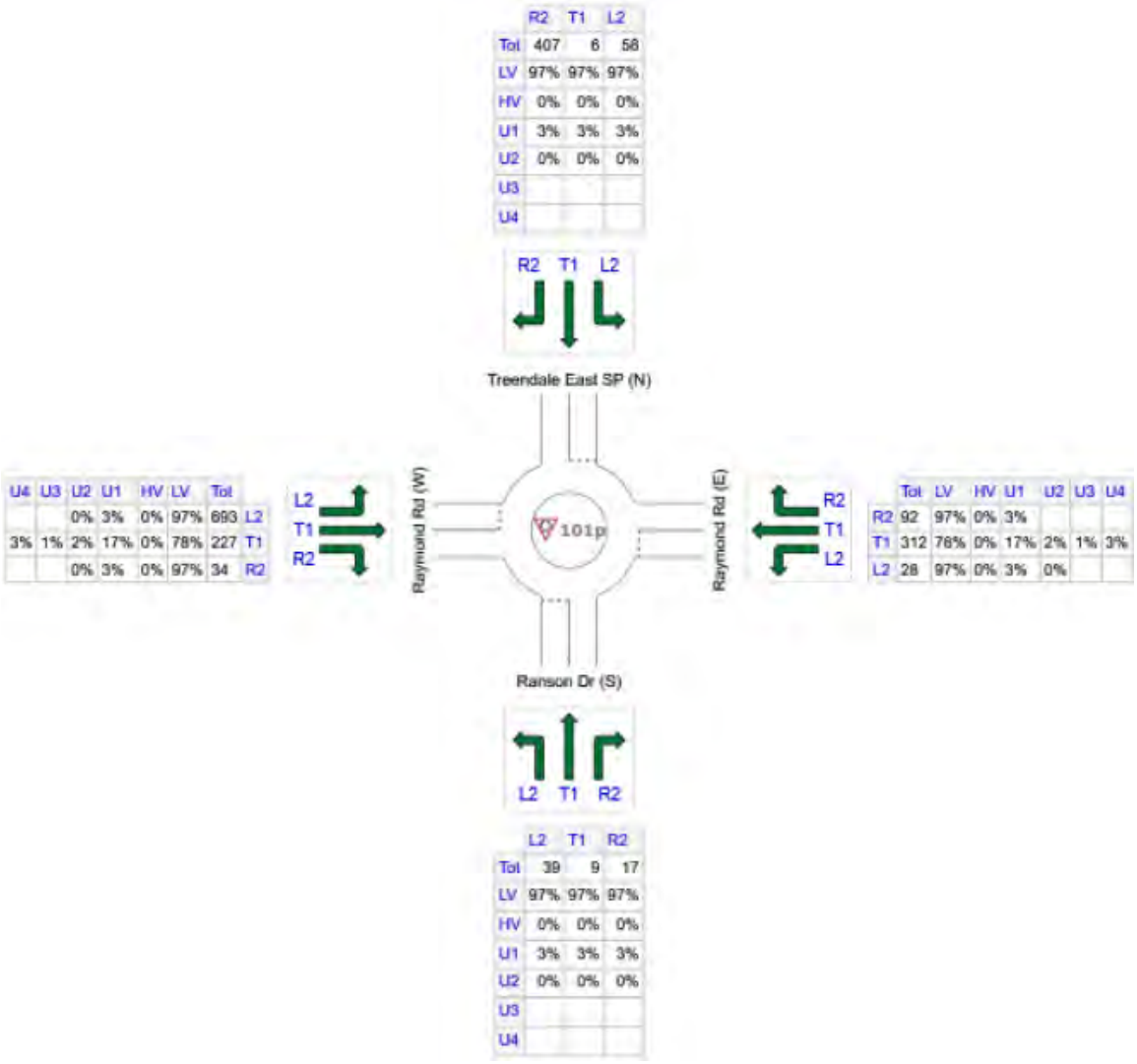

R2 T1 L2
Tot 407 6 58
LV 97% 97% 97%
HV 0% 0% 0%
U1 3% 3% 3%
U2 0% 0% 0%
U3
U4
R2 T1 L2
Treendale East SP (N)
U4 U3 U2 U1 HV LV Tot
0% 3% 0% 97% 693 L2
3% 1% 2% 17% 0% 78% 227 T1
0% 3% 0% 97% 34 R2
L2
T1
R2
Raymond Rd (W)
101p
Raymond Rd (E)
R2
T1
L2
Tot LV HV U1 U2 U3 U4
R2 92 97% 0% 3%
T1 312 78% 0% 17% 2% 1% 3%
L2 28 97% 0% 3% 0%
Ranson Dr (S)
L2 T1 R2
L2 T1 R2
Tot 39 9 17
LV 97% 97% 97%
HV 0% 0% 0%
U1 3% 3% 3%
U2 0% 0% 0%
U3
U4

Table C3a. SIDRA results – Forrest Hwy / Treendale East access road LILO intersection – 2041 weekday AM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Forrest Hwy (S)															
2	T1	All MCs	643	16.0	643	16.0	0.200	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach			643	16.0	643	16.0	0.200	0.1	NA	0.0	0.0	0.00	0.00	0.00	79.9
East: Treendale East (E)															
4	L2	All MCs	271	3.3	271	3.3	0.301	6.9	LOS A	1.3	9.9	0.48	0.67	0.50	38.5
Approach			271	3.3	271	3.3	0.301	6.9	LOS A	1.3	9.9	0.48	0.67	0.50	38.5
North: Forrest Hwy (N)															
7	L2	All MCs	48	3.3	48	3.3	0.027	7.6	LOS A	0.0	0.0	0.00	0.60	0.00	64.8
8	T1	All MCs	651	16.0	651	16.0	0.202	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach			699	15.1	699	15.1	0.202	0.6	NA	0.0	0.0	0.00	0.04	0.00	78.1
All Vehicles			1613	13.5	1613	13.5	0.301	1.4	NA	1.3	9.9	0.08	0.13	0.08	75.3

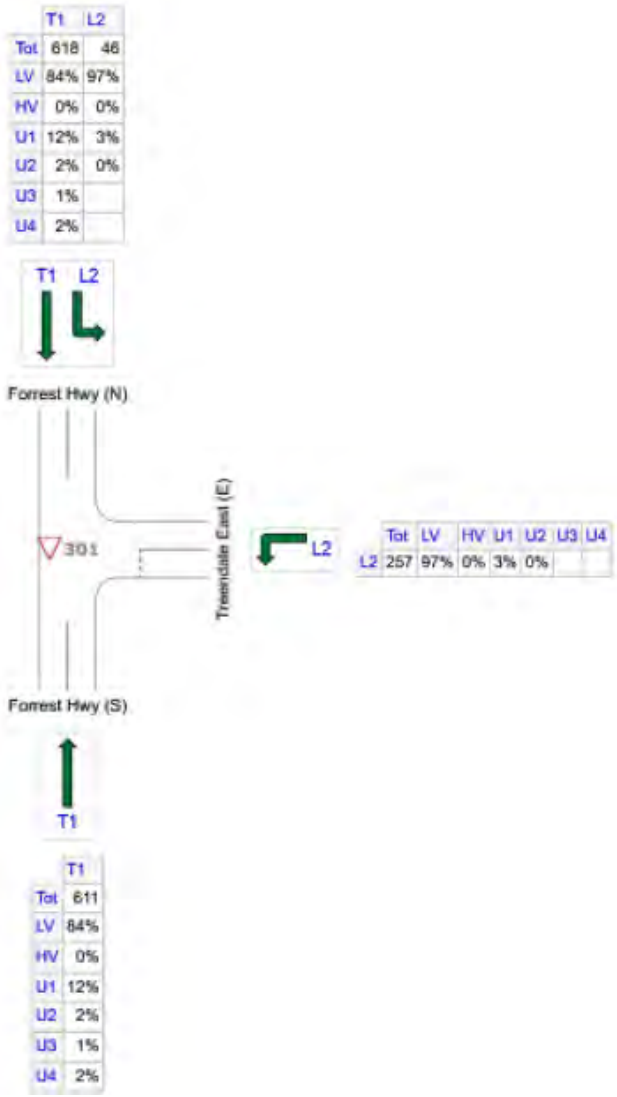
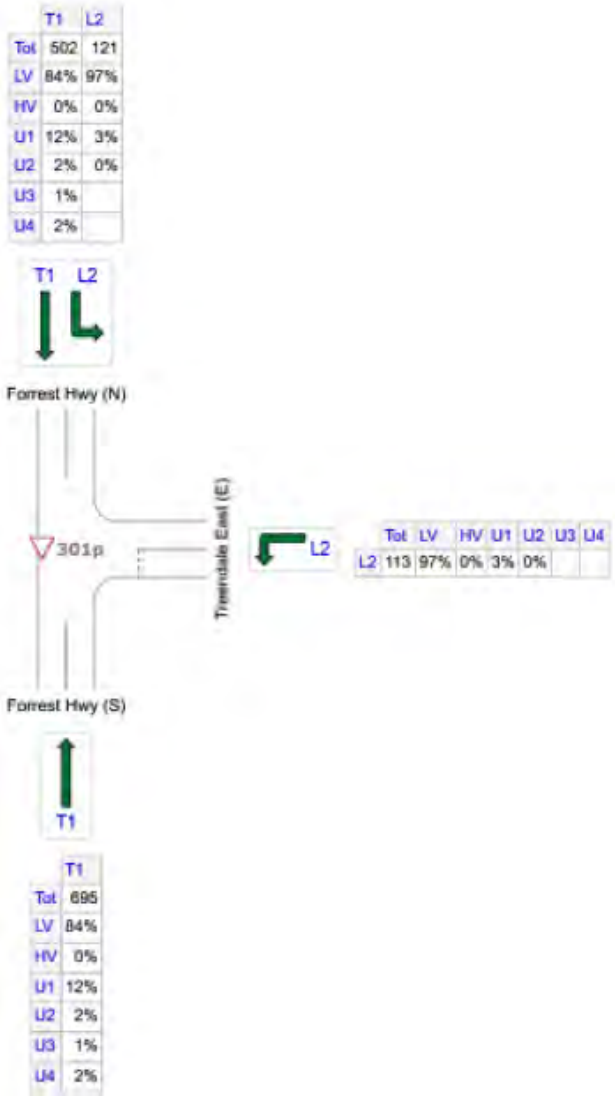


Table C3b. SIDRA results – Forrest Hwy / Treendale East access road LILO intersection – 2041 weekday PM peak with Treendale East Structure Plan

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Forrest Hwy (S)															
2	T1	All MCs	732	16.0	732	16.0	0.227	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
Approach			732	16.0	732	16.0	0.227	0.1	NA	0.0	0.0	0.00	0.00	0.00	79.8
East: Treendale East (E)															
4	L2	All MCs	119	3.3	119	3.3	0.122	6.0	LOS A	0.5	3.5	0.38	0.61	0.38	39.4
Approach			119	3.3	119	3.3	0.122	6.0	LOS A	0.5	3.5	0.38	0.61	0.38	39.4
North: Forrest Hwy (N)															
7	L2	All MCs	127	3.3	127	3.3	0.070	7.7	LOS A	0.0	0.0	0.00	0.60	0.00	64.8
8	T1	All MCs	528	16.0	528	16.0	0.164	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach			656	13.5	656	13.5	0.164	1.5	NA	0.0	0.0	0.00	0.12	0.00	75.4
All Vehicles			1506	13.9	1506	13.9	0.227	1.2	NA	0.5	3.5	0.03	0.10	0.03	76.8



Appendix 3. Environmental Assessment & Management Strategy

Environmental Assessment and Management Strategy

Lots 151, 152 and 153 Raymond Road, Roelands

Project No: EP21-022(05)

Prepared for Treendale East Landowner Group
April 2025



Document Control

Doc name:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands				
Doc no.:	**EP21-022(05)—002b TEM**				
Version	**Date**	**Author**		**Reviewer**	
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		Brodie Mastrangelo	BFM		
	Issued to client.				
A	February 2022	Kirsten Knox	KK	Kirsten Knox	KK
	Minor text edits following client review. Final for submission.				
B	April 2025	Kirsten Knox	KK	Kirsten Knox	KK
	Inclusion of updated structure plan and minor text updates to address amended structure plan and ensure text alignment with the structure plan and other supporting documents.				

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Executive Summary

Treendale East Landowner Group (the proponent) is proposing to rezone Lots 151, 152 and 153 Raymond Road, Roelands (herein referred to as the 'site') to support residential development. The site is currently zoned 'rural' under the Greater Bunbury Region Scheme (GBRS) and 'general farming' and 'intensive farming' under the Shire of Harvey District Planning Scheme No. 1 (DPS No. 1). It is bounded by the future Bunbury Outer Ring Road (BORR) corridor to the north and east, Raymond Road and Meadow Landing Estate to the south and Forrest Highway and Treendale residential and light industrial estates to the west. This Environmental Assessment and Management Strategy (EAMS) has been prepared as the primary environmental documentation supporting the scheme amendment and structure plan and demonstrates that urban development can be supported within the site while protecting environmental values.

Planning and environmental assessment context

The structure plan has been prepared to satisfy the 'detailed planning' requirements for the East Treendale 'urban expansion area', as outlined in the *Bunbury-Geographe Sub-regional Strategy* (WAPC 2022). It is intended to support amendments to both the GBRS and the Shire of Harvey DPS No. 1.

Amendments to the GBRS and Shire of Harvey DPS No. 1 would be referred to the Environmental Protection Authority (EPA) pursuant to Section 48A of the *Environmental Protection Act 1986* (EP Act), who will consider whether implementation of the proposed future urban land use would be likely to result in significant environmental impacts and as such, whether environmental assessment is required.

Based on the outcomes of this EAMS, it is considered unlikely that implementation of the proposed urban development within the site would result in significant residual impacts to the environment, given potential environmental impacts will be appropriately mitigated through a range of proposed impact avoidance, minimisation and rehabilitation measures that have been outlined below and in the main report.

Site-specific investigations

There is a significant amount of data available to understand the environmental values present within the site, and to support consideration of management requirements as part of the future development process. Investigations used to inform the preparation of the structure plan:

- State-based publicly available databases and information sources, including detailed mapping.
- Detailed environmental surveys (flora, vegetation, fauna, Aboriginal heritage, noise, visual impact) that were undertaken to support the state and federal environmental approval process for the BORR which included portions of the site (Main Roads Western Australia 2018; Biota Environmental Sciences 2019; BORR Team 2019; WRM 2019; BORR Team 2020a; BORR Team 2020b);
- Assessments undertaken by Emerge Associates, including
  - A number of detailed site inspections to review the values identified by the BORR investigations and also the portions of the site not addressed by those investigations.
  - Groundwater monitoring.

- Preparation of a water management strategy (WMS), including biophysical assessment for waterways identified within the site.
- Preparation of a bushfire management plan (BMP), to assess bushfire risk and consideration of vegetation retention and proposed revegetation.

Key environmental factors and values

The environmental values relevant to the site and the proposed urban development have been addressed in the context of the EPA environmental factors, detailed within the *Statement of Environmental Principles, Factors and Objectives* (EPA 2021a). Key values identified in or associated with the site include:

Flora and vegetation

- The majority of the site has been cleared of native vegetation and used for agriculture and grazing purposes. Intact native vegetation is present within the northern portion of the site, while stands (and isolated individuals) of remnant native *Corymbia calophylla* (marri), *Eucalyptus marginata* (jarrah), *Agonis flexuosa* (peppermint) and *Melaleuca rhaphiophylla* are present across the site.
- The majority of the site is identified within the Southern River Complex, while the western portion of the site (and areas of intact native vegetation) is found within the Bassendean Complex – Central and South. The Bassendean Complex – Central and South community has approximately 27% of its pre-European extent remaining, while the Southern River Complex has 18%.
- The majority of the intact remnant vegetation within the northern portion of the site has been identified as of the 'Banksia woodlands of the Swan Coastal Plain' threatened ecological community (TEC).
- A Priority 4 species, *Acacia semitrullata*, was identified within the northern portion of the site

Terrestrial fauna

- Fauna habitat within the site for conservation significant species is largely limited to the areas of intact native remnant vegetation within the northern portion of the site. Stands of (and isolated individual) remnant native paddocks trees and riparian vegetation associated with the identified waterways are also likely to provide some habitat value, although is of a lower quality than the vegetation in the north.
- Conservation significant fauna species that occur or may occur within the site include:
  - Three black cockatoo species (Carnaby's, Baudin's and forest red-tailed), with foraging and potential roosting and breeding habitat identified within the site.
  - Western ringtail possum. Foraging and refuge habitat has been identified within the northern portion of the site.
  - Southern brown bandicoot (quenda), likely to be largely associated with the intact vegetation in the north.
  - South-western brush-tailed phascogale. Similarly, likely to utilise vegetation in the northern portion of the site.
  - Carter's freshwater mussel. Surveys undertaken for the BORR indicate that no suitable habitat for the species is present within the site.

Inland waters

- Two incised waterways occur within the south-eastern portion of the site, one which runs from north-east to south-west (Treendale main drain), the other runs from east to west (Treendale branch drain) and intersect at the southern boundary of the site (near Raymond Road). These waterways have limited riparian vegetation, largely remnant trees over grass.
- The majority of the site is identified as a multiple use wetland, and is generally associated with existing cleared areas.
- Groundwater monitoring undertaken for the site indicates that the maximum groundwater level (metres below ground level (mBGL)) occurred between July to August and ranged from 0 to 6.96 mBGL. It is possible, based on the geology within the site, that groundwater observed may be associated with seepage due to a low permeability layer, and therefore is likely to represent perched groundwater across the central, western and south-western portions of the site (Emerge Associates 2022b).

Terrestrial environmental quality

- The entire site is mapped as having a moderate to low risk of ASS occurring within 3 m of the natural soil surface.
- The existing agricultural (grazing) land use present across the majority site is not identified as potentially contaminating land uses, and therefore is not considered to represent any significant risk of potential contamination. If contamination is present, it is likely to be small scale in nature and can be managed through the typical land development process.

Social surroundings

- A registered Aboriginal heritage site Collie River Waugal (Site No. 16713) is located within the south-eastern portion of the site, associated with one of the waterways. Further consultation will be undertaken with Aboriginal people as part of the development process and to address statutory approval requirements.
- Future residents could be impacted by noise from the surrounding strategic freight and major traffic roads, namely Forrest Highway to the west, the BORR to the north and east and Raymond Road to the south.
- The Dampier to Bunbury Natural Gas Pipeline is present within the western portion of the site, within a 15.9 m-wide easement. *Planning Bulletin 87 High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region (WAPC 2007)* indicates that south of Baldivis (approximately 115 km north of the site), the Dampier to Bunbury Natural Gas Pipeline is indicated to have a depth of cover of 1.2 m.
- A light industrial area is located west of the site, adjacent to Forrest Highway. Based on the zoning of the land, it is not likely that existing or future land uses will impact on the
- The proposed residential development will change the existing largely rural views east across the site and towards the Darling Scarp, however the view was already going to change due to the construction and operation of the BORR.

Other considerations

- Bushfire risk. Bushfire risk to the site has been considered in the context of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* and its associated Guidelines. This included the preparation of a bushfire management plan, which demonstrated that bushfire risk can be appropriately managed while also addressing the identified environmental values, in particular retention of vegetation.
- Land capability. The eastern portion of the site is identified as Priority Agricultural Land' within the *Greater Bunbury Region Scheme Priority Agricultural Land Policy 2017* (DPLH 2017b), however . is a very small portion of priority agricultural land identified in the region. The proposed development of the site would not decrease available agricultural land to any significant extent, with the BORR providing an appropriate and logical boundary between agriculture areas and urban development.

Proposed environmental mitigation measures

A range of environmental impact avoidance, minimisation and rehabilitation mitigation measures are proposed to be implemented through the scheme amendment and structure plan and subsequent stages of the land use planning process. These can be split into two key components, summarised as follows:

- **Spatial responses of the structure plan to avoid future impacts to environmental values as a result of urban development**. In this respect, the structure plan provides for the following:
  - Future 'recreation (conservation values)' public open space areas, which have been strategically located within the northern and south-eastern portions of the site to provide for the future retention of a range of key environmental values across the site, namely:
    - Intact native vegetation within the northern portion of the site, which includes the Banksia Woodland TEC, priority flora species and habitat for the conservation significant fauna species. Existing vegetation values will be retained and may include revegetation in the future.
    - Foreshore reserves associated with the two waterways within the south-eastern portion of the site. The foreshore reserve is based on the outcomes of a biophysical assessment and maintains the existing waterways and associated riparian vegetation, areas with a slope exceeding 10% and the 1% average exceedance probability (AEP) flooding. The location of the foreshore reserve also protects the registered Aboriginal heritage site and assumes revegetation of the waterway.
  - Future 'recreation' public open space areas within the site and around the perimeter to address the following:
    - Maximise retention of the existing stands (and individual) paddock trees, with public open space located where the greatest density of trees is present.
    - Avoiding the Dampier to Bunbury Natural Gas Pipeline possible encroachment of residential development within the identified easement.
    - Support the movement of surface water, groundwater and stormwater through a network of conveyance swales, mimicking existing conditions within the site.
    - Support the management of noise impacts, through the provision of separation between future development cells and the surrounding strategic freight and major

traffic roads, and providing spatial provision for future noise barriers (if deemed to be required/desired).

- **Proposed local scheme and/or structure plan provisions to define future environmental management requirements**. The proposed provisions would be established as part of the amendment to the Shire of Harvey DPS No. 1 and would specify the environmental management requirements to be addressed as part of the future development stages. Implementation of these requirements would occur during the future local structure planning and subdivision stages of development, providing for further environmental impact avoidance, minimisation and rehabilitation measures. The proposed local scheme provisions will be confirmed prior to lodgement of the future Shire of Harvey DPS No. 1 amendment, but are proposed to include requirements for:
  - Local structure plans to provide the 'recreation (conservation value)' reserves consistent with those shown in the structure plan.
  - Preparation of various management strategies and plans, including:
    - Reserve management plan/s, for the 'recreation (conservation value)' public open space areas, to outline the proposed environmental management framework to be implemented to protect the vegetation, fauna, waterway and heritage values.
    - Urban mater management plan/s, to outline how groundwater and surface water will be managed during urban development and subdivision works in accordance with the Water Management Strategy (prepared to support the scheme amendment and structure plan process).
    - Construction environmental management plan/s, to outline the proposed environmental management requirements to be implemented during construction to ensure retained conservation values and/or trees are protected. This will include consideration of construction risks such as dieback, disease, weeds, fauna and access management.
    - Noise management plan/s, to detail the management of noise impacts associated with Forrest Highway, the BORR and Raymond Road and may only be required if the 'deemed-to-satisfy' pathway in *State Planning Policy 5.4 Road and Rail Noise* and the *Road and Rail Noise Guidelines* (DPLH 2019) is not followed.

As part of the above, the potential implications of managing bushfire risk (largely clearing or modification of native vegetation) have been considered in detail as part of preparing the structure plan. Appropriate separation between future habitable buildings and bushfire hazards is supported by the current structure plan and concept which provides appropriate separation through road locations, managed public open space and/or development cell depths. Management of bushfire risk is not reliant on ongoing management of retained remnant native vegetation or proposed revegetation areas.

Holistic impact assessment

Overall, the structure plan provides a local-level framework to achieve conservation outcomes for a range of environmental values, which will be implemented through future stages of the urban development process. This is primarily achieved through the proposed 'recreation' public open space areas/reserves shown in the structure plan, which will provide for the future retention of conservation significant environmental values. In particular, the preservation of native intact

remnant vegetation in the north of the site, retention and protection of the waterways and riparian vegetation within the south-east of the site, and retention of paddock trees in the central and south-eastern portions of the site. These reserves also support the maintenance of the existing hydrological functions within the site, and will enable the enhancement of water quality.

Structure plan response to strategic planning and environmental framework

Overall, the structure plan provides appropriate mitigation measures and responses to suitably address the key environmental values of the site, such that it is unlikely that the proposed future implementation of urban development within the site in accordance with the structure plan would result in significant residual environmental impacts. The structure plan addresses the key requirements set out in the overarching strategic planning framework (in particular, retention of the majority of the intact remnant native vegetation within the site and the waterway features), and can be managed appropriately through the future subdivision and development phases in line with standard development processes and the relevant state and local government legislation, policies and guidelines and best management practices.

Table of Contents

1 Introduction 1

1.1 Background 1
1.2 Purpose and structure of this document 1

2 Planning and Environmental Assessment Context 3

2.1 Existing zoning and reservations 3
2.2 Bunbury-Geographe Sub-regional Strategy 3
2.3 Treendale East Structure Plan 4
2.4 Future land use planning processes 4
2.4.1 Greater Bunbury Region Scheme and Local Planning Scheme amendments 4
2.4.2 Structure Plan 5
2.4.3 Subdivision and development 5
2.5 Future environmental assessment processes 5
2.5.1 *Environmental Protection Act 1986* – Section 48 5
2.5.2 *Environmental Protection Act 1986* – Section 38 6
2.5.3 Environment Protection and Biodiversity Conservation Act 1999 6
2.6 Future offset requirements 7

3 Environmental Principles and Factors 8

3.1 Site context 8
3.2 Environmental principles 8
3.3 Key environmental factors 10
3.4 Flora and vegetation 15
3.4.1 EPA objective 15
3.4.2 Policy and guidance 15
3.4.3 Receiving environment 15
3.4.3.1 Regional context 15
3.4.3.2 Site-specific investigations 18
3.4.3.3 Vegetation condition 24
3.4.3.4 Threatened and priority ecological communities 24
3.4.3.5 Threatened and priority flora 28
3.4.3.6 Environmentally sensitive areas 29
3.4.3.7 Conservation reserves 29
3.4.4 Potential impacts of the structure plan 29
3.4.5 Assessment of potential impacts and impact mitigation 30
3.4.5.1 Avoid 30
3.4.5.2 Minimise 30
3.4.5.3 Rehabilitate 31
3.4.6 Predicted outcome 31
3.5 Terrestrial fauna 32
3.5.1 EPA objective 32
3.5.2 Policy and guidance 32
3.5.3 Receiving environment 32
3.5.3.1 Regional context 32
3.5.3.2 Site-specific investigations 32
3.5.3.3 Fauna habitat types 33
3.5.3.4 Conservation-significant species 34
3.5.3.5 Ecological linkages 40
3.5.4 Potential impacts of the structure plan 41
3.5.5 Assessment of potential impacts and impact mitigation 41
3.5.5.1 Avoid 41

3.5.5.2 Minimise 41
3.5.5.3 Rehabilitate 42
3.5.6 Predicted outcome 43
3.6 Inland waters 43
3.6.1 EPA objective 43
3.6.2 Policy and guidance 43
3.6.3 Receiving environment 44
3.6.3.1 Regional context 44
3.6.3.2 Groundwater 44
3.6.3.3 Wetlands 45
3.6.3.4 Groundwater dependent ecosystems 46
3.6.3.5 Surface water 46
3.6.3.6 Sewerage sensitive areas 47
3.6.3.7 Public drinking water source areas 47
3.6.4 Potential impacts of the structure plan 48
3.6.5 Assessment of potential impacts and impact mitigation 48
3.6.5.1 Avoid 48
3.6.5.2 Minimise 49
3.6.5.3 Rehabilitate 50
3.6.5.4 Predicted outcome 50
3.7 Terrestrial environmental quality 51
3.7.1 EPA objective 51
3.7.2 Policy and guidance 51
3.7.3 Receiving environment 51
3.7.3.1 Regional context 51
3.7.3.2 Acid sulfate soils 52
3.7.3.3 Potential contamination 53
3.7.4 Potential impacts of the structure plan 53
3.7.5 Assessment of potential impacts and impact mitigation 54
3.7.5.1 Avoid 54
3.7.5.2 Minimise 54
3.7.5.3 Rehabilitate 54
3.7.6 Predicted outcome 54
3.8 Social surroundings 55
3.8.1 EPA objective 55
3.8.2 Policy and guidance 55
3.8.3 Receiving environment 55
3.8.3.1 Aboriginal heritage 55
3.8.3.2 Non-indigenous heritage 55
3.8.3.3 Amenity and nearby land uses 56
3.8.4 Potential impacts of the structure plan 58
3.8.5 Assessment of potential impacts and impact mitigation 59
3.8.5.1 Avoid 59
3.8.5.2 Minimise 60
3.8.5.3 Rehabilitate 62
3.8.6 Predicted outcome 62

4 Other Environmental Matters 63

4.1 Bushfire 63
4.2 Land capability 65

5 Holistic Impact Assessment 66

5.1 Summary of predicted environmental outcomes 66
5.2 Structure plan response to planning framework 67

6 Implementation Framework 69

7 Conclusions 73

8 References 75

8.1 General references 75
8.2 Online references 79

List of Tables

Table 1: EP Act Principles 9
Table 2: EPA factors applicable to the structure plan. Shaded green cells indicate factors relevant for the assessment. 11
Table 3: Vegetation complexes on the Bassendean Dune and Combination Pinjarra Plain/Bassendean Dunes (DBCA 2019) 15
Table 4: Threatened and priority flora identified through publicly available environmental databases. 28
Table 5: Fauna species potentially occurring within the site which are listed under State and/or Commonwealth legislation 35
Table 6: Measured depth to groundwater (mBGL) 45
Table 7: General soil profile zones across the site 52
Table 8: Noise targets as outlined within SPP 5.4 57
Table 9: East Treendale urban expansion area key planning issues with regard to the environment (WAPC 2022) 67
Table 10: Environmental management framework implementation table 69

Plates

Plate 1: Vegetation complexes identified within the site (Heddle et al 1980) 17
Plate 2: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing portions of the site and nearby subject to survey. 19
Plate 3: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing plant communities within portions of the site. 20
Plate 4: 'Agonis flexuosa closed woodland over pasture grasses' community within the northern portion of the site 21
Plate 5: 'Woodland of Eucalyptus marginata over Agonis flexuosa, Banksia attenuata and B. ilicifolia community' within the northern portion of the site. 21
Plate 6: 'Very open woodland of Melaleuca rhaphiophylla over introduced grasses and herbs in paddocks and road reserves' community within the north-western portion of the site 22
Plate 7: 'Low woodland of Eucalyptus rudis and Melaleuca rhaphiophylla community', associated with the waterways in the south-eastern portion of the site 22
Plate 8: 'Low woodland of Eucalyptus rudis and Melaleuca rhaphiophylla' community, associated with the waterways in the south-eastern portion of the site 23
Plate 9: 'Isolated trees of Eucalyptus species / Agonis flexuosa and Melaleuca species in paddocks' community throughout the site 23
Plate 10: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing vegetation condition within portions of the site. 26
Plate 11: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing extent of Banksia Woodland TEC/PEC (and priority flora) within the northern portion of the site. 27
Plate 12: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) fauna habitat identified within portions of the site. 34
Plate 13: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) showing black cockatoo potential breeding habitat identified within portions of the site. 39

Plate 14: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) showing black cockatoo foraging habitat quality identified within portions of the site. 40
Plate 15: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021) 63

Figures

Figure 1: Site Locality
Figure 2: Topographic Contours
Figure 3: ESAs and Geomorphic Wetlands
Figure 4: Foreshore Biophysical Assessment
Figure 5: Environmental Geology
Figure 6: Acid Sulfate Soil Risk Mapping
Figure 7: Aboriginal Hertiage Sites
Figure 8: Nearby Land Uses and Amenity Considerations
Figure 9: Predicted Bushfire Prone Areas

Appendices

Appendix A

Structure Plan (CDP 2025)

Abbreviation Tables

Table A1: Abbreviations – organisations

Organisations	
DBCA	Department of Biodiversity, Conservation and Attractions
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
OBRM	Office of Bushfire Risk Management
WAPC	Western Australian Planning Commission

Table A2: Abbreviations – general terms

General terms	
CCW	Conservation category wetland
FCT	Floristic community type
IBRA	Interim Biogeographic Regionalisation of Australia
MUW	Multiple use wetland
PEC	Priority Ecological Community
REW	Resource enhancement wetland
TF	Threatened flora
TEC	Threatened ecological community
UFI	Unique feature identifier

Table A3: Abbreviations – legislation

Legislation		
EP Act	Environmental Protection Act 1986	
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999	
	EPP	Environment Protection Policy

Table A4: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
m	Metre
m AHD	m in relation to the Australian height datum
m BGL	Metres below ground level

1 Introduction

1.1 Background

Treendale East Landowner Group (the proponent) is rezoning a portion of Lots 151, 152 and 153 Raymond Road, to become Treendale East Estate, Roelands (herein referred to as the 'site'), located in the Shire of Harvey. The site is proposed to be developed for residential purposes, which will require a Greater Bunbury Region Scheme (GBRS) and Shire of Harvey Local Planning Scheme (LPS) amendment. It is bounded by the future Bunbury Outer Ring Road (BORR) corridor to the north and east, Raymond Road and Meadow Landing Estate to the south and Forrest Highway and Treendale residential/light industrial estates to the west. This Environmental Assessment and Management Strategy (EAMS) has been prepared as the primary environmental documentation supporting the DSP. The is provided in **Appendix A**.

Site is currently zoned 'Rural' under the Greater Bunbury Region Scheme (Government of Western Australia 2014) and a combination of 'General Farming' (Lots 151 and 153) and 'Intensive Farming' (south eastern portion of Lot 152) under the Shire of Harvey District Planning Scheme No. 1 (DPLH 2019b). The site was Designating the site as an urban expansion area is identified in the draft *Bunbury-Geographe Sub-regional Strategy* (DPLH 2020) as a strategic direction.

Treendale East Landowner Group ('the proponent') is progressing with a local scheme amendment to facilitate a residential development within portions of Lots 151, 152 and 153, Roelands (herein referred to as 'the site'), as shown in **Figure 1**. The site is situated within the Shire of Harvey (herein referred to as 'the Shire').

The site covers approximately 182.9 hectares, and is bound by Forrest highway to the west, Raymond Road to the south, and existing farmland towards the east and north. Main Roads Western Australia (Main Roads) is proposing to construct the northern and central sections of the Bunbury outer ring road (BORR), which once complete will enclose the northern and eastern edges of the development.

1.2 Purpose and structure of this document

Emerge Associates were engaged to undertake an environmental assessment of the site, to document the existing environmental attributes and values relevant to the site and ensure that any applicable environmental values can be accommodated within the structure plan, and/or managed through future stages of planning and development of the site.

This Environmental Assessment and Management Strategy (EAMS) has been prepared as the primary environmental documentation supporting the structure plan. It documents the environmental considerations relevant to the site, which will be assessed by applicable local and state government authorities as part of their consideration of the structure plan.

The EAMS has been structured to align with the Environmental Protection Authority's (EPA) recommended structure for Environmental Review Documents, to enable it to support subsequent stages of the land use planning process where the EPA have statutory involvement (for example, future Greater Bunbury Region Scheme and Shire of Harvey DPS amendments). This EAMS includes the following sections:

- **Section 1** – which introduces the purpose of the document.
- **Section 2**– which outlines the planning and environmental assessment context applicable to the structure plan, in addition to the future stages of the land use planning process.
- **Section 3** – which outlines the environmental factors (based on EPA definitions) applicable to the structure plan. For each of these factors, the receiving environment, potential impacts of the structure plan, mitigation measures and predicted environment outcomes are outlined.
- **Section 4** – which outlines other environmental matters applicable to the structure plan which are not addressed through consideration of the EPA environmental factors but are relevant for managing the environment, such as bushfire risk.
- **Section 5** – which provides a holistic environmental impact assessment for the structure plan and associated future urban development of the site.
- **Section 6** – which summarises the proposed implementation measures.

To prepare this EAMS, Emerge Associates have considered the site in the context of publicly available environmental data including:

- State-based publicly available databases and information sources, including detailed mapping.
- Detailed environmental surveys that were undertaken to support the state and federal environmental approval process for the BORR which included portions of the site (Main Roads Western Australia 2018; Biota Environmental Sciences 2019; BORR Team 2019; WRM 2019; BORR Team 2020a; BORR Team 2020b);
- Assessments undertaken by Emerge Associates, including
  - A number of detailed site inspections to review the values identified by the BORR investigations and also the portions of the site not addressed by those investigations.
  - Groundwater monitoring.
  - Preparation of a water management strategy (WMS), including biophysical assessment for waterways identified within the site
  - Preparation of a bushfire management plan (BMP), to assess bushfire risk and consideration of vegetation retention and proposed revegetation.

There is a significant amount of data available to understand the environmental values present within the site, and to support consideration of management requirements as part of the future development process.

2 Planning and Environmental Assessment Context

2.1 Existing zoning and reservations

As outlined above, the site is currently zoned 'Rural' under the GBRS and a combination of 'General Farming' and 'Intensive Farming' under the Shire of Harvey DPS No. 1. The *Bunbury-Geographe Sub-regional Strategy* (DPLH 2020) has designated the site as the 'East Treendale Urban Expansion Area', to support a logical extension of the urban front in the Bunbury-Geographe region. To support urban development of the site, the GBRS and Shire of Harvey DPS No. 1 will need to be amended.

2.2 Bunbury-Geographe Sub-regional Strategy

The Western Australian Planning Commission (WAPC) released the *Bunbury-Geographe Sub-regional Strategy* in January 2022, providing the strategic direction for managing growth and development within the Bunbury-Geographe sub-region.

The site is identified in the *Bunbury-Geographe Sub-regional Strategy* as an 'urban expansion area':

> *"East Treendale is identified as an urban expansion area as it represents the logical extension of the urban front and "rounds off" the footprint of the Bunbury urban area west of the Bunbury Outer Ring Road*." (DPLH 2020)

'Urban expansion areas' are identified as those requiring detailed planning prior to the WAPC considering rezoning requests under the GBRS. The *Bunbury-Geographe Sub-regional Strategy* identifies the following 'key' planning issues with regard to the environment:

- Balancing growth with the protection of areas with high biodiversity significance and other environmental values.
- The need to sustainably manage natural resources, including minimising fill on development sites and encouraging lightweight construction and alternative road construction materials and methods.
- The need to respond to the potential impacts of climate change, including a drying climate, reducing groundwater and surface water availability, and sea-level rise.
- Natural hazards (such as bushfire, coastal inundation/erosion and flooding) pose a risk to existing and future development.

With regard to the East Treendale 'urban expansion area', the following need to be considered:

- Biodiversity value protection.
- Bushfire risk.
- Drainage.
- Landscape value protection.
- Protection of significant environmental values.
- Utility services capacity.
- Water source impact (groundwater and surface water).
- Regional road access.
- Road and rail noise.

- Basic raw material demand.
- Geotechnical factors.
- Aboriginal heritage.

A summary of how the 'key' planning issues related to the environmental matters have been addressed as part of the structure plan is provided in **Section 5**, as part of the holistic impact assessment.

2.3 Treendale East Structure Plan

The structure plan has been prepared to address the requirements of the *Bunbury-Geographe Sub-regional Strategy*, to support both the scheme amendment processes and structure plan approval process. The proposed structure plan, including a concept masterplan, has been provided in **Appendix A** and is intended to support greenfield residential development as well as strata titled development. The proposed development within the site will include:

- Lots of various sizes, meeting residential density codes of R25 to R80.
- A strata titled village development cell, within the south-east.
- Interconnected road network, including perimeter roads and external connections to Forrest Highway and Raymond Road.
- Public open space (POS) areas, supporting managed vegetation and retention of existing trees available for future residents to use for passive and active recreation.
- Primary school, and associated shared sports fields.
- Neighbourhood activity centre.
- Riparian corridors (identified as 'recreation (conservation values)' in the structure plan), which will include revegetation of the immediate waterways within the south-eastern portion of the site, whilst the remainder of the corridor will be used for recreation.
- Conservation areas (identified as 'recreation (conservation values)' in the structure plan), associated with the retention and protection of existing vegetation within the north-western portion of the site.

2.4 Future land use planning processes

2.4.1 Greater Bunbury Region Scheme and Local Planning Scheme amendments

Requests to amend the GBRS and Shire of Harvey DPS No. 1 will be lodged with the respective state and local authorities, in order to appropriately rezone the site at a regional and local level to be consistent with the structure plan and enable future urban development.

It is anticipated that the future GBRS amendment would propose an 'Urban' zone over the site, consistent with the structure plan. The future Shire of Harvey DPS No. 1 amendment would propose a suitable overarching 'Residential Development' zone (or similar) across the site. In addition, the amendment is expected to insert a number of provisions within the scheme text and/or through the structure plan, which will specify the various requirements (including environmental) that would need to be addressed as part of the future development stages applicable to the site (such as subdivision and development). It is anticipated that the scheme text provisions will include a

requirement for structure plans to accommodate the local reserves, as shown on the structure plan in **Appendix A**, as well as the preparation and implementation of a number of management plans.

The proposed amendments to the GBRS and Shire of Harvey DPS No. 1 would be referred to the EPA pursuant to Section 48A of the *Environmental Protection Act 1986* (EP Act), to determine if the proposed amendments are likely to result in significant environmental impacts and therefore whether environmental assessment by the EPA is required. This is considered further in **Section 2.5**.

2.4.2 Structure Plan

Following amendment to the GBRS and Shire of Harvey DPS No. 1, a structure plan/s would typically be prepared. Based on the scale of the site and land ownership, the scheme amendment and structure plan stages will be addressed concurrently for the site, through the same documentation and plan. The purpose of a structure plan is to address and planning scheme provisions and to provide a more detailed layout of the proposed urban land uses for that area, and would include identification of features such as residential development cells, local reserves and the local road network. This has been considered as part of this document.

The EPA is not involved in the assessment of structure plans, given they are not able to be referred to the EPA for assessment under either Section 38 or Section 48A of the EP Act where a scheme amendment has been considered.

2.4.3 Subdivision and development

Following approval of the structure plan, the area within the structure plan area will be subdivided and developed for urban land uses. The subdivision application process will need to address the requirements of any relevant local scheme provisions or other requirements included within the approved structure plan. Once issued, subdivision approval/s would include a range of conditions, some of which may relate to environmental matters, which will need to be implemented as part of the subdivision and development process, before titles for subdivided lots are issued. Other components of development may be progressed through development approval, for example forward bulk earthworks or other non-subdivisional works.

It is anticipated that all environmental impacts associated with implementation of urban subdivision and development works across the site will be considered by the EPA under Section 48A of the EP Act at the GBRS and Shire of Harvey DPS No. 1 scheme amendment stages.

2.5 Future environmental assessment processes

2.5.1 *Environmental Protection Act 1986* – Section 48

All amendments to regional and local planning schemes (such as the GBRS and the Shire of Harvey DPS No. 1) are required to be referred to the EPA by the responsible authority under Section 48A of the EP Act. The EPA then makes one of the following determinations on the proposed scheme amendment:

- **The proposed scheme amendment should <u>not</u> be assessed by the EPA**, on the basis that it is considered unlikely to result in significant environmental impacts. In making this

determination, the EPA may choose to also provide informal advice in relation to how environmental factors are expected to be addressed as part of future stages of the planning and development process.

- **The proposed scheme amendment should be assessed by the EPA**, on the basis that it is considered likely to result in significant environmental impacts. An environmental impact assessment process is then undertaken and the Minister for Environment may then choose to issue a Ministerial Statement allowing the scheme to be implemented.
- **The proposed scheme amendment is by its nature incapable of being made environmentally acceptable.**

The structure plan considered by this EAMS is intended to support a scheme amendment process for both the GBRA and Shire of Harvey DPS No. 1, and as such it is expected that it will be referred to the EPA pursuant to Section 48A of the EP Act by the responsible authority (DPLH or Shire of Harvey respectively) to the EPA. The following scheme amendments are proposed:

- An amendment to the GBRS to establish an 'Urban' zone over the site, to address the recommendations of the *Bunbury-Geographe Sub-regional Strategy* and to support implementation of the structure plan.
- An amendment to Shire of Harvey DPS No. 1 to establish a 'Residential Development' zone (or similar) over the site.

2.5.2 *Environmental Protection Act 1986* – Section 38

Section 38 of the EP Act enables any person to refer a proposal likely to have a significant impact on the environment to the EPA, who then decide whether or not to assess the proposal.

Section 48I outlines that any proposal likely to have a significant impact on the environment, but which is within an area and for a land use that is subject to an assessed scheme (i.e. a scheme for which a determination has been made by the EPA under Section 48A), is not required to be referred to the EPA under Section 38 of the EP Act.

Given the environmental impacts associated with implementation of urban subdivision and development works across the site will be considered by the EPA under Section 48A of the EP Act (at the GBRS and Shire of Harvey DPS No. 1 scheme amendment stages), it is not anticipated that the implementation of urban development works within the site will be referred under Section 38 of the EP Act. However, this only applies to proposed works which are consistent with those considered through the Section 48A process and where their potential environmental impacts were considered by the EPA. The EPA may choose to defer assessment of environmental factors to subsequent stages of the planning process, which would mean Section 48I would not apply in such instances.

2.5.3 Environment Protection and Biodiversity Conservation Act 1999

Any proposed action which is likely to result in significant impacts to Matters of National Environmental Significance (MNES) listed under the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required to be referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) to determine whether it requires assessment under the EPBC Act.

The site contains occurrences and habitat for a number of MNES, including habitat for threatened black cockatoo species and western ringtail possum, as well as occurrences of the Banksia Woodlands of the Swan Coastal Plain threatened ecological community. Based on the structure plan (considered in detail in **Section 3**), impacts to MNES are likely to be minimised and referral pursuant to the EPBC Act is unlikely to be required.

The timing of EPBC Act referrals are not directly linked to the state planning processes. In an urban development context, EPBC Act referrals are typically undertaken once the development layout has been determined (for example, after the approval of the structure plan) such that the impacts to MNES can be quantified. As such, it is expected that any EPBC Act referrals determined to be required to enable implementation of the structure plan would likely be made at future stages of the land use planning process, subsequent to finalisation of the structure plan process.

2.6 Future offset requirements

Under separate state and commonwealth environmental policy frameworks, if a potential impact to an environmental value cannot be suitably mitigated through avoidance, minimisation and/or rehabilitation measures such that a significant residual impact remains, then environmental offsets may be required to counterbalance the proposed environmental impacts. This principle is applied to the environmental assessment process administered under both state and commonwealth environmental protection legislation (the EP Act and EPBC Act, respectively).

With regard to environmental matters afforded protection under the state EP Act and in the context of regional and local scheme amendments to be progressed across the site, the structure plan (considered in detail in **Section 3**) provides suitable mitigation of potential impacts through impact avoidance and minimisation measures, such that there will be no significant residual impacts for each of the relevant environmental factors. As such, no offsets are considered likely to be required for environmental matters protected under the EP Act.

With regard to MNES afforded protection under the commonwealth EPBC Act, the structure plan provides mitigation of potential impacts through impact avoidance and minimisation measures. Implementation of the structure plan is likely to result in no or minimal impacts to occurrences and habitat for MNES (including black cockatoos and the Banksia Woodlands of the Swan Coastal Plain threatened ecological community), and offsets are unlikely to be required.

3 Environmental Principles and Factors

3.1 Site context

The site is located on the Swan Coastal Plain (SCP) in the Shire of Harvey and is situated approximately 12 km east-northeast of the Bunbury town centre. Topography across the site is relatively flat however, generally grades down towards to the waterways occur within the south-eastern portion of the site (discussed further in **Section 3.6**). Elevations range from 20 metres Australian height datum (mAHD) at a localised high point around the central north, down to 7 mAHD around the southern watercourse (Thompson Surveying 2021). Topographic contours across the site are shown in **Figure 2.**

The site is generally located in an area that has historically supported agricultural land uses (predominantly grazing and crop production), however is transitioning to residential land uses. The western portion of the site contains the Dampier to Bunbury Natural Gas Pipeline (DBNGP), while the eastern portion of the site contains a Western Power high-voltage powerline. Based on publicly available aerial imagery, prior to 1996 the majority of site was cleared of native vegetation, with vegetation present within the northern portion of the site, and as scattered trees/groups of trees within the central and southern portion of the site, including two waterways within the south-eastern portion of the site. The site is currently used for predominantly grazing purposes.

The site is bounded by (see **Figure 1**):

- The BORR corridor, which is identified as a 'planning control area' under the GBRS, to support development of a major regional connector road to the north. The BORR is currently undergoing construction, with clearing and road construction commenced.
- The BORR corridor and agricultural land to the east.
- Raymond Road to the south, a major regional connector providing access to the east and west. Meadow Landing Estate is located further south, with the Collie River located approximately 700 m (in a straight line) to the south. The future 'Wanju' residential development is located to the south of Collie River.
- Forrest Highway to the west, a major regional connector between Perth and the south west region. Treendale residential and light industrial areas are located further to the west. .

3.2 Environmental principles

The five principles of environmental protection in Western Australia are set out in Section 4A of the EP Act. The manner in which these principles have been considered within the structure plan and will be addressed through future planning and development stages is presented in **Table 1**. Further detail on the environmental values within the site and proposed management are considered further in sections further below.

Table 1: EP Act Principles

Principle	Consideration
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this 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.*	The proponent has addressed the precautionary principle by developing a suitable understanding of the environmental values of the site (flora, vegetation, fauna, wetlands, surface water, groundwater, acoustic and geotechnical conditions) such that decisions regarding the structure plan and its design can be made without the risk of any potentially unknown environmental values being impacted. The structure plan design has been informed by and responds to the outcomes of environmental investigations completed to date for the BORR (which covers the portions of the site with intact remnant native vegetation and the waterways) and site investigations, through the adoption of an impact-avoidance approach to mitigate potential environmental impacts. This reduces the risk of significant environmental impacts occurring, which reduces any potential environmental risks associated with future implementation of the structure plan.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	Environmental values within the site are currently located within a number of privately owned land parcels, which are not accessible to the public, nor are these environmental values currently managed for conservation purposes. Whilst implementation of the structure plan may result in some environmental impacts, significant impact avoidance measures have been incorporated into the structure plan layout, through the proposed public open space network. As such, implementation of the structure plan will allow for the proposed public open space areas (containing environmental values) to be transferred into public land tenure and ownership, and managed for conservation purposes in the long-term. This will ensure that significant environmental values within the site will be accessible to the public and will be maintained and enhanced in the long-term for the benefit of future generations.
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	The site has been historically cleared to support agricultural land uses, however the remaining values, namely intact remnant native vegetation, remnant scattered trees and the waterway features (i.e. the areas offering potential values of conservation significance) are being preserved within public open space providing opportunities for rehabilitation (i.e. within the 'recreation (conservation values)' public open space areas), responding to this principle. The future retention and conservation of significant environmental values within the site will support the improvement of biological diversity and ecological integrity.

Continued below.

Table 1: EP Act Principles (continued)

Principle	Consideration
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 principles – those who generate pollution and waste should bear the cost of containment, avoidance and 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 structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.*	The structure plan proposes a public open space network which targets the large contiguous area of intact native vegetation in the north-western portion of the site, as well as the waterway corridors in the south-eastern portion of the site. These environmental values have been targeted for future retention through the proposed public open space areas given they are of suitable area, shape, geometry, condition and connectivity such that they have high ecological viability and resilience, which means ongoing and long-term maintenance and management costs of these areas will be minimised, while preserving the original ecological viability of the environmental values. In contrast, smaller, isolated and more disturbed areas of environmental values are typically less ecologically viable and can be more difficult to maintain or restore in the long-term, and ongoing management costs become increasingly higher, which is generally not practical for land management authorities. In some situations, these areas are suitable to support multiple uses, whereby some environmental characteristics can be retained (for example mature trees) while also allowing other recreational activities or drainage functions. Public open space areas not associated with 'conservation values' have been located to target retention of existing mature trees.
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.*	Future implementation of urban development across the site will take all reasonable and practical measures to minimise the generation of waste and its discharge into the environment.

3.3 Key environmental factors

The EPA policy framework (EPA 2021a) considers 13 environmental factors, relating to five themes; sea, land, water, air and people. For each of these factors, the EPA has identified an environmental objective aimed towards ensuring the objects and principles of the EP Act are achieved. **Table 2** outlines each of these environmental factors, the EPA's stated objective and a scoping assessment of whether each of the listed environmental factors are applicable to the structure plan.

The environmental factors determined to be applicable to the structure plan are discussed in detail in **Sections 3.4** to **0**. Other relevant matters not addressed through the factors, such as bushfire and land capability are addressed in **Section 4**. Investigations utilised to support the understanding of values within the site and nearby have been discussed in **Section 1.2**.

Table 2: EPA factors applicable to the structure plan. Shaded green cells indicate factors relevant for the assessment.

Theme	Factor	Definition of factor	Objective	Applicable to structure plan	EAMS section
Sea	Benthic Communities and Habitats	Benthic communities are biological communities that live in or on the seabed.	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	**No**. The site is situated approximately 7 km inland from the coast and does not contain or interact with the marine environment. As such, this is not an applicable factor for the structure plan or any associated future urban development of the site.	Not applicable
	Coastal Processes	Coastal processes relate to 'any action of natural forces on the coastal environment'.	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.		Not applicable
	Marine Environmental Quality	Relates to coastal waters and estuaries and the level of contaminants in water, sediments or biota or to changes in the physical or chemical properties of waters and sediments relative to a natural state.	To maintain the quality of water, sediment and biota so that environmental values are protected.		Not applicable
	Marine Fauna	It is described as 'animals that live in the ocean or rely on the ocean for all or part of their lives'.	To protect marine fauna so that biological diversity and ecological integrity are maintained.		Not applicable
Land	Flora and Vegetation	Flora is defined as native vascular plants, while vegetation relates to groupings of different flora patterned across the landscape.	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	**Yes**. The site contains a range of flora and vegetation values, of varying local and regional significance. The structure plan has been formulated such that future urban development can mitigate significant impacts to existing flora and vegetation values. Notwithstanding, this is an applicable factor for the structure plan and is considered further below.	**Section 3.4**
	Landforms	Relate to 'the distinctive, recognisable physical features of the earth's surface having a characteristic shape produced by natural processes. A landform is defined by the combination of its geology (composition) and morphology (form)'.	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	**No**. The site is generally flat and soils are of aeolian origin, comprising a palusplain wetland landform across its majority. The physical landforms which occur within the site are not significant, given they are common and widespread across the local area. As such, this is not an applicable factor for the structure plan and any associated future urban development of the site.	Not applicable

Table 2: EPA factors applicable to the structure plan. Shaded green cells indicate factors relevant for the assessment. (continued)

Theme	Factor	Definition of factor	Objective	Applicable to structure plan	EAMS section
Land (continued from above)	Subterranean Fauna	This relates to fauna which live their entire lives (obligate) below the surface of the earth and include stygofauna (aquatic/living in groundwater) and troglofauna (air-breathing/living in caves and voids).	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	**No**. It is unlikely that the site supports any significant habitat values for subterranean fauna, given the key known habitat types (such as calcretes, fractured rock aquifers and karst limestone) do not occur. Whilst there is some uncertainty as to the specific occurrence of subterranean fauna, the risk of any significant impacts to subterranean fauna as a result of any future urban development outlined in the structure plan is low, due to the proposed groundwater management strategy, as discussed in relation to the inland waters factor (see **Section 3.6**). As such, this is not an applicable factor for the structure plan and any associated future urban development of the site.	Not applicable
	Terrestrial Environmental Quality	Relates to 'the chemical, physical, biological and aesthetic characteristics of soils'	To maintain the quality of land and soils so that environmental values are protected.	**Yes**. Regional acid sulfate soil (ASS) risk mapping identifies the potential for ASS to occur within the site. Whilst investigations to date have not identified any significant terrestrial environmental quality risks associated with the proposed future urban land uses within the site, this is an applicable factor for the structure plan and is considered further below.	**Section 3.7**
	Terrestrial Fauna	It relates to animals living on land or using land (including aquatic systems) for all or part of their lives.	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	**Yes**. The site contains vegetation which has the potential to be used by native fauna, including conservation-significant fauna species. The structure plan has been designed to avoid significant impacts on existing fauna habitat values. Notwithstanding, this is an applicable factor for the structure plan and is considered further below.	**Section 3.5**

Table 2: EPA factors applicable to the structure plan. Shaded green cells indicate factors relevant for the assessment. (continued)

Theme	Factor	Definition of factor	Objective	Applicable to structure plan	EAMS section
Water	Inland Waters	Inland waters are described as 'the occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality)'. It includes groundwater and surface water.	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	**Yes**. The site contains a number of surface water features, including waterways and palusplain wetlands. The structure plan has been designed to avoid significant impacts on existing surface water and groundwater regimes to the extent that environmental values are maintained. Notwithstanding, this is an applicable factor for the structure plan and is considered further below.	**Section 3.6**
Air	Air Quality	Air quality relates to 'the chemical, physical, biological and aesthetic characteristics of air'. The EPA defines 'air' as all the air above the ground up to and including the stratosphere.	To maintain air quality and minimise emissions so that environmental values are protected.	**No**. The structure plan does not propose any future land uses within the site which would generate emissions that would significantly impact air quality. In addition, the structure plan does not propose any sensitive land uses to be established in proximity to any existing operations whose emissions significantly impact air quality. As such, this is not an applicable factor for the structure plan and any associated future urban development of the site.	Not applicable
Air (continued from above)	Greenhouse Gas Emissions	Relates to six categories of greenhouse gases namely carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulphur hexafluoride (SF6), hydro fluorocarbons (HFCs) and perfluorocarbons (PFCs) and their production.	To protect the environment and to prevent, control and abate pollution and environmental harm.	**No**. For this factor, greenhouse gas emissions from a proposal will be assessed where they exceed 100,000 tonnes of scope 1 emissions (which are emissions released to the atmosphere as a direct result of an activity) each year measured in CO2-e. While the proposed development and any clearing of native vegetation may be a consideration under this factor (as an activity that can release greenhouse gases), as existing remnant vegetation is proposed to be retained (discussed further below) and additional vegetation will be planted across the site as part of the future development for residential purposes, greenhouse gases is not considered a relevant factor and will be addressed through addressing flora and vegetation and fauna impacts.	Not applicable

Table 2: EPA factors applicable to the structure plan. Shaded green cells indicate factors relevant for the assessment. (continued)

Theme	Factor	Definition of factor	Objective	Applicable to structure plan	EAMS section
People	Social Surroundings	Social surroundings are referenced within the EP Act, and relate to a person's 'aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by [their] physical or biological surroundings'.	To protect social surroundings from significant harm.	**Yes**. The social surroundings factor encompasses a number of values/considerations and relate to protect these values and or managing impacts on people, including Aboriginal heritage and amenity impact such as noise, visual, odour or similar. A registered Aboriginal heritage site pursuant to the *Aboriginal Heritage Act 1972* is mapped as occurring within the site, associated one of the waterways. In addition, there a number of uses within or surrounding the site which could affect the amenity of future urban land uses including the Dampier to Bunbury Natural Gas Pipeline, Forrest Highway, Raymond Road, the BORR and a potential fast rail train line adjacent to Forrest Highway. Whilst all of these considerations can be suitably managed through the land use planning process or other statutory requirements to avoid significant impacts to social surrounds, this is an applicable factor for the structure plan and is considered further below.	**Section 3.8**
	Human Health	Human health is described as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity'.	To protect human health from significant harm.	**No**. This factor relates solely to impacts to human health arising from the emission of radiation. The structure plan does not propose any future land uses within the site which would produce radioactive emissions that would impact human health. In addition, the structure plan does not propose any sensitive land uses to be established in proximity to any existing operations which emit radioactive emissions impacting human health. As such, this is not an applicable factor for the structure plan and any associated future urban development of the site.	Not applicable

3.4 Flora and vegetation

3.4.1 EPA objective

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

3.4.2 Policy and guidance

Relevant policy and guidance documents for flora and vegetation, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- *Environmental Factor Guideline – Flora and Vegetation* (EPA 2016b)
- *Guidance for planning and development: Protection of naturally vegetated areas in urban and peri-urban areas* (EPA 2021b)
- *Guidance Statement No. 33. Environmental Guidance for Planning and Development* (EPA 2008)
- *Technical Guidance – Flora and Vegetation Surveys Environmental Impact Assessment (EPA 2016d)*.

3.4.3 Receiving environment

3.4.3.1 Regional context

The site is situated within the central portion of the Swan Coastal Plain, within the eastern portion of the Bassendean Dunes and the western portion of the Pinjarra Plain. This area is broadly mapped as containing six different vegetation complexes, of varying composition, as described by Heddle *et al.* (1980). Historical agricultural development and associated land clearing across the Bassendean Dune/Pinjarra Plain has resulted in a highly modified environment, with reduced areas of intact native vegetation remaining, as evidenced in **Table 3** which compares the pre-European extent of each vegetation complex to its 2018 mapped extent (DBCA 2019).

Table 3: Vegetation complexes on the Bassendean Dune and Combination Pinjarra Plain/Bassendean Dunes (DBCA 2019)

Vegetation complex	Pre-European extent (ha)	2018 extent (ha)	Percentage remaining 2018
Cannington Complex	16,661	1,965	12%
Southern River Complex	58,781	10,832	18%
Bassendean Complex-North	79,057	56,659	72%
Bassendean Complex-Central and South	87,476	23,508	27%
Bassendean Complex-North Transition	20,856	18,552	89%
Bassendean Complex-Central and South Transition	2,178	2,143	98%

Denotes vegetation complexes identified across the site

As shown in **Plate 1**, the site is largely identified within the Southern River Complex, with the western portion of the site mapped within the Bassendean Complex – Central and South. These complexes are described as (Heddle *et al.* 1980):

- Bassendean Complex - Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* - *Casuarina fraseriana* - *Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.
- Southern River Complex: Open woodland of *Eucalyptus calophylla* - *Eucalyptus marginata* - Banksia spp. with fringing woodland of *Eucalyptus rudis* - *Melaleuca rhaphiophylla* along creek beds.

The EPA (2003) outline the following objectives for regional vegetation complexes:

- Retain at least 30% of the pre-clearing extent of the ecological communities in the Greater Bunbury Region, where greater than 30% of an ecological community remains on the Swan Coastal Plain.
- Preferentially locate developments in cleared areas, where 30% or less of the pre-clearing extent of the ecological community remains on the Swan Coastal Plain.

Based on the mapping prepared by the EPA (2003), the site is within the 'constrained area' of the Greater Bunbury Region where the following objectives instead apply:

- Retain at least 10% of the pre-clearing extent of the ecological community in the 'constrained area' of the Greater Bunbury Region where greater than 10% of the ecological community remains on the Swan Coastal Plain (the natural region); or
- Retain all remaining areas of each ecological community in the 'constrained area' of the GBR where 10% or less than 10% of this ecological community remains on the Swan Coastal Plain.

The site is highly modified from its natural state as a result of historical land clearing and primarily comprises cleared land and pasture. Notwithstanding, the site does contain scattered remnant vegetation in addition to some larger, more intact areas of native vegetation. Land surrounding the site also comprises a combination of cleared agricultural land and areas of remnant vegetation.

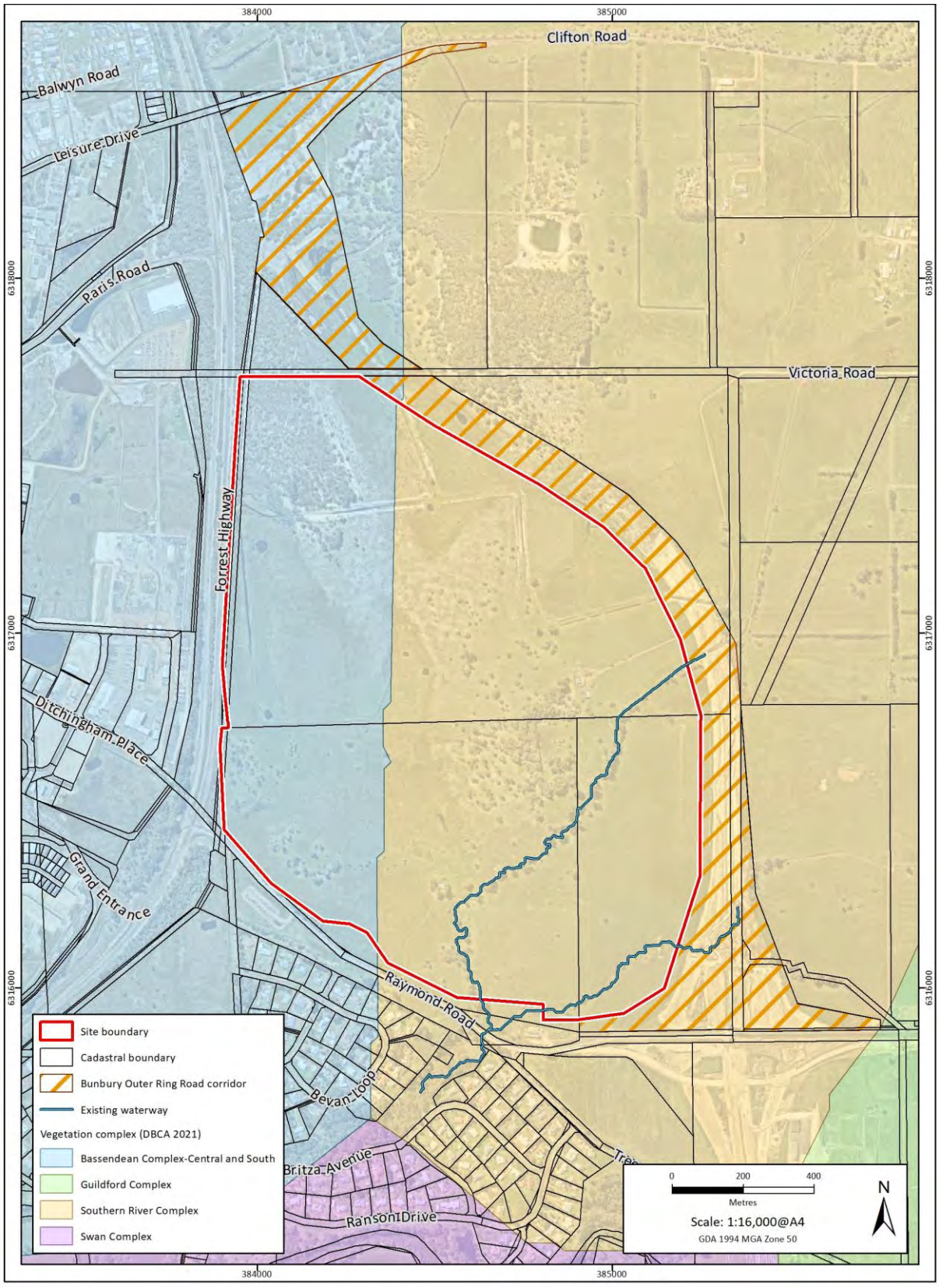


Plate 1: Vegetation complexes identified within the site (Heddle et al 1980)

3.4.3.2 Site-specific investigations

A number of flora and vegetation surveys commissioned by Main Roads WA have been undertaken in relation to the BORR development. The surveys included the northern and eastern portions of the site and surrounding land (shown in **Plate 2**) and are listed as follows:

- *Bunbury Outer Ring Road Northern and Central Sections - Vegetation and Flora Study* (BORR Team 2019b).
- *Bunbury Outer Ring Road Northern and Central Sections Response to EPA Notice of Decision to Assess: Additional Information Requirements* (BORR Team 2020a)
- *Bunbury Outer Ring Road Northern and Central Sections – Vegetation and Flora Study* (BORR 2020b)
- *Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment* (Biota Environmental Sciences 2019a)

Due to prevalence of existing rural land uses across the site, the majority of the site comprises pasture grass/weeds and scattered remnant trees. Remnant intact native vegetation within the site is generally concentrated in the north.

Surveys undertaken by the BORR (2019a; 2020b) recorded the following native plant communities within the northern and eastern portions of the site:

- *Woodland of Eucalyptus marginata over Agonis flexuosa, Banksia attenuata and B. ilicifolia.*
- *Woodland of Melaleuca preissiana and Kunzea glabrescens in damplands*
- *Agonis flexuosa closed woodland over pasture grasses*
- *Woodland of Corymbia calophylla and Agonis flexuosa over weedy grasses and herbland*
- *Isolated trees of Eucalyptus species / Agonis flexuosa and Melaleuca species in paddocks*
- *Very open woodland of Melaleuca rhaphiophylla over introduced grasses and herbs in paddocks and road reserves*
- *Low woodland of Eucalyptus rudis and Melaleuca rhaphiophylla*, associated with the waterways within the south-eastern portion of the site and would be considered 'riparian vegetation'. While not all the waterway was surveyed, values identified through the BORR would apply to the remainder of these corridors in the site.

An extract of the areas of the site included in the surveys is provided in **Plate 2**, while the location of the plant communities identified within the site is provided in **Plate 3**. Based on a site assessment by Emerge Associates, the remainder of the site, not included within the BORR investigations would be consistent with being '*highly modified/cleared*' and/or areas with '*isolated trees of Eucalyptus species / Agonis flexuosa and Melaleuca species in paddocks*', plant communities as described in BORR (2019a; 2020b). Photos of the vegetation within the site are provided in **Plate 4** to **Plate 9** below.

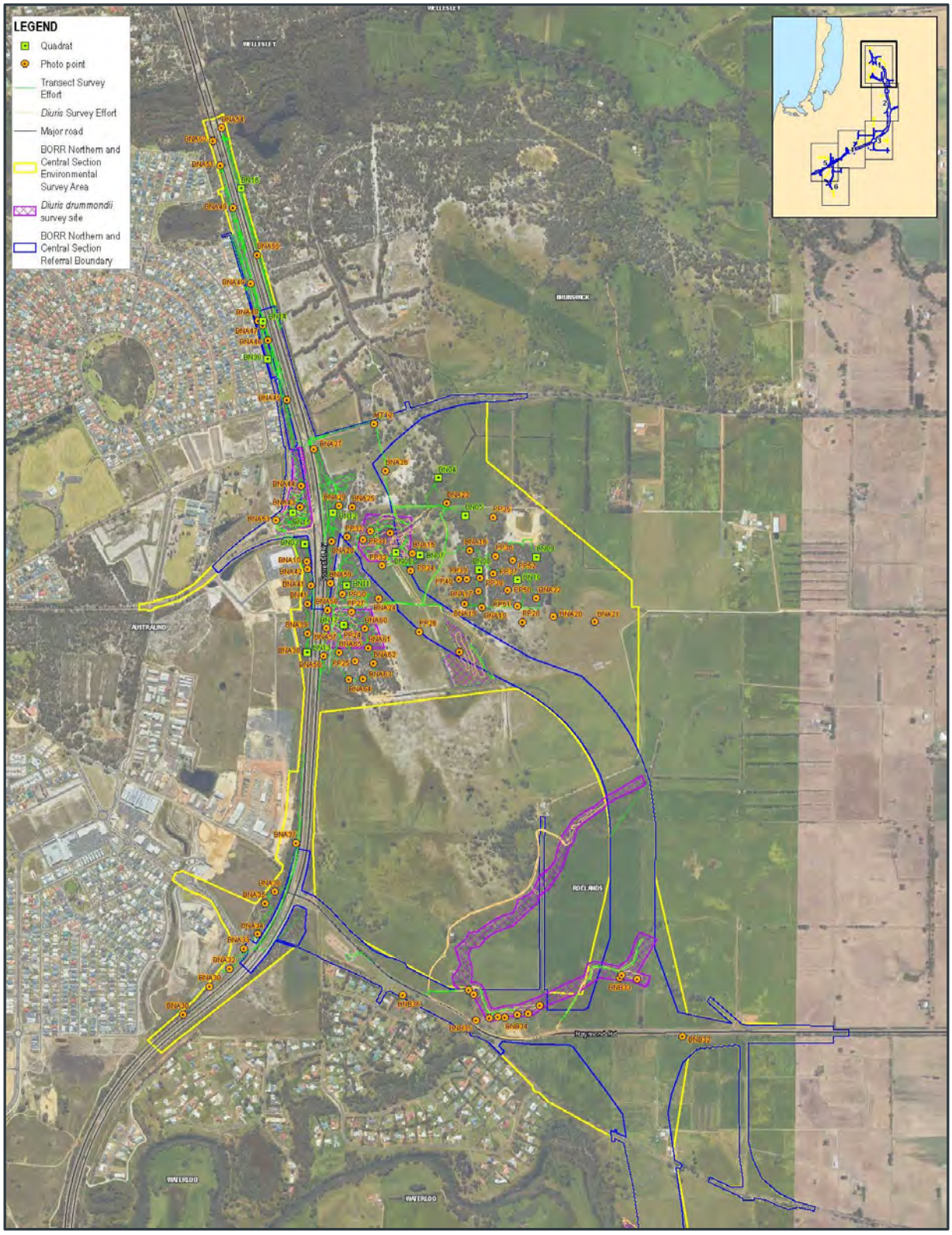


Plate 2: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing portions of the site and nearby subject to survey.

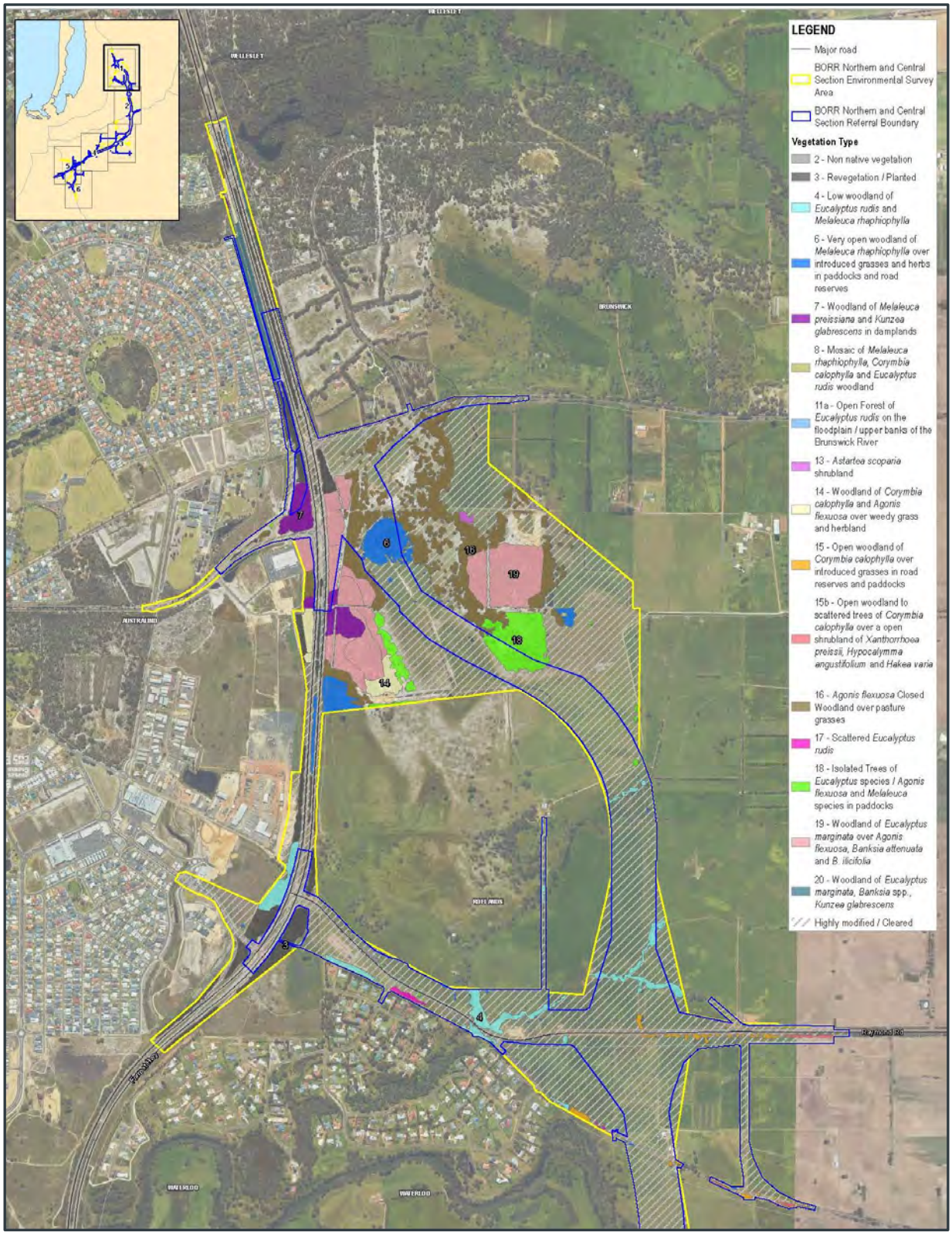


Plate 3: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing plant communities within portions of the site.



Plate 4: 'Agonis flexuosa closed woodland over pasture grasses' community within the northern portion of the site



Plate 5: 'Woodland of Eucalyptus marginata over Agonis flexuosa, Banksia attenuata and B. ilicifolia community' within the northern portion of the site.



Plate 6: 'Very open woodland of Melaleuca rhaphiophylla over introduced grasses and herbs in paddocks and road reserves' community within the north-western portion of the site



Plate 7: 'Low woodland of Eucalyptus rudis and Melaleuca rhaphiophylla community', associated with the waterways in the south-eastern portion of the site



Plate 8: 'Low woodland of Eucalyptus rudis and Melaleuca rhaphiophylla' community, associated with the waterways in the south-eastern portion of the site



Plate 9: 'Isolated trees of Eucalyptus species / Agonis flexuosa and Melaleuca species in paddocks' community throughout the site

3.4.3.3 Vegetation condition

Vegetation condition within the northern portion of the site (within the patch of intact vegetation) was assessed as ranging from 'good' to 'completely degraded', as shown in **Plate 10**. The portions of the site not included within the BORR surveys (the majority of the site) would be largely described in either a 'degraded to completely degraded' condition, where associated with areas containing trees over pasture grasses and 'completely degraded' condition where associated with pasture grass/paddock areas.

3.4.3.4 Threatened and priority ecological communities

Generally, ecological communities can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. An ecological community's structure, composition and distribution are determined by a range of environmental factors. 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the EPBC Act. TECs listed under the EPBC Act are categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a TEC listed under the EPBC Act (either critically endangered or endangered TECs) requires approval from the Commonwealth Minister for the Environment.

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and the Department of Biodiversity Conservation and Attractions (DBCA). The TECs endorsed by the State Minister are published by DBCA (DBCA 2018b). TECs are afforded direct statutory protection at a State level under the BC Act and Biodiversity Conservation Regulations 2018 (BC regulations). Ecological communities are listed under Section 27(1) and 33 of the BC Act.

Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the *Environmental Protection Act 1986*; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 of 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

An ecological community under consideration for listing as a TEC in Western Australia, but which does not yet meet survey criteria or has not been adequately defined, or which is rare but not currently threatened, is referred to as a 'priority ecological community' (PEC). Whilst PECs are not afforded statutory protection in Western Australia, they are considered during the approval process.

Based on the survey work completed, portions of the intact native vegetation within the northern portion of the site have been identified as the federally listed 'Banksia Woodlands of the Swan Coastal Plain' TEC (Banksia Woodlands TEC), based on meeting patch size and vegetation condition requirements. This same vegetation would also be considered the state listed *Banksia* dominated woodlands of the Swan Coastal Plain IBRA region Priority 3 PEC. The extent of the Banksia Woodland TEC/PEC within the site is shown in **Plate 11**.

No other vegetation within the site would be considered wither a TEC or PEC based on the extent of disturbance within the site.

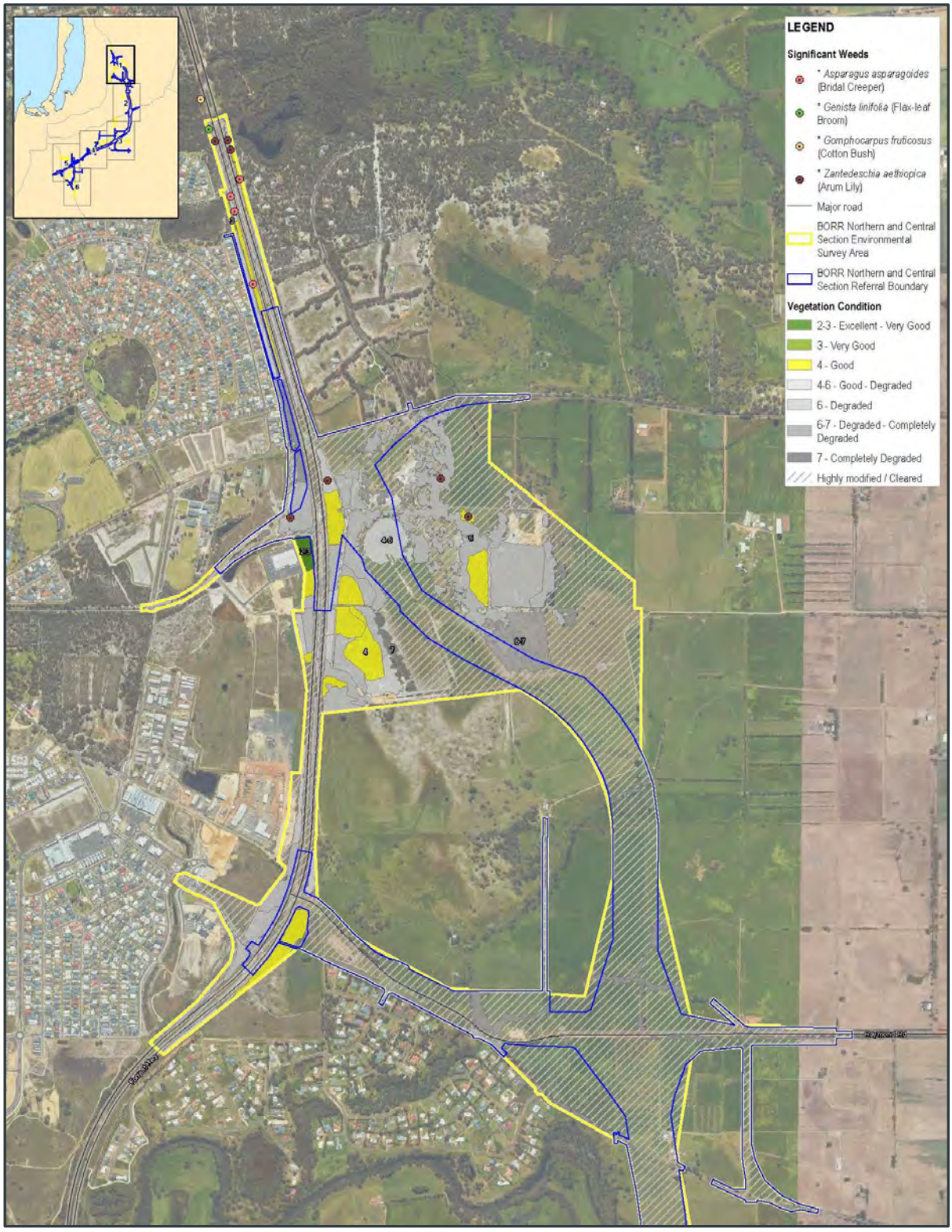


Plate 10: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing vegetation condition within portions of the site.

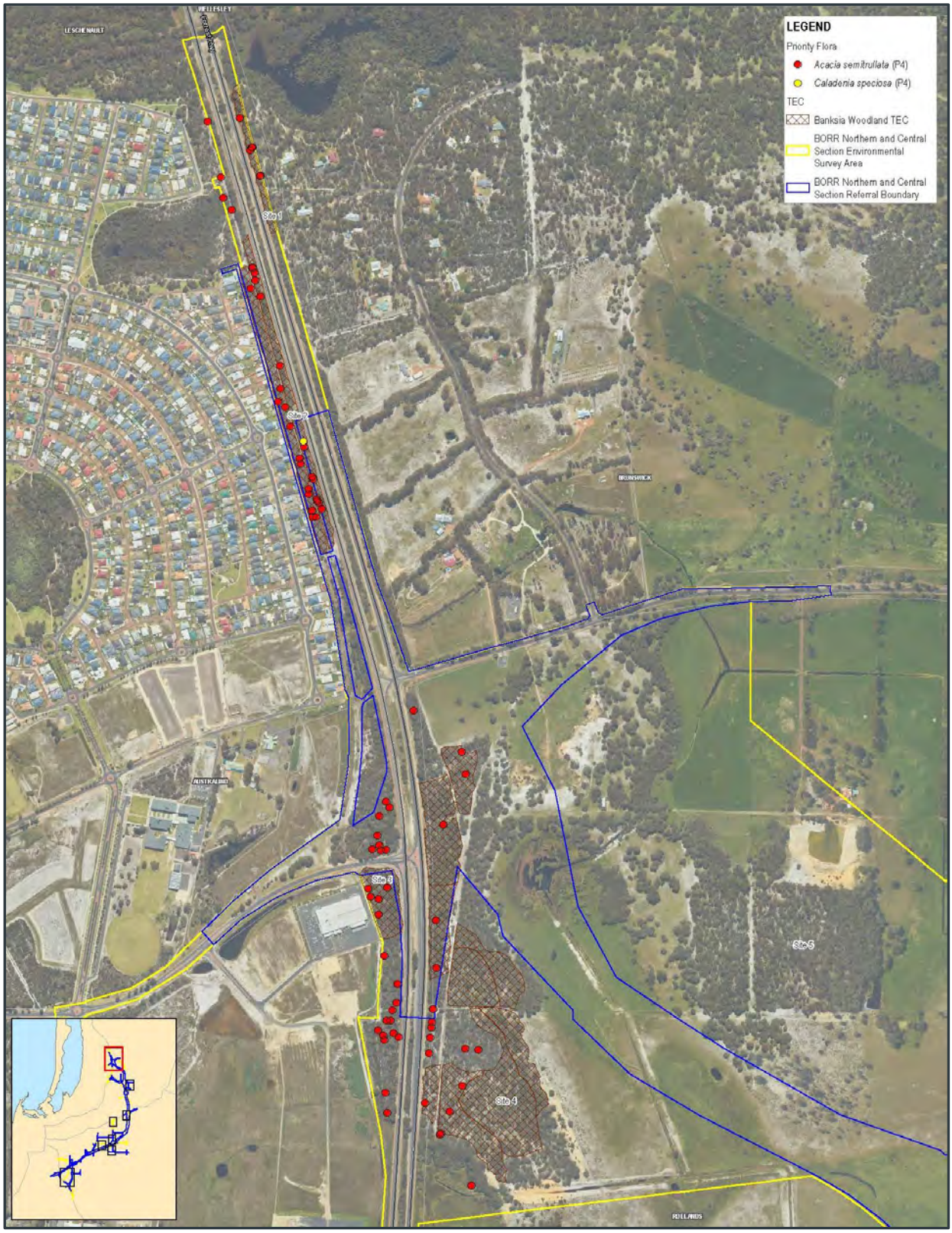


Plate 11: Extract from BORR Northern and Central Sections Vegetation and Flora Study (BORR 2020) showing extent of Banksia Woodland TEC/PEC (and priority flora) within the northern portion of the site.

3.4.3.5 Threatened and priority flora

Certain flora species that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

In Western Australia flora species may also be classed as 'threatened' under the BC Act. It is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval. Section 5(1)1 of the Act defines to take as including "… to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means" or to cause or permit the same to be done.

A search was conducted for threatened and priority flora within a 5 km radius of the site using the *Protected Matters Search Tool* (DAWE 2021), *NatureMap* (DBCA 2021) and searches conducted for the BORR flora and vegetation surveys, with the results summarised in **Table 4**.

The flora and vegetation survey undertaken by RPS (2008d) identified no threatened or priority flora as occurring within the site. Based on the site visit undertaken by Emerge Associates (October 2021), including a comparison to descriptions of the vegetation units and on ground conditions, it is considered unlikely that any occurrences of threatened or priority flora species would be found within the site (particularly the cleared areas, or areas with blue gum plantation).

The vegetation and flora study completed for the BORR (BORR Team 2020b) identified the 'Priority 4' *Acacia semitrullata* within the northern portion of the site, as shown in **Plate 11**. No other threatened or priority flora species were identified within the portions of the site surveyed (which contained the areas of intact vegetation, shown in **Plate 2**), and none are likely to occur in the portions of the site not included in these surveys given the high degree of disturbance.

Table 4: Threatened and priority flora identified through publicly available environmental databases.

Species		Conservation status	
Scientific name	**Common name**	**State**	**Federal**
Acacia semitrullata	-	Priority 4	-
Calendenia huegelii	King spider orchid	Threatened – critically endangered	Endangered
Caladenia speciosa	Sandplain white spider orchid	Priority 4	-
Carex tereticaulis	-	Priority 3	-
Diuris drummondi	Tall donkey orchid	Threatened – vulnerable	Vulnerable
Diuris micrantha	Dwarf bee orchid	Threatened – vulnerable	Vulnerable
Drakaea elastica	Glossy leaved hammer orchid	Threatened – critically endangered	Endangered
Drakaea micrantha	Dwarf hammer orchid	Threatened – endangered	Vulnerable
Eleocharis keigheryi	Keighery's Eleocharis	Threatened – vulnerable	Vulnerable

Table 4: Threatened and priority flora identified through publicly available environmental databases. (continued)

Species		Conservation status	
Scientific name	Common name	State	Federal
Lasiopetalum membranaceum	Velvet bush	Priority 3	-
Pultenaea skinneri	Skinner's Pea	Priority 4	-
Verticordia attenuata	-	Priority 3	-

3.4.3.6 Environmentally sensitive areas

Environmentally Sensitive Areas (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened, or scheduled flora, vegetation communities or ecosystems. Within an ESA none of the exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply and would indicate that the site is likely to support significant environmental values. However, exemptions under Schedule 6 of the *Environmental Protection Act 1986* still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the *Environmental Protection Act 1986*).

No ESAs are mapped within the site. The nearest ESA is located 130 m to the south, likely associated with the Collie River/Treendale Gully riparian vegetation (see **Figure 3**).

3.4.3.7 Conservation reserves

No DBCA managed lands or waters have been identified within the site. The nearest DBCA managed area in the vicinity of the site is located approximately 4.5 km west-southwest of the site and is associated with the Morangarel Nature Reserve.

3.4.4 Potential impacts of the structure plan

There are a number of potential impacts to flora and vegetation values which may occur as a result of future implementation of the structure plan, including:

- Direct impacts
  - Clearing of intact native vegetation within the northern portion of the site, the majority of which represents the federally protected Banksia Woodland TEC and state-listed Banksia Woodland PEC.
  - Clearing of the Priority 4 species *Acacia semitrullata*.
  - Clearing of riparian vegetation, associated with the waterways within the south-eastern portions of the site.
- Indirect impacts
  - Fragmentation of flora and vegetation.
  - Introduction and/or spread of weeds and or/disease.

3.4.5 Assessment of potential impacts and impact mitigation

To mitigate impacts to flora and vegetation values within the site as a result of future implementation of the structure plan, a range of impact avoidance, minimisation and rehabilitation measures are proposed, as discussed below.

3.4.5.1 Avoid

Avoidance of impacts to flora and vegetation values has been achieved through the identification of public open space (POS) in the structure plan, which will provide for the future retention of flora and vegetation values. The following 'recreation (conservation values)' POS areas (local reserves) have been proposed:

- An area in the northern portion of the site, which will support the retention and protection of the intact remnant vegetation occurring within the site, including the Banksia Woodland TEC/PEC and the priority flora species.
- Riparian corridors (discussed further in **Section 3.6**) within the south-eastern portion of the site, to protect the waterways, including the associated remnant riparian vegetation. This corridor will serve a multi-use function (supporting drainage, flood storage, conservation and recreation), however existing remnant trees will be retained.

In addition, other areas of 'recreation' POS have been strategically located across the site to support the retention of existing remnant paddock trees. These areas of POS will be used for active and passive recreation as well as drainage.

3.4.5.2 Minimise

Minimisation of impacts to flora and vegetation values will be provided at future stages of the land use planning process, through the following mitigation measures:

- Preparation and implementation of a management plan for the proposed 'recreation (conservation values)' POS areas, which will outline how these reserves will be managed to maintain existing flora and vegetation values, including minimising the introduction of weeds and/or disease. This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring these management plans to be prepared and implemented as part of the subdivision process.
  - At the subdivision and development stage; these management plans will be prepared and implemented.
- Ensuring bushfire mitigation includes consideration of the protected and retained vegetation based on no fuel load management. This ensures setbacks to address bushfire risk are accommodated outside areas of vegetation protection and retention.
- Identification of remnant trees for retention in areas of POS, with measures to be implemented through the standard subdivision process to identify and protect trees as part of development.

- Preparation and implementation of construction environmental management plan/s, to outline the proposed environmental management requirements to be implemented during construction to ensure retained conservation values and/or trees are protected. This will include consideration of construction risks such as dieback, disease, weeds, fauna and access management. This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring these management plans to be prepared and implemented as part of the subdivision process.
  - At the subdivision and development stage; these management plans will be prepared and implemented.

Implementation of the POS areas shown in the structure plan, in addition to the proposed management plan framework, will minimise a range of potential impacts to flora and vegetation values within the site, including weed introduction and/or spread of weeds and or/disease, unauthorised vehicular and pedestrian access to reserves, and edge effects.

3.4.5.3 Rehabilitate

A 10 m-wide (in total) revegetation corridor along the waterways (5 m either side, measured from top of bank) is proposed to improve the current degraded vegetation values. This has been considered as part of managing bushfire risk within the site and is considered further in **Section 4.1**. In line with the subdivision and development process, further rehabilitation mitigation measures are likely to be identified, particularly associated with the areas of intact remnant native vegetation within the northern portion of the site, and opportunities to enhance these values.

3.4.6 Predicted outcome

The EPA objective for flora and vegetation is 'to protect flora and vegetation so that biological diversity and ecological integrity are maintained'.

Implementation of the structure plan is likely to have minimal impact on the flora and vegetation values within the site, with:

- The area of intact remnant vegetation in the northern portion of the site being fully retained and protected within recreation (conservation value) POS. This includes the federally protected Banksia Woodland TEC, as well as the associated Banksia Woodland PEC and priority flora.
- Riparian vegetation associated with the waterways in the south-eastern portion of the site will be retained and protected within recreation (conservation value) POS. Road crossings of the waterways can be located to minimise the removal of existing remnant trees.
- Areas of other POS being strategically located to maximise the retention of remnant paddock trees.

The avoidance, mitigation and rehabilitation measures mean that it is unlikely any significant residual impacts will occur and the EPA objective will be met.

3.5 Terrestrial fauna

3.5.1 EPA objective

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

3.5.2 Policy and guidance

Relevant policy and guidance documents for terrestrial fauna, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- *Environmental Factor Guideline – Terrestrial Fauna* (EPA 2016a)
- *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)*.
- *Guidance for planning and development: Protection of naturally vegetated areas in urban and peri-urban areas* (EPA 2021)
- *Guidance Statement No. 33. Environmental Guidance for Planning and Development* (EPA 2008)
- *EPBC Act Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo.* (DSEWPaC 2012)
- *Western Ringtail Possum (Pseudocheirus occidentalis) Recovery Plan (DPaW 2017)*

3.5.3 Receiving environment

3.5.3.1 Regional context

As outlined in **Section 3.4**, the site is located in a highly modified landscape, resulting in generally reduced fauna habitat values. Notwithstanding, the site does contain a larger, more consolidated area of fauna habitat, primarily associated with the intact remnant vegetation in the north of the site which connects with areas to the north. Mature native paddock trees occur sporadically within the site (including in association with the waterways in the south-eastern portion of the site) and within the broader rural land across the locality and region, providing fauna habitat values, primarily for avifauna species, including state and federally protected black cockatoo species.

Overall, the site is situated within a regional landscape that has been subject to significant historical disturbance. Whilst the site provides habitat of varying composition and condition for native fauna, the fauna assemblages utilising the site would be reduced compared to what would be expected if the site had not been subject to such historical disturbances.

3.5.3.2 Site-specific investigations

A number of fauna surveys commissioned by Main Roads WA have been undertaken in relation to the BORR development. The surveys included the northern and eastern portions of the site and surrounding land (shown in) and are listed as follows:

- *Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment* (Biota Environmental Sciences 2019a)

- *Bunbury Outer Ring Road Northern and Central Sections Response to EPA Notice of Decision to Assess: Additional Information Requirements* (BORR Team 2020a)
- *Bunbury Outer Ring Road Northern and Central Sections - Vegetation and Flora Study* (BORR Team 2019b).
- *Bunbury Outer Ring Road Northern and Central Sections – Vegetation and Flora Study* (BORR 2020b).

3.5.3.3 Fauna habitat types

The site primarily comprises cleared paddocks dominated by weed species, with the majority of native vegetation cleared. As outlined within **Section 3.4**, areas of intact native vegetation are present within the northern portion of the site, and would provide the better quality habitat for fauna species. Surveys undertaken to support the BORR identified the following habitat within the surveyed portions of the site:

- Marri/Eucalyptus woodland, mix of *Corymbia calophylla* and *Eucalyptus marginata* dominated overstorey over mixed native understorey and/or paddock grasses.
- Peppermint woodland, largely uniform stands of *Agonis flexuosa* over paddock grasses.
- Dampland with *Melaleuca* shrubland and/or woodland, associated with waterway features in the south-eastern portion of the site and included trees over heavily grazed grasses.
- Artificial wetland, associated with man-made drainage channels used to create artificial wetlands.
- Highly modified/cleared.

These areas are shown in **Plate 12** below. The portions of the site not subject to the BORR surveys would be largely considered 'highly modified/cleared' from a fauna habitat perspective, although the waterway features would contain the 'dampland with *Melaleuca* shrubland and/or woodland' habitat (which is predominantly flooded gum), while the central and southern portions of the site would also contain scattered/small stands of paddock trees.

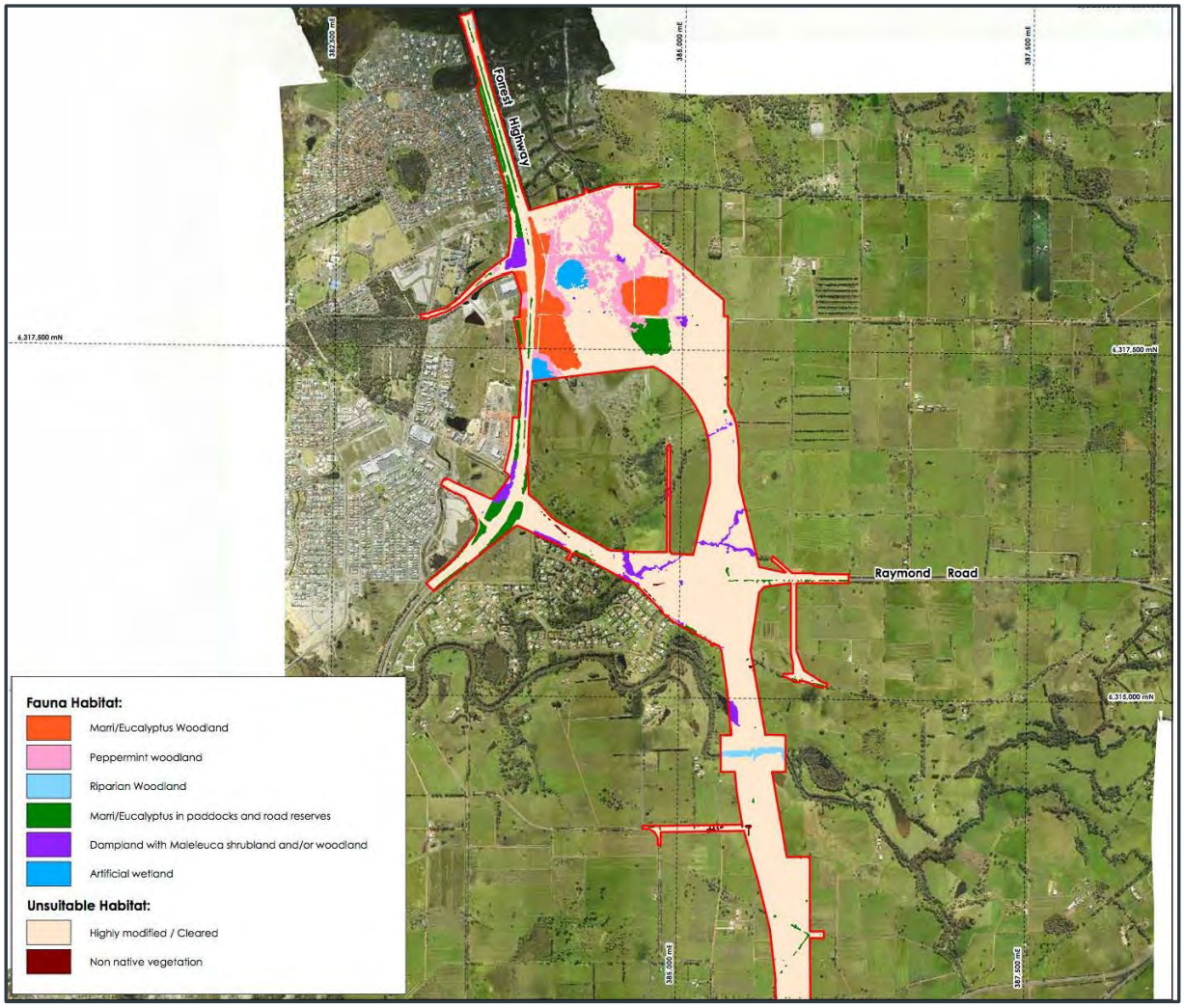


Plate 12: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) fauna habitat identified within portions of the site.

3.5.3.4 Conservation-significant species

Fauna species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, fauna species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the federal Minister for the Environment.

At a state level, fauna species are listed as 'threatened' under section sections 13, 19 and 26(2) of the BC Act. It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval. In addition to this, the DBCA maintains a list of priority fauna species which, while not considered threatened under the BC Act and therefore not protected directly, involve some concern over their long-term survival.

To understand the extent of significant fauna species that are likely to occur within the local area, searches were undertaken of the DBCA's NatureMap database (DBCA 2021a) and the federal Department of Agriculture Water and the Environment (DAWE) Protected Matters database (DAWE 2021) within approximately 1 km. The results of detailed in **Table 5** include conservation significant

species listed under the EPBC Act, BC Act or listed as DBCA priority species. It is important to note that these searches do not take into account the types and condition of fauna habitat occurring on the site, but are based on the proximity of the site to known occurrence of significant species.

Table 5: Fauna species potentially occurring within the site which are listed under State and/or Commonwealth legislation

Species	Common name	Conservation status		Likelihood of occurrence based on habitat within the site
		State	Federal	
Birds				
Actitis hypoleucos	Common s andpiper	Migratory	Migratory	Potentially. Habitat widespread in region
Apus pacificus	Fork-tailed swift	Migratory	Migratory	Potential, fly-over. Habitat widespread in region.
Ardenna carneipes	Flesh-footed shearwater	Migratory	Vulnerable	Unlikely, prefers coastal habitats.
Botaurus poiciloptilus	Australasian bittern	Endangered	Endangered	Potentially. Habitat widespread in region.
Calidris acuminata	Sharp-tailed sandpiper	Migratory	Migratory	Potentially. Habitat widespread in region.
Calidris canutus	Red knot	Endangered	Endangered, migratory	Potentially. Habitat widespread in region.
Calidris ferruginea	Curlew sandpiper	Critically endangered	Critically endangered, migratory	Potentially. Habitat widespread in region.
Calidris melanotus	Pectoral sandpiper	Migratory	Migratory	Potentially. Habitat widespread in region.
Calyptorhynchus banksii naso	Forest red-tailed black-cockatoo	Vulnerable	Vulnerable	Likely, associated with remnant vegetation in northern portion of the site and paddock trees.
Charadrius leschenaultia	Greater sand plover	Vulnerable	Vulnerable, migratory	Unlikely, prefers coastal, littoral and estuarine habitats.
Falco hypoleucos	Grey falcon	Vulnerable	Vulnerable	Potentially, however prefers arid and semi-arid habitats.
Falco peregrinus	Peregrine Falcon	Other specially protected fauna		Potentially, fly-over or foraging. Habitat widespread in region.
Motacilla cinera	Grey wagtail	Migratory	Migratory	Potentially. Habitat widespread in region.
Numenius madagascariensis	Eastern curlew	Critically endangered	Critically endangered, migratory	Unlikely, prefers coastal, littoral and estuarine habitats.
Oxyura australis	Blue-billed duck	Priority 4	-	Unlikely. Is largely wholly aquatic and requires large permanent water bodies.

Table 5: Fauna species potentially occurring within the site which are listed under State and/or Commonwealth legislation (continued)

Species	Common name	Conservation status		Likelihood of occurrence based on habitat within the site
		State	Federal	
Birds (continued)				
Rostratula australis	Australian painted snipe	Endangered	Endangered	Potentially. Habitat widespread in region.
Sternula nereis nereis	Australian fairy tern	Vulnerable	Vulnerable	Unlikely, prefers coastal, littoral and estuarine habitats.
Tringa nebularia	Common greenshank	Migratory	Migratory	Potentially. Habitat widespread in region.
Zanda baudinii	Baudin's black-cockatoo	Endangered	Endangered	Likely, associated with remnant vegetation in northern portion of the site and paddock trees.
Zandas latirostris	Carnaby's black-cockatoo	Endangered	Endangered	Likely, associated with remnant vegetation in northern portion of the site and paddock trees.
Reptiles				
Ctenotus ora	Coastal plains skink	Priority 3	-	Potentially. Likely to be associated with areas intact woodland vegetation.
Mammals				
Bettongia penicillate ogilbyi	Woylie	Critically endangered	Endangered	Unlikely. Restricted to Dryandra woodland and upper Warren Region.
Dasyurus geoffroii	Chudtich	Vulnerable	Vulnerable	Unlikely. Reliant on large patches of connected woodland vegetation.
Falsistrellus mackenziei	Western false pipistrelle	Priority 4	-	Potentially. Likely to be associated with areas intact woodland vegetation.
Hydromys chrysogaster	Water-rat	Priority 4	-	Unlikely, waterway is ephemeral.
Isoodon fusciventer	Quenda	Priority 4	-	Potentially. Likely to be associated with areas containing dense understorey vegetation.
Notamacropus irma	Western brush wallaby	Priority 4	-	Unlikely. Requires large woodland areas.
Myrmecobius fasciatus	Numbat	Endangered	Endangered	Unlikely. No recent records.

Table 5: Fauna species potentially occurring within the site which are listed under State and/or Commonwealth legislation (continued)

Species	Common name	Conservation status		Likelihood of occurrence based on habitat within the site
		State	Federal	
Mammals (continued)				
Phascogale tapoatafa subsp. Wambenger	South-western brush-tailed phascogale	Conservation dependent fauna		Potentially. Likely to be associated with areas intact woodland vegetation.
Pseudocheirus occidentalis	Western ringtail possum	Critically endangered	Critically endangered	Likely, associated with remnant vegetation in northern portion of the site.
Setonix brachyurus	Quokka	Vulnerable	Vulnerable	Unlikely. Prefers dense understorey with water nearby.
Fish				
Nannatherina balstoni	Balston's pigmy perch	Vulnerable	Vulnerable	
Invertebrates				
Westralunio carteri	Carter's freshwater mussel	Vulnerable	Vulnerable	Potentially. Aquatic, so restricted to major creeklines with shallow sandy banks

Of the species outlined in **Table 5**, the following species of conservation significance were identified as potentially occurring within the vicinity of the site and potentially subject to impact if available habitat was impacted:

- Western ringtail possum (*Pseudocheirus occidentalis*) (state and federally listed).
- Three black cockatoo species, namely: Baudin's black cockatoo (*Zanda baudinii*) (state and federally listed); Carnaby`s black cockatoo (*Zanda latirostris*) (state and federally listed) and Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (state and federally listed).
- Carter's freshwater mussel (*Westralunio carteri*) (state and federally listed)
- South-western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) (state listed).
- Quenda (*Isoodon fusciventer*) (state priority species).

Further consideration of these species is provided below.

Western ringtail possum

Western ringtail possum (*Pseudocheirus occidentalis*) is listed as 'critically endangered' under the federal (EPBC Act) and state (BC Act) legislation. It is known to occur within the south-west of Western Australia, and it's habitat is generally classed into three zones, namely: the 'Swan Coastal Plain'; the 'Southern Forests' and the 'South Coast', with the site found within the Swan Coastal Plain Zone. Habitat critical for survival is generally associated with areas that provide high nutrient foliage for food, suitable structures for protection/nesting (including suitable hollows), and canopy continuity. On the Swan Coastal Plain, critical habitat includes areas of mature unburnt peppermint woodlands with high canopy continuity, high nutrient foliage and connectivity with other patches

(DPaW, 2017). Western ringtail possums were identified as occurring within the intact native vegetation within the northern portion of the site (Biota Environmental Services 2019), namely the 'Marri/Eucalypt Woodland' and 'Peppermint Woodland' habitat types (see **Plate 12**).

Black cockatoos

Three black cockatoo species, namely: Baudin's black cockatoo (*Zanda baudinii*) (listed as 'endangered' under the federal (EPBC Act) and state (BC Act) legislation); Carnaby`s black cockatoo (*Zanda latirostris*) (listed as 'endangered' under the federal (EPBC Act) and state (BC Act) legislation) and Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) (listed as 'vulnerable' under the federal (EPBC Act) and state (BC Act) legislation) have been identified in association with the site.

As part of the investigations for the BORR (Biota Environmental Services 2019) foraging and potential breeding habitat for the three black cockatoo species was identified within the northern and southern portions of the site, including evidence of use. This included the 'Marri/Eucalypt Woodland' and 'Peppermint Woodland' habitat types within the northern portion of the site, and the 'Dampland with *Melaleuca* shrubland and/or woodland' in the southern portion of the site. The vegetation within the northern portion of the site is identified as the higher quality habitat (Biota Environmental Services 2019), as shown in **Plate 13** and **Plate 14.** Similar observations were made by Emerge Associates as part of the detailed site inspections, and it is also possible that paddock trees in the unsurveyed portions of the site could also provide foraging and potential breeding habitat.

Carter's freshwater mussel

Carter's freshwater mussel (*Westralunio carteri*) is listed as 'vulnerable' under federal (EPBC Act) and state (BC Act) legislation, and is known to occur within the south-west of Western Australia, primarily freshwater waterways within 50 km to 100 km of the coast. Carter's freshwater mussel is only likely to be associated with the agricultural drainage lines and/or waterways within the site which retain permanent water. Surveys undertaken as part of the BORR (which including consideration of habitat within the site) did not record Carter's freshwater mussel within the lower Collie River (which would include the waterways identified within the site), and this is likely due to the elevated salinity levels (WRM 2019). It is unlikely that Carter's freshwater mussel occurs within the site.

South-western brush-tailed phascogale

The south-western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) is listed as 'conservation dependent' under state (BC Act) legislation, and are generally found in dry sclerophyll forests and open woodlands. This species requires relatively large territories and will typically forage in tree canopies (Biota Environmental Services 2019). Based on the fauna habitat within the site, the south-western brush-tailed phascogale, if present, is likely to be largely limited to the 'Marri/Eucalypt Woodland' habitat type within the northern portion of the site (see **Plate 12**).

Quenda

The quenda (*Isoodon fusciventer*) is listed as 'priority 4' by DBCA, and generally prefer dense shrublands and forests. Based on the fauna habitat within the site, the quenda, if present, is likely to be limited to the 'Marri/Eucalypt Woodland' habitat type within the northern portion of the site (see **Plate 12**), where more intact native understorey is present.

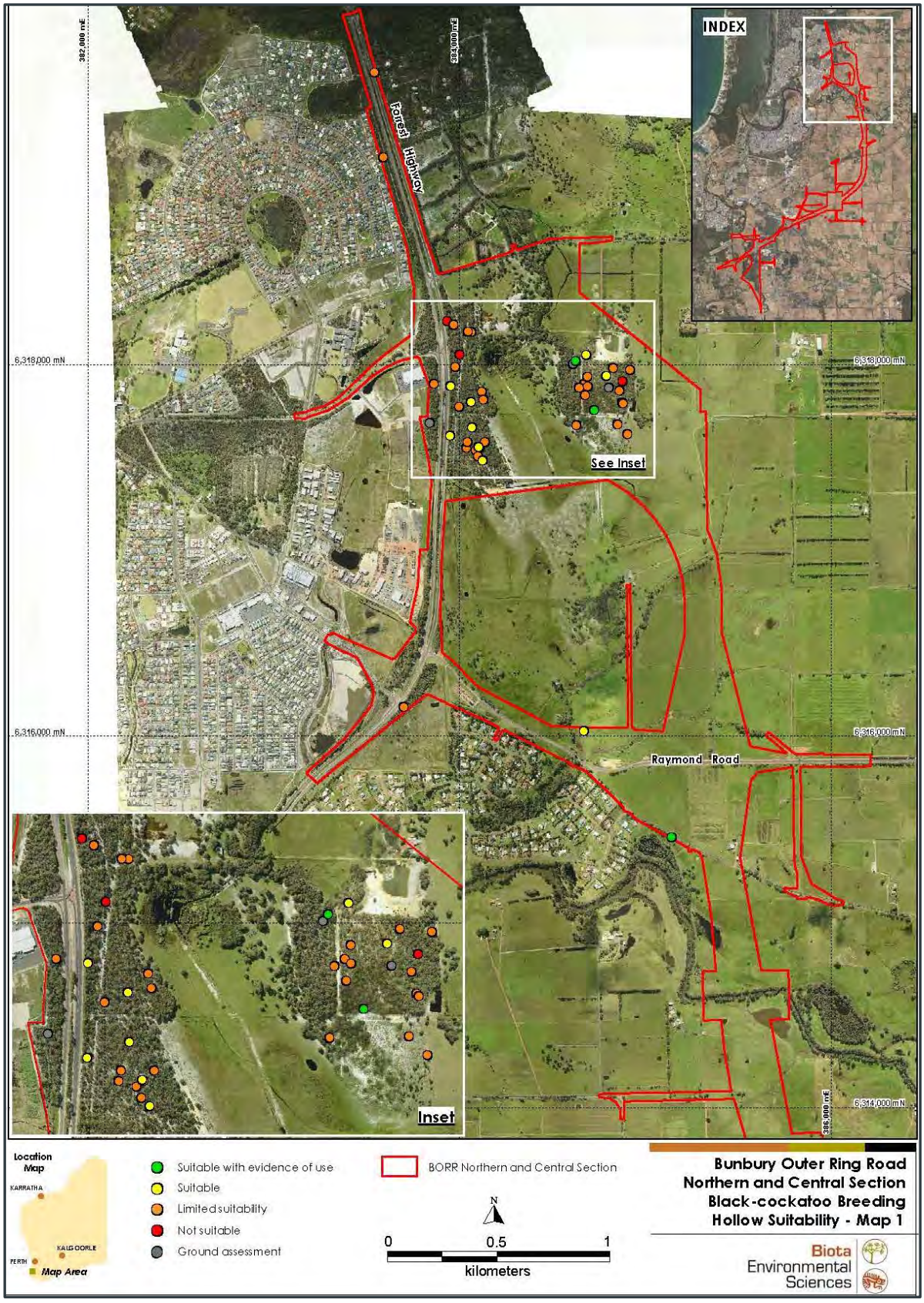


Plate 13: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) showing black cockatoo potential breeding habitat identified within portions of the site.

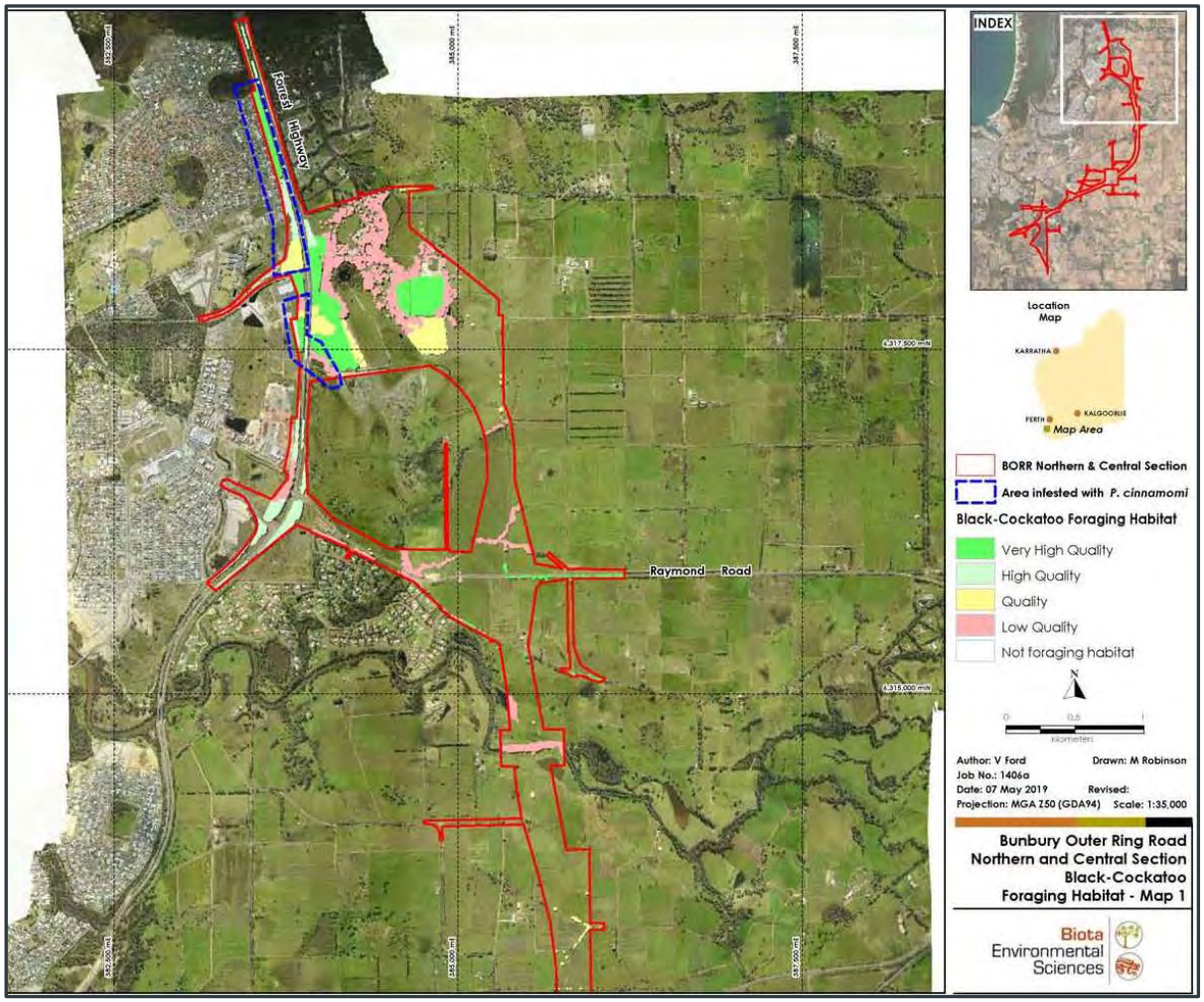


Plate 14: Extract from BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019) showing black cockatoo foraging habitat quality identified within portions of the site.

3.5.3.5 Ecological linkages

Ecological or biodiversity linkages are described as areas of native vegetation which provide a corridor or linkage (typically linear) between patches of vegetation to allow movement of flora and fauna and their genetic material through the landscape, helping to maintain metapopulations.

Ecological linkages are often continuous or near continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), has identified, and mapped regional ecological linkages within the Perth Metropolitan Region (PBP 2007).

No regional ecological linkages have been mapped within the site. The nearest identified regional ecological linkage is approximately 700 m to the south of the site, associated with the Collie River.

3.5.4 Potential impacts of the structure plan

There are a number of potential impacts to terrestrial fauna values which may occur as a result of future implementation of the structure plan, including:

- Direct impacts, namely:
  - Potential fauna interactions during future development works resulting in fauna injury or mortality.
- Indirect impacts, namely:
  - Clearing and reduction of suitable fauna habitat within the site, including:
    - General fauna habitat types.
    - Foraging and potential breeding habitat for the three black cockatoo species
    - Suitable habitat for western ringtail possum.

3.5.5 Assessment of potential impacts and impact mitigation

To mitigate impacts to terrestrial fauna values within the site as a result of future implementation of the structure plan, a range of avoidance, minimisation and rehabilitation measures are proposed, as discussed below.

3.5.5.1 Avoid

Similar to the flora and vegetation values, avoidance of impacts to fauna values has been achieved through the identification of POS in the structure plan, which will provide for the future retention of fauna habitat values. The following 'recreation (conservation values)' POS areas (local reserves) have been proposed:

- An area in the northern portion of the site, which will support the retention and protection of the intact remnant vegetation occurring within the site, including the 'Marri/Eucalypt Woodland' and 'Peppermint Woodland' habitat types. This includes the areas of higher quality habitat for the three black cockatoo species, western ringtail possum, south-western phascogale and quenda.
- Riparian corridors (discussed further in **Section 3.6**) within the south-eastern portion of the site, to protect the waterways, including the associated remnant riparian vegetation. This corridor will serve a multi-use function (supporting drainage, flood storage, conservation and recreation), however existing remnant trees will be retained.

In addition, other areas of 'recreation' POS have been strategically located across the site to support the retention of existing remnant paddock trees, which is likely to be associated with foraging and potential breeding habitat for the three black cockatoo species. These areas of POS will be used for active and passive recreation as well as drainage.

3.5.5.2 Minimise

Minimisation of impacts to flora and vegetation values will be provided at future stages of the land use planning process, through the following mitigation measures:

- Preparation and implementation of a management plan for the proposed 'recreation (conservation values)' POS areas, which will outline how these reserves will be managed to maintain existing flora and vegetation values (and associated fauna habitat values), including minimising the introduction of weeds and/or disease. This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring these management plans to be prepared and implemented as part of the subdivision process.
  - At the subdivision and development stage; these management plans will be prepared and implemented.
- Ensuring bushfire mitigation includes consideration of the protected and retained vegetation based on no fuel load management. This ensures setbacks to address bushfire risk are accommodated outside areas of vegetation protection and retention.
- Identification of remnant trees for retention in areas of POS, with measures to be implemented through the standard subdivision process to identify and protect trees as part of development.
- Preparation and implementation of construction environmental management plan/s, to outline the proposed environmental management requirements to be implemented during construction to ensure fauna (and other values) are protected. This will include consideration of construction risks such as fauna interactions and potential injury or mortality during the construction process. This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring these management plans to be prepared and implemented as part of the subdivision process.
  - At the subdivision and development stage; these management plans will be prepared and implemented.

Implementation of the POS areas shown in the structure plan, in addition to the proposed management plan framework, will minimise a range of potential impacts to fauna and fauna habitat values within the site with the majority of fauna habitat proposed to be retained.

3.5.5.3 Rehabilitate

As discussed for flora and vegetation values, a 10 m-wide (in total) revegetation corridor along the waterways (5 m either side, measured from top of bank) is proposed to improve the current degraded vegetation values, and would also improve fauna linkages across the site, particularly for species that require dense understorey and/or connected canopies (such as western ringtail possum, quenda and the south-western phascogale). Similarly, the proposed 'recreation' POS corridors adjacent to the perimeter of the site are proposed to be planted and will support enter vegetation. These revegetated areas have been assessed as a bushfire risk (discussed further in **Section 4.1**), meaning no ongoing management is assumed and is therefore likely to be a denser form of planting, and able to provide for fauna habitat and linkages across the site. In line with the subdivision and development process, further rehabilitation mitigation measures are likely to be identified, particularly associated with the areas of intact remnant native vegetation within the northern portion of the site, and opportunities to enhance these values.

3.5.6 Predicted outcome

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

Implementation of the structure plan is likely to have minimal impact on the fauna and fauna habitat values within the site, with:

- The area of intact remnant vegetation in the northern portion of the site being fully retained and protected within recreation (conservation value) POS. This includes the areas of higher quality habitat for the three black cockatoo species and western ringtail possum.
- Riparian vegetation (associated with black cockatoo foraging and potential breeding habitat) associated with the waterways in the south-eastern portion of the site will be retained and protected within recreation (conservation value) POS. Road crossings of the waterways can be located to minimise the removal of existing remnant trees, and the central corridor will be revegetated, enhancing currently degraded/lower quality fauna habitat values.
- Areas of other POS being strategically located to maximise the retention of remnant paddock trees.

The avoidance, mitigation and rehabilitation measures mean that it is unlikely any significant residual impacts will occur and the EPA objective will be met.

3.6 Inland waters

3.6.1 EPA objective

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

3.6.2 Policy and guidance

Relevant policy and guidance documents for inland waters, which have been used to assess potential impacts, include:

- *Environmental Factor Guideline – Inland Waters* (EPA 2018)
- *State Planning Policy 2.9: Water Resources* (WAPC 2006)
- *Better Urban Water Management* (WAPC 2008)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *Australian Runoff Quality: A guide to Water Sensitive Urban Design* (Engineers Australia 2006)
- *Stormwater Management Manual for Western Australia* (DoW 2007).

The *Draft State Planning Policy 2.9 Planning for Water* Policy (DPLH 2021b) and associated guidelines (DPLH 2021c) have also been considered where appropriate in the *Water Management Strategy* (Emerge Associates 2022b) and as part of this EAMS.

3.6.3 Receiving environment

A *Water Management Strategy* (WMS) (Emerge Associates 2022b) has been prepared for the site to support the structure plan. The WMS details the existing hydrological conditions of the site, which have been summarised below, and can be referred to for further detail.

3.6.3.1 Regional context

As outlined in **Section 3.4.3**, the site is situated within the central portion of the Swan Coastal Plain, within the eastern portion of the Bassendean Dunes and the western portion of the Pinjarra Plain. In a hydrological context, this portion of the Swan Coastal Plain is characterised by Pleistocene sand dunes with very low relief, leached grey siliceous sand intervening sandy and clayey swamps and gently undulating plains which overlie a broad low relief plain (associated with the Pinjarra Plain), comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems (Barnesby et al 1995) This landscape contains expressions of perched groundwater and is interspersed with a large number of poorly defined and low-incised waterway and wetland features.

3.6.3.2 Groundwater

A review of the *Water Register* (DWER 2021c) indicates that aquifers beneath the site are the comprised of the Superficial Swan (an unconfined aquifer); the Leederville (a confined aquifer); and the Yarragadee south (a confined aquifer).

Eight (8) groundwater monitoring bores were installed across the site in May 2021 and monitored for a six-month period, to capture the 2021 seasonal peak. The location of these bores is shown in **Figure 3**. In addition, one long-term DWER groundwater monitoring bore (Ref 61118032) is located within the site adjacent to the southern boundary, along Raymond Road (see **Figure 3)**.

The monitoring results have been provided in **Table 6** and indicate that the maximum groundwater level (metres below ground level (mBGL)) occurred between July to August and ranged from 0 to 6.96 mBGL. It is possible, based on the geology within the site (discussed further in **Section 3.7**), that groundwater observed may be associated with seepage due to a low permeability layer, and therefore is likely to represent perched groundwater across the central, western and south-western portions of the site (Emerge Associates 2022b).

Table 6: Measured depth to groundwater (mBGL)

	Depth to water (mBGL) based on month/year						
	05/2021	06/2021	07/2021	08/2021	09/2021	10/2021	11/2021
MW1	0.40	0.40	0.01	0.01	0.08	0.57	0.88
MW2	0.00	0.15	0.07	0.05	0.00	0.44	0.63
MW3	2.45	2.62	1.97	1.87	2.06	2.15	2.31
MW4	5.63	5.63	2.32	2.42	3.58	4.54	5.26
MW5	5.70	5.81	4.18	3.28	3.50	3.87	3.99
MW6	7.73	7.73	6.52	6.96	7.32	7.76	7.87
MW7	3.55	2.76	2.22	2.25	2.37	2.52	2.62
MW8	1.72	1.54	1.06	1.05	1.07	1.2	0.88
61118032	-	-	-	-	0.27	-	-

Overall, maximum groundwater levels beneath the site are variable, and heavily influenced by:

- Localised (clay) soil profiles, where seasonal peak levels will likely reflect local soil conditions and will be at or close to the surface (i.e. the south eastern portion of the site)
- Shallow groundwater conditions in permeable soils which are close to or at the surface and underlain by clay (i.e. in the south western portion of the site).
- Shallow groundwater conditions in permeable sand with modest (~2m) depth below the surface (i.e. central and more elevated portion of the site).

Groundwater quality sampling was undertaken across all monitoring bores (Emerge Associates 2022b). The results of the monitoring indicate elevated total nitrogen concentrations across the majority of bores in comparison to the *National Water Quality Management Strategy (NWQMS)* (Australian Government 2018) guideline values for lowland rivers. In particular, monitoring locations within the southern central area (bores MW3 and MW4) recorded elevated levels of total nitrogen between 4 – 5.2 mg/L and total phosphorus levels 0.15 - 1.77 mg/L. These levels are not unexpected based on the historical and current agricultural land uses within the site and broader region.

3.6.3.3 Wetlands

Wetlands are areas which are permanently, seasonally, or intermittently waterlogged or inundated with water. Naturally occurring wetland features are common across the Swan Coastal Plain and can contain fresh or salty water, which may be flowing or still. Wetlands can be further categorised based on their hydrological characteristics and physical structure.

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017)
- *A Directory of Important Wetlands in Australia* (DBCA 2018).

No Ramsar or listed 'important wetlands' are located within or nearby (within 1 km) of the site.

A review of the *Geomorphic Wetlands of the Swan Coastal Plain dataset* (DBCA 2021) indicates that a number of multiple use wetland (MUW) (UFI 1733, 1734 and 1748) are present across majority of the site (see **Figure 3**Figure 3), and are generally associated with existing cleared areas. A conservation category wetland (CCW) (UFI 15223) is located more than 100 m south of the site, as shown in **Figure 3**.

3.6.3.4 Groundwater dependent ecosystems

Due to the high groundwater levels across the site associated with the unconfined groundwater aquifer, many of the environmental assets within the site are likely to be groundwater dependent. This is likely to be primarily associated with existing wetland features and associated wetland-type vegetation. The surface water features within the site (discussed below), whilst primarily associated with surface-water flows, may also be groundwater-dependent due to the minimal separation to groundwater.

3.6.3.5 Surface water

The site is found within the lower Collie River catchment area. The DWER *Hydrography Linear* (DWER 2020) dataset indicates that multiple major drains, waterways and earth dams are located within the site. Two incised waterways occur within the south-eastern portion of the site (see **Figure 3**), one which runs from north-east to south-west (Treendale main drain), the other runs from east to west (Treendale branch drain) and intersect at the southern boundary of the site (near Raymond Road) and flow south-west into a CCW (UFI 1748) and eventually into to the Collie River approximately 1 km downstream. A number of surface water flow paths and modified agricultural drains occur within the central and northern portions of the site and convey surface water to the west and south-east.

As described in **Section 3.4**, the two waterways have limited riparian vegetation (largely remnant trees over grass) and are within a well incised corridor which is up to 60 m wide is some sections. A biophysical assessment of the waterways was undertaken by Emerge Associates as part of the WMS (Emerge Associates 2022b), to assist with defining an appropriate 'foreshore reserve'. The following biophysical criteria require consideration when identifying a foreshore area (WRC 2001):

- Vegetation – The extent of the riparian vegetation
- Hydrology – Extent of the floodway/floodplain
- Soil type – Soil types that typically support riparian vegetation
- Erosion – Soil types that are prone to erosion
- Topography – Landscape features
- Function – Foreshore function
- Habitat – Valuable habitat areas
- Land use – Areas that might be harmed by adjacent land use pressures.

Based on the outcomes of the biophysical assessment the following considerations were identified:

- The foreshore should include the outermost extent of the riparian vegetation immediately adjacent to the waterways as shown in **Figure 4**.

- All areas connected to the waterways with slope exceeding 10% should be within the foreshore area, as shown in **Figure 4**.
- The foreshore should generally include the outermost extent of 1% average exceedance probability (AEP) flooding determined through site specific flood modelling discussed in the WMS (Emerge Associates 2022b) and shown in **Figure 4**. The exception to this is flooding near the north eastern portion of the Treendale main drain, where part of the site is lower than the 1% AEP top water level. A site setback of 30 m from the stream centreline is proposed for this area.
- Apply a 10 m setback from the outermost extent of the above constraints to allow for the following:
  - + 4 m along entire corridor for management and fire emergency services access
  - + 6 m for earthwork/side slope integration.

Based on the above considerations, the recommended foreshore area is shown in **Figure 4**.

Results from surface water quality sampling for the waterways were found to have moderately elevated total nitrogen and total phosphorous concentrations across all sampling locations, in comparison to the NWQMS (Australian Government 2018) guideline values for lowland rivers. Results from the sites inlet sampling location showed slightly higher levels of nutrients compared with the outlet locations, but is not unexpected given the agricultural land uses upstream of the site.

3.6.3.6 Sewerage sensitive areas

The entirety of the site is classified as a sewage sensitive area by the *Government Sewerage Policy* (GSP) (DPLH 2019a). The policy defines sewage sensitive areas geographically based on proximity to a variety of environmental assets and sensitivity to on-site sewage disposal. The two classifications of relevance to the site define a sewage sensitive area as:

- Estuary catchments on the Swan and Scott Coastal Plains.
- Within 1 km of a significant wetland.

As wastewater within the site is proposed to be reticulated, no measures in accordance with the GSP are required.

3.6.3.7 Public drinking water source areas

Public Drinking Water Source Areas (PDWSAs) are proclaimed by DWER to protect identified drinking water sources, including surface water and groundwater sources (DoW 2009). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas.

The site is not located within a proclaimed PDWSA.

3.6.4 Potential impacts of the structure plan

There are a number of potential impacts to inland water values which may occur as a result of future implementation of the structure plan, including:

- Direct impacts
  - Loss of MUW features and landform.
  - Modification of existing surface water hydrology within the site, resulting in potential impacts to wetlands and waterways and associated flora and vegetation and terrestrial fauna habitat values.
  - Modification of existing groundwater hydrology within the site, resulting in potential impacts to groundwater dependent ecosystems.
- Indirect impacts
  - Downstream impacts to the Collie River from altered hydrology within the site.

3.6.5 Assessment of potential impacts and impact mitigation

Overall, impacts to hydrological values within the site can be managed appropriately in accordance with the *Better Urban Water Management* (WAPC 2008) framework, with the proposed management approach detailed within the WMS (Emerge Associates 2022b) based on:

- Maintaining the existing hydrology of the site by ensuring that the surface water post-development peak flow and discharge locations are consistent with the existing environment;
- Maintaining separation to groundwater through the use of a sub-soil drainage systems, to control groundwater levels. This will also reduce the quantity of imported fill that will be required to achieve suitable groundwater separation for residential land uses, minimising impact on landform. Sub-soil drainage systems will be installed at or above the measured maximum groundwater level, maintain the existing hydrological function.
- The use of water sensitive design (WSUD) features (including tree pits, rain gardens, treatment swales, conveyance swales, bioretention areas (BRAs), and inline storage and treatment within the existing waterway corridors) to meet peak flow rates and enable infiltration of water as close to source as possible.

The agricultural drains present across the site will be impacted by future urban development, due to the need to fill the land to achieve suitable separation to groundwater for urban land uses and to establish construction footings for built form. Notwithstanding, the majority of these surface water features are highly modified agricultural drains or flow-paths, with little to no native riparian vegetation, thus their potential loss is unlikely to be considered significant.

To mitigate impacts to inland waters within the site as a result of future implementation of the structure plan, a range of avoidance, minimisation and rehabilitation measures are proposed, as discussed below.

3.6.5.1 Avoid

Similar to the flora, vegetation and fauna values, avoidance of impacts to inland water values has been achieved through the identification of POS in the structure plan, which will provide for the future retention of the identified foreshore reserve for the two waterways in the southern portion of

the site. A 'recreation (conservation values)' POS area (local reserves) has been proposed in the south-eastern portion of the site, to protect the waterways, including the associated remnant riparian vegetation. This corridor aligns with the foreshore reserve identified through the biophysical assessment (see **Section 3.6.3.5** and **Figure 4**) and will serve a multi-use function (supporting drainage, flood storage, conservation and recreation) with existing remnant trees to be retained.

3.6.5.2 Minimise

Minimisation of impacts to inland water values have been accommodated within the structure plan, and will also be provided at future stages of the land use planning process, through the following mitigation measures:

- Provision of other areas of 'recreation' POS within the structure plan, providing for the conveyance and/or infiltration of surface water and groundwater, to ensure the existing hydrological functions within the site area maintained. These areas of POS will be used for active and passive recreation as well as drainage, and include conveyance swales around the perimeter of the site mimicking existing functions.
- Implementation of the WMS (Emerge Associates 2022b), which has been prepared to support the structure plan, and the associated water management requirements it proposes including:
  - Conserving water through use of water efficient fixtures and appliances and consumer education.
  - Reducing irrigation requirements through appropriate landscape design, and where possible seeking alternative non-potable water supply such as water provided through the Harvey Water irrigation scheme.
  - Managing small rainfall event runoff as close to source as possible
  - Ensuring the post-development peak discharge flow rates do not exceed the pre-development peak flow discharge rates.
  - Maintaining existing surface water discharge locations, including the existing waterways. Utilise best management practices to reduce the risk of nutrient loading to groundwater, stormwater and the downstream environment, including use of water sensitive urban design (WSUD) features.
- Managing perched groundwater levels using a subsoil drainage network, to be set at or above existing maximum groundwater level and to achieve the minimum separation distances recommended by the Institute of Public Works Engineering Australasia (IPWEA).
- Future preparation and implementation of Urban Water Management Plan/s, which will detail:
  - How groundwater will be managed as part of urban development, in accordance with the criteria established in the WMS, to ensure that no significant impacts to the conservation category wetlands to the south of the site occur.
  - How surface water will be managed as part of urban development, in accordance with the criteria established in the WMS, to ensure that no significant impacts to the waterways (and associated riparian vegetation and fauna habitat values) within the south-eastern portion of the site occur, as well as Treendale Gully and Collie River to the south.

  This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring the Urban Water Management Plan/s be prepared and implemented as part of the subdivision process.

- At the subdivision and development stage, the Urban Water Management Plan/s will be prepared and implemented.

- Preparation and implementation of a management plan for the proposed 'recreation (conservation values)' POS areas associated with the foreshore reserve for waterways within the south-eastern portion of the site, which will outline how these reserves will be managed to maintain existing flora and vegetation values, including minimising the introduction of weeds and/or disease. This will be implemented through the following stages of the land use planning process:
  - As part of the scheme amendment and/or structure plan, text provisions will be included requiring these management plans to be prepared and implemented as part of the subdivision process.
  - At the subdivision and development stage; the first stage of subdivision that includes the POS areas associated with the waterways will prepare a foreshore management plan for the entire corridor. This is anticipated to be a condition of subdivision approval. Detailed design for and implementation of the foreshore management plan will be prepared and implemented in accordance with stages of subdivision.
- Ensuring bushfire mitigation includes consideration of the riparian vegetation (in particular the revegetated area) based on no fuel load management. This ensures setbacks to address bushfire risk are accommodated outside areas of vegetation protection and retention.

3.6.5.3 Rehabilitate

A 10 m-wide (in total) revegetation corridor (within the determined foreshore reserve) is proposed along the waterways (5 m either side, measured from top of bank) to improve the current degraded vegetation values. This is to improve the existing vegetation values, and to provide for protection of the banks (by stabilising with vegetation to prevent erosion) and improving water quality due to additional filtering provided by the vegetation, whilst also balancing bushfire risk. In line with the subdivision and development process, further detail on the rehabilitation mitigation measures will be detailed within a management plan for the foreshore reserve.

3.6.5.4 Predicted outcome

The EPA objective for inland waters is 'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'.

Implementation of the structure plan is likely to have minimal impact on the inland water values within the site, given:

- The identified foreshore reserve associated with the waterways (Treendale main drain and Treendale branch drain) in the south eastern portion of the site will be retained and protected within recreation (conservation value) POS. The central corridor will be revegetated, supporting protection of the waterways from ongoing erosion and enhancement of water quality.
- The WMS (Emerge Associates 2022b) provides a comprehensive framework to manage water, and it will be a condition of the structure plan for future development to meet the outlined requirements. This includes maintaining the pre-development peak flow rate during flood events, infiltrating water as close to source as possible, managing groundwater levels in

accordance with current maximum groundwater levels and maximising water conservation measures including use of alternative non-potable water supply schemes.
- Areas of other POS have been strategically located to support the conveyance of surface water and has consider the retention of vegetation.

The avoidance and mitigation measures mean that it is unlikely any significant residual impacts will occur and the EPA objective will be met.

3.7 Terrestrial environmental quality

3.7.1 EPA objective

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

3.7.2 Policy and guidance

Relevant policy and guidance documents for terrestrial environmental quality, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- *Environmental Factor Guideline – Terrestrial Environmental Quality* (EPA 2016)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009)
- *Managing urban development in acid sulfate soil areas* (DWER 2015a)
- *Identification and investigation of acid sulfate soils and acidic landscapes* (DER 2015)
- *Treatment and management of soil and water in acid sulfate soil landscapes* (DWER 2015b)
- *Assessment and management of contaminated sites: Contaminated sites guidelines* (DER 2014).

3.7.3 Receiving environment

3.7.3.1 Regional context

Landforms and soil mapping identifies the site within the Swan Coastal Plain and the central eastern portion, associated with Bassendean and Southern River aeolian deposits. Each of these landform units has been discussed below:

- Bassendean: Sand plains with low dunes and occasional swamps; iron and humus podzols.
- Southern River: Sandplain with low dunes and many intervening swamps; iron and humus podzols, peats and clays.

Environmental geology for the site has been mapped by the *Geological Survey of Western Australia* (DMIRS 2021). The site consists of:

- Qhao – Alluvium, older river terraces.
- Qpa – Guilford ormation: mainly alluvial sandy clay.
- Qpb – Bassendean Sand, low rounded dunes.

Regional geology across the site is shown in **Figure 5**.

A geotechnical investigated was conducted by WML (2021) and included the installation of 72 test pits (TP01 – TP72) within the site. Test pits were excavated up to 2 mBGL and the outcomes of the investigation concluded the soil profile generally aligned with the regional mapping. Three main zones were identified under the site, namely: sand (zone 1); sand above clay (zone 2) and clay (zone 3) which are further outlined in **Table 7**. The WMS (Emerge Associates 2022b) can be referred to for further detail.

Table 7: General soil profile zones across the site

Zone	Soil layer	Depth (m)	Description
1	Sand with silt	0.0 – 2.0	Moist, grey to yellow, loose to medium dense, fine to medium grained sand with a variable percentage of silt and a trace of fine roots.
	Coffee Rock	1.1 – 2.0	Moist, black slightly mottled brown, very dense, fine to medium grained indurated sand with some silt and some organics. Generally, no thicker than 150 mm.
2	Sand / silty sand	0.0 – 1.25	Dry to moist, pale grey to yellow/orange, loose to dense, fine to medium grained sand, with a variable percentage of silt and a trace of fine to medium roots.
	Clay / sandy clay	0.7 – 2.0	Moist to wet, grey mottled orange to brown mottled grey, clay, with a variable percentage of fine to coarse sand and roots.
3	Clay / sandy clay	0.0 – 0.6	Dry to moist, stiff to hard, clay with a variable percentage of fine to medium grained sand and a trace of fine roots.
	Clay	0.4 – 2.0	Moist, stiff to hard, clay with a variable percentage of fine to medium grained sand and fine to coarse grained gravel, and a trace of relic tree roots. Gravels were often ironstone. Approximately half of the test pits performed in zone 3 observed a clay layer between 0.5-1.5m thick of medium to highly reactive soils with linear shrinkage values between 12.5-16.5%.

3.7.3.2 Acid sulfate soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged anoxic conditions and do not present any risk to the environment. When oxidised, ASS produce sulphuric acid, which can pose risks to the surrounding environment, infrastructure, and human health.

Regional acid sulfate soil (ASS) risk mapping identifies the entire site as having a 'moderate to low' risk of ASS occurring within 3 m of the natural soil surface (DWER 2021) and is shown in **Figure 6.** The risk maps do not describe the actual severity of ASS in a particular area but provide an indication of whether ASS could be present based on surface elevations and landforms.

As part of the geotechnical investigations (WML 2021), ASS sampling was undertaken within 20 test pits across the site at 0.5 m intervals. The sampling found no evidence of actual ASS, however a number of sample results indicated that potential ASS may be present within the southern and northern portions of the site, generally at greater than 1 m below the surface).

The extent of ASS which is encountered and potentially disturbed, and any management requirements, will be largely dependent upon the future extent of excavation below the natural soil

surface and any potential dewatering activities associated with development of the site. Subdivision approval is likely to receive an ASS related condition given the whole site is mapped as having a moderate to low risk.

3.7.3.3 Potential contamination

DWER Contaminated Sites Database

DWER are the responsible authority for administering the *Contaminated Sites Act 2003* and its associated procedures. DWER maintain the *Contaminated Sites Database* which holds information on known contaminated sites that have been classified by DWER as 'contaminated – remediation required', 'contaminated – restricted use' or 'remediated for restricted use'.

A search of the *Contaminated Sites Database* indicated no registered contaminated sites (as listed above) occur within the site, nor are there any registered sites within 3 km of the site (DWER 2021).

Historic and existing land uses

Based on a review of publicly available historic aerial imagery (Landgate 2019), the majority of the site was historically cleared of native vegetation prior to 1996 and has largely been used for agricultural purposes. Minimal regrowth of native vegetation has occurred within the site since clearing occurred. The area of intact vegetation within the northern portion of the site does not appear to have been subject to significant historic clearing.

The lack of visual evidence of past horticultural uses within the majority of the site (associated with fertilizer, herbicide and pesticide use) or other contaminating land uses is consistent with the site being unlikely to be contaminated. Scattered tyres and roof tin occur adjacent to sheds in the south of Lot 151 but no visual signs of contamination were observed during site investigations.

Based on a review of the guideline titled *Assessment and management of contaminated sites: Contaminated sites guidelines* (DER 2014), the existing agricultural (grazing) land use present across the majority site is not identified as potentially contaminating land uses, and therefore is not considered to represent any significant risk of potential contamination. If contamination is present, it is likely to be small scale in nature and can be managed through the typical land development process.

Unexploded ordinance

A review of the Department of Defence Unexploded Ordinance (UXO) search tool (Department of Defence 2021) did not identify any potential UXO occurrences within the local area.

3.7.4 Potential impacts of the structure plan

As previously outlined, the entire site is identified as having 'moderate to low risk' of ASS. A potential impact to terrestrial environmental quality which may occur as a result of future implementation of the structure plan includes disturbance of ASS, resulting in acidification and release of heavy metals from ASS. Disturbance of potential ASS soils could occur as a result of future urban development works, including excavation of soils (particularly for installation of deep services such as sewer), dewatering and the temporary or permanent lowering of groundwater table. As such, the extent to

which ASS is encountered and potentially disturbed (if any), and any management requirements, will be largely dependent upon the extent to which these activities occur

3.7.5 Assessment of potential impacts and impact mitigation

To mitigate impacts to terrestrial environmental quality within the site as a result of future implementation of the structure plan, a range of avoidance, minimisation and rehabilitation measures are proposed, as discussed below.

3.7.5.1 Avoid

Opportunities to avoid areas of potential ASS and potential contamination within the site would be dependent on the type and depth of works proposed as part of future urban development of the site. Based on typical urban development construction requirements (e.g. the installation of deep sewer), it is unlikely that these areas can be avoided. Notwithstanding, potential impacts to terrestrial environmental quality can be suitably minimised, as discussed below.

3.7.5.2 Minimise

Minimisation of impacts to terrestrial environmental quality will be provided at future stages of the land use planning process, largely as part of the subdivision process through the following mitigation measures:

- Completion of an ASS self-assessment form, to determine whether an ASS management plan is required.
- If determined to be required, an ASS management plan will then be prepared and implemented as part of subdivisional and development works.
- This requirement is a standard condition of subdivision approval where ASS risk has been mapped as ‘moderate to low’ or ‘high to moderate’.

3.7.5.3 Rehabilitate

No rehabilitation is proposed or expected to be required. Should soil and/or groundwater contamination occur and require remediation, this will be implemented in accordance with remediation requirements and any associated management plan, as discussed above.

3.7.6 Predicted outcome

As outlined, the EPA objective for inland waters is ‘to maintain the quality of land and soils so that environmental values are protected.’

The risk for ASS to occur within the site is within the lower risk category (‘moderate to low’) and is likely only going to be a consideration where activities extent below the permanent groundwater table, or where dewatering is required. The proposed measures that will be implemented through the typical land use planning process for urban development will suitably mitigate the risk of any potential impacts to terrestrial environmental quality, such that it is unlikely any significant residual impacts will occur and the EPA objective can be achieved.

3.8 Social surroundings

3.8.1 EPA objective

To protect social surroundings from significant harm.

3.8.2 Policy and guidance

Relevant policy and guidance documents for social surroundings, which have informed site-specific investigations and/or have been used to assess potential impacts, include:

- *Environmental Factor Guideline – Social Surroundings* (EPA 2016c)
- *Aboriginal Heritage Due Diligence Guidelines* (DAA 2013)
- *EPA Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005)
- *State Planning Policy 2.4 Basic Raw Materials* (WAPC 2000)
- *Draft State Planning Policy 2.4 Basic Raw Materials* (DPLH 2018)
- *State Planning Policy 5.4 Road and Rail Noise* (DPLH 2019c).

3.8.3 Receiving environment

3.8.3.1 Aboriginal heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* by the Department of Planning, Lands and Heritage (DPLH), containing information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia.

In accordance with the *Aboriginal Heritage Due Diligence Guidelines* (DAA 2013), a search of the AHIS online database (DAA 2021) was undertaken. The results of this search indicated that one registered Aboriginal heritage site, the 'Collie River Waugal' is located within the site (Site 16713), and is a mythological site associated with one of the waterways within the south-eastern protion of the site, the Treendale Main Drain, which as discussed previously is a tributary of the Collie River. The location of the registered Aboriginal site is shown in **Figure 7.**

Any disturbance to the site is likely to require Section 18 approval (and consultation with Aboriginal people), however would not necessarily prevent development occurring within the boundary of the site.

3.8.3.2 Non-indigenous heritage

In order to determine the actual or potential presence of sites or features of non-indigenous heritage significance within the site, a review of the Australian Heritage Database, which includes the National and Commonwealth Heritage Lists (Department of Agriculture 2019), the State Heritage Office database, which includes state and local lists (Heritage Council of WA 2021), and the Shire of Harvey Heritage Inventory (Hocking Heritage Studio 2017)was undertaken to determine if any of the following occur within the site:

- World Heritage Sites
- National Heritage Places

- Commonwealth Heritage Places
- Sites listed in the State Register of Heritage Places
- Sites listed in the Shire of Harvey Heritage List.

The outcomes of the search indicates that the site does not contain any non-indigenous heritage sites. The nearest non-indigenous heritage place is Shenton's Cottage (Place No. 26394), located approximately 500 m south of the site within the Kalgulup Regional Park (R 47717) on the northern foreshore of the Collie River and adjacent to Meadow Landing Estate.

3.8.3.3 Amenity and nearby land uses

A range of land uses can result in amenity impacts to existing or future residents, related to noise, vibration, odour and dust and/or the proposed development could impact on existing land uses. These have been considered below.

Dampier to Bunbury Natural Gas Pipeline

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement is located within the western portion of the site, directly adjacent to the Forrest Highway road reserve and is shown in **Figure 8**. *Draft Development Control Policy 4.3 Planning for High Pressure Gas Pipelines* (2016) indicates proponents will need to engage with the pipeline owner to understand potential risk mitigation measures (including setbacks). Based on *Planning Bulletin 87 High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region (WAPC 2007)* (which was prepared for the Perth Metropolitan area and will be superseded by *Development Control Policy 4.3* when it is approved), it is possible that a setback of up to 100 m may be required to residential land uses. However, setback distances are highly dependent on the construction of the pipeline (for example wall thickness, types of joins and depth of cover), and where pipeline cover is 1.2 m of greater, *Planning Bulletin 87 High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region (WAPC 2007)* indicates that residential development can occur at the boundary of the existing easement with no further buffer/separation required. The DBNGP south of Baldivis (approximately 115 km north of the site) is indicated to have a depth of cover of 1.2 m (as outlined in *Planning Bulletin 87 High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region (WAPC 2007))*, suggesting no further buffer/separation than the current easement would be required.

Road traffic noise

The site is surrounded by a number of roads that have been identified through *State Planning Policy 5.4 Road and Rail Noise* (SPP 5.4) (DPLH 2019b) as having the potential to result in noise impacts, and these roads include:

- Forrest Highway to the west, a 'strategic freight and/or major traffic route'.
- Raymond Road to the south, an 'other significant freight /traffic route.
- The BORR to the north and east, a 'proposed strategic freight route'.

The purpose of SPP 5.4 is to minimise the adverse impact of road and rail noise on noise-sensitive land use and/or development within the specified trigger distance of strategic freight and major traffic routes and other significant freight and traffic routes, namely 300 m and 200 m respectively from the road carriageway edge. Under SPP 5.4, new noise sensitive land uses (which includes

residential development) within the trigger distance of an existing/proposed transport corridor is required to meet the criteria outlined in **Table 8**. Noise exposure forecast tables provided as part of the implementation guidelines for SPP 5.4 indicate noise impacts requiring treatment (either barriers and/or quiet house design) could occur up to 150 m from the road carriageway. Investigations undertaken for the BORR (BORR Team 2019) suggest noise emissions from the existing and proposed surrounding roads will exceed 55 dB outdoor day noise target up to 500 m from the BORR, 350 m from Forrest Highway and 150 m from Raymond Road.

Based on the noise exposure forecast table provided in SPP 5.4 and the implementation guidelines, a minimum 20 m setback would be required to avoid locating noise sensitive development in areas generally not recommended for development (based on a 2 to 4 lane road), unless supported by a site-specific noise management plan.

Table 8: Noise targets as outlined within SPP 5.4

Proposal type	New/upgrade	Noise targets		
		Outdoor		Indoor
		Day (L_{Aeq}(Day) dB) (6 am -10 pm)	Night (L_{Aeq}(Night) dB) (10 pm – 6 am)	(L_{Aeq} dB)
Noise sensitive land-use and/or development	New noise sensitive land use and/or development within the trigger distance of an existing/proposed transport corridor.	55	50	L_{Aeq}(Night) dB) 40 (living and work areas) L_{Aeq}(Night) dB) 35 (bedrooms)

Treendale light industrial area

Land to the west of the site and Forrest Highway is zoned 'Urban' under the Greater Bunbury Region Scheme (Government of Western Australia 2014) and 'Light Industry' under the Shire of Harvey District Planning Scheme No. 1 (DPLH 2019b). The Shire of Harvey District Planning Scheme No. 1 (DPLH 2019b) defines light industry as industry:

a. *In which the processes carried on, the machinery used, and the goods and commodities carried to and from the premises will not cause any injury to, or will not adversely affect the amenity of the locality by reason of emission of light, noise, electrical interference, vibration, smell, fumes, smoke, vapour, steam, soot, ash, dust, waste water or other waste products; and*
b. *the establishment of which will not, or the conduct of which does not, impose an undue load on any existing or projected service for the supply or provision of water, gas, electricity, sewerage facilities, or any other like services.*

Existing land uses within the light industrial area reflect the above, and would generally be able to manage potential impacts within the boundary of each landholding and/or the light industry area based on the industries observed. Existing residential (sensitive) land uses associated with Treendale are within 200 m of this area. A concrete batching and manufacturing business is located within the light industry area, however is approximately 350 m from the site. This concrete batching facility does not appear to hold a Part V *Environmental Protection Act 1986* works approval or licence, which suggests it produces less than 100 tonnes per annum. *EPA Guidance Statement No. 3 Separation*

Distances between Industrial and Sensitive Land Uses (EPA 2005), while only used for guidance, indicates that cement product manufacturing works up to 5000 tonnes per annum in size should have between a 350 m – 500 m separation (depending upon the size of the project). Given existing sensitive land uses in Treendale are within 200 m of the existing light industry area, the 350 m separation is considered sufficient to manage potential impacts (particularly given Forrest Highway is located between the site and the light industry area).

Power lines

An existing 132 kV overhead power line and associated easement traverses the southeast portion of the site and is proposed to be realigned as part of the future urban development of the site (refer to **Appendix A**).

Visual amenity

The existing amenity of the site includes pockets of native vegetation interspersed with relatively flat cleared grassy agricultural areas used for grazing with sporadic paddock trees. Meandering linear strips of vegetation follow the base of a gently rolling valley, associated with the waterways within the southern portion of the site. The outline of the Darling Scarp is visible in the far distance to the east of the site, in particular as a viewer looks east/north-east along Raymond Road, or east from Forrest Highway with glimpses through existing vegetation within the road reserve.

Relevantly, the BORR which is currently under construction will change the viewscape to the east for the majority of nearby residential land uses, intersecting the relatively open views across the cleared paddocks, particularly given the BORR will be higher than the current existing ground levels.

3.8.4 Potential impacts of the structure plan

There are a number of potential impacts to social surroundings which may occur as a result of future implementation of the structure plan, including:

- Direct impacts
  - Disturbance of the registered Aboriginal heritage site (Site 16713) *Collie River Waugal* during future development works.
  - Generation of dust during future development works, impacting on nearby existing land uses, or future residential development as part of staged development.
  - Change to the current visual amenity for existing residential land uses to the south and east of the site, based on a largely rural landscape being converted to urban residential development.
- Indirect impacts
  - Sensitive land uses being located in areas that are subject to noise levels greater than the noise criteria determined acceptable in accordance with SPP 5.4.

3.8.5 Assessment of potential impacts and impact mitigation

To mitigate direct and indirect impacts to social surroundings, largely associated with the registered Aboriginal heritage site and amenity impacts from existing/proposed land uses on the future residential development, a range of avoidance, minimisation and rehabilitation measures are proposed, as discussed below.

3.8.5.1 Avoid

Aboriginal heritage

Similar to the flora, vegetation and fauna values, avoidance of impacts to the registered Aboriginal heritage values has been achieved through the identification of POS in the structure plan, which will provide for the future retention of the mapped registered site. A 'recreation (conservation values)' POS area (local reserves) has been proposed in the south-eastern portion of the site, to protect the waterways, including the associated remnant riparian vegetation which are associated with the registered heritage site. Provision of the Aboriginal heritage site within future POS will also enable future generations to access and utilise this area, compared to the existing land arrangements which mean the land is held in private freehold title and not accessible to the public without permission. It is possible that some disturbance to the registered Aboriginal heritage site will occur as part of the, but this is likely to be limited to revegetating the area within 10 m of the waterway. Minimising impacts is discussed further below.

Amenity and nearby land uses

With regard to amenity and nearby land uses:

- DBNGP
  - Impacts to the DBNGP is avoided through the provision of 'recreation' POS adjacent to the western boundary of the site, which accommodates the 15.9 m-wide DBNGP easement, currently identified within the site (shown in **Figure 8**). This 'recreation' POS corridor prevents the proposed residential development from encroaching within the identified easement.
- Noise impacts
  - Given the presence of the development within 300 m strategic freight and major traffic routes and other significant freight and traffic routes around the perimeter of the site, it is not possible to avoid development within the assessment trigger area under SPP 5.4. Notwithstanding residential land uses being located within the SPP 5.4 trigger area, potential impacts to amenity for future sensitive land uses can be suitably minimised, as discussed below.
- Visual amenity
  - Similar to noise, it is not possible to avoid development that would change the current visual landscape, however notwithstanding this, potential impacts to visual amenity for existing nearby residential land uses can be suitably minimised particularly in the context of the BORR that is currently being constructed, as discussed below.

3.8.5.2 Minimise

Aboriginal heritage

Impacts to the Aboriginal heritage site will be largely associated with potential disturbance that may result as part of rehabilitating the existing waterway (discussed in **Section 3.4.5.3** and **Section 3.6.5.3**) or installing road crossings and services. Minimisation of impacts to Aboriginal heritage values have been accommodated within the structure plan, and will also be provided for as part of future stages of the land use planning process, through the following mitigation measures:

- Consultation with local Aboriginal groups to understand key concerns and recommendations with regard to managing potential impacts. This is likely to include requirement to prepare an Aboriginal Heritage Management Plan, to outline actions and responsibilities.
- Locating any road crossings, pedestrian crossings, services or similar to minimise disturbance of the areas identified as part of the registered Aboriginal heritage site.
- If required, depending upon the extent of any works, seeking appropriate approvals in accordance with the legal framework. Currently, Section 18 approval pursuant to the *Aboriginal Heritage Act 1972* would be required, however recently the Western Australian government passed the *Aboriginal Cultural Heritage Act 2021* and when this comes into full effect, approval pursuant to this act will be required.
- Implementation of the WMS (Emerge Associates 2022b) and any associated UWMPs, to assist with protecting and enhancing water quality of the waterway. This includes infiltrating rainfall as close to source as possible, and implementing best management practices to reduce the risk of nutrient loading to groundwater, stormwater and the downstream environment, including use of WSUD features.
- Preparation and implementation of a management plan for the proposed 'recreation (conservation values)' POS areas associated with the foreshore reserve for waterways within the south-eastern portion of the site, which will outline how these reserves will be managed to maintain existing flora and vegetation values, including minimising the introduction of weeds and/or disease, and protecting the Aboriginal heritage site and managing in accordance with any approvals. This will be a requirement of the subdivision process.
- Ensuring bushfire mitigation includes consideration of the riparian vegetation (in particular the revegetated area) based on no fuel load management. This ensures setbacks to address bushfire risk are accommodated outside areas of vegetation protection and retention, which form part of the registered Aboriginal heritage sit boundary.

Amenity and nearby land uses

Minimisation of impacts to amenity values, and in particular addressing noise impacts from the surrounding strategic freight and major traffic routes and visual amenity, have been accommodated within the structure plan, and will also be provided at future stages of the land use planning process, through the following mitigation measures:

- **Noise impacts**
  - Provision of other areas of 'recreation' POS within the structure plan as well as a 'perimeter' road, providing a minimum 40 m setback between the road carriageway within Forrest Highway, the BORR and Raymond Road and future residential (noise sensitive)

development. As outlined above, based on the noise exposure forecast table provided in SPP 5.4, a minimum 20 m setback would be required to avoid locating noise sensitive development in areas generally not recommended for development, unless supported by a site-specific noise management plan. The setback accommodated by the proposed spatial layout accommodates this requirement. The strata-titled village within the south eastern portion of the site does not currently show any POS areas or similar, but suitable setbacks can be addressed as part of future detailed design for this area.

- Provision of 'recreation' POS around perimeter of the site, which could support the implementation of a noise barrier or similar if required. The requirement for this will be dependent upon site specific noise investigations to be undertaken as part of the subdivision process, however has been spatially accommodated in the structure plan.
- Preparation of a site-specific noise assessment and management plan based on finished floor levels predicted within the site, to address the objective of SPP 5.4 to achieve:
  - Indoor levels in accordance with those summarised in **Table 8**.
  - A reasonable degree of acoustic amenity for outdoor living areas on each residential lot.

  In particular, a noise management plan would be aimed at exploring possible ways to achieve the outdoor noise target and/or a reasonable degree of amenity, particularly for those lots closest to the freight and traffic corridors.
- Requirement for construction of future habitable buildings in accordance with quiet house design requirements. This is a typical requirement of the subdivision and development process, and generally enforced through the preparation and implementation of a local development plan or similar.
- Notifications on title, to warn prospective lot owners of likely noise impacts from nearby freight and major traffic corridors. This requirement is a typical condition of subdivision approval for lots within the SPP 5.4 trigger area (shown in **Figure 8**).

- **Dust impacts**
  - Preparation and implementation of a construction management plan or similar, to address dust impacts in consideration of the DWER dust control guidelines for development sites. This can be addressed as part of the subdivision and development stage and is a typical requirement of the urban development process.
- **Visual amenity**
  - Provision of other areas of 'recreation' POS around the perimeter of the site within the structure plan, which will support buffer planting. These areas of POS will be used for active and passive recreation as well as drainage, and will provide visual screening of the future development from nearby residential land uses.
  - Provision of 'recreation (conservation values)' POS areas (local reserves) within the northern and south-eastern portions of the site, to protect existing intact native vegetation and the waterways and associated remnant riparian vegetation respectively. The provision of this reserve will assist with maintaining the existing green links across the site, provide for view corridors to the Darling Scarp and natural areas.
  - Minimising extent of cut and fill across the site, reducing changes to the existing contours which in turn will maximise tree retention (and current views of tree tops) and existing views across to the Darling Scarp (where not intersected by the BORR to the east of the site).

3.8.5.3 Rehabilitate

Aboriginal heritage

As discussed in previous sections, a 10 m-wide (in total) revegetation corridor (5 m either side of the waterway, measured from top of bank) is proposed to improve the current degraded vegetation values immediately adjacent to the waterway (which also aligns with the mapped registered Aboriginal heritage site). This would improve fauna linkages across the site and also assist with improving water quality. Any future rehabilitation activities would be undertaken in accordance with relevant Aboriginal heritage approvals and based on consultation with local Aboriginal people.

Amenity and nearby land uses

No rehabilitation is proposed or expected to be required to address amenity impacts, although the proposed 'recreation' POS corridors adjacent to the perimeter of the site are proposed to be planted and will support denser form of planting. These corridors have been assessed as a bushfire risk (discussed further in **Section 4.1**), meaning no ongoing management is assumed and is therefore likely to be a denser form of planting, providing screening but also able to provide for fauna habitat and ecological linkages across the site. In line with the subdivision and development process, further rehabilitation mitigation measures are likely to be identified, particularly associated with the areas of intact remnant native vegetation within the northern portion of the site, and opportunities to enhance these values.

3.8.6 Predicted outcome

The EPA objective for social surroundings is 'to protect social surroundings from significant harm.'

Implementation of the structure plan is likely to have minimal impact on the existing social surroundings (in particular Aboriginal heritage) and future sensitive land uses within the site, with:

- The registered Aboriginal heritage site and associated waterway and vegetation will be retained and protected within recreation (conservation value) POS. Road crossings of the waterways can be located to minimise the removal of existing remnant trees and disturbance to the registered Aboriginal heritage site, and the central corridor will be revegetated, enhancing currently degraded/lower quality areas of vegetation and fauna habitat.
- Areas of other POS and the internal perimeter roads strategically located to provide separation between the existing and proposed strategic freight and major traffic corridors, enabling the requirements of SPP 5.4 to be satisfied. These corridors will also support the implementation of visual screening planting and a noise barrier or similar if this is deemed to be required.
- Areas of other POS being strategically located to maximise the retention of remnant paddock trees and a tree canopy across the site from a viewscape perspective.

A range of site-specific investigations will be undertaken as part of future stages of the land use planning process as part of addressing Aboriginal heritage and noise mitigation in further detail. Notwithstanding, the avoidance, mitigation and rehabilitation measures mean that it is unlikely any significant residual impacts will occur and the EPA objective will be met.

4 Other Environmental Matters

This section considers environmental and/or landscape considerations relevant to considering environmental impact but not specifically addressed by the EPA environmental factors, detailed within the *Statement of Environmental Principles, Factors and Objectives* (EPA 2021a). Specifically, bushfire and land capability considerations have been addressed in the context of the applicable state government policy frameworks.

4.1 Bushfire

Portions of the site has been identified as bushfire prone under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2021), as shown in **Plate 15**. The identification of a site within an area declared as bushfire prone necessitates that further assessment of the determined bushfire risk of the proposed development is to be undertaken in accordance with *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959)) and satisfactory compliance of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015b) and *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021). A *Bushfire Management Plan* (Emerge Associates 2022a) has been prepared for the site to support the proposed scheme amendment and structure plan, and the outcomes have been summarised below, including an outline of key assumptions regarding environmental values.

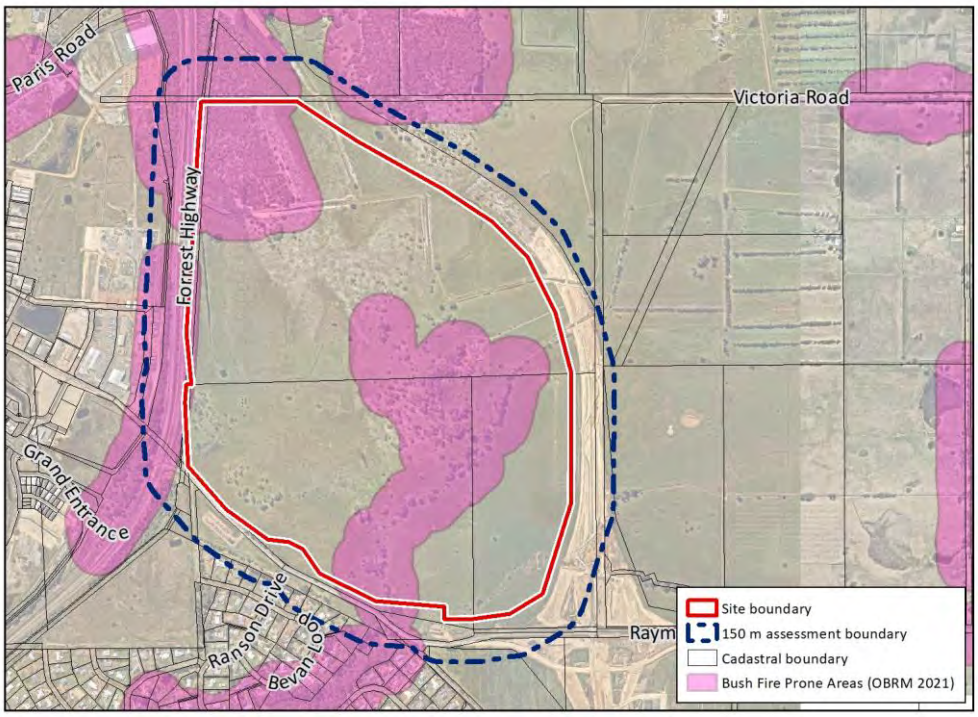


Plate 15: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021)

Under SPP 3.7, residential development should be located in areas subject to a 'moderate' or 'low' risk and/or able to achieve a bushfire attack level (BAL) or BAL-29 or less.

The existing vegetation within the site and 150 m of the site has been classified in accordance with AS 3959, which has then informed a bushfire hazard level assessment. This bushfire hazard level assessment indicates that the majority of the site is subject to a 'moderate' bushfire hazard as it is largely cleared paddock areas. As part of assessing the long-term bushfire risk to the site, vegetation classifications have been detailed for a post-development scenario (based on the structure plan) in order to inform a bushfire attack level (BAL) assessment to determine areas subject to BAL-LOW to BAL-FZ. Relevant to the protection of environmental values, particularly flora, vegetation, fauna, waterway and Aboriginal heritage values, the following assumptions have underpinned the BAL assessment:

- Vegetation outside the site is assumed to remain in its existing condition (or where BORR is located, to be revegetated), with no modification to vegetation external to the site required to manage bushfire risk for proposed future residential development.
- Within the 'recreation (conservation values)' POS area in the northern portion of the site, existing remnant vegetation will be retained and protected, with no vegetation modification for bushfire purposes assumed. This vegetation achieves a 'forest' classification, the highest vegetation classification from a bushfire risk perspective.
- Within the 'recreation (conservation values)' POS area associated with the waterways in the southern portion of the site:
  - A 10 m -wide (in total) revegetated corridor (to achieve a 'forest' classification) measured 5 m either side of the waterways (top of bank) has been assumed.
  - The remainder of the corridor will also be unmanaged, but in accordance with the existing grassland (cleared paddock areas with scattered trees) classification, as part of supporting recreation activities within the corridor and to accommodate seasonal variability in maintenance regimes.
- The other 'recreation' POS corridors around the perimeter of the site will be planted to achieve a scrub (Class D) classification and unmanaged. Scrub classification aligns with existing vegetation planted adjacent to Forrest Highway.

Areas of bushfire risk and futures areas within the site likely to be bushfire prone (based on being within 100 m of areas of risk) and requiring further assessment in the future have been shown in **Figure 9**.

The BMP (Emerge Associates 2022a) can be referred to for further detail, but demonstrates that the structure plan can meet an acceptable solution for each of the applicable bushfire protection criteria outlined in the Guidelines, namely:

- **Element 1 Location:** The majority of the site is subject to a 'moderate' or less bushfire hazard level, and the structure plan provides for sufficient areas within the site that can achieve BAL-29 or less without requiring modification of areas of vegetation proposed for retention and/or revegetation.
- **Element 2 Siting and Design:** Following on from Element 1, and in consideration of the environmental values proposed to be retained, accommodated (i.e. planting for visual amenity) or enhanced (i.e. revegetation of the waterways), there is sufficient area available within the site for future residential lots (and in particular habitable buildings) to achieve a BAL rating of BAL-29 or less (see **Figure 9**). Separation from bushfire hazards is achieved through the provision of

perimeter public roads, low threat landscaping within the managed POS areas and in-lot setbacks.

- **Element 3 Vehicular Access:** The structure plan provides for an internal interconnected public road network which connects to Forrest Highway and Raymond Road at defined locations, which these locations minimising the requirement for vegetation removal.
- **Element 4 Water:** water supply for fire-fighting purposes will be satisfied through the provision of a reticulated water network.

The anticipated environmental impacts of the structure plan have specifically considered the bushfire management requirements. The bushfire assessment demonstrates that the requirements of SPP 3.7 and the associated Guidelines can be satisfied whilst also protecting and enhancing environmental values.

4.2 Land capability

Lot 152 within the south-eastern portion of the site is identified within the *Greater Bunbury Region Scheme Priority Agricultural Land Policy 2017* (DPLH 2017b) as 'Priority Agricultural Land', which means it has been identified as having soils suitable for supporting extensive and intensive agricultural activities, however land uses are required to consider the potential for nutrient export and manage land and activities accordingly. A 500 m wide 'Priority Agricultural Land Policy' buffer extending into Lots 151 and 153 (DPLH 2017b) based on the proximity of these lots to Lot 152 and is intended to protect the primacy of agricultural activities.

The 'Priority Agricultural Land' area extends over a larger area to the north-east, east and south-east of the site, with Lot 152 within the site forming a very small portion of priority agricultural land in the region. Development of the site would not decrease available agricultural land to any significant extent, with the BORR providing an appropriate and logical boundary between agriculture areas and urban development. The BORR also provides a separation and buffer between residential development in the site and the priority agricultural land to the east, and therefore no buffer needs to be accommodated within the site.

Future residential development of the land, as identified in the *Bunbury Geographe Sub-regional Strategy* (WPAC 2022), is not expected to have a significant impact on availability of agricultural land. It is anticipated that the *Greater Bunbury Region Scheme Priority Agricultural Land Policy 2017* (DPLH 2017b) will be updated following rezoning of the site and approval of the structure plan.

5 Holistic Impact Assessment

Overall, the structure plan provides a local-level framework across the site to achieve conservation outcomes for a range of environmental values, which will be implemented through future stages of the urban development process. This is primarily achieved through the proposed 'recreation (conservation values)' POS areas in the northern and south-eastern portions of the site shown in the structure plan (see **Appendix A**). These areas also support the maintenance of the existing hydrological functions within the site, and will enable the enhancement of water quality.

5.1 Summary of predicted environmental outcomes

The following is a summary of the predicted environmental outcomes for the key environmental values within the site, which will be achieved through implementation of the structure plan design as part of future stages of the land use planning process and the associated future urban development of the site:

- Retention of the majority of black cockatoo foraging, roosting and potential breeding habitat through the 'recreation (conservation values)' POS in the northern portion of the site, and strategic location of other POS areas where the greatest density of paddock trees are present.
- Retention of the western ringtail possum habitat through the 'recreation (conservation values)' POS in the northern portion of the site, and enhancement of ecological linkages through the perimeter POS corridors, which are assumed to be planted/revegetated to provide for visual screening.
- Retention of the Banksia Woodland TEC and Priority 4 flora species occurring in the north of the site through the provision of the 'recreation (conservation values)' POS.
- Retention and enhancement of the waterways in the southeast of the site, including protection of existing riparian vegetation. This was achieved through the determination of a foreshore reserve which has been protected in 'recreation (conservation values)' POS.
- Maintaining existing water flows from the site whilst also enhancing water quality entering the Collie River, through infiltration of rainfall as close to source as possible, detaining water on site through the use of flood storage and provision for water sensitive urban design features as part of future development.
- Retention and protection of the registered Aboriginal heritage site (Site 16713) as part of the 'recreation (conservation values)' POS within the south-eastern portion of the site.
- Minimising amenity impacts on future residents by considering potential noise impacts from Forrest Highway, the BORR and Raymond Road, and accommodating setbacks that mean noise is likely to be able to be mostly addressed through quiet house design.
- Avoiding the DBNGP through the provision of 'recreation' POS adjacent to the western boundary of the site, which accommodates the 15.9 m-wide DBNGP easement, currently identified within the site. This 'recreation' POS corridor prevents the proposed residential development from encroaching within the identified easement.

5.2 Structure plan response to planning framework

The structure plan has been prepared to be consistent with *Bunbury-Geographe Sub-regional Strategy* (WAPC 2022) and can address the key issues identified for the strategy as they relate to the environment. A summary of the key environmental planning considerations (and how the proposed structure plan addresses these is provided in **Table 9**. It is likely that other measures will be employed through the implementation of the proposed development, including addressing housing construction, waste, energy and water needs holistically and in consideration of best practice sustainability practices.

Table 9: East Treendale urban expansion area key planning issues with regard to the environment (WAPC 2022)

Key considerations	Response for potential urban development of the site
Balancing growth with the protection of areas with high biodiversity significance and other environmental values.	• The proposed structure provides for the retention and protection of the areas of biodiversity, including: o Intact native vegetation within the northern portion of the site, which contains a threatened and priority ecological communities, priority flora and habitat for conservation significant fauna species such as western ringtail possum and the three black cockatoo species. This vegetation is also a vegetation complex which has less than 30% remaining, so retention would contribute to the broader conservation estate. o Two waterways within the southern portion of the site and the associated riparian vegetation and Aboriginal heritage values. A foreshore reserve has been determined for these waterways, and is wholly retained within a foreshore reserve. o A network of public open space areas which have been strategically located to maximise the retention of existing trees.
The need to sustainably manage natural resources, including minimising fill on development sites and encouraging lightweight construction	• A key requirement for fill is often to manage groundwater levels close to the natural soil surface. Groundwater is close to the surface in portions of the site, however, the proposed development of the site aims to minimise the requirement for fill through strategies such as grading the existing clay layer towards roads and the waterways; using subsoils beneath road reserves and drainage features; using a conveyance (perimeter) swale to direct water, rather than all pipes. Further consideration of this is outlined within the Water Management Strategy (Emerge Associates 2022b).
The need to respond to the potential impacts of climate change, including a drying climate and sea-level rise.	• While climate change has not been explicitly addressed as part of this EAMS, the structure plan supports minimising the impacts of climate change through: o Retention of existing vegetation across the site. o Proposed revegetation of existing degraded areas, particularly associated with the waterways in the south-eastern portion of the site. o Provision of a road network (including width of roads) to encourage planting and long-term retention of street trees, increasing shade across and existing largely cleared landscape. o Provision of a perimeter public open space network that will not only assist with addressing amenity considerations such as noise and visual impact, but will also contribute to green linkages around the perimeter of the site. o Requirement for the use water sensitive urban design, to infiltrate rainfall as close to source as possible and employ water conservation measures as part of public open space design and implementation.

Continued below.

Table 9: East Treendale urban expansion area key planning issues with regard to the environment (WAPC 2022) (continued)

Key considerations	Response for potential urban development of the site
Natural hazards (such as bushfire, coastal inundation/erosion and flooding) pose a risk to existing and future development.	• Bushfire risk has been appropriately considered in accordance with SPP 3.7 and the associated Guidelines, and as part of this, the retention of existing vegetation and enhancement of degraded areas has been considered. Areas of conservation value will not need to be modified to address bushfire requirements. • Flood risk has been considered through the preparation of a Water Management Strategy, and considered flood risk in the context of the latest predictions for rainfall and runoff by Geoscience Australia (Ball et al.). This has addressed the need of ensuring the post development flows meet the pre development environment.

6 Implementation Framework

A summary of how the structure plan responds to the environmental values and attributes within the site is provided in **Table 10**. The table also outlines the future management likely to be required as part of the subdivision and development process.

Table 10: Environmental management framework implementation table

Factor	Structure plan phase	Subdivision phase	Part of development works
Flora and vegetation	• Assessment of flora and vegetation values present within the site and identification of conservation significant values. • Spatial provision POS to retain intact vegetation in the north of the site, riparian vegetation associated with the waterways and paddock trees across the site.	• Undertake detailed analysis of final subdivision layout and engineering design to determine tree retention opportunities. • Provision for POS, including 'conservation value' areas to retain identified native vegetation (or as agreed). • Preparation of vegetation / foreshore management plan(s) to ensure values are protected and to satisfy subdivision conditions. • Foreshore management plan will address the entire foreshore area in a single document.	• Implement relevant management plan(s) based on stages of development. • Ensure areas of retention (in public open space/ conservation areas) are protected, accommodate these as part of construction and landscaping works. • Undertake revegetation work as required.
Fauna	• Assessment of fauna habitat and preliminary consideration of potential retention opportunities. • Provision for POS to retain remnant vegetation in the north of the site, riparian vegetation associated with the waterways and paddock trees across the site	• Undertake detailed analysis of final subdivision layout and engineering design to determine further potential tree retention opportunities. • Provision for POS, including 'conservation value' areas to retain identified native vegetation (or as agreed). • Preparation of vegetation / fauna management plan(s) to ensure values are protected and to satisfy subdivision conditions.	• Ensure areas of retention are protected, accommodate these as part of construction and landscaping works. • Implement pre-clearance checks and/or management plan requirements to ensure fauna is managed appropriately to minimise harm. • If required, obtain and implement licences pursuant to the *Biodiversity Conservation Act 2016* to disturb/relocate fauna prior to works commencing.

Table 10: Environmental management framework implementation table (continued)

Factor	Structure plan phase	Subdivision phase	Part of development works
Inland waters	• Preparation of a Water Management Strategy (WMS). • Spatial provision for bioretention areas, stormwater conveyance, flood storage areas and foreshore reserve to accommodate stormwater, groundwater and flood events.	• Preparation of an Urban Water Management Plan (UWMP). • Spatial provision for bioretention areas and flood storage areas. • Preparation of a foreshore management plan to address waterway, retention of riparian vegetation and protection of values during construction. This will be a single plan addressing the entire corridor.	• Implementation of the WMP. • Design and implementation of drainage reserves/ management features as per the requirements of the WMP. • Implement relevant management plan(s) based on stages of development.
Terrestrial environmental quality	• Consider ASS risk mapping as prepared by DWER. No spatial response in structure plan required. • Consider presence of contamination from historic land uses. No spatial provision required.	• If required, completion of the ASS self-assessment form (as prepared by the DPLH). • If required, preparation of an Acid Sulfate Soil and Dewatering Management Plan.	• If required, implementation of an Acid Sulfate Soil and Dewatering Management Plan.
Social surroundings	<u>Aboriginal heritage</u> • Understand presence of Aboriginal heritage values, including registered sites and other heritage places. • Provision for retention and protection of the registered Aboriginal heritage site, associated with one of the waterways in the south-eastern portion of the site.	<u>Aboriginal heritage</u> • Undertake consultation with Aboriginal stakeholders to understand key consideration for implementation and ongoing management. • Gain appropriate approvals (in accordance with legislation in effect at the time) where disturbance of the Aboriginal heritage site is proposed. • Preparation of a foreshore management plan (as a condition of subdivision) to address the waterway, retention of riparian vegetation and protection of values during construction.	<u>Aboriginal heritage</u> • Implementation of Aboriginal heritage approval requirements. • Implementation of the foreshore management plan and detailed landscape design.

Table 10: Environmental management framework implementation table (continued)

Factor	Structure plan phase	Subdivision phase	Part of development works
Social surroundings (continued)	Noise impacts • Understand presence of land uses that require setbacks to sensitive land uses to be accommodated and consider future development requirements. Forrest Highway, the BORR and Raymond Road surround the site and require consideration pursuant to SPP 5.4.	Noise impacts • Where required, demonstrate appropriate separation is provided between the future habitable buildings and Forrest Highway, the BORR and Raymond Road. This may include preparation of an acoustic assessment / noise management plan, where the 'deemed-to-satisfy' pathway is not achievable or considered appropriate. • Spatial provision to address noise impacts, including lots of an appropriate depth to accommodate quiet house design or provision of a noise bund or similar.	Noise impacts • Where required, implementation of the recommendations of an acoustic assessment / noise management plan. • As part of building licence (by future lot owners) ensure buildings are constructed to appropriate requirements (e.g. quiet house design).
	Visual amenity • Understand potential visual impacts as a result of converting existing cleared agricultural land to urban purposes.	Visual amenity • Undertake detailed analysis of final subdivision layout and engineering design to determine opportunities to reduce requirement for cut and fill. • Provision for POS, including 'conservation value' areas to retain identified native vegetation (or as agreed) and POS corridors around the perimeter of the site. • Preparation of vegetation / foreshore management plan(s) to ensure values are protected and to satisfy subdivision conditions. • Foreshore management plan will address the entire foreshore area in a single document.	Visual amenity • Implement relevant management plan(s). • Ensure areas of retention (in POS/conservation areas) are protected, accommodate these as part of construction and landscaping works. • Undertake revegetation work as required, including planting within the POS corridors around the perimeter of the site.

Table 10: Environmental management framework implementation table (continued)

Factor	Structure plan phase	Subdivision phase	Part of development works
Bushfire risk	• Preparation of a BMP. • Provision for road reserves, managed POS and appropriately sized development areas to accommodate setbacks to achieve BAL-29 or less from identified bushfire risk (including retained vegetation and areas subject to revegetation or no management within the site). • Provision for a road network that connects the site to the public road network and provides access to at least two destinations.	• Provision for separation between habitable buildings and identified bushfire hazards, including through use of road reserves, managed POS and/or appropriately sized lots. • Provision for an appropriate road network that provides access to at least two destinations. • If required, prepare an updated BMP to support the subdivision application.	• Where identified as low threat in the BMP, design, implement and maintain public open space to achieve low threat in accordance with Clause 2.2.3.2 (f) of AS 3959.
Land capability	• Consideration of existing agricultural land uses and capability in the context of the policy framework and strategic planning direction for the site.	• No further consideration required.	• No further consideration required.

7 Conclusions

This EAMS has been prepared on behalf of the proponent to support the rezoning and structure plan prepared for Lots 151, 152 and 153 Raymond Road, Roelands (the site), to guide the proposed residential development. This EAMS has been prepared by Emerge Associates to support the structure plan, together with:

- *Bushfire Management Plan* (Emerge Associates 2022) (BMP).
- *Water Management Strategy* (Emerge Associates 2022) (LWMS).

The structure plan design has responded to site-specific environmental considerations where necessary and possible, including: retention and protection of existing intact remnant native vegetation within the site with TEC, fauna habitat and priority flora values; retention and protection of the waterway features and riparian vegetation (and associated foreshore area); accommodation of flooding and stormwater management within road reserves and POS areas consistent with the WMS; protection of the Aboriginal heritage site; provision of separation to minimise noise impacts from the surrounding strategic freight and major traffic roads; and providing appropriate separation between future habitable buildings and areas of bushfire risk identified within and external to the site.

This document provides an outline of the management requirements that will need to be considered as part of future subdivision and development stages, which can all be managed in accordance with the typical development process with minimal risk to the environment. The key management considerations are summarised as follows.

- **Flora, vegetation and fauna values**: existing intact remnant vegetation within the site (which also provides habitat for fauna) will be retained and protected as part of the proposed development, through the strategic location of 'recreation (conservation value)' POS. This includes the riparian vegetation associated with the waterways, which are protected within the 'recreation (conservation value)' POS in the south eastern portion of the site. Impacts to flora, vegetation and fauna are therefore minimised and any impacts from minor clearing can be managed through the subdivision process.
- **Inland waters**:
    - Flood and stormwater management requirements to be implemented as outlined within the Water Management Strategy (WMS), and will include preparation of an Urban Water Management Plan (UWMP) for each stage of future subdivision. The proposed road and POS network is sufficient to accommodate the movement and treatment of water across the site, including flooding associated with the waterway in larger rainfall events. Spatial provision will need to be made for stormwater management features at subdivision.
    - The foreshore area identified for the waterways within the south-eastern portion of the site, which includes riparian vegetation, is to be retained within a 'recreation (conservation value)' POS. A foreshore management plan (or similar) can be prepared as a condition of future subdivision approval, to support retention, protection and any recreation activities that may be associated with the waterway or adjacent areas.

- **Terrestrial environmental quality and acid sulfate soils**: it is possible that future investigations and management considerations will be required at subdivision, particularly if services are likely to be installed below the permanent groundwater table or dewatering is required. This can be managed through the standard subdivision approval process.
- **Aboriginal heritage:** A registered Aboriginal heritage sites is located within the south-eastern portion of the site, associated with one of the waterways. The registered Aboriginal heritage site is accommodated within the proposed 'recreation (conservation value)' POS area and relevant approvals can be addressed as required in accordance with the relevant heritage legislation at the time.
- **Noise impacts**: Based on a review of SPP 5.4 and the *Road and Rail Noise Guidelines* (DPLH 2019), it is anticipated that noise impacts from Forrest Highway, the BORR and Raymond Road will be manageable particularly given the proposed setbacks to the road carriageway, through either noise barriers or quiet house design architectural packages. As part of the future stages of development, additional investigations (e.g. an acoustic assessment/ noise management plan) may be required, but not until subdivision when finished floor levels are likely to be known and is only likely to be required if the 'deemed-to-satisfy' pathway in SPP 5.4 and the *Road and Rail Noise Guidelines* (DPLH 2019) is not followed.
- **Bushfire risks**: provision of appropriate separation between future habitable buildings and bushfire hazards will need to be accommodated as part of subdivision design, and is supported by the current structure plan and concept which provides appropriate separation through road locations, managed public open space and/or development cell depths. Management of bushfire risk is not reliant on ongoing management of retained remnant native vegetation or proposed revegetation areas. Vehicle access will also need to accommodate access to at least two destinations (which the current design achieves). This can be addressed as part of future bushfire management plans supporting subdivision and/or development approval, whichever is applicable.

Overall, the structure plan provides appropriate mitigation measures and responses to suitably address the key environmental values of the site, such that it is unlikely that the proposed future implementation of urban development within the site in accordance with the structure plan would result in significant residual environmental impacts. The structure plan addresses the key requirements set out in the overarching strategic planning framework (in particular, retention of the majority of the intact remnant native vegetation within the site and the waterway features), and can be managed appropriately through the future subdivision and development phases in line with standard development processes and the relevant state and local government legislation, policies and guidelines and best management practices.

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Figures

Figure 1: Site Locality

Figure 2: Topographic Contours

Figure 3: ESAs and Geomorphic Wetlands

Figure 4: Foreshore Biophysical Assessment

Figure 5: Environmental Geology

Figure 6: Acid Sulfate Soil Risk Mapping

Figure 7: Aboriginal Hertiage Sites

Figure 8: Nearby Land Uses and Amenity Considerations

Figure 9: Predicted Bushfire Prone Areas

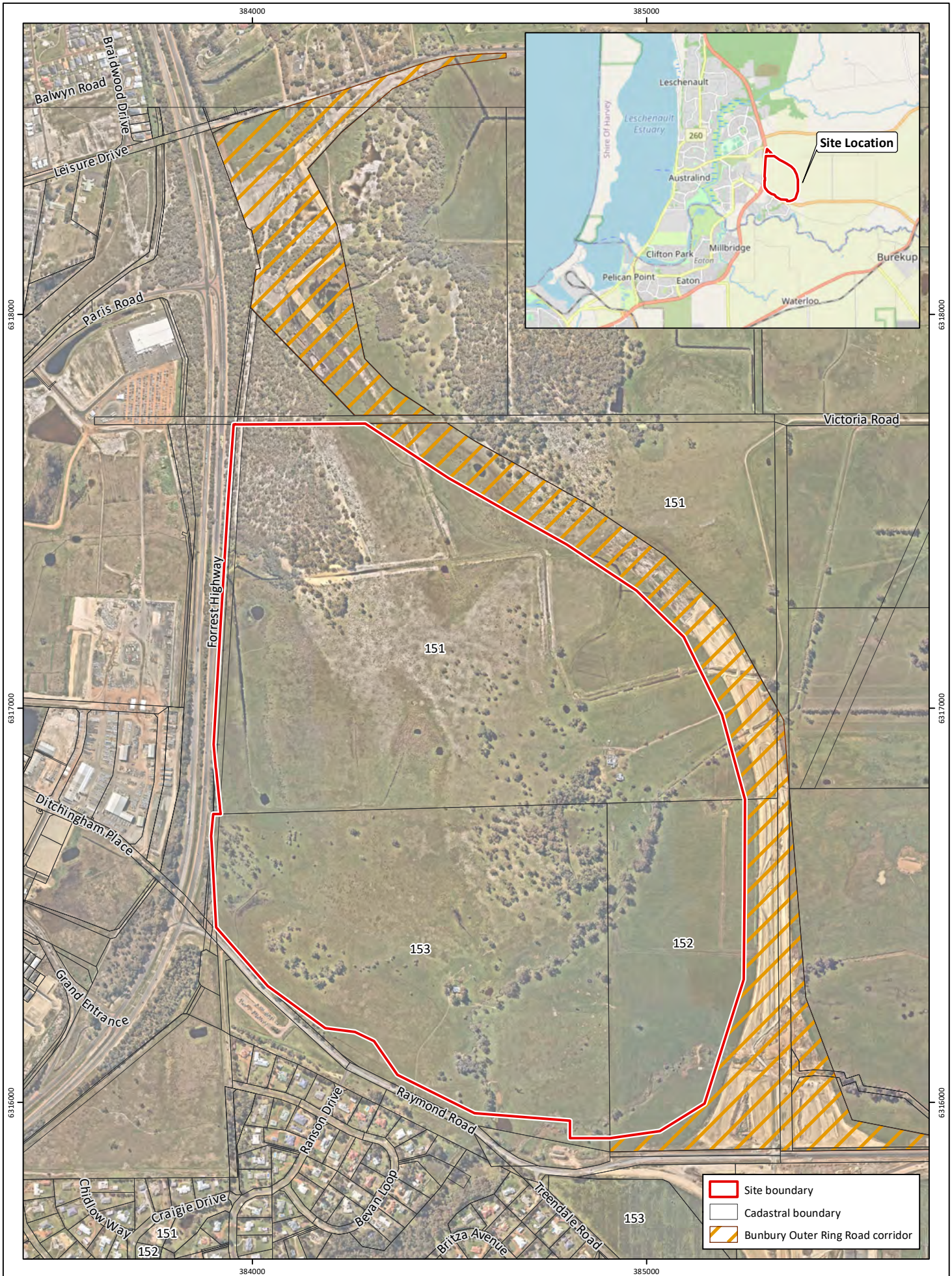


Figure 1: **Site Locality**

Project:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(05)--F12

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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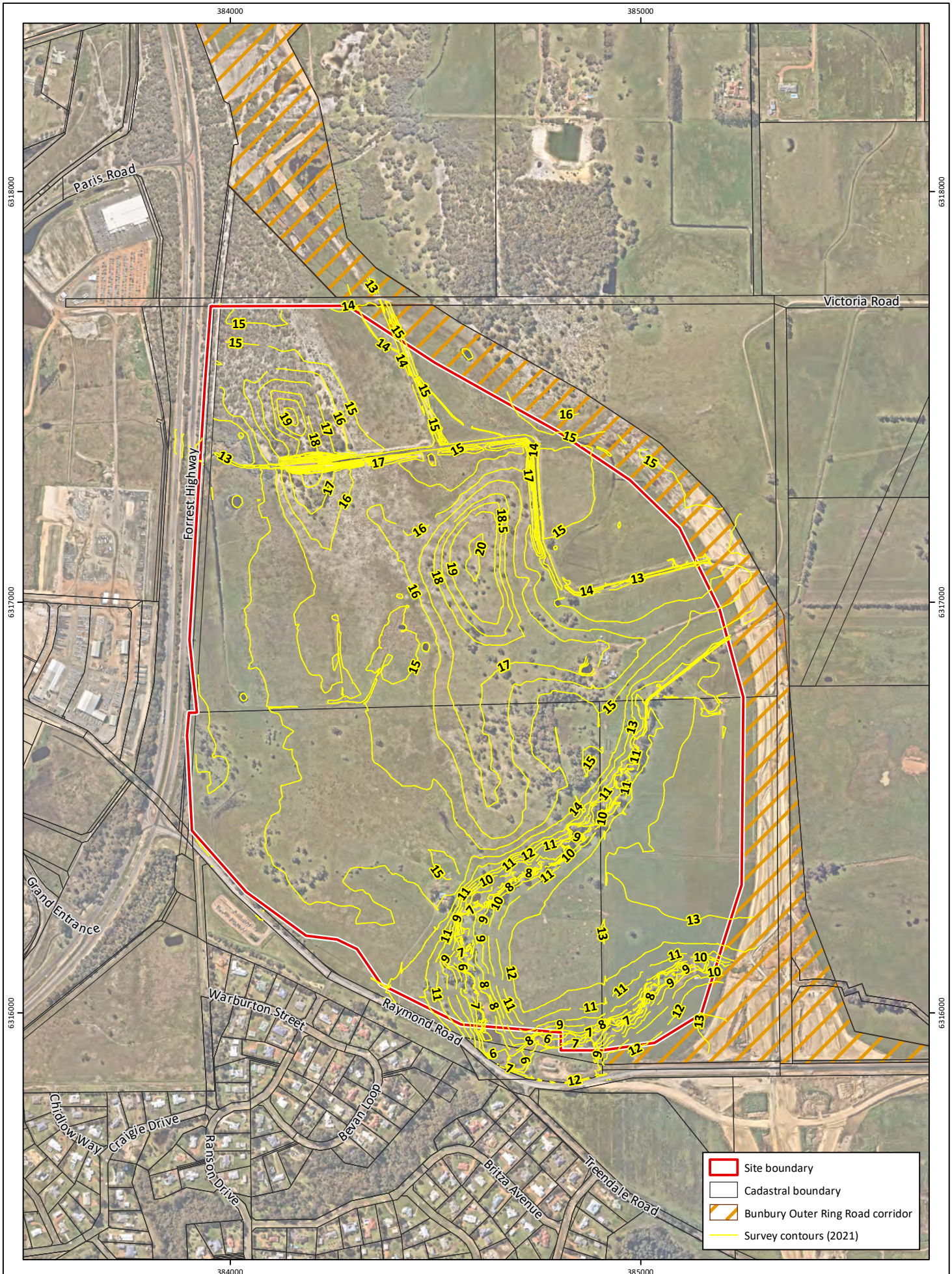


Figure 2: Topographic Contours

Project:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(05)--F13

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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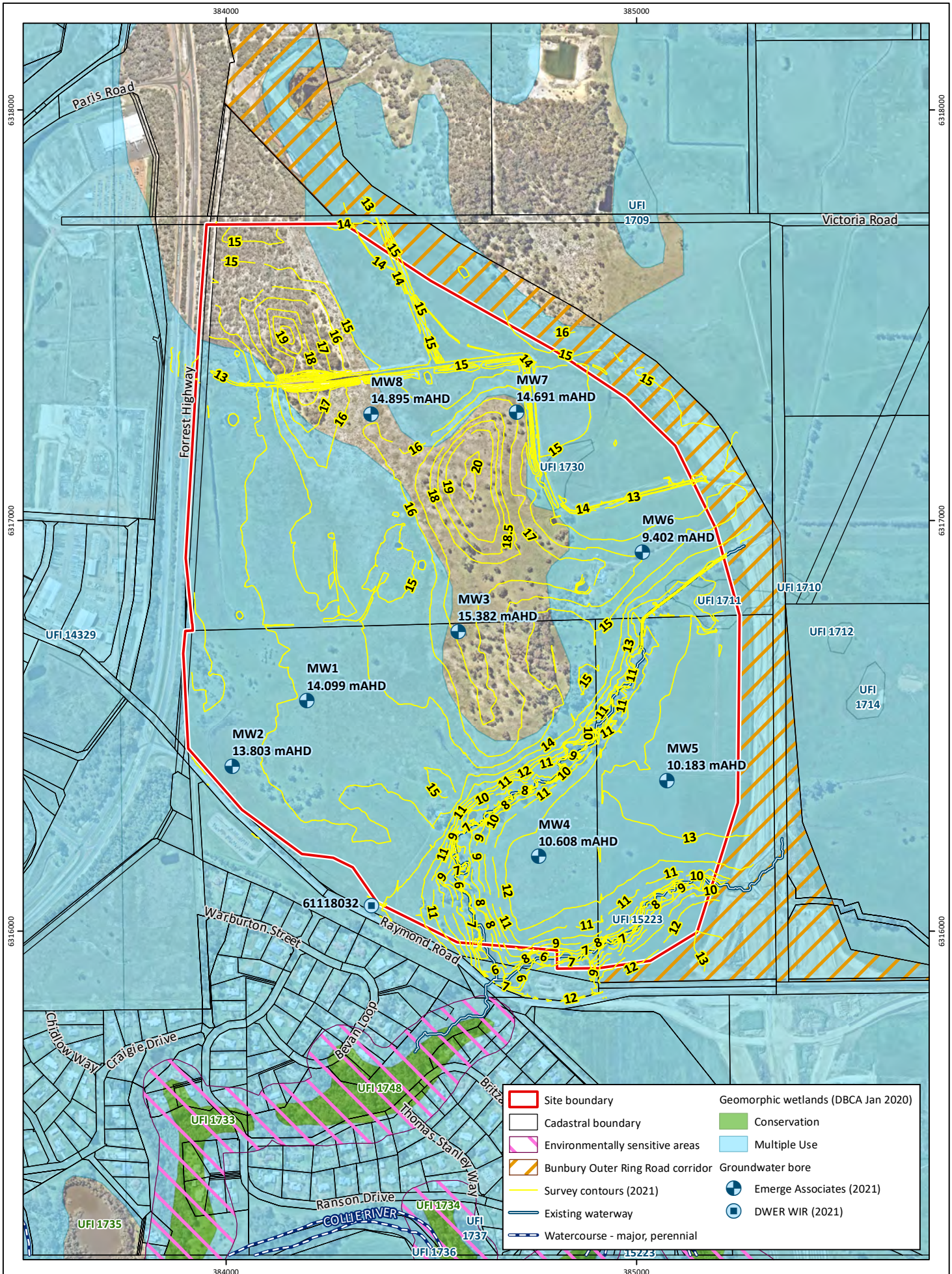


Figure 3: **ESAs and Geomorphic Wetlands**

Project: Environmental Assessment and Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(05)--F16

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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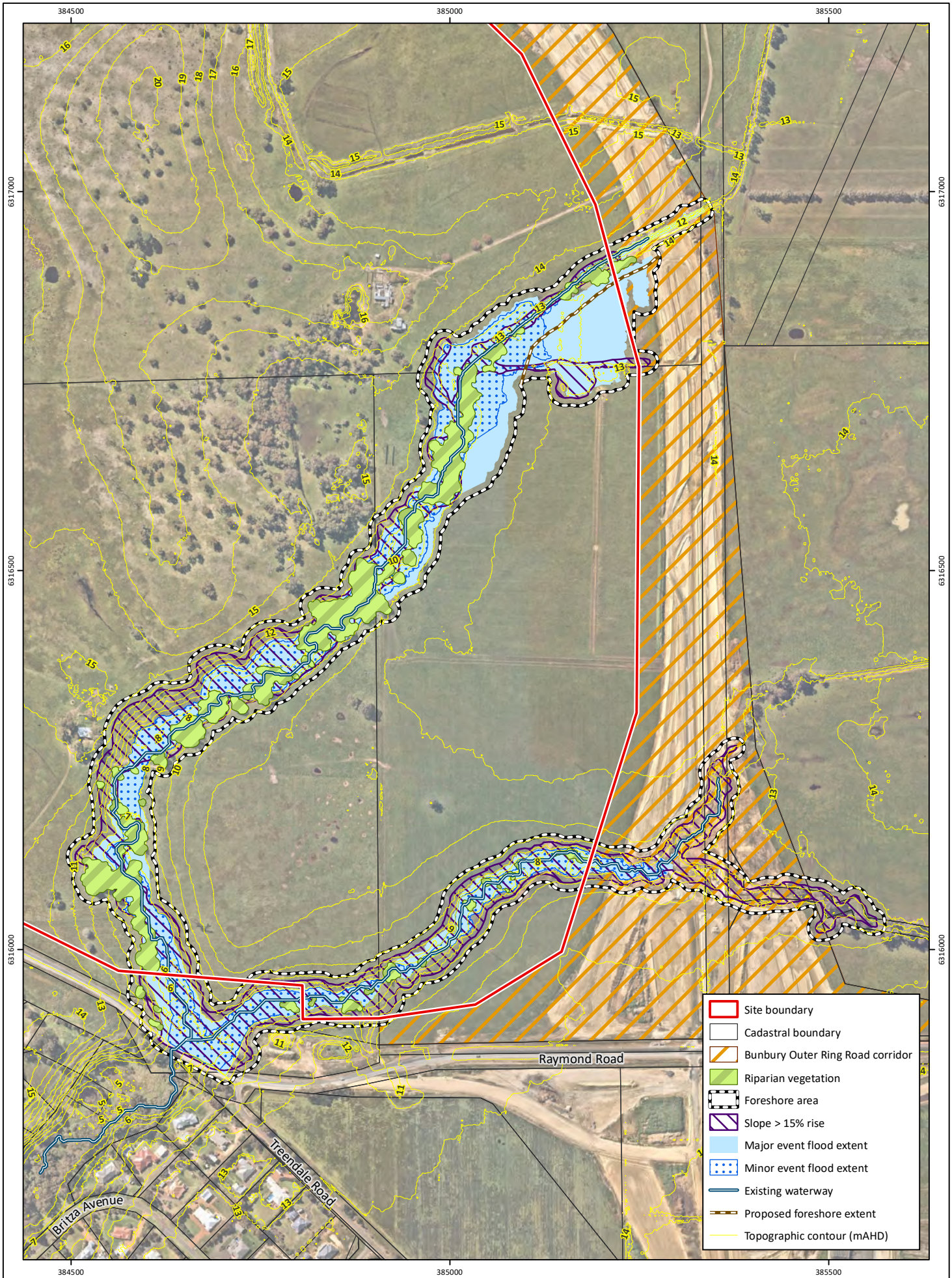


Figure 4: Foreshore Biophysical Assessment

Project: Environmental Assessment and Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number:
EP21-022(05)--F17

Drawn:	GAR
Date:	01/02/2022
Checked:	BMF
Approved:	KK
Date:	01/02/2022

N

0 50 100 150
Metres

Scale: 1:6,500@A4

GDA 1994 MGA Zone 50

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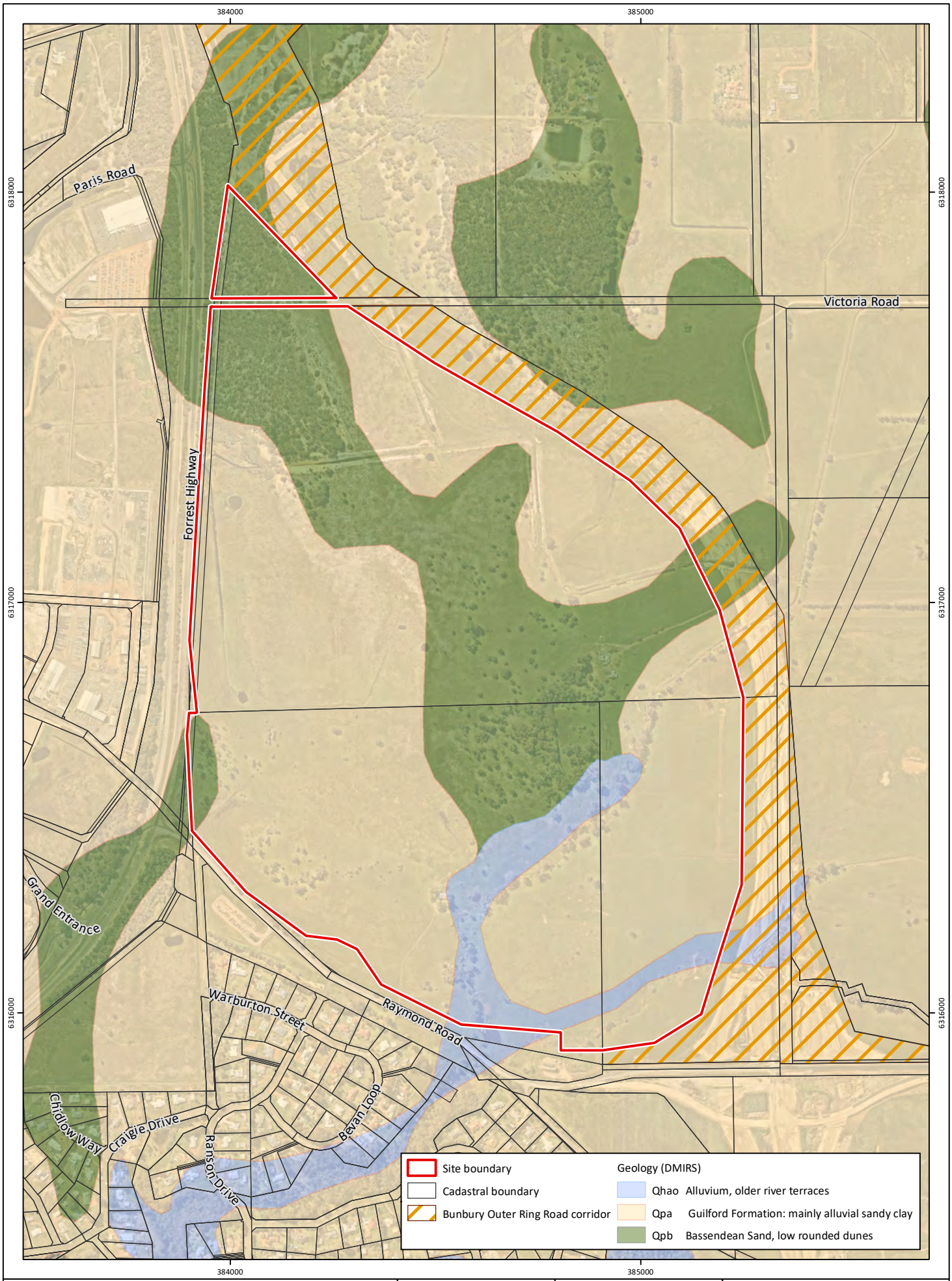


Figure 3: Environmental Geology

Project:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(05)--F14

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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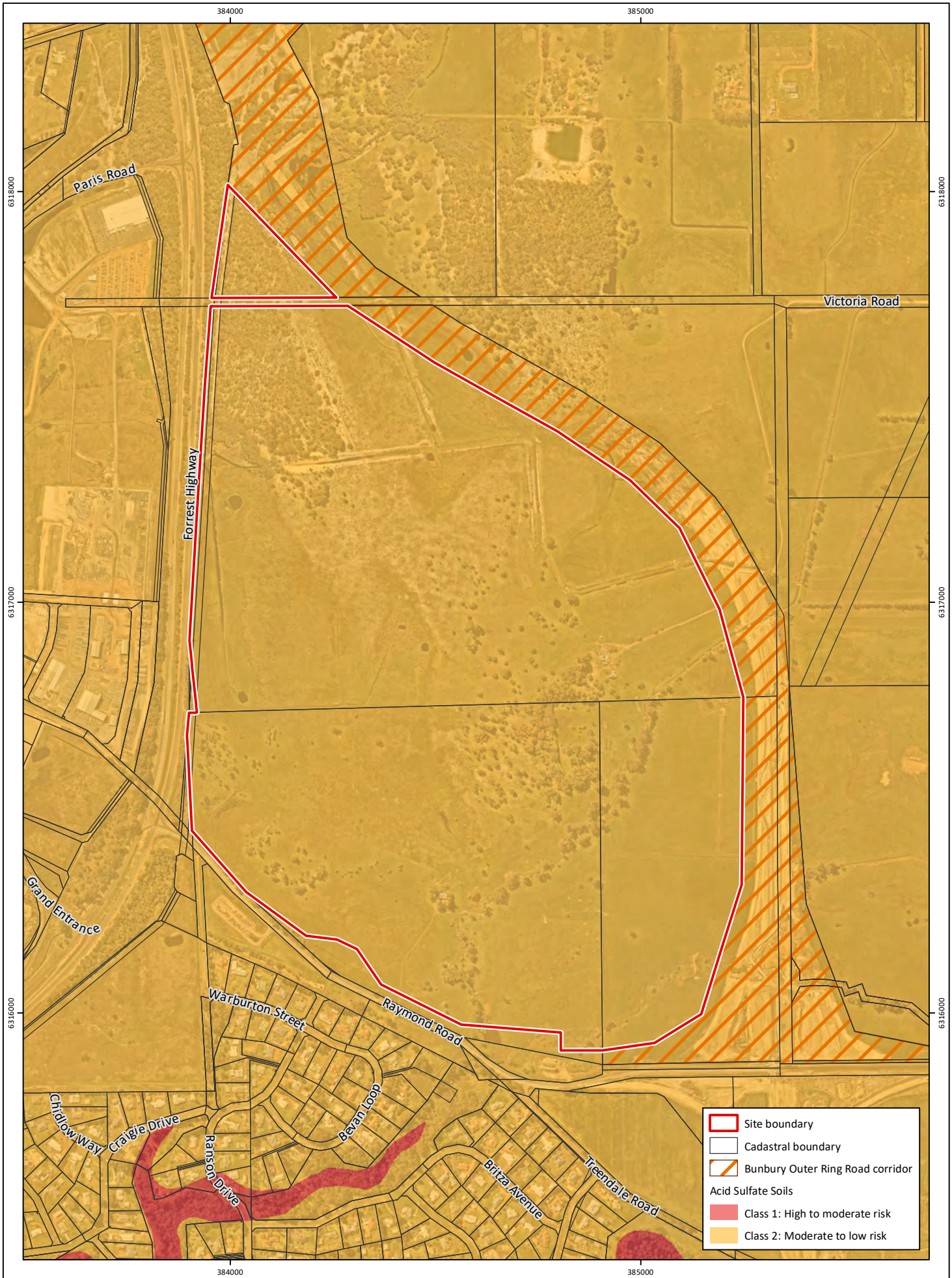


Figure 4: Acid Sulfate Soil Risk Mapping

Project:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(05)--F15

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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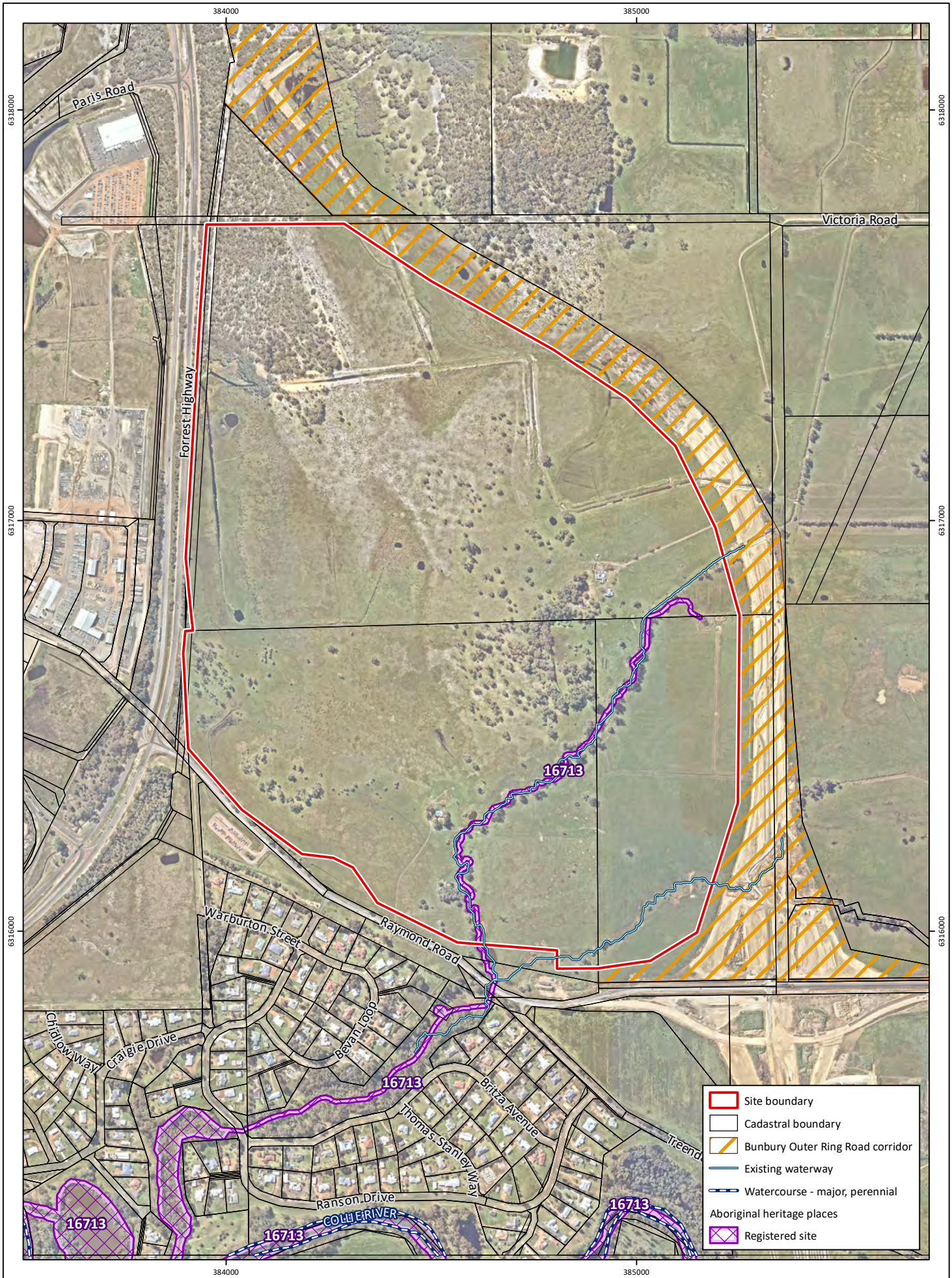


Figure 7: Aboriginal Heritage Sites

Project: Environmental Assessment and Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(05)--F18

Drawn:	TEM
Date:	19/04/2021
Checked:	BFM
Approved:	KK
Date:	01/02/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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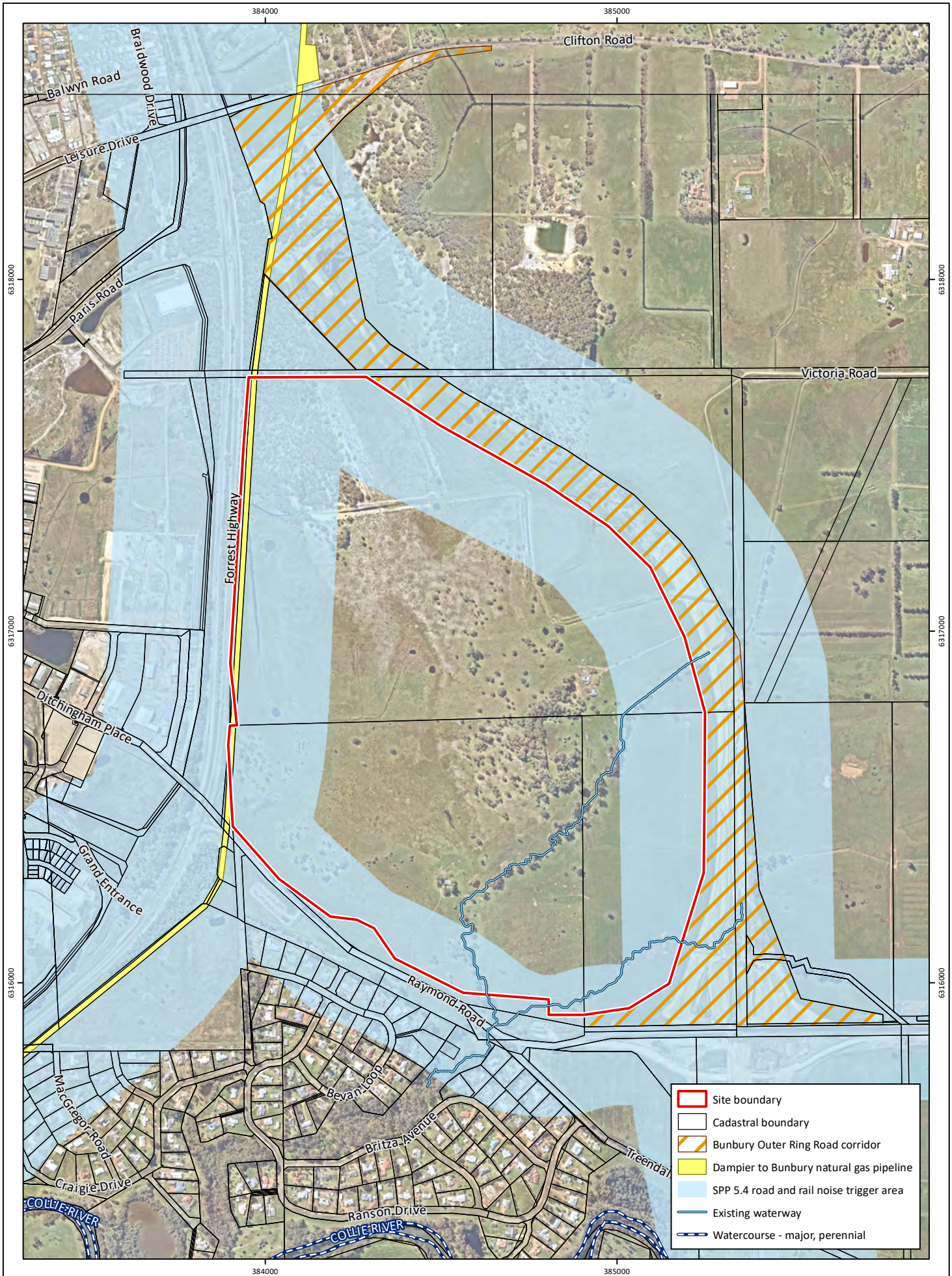


Figure 8: Nearby Land Uses and Amenity Considerations

Project:	Environmental Assessment and Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(05)--F36

Drawn:	GAR	
Date:	01/02/2022	
Checked:	BFM	
Approved:	KK	
Date:	01/02/2022	

N

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Metres

Scale: 1:14,000@A4

GDA 1994 MGA Zone 50

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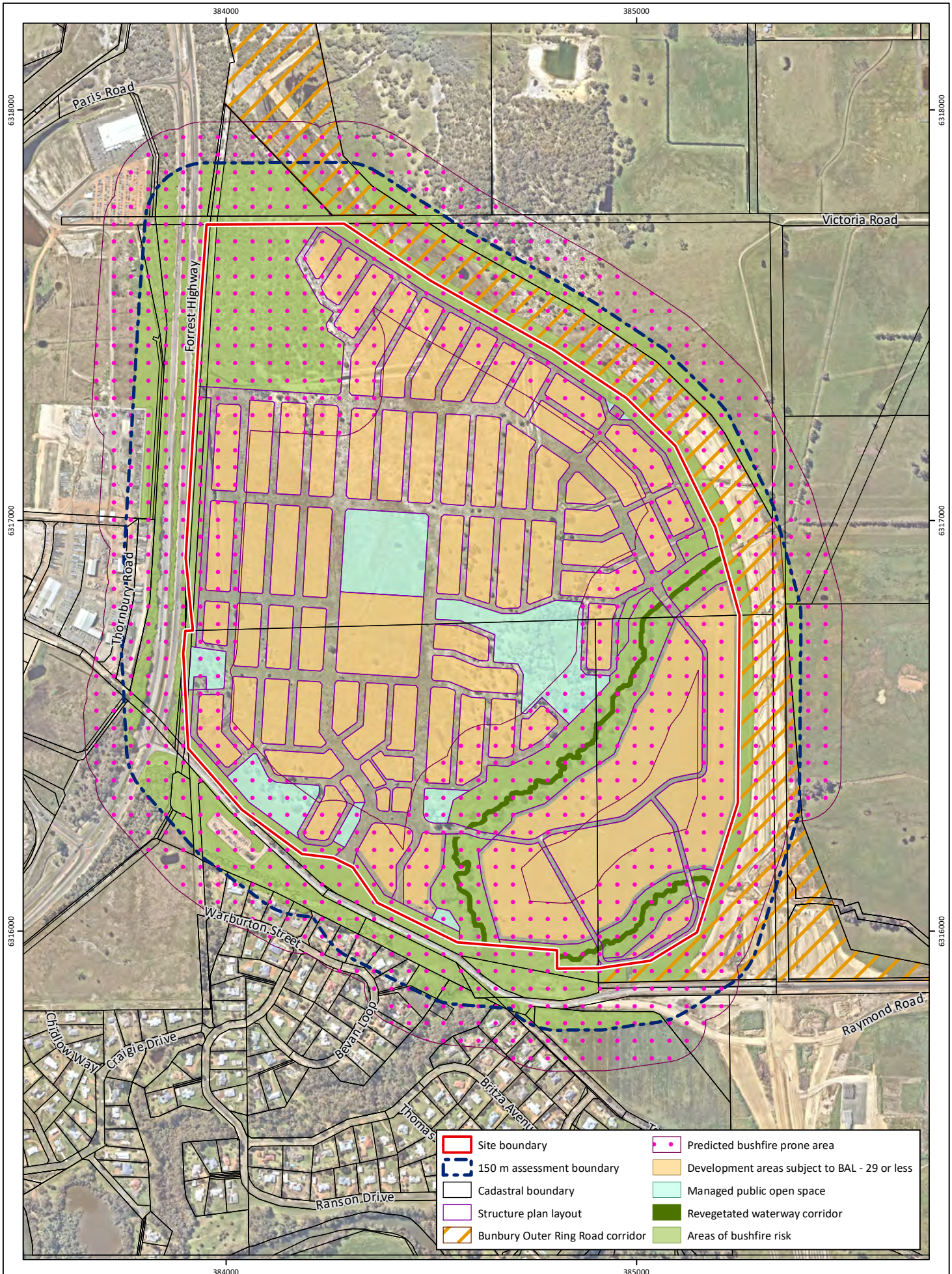


Figure 9: Predicted Bushfire Prone Areas

Project: Environmental Assessment and Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(05)--F38a

Drawn:	GAR
Date:	28/03/2025
Checked:	KK
Approved:	KK
Date:	02/04/2025

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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Appendix A

Structure Plan (CDP 2025)

STRUCTURE PLAN LEGEND

LOCAL SCHEME ZONES

- RESIDENTIAL
- NEIGHBOURHOOD CENTRE
- PS — PUBLIC PURPOSES PS (PRIMARY SCHOOL)
- RECREATION (PUBLIC OPEN SPACE)
  - (C) CONSERVATION VALUES
  - (L) LOCAL
  - (N) NEIGHBOURHOOD
  - (D) DISTRICT
  - (*) DRAINAGE

GREATER BUNBURY REGION SCHEME ZONES

- PRIMARY REGIONAL ROADS
- FUTURE PRIMARY REGIONAL ROADS
- WC — PUBLIC PURPOSES WC (WATERCORP)

LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN

- STRUCTURE PLAN BOUNDARY
- RESIDENTIAL DENSITY RANGE BOUNDARIES
- PRINCIPAL SHARED PATH
- LDP — LOCAL DEVELOPMENT PLAN REQUIRED
- EXISITNG GAS PIPELINE EASEMENT
- 132kV POWERLINE EASEMENT, PYLONS
- CONSTRUCTION OR CONTRIBUTION TOWARDS INTERSECTION UPGRADE
- LEFT IN/LEFT OUT INTERSECTION
- TEMPORARY LEFT IN/LEFT OUT INTERSECTION
- ACOUSTIC CONSIDERATIONS (SPP 5.4) VEGETATED BUNDS ARE TO BE PROVIDED WHERE REQUIRED. IF NOISE WALLS ARE REQUIRED IN ADDITION TO A VEGETATED BUND VISUAL IMPACT IS TO BE REDUCED BY SCREENING VEGETATION
- LOTS WITHIN 100m OF "CLASSIFIED VEGETATION" AND SUBJECT TO BUSHFIRE ATTACK LEVEL ASSESSMENT. REFER BUSHFIRE MANAGEMENT PLAN AND ANY SUBSEQUENT BAL ASSESSMENTS.
- AU — ADDITIONAL USE
- AS — ADDITIONAL SITE REQUIREMENTS

ROAD HIERARCHY

- INTEGRATOR ARTERIAL B
- NEIGHBOURHOOD CONNECTOR A
- NEIGHBOURHOOD CONNECTOR B
- ACCESS STREET A
- ACCESS STREET C
- ACCESS STREET D
- LANEWAY
- VILLAGE - COMMUNAL ROAD B

NOTES

1. The Raymond Road Left In/Left Out intersection shall be temporary only for rural access and shall be removed upon development of the Village Precinct.

BUNBURY OUTER RING ROAD
FORREST HIGHWAY
RAYMOND ROAD
RANSON DRIVE
POS 1 (C)
POS 2 (*, L)
POS 3 (D)
POS 4 (N, *)
POS 5 (C, *)
POS 6 (C, *)
POS 7 (L, *)
POS 8 (C, *)
POS 9 (L, L)
POS 10 (*, L)
POS 11 (C, *)
POS 12
POS 13 (N)
POS 14 (*, L)
POS 15 (L, *)
POS 16 (L)
POS 17 (*, L)
POS 18 (*, L)
POS 19 (L)
PS
WC
R25-R80
R80 LDP
R30 LDP
AU AS
151
152
50

NORTH

Not to Scale @ A3
0 50 100 150m

Date: 08/04/2025 **Plan:** TAYTE-2-002F

TREENDALE EAST STRUCTURE PLAN

Plan 1

LEGEND

TREENDALE EAST SUBJECT SITE

LAND USES

RESIDENTIAL
STRATA TITLED VILLAGE
NEIGHBOURHOOD ACTIVITY CENTRE
SCHOOLS
SEWER PUMP STATION
PUBLIC OPEN SPACE & DRAINAGE
GAS PIPELINE EASEMENT
132kV POWERLINE EASEMENT

ROAD HIERARCHY

INTEGRATOR ARTERIAL B - 30.0m
NEIGHBOURHOOD CONNECTOR A - 31.5m
NEIGHBOURHOOD CONNECTOR B - 31.5m
NEIGHBOURHOOD CONNECTOR B - 26.0m
NEIGHBOURHOOD CONNECTOR B - 19.5m
ACCESS STREET A - 26.0m
ACCESS STREET C - 18.0m
ACCESS STREET D - 19.5m
ACCESS STREET D (ADJACENT BUSHLAND) - 20.0m
ACCESS STREET D - 15.0m
ACCESS STREET D (ADJACENT POS) - 13.0m
LANEWAY - 6.0m
VILLAGE - COMMUNAL ROAD B - 12.0m

EXISTING ROAD RESERVE
BUNBURY OUTER RING ROAD
FORREST HIGHWAY
RAYMOND ROAD
RANSON DRIVE
BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1
12.070ha
POS 2
3.824ha
POS 17
1.376ha
POS 16
2370m²
POS 15
7589m²
PUMP
1000m²
PUMP
500m²
PUBLIC OPEN SPACE 3
4.105ha
PROPOSED PRIMARY SCHOOL
4.0ha
PUBLIC OPEN SPACE 4
5.739ha
POS 18
4000m²
PUBLIC OPEN SPACE 5
1.410ha
POS 19
3796m²
PUBLIC OPEN SPACE 6
8.039ha
PUBLIC OPEN SPACE 13
1.989ha
POS 14
1.341ha
POS 12
3392m²
POS 7
5948m²
POS 10
8155m²
POS 9
1960m²
NEIGHBOURHOOD ACTIVITY CENTRE
1.476ha
COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)
1.417ha
PUBLIC OPEN SPACE 8
2.776ha
PUBLIC OPEN SPACE 11
3.201ha
STRATA TITLED VILLAGE
28.285ha
STRATA TITLED VILLAGE
1.584ha
151
152
153
132kV POWERLINE EASEMENT
15.9m GAS PIPELINE EASEMENT

CELL STRUCTURE PLAN

Treendale East

A Taycot Development Project

DRAFT

NORTH
Scale 1:3000 @ A1
0 30 60 90m
PLAN: TAYTE-P114
DATE: 03/04/2025
PROJECTION: PCG 2020
DATUM: AHD
REVISION: K
DRAWN: JP
PLANNER: DM
CHECK: DM

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

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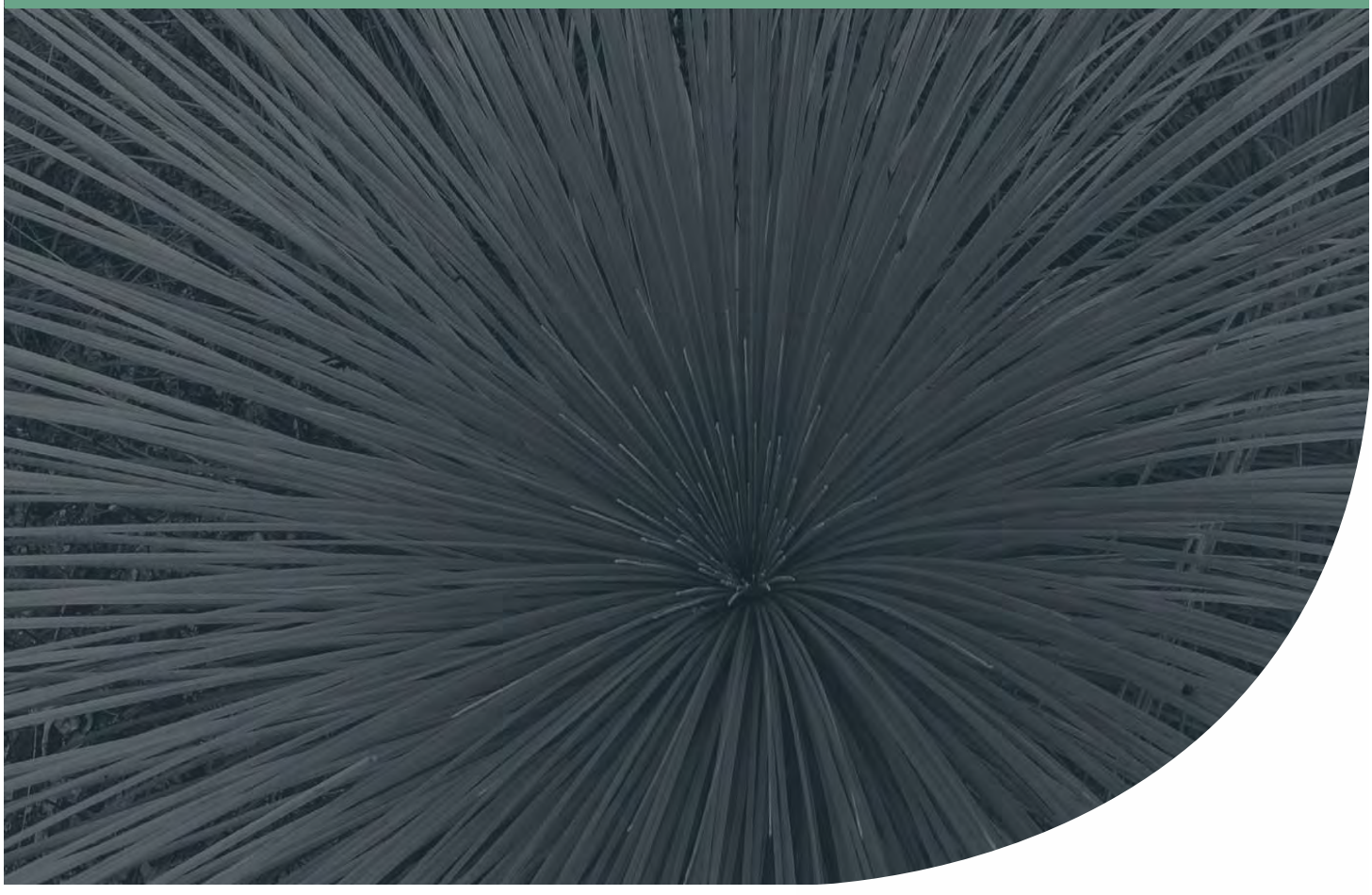
Appendix 4.
Water Management Strategy

Water Management Strategy

Lots 151, 152 and 153 Raymond Road, Roelands

Project No: EP21-022(04)

Prepared for Treendale East Landowner Group
October 2025



Document Control

Doc name:	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands				
Doc no.:	**EP21-022(04)—001 TEM**				
Version	**Date**	**Author**		**Reviewer**	
1	January 2022	Tess McAllister Johanna Boonzaaier	TEM JB	Dave Coremans	DPC
	For client review				
A	March 2022	Kirsten Knox	KK	Dave Coremans	DPC
	Minor update following client review. Final for submission.				
B	April 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments.				
C	September 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments.				
D	October 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments.				
E	October 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments.				
F	October 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments.				
G	October 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updated following agency comments. Final for submission.				

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Executive Summary

Treendale East Landowner Group ('the proponent') is progressing with a local scheme amendment and structure plan to facilitate a residential development on Lots 151, 152 and 153 in the locality of Roelands (herein referred to as 'the site'). The site is situated within the Shire of Harvey (herein referred to as 'the Shire').

The site covers approximately 182 ha, and is bound by Forrest Highway to the west, Raymond Road to the south, and existing farmland towards the east and north. Main Roads Western Australia (Main Roads) is currently constructing the northern and central sections of the Bunbury Outer Ring Road (BORR), which once complete will enclose the northern and eastern edges of the development.

The conceptual land use plan allows for the creation of residential lots, a neighbourhood activity centre, public open space (POS), including areas for conservation and recreation, a primary school, and integration with an existing waterway corridor that cuts through the south-east portion of the site.

The site is zoned as "Urban Development" under the Shire's Local Planning Scheme No. 2 (SoH 2024).

This water management strategy (WMS) details the water management approach to meet the expectations of the Department of Water and Environmental Regulation (DWER) and the Shire. The level of detail provided in this WMS is intended to be generally consistent with both a district water management strategy (DWMS) and a local water management strategy (LWMS) as defined under *Better Urban Water Management* (WAPC 2008).

In summary, environmental investigations undertaken during the WMS preparation indicate that:

- The site has historically been used for pasture/grazing.
- The site receives 953.8 mm of rainfall per year on average, predominantly occurring between May and August.
- The site topography ranges from 20 m AHD at a localised high point along around the central north, down to ~5.5 m AHD around the southern watercourse.
- Regional geology indicates that the site is underlain by sand, sand over clay or alluvium.
- The geotechnical investigation undertaken across 72 test pits across the site recorded three main soil profile zones, being – 'sand' across the central north, 'sand above clay' towards the western and south-western boundary, and along the north-east, and 'clay' in the south-eastern corner.
- The site has a 'moderate to low' risk of acid sulfate soils (ASS) occurring within 3 m of the natural soil surface.
- The site is within a sewage sensitive area.
- There are numerous drains, watercourses, and earth dams present across the site. Two main incised waterways, one which runs from north to south (Treendale main drain), the other which runs from east to west (Treendale branch drain) intersect at the southern boundary of the site (near Raymond Road) and flow south-west into a CCW (UFI 1748) and eventually into to the Collie River approximately 1 km downstream.
- The western side of the site adjacent to Forrest Highway is known to be seasonally inundated (i.e. during winter), with water ponding above the ground surface following rainfall.

- An existing drainage outlet from the site exists beneath Forrest Highway and conveys runoff to the west.
- The 1% Annual Exceedance Probability (AEP) peak flow rate entering the site at the Treendale main drain (north-south waterway) is 4.0 m^3/s and peak flow rates entering the site at the Treendale branch drain (east-west waterway) is 5.6 m^3/s.
- Surface water has moderately elevated total nitrogen (TN) and total phosphorous (TP) concentrations within the Treendale drains.
- The seasonal peak groundwater levels beneath the site vary from 0.00 mBGL to 6.43 mBGL. The majority of the levels recorded likely reflect shallow soil profiles and not a permanent superficial aquifer given the low permeability of soils observed.
- Groundwater is slightly acidic in the context of a waterway in south west Australia with pH values ranging between 4.82 to 6.55, however negligible impacts on proposed concrete infrastructure would be expected from this. There are also elevated TN and TP levels across majority of bores, with results being a reflection of the current and historical agricultural use.
- There is some riparian vegetation along the waterways (mainly *Eucalyptus rudis* (flooded gum) and *Melaleuca* sp.) immediately adjacent to the stream centreline(s) however generally the waterways are highly disturbed due to grazing cattle and weed invasion.

A biophysical assessment has been undertaken to determine the location and extent of the foreshore area encompassing the waterways. The assessment considered vegetation, hydrology, soil type, erosion, topography, function, habitat and land use.

Based on the results of the biophysical assessment the following has determined the proposed foreshore area:

- The outermost extent of the riparian vegetation immediately adjacent to the waterways.
- All areas connected to the waterways with slope exceeding 10%.
- The outermost extent of 1% AEP flooding determined in the XPSWMM flood modelling.
- The exception to inclusion of the extent of 1% AEP flooding is the north eastern boundary of the Treendale main drain, where part of the site is inundated as it is lower than the 1% AEP top water level (TWL). A setback area of 30 m from the stream centreline is proposed for the foreshore in this area.
- Apply a 10 m setback from the outermost extent of the above constraints to allow for the following:
    - + 4 m along entire corridor for management and fire emergency services access
    - + 6 m for earthwork/side slope integration.

The overall approach to water supply is to utilise scheme water for in-house uses, a non-potable scheme service by Harvey Water for irrigation, and implement water conservation measures (e.g. water efficient fixtures and appliances). The use of water sensitive urban design (WSUD) measures across the development and water wise landscaping measures will also assist in reducing water demand.

The principle behind the stormwater management strategy is to maintain the existing hydrology of the site by ensuring that the post-development peak flow and discharge locations are consistent with the existing environment. This will be achieved by ensuring runoff up to the 1% AEP event is detained within the development, before discharging off site at a flow rate that mimics the existing hydrology.

WSUD measures proposed across the site include tree pits, raingardens, treatment swales, conveyance swales, bioretention areas (BRAs), and inline storage and treatment within the existing riparian corridor. The significant storage available in the incised waterway corridors will be utilised to provide flood detention for storm events > the 20% AEP event. This will minimise the need for large flood detention structures within POS areas.

Groundwater management will include shaping of the shallow and low permeability clay layer towards the existing waterways, subsoil drains (over a portion of the site) to control rise of localised perched groundwater above the low permeability clays and the use of imported fill to maintain sufficient clearance to groundwater. Groundwater quality will be managed through the appropriate treatment of surface runoff prior to infiltration to groundwater (i.e. via WSUD measures), landscape management practices (i.e. minimising fertiliser use) and the treatment of subsoil drain discharge within surface-based vegetated treatment structures.

This WMS is a key supportive document for the proposed rezoning and subsequent development. It provides a usable framework to assist in establishing a stormwater management approach based on site-specific investigations that are consistent with relevant State and Local Government legislation, policies and guidelines. It is also intended to provide guidance to the general stormwater management principles for the area and to guide the future water management plan (WMP).

The water management criteria and the manner in which these are achieved are summarised in **Table E1**.

Table E 1: Water management criteria and compliance summary

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water Conservation	WC1	Consumption target for water of 100 kL/person/year, including not more than 60 kL/person/year of scheme water	Use of Water efficient fixtures and appliances (WEFA) by lot owners	Lot owner	Building approval
			Adoption of waterwise gardening (WWG) practices by lot owners	Lot owner	Landscape design and implementation
			Education regarding water conservation provided to lot purchasers	Proponent	At point of sale
	WC2	Adopt a fit for purpose water supply strategy to meet potable and non-potable needs.	Scheme water provided for potable uses.	Proponent	Detailed design
			Rainwater tanks encouraged for lot owners to supplement non-potable uses.	Lot owner	At point of sale
			Non-potable water provided by Harvey Water to meet estate scale irrigation requirements.	Proponent	Detailed design
	WC3	Reduce irrigation requirements across the development	Landscape design adopts waterwise gardening practices.	Proponent	Landscape design and implementation
Surface water management	SW1	Manage the small event runoff (i.e. first 15 mm) as close to source as possible.	Lots will retain the small rainfall event onsite within gardens and soakwells.	Lot owner /Shire	Building approval
			Small rainfall events across the development not able to be captured by lot soakwells will be treated via WSUD measures (swales and bio-retention areas (BRAs)).	Proponent	Detailed drainage design and implementation
	SW2	Post-development peak flow discharge rates from the site should not exceed pre-development peak flow discharge rates.	1% and 20% AEP post development peak flow discharges are slightly lower than pre development peak flow discharges due to onsite treatment/retention within median swales, perimeter swales, bioretention areas and flood storage areas located upstream of the waterway. Inline detention storage within the waterway also assists with achieving 1% AEP peak flow rates.	Proponent	Detailed drainage design and implementation

Table E 1 (Continued): Water management criteria and compliance summary

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Surface water management	SW3	Discharge locations from the site should be consistent with the pre-development environment.	The pre development discharge locations are retained.	Proponent	Detailed drainage design and implementation
	SW4	Provide adequate land area within the site for detention of runoff up to the major event (1% AEP).	Detention is provided within extended detention conveyance swales, BRAs and the existing waterway/riparian corridor.	Proponent	Detailed drainage design and implementation
	SW5	Finished floor levels should provide appropriate clearance above the major (1 % AEP) event flood levels within flood detention structures.	Finish floor levels will provide at least 500 mm clearance from the adjacent top water level (TWL) within the waterway and conveyance swales.	Proponent	Detailed drainage design and implementation
	SW6	Utilise best management practices to reduce the risk of nutrient loading to stormwater and the downstream environment.	Minimise fertiliser use to establish and maintain vegetation.	Maintenance contractor/Lot owner	Landscape implementation
			Use drought tolerant species that require minimal water and nutrients	Proponent/Lot owner	Landscape design and implementation
			Contractor management of sediment	Proponent	During construction
			Street sweeping	Proponent/the Shire	Post construction
			Maintenance of POS and WSUD/stormwater infrastructure	Maintenance contractor	Two years following construction
			The location of garden beds away from treatment and conveyance structures.	Proponent/Lot owner	Landscape design and implementation
			Education of residents.	Proponent	Point of sale
			Raingardens to be placed within dual frontage lots and road reserves higher in catchment.	Proponent	Detailed drainage design and implementation
			Tree pits may be adopted subject to meeting SoH design requirements	Proponent	Detailed drainage design and implementation

Table E 1 (Continued): Water management criteria and compliance summary

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Groundwater management	GW1	Perched water levels to be managed using a subsoil drainage network, to be set at or above existing MGL.	Up to 1.2 m of imported sand fill, minor grading of the clay layer and a sub-soil network are proposed to manage perched groundwater levels post development.	Developer	Detailed earthworks, drainage design and implementation
	GW2	The combined earthworks and subsoil drain approach will achieve minimum separation distances recommended by the Institute of Public Works Engineering Australasia (IPWEA).	The design lot levels will have a minimum clearance of 1.2 m to the subsoil network.	Developer	Detailed drainage design and implementation
	GW3	Groundwater captured by subsoil drains will be appropriately treated.	Subsoil drains will discharge to swales, BRAs/FSAs or the existing vegetated waterways for treatment.	Developer	Detailed drainage design and implementation
	GW4	All subsoil drainage to have a free draining outfall.	All subsoil drains will have a clearance of 150-300 mm from the discharge point, thereby providing a free-flowing outlet.	Developer	Detailed drainage design and implementation
	GW5	Utilise appropriate measures to manage nutrient loads to groundwater.	Education of lot owners.	Developer	At point of sale
			Minimise fertiliser application by adopting waterwise landscaping principles.	Developer	Landscape design and implementation
			The use of WSUD measures to treat the small rainfall event.	Developer and lot owner	Detailed drainage design and implementation, and lot construction
			Vegetation of treatment areas (swales, BRAs and waterway/riparian corridor) to provide treatment prior to runoff discharging off-site.	Developer	Detailed drainage and landscape design and implementation
			Treatment of discharges from subsoil drains within WSUD measures.	Developer	Detailed drainage and landscape design and implementation

Table of Contents

1 Introduction 1

1.1 Background 1
1.2 Planning context 1
1.3 Purpose 1
1.4 Policy framework 2
1.5 WMS objectives 2

2 Proposed Development 4

3 Existing Environment 5

3.1 Sources of information 5
3.2 Historical land uses 5
3.3 Climate 5
3.4 Geotechnical conditions 5
3.4.1 Topography 5
3.4.2 Regional geology 6
3.4.3 Local geology and soils 6
3.5 Surface water 7
3.5.1 Wetlands 7
3.5.2 Existing hydrology 7
3.5.2.1 Pre-development surface runoff modelling 8
3.5.3 Surface water quality 9
3.6 Groundwater 9
3.6.1 Groundwater resources 9
3.6.2 Groundwater levels 10
3.6.3 Groundwater quality 11
3.7 Sewage sensitive areas 11
3.8 Flora and fauna 12
3.9 Summary of existing environment 12

4 Biophysical Assessment 14

4.1 Policy framework 14
4.2 Biophysical assessment 14
4.3 Proposed foreshore area 16

5 Design Criteria and Objectives 17

5.1 Integrated water cycle management 17
5.2 Water conservation 17
5.3 Surface water management 18
5.4 Groundwater management 18

6 Water Conservation Strategy 19

6.1 Fit-for-purpose water use 19
6.1.1 Scheme water 19
6.1.2 Groundwater 19
6.1.3 Surface Water 19
6.1.4 Rainwater tanks 19
6.2 Irrigation demand 20
6.3 Water conservation measures 21
6.3.1 Water efficient fixtures and appliances 21
6.3.2 Water wise gardens 21
6.4 Wastewater management 22
6.5 Water conservation criteria compliance summary 22

7 Surface Water Management 23

7.1 Lot drainage 23
7.1.1 Residential lots 23
7.1.2 Non-residential lots 24
7.2 Estate drainage 24
7.2.1 Road drainage network 24
7.2.2 Tree pits 25
7.2.3 Raingardens/verge swales 25
7.2.3.1 Treatment swales 26
7.2.4 Perimeter swales 27
7.2.5 Bio-retention areas 28
7.2.6 Flood storage areas 29
7.2.7 Existing retained waterways 29
7.3 Stormwater management design 30
7.3.1 Treatment of stormwater 30
7.3.2 Flood detention and conveyance 31
7.3.3 Post-development peak flows 32
7.3.4 Sensitivity analysis 33
7.4 Stormwater compliance criteria 34

8 Groundwater Management Strategy 35

8.1 Groundwater level management 35
8.1.1 Clay layer management 35
8.1.2 Subsoil drains 35
8.1.2.1 Road reserves 35
8.1.2.2 Drainage infrastructure 37
8.1.3 Sand fill specifications 37
8.2 Groundwater quality management 38
8.2.1 Nutrients from stormwater 38
8.2.2 Subsoil drains 38
8.2.3 Legacy nutrients within groundwater 38
8.3 Groundwater criteria compliance summary 39

9 Subdivision and Water Management Plans 40

9.1 BORR drainage requirements 40
9.2 Implementation of water conservation strategies 40
9.3 Lot drainage 41
9.4 Fill specifications and approach 41
9.5 Modelling of local road drainage network 41
9.6 Subsoil drain network specifications and design 42
9.7 Non-structural water quality improvement measures 42
9.8 Construction management and monitoring 42
9.9 Ongoing management and maintenance 42
9.10 Conveyance swale design specifications 43
9.11 Foreshore area management 43

10 Monitoring and Maintenance 45

10.1 Pre-development monitoring 45
10.2 Post-development monitoring 45
10.2.1 Condition 45
10.2.2 Surface water monitoring 45
10.2.3 Subsoil network monitoring 46
10.2.4 Groundwater monitoring 46
10.3 Guideline values 46

10.4 Contingency actions 47
10.5 Reporting 47

11 Implementation 48

11.1 Roles and responsibility 48
11.2 Funding 48
11.3 Review 48

12 References 49

12.1 General references 49
12.2 Online references 51

List of Tables

Table 1: General soil profile zones across the site 6
Table 2: Pre-development 1% AEP peak flow rate 8
Table 3: Surface quality results (Emerge Associates 2022) 9
Table 4: Measured seasonal peaks GWL (mBGL) – 2021 to 2023 10
Table 5: Groundwater quality results (2022) 11
Table 6: Biophysical criteria and assessment 15
Table 7: Indicative irrigation calculations 20
Table 8: Water conservation compliance summary 22
Table 9: Stormwater treatment assets size and spatial requirements. 30
Table 10 (cont): Stormwater treatment assets size and spatial requirements. 31
Table 11: Flood storage area requirements 32
Table 12: 20% AEP pre and post development flow rates contributing to existing waterway corridor. 32
Table 13: Pre and post development discharge rates 33
Table 14: 1% AEP sensitivity analysis results 33
Table 15: Stormwater management compliance summary 34
Table 16: Drainage infrastructure minimum invert requirements. 37
Table 17: Groundwater management compliance summary 39
Table 18: Monitoring program summary 46
Table 19: Water quality monitoring trigger values 47

List of Plates

Plate 1: Indicative tree pit design 25
Plate 2: Indicative rain garden design 26
Plate 3: Indicative median swale design 27
Plate 4: Typical perimeter swale cross-section 28
Plate 5: Typical subsoil drainage configuration. 36

Figures

Figure 1: Site Location
Figure 2: Topograhic Contours
Figure 3: Slope Analysis
Figure 4: Geological mapping and Test Pit locations
Figure 5: Acid Sulfate Soil Risk Mapping
Figure 6: Existing Hydrological Features and Geomorphic Wetlands
Figure 7: Foreshore Biophysical Assessment

Figure 8: Depth to Groundwater
Figure 9: Sewage Sensitive Areas
Figure 10: Stormwater Management Plan
Figure 11: Small Event Inundation (first 15mm)
Figure 12: Minor Event Inundation (20% AEP)
Figure 13: Major Event Inudnation (1% AEP)
Figure 14: Conceptual Subsoil Drainage Plan

Appendices

Appendix A

Concept master and structure plans

Appendix B

Concept landscaping plan

Appendix C

Concept civil designs

Appendix D

Geotechnical logs

Appendix E

BORR report - Transverse drainage Northern & Central Sections

Appendix F

Modelling assumptions report

Appendix G

Groundwater bore logs and monitoring data

Appendix H

Education material

Appendix I

Harvey Water – water supply confirmation

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
BOM	Bureau of Meteorology
DBCA	Department of Biodiversity Conservation and Attractions
DWER	Department of Water and Environmental Regulation
IPWEA	Institute of Public Works Engineering Australasia
Shire	Shire of Harvey

Table A2: Abbreviations – General terms

General terms	
AEP	Average exceedance probability
ASS	Acid sulfate soils
BRA	Bioretention area
BUWM	Better urban water management
DWMS	District water management strategy
LWMS	Local water management strategy
MGL	Maximum groundwater level
POS	Public open space
PRI	Phosphorus retention index
RWT	Rainwater tanks
TWL	Top water level
WEFA	Water efficient fixtures and appliances
WSUD	Water sensitive urban design
WWG	Water wise gardens
WMP	Water management plan

Table A3: Abbreviations – units of measurement

Units of measurement	
mm	Millimetre
m	Metre
m^2	Square metre
m^3	Cubic metre
m^3/s	Cubic metre per second
m AHD	Metres in relation to Australian height datum
mBGL	Metres below ground level
ha	Hectare
km	Kilometre

1 Introduction

1.1 Background

Treendale East Landowner Group ('the proponent') is progressing with a local scheme amendment and structure plan to facilitate residential development on Lots 151, 152 and 153 in the locality of Roelands (herein referred to as 'the site'), as shown on **Figure 1**. The site is situated within the Shire of Harvey (herein referred to as 'the Shire').

The site covers approximately 188 ha, and is bound by Forrest Highway to the west, Raymond Road to the south, and existing farmland towards the east and north. Main Roads Western Australia (MRWA) is proposing to construct the northern and central sections of the Bunbury Outer Ring Road (BORR), which once complete will enclose the northern and eastern edges of the development.

The conceptual land use plan allows for the creation of residential lots, neighbourhood activity centre, public open space (POS), including areas for conservation and recreation, a primary school, and integration with two existing waterways that cut through the south-east portion of the site. The proposed development is discussed further in **Section 2** and the masterplan is provided in **Appendix A**.

1.2 Planning context

The site is zoned as "Urban Development" under the Shire's Local Planning Scheme No. 2 (SoH 2024).

1.3 Purpose

This water management strategy (WMS) documents the manner in which water will be managed to avoid flooding and protects the environment. It details the water management approach to meet the expectations of the Department of Water and Environmental Regulation (DWER) and the Shire.

The level of detail provided in this WMS is intended to satisfy both a district water management strategy (DWMS) and a local water management strategy (LWMS) as defined under *Better Urban Water Management* (WAPC 2008).

The WMS aims to demonstrate that the land is capable of being developed for the proposed land use and to identify any additional works that may be required to support future development of the site, and to provide 'proof of concept' that the proposed land use plan can meet appropriate water management criteria.

1.4 Policy framework

There are a number of Local and State Government policies of relevance to the development. These policies include:

- *State Water Strategy* (Government of WA 2003)
- *State Planning Policy 2.9 Water Resources* (WAPC 2006a)
- Draft *State Planning Policy 2.9 Planning for Water* (DPLH & WAPC 2021)
- *Statement of Planning Policy No. 3: Urban Growth and Settlement* (WAPC 2006b)
- *State Water Plan* (Government of WA 2007)
- *Liveable Neighbourhoods Edition 4* (WAPC 2007)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009)
- *Water Wise Perth-Two Year Action Plan* (Government of WA 2019).

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that developments should aim to achieve. These are key inputs that relate either directly or indirectly to the development and include:

- *Australian Runoff Quality* (Engineers Australia 2006)
- *Stormwater Management Manual for Western Australia* (DoW 2007)
- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008)
- *Better Urban Water Management (BUWM)* (WAPC 2008)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *National Water Quality Management Strategy* (Australian Government 2018)
- *Australian Rainfall and Runoff* (Ball J *et al.* 2019)
- *Shire of Harvey - District Planning Scheme No. 1* (DPLH 2019b)
- *Shire of Harvey - Local Planning Strategy* (DPLH 2020)
- *Bunbury-Geographe Sub-Regional Strategy* (WAPC 2020).

1.5 WMS objectives

This WMS has been developed in consideration of the objectives and principles detailed in *Better Urban Water Management* (BUWM) (WAPC 2008) and is intended to support the development within the site and is based on the following major objectives:

- Maintain the existing hydrological regime through and discharging from the site.
- Protect and enhance the existing waterways and key hydrological features within the site.
- Utilise the existing natural features of the site to facilitate a water sensitive urban design (WSUD) approach which retains key landform features.
- Provide a broad level stormwater management framework to support future urban development.
- Implement a sustainable approach to finished levels within the site, which acknowledges the existing hydrogeological and geotechnical conditions.
- Develop a water conservation strategy for the site that will ensure the efficient use of all water resources.

- Incorporate appropriate best management practices (BMPs) into the development that address the environmental and water management issues identified.
- Ensure that sufficient land area is set aside to manage stormwater runoff quality and quantity.
- Protect the downstream environment by reducing pollutant loads discharged into surface water and groundwater systems.
- Minimise ongoing operation and maintenance costs for landowners and the Shire.
- Gain support from DWER and the Shire for the proposed method to manage stormwater within the site.

Detailed objectives for water management within the site are further discussed in **Section 5**.

2 Proposed Development

The development will allow for the creation of a range of land uses specific to the south-west region. The masterplan is provided in **Appendix A** and proposes the following:

- Residential lots (63.2 ha)
- Strata titled village (28.4 ha)
- Road reserve (39.7 ha)
- Conservation public open space (POS) (12.2 ha)
- Riparian corridor (15.1 ha)
- Primary school (3.5 ha)
- Neighbourhood activity centre, short stay accommodation and other commercial (2.7 ha)
- Existing gas pipeline corridor and powerline easement (0.7 ha)
- Landscape and acoustic buffer (3.8 ha)
- Recreational POS, WSUD features and streetscapes (14.4 ha)
- Sporting oval (4.8ha)

The conceptual landscaping masterplan and civil/earthworks conceptual designs are provided in **Appendix B** and **Appendix C**, respectively.

The stormwater management plan for the site proposes the following WSUD features (discussed further in **Section 7**):

- Lot scale infiltration (soakwells)
- Tree pits
- Road verge and median treatment swales
- Water quality treatment and conveyance (perimeter) swales
- Bio-retention areas (BRAs)
- Flood storage areas (FSAs)
- Inline flood detention storage areas
- Living stream principles adopted within existing retained waterways and adjacent riparian corridor
- Waterwise gardening principles.

3 Existing Environment

3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context to the site:

- *Weather and Climate Statistics* (BoM 2021)
- *Geological survey of Western Australia* (Gozzard 1986)
- *Acid sulfate soils (ASS) risk mapping* (DWER 2021b)
- *Geomorphic wetlands of the Swan Coastal Plain database* (DBCA 2021)
- *Water register* (DWER 2021a)
- *Water Information Reporting* (DWER 2021b)
- *Landgate Aerial Photography* (WALIA 2021)
- *National Water Quality Management Strategy (NWQMS)* (Australian Government 2018)
- *Treendale East Estate – Preliminary Geotechnical Investigation* (WML 2021).

3.2 Historical land uses

Review of historical aerial imagery (WALIA 2021) shows the site has been used for pasture/grazing. The cluster of vegetation within the northern portion of the site has remained relatively untouched since 1996.

3.3 Climate

South-western Australia experiences a dry Mediterranean climate of hot dry summers and moderately wet, mild winters. Long term climatic averages indicate that the site is located in an area of moderate to high rainfall, receiving an average of 953.8 mm annually (BoM 2021) with the majority of rainfall received between May and August. Mean maximum temperatures range from 16.7^{o}C in July to 31^{o}C in January, while mean minimum temperatures range from 8^{o}C in August to 16.1^{o}C in February (BoM 2021).

3.4 Geotechnical conditions

3.4.1 Topography

Topography across the site is relatively flat however generally grades down towards to the waterways traversing the site (discussed further in **Section 3.5.2**). Elevations range from 20 metres Australian height datum (mAHD) at a localised high point around the central north, down to ~5.5 mAHD around the southern boundary of the incised waterways (Thompson Surveying 2021). Topographic contours across the site are shown on **Figure 2.**

The landscape slope generally ranges from 0.55% to 4% across most of the site, however some parts of the site adjacent to the waterway corridor exceed 15%. A slope analysis has been undertaken demonstrating the location of the steepest parts of the site adjacent to the waterways, and this is shown on **Figure 3**.

3.4.2 Regional geology

Environmental geology for the site has been mapped by the *Geological Survey of Western Australia* (Gozzard 1986). The site consists of:

- Qhao – Alluvium, older river terraces.
- Qpa – Guilford Formation: mainly alluvial sandy clay.
- Qpb – Bassendean Sand, low rounded dunes.

Regional geology across the site is shown on **Figure 4**.

3.4.3 Local geology and soils

A geotechnical investigated was conducted by WML (2021) and includes the installation of 72 test pits (TP01 – TP72) within the site. Test pits were excavated up to 2 m below ground level (mBGL). Test pit locations are shown on **Figure 4**.

In summary, WML (2021) concluded the soil profile beneath the site has three main zones, sand (zone 1), sand above clay (zone 2) and clay (zone 3) which are further outlined in **Table 1**. Zone 1, 2 and 3 were classified as Class P, M and H, respectively (WML 2021). Soil profile zones are shown on **Figure 4** and geotechnical logs are provided **Appendix D**.

Table 1: General soil profile zones across the site

Zone	Soil layer	Depth (m)	Description
1	Sand with silt	0.0 – 2.0	Moist, grey to yellow, loose to medium dense, fine to medium grained sand with a variable percentage of silt and a trace of fine roots.
	Coffee Rock	1.1 – 2.0	Moist, black slightly mottled brown, very dense, fine to medium grained indurated sand with some silt and some organics. Generally, no thicker than 150 mm.
2	Sand / silty sand	0.0 – 1.25	Dry to moist, pale grey to yellow/orange, loose to dense, fine to medium grained sand, with a variable percentage of silt and a trace of fine to medium roots.
	Clay / sandy clay	0.7 – 2.0	Moist to wet, grey mottled orange to brown mottled grey, clay, with a variable percentage of fine to coarse sand and roots.
3	Clay / sandy clay	0.0 – 0.6	Dry to moist, stiff to hard, clay with a variable percentage of fine to medium grained sand and a trace of fine roots.
	Clay	0.4 – 2.0	Moist, stiff to hard, clay with a variable percentage of fine to medium grained sand and fine to coarse grained gravel, and a trace of relic tree roots. Gravels were often ironstone. Approximately half of the test pits performed in zone 3 observed a clay layer between 0.5-1.5m thick of medium to highly reactive soils with linear shrinkage values between 12.5-16.5%.

During groundwater monitoring (discussed in **Section 3.6.2**) Emerge Associates recorded the logs of eight bores (MW1-MW8) installed beneath the site. Lithology observed was consistent with the geotechnical investigation undertaken by WML (2021). In summary:

- The southwestern area (bores MW1, MW2, MW3) is likely an aged depositional floodplain.
- The south-eastern portion (MW4, MW5) shows an area of in-situ weathering of laterite based profile producing a deep red clay layer.
- The northern portion (MW8 and MW7) is an aeolian deposition area (remanent sand dune) and overlays the lower level and broader geology (MW6).

3.4.4 Acid sulfate soil

Regional acid sulfate soil (ASS) risk mapping identifies the entire site as having a 'moderate to low' risk of ASS occurring within 3 m of the natural soil surface (DWER 2021). Regional ASS mapping is shown on **Figure 5.**

ASS sampling was conducted as part of geotechnical investigations by WML (2021) at 0.5 m intervals from 20 test pits. Laboratory analysis indicated nine out of 20 test pits have potential acid sulfate soils (PASS).

The extent of ASS which is encountered and potentially disturbed, and any management requirements, will be largely dependent upon the future extent of excavation below the natural soil surface and any potential dewatering activities associated with development of the site, which will be outlined during detailed design.

3.5 Surface water

3.5.1 Wetlands

A review of the *Geomorphic Wetlands of the Swan Coastal Plain dataset* (DBCA 2021) indicates that a multiple use wetland (MUW) (UFI 1730, 1711 and 15223) is present across the majority of the site (see **Figure 6**). A conservation category wetland (CCW) (UFI 1748) is also present 180 m south of the site.

3.5.2 Existing hydrology

Runoff generated from the site is expected to be locally variable due to infiltration capacity of soils in three distinct soil zones outlined in **Section 3.4.3**. Zone 1 (sand) is expected to have some infiltration capacity, whereas Zone 2 (sand above clay) and Zone 3 (clay) are known to be seasonally inundated, with water frequently ponding above the natural surface.

The DWER *Hydrography Linear* (DWER 2020) dataset indicates that multiple major drains, waterways and earth dams are located within the site. Two main incised waterways, one which runs from north to south (Treendale main drain), the other which runs from east to west (Treendale branch drain) intersect at the southern boundary of the site (near Raymond Road) and flow south-west into a CCW (UFI 1748) and eventually into to the Collie River approximately 1 km downstream.

Both waterways are delineated in the *Hydrography Linear* (DWER 2020) dataset, however have 'no data' recorded. The two waterways have limited riparian vegetation and are within a well incised corridor which is up to 60 m wide is some sections. It is noted these two waterways are within the Brunswick River and Tributaries surface water areas and under the *Rights in Water and Irrigation Act,* any potential works within the waterway area may require a Bed and Banks permit from DWER.

A supply chain network (Harvey Water) is also delineated in the dataset (DWER 2020) within a section of the eastern boundary. This is currently used to deliver non-potable water to the site.

There are also some minor drains within the site which are straight and appear excavated (with soil heaped beside the drains). These have presumably been installed to facilitate draining of seasonally saturated land. Existing hydrological features are shown on **Figure 6**.

3.5.2.1 Pre-development surface runoff modelling

MRWA supplied results from the pre-development modelling performed by the BORR team (**Appendix E**). These included 1% annual exceedance probability (AEP) peak flow rates entering the site at the Treendale main drain of 4.0 m^3/s (Inflow 1) and 5.6 m^3/s entering the site at Treendale branch drain (Inflow 2), as shown of **Figure 6**.

Emerge Associates prepared a 1D pre-development hydrological model to characterise the existing environment of the site (using XPSWMM software). As indicated above, upstream catchments were represented by utilising information provided by MRWA.

Results from the pre-development analysis indicate the following:

- Runoff enters the site from upstream catchments at two locations along the eastern boundary (Inflow 1 and 2 shown on **Figure 6**) and flows southerly via the two existing waterways.
- Due to a localised topographic high towards the north-west of the site, a portion of runoff sheet flows west and discharges from site at 'Outflow 1' via existing culverts along Forrest highway.
- The majority of runoff from the site (i.e. that which exceeds local infiltration capacity of soils) traverses south into the Treendale main drain and discharges from site at 'Outflow 2'.
- A small portion of runoff from the south-eastern catchments flows south into the Treendale branch drain to discharge from site at 'Outflow 3'.

The pre-development peak inflow and outflow flow rates from a 1% annual exceedance probability (AEP), 20% AEP and 1 event per year (EY) at key control points are shown in **Table 2**.

Table 2: Pre-development 1% AEP peak flow rate

Location	Site description	Outflow Configuration	1EY peak flow rate (m^3/s)	20% AEP peak flow rate (m^3/s)	1% AEP peak flow rate (m^3/s)
Inflow 1	Treendale main drain	Open drain	0.9	2.23	4.0
Inflow 2	Treendale branch drain	Open drain	1.25	3.13	5.6
Outflow 1	Culvert beneath Forrest Highway (westerly discharge)	Twin 300 mm x 1200 mm box culvert	0	0.3	1.8

Outflow 2 & 3	Culverts beneath Raymond Road (southerly discharge)	Single 1250 mm culvert	1.9	6.6	11.9

The modelling assumptions report provided in **Appendix** presents the detailed methods and assumptions used to develop the surface runoff model. The extent of inundation within the two incised waterways and immediate surrounds based on the 1D modelling undertaken by Emerge Associates is shown on **Figure 7**.

3.5.3 Surface water quality

The site is situated within the Leschenault Inlet Management Area (LIMA) which supports diverse ecological habitats and species within the region. Under the *Waterways Conservation Act 1976* there is a need for coordinated management of these areas such that a balance between ecological health and human development can be established.

Surface water quality sampling was undertaken by Emerge Associates in July 2021, August 2022 and November 2022 at three locations (see **Figure 6**).

The results of the monitoring exhibit moderately elevated total nitrogen (TN) and total phosphorous (TP) concentrations across all sampling locations; in comparison to the *National Water Quality Management Strategy* (NWQMS) (Australian Government 2018) guideline values for lowland rivers. The results from the sites inlet sampling location (S2) showed slightly higher levels of nutrients compared with the outlet locations (S1 and S3), suggesting that the existing waterways provide some measure of water quality improvement to runoff entering the site. Results of the monitoring are summarised in **Table 3**.

Table 3: Surface quality results (Emerge Associates 2022)

Monitoring location	pH	EC	DO	TN	NH_3	TKN	TP
	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L
NWQMS (Australian Government 2018)	6.5 - 8			1.2			0.065
S1	7.01	1039	7.32	2.5	0.05	2.4	0.45
S2	7.10	1134	7.14	2.9	0.08	2.8	0.65
S3	7.47	933	5.72	1.8	0.06	1.8	0.23

Note: Shaded results indicate exceedance of the adopted trigger value

3.6 Groundwater

3.6.1 Groundwater resources

The *Water Register* (DWER 2021a) indicates aquifers beneath the site comprise of the following:

- Superficial Swan
- Leederville
- Yarragadee south.

At the time of preparing this report (June 2021), all aquifers are recorded as fully allocated.

3.6.2 Groundwater levels

Review of the *Perth Groundwater Map* (DWER 2021b), indicates that the site is located beyond the extend of the mapping, and hence no maximum groundwater contours are available for the site. One long-term DWER groundwater monitoring bore (Ref 61118032) is however located within the site adjacent to the southern boundary, along Raymond Road (see **Figure 8)**.

Emerge Associates installed eight monitoring bores across the site in May 2021 to undertake groundwater quality and level monitoring. Groundwater level monitoring was undertaken monthly with the aim of capturing the seasonal peak groundwater levels between 2021 to 2023, with the results summarised in **Table 4**. Bore locations and depth to groundwater elevations are shown on **Figure 8.**

It is noted that MW3 could be considered an outlier, therefore potential depth to groundwater may decrease based on data from surrounding bores.

Based on the geotechnical report (see **Section 3.4.3**) groundwater seepage within some of the bores (e.g. MW1 and MW2) are inferred to be associated with a low permeability layer, therefore are considered to represent perched groundwater.

Groundwater was also identified during geotechnical investigated conducted by WML (2021) in May 2020. Of the 72 test pits, 16 recorded groundwater to depths ranging between 0.65 to 1.90 mBGL. WML (2021) noted that of these 16, at least 11 were a perched or seasonal groundwater table due to the permeable sands above low permeability coffee rock or clays, with no groundwater identified below these low permeability layers.

Bores MW03, MW07 and MW08 were installed into sand up to 6.5 mBGL, however recorded an MGL between 1.05 - 2.22 mBGL, hence are potentially a representative of the Superficial Swan aquifer.

Groundwater monitoring data (including bore lithology logs) are provided in **Appendix G**.

Table 4: Measured seasonal peaks GWL (mBGL) – 2021 to 2023

Bore ID	Depth to water (mBGL)		
	2021	2022	2023
MW1	0.01	0.19	0.20
MW2	0.00	0.00	0.00
MW3	1.87	1.88	2.12
MW4	2.32	3.44	3.40
MW5	3.28	3.58	3.88
MW7	2.22	2.09	2.36
MW8	0.88	0.94	1.12

Based on all information available regarding shallow groundwater conditions beneath the site, it is concluded that seasonal peak levels beneath the site are variable, and heavily influenced by:

- Localised (clay) soil profiles, where seasonal peak levels will likely reflect local soil conditions and will be at or close to the surface (i.e. the south eastern portion of the site – Zone 3 identified in the geotechnical investigation)
- Shallow groundwater conditions in permeable soils which are close to or at the surface and underlain by clay (i.e. in the south western portion of the site – Zone 2 identified in the geotechnical investigation).
- Shallow groundwater conditions in permeable sand with modest (~2m) depth below the surface (i.e. central and more elevated portion of the site – central Zone 1 identified in the geotechnical investigation).

Given the above, groundwater should be managed with the assumption that the majority of the site has groundwater at or close to the surface, and will likely require fill and/or subsoil drains to achieve appropriate separation from groundwater.

3.6.3 Groundwater quality

Groundwater quality sampling was undertaken by Emerge Associates in 2021 and 2022 across all monitoring bores. The results of the monitoring indicate elevated TN concentrations across the majority of bores in comparison to the NWQMS (Australian Government 2018) guideline values for lowland rivers. In particular, monitoring locations within the southern central area (bores MW3 and MW4) recorded elevated levels of TN between 4 – 5.2 mg/L and TP levels 0.15 - 1.77 mg/L. The groundwater quality results are typical for the current and historical agricultural uses across the site. Results to date are shown in **Table 5**.

Table 5: Groundwater quality results (2022)

Monitoring location	pH	EC	DO	TN	Ammonia	KNT	TP
	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L
NWQMS (Australian Government 2018)	6.5 - 8	-	-	1.2	-	-	0.065
MW1	5.79	1373	1.67	4.3	0.01	2.0	0.13
MW2	4.86	309.8	0.04	5.3	2.70	5.3	1.76
MW3	5.80	319.2	0.36	1.2	0.14	1.2	0.08
MW4	5.19	389.75	0.92	0.8	0.07	0.5	0.04
MW5	5.25	1171.5	5.39	5.5	0.03	1.1	0.06
MW6	6.55	3107.5	2.70	4.7	0.03	4.6	0.67
MW7	6.22	188.6	1.62	2.7	0.07	2.6	0.40
MW8	5.56	151.95	0.56	3.4	0.92	2.5	0.30

Note: Shaded results indicate exceedance of the adopted trigger value

3.7 Sewage sensitive areas

The entirety of the site is classified as a sewage sensitive area by the *Government Sewerage Policy (GSP)* (DPLH 2019a) as shown on **Figure 9**: Sewage Sensitive Areas

The policy defines sewage sensitive areas geographically based on proximity to a variety of environmental assets and sensitivity to on-site sewage disposal. The two classifications of relevance to the site define a sewage sensitive area as:

- Estuary catchments on the Swan and Scott Coastal Plains.
- Within 1 km of a significant wetland.

As wastewater within the site is proposed to be reticulated, no measures in accordance with the GSP are required.

3.8 Flora and fauna

Whilst there have not been any detailed flora or fauna surveys across the entire site, a targeted flora survey for the species *Diuris drummondii* (Tall Donkey Orchid) was undertaken in and around the two incised waterways (discussed in **Section 3.5.2**). The targeted survey was carried out in December 2018 in relation to the BORR development directly adjacent to the site (BORR Team 2020).

As part of this survey, no *Diuris drummondii* were observed and it was identified that the waterways within the site were highly disturbed with limited native species remaining, high weed invasion and grazed by cattle.

During on-site investigations in August and October 2021 Emerge Associates noted that there is some riparian vegetation (native trees) along the waterways (mainly *Eucalyptus rudis* (flooded gum) and *Melaleuca sp.*) immediately adjacent to the stream centreline(s) however generally the waterways are highly disturbed due to grazing cattle and weed invasion. Details regarding the proposed retention of the riparian vegetation is discussed in the biophysical assessment outlined in **Section 4**.

3.9 Summary of existing environment

In summary, environmental investigations undertaken during the WMS works indicate that:

- Historical images show that the site has been used for pasture/grazing.
- The site receives 953.8 mm of rainfall per year on average, predominantly occurring between May and August.
- Site topography ranges from 20 m AHD at a localised high point along around the central north, down to ~5.5 m AHD around the southern watercourse.
- Regional geology indicates that the site is underlain by sand, sand over clay or alluvium.
- A geotechnical investigation was undertaken across 72 test pits across the site. The investigation recorded three main soil profile zones, being – ‘sand’ across the central north, ‘sand above clay’ towards the western and south-western boundary, and a pocked along the north-east, and ‘clay’ along the south-eastern corner.
- The site has a ‘moderate to low’ risk of ASS occurring within 3 m of the natural soil surface.
- The site is within a sewage sensitive area.
- There are numerous drains, watercourses, and earth dams present across the site. Two main incised waterways, one which runs from north to south (Treendale main drain), the other which runs from east to west (Treendale branch drain) intersect at the southern boundary of the site

(near Raymond Road) and flow south-west into a CCW (UFI 1748) and eventually into to the Collie River approximately 1 km downstream.

- The western side of the site adjacent to Forrest Highway is known to be seasonally inundated (i.e. during winter), with water ponding above the ground surface following rainfall.
- An existing outlet from the site exists beneath Forrest Highway and conveys runoff to the west.
- MRWA have provided surface runoff modelling of the broader and upstream catchment undertaken to support the BORR.
- MRWA 1% AEP peak flow rate entering the site at the Treendale main drain (north-south waterway) is 4.0 m^3/s (Inflow 1) and peak flow rates entering the site at the Treendale branch drain (east-west waterway) is 5.6 m^3/s (Inflow 2).
- Surface water has moderately elevated TN and TP concentrations across all sampling locations.
- The seasonal peak groundwater levels beneath the site vary from 0.00 mBGL to 6.43 mBGL. The majority of the levels recorded likely reflect shallow soil profiles and not a permanent superficial aquifer given the low permeability of soils observed.
- Groundwater is slightly acidic with slightly elevated TN and TP levels across majority of bores. Results are a reflection of the current and historical agricultural use.
- There is some riparian vegetation along the waterways (mainly *Eucalyptus rudis* (flooded gum) and *Melaleuca sp.*) immediately adjacent to the stream centreline(s) however generally the waterways are highly disturbed due to grazing cattle and weed invasion.

4 Biophysical Assessment

4.1 Policy framework

Government policy and guidance relating to waterways foreshore areas is primarily administered by DWER. A number of guidance documents assist with the determination of foreshore areas. These documents include:

- *Operation Policy 4.3:* Identifying and establishing waterways foreshore areas (DoW 2012)
- Guidance Note 6: Identifying and establishing waterways foreshore areas (DoW 2013)
- Water Note 23: Determining foreshore *reserves* (WRC 2001)

The following biophysical criteria require consideration when identifying a foreshore area (WRC 2001):

- Vegetation – The extent of the riparian vegetation
- Hydrology – Extent of the floodway/floodplain
- Soil type – Soil types that typically support riparian vegetation
- Erosion – Soil types that are prone to erosion
- Topography – Landscape features
- Function – Foreshore function
- Habitat – Valuable habitat areas
- Land use – Areas that might be harmed by adjacent land use pressures.

4.2 Biophysical assessment

A biophysical assessment has been undertaken to determine the location and extent of the foreshore area, i.e. the area required to protect the two incised waterways (Treendale main drain and Treendale branch drain), from potential development impacts. The biophysical assessment informs spatial planning of the site and any foreshore reserve proposed.

The biophysical criteria listed in **Section 4.1** have been considered for the existing environment (see **Section 3**) and includes observations and data from on-site assessments undertaken in relation to the BORR development. The assessment is summarised in **Table 6**.

Table 6: Biophysical criteria and assessment

Biophysical factor	Assessment of biophysical factor	Spatial implications of biophysical factor
Vegetation	Targeted flora surveys for *Diuris drummondii* have been undertaken (BORR Team 2020). During detailed site inspections, Emerge noted that native trees along the waterways are mainly *Eucalyptus rudis* (flooded gum) and *Melaleuca sp.*, although generally the waterways are highly disturbed due to grazing and weeds.	Riparian vegetation across the waterways is limited to trees which are immediately adjacent to banks of the waterways. The riparian vegetation connected to waterways should be incorporated within a foreshore area.
Hydrology	The existing waterways connect to the Collie River approximately 1km downstream. The inundated areas have been delineated using surveyed contours of the riparian corridor and 1% AEP flood depths from 1D modelling analysis. The spatial extent of the 1% AEP inundated area is approximately 13.2 m AHD upstream and 5.3 m AHD at the discharge point along Raymond Road.	All areas inundated in a 1% AEP event are included in the foreshore area, with the exception of the north eastern boundary of the Treendale main drain, where local and adjacent land levels are lower than the 1% AEP top water level (TWL). These are not required to be excluded from development to protect the values of the waterway, and a setback of 30m from the stream centreline plus 16m for management access and fill integration should be adopted.
Topography	Some parts of the site immediately adjacent to the waterway have slopes which exceed 10%. Slopes exceeding 10% are more susceptible to erosion. If these areas are developed the integration of development levels with the remainder of the foreshore area may be challenging.	A slope analysis (see **Figure 3**) demonstrates areas where slopes exceed 10%. These areas should be included in the foreshore area.
Soil Type	The site is generally underlain by clays, sandy-clays and clayey-sand. These will have generally low permeability. Soils associated with riparian vegetation are generally clay, and mapping of these soils generally aligns with the floodway extents.	Soils associated with the riparian vegetation do not extend across the majority of the site and are largely limited to the floodway.
Erosion	The incised nature of the waterways and low permeability of surrounding soils will result in a low potential for channel changes to occur.	Any development which occurs within the floodplain will need to ensure that sufficient erosion protection is incorporated, however there are no immediate spatial considerations.
Function	Historical function of the waterways is flood conveyance to the Collie River.	The future function of the foreshore area will be flood detention and conveyance, integration with POS, retention of existing riparian vegetation, flood detention and management access.
Habitat	No detailed fauna surveys have been undertaken across the riparian corridor. Aerial imagery shows some riparian vegetation associated with the waterways although large sections are observed to have been cleared.	Existing riparian vegetation likely provides some measure of fauna habitat and riparian vegetation directly connected to the waterway should be retained.
Land Use	Majority of the areas adjacent to the riparian vegetation have historically been used for agricultural purposes.	The future function of the foreshore area will be to maintain the existing hydrology by ensuring flows entering the site are conveyed to downstream environmental assets.

4.3 Proposed foreshore area

Based on the information provided in **Table 6**, and in order to determine the foreshore area required to protect the waterways, the following is proposed:

- The foreshore should include the outermost extent of the riparian vegetation immediately adjacent to the waterways as shown on **Figure 7**.
- All areas connected to the waterways with slope exceeding 10% should be within the foreshore area.
- The foreshore should include the outermost extent of 1% AEP flooding determined in the 1D XPSWMM flood modelling discussed in **Section 3.5.2.1** and shown on **Figure 7**.
- The exception to the extent of 1% AEP flooding is the north eastern boundary of the Treendale main drain, where part of the site is lower than the 1% AEP TWL. A site setback of 30 m from the stream centreline is proposed for this area.
- Apply a 10 m setback from the outermost extent of the above constraints to allow for the following:
  - + 4 m along entire corridor for management and fire emergency services access
  - + 6 m for earthwork/side slope integration.

Based on the above considerations, the recommended foreshore area is shown on **Figure 10**.

5 Design Criteria and Objectives

This section outlines the objectives and design criteria that this WMS and future water management plans must achieve. The water management strategy includes water conservation, surface water management and groundwater management.

5.1 Integrated water cycle management

The *State Water Strategy* (Government of WA 2003) and *BUWM* (WAPC 2008) endorses the promotion of total water cycle management and application of WSUD principles to provide improvements in the management of surface water, and to increase the efficient use of other existing water supplies.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, surface water and groundwater.
- Integrating water and land use planning.
- Allocating and using water sustainably and equitably.
- Integrating water use with natural water processes.
- Adopting a whole catchment integration of natural resource use and management.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Stormwater management design objectives should therefore seek to deliver best practice outcomes in terms of:

- Potable water consumption
- Flood mitigation
- Surface water management
- Groundwater management.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of National and State policies and guidelines, as detailed in **Section 1.4**.

5.2 Water conservation

The water conservation design criteria proposed are consistent with the guidelines presented in *BUWM* (WAPC 2008). This WMS proposes the following water conservation criteria:

Criteria WC1 Consumption target of 100 kL/person/year with no more than 40 – 60 kL/person/year of scheme water.

Criteria WC2 Adopt a fit for purpose water supply strategy to meet potable and non-potable needs.

Criteria WC3 Reduce irrigation requirements across the development.

The manner in which the above objectives will be achieved is further detailed in **Section 6**.

5.3 Surface water management

The principle behind surface water management at the site is to mimic the pre-development hydrological conditions. This WMS proposes the following surface water design criteria:

Criteria SW1 Manage the small event runoff (i.e. first 15 mm) as close to source as possible.

Criteria SW2 Post-development peak discharge rates from the site should not exceed pre-development peak discharge rates.

Criteria SW3 Discharge locations from the site should be consistent with the pre-development environment.

Criteria SW4 Provide adequate land area within the site for inline detention of runoff up to the 1% AEP major event.

Criteria SW5 Finished floor levels should provide 500 mm clearance above the major (1% AEP) event flood levels within the central waterways.

Criteria SW6 Utilise best management practices to reduce the risk of nutrient loading to stormwater and the downstream environment.

The manner in which these objectives will be achieved is further detailed in **Section 7**.

5.4 Groundwater management

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology. This WMS proposes the following groundwater design criteria:

Criteria GW1 Perched groundwater levels to be managed using imported fill, low permeability layer grading and/or a subsoil drainage network.

Criteria GW2 The combined earthworks and subsoil drain approach will achieve minimum separation distances recommended by the Institute of Public Works Engineering Australasia (IPWEA).

Criteria GW3 Groundwater captured by subsoil drains will be appropriately treated.

Criteria GW4 All subsoil drainage to have a free draining outfall.

Criteria GW5 Utilise appropriate measures to manage nutrient loads to groundwater.

The manner in which these objectives will be achieved is further detailed in **Section 8**.

6 Water Conservation Strategy

6.1 Fit-for-purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that scheme water is not wasted. Fit-for-purpose principles have been utilised in the water conservation strategy for the site and will help to achieve **Criteria WC1** and **WC2**.

6.1.1 Scheme water

The development operates within the Water Corporation's Integrated Water Supply System (IWSS) and therefore lots will be supplied by scheme water for potable and non-potable uses.

6.1.2 Groundwater

As discussed in **Section 3.6.1**, the site is underlain by a multi-layered system comprising of the Superficial Swan, Leederville and Yarragadee aquifers.

At the time of preparing this report (June 2021), all aquifers are fully allocated. Groundwater is therefore not proposed as a non-potable source of water for the development. A water trade within the Yarragadee aquifer is not considered a viable option for either party as the depth requires the need for substantial bore sizes and spatially the scale of the development would require the need for multiple bores, resulting in significant upfront costs and potentially prohibitive maintenance and replacement costs for the Shire in the long term.

6.1.3 Surface Water

The total annual irrigation requirements of 215,250 kL for the development (refer to **Table 7**) is proposed to be met by a non-potable supply channel operated by Harvey Water. Harvey Water indicate that a non-potable source of water will be available to service the entire irrigation demands and represents a more efficient use of available water supply as opposed to the traditional and costly additional ground water extractions source. The detailed design of this strategy is currently being prepared and will be outlined in the future water management plan (WMP). The existing infrastructure and supply locations will be maintained, providing certainty that the site can be provided with non-potable water by Harvey Water. Harvey Water's commitment is provided in **Appendix I.**

6.1.4 Rainwater tanks

Collection of runoff from roof surfaces can be undertaken, with this water stored within rainwater tanks (RWTs) for later use. Stored rainwater may be used for some irrigation requirements however this will need to be supplemented with scheme water during the lower rainfall months. During the higher rainfall months, the majority of the stored rainwater can be used to supplement internal building non-potable uses. The water efficiency strategy recommends that rainwater is used in washing machines, toilets and hot water systems.

RWTs will not be mandated for the site however they will be promoted by the proponent at point of sale by providing educational literature regarding the benefits of their use. The stormwater

management strategy does not rely on the use of RWTs, and they are therefore only considered to be a water conservation measure. It is assumed for the purposes of the water usage analysis (detailed in the WMS) that, where installed, RWTs will have at least 3 kL of storage capacity and will be plumbed for internal supply to toilets, washing machine and domestic hot water systems. The water usage analysis assumes an uptake rate of 9%, informed by the Australian Bureau of Statistics (ABS) studies (ABS 2013).

The above measures will assist in achieving **Criteria WC1**.

6.2 Irrigation demand

The irrigation demand for the development has been approximated based on the likely large proportion of open space and verges within the site (which could be up to 55ha), however not all open space areas will be permanently irrigated. Proposed areas to be irrigated to some extent will likely include POS areas (turf and landscaped areas), drainage assets (WSUD features, waterway corridors, conveyance swale corridor, etc.), road reserves (medians, street trees), the sporting oval and the school site.

Irrigation rates are yet to be finalised however are assumed to nominally be 7,500 kL/ha/year for the purposes of initial demand assessment. The area requiring irrigation is estimated to be approximately 23.5 ha.

The concept plan proposes to create approximately 55 ha of open space and if all green spaces and adjacent verges (62 ha total) within the site were to be irrigated at full rates, irrigation requirements would likely exceed 435,000 kL/year. However, of the 62 ha open space and adjacent verges, 35.2 ha will be reserved for conservation purposes, riparian corridor and landscape and acoustic barrier and WSUD features that will not be permanently irrigated. Of the remaining recreational POS, not all will require permanent ongoing irrigation at full traditional irrigation rates. A summary of the potential irrigation is provided in **Table 7**.

Table 7: Indicative irrigation calculations

Open space type	Open space area (ha)	Potential irrigated area including adjacent verges (ha)	Area requiring permanent irrigation (ha)	Permanent irrigation needed (kL/year)
Conservation POS	12.2	12.6	1.3	9.750
Recreational POS, WSUD features and streetscapes	18.5	24.3	18	135,000
Riparian Corridor	15.5	16.0	1.9	14,250
Sporting oval	4.8	5.3	5.3	39,750
Landscape and acoustic barrier	3.8	3.8	0.2	1,500
School	2.0		2.0	15,000
Total	56.8	62.0	28.7	215,250

Whilst the initial estimate of annual volume required to irrigate landscaped areas is 215,250 kL, this may vary in the future pending design of these areas, the requirements of the Shire and non-potable water available.

The allocation of 215,250 kL of non-potable water by Harvey Water will not remove water from Yarragadee aquifer and will remain available for more appropriate land uses within the locality. The proposed allocation by Harvey Water also represents the use of water currently wasted within the existing system.

6.3 Water conservation measures

The development will utilise water wise garden (WWG) principles for lot scale gardens and estate landscaping, and water efficient fixtures and appliances (WEFA) to ensure that the development minimises the use of water. These measures are further discussed in the following sections.

6.3.1 Water efficient fixtures and appliances

Significant reductions in in-house water uses can be achieved with the use of WEFA and the water conservation strategy proposes that all dwellings use WEFA. Water efficient fittings will be implemented by the lot owner during building construction, while uptake of water efficient appliances will be encouraged by the proponent through provision of educational materials at point of sale. Examples of educational material are provided in **Appendix H**.

The above measures will assist in achieving **Criteria WC1**.

6.3.2 Water wise gardens

Reductions in water use for irrigation by employing water efficiency measures can significantly reduce the total water usage. The following water efficiency measures will be used:

- Retain remnant native trees and vegetation where possible.
- Where required, soil shall be improved with soil conditioner certified to Australian Standard AS4454 to a minimum depth of 150 mm where turf is to be planted and a minimum depth of 300 mm for garden beds.
- Garden beds to be mulched to 75 mm with a product certified to Australian Standard AS4454.
- Implementation of hydrozoning design practices, which will group plant species with similar / same irrigation requirements.
- Irrigation systems will have emitters which disperse coarse droplets to minimise losses to evaporation.
- Irrigation will not be utilised during winter months.
- The adoption of xeriscape gardens (garden beds are landscaped using drought tolerant species that require minimal water and nutrients) where possible.
- Community awareness of water conservation will be promoted at the point of sale and during the development sales lifespan.

WWG principles will be utilised within POS and road reserves at an irrigation rate between 3,375 kL/ha/year (for garden areas) to 10,000 kL/ha/year (for the average oval). Uptake of WWG practices

for lot landscaping will be encouraged by the proponent at point of sale of lots through provision of educational material (see examples provided in **Appendix**).

The above measures will assist in achieving **Criteria WC1**, **WC2, WC3, SW6** and **GW5**.

6.4 Wastewater management

The development will be connected to the Water Corporation's deep sewer network. The conceptual sewage network is illustrated in **Appendix C**.

6.5 Water conservation criteria compliance summary

A summary of the proposed water conservation design criteria and how these are addressed within the site is provided in **Table 8**.

Table 8: Water conservation compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Consumption target for water of 100 kL/person/year, including not more than 60 kL/person/year of scheme water	Use of WEFA by lot owners.
		Adoption of WWG practices by lot owners.
		Education regarding water conservation provided to lot purchasers.
WC2	Adopt a fit for purpose water supply strategy to meet potable and non-potable needs.	Scheme water provided for potable uses. Rainwater tanks encouraged for lot owners to supplement non-potable uses Non-potable water provided by Harvey Water to meet estate scale irrigation requirements.
WC3	Reduce irrigation requirements across the development	Landscape design that follows WWG practices.

7 Surface Water Management

The principle behind the stormwater management strategy is to maintain the existing hydrology of the site by retaining the main waterway corridors and immediately adjacent landforms, and by ensuring that the post-development peak flow rate and discharge locations are consistent with the pre-development environment. This will be achieved by ensuring runoff up to the 1% AEP rainfall event is first treated as close to source as possible and then detained within the waterway corridors, before discharging off site at an appropriate flow rate which mimics the existing hydrology.

The presence of clayey soils at relatively shallow levels across the majority of the site along with locally perched ground water would likely diminish the near-surface storage capacity of the site after periods of high rainfall. Notwithstanding, WSUD measures can still be appropriately implemented however these will have specific design considerations to manage sedimentation, erosion and to ensure that they are able to dry out in an acceptable time and provide the required water quality treatment outcomes.

The stormwater management measures that are proposed for the site are discussed in the following sections and include:

- Lot scale infiltration (soakwells) where soils allow
- Tree pits
- Road verge/median water quality treatment areas
- Perimeter water quality treatment and conveyance swales
- BRAs/FSAs
- Inline flood detention storage areas within the existing retained waterways
- Living stream principles adopted within waterways and adjacent riparian corridor
- Waterwise gardening principles.

7.1 Lot drainage

7.1.1 Residential lots

Residential lots will be required to provide soakwells to retain and infiltrate runoff from the small rainfall event (i.e. first 15 mm) from roof and impervious areas.

Due to the low infiltration capacity of in situ soils towards the south-east (Zone 3, see **Section 3.4.3**), sand fill (approximately 1.2 m) will be used to achieve final lot levels across the site, and soakwells will be installed into the sand fill. The invert of the soakwells and/or soakage structures will achieve the clearances required by IPWEA (2016), being above the 50% AEP phreatic surface beneath soakwells and 300 mm below surface based soakage structures.

Subsoil drains will be located within road reserves to ensure that the soakwells within private lots function appropriately and to protect the longevity of road pavement (discussed further in **Section 8.1.2**). All roof runoff should be directed to soakwells, and these should be installed at the front of lot to ensure that the benefit of an adjacent subsoil drain is realised. Soakwells should not be installed at the rear of lots.

The design of lot stormwater systems will meet the following criteria:

- The lot incorporates an overland flow route for runoff greater than the at-source retention to ensure there are no trapped low points within the lot.
- All lots are required to infiltrate/retain the first 15 mm, and this is assumed to be within soakwells and surrounding pervious areas (gardens).
- Runoff exceeding lot storage capacity will ultimately be routed to the downstream pit and pipe network.
- Overland rainfall on paved areas at the front of lots (10% of the lot area) is assumed to runoff towards the road reserve in all rainfall events.

The exception to the requirement for soakwells will be the south eastern portion of the site which is underlain by low permeability clays. The built form approach for this part of the site is yet to be determined, however at lot retention may not be possible without import of significant quantities of fill. If this is the case, lots will need to be provided with a lot connection pit to ensure effective at-lot drainage.

The use of soakwells within lots will assist in achieving **Criteria SW1.**

It is noted that the Shire may require some form of planning control or specific requirements regarding at-lot storage. The proponent will work with the Shire to ensure that whatever approach is taken, the at-lot storage assumptions can and will be implemented.

7.1.2 Non-residential lots

A range of non-residential lots are proposed across the structure plan, including a primary school, eco village, neighborhood activity centre, short stay accommodation and microbrewery (see **Appendix A**). From a stormwater management perspective, these non-residential lots will manage runoff in a manner consistent with residential lots (discussed in **Section 7.1.1**).

7.2 Estate drainage

7.2.1 Road drainage network

The engineered drainage network proposed will adopt a combination of traditional stormwater conveyance measures and WSUD measures, as appropriate to localised site context. The WSUD measures are described in the following sections and will be integrated with a stormwater pit and pipe network. Collectively the system will be designed to convey runoff from a 20% AEP event. Therefore, all local roads will be passable in the 20% AEP event.

It is noted that any WSUD measures that are proposed to be implemented will need to meet the Shire's requirements, and this may include demonstrating mitigation of localised inundation, damage to surrounding infrastructure (e.g. kerbs) and maintenance requirements.

Note that whilst tree pits and raingardens/verge swales are indicated below as potential WSUD measures to be adopted, the storage volumes potentially provided by these has not been accounted for in the runoff modelling at this stage, thereby providing flexibility for their adoption at later stages.

7.2.2 Tree pits

Tree pits are a localised water quality treatment measure that can be used to capture a portion of the small runoff event (i.e. first 15 mm) from road reserves. The specific number, location and storage capacity of tree pits are yet to be determined, but if required would ultimately be placed higher in the catchment within road reserves or on the non-active side of dual frontage lots. Their adoption will be considered at detailed civil and landscape design. If implemented the designs will need to comply with the requirements of the Shire, and this would be outlined in a future UWMP.

An example of a tree pit is shown in **Plate** 1**.**



Plate 1: Indicative tree pit design

7.2.3 Raingardens/verge swales

Vegetated raingardens/verge swales can be provided in road verges on the non-active side of dual frontage lots, where other services, crossovers, parking etc. allow adequate space to install them. Raingardens can be used to treat a portion of the small event runoff (first 15 mm) from road reserves with excess runoff above the small event directed to downstream POS. Raingardens would typically be designed considering the following parameters:

- Vegetated with native nutrient removing plant species.
- Underlain by soil suitable for water quality treatment.
- Depth 300 mm.
- Side slopes 1:3, though may be steeper in some site contexts and where allowed by the Shire.

The extent of adoption of raingardens/verge swales will be confirmed at detailed design in future UWMPs, but if required would ultimately be placed higher in the catchment within road reserves.

An example of a raingarden is shown in Plate 2. The use of raingardens will assist in achieving **Criteria SW1** and **SW4**.



Plate 2: Indicative rain garden design

7.2.3.1 Treatment swales

Vegetated median swales will be used in some wider road reserves within the development to manage the small event runoff from immediately adjacent road pavement. Median swales will typically be 6 m wide, have 1:6 side slopes, a maximum depth of 500 mm and will be vegetated with nutrient removing plant species.

Swales will be vegetated using plant species with high nutrient uptake capacities and low water requirements, consistent with the *Vegetation guidelines for stormwater biofilters in the South West of Western Australia* (Monash University 2014). Swales will be underlain with soil which encourages water quality treatment.



Plate 3: Indicative median swale design

The proposed locations for median swales are shown on **Figure 10**. Median swales will assist in achieving **Criteria SW1**, **SW4** and **SW6**.

7.2.4 Perimeter swales

Perimeter swales will be located within a 25 m to 30 m POS corridor around the perimeter of the site boundary, adjacent to BORR, Forrest Highway and Raymond Road.

These POS corridors will provide several purposes including noise mitigation bunds and vegetation screening in addition to being utilised for the treatment and conveyance of runoff from the development (discussed in **Section 7.2.7**). The perimeter swales will be:

- Vegetated with native nutrient removing plant species.
- Underlain by soil suitable for water quality treatment
- Width 12 m (nominal is this may vary slightly)
- Maximum depth 500 mm (though note that modelled depths are typically mush less than this)
- Side slopes 1:6
- Longitudinal grade up to 1:500
- Cross sectional profile has a central V channel of nominal (approximately 300 mm) depth to limit the width of baseflow within the swale
- Sized to convey the 1% AEP peak flows from the development.

The conceptual locations of perimeter swales are shown on **Figure 10** and a typical cross-section shown in **Plate 4**, with the road hierarchy cross-sections shown in **Appendix B**.



Plate 4: Typical perimeter swale cross-section

Perimeter swale inverts will likely intersect seasonal peak groundwater conditions. This is acceptable and will form part of the overall earthworks and groundwater management strategy. It will provide discharge locations for subsoil drains, and given the large vegetated surface area it will provide appropriate water quality treatment of surface runoff and subsoil discharges. The perimeter swales may be underlain by a longitudinal subsoil drain that will be approximately 500 mm below the swale invert to ensure that these dry out as soon as possible following storm events. The inclusion or otherwise of a subsoil system beneath the swale will be confirmed in future detailed design stages.

It should be noted that Forest Highway and Raymond Road do not contribute to the site. Parts of the BORR contribute to the Treendale Main Drain which flows through the site and has been accounted for in runoff modelling done by MRWA and Emerge. Ther perimeter swale along the northern boundary enters the waterway but is not affected by upstream flows as it is significantly higher than the main drain.

The size and spatial requirements for swales are shown in **Table 9** and illustrated on **Figure 10.** Conveyance swales will assist in achieving **Criteria SW1**, **SW4** and **SW6**.

7.2.5 Bio-retention areas

Runoff from the small rainfall event not retained higher in catchment will be treated within vegetated BRAs. Where implemented, BRAs have been sized to treat the small rainfall event (i.e. first 15 mm) from the road reserve and other private spaces which may not achieve infiltration of the first 15 mm (e.g. development in Zone 3 areas). BRAs provide water quality treatment by removing fine sediments, trace metals, nutrients, bacteria and organics and can be located within the POS areas. Characteristics of BRAs include:

- Vegetated with native nutrient removing plant species.
- Depth of 300 mm (though this may extend to 500 mm if localised constraints dictate).
- Side slopes 1:3.
- Underlain by soil suitable for treatment of water quality treatment.

BRAs are not designed to be permanently wet. Instead, stormwater will infiltrate into the underlying soil medium, will continue to fill into a co-located FSA or overland flow to the adjacent swale/retained waterway corridor. If required, subsoil drains may also be utilised within the BRAs to ensure they can dry out in adequate time (further discussed in **Section 8.1.2**)

The size and spatial requirements for BRAs are shown in **Table 9** and illustrated on **Figure 10.** BRAs will assist in achieving **Criteria SW1**, **SW4** and **SW6**.

7.2.6 Flood storage areas

In areas where the runoff exceeds the capacity of the upstream WSUD measures (tree pits, verge swales, median swales, BRAs), it will either continue to fill the same storage (in the case of a collocated BRA/FSA) or will over top into a separate FSA, providing further detention such that pre-development 20% AEP outflows from the development area are maintained, and so that the overall 1% AEP flow rates at Raymond Road/Forrest Highway are maintained. Characteristics of FSAs include:

- Depth of up to 1.0 m (including the BRA portion, where relevant)
- Side slopes 1:6.

The size and spatial requirements for FSAs are shown in **Table 9** and illustrated on **Figure 10**. FSAs will assist in achieving **Criteria SW4** and **SW6**.

7.2.7 Existing retained waterways

As discussed in **Section 3.5.2**, the site has two incised waterways (Treendale main drain and Treendale branch drain), within approximately 15.5 ha of riparian corridor. Both are located in the south-western portion of the site and will be retained within a dedicated foreshore area. It is acknowledged that both the Shire and Water Corporation will have requirements regarding tenure, access and maintenance that will need to be accommodated on implementation.

Runoff not detained within the development and which exceeds the capacity of the WSUD measures previously described (i.e. runoff which exceed pre-development 20% AEP peak flow rates) will be conveyed by the two waterways. There will still be some measure of flow within the retained waterway in a 20% AEP event due to upstream catchments and the waterway corridor catchment itself, however the waterway capacity is not required to detain the 20% AEP event runoff from the development area.

The alignment/meanders of the waterways will generally be retained, and the banks approximately 5 m either side will be revegetated consistent with a natural waterway. The revegetation will incorporate and support the existing trees that will be retained. The remainder of the corridor will be appropriately treated and managed, however will not necessarily be revegetated.

Both waterway corridors will provide additional water quality treatment, as is inferred to already occur (based on the results of surface water quality monitoring discussed in **Section 3.5.3**). They will also be utilised to provide flood detention of rainfall events up to a 1% AEP event. The adoption of inline flood detention will utilise the existing landforms and will reduce the need for large flood detention basins elsewhere within the development. Inline flood detention will be provided by constricting flows at several locations, typically at road crossing points that will have culverts installed regardless of flood mitigation strategies. Each inline detention has been sized by providing a low flow culvert and higher level weir overflow. The configuration of these can be modified in the future as long as they are able to convey small rainfall events, mitigate major flood events and provide a high level (extreme event) overflow (in case of blockage).

The volume/capacity of the inline storage will be provided by the existing landform – these are not proposed to be modified in order to retain the existing characteristics of the waterways. This will result in some localised (i.e. existing) steep side slopes and 1% AEP peak flood depths generally less than 1.2 m, with the exception of the uppermost inline storage area (which has an instantaneous peak depth of 1.43 m at the deepest part of the inline detention area (i.e. immediately upstream of flow constriction locations). This portion of the waterway has a time of peak inundation of up to 40 mins in response to a 1% AEP event and therefore safety in design, public access and maintenance will need to be considered in the final design.

Access control in these areas will be required as part of the landscape design, and this may include vegetation, fencing, balustrades, walkways or other measures to limit public access and to provide consideration of safety in design.

The design of the waterways will adopt living stream principles, and adjacent lot levels will be such that finished floor levels of adjacent lots will be at least 500 mm above the maximum TWL to ensure protection from flooding during major rainfall events.

The size and spatial requirements for the inline storage within the waterway corridors are shown in **Table 11** and the locations are illustrated on **Figure 10**. Integration and enhancement of the existing waterway/riparian corridor will assist in achieving **Criteria SW2**, **SW3**, **SW4** and **SW6**.

7.3 Stormwater management design

The sizing of stormwater management infrastructure has been determined using XPSWMM hydrological and hydraulic modelling software. The post development model uses an “initial loss – continual loss” infiltration model, and the modelling assumptions and parameters are detailed in the modelling assumptions report provided in **Appendix F**.

7.3.1 Treatment of stormwater

As previously discussed, lots will retain the small rainfall event within the lot (via soakwells or alternative measures) where local soils permit. Therefore, downstream treatment structures (e.g. raingardens, swales, BRAs) are required to manage the first 15 mm of rainfall from the road reserves. The vegetated riparian corridor will also provide additional inline water quality treatment, however this treatment is not proposed to retain the first 15 mm in order to manage it.

The size/spatial requirements of treatment assets are presented in **Table 9**, and shown on **Figure 11**.

Table 9: Stormwater treatment assets size and spatial requirements.

		Small rainfall event (first 15mm)			Minor rainfall event (20% AEP)		
Catchment	Treatment asset	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)
Ct-P02	BRA	0.26	629	153	0.28	637	168
Ct-P04	Swale	0.50	1,200	300	0.50	1,200	300
Ct-P04(C)	BRA	0.46	610	250	0.54	622	303
Ct-P04(C)	FSA	0	0	0	0.49	2,032	970

Table 10 (cont): Stormwater treatment assets size and spatial requirements.

		Small rainfall event (first 15mm)			Minor rainfall event (20% AEP)		
Catchment	Treatment asset	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)
Ct-P04(S)	BRA	0.48	670	290	0.54	675	332
Ct-P04(S)	FSA	0	0	0	0.50	3,149	1462
Ct-P05	Swale	0.48	691	163	0.50	720	183
Ct-P05	Co-located basin	0.50	598	153	0.84	1,218	899
Ct-P06	Swale	0.49	2,617	628	0.50	2,700	896
Ct-P06	FSA	0	0	0	0.95	3,683	3,224
Ct-P07	Co-located basin	0.50	898	229	0.81	1,826	1,348
Ct-P08	Co-located basin	0.30	757	210	0.96	1,609	1,176
Ct-P09	BRA	0.10	460	12	0.49	586	255
Ct-P10	Co-located basin	0.22	1,876	395	0.50	2,057	950
Ct-P11	Co-located basin	0.21	2,027	414	0.52	2,213	1,080
Ct-P12	Co-located basin	0.28	3,606	966	0.68	3,890	2,518
Ct-P13	Co-located basin	0.20	2,440	450	0.50	2,621	1,248
Ct-P14	BRA	0.17	2,084	364	0.48	2,252	1,024
Ct-P15	BRA	0.27	600	150	0.30	608	166

7.3.2 Flood detention and conveyance

The WSUD measures previously discussed (soakwells, swales, FSAs/BRAs, and perimeter swales)) have been designed to detain runoff to up to the minor (20% AEP) rainfall event outside the existing waterway corridor to maintain the existing hydrology. Major (1%AEP) rainfall events will be detained by inline flood storages that will attenuate peak flow rates before discharging from site at three discharge locations (Outflow 1, 2 and 3 shown on **Figure 10**.)

Runoff from Ct-P01, Ct-P02 and Ct-P03 will be conveyed through a swale and discharge to an existing culvert under Forrest Highway ('Outflow 1'). The remaining runoff (Ct-P04 – Ct-P15) will be conveyed via perimeter swales and existing waterways to discharge off site to an existing culvert under Raymond Road (outflow 2' and Outflow 3'). Discharge locations are shown on **Figure 10**.

Inundation from the minor (20% AEP) and major (1% AEP) events are illustrated on **Figure 12** and **Figure 13**, respectively. The waterway storage requirements which will assist in achieving **Criteria SW3** are provided in **Table 11**.

Table 11: Flood storage area requirements

Catchment	Minor event (20%AEP)			Major event (1% AEP)		
	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)
Ct-P06 (downstream)	0.94	3,105	2,745	1.43	3,332	4,343
Ct-P07 (upstream)	0.74	7,116	5,108	1.11	7,388	7,851
Ct-P07 (middle)	0.78	7,387	5,583	1.15	7,665	8,391
Ct-P07 (downstream)	0.74	7,782	5,615	1.14	8,066	8,847
Ct-P15	0.65	2,483	1,541	1.07	2,645	2,707

7.3.3 Post-development peak flows

In order to address the requirement to achieve flood detention of the 20% AEP outside the flood corridor, additional flood detention has been provided within the development area, outside the waterway corridor/foreshore area as summarised in **Table 9**. The pre-development versus post-development peak flow rates for the comparable catchments in a 20% AEP event is summarised in **Table 12**.

Table 12: 20% AEP pre and post development flow rates contributing to existing waterway corridor.

Post-development catchment ID	Equivalent Pre-development catchment ID	20% AEP pre-development flow (m^3/s)	20% AEP post development flow (m^3/s)
Ct-P07	Ct-22, Ct-23, & Ct-24	0.271	0.519
Ct-P08	Ct-20 & Ct-21	0.301	0.069
Ct-P10	Ct-26	0.289	0.128
Ct-P11	Ct-28	0.140	0.083
Ct-P12	Ct-29	0.203	0.194
Ct-P13	Ct-27 & Ct-30	0.214	0.035
Ct-P14	Ct-31 & Ct-32	0.220	0.011
Ct-P15	Ct-34 & Ct-35	0.216	0.120
Treendale main drain (total)		1.22	0.84
Treendale branch drain (total)		0.64	0.33

For the waterway and site overall, the major (1% AEP) storm event runoff will be discharged from the site via culverts at the discharge locations shown on **Figure 10**. The conceptual design at the discharge locations has a low flow outlet and a weir to provide a peak flow control and to ensure that adequate flood storage is achieved, however it is acceptable that at detailed design stage the configuration may be amended to suit design requirements.

A comparison between pre and post development flow rates for the entire site is shown in **Table 13.**

Table 13: Pre and post development discharge rates

Discharge location	Pre development peak flow rate (m^3/s)		Post development peak flow rate (m^3/s)	
	Minor event (20% AEP)	Major event (1% AEP)	Minor event (20% AEP)	Major event (1% AEP)
Forrest Highway ('Outflow 1)	0.3	1.8	0.2	0.4
Raymond Road (Outflow 2 and 3 combined)	6.6	11.9	5.9	11.85

The flow rates summarised in **Table 13** and **Table 12** demonstrate that **Criteria SW2** can be achieved, and that the LSP is capable of providing the flood detention required (within WSUD measures previously described) to manage runoff from upstream catchments and the site itself.

7.3.4 Sensitivity analysis

A sensitivity analysis was undertaken to consider the impact on the stormwater infrastructure if 20% of lot area is assumed to runoff from impervious areas, rather than the designed 10%. Results show a slight increase in depths and volumes within flood storage areas and a slight overall increase in the peak flow rate leaving the site at Raymond Road of 11.92 m^3/s, however this is still comparable to the pre-development peak flow of 11.90 m^3/s. **Table 14** summarises the results of sensitivity analysis below.

Table 14: 1% AEP sensitivity analysis results

Catchment	Major event (1% AEP)			Difference		
	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)
Ct-P06 (downstream)	1.43	3,332	4,343	0.01	0	0
Ct-P07 (upstream)	1.12	7,388	7,888	0.01	0	37
Ct-P07 (middle)	1.16	7,665	8,442	0.01	0	51
Ct-P07 (downstream)	1.16	8,066	8,903	0.02	0	56
Ct-P15	1.12	2,686	2,776	0.05	41	69

7.4 Stormwater compliance criteria

A summary of the proposed stormwater management design criteria and how these are addressed within the structure plan design is provided in **Table 15**.

Table 15: Stormwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	Manage the small event runoff (i.e. first 15 mm) as close to source as possible.	Lots will retain the small rainfall event onsite within gardens and soakwells.
		Small rainfall events across the development not able to be captured by lot soakwells will be treated via WSUD measures (swales and bio-retention areas (BRAs)).
SW2	Post-development peak discharge rates from the site should not exceed pre-development peak discharge rates.	The 20% and 1% AEP post development peak flow discharges are lower than pre development peak flow discharges due to onsite treatment/retention within median swales, perimeter swales, BRAs, FSAs and for the waterway within inline detention storages.
SW3	Discharge locations from the site should be consistent with the pre-development environment.	The pre development discharge locations are retained.
SW4	Provide adequate land area within the site for detention of runoff up to the major event (1% AEP).	Detention is provided within extended detention conveyance swales, BRAs and the existing waterway/riparian corridor.
SW5	Finished floor levels should provide 500 mm clearance above the major (1 % AEP) event flood levels within the central waterways	Finish floor levels will provide at least 500 mm clearance from the adjacent top water level (TWL) within the waterway.
SW6	Utilise best management practices to reduce the risk of nutrient loading to stormwater and the downstream environment.	Minimise fertiliser use to establish and maintain vegetation.
		Use drought tolerant species that require minimal water and nutrients
		Contractor management of sediment
		Street sweeping
		Maintenance of POS and WSUD/stormwater infrastructure
		The location of garden beds away from treatment and conveyance structures.
		Education of residents.
		Raingardens/verge swales to placed within on non-active frontage of dual frontage lots, within road reserves.
		Tree pits to be installed in consultation with and in compliance with Shire standards.

8 Groundwater Management Strategy

8.1 Groundwater level management

Whilst there are some patches of remnant vegetation within the site these are mostly isolated paddock trees that would not be significantly affected by localised groundwater control. Control of groundwater is unlikely to have a detrimental effect on groundwater dependant ecosystems given that groundwater control can be no lower than the potential discharge locations within the site, and that localised soils will limit the spatial influence of groundwater control measures.

Consistent with the geotechnical conditions and hydrology described in **Section 3**, it is possible that infiltrated stormwater may perch on the clayey soils layer within portions of the site. Therefore, the groundwater management measures proposed across the site are:

- Grading of underlying lower permeability layer (where present) towards road drainage infrastructure and the waterway corridors.
- Use of subsoil drains beneath road reserves.
- Subsoil drains may also be used at the base of some BRAs to ensure that these will dry out in an acceptable timeframe and between storm events.
- Discharge of subsoil drains to a perimeter swale, which will be graded at a minimum of 1:500 towards the waterway corridors.
- Use of up to 1.2 m of permeable sand fill above the low permeability soil layer to achieve finished lot levels.

These components and the measures that will be implemented as a part of these components will assist in achieving **Criteria SW5**, **GW1**, **GW2** and **GW4**.

8.1.1 Clay layer management

Grading of the clay layer is likely in some portions of the site, namely the south eastern portion (Zone 3). This will typically occur where the depth of sand/fill above the clay layer is less than 1.5 m and will aim to direct locally infiltrated groundwater towards subsoil drains within road reserves or to the waterway corridor(s). Grading of the clay layer, in combination with permeable sand fill and subsoil drains, will ensure that the shallow soil profile beneath lots and roads will maintain an appropriate moisture content, and that and open spaces will dry between storm events.

8.1.2 Subsoil drains

8.1.2.1 Road reserves

The final earthwork levels across the site will result in a minimum of 1.2 m of permeable sand overlying clay layers. It is likely that in absence of any mitigating measures locally infiltrated stormwater (e.g. from soakwells) may perch above the low permeability layer. Therefore, in addition to grading the clay sub-layer, groundwater rise beneath lots and road reserves will be controlled through the installation of subsoil drains. Installation of subsoil drains within road reserves will result in typical spacing of drains being 75 m to 80 m apart. This typically results in a 20% AEP phreatic surface which peaks approximately 0.8 m above the subsoil drain invert, leaving a minimum

of 0.5 m clearance at the rear of lots (where fill depth above subsoil drains is 1.2 m). Much of the site will have greater that 1.2 m of fill above the clay layer, thereby providing even greater clearance.

Subsoil drain inverts are not proposed with the intention of lowering the superficial aquifer as they will be typically set above MGL or the graded clay surface, and are largely influenced by other groundwater controls, being the inverts of the perimeter swales or the existing drainage channels. Subsoil drains beneath road reserves are therefore intended to provide an up-front contingency should groundwater rise post-development. Notwithstanding, the conceptual subsoil plan shown on **Figure 14** shows the *minimum* subsoil invert, which is based on the invert of downstream structures. In the case where the minimum subsoil invert is lower than groundwater or the clay layer (e.g. for some parts in the southwestern portion of the site) these subsoils are likely to be set at a higher elevation, at approximately 1.2 m to 1.5 m below the finished design surface.

Whilst the invert of the perimeter swale may at some locations be below the surrounding groundwater level, these will not impact any groundwater dependant ecosystems as in these areas there are none, and localised groundwater is more driven by the low permeability of clay and alluvial soils and not a reflection of a permanent permeable aquifer.

Subsoil drains will discharge into the perimeter conveyance swales, or the existing waterways. Discharge will be to a vegetated structure where it will be treated by the vegetation and soil media proposed in these areas. Subsoil discharges will have a minimum 150-300 mm clearance from the downstream invert to ensure that they remain free draining.

Clearance from the invert of subsoil drains and the pre-development MGL or low permeability clay layer will vary across the site and generally increases from the subsoil drain outlet upstream at a minimum grade of 1:500. The conceptual subsoil drainage plan is provided on **Figure 14**.

Subsoil drains will typically be installed in a 600 mm wide trench, backfilled with aggregate and protected by geofabric or similar to prevent blockages. Most subsoil drains will be located within road reserves and coordination with other services will be essential and considered with the civil designs. Subsoil drains will be installed with inspection ports/ rodding points so they can be inspected and maintained as required. A typical subsoil drain configuration is illustrated in **Plate 5.**

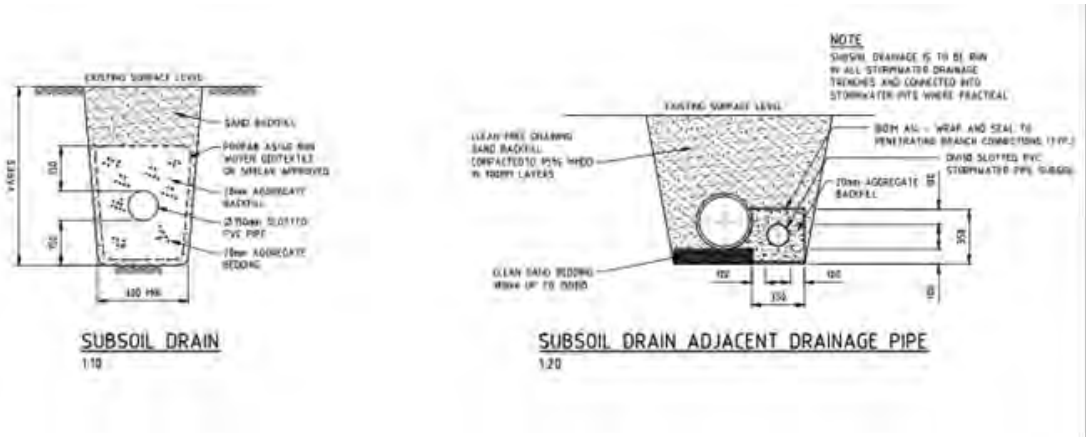


Plate 5: Typical subsoil drainage configuration.

8.1.2.2 Drainage infrastructure

There may be a need for subsoil drains to be installed beneath BRAs or perimeter swales to ensure that these dry within a reasonable timeframe between storm events. This will be possible where the inverts have sufficient clearance from the downstream waterway corridor (which all locations nominally proposed). As with the road reserve subsoil drains, subsoils beneath BRAs will have at least 150 mm clearance from the discharge invert to ensure a free draining outlet. The use of subsoil drains will therefore require the invert of the drainage infrastructure to be a minimum of 600 mm above the swale or waterway invert, thereby allowing 300 mm of cover over subsoil pipes and a nominal rise in the subsoil pipe due to minimum grade. The BRA locations adjacent waterways (**Table 16**) are several metres above the waterway inverts and therefore the minimum clearance will be readily achieved.

Table 16: Drainage infrastructure minimum invert requirements.

Catchment	Recorded peak seasonal GW level (m AHD)	Approximate invert of level BRA (m AHD)	Installation considerations
Ct-P04(C)	14.25	14.0	Adjacent conveyance swale will be lower and will facilitate subsoil drainage
Ct-P04(S)	14.00	13.8	Adjacent conveyance swale will be lower and will facilitate subsoil drainage
Ct-P05	15.13	15.3	Minor design refinement may be required at detailed design stage
Ct-P06	9.32	13.7	Adequate clearance available
Ct-P07	15.13	14.2	Adjacent waterway is significantly lower and will facilitate subsoil drainage
Ct-P08	13.99	14.5	Adjacent waterway is significantly lower and will facilitate subsoil drainage
Ct-P10	10.22	12.5	Adequate clearance available
Ct-P11	10.22	12.5	Adequate clearance available
Ct-P12	10.22	12.0	Adequate clearance available
Ct-P13	10.43	10.5	Adequate clearance available
Ct-P14	10.43	10.5	Adequate clearance available
Ct-P15	10.43	11.0	Adequate clearance available

8.1.3 Sand fill specifications

As shown in the conceptual civil designs provided in **Appendix C**, lots are proposed to be filled with an average of 1 m of sand fill to allow for adequate clearance to groundwater, effective conveyance of stormwater, vertical separation from the existing waterway and to provide appropriate geotechnical classification.

Fill levels and supportive drainage infrastructure (e.g. subsoils) will comply with the IPWEA (2016) *Specification Separation Distances for Groundwater Controlled Urban Development*. Fill utilised should aim to achieve a permeability of 4 m/day. Where a lower permeability specification of fill is

adopted consideration of this should be made within surface runoff modelling, fill depth assumptions and other aspects relying on infiltration.

8.2 Groundwater quality management

Management of groundwater quality within the site will occur both through stormwater quality management (i.e. WSUD) features that will treat runoff before it infiltrates, and by treating water intersected by subsoil drains within downstream BRAs, swales or vegetated waterways. These measures will assist in achieving **Criteria GW5**.

8.2.1 Nutrients from stormwater

The following measures will reduce the total nutrient load into groundwater and improve the quality of the water prior to it infiltrating into the underlying groundwater:

- Removal of former agricultural uses.
- Minimise fertiliser application to open space areas by adopting waterwise landscaping principles.
- Treat the first 15 mm of rainfall and runoff generated on impervious surfaces within lots and throughout the development as close to source as possible (see **Section 7**).
- Adoption of surface-based conveyance where possible. This will facilitate natural processes which trap/treat pollutants.
- Vegetation within the raingardens, BRAs, median swales, perimeter swales and the waterway corridors will provide treatment prior to runoff being either locally infiltrated or discharging off-site.
- Education of lot owners regarding fertiliser use and nutrient absorbing vegetation species appropriate for use within lots.

8.2.2 Subsoil drains

Discharges from subsoil drains beneath residential areas will be treated. Treatment will be achieved by locating the subsoil drain outlet into a treatment area (BRA or perimeter swale), where it will be treated by the same processes that will address stormwater runoff quality.

8.2.3 Legacy nutrients within groundwater

It is acknowledged that the quality of groundwater measured within the site is variable (see **Section 3.6.3**), and therefore, the development should mitigate the potential for legacy nutrients to be mobilised. The following approaches will assist in addressing legacy nutrients within groundwater:

- If subsoil drains are required, they will preferentially be located above the measured MGL or low permeability clay layer. Any water intersected by subsoil drains will therefore be infiltrated stormwater that will have been treated prior to infiltration and will not be mobilising legacy nutrients.
- The treatment train proposed for the treatment of stormwater runoff includes numerous WSUD measures throughout the development. These measures have been described in **Section 7**.

8.3 Groundwater criteria compliance summary

A summary of the proposed groundwater management design criteria and how these are addressed within the spatial layout of the structure plan is provided in **Table 17**.

Table 17: Groundwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Perched water levels to be managed using a subsoil drainage network, to be set at or above existing peak seasonal groundwater level.	Up to 1.2 m of imported sand fill, minor grading of the clay layer and a sub-soil network are proposed to manage perched groundwater levels post development.
GW2	The combined earthworks and subsoil drain approach will achieve minimum separation distances recommended by the Institute of Public Works Engineering Australasia (IPWEA).	The design lot levels will have a minimum clearance of 1.2 m to the subsoil network.
GW3	Groundwater captured by subsoil drains will be appropriately treated.	Subsoil drains will discharge to swales, BRAs or the existing vegetated waterways for treatment.
GW4	All subsoil drainage to have a free draining outfall.	All subsoil drains will have a clearance of 150-300 mm from the discharge point, thereby providing a free-flowing outlet.
GW5	Utilise appropriate measures to manage nutrient loads to groundwater.	Education of lot owners.
		Minimise fertiliser application by adopting waterwise landscaping principles.
		The use of WSUD measures to treat the small rainfall event.
		Vegetation of treatment areas (swales, BRAs and waterway/riparian corridor) to provide treatment prior to runoff discharging off-site.
		Treatment of discharges from subsoil drains within WSUD measures.

9 Subdivision and Water Management Plans

The requirement to undertake preparation of a more detailed water management plan to support subdivision is generally imposed as a condition of subdivision. The development of the WMP should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008) and the *Draft State Planning Policy 2.9 Planning for Water* (DPLH & WAPC 2021) which provides some updates to the requirements for water management reports at subdivision stage.

While strategies have been provided within this WMS address planning for water management within the site, it is a logical progression that future subdivision designs and the supportive WMP(s) will clarify details not provided within the WMS. The main areas that will require further clarification within future WMP(s) include:

- Implementation of water conservation strategies
- Lot drainage
- Imported fill strategy
- Modelling of local road drainage network
- Subsoil drain network specifications and design
- Non-structural surface water and groundwater quality improvement measures
- Construction management and monitoring
- Ongoing management and maintenance
- Design and ongoing maintenance for corrosion of sub-surface infrastructure
- Design, quality, management, and costings of non-potable water supply.

These are further detailed in the following sections.

9.1 BORR drainage requirements

It is acknowledged that there may be some existing surface overland flow from the BORR to the northeast of the site, which could potentially cause temporary inundation adjacent to the proposed noise bund. The detailed design of the Forrest Highway noise bund will also need to be reviewed at the detailed design stage to avoid creating trapped low areas on the western side of the Forrest Highway noise bund. The management/routing needs of these areas is acknowledged and will be addressed at future detailed design stages in consultation with MRWA.

9.2 Implementation of water conservation strategies

A number of potential measures to conserve water were presented within **Section 6.1** of this WMS. These water conservation strategies will be incorporated into the design and the ongoing maintenance of all open space areas. The future WMP will describe the open space irrigation strategy based upon the proposed designs as these are further developed. Landscape design measures that will be incorporated into the water conservation strategy will be further detailed within the future WMP for each relevant stage.

The manner in which the proponent intends to promote water conservation measures discussed in this WMS to future lot owners will also be discussed within the future WMP.

9.3 Lot drainage

This WMS has assumed that all lots will retain the first 15 mm of rainfall within the lot via infiltration within soakwells or pervious garden areas (see **Section 7.1**). However, the provision of WSUD measures to retain the first 15 mm of rainfall can be difficult to achieve within small lots underlain by clayey soils. In these cases, it is recommended that lots retain as much as practicable and that alternative/new WSUD measures be investigated.

Where not retained/treated within the lot, the balance of runoff from the first 15 mm rainfall event will need to be treated within downstream WSUD measures; if this approach is taken the size of downstream BRAs will need to be revised.

Therefore, surface runoff modelling to size WSUD treatment measures will be reviewed once lot sizing (from approved subdivision plans) is available and the lot drainage strategy refined.

It is also preferable that soakwells are installed at the front of lots. The future WMP will confirm the mechanism proposed to ensure that this occurs.

9.4 Fill specifications and approach

While an initial earthworks strategy has been developed, the approach to localised grading of clay layers and the fill specifications will need to be refined at subdivision stage. Should the permeability specifications change these will be documented in the WMP and the assumptions for surface runoff modelling will be updated as required.

9.5 Modelling of local road drainage network

The design of the drainage system to date has been undertaken at an appropriate level for local structure planning and needs to integrate with the road design. The primary purpose of the local stormwater drainage system is to remove stormwater from the road surface. Under a 10% AEP storm event, kerb line flow width should not exceed 1.5 m.

Surface runoff modelling of the stormwater drainage system will be reviewed once detailed drainage design has commenced for the area. The modelling assumptions (see **Appendix F**) are considered adequate for development of treatment and drainage structures and are of an appropriate level of detail. However, if the site layout is refined then verification of proposed subdivision drainage designs will be undertaken by modelling the catchments serviced by the drainage network. Such modelling will allow verification that the development undertaken within the structure planning area is consistent with this WMS. It is anticipated that this will occur during the subdivision design process and detailed within the future WMP.

As previously mentioned, the inclusion or exclusion of the use of tree pits will need to be considered in civil and landscape (streetscape) at the design stage.

9.6 Subsoil drain network specifications and design

As discussed in **Section 8.1**, sand fill, minor clay grading and subsoil drainage will likely be required to ensure sufficient clearances are achieved between finished lot levels and the phreatic crest. The current cut to fill strategy and lot elevations provide most lots across the structure planning area with approximately 1 m of permeable sand fill. If the fill depth over the clay layer or pre-development MGL were to be reduced, groundwater modelling may be required to calculate the post-development phreatic surface rise between subsoil drains.

The need for subsoil drains beneath swales/BRAs will also be further refined as the design of individual open space areas progresses, along with an understanding of the localised clay layer, if/how this is graded towards the downstream riparian corridor. The future WMP will provide detailed earthwork and subsoil drainage drawings to demonstrate that the required clearances are achieved.

9.7 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia (DoW 2007)* but should also consider the maintenance standards and requirements of the Shire of Harvey, which includes maintenance for corrosion of subsurface infrastructure. Some measures will be more appropriately implemented at a local government level, such as street sweeping, however many can be implemented within the design and maintenance of the road reserves, drainage reserves, POS, the waterway corridor and drainage infrastructure therein.

The future WMP will provide additional detail to the measures proposed (e.g. public education through signage to raise awareness of the role and function of WSUD features).

9.8 Construction management and monitoring

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed either in the future WMP or a separate Construction Management Plan (CMP).

The staging of works and cross over between civil and landscape design packages will need to be managed to ensure that open spaces are maintained in a safe condition.

It is also anticipated that construction water will either be sourced from Harvey Water, imported scheme water or it may be possible to source a temporary licence from DWER to meet construction/dust requirements.

9.9 Ongoing management and maintenance

It will be necessary to confirm that the management measures that are implemented are able to fulfil their intended management purpose, and are in a satisfactory condition at the point of management hand over to the Shire. This may include the preparation of an Operation and

Maintenance plan prior to handover to the Shire that outlines and differentiates between operating activities and maintenance activities. It should include (but not limited to) frequency, costs and intervention levels associated with each activity.

For instance, as previously mentioned, the ongoing maintenance of the POS required to be delivered is anticipated to rely on an allocation of approximately 215,250 kL of non-potable water per annum, to be supplied by Harvey Water. Therefore, it is anticipated that the Shire's ongoing maintenance of the POS area, will be an annual consumption cost of the non-potable water, this cost will be assessed against the Community Stand Pipe connection rates applicable at the time of hand over to the Shire of Harvey. The costs associated with normal maintenance of POS mowing, irrigation pipes, sprinklers etc will be incurred by the Shire.

A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations. These monitoring programs are detailed in **Section 10** of this WMS and will be further detailed at the WMP stage.

9.10 Conveyance swale design specifications

It is acknowledged that future designs of the conveyance swale along Roelands Road interface will need to consider side slopes, ongoing maintenance requirements whilst also providing the necessary drainage conveyance. The designs will meet SoH design requirements, which may include refinement of POS and adjacent development cell shape to remove pinch points, extension of culverts (that will already be installed beneath the entry road) or an alternative swale profile.

9.11 Foreshore area management

Given the prominence of the foreshore area and likely expectations on function and amenity, it is expected that the management requirements and design considerations for the waterway will need to be appropriately documented. Any relevant aspects from the proposed approach to managing the waterway will need to be considered during detailed design process. This will include consideration of all aspects but not limited to;

- Hydraulic function
- Revegetation
- Landscaping
- Erosion control
- Public recreation infrastructure
- Public safety
- Maintenance and access
- Implementation and ongoing management
- Roles and responsibilities.

These management and design considerations (i.e. those relevant to water management) will likely be documented in a separate Foreshore Management Plan, however the actions relevant to water management will also be included in future WMPs.

A single plan addressing the entire foreshore is the preferred approach and this will be addressed when subdivision includes creation of the foreshore area becomes a consideration.

10 Monitoring and Maintenance

The design of the site and water management infrastructure will be undertaken in a manner that promotes the long-term health of the water management systems. These systems often require active ongoing management, particularly in the first years after construction, to ensure that they continue to provide their intended functions. Construction and ongoing management typically incorporate a monitoring regime that guides management actions which will ensure that the overall objectives are met. The management objectives of ongoing monitoring and maintenance will be:

- Protect the downstream environment during construction and operation
- Maintain the intended functions of stormwater management systems.

10.1 Pre-development monitoring

In addition to the groundwater level data collected by Emerge Associates in 2021 (see **Section 3.6.2**), further pre-development monitoring was undertaken in 2022 and 2023. This additional monitoring will be used to inform concept civil and landscape designs and further refine guideline values discussed in **Section 10.3**.

10.2 Post-development monitoring

10.2.1 Condition

The overall condition of the development will be monitored on a bi-annual basis from completion of the civil and landscaping works. A visual assessment will be undertaken to monitor the overall condition of the development, with the aim to ascertain that the maintenance activities (which will be detailed in the WMP as described in **Section 9**) are achieving the overall management objectives for the development. The parameters that will be monitored include:

- Nutrients and water quality
- Gross pollutants
- Terrestrial weeds
- Drainage infrastructure.

Condition monitoring will continue for a period of two years to ensure that the development is in a satisfactory condition at the point of management handover to the Shire.

10.2.2 Surface water monitoring

Surface water quality will be monitored to provide an indication of the overall performance of the development and to ascertain whether surface water has been appropriately managed or if contingency actions are required. Surface water quality is proposed to be monitored at the two inlet locations (Inflow 1 and 2) and outlet locations (Outflow 1, 2 and 3) as shown on **Figure 10**.

Surface water monitoring will be conducted five times per year for two years until handover of the open space area to the Shire.

10.2.3 Subsoil network monitoring

Monitoring of water quality discharging from the subsoil network is also proposed. Water quality will be sampled at one subsoil discharge location per development stage. Sampling will be conducted quarterly for two years until handover of the relevant section of perimeter swale to the Shire.

10.2.4 Groundwater monitoring

The pre-development monitoring bore locations (shown on **Figure 8)** will be retained where possible and used for post-development monitoring to provide a direct comparison (as detailed in **Table 18**).

Given the variability in the observed water quality data, it is proposed that post-development monitoring will reference both a derived water quality target, and an upstream/downstream comparison of water quality at key locations within the site.

Monitoring of groundwater quality concentrations is proposed close to or at the pre-development bore locations (see **Figure 8**) if these locations can be retained. Where they cannot be retained, they will be reinstalled as close as practicable, providing upstream/downstream representative locations. Monitoring will be conducted quarterly for a period of two years from practical completion of open space areas.

A summary of the post-development monitoring program is shown in **Table 18**. Post-development monitoring will be conducted for two years, commencing on completion of the first stage of the subdivision.

Table 18: Monitoring program summary

Monitoring Type	Locations	Frequency	Parameters	Length of monitoring
Surface water	Upstream and downstream ends of the existing waterways	Five times per year for two years	In situ pH, EC, temperature. Sample TSS, TN, TKN, NH4, NOX, TP, FRP	From landscape completion to handover (minimum 2 years)
Subsoil drains	Two discharge locations of the subsoil drain	Quarterly for two years		
Groundwater	Bores upstream and downstream of key representative areas	Quarterly (typically Jan, April, July, Oct).		

10.3 Guideline values

Water quality guideline values for the site have been derived in consideration of the pre-development monitoring (see **Section 3**) and the *National Water Quality Management Strategy* (Australian Government 2018) guideline values. Guideline values are considered to be dynamic and should be reviewed regularly to incorporate any additional data obtained. Guideline values for the site are provided in **Table 19**.

Table 19: Water quality monitoring trigger values

Analyte	Surface water quality trigger value	Groundwater and subsoil discharge water quality trigger value	Secondary/longer term groundwater trigger values
TN (mg/L)	3.6	2.58	1.2
TP (mg/L)	0.76	0.38	0.65

10.4 Contingency actions

A contingency action plan (CAP) will be detailed and implemented as a part of the future WMP. The CAP is effectively a plan of steps that will be undertaken should specific water quality criteria be reached.

If the results from the initial monitoring indicate that nutrient concentrations exceed the nominated guideline values, a number of contingency measures will be employed.

The first action that will be undertaken if groundwater criteria is exceeded is to repeat the monitoring to eliminate sampling error. If repeat monitoring still shows results breaching the trigger value, upstream (incoming) nutrient concentrations will be compared with the outgoing (downstream) nutrient concentrations.

If the downstream nutrient concentrations are >20% higher than the upstream nutrient concentrations, the following actions will be undertaken:

1. Review POS nutrient application practices to identify source if possible.
2. Conduct surveillance of subdivision area to determine any other potential and obvious nutrient inputs.
3. Remove source if possible (e.g. fertiliser input, etc.).
4. Remove sediment-bound nutrients by removing basin sediments.
5. Manual removal of plant material from swales to facilitate further nutrient uptake.

If the downstream nutrient concentrations are found to be generally consistent with the upstream concentrations, a site-specific comparison of background data collected within the site prior to development will be conducted. If variability in nutrient concentrations (both spatially and temporally) are experienced across the development area, the trigger values may need to be modified following additional monitoring. This information should then be used, as a management tool in consultation with DWER, to determine if the guideline values should be revised.

10.5 Reporting

A post-development monitoring report will be prepared annually until the conclusion of the monitoring period (two years). Monitoring reports and interim results can be provided to the Shire on request.

11 Implementation

The WMS is a key supportive document for the Treendale East structure plan. The development of the WMS has been undertaken with the intention of providing a structure consistent with an integrated water cycle management approach within which subsequent development can occur. It is also intended to provide overall guidance to the general stormwater management principles for the area and to guide the development of the future WMP(s).

11.1 Roles and responsibility

The WMS provides a usable framework for the proponent to assist in establishing stormwater management methods, based on site-specific investigations (see **Section 3**), that are consistent with relevant State and Local Government policies and endorsed by the Shire. The responsibility for working within the framework established within the WMS rests with the proponent, although it is anticipated that future WMP(s) will be developed in consultation with various agencies and in consideration of other relevant policies and documents.

11.2 Funding

As the site constitutes a single landholding, the management strategies outlined in this WMS will be borne solely by the proponent.

11.3 Review

It is not anticipated that this WMS will be reviewed, unless the structure plan undergoes significant changes post-lodgement of this WMS. If additional areas are required to be covered by the WMS it is most likely that an addendum covering these areas will be prepared. If the structure plan is substantially modified, this WMS and criteria will need to be reviewed to ensure that all are still appropriate.

The next stage of water management is anticipated to be detailed design of subdivision. Detailed civil designs should be supported by a WMP. The WMP is largely an extension of the WMS, as it should provide detail to the designs proposed within this WMS and will demonstrate compliance with the criteria proposed in **Section 5**.

12 References

12.1 General references

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Figures

Figure 1: Site Location

Figure 2: Topograhic Contours

Figure 3: Slope Analysis

Figure 4: Geological mapping and Test Pit locations

Figure 5: Acid Sulfate Soil Risk Mapping

Figure 6: Existing Hydrological Features and Geomorphic Wetlands

Figure 7: Foreshore Biophysical Assessment

Figure 8: Depth to Groundwater

Figure 9: Sewage Sensitive Areas

Figure 10: Stormwater Management Plan

Figure 11: Small Event Inundation (first 15mm)

Figure 12: Minor Event Inundation (20% AEP)

Figure 13: Major Event Inudnation (1% AEP)

Figure 14: Conceptual Subsoil Drainage Plan

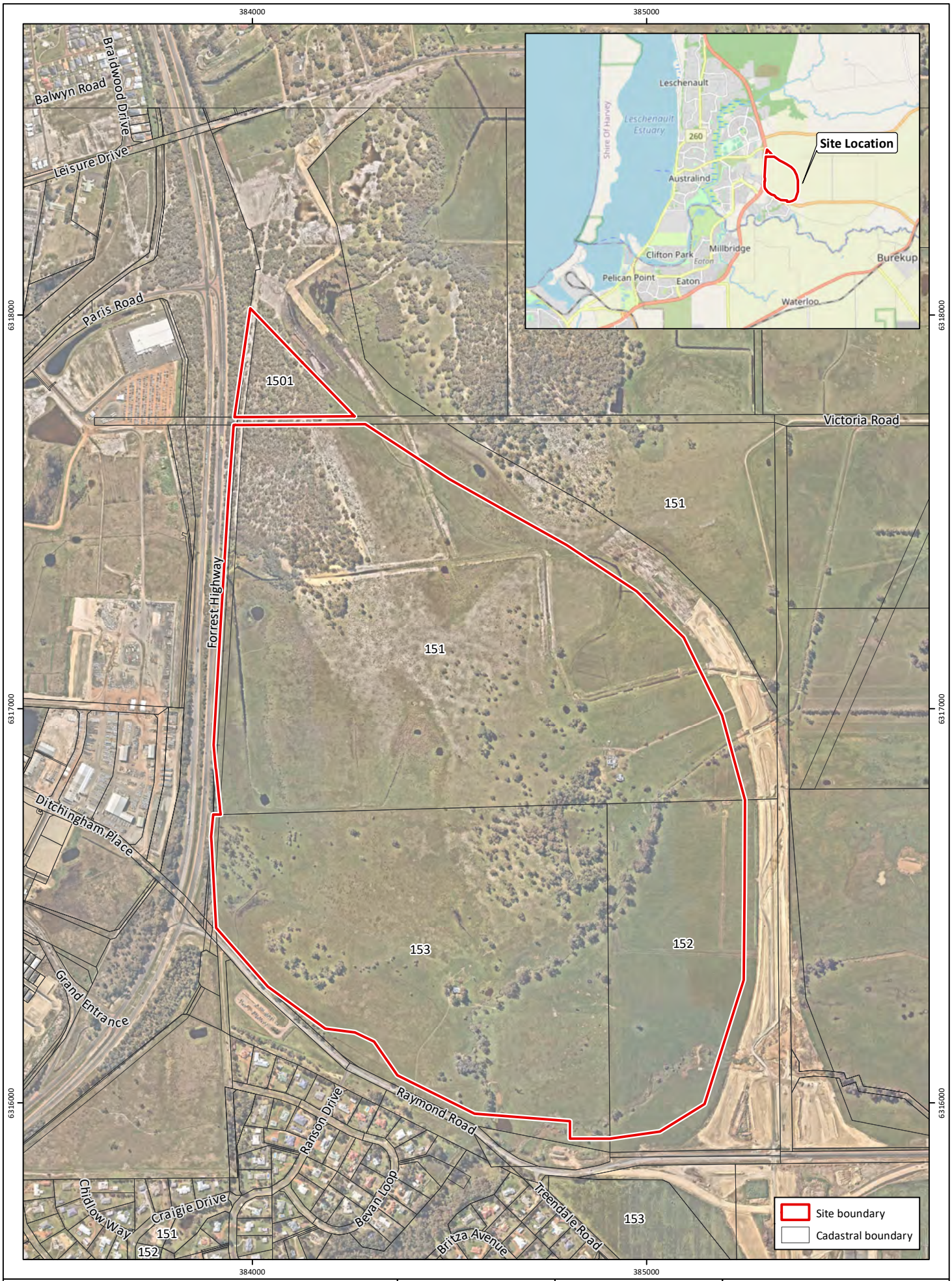


Figure 1: Site Locality

Project:	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number:
EP21-022(04)--F01

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	24/01/2022

N

0 100 200 300
Metres

Scale: 1:12,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.

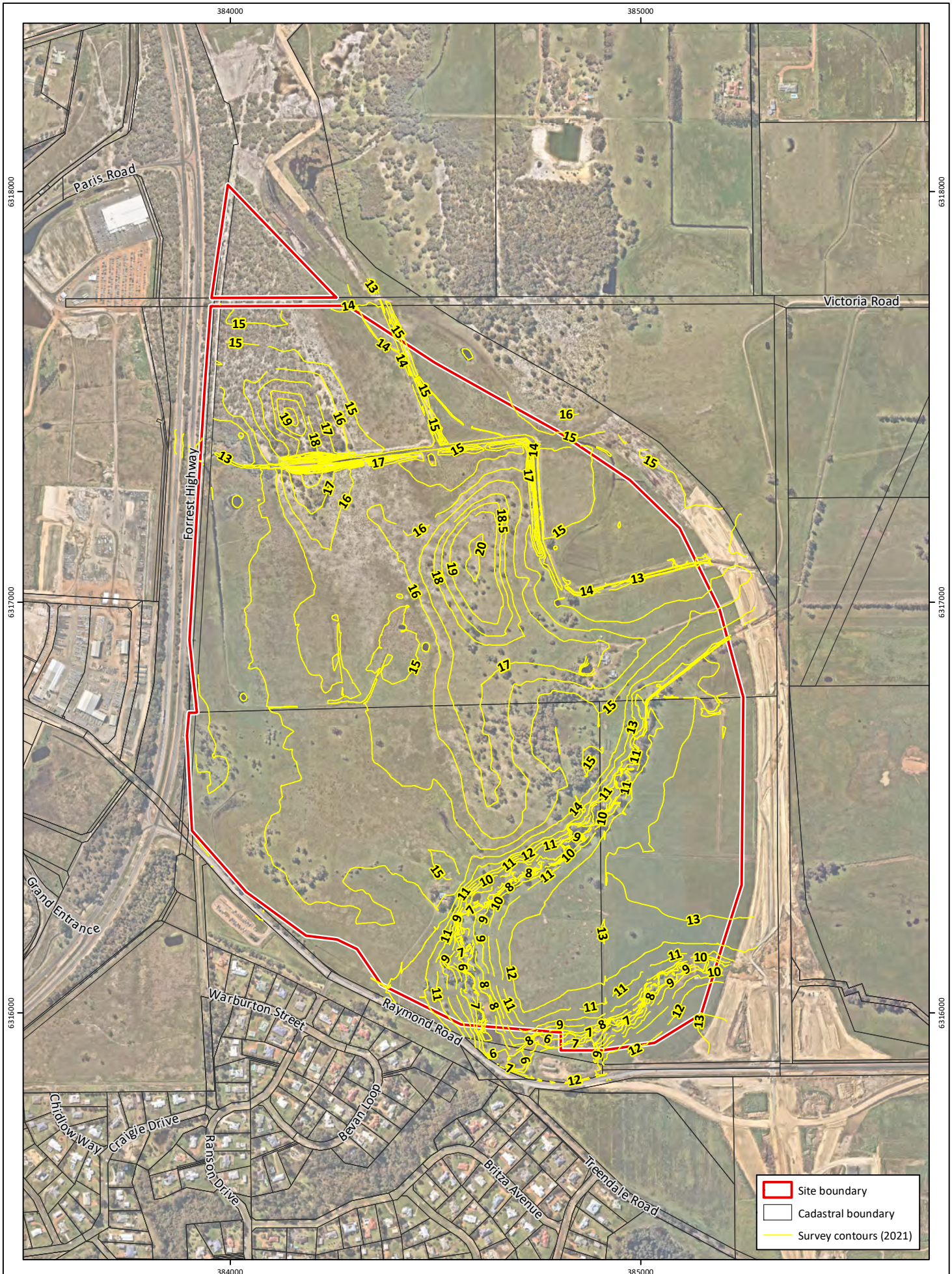


Figure 2: Topographic Contours

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F02

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	24/01/2022

N

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.

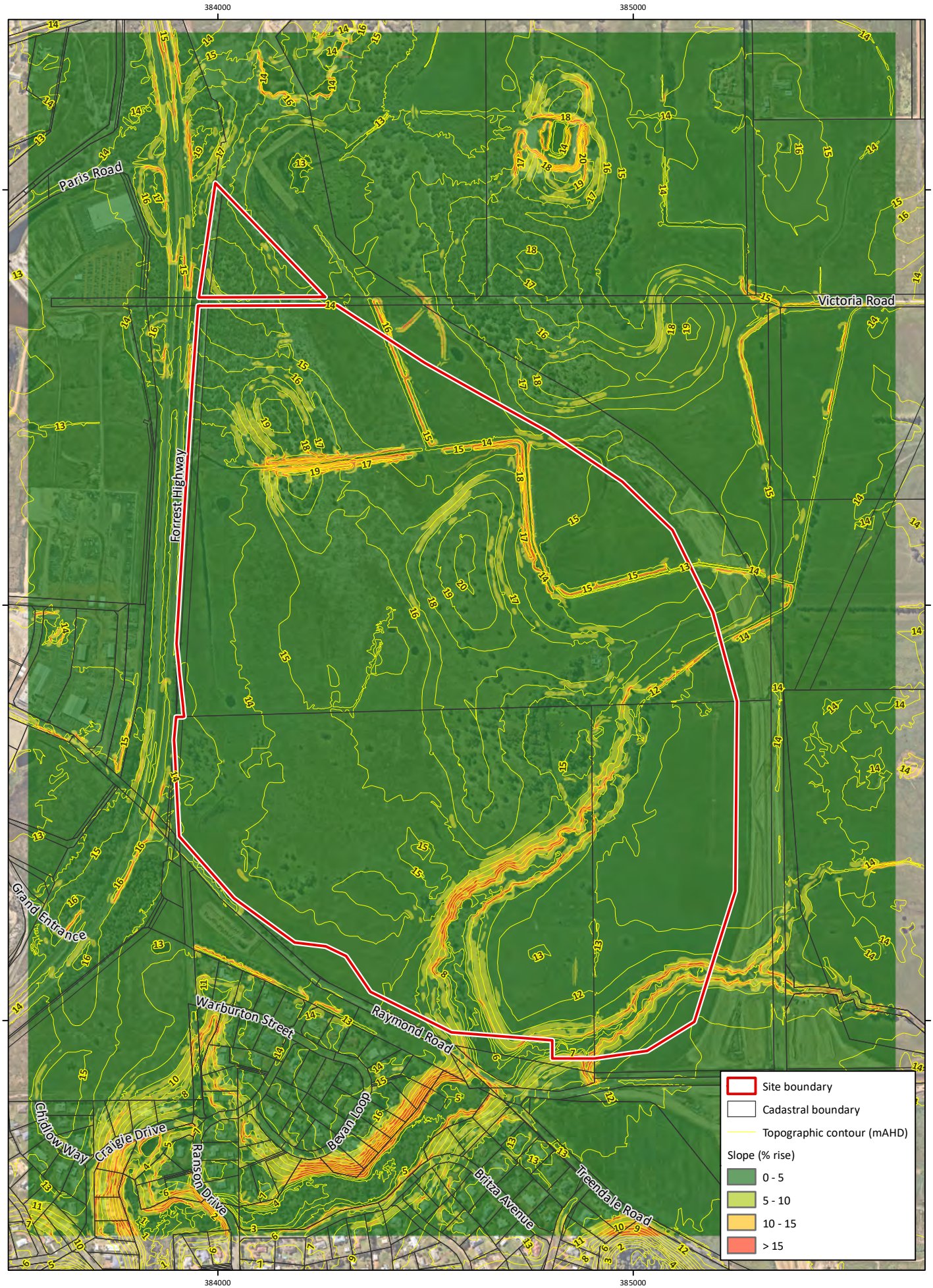


Figure 3: Slope Analysis

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands
Client: Treendale East Landowner Group

Plan Number:
EP21-022(04)--F29

Drawn:	GAR
Date:	14/01/2022
Checked:	JB
Approved:	DPC
Date:	24/01/2022

N

0 100 200 300
Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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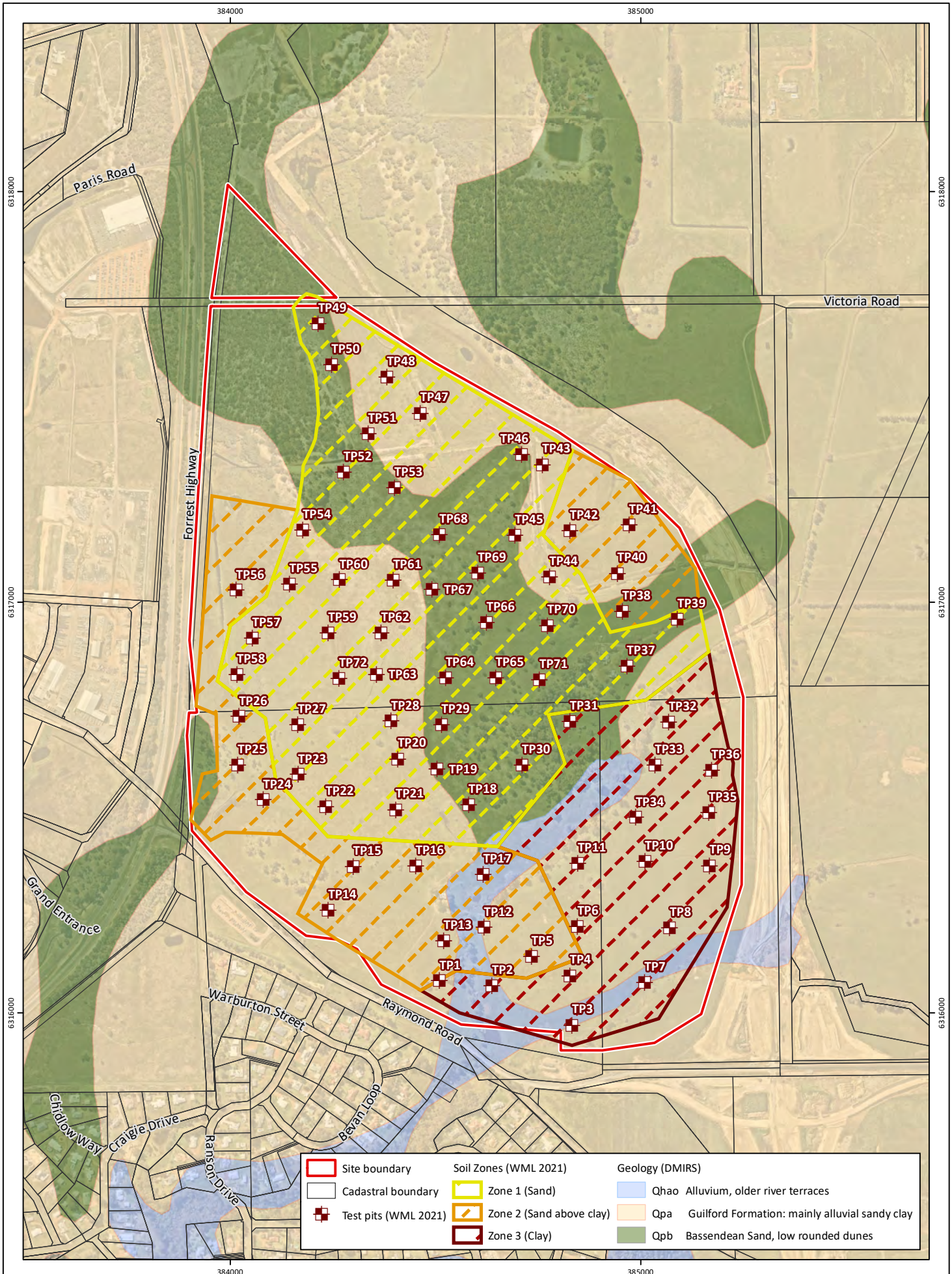


Figure 4: Geological Mapping and Test Pit Locations

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F03

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	24/01/2022

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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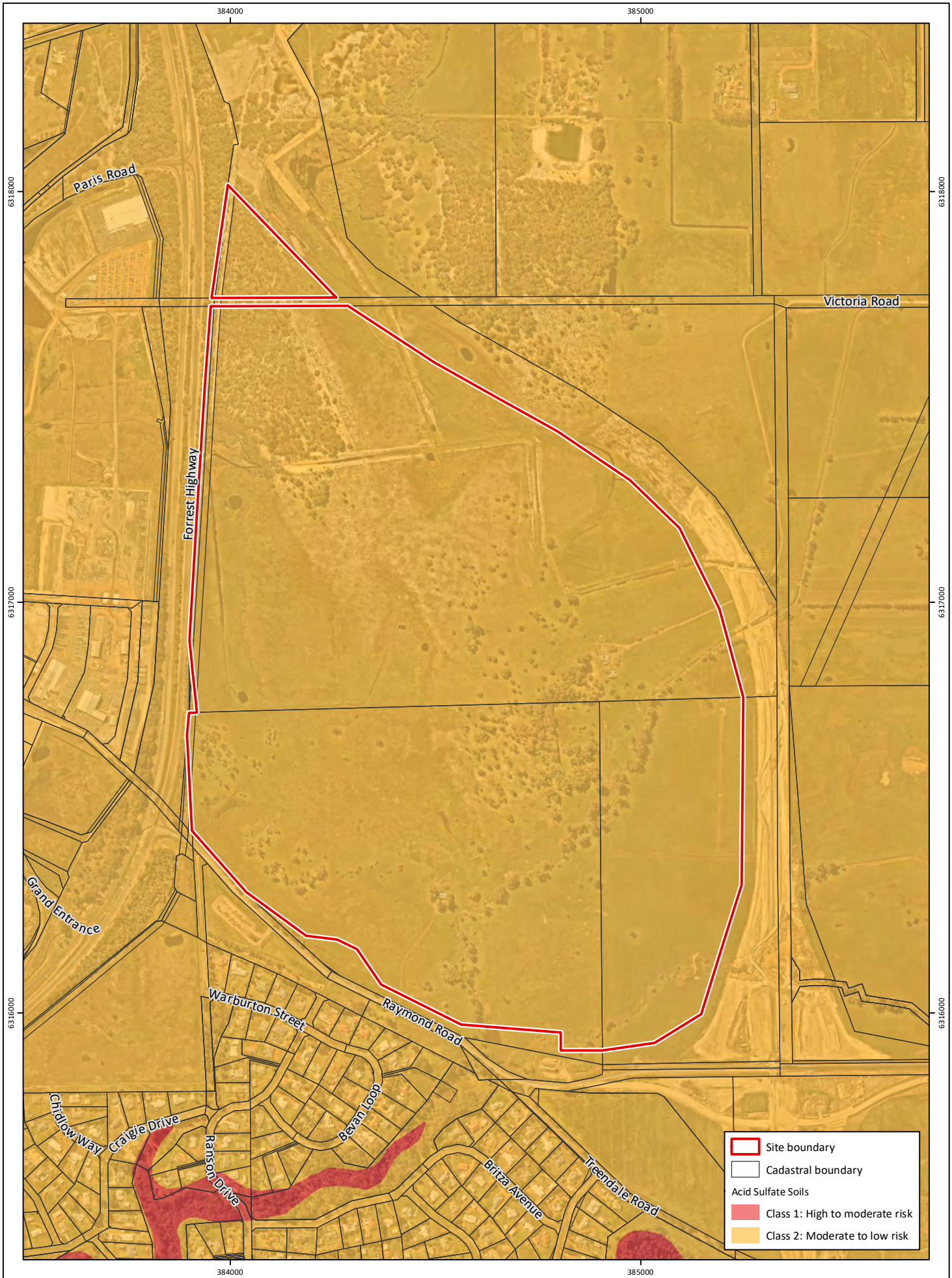


Figure 5: Acid Sulfate Soil Risk Mapping

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands
Client: Treendale East Landowner Group

Plan Number:
EP21-022(04)--F04

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	24/01/2022

N

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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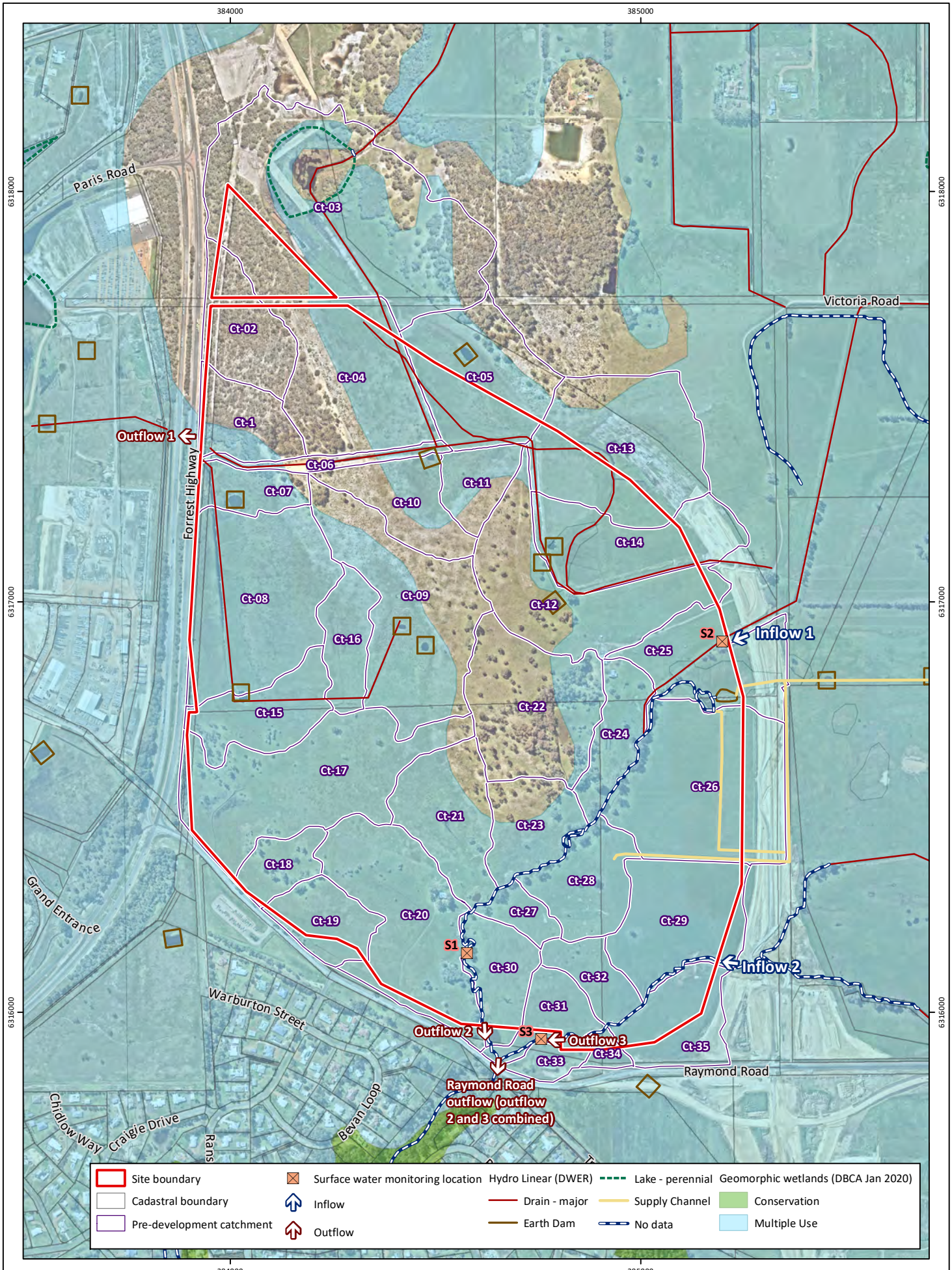


Figure 6: **Existing Hydrological Features and Geomorphic Wetlands**

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F05
Drawn: TEM
Date: 19/04/2021
Checked: JB
Approved: DPC
Date: 24/01/2022

N

0 100 200 300
Metres
Scale: 1:12,000@A4
GDA 1994 MGA Zone 50

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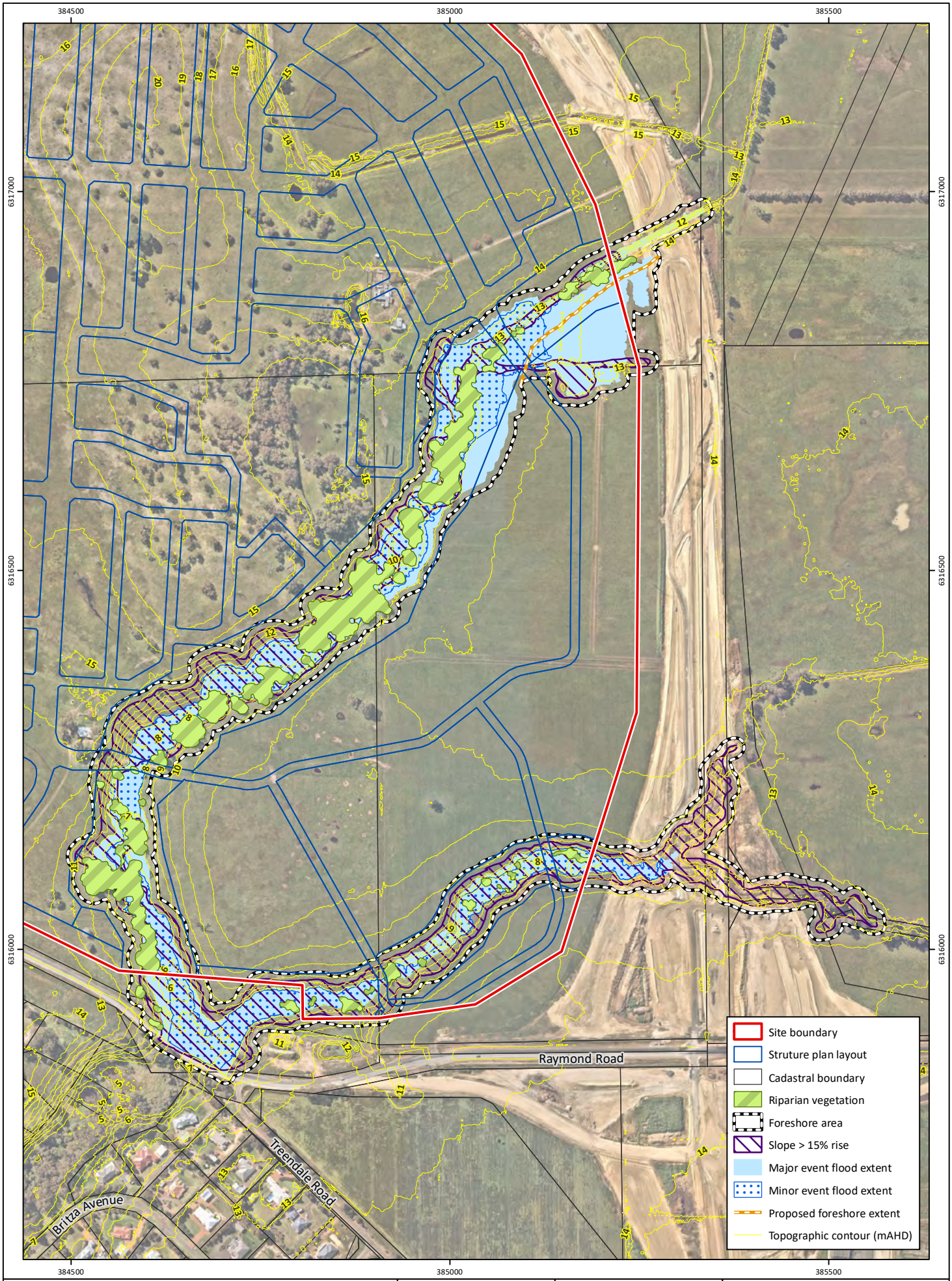


Figure 7: Foreshore Biophysical Assessment

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F30a

Drawn:	GAR
Date:	14/01/2022
Checked:	JB
Approved:	DPC
Date:	01/04/2025

N

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Metres

Scale: 1:6,500@A4

GDA 1994 MGA Zone 50

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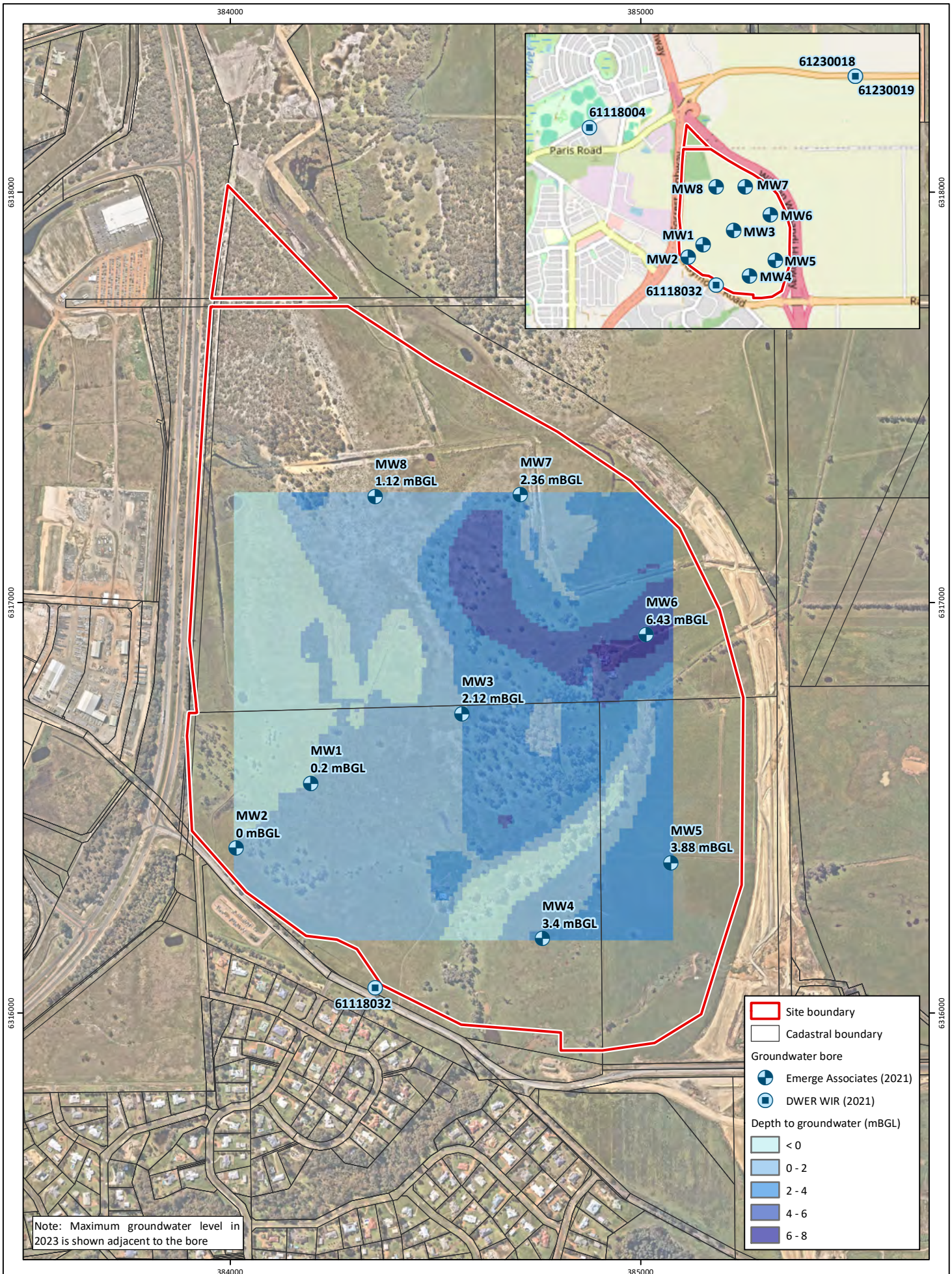


Figure 8: Depth to Groundwater

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F06a

Drawn:	GAR
Date:	07/10/2021
Checked:	JB
Approved:	DPC
Date:	01/04/2025

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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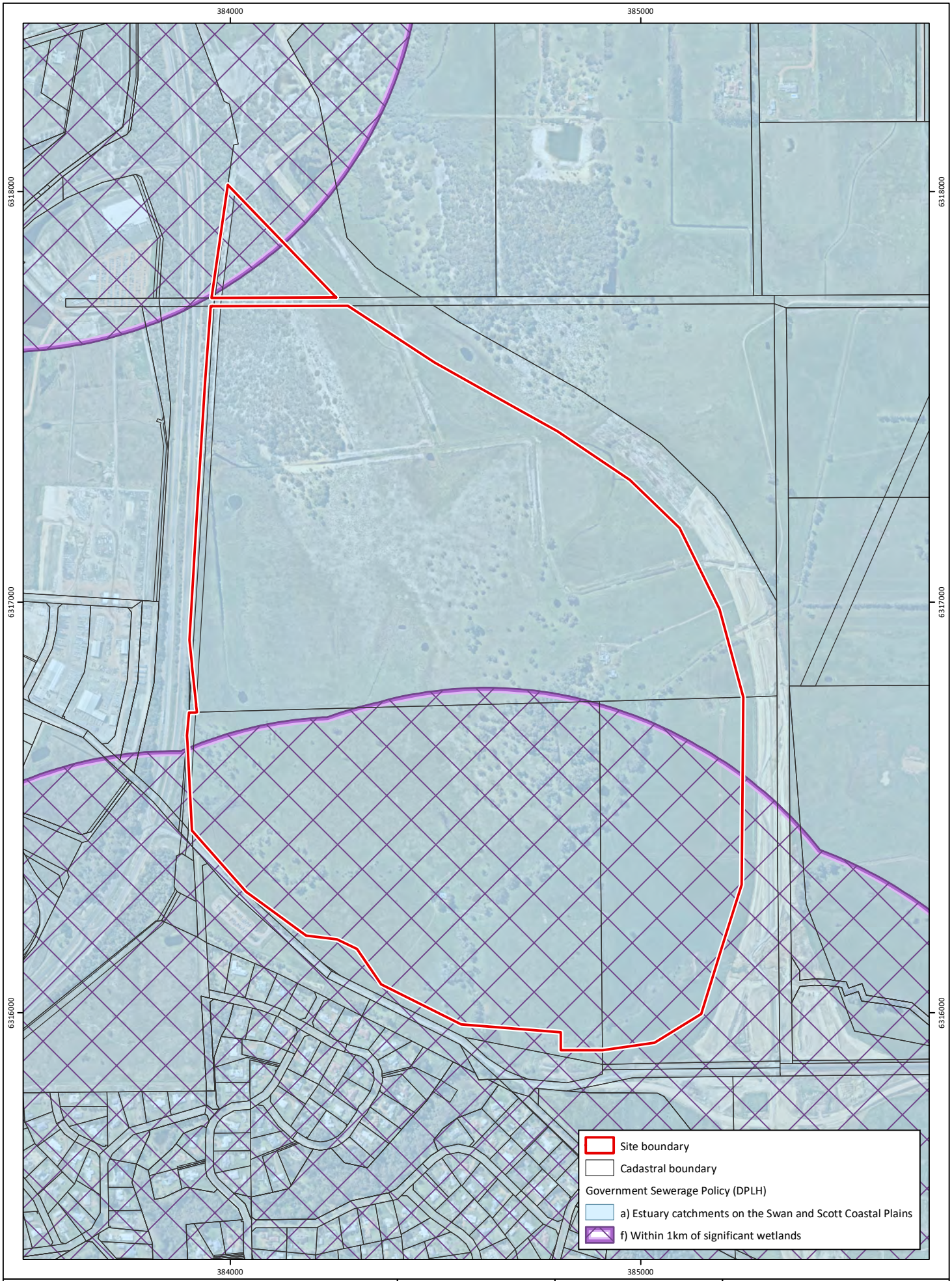


Figure 9: Sewage Sensitive Areas

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number:
EP21-022(04)--F07

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	24/01/2022

N

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

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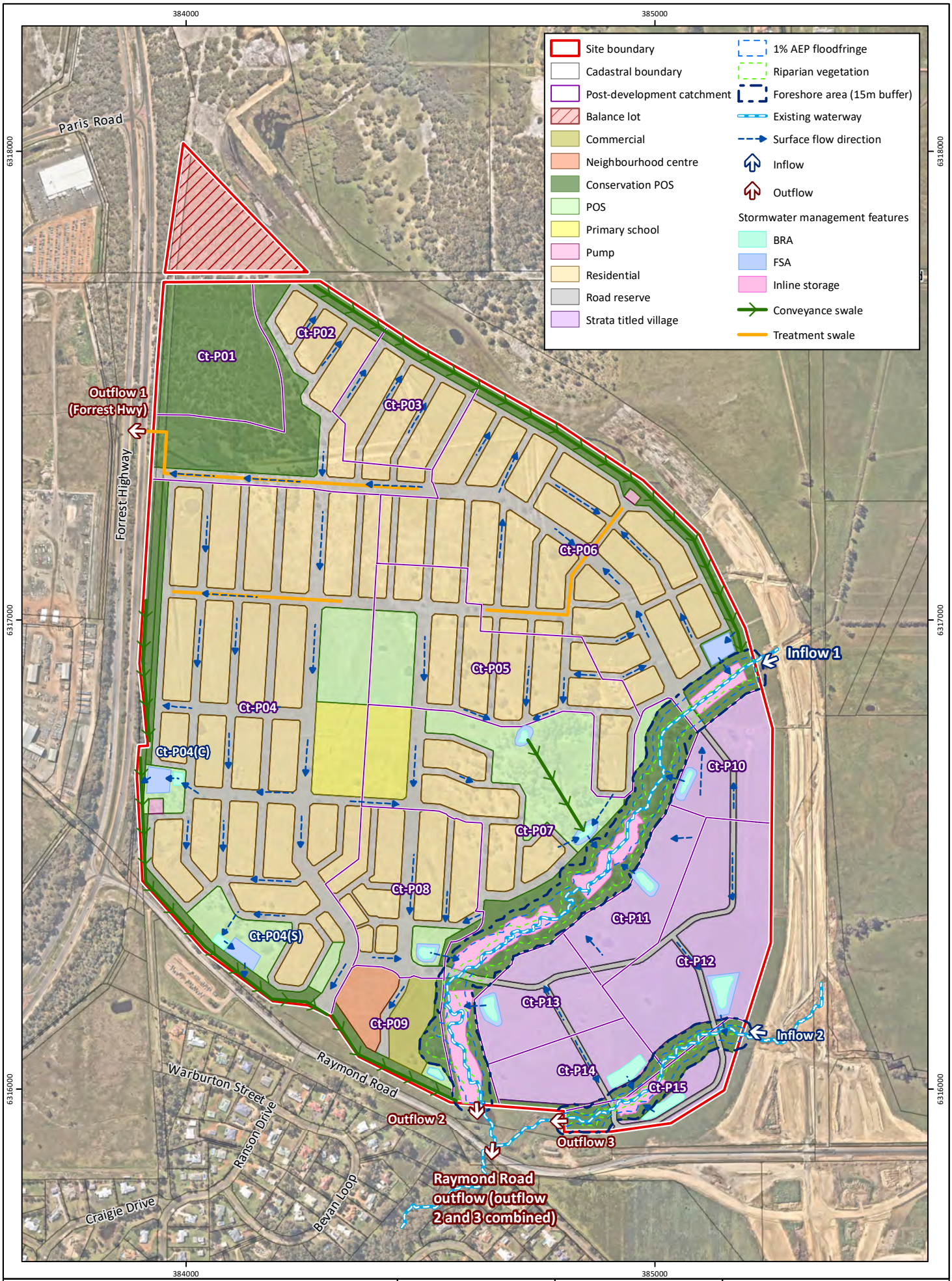


Figure 10: Stormwater Management Strategy

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F08b

Drawn:	GAR
Date:	25/08/2025
Checked:	MDB
Approved:	DPC
Date:	26/08/2025

N

0 100 200 300
Metres

Scale: 1:10,500@A4

GDA 1994 MGA Zone 50

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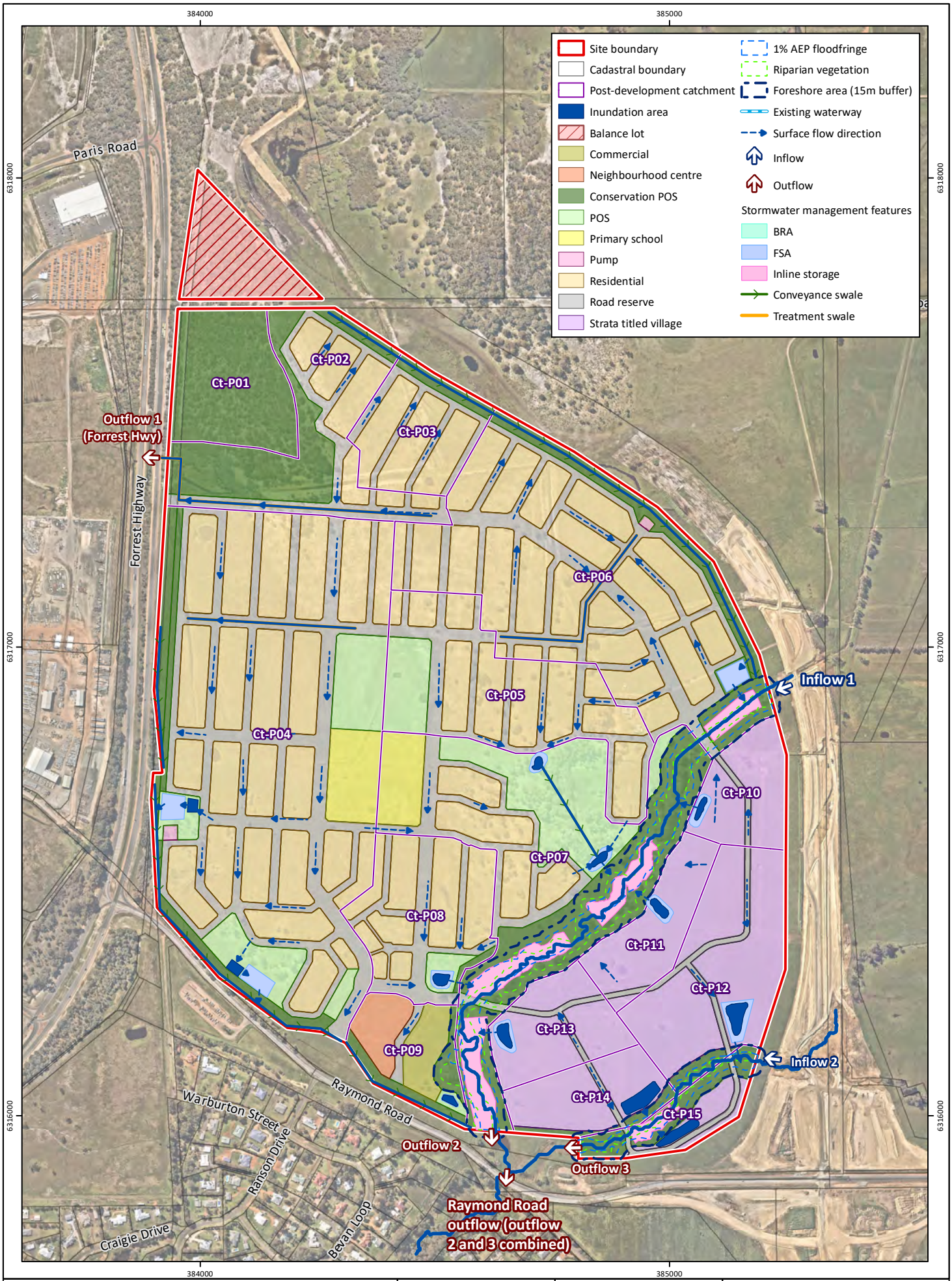


Figure 11: Small Event Inundation (First 15mm)

Project:	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number: EP21-022(04)--F31b

Drawn:	GAR
Date:	25/08/2025
Checked:	MDB
Approved:	DPC
Date:	26/08/2025

N

0 100 200 300

Metres

Scale: 1:10,500@A4

GDA 1994 MGA Zone 50

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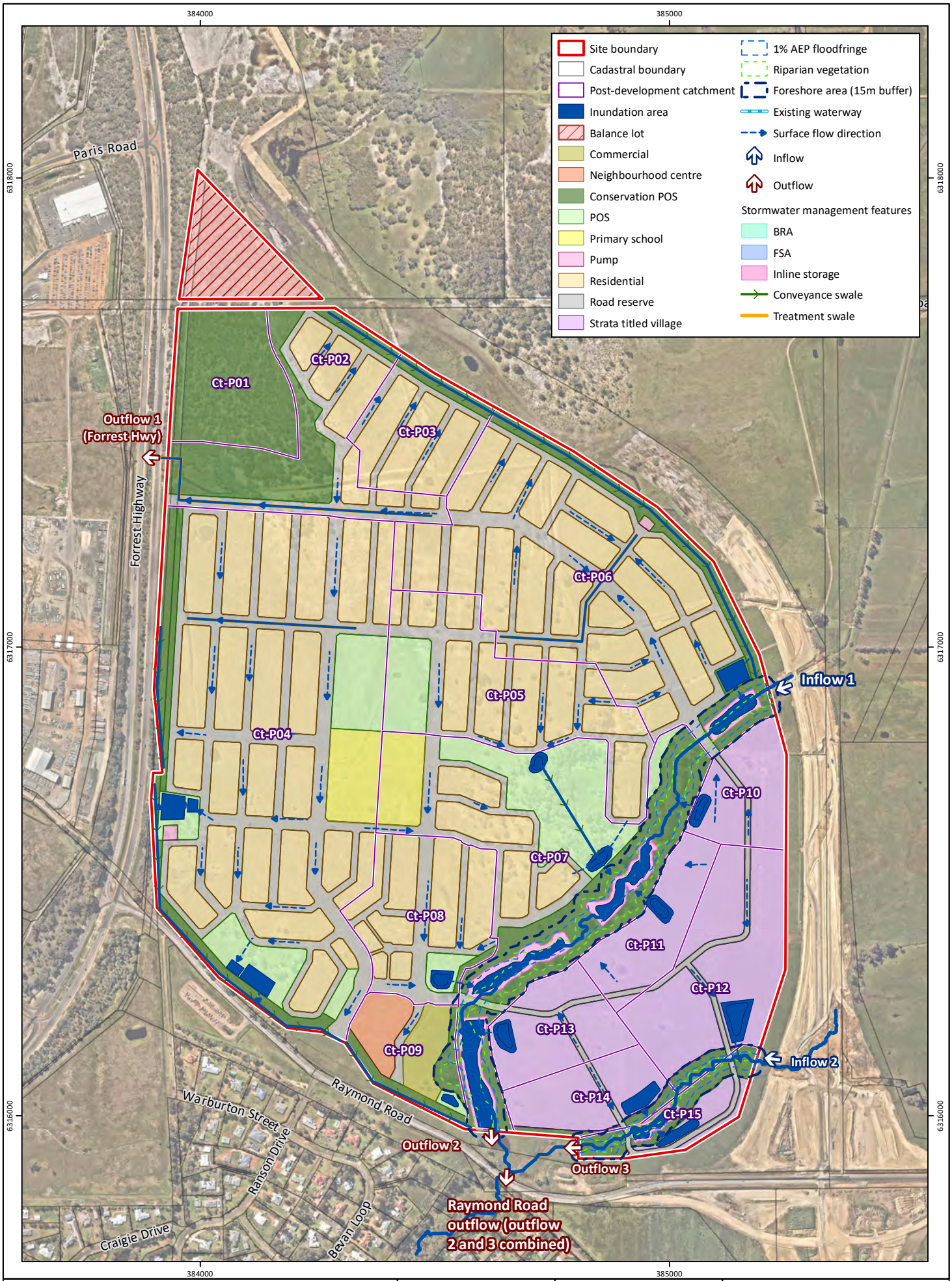


Figure 12: Minor Event Inundation (20% AEP)

Project: Water Management Strategy
Lots 151, 152 and 153 Raymond Road, Roelands

Client: Treendale East Landowner Group

Plan Number: EP21-022(04)--F32b

Drawn:	GAR
Date:	25/08/2025
Checked:	MDB
Approved:	DPC
Date:	26/08/2025

N

0 100 200 300
Metres

Scale: 1:10,500@A4

GDA 1994 MGA Zone 50

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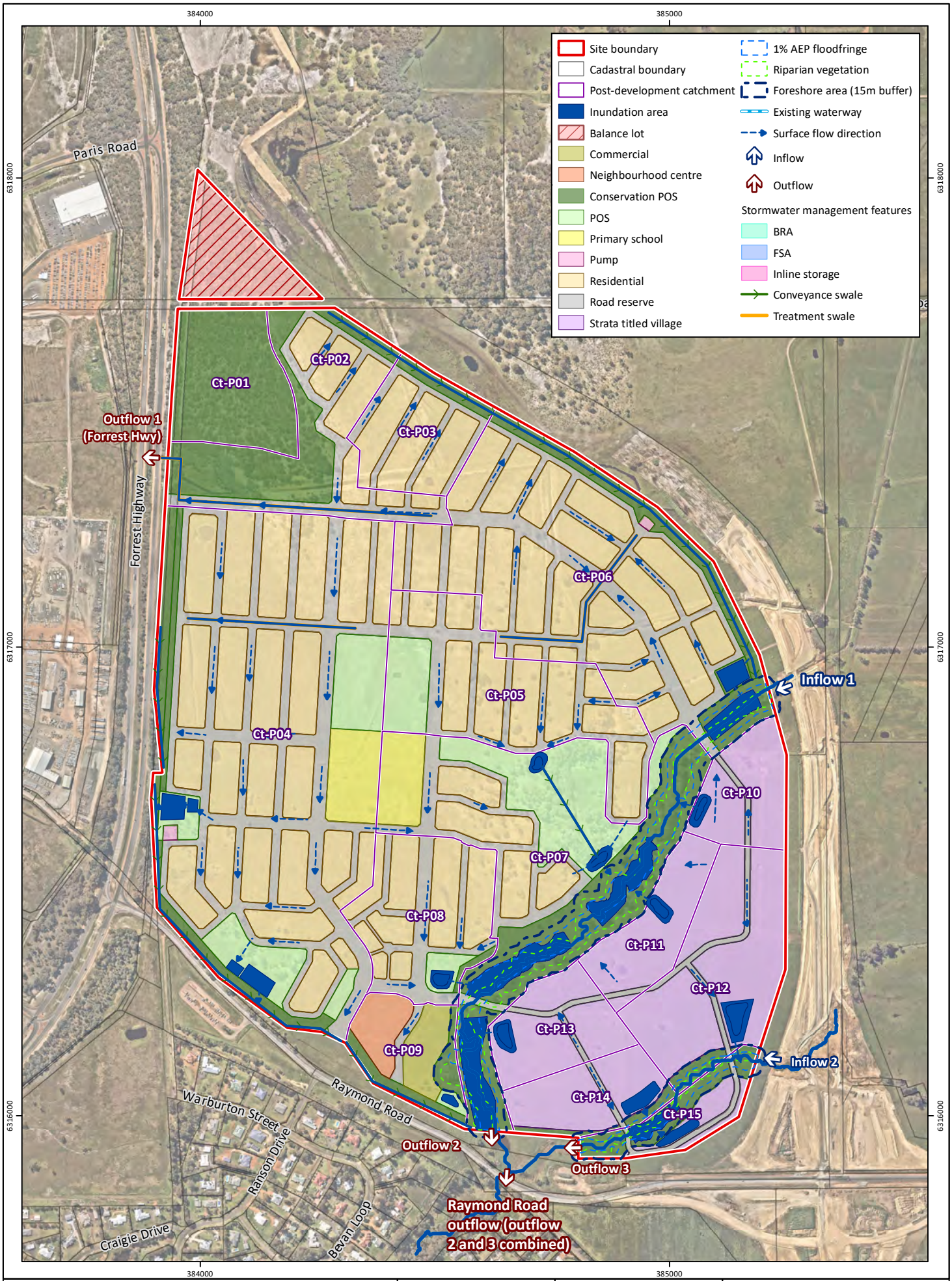


Figure 13: Major Event Inundation (1% AEP)

Project:	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number: EP21-022(04)--F33b
Drawn: GAR
Date: 25/08/2025
Checked: MDB
Approved: DPC
Date: 26/08/2025

N

0 100 200 300
Metres
Scale: 1:10,500@A4
GDA 1994 MGA Zone 50

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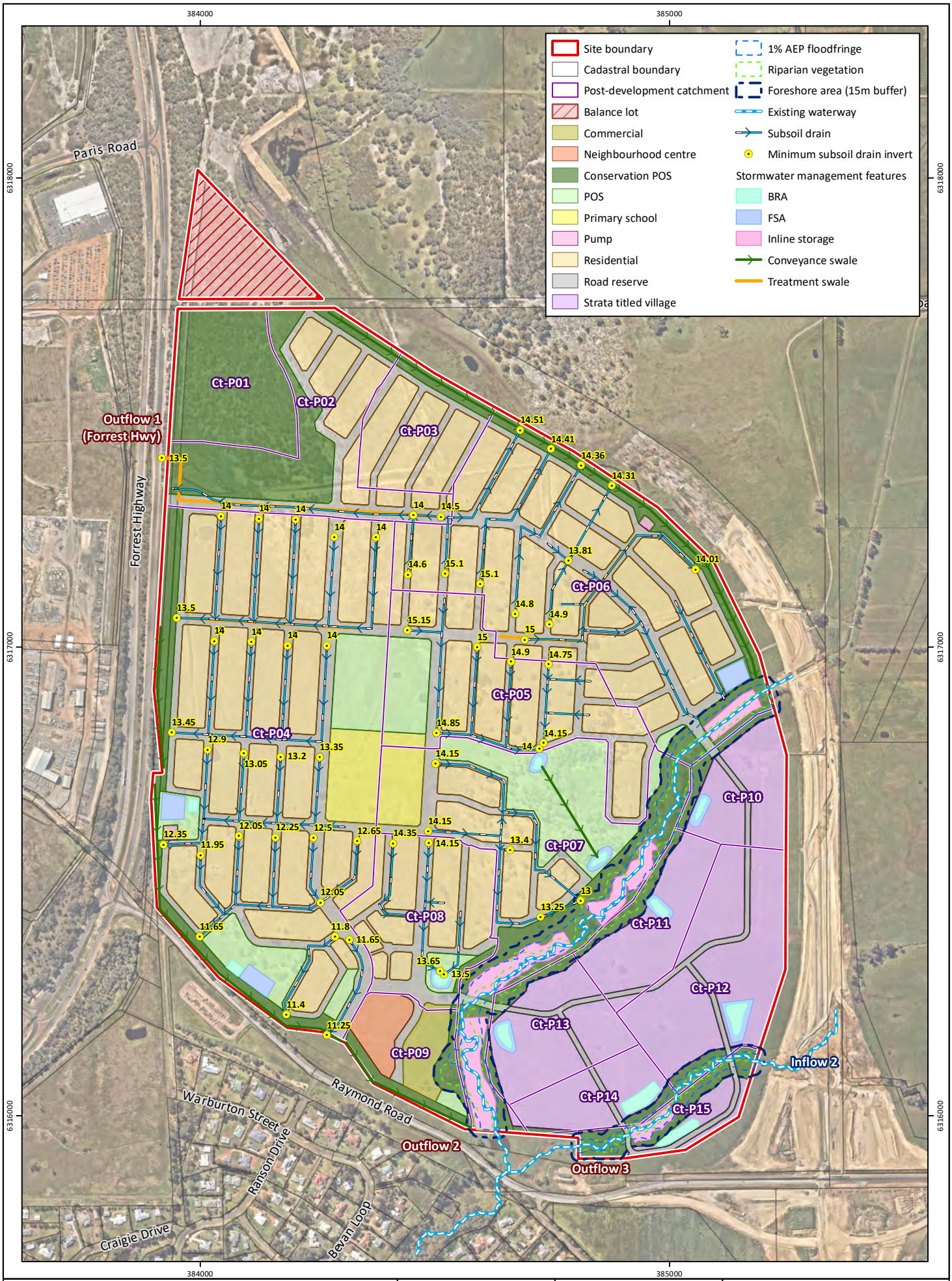


Figure 14: Conceptual Subsoil Drainage Plan

Project:	Water Management Strategy Lots 151, 152 and 153 Raymond Road, Roelands
Client:	Treendale East Landowner Group

Plan Number: EP21-022(04)--F34a

Drawn:	TEM
Date:	19/04/2021
Checked:	JB
Approved:	DPC
Date:	07/04/2025

N

0 100 200 300

Metres

Scale: 1:10,500@A4

GDA 1994 MGA Zone 50

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Appendix A

Concept master and structure plans

Prepared by CDP (2021)

LEGEND

TREENDALE EAST SUBJECT SITE

LAND USES

RESIDENTIAL
STRATA TITLED VILLAGE
NEIGHBOURHOOD ACTIVITY CENTRE
SCHOOLS
SEWER PUMP STATION
PUBLIC OPEN SPACE & DRAINAGE
GAS PIPELINE EASEMENT
132kV POWERLINE EASEMENT

ROAD HIERARCHY

INTEGRATOR ARTERIAL B - 30.0m
NEIGHBOURHOOD CONNECTOR A - 31.5m
NEIGHBOURHOOD CONNECTOR B - 31.5m
NEIGHBOURHOOD CONNECTOR B - 26.0m
NEIGHBOURHOOD CONNECTOR B - 19.5m
ACCESS STREET A - 26.0m
ACCESS STREET C - 18.0m
ACCESS STREET D - 19.5m
ACCESS STREET D (ADJACENT BUSHLAND) - 20.0m
ACCESS STREET D - 15.0m
ACCESS STREET D (ADJACENT POS) - 13.0m
LANEWAY - 6.0m
VILLAGE - COMMUNAL ROAD B - 12.0m

EXISTING ROAD RESERVE
BUNBURY OUTER RING ROAD
FORREST HIGHWAY
RAYMOND ROAD
RANSON DRIVE
BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1
12.070ha
POS 2
3.824ha
POS 17
1.376ha
POS 16
2370m²
POS 15
7589m²
PUMP
1000m²
PUMP
500m²
PUBLIC OPEN SPACE 3
4.105ha
PROPOSED PRIMARY SCHOOL
4.0ha
PUBLIC OPEN SPACE 4
5.739ha
POS 18
4000m²
PUBLIC OPEN SPACE 5
1.410ha
POS 19
3796m²
PUBLIC OPEN SPACE 6
8.039ha
PUBLIC OPEN SPACE 13
1.989ha
POS 14
1.341ha
POS 12
3392m²
POS 7
5948m²
POS 10
8155m²
POS 9
1960m²
NEIGHBOURHOOD ACTIVITY CENTRE
1.476ha
COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)
1.417ha
PUBLIC OPEN SPACE 8
2.776ha
PUBLIC OPEN SPACE 11
3.201ha
STRATA TITLED VILLAGE
28.285ha
STRATA TITLED VILLAGE
1.584ha
151
152
153
132kV POWERLINE EASEMENT
15.9m GAS PIPELINE EASEMENT

CELL STRUCTURE PLAN

Treendale East

A Taycot Development Project

DRAFT

NORTH
Scale 1:3000 @ A1
0 30 60 90m
PLAN: TAYTE-P114
DATE: 03/04/2025
PROJECTION: PCG 2020
DATUM: AHD
REVISION: K
DRAWN: JP
PLANNER: DM
CHECK: DM

cdp
Town Planning & Urban Design

Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

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Appendix B

Concept landscaping plan

Prepared by Emerge Associates (2021)

August 2025

TREENDALE EAST for Taycot Development

Local Structure Plan - Landscape and Irrigation Strategy



REV D - 14/08/2025

emerge ASSOCIATES
Integrated Science & Design

1. CONTENTS

1. CONTENTS 3

2. LANDSCAPE PRINCIPLES 4

3. PUBLIC OPEN SPACE TYPOLOGIES 5

3.1. Linear Open Space Networks / RIPARIAN CorridorS 6
3.2. Neighbourhood Parks 7
3.3. Playing Fields 7
3.4. Civic POS 7
3.5. Conservation 7
3.6. Buffer 7

4. LANDSCAPE MASTERPLAN 8

5. DETAIL PLAN - POS 7 9

6. DRAINAGE MASTERPLAN 10

7. STREETSCAPES 12

8. STREET HIERARCHY PLAN 13

8.1. STREET HIERACHY SECTIONS 14
8.2. Proposed Planting in the Public Realm 18
8.3. Retained Vegetation 19
8.4. Entry Treatments 19
8.5. Drainage/Stormwater 20
8.6. Drainage Treatment Adjacent to POS 20
8.7. Irrigation Strategy 20
8.8. Site Furniture 21
8.9. playgrounds 22
8.10. Public Art 22
8.11. Maintenance Minimisation 22

9. POS STRATEGY - GREEN STREETS 23

10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS 24

10.1. CONCEPT SECTIONS 25

11. POS STRATEGY - NEIGHBORHOOD PARKS 28

12. POS STRATEGY - PLAYING FIELDS 29

13. POS STRATEGY - CIVIC POS 30

14. POS STRATEGY - CONSERVATION POS 31

15. POS STRATEGY - BUFFER POS 32

16. PROPOSED PLANT PALETTE 33

15.1 Drainage corridor Vegetation 33

1. CONTENTS

16. IMPLEMENTATION 34

16.1. Approvals 34
16.2. Practical Completion 34
16.3. Landscape Maintenance Responsibility 34
16.4. Scheduled Handover 34

2. LANDSCAPE PRINCIPLES

The development of this site in the south west of Western Australia provides the opportunity for the rural character & natural landscape features of the existing locale to be interpreted and sensibly enhanced within practical limits throughout the project area.

Hence the key Landscape Principles to be explored during the design phase shall be:

- The village environment and the elements that define the site as a place, is an avenue that is to be explored and referenced in the design of the landscape.
- Respecting the ecological corridors/buffers and incorporating these into a linear Public Open Space (POS) network and, adopting a programme of revegetation and rehabilitation.
- Understanding that the linear POS network provides the opportunity to establish a highly legible and pedestrian/bicycle friendly framework within the estate.
- Retention of existing stands of scattered and isolated *Eucalyptus* & *Melaleuca* tree species, via incorporation into POS or through the creation of wider road reserves.
- Appreciation that a balanced approach is required to ensure the social and recreational requirements of the future residents are balanced with the ecological and engineering constraints imposed by the site.
- Provide a variety of outdoor public space for recreational and social opportunities appropriate to the size of the proposed community.
- Provide a legible network of walking and bicycle paths linking the town centre and areas of public open space, schools and other community infrastructure.
- Mitigate post development drainage flows through incorporation of waterway treatment drains within the open space network and widened road reserves. Ensure riparian corridors are sensitively designed to allow for multiple public uses.

The project will be developed around offering a range of open space opportunities. The public open space within the site has been planned to provide a network of parkland and corridors which integrate with the conservation & buffer areas, and aims to contribute to the ecological and social fabric of the community. Being strategically located, they will provide accessibility and connectivity through the development whilst also playing an important role in protecting the sites natural assets which are unique to the area.

The areas of POS have been separated into broad categories based on their specific treatments and design:

- Green Streets
- Linear Open Space/ Riparian Corridors
- Neighbourhood Open Space
- Playing Fields
- Civic POS
- Conservation Areas
- Buffer Areas

3. PUBLIC OPEN SPACE TYPOLOGIES

The Public Open Space (POS) Network consists of the following and, are defined where appropriate under Liveable Neighbourhoods:

- **Green Streets:**
  Streets lined with trees that provide canopy and shade on main thoroughfares.

- **Linear POS Networks / Riparian Corridors:**
  Open spaces which provide a connection between smaller recreational nodes (neighbourhood POS). Provides legibility and sense of place for local residents. Also enables retention of existing trees and allows for drainage conveyance through the site.

- **Neighbourhood POS:**
  Located throughout the development (1,800 - 19,800m2) and provides local residents with areas of turf and planting for informal kick-about play and passive uses. Also provides seating areas under shelter/ shade and are typically within 400m of most dwellings. Are able to service approx. 600 dwellings within the surrounding area.

- **Playing Fields:**
  Approximately 48,900m2adjacent the proposed primary school to service both the school and the wider community. Provides local residents and community with an open area capable for servicing local sports, events and gatherings. Caters for the combination of passive (including informal play areas) and active recreation and are generally within 1km of most dwellings.

- **Civic POS:**
  Provision for a main street and town/village square within the development. Predominantly hard paved and located at the conjunction of major thoroughfares and town/village centre in order to provide a landmark for community gatherings and events.

- **Conservation Areas:**
  The proposed development area includes conservation zone designed to enhance/protect the natural assets of the site to the benefit of the environment and greater community. These areas will provide opportunities for passive recreation (walking trails), education and conservation.

- **Buffer Areas:**
  Linear public open space adjacent Forrest Highway, Raymond Road and Bunbury Outer Ring Road. These areas will provide opportunities for passive recreation (walking trails) and serve a critical role to provide a visual & noise buffer, as well as drainage conveyance and detention.





3.1. **LINEAR OPEN SPACE NETWORKS / RIPARIAN CORRIDORS**

In order to address the requirements of retaining site topography and the principle of protecting existing trees and ecological linkages, the structure plan includes a series of linear open spaces. The design intent of these spaces is to enhance existing vegetation as well as incorporate existing stands of isolated trees and drainage alignments. Through respecting the existing topography in these areas, the linear POS will provide a necessary drainage function as well as provide visual amenity to the public realm. Some of these linear POS align with existing drainage corridors. These are to be integrated & enhanced to provide important ecological function.

As surrounding lots and roads require imported fill to ensure suitable structural conditions for housing, these linear parks will sit at a lower grade. This will ensure that drainage will flow towards these areas and discrete into bio-retention and online flood detention areas, that will be incorporated along the length of the linear parks. These areas assist in the collection, detention, treatment and reconveyance of water during major storm events. This is achieved with existing and/or a proposed system of inlet and overflow structures that ensure designated parkland areas are kept dry and usable.

Waterways may be included through linear parks with an interface to a dual use path (DUP). There will be native shrub planting on the banks and native reed/sedge planting to enhance nutrient uptake. With planting to consist of endemic species with a variety of tree, shrub, groundcover, reed and sedge species. Bank stabilisation will be incorporated into the design and a variety of tree species will be used to provide a diverse tree canopy. Treatment along the length of the waterway will be dependent upon the width of the corridor and the engineering constraints.

The waterways will provide not only a viable drainage function but also a variety of ecological zones and restoration opportunities. The waterways will undertake important ecological functions that include but are not limited to; filtration of stormwater pollutants, restoration of the aquatic ecosystem, control of water flow rates, and the planting of sedges and shrubs to stabilise riverbanks and prevent erosion.

Linear parks and widened road reserves not only serve an environmental and drainage function but, also provide an efficient means of supporting a legible pedestrian and bicycle network. This network will be designed to encourage passive surveillance from overlooking residents in accordance with Liveable Neighbourhood guidelines and best practice in terms of 'Designing out Crime'.









3.2. **NEIGHBOURHOOD PARKS**

Neighbourhood Parks are to be larger POS areas catering as a destination along the linear POS network or larger individual parcels within the developed area. The landscape treatment of these spaces will be generally informal in nature and characterised by revegetation and native parkland plantings which encourage passive recreation uses. Localised areas of turf that cater for informal active recreation may also feature. Typically this park will consist of retained remnant trees with a centrally built feature playground. Path systems will link to the adjoining residential streets and to the linear POS network to provide access as necessary.

Drainage areas may be required in these open spaces, and where provided, will be landscaped basins serving a recreational and amenity function. Drainage swales catering for events greater than a 1 in 5 year rainfall event within Neighbourhood POS areas, will have turf to enable a multiple use space and ease of maintenance.

The extent of hardscape and the urbanity of the space will increase in proximity to the town centre.

3.3. **PLAYING FIELDS**

Covering an area of 48,900m2, Playing Fields serve a critical role in providing vegetation and large open turfed spaces capable of servicing a diverse range of passive and recreational activities. These large open spaces serve as a landmark or destination for residents and community groups as they provide amenities such as large kick about areas, shelters, BBQ, nature play and exercise nodes. The landscape treatment of these spaces will be more formalised in nature with the provision of distinct active/passive zones amongst activities and age groups. Planting will typically be used to provide shade for resting and play areas. In addition, perimeter planting will be implemented to allow for a visual buffer between road/path networks.

The site's playing field is located adjacent to the future zoned primary school, the proposed playing field represents an opportunity to co-locate amenities capable of servicing the local school, residents and the greater community. Due to its potential in servicing the proposed school as well as providing for seasonal sporting activities and everyday recreational use, areas may be set aside for multi-purpose fields, hardcourts, potential amenity block, carparking and a grandstand for spectators. Its capacity to allow for organised sporting and large scale community events will contribute towards nurturing social interaction and promoting local connections within the community.

3.4. **CIVIC POS**

The site's civic centre will include a neighbourhood activity centre and commercial centre which, may include short stay accommodation and a proposed micro brewery. Public open space and streetscapes in proximity to this zone will be predominantly hard paved in order to provide an urban landmark for community gatherings and events.

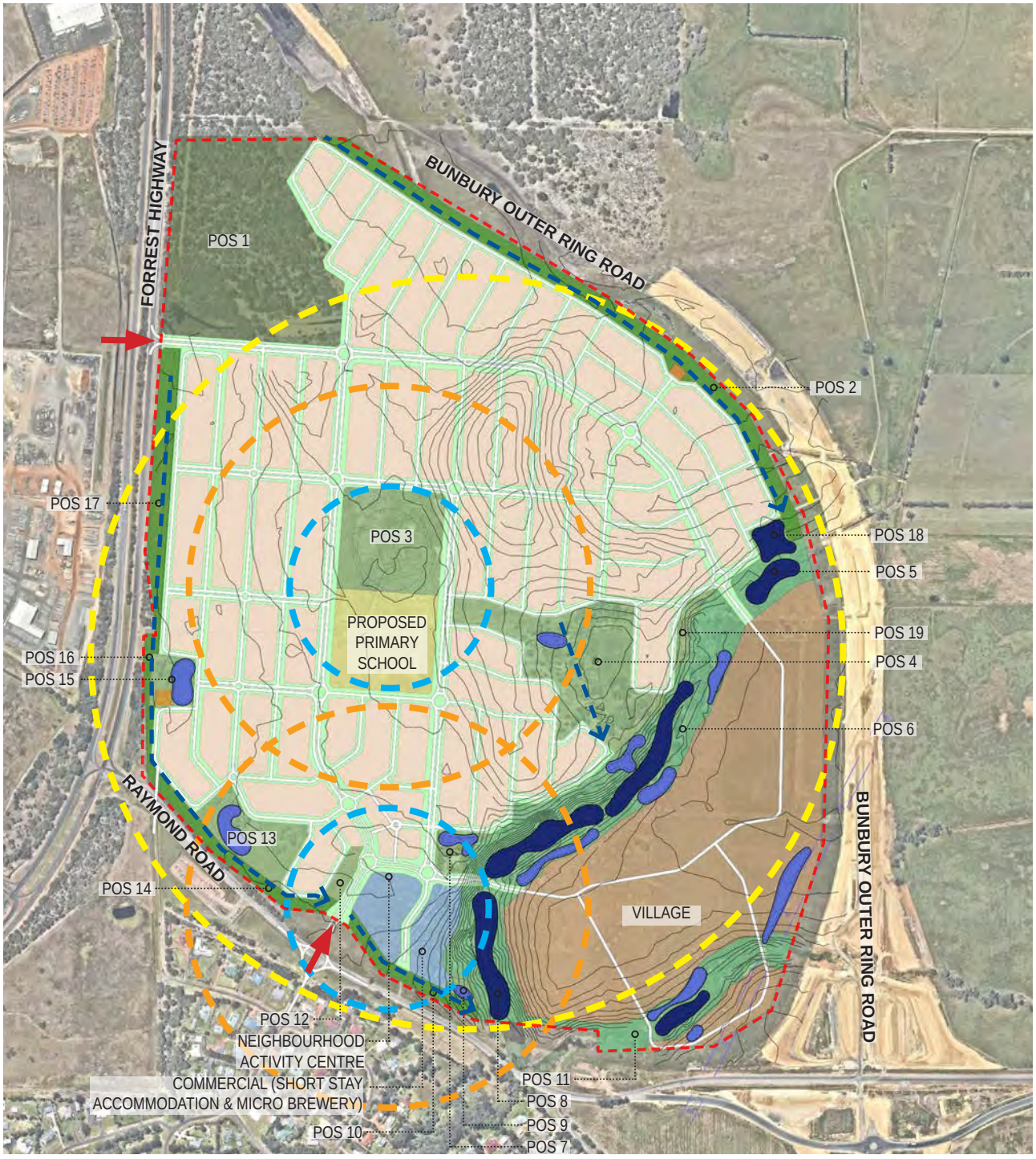
Key pedestrian and cycle networks will converge on this civic space, marking it as the starting point for a pedestrian shed. A pedestrian shed is generally a circular area encompassed by the walking distance from the civic centre, with a radius of 400 metres or more. This radius indicates the walkability of the precinct and its proximity to other key activity centres, such as the playing fields, primary school and larger neighbourhood parks.

3.5. **CONSERVATION**

The value of existing vegetation has been recognised and where possible this vegetation is to be retained and protected. A key area of existing vegetation within the site's extent has been identified and is to be included within a conservation POS. Typically a Conservation POS will include weed control, rehabilitation and paths/ trail networks in conjunction with educational signage to ensure the ecological value is maintained/ enhanced and, respected into the future.

3.6. **BUFFER**

The site is bounded by Forrest Highway to the west, Raymond Road to the south and Bunbury Outer Ring Road to the north/east. In addition to providing a drainage conveyance function and ecological/ pedestrian links, a key role of these buffer POS' will be to provide a noise and visual buffer between the community and these major roads, through the inclusion of vegetated bunds or similiar.



LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale
- 400m Ped Shed
- 800m Ped Shed
- 1500m Ped Shed
- Entry Point

SCALE 1:16,000 @ A4

5. DETAIL PLAN - POS 7

CONCEPT
- Small local POS
- Provides green pedestrian link within path network

FUNCTIONS
- Shade structure and seating area
- Passive turf area for informal gatherings and picnics

ENVIRONMENTAL CONSIDERATIONS
- Water-wise native plant species selections
- Water treatment planting selection to bio-retention area

BIO-RETENTION AREA 08	
1% AEP TWL (mAHD)	14.48
Volume (cub m)	1,178
Slope	1:6
Depth (m)	0.96

LEGEND
- Residential Lots
- Verge
- Turf
- Planting
- Basin Planting
- Footpath network
- Existing Tree
- Proposed Tree
- Street Tree







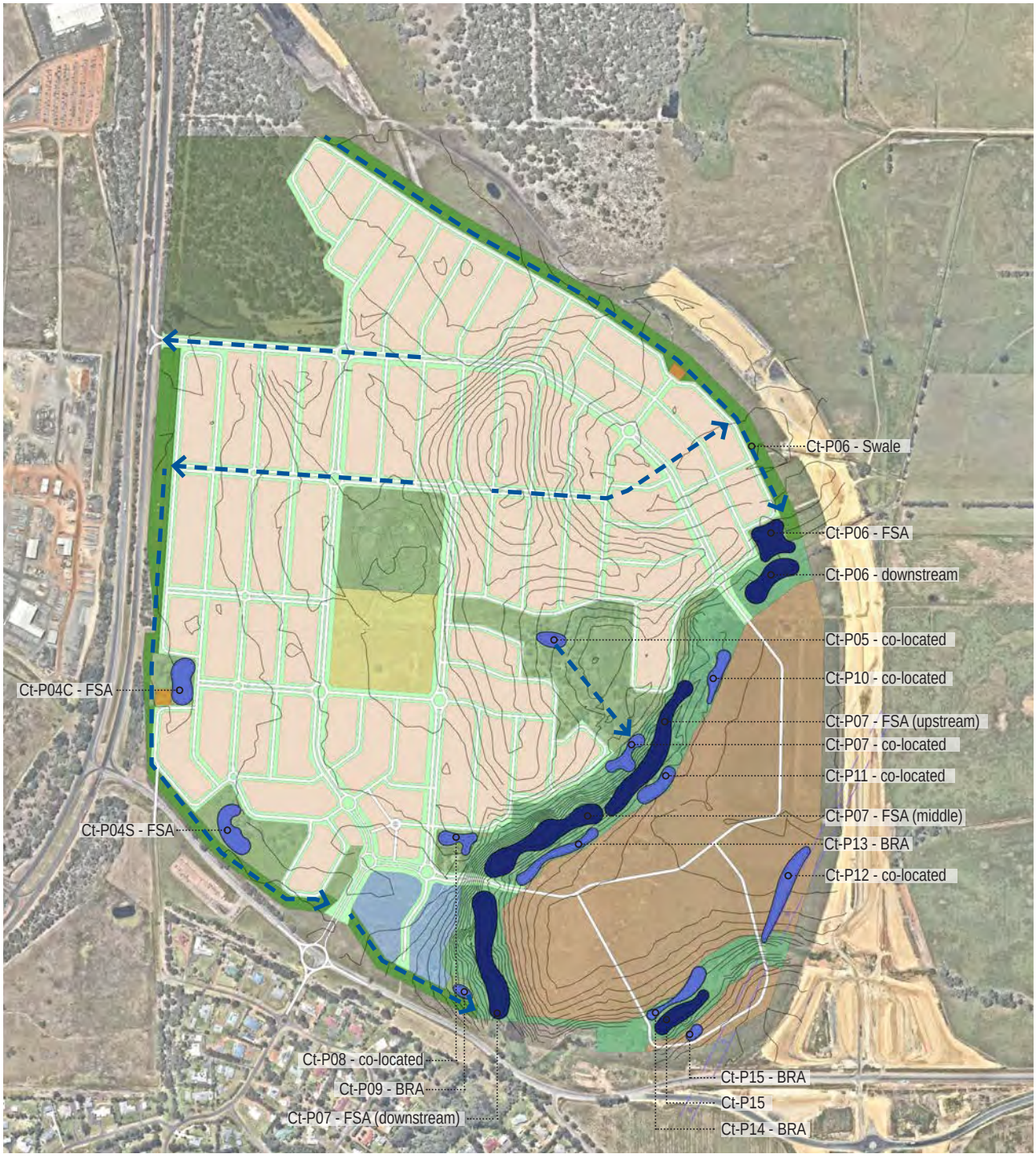












LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale

DRAINAGE DATA - 20% AEP

CATCHMENT	Depth (m)	TWL Surface Area (sq m)	Volume (cub m)
Ct-P02 (BRA)	0.28	629	168
Ct-P04 (Swale)	0.5	1,200	356
Ct-P04 (FSA- C)	0.49	2,005	922
Ct-P04 (FSA- S)	0.49	3,149	1,462
Ct-P05 (Swale)	0.5	720	183
Ct-P05 (co-located)	0.98	1,230	956
Ct-P06 (Swale)	0.56	2,700	896
Ct-P06 (FSA)	0.96	3,683	3,234
Ct-P07 (co-located)	0.98	1,845	1,434
Ct-P08 (co-located)	0.96	1,610	1,178
Ct-P09 (BRA)	0.49	588	255
Ct-P10 (co-located)	0.50	2,057	950
Ct-P11 (co-located)	0.52	2,212	1,080
Ct-P12 (co-located)	0.69	3,890	2,533
Ct-P13 (BRA)	0.50	2,621	1,248
Ct-P14 (BRA)	0.48	2,252	1,025
Ct-P15 (BRA)	0.30	610	170

DRAINAGE DATA - MINOR EVENT (20 % AEP)

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	0.94	3,105	2,745
Ct-P07 (upstream)	0.74	7,116	5,108
Ct-P07 (middle)	0.78	7,387	5,583
Ct-P07 (downstream)	0.74	7,782	5,615
Ct-P15	0.65	2,483	1,541

DRAINAGE DATA - MAJOR EVENT (1% AEP)

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	1.43	3,332	4,343
Ct-P07 (upstream)	1.11	7,388	7,851
Ct-P07 (middle)	1.15	7,665	8,391
Ct-P07 (downstream)	1.14	8,066	8,847
Ct-P15	1.07	2,645	2,707

7. STREETSCAPES

Streetscapes throughout the development shall incorporate a variety of treatments in response to the street hierarchy network. This network aims to establish a mottled patchwork of tree canopy to provide a shady, leafy and green matrix that stretches across the estate. In all cases, landscape works shall incorporate tree planting in accordance with the accepted traffic standards. Treatments may include soft works such as street trees, small shrubs and groundcovers.

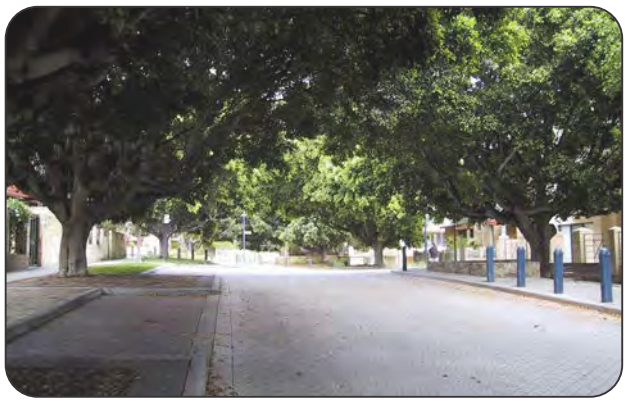
It is envisaged that the stormwater runoff from residential roads will be contained upstream mainly in a series of bio-retention swales distributed along road reserves and the linear open space network, where it is later conveyed to existing waterways.

Tree species are yet to be allocated however it is anticipated that within the POS', predominantly native trees will be used. It is proposed that species selections for streetscapes will also include species which reference the historic and cultural influences in the area. Deciduous exotic species historically used around rural homesteads will be used for major roads and civic areas to provide landmarks and promote legibility throughout the street network. The timing of installation (pre or post home construction) is yet to be determined.



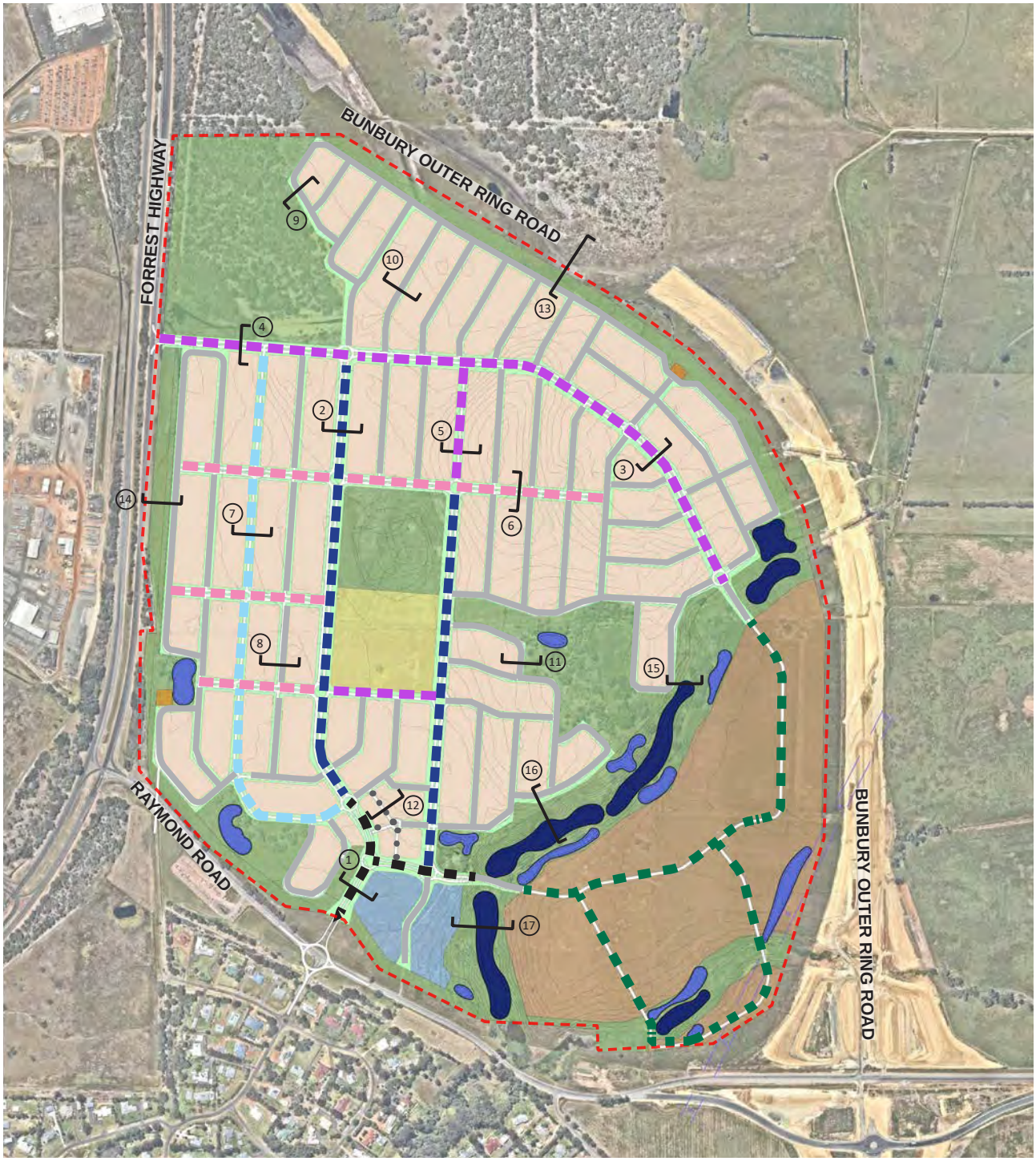








8. STREET HIERARCHY PLAN



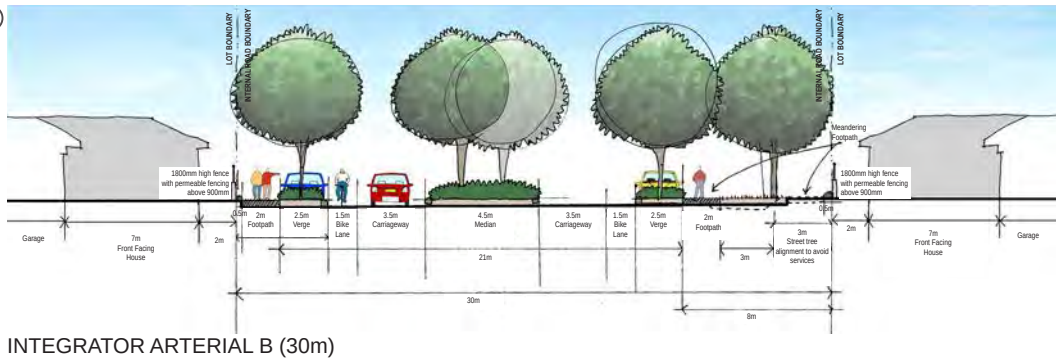
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LEGEND

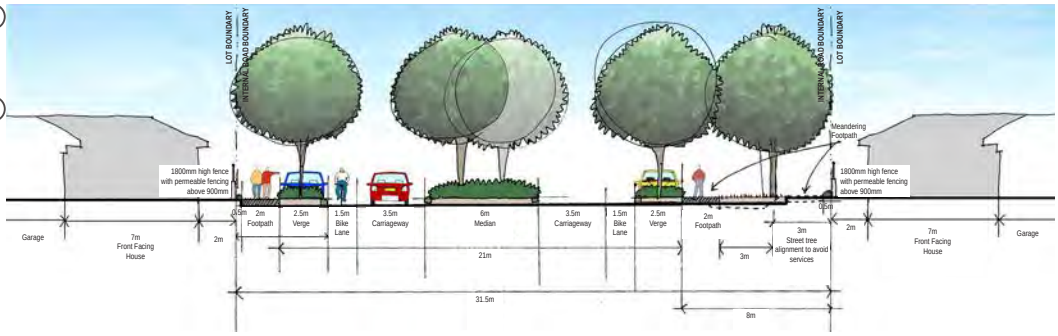
- Site Boundary
- (1) Integrator Arterial B (30m)
- (2) Neighbourhood Connector A (31.5m)
- (3) Neighbourhood Connector B (31.5m)
- (4) Neighbourhood Connector B (26m)
- (5) Neighbourhood Connector B (19.5m)
- (6) Access Street A (26m)
- (7) Access Street C (18m)
- (8) Access Street D (19.5m)
- (9) Access Street D, adjacent Bushland (20m)
- (10) Access Street D (15m)
- (11) Access Street D, adjacent POS (13m)
- (12) Laneway (6m)
- Village - Communal Road B (12m) - subject to separate design review
- (13) Access Street D, adjacent bio-retention swale/ landscaped buffer & BORR (13m)
- (14) Access Street D, adjacent gas pipeline easement & Australind Bypass/ Forest (13m)
- (15) Access Street D, adjacent upstream drainage (15m)
- (16) Access Street D, adjacent middle stream drainage (20m)
- (17) Downstream drainage

8.1. **STREET HIERACHY SECTIONS**

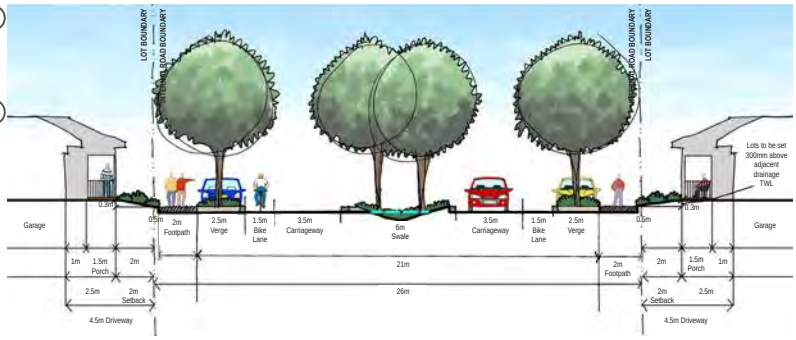
The below cross-sections are indicative only and will be subject to further detailed design at the subdivision stage.



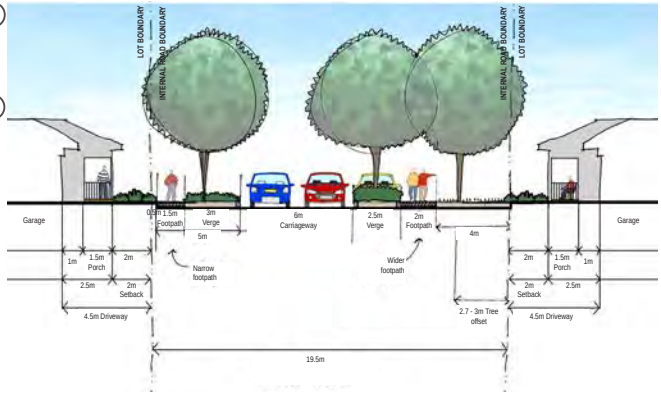
INTEGRATOR ARTERIAL B (30m)
SCALE 1:400 @ A4



2 NEIGHBOURHOOD CONNECTOR A (31.5m)
3 NEIGHBOURHHOD CONNECTOR B (31.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4

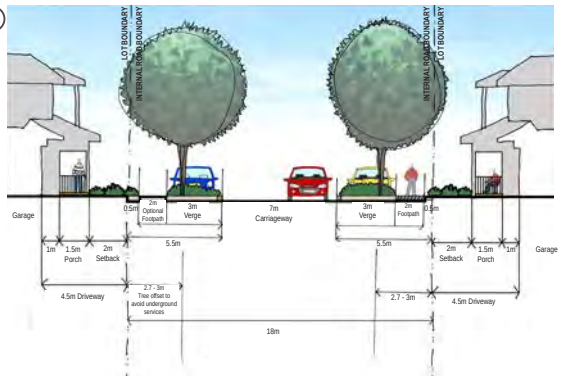


4 NEIGHBOURHOOD CONNECTOR B (26m)
6 ACCESS STREET A (26m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4



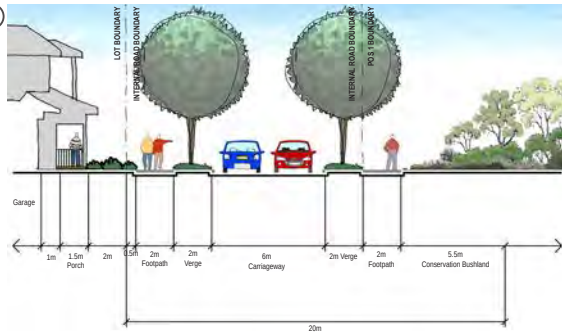
5 NEIGHBOURHOOD CONNECTOR B (19.5m)
8 ACCESS STREET D (19.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4

7



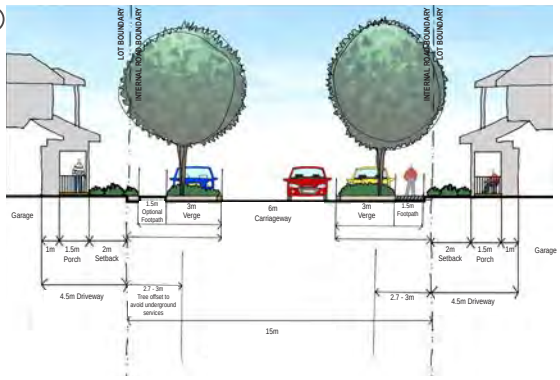
ACCESS STREET C - (18m)
SCALE 1:400 @ A4

9



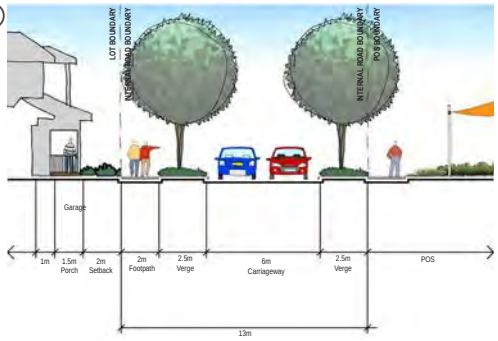
ACCESS STREET D, ADJACENT BUSHLAND (20m)
SCALE 1:400 @ A4

10



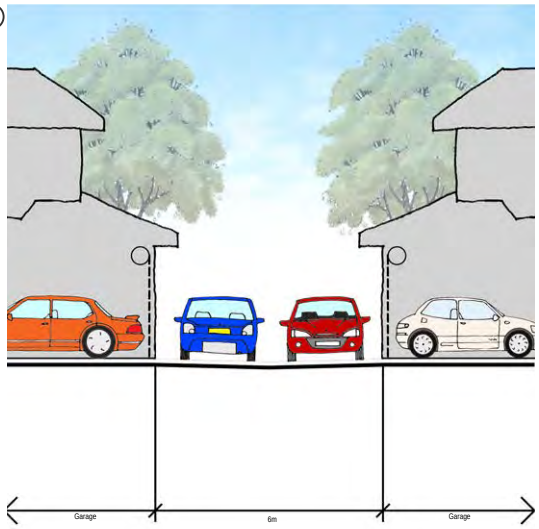
ACCESS STREET D - (15m)
SCALE 1:400 @ A4

11



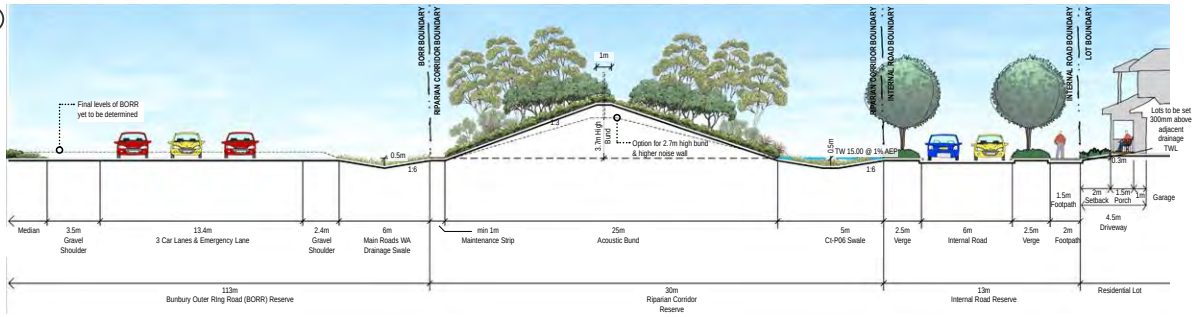
ACCESS STREET D, ADJACENT POS (13m)
SCALE 1:400 @ A4

12



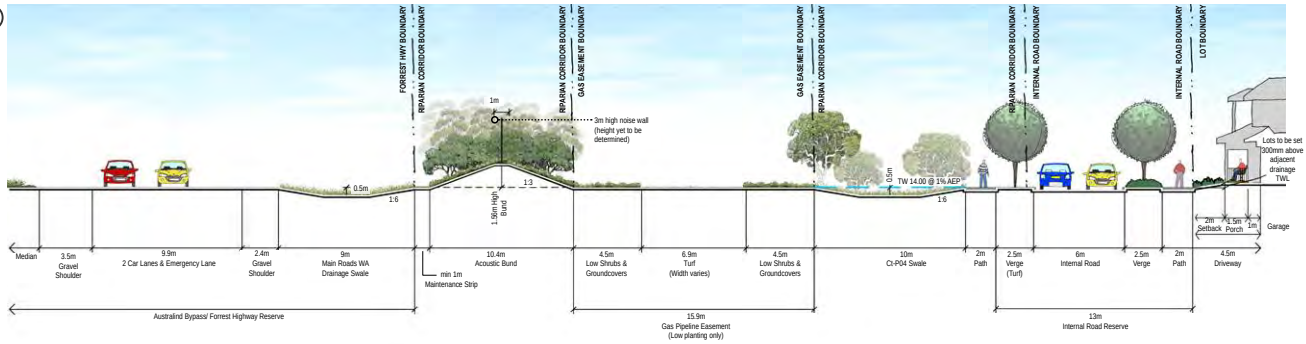
LANEWAY (6m)
SCALE 1:200 @ A4

13



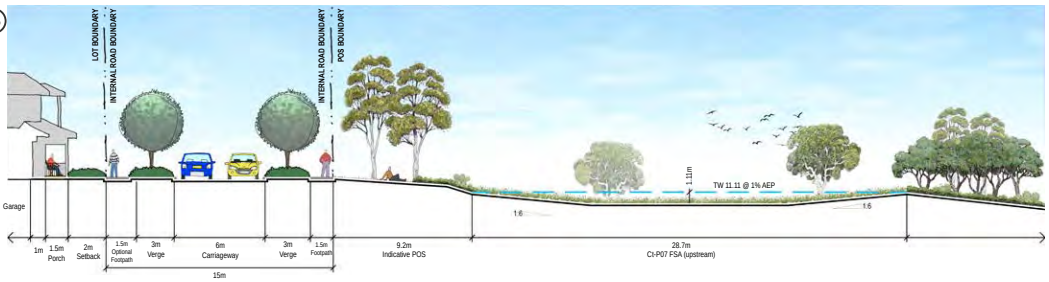
ACCESS STREET D, ADJACENT BIORETENTION SWALE/ LANDSCAPED BUFFER & BORR (13m)
SCALE 1:500 @ A4

14



ACCESS STREET D, ADJACENT GAS PIPELINE EASEMENT & AUSTRALIND BYPASS/ FORREST HWY (13m)
SCALE 1:500 @ A4

15



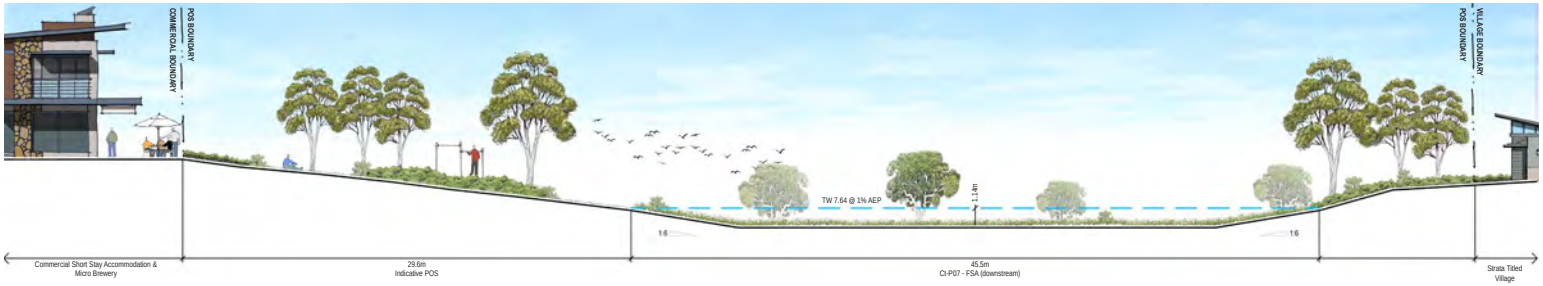
ACCESS STREET D, ADJACENT UPSTREAM DRAINAGE (15m)
SCALE 1:500 @ A4

16



ACCESS STREET D, ADJACENT MIDDLE STREAM DRAINAGE (20m)
SCALE 1:500 @ A4

17



DOWNSTREAM DRAINAGE
SCALE 1:500 @ A4

8.2. **PROPOSED PLANTING IN THE PUBLIC REALM**

The provision of planting in public areas and streetscapes serves to provide character, shade, interest, habitat and a point of reference in major streets or feature locations. Refer to section 14 for proposed species lists.

The locations of planting and types of vegetation will include;

- Predominantly native tree species to be nominated throughout the estate.
- Exotic specimen, shade and historical/cultural reference trees are to be nominated in high profile street or entry locations.
- Smaller scale exotic trees may be nominated in feature locations and avenue plantings to secondary residential streets,
- Bushland and habitat regeneration in disturbed areas,
- Shrub planting for screening and to provide spatial definition,
- Groundcover planting to medians, planters and areas requiring clear views,
- Reed and sedge planting to waterways,
- Irrigated grass to informal open space and recreation areas,

The proposed mix of native species and exotic cultural plantings in feature locations will provide a variation of character and define feature points. In general POS planting shall be composed of 75% native species.

The selection and placement of species shall consider adjacent elements so as to limit future maintenance and public health and safety issues. It will promote the survival and health of the existing vegetation, while also providing ongoing social and visual benefits. Items of consideration may include;

- Proximity to traffic sight lines to ensure suitable view corridors,
- Proximity and alignment to underground services to ensure no adverse impact,
- Seasonal influence of shade on adjacent facilities and areas,
- Passive solar benefits influencing adjacent built form and residential dwellings,
- Provision of seasonal visual colour,
- Provision of a seasonal food source to local fauna,
- Plant selection based on suitability to local climate, soils, rainfall and temperatures,
- Selection based on reduced maintenance, trimming, pruning, fertilising and watering
- Develop a species palette with subtle variations through the development to tie in with identifiable communities.
- Buffer screening will be provided to residential or sensitive areas where required
- Fringing vegetation to the surrounding areas is to be retained and protected.





Street trees

Street trees are a desirable design element to increase shade and amenity. The selection and placement of street trees shall vary, depending on the street hierarchy network. It is proposed that along major roads, street trees will form a strong visual avenue, and not impede traffic flow, safety or sightlines.

In residential streets, the roads may vary in character from precinct to precinct; however they are characterised as smaller scale pedestrian friendly environments. Therefore, street trees will be of a smaller scale, and will take advantage of passive solar principles that allows for summer shade and winter sun. As the road reserve widths may vary to allow for the retention of existing vegetation and the interconnection of the linear park network, it may be possible to allow for clustering or grouping of trees in the road reserve. This will be reviewed at the detailed design phase.

Water Wise Planting

It is intended that local species shall be used where suitable to maximise local habitat advantage and minimise water dependence. Soil amendments will be used in order to reduce leaching and increase soil moisture holding capacity. All garden beds will be mulched to reduce water loss through evaporation.

8.3. **RETAINED VEGETATION**

A primary goal of the Local Strategy Plan is the protection of existing vegetation. The retention of existing vegetation in defined locations caters for existing habitat, preserves natural assets and provides visual relief against the broader development area.

Vegetation Type and Quality

Whilst some of the vegetation on site has suffered through the effect of historical land uses and management, the areas of remnant vegetation offer positive outcomes if the development can be engineered to protect these areas. The majority of remnant vegetation is aligned with the conservation public open space and general public open space, in the form of occasional isolated individual trees in a cleared pastoral setting.

The retention of vegetation shall be maximised through minor realignment of road reserves, carriageways and lot boundaries, through the creation of tree islands in between carriageways or grade separated carriageways.

Retention and Protection

The retention and protection of defined existing trees shall occur during construction, following building works and in conjunction with maintenance. Retention and protection strategies shall include;

- Temporary fencing and signage to all retained areas and individual specimen trees.
- Ripping or compaction within 5m of the drip line of existing trees to be prohibited.
- In order to restrict the spread of exotic weeds the construction of clearly defined and easily maintained boundaries between retained vegetation and ornamental landscape may include methods such as, increased depth to mowing kerbs, footpaths, roads, bollards and permanent fencing.
- All works shall comply with the recommendations of the Bushfire Management Plan.
- Mandatory Arborist Report for all retained existing vegetation within public spaces.
- Mandatory Asset Management Plan outlining interventions and inspection frequency requirements.

8.4. **ENTRY TREATMENTS**

The entry points as defined on the Landscape Masterplan should express the design character of the development in respect to the local context. Any signage shall be clearly legible, reflect the estate's design style and comply with the local authority's signage policy.

Where appropriate, street trees and entry features will be used to promote the significant nature of these entry precincts by creating landmarks, forming strong avenues and framing views to distant feature elements. Feature planting is preferable in order to create a landmark and, assist in providing a hierarchy and legibility through the streetscape network. Landscape design options shall be tailored to meet all necessary civil design standards while expressing the character of the precinct.

8.5. **DRAINAGE/STORMWATER**

The development aims to utilise water sensitive urban design principles covering the following:

- At source treatment of water quality within select road medians
- Bio retention swales to treat water quality and convey stormwater runoff to existing waterways
- Reed and fringing vegetation to swales to provide a nutrient stripping function
- Online flood detention areas with the existing waterway to minimise downstream flows following major storm events
- Flood detention within waterways achieved by existing and/or proposed crossings

It is important that proposed swales/basins allow for multiple uses; including recreation, storm water management and creation of natural habitat.

8.6. **DRAINAGE TREATMENT ADJACENT TO POS**

All stormwater from the development will be directed into a system of drainage swales and bio-retention basins constructed along the edges of the POS and within the road reserve. These devices will be sized to treat the flows from the 1 in 1 yr event in accordance with the principles of the Department of Water, Stormwater Management Manual for Western Australia. Storm events in excess of these will be directed into outlet basins located within the POS area.

8.7. **IRRIGATION STRATEGY**

In general terms the project is committed to undertaking water sensitive urban design with no reliance on existing groundwater and the preservation of water quality. The project is also committed to minimising the volume of water used for irrigation. The following principles are held.

- Minimise the extent of irrigation and the volume of water consumed
- Minimise the extent of irrigated turf
- Minimise the extent of long term irrigation use on planted beds
- Use of hydrozoning
- Use of xeriscaping where practical

Irrigation shall aim to incorporate elements of subsurface, drip and trickle water application methods. Water application shall be based on seasonal need and be constructed of reliable, readily available and cost effective fittings, infrastructure and materials. Hydrozoning principles shall be incorporated at the detailed design stage.

All irrigation shall be installed to the local authority's standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authority's standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to the Council in accordance with relevant policies. Non-potable water will be supplied by Harvey Water via an existing agricultural supply network.





Existing drainage swales through site

8.8. **SITE FURNITURE**

The provision of street furniture demonstrates detailed consideration of human use and comfort. The inclusion of quality street furniture elements reinforces the intended design character, develops a sense of community and ownership amongst residents and encourages outdoor activities.

The location of street furniture elements should closely correspond with more intensive areas of human use, gathering and recreation. Basic functional requirements shall typically include;

- Local availability for quick and cost effective replacement or parts as may be required,
- Cost effectiveness of installation, ongoing replacement and maintenance,
- Robust design to minimise the effects of vandalism or weathering,
- Robust appropriate fixing methods to prevent theft but allow maintenance,
- Colour being defined but neutral where possible to enable the maximum chance of matching with other site elements,
- Galvanised and powder coated finishes to maximise lifespan.

Elements shall provide a visually recognisable, clear and useful function. The types of street furniture envisaged include;

- Picnic settings & seating (formal and informal)
- Shade structures/ Shade Sails to assist with providing built shade options
- BBQs
- Rubbish bins
- Bollards
- Bicycle parking
- Drinking fountains
- Boardwalks
- Conservation fencing
- Interpretive signage

Note: All furniture specified within public spaces are to be consistent with the Shire of Harvey's Signage and Infrastructure Style Guide Parts 1 & 2.

https://www.harvey.wa.gov.au/build-and-develop/infrastructure/signage-and-infrastructure-style-guide





8.9. **PLAYGROUNDS**

Plagrounds are a vital community space that support physical, social and emotional well-being. Play opportunities should provide for all ages, welcome all genders, encourage social interaction and promote physical development. Play features that inspire adventure and discovery are prioritised to spark creativity, build problem-solving skills and keep children engaged longer. Designing with durable materials ensures long-term value and minimal maintenance. All playgrounds are required to be consistent with the Shire of Harvey's Playspace Strategy.

8.10. **PUBLIC ART**

The selection and installation of appropriate public art creates interest, social discussion and promotes a sense of community and ownership to public spaces. Public art can provide historic, social, cultural and environmental comment and act as a reference to define a local area and community values.

It is intended that public art be distributed at either high profile points or community gathering spaces to ensure its value in place making is maximised. Locations should include vista and axis views from roads or pedestrian paths, inclusion into playgrounds or placement adjacent picnic locations. Individual lighting may be desirable in some instances to provide additional importance and focus to specific artwork.

8.11. **MAINTENANCE MINIMISATION**

In conjunction with the detail design of public open space and verge areas, they are ultimately vested and controlled by the Local Government Authority (LGA), a maintenance minimisation review and an asset management plan shall be undertaken by the developer to assist in assessing and reducing the likely future maintenance costs. This process may typically include;

- review of all materials to ensure fitness for purpose and lifespan requirement,
- review of the areas of planting verses turf,
- review of plant and turf species and their specific growth habits and requirements,
- monitoring of groundwater quality and levels,
- review of irrigation materials and standards,
- implementation of sustainability and water wise principles to enable the reduction of ongoing costs, through removal of some short term landscape establishment assets,
- review of all structural design to ensure fitness for purpose and lifespan





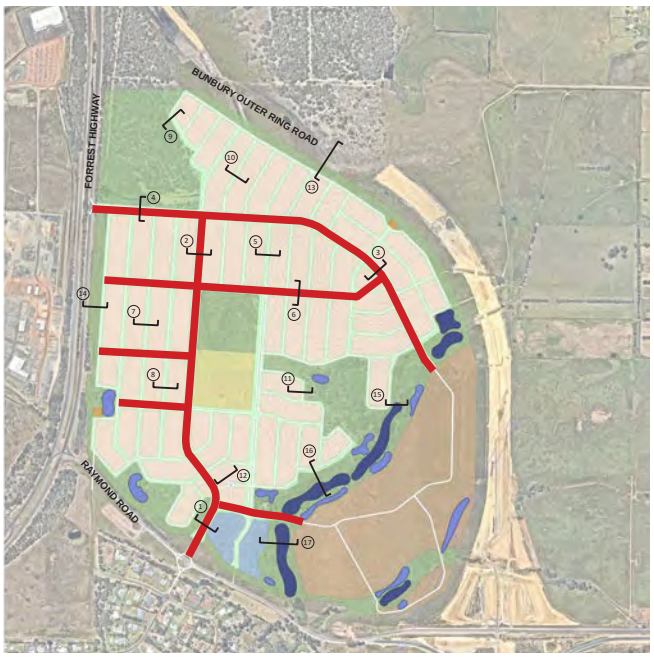


9. POS STRATEGY - GREEN STREETS

BRIEF DESCRIPTION

The Green Street is a widened road reserve to create a sense of space and connectivity throughout the estate. This promotes legibility via creation of a landmark and establishes a hierarchy within the streets. It offers the opportunity for stormwater and bio-filtration within widened road reserves

SIZE (Verge) 70,886 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Path network
- Historical and cultural character
- Landmark and feature planting
- Habitat corridors
- Passive recreation opportunities

ENVIRONMENTAL CONSIDERATIONS

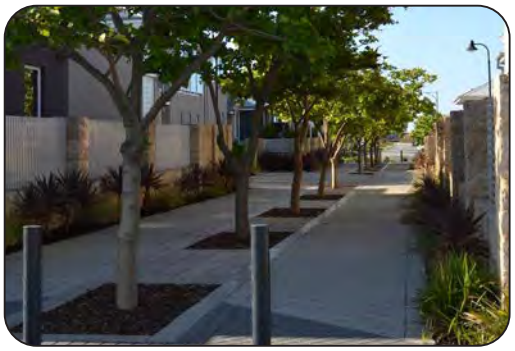
- Waterwise native planting
- Planting design to be zoned according to irrigation requirement
- Consider stormflows and drainage requirements









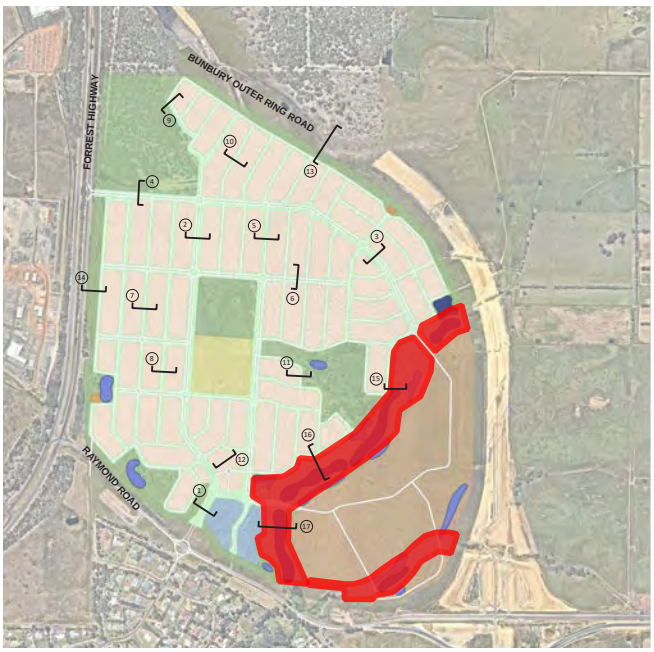


10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS

BRIEF DESCRIPTION

Located between the development and the proposed strata titled village, the the linear POS/ riparian corridor incorporates drainage requirements with pedestrian and bicycle networks. While drainage is the predominant function for this space there will also be informal turf areas, path networks, crossings, shelters and picnic nodes etc.

SIZE (Excluding Verges) 154,256.2 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting
- Living stream

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials



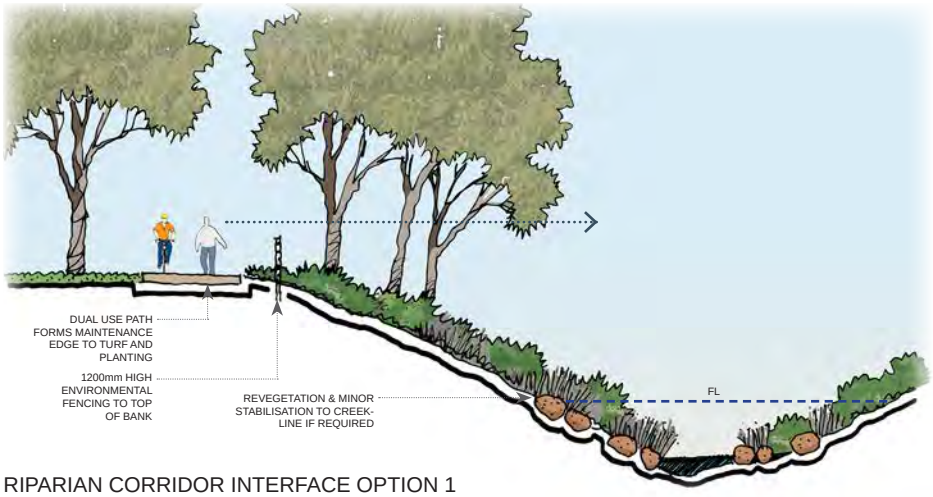




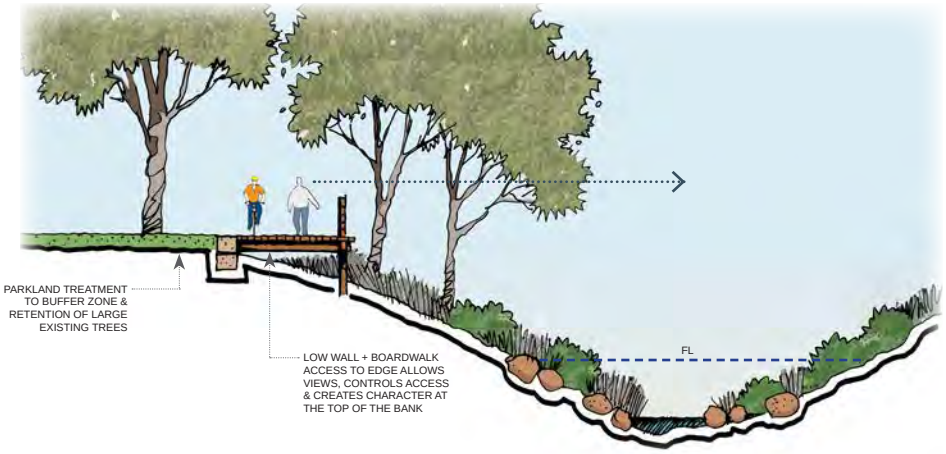


10.1. **CONCEPT SECTIONS**

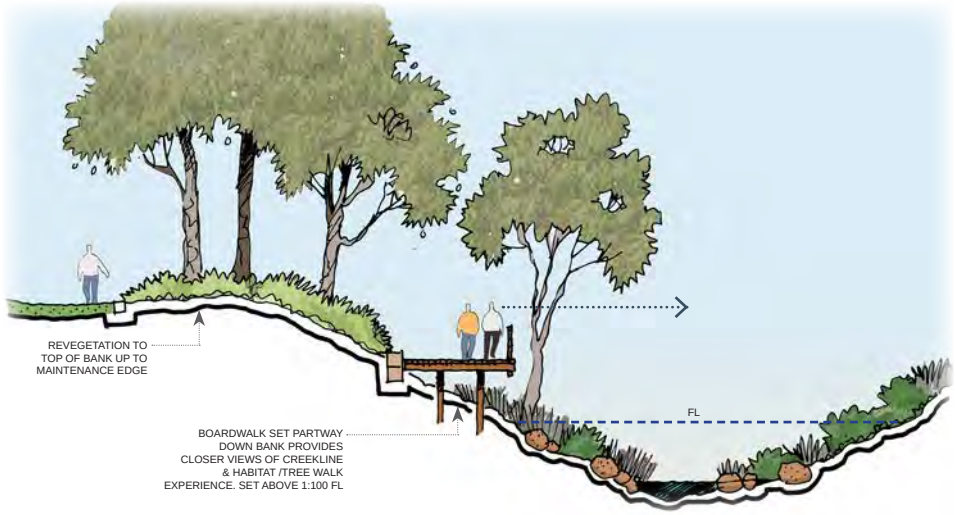
The following sections are concept diagrams exploring design opportunities along the enhanced riparian corridor.



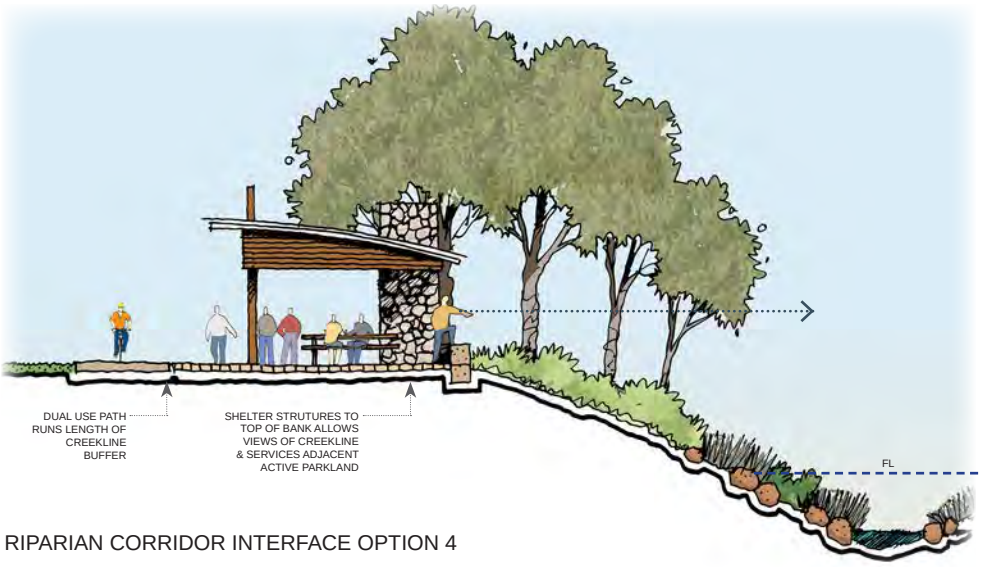
RIPARIAN CORRIDOR INTERFACE OPTION 1



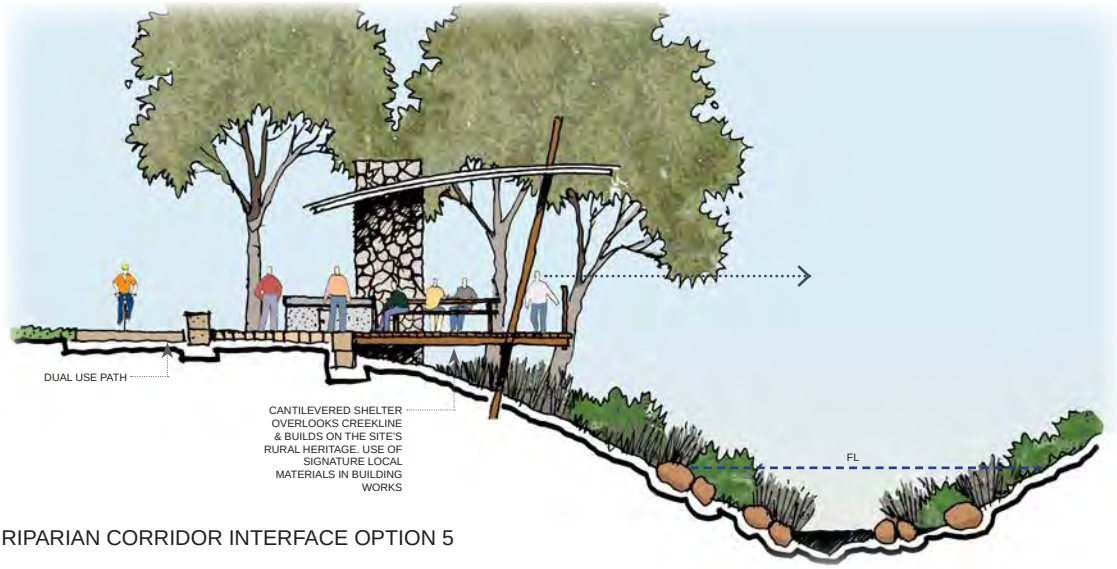
RIPARIAN CORRIDOR INTERFACE OPTION 2



RIPARIAN CORRIDOR INTERFACE OPTION 3



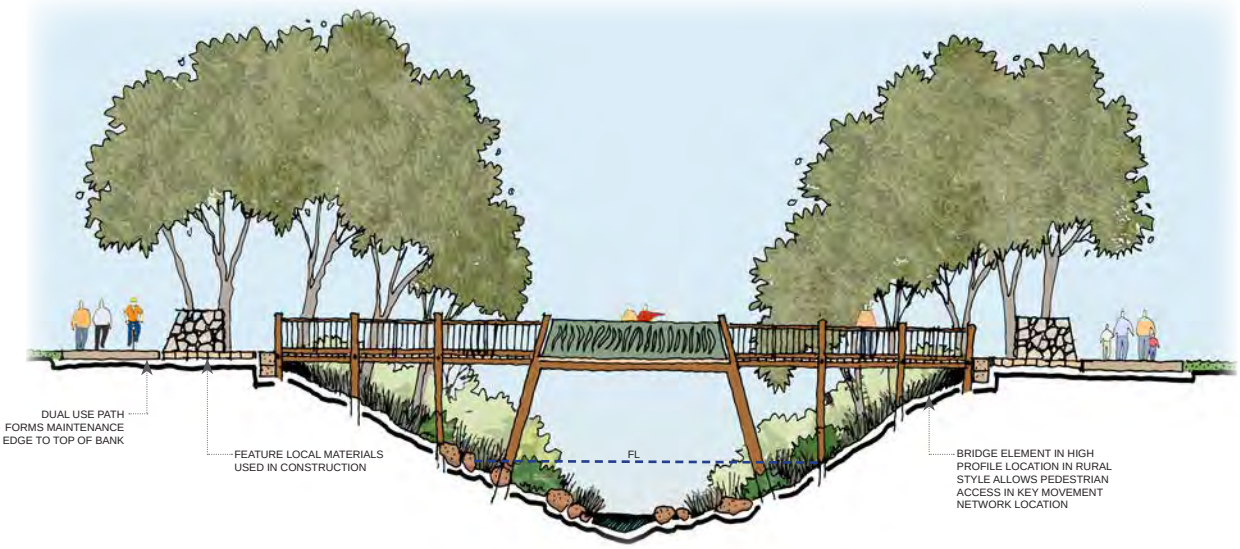
RIPARIAN CORRIDOR INTERFACE OPTION 4



RIPARIAN CORRIDOR INTERFACE OPTION 5



RIPARIAN CORRIDOR INTERFACE OPTION 6



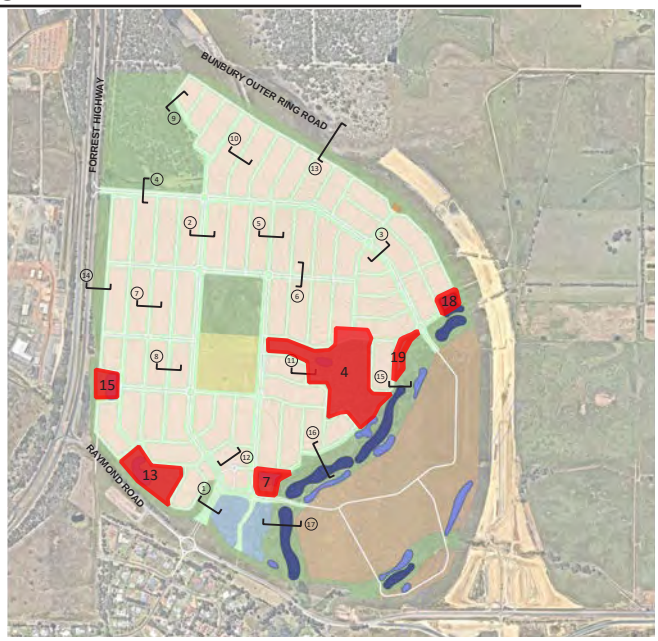
RIPARIAN CORRIDOR INTERFACE OPTION 7

11. POS STRATEGY - NEIGHBORHOOD PARKS

BRIEF DESCRIPTION

Located throughout the development, the Neighbourhood POS provides residents with open space in close proximity to their dwellings. The parks have areas of turf for passive play and informal kick-about area with nodes of seating and shelter either provided by trees or built structure. A path network through and around the POS allows footpath connection to surrounding streets and other POS. Drainage will be incorporated within these areas.

SIZE (Excluding Verges)
POS 4: 63,637.6 sq.m
POS 7: 5,948.2 sq.m
POS 13: 19,892.3 sq.m
POS 15: 8,592.3 sq.m
POS 18: 3,696.1 sq.m
POS 19: 3,796.2 sq.m



FUNCTIONS

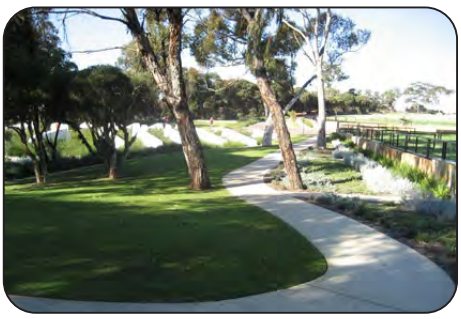
- Native, water wise planting. Deciduous used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Playground
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







12. POS STRATEGY - PLAYING FIELDS

BRIEF DESCRIPTION

- Landmark/destination for residents and community groups
- Opportunity to co-locate facilities (i.e. playing fields, junior ovals and hardcourts for future school and community)
- Provide shared amenities (i.e. shelters, BBQ areas, play and exercise nodes)
- Distinct active/passive zones amongst activities and age groups
- Promote accessibility and usage by community
- Pedestrian and cycle path along perimeter to connect into broader path network
- Playing fields with capacity for organised sporting and large scale community events
- Potential for viewing grandstand
- Allow for drainage and stormwater flows
- Allow for access and carparking

SIZE POS 3 (Excluding Verges) = 40,045.1 sq.m



FUNCTIONS

- Service diverse range of passive and active recreational activities
- Open area for informal/formal sports and events
- Predominantly irrigated turf for sporting fields
- Maximise shade trees
- Play elements for all ages
- Drainage
- Connection/Colocation with education facilities

ENVIRONMENTAL CONSIDERATIONS

- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the formal turf sporting fields
- Consider stormflows and drainage requirements
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







13. POS STRATEGY - CIVIC POS

BRIEF DESCRIPTION
- Civic landscape predominantly hardscape for events
- Shared pedestrian and vehicle town centre streetscape

SIZE (Excluding Verges)
POS 12: 3, 391.8 sq.m
Access Street D: 3,240 sq.m
POS 9: 1,960 sq.m

FUNCTIONS
- Village centre acting as central 'heart' of greater masterplan
- Neighbourhood hub for formal and informal public gatherings
- Open hardscaped areas to host local events, markets and food trucks
- Maximise shade trees with native and/or deciduous species where appropriate
- Community engagement & connection
- Path network connecting between activity centre buildings and into broader path network
- Landmark & feature planting

ENVIRONMENTAL CONSIDERATIONS
- Formal planting
- Trees for shade
- Designed with CPTED principles















14. POS STRATEGY - CONSERVATION POS

BRIEF DESCRIPTION

- Existing vegetation to be retained
- Revegetate and enhance
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with adjacent neighbourhood or linear POS recreational nodes.
- Boardwalks/interpretive/signage/educational opportunities

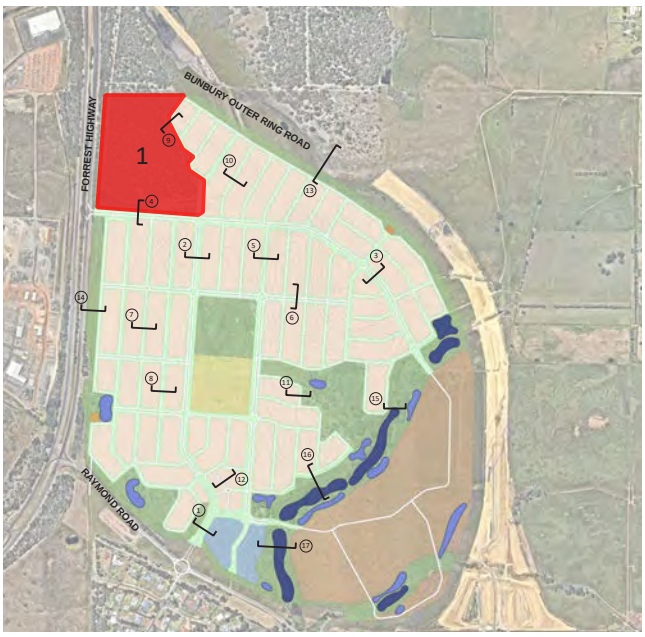
SIZE (Excluding Verges) = 120,696.6 sq.m

FUNCTIONS

- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader path network
- Ecological function
- Habitat
- Education
- Connection

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, unirrigated where possible.
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing site









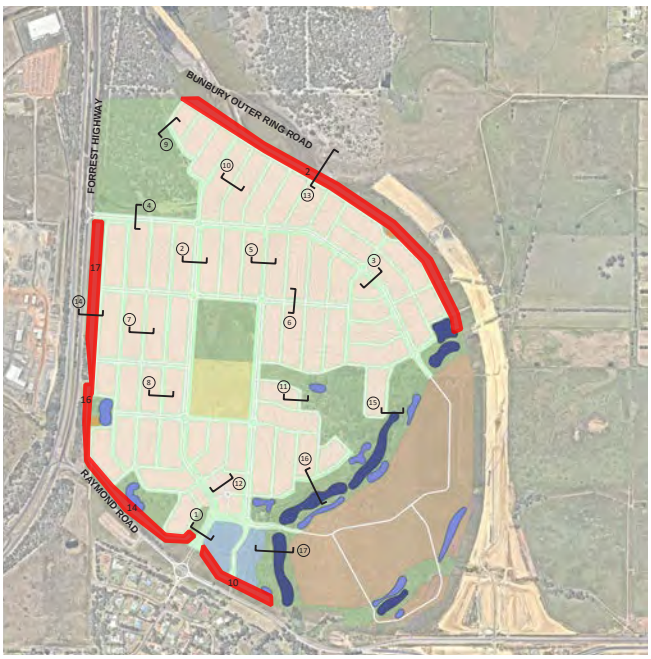




15. POS STRATEGY - BUFFER POS

BRIEF DESCRIPTION
- Provides a buffer to adjacent high use roads
- Vegetation corridors
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with recreational nodes along linear route/network.
- Allow for drainage and stormwater flows

SIZE (Excluding Verges)
POS 2: 37,679 sq.m
POS 10: 8,154.9 sq.m
POS 14: 13,406.7 sq.m
POS 16: 2,370.4 sq.m
POS 17: 19,759.9 sq.m



FUNCTIONS
- Buffer to adjacent high use roads
- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader development
- Drainage
- Ecological function
- Habitat
- Connection

ENVIRONMENTAL CONSIDERATIONS
- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing areas
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing and historic creekline











16. PROPOSED PLANT PALETTE

15.1 DRAINAGE CORRIDOR VEGETATION

Inundated - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree

Trees

Melaleuca rhaphiophylla	Swamp Paperbark

Lower Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Hypocalymma angustifolium	White Myrtle
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Melaleuca preissiana	Moonah
Melaleuca rhaphiophylla	Swamp Paperbark
Taxandria linearifolia	

Mid Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Astartea scoparia	
Dasypogon bromefolius	Pineapple Bush
Kunzea glabrescens	
Hypocalymma angustifolium	White Myrtle
Leucopogon tenuis	

Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Eucalyptus rudis	Flooded Gum
Melaleuca preissiana	Moonah
Taxandria linearifolia	

Upper Slope - Foreshore

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Astartea scoparia	
Kunzea glabrescens	
Leucopogon tenuis	
Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	

Trees

Corymbia calophylla	Marri
Euclayptus lane-poolei	Salmon White Gum
Eucalyptus marginata	Jarrah
Eucalyptus wandoo	Wandoo
Melaleuca preissiana	Moonah
Taxandria linearifolia	
Xanthorrhoea preissii	Grass Tree

Dryland Revegetation

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Acacia divergens	
Acacia pulchella	Prickly Moses
Acacia saligna	Orange Wattle
Allocasuarina humilis	Dwarf Sheoak
Anigozanthos manglesii	Mangles Kangaroo Paw
Conostylis aculeata	Prickly Conostylis
Dampiera linearis	Common Dampiera
Dianella revoluta	Dianella
Dryandra nivea	Honeypot Dryandra
Ficinia nodosa	Knotted Club Rush
Grevillea pilulifera	Woolly Flowered Grevillea
Hakea ceratophylla	Norned Leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea prostrata	Harsh Hakea
Hakea stenocarpa	Narrow Fruited Hakea
Hakea trifurcata	Two Leaf Hakea
Hypocalymma angustifolium	White Myrtle
Hypocalymma robustum	Swan River Myrtle
Kunzea micrantha	
Melaleuca laterifolia	Gorada
Patersonia occidentalis	Purple Flag

Eremophila glabra	Tar Bush
Grevillea crithmifolia	

Trees	
Allocasuarina fraseriana	Sheoak
Corymbia calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus wandoo	Wandoo
Nuytsia floribunda	Christmas Tree

15.2 PARKLAND PLANTING (POS AREAS/BUFFERS/BOULEVARDS)

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	**Common Name**
Acacia cognata 'Limelight'	Limelight
Acacia cognata	
Adenanthos sericea	Albany Woolly Bush
Agonis flexuosa 'Nana'	
Anigozanthus ssp.	Kangaroo Paw
Carex comans	
Dianella ssp.	Dianella
Dryandra nivea	Honeypot Dryandra
Eremophila 'Carramar Grey'	
Ficinia nodosa	Knotted Club Rush
Grevillea crithmifolia	
Grevillea obtusifolia 'Gin Gin Gem'	Gin Gin Gem
Grevillea 'Golden Lyre'	Golden Lyre
Grevillea 'Lollypops'	Lollypops
Grevillea thelemanniana	Spidernet Grevillea
Lomandra ssp	Lomandra
Pattersonia occidentalis	Purple Flag
Olearia axillaris	Coastal Daisy Bush
Phormium tenax 'Purpurea'	Phormium
Westringia fruticosa	Coastal Rosemary

Trees	
Agonis flexuosa	Native Peppermint
Brachychiton acerifolius	Illawarra Flame Tree
Corymbia calophylla	Marri
Corymbia maculata	Spotted Gum
Erythrina indica	Coral Tree
Eucalyptus marginata	Jarrah
Fraxinus raywoodii	Claret Ash
Liquidambar styraciflua	Liquidambar
Platanus acerifolia	London Plane Tree
Xanthorrhoea preissii	Grass Tree

15.3 TREE SPECIES SELECTION

15.3.1 NATIVE SPECIES



Agonis flexuosa
Willow Myrtle



Allocasuarina fraseriana



Callistemon 'Kings Park Special'



Casuarina obesa
Swamp Sheoak



Corymbia calophylla
Marri



Eucalyptus lane-poolei
Salmon White Gum



Eucalyptus marginata
Jarrah



Eucalyptus rudis
Flooded Gum



Eucalyptus todtiana
Prickly bark



Eucalyptus wandoo
White Gum



Melaleuca preissiana
Modong



Melaleuca rhaphiophylla
Swamp Paperbark



Nuytsia floribunda
WA Christmas Tree



Taxandria linearifolia



Xanthorrhoea preissii
Grasstree

15.3.2 EXOTIC SPECIES



Brachychiton acerifolius
Illawara Flame Tree



Corymbia maculata
Spotted Gum



Eucalyptus camaldulensis
River Red Gum



Erythrina indica
Coral Tree



Fraxinus Raywoodii



Jacaranda mimosifolia
Jacaranda



Liquidambar styraciflua
Sweet Gum



Platanus acerifolia
London Plane Tree



Ulmus parvifolia
Chinese Elm

17. IMPLEMENTATION

17.1. APPROVALS

As part of an ongoing process, once the Local Structure Plan has been endorsed by the LGA and the sub division approvals received, each POS landscape and irrigation design will be submitted as a detailed documentation package to the Shire for review and approval.

The landscape design will incorporate recreation and environmental requirements, while focusing on maintenance minimisation principles and techniques.

The developer is committed to working with the local council to deliver long term outcomes in this process to reflect best practice throughout the development.

17.2. PRACTICAL COMPLETION

Upon reaching Practical Completion of the landscape and irrigation works, a meeting shall be arranged and attended by the consulting landscape architect and the relevant council officers to inspect the completed landscape works.

Following this inspection the Developer's representative shall issue to council the following:

- A list of items requiring completion
- As-constructed landscape and irrigation drawings
- Details including capital costs of all physical assets for inclusion in the Councils asset register

Following Practical Completion the Developer shall organise to:

- Carry out any remedial works noted during the Practical Completion inspection without delay
- Undertake maintenance of the POS as agreed with council

17.3. LANDSCAPE MAINTENANCE RESPONSIBILITY

The developer funded and managed landscape and irrigation maintenance period of two years will apply to all public open space areas following completion of landscape construction works.

The maintenance period commences on the date of Practical Completion. Typically the first year is an establishment period, followed by a year of landscape maintenance.

After the two year period the POS landscape and irrigation maintenance will be handed over to the Local Government Authority to control, fund and manage.

17.4. SCHEDULED HANDOVER

Three months prior to the expiration of the maintenance period (from practical completion), the Developer shall contact the relevant Council officer to initiate the handover process, which will commence with an inspection of the POS.

At the handover inspection, the Developer shall provide to the Officer:

- Details of the areas maintained
- As-constructed irrigation drawings to include changes made to the system during the maintenance period
- Warranties, manuals and logbooks.

Following handover inspection and prior to the handover date, the Developer shall:

- Rectify all defects noted during the handover inspection and others that may emerge before the handover date
- The Council shall provide written confirmation that Council accepts responsibility for maintenance and liability for the location involved.


emerge
ASSOCIATES
Integrated Science & Design

Appendix C

Concept civil designs

Prepared by WML (2021)

LEGEND

- EXISTING NATURAL SURFACE CONTOUR (1m INTERVALS)
- LOT NUMBERS
- CONCEPTUAL EARTHWORK LEVEL
- GEOTECHNICAL ZONE

EXISTING ROAD RESERVE
GAS PIPELINE EASEMENT
HIGHWAY
FORREST
BUNBURY OUTER RING ROAD
RAYMOND ROAD
CONSERVATION PUBLIC OPEN SPACE
PUBLIC OPEN SPACE 7
PUBLIC OPEN SPACE 3
PROPOSED PRIMARY SCHOOL
NEIGHBOURHOOD ACTIVITY CENTRE
SHORT STAY ACCOMMODATION
MICRO BREWERY
MEDIUM DENSITY APARTMENTS
PROPOSED ECO VILLAGE
CLUBHOUSE
PROPOSED 60m RIPARIAN CORRIDOR
VEHICLE/ CARAVAN/ BOAT STORAGE
POS 1
POS 4
POS 5
POS 6
ZONE 1
ZONE 2
ZONE 3
1501
500
501
502
151
152
153

GEOTECHNICAL ZONE LEGEND

ZONE 1 - SAND

ZONE 2 - SAND ABOVE CLAY

ZONE 3 - CLAY

SCALE 1:3000

A1

WML Consulting Engineers
Civil | Geotechnical | Structural

BUNBURY +61 8 9722 3544
KALGOORLIE +61 8 9021 1811
PERTH +61 8 9722 3566
wml.com.au

REVISIONS				
C	NTH SECTION CONCEPTUAL EARTHWORK LEVEL REVISED	L. RUSCONI	9/4/25	WRS
B	LAYOUT UPDATED/ISSUED FOR INFORMATION	L. RUSCONI	7/10/21	WRS
A	ISSUED FOR INFORMATION	L. RUSCONI	26/8/21	WRS
N°.	DESCRIPTION	APPROVED	DATE	DRAWN

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	2/6/21
DRAWN	W. STEWART	20/8/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL EARTHWORKS PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK03 C

REVISION

LEGEND

- 15x20 — LOT FFL
- GRAVITY SEWER
- PRESSURE MAIN
- GRAVITY MAIN - CONTROL LINE
- ALTERNATE PUMP STATION - PSG LOCATION

EXISTING ROAD RESERVE

15.9m GAS PIPELINE EASEMENT

BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1

PUMP STATION AUSTRALIND PSC
SEWER DESIGN FLOW: 9.9L/s
LONG TERM PUMP RATE: 198.5L/s

POS 2

PUMP STATION No. 1
SEWER DESIGN FLOW: 8.2L/s
LONG TERM PUMP RATE: 10.9L/s
DEPTH TO INVERT 6.0m

PUMP STATION

FORREST HIGHWAY

POS 17

PUBLIC OPEN SPACE 3

PUBLIC OPEN SPACE 5

PROPOSED PRIMARY SCHOOL

PUBLIC OPEN SPACE 4

DISCHARGE POINT

POS 16

POS 15

PUMP STATION AUSTRALIND PSG
SEWER DESIGN FLOW: 13.1L/s
LONG TERM PUMP RATE: 37.5L/s
DEPTH TO INVERT 7.0m

PUMP STATION

PUBLIC OPEN SPACE 13

POS 14

POS 12

NEIGHBOURHOOD ACTIVITY CENTRE

COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)

PROPOSED 60m RIPARIAN CORRIDOR

POS 7

PUBLIC OPEN SPACE 8

POS 9

POS 10

PUBLIC OPEN SPACE 6

PUMP STATION PRIVATE???
SEWER DESIGN FLOW: 11.8L/s

PUMP STATION

PROPOSED 60m RIPARIAN CORRIDOR

STRATA TITLED VILLAGE

POSSIBLE REALIGNED 132kV POWERLINE EASEMENT & POLES

EXISTING 132kV POWERLINE EASEMENT TO BE REALIGNED

PUBLIC OPEN SPACE 11

STRATA TITLED VILLAGE

BUNBURY OUTER RING ROAD

RAYMOND ROAD

RANSON DRIVE

SCALE 1:3000

A1

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REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
C	LAYOUT UPDATED/ISSUED FOR REVIEW	L. RUSCONI	21/08/24	NT
B	LAYOUT UPDATED/ISSUED FOR INFORMATION	L. RUSCONI	7/10/21	WRS
A	ISSUED FOR INFORMATION	L. RUSCONI	26/8/21	WRS

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	2/6/21
DRAWN	W. STEWART	24/8/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL SEWER PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK05

REVISION: C

LEGEND

- EXISTING NATURAL SURFACE CONTOUR (1m INTERVALS)
- SWALE DRAIN & DIRECTION FLOW INDICATOR
- BIORETENTION BASIN STORAGE
- DRAINAGE CATCHMENT
- SUBSOIL DRAINAGE INDICATIVE FLOW DIRECTION
- 14.51 SUBSOIL DRAINAGE INDICATIVE INVERT LEVELS
- 15.20 LOT FFL

GAS PIPELINE EASEMENT
EXISTING ROAD RESERVE
OPEN DRAIN INVERT RL13.50
OPEN DRAIN INVERT RL13.30
OPEN DRAIN INVERT RL13.10
OPEN DRAIN INVERT RL12.90
OPEN DRAIN INVERT RL12.70
OPEN DRAIN INVERT RL12.50
OPEN DRAIN INVERT RL12.30
OPEN DRAIN INVERT RL13.50
OPEN DRAIN INVERT RL12.20
OPEN DRAIN INVERT RL11.50
CONSERVATION PUBLIC OPEN SPACE
HIGHWAY
FORREST
OUTER RING ROAD
BUNBURY OUTER RING ROAD
RAYMOND ROAD
PUBLIC OPEN SPACE 7
PUBLIC OPEN SPACE 3
PROPOSED PRIMARY SCHOOL
NEIGHBOURHOOD ACTIVITY CENTRE
SHORT STAY ACCOMMODATION
MICRO BREWERY
MEDIUM DENSITY APARTMENTS
PROPOSED ECO VILLAGE
CLUBHOUSE
VEHICLE/ CARAVAN/ BOAT STORAGE
FUTURE STREAM
PROPOSED 60m RIPARIAN CORRIDOR
POS 4
POS 5
POS 6
1501
500
501
502
504

SCALE 1:3000
A1

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BUNBURY +61 8 9722 3544
KALGOORLIE +61 8 9021 1811
PERTH +61 8 9722 3566
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REVISIONS				
N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	ISSUED FOR APPROVAL	L. RUSCONI	25/08/25	NT
A	ISSUED FOR INFORMATION	L. RUSCONI	9/11/21	WRS

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	9/11/21
DRAWN	W. STEWART	9/11/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL SUBSOIL DRAINAGE PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK06 B

REVISION: B

Appendix D

Geotechnical logs

Prepared by WML (2021)

WML accessible expertise	**TRIAL PIT: TP1**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6316078.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 18 0.35 - 0.50 19 0.50 - 0.65 29 0.65 - 0.80 31 0.80 - 0.95 25 0.95 - 1.10 25		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CL	Dry, pale grey, firm, fine to medium grained, **sandy CLAY** with a trace of silt and a trace of fine roots.
	0.5			CH	Dry, orange slightly mottled grey, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
				CH	Dry, pale grey mottled red, very stiff, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP2

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384638.0 m E 6316066.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 9 0.35 - 0.50 12 0.50 - 0.65 12 0.65 - 0.80 9 0.80 - 0.95 6 0.95 - 1.10 6 0.50m In-situ VS P=120kPa		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			CI	Dry, pale yellow, firm, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0			CL	Moist, yellow, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel and a trace of coarse roots.
	1.5			CH	Moist, grey banded red yellow, stiff, **CLAY** with a trace of fine roots. *Relic roots.*
	2.0				Hole Terminated at 1.60 m Hard Digging

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP3

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384833.0 m E 6315970.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 6 0.20 - 0.35 10 0.35 - 0.50 15 0.50 - 0.65 10 0.65 - 0.80 17 0.80 - 0.95 25 0.95 - 1.10 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	1.0			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.5	1.50m In-situ VS P>120kPa		SP	Moist, orange, dense, fine to medium grained, **clayey SAND** with a trace of boulders and a trace of fine to medium gravel. *Ironstone boulders present at 1.7m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP4

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316091.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 13 0.20 - 0.35 5 0.35 - 0.50 4 0.50 - 0.65 10 0.65 - 0.80 13 0.80 - 0.95 13 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CI	Dry, grey brown, stiff, **silty CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	0.5	0.50m PSD / PI		CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5	1.50m		CH	Moist, orange slightly mottled pale grey, stiff, fine to medium grained, **sandy CLAY** with a trace of cobbles. *Ironstone boulder around 1.8m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP5

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384734.0 m E 6316138.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 9 0.35 - 0.50 3 0.50 - 0.65 10 0.65 - 0.80 12 0.80 - 0.95 12 0.95 - 1.10 13		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	0.5			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP6

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384846.0 m E 6316210.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 5 0.35 - 0.50 3 0.50 - 0.65 3 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.50m		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.50m ASS			
		1.00m			Moist, brown mottled red grey, very stiff, **CLAY**.
	1.0	1.00m ASS		CH	
		1.30m In-situ VS P>120kPa			
		1.50m			
	1.5	1.50m ASS			
		2.00m		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0	2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP7

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385010.0 m E 6316074.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 16 0.20 - 0.35 17 0.35 - 0.50 20 0.50 - 0.65 12 0.65 - 0.80 8 0.80 - 0.95 8 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, pale grey, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5			CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5			CH	Moist, brown mottled red grey, very stiff, **CLAY**.
	2.0			CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP8

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385071.0 m E 6316207.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 14 0.35 - 0.50 10 0.50 - 0.65 10 0.65 - 0.80 10 0.80 - 0.95 11 0.95 - 1.10 12		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, grey brown, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.60m In-situ VS P>120kPa		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
		1.90m In-situ VS P>120kPa		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP9

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385168.0 m E 6316359.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 20 0.20 - 0.35 20 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 14 0.95 - 1.10 13		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, brown, very stiff, **CLAY** with a trace of fine roots and a trace of fine to medium grained sand.
	0.5			CH	Dry, brown mottled grey, hard, **CLAY**.
	1.0				
	1.5				
				CH	Moist, dark grey mottled red, very stiff, **CLAY** with a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP10**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385011.0 m E 6316369.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 7 0.35 - 0.50 9 0.50 - 0.65 5 0.65 - 0.80 4 0.80 - 0.95 4 0.95 - 1.10 4 1.10 - 1.25 4 1.25 - 1.40 3 1.40 - 1.55 5 1.55 - 1.70 4 1.70 - 1.85 5 1.85 - 2.00 5 2.00 - 2.15 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				ML	Dry, brown slightly mottled red, hard, **SILT** with some fine to medium grained sand and a trace of fine roots. *Iron content adding to material strength.*
	0.5			CI	Moist, orange, stiff, fine to medium grained, **CLAY** with some fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5			CI	Dry, orange brown mottled grey, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots. *Relic tree roots.*
				CI	Moist, orange brown slightly mottled red grey, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP11**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384847.0 m E 6316364.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 13 0.35 - 0.50 20 0.50 - 0.65 24 0.65 - 0.80 18 0.80 - 0.95 12 0.95 - 1.10 10		CI	Dry, pale yellow grey, firm, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m In-situ VS P>120kPa			
	1.5	1.60m PSD / PI		CH	Moist, red mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine gravel and a trace of fine roots. *Relic tree roots.*
	2.0	2.00m			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP12

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384619.0 m E 6316208.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 5 0.35 - 0.50 12 0.50 - 0.65 14 0.65 - 0.80 13 0.80 - 0.95 9 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND**.
	0.5			CI	Moist, orange, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.0			SP	Moist, orange, dense, fine to coarse grained, **clayey SAND** with a trace of cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

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WML accessible expertise	**TRIAL PIT: TP13**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384520.0 m E 6316176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 27 0.20 - 0.35 23 0.35 - 0.50 19 0.50 - 0.65 21 0.65 - 0.80 17 0.80 - 0.95 11 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.30m PSD / PI		SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of fine to medium gravel.
		0.70m PSD / PI		CH	Moist, grey mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m			
	1.5	1.30m In-situ VS P=85kPa 1.40m In-situ VS P>120kPa		CH	Moist, grey mottled orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine gravel.
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP14**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316250.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
		Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 7 0.35 - 0.50 6 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 3		SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5	0.95 - 1.10 3 1.10 - 1.25 3 1.25 - 1.40 2 1.40 - 1.55 3 1.55 - 1.70 5 1.70 - 1.85 10 1.85 - 2.00 26		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			CI	Moist, yellow, firm, fine to medium grained, **sandy CLAY**. *Moist to wet.*
	1.5	1.60m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0			CI	Moist, grey mottled red, very stiff, fine to coarse grained, **sandy CLAY** with a trace of fine roots.
					Hole Terminated at 2.00 m Target depth

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WML accessible expertise	**TRIAL PIT: TP15**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384300.0 m E 6316357.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
1m	1.0			SP	Wet, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
	1.5			Cl	Moist, grey blue slightly mottled orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0			Cl	Moist, banded brown green, stiff, fine to medium grained, **sandy CLAY**.
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP16**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384452.0 m E 6316358.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 6 0.45 - 0.60 5 0.60 - 0.75 4 0.75 - 0.90 4 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
1.4m				SP	Moist, grey, medium dense, fine to medium grained, **clayey SAND** with a trace of silt. *Most to wet.*
	1.5	1.70m In-situ VS P=90kPa		CI	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP17

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384617.0 m E 6316337.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows PSD / PI 0.00 - 0.15 3 0.15 - 0.30 5 0.30 - 0.45 4 0.45 - 0.60 7 0.60 - 0.75 11 0.75 - 0.90 16 0.90 - 1.05 13 0.50m		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium roots.
	1.0			SP	Moist, grey brown, dense, fine to coarse grained, **clayey SAND** with a trace of fine gravel and a trace of fine roots.
	1.5			CI	Moist, grey mottled brown, very stiff, **CLAY** with a trace of fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
				CI	Moist, brown mottled grey, very stiff, **CLAY** with some fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP18

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384581.0 m E 6316507.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 2 0.60 - 0.75 3 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 3 1.95 - 2.10 4		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			SP	Moist, yellow orange, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP19**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384504.0 m E 6316594.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 6 1.65 - 1.80 25		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots. *Medium root at 0.4m.*
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP20**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384408.0 m E 6316619.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5	0.90m ASS		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
		1.80m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP21**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384403.0 m E 6316495.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.65m 1.65m PSD / PI		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.70 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP22**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384233.0 m E 6316503.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 3 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP23**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384166.0 m E 6316581.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 5 1.05 - 1.20 13 1.20 - 1.35 22		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
1m	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.90m In-situ VS P=60kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP24**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384080.0 m E 6316519.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 6 0.15 - 0.30 8 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 3 1.05 - 1.20 8 1.20 - 1.35 12		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.50m In-situ VS P=110kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP25**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384018.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 7 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 6		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey brown, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt.
				CI	Moist, pale green blue, stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **clayey SAND**. *Clayey sand with clods of sandy clay.*
				CH	Dry, grey, hard, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP26**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384021.0 m E 6316722.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 10 0.20 - 0.35 6 0.35 - 0.50 3 0.50 - 0.65 6 0.65 - 0.80 14 0.80 - 0.95 12 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale grey yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of cobbles. *Clods of clay.*
	1.0	1.00m In-situ VS P>120kPa		CH	Moist, orange grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Clods of clay.*
	1.5	1.70m 1.70m PSD / PI		CH	Moist, yellow mottled grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Small to large lumps of clay with sand among clayey sand.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP27**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384165.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 6 0.90 - 1.05 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.5				Hole Terminated at 1.30 m Refusal
	2.0				

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP28**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384392.0 m E 6316711.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 5 1.65 - 1.80 10		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP29**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384515.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 5 1.65 - 1.80 6 1.80 - 1.95 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
0.8m ▽	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP30**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384711.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 1 0.45 - 0.60 1 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 3 1.65 - 1.80 3 1.80 - 1.95 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP31

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316710.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 4 0.95 - 1.10 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	0.90m In-situ VS P>120kPa		CL	Moist, dark grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			CI	Moist, orange yellow slightly mottled grey, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP32

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385068.0 m E 6316709.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 7 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 7 0.95 - 1.10 7		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5			CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP33**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385035.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 6 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 6		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.60m In-situ VS P>120kPa		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0				
	1.5	1.90m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP34**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384988.0 m E 6316476.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 9 0.65 - 0.80 7 0.80 - 0.95 8 0.95 - 1.10 9		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.50m 0.50m ASS		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m ASS		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	1.5	1.50m		CI	Moist, grey mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots. *Relic tree roots, minor cementation.*
	2.0	2.00m 2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP35**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385166.0 m E 6316488.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 6 0.35 - 0.50 6 0.50 - 0.65 5 0.65 - 0.80 5 0.80 - 0.95 5 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0				
	1.5			CH	Moist, brown red, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP36**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385173.0 m E 6316591.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 21 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 8 0.65 - 0.80 5 0.80 - 0.95 4 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.80m PSD PI In-situ VS P>120kPa		CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0			CH	Moist, brown mottled grey orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	1.5	1.50m		CH	Moist, brown mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to coarse gravel. *Ironstone gravel as excavated.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP37

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384967.0 m E 6316845.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 2 0.30 - 0.45 3 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 4 1.95 - 2.10 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP38**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384956.0 m E 6316978.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 7 0.30 - 0.45 7 0.45 - 0.60 6 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 6 1.05 - 1.20 11		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of cobbles. *Ironstone cobbles around 1.1m at top of clay layer.*
				Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP39**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385090.0 m E 6316960.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 7 0.30 - 0.45 8 0.45 - 0.60 6 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 5 1.95 - 2.10 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5	1.70m			
		PSD / PI		SP	Moist, yellow orange, medium dense, fine to medium grained, **clayey SAND**.
	2.0	2.00m			
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP40

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384944.0 m E 6317071.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 7 0.90 - 1.05 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			CH	Moist, grey brown mottled orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	1.5			CH	Dry, grey mottled orange, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP41

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384972.0 m E 6317189.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 7 0.60 - 0.75 9 0.75 - 0.90 11 0.90 - 1.05 21		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey brown mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine to medium roots. *Weakly cemented gravel and cobbles.*
		1.70m In-situ VS P=100kPa 1.90m In-situ VS P>120kPa		CI	Moist, grey mottled orange, very stiff, fine to coarse grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP42

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6317175.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 8 0.30 - 0.45 6 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey brown mottled red orange, very dense, fine to medium grained, **clayey SAND** with some cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles as excavated.*
	1.5			CH	Moist, grey orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP43**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384761.0 m E 6317336.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 5 0.50 - 0.65 2 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 6		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP44

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384778.0 m E 6317062.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 11 0.15 - 0.30 17 0.30 - 0.45 13 0.45 - 0.60 7 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 6 1.50 - 1.65 10 1.65 - 1.80 15		ML	Dry, brown, very stiff, **SILT** with some fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5			SP	Moist, black, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots and a trace of fine to medium gravel. *Wet to moist, water seeping in at 1.5m, likely from drainage channel.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP45

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384694.0 m E 6317164.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 2 0.35 - 0.50 4 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 7		SP	Dry, grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP46**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384710.0 m E 6317361.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 5 0.90 - 1.05 4 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 5 1.50 - 1.65 7 1.65 - 1.80 5 1.80 - 1.95 7 1.95 - 2.10 7		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to coarse gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP47**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384463.0 m E 6317461.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 4 0.30 - 0.45 5 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 10		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	1.35m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
		PSD / PI		SP	Moist, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
▽ 1.65m	1.5	1.65m		SP	Wet, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP48**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384382.0 m E 6317549.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 3 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 2 0.95 - 1.10 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
▽ 1.3m				SP	Wet, black brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium gravel.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP49

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384214.0 m E 6317679.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 3 0.35 - 0.50 3 0.50 - 0.65 4 0.65 - 0.80 3 0.80 - 0.95 3 0.95 - 1.10 3 1.10 - 1.25 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP50

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384247.0 m E 6317579.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 3 1.65 - 1.80 17		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP51**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384336.0 m E 6317411.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 3 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 2 1.65 - 1.80 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
▽ 1.6m				SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP52**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384276.0 m E 6317317.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 5 1.65 - 1.80 5 1.80 - 1.95 4 1.95 - 2.10 5		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP53

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384400.0 m E 6317280.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 2 1.65 - 1.80 3 1.80 - 1.95 3 1.95 - 2.10 3		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, pale grey tending grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
1.5m	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP54

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384177.0 m E 6317176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP55**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384144.0 m E 6317045.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5	1.50m In-situ VS P>120kPa			
		1.90m In-situ VS P=70kPa		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP56

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384014.0 m E 6317030.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, brown, dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
	1.5			CI	Moist, yellow mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
				CI	Moist, grey mottled yellow, stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP57**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384054.0 m E 6316913.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	0.5				
▽ 0.65m				SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.0			SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to coarse gravel.
	1.5			CH	Moist, pale green grey slightly mottled yellow, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP58

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384016.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse gravel and a trace of cobbles.
	0.5			SP	Moist, pale brown, dense, fine to medium grained, **clayey SAND** with some fine to medium gravel and a trace of fine roots. *Clods of clay within the clayey SAND.*
				SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel. *Strongly cemented layer.*
	1.0			SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel.
	1.5			CI	Moist, yellow mottled grey, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP59**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
1.4m	1.0				
	1.5			SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP60**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384266.0 m E 6317055.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.5m	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Dry Collapse; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP61**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384397.0 m E 6317054.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5				
	1.0				
	1.5				
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP62**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384368.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine to coarse roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse roots.
	1.0				
	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP63**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384357.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.2			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
▽ 1.2m	1.0			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Wet, dark brown, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Strongly cemented.*
	1.7			SP	Wet, grey yellow, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Cemented.*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP64**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384525.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP65

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384647.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5	0.50m 0.50m ASS			
	1.0	1.00m 1.00m ASS		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5	1.50m 1.50m ASS			
	2.0	2.00m 2.00m ASS		SP	Moist, yellow, dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of cobbles and a trace of clay. *Ironstone and weakly cemented SAND gravel/cobbles.*
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP66**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384625.0 m E 6316951.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, grey banded orange, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP67

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384492.0 m E 6317032.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5				
	1.0	1.00m PSD / PI		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.50m			
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP68

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6317165.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP69**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384603.0 m E 6317072.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP70**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384773.0 m E 6316944.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP71**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384754.0 m E 6316812.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
▽ 1.9m				SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP72**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384265.0 m E 6316815.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0				
1.4m					
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

MOISTURE DENSITY RELATIONSHIP REPORT

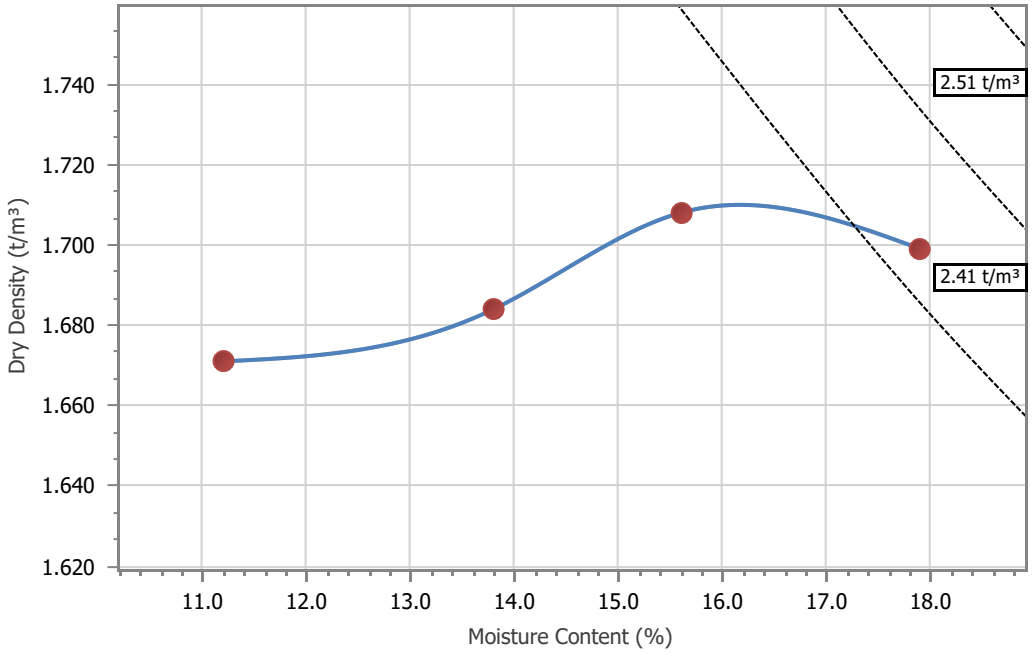
Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76952-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	18/09/2024 Page 1 of 1

Test Procedures	WA133.1, WA110.1, WA115.2, WA105.1	Location	South
Sample Number	5022/S/130373		
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	17/09/2024	Compactive Effort	Modified
Material Source	Pearson Pit	Percent Retained 37.5mm (%)	0
Material Type	Sand	Percent Retained 19.0mm (%)	0
Liquid Limit Method	n/a	Total Curing Time (hrs)	16.3
Material Description	Limestone		

Moisture / Density Relationship Data

Moisture Content (%)	Dry Density (t/m³)
11.2	1.671
13.8	1.684
15.6	1.708
17.9	1.699

MOISTURE DENSITY RELATIONSHIP PLOT



Maximum Dry Density (t/m³):	1.710	**Optimum Moisture Content (%):**	16.2

Remarks

NATA

Accredited for compliance with ISO/IEC 17025 – Testing

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W4Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

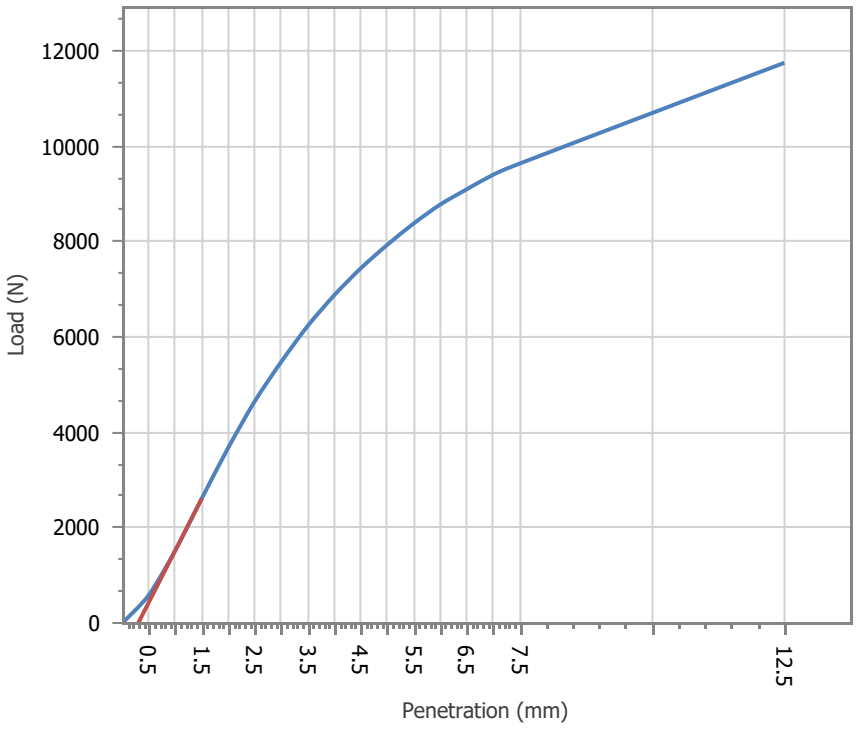
CALIFORNIA BEARING RATIO REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/77463-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	2/10/2024 Page 1 of 1

Test Procedures	WA141.1, WA105.1, WA133.1, WA110.1		
Sample Number	5022/S/130373	Location	South
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	1/10/2024		
Material Source	Pearson Pit	Material Limit Start	-
Material Type	Sand	Material Limit End	-
Client Reference	-	Compactive Effort	Modified
Material Description	Limestone		
Compaction Method	14 Blows per Layer		

Maximum Dry Density (t/m³):	1.710
Optimum Moisture Content (%):	16.2
Field Moisture Content (%):	8.9
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	94
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.619
Placement Dry Density Ratio (%):	94.7
Placement Moisture Content (%):	15.4
Placement Moisture Ratio (%):	95.1
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density Ratio After Soak (%)	95.6
Moisture / Ratio After Soak (% / t/m³)	19.4 / 120.0
Moisture (top 30mm) After Pen (%):	20.7
Mst Ratio (top 30mm) After Pen (%)	128.0
Moisture (remainder) After Pen (%):	19.3
Mst Ratio (remainder) After Pen (%)	119.0
CBR Swell (%):	-1.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**40**

CBR PENETRATION PLOT



Remarks

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

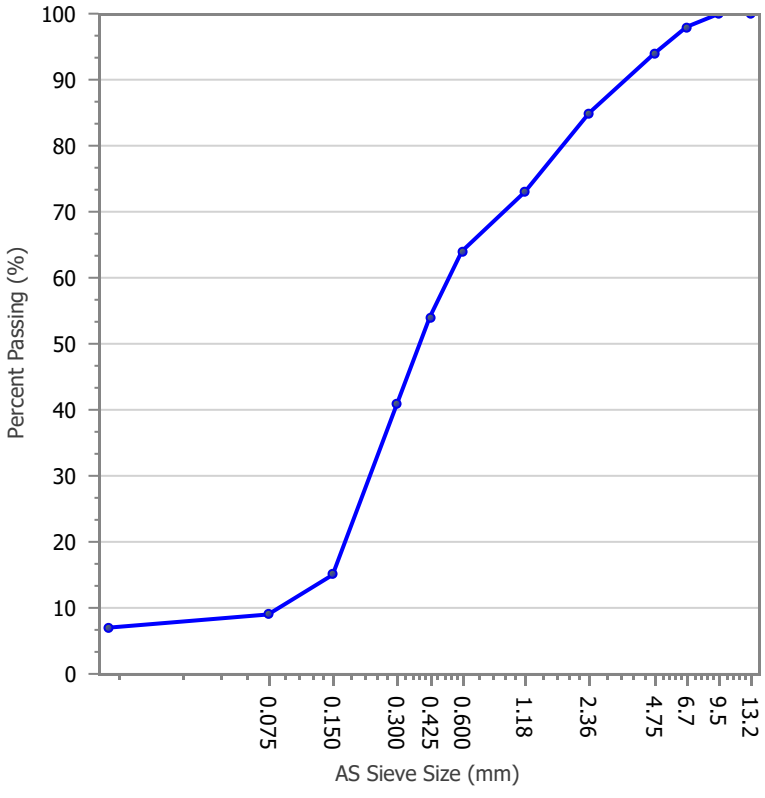
PARTICLE SIZE DISTRIBUTION REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76951-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	18/09/2024 Page 1 of 1

Test Procedures:	WA115.1, WA105.1		
Sample Number	5022/S/130373	Location	South
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	17/09/2024	Material Source	Pearson Pit
Prep / Drying Method	Decanted / -	Material Type	Sand
		Specification	-

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
13.2		**100**	
9.5		**100**	
6.7		**98**	
4.75		**94**	
2.36		**85**	
1.18		**73**	
0.600		**64**	
0.425		**54**	
0.300		**41**	
0.150		**15**	
0.075		**9**	
0.0135		**7**	

PARTICLE SIZE DISTRIBUTION GRAPH



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W9Rep Rev 3

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC24-02084-S01
Issue No: 1

Client: Construction Sciences Pty Ltd
PO Box 5004 Bunbury DC WA 6230
Project: Quality Control (Construction Sciences)

Location: B & J Catalano Pty Ltd
5029/P/295 - Pearson Pit

Accredited for compliance with ISO/IEC 17025-Testing
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Mark Buckels
(Senior Technician)
Date of Issue: 23/08/2024

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC24-02084-S01
Date Sampled	15/08/2024
Sampling Method	Tested as received
Material	Sand
Soil Description	Limestone Sand
Client ID	5022/S/128817
Sample Location	Pearson Lime Sand

Test Results

Description	Method	Result	Limits
Organic Matter (%)	AS 1289.4.1.1	0.2	
Date Tested		23/08/2024	

Comments

N/A

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Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

CLAY AND FINE SILT REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76516-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/102
Project:	Runnymede Pit	Lot Number:	Screen Sand (30/08/24)
Location:	Bunbury	Internal Test Request:	5022/T/23934
Supplied To:	n/a	Client Reference/s:	PO 429885
Area Description:		Report Date / Page:	4/09/2024 Page 1 of 1

Test Procedures:	AS1141.33		
Sample Number	5022/S/129917	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	30/08/2024	Area	
Sampled By	Client Sampled	Location	Screen Sand (30/08/24)
Date Tested	04/09/2024	Sample No.	
Material Source	Runnymede Sand Pit	Material Type	Yellow SAND

Test Methodology Used:	Standard

Clay and Fine Silt (%)	7

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W41Rep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

CALCIUM CARBONATE CONTENT REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/77177-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	25/09/2024 Page 1 of 1

Test Procedures:	WA915.1		
Sample Number	5022/S/130373	Sample Location	
Sampling Method	WA100.1 Cl 6.2.5.1	Location	South
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	25/09/2024		
Material Source	Pearson Pit	Material Type	Sand

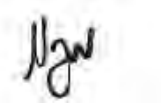
Average Calcium Carbonate Content (%)	57.9

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022



Approved Signatory: Hermanus Coetzee
Form ID: W52Rep

Appendix E

BORR report - Transverse drainage Northern & Central Sections

Supplied by MRWA

BORR Team

Transverse Drainage
Northern & Central Sections

27 February 2020



4 HYDROLOGIC ASSESSMENT

4.1 Flood Estimation Procedures

The following scope was carried out to estimate design flows from rural, ungauged catchments in the study area:

- Preliminary catchment delineation was undertaken based on LiDAR topographic data. For several areas it was not possible to define the catchment due to flat topography and drainage/irrigation channels
- For catchments which could be defined, peak flows were estimated using the following regional methods:
  - ARR1987 Rational and Index Flood Methods
  - ARR2019 RFFE Method
  - JDA 2018 Swan Coastal Plain Method
- 2-dimensional (2D) TUFLOW hydrodynamic models were developed to estimate 1% AEP peak flows at the same locations adopting the same inputs and parameters as the recently completed *Millars Creek Flood Study* (DWER, 2018)
- Estimated peak flows from the TUFLOW models were compared to those obtained using regional methods to determine a suitable methodology for sizing hydraulic structures.

Based on the outcomes of the assessment, the TUFLOW models are considered a suitable method to estimate design flows from ungauged catchments. A position paper was submitted to Main Roads WA for endorsement, which summarised the assessment methodology and outcomes (Appendix A).

4.2 Validation

1% AEP design flows from the 2D hydraulic models were compared to design flows adopted for several other studies within the project area.

4.2.1 Victory Main Drain

DWER (2018) estimated 1% AEP design flow of 62 m^3/s at the proposed BORR crossing. The 'Millars Creek' 2D hydraulic model used for this study estimated a 1% AEP design flow of 58 m^3/s.

4.2.2 Raymond Road – Treendale Main Drain

The Treendale Main Drain crossing at Raymond Road comprises an existing DN1050 RCP culvert. The upstream catchment shares similar characteristics to the Vindictive Main Drain catchment (cleared, flat paddocks with network of constructed drains). The 1% AEP flow of 2.5 m^3/s at the Vindictive Main Drain gauge obtained by JDA (2018) using at-site flood frequency analysis was used to estimate the design flow at the Raymond Road crossing which has a catchment area of 11.9 km^2 using the Equation:

$$Q_2 = Q_1 (A_2/A_1)^{0.745}$$

This resulted in a 1% AEP flow estimate of 8.8 m^3/s which compares well to the design flow from the TUFLOW model of 8.4 m^3/s.

4.2.3 Five Mile Brook

The *Five Mile Brook Flood Study* was carried out by Department of Water (now DWER) in 2018. As part of the study a RORB rainfall-runoff model was developed for the Five Mile Brook catchment which produced a 1%

AEP design flow at the BORR crossing of 17 m^3/s. This is consistent with the design flow obtained from the 'T01' BORR 2D hydraulic model.

4.2.4 Eadle's Gully

A 1% AEP design flow of 3.7 m^3/s was estimated for Eadle's Gully as part of the *Eadle's Gully Flood Study (WAWA, 1989).* The Eadle's Gully TUFLOW model developed for the BORR projects results in a 1% AEP design flow of 4.6 m^3/s. The 1989 report notes that the extent of swamp areas in the catchment can have a significant impact on runoff.

4.2.5 Vindictive Main Drain

Vindictive Main Drain has a stream gauging station with 20 years of recorded data spanning 1975 to 1995. The gauge has a contributing catchment area of 2.2 km^2 comprising relatively flat paddocks with a network of constructed drains. A flood frequency analysis on this gauge was carried out as part of the JDA (2018) study resulting in a 1% AEP design flow of 2.5 m^3/s. The 2D hydraulic model used for this study estimated a 1% AEP design flow of 4.5 m^3/s which may be conservative.

4.3 Design Flows

1% AEP peak flows extracted from the TUFLOW models under the pre-development scenario are summarised in Table 4-1 for the major crossings which are further described in Section 5. Locations are shown in the flood maps in Appendix E.

Table 4-1: 1% AEP Design Flows at Significant Crossings

Crossing Location	1% AEP Design Flow (m^3/s)
Treendale Main Drain	4.0
Treendale Branch Drains A and A1	5.6
Treendale Main Drain – Raymond Road	8.4
Raymond Road Diversion Channel	3.1
Collie River North	2.2
Victory Main Drain – Railway Road	27.0
Victory Main Drain – Waterloo Road	62.0
Vindictive Branch Drain C	7.5
Vindictive Main Drain	4.5
Moore Link Road	3.5
Gavins Gully Main Drain	24.5

- RCB culverts were adopted for the Harvey Water irrigation channels. Culverts were sized to have a width equal to or greater than the top width of the drain, and a height equal to or greater than the depth of the drain.
- Fauna crossings were incorporated either as stand-alone crossings or dual use culverts based on advice from Neil McCarthy (Environment & Heritage Leader).
- Culvert sizes/barrels were increased where required to manage backwater during the 1% AEP event.
- Where practical RCP culverts were adopted in lieu of RCB culverts. RCB culverts require the construction of a concrete base slab below the existing ground surface which is likely to be difficult because of high groundwater levels (especially during winter).
- A minimum RCP culvert diameter of 450 mm was adopted.
- A minimum cover of 0.6 m was adopted for culverts beneath the highway. It is expected that local/service roads and the PSP will have reduced cover requirements.

5.3 Significant Crossings

This section highlights some of the significant crossings (listed from north to south). Collie, Ferguson, and Preston River crossings are documented in the *Major Waterways Assessment* (BORR-01-RP-DR-0003) report.

5.3.1 Treendale Main Drain

The BORR crosses the Treendale Main Drain at approximate Ch 83,480 at a slight skew of 9°. The drain flows from the northeast to the southwest and will require a culvert under the highway and adjacent PSP. The post-development 1% AEP design flow for the Treendale Main Drain is approximately 3.0 m^3/s. 1x3000x2100 RCB culvert is proposed in this location based on the estimated size of the existing artificial channel. It is proposed to install the culvert skewed to the highway, however, options to provide a square culvert with stream training can be pursued during detailed design.

5.3.2 Treendale Branch Drains A and A1

The BORR crosses Treendale Branch Drains A and A1 at approximate Ch 84,300. The drains flow from east to west and converge at the proposed BORR crossing location. Both drains are skewed to the highway alignment and the geometry/proximity of the two at the downstream side of the crossing would be problematic if separate culverts were provided, therefore, it is proposed to divert Treendale Branch Drain A1 south to a single, square culvert crossing for the two drains. 2x2400x1200 RCB culverts are proposed in this location based on the estimated sizes of the existing artificial channels. The 1% AEP design flow at this location is 5.6 m^3/s.

5.3.3 Treendale Main Drain – Raymond Road

Flows from Treendale Main Drain are conveyed beneath the existing Raymond Road via a DN1500 RCP culvert. The post-development 1% AEP design flow at this location is 6.7 m^3/s. It is proposed to extend/replace the existing culvert in this location.

5.3.4 Raymond Road Diversion

2D flood modelling of the pre-development condition at Raymond Road near the proposed BORR alignment identified a 1% AEP flow in the order of 3.5 m^3/s along the southern side of Raymond Road. This flow currently passes under Raymond Road, into the Treendale Branch Drain A, at a stock underpass approximately 190 m east of Treendale Road. The Treendale Branch Drain A joins the Main Drain to the west of Treendale Road at the upstream side of a culvert that conveys the flow from both drains under Raymond Road and into the Collie River to the south.

5.3.14 Minor Waterway and Balancing Culverts

In addition to the waterway crossings and Water Corporation drain crossings discussed in the previous sections, there are Harvey Water irrigation channels, Local Government roadside drains, farm drains and local depressions across the northern and central sections. Culverts or diversion drains have been proposed at all these locations to minimise the impacts of the project on the surface flow across the site as much as possible and to maintain connectivity for irrigation and farming activities.

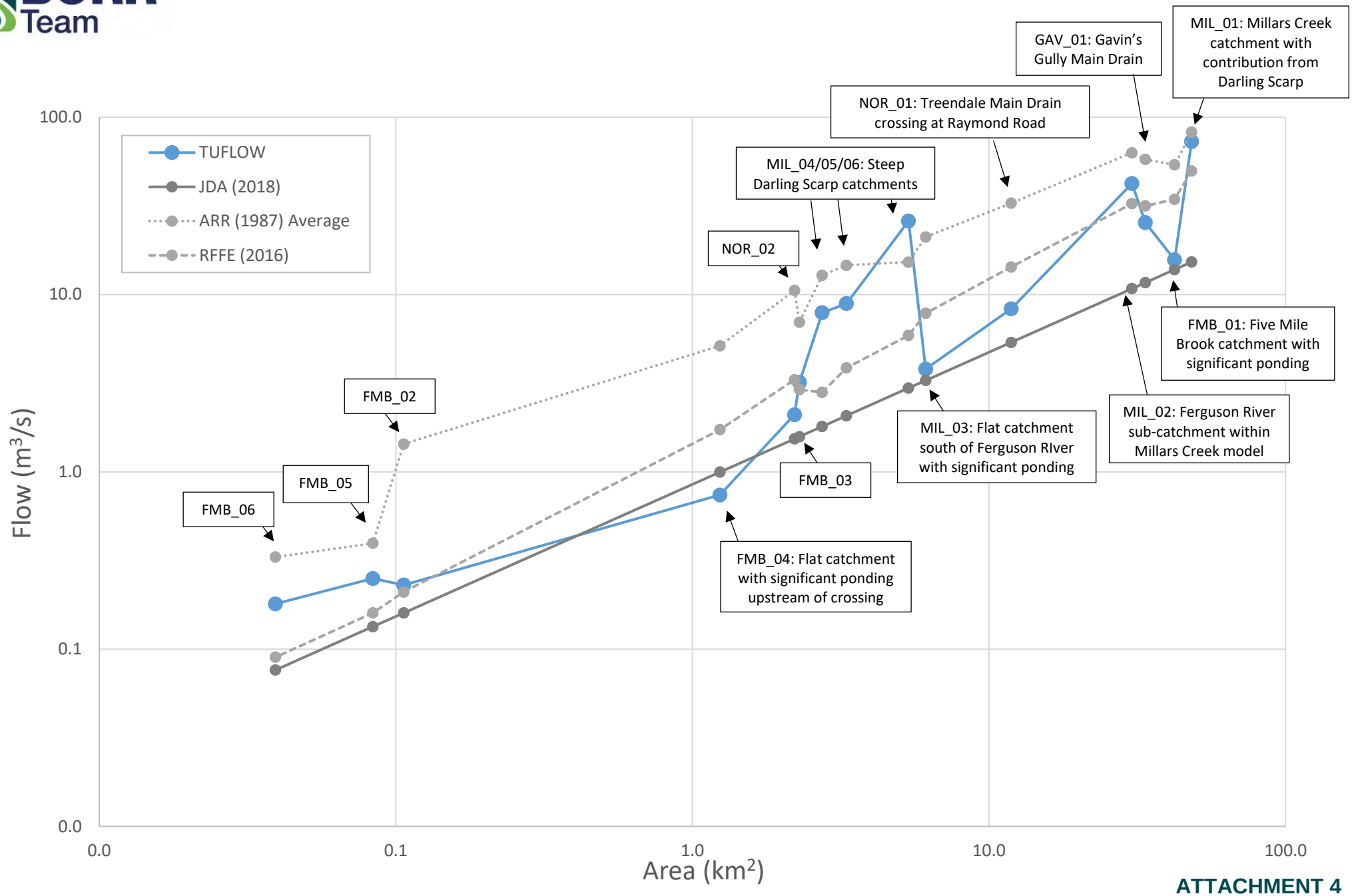
Culverts proposed under BORR between South Western Highway and the Railway also ensure hydrologic connectivity is maintained for the Resource Enhancement Category wetland and Threatened Ecological Community to the west of the alignment.

5.4 Limitations

Modelling and design has been carried out for the purpose of a planning study. The following limitations should be understood for detailed design.

- Minimum culvert diameter of 0.45 m has been assumed and shall be confirmed during detailed design.
- Culvert inverts have been estimated based on LiDAR data and should be confirmed using field survey.
- Existing channel sizes and capacities are difficult to ascertain using LiDAR data due to the presence of base flow or standing water. Field survey of the drainage channels would improve these estimates.
- The hydraulic models have adopted a 5 m grid resolution to achieve practical runtimes. Culvert sizing may be influenced by tailwater levels in the receiving drainage channels which are not well defined in the LiDAR or 2D models. Major channels (Victory Main Drain, Vindictive Branch Drain C) have been modelled as 1-dimensional elements to better define the channel section.
- High level checks were carried out for most culverts for compliance with minimum cover and freeboard criteria. Some crossings for some local/service roads and PSP may not meet freeboard/cover requirements.
- Culvert sizing for Water Corporation and Harvey Water channels has been based on existing channel section. Further consultation is required with Water Corporation and Harvey Water regarding suitability of culvert sizes.
- The hydraulic models have been developed to establish a concept design for the planning study. Refinements are likely to be required during future design stages.

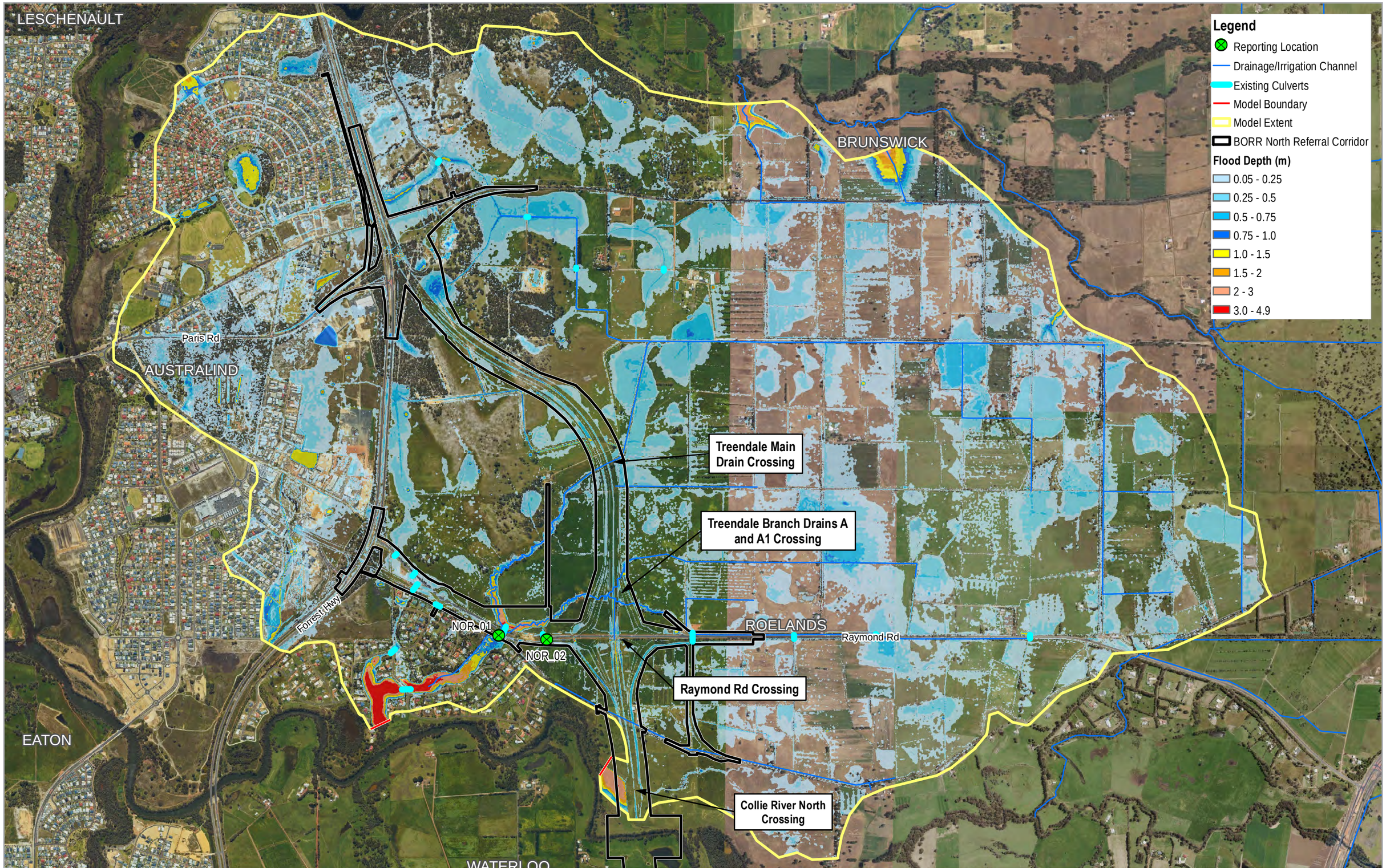
Transverse Drainage Hydrology Method Position Paper



ATTACHMENT 4

1% AEP FLOW VERSUS CATCHMENT AREA

1% AEP Flood Mapping



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Bunbury Outer Ring Road

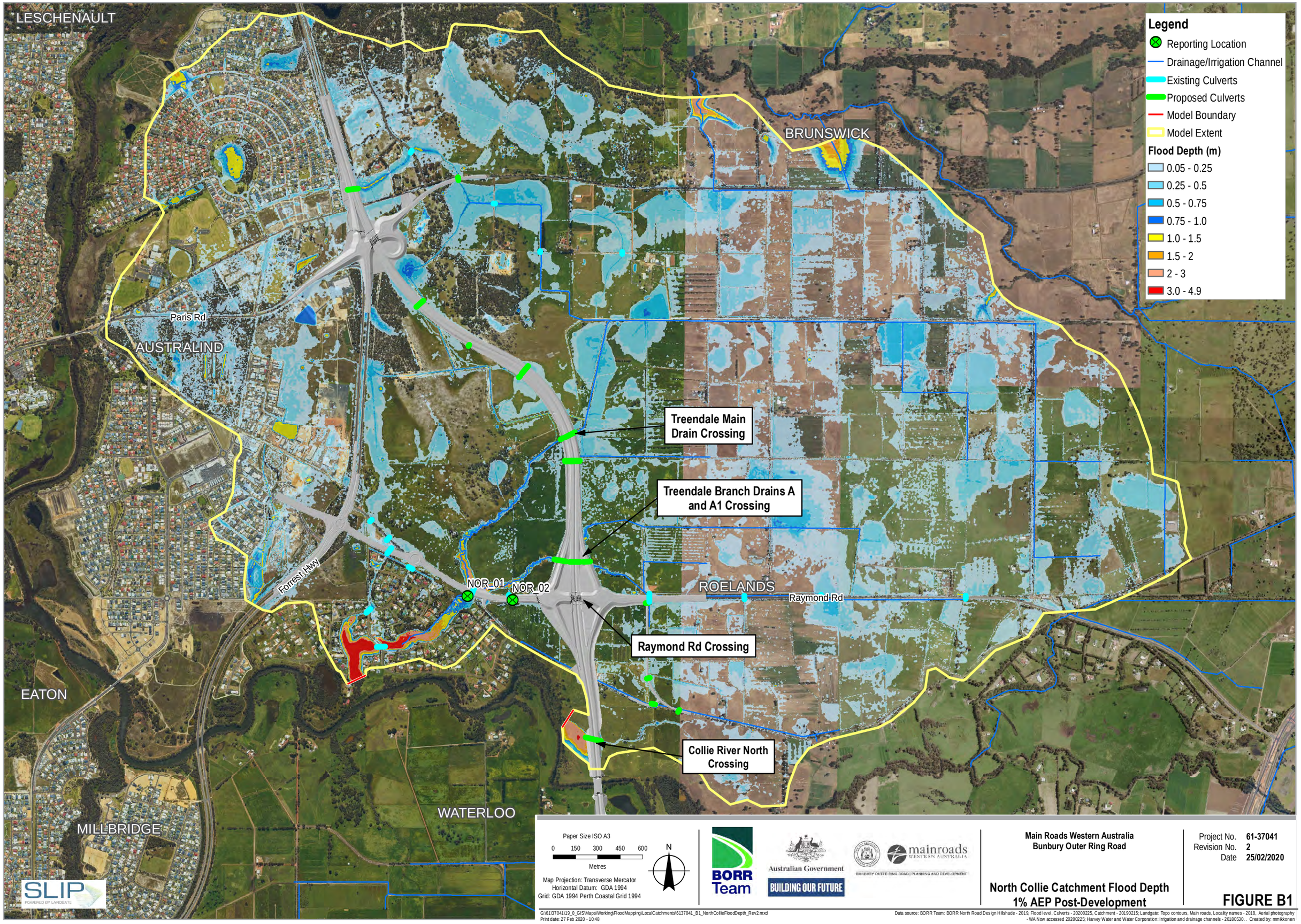
Project No. 61-37041
Revision No. 6
Date 25/02/2020

North Collie Catchment Flood Depth 1% AEP Pre-Development

FIGURE A1

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Print date: 27 Feb 2020 - 10:24

Data source: BORR Team: BORR North Referral Corridor - 20191016, Flood depth, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225, Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530. . Created by: mmikkonen



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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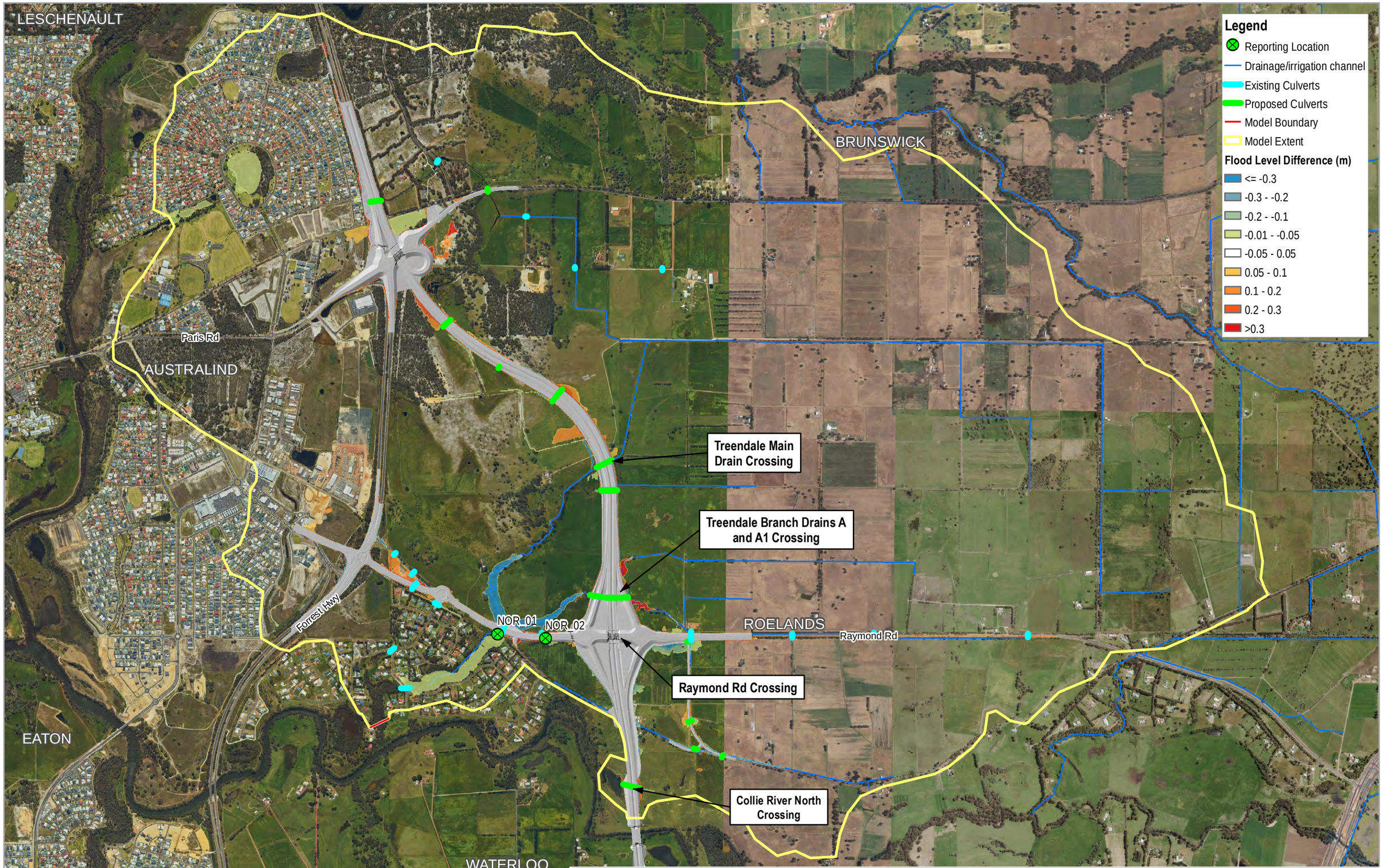
North Collie Catchment Flood Depth
1% AEP Post-Development

Project No. **61-37041**
Revision No. **2**
Date **25/02/2020**

FIGURE B1

G:\61\37041\19_0_GIS\Maps\Working\FloodMapping\LocalCatchments\6137041_B1_NorthCollieFloodDepth_Rev2.mxd
Print date: 27 Feb 2020 - 10:48

Data source: BORR Team: BORR North Road Design Hillshade - 2019, Flood level, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225, Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530.. Created by: mmikkonen



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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North Collie Catchment
1% AEP Flood Level Difference

Project No. **61-37041**
Revision No. **2**
Date **25/02/2020**

FIGURE C1

G:\61\37041\19_0_GIS\Maps\Working\FloodMapping\LocalCatchments\6137041_C1_NorthCollieFloodDepth_Rev2.mxd
Print date: 26 Feb 2020 - 16:35

Data source: BORR Team: BORR North Road Design Hillshade - 2019, Flood level difference, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225; Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530.. Created by: mmikkonen

Appendix F

Modelling assumptions report

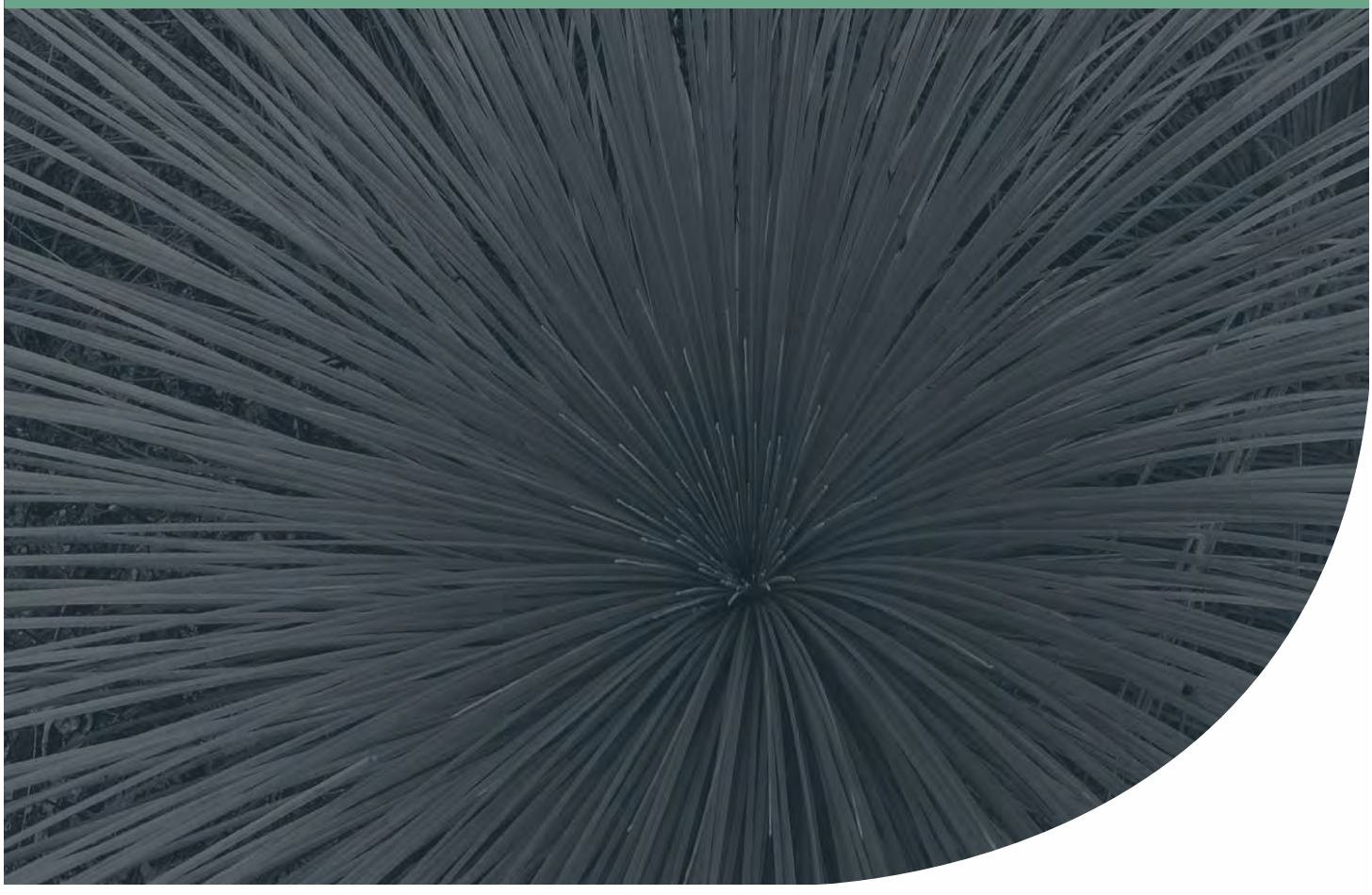
Prepared by Emerge Associates (2021)

Modelling Assumptions Report

Lots 151, 152 and 153 Raymond Road, Roelands

Project No: EP21-022(04)

Prepared for Treendale East Landowner Group
August 2025



Document Control

Doc name:	Modelling Assumptions Report Lots 151, 152 and 153 Raymond Road, Roelands				
Doc no.:	EP21-022(04)—010B				
Version	**Date**	**Author**		**Reviewer**	
1	January 2022	Johanna Boonzaaier	JB	Dave Coremans	DPC
	Prepared to support the WMS				
A	April 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updates to support the WMS				
B	August 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updates to support the WMS				

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Table of Contents

1 Purpose of this Report 4

2 Methodology. 5

2.1 Rainfall 5
2.2 Inflows 6

3 Pre-development 7

3.1 Pre-development model 7
3.2 Results 8

4 Post development 9

4.1 Post development model 9
4.2 Post development discharges 11

5 References 12

5.1 General references 12
5.2 Online references 12

List of Tables

Table 1: 1% AEP design flows (BORR) 6
Table 2: Pre-development parameters 7
Table 3: Pre-development catchment areas and slopes 7
Table 4: Pre-development discharges 8
Table 5: Post-development parameters 9
Table 6: Post-development catchment areas (ha) 9
Table 7: Post-development discharges 11

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
AR& R	Australian Rainfall and Runoff
BOM	Bureau of Meteorology
BORR	Bunbury Outer Ring Road
FMDADS	Forrestdale main drain arterial drainage strategy
MRWA	Main Roads Western Australia

Table A2: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
AHD	Australian height datum
ARI	Average recurrence interval
CL	Continuing loss
GIS	Geographical information systems
IFD	Intensity, frequency and duration
IL	Initial loss
WMS	Water Management Strategy

Table A3: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
km	Kilometre
m	Metre
m AHD	Metres in relation to the Australian height datum
m/day	Metres per day
m^2	Square metre
m^3	Cubic metre
m^3/s	Cubic metre per second
mm	Millimetre
mm/hr	Millimetres per hour
%	Percentage

Table A4: Terminology - design rainfall

Equivalent average recurrence interval (ARI) terminology	Average exceedance probability (AEP) terminology utilised
1 in 1 year ARI event	63.2% AEP event
1 in 1.5 year ARI event	50% AEP event
1 in 5 year ARI event	20% AEP event
1 in 10 year ARI event	10% AEP event
1 in 20 ARI event	5% AEP event
1 in 50 ARI event	2% AEP event
1 in 100 ARI event	1% AEP event
1 in 200 ARI event	1 in 200 AEP event
1 in 500 ARI event	1 in 500 AEP event

1 Purpose of this Report

This report provides a summary of the assumptions informing the hydrological modelling that was undertaken to inform the water management strategy (WMS) and drainage design for the proposed urban development (Treendale East Estate) located on Lots 151, 152 and 153, Roelands within the Shire of Harvey.

The site covers approximately 182 ha, and is bound by Forrest Highway to the west, Raymond Road to the south, and existing farmland towards the east and north. Main Roads Western Australia (MRWA) is proposing to construct the northern and central sections of the Bunbury outer ring road (BORR), which once complete will enclose the northern and eastern edges of the development.

2 Methodology.

XPSWMM hydrological and hydraulic modelling software was used to calculate the surface water runoff volumes. The hydrological component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrological model include:

- Runoff is proportional to slope, area, infiltration and percentage imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from surveyed topographical data and earthworks plans.
- Infiltration rates and percentage imperviousness have been selected based on experience with model preparation for similar soil conditions.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSWMM. Generally, assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow path onsite) between nodes within a sub-catchment are given a length of 10 m and slope of 0.05 to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in a 1% average exceedance probability (AEP) event). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- All channels are designed with a width of 5 m, roughness of 0.014 (Manning's n) and are trapezoidal in shape. This allows for easy conveyance and represents concrete pipes and road surfaces within the model.
- Where relevant, soakwells, verge swales, bio-retention areas (BRAs), and flood storage areas (FSAs) are modelled as nodal-reservoirs with infiltration depth-rating curves to account for differential infiltration rates with changing depth.

2.1 Rainfall

The ensemble temporal patterns obtained from the Australian Rainfall and Runoff (AR&R) Data Hub (AR&R 2019) were used for the rainfall analysis.

Up to eight durations ranging between 1 hour and 72 hours were tested, with the peak flow being assessed as the determining result.

Following the process suggested by AR&R (Ball J *et al.* 2019), the highest mean duration was selected as the critical duration. AR&R also recommends that when it is not practical to run the entire ensemble array, the ensemble that produces the result closest to the mean (for the critical duration) should be adopted. The 4.5 hour duration ensemble 3 and the 4.5 hour duration ensemble 5 was adopted for the 1% AEP and 20% AEP events respectively for the post-development scenario.

2.2 Inflows

1% AEP design flows at significant crossings were determined by the BORR team and supplied by MRWA (BORR Team 2020) . Design flows for the Treendale main drain and branch drain (**Table 1)** were used to create triangular hydrographs as inflow into the site at these locations. Inflow hydrographs were scaled for the 20% AEP event based on the difference in rainfall.

Table 1: 1% AEP design flows (BORR)

Location	Design flow (m^3/s)
Treendale main drain	4
Treendale branch drain	5.6

3 Pre-development

3.1 Pre-development model

Pre-development modelling was undertaken to determine the discharge from the site. An initial loss continuing loss model was adopted to account for catchment losses. Loss values, roughness and runoff coefficients were based on characteristics of the site and are shown in **Table 2**.

Table 2: Pre-development parameters

Land type	Initial loss (mm)	Continuing loss	Roughness
Sandy areas	25	5	0.05
Clay areas	15	2	0.03

The pre-development catchment areas and land use types were digitised using aerial photography and these are shown in **Table 3**.

Table 3: Pre-development catchment areas and slopes

Land type	Slope	Sandy (ha)	Clay (ha)	Slope (m/m)
Ct-01	0.044	4.230	0.000	0.044
Ct-02	0.03	5.431	0.000	0.030
Ct-03	0.026	25.845	0.000	0.026
Ct-04	0.03	11.451	0.000	0.030
Ct-05	0.029	9.616	0.000	0.029
Ct-06	0.191	1.603	0.000	0.191
Ct-07	0.021	2.862	0.000	0.021
Ct-08	0.009	13.801	0.000	0.009
Ct-09	0.019	13.166	0.000	0.019
Ct-10	0.031	5.019	0.000	0.031
Ct-11	0.044	2.997	0.000	0.044
Ct-12	0.038	11.130	0.000	0.038
Ct-13	0.021	12.974	0.000	0.021
Ct-14	0.043	6.012	0.000	0.043
Ct-15	0.012	5.246	0.000	0.012
Ct-16	0.012	3.550	0.000	0.012
Ct-17	0.009	14.381	0.000	0.009
Ct-18	0.008	2.566	0.000	0.008
Ct-19	0.009	3.771	0.000	0.009

Table 3: Pre-development catchment areas and slopes (continued)

Land type	Slope	Sandy (ha)	Clay (ha)	Slope (m/m)
Ct-20	0.016	0.000	11.953	0.033
Ct-21	0.019	0.000	6.778	0.028
Ct-22	0.027	0.000	10.214	0.027
Ct-23	0.027	0.000	4.690	0.057
Ct-24	0.04	0.000	3.940	0.061
Ct-25	0.03	0.000	7.389	0.040
Ct-26	0.013	0.000	14.419	0.018
Ct-27	0.028	0.000	1.670	0.044
Ct-28	0.023	0.000	5.235	0.038
Ct-29	0.022	8.316	0.000	0.022
Ct-30	0.053	0.000	4.161	0.053
Ct-31	0.054	0.000	3.066	0.054
Ct-32	0.038	2.754	0.000	0.038
Ct-33	0.1	1.483	0.000	0.100
Ct-34	0.095	0.000	0.765	0.095
Ct-35	0.032	0.000	5.136	0.044

3.2 Results

The pre-development discharges from the site for the 20% AEP and 1% AEP events are shown in **Table 4**.

Table 4: Pre-development discharges

Location	AEP event	Discharge (m^3/s)
Raymond Road	20% AEP	6.6
	1% AEP	11.9
Forrest Highway	20% AEP	0.3
	1% AEP	1.8

4 Post development

4.1 Post development model

An initial loss continuing loss model was adopted to account for post-development catchment losses. The post-development catchment area, land types and loss values were based on the structure plan design, typical infiltration rates for the soils which occur onsite and based on project team experience. **Table 5** summarises the loss parameters used within the post-development model, with other catchment parameters detailed in

Table 6.

Table 5: Post-development parameters

Land type	Initial loss (mm)	Continual loss (mm)	Roughness
Road Surface	1	0.1	0.02
Road Verge	9	1	0.05
Lot pervious	25	3.5	0.05
Lot impervious	15	0.1	0.02
POS	20	2.5	0.05
Eco village pervious	15	0.1	0.02
Eco village impervious	1	0.1	0.05

Table 6: Post-development catchment areas (ha)

Catchment	Road surface	Road verge	Lot impervious	Lot Pervious	POS / Riparian/ Pipeline easement
Ct-P01	0.000	0.000	0.000	0.000	6.974
Ct-P02	0.856	0.571	1.273	1.273	0.584
Ct-P02a	1.224	0.816	0.51	0.351	5.085
Ct-P03	0.953	0.635	1.871	1.871	0.701
Ct-P04	4.391	2.928	7.736	7.736	4.143
Ct-P04C	1.942	1294	2.483	2.483	1.351
Ct-P04S	2.267	1.512	2.474	2.474	3.547
Ct-P05	2.434	1.623	3.697	3.697	1.875
Ct-P06	5.702	3.382	8.391	8.391	4.348
Ct-P07	1.900	1.267	2.688	2.688	16.944
Ct-P08	1.718	1.145	2.627	2.627	0.595
Ct-P09	0.207	0.138	2.156	2.156	1.012
Ct-P10	0.000	0.000	3.464	0.866	0.000
Ct-P11	0.000	0.000	3.650	0.913	0.000
Ct-P12	0.000	0.000	8.229	2.057	0.000
Ct-P13	0.000	0.000	4.028	1.007	0.000

Ct-P14	0.000	0.000	3.282	0.820	0.000
Ct-P15	0.000	0.000	1.267	0.317	3.201

The catchment layout and runoff storage locations are shown on **Figure 8** of the WMS.

The following assumptions were incorporated into the post-development model:

- Lots
  - Pervious areas on lots will retain the first 15 mm of runoff.
  - Impervious areas (driveways/paved areas) discharge to the road network.
  - Residential lots will have little slope (i.e. will be flat) and pockets of storage are likely. This will effectively increase the initial loss (storage) and overall infiltration rate (continual loss).
  - Garden areas in lots will have high infiltration rates as it is likely that sand-based landscape mix or mulch will be used.
- Road reserve
  - There will be no infiltration on roads, pavements and driveways. There will however be some minor absorption storage loss which is accounted for in the initial and continuing loss values.
  - The road reserve contains 40% pervious verge and 60% impervious bitumen areas for all catchments.
- POS
  - POS are assumed to be 95% pervious 5% impervious.
  - POS will likely contain dense vegetation or turf over a sand-based landscape mix.
- Storage/treatment
  - Bio-retention areas (BRAs) have 1:3 side slopes and maximum depths of 0.5 m.
  - BRAs retain small event runoff (first 15 mm) from road reserves and some lots (e.g. any that are directly connected due to localised soil conditions).
  - In-line storage areas with the waterway corridors detain the 1% AEP event in order to match the pre-development discharge from site.
  - Depth and size of in-line storage areas area based on the site topography as provided by the project team.
  - Median swales have a depth of 0.5 m with 1:6 side slopes
- Infiltration
  - A hydraulic conductivity of 2 m/day, with a clogging factor of 50%, is assumed for the infiltration in BRAs.
  - No infiltration in the in-line storages.
- Evapotranspiration
  - Volumes leaving the system through evapotranspiration were assumed to be negligible when compared to the total runoff volume and since the duration of the model run was comparatively short. XPSWMM default evapotranspiration assumptions are therefore used.

4.2 Post development discharges

The post-development discharges from the site for the 20% AEP and 1% AEP events are shown in **Table 7**.

Table 7: Post-development discharges

Location	AEP event	Discharge (m^3/s)
Raymond Road	20% AEP	5.9
	1% AEP	11.85
Forrest Highway	20% AEP	0.2
	1% AEP	0.4

5 References

5.1 General references

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Editors) 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

BORR Team 2020, *Transverse Drainage Northern and Central Sections*.

5.2 Online references

Bureau of Meteorology (BoM) 2021a, *Climate Data Online,* viewed 16 September 2021, Available from, < http://www.bom.gov.au/climate/data/>.

Bureau of Meteorology (BoM) 2021b, *Design Rainfall Data System (2016),* viewed 16 September 2021, Available from, <http://www.bom.gov.au/water/designRainfalls/revised-ifd/>.

Appendix G

Groundwater bore logs and monitoring data

Prepared by Emerge Associates (2021)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2109688**	Page	: 1 of 7
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: DAVID COREMANS	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9380 4988	Telephone	: 08 9406 1307
Project	: EP21-022(03) Treendale GWQ and SWQ monitoring	Date Samples Received	: 23-Aug-2021 11:30
Order number	: EP20-141	Date Analysis Commenced	: 23-Aug-2021
C-O-C number	: ----	Issue Date	: 31-Aug-2021 12:19
Sampler	: Fabio Hernandez		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK061G/EK067G (TKN/TP): LOR for sample EP2109688-006 raised due to possible sample matrix interference.
- EK055G, EK057G, EK059G and EK071G for sample #1 to 12 were analyzed from UT field filtered/frozen nutrient bottles.
- EK055G, EK057G, EK059G and EK071G for sample #13 to 24 were analyzed from unpreserved natural bottle.
- It has been noticed that there were some results disparity between two bottle types of the same sample. RP results of sample #1, 2, 3 and 5, NOx results of sample #1, 2, 4, 7, 8, 11 and 12, and NH3 results of sample #5 and 11 have been confirmed by re-preparation and re-analysis. Please scrutinize results accordingly.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	SW01	SW02	SW03	MW1	MW2
				Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00
					EP2109688-001	EP2109688-002	EP2109688-003	EP2109688-004	EP2109688-005
					Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**112**	**220**	**8**	**12**	**40**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.08**	**0.07**	**0.05**	<0.01	**1.22**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.18**	**0.15**	**0.07**	**1.96**	**0.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.18**	**0.16**	**0.07**	**1.96**	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.5**	**4.6**	**2.3**	**0.8**	**5.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.7**	**4.8**	**2.4**	**2.8**	**5.2**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.77**	**1.14**	**0.38**	**0.01**	**1.77**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.13**	**0.11**	**0.08**	<0.01	**0.83**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	MW3	MW4	MW5	MW6	MW7
				Sampling date / time	19-Aug-2021 00:00	20-Aug-2021 00:00	20-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00
					EP2109688-006	EP2109688-007	EP2109688-008	EP2109688-009	EP2109688-010
					Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**475**	**33**	**96**	**44**	**7550**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.09**	**0.07**	**0.03**	<0.01	**0.03**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**0.34**	**2.84**	**0.06**	**0.04**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**0.34**	**2.84**	**0.06**	**0.04**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.1**	**0.5**	**1.2**	**1.4**	**2.8**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.1**	**0.8**	**4.0**	**1.5**	**2.8**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.02	**0.05**	**0.04**	**0.15**	**0.41**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW8	QA 01	SW01	SW02	SW03
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00
Compound	CAS Number	LOR	Unit	EP2109688-011	EP2109688-012	EP2109688-013	EP2109688-014	EP2109688-015
				Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	133	17	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.79	<0.01	0.07	0.08	0.06
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.01	0.02	0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.79	0.85	0.40	0.22	0.07
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.79	0.85	0.41	0.24	0.08
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.6	0.6	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	3.4	1.4	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.36	0.02	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.04	<0.01	0.25	0.21	0.12

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW1	MW2	MW3	MW4	MW5
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00	20-Aug-2021 00:00
Compound	CAS Number	LOR	Unit	EP2109688-016	EP2109688-017	EP2109688-018	EP2109688-019	EP2109688-020
				Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	**2.47**	**0.13**	**0.03**	**0.01**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**2.99**	<0.01	<0.01	**0.66**	**6.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**3.00**	<0.01	<0.01	**0.66**	**6.02**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**2.12**	<0.01	**0.01**	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW6	MW7	MW8	QA 01	----
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	----
Compound	CAS Number	LOR	Unit	EP2109688-021	EP2109688-022	EP2109688-023	EP2109688-024	--------
				Result	Result	Result	Result	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	**0.06**	**1.14**	<0.01	**----**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	**----**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.10**	**0.05**	**1.87**	**2.99**	**----**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	**0.05**	**1.87**	**3.00**	**----**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2112356**	Page	: 1 of 5
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: DAVID COREMANS	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9380 4988	Telephone	: 08 9406 1307
Project	: EP21-022 Treendale East monitoring	Date Samples Received	: 14-Oct-2021 14:00
Order number	: EP21-062	Date Analysis Commenced	: 15-Oct-2021
C-O-C number	: ----	Issue Date	: 22-Oct-2021 13:45
Sampler	: Brodie Mastrangelo		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 12		
No. of samples analysed	: 12		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that total phosphorus (EK067G) is less than reactive phosphorus (EK071G) for sample #2. However, the difference is within experimental variation of the methods.
- EK061G/EK067G: TKN and Total Phosphorus results for sample #1, 7 and 12 have been confirmed by re-extraction and re-analysis.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	MW1	MW2	MW3	MW4	MW5
				Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00
					EP2112356-001	EP2112356-002	EP2112356-003	EP2112356-004	EP2112356-005
					Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	**2.93**	**0.14**	<0.01	<0.01
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**2.57**	**0.01**	<0.01	**0.40**	**6.13**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**2.57**	**0.01**	<0.01	**0.40**	**6.13**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.1**	**5.3**	**1.2**	**0.4**	**0.9**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**5.7**	**5.3**	**1.2**	**0.8**	**7.0**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.24**	**1.74**	**0.08**	**0.03**	**0.08**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**1.84**	<0.01	**0.01**	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW6	MW7	MW8	SW1	SW2
			Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EP2112356-006	EP2112356-007	EP2112356-008	EP2112356-009	EP2112356-010
				Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	**0.07**	**0.69**	**0.02**	<0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.07**	**0.14**	**0.95**	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.07**	**0.14**	**0.98**	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**7.8**	**2.4**	**2.3**	**1.3**	**0.9**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**7.9**	**2.5**	**3.3**	**1.3**	**0.9**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**1.18**	**0.39**	**0.23**	**0.12**	**0.16**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	**0.09**	**0.02**	**0.03**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SW3	DUP1	----	----	----
			Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP2112356-011	EP2112356-012	--------	--------	--------
				Result	Result	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	**0.04**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.12**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.12**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.2**	**1.0**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**1.2**	**1.1**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.21**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	----	----	----

Appendix H

Education material

Planning your planting

Create 'watering zones' in your garden by grouping plants with similar watering needs. This will allow you to make more efficient use of your garden water by ensuring that no plants are over or under watered.

The Waterwise 'Drop Zone' system makes it easy to identify a plant's water requirements. This system divides plants into one of three groups depending on their watering needs. 'Three Drop' plants require the most watering (usually every second day in summer), whereas 'Two Drop' and 'One Drop' plants require less watering respectively.

It's also important to reticulate only once on your allocated days, either before 9am or after 6pm. Look for the Waterwise 'Drop Zone' system at your local Waterwise garden centre. To find the centre closest to you, visit www.watercorporation.com.au or call the Waterwise Helpline on 13 10 39.

Remember, a small amount of planning now can save plenty of water in the future.

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

DOW310858



Government of **Western Australia**
Department of **Water**

Planting a local native garden

Looking after all our water needs









In an era of rising temperatures and decreasing rainfall it is important to look at how we use water in our gardens.

Did you know?

About half of the water typically used in our homes is actually used to water the garden (and of that almost all is used to water lawns).

Many of us water lawns that we simply don't use, or water more than we need to. Similarly, often the plant species in our gardens are exotic and not entirely suitable to our climate – needing more water to survive.

Why go native?

- Local native plants are best suited to the local climate, conditions and soil. Therefore they require minimal inputs such as water, fertiliser and maintenance.
- They attract local wildlife, insects and birds and provide corridors of biodiversity in developed areas.
- They have minimal impact on the environment – unlike many introduced species, which have become bushland weeds and prove difficult and expensive to eradicate.
- They represent local heritage, teaching us about nature and our local identity.

Mulch. Mulch. Mulch.

If everyone fully utilised mulch in the garden, a much lower percentage of household water usage would end up on the garden.

The even better news is that mulching is very easy! Raw materials like woodchips and tree clippings are best, but any organic mulch will suffice. Simply spread at least 50mm of mulch over the whole planting area, leaving a small amount of breathing space at the base of the stem. This mulch won't need to be topped up again until autumn. Be sure not to turn or disturb the mulch as this will break the fine feeder roots that develop between the mulch and the soil.

In addition to mulch, a wetting agent can help overcome water repellence in soils, allowing water to penetrate the soil more quickly and in larger amounts. You can find wetting agents at your local nursery or garden centre.

Want to know more?

The Department of Water is committed to making sure that the water needs of Western Australia are met now, and in the future. Small steps we each take can make a big difference to the sustainability of our precious water supply. If you would like to know more, visit the Department of Water website – www.water.wa.gov.au.

Key tips for reducing groundwater use

- Design gardens and landscaping to enhance absorption of rain into the ground and to minimise evaporation – by using local native garden beds, mulch and subsurface irrigation etc.
- Keep planted areas dense and group plants with similar water needs together and make use of windbreaks.
- Prepare the soil before planting to ensure that plants can make the most of the water they need.
- Re-use water from the home in the garden – this includes bucketing greywater from the laundry and bathroom as well as water from downpipes connected to your house gutters. You can also install a subsurface greywater reuse system. For further information, contact your local council or visit www.water.wa.gov.au

Key tips for protecting our groundwater

- **Reduce your reliance on bore water.** Our rainfall has reduced, which means less water to recharge our aquifers. Continued housing development in some areas can increase the number of new garden bores and the use of groundwater.

  The Department of Water has drawn up a map of Perth's groundwater area with boundaries showing which areas are better suited for bores.

- **Design gardens and landscaping to enhance maximum absorption of rainfall into the groundwater and minimise evaporation.** Use local native plants, mulch and subsurface irrigation.

- **Reduce your use of fertilisers and chemicals.** These can contaminate groundwater, particularly products high in phosphate.

- **Reduce water use through a variety of water saving mechanisms in the home and garden.**

- **Re-use water from the home in the garden – this includes bucketing greywater from the laundry and bathroom as well as water from downpipes connected to your house gutters. You can also install a subsurface greywater reuse system. For further information, contact your local council or visit www.water.wa.gov.au**

For your watering days and other information on water saving in homes and gardens visit www.watercorporation.com.au or call 1800 508 55

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

DOW310858



Government of **Western Australia**
Department of **Water**

Looking after all our water needs

Extracting groundwater





Water quality

The quality of groundwater can be affected in many ways.

- The use of lawn and garden fertilisers heavy in phosphate is a major issue in Perth. Phosphates easily soak through the sand plain into the aquifer, rivers, ocean, creeks and swamps. This results in aquatic life dying and the growth of dangerous algae in freshwater lakes and rivers.
- Oils, paint thinners, various workshop chemicals – if poured into the sandy soil – will soak through to the aquifer and create long-term pollution issues.
- Heavy metal particles are dangerous to our health, as are hydrocarbons. These come from vehicle fuel systems, brake linings and exhaust systems. When vehicles are parked on private driveways and carports, such material will wash into your private soak wells and eventually into the aquifer. Remember to clean out your soak wells annually, to remove any leaf and pollutant build-up. This will also aid in the efficiency of your soak wells and reduce internal flooding problems.

Groundwater – the situation

Over two-thirds of Perth's water supply comes from groundwater. The Perth region has an underground geology which includes large areas of deep sand and limestone. Rain falling over this area and running off the hills builds up underground as a shallow semi-freshwater aquifer, which is available for household bores in some areas.

The freshwater aquifer is renewed each year with rainfall. With rainfall continuing to decline in Perth, and more homes being equipped with bores, the draw on the aquifer is increasing, thus creating a threat to ongoing bore water supply.

Groundwater recharge

Traditionally, stormwater run-off from roofs and roads and other surfaces has been collected in drainage pipes and exported into the ocean or waterways.

This 'lost' water can be a valuable resource to recharge a shallow groundwater aquifer. Sandy soils are extremely permeable and well suited to infiltration of stormwater to increase groundwater levels.

Recharging the groundwater aquifer with stormwater helps manage the local water cycle balance and prevents problems associated with increased bore water extraction, acid sulphate soils, salinity and waterlogging.

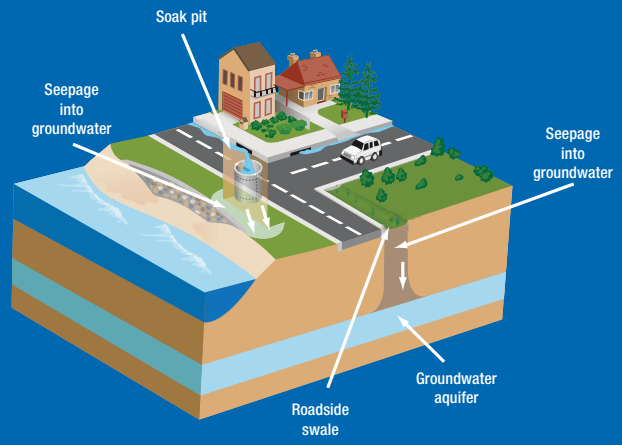


Managing local stormwater

'Stormwater' is a term used to describe the water which runs off surfaces such as houses and driveways and flows down into drains and stormwater pipes.

Poor stormwater management can damage not only individual properties but the environment in general. Local councils invest significant amounts of money into operating and maintaining the stormwater network.

Maximising infiltration of stormwater into groundwater can be achieved by replacing traditional drainage pipes with infiltration devices such as soakage pits and bioretention swales, as illustrated below.



Government of Western Australia
Department of Water

Looking after all our water needs

Water sensitive urban design

Rainwater storage and reuse systems

Summary

Rainwater storage systems are a simple method of capturing rainwater, traditionally from roofs, for use as an alternative water supply source and to reduce consumption of scheme water. When installed and maintained in accordance with recommended guidelines, they can provide a high quality source of water.

This brochure is part of a series that explain various aspects of water sensitive urban design. Please see *Water sensitive urban design in Western Australia* for background information on water sensitive urban design.

Main benefits

- Rainwater storage systems reduce the demand on potable water supplies.
- More rainwater is harvested when the tank is plumbed inside the house for uses such as toilet flushing. This creates a consistent drawdown on the tank supply, so there is always space to collect rainwater.
- They reduce the amount of directly connected impervious areas.
- They reduce stormwater peak flow rates and volumes.
- They reduce water supply peak flow rates and volumes.
- They can be retrofitted in houses and other buildings, including in high density urban areas.
- They can provide a water supply for (water sensitive) urban gardens and reduce the heat island effect in high density urban landscapes.

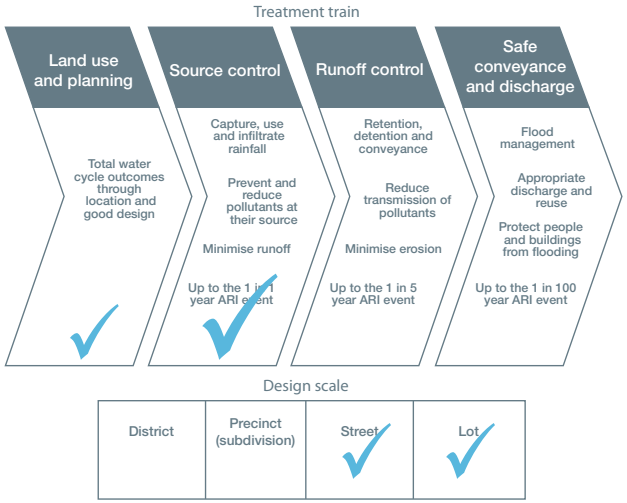
Design factors

- Put 'first flush' devices and mesh screens over all inlets and outlets to minimise maintenance requirements and preserve water quality.
- Designs for stormwater management include an air gap with trickle feed discharge level control and may include an infiltration trench or soakwell, depending on site characteristics.
- Storage can be above or below ground.
- Match storage size to collection area, end use, rainfall quantity and seasonal variability.
- Larger storage sizes are required where rainfall is unreliable and alternative supplies are not available.

Target pollutants

Rainwater storage systems are not designed to achieve direct improvements in stormwater quality.

Where they can be used in the water sensitive urban design process





Concrete underground tank



Slimline domestic rainwater tank

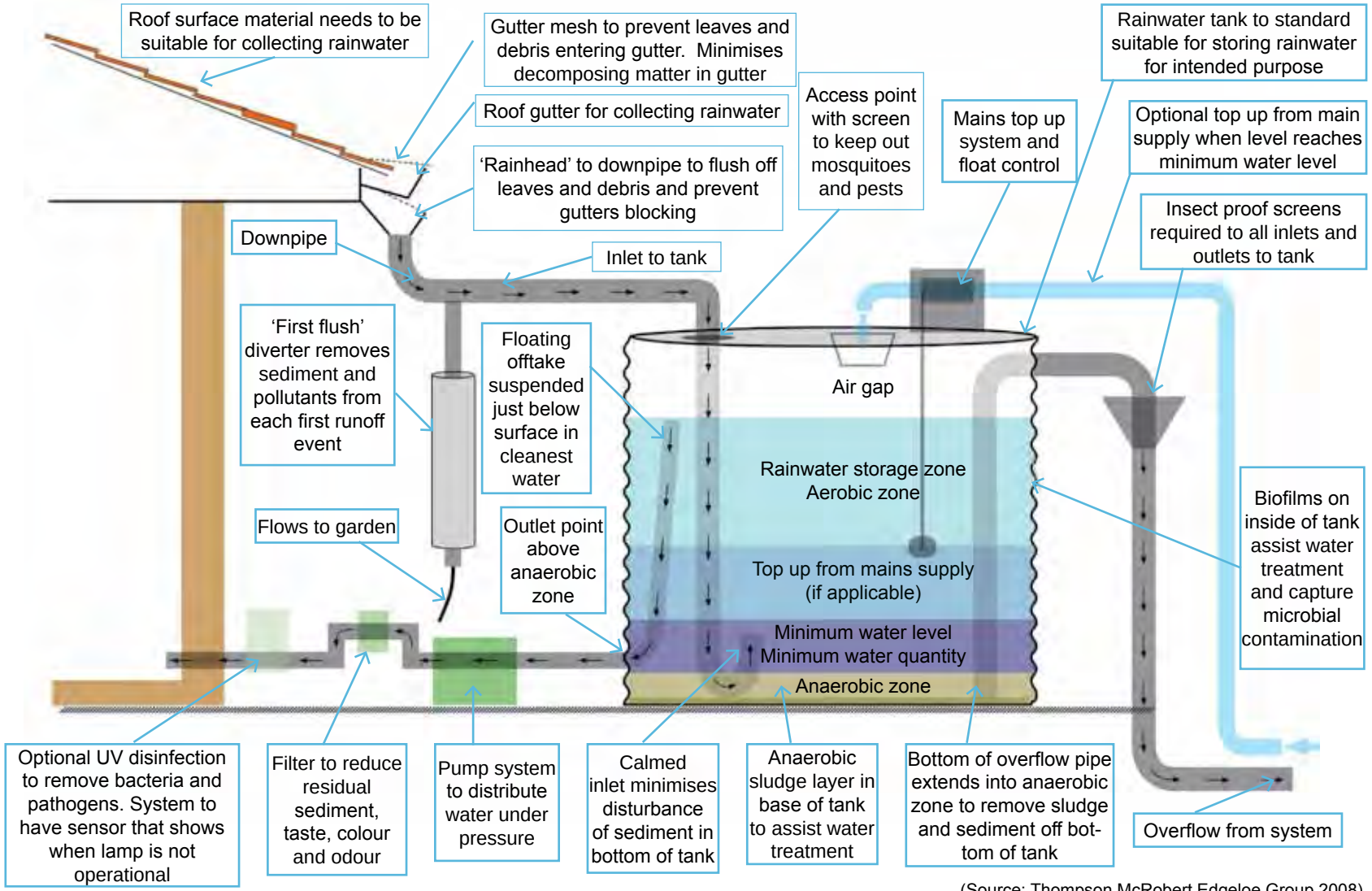


Poly domestic rainwater tanks

Water sensitive urban design

Rainwater storage and reuse systems

Example of above ground rainwater tank



(Source: Thompson McRobert Edgeloe Group 2008)

Required reading

Australian runoff quality: a guide to water sensitive urban design, 2006, Engineers Australia, available at <www.arq.org.au>.

Rainwater tank design and installation handbook, 2008, HB230-2008, Standards Australia.

Stormwater management manual for Western Australia, 2004–07, Department of Water, available at <www.water.wa.gov.au>. See Section 2.1 of Chapter 9 – Structural controls.

Testing of products for use in contact with drinking water, 2005, AS/NZS 4020:2005, Standards Australia.

Urban rainwater collection guidelines, Department of Health, Western Australia.

The department acknowledges the past project contributions of the Leschenault Catchment Council.

Department of **Water**
168 St Georges Terrace
Perth Western Australia
PO Box K822 Perth
Western Australia 6842
Ph: 08 6364 7600 • Fax: 08 6364 7601
www.water.wa.gov.au

June 2011
21592_100_06/11

Government of **Western Australia**
Department of **Water**

Saving water in the garden.

Did you know?

Pot plants use a lot more water than plants in the ground. They're more exposed to the sun and wind, only store a small amount of water and dry out faster, so you water them more.







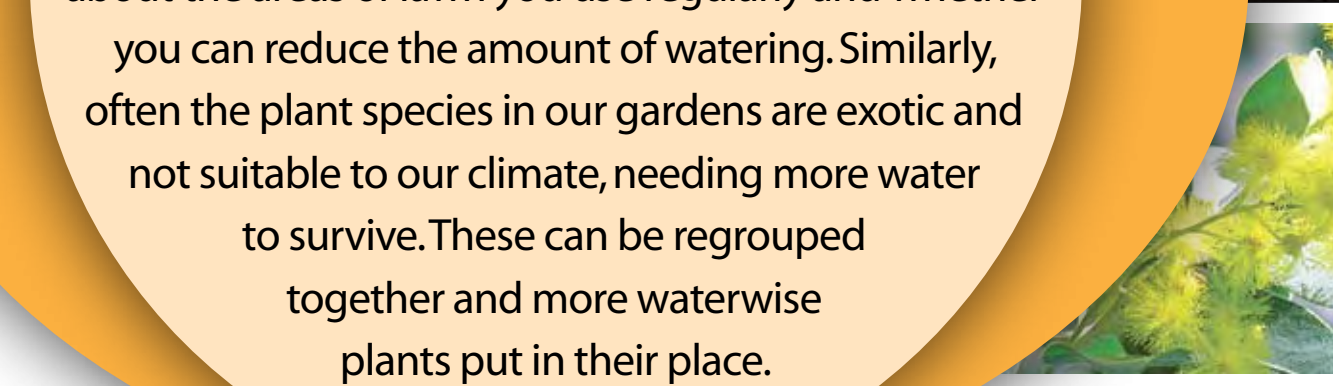
- Reduce your lawn cover. Most of the water used in our homes goes on the lawn.
- Plant local natives. They require less water and fertiliser.
- Mulch. Organic mulches reduce evaporation and restrict weed growth.
- Collect rainwater. This will save scheme water.
- Water deeply. Watering slower, for longer, less often encourages deep root growth.
- Use greywater. Re-use your laundry and bathroom water on your garden.
- Install a drip irrigation system. This will deliver water straight to the root system.
- Landscape. Group plants to suit watering needs. Keep high water use plants together.
- Use a pool cover. It will reduce evaporation by up to 97%, saving water and money.
- Maintain. Check taps and reticulation regularly for leaks and blockages.

Government of **Western Australia**
Department of **Water**

Grow local native plants and save water.

Did you know?

About half the water typically used in our homes is used to water the garden, generally lawns. Many of us water a large lawn and only use part of that lawn. Some of us overwater even those parts of the lawn we do use regularly. Think about the areas of lawn you use regularly and whether you can reduce the amount of watering. Similarly, often the plant species in our gardens are exotic and not suitable to our climate, needing more water to survive. These can be regrouped together and more waterwise plants put in their place.







- Local native plants are best suited to the local climate, conditions and soil.
- They require less water, fertiliser and maintenance.
- They attract local wildlife, insects and birds.
- They have minimal impact on the environment, unlike some introduced species which have become bushland weeds.
- Local plants represent local heritage, teaching us about nature and our local identity.

Government of **Western Australia**
Department of **Water**

Protect and maintain our local water supplies.
FertiliseWISE.



Did you know?

Fertilisers are a major contributor to surface and groundwater contamination. They run off into the stormwater system through roadside drains, collect in sumps and leach into the groundwater system. They also wash into the rivers and sea, creeks and swamps where they can do major damage to reefs and aquatic life.







WHAT YOU CAN DO TO HELP

• Minimise lawn areas and use plants that don't use fertiliser • Grow local native plants – they require less water and fertiliser • Where possible, use organic fertilisers • If you must use a chemical fertiliser, look for one that is phosphorus free. Use a nitrogen to phosphorus to potassium (N:P:K) ratio of 10:0:6. • Use a slow release fertiliser • Only apply in spring or early autumn, not in winter or summer • Fertilise only when symptoms of deficiency occur (e.g. yellowing) • Use liquid fertiliser if you have a subsurface irrigation system • Compost your garden waste • Don't fertilise near waterways or road verges • Don't let grass clippings or leaves go down the drain • Wash your car on the lawn (if you have any) not on the driveway • Pick up after your dog • Use phosphorus-free detergents (always read the labels)

Looking after all our water needs

Top 5 tips for saving water in the kitchen

Did you know the kitchen is a major consumer of water in the home using around 10 per cent of total household water for consumption for cooking, cleaning, washing or drinking?

If you follow these simple tips you can reduce your use dramatically.

- If you have a leaking tap, replace the washer or other components as required. Dripping taps can waste 30 – 200 litres of water per day.
- Look for dishwashers that have a National Water Conservation or WELS Label. The best water rating achieved by dishwashers is 5 stars.
- To avoid wasting warm water from a running tap when you first turn it on, collect it in a bottle or a jug and store it in the fridge until it is cool enough to drink.
- Only use dishwashers when you have full load.
- When boiling vegetables, use enough water to cover them and keep the lid on the saucepan. Your vegetables will boil quicker and it will save you water and power.

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

Copies of this document are also available in alternative formats on request for those with special needs. The Department of Water is committed to quality service to its customers and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document. However, changes in circumstances after time of publication may impact the quality of this information.

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Government of **Western Australia**
Department of **Water**

WATER SAVING TIPS

Saving water in the home

Looking after all our water needs









In southern Western Australia, water resources are under pressure due to reduced rainfall, increased population and other factors.

With the current pressure on Western Australia's water resources, it's time for us all to do our bit to protect and maintain them.

Did you know?

In the typical house, the use of showers, clothes washing machines and toilets can consume more than three quarters of all indoor water use. In the majority of homes, all of this quality drinking water is used once then goes to the sewer. There are now simple, low cost ways of reducing this water use whilst saving on your water costs.



Water use in the home and garden

Consider the following to reduce water use:

- Don't use drinking quality water to water your garden. Use bore water and/or water recycled from showers and clothes washing machines (grey water).
- Use covers on swimming pools and spas, to reduce evaporation. Evaporation can remove more water from a pool per year than toilet use in a home.
- A home can be cooled in summer using good orientation, window shading, natural ventilation and fans. This could remove the need for an air conditioner, particularly evaporative, where large amounts of water are used.
- All new houses must adhere to the criteria of 5 Star Plus for water efficiency, but the guidelines can also be used when renovating to help create a more waterwise home.
- Install flow control aerators on taps. They are inexpensive and can reduce water flow by 50 per cent.

Find out more

For information on greywater use and systems visit the Department of Health website at www.health.wa.gov.au
For waterwise tips see the Water Corporation website at www.watercorporation.com.au and follow the "Being Waterwise" links.
To find out more visit www.water.wa.gov.au

What you can do to help?

- **Buy and install water smart fittings and appliances in the kitchen, bathroom and laundry.** Low flow showers and taps, systems that store colder water while the hot tap is reaching the desired temperature, toilets with lower flush volumes, waterless toilets, front loading washing machines etc are all modern ways of saving on water use and cost.
- **Consider installing rainwater tanks.** The stored water can be used in a number of ways, even in Perth where there are less summer rain events. Such water can be plumbed into toilets and reduce the use of high-quality treated scheme water for flushing.
- **Install a waterwise garden and/or irrigation system.** The garden and irrigation system can be designed to minimize water use.

Use products and services with the Smart Approved WaterMark label. This is a water saving program for outdoor water use and ensures any product bearing the label will save water.

Visit www.smartwatermark.org for more information

Appendix I

Harvey Water – water supply confirmation

Additional content can go here

The subtitle will appear in the table of contents provided the ‘Emerge-H2 Appendix Subtitle White style is used.

Travis Taylor | Director

Level 1, 149 Victoria St

Bunbury WA 6230

Harvey, 2nd September 2025

Dear Travis,

Harvey Water, Taycot and Emerge Associates have been working together to refine the non-potable water demand for open spaces within the structure planning area and the manner in which this demand can be met. This includes the long-term planning across the entire site, including the school area. The water demand analysis indicates that a maximum of 215,250kL will be required to meet non-potable irrigation demand. Harvey Water confirms that we have the capacity to supply this amount to the site, and our resilience to deliver this is bolstered by, not only significant existing surface water supplies, but also by a Leederville licence held by Harvey Water in the region.

Harvey Water re-affirms that we have the intent to supply fit for purpose non-potable water to the Treendale East site to meet the above non-potable demand. This can be achieved using the existing water delivery locations to the site, and it would be on terms consistent with water already being delivered to the Shire in other areas via Community Stand Pipe connections. Water quality has also been considered, and will be addressed by the use of a reverse osmosis plant which is in an advanced planning stage being implemented upstream of the site. This will deliver high quality water that meets requirements for long term irrigation, i.e. it will be fit for purpose non-potable water.

The above confirmation is provided with the intent of addressing the queries raised by both the Shire and Department of Water and Environmental Regulation (DWER) during assessment of the Local Water Management Strategy which supports the Structure Plan. We trust that the above satisfies both the Shire and DWER queries, and we look forward to continuing to work with the Shire in the future and to deliver high quality open spaces within Treendale East.

Yours Sincerely

Bruce Hathway

Chief Executive Officer

Eckersley House

1 Turnbull Street, Harvey

PO BOX 456, Harvey WA 6220

T: (08) 9729 0100

E: admin@harveywater.com.au

www.harveywater.com.au

August 2025

TREENDALE EAST for Taycot Development

Local Structure Plan - Landscape and Irrigation Strategy



REV D - 14/08/2025

emerge ASSOCIATES
Integrated Science & Design

1. CONTENTS

1. CONTENTS 3

2. LANDSCAPE PRINCIPLES 4

3. PUBLIC OPEN SPACE TYPOLOGIES 5

3.1. Linear Open Space Networks / RIPARIAN CorridorS 6
3.2. Neighbourhood Parks 7
3.3. Playing Fields 7
3.4. Civic POS 7
3.5. Conservation 7
3.6. Buffer 7

4. LANDSCAPE MASTERPLAN 8

5. DETAIL PLAN - POS 7 9

6. DRAINAGE MASTERPLAN 10

7. STREETSCAPES 12

8. STREET HIERARCHY PLAN 13

8.1. STREET HIERACHY SECTIONS 14
8.2. Proposed Planting in the Public Realm 18
8.3. Retained Vegetation 19
8.4. Entry Treatments 19
8.5. Drainage/Stormwater 20
8.6. Drainage Treatment Adjacent to POS 20
8.7. Irrigation Strategy 20
8.8. Site Furniture 21
8.9. playgrounds 22
8.10. Public Art 22
8.11. Maintenance Minimisation 22

9. POS STRATEGY - GREEN STREETS 23

10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS 24

10.1. CONCEPT SECTIONS 25

11. POS STRATEGY - NEIGHBORHOOD PARKS 28

12. POS STRATEGY - PLAYING FIELDS 29

13. POS STRATEGY - CIVIC POS 30

14. POS STRATEGY - CONSERVATION POS 31

15. POS STRATEGY - BUFFER POS 32

16. PROPOSED PLANT PALETTE 33

15.1 Drainage corridor Vegetation 33

1. CONTENTS

16. IMPLEMENTATION 34

16.1. Approvals 34
16.2. Practical Completion 34
16.3. Landscape Maintenance Responsibility 34
16.4. Scheduled Handover 34

2. LANDSCAPE PRINCIPLES

The development of this site in the south west of Western Australia provides the opportunity for the rural character & natural landscape features of the existing locale to be interpreted and sensibly enhanced within practical limits throughout the project area.

Hence the key Landscape Principles to be explored during the design phase shall be:

- The village environment and the elements that define the site as a place, is an avenue that is to be explored and referenced in the design of the landscape.
- Respecting the ecological corridors/buffers and incorporating these into a linear Public Open Space (POS) network and, adopting a programme of revegetation and rehabilitation.
- Understanding that the linear POS network provides the opportunity to establish a highly legible and pedestrian/bicycle friendly framework within the estate.
- Retention of existing stands of scattered and isolated *Eucalyptus* & *Melaleuca* tree species, via incorporation into POS or through the creation of wider road reserves.
- Appreciation that a balanced approach is required to ensure the social and recreational requirements of the future residents are balanced with the ecological and engineering constraints imposed by the site.
- Provide a variety of outdoor public space for recreational and social opportunities appropriate to the size of the proposed community.
- Provide a legible network of walking and bicycle paths linking the town centre and areas of public open space, schools and other community infrastructure.
- Mitigate post development drainage flows through incorporation of waterway treatment drains within the open space network and widened road reserves. Ensure riparian corridors are sensitively designed to allow for multiple public uses.

The project will be developed around offering a range of open space opportunities. The public open space within the site has been planned to provide a network of parkland and corridors which integrate with the conservation & buffer areas, and aims to contribute to the ecological and social fabric of the community. Being strategically located, they will provide accessibility and connectivity through the development whilst also playing an important role in protecting the sites natural assets which are unique to the area.

The areas of POS have been separated into broad categories based on their specific treatments and design:

- Green Streets
- Linear Open Space/ Riparian Corridors
- Neighbourhood Open Space
- Playing Fields
- Civic POS
- Conservation Areas
- Buffer Areas

3. PUBLIC OPEN SPACE TYPOLOGIES

The Public Open Space (POS) Network consists of the following and, are defined where appropriate under Liveable Neighbourhoods:

- **Green Streets:**
  Streets lined with trees that provide canopy and shade on main thoroughfares.

- **Linear POS Networks / Riparian Corridors:**
  Open spaces which provide a connection between smaller recreational nodes (neighbourhood POS). Provides legibility and sense of place for local residents. Also enables retention of existing trees and allows for drainage conveyance through the site.

- **Neighbourhood POS:**
  Located throughout the development (1,800 - 19,800m2) and provides local residents with areas of turf and planting for informal kick-about play and passive uses. Also provides seating areas under shelter/ shade and are typically within 400m of most dwellings. Are able to service approx. 600 dwellings within the surrounding area.

- **Playing Fields:**
  Approximately 48,900m2adjacent the proposed primary school to service both the school and the wider community. Provides local residents and community with an open area capable for servicing local sports, events and gatherings. Caters for the combination of passive (including informal play areas) and active recreation and are generally within 1km of most dwellings.

- **Civic POS:**
  Provision for a main street and town/village square within the development. Predominantly hard paved and located at the conjunction of major thoroughfares and town/village centre in order to provide a landmark for community gatherings and events.

- **Conservation Areas:**
  The proposed development area includes conservation zone designed to enhance/protect the natural assets of the site to the benefit of the environment and greater community. These areas will provide opportunities for passive recreation (walking trails), education and conservation.

- **Buffer Areas:**
  Linear public open space adjacent Forrest Highway, Raymond Road and Bunbury Outer Ring Road. These areas will provide opportunities for passive recreation (walking trails) and serve a critical role to provide a visual & noise buffer, as well as drainage conveyance and detention.





3.1. **LINEAR OPEN SPACE NETWORKS / RIPARIAN CORRIDORS**

In order to address the requirements of retaining site topography and the principle of protecting existing trees and ecological linkages, the structure plan includes a series of linear open spaces. The design intent of these spaces is to enhance existing vegetation as well as incorporate existing stands of isolated trees and drainage alignments. Through respecting the existing topography in these areas, the linear POS will provide a necessary drainage function as well as provide visual amenity to the public realm. Some of these linear POS align with existing drainage corridors. These are to be integrated & enhanced to provide important ecological function.

As surrounding lots and roads require imported fill to ensure suitable structural conditions for housing, these linear parks will sit at a lower grade. This will ensure that drainage will flow towards these areas and discrete into bio-retention and online flood detention areas, that will be incorporated along the length of the linear parks. These areas assist in the collection, detention, treatment and reconveyance of water during major storm events. This is achieved with existing and/or a proposed system of inlet and overflow structures that ensure designated parkland areas are kept dry and usable.

Waterways may be included through linear parks with an interface to a dual use path (DUP). There will be native shrub planting on the banks and native reed/sedge planting to enhance nutrient uptake. With planting to consist of endemic species with a variety of tree, shrub, groundcover, reed and sedge species. Bank stabilisation will be incorporated into the design and a variety of tree species will be used to provide a diverse tree canopy. Treatment along the length of the waterway will be dependent upon the width of the corridor and the engineering constraints.

The waterways will provide not only a viable drainage function but also a variety of ecological zones and restoration opportunities. The waterways will undertake important ecological functions that include but are not limited to; filtration of stormwater pollutants, restoration of the aquatic ecosystem, control of water flow rates, and the planting of sedges and shrubs to stabilise riverbanks and prevent erosion.

Linear parks and widened road reserves not only serve an environmental and drainage function but, also provide an efficient means of supporting a legible pedestrian and bicycle network. This network will be designed to encourage passive surveillance from overlooking residents in accordance with Liveable Neighbourhood guidelines and best practice in terms of 'Designing out Crime'.









3.2. **NEIGHBOURHOOD PARKS**

Neighbourhood Parks are to be larger POS areas catering as a destination along the linear POS network or larger individual parcels within the developed area. The landscape treatment of these spaces will be generally informal in nature and characterised by revegetation and native parkland plantings which encourage passive recreation uses. Localised areas of turf that cater for informal active recreation may also feature. Typically this park will consist of retained remnant trees with a centrally built feature playground. Path systems will link to the adjoining residential streets and to the linear POS network to provide access as necessary.

Drainage areas may be required in these open spaces, and where provided, will be landscaped basins serving a recreational and amenity function. Drainage swales catering for events greater than a 1 in 5 year rainfall event within Neighbourhood POS areas, will have turf to enable a multiple use space and ease of maintenance.

The extent of hardscape and the urbanity of the space will increase in proximity to the town centre.

3.3. **PLAYING FIELDS**

Covering an area of 48,900m2, Playing Fields serve a critical role in providing vegetation and large open turfed spaces capable of servicing a diverse range of passive and recreational activities. These large open spaces serve as a landmark or destination for residents and community groups as they provide amenities such as large kick about areas, shelters, BBQ, nature play and exercise nodes. The landscape treatment of these spaces will be more formalised in nature with the provision of distinct active/passive zones amongst activities and age groups. Planting will typically be used to provide shade for resting and play areas. In addition, perimeter planting will be implemented to allow for a visual buffer between road/path networks.

The site's playing field is located adjacent to the future zoned primary school, the proposed playing field represents an opportunity to co-locate amenities capable of servicing the local school, residents and the greater community. Due to its potential in servicing the proposed school as well as providing for seasonal sporting activities and everyday recreational use, areas may be set aside for multi-purpose fields, hardcourts, potential amenity block, carparking and a grandstand for spectators. Its capacity to allow for organised sporting and large scale community events will contribute towards nurturing social interaction and promoting local connections within the community.

3.4. **CIVIC POS**

The site's civic centre will include a neighbourhood activity centre and commercial centre which, may include short stay accommodation and a proposed micro brewery. Public open space and streetscapes in proximity to this zone will be predominantly hard paved in order to provide an urban landmark for community gatherings and events.

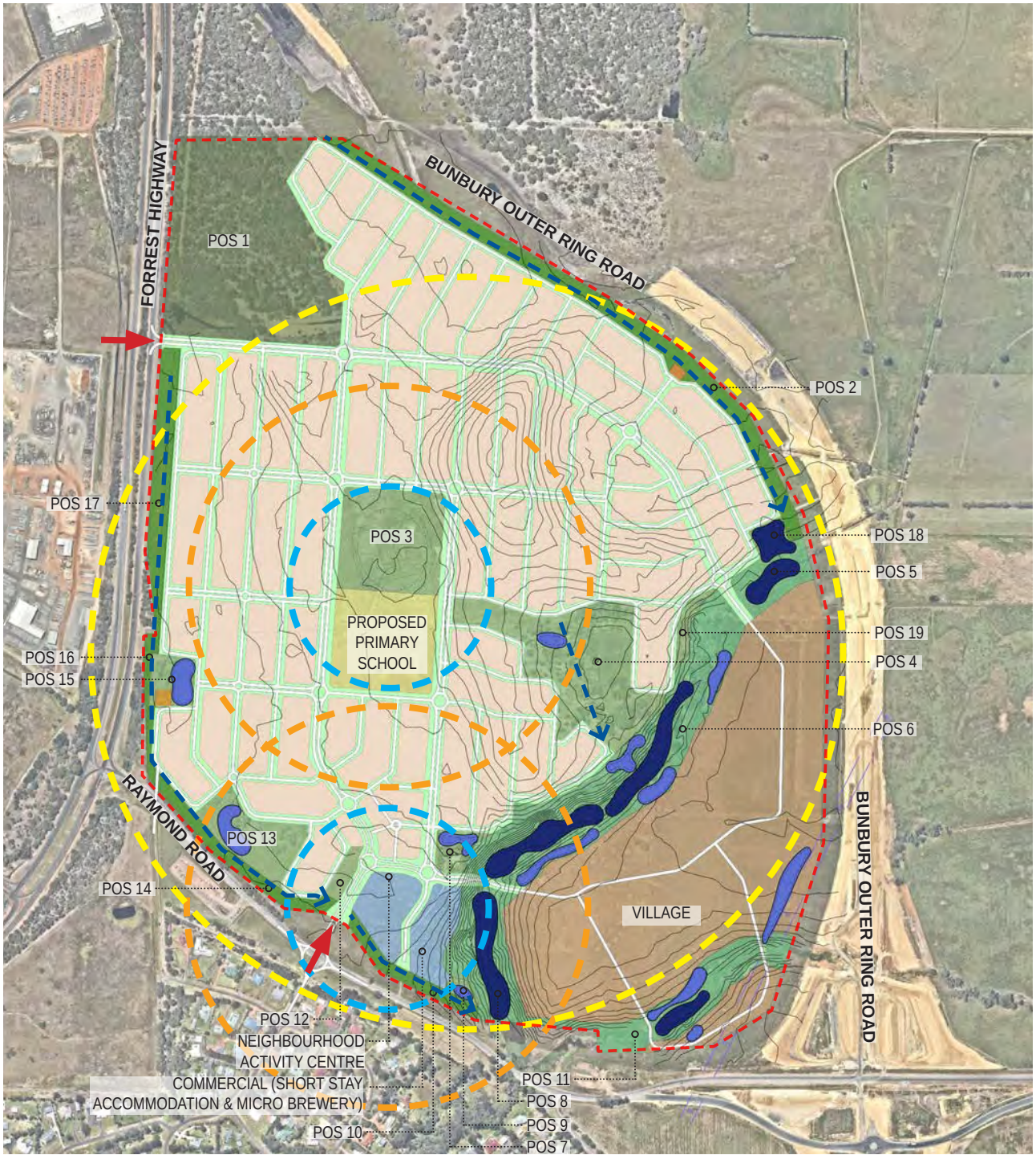
Key pedestrian and cycle networks will converge on this civic space, marking it as the starting point for a pedestrian shed. A pedestrian shed is generally a circular area encompassed by the walking distance from the civic centre, with a radius of 400 metres or more. This radius indicates the walkability of the precinct and its proximity to other key activity centres, such as the playing fields, primary school and larger neighbourhood parks.

3.5. **CONSERVATION**

The value of existing vegetation has been recognised and where possible this vegetation is to be retained and protected. A key area of existing vegetation within the site's extent has been identified and is to be included within a conservation POS. Typically a Conservation POS will include weed control, rehabilitation and paths/ trail networks in conjunction with educational signage to ensure the ecological value is maintained/ enhanced and, respected into the future.

3.6. **BUFFER**

The site is bounded by Forrest Highway to the west, Raymond Road to the south and Bunbury Outer Ring Road to the north/east. In addition to providing a drainage conveyance function and ecological/ pedestrian links, a key role of these buffer POS' will be to provide a noise and visual buffer between the community and these major roads, through the inclusion of vegetated bunds or similiar.



LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale
- 400m Ped Shed
- 800m Ped Shed
- 1500m Ped Shed
- Entry Point

SCALE 1:16,000 @ A4

5. DETAIL PLAN - POS 7

CONCEPT
- Small local POS
- Provides green pedestrian link within path network

FUNCTIONS
- Shade structure and seating area
- Passive turf area for informal gatherings and picnics

ENVIRONMENTAL CONSIDERATIONS
- Water-wise native plant species selections
- Water treatment planting selection to bio-retention area

BIO-RETENTION AREA 08	
1% AEP TWL (mAHD)	14.48
Volume (cub m)	1,178
Slope	1:6
Depth (m)	0.96

LEGEND
- Residential Lots
- Verge
- Turf
- Planting
- Basin Planting
- Footpath network
- Existing Tree
- Proposed Tree
- Street Tree







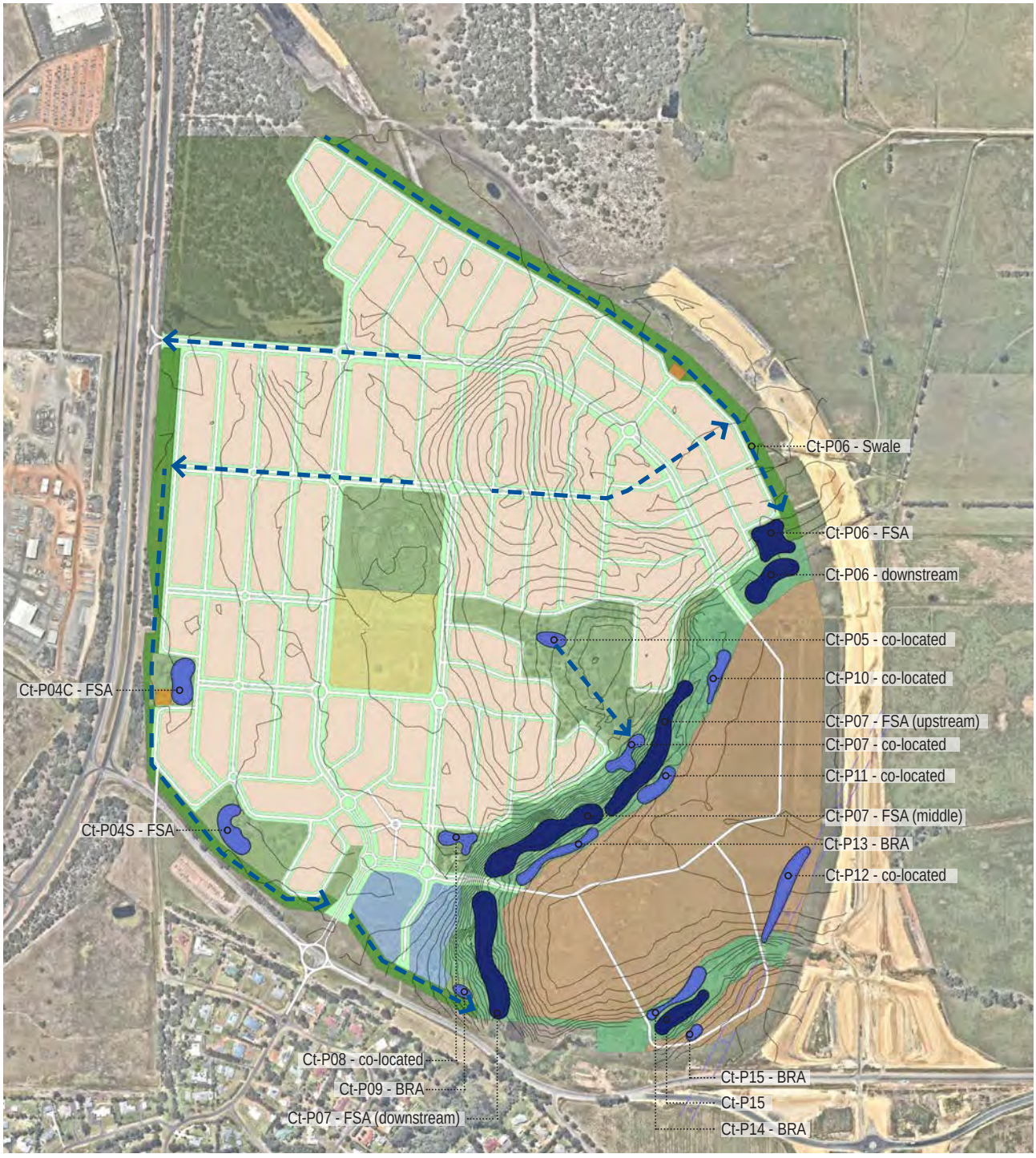












LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale

DRAINAGE DATA - 20% AEP

CATCHMENT	Depth (m)	TWL Surface Area (sq m)	Volume (cub m)
Ct-P02 (BRA)	0.28	629	168
Ct-P04 (Swale)	0.5	1,200	356
Ct-P04 (FSA- C)	0.49	2,005	922
Ct-P04 (FSA- S)	0.49	3,149	1,462
Ct-P05 (Swale)	0.5	720	183
Ct-P05 (co-located)	0.98	1,230	956
Ct-P06 (Swale)	0.56	2,700	896
Ct-P06 (FSA)	0.96	3,683	3,234
Ct-P07 (co-located)	0.98	1,845	1,434
Ct-P08 (co-located)	0.96	1,610	1,178
Ct-P09 (BRA)	0.49	588	255
Ct-P10 (co-located)	0.50	2,057	950
Ct-P11 (co-located)	0.52	2,212	1,080
Ct-P12 (co-located)	0.69	3,890	2,533
Ct-P13 (BRA)	0.50	2,621	1,248
Ct-P14 (BRA)	0.48	2,252	1,025
Ct-P15 (BRA)	0.30	610	170

DRAINAGE DATA - MINOR EVENT (20 % AEP)

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	0.94	3,105	2,745
Ct-P07 (upstream)	0.74	7,116	5,108
Ct-P07 (middle)	0.78	7,387	5,583
Ct-P07 (downstream)	0.74	7,782	5,615
Ct-P15	0.65	2,483	1,541

DRAINAGE DATA - MAJOR EVENT (1% AEP)

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	1.43	3,332	4,343
Ct-P07 (upstream)	1.11	7,388	7,851
Ct-P07 (middle)	1.15	7,665	8,391
Ct-P07 (downstream)	1.14	8,066	8,847
Ct-P15	1.07	2,645	2,707

7. STREETSCAPES

Streetscapes throughout the development shall incorporate a variety of treatments in response to the street hierarchy network. This network aims to establish a mottled patchwork of tree canopy to provide a shady, leafy and green matrix that stretches across the estate. In all cases, landscape works shall incorporate tree planting in accordance with the accepted traffic standards. Treatments may include soft works such as street trees, small shrubs and groundcovers.

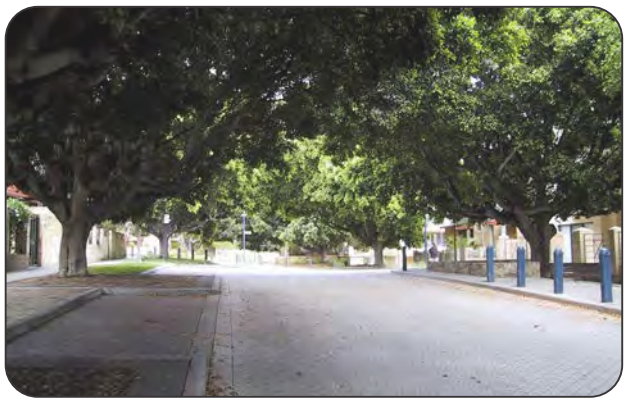
It is envisaged that the stormwater runoff from residential roads will be contained upstream mainly in a series of bio-retention swales distributed along road reserves and the linear open space network, where it is later conveyed to existing waterways.

Tree species are yet to be allocated however it is anticipated that within the POS', predominantly native trees will be used. It is proposed that species selections for streetscapes will also include species which reference the historic and cultural influences in the area. Deciduous exotic species historically used around rural homesteads will be used for major roads and civic areas to provide landmarks and promote legibility throughout the street network. The timing of installation (pre or post home construction) is yet to be determined.



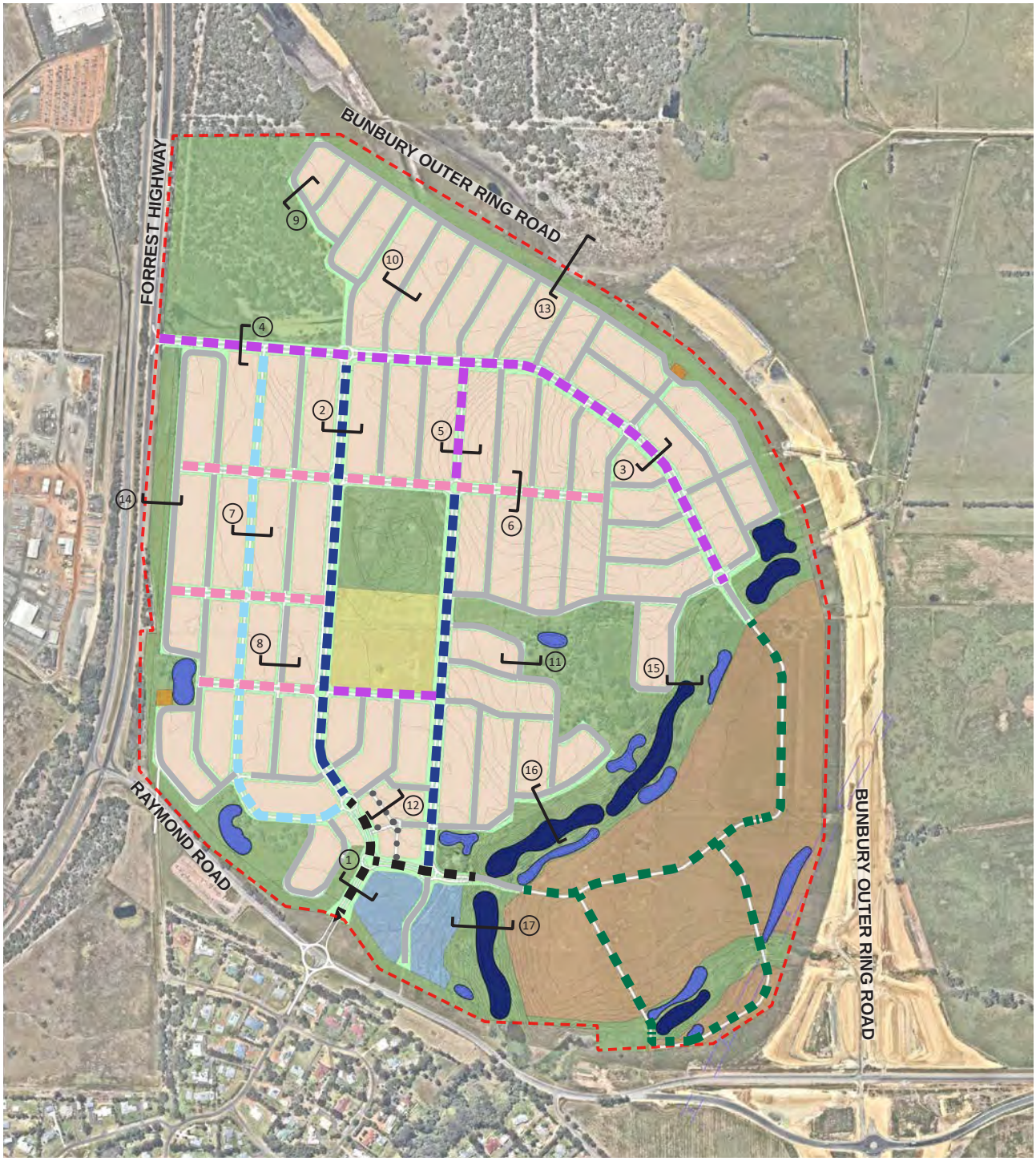








8. STREET HIERARCHY PLAN



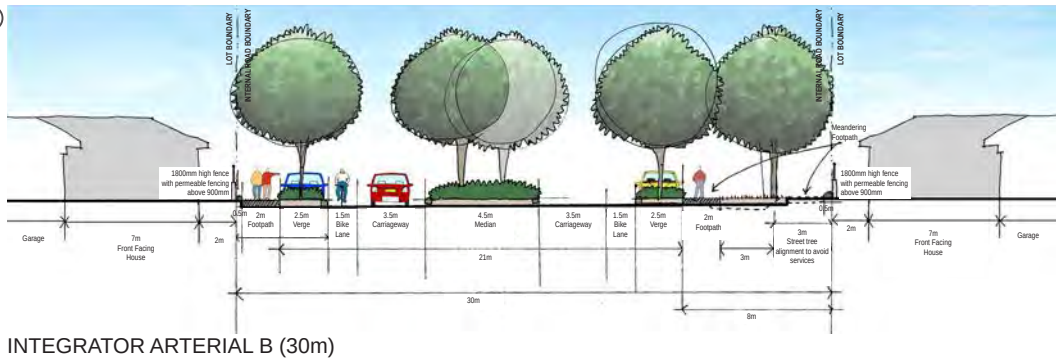
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LEGEND

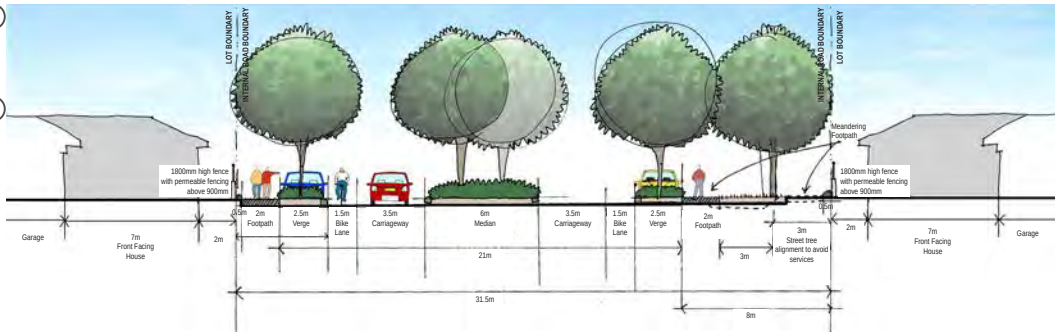
- Site Boundary
- (1) Integrator Arterial B (30m)
- (2) Neighbourhood Connector A (31.5m)
- (3) Neighbourhood Connector B (31.5m)
- (4) Neighbourhood Connector B (26m)
- (5) Neighbourhood Connector B (19.5m)
- (6) Access Street A (26m)
- (7) Access Street C (18m)
- (8) Access Street D (19.5m)
- (9) Access Street D, adjacent Bushland (20m)
- (10) Access Street D (15m)
- (11) Access Street D, adjacent POS (13m)
- (12) Laneway (6m)
- Village - Communal Road B (12m) - subject to separate design review
- (13) Access Street D, adjacent bio-retention swale/ landscaped buffer & BORR (13m)
- (14) Access Street D, adjacent gas pipeline easement & Australind Bypass/ Forest (13m)
- (15) Access Street D, adjacent upstream drainage (15m)
- (16) Access Street D, adjacent middle stream drainage (20m)
- (17) Downstream drainage

8.1. **STREET HIERACHY SECTIONS**

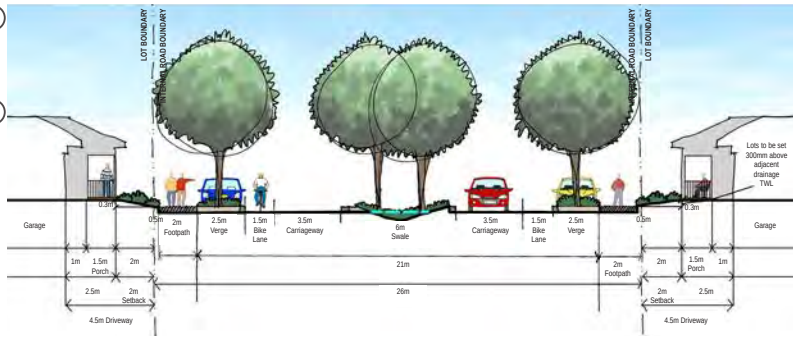
The below cross-sections are indicative only and will be subject to further detailed design at the subdivision stage.



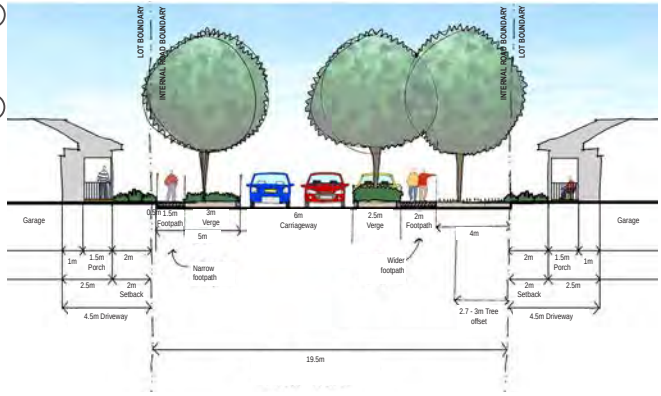
INTEGRATOR ARTERIAL B (30m)
SCALE 1:400 @ A4



2 NEIGHBOURHOOD CONNECTOR A (31.5m)
3 NEIGHBOURHHOD CONNECTOR B (31.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4

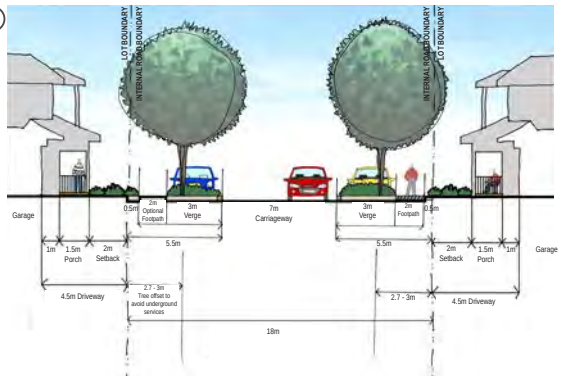


4 NEIGHBOURHOOD CONNECTOR B (26m)
6 ACCESS STREET A (26m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4



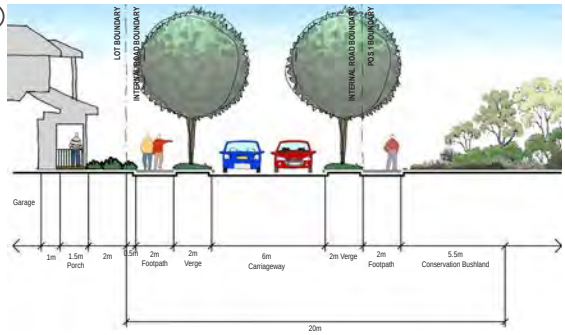
5 NEIGHBOURHOOD CONNECTOR B (19.5m)
8 ACCESS STREET D (19.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4

7



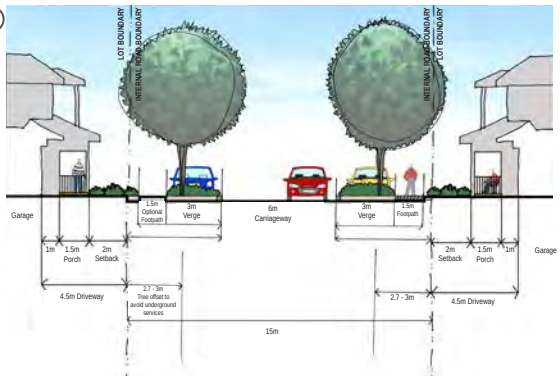
ACCESS STREET C - (18m)
SCALE 1:400 @ A4

9



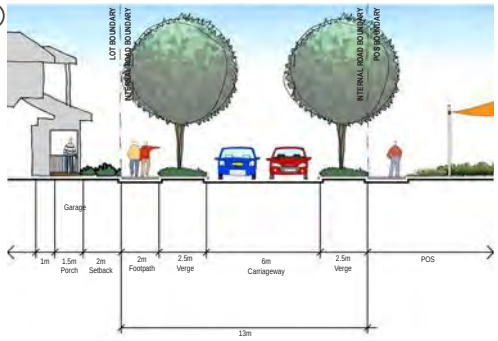
ACCESS STREET D, ADJACENT BUSHLAND (20m)
SCALE 1:400 @ A4

10



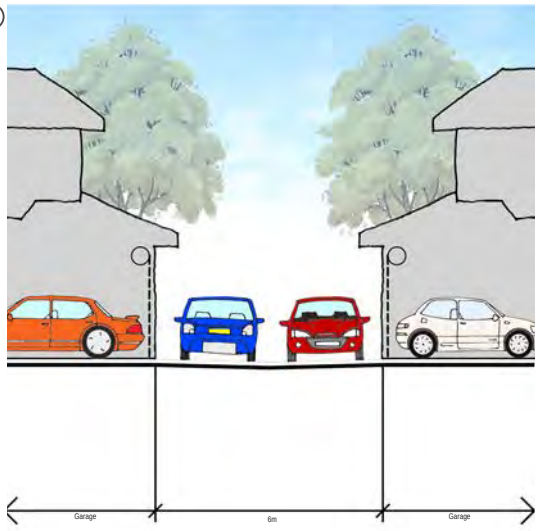
ACCESS STREET D - (15m)
SCALE 1:400 @ A4

11



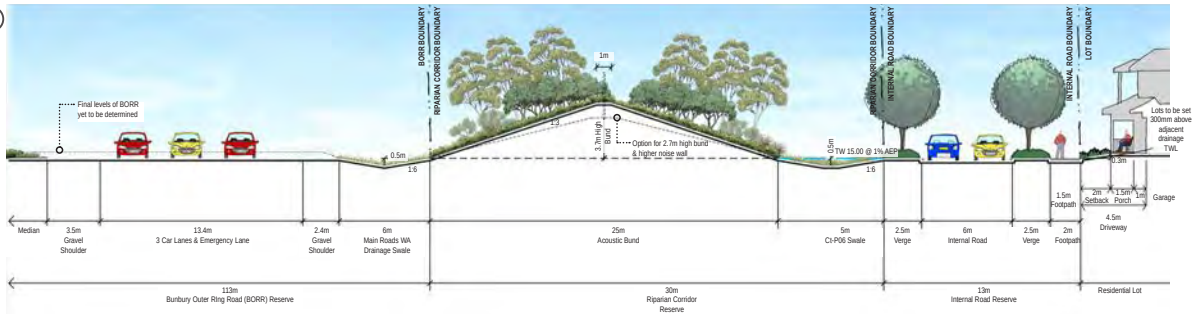
ACCESS STREET D, ADJACENT POS (13m)
SCALE 1:400 @ A4

12



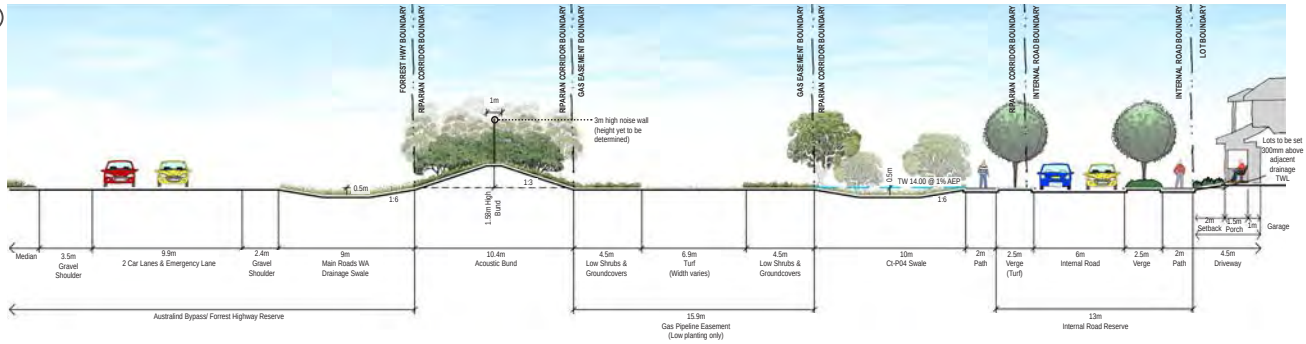
LANEWAY (6m)
SCALE 1:200 @ A4

13



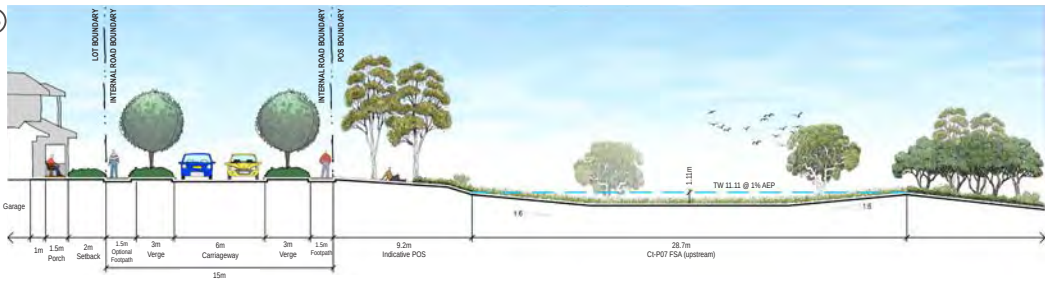
ACCESS STREET D, ADJACENT BIORETENTION SWALE/ LANDSCAPED BUFFER & BORR (13m)
SCALE 1:500 @ A4

14



ACCESS STREET D, ADJACENT GAS PIPELINE EASEMENT & AUSTRALIND BYPASS/ FORREST HWY (13m)
SCALE 1:500 @ A4

15



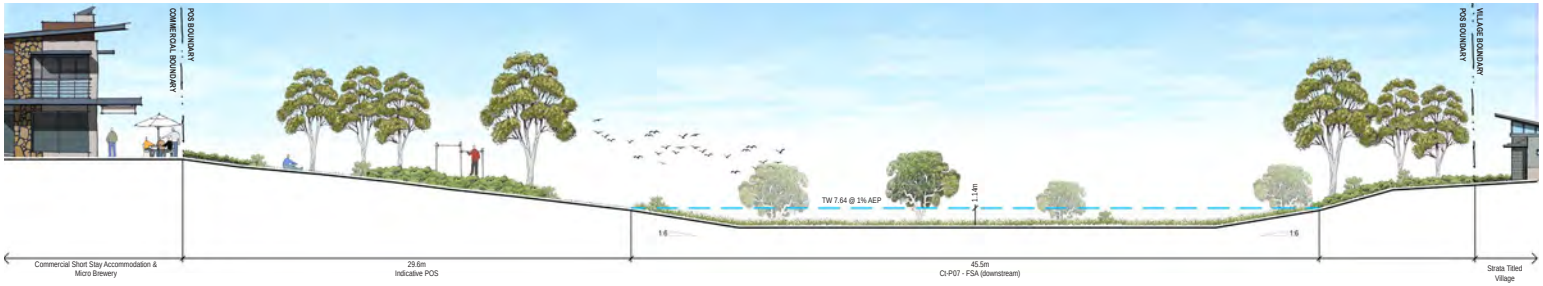
ACCESS STREET D, ADJACENT UPSTREAM DRAINAGE (15m)
SCALE 1:500 @ A4

16



ACCESS STREET D, ADJACENT MIDDLE STREAM DRAINAGE (20m)
SCALE 1:500 @ A4

17



DOWNSTREAM DRAINAGE
SCALE 1:500 @ A4

8.2. **PROPOSED PLANTING IN THE PUBLIC REALM**

The provision of planting in public areas and streetscapes serves to provide character, shade, interest, habitat and a point of reference in major streets or feature locations. Refer to section 14 for proposed species lists.

The locations of planting and types of vegetation will include;

- Predominantly native tree species to be nominated throughout the estate.
- Exotic specimen, shade and historical/cultural reference trees are to be nominated in high profile street or entry locations.
- Smaller scale exotic trees may be nominated in feature locations and avenue plantings to secondary residential streets,
- Bushland and habitat regeneration in disturbed areas,
- Shrub planting for screening and to provide spatial definition,
- Groundcover planting to medians, planters and areas requiring clear views,
- Reed and sedge planting to waterways,
- Irrigated grass to informal open space and recreation areas,

The proposed mix of native species and exotic cultural plantings in feature locations will provide a variation of character and define feature points. In general POS planting shall be composed of 75% native species.

The selection and placement of species shall consider adjacent elements so as to limit future maintenance and public health and safety issues. It will promote the survival and health of the existing vegetation, while also providing ongoing social and visual benefits. Items of consideration may include;

- Proximity to traffic sight lines to ensure suitable view corridors,
- Proximity and alignment to underground services to ensure no adverse impact,
- Seasonal influence of shade on adjacent facilities and areas,
- Passive solar benefits influencing adjacent built form and residential dwellings,
- Provision of seasonal visual colour,
- Provision of a seasonal food source to local fauna,
- Plant selection based on suitability to local climate, soils, rainfall and temperatures,
- Selection based on reduced maintenance, trimming, pruning, fertilising and watering
- Develop a species palette with subtle variations through the development to tie in with identifiable communities.
- Buffer screening will be provided to residential or sensitive areas where required
- Fringing vegetation to the surrounding areas is to be retained and protected.





Street trees

Street trees are a desirable design element to increase shade and amenity. The selection and placement of street trees shall vary, depending on the street hierarchy network. It is proposed that along major roads, street trees will form a strong visual avenue, and not impede traffic flow, safety or sightlines.

In residential streets, the roads may vary in character from precinct to precinct; however they are characterised as smaller scale pedestrian friendly environments. Therefore, street trees will be of a smaller scale, and will take advantage of passive solar principles that allows for summer shade and winter sun. As the road reserve widths may vary to allow for the retention of existing vegetation and the interconnection of the linear park network, it may be possible to allow for clustering or grouping of trees in the road reserve. This will be reviewed at the detailed design phase.

Water Wise Planting

It is intended that local species shall be used where suitable to maximise local habitat advantage and minimise water dependence. Soil amendments will be used in order to reduce leaching and increase soil moisture holding capacity. All garden beds will be mulched to reduce water loss through evaporation.

8.3. **RETAINED VEGETATION**

A primary goal of the Local Strategy Plan is the protection of existing vegetation. The retention of existing vegetation in defined locations caters for existing habitat, preserves natural assets and provides visual relief against the broader development area.

Vegetation Type and Quality

Whilst some of the vegetation on site has suffered through the effect of historical land uses and management, the areas of remnant vegetation offer positive outcomes if the development can be engineered to protect these areas. The majority of remnant vegetation is aligned with the conservation public open space and general public open space, in the form of occasional isolated individual trees in a cleared pastoral setting.

The retention of vegetation shall be maximised through minor realignment of road reserves, carriageways and lot boundaries, through the creation of tree islands in between carriageways or grade separated carriageways.

Retention and Protection

The retention and protection of defined existing trees shall occur during construction, following building works and in conjunction with maintenance. Retention and protection strategies shall include;

- Temporary fencing and signage to all retained areas and individual specimen trees.
- Ripping or compaction within 5m of the drip line of existing trees to be prohibited.
- In order to restrict the spread of exotic weeds the construction of clearly defined and easily maintained boundaries between retained vegetation and ornamental landscape may include methods such as, increased depth to mowing kerbs, footpaths, roads, bollards and permanent fencing.
- All works shall comply with the recommendations of the Bushfire Management Plan.
- Mandatory Arborist Report for all retained existing vegetation within public spaces.
- Mandatory Asset Management Plan outlining interventions and inspection frequency requirements.

8.4. **ENTRY TREATMENTS**

The entry points as defined on the Landscape Masterplan should express the design character of the development in respect to the local context. Any signage shall be clearly legible, reflect the estate's design style and comply with the local authority's signage policy.

Where appropriate, street trees and entry features will be used to promote the significant nature of these entry precincts by creating landmarks, forming strong avenues and framing views to distant feature elements. Feature planting is preferable in order to create a landmark and, assist in providing a hierarchy and legibility through the streetscape network. Landscape design options shall be tailored to meet all necessary civil design standards while expressing the character of the precinct.

8.5. **DRAINAGE/STORMWATER**

The development aims to utilise water sensitive urban design principles covering the following:

- At source treatment of water quality within select road medians
- Bio retention swales to treat water quality and convey stormwater runoff to existing waterways
- Reed and fringing vegetation to swales to provide a nutrient stripping function
- Online flood detention areas with the existing waterway to minimise downstream flows following major storm events
- Flood detention within waterways achieved by existing and/or proposed crossings

It is important that proposed swales/basins allow for multiple uses; including recreation, storm water management and creation of natural habitat.

8.6. **DRAINAGE TREATMENT ADJACENT TO POS**

All stormwater from the development will be directed into a system of drainage swales and bio-retention basins constructed along the edges of the POS and within the road reserve. These devices will be sized to treat the flows from the 1 in 1 yr event in accordance with the principles of the Department of Water, Stormwater Management Manual for Western Australia. Storm events in excess of these will be directed into outlet basins located within the POS area.

8.7. **IRRIGATION STRATEGY**

In general terms the project is committed to undertaking water sensitive urban design with no reliance on existing groundwater and the preservation of water quality. The project is also committed to minimising the volume of water used for irrigation. The following principles are held.

- Minimise the extent of irrigation and the volume of water consumed
- Minimise the extent of irrigated turf
- Minimise the extent of long term irrigation use on planted beds
- Use of hydrozoning
- Use of xeriscaping where practical

Irrigation shall aim to incorporate elements of subsurface, drip and trickle water application methods. Water application shall be based on seasonal need and be constructed of reliable, readily available and cost effective fittings, infrastructure and materials. Hydrozoning principles shall be incorporated at the detailed design stage.

All irrigation shall be installed to the local authority's standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authority's standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to the Council in accordance with relevant policies. Non-potable water will be supplied by Harvey Water via an existing agricultural supply network.





Existing drainage swales through site

8.8. **SITE FURNITURE**

The provision of street furniture demonstrates detailed consideration of human use and comfort. The inclusion of quality street furniture elements reinforces the intended design character, develops a sense of community and ownership amongst residents and encourages outdoor activities.

The location of street furniture elements should closely correspond with more intensive areas of human use, gathering and recreation. Basic functional requirements shall typically include;

- Local availability for quick and cost effective replacement or parts as may be required,
- Cost effectiveness of installation, ongoing replacement and maintenance,
- Robust design to minimise the effects of vandalism or weathering,
- Robust appropriate fixing methods to prevent theft but allow maintenance,
- Colour being defined but neutral where possible to enable the maximum chance of matching with other site elements,
- Galvanised and powder coated finishes to maximise lifespan.

Elements shall provide a visually recognisable, clear and useful function. The types of street furniture envisaged include;

- Picnic settings & seating (formal and informal)
- Shade structures/ Shade Sails to assist with providing built shade options
- BBQs
- Rubbish bins
- Bollards
- Bicycle parking
- Drinking fountains
- Boardwalks
- Conservation fencing
- Interpretive signage

Note: All furniture specified within public spaces are to be consistent with the Shire of Harvey's Signage and Infrastructure Style Guide Parts 1 & 2.

https://www.harvey.wa.gov.au/build-and-develop/infrastructure/signage-and-infrastructure-style-guide





8.9. **PLAYGROUNDS**

Plagrounds are a vital community space that support physical, social and emotional well-being. Play opportunities should provide for all ages, welcome all genders, encourage social interaction and promote physical development. Play features that inspire adventure and discovery are prioritised to spark creativity, build problem-solving skills and keep children engaged longer. Designing with durable materials ensures long-term value and minimal maintenance. All playgrounds are required to be consistent with the Shire of Harvey's Playspace Strategy.

8.10. **PUBLIC ART**

The selection and installation of appropriate public art creates interest, social discussion and promotes a sense of community and ownership to public spaces. Public art can provide historic, social, cultural and environmental comment and act as a reference to define a local area and community values.

It is intended that public art be distributed at either high profile points or community gathering spaces to ensure its value in place making is maximised. Locations should include vista and axis views from roads or pedestrian paths, inclusion into playgrounds or placement adjacent picnic locations. Individual lighting may be desirable in some instances to provide additional importance and focus to specific artwork.

8.11. **MAINTENANCE MINIMISATION**

In conjunction with the detail design of public open space and verge areas, they are ultimately vested and controlled by the Local Government Authority (LGA), a maintenance minimisation review and an asset management plan shall be undertaken by the developer to assist in assessing and reducing the likely future maintenance costs. This process may typically include;

- review of all materials to ensure fitness for purpose and lifespan requirement,
- review of the areas of planting verses turf,
- review of plant and turf species and their specific growth habits and requirements,
- monitoring of groundwater quality and levels,
- review of irrigation materials and standards,
- implementation of sustainability and water wise principles to enable the reduction of ongoing costs, through removal of some short term landscape establishment assets,
- review of all structural design to ensure fitness for purpose and lifespan





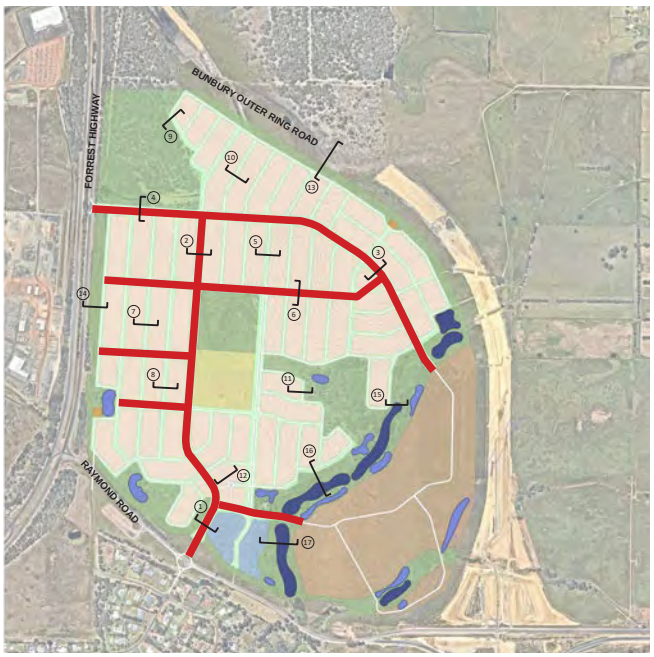


9. POS STRATEGY - GREEN STREETS

BRIEF DESCRIPTION

The Green Street is a widened road reserve to create a sense of space and connectivity throughout the estate. This promotes legibility via creation of a landmark and establishes a hierarchy within the streets. It offers the opportunity for stormwater and bio-filtration within widened road reserves

SIZE (Verge) 70,886 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Path network
- Historical and cultural character
- Landmark and feature planting
- Habitat corridors
- Passive recreation opportunities

ENVIRONMENTAL CONSIDERATIONS

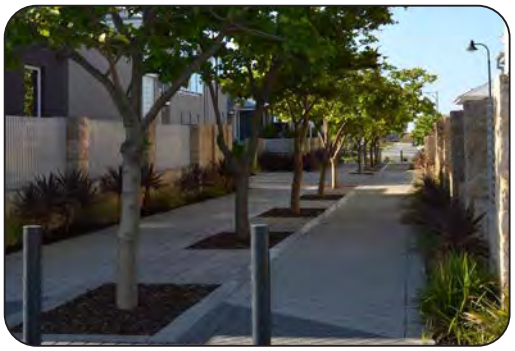
- Waterwise native planting
- Planting design to be zoned according to irrigation requirement
- Consider stormflows and drainage requirements









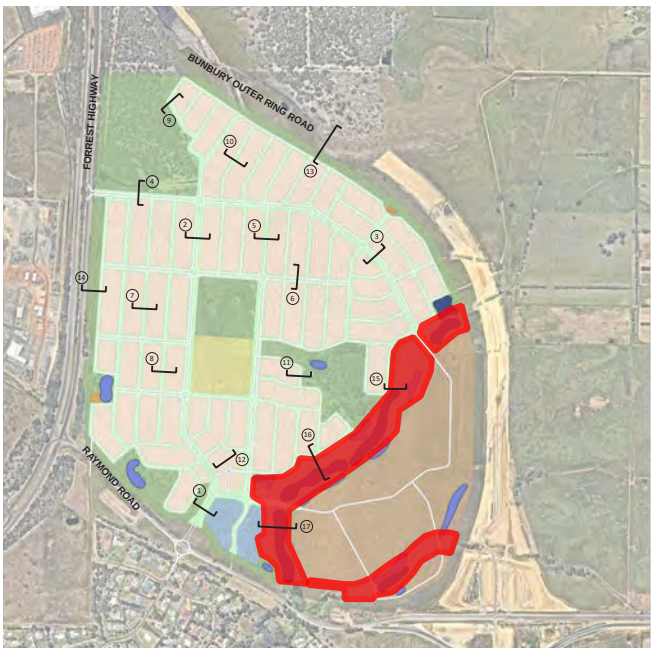


10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS

BRIEF DESCRIPTION

Located between the development and the proposed strata titled village, the the linear POS/ riparian corridor incorporates drainage requirements with pedestrian and bicycle networks. While drainage is the predominant function for this space there will also be informal turf areas, path networks, crossings, shelters and picnic nodes etc.

SIZE (Excluding Verges) 154,256.2 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting
- Living stream

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials



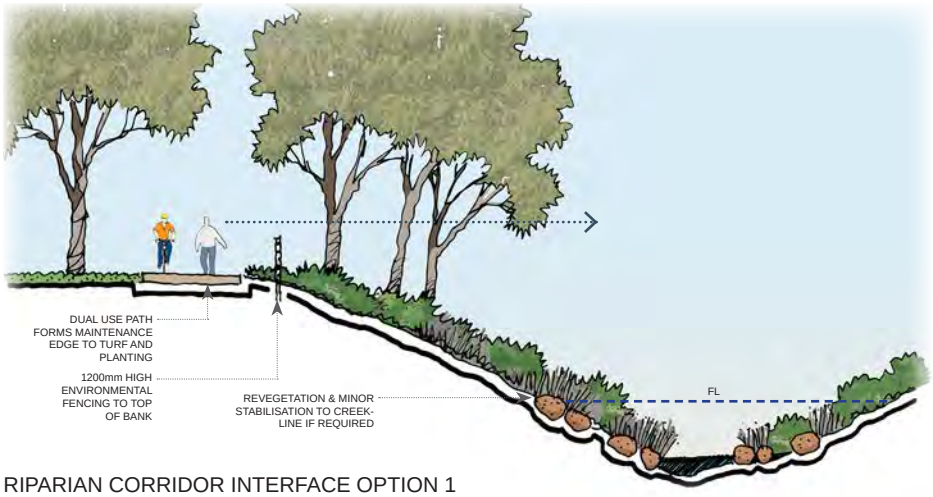




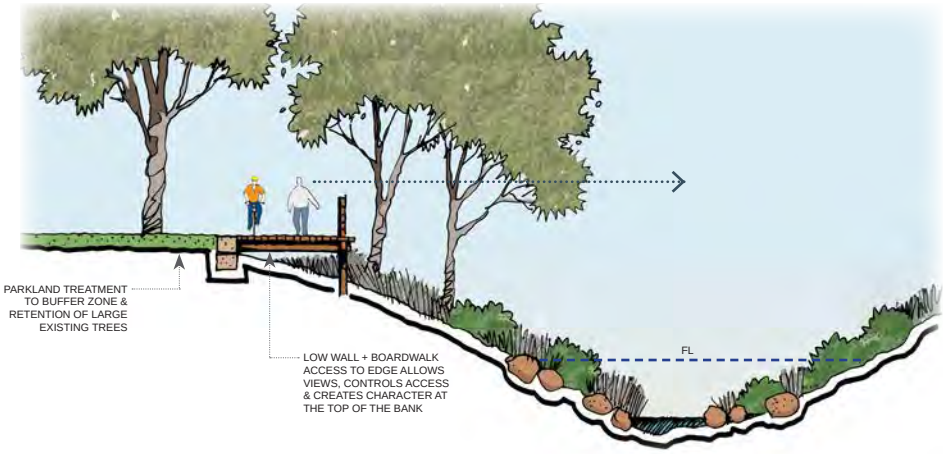


10.1. **CONCEPT SECTIONS**

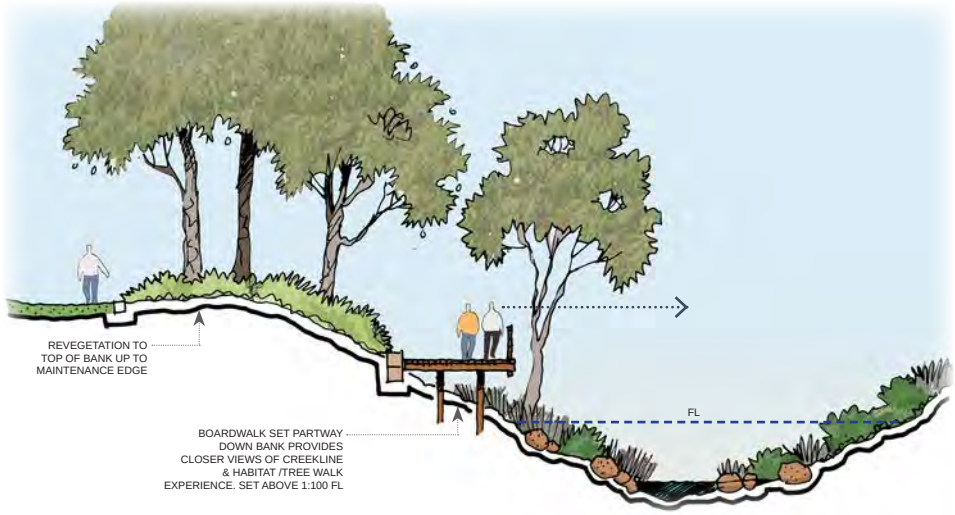
The following sections are concept diagrams exploring design opportunities along the enhanced riparian corridor.



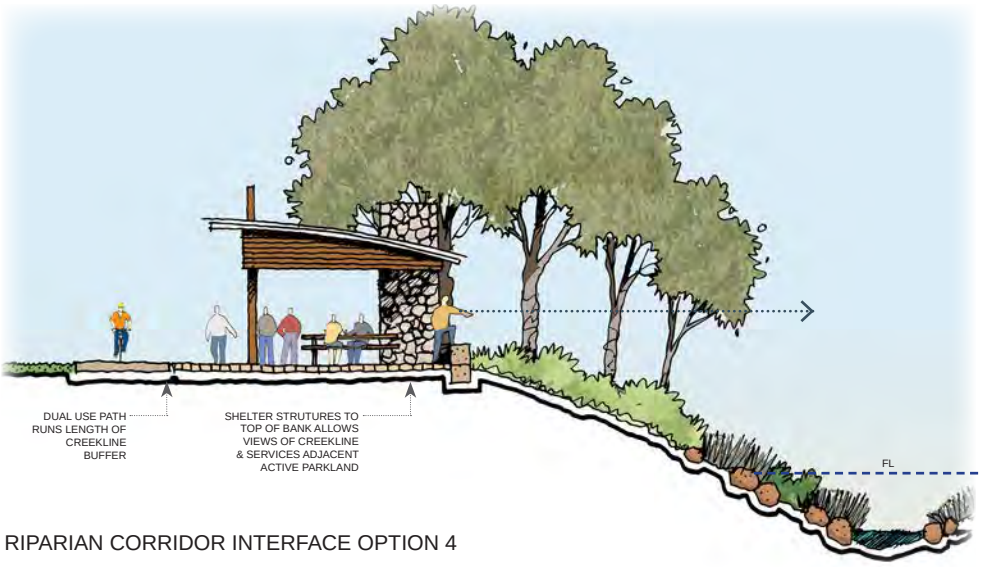
RIPARIAN CORRIDOR INTERFACE OPTION 1



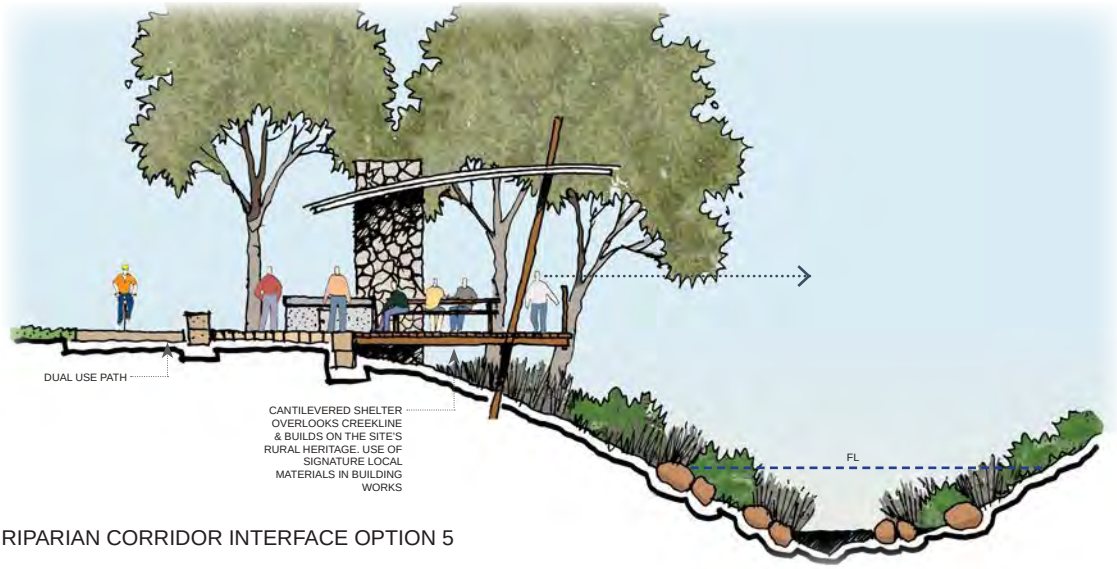
RIPARIAN CORRIDOR INTERFACE OPTION 2



RIPARIAN CORRIDOR INTERFACE OPTION 3



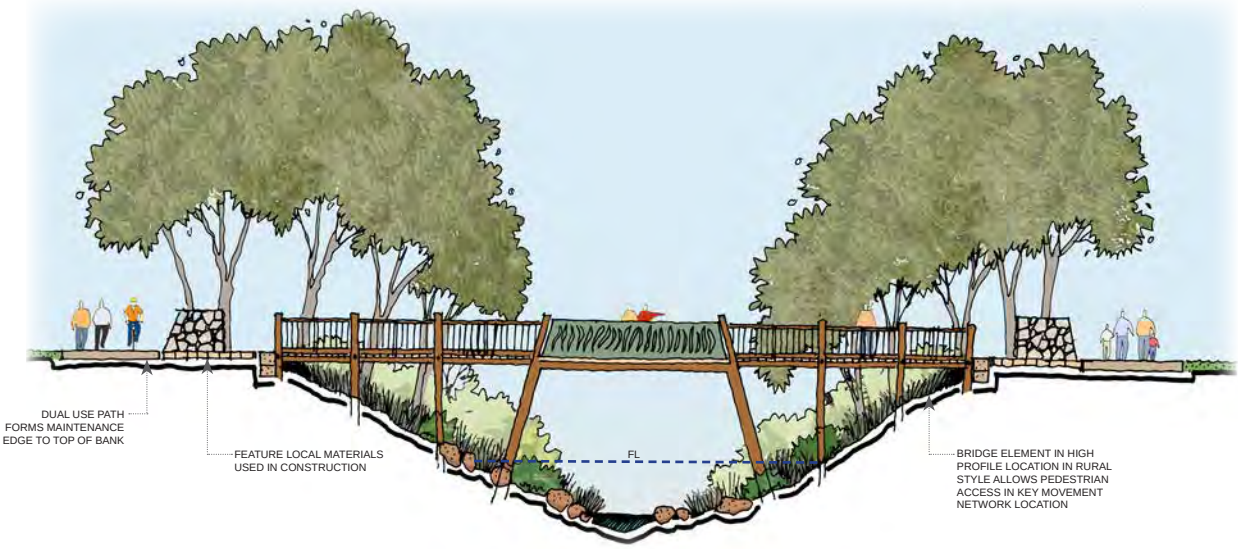
RIPARIAN CORRIDOR INTERFACE OPTION 4



RIPARIAN CORRIDOR INTERFACE OPTION 5



RIPARIAN CORRIDOR INTERFACE OPTION 6



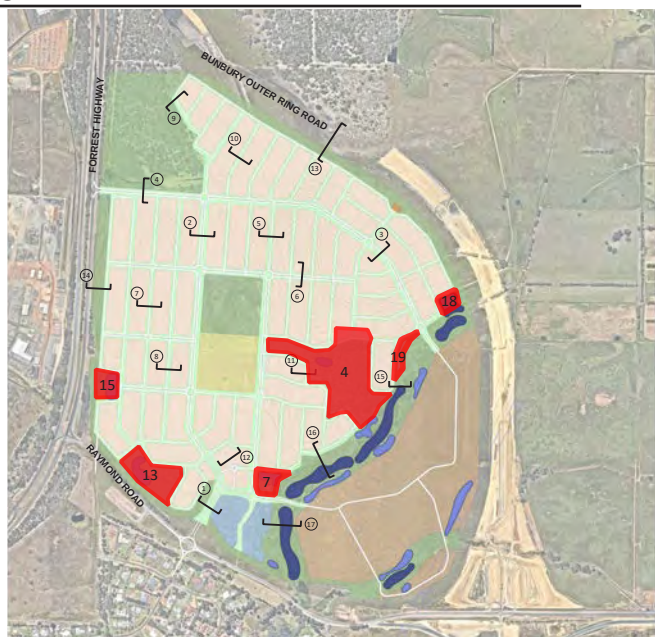
RIPARIAN CORRIDOR INTERFACE OPTION 7

11. POS STRATEGY - NEIGHBORHOOD PARKS

BRIEF DESCRIPTION

Located throughout the development, the Neighbourhood POS provides residents with open space in close proximity to their dwellings. The parks have areas of turf for passive play and informal kick-about area with nodes of seating and shelter either provided by trees or built structure. A path network through and around the POS allows footpath connection to surrounding streets and other POS. Drainage will be incorporated within these areas.

SIZE (Excluding Verges)
POS 4: 63,637.6 sq.m
POS 7: 5,948.2 sq.m
POS 13: 19,892.3 sq.m
POS 15: 8,592.3 sq.m
POS 18: 3,696.1 sq.m
POS 19: 3,796.2 sq.m



FUNCTIONS

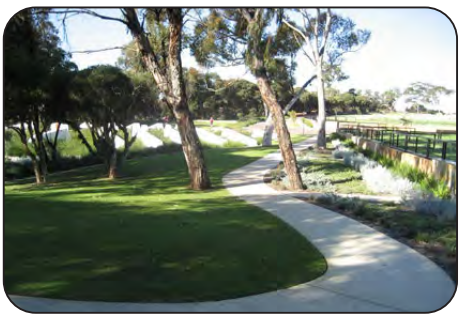
- Native, water wise planting. Deciduous used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Playground
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







12. POS STRATEGY - PLAYING FIELDS

BRIEF DESCRIPTION

- Landmark/destination for residents and community groups
- Opportunity to co-locate facilities (i.e. playing fields, junior ovals and hardcourts for future school and community)
- Provide shared amenities (i.e. shelters, BBQ areas, play and exercise nodes)
- Distinct active/passive zones amongst activities and age groups
- Promote accessibility and usage by community
- Pedestrian and cycle path along perimeter to connect into broader path network
- Playing fields with capacity for organised sporting and large scale community events
- Potential for viewing grandstand
- Allow for drainage and stormwater flows
- Allow for access and carparking

SIZE POS 3 (Excluding Verges) = 40,045.1 sq.m



FUNCTIONS

- Service diverse range of passive and active recreational activities
- Open area for informal/formal sports and events
- Predominantly irrigated turf for sporting fields
- Maximise shade trees
- Play elements for all ages
- Drainage
- Connection/Colocation with education facilities

ENVIRONMENTAL CONSIDERATIONS

- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the formal turf sporting fields
- Consider stormflows and drainage requirements
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







13. POS STRATEGY - CIVIC POS

BRIEF DESCRIPTION
- Civic landscape predominantly hardscape for events
- Shared pedestrian and vehicle town centre streetscape

SIZE (Excluding Verges)
POS 12: 3, 391.8 sq.m
Access Street D: 3,240 sq.m
POS 9: 1,960 sq.m

FUNCTIONS
- Village centre acting as central 'heart' of greater masterplan
- Neighbourhood hub for formal and informal public gatherings
- Open hardscaped areas to host local events, markets and food trucks
- Maximise shade trees with native and/or deciduous species where appropriate
- Community engagement & connection
- Path network connecting between activity centre buildings and into broader path network
- Landmark & feature planting

ENVIRONMENTAL CONSIDERATIONS
- Formal planting
- Trees for shade
- Designed with CPTED principles















14. POS STRATEGY - CONSERVATION POS

BRIEF DESCRIPTION

- Existing vegetation to be retained
- Revegetate and enhance
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with adjacent neighbourhood or linear POS recreational nodes.
- Boardwalks/interpretive/signage/educational opportunities

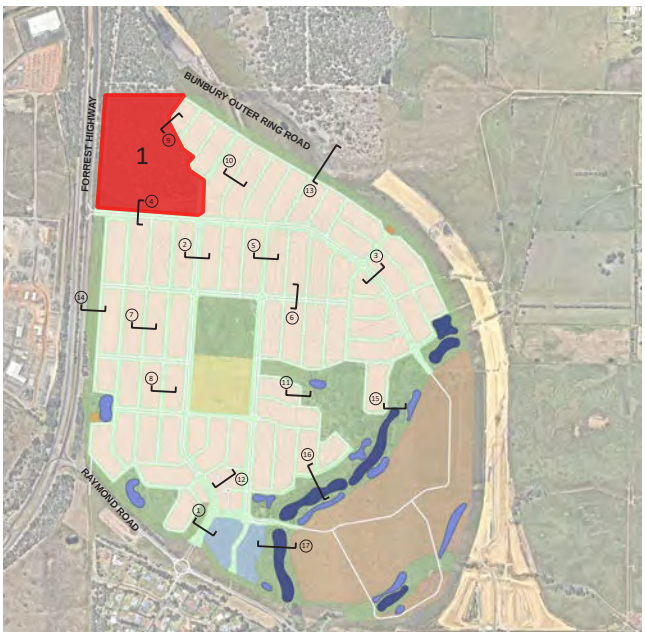
SIZE (Excluding Verges) = 120,696.6 sq.m

FUNCTIONS

- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader path network
- Ecological function
- Habitat
- Education
- Connection

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, unirrigated where possible.
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing site









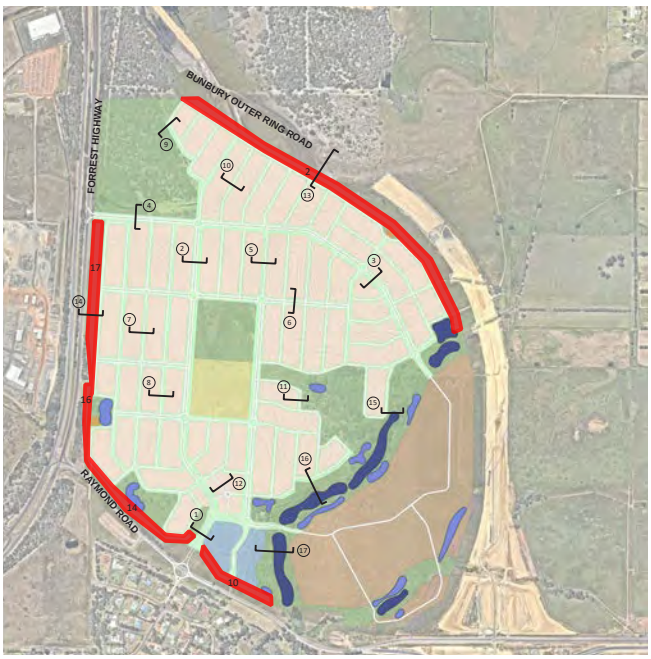




15. POS STRATEGY - BUFFER POS

BRIEF DESCRIPTION
- Provides a buffer to adjacent high use roads
- Vegetation corridors
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with recreational nodes along linear route/network.
- Allow for drainage and stormwater flows

SIZE (Excluding Verges)
POS 2: 37,679 sq.m
POS 10: 8,154.9 sq.m
POS 14: 13,406.7 sq.m
POS 16: 2,370.4 sq.m
POS 17: 19,759.9 sq.m



FUNCTIONS
- Buffer to adjacent high use roads
- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader development
- Drainage
- Ecological function
- Habitat
- Connection

ENVIRONMENTAL CONSIDERATIONS
- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing areas
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing and historic creekline











16. PROPOSED PLANT PALETTE

15.1 DRAINAGE CORRIDOR VEGETATION

Inundated - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree

Trees

Melaleuca rhaphiophylla	Swamp Paperbark

Lower Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Hypocalymma angustifolium	White Myrtle
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Melaleuca preissiana	Moonah
Melaleuca rhaphiophylla	Swamp Paperbark
Taxandria linearifolia	

Mid Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Astartea scoparia	
Dasypogon bromefolius	Pineapple Bush
Kunzea glabrescens	
Hypocalymma angustifolium	White Myrtle
Leucopogon tenuis	

Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Eucalyptus rudis	Flooded Gum
Melaleuca preissiana	Moonah
Taxandria linearifolia	

Upper Slope - Foreshore

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Astartea scoparia	
Kunzea glabrescens	
Leucopogon tenuis	
Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	

Trees

Corymbia calophylla	Marri
Euclayptus lane-poolei	Salmon White Gum
Eucalyptus marginata	Jarrah
Eucalyptus wandoo	Wandoo
Melaleuca preissiana	Moonah
Taxandria linearifolia	
Xanthorrhoea preissii	Grass Tree

Dryland Revegetation

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Acacia divergens	
Acacia pulchella	Prickly Moses
Acacia saligna	Orange Wattle
Allocasuarina humilis	Dwarf Sheoak
Anigozanthos manglesii	Mangles Kangaroo Paw
Conostylis aculeata	Prickly Conostylis
Dampiera linearis	Common Dampiera
Dianella revoluta	Dianella
Dryandra nivea	Honeypot Dryandra
Ficinia nodosa	Knotted Club Rush
Grevillea pilulifera	Woolly Flowered Grevillea
Hakea ceratophylla	Norned Leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea prostrata	Harsh Hakea
Hakea stenocarpa	Narrow Fruited Hakea
Hakea trifurcata	Two Leaf Hakea
Hypocalymma angustifolium	White Myrtle
Hypocalymma robustum	Swan River Myrtle
Kunzea micrantha	
Melaleuca laterifolia	Gorada
Patersonia occidentalis	Purple Flag

Eremophila glabra	Tar Bush
Grevillea crithmifolia	

Trees	
Allocasuarina fraseriana	Sheoak
Corymbia calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus wandoo	Wandoo
Nuytsia floribunda	Christmas Tree

15.2 PARKLAND PLANTING (POS AREAS/BUFFERS/BOULEVARDS)

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	**Common Name**
Acacia cognata 'Limelight'	Limelight
Acacia cognata	
Adenanthos sericea	Albany Woolly Bush
Agonis flexuosa 'Nana'	
Anigozanthus ssp.	Kangaroo Paw
Carex comans	
Dianella ssp.	Dianella
Dryandra nivea	Honeypot Dryandra
Eremophila 'Carramar Grey'	
Ficinia nodosa	Knotted Club Rush
Grevillea crithmifolia	
Grevillea obtusifolia 'Gin Gin Gem'	Gin Gin Gem
Grevillea 'Golden Lyre'	Golden Lyre
Grevillea 'Lollypops'	Lollypops
Grevillea thelemanniana	Spidernet Grevillea
Lomandra ssp	Lomandra
Pattersonia occidentalis	Purple Flag
Olearia axillaris	Coastal Daisy Bush
Phormium tenax 'Purpurea'	Phormium
Westringia fruticosa	Coastal Rosemary

Trees	
Agonis flexuosa	Native Peppermint
Brachychiton acerifolius	Illawarra Flame Tree
Corymbia calophylla	Marri
Corymbia maculata	Spotted Gum
Erythrina indica	Coral Tree
Eucalyptus marginata	Jarrah
Fraxinus raywoodii	Claret Ash
Liquidambar styraciflua	Liquidambar
Platanus acerifolia	London Plane Tree
Xanthorrhoea preissii	Grass Tree

15.3 TREE SPECIES SELECTION

15.3.1 NATIVE SPECIES



Agonis flexuosa
Willow Myrtle



Allocasuarina fraseriana



Callistemon 'Kings Park Special'



Casuarina obesa
Swamp Sheoak



Corymbia calophylla
Marri



Eucalyptus lane-poolei
Salmon White Gum



Eucalyptus marginata
Jarrah



Eucalyptus rudis
Flooded Gum



Eucalyptus todtiana
Prickly bark



Eucalyptus wandoo
White Gum



Melaleuca preissiana
Modong



Melaleuca rhaphiophylla
Swamp Paperbark



Nuytsia floribunda
WA Christmas Tree



Taxandria linearifolia



Xanthorrhoea preissii
Grasstree

15.3.2 EXOTIC SPECIES



Brachychiton acerifolius
Illawara Flame Tree



Corymbia maculata
Spotted Gum



Eucalyptus camaldulensis
River Red Gum



Erythrina indica
Coral Tree



Fraxinus Raywoodii



Jacaranda mimosifolia
Jacaranda



Liquidambar styraciflua
Sweet Gum



Platanus acerifolia
London Plane Tree



Ulmus parvifolia
Chinese Elm

17. IMPLEMENTATION

17.1. APPROVALS

As part of an ongoing process, once the Local Structure Plan has been endorsed by the LGA and the sub division approvals received, each POS landscape and irrigation design will be submitted as a detailed documentation package to the Shire for review and approval.

The landscape design will incorporate recreation and environmental requirements, while focusing on maintenance minimisation principles and techniques.

The developer is committed to working with the local council to deliver long term outcomes in this process to reflect best practice throughout the development.

17.2. PRACTICAL COMPLETION

Upon reaching Practical Completion of the landscape and irrigation works, a meeting shall be arranged and attended by the consulting landscape architect and the relevant council officers to inspect the completed landscape works.

Following this inspection the Developer's representative shall issue to council the following:

- A list of items requiring completion
- As-constructed landscape and irrigation drawings
- Details including capital costs of all physical assets for inclusion in the Councils asset register

Following Practical Completion the Developer shall organise to:

- Carry out any remedial works noted during the Practical Completion inspection without delay
- Undertake maintenance of the POS as agreed with council

17.3. LANDSCAPE MAINTENANCE RESPONSIBILITY

The developer funded and managed landscape and irrigation maintenance period of two years will apply to all public open space areas following completion of landscape construction works.

The maintenance period commences on the date of Practical Completion. Typically the first year is an establishment period, followed by a year of landscape maintenance.

After the two year period the POS landscape and irrigation maintenance will be handed over to the Local Government Authority to control, fund and manage.

17.4. SCHEDULED HANDOVER

Three months prior to the expiration of the maintenance period (from practical completion), the Developer shall contact the relevant Council officer to initiate the handover process, which will commence with an inspection of the POS.

At the handover inspection, the Developer shall provide to the Officer:

- Details of the areas maintained
- As-constructed irrigation drawings to include changes made to the system during the maintenance period
- Warranties, manuals and logbooks.

Following handover inspection and prior to the handover date, the Developer shall:

- Rectify all defects noted during the handover inspection and others that may emerge before the handover date
- The Council shall provide written confirmation that Council accepts responsibility for maintenance and liability for the location involved.


emerge
ASSOCIATES
Integrated Science & Design

Appendix C

Concept civil designs

Prepared by WML (2021)

LEGEND

- EXISTING NATURAL SURFACE CONTOUR (1m INTERVALS)
- LOT NUMBERS
- CONCEPTUAL EARTHWORK LEVEL
- GEOTECHNICAL ZONE

EXISTING ROAD RESERVE
GAS PIPELINE EASEMENT
HIGHWAY
FORREST
BUNBURY OUTER RING ROAD
RAYMOND ROAD
CONSERVATION PUBLIC OPEN SPACE
PUBLIC OPEN SPACE 7
PUBLIC OPEN SPACE 3
PROPOSED PRIMARY SCHOOL
NEIGHBOURHOOD ACTIVITY CENTRE
SHORT STAY ACCOMMODATION
MICRO BREWERY
MEDIUM DENSITY APARTMENTS
PROPOSED ECO VILLAGE
CLUBHOUSE
PROPOSED 60m RIPARIAN CORRIDOR
VEHICLE/ CARAVAN/ BOAT STORAGE
POS 1
POS 4
POS 5
POS 6
ZONE 1
ZONE 2
ZONE 3
1501
500
501
502
151
152
153

GEOTECHNICAL ZONE LEGEND

ZONE 1 - SAND

ZONE 2 - SAND ABOVE CLAY

ZONE 3 - CLAY

SCALE 1:3000

A1

WML Consulting Engineers
Civil | Geotechnical | Structural

BUNBURY +61 8 9722 3544
KALGOORLIE +61 8 9021 1811
PERTH +61 8 9722 3566
wml.com.au

REVISIONS				
C	NTH SECTION CONCEPTUAL EARTHWORK LEVEL REVISED	L. RUSCONI	9/4/25	WRS
B	LAYOUT UPDATED/ISSUED FOR INFORMATION	L. RUSCONI	7/10/21	WRS
A	ISSUED FOR INFORMATION	L. RUSCONI	26/8/21	WRS
N°.	DESCRIPTION	APPROVED	DATE	DRAWN

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	2/6/21
DRAWN	W. STEWART	20/8/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL EARTHWORKS PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK03 C

REVISION

LEGEND

- 15x20 — LOT FFL
- GRAVITY SEWER
- PRESSURE MAIN
- GRAVITY MAIN - CONTROL LINE
- ALTERNATE PUMP STATION - PSG LOCATION

EXISTING ROAD RESERVE

15.9m GAS PIPELINE EASEMENT

BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1

PUMP STATION AUSTRALIND PSC
SEWER DESIGN FLOW: 9.9L/s
LONG TERM PUMP RATE: 198.5L/s

POS 2

PUMP STATION No. 1
SEWER DESIGN FLOW: 8.2L/s
LONG TERM PUMP RATE: 10.9L/s
DEPTH TO INVERT 6.0m

PUMP STATION

FORREST HIGHWAY

POS 17

PUBLIC OPEN SPACE 3

PUBLIC OPEN SPACE 5

PROPOSED PRIMARY SCHOOL

PUBLIC OPEN SPACE 4

DISCHARGE POINT

POS 16

POS 15

PUMP STATION AUSTRALIND PSG
SEWER DESIGN FLOW: 13.1L/s
LONG TERM PUMP RATE: 37.5L/s
DEPTH TO INVERT 7.0m

PUMP STATION

PUBLIC OPEN SPACE 13

POS 14

POS 12

NEIGHBOURHOOD ACTIVITY CENTRE

COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)

PROPOSED 60m RIPARIAN CORRIDOR

POS 7

PUBLIC OPEN SPACE 8

POS 9

POS 10

PUBLIC OPEN SPACE 6

PUMP STATION PRIVATE???
SEWER DESIGN FLOW: 11.8L/s

PUMP STATION

PROPOSED 60m RIPARIAN CORRIDOR

STRATA TITLED VILLAGE

POSSIBLE REALIGNED 132kV POWERLINE EASEMENT & POLES

EXISTING 132kV POWERLINE EASEMENT TO BE REALIGNED

PUBLIC OPEN SPACE 11

STRATA TITLED VILLAGE

BUNBURY OUTER RING ROAD

RAYMOND ROAD

RANSON DRIVE

SCALE 1:3000

A1

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PERTH +61 8 9722 3566
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REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
C	LAYOUT UPDATED/ISSUED FOR REVIEW	L. RUSCONI	21/08/24	NT
B	LAYOUT UPDATED/ISSUED FOR INFORMATION	L. RUSCONI	7/10/21	WRS
A	ISSUED FOR INFORMATION	L. RUSCONI	26/8/21	WRS

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	2/6/21
DRAWN	W. STEWART	24/8/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL SEWER PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK05

REVISION: C

LEGEND

- EXISTING NATURAL SURFACE CONTOUR (1m INTERVALS)
- SWALE DRAIN & DIRECTION FLOW INDICATOR
- BIORETENTION BASIN STORAGE
- DRAINAGE CATCHMENT
- SUBSOIL DRAINAGE INDICATIVE FLOW DIRECTION
- 14.51 SUBSOIL DRAINAGE INDICATIVE INVERT LEVELS
- 15.20 LOT FFL

GAS PIPELINE EASEMENT
EXISTING ROAD RESERVE
OPEN DRAIN INVERT RL13.50
OPEN DRAIN INVERT RL13.30
OPEN DRAIN INVERT RL13.10
OPEN DRAIN INVERT RL12.90
OPEN DRAIN INVERT RL12.70
OPEN DRAIN INVERT RL12.50
OPEN DRAIN INVERT RL12.30
OPEN DRAIN INVERT RL13.50
OPEN DRAIN INVERT RL12.20
OPEN DRAIN INVERT RL11.50
CONSERVATION PUBLIC OPEN SPACE
HIGHWAY
FORREST
OUTER RING ROAD
BUNBURY OUTER RING ROAD
RAYMOND ROAD
PUBLIC OPEN SPACE 7
PUBLIC OPEN SPACE 3
PROPOSED PRIMARY SCHOOL
NEIGHBOURHOOD ACTIVITY CENTRE
SHORT STAY ACCOMMODATION
MICRO BREWERY
MEDIUM DENSITY APARTMENTS
PROPOSED ECO VILLAGE
CLUBHOUSE
VEHICLE/ CARAVAN/ BOAT STORAGE
FUTURE STREAM
PROPOSED 60m RIPARIAN CORRIDOR
POS 4
POS 5
POS 6
1501
500
501
502
504

SCALE 1:3000
A1

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BUNBURY +61 8 9722 3544
KALGOORLIE +61 8 9021 1811
PERTH +61 8 9722 3566
wml.com.au

REVISIONS				
N°.	DESCRIPTION	APPROVED	DATE	DRAWN
B	ISSUED FOR APPROVAL	L. RUSCONI	25/08/25	NT
A	ISSUED FOR INFORMATION	L. RUSCONI	9/11/21	WRS

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	9/11/21
DRAWN	W. STEWART	9/11/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL SUBSOIL DRAINAGE PLAN (REVISED LAYOUT)

THIS DRAWING SHALL BE TREATED AS PRELIMINARY AND IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED.

DRAWING NUMBER: 9723-C-SK06 B

REVISION: B

Appendix D

Geotechnical logs

Prepared by WML (2021)

WML accessible expertise	**TRIAL PIT: TP1**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6316078.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 18 0.35 - 0.50 19 0.50 - 0.65 29 0.65 - 0.80 31 0.80 - 0.95 25 0.95 - 1.10 25		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CL	Dry, pale grey, firm, fine to medium grained, **sandy CLAY** with a trace of silt and a trace of fine roots.
	0.5			CH	Dry, orange slightly mottled grey, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
				CH	Dry, pale grey mottled red, very stiff, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP2

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384638.0 m E 6316066.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 9 0.35 - 0.50 12 0.50 - 0.65 12 0.65 - 0.80 9 0.80 - 0.95 6 0.95 - 1.10 6 0.50m In-situ VS P=120kPa		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			CI	Dry, pale yellow, firm, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0			CL	Moist, yellow, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel and a trace of coarse roots.
	1.5			CH	Moist, grey banded red yellow, stiff, **CLAY** with a trace of fine roots. *Relic roots.*
	2.0				Hole Terminated at 1.60 m Hard Digging

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP3

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384833.0 m E 6315970.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 6 0.20 - 0.35 10 0.35 - 0.50 15 0.50 - 0.65 10 0.65 - 0.80 17 0.80 - 0.95 25 0.95 - 1.10 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	1.0			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.5	1.50m In-situ VS P>120kPa		SP	Moist, orange, dense, fine to medium grained, **clayey SAND** with a trace of boulders and a trace of fine to medium gravel. *Ironstone boulders present at 1.7m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP4

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316091.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 13 0.20 - 0.35 5 0.35 - 0.50 4 0.50 - 0.65 10 0.65 - 0.80 13 0.80 - 0.95 13 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CI	Dry, grey brown, stiff, **silty CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	0.5	0.50m PSD / PI		CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5	1.50m		CH	Moist, orange slightly mottled pale grey, stiff, fine to medium grained, **sandy CLAY** with a trace of cobbles. *Ironstone boulder around 1.8m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP5

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384734.0 m E 6316138.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 9 0.35 - 0.50 3 0.50 - 0.65 10 0.65 - 0.80 12 0.80 - 0.95 12 0.95 - 1.10 13		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	0.5			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP6

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384846.0 m E 6316210.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 5 0.35 - 0.50 3 0.50 - 0.65 3 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.50m		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.50m ASS			
		1.00m			Moist, brown mottled red grey, very stiff, **CLAY**.
	1.0	1.00m ASS		CH	
		1.30m In-situ VS P>120kPa			
		1.50m			
	1.5	1.50m ASS			
		2.00m		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0	2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP7

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385010.0 m E 6316074.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 16 0.20 - 0.35 17 0.35 - 0.50 20 0.50 - 0.65 12 0.65 - 0.80 8 0.80 - 0.95 8 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, pale grey, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5			CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5			CH	Moist, brown mottled red grey, very stiff, **CLAY**.
	2.0			CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP8

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385071.0 m E 6316207.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 14 0.35 - 0.50 10 0.50 - 0.65 10 0.65 - 0.80 10 0.80 - 0.95 11 0.95 - 1.10 12		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, grey brown, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.60m In-situ VS P>120kPa		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
		1.90m In-situ VS P>120kPa		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP9

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385168.0 m E 6316359.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 20 0.20 - 0.35 20 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 14 0.95 - 1.10 13		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, brown, very stiff, **CLAY** with a trace of fine roots and a trace of fine to medium grained sand.
	0.5			CH	Dry, brown mottled grey, hard, **CLAY**.
	1.0				
	1.5				
				CH	Moist, dark grey mottled red, very stiff, **CLAY** with a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP10**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385011.0 m E 6316369.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 7 0.35 - 0.50 9 0.50 - 0.65 5 0.65 - 0.80 4 0.80 - 0.95 4 0.95 - 1.10 4 1.10 - 1.25 4 1.25 - 1.40 3 1.40 - 1.55 5 1.55 - 1.70 4 1.70 - 1.85 5 1.85 - 2.00 5 2.00 - 2.15 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				ML	Dry, brown slightly mottled red, hard, **SILT** with some fine to medium grained sand and a trace of fine roots. *Iron content adding to material strength.*
	0.5			CI	Moist, orange, stiff, fine to medium grained, **CLAY** with some fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5			CI	Dry, orange brown mottled grey, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots. *Relic tree roots.*
				CI	Moist, orange brown slightly mottled red grey, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP11**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384847.0 m E 6316364.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 13 0.35 - 0.50 20 0.50 - 0.65 24 0.65 - 0.80 18 0.80 - 0.95 12 0.95 - 1.10 10		CI	Dry, pale yellow grey, firm, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m In-situ VS P>120kPa			
	1.5	1.60m PSD / PI		CH	Moist, red mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine gravel and a trace of fine roots. *Relic tree roots.*
	2.0	2.00m			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP12

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384619.0 m E 6316208.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 5 0.35 - 0.50 12 0.50 - 0.65 14 0.65 - 0.80 13 0.80 - 0.95 9 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND**.
	0.5			CI	Moist, orange, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.0			SP	Moist, orange, dense, fine to coarse grained, **clayey SAND** with a trace of cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP13**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384520.0 m E 6316176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 27 0.20 - 0.35 23 0.35 - 0.50 19 0.50 - 0.65 21 0.65 - 0.80 17 0.80 - 0.95 11 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.30m PSD / PI		SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of fine to medium gravel.
		0.70m PSD / PI		CH	Moist, grey mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m			
	1.5	1.30m In-situ VS P=85kPa 1.40m In-situ VS P>120kPa		CH	Moist, grey mottled orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine gravel.
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP14**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316250.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
		Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 7 0.35 - 0.50 6 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 3		SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5	0.95 - 1.10 3 1.10 - 1.25 3 1.25 - 1.40 2 1.40 - 1.55 3 1.55 - 1.70 5 1.70 - 1.85 10 1.85 - 2.00 26		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			CI	Moist, yellow, firm, fine to medium grained, **sandy CLAY**. *Moist to wet.*
	1.5	1.60m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0			CI	Moist, grey mottled red, very stiff, fine to coarse grained, **sandy CLAY** with a trace of fine roots.
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP15**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384300.0 m E 6316357.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
1m	1.0			SP	Wet, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
	1.5			Cl	Moist, grey blue slightly mottled orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0			Cl	Moist, banded brown green, stiff, fine to medium grained, **sandy CLAY**.
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP16**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384452.0 m E 6316358.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 6 0.45 - 0.60 5 0.60 - 0.75 4 0.75 - 0.90 4 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
1.4m				SP	Moist, grey, medium dense, fine to medium grained, **clayey SAND** with a trace of silt. *Most to wet.*
	1.5	1.70m In-situ VS P=90kPa		CI	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP17

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384617.0 m E 6316337.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows PSD / PI 0.00 - 0.15 3 0.15 - 0.30 5 0.30 - 0.45 4 0.45 - 0.60 7 0.60 - 0.75 11 0.75 - 0.90 16 0.90 - 1.05 13 0.50m		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium roots.
	1.0			SP	Moist, grey brown, dense, fine to coarse grained, **clayey SAND** with a trace of fine gravel and a trace of fine roots.
	1.5			CI	Moist, grey mottled brown, very stiff, **CLAY** with a trace of fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
				CI	Moist, brown mottled grey, very stiff, **CLAY** with some fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP18

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384581.0 m E 6316507.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 2 0.60 - 0.75 3 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 3 1.95 - 2.10 4		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			SP	Moist, yellow orange, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP19**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384504.0 m E 6316594.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 6 1.65 - 1.80 25		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots. *Medium root at 0.4m.*
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP20**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384408.0 m E 6316619.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5	0.90m ASS		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
		1.80m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP21**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384403.0 m E 6316495.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.65m 1.65m PSD / PI		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.70 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP22**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384233.0 m E 6316503.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 3 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP23**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384166.0 m E 6316581.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 5 1.05 - 1.20 13 1.20 - 1.35 22		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
1m	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.90m In-situ VS P=60kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP24**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384080.0 m E 6316519.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 6 0.15 - 0.30 8 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 3 1.05 - 1.20 8 1.20 - 1.35 12		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.50m In-situ VS P=110kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP25**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384018.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 7 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 6		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey brown, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt.
				CI	Moist, pale green blue, stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **clayey SAND**. *Clayey sand with clods of sandy clay.*
				CH	Dry, grey, hard, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP26**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384021.0 m E 6316722.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 10 0.20 - 0.35 6 0.35 - 0.50 3 0.50 - 0.65 6 0.65 - 0.80 14 0.80 - 0.95 12 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale grey yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of cobbles. *Clods of clay.*
	1.0	1.00m In-situ VS P>120kPa		CH	Moist, orange grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Clods of clay.*
	1.5	1.70m 1.70m PSD / PI		CH	Moist, yellow mottled grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Small to large lumps of clay with sand among clayey sand.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP27**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384165.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 6 0.90 - 1.05 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.5				Hole Terminated at 1.30 m Refusal
	2.0				

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP28**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384392.0 m E 6316711.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 5 1.65 - 1.80 10		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP29**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384515.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 5 1.65 - 1.80 6 1.80 - 1.95 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
0.8m ▽	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP30**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384711.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 1 0.45 - 0.60 1 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 3 1.65 - 1.80 3 1.80 - 1.95 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP31

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316710.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 4 0.95 - 1.10 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	0.90m In-situ VS P>120kPa		CL	Moist, dark grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			CI	Moist, orange yellow slightly mottled grey, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP32

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385068.0 m E 6316709.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 7 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 7 0.95 - 1.10 7		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5			CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP33**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385035.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 6 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 6		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.60m In-situ VS P>120kPa		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0				
	1.5	1.90m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP34**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384988.0 m E 6316476.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 9 0.65 - 0.80 7 0.80 - 0.95 8 0.95 - 1.10 9		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.50m 0.50m ASS		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m ASS		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	1.5	1.50m		CI	Moist, grey mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots. *Relic tree roots, minor cementation.*
	2.0	2.00m 2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP35**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385166.0 m E 6316488.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 6 0.35 - 0.50 6 0.50 - 0.65 5 0.65 - 0.80 5 0.80 - 0.95 5 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0				
	1.5			CH	Moist, brown red, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP36**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385173.0 m E 6316591.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 21 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 8 0.65 - 0.80 5 0.80 - 0.95 4 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.80m PSD PI In-situ VS P>120kPa		CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0			CH	Moist, brown mottled grey orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	1.5	1.50m		CH	Moist, brown mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to coarse gravel. *Ironstone gravel as excavated.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP37

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384967.0 m E 6316845.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 2 0.30 - 0.45 3 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 4 1.95 - 2.10 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP38**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384956.0 m E 6316978.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 7 0.30 - 0.45 7 0.45 - 0.60 6 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 6 1.05 - 1.20 11		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of cobbles. *Ironstone cobbles around 1.1m at top of clay layer.*
				Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP39**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385090.0 m E 6316960.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 7 0.30 - 0.45 8 0.45 - 0.60 6 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 5 1.95 - 2.10 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5	1.70m			
		PSD / PI		SP	Moist, yellow orange, medium dense, fine to medium grained, **clayey SAND**.
	2.0	2.00m			
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP40

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384944.0 m E 6317071.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 7 0.90 - 1.05 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			CH	Moist, grey brown mottled orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	1.5			CH	Dry, grey mottled orange, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP41

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384972.0 m E 6317189.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 7 0.60 - 0.75 9 0.75 - 0.90 11 0.90 - 1.05 21		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey brown mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine to medium roots. *Weakly cemented gravel and cobbles.*
		1.70m In-situ VS P=100kPa 1.90m In-situ VS P>120kPa		CI	Moist, grey mottled orange, very stiff, fine to coarse grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP42

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6317175.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 8 0.30 - 0.45 6 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey brown mottled red orange, very dense, fine to medium grained, **clayey SAND** with some cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles as excavated.*
	1.5			CH	Moist, grey orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP43**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384761.0 m E 6317336.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 5 0.50 - 0.65 2 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 6		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP44

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384778.0 m E 6317062.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 11 0.15 - 0.30 17 0.30 - 0.45 13 0.45 - 0.60 7 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 6 1.50 - 1.65 10 1.65 - 1.80 15		ML	Dry, brown, very stiff, **SILT** with some fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5			SP	Moist, black, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots and a trace of fine to medium gravel. *Wet to moist, water seeping in at 1.5m, likely from drainage channel.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP45

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384694.0 m E 6317164.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 2 0.35 - 0.50 4 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 7		SP	Dry, grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP46**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384710.0 m E 6317361.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 5 0.90 - 1.05 4 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 5 1.50 - 1.65 7 1.65 - 1.80 5 1.80 - 1.95 7 1.95 - 2.10 7		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to coarse gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP47**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384463.0 m E 6317461.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 4 0.30 - 0.45 5 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 10		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	1.35m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
		PSD / PI		SP	Moist, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
▽ 1.65m	1.5	1.65m		SP	Wet, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP48**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384382.0 m E 6317549.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 3 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 2 0.95 - 1.10 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
▽ 1.3m				SP	Wet, black brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium gravel.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP49

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384214.0 m E 6317679.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 3 0.35 - 0.50 3 0.50 - 0.65 4 0.65 - 0.80 3 0.80 - 0.95 3 0.95 - 1.10 3 1.10 - 1.25 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP50

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384247.0 m E 6317579.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 3 1.65 - 1.80 17		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP51**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384336.0 m E 6317411.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 3 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 2 1.65 - 1.80 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
▽ 1.6m				SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP52**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384276.0 m E 6317317.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 5 1.65 - 1.80 5 1.80 - 1.95 4 1.95 - 2.10 5		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP53

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384400.0 m E 6317280.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 2 1.65 - 1.80 3 1.80 - 1.95 3 1.95 - 2.10 3		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, pale grey tending grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
1.5m	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP54

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384177.0 m E 6317176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP55**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384144.0 m E 6317045.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5	1.50m In-situ VS P>120kPa			
		1.90m In-situ VS P=70kPa		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP56

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384014.0 m E 6317030.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, brown, dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
	1.5			CI	Moist, yellow mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
				CI	Moist, grey mottled yellow, stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP57**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384054.0 m E 6316913.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	0.5				
▽ 0.65m				SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.0			SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to coarse gravel.
	1.5			CH	Moist, pale green grey slightly mottled yellow, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP58

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384016.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse gravel and a trace of cobbles.
	0.5			SP	Moist, pale brown, dense, fine to medium grained, **clayey SAND** with some fine to medium gravel and a trace of fine roots. *Clods of clay within the clayey SAND.*
				SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel. *Strongly cemented layer.*
	1.0			SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel.
	1.5			CI	Moist, yellow mottled grey, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP59**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
1.4m	1.0				
	1.5			SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP60**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384266.0 m E 6317055.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.5m	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Dry Collapse; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP61**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384397.0 m E 6317054.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5				
	1.0				
	1.5				
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP62**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384368.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine to coarse roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse roots.
	1.0				
	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP63**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384357.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.2			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
▽ 1.2m	1.0			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Wet, dark brown, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Strongly cemented.*
	1.7			SP	Wet, grey yellow, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Cemented.*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP64**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384525.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP65

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384647.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5	0.50m 0.50m ASS			
	1.0	1.00m 1.00m ASS		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5	1.50m 1.50m ASS			
	2.0	2.00m 2.00m ASS		SP	Moist, yellow, dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of cobbles and a trace of clay. *Ironstone and weakly cemented SAND gravel/cobbles.*
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP66**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384625.0 m E 6316951.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, grey banded orange, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP67

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384492.0 m E 6317032.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5				
	1.0	1.00m PSD / PI		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.50m			
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP68

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6317165.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP69**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384603.0 m E 6317072.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP70**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384773.0 m E 6316944.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP71**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384754.0 m E 6316812.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
▽ 1.9m				SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP72**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384265.0 m E 6316815.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0				
1.4m					
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

MOISTURE DENSITY RELATIONSHIP REPORT

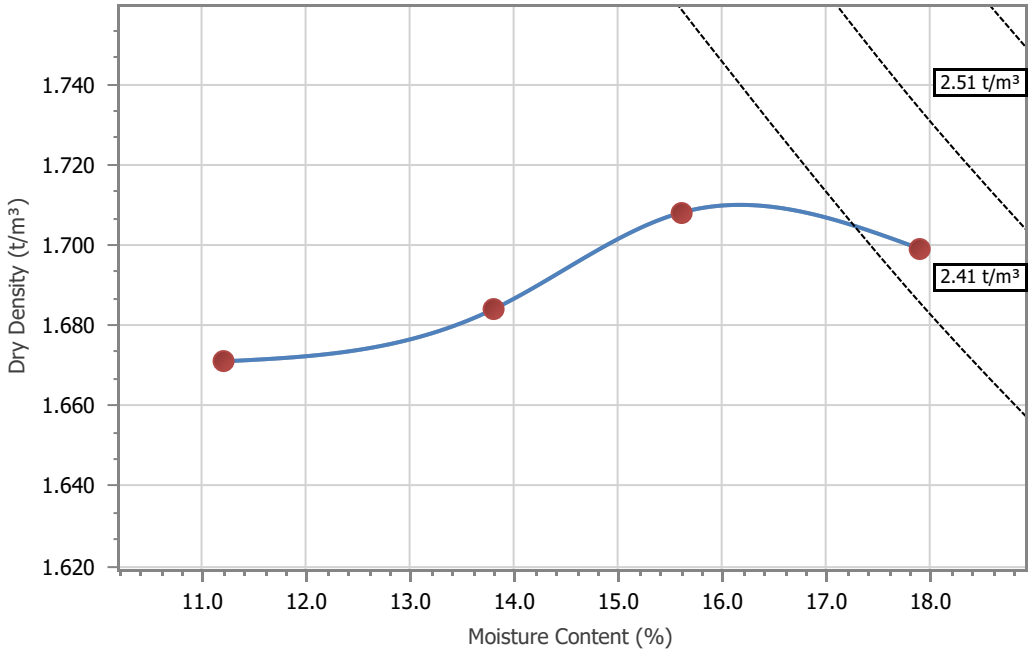
Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76952-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	18/09/2024 Page 1 of 1

Test Procedures	WA133.1, WA110.1, WA115.2, WA105.1	Location	South
Sample Number	5022/S/130373		
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	17/09/2024	Compactive Effort	Modified
Material Source	Pearson Pit	Percent Retained 37.5mm (%)	0
Material Type	Sand	Percent Retained 19.0mm (%)	0
Liquid Limit Method	n/a	Total Curing Time (hrs)	16.3
Material Description	Limestone		

Moisture / Density Relationship Data

Moisture Content (%)	Dry Density (t/m³)
11.2	1.671
13.8	1.684
15.6	1.708
17.9	1.699

MOISTURE DENSITY RELATIONSHIP PLOT



Maximum Dry Density (t/m³):	1.710	**Optimum Moisture Content (%):**	16.2

Remarks

NATA

Accredited for compliance with ISO/IEC 17025 – Testing

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W4Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

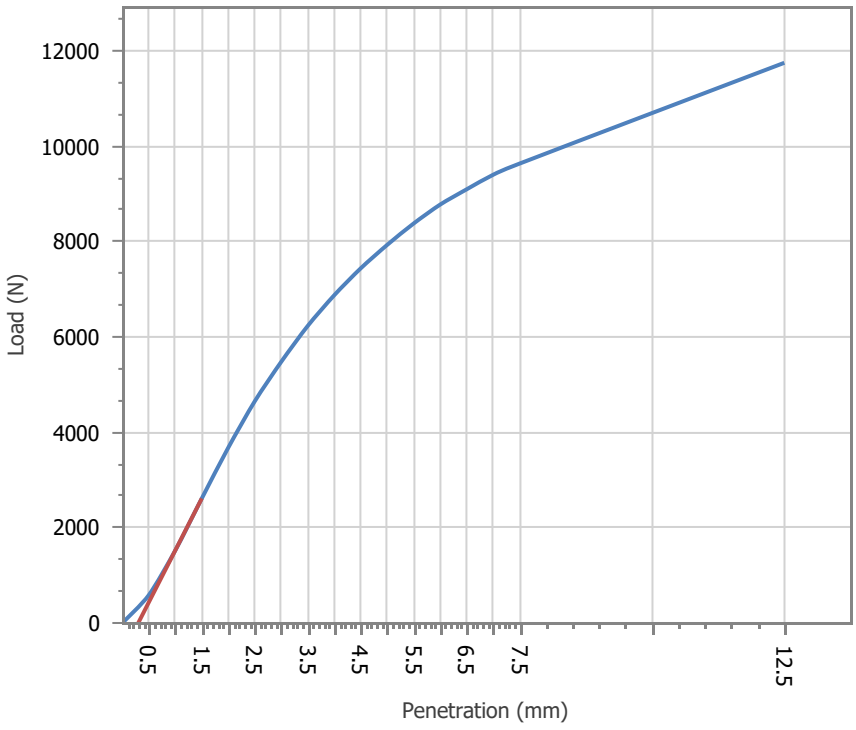
CALIFORNIA BEARING RATIO REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/77463-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	2/10/2024 Page 1 of 1

Test Procedures	WA141.1, WA105.1, WA133.1, WA110.1		
Sample Number	5022/S/130373	Location	South
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	1/10/2024		
Material Source	Pearson Pit	Material Limit Start	-
Material Type	Sand	Material Limit End	-
Client Reference	-	Compactive Effort	Modified
Material Description	Limestone		
Compaction Method	14 Blows per Layer		

Maximum Dry Density (t/m³):	1.710
Optimum Moisture Content (%):	16.2
Field Moisture Content (%):	8.9
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	94
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.619
Placement Dry Density Ratio (%):	94.7
Placement Moisture Content (%):	15.4
Placement Moisture Ratio (%):	95.1
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density Ratio After Soak (%)	95.6
Moisture / Ratio After Soak (% / t/m³)	19.4 / 120.0
Moisture (top 30mm) After Pen (%):	20.7
Mst Ratio (top 30mm) After Pen (%)	128.0
Moisture (remainder) After Pen (%):	19.3
Mst Ratio (remainder) After Pen (%)	119.0
CBR Swell (%):	-1.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**40**

CBR PENETRATION PLOT



Remarks

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

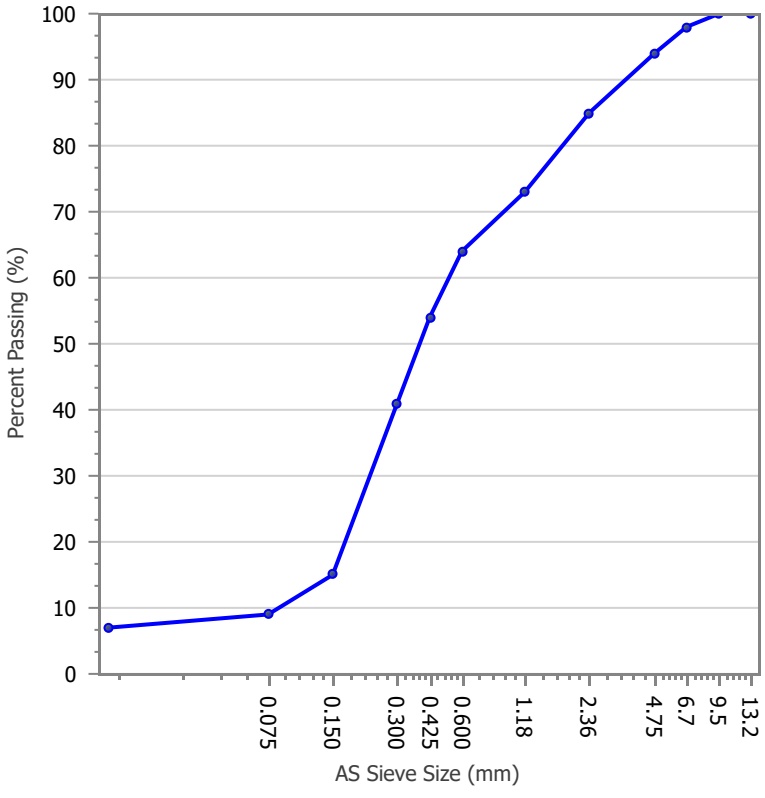
PARTICLE SIZE DISTRIBUTION REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76951-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	18/09/2024 Page 1 of 1

Test Procedures:	WA115.1, WA105.1		
Sample Number	5022/S/130373	Location	South
Sampling Method	WA100.1 Cl 6.2.5.1		
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	17/09/2024	Material Source	Pearson Pit
Prep / Drying Method	Decanted / -	Material Type	Sand
		Specification	-

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
13.2		**100**	
9.5		**100**	
6.7		**98**	
4.75		**94**	
2.36		**85**	
1.18		**73**	
0.600		**64**	
0.425		**54**	
0.300		**41**	
0.150		**15**	
0.075		**9**	
0.0135		**7**	

PARTICLE SIZE DISTRIBUTION GRAPH



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W9Rep Rev 3

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC24-02084-S01
Issue No: 1

Client: Construction Sciences Pty Ltd
PO Box 5004 Bunbury DC WA 6230
Project: Quality Control (Construction Sciences)

Location: B & J Catalano Pty Ltd
5029/P/295 - Pearson Pit

Accredited for compliance with ISO/IEC 17025-Testing
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Mark Buckels
(Senior Technician)
Date of Issue: 23/08/2024

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC24-02084-S01
Date Sampled	15/08/2024
Sampling Method	Tested as received
Material	Sand
Soil Description	Limestone Sand
Client ID	5022/S/128817
Sample Location	Pearson Lime Sand

Test Results

Description	Method	Result	Limits
Organic Matter (%)	AS 1289.4.1.1	0.2	
Date Tested		23/08/2024	

Comments

N/A

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Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

CLAY AND FINE SILT REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/76516-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/102
Project:	Runnymede Pit	Lot Number:	Screen Sand (30/08/24)
Location:	Bunbury	Internal Test Request:	5022/T/23934
Supplied To:	n/a	Client Reference/s:	PO 429885
Area Description:		Report Date / Page:	4/09/2024 Page 1 of 1

Test Procedures:	AS1141.33		
Sample Number	5022/S/129917	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	30/08/2024	Area	
Sampled By	Client Sampled	Location	Screen Sand (30/08/24)
Date Tested	04/09/2024	Sample No.	
Material Source	Runnymede Sand Pit	Material Type	Yellow SAND

Test Methodology Used:	Standard

Clay and Fine Silt (%)	7

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Hermanus Coetzee
Form ID: W41Rep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

CALCIUM CARBONATE CONTENT REPORT

Client:	B & J Catalano Pty Ltd	Report Number:	5022/R/77177-1
Client Address:	South Western Highway, BRUNSWICK JUNCTION	Project Number:	5029/P/295
Project:	Pearson Pit	Lot Number:	Pearson's Sand-South
Location:	Myalup WA	Internal Test Request:	5022/T/24011
Supplied To:	n/a	Client Reference/s:	PO 429720 / Pearson's Sand
Area Description:		Report Date / Page:	25/09/2024 Page 1 of 1

Test Procedures:	WA915.1		
Sample Number	5022/S/130373	Sample Location	
Sampling Method	WA100.1 Cl 6.2.5.1	Location	South
Date Sampled	9/09/2024		
Sampled By	Anton Bosch		
Date Tested	25/09/2024		
Material Source	Pearson Pit	Material Type	Sand

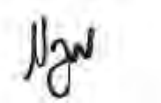
Average Calcium Carbonate Content (%)	57.9

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022



Approved Signatory: Hermanus Coetzee
Form ID: W52Rep

Appendix E

BORR report - Transverse drainage Northern & Central Sections

Supplied by MRWA

BORR Team

Transverse Drainage
Northern & Central Sections

27 February 2020



4 HYDROLOGIC ASSESSMENT

4.1 Flood Estimation Procedures

The following scope was carried out to estimate design flows from rural, ungauged catchments in the study area:

- Preliminary catchment delineation was undertaken based on LiDAR topographic data. For several areas it was not possible to define the catchment due to flat topography and drainage/irrigation channels
- For catchments which could be defined, peak flows were estimated using the following regional methods:
  - ARR1987 Rational and Index Flood Methods
  - ARR2019 RFFE Method
  - JDA 2018 Swan Coastal Plain Method
- 2-dimensional (2D) TUFLOW hydrodynamic models were developed to estimate 1% AEP peak flows at the same locations adopting the same inputs and parameters as the recently completed *Millars Creek Flood Study* (DWER, 2018)
- Estimated peak flows from the TUFLOW models were compared to those obtained using regional methods to determine a suitable methodology for sizing hydraulic structures.

Based on the outcomes of the assessment, the TUFLOW models are considered a suitable method to estimate design flows from ungauged catchments. A position paper was submitted to Main Roads WA for endorsement, which summarised the assessment methodology and outcomes (Appendix A).

4.2 Validation

1% AEP design flows from the 2D hydraulic models were compared to design flows adopted for several other studies within the project area.

4.2.1 Victory Main Drain

DWER (2018) estimated 1% AEP design flow of 62 m^3/s at the proposed BORR crossing. The 'Millars Creek' 2D hydraulic model used for this study estimated a 1% AEP design flow of 58 m^3/s.

4.2.2 Raymond Road – Treendale Main Drain

The Treendale Main Drain crossing at Raymond Road comprises an existing DN1050 RCP culvert. The upstream catchment shares similar characteristics to the Vindictive Main Drain catchment (cleared, flat paddocks with network of constructed drains). The 1% AEP flow of 2.5 m^3/s at the Vindictive Main Drain gauge obtained by JDA (2018) using at-site flood frequency analysis was used to estimate the design flow at the Raymond Road crossing which has a catchment area of 11.9 km^2 using the Equation:

$$Q_2 = Q_1 (A_2/A_1)^{0.745}$$

This resulted in a 1% AEP flow estimate of 8.8 m^3/s which compares well to the design flow from the TUFLOW model of 8.4 m^3/s.

4.2.3 Five Mile Brook

The *Five Mile Brook Flood Study* was carried out by Department of Water (now DWER) in 2018. As part of the study a RORB rainfall-runoff model was developed for the Five Mile Brook catchment which produced a 1%

AEP design flow at the BORR crossing of 17 m^3/s. This is consistent with the design flow obtained from the 'T01' BORR 2D hydraulic model.

4.2.4 Eadle's Gully

A 1% AEP design flow of 3.7 m^3/s was estimated for Eadle's Gully as part of the *Eadle's Gully Flood Study (WAWA, 1989).* The Eadle's Gully TUFLOW model developed for the BORR projects results in a 1% AEP design flow of 4.6 m^3/s. The 1989 report notes that the extent of swamp areas in the catchment can have a significant impact on runoff.

4.2.5 Vindictive Main Drain

Vindictive Main Drain has a stream gauging station with 20 years of recorded data spanning 1975 to 1995. The gauge has a contributing catchment area of 2.2 km^2 comprising relatively flat paddocks with a network of constructed drains. A flood frequency analysis on this gauge was carried out as part of the JDA (2018) study resulting in a 1% AEP design flow of 2.5 m^3/s. The 2D hydraulic model used for this study estimated a 1% AEP design flow of 4.5 m^3/s which may be conservative.

4.3 Design Flows

1% AEP peak flows extracted from the TUFLOW models under the pre-development scenario are summarised in Table 4-1 for the major crossings which are further described in Section 5. Locations are shown in the flood maps in Appendix E.

Table 4-1: 1% AEP Design Flows at Significant Crossings

Crossing Location	1% AEP Design Flow (m^3/s)
Treendale Main Drain	4.0
Treendale Branch Drains A and A1	5.6
Treendale Main Drain – Raymond Road	8.4
Raymond Road Diversion Channel	3.1
Collie River North	2.2
Victory Main Drain – Railway Road	27.0
Victory Main Drain – Waterloo Road	62.0
Vindictive Branch Drain C	7.5
Vindictive Main Drain	4.5
Moore Link Road	3.5
Gavins Gully Main Drain	24.5

- RCB culverts were adopted for the Harvey Water irrigation channels. Culverts were sized to have a width equal to or greater than the top width of the drain, and a height equal to or greater than the depth of the drain.
- Fauna crossings were incorporated either as stand-alone crossings or dual use culverts based on advice from Neil McCarthy (Environment & Heritage Leader).
- Culvert sizes/barrels were increased where required to manage backwater during the 1% AEP event.
- Where practical RCP culverts were adopted in lieu of RCB culverts. RCB culverts require the construction of a concrete base slab below the existing ground surface which is likely to be difficult because of high groundwater levels (especially during winter).
- A minimum RCP culvert diameter of 450 mm was adopted.
- A minimum cover of 0.6 m was adopted for culverts beneath the highway. It is expected that local/service roads and the PSP will have reduced cover requirements.

5.3 Significant Crossings

This section highlights some of the significant crossings (listed from north to south). Collie, Ferguson, and Preston River crossings are documented in the *Major Waterways Assessment* (BORR-01-RP-DR-0003) report.

5.3.1 Treendale Main Drain

The BORR crosses the Treendale Main Drain at approximate Ch 83,480 at a slight skew of 9°. The drain flows from the northeast to the southwest and will require a culvert under the highway and adjacent PSP. The post-development 1% AEP design flow for the Treendale Main Drain is approximately 3.0 m^3/s. 1x3000x2100 RCB culvert is proposed in this location based on the estimated size of the existing artificial channel. It is proposed to install the culvert skewed to the highway, however, options to provide a square culvert with stream training can be pursued during detailed design.

5.3.2 Treendale Branch Drains A and A1

The BORR crosses Treendale Branch Drains A and A1 at approximate Ch 84,300. The drains flow from east to west and converge at the proposed BORR crossing location. Both drains are skewed to the highway alignment and the geometry/proximity of the two at the downstream side of the crossing would be problematic if separate culverts were provided, therefore, it is proposed to divert Treendale Branch Drain A1 south to a single, square culvert crossing for the two drains. 2x2400x1200 RCB culverts are proposed in this location based on the estimated sizes of the existing artificial channels. The 1% AEP design flow at this location is 5.6 m^3/s.

5.3.3 Treendale Main Drain – Raymond Road

Flows from Treendale Main Drain are conveyed beneath the existing Raymond Road via a DN1500 RCP culvert. The post-development 1% AEP design flow at this location is 6.7 m^3/s. It is proposed to extend/replace the existing culvert in this location.

5.3.4 Raymond Road Diversion

2D flood modelling of the pre-development condition at Raymond Road near the proposed BORR alignment identified a 1% AEP flow in the order of 3.5 m^3/s along the southern side of Raymond Road. This flow currently passes under Raymond Road, into the Treendale Branch Drain A, at a stock underpass approximately 190 m east of Treendale Road. The Treendale Branch Drain A joins the Main Drain to the west of Treendale Road at the upstream side of a culvert that conveys the flow from both drains under Raymond Road and into the Collie River to the south.

5.3.14 Minor Waterway and Balancing Culverts

In addition to the waterway crossings and Water Corporation drain crossings discussed in the previous sections, there are Harvey Water irrigation channels, Local Government roadside drains, farm drains and local depressions across the northern and central sections. Culverts or diversion drains have been proposed at all these locations to minimise the impacts of the project on the surface flow across the site as much as possible and to maintain connectivity for irrigation and farming activities.

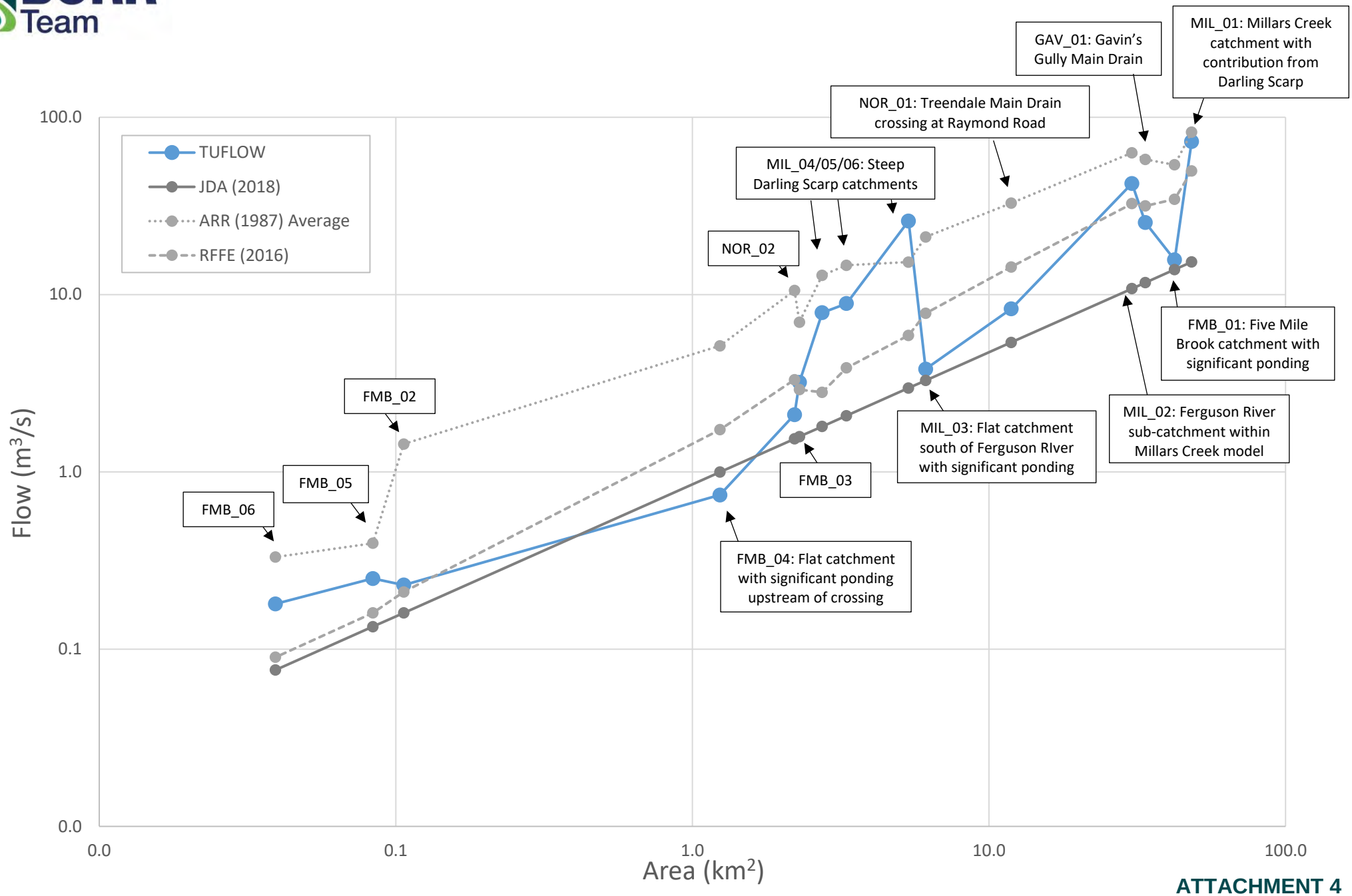
Culverts proposed under BORR between South Western Highway and the Railway also ensure hydrologic connectivity is maintained for the Resource Enhancement Category wetland and Threatened Ecological Community to the west of the alignment.

5.4 Limitations

Modelling and design has been carried out for the purpose of a planning study. The following limitations should be understood for detailed design.

- Minimum culvert diameter of 0.45 m has been assumed and shall be confirmed during detailed design.
- Culvert inverts have been estimated based on LiDAR data and should be confirmed using field survey.
- Existing channel sizes and capacities are difficult to ascertain using LiDAR data due to the presence of base flow or standing water. Field survey of the drainage channels would improve these estimates.
- The hydraulic models have adopted a 5 m grid resolution to achieve practical runtimes. Culvert sizing may be influenced by tailwater levels in the receiving drainage channels which are not well defined in the LiDAR or 2D models. Major channels (Victory Main Drain, Vindictive Branch Drain C) have been modelled as 1-dimensional elements to better define the channel section.
- High level checks were carried out for most culverts for compliance with minimum cover and freeboard criteria. Some crossings for some local/service roads and PSP may not meet freeboard/cover requirements.
- Culvert sizing for Water Corporation and Harvey Water channels has been based on existing channel section. Further consultation is required with Water Corporation and Harvey Water regarding suitability of culvert sizes.
- The hydraulic models have been developed to establish a concept design for the planning study. Refinements are likely to be required during future design stages.

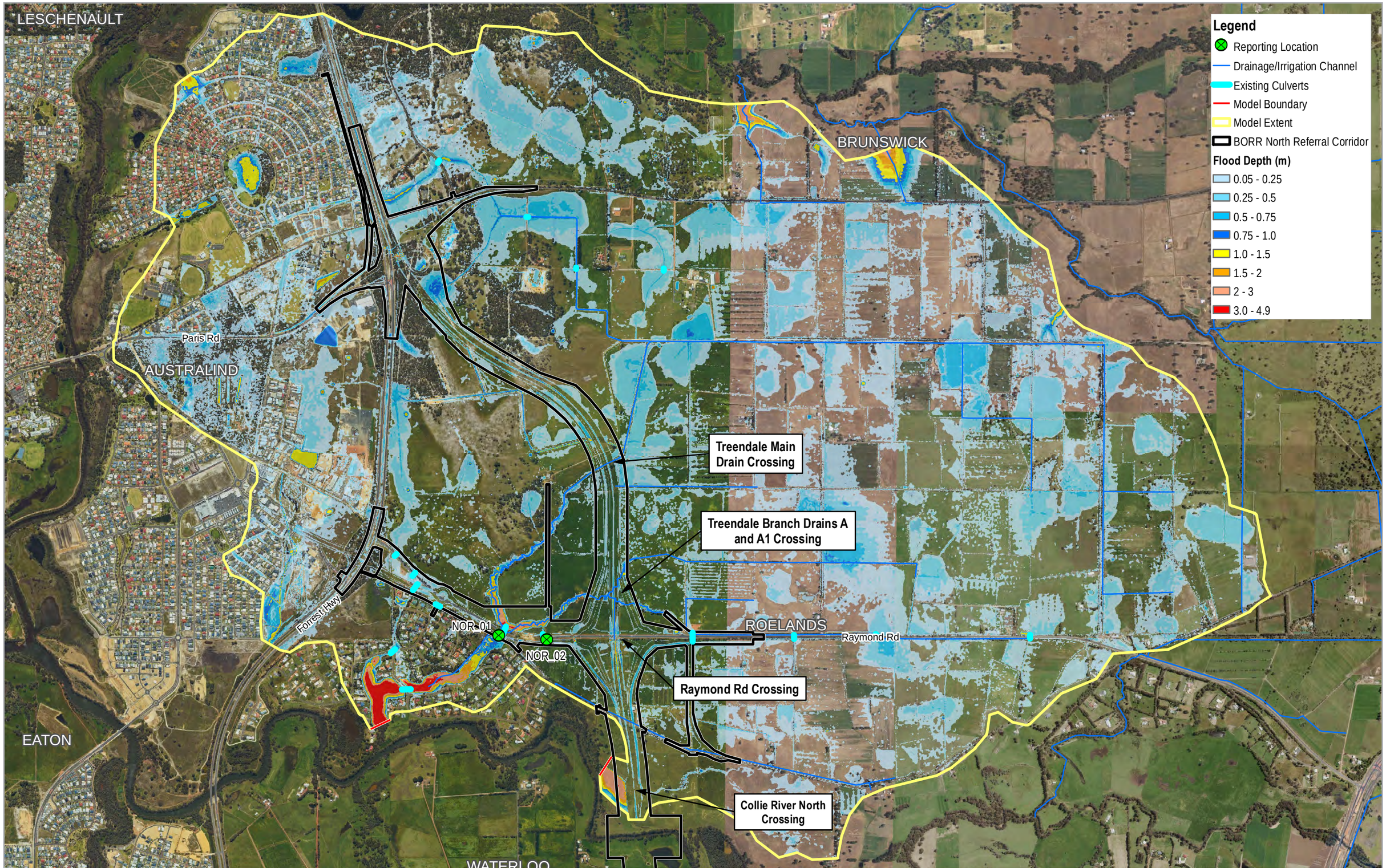
Transverse Drainage Hydrology Method Position Paper



ATTACHMENT 4

1% AEP FLOW VERSUS CATCHMENT AREA

1% AEP Flood Mapping



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Main Roads Western Australia
Bunbury Outer Ring Road

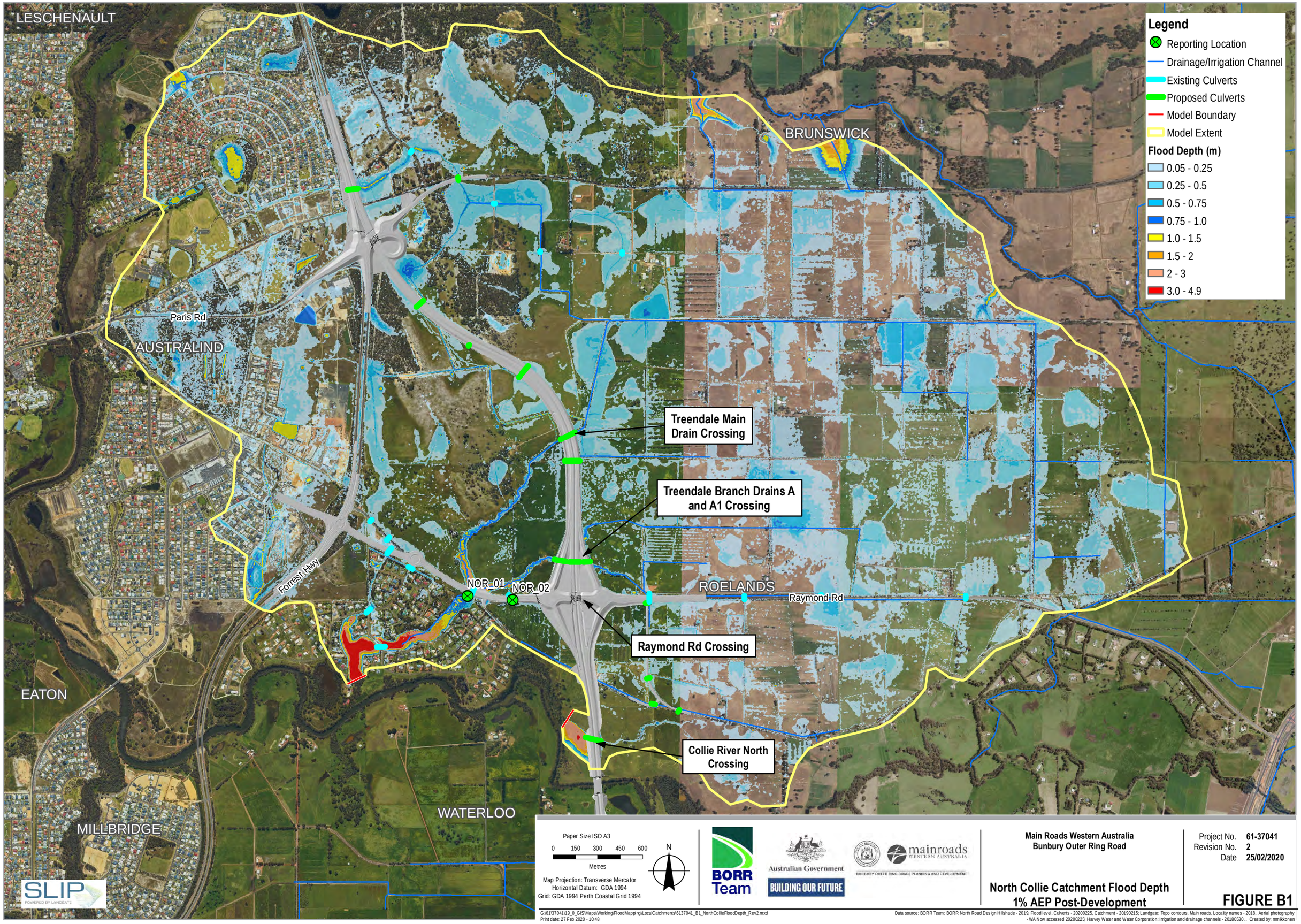
Project No. 61-37041
Revision No. 6
Date 25/02/2020

North Collie Catchment Flood Depth 1% AEP Pre-Development

FIGURE A1

G:\61\37041\19_0_GIS\Maps\Working\FloodMapping\LocalCatchments\6137041_A1_NorthCollieFloodDepth_Rev6.mxd
Print date: 27 Feb 2020 - 10:24

Data source: BORR Team: BORR North Referral Corridor - 20191016, Flood depth, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225, Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530. . Created by: mmikkonen



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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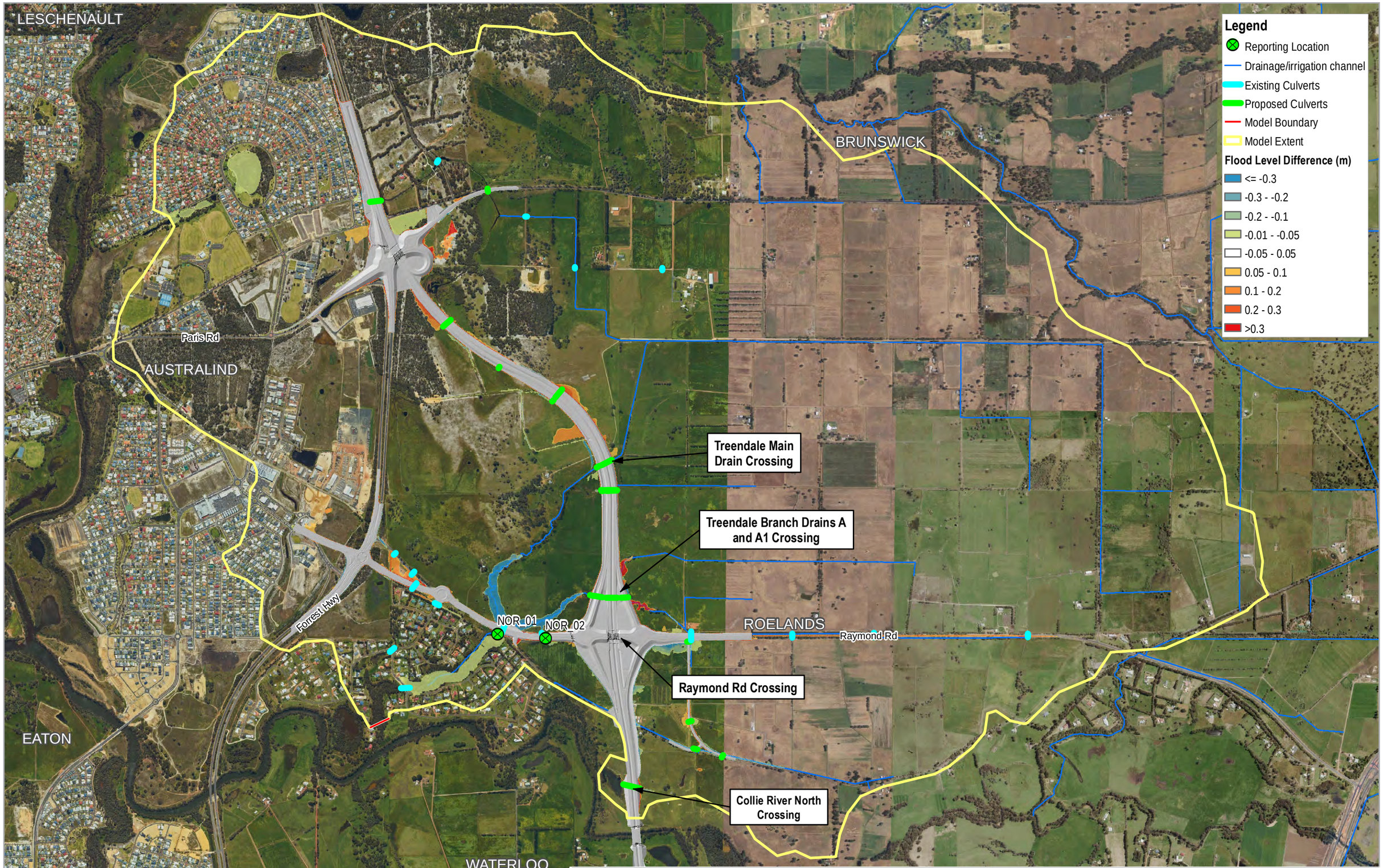
North Collie Catchment Flood Depth
1% AEP Post-Development

Project No. **61-37041**
Revision No. **2**
Date **25/02/2020**

FIGURE B1

G:\61\37041\19_0_GIS\Maps\Working\FloodMapping\LocalCatchments\6137041_B1_NorthCollieFloodDepth_Rev2.mxd
Print date: 27 Feb 2020 - 10:48

Data source: BORR Team: BORR North Road Design Hillshade - 2019, Flood level, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225, Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530.. Created by: mmikkonen



Paper Size ISO A3

0 150 300 450 600

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Bunbury Outer Ring Road

North Collie Catchment
1% AEP Flood Level Difference

Project No. **61-37041**
Revision No. **2**
Date **25/02/2020**

FIGURE C1

G:\61\37041\19_0_GIS\Maps\Working\FloodMapping\LocalCatchments\6137041_C1_NorthCollieFloodDepth_Rev2.mxd
Print date: 26 Feb 2020 - 16:35

Data source: BORR Team: BORR North Road Design Hillshade - 2019, Flood level difference, Culverts - 20200225, Catchment - 20190215; Landgate: Topo contours, Main roads, Locality names - 2018, Aerial photography - WA Now accessed 20200225; Harvey Water and Water Corporation: Irrigation and drainage channels - 20180530.. Created by: mmikkonen

Appendix F

Modelling assumptions report

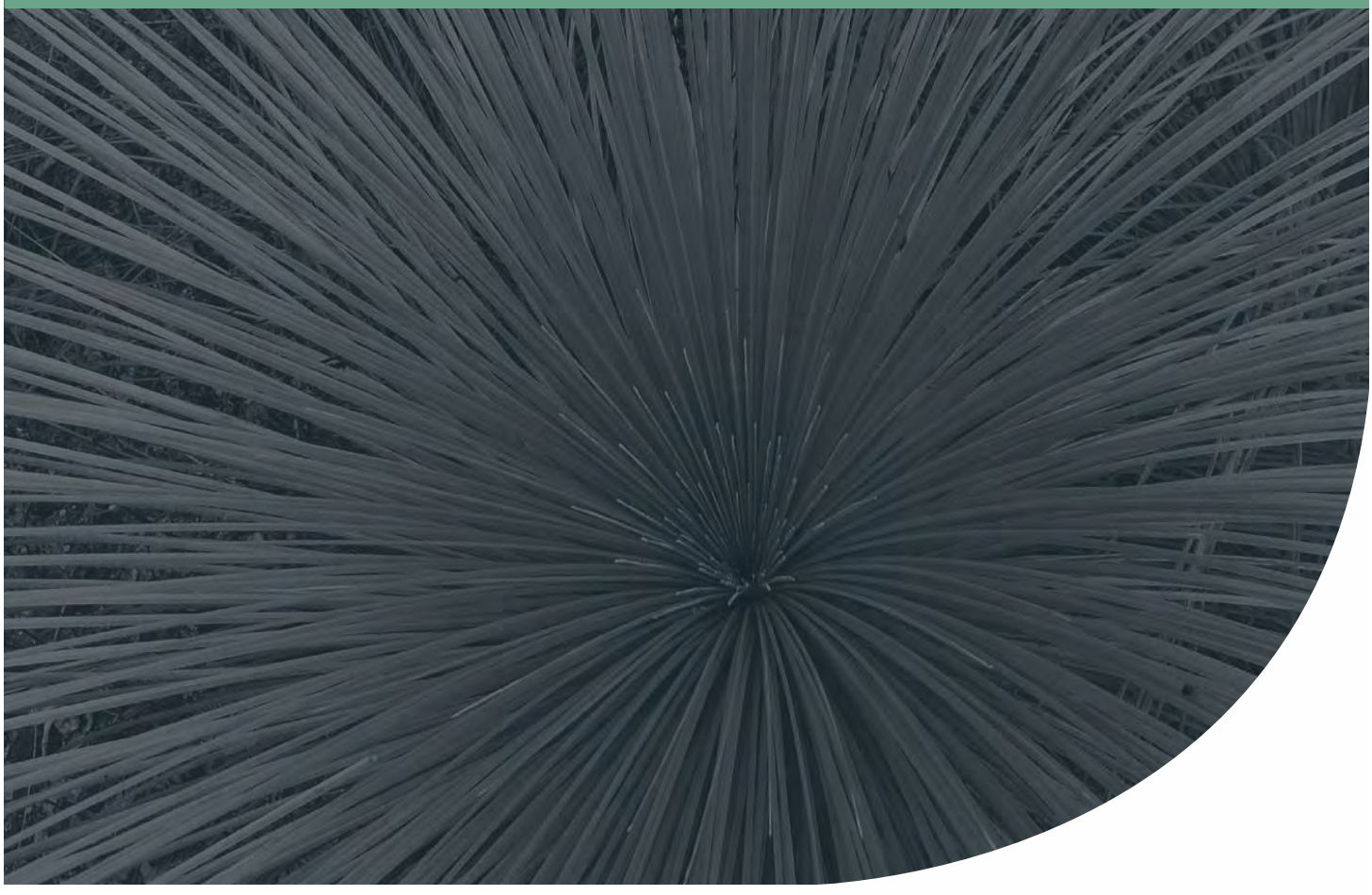
Prepared by Emerge Associates (2021)

Modelling Assumptions Report

Lots 151, 152 and 153 Raymond Road, Roelands

Project No: EP21-022(04)

Prepared for Treendale East Landowner Group
August 2025



Document Control

Doc name:	Modelling Assumptions Report Lots 151, 152 and 153 Raymond Road, Roelands				
Doc no.:	EP21-022(04)—010B				
Version	**Date**	**Author**		**Reviewer**	
1	January 2022	Johanna Boonzaaier	JB	Dave Coremans	DPC
	Prepared to support the WMS				
A	April 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updates to support the WMS				
B	August 2025	Mark Bretnall	MDB	Dave Coremans	DPC
	Updates to support the WMS				

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Table of Contents

1 Purpose of this Report 4

2 Methodology. 5

2.1 Rainfall 5
2.2 Inflows 6

3 Pre-development 7

3.1 Pre-development model 7
3.2 Results 8

4 Post development 9

4.1 Post development model 9
4.2 Post development discharges 11

5 References 12

5.1 General references 12
5.2 Online references 12

List of Tables

Table 1: 1% AEP design flows (BORR) 6
Table 2: Pre-development parameters 7
Table 3: Pre-development catchment areas and slopes 7
Table 4: Pre-development discharges 8
Table 5: Post-development parameters 9
Table 6: Post-development catchment areas (ha) 9
Table 7: Post-development discharges 11

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
AR& R	Australian Rainfall and Runoff
BOM	Bureau of Meteorology
BORR	Bunbury Outer Ring Road
FMDADS	Forrestdale main drain arterial drainage strategy
MRWA	Main Roads Western Australia

Table A2: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
AHD	Australian height datum
ARI	Average recurrence interval
CL	Continuing loss
GIS	Geographical information systems
IFD	Intensity, frequency and duration
IL	Initial loss
WMS	Water Management Strategy

Table A3: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
km	Kilometre
m	Metre
m AHD	Metres in relation to the Australian height datum
m/day	Metres per day
m^2	Square metre
m^3	Cubic metre
m^3/s	Cubic metre per second
mm	Millimetre
mm/hr	Millimetres per hour
%	Percentage

Table A4: Terminology - design rainfall

Equivalent average recurrence interval (ARI) terminology	Average exceedance probability (AEP) terminology utilised
1 in 1 year ARI event	63.2% AEP event
1 in 1.5 year ARI event	50% AEP event
1 in 5 year ARI event	20% AEP event
1 in 10 year ARI event	10% AEP event
1 in 20 ARI event	5% AEP event
1 in 50 ARI event	2% AEP event
1 in 100 ARI event	1% AEP event
1 in 200 ARI event	1 in 200 AEP event
1 in 500 ARI event	1 in 500 AEP event

1 Purpose of this Report

This report provides a summary of the assumptions informing the hydrological modelling that was undertaken to inform the water management strategy (WMS) and drainage design for the proposed urban development (Treendale East Estate) located on Lots 151, 152 and 153, Roelands within the Shire of Harvey.

The site covers approximately 182 ha, and is bound by Forrest Highway to the west, Raymond Road to the south, and existing farmland towards the east and north. Main Roads Western Australia (MRWA) is proposing to construct the northern and central sections of the Bunbury outer ring road (BORR), which once complete will enclose the northern and eastern edges of the development.

2 Methodology.

XPSWMM hydrological and hydraulic modelling software was used to calculate the surface water runoff volumes. The hydrological component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrological model include:

- Runoff is proportional to slope, area, infiltration and percentage imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from surveyed topographical data and earthworks plans.
- Infiltration rates and percentage imperviousness have been selected based on experience with model preparation for similar soil conditions.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSWMM. Generally, assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow path onsite) between nodes within a sub-catchment are given a length of 10 m and slope of 0.05 to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in a 1% average exceedance probability (AEP) event). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- All channels are designed with a width of 5 m, roughness of 0.014 (Manning's n) and are trapezoidal in shape. This allows for easy conveyance and represents concrete pipes and road surfaces within the model.
- Where relevant, soakwells, verge swales, bio-retention areas (BRAs), and flood storage areas (FSAs) are modelled as nodal-reservoirs with infiltration depth-rating curves to account for differential infiltration rates with changing depth.

2.1 Rainfall

The ensemble temporal patterns obtained from the Australian Rainfall and Runoff (AR&R) Data Hub (AR&R 2019) were used for the rainfall analysis.

Up to eight durations ranging between 1 hour and 72 hours were tested, with the peak flow being assessed as the determining result.

Following the process suggested by AR&R (Ball J *et al.* 2019), the highest mean duration was selected as the critical duration. AR&R also recommends that when it is not practical to run the entire ensemble array, the ensemble that produces the result closest to the mean (for the critical duration) should be adopted. The 4.5 hour duration ensemble 3 and the 4.5 hour duration ensemble 5 was adopted for the 1% AEP and 20% AEP events respectively for the post-development scenario.

2.2 Inflows

1% AEP design flows at significant crossings were determined by the BORR team and supplied by MRWA (BORR Team 2020) . Design flows for the Treendale main drain and branch drain (**Table 1)** were used to create triangular hydrographs as inflow into the site at these locations. Inflow hydrographs were scaled for the 20% AEP event based on the difference in rainfall.

Table 1: 1% AEP design flows (BORR)

Location	Design flow (m^3/s)
Treendale main drain	4
Treendale branch drain	5.6

3 Pre-development

3.1 Pre-development model

Pre-development modelling was undertaken to determine the discharge from the site. An initial loss continuing loss model was adopted to account for catchment losses. Loss values, roughness and runoff coefficients were based on characteristics of the site and are shown in **Table 2**.

Table 2: Pre-development parameters

Land type	Initial loss (mm)	Continuing loss	Roughness
Sandy areas	25	5	0.05
Clay areas	15	2	0.03

The pre-development catchment areas and land use types were digitised using aerial photography and these are shown in **Table 3**.

Table 3: Pre-development catchment areas and slopes

Land type	Slope	Sandy (ha)	Clay (ha)	Slope (m/m)
Ct-01	0.044	4.230	0.000	0.044
Ct-02	0.03	5.431	0.000	0.030
Ct-03	0.026	25.845	0.000	0.026
Ct-04	0.03	11.451	0.000	0.030
Ct-05	0.029	9.616	0.000	0.029
Ct-06	0.191	1.603	0.000	0.191
Ct-07	0.021	2.862	0.000	0.021
Ct-08	0.009	13.801	0.000	0.009
Ct-09	0.019	13.166	0.000	0.019
Ct-10	0.031	5.019	0.000	0.031
Ct-11	0.044	2.997	0.000	0.044
Ct-12	0.038	11.130	0.000	0.038
Ct-13	0.021	12.974	0.000	0.021
Ct-14	0.043	6.012	0.000	0.043
Ct-15	0.012	5.246	0.000	0.012
Ct-16	0.012	3.550	0.000	0.012
Ct-17	0.009	14.381	0.000	0.009
Ct-18	0.008	2.566	0.000	0.008
Ct-19	0.009	3.771	0.000	0.009

Table 3: Pre-development catchment areas and slopes (continued)

Land type	Slope	Sandy (ha)	Clay (ha)	Slope (m/m)
Ct-20	0.016	0.000	11.953	0.033
Ct-21	0.019	0.000	6.778	0.028
Ct-22	0.027	0.000	10.214	0.027
Ct-23	0.027	0.000	4.690	0.057
Ct-24	0.04	0.000	3.940	0.061
Ct-25	0.03	0.000	7.389	0.040
Ct-26	0.013	0.000	14.419	0.018
Ct-27	0.028	0.000	1.670	0.044
Ct-28	0.023	0.000	5.235	0.038
Ct-29	0.022	8.316	0.000	0.022
Ct-30	0.053	0.000	4.161	0.053
Ct-31	0.054	0.000	3.066	0.054
Ct-32	0.038	2.754	0.000	0.038
Ct-33	0.1	1.483	0.000	0.100
Ct-34	0.095	0.000	0.765	0.095
Ct-35	0.032	0.000	5.136	0.044

3.2 Results

The pre-development discharges from the site for the 20% AEP and 1% AEP events are shown in **Table 4**.

Table 4: Pre-development discharges

Location	AEP event	Discharge (m^3/s)
Raymond Road	20% AEP	6.6
	1% AEP	11.9
Forrest Highway	20% AEP	0.3
	1% AEP	1.8

4 Post development

4.1 Post development model

An initial loss continuing loss model was adopted to account for post-development catchment losses. The post-development catchment area, land types and loss values were based on the structure plan design, typical infiltration rates for the soils which occur onsite and based on project team experience. **Table 5** summarises the loss parameters used within the post-development model, with other catchment parameters detailed in

Table 6.

Table 5: Post-development parameters

Land type	Initial loss (mm)	Continual loss (mm)	Roughness
Road Surface	1	0.1	0.02
Road Verge	9	1	0.05
Lot pervious	25	3.5	0.05
Lot impervious	15	0.1	0.02
POS	20	2.5	0.05
Eco village pervious	15	0.1	0.02
Eco village impervious	1	0.1	0.05

Table 6: Post-development catchment areas (ha)

Catchment	Road surface	Road verge	Lot impervious	Lot Pervious	POS / Riparian/ Pipeline easement
Ct-P01	0.000	0.000	0.000	0.000	6.974
Ct-P02	0.856	0.571	1.273	1.273	0.584
Ct-P02a	1.224	0.816	0.51	0.351	5.085
Ct-P03	0.953	0.635	1.871	1.871	0.701
Ct-P04	4.391	2.928	7.736	7.736	4.143
Ct-P04C	1.942	1294	2.483	2.483	1.351
Ct-P04S	2.267	1.512	2.474	2.474	3.547
Ct-P05	2.434	1.623	3.697	3.697	1.875
Ct-P06	5.702	3.382	8.391	8.391	4.348
Ct-P07	1.900	1.267	2.688	2.688	16.944
Ct-P08	1.718	1.145	2.627	2.627	0.595
Ct-P09	0.207	0.138	2.156	2.156	1.012
Ct-P10	0.000	0.000	3.464	0.866	0.000
Ct-P11	0.000	0.000	3.650	0.913	0.000
Ct-P12	0.000	0.000	8.229	2.057	0.000
Ct-P13	0.000	0.000	4.028	1.007	0.000

Ct-P14	0.000	0.000	3.282	0.820	0.000
Ct-P15	0.000	0.000	1.267	0.317	3.201

The catchment layout and runoff storage locations are shown on **Figure 8** of the WMS.

The following assumptions were incorporated into the post-development model:

- Lots
  - Pervious areas on lots will retain the first 15 mm of runoff.
  - Impervious areas (driveways/paved areas) discharge to the road network.
  - Residential lots will have little slope (i.e. will be flat) and pockets of storage are likely. This will effectively increase the initial loss (storage) and overall infiltration rate (continual loss).
  - Garden areas in lots will have high infiltration rates as it is likely that sand-based landscape mix or mulch will be used.
- Road reserve
  - There will be no infiltration on roads, pavements and driveways. There will however be some minor absorption storage loss which is accounted for in the initial and continuing loss values.
  - The road reserve contains 40% pervious verge and 60% impervious bitumen areas for all catchments.
- POS
  - POS are assumed to be 95% pervious 5% impervious.
  - POS will likely contain dense vegetation or turf over a sand-based landscape mix.
- Storage/treatment
  - Bio-retention areas (BRAs) have 1:3 side slopes and maximum depths of 0.5 m.
  - BRAs retain small event runoff (first 15 mm) from road reserves and some lots (e.g. any that are directly connected due to localised soil conditions).
  - In-line storage areas with the waterway corridors detain the 1% AEP event in order to match the pre-development discharge from site.
  - Depth and size of in-line storage areas area based on the site topography as provided by the project team.
  - Median swales have a depth of 0.5 m with 1:6 side slopes
- Infiltration
  - A hydraulic conductivity of 2 m/day, with a clogging factor of 50%, is assumed for the infiltration in BRAs.
  - No infiltration in the in-line storages.
- Evapotranspiration
  - Volumes leaving the system through evapotranspiration were assumed to be negligible when compared to the total runoff volume and since the duration of the model run was comparatively short. XPSWMM default evapotranspiration assumptions are therefore used.

4.2 Post development discharges

The post-development discharges from the site for the 20% AEP and 1% AEP events are shown in **Table 7**.

Table 7: Post-development discharges

Location	AEP event	Discharge (m^3/s)
Raymond Road	20% AEP	5.9
	1% AEP	11.85
Forrest Highway	20% AEP	0.2
	1% AEP	0.4

5 References

5.1 General references

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Editors) 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

BORR Team 2020, *Transverse Drainage Northern and Central Sections*.

5.2 Online references

Bureau of Meteorology (BoM) 2021a, *Climate Data Online,* viewed 16 September 2021, Available from, < http://www.bom.gov.au/climate/data/>.

Bureau of Meteorology (BoM) 2021b, *Design Rainfall Data System (2016),* viewed 16 September 2021, Available from, <http://www.bom.gov.au/water/designRainfalls/revised-ifd/>.

Appendix G

Groundwater bore logs and monitoring data

Prepared by Emerge Associates (2021)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2109688**	Page	: 1 of 7
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: DAVID COREMANS	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9380 4988	Telephone	: 08 9406 1307
Project	: EP21-022(03) Treendale GWQ and SWQ monitoring	Date Samples Received	: 23-Aug-2021 11:30
Order number	: EP20-141	Date Analysis Commenced	: 23-Aug-2021
C-O-C number	: ----	Issue Date	: 31-Aug-2021 12:19
Sampler	: Fabio Hernandez		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK061G/EK067G (TKN/TP): LOR for sample EP2109688-006 raised due to possible sample matrix interference.
- EK055G, EK057G, EK059G and EK071G for sample #1 to 12 were analyzed from UT field filtered/frozen nutrient bottles.
- EK055G, EK057G, EK059G and EK071G for sample #13 to 24 were analyzed from unpreserved natural bottle.
- It has been noticed that there were some results disparity between two bottle types of the same sample. RP results of sample #1, 2, 3 and 5, NOx results of sample #1, 2, 4, 7, 8, 11 and 12, and NH3 results of sample #5 and 11 have been confirmed by re-preparation and re-analysis. Please scrutinize results accordingly.

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	SW01	SW02	SW03	MW1	MW2
				Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00
					EP2109688-001	EP2109688-002	EP2109688-003	EP2109688-004	EP2109688-005
					Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**112**	**220**	**8**	**12**	**40**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.08**	**0.07**	**0.05**	<0.01	**1.22**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.18**	**0.15**	**0.07**	**1.96**	**0.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.18**	**0.16**	**0.07**	**1.96**	**0.02**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.5**	**4.6**	**2.3**	**0.8**	**5.2**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.7**	**4.8**	**2.4**	**2.8**	**5.2**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.77**	**1.14**	**0.38**	**0.01**	**1.77**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.13**	**0.11**	**0.08**	<0.01	**0.83**

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	MW3	MW4	MW5	MW6	MW7
				Sampling date / time	19-Aug-2021 00:00	20-Aug-2021 00:00	20-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00
					EP2109688-006	EP2109688-007	EP2109688-008	EP2109688-009	EP2109688-010
					Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**475**	**33**	**96**	**44**	**7550**
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.09**	**0.07**	**0.03**	<0.01	**0.03**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**0.34**	**2.84**	**0.06**	**0.04**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**0.34**	**2.84**	**0.06**	**0.04**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.1**	**0.5**	**1.2**	**1.4**	**2.8**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.1**	**0.8**	**4.0**	**1.5**	**2.8**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.02	**0.05**	**0.04**	**0.15**	**0.41**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW8	QA 01	SW01	SW02	SW03
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00
Compound	CAS Number	LOR	Unit	EP2109688-011	EP2109688-012	EP2109688-013	EP2109688-014	EP2109688-015
				Result	Result	Result	Result	Result
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	133	17	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.79	<0.01	0.07	0.08	0.06
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.01	0.02	0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.79	0.85	0.40	0.22	0.07
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.79	0.85	0.41	0.24	0.08
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.6	0.6	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	3.4	1.4	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.36	0.02	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.04	<0.01	0.25	0.21	0.12

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW1	MW2	MW3	MW4	MW5
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	20-Aug-2021 00:00	20-Aug-2021 00:00
Compound	CAS Number	LOR	Unit	EP2109688-016	EP2109688-017	EP2109688-018	EP2109688-019	EP2109688-020
				Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	**2.47**	**0.13**	**0.03**	**0.01**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**2.99**	<0.01	<0.01	**0.66**	**6.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**3.00**	<0.01	<0.01	**0.66**	**6.02**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**2.12**	<0.01	**0.01**	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW6	MW7	MW8	QA 01	----
			Sampling date / time	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	19-Aug-2021 00:00	----
Compound	CAS Number	LOR	Unit	EP2109688-021	EP2109688-022	EP2109688-023	EP2109688-024	--------
				Result	Result	Result	Result	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	**0.06**	**1.14**	<0.01	**----**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	**----**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.10**	**0.05**	**1.87**	**2.99**	**----**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	**0.05**	**1.87**	**3.00**	**----**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2112356**	Page	: 1 of 5
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: DAVID COREMANS	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9380 4988	Telephone	: 08 9406 1307
Project	: EP21-022 Treendale East monitoring	Date Samples Received	: 14-Oct-2021 14:00
Order number	: EP21-062	Date Analysis Commenced	: 15-Oct-2021
C-O-C number	: ----	Issue Date	: 22-Oct-2021 13:45
Sampler	: Brodie Mastrangelo		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 12		
No. of samples analysed	: 12		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that total phosphorus (EK067G) is less than reactive phosphorus (EK071G) for sample #2. However, the difference is within experimental variation of the methods.
- EK061G/EK067G: TKN and Total Phosphorus results for sample #1, 7 and 12 have been confirmed by re-extraction and re-analysis.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	MW1	MW2	MW3	MW4	MW5
				Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00
					EP2112356-001	EP2112356-002	EP2112356-003	EP2112356-004	EP2112356-005
					Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	**2.93**	**0.14**	<0.01	<0.01
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**2.57**	**0.01**	<0.01	**0.40**	**6.13**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**2.57**	**0.01**	<0.01	**0.40**	**6.13**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.1**	**5.3**	**1.2**	**0.4**	**0.9**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**5.7**	**5.3**	**1.2**	**0.8**	**7.0**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.24**	**1.74**	**0.08**	**0.03**	**0.08**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**1.84**	<0.01	**0.01**	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW6	MW7	MW8	SW1	SW2
			Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00	13-Oct-2021 00:00
Compound	CAS Number	LOR	Unit	EP2112356-006	EP2112356-007	EP2112356-008	EP2112356-009	EP2112356-010
				Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	**0.07**	**0.69**	**0.02**	<0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.07**	**0.14**	**0.95**	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.07**	**0.14**	**0.98**	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**7.8**	**2.4**	**2.3**	**1.3**	**0.9**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**7.9**	**2.5**	**3.3**	**1.3**	**0.9**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**1.18**	**0.39**	**0.23**	**0.12**	**0.16**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	**0.09**	**0.02**	**0.03**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SW3	DUP1	----	----	----
			Sampling date / time	13-Oct-2021 00:00	13-Oct-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP2112356-011	EP2112356-012	--------	--------	--------
				Result	Result	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	**0.04**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.12**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.12**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.2**	**1.0**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**1.2**	**1.1**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.21**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	----	----	----

Appendix H

Education material

Planning your planting

Create 'watering zones' in your garden by grouping plants with similar watering needs. This will allow you to make more efficient use of your garden water by ensuring that no plants are over or under watered.

The Waterwise 'Drop Zone' system makes it easy to identify a plant's water requirements. This system divides plants into one of three groups depending on their watering needs. 'Three Drop' plants require the most watering (usually every second day in summer), whereas 'Two Drop' and 'One Drop' plants require less watering respectively.

It's also important to reticulate only once on your allocated days, either before 9am or after 6pm. Look for the Waterwise 'Drop Zone' system at your local Waterwise garden centre. To find the centre closest to you, visit www.watercorporation.com.au or call the Waterwise Helpline on 13 10 39.

Remember, a small amount of planning now can save plenty of water in the future.

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

DOW310858



Government of **Western Australia**
Department of **Water**

Planting a local native garden

Looking after all our water needs









In an era of rising temperatures and decreasing rainfall it is important to look at how we use water in our gardens.

Did you know?

About half of the water typically used in our homes is actually used to water the garden (and of that almost all is used to water lawns).

Many of us water lawns that we simply don't use, or water more than we need to. Similarly, often the plant species in our gardens are exotic and not entirely suitable to our climate – needing more water to survive.

Why go native?

- Local native plants are best suited to the local climate, conditions and soil. Therefore they require minimal inputs such as water, fertiliser and maintenance.
- They attract local wildlife, insects and birds and provide corridors of biodiversity in developed areas.
- They have minimal impact on the environment – unlike many introduced species, which have become bushland weeds and prove difficult and expensive to eradicate.
- They represent local heritage, teaching us about nature and our local identity.

Mulch. Mulch. Mulch.

If everyone fully utilised mulch in the garden, a much lower percentage of household water usage would end up on the garden.

The even better news is that mulching is very easy! Raw materials like woodchips and tree clippings are best, but any organic mulch will suffice. Simply spread at least 50mm of mulch over the whole planting area, leaving a small amount of breathing space at the base of the stem. This mulch won't need to be topped up again until autumn. Be sure not to turn or disturb the mulch as this will break the fine feeder roots that develop between the mulch and the soil.

In addition to mulch, a wetting agent can help overcome water repellence in soils, allowing water to penetrate the soil more quickly and in larger amounts. You can find wetting agents at your local nursery or garden centre.

Want to know more?

The Department of Water is committed to making sure that the water needs of Western Australia are met now, and in the future. Small steps we each take can make a big difference to the sustainability of our precious water supply. If you would like to know more, visit the Department of Water website – www.water.wa.gov.au.

Key tips for reducing groundwater use

- Design gardens and landscaping to enhance absorption of rain into the ground and to minimise evaporation – by using local native garden beds, mulch and subsurface irrigation etc.
- Keep planted areas dense and group plants with similar water needs together and make use of windbreaks.
- Prepare the soil before planting to ensure that plants can make the most of the water they need.
- Re-use water from the home in the garden – this includes bucketing greywater from the laundry and bathroom as well as water from downpipes connected to your house gutters. You can also install a subsurface greywater reuse system. For further information, contact your local council or visit www.water.wa.gov.au

Key tips for protecting our groundwater

- **Reduce your reliance on bore water.** Our rainfall has reduced, which means less water to recharge our aquifers. Continued housing development in some areas can increase the number of new garden bores and the use of groundwater.

  The Department of Water has drawn up a map of Perth's groundwater area with boundaries showing which areas are better suited for bores.

- **Design gardens and landscaping to enhance maximum absorption of rainfall into the groundwater and minimise evaporation.** Use local native plants, mulch and subsurface irrigation.

- **Reduce your use of fertilisers and chemicals.** These can contaminate groundwater, particularly products high in phosphate.

- **Reduce water use through a variety of water saving mechanisms in the home and garden.**

- **Re-use water from the home in the garden – this includes bucketing greywater from the laundry and bathroom as well as water from downpipes connected to your house gutters. You can also install a subsurface greywater reuse system. For further information, contact your local council or visit www.water.wa.gov.au**

For your watering days and other information on water saving in homes and gardens visit www.watercorporation.com.au or call 1800 508 55

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

DOW310858



Government of **Western Australia**
Department of **Water**

Looking after all our water needs

Extracting groundwater





Water quality

The quality of groundwater can be affected in many ways.

- The use of lawn and garden fertilisers heavy in phosphate is a major issue in Perth. Phosphates easily soak through the sand plain into the aquifer, rivers, ocean, creeks and swamps. This results in aquatic life dying and the growth of dangerous algae in freshwater lakes and rivers.
- Oils, paint thinners, various workshop chemicals – if poured into the sandy soil – will soak through to the aquifer and create long-term pollution issues.
- Heavy metal particles are dangerous to our health, as are hydrocarbons. These come from vehicle fuel systems, brake linings and exhaust systems. When vehicles are parked on private driveways and carports, such material will wash into your private soak wells and eventually into the aquifer. Remember to clean out your soak wells annually, to remove any leaf and pollutant build-up. This will also aid in the efficiency of your soak wells and reduce internal flooding problems.

Groundwater – the situation

Over two-thirds of Perth's water supply comes from groundwater. The Perth region has an underground geology which includes large areas of deep sand and limestone. Rain falling over this area and running off the hills builds up underground as a shallow semi-freshwater aquifer, which is available for household bores in some areas.

The freshwater aquifer is renewed each year with rainfall. With rainfall continuing to decline in Perth, and more homes being equipped with bores, the draw on the aquifer is increasing, thus creating a threat to ongoing bore water supply.

Groundwater recharge

Traditionally, stormwater run-off from roofs and roads and other surfaces has been collected in drainage pipes and exported into the ocean or waterways.

This 'lost' water can be a valuable resource to recharge a shallow groundwater aquifer. Sandy soils are extremely permeable and well suited to infiltration of stormwater to increase groundwater levels.

Recharging the groundwater aquifer with stormwater helps manage the local water cycle balance and prevents problems associated with increased bore water extraction, acid sulphate soils, salinity and waterlogging.

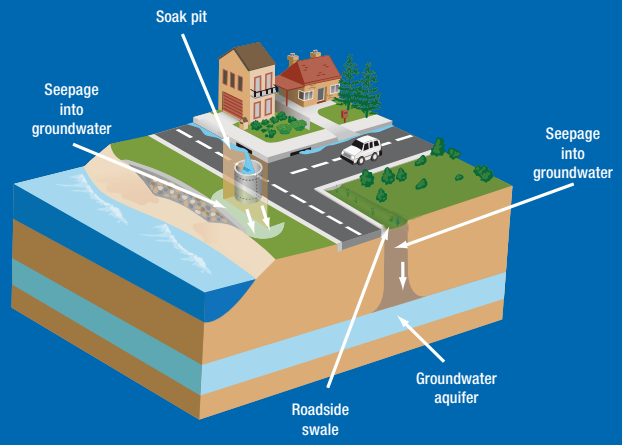


Managing local stormwater

'Stormwater' is a term used to describe the water which runs off surfaces such as houses and driveways and flows down into drains and stormwater pipes.

Poor stormwater management can damage not only individual properties but the environment in general. Local councils invest significant amounts of money into operating and maintaining the stormwater network.

Maximising infiltration of stormwater into groundwater can be achieved by replacing traditional drainage pipes with infiltration devices such as soakage pits and bioretention swales, as illustrated below.



Government of Western Australia
Department of Water

Looking after all our water needs

Water sensitive urban design

Rainwater storage and reuse systems

Summary

Rainwater storage systems are a simple method of capturing rainwater, traditionally from roofs, for use as an alternative water supply source and to reduce consumption of scheme water. When installed and maintained in accordance with recommended guidelines, they can provide a high quality source of water.

This brochure is part of a series that explain various aspects of water sensitive urban design. Please see *Water sensitive urban design in Western Australia* for background information on water sensitive urban design.

Main benefits

- Rainwater storage systems reduce the demand on potable water supplies.
- More rainwater is harvested when the tank is plumbed inside the house for uses such as toilet flushing. This creates a consistent drawdown on the tank supply, so there is always space to collect rainwater.
- They reduce the amount of directly connected impervious areas.
- They reduce stormwater peak flow rates and volumes.
- They reduce water supply peak flow rates and volumes.
- They can be retrofitted in houses and other buildings, including in high density urban areas.
- They can provide a water supply for (water sensitive) urban gardens and reduce the heat island effect in high density urban landscapes.

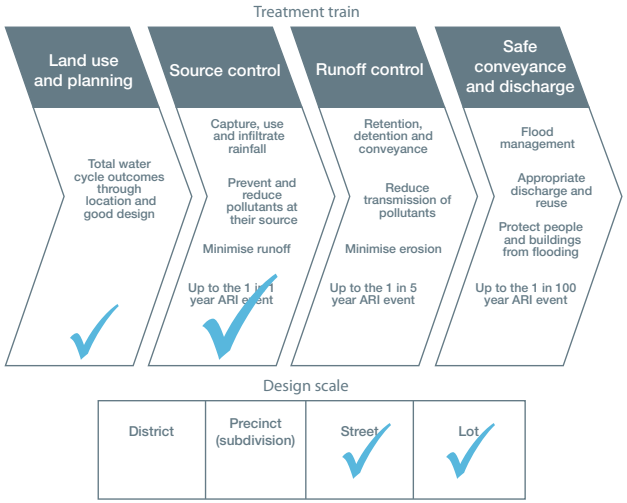
Design factors

- Put 'first flush' devices and mesh screens over all inlets and outlets to minimise maintenance requirements and preserve water quality.
- Designs for stormwater management include an air gap with trickle feed discharge level control and may include an infiltration trench or soakwell, depending on site characteristics.
- Storage can be above or below ground.
- Match storage size to collection area, end use, rainfall quantity and seasonal variability.
- Larger storage sizes are required where rainfall is unreliable and alternative supplies are not available.

Target pollutants

Rainwater storage systems are not designed to achieve direct improvements in stormwater quality.

Where they can be used in the water sensitive urban design process





Concrete underground tank



Slimline domestic rainwater tank

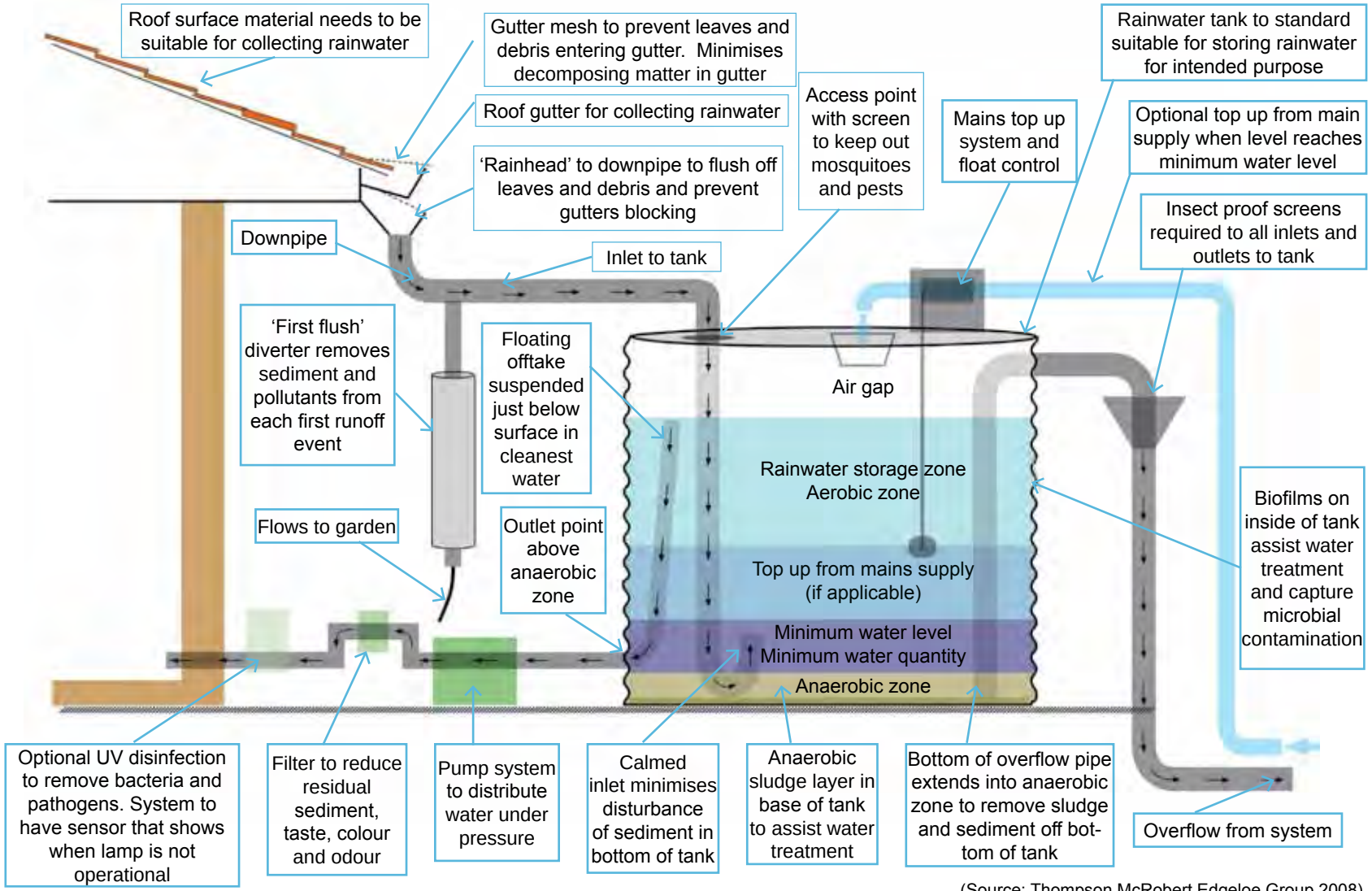


Poly domestic rainwater tanks

Water sensitive urban design

Rainwater storage and reuse systems

Example of above ground rainwater tank



(Source: Thompson McRobert Edgeloe Group 2008)

Required reading

Australian runoff quality: a guide to water sensitive urban design, 2006, Engineers Australia, available at <www.arq.org.au>.

Rainwater tank design and installation handbook, 2008, HB230-2008, Standards Australia.

Stormwater management manual for Western Australia, 2004–07, Department of Water, available at <www.water.wa.gov.au>. See Section 2.1 of Chapter 9 – Structural controls.

Testing of products for use in contact with drinking water, 2005, AS/NZS 4020:2005, Standards Australia.

Urban rainwater collection guidelines, Department of Health, Western Australia.

The department acknowledges the past project contributions of the Leschenault Catchment Council.

Department of **Water**
168 St Georges Terrace
Perth Western Australia
PO Box K822 Perth
Western Australia 6842
Ph: 08 6364 7600 • Fax: 08 6364 7601
www.water.wa.gov.au

June 2011
21592_100_06/11

Government of **Western Australia**
Department of **Water**

Saving water in the garden.

Did you know?

Pot plants use a lot more water than plants in the ground. They're more exposed to the sun and wind, only store a small amount of water and dry out faster, so you water them more.







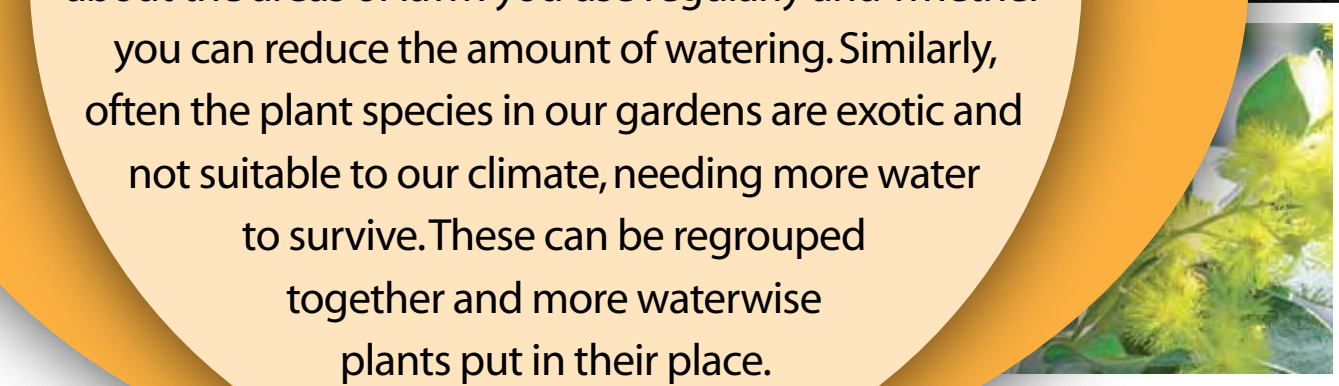
- Reduce your lawn cover. Most of the water used in our homes goes on the lawn.
- Plant local natives. They require less water and fertiliser.
- Mulch. Organic mulches reduce evaporation and restrict weed growth.
- Collect rainwater. This will save scheme water.
- Water deeply. Watering slower, for longer, less often encourages deep root growth.
- Use greywater. Re-use your laundry and bathroom water on your garden.
- Install a drip irrigation system. This will deliver water straight to the root system.
- Landscape. Group plants to suit watering needs. Keep high water use plants together.
- Use a pool cover. It will reduce evaporation by up to 97%, saving water and money.
- Maintain. Check taps and reticulation regularly for leaks and blockages.

Government of **Western Australia**
Department of **Water**

Grow local native plants and save water.

Did you know?

About half the water typically used in our homes is used to water the garden, generally lawns. Many of us water a large lawn and only use part of that lawn. Some of us overwater even those parts of the lawn we do use regularly. Think about the areas of lawn you use regularly and whether you can reduce the amount of watering. Similarly, often the plant species in our gardens are exotic and not suitable to our climate, needing more water to survive. These can be regrouped together and more waterwise plants put in their place.







- Local native plants are best suited to the local climate, conditions and soil.
- They require less water, fertiliser and maintenance.
- They attract local wildlife, insects and birds.
- They have minimal impact on the environment, unlike some introduced species which have become bushland weeds.
- Local plants represent local heritage, teaching us about nature and our local identity.

Government of **Western Australia**
Department of **Water**

Protect and maintain our local water supplies.
FertiliseWISE.



Did you know?

Fertilisers are a major contributor to surface and groundwater contamination. They run off into the stormwater system through roadside drains, collect in sumps and leach into the groundwater system. They also wash into the rivers and sea, creeks and swamps where they can do major damage to reefs and aquatic life.







WHAT YOU CAN DO TO HELP

• Minimise lawn areas and use plants that don't use fertiliser • Grow local native plants – they require less water and fertiliser • Where possible, use organic fertilisers • If you must use a chemical fertiliser, look for one that is phosphorus free. Use a nitrogen to phosphorus to potassium (N:P:K) ratio of 10:0:6. • Use a slow release fertiliser • Only apply in spring or early autumn, not in winter or summer • Fertilise only when symptoms of deficiency occur (e.g. yellowing) • Use liquid fertiliser if you have a subsurface irrigation system • Compost your garden waste • Don't fertilise near waterways or road verges • Don't let grass clippings or leaves go down the drain • Wash your car on the lawn (if you have any) not on the driveway • Pick up after your dog • Use phosphorus-free detergents (always read the labels)

Looking after all our water needs

Top 5 tips for saving water in the kitchen

Did you know the kitchen is a major consumer of water in the home using around 10 per cent of total household water for consumption for cooking, cleaning, washing or drinking?

If you follow these simple tips you can reduce your use dramatically.

- If you have a leaking tap, replace the washer or other components as required. Dripping taps can waste 30 – 200 litres of water per day.
- Look for dishwashers that have a National Water Conservation or WELS Label. The best water rating achieved by dishwashers is 5 stars.
- To avoid wasting warm water from a running tap when you first turn it on, collect it in a bottle or a jug and store it in the fridge until it is cool enough to drink.
- Only use dishwashers when you have full load.
- When boiling vegetables, use enough water to cover them and keep the lid on the saucepan. Your vegetables will boil quicker and it will save you water and power.

Department of Water
The Atrium
168 St Georges Terrace
Perth WA 6000
Ph (08) 6364 7600
Fax (08) 6364 7601
www.water.wa.gov.au

Copies of this document are also available in alternative formats on request for those with special needs. The Department of Water is committed to quality service to its customers and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document. However, changes in circumstances after time of publication may impact the quality of this information.

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Government of **Western Australia**
Department of **Water**

WATER SAVING TIPS

Saving water in the home

Looking after all our water needs









In southern Western Australia, water resources are under pressure due to reduced rainfall, increased population and other factors.

With the current pressure on Western Australia's water resources, it's time for us all to do our bit to protect and maintain them.

Did you know?

In the typical house, the use of showers, clothes washing machines and toilets can consume more than three quarters of all indoor water use. In the majority of homes, all of this quality drinking water is used once then goes to the sewer. There are now simple, low cost ways of reducing this water use whilst saving on your water costs.



Water use in the home and garden

Consider the following to reduce water use:

- Don't use drinking quality water to water your garden. Use bore water and/or water recycled from showers and clothes washing machines (grey water).
- Use covers on swimming pools and spas, to reduce evaporation. Evaporation can remove more water from a pool per year than toilet use in a home.
- A home can be cooled in summer using good orientation, window shading, natural ventilation and fans. This could remove the need for an air conditioner, particularly evaporative, where large amounts of water are used.
- All new houses must adhere to the criteria of 5 Star Plus for water efficiency, but the guidelines can also be used when renovating to help create a more waterwise home.
- Install flow control aerators on taps. They are inexpensive and can reduce water flow by 50 per cent.

Find out more

For information on greywater use and systems visit the Department of Health website at www.health.wa.gov.au
For waterwise tips see the Water Corporation website at www.watercorporation.com.au and follow the "Being Waterwise" links.
To find out more visit www.water.wa.gov.au

What you can do to help?

- **Buy and install water smart fittings and appliances in the kitchen, bathroom and laundry.** Low flow showers and taps, systems that store colder water while the hot tap is reaching the desired temperature, toilets with lower flush volumes, waterless toilets, front loading washing machines etc are all modern ways of saving on water use and cost.
- **Consider installing rainwater tanks.** The stored water can be used in a number of ways, even in Perth where there are less summer rain events. Such water can be plumbed into toilets and reduce the use of high-quality treated scheme water for flushing.
- **Install a waterwise garden and/or irrigation system.** The garden and irrigation system can be designed to minimize water use.

Use products and services with the Smart Approved WaterMark label. This is a water saving program for outdoor water use and ensures any product bearing the label will save water.

Visit www.smartwatermark.org for more information

Appendix I

Harvey Water – water supply confirmation

Travis Taylor | Director

Level 1, 149 Victoria St

Bunbury WA 6230

Harvey, 2nd September 2025

Dear Travis,

Harvey Water, Taycot and Emerge Associates have been working together to refine the non-potable water demand for open spaces within the structure planning area and the manner in which this demand can be met. This includes the long-term planning across the entire site, including the school area. The water demand analysis indicates that a maximum of 215,250kL will be required to meet non-potable irrigation demand. Harvey Water confirms that we have the capacity to supply this amount to the site, and our resilience to deliver this is bolstered by, not only significant existing surface water supplies, but also by a Leederville licence held by Harvey Water in the region.

Harvey Water re-affirms that we have the intent to supply fit for purpose non-potable water to the Treendale East site to meet the above non-potable demand. This can be achieved using the existing water delivery locations to the site, and it would be on terms consistent with water already being delivered to the Shire in other areas via Community Stand Pipe connections. Water quality has also been considered, and will be addressed by the use of a reverse osmosis plant which is in an advanced planning stage being implemented upstream of the site. This will deliver high quality water that meets requirements for long term irrigation, i.e. it will be fit for purpose non-potable water.

The above confirmation is provided with the intent of addressing the queries raised by both the Shire and Department of Water and Environmental Regulation (DWER) during assessment of the Local Water Management Strategy which supports the Structure Plan. We trust that the above satisfies both the Shire and DWER queries, and we look forward to continuing to work with the Shire in the future and to deliver high quality open spaces within Treendale East.

Yours Sincerely

Bruce Hathway

Chief Executive Officer

Eckersley House

1 Turnbull Street, Harvey

PO BOX 456, Harvey WA 6220

T: (08) 9729 0100

E: admin@harveywater.com.au

www.harveywater.com.au

Appendix 5.
Landscape & Irrigation Strategy

April 2025

TREENDALE EAST for Taycot Development

Local Structure Plan - Landscape and Irrigation Strategy



REV C - 03/04/2025

emerge ASSOCIATES
Integrated Science & Design

1. CONTENTS

1. CONTENTS 3

2. LANDSCAPE PRINCIPLES 4

3. PUBLIC OPEN SPACE TYPOLOGIES 5

3.1. Linear Open Space Networks / RIPARIAN CorridorS 6
3.2. Neighbourhood Parks 7
3.3. Playing Fields 7
3.4. Civic POS 7
3.5. Conservation 7
3.6. Buffer 7

4. LANDSCAPE MASTERPLAN 8

5. DETAIL PLAN - POS 7 9

6. DRAINAGE MASTERPLAN 10

7. STREETSCAPES 12

8. STREET HIERARCHY PLAN 13

8.1. STREET HIERACHY SECTIONS 14
8.2. Proposed Planting in the Public Realm 18
8.3. Retained Vegetation 19
8.4. Entry Treatments 19
8.5. Drainage/Stormwater 20
8.6. Drainage Treatment Adjacent to POS 20
8.7. Irrigation Strategy 20
8.8. Site Furniture 21
8.9. playgrounds 22
8.10. Public Art 22
8.11. Maintenance Minimisation 22

9. POS STRATEGY - GREEN STREETS 23

10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS 24

10.1. CONCEPT SECTIONS 25

11. POS STRATEGY - NEIGHBORHOOD PARKS 28

12. POS STRATEGY - PLAYING FIELDS 29

13. POS STRATEGY - CIVIC POS 30

14. POS STRATEGY - CONSERVATION POS 31

15. POS STRATEGY - BUFFER POS 32

16. PROPOSED PLANT PALETTE 33

15.1 Drainage corridor Vegetation 33

1. CONTENTS

16. IMPLEMENTATION 34

16.1. Approvals 34
16.2. Practical Completion 34
16.3. Landscape Maintenance Responsibility 34
16.4. Scheduled Handover 34

2. LANDSCAPE PRINCIPLES

The development of this site in the south west of Western Australia provides the opportunity for the rural character & natural landscape features of the existing locale to be interpreted and sensibly enhanced within practical limits throughout the project area.

Hence the key Landscape Principles to be explored during the design phase shall be:

- The village environment and the elements that define the site as a place, is an avenue that is to be explored and referenced in the design of the landscape.
- Respecting the ecological corridors/buffers and incorporating these into a linear Public Open Space (POS) network and, adopting a programme of revegetation and rehabilitation.
- Understanding that the linear POS network provides the opportunity to establish a highly legible and pedestrian/bicycle friendly framework within the estate.
- Retention of existing stands of scattered and isolated *Eucalyptus* & *Melaleuca* tree species, via incorporation into POS or through the creation of wider road reserves.
- Appreciation that a balanced approach is required to ensure the social and recreational requirements of the future residents are balanced with the ecological and engineering constraints imposed by the site.
- Provide a variety of outdoor public space for recreational and social opportunities appropriate to the size of the proposed community.
- Provide a legible network of walking and bicycle paths linking the town centre and areas of public open space, schools and other community infrastructure.
- Mitigate post development drainage flows through incorporation of waterway treatment drains within the open space network and widened road reserves. Ensure riparian corridors are sensitively designed to allow for multiple public uses.

The project will be developed around offering a range of open space opportunities. The public open space within the site has been planned to provide a network of parkland and corridors which integrate with the conservation & buffer areas, and aims to contribute to the ecological and social fabric of the community. Being strategically located, they will provide accessibility and connectivity through the development whilst also playing an important role in protecting the sites natural assets which are unique to the area.

The areas of POS have been separated into broad categories based on their specific treatments and design:

- Green Streets
- Linear Open Space/ Riparian Corridors
- Neighbourhood Open Space
- Playing Fields
- Civic POS
- Conservation Areas
- Buffer Areas

3. PUBLIC OPEN SPACE TYPOLOGIES

The Public Open Space (POS) Network consists of the following and, are defined where appropriate under Liveable Neighbourhoods:

- **Green Streets:**
  Streets lined with trees that provide canopy and shade on main thoroughfares.

- **Linear POS Networks / Riparian Corridors:**
  Open spaces which provide a connection between smaller recreational nodes (neighbourhood POS). Provides legibility and sense of place for local residents. Also enables retention of existing trees and allows for drainage conveyance through the site.

- **Neighbourhood POS:**
  Located throughout the development (1,800 - 19,800m2) and provides local residents with areas of turf and planting for informal kick-about play and passive uses. Also provides seating areas under shelter/ shade and are typically within 400m of most dwellings. Are able to service approx. 600 dwellings within the surrounding area.

- **Playing Fields:**
  Approximately 48,900m2adjacent the proposed primary school to service both the school and the wider community. Provides local residents and community with an open area capable for servicing local sports, events and gatherings. Caters for the combination of passive (including informal play areas) and active recreation and are generally within 1km of most dwellings.

- **Civic POS:**
  Provision for a main street and town/village square within the development. Predominantly hard paved and located at the conjunction of major thoroughfares and town/village centre in order to provide a landmark for community gatherings and events.

- **Conservation Areas:**
  The proposed development area includes conservation zone designed to enhance/protect the natural assets of the site to the benefit of the environment and greater community. These areas will provide opportunities for passive recreation (walking trails), education and conservation.

- **Buffer Areas:**
  Linear public open space adjacent Forrest Highway, Raymond Road and Bunbury Outer Ring Road. These areas will provide opportunities for passive recreation (walking trails) and serve a critical role to provide a visual & noise buffer, as well as drainage conveyance and detention.





3.1. **LINEAR OPEN SPACE NETWORKS / RIPARIAN CORRIDORS**

In order to address the requirements of retaining site topography and the principle of protecting existing trees and ecological linkages, the structure plan includes a series of linear open spaces. The design intent of these spaces is to enhance existing vegetation as well as incorporate existing stands of isolated trees and drainage alignments. Through respecting the existing topography in these areas, the linear POS will provide a necessary drainage function as well as provide visual amenity to the public realm. Some of these linear POS align with existing drainage corridors. These are to be integrated & enhanced to provide important ecological function.

As surrounding lots and roads require imported fill to ensure suitable structural conditions for housing, these linear parks will sit at a lower grade. This will ensure that drainage will flow towards these areas and discrete into bio-retention and online flood detention areas, that will be incorporated along the length of the linear parks. These areas assist in the collection, detention, treatment and reconveyance of water during major storm events. This is achieved with existing and/or a proposed system of inlet and overflow structures that ensure designated parkland areas are kept dry and usable.

Waterways may be included through linear parks with an interface to a dual use path (DUP). There will be native shrub planting on the banks and native reed/sedge planting to enhance nutrient uptake. With planting to consist of endemic species with a variety of tree, shrub, groundcover, reed and sedge species. Bank stabilisation will be incorporated into the design and a variety of tree species will be used to provide a diverse tree canopy. Treatment along the length of the waterway will be dependent upon the width of the corridor and the engineering constraints.

The waterways will provide not only a viable drainage function but also a variety of ecological zones and restoration opportunities. The waterways will undertake important ecological functions that include but are not limited to; filtration of stormwater pollutants, restoration of the aquatic ecosystem, control of water flow rates, and the planting of sedges and shrubs to stabilise riverbanks and prevent erosion.

Linear parks and widened road reserves not only serve an environmental and drainage function but, also provide an efficient means of supporting a legible pedestrian and bicycle network. This network will be designed to encourage passive surveillance from overlooking residents in accordance with Liveable Neighbourhood guidelines and best practice in terms of 'Designing out Crime'.









3.2. **NEIGHBOURHOOD PARKS**

Neighbourhood Parks are to be larger POS areas catering as a destination along the linear POS network or larger individual parcels within the developed area. The landscape treatment of these spaces will be generally informal in nature and characterised by revegetation and native parkland plantings which encourage passive recreation uses. Localised areas of turf that cater for informal active recreation may also feature. Typically this park will consist of retained remnant trees with a centrally built feature playground. Path systems will link to the adjoining residential streets and to the linear POS network to provide access as necessary.

Drainage areas may be required in these open spaces, and where provided, will be landscaped basins serving a recreational and amenity function. Drainage swales catering for events greater than a 1 in 5 year rainfall event within Neighbourhood POS areas, will have turf to enable a multiple use space and ease of maintenance.

The extent of hardscape and the urbanity of the space will increase in proximity to the town centre.

3.3. **PLAYING FIELDS**

Covering an area of 48,900m2, Playing Fields serve a critical role in providing vegetation and large open turfed spaces capable of servicing a diverse range of passive and recreational activities. These large open spaces serve as a landmark or destination for residents and community groups as they provide amenities such as large kick about areas, shelters, BBQ, nature play and exercise nodes. The landscape treatment of these spaces will be more formalised in nature with the provision of distinct active/passive zones amongst activities and age groups. Planting will typically be used to provide shade for resting and play areas. In addition, perimeter planting will be implemented to allow for a visual buffer between road/path networks.

The site's playing field is located adjacent to the future zoned primary school, the proposed playing field represents an opportunity to co-locate amenities capable of servicing the local school, residents and the greater community. Due to its potential in servicing the proposed school as well as providing for seasonal sporting activities and everyday recreational use, areas may be set aside for multi-purpose fields, hardcourts, potential amenity block, carparking and a grandstand for spectators. Its capacity to allow for organised sporting and large scale community events will contribute towards nurturing social interaction and promoting local connections within the community.

3.4. **CIVIC POS**

The site's civic centre will include a neighbourhood activity centre and commercial centre which, may include short stay accommodation and a proposed micro brewery. Public open space and streetscapes in proximity to this zone will be predominantly hard paved in order to provide an urban landmark for community gatherings and events.

Key pedestrian and cycle networks will converge on this civic space, marking it as the starting point for a pedestrian shed. A pedestrian shed is generally a circular area encompassed by the walking distance from the civic centre, with a radius of 400 metres or more. This radius indicates the walkability of the precinct and its proximity to other key activity centres, such as the playing fields, primary school and larger neighbourhood parks.

3.5. **CONSERVATION**

The value of existing vegetation has been recognised and where possible this vegetation is to be retained and protected. A key area of existing vegetation within the site's extent has been identified and is to be included within a conservation POS. Typically a Conservation POS will include weed control, rehabilitation and paths/ trail networks in conjunction with educational signage to ensure the ecological value is maintained/ enhanced and, respected into the future.

3.6. **BUFFER**

The site is bounded by Forrest Highway to the west, Raymond Road to the south and Bunbury Outer Ring Road to the north/east. In addition to providing a drainage conveyance function and ecological/ pedestrian links, a key role of these buffer POS' will be to provide a noise and visual buffer between the community and these major roads, through the inclusion of vegetated bunds or similiar.



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LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale
- 400m Ped Shed
- 800m Ped Shed
- 1500m Ped Shed
- Entry Point

5. DETAIL PLAN - POS 7

CONCEPT
- Small local POS
- Provides green pedestrian link within path network

FUNCTIONS
- Shade structure and seating area
- Passive turf area for informal gatherings and picnics

ENVIRONMENTAL CONSIDERATIONS
- Water-wise native plant species selections
- Water treatment planting selection to bio-retention area

BIO-RETENTION AREA 08	
1% AEP TWL (mAHD)	14.48
Volume (cub m)	1,199
Slope	1:6
Depth (m)	0.98

LEGEND
- Residential Lots
- Verge
- Turf
- Planting
- Basin Planting
- Footpath network
- Existing Tree
- Proposed Tree
- Street Tree







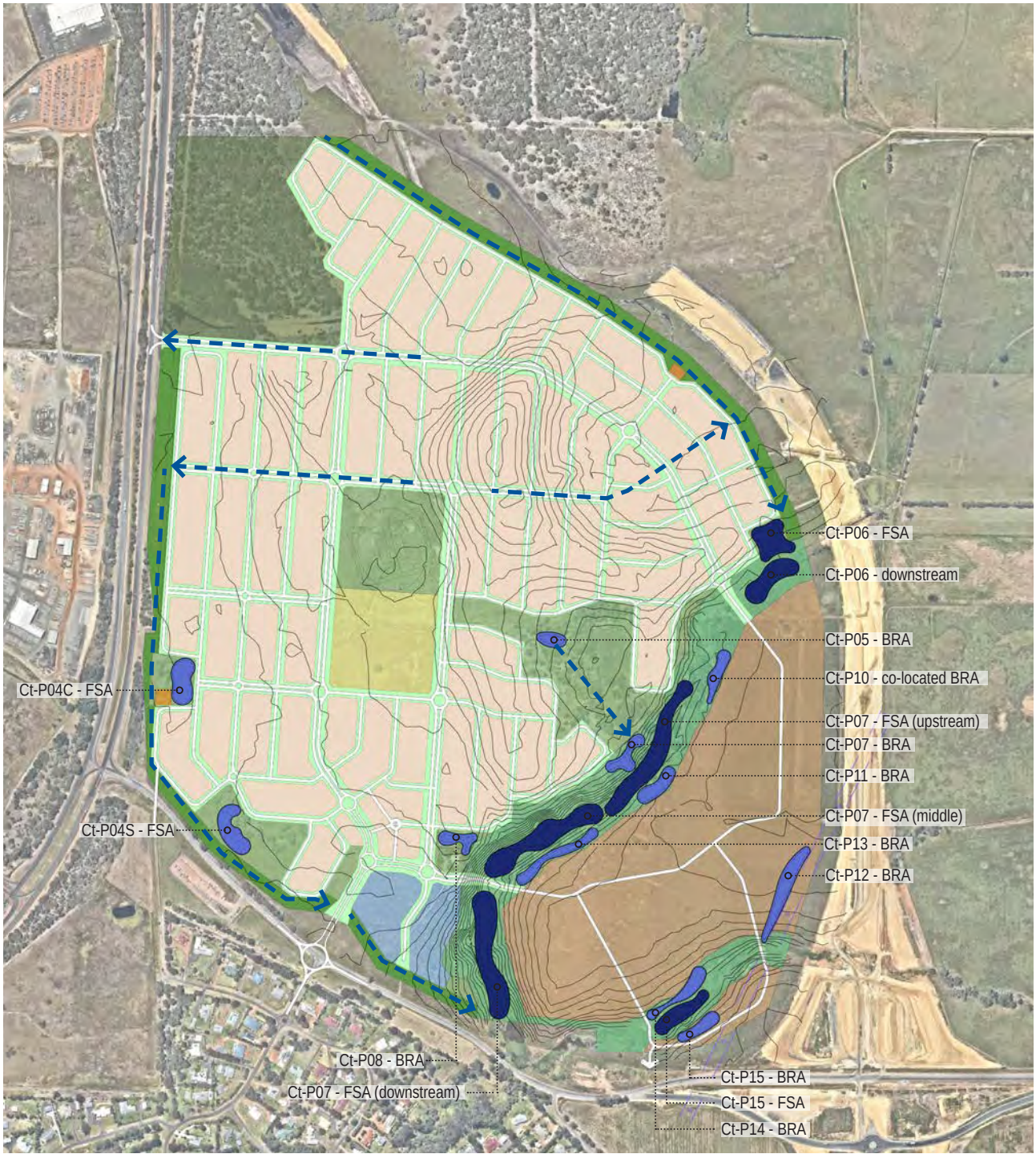












LEGEND

- Site Boundary
- Public Open Space (POS)
- Riparian Corridor
- Conservation Area
- Buffer Area
- Verge
- Indicative Flood Storage Area (FSA)
- Indicative Bio-Retention Area (BRA)
- Swale

DRAINAGE DATA - 20% AEP

CATCHMENT	Depth (m)	TWL Surface Area (sq m)	Volume (cub m)
Ct-P02 (BRA)	0.28	637	170
Ct-P04 (Swale)	0.5	1,200	300
Ct-P04 (FSA- C)	0.5	3,166	1,520
Ct-P04 (FSA- S)	0.3	3,166	987
Ct-P05 (Swale)	0.5	717	176
Ct-P05 (BRA)	0.84	1,153	836
Ct-P06 (Swale)	0.5	2,700	861
Ct-P06 (FSA)	0.96	3,683	3,254
Ct-P07 (BRA)	0.81	1,881	1,364
Ct-P08 (BRA)	0.98	1,616	1,199
Ct-P10 (BRA)	0.3	1,915	555
Ct-P11 (BRA)	0.53	2,214	1,088
Ct-P12 (BRA)	0.56	3,815	2,046
Ct-P13 (BRA)	0.56	2,584	1,343
Ct-P14 (BRA)	0.22	2,446	529
Ct-P15 (BRA)	0.3	1,762	509

DRAINAGE DATA - 20 % FLOOD STORAGE AREA

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	0.94	3,105	2,736
Ct-P07 (upstream)	0.73	7,116	5,043
Ct-P07 (middle)	0.77	7,387	5,515
Ct-P07 (downstream)	0.74	7,782	5,601
Ct-P15	0.65	2,483	1,542

DRAINAGE DATA - 1% FLOOD STORAGE AREA

CATCHMENT	Depth	TWL Surface Area (sq m)	Volume (cub m)
Ct-P06 (downstream)	1.43	3,332	4,340
Ct-P07 (upstream)	1.11	7,388	7,787
Ct-P07 (middle)	1.15	7,665	8,366
Ct-P07 (downstream)	1.14	8,066	8,805
Ct-P15	1.07	2,645	2,629

7. STREETSCAPES

Streetscapes throughout the development shall incorporate a variety of treatments in response to the street hierarchy network. This network aims to establish a mottled patchwork of tree canopy to provide a shady, leafy and green matrix that stretches across the estate. In all cases, landscape works shall incorporate tree planting in accordance with the accepted traffic standards. Treatments may include soft works such as street trees, small shrubs and groundcovers.

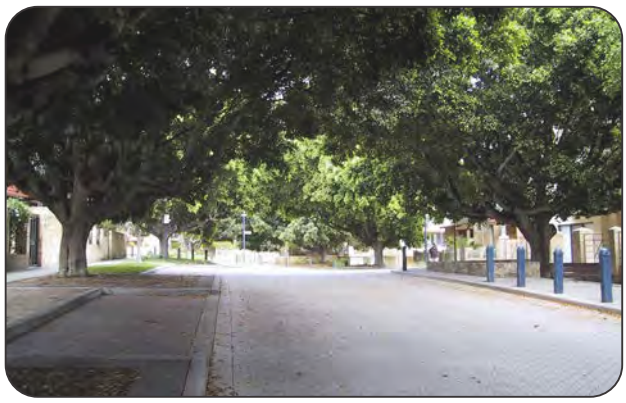
It is envisaged that the stormwater runoff from residential roads will be contained upstream mainly in a series of bio-retention swales distributed along road reserves and the linear open space network, where it is later conveyed to existing waterways.

Tree species are yet to be allocated however it is anticipated that within the POS', predominantly native trees will be used. It is proposed that species selections for streetscapes will also include species which reference the historic and cultural influences in the area. Deciduous exotic species historically used around rural homesteads will be used for major roads and civic areas to provide landmarks and promote legibility throughout the street network. The timing of installation (pre or post home construction) is yet to be determined.



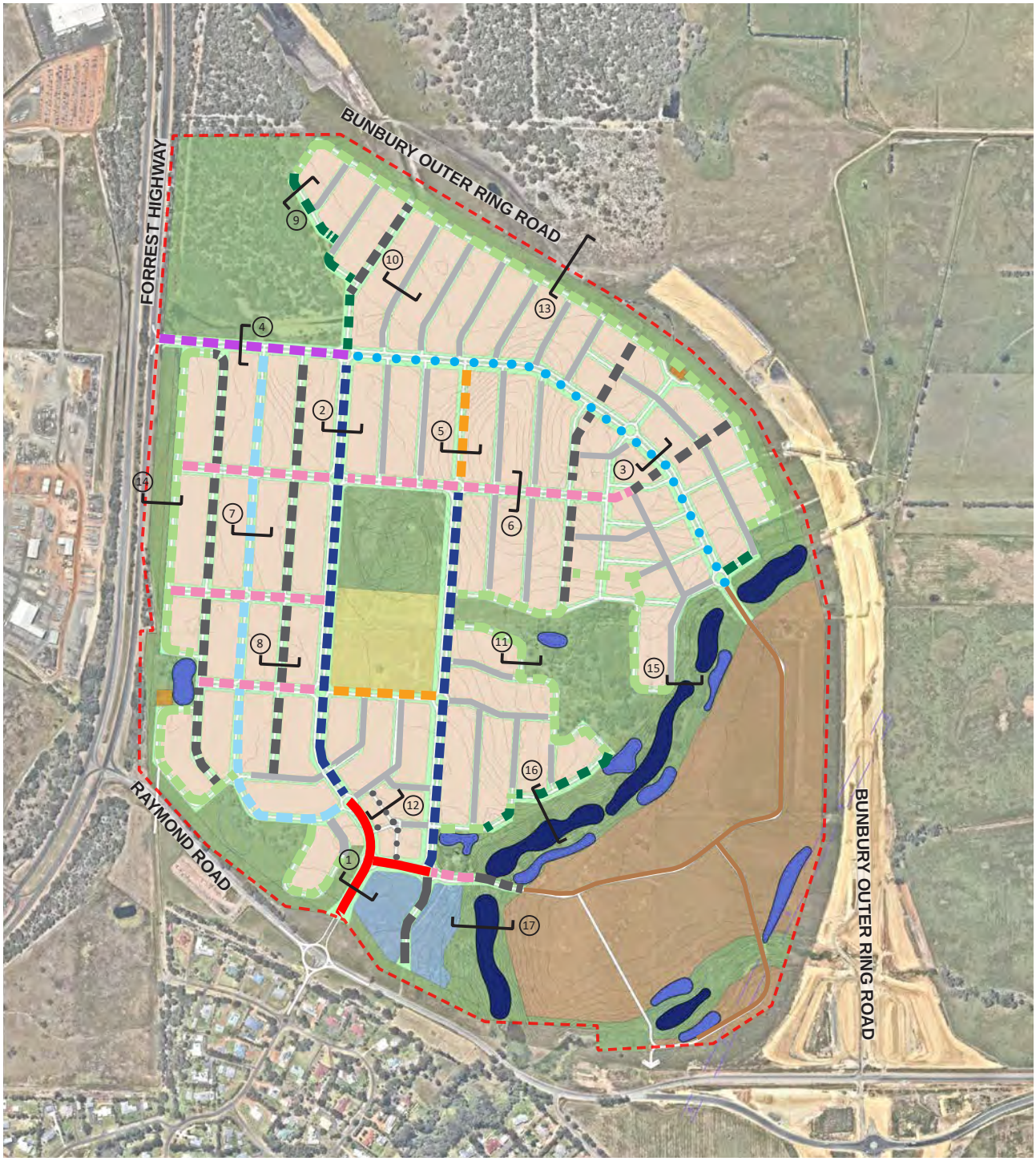








8. STREET HIERARCHY PLAN



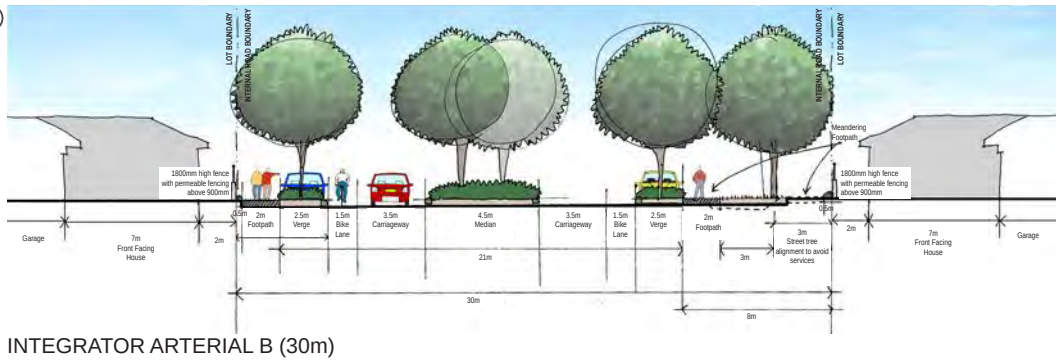
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LEGEND

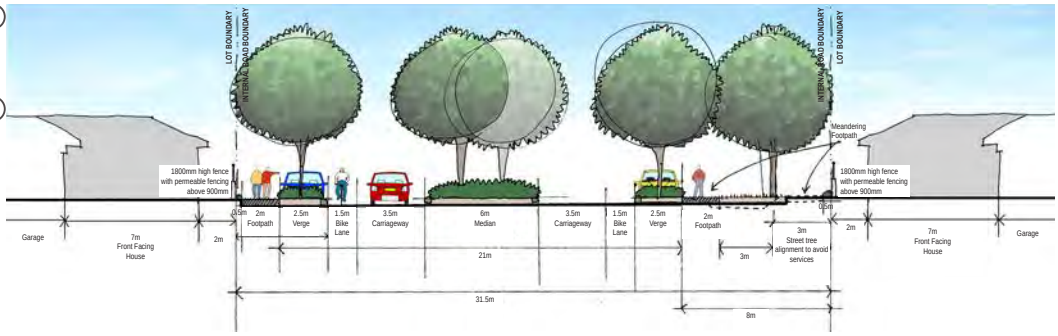
- Site Boundary
- (1) Integrator Arterial B (30m)
- (2) Neighbourhood Connector A (31.5m)
- (3) Neighbourhood Connector B (31.5m)
- (4) Neighbourhood Connector B (26m)
- (5) Neighbourhood Connector B (19.5m)
- (6) Access Street A (26m)
- (7) Access Street C (18m)
- (8) Access Street D (19.5m)
- (9) Access Street D, adjacent Bushland (20m)
- (10) Access Street D (15m)
- (11) Access Street D, adjacent POS (13m)
- (12) Laneway (6m)
- Village - Communal Road B (12m) - subject to separate design review
- (13) Access Street D, adjacent bio-retention swale/ landscaped buffer & BORR (13m)
- (14) Access Street D, adjacent gas pipeline easement & Australind Bypass/ Forest (13m)
- (15) Access Street D, adjacent upstream drainage (15m)
- (16) Access Street D, adjacent middle stream drainage (20m)
- (17) Downstream drainage

8.1. **STREET HIERACHY SECTIONS**

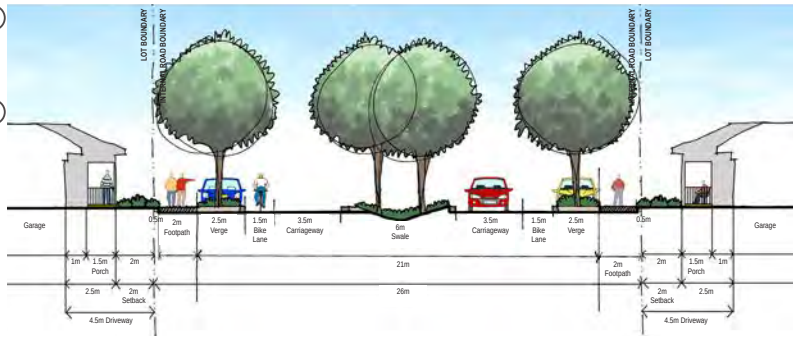
The below cross-sections are indicative only and will be subject to further detailed design at the subdivision stage.



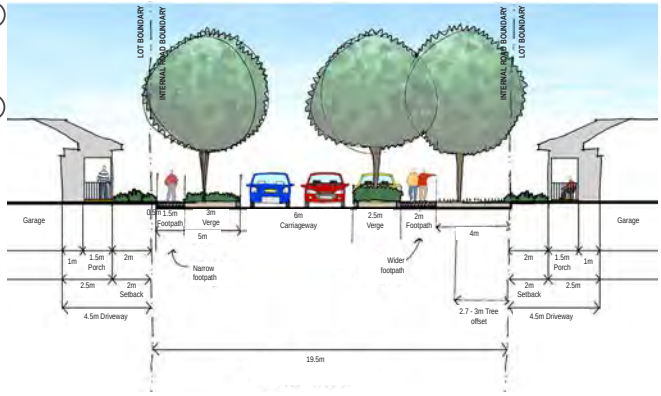
1 INTEGRATOR ARTERIAL B (30m)
SCALE 1:400 @ A4



2 NEIGHBOURHOOD CONNECTOR A (31.5m)
3 NEIGHBOURHHOD CONNECTOR B (31.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4

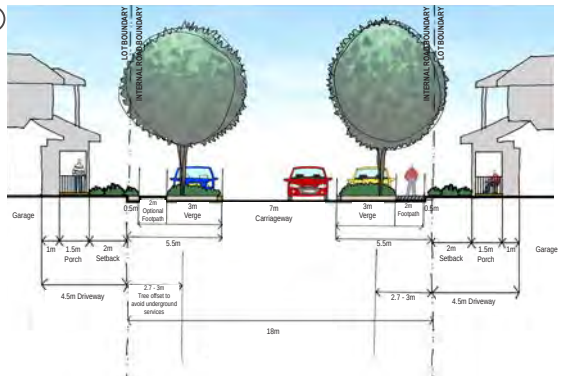


4 NEIGHBOURHOOD CONNECTOR B (26m)
6 ACCESS STREET A (26m) - WIDER MEDIAN AND VERGE TREATEMENTS
SCALE 1:400 @ A4



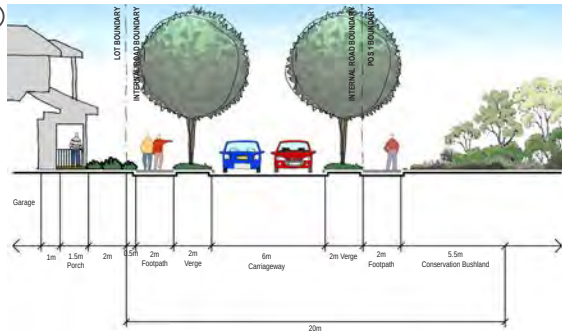
5 NEIGHBOURHOOD CONNECTOR B (19.5m)
8 ACCESS STREET D (19.5m) - WIDER MEDIAN AND VERGE TREATEMENTS
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7



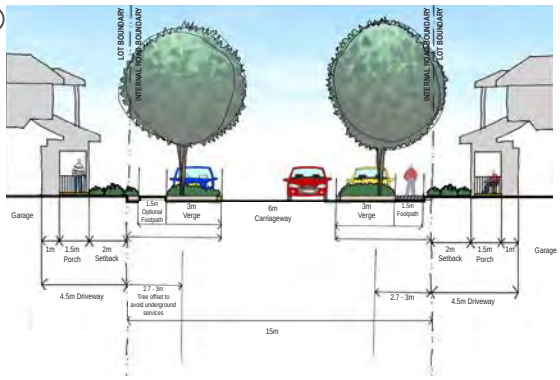
ACCESS STREET C - (18m)
SCALE 1:400 @ A4

9



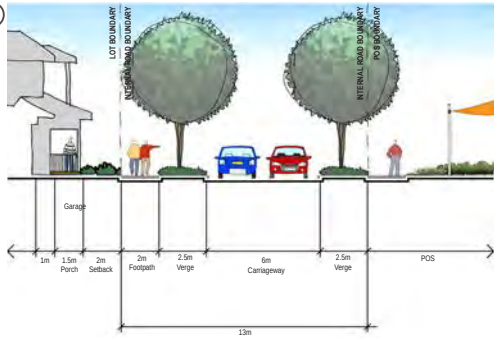
ACCESS STREET D, ADJACENT BUSHLAND (20m)
SCALE 1:400 @ A4

10



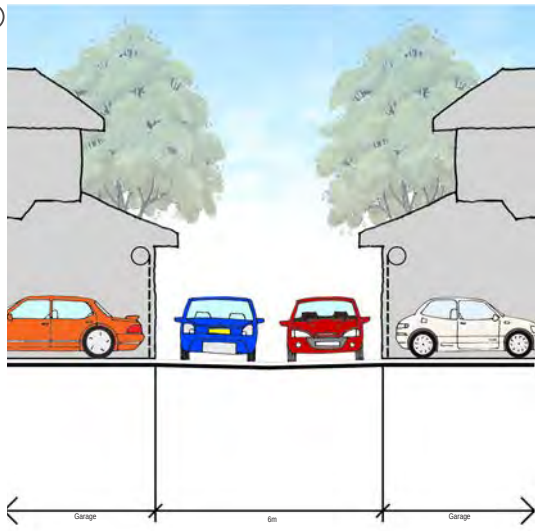
ACCESS STREET D - (15m)
SCALE 1:400 @ A4

11



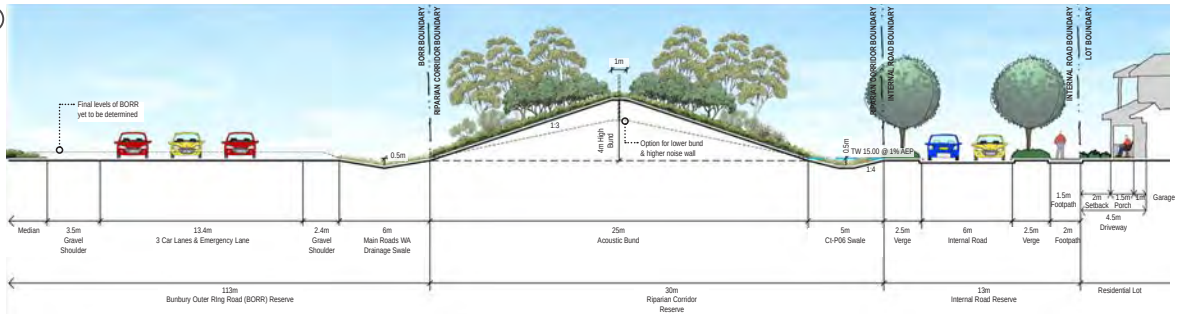
ACCESS STREET D, ADJACENT POS (13m)
SCALE 1:400 @ A4

12



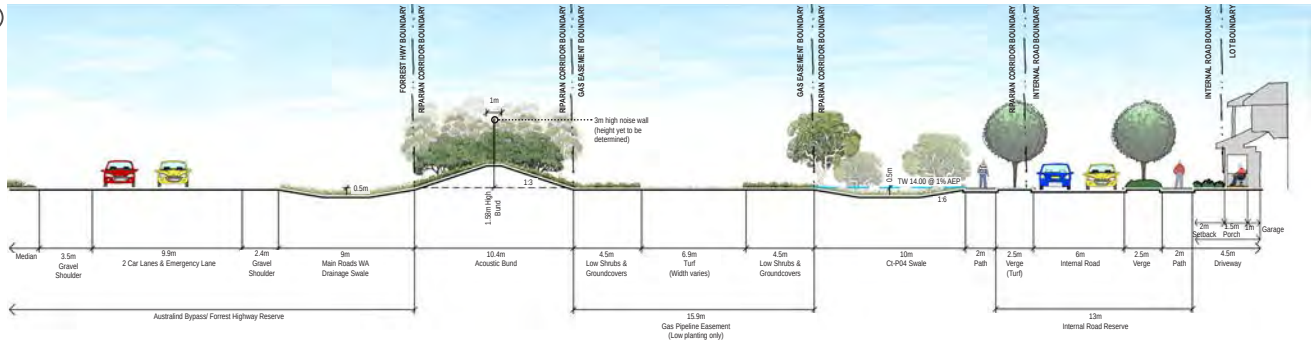
LANEWAY (6m)
SCALE 1:200 @ A4

13



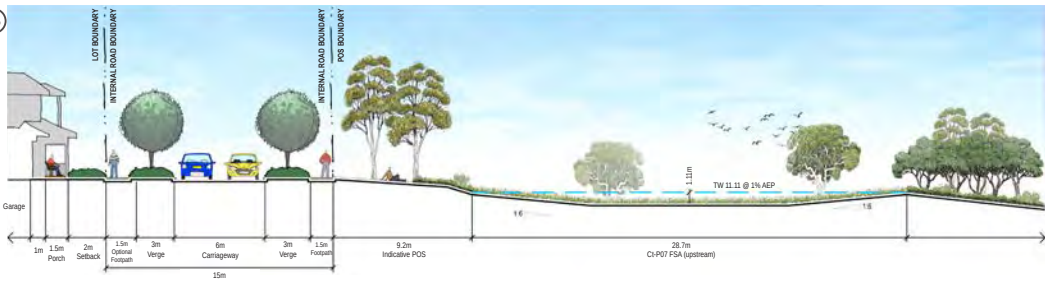
ACCESS STREET D, ADJACENT BIORETENTION SWALE/ LANDSCAPED BUFFER & BORR (13m)
SCALE 1:500 @ A4

14



ACCESS STREET D, ADJACENT GAS PIPELINE EASEMENT & AUSTRALIND BYPASS/ FORREST HWY (13m)
SCALE 1:500 @ A4

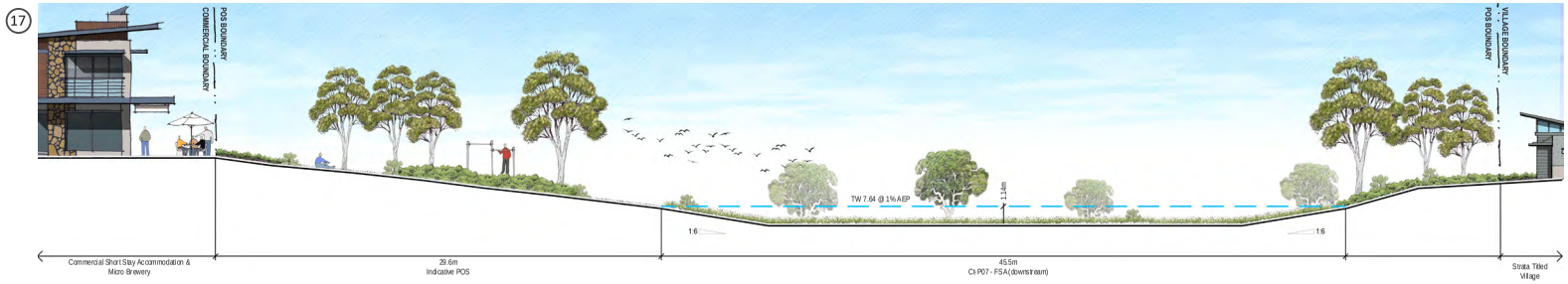
15



ACCESS STREET D, ADJACENT UPSTREAM DRAINAGE (15m)
SCALE 1:500 @ A4



ACCESS STREET D, ADJACENT MIDDLE STREAM DRAINAGE (20m)
SCALE 1:500 @ A4



DOWNSTREAM DRAINAGE
SCALE 1:500 @ A4

8.2. **PROPOSED PLANTING IN THE PUBLIC REALM**

The provision of planting in public areas and streetscapes serves to provide character, shade, interest, habitat and a point of reference in major streets or feature locations. Refer to section 14 for proposed species lists.

The locations of planting and types of vegetation will include;

- Predominantly native tree species to be nominated throughout the estate.
- Exotic specimen, shade and historical/cultural reference trees are to be nominated in high profile street or entry locations.
- Smaller scale exotic trees may be nominated in feature locations and avenue plantings to secondary residential streets,
- Bushland and habitat regeneration in disturbed areas,
- Shrub planting for screening and to provide spatial definition,
- Groundcover planting to medians, planters and areas requiring clear views,
- Reed and sedge planting to waterways,
- Irrigated grass to informal open space and recreation areas,

The proposed mix of native species and exotic cultural plantings in feature locations will provide a variation of character and define feature points. In general POS planting shall be composed of 75% native species.

The selection and placement of species shall consider adjacent elements so as to limit future maintenance and public health and safety issues. It will promote the survival and health of the existing vegetation, while also providing ongoing social and visual benefits. Items of consideration may include;

- Proximity to traffic sight lines to ensure suitable view corridors,
- Proximity and alignment to underground services to ensure no adverse impact,
- Seasonal influence of shade on adjacent facilities and areas,
- Passive solar benefits influencing adjacent built form and residential dwellings,
- Provision of seasonal visual colour,
- Provision of a seasonal food source to local fauna,
- Plant selection based on suitability to local climate, soils, rainfall and temperatures,
- Selection based on reduced maintenance, trimming, pruning, fertilising and watering
- Develop a species palette with subtle variations through the development to tie in with identifiable communities.
- Buffer screening will be provided to residential or sensitive areas where required
- Fringing vegetation to the surrounding areas is to be retained and protected.





Street trees

Street trees are a desirable design element to increase shade and amenity. The selection and placement of street trees shall vary, depending on the street hierarchy network. It is proposed that along major roads, street trees will form a strong visual avenue, and not impede traffic flow, safety or sightlines.

In residential streets, the roads may vary in character from precinct to precinct; however they are characterised as smaller scale pedestrian friendly environments. Therefore, street trees will be of a smaller scale, and will take advantage of passive solar principles that allows for summer shade and winter sun. As the road reserve widths may vary to allow for the retention of existing vegetation and the interconnection of the linear park network, it may be possible to allow for clustering or grouping of trees in the road reserve. This will be reviewed at the detailed design phase.

Water Wise Planting

It is intended that local species shall be used where suitable to maximise local habitat advantage and minimise water dependence. Soil amendments will be used in order to reduce leaching and increase soil moisture holding capacity. All garden beds will be mulched to reduce water loss through evaporation.

8.3. **RETAINED VEGETATION**

A primary goal of the Local Strategy Plan is the protection of existing vegetation. The retention of existing vegetation in defined locations caters for existing habitat, preserves natural assets and provides visual relief against the broader development area.

Vegetation Type and Quality

Whilst some of the vegetation on site has suffered through the effect of historical land uses and management, the areas of remnant vegetation offer positive outcomes if the development can be engineered to protect these areas. The majority of remnant vegetation is aligned with the conservation public open space and general public open space, in the form of occasional isolated individual trees in a cleared pastoral setting.

The retention of vegetation shall be maximised through minor realignment of road reserves, carriageways and lot boundaries, through the creation of tree islands in between carriageways or grade separated carriageways.

Retention and Protection

The retention and protection of defined existing trees shall occur during construction, following building works and in conjunction with maintenance. Retention and protection strategies shall include;

- Temporary fencing and signage to all retained areas and individual specimen trees.
- Ripping or compaction within 5m of the drip line of existing trees to be prohibited.
- In order to restrict the spread of exotic weeds the construction of clearly defined and easily maintained boundaries between retained vegetation and ornamental landscape may include methods such as, increased depth to mowing kerbs, footpaths, roads, bollards and permanent fencing.
- All works shall comply with the recommendations of the Bushfire Management Plan.
- Mandatory Arborist Report for all retained existing vegetation within public spaces.
- Mandatory Asset Management Plan outlining interventions and inspection frequency requirements.

8.4. **ENTRY TREATMENTS**

The entry points as defined on the Landscape Masterplan should express the design character of the development in respect to the local context. Any signage shall be clearly legible, reflect the estate's design style and comply with the local authority's signage policy.

Where appropriate, street trees and entry features will be used to promote the significant nature of these entry precincts by creating landmarks, forming strong avenues and framing views to distant feature elements. Feature planting is preferable in order to create a landmark and, assist in providing a hierarchy and legibility through the streetscape network. Landscape design options shall be tailored to meet all necessary civil design standards while expressing the character of the precinct.

8.5. **DRAINAGE/STORMWATER**

The development aims to utilise water sensitive urban design principles covering the following:

- At source treatment of water quality within select road medians
- Bio retention swales to treat water quality and convey stormwater runoff to existing waterways
- Reed and fringing vegetation to swales to provide a nutrient stripping function
- Online flood detention areas with the existing waterway to minimise downstream flows following major storm events
- Flood detention within waterways achieved by existing and/or proposed crossings

It is important that proposed swales/basins allow for multiple uses; including recreation, storm water management and creation of natural habitat.

8.6. **DRAINAGE TREATMENT ADJACENT TO POS**

All stormwater from the development will be directed into a system of drainage swales and bio-retention basins constructed along the edges of the POS and within the road reserve. These devices will be sized to treat the flows from the 1 in 1 yr event in accordance with the principles of the Department of Water, Stormwater Management Manual for Western Australia. Storm events in excess of these will be directed into outlet basins located within the POS area.

8.7. **IRRIGATION STRATEGY**

In general terms the project is committed to undertaking water sensitive urban design with no reliance on existing groundwater and the preservation of water quality. The project is also committed to minimising the volume of water used for irrigation. The following principles are held.

- Minimise the extent of irrigation and the volume of water consumed
- Minimise the extent of irrigated turf
- Minimise the extent of long term irrigation use on planted beds
- Use of hydrozoning
- Use of xeriscaping where practical

Irrigation shall aim to incorporate elements of subsurface, drip and trickle water application methods. Water application shall be based on seasonal need and be constructed of reliable, readily available and cost effective fittings, infrastructure and materials. Hydrozoning principles shall be incorporated at the detailed design stage.

All irrigation shall be installed to the local authority's standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authority's standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to the Council in accordance with relevant policies. Non-potable water will be supplied by Harvey Water via an existing agricultural supply network.





Existing drainage swales through site

8.8. **SITE FURNITURE**

The provision of street furniture demonstrates detailed consideration of human use and comfort. The inclusion of quality street furniture elements reinforces the intended design character, develops a sense of community and ownership amongst residents and encourages outdoor activities.

The location of street furniture elements should closely correspond with more intensive areas of human use, gathering and recreation. Basic functional requirements shall typically include;

- Local availability for quick and cost effective replacement or parts as may be required,
- Cost effectiveness of installation, ongoing replacement and maintenance,
- Robust design to minimise the effects of vandalism or weathering,
- Robust appropriate fixing methods to prevent theft but allow maintenance,
- Colour being defined but neutral where possible to enable the maximum chance of matching with other site elements,
- Galvanised and powder coated finishes to maximise lifespan.

Elements shall provide a visually recognisable, clear and useful function. The types of street furniture envisaged include;

- Picnic settings & seating (formal and informal)
- Shade structures/ Shade Sails to assist with providing built shade options
- BBQs
- Rubbish bins
- Bollards
- Bicycle parking
- Drinking fountains
- Boardwalks
- Conservation fencing
- Interpretive signage

Note: All furniture specified within public spaces are to be consistent with the Shire of Harvey's Signage and Infrastructure Style Guide Parts 1 & 2.

https://www.harvey.wa.gov.au/build-and-develop/infrastructure/signage-and-infrastructure-style-guide





8.9. **PLAYGROUNDS**

Plagrounds are a vital community space that support physical, social and emotional well-being. Play opportunities should provide for all ages, welcome all genders, encourage social interaction and promote physical development. Play features that inspire adventure and discovery are prioritised to spark creativity, build problem-solving skills and keep children engaged longer. Designing with durable materials ensures long-term value and minimal maintenance. All playgrounds are required to be consistent with the Shire of Harvey's Playspace Strategy.

8.10. **PUBLIC ART**

The selection and installation of appropriate public art creates interest, social discussion and promotes a sense of community and ownership to public spaces. Public art can provide historic, social, cultural and environmental comment and act as a reference to define a local area and community values.

It is intended that public art be distributed at either high profile points or community gathering spaces to ensure its value in place making is maximised. Locations should include vista and axis views from roads or pedestrian paths, inclusion into playgrounds or placement adjacent picnic locations. Individual lighting may be desirable in some instances to provide additional importance and focus to specific artwork.

8.11. **MAINTENANCE MINIMISATION**

In conjunction with the detail design of public open space and verge areas, they are ultimately vested and controlled by the Local Government Authority (LGA), a maintenance minimisation review and an asset management plan shall be undertaken by the developer to assist in assessing and reducing the likely future maintenance costs. This process may typically include;

- review of all materials to ensure fitness for purpose and lifespan requirement,
- review of the areas of planting verses turf,
- review of plant and turf species and their specific growth habits and requirements,
- monitoring of groundwater quality and levels,
- review of irrigation materials and standards,
- implementation of sustainability and water wise principles to enable the reduction of ongoing costs, through removal of some short term landscape establishment assets,
- review of all structural design to ensure fitness for purpose and lifespan





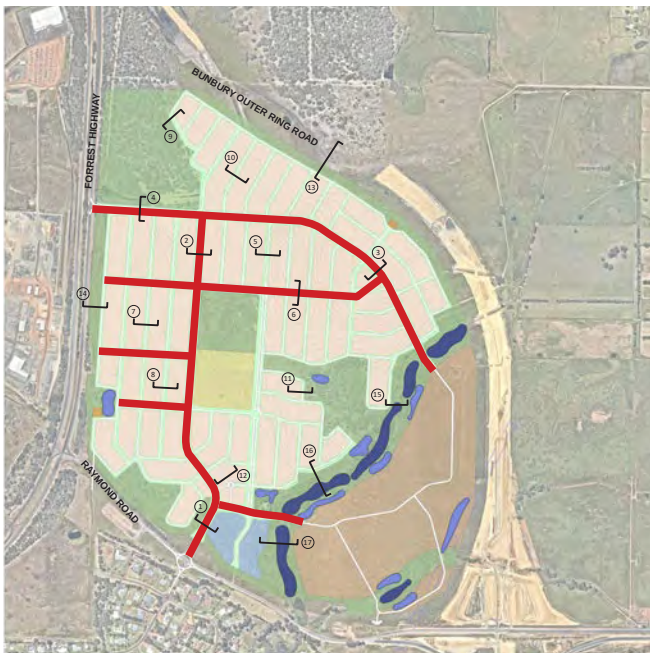


9. POS STRATEGY - GREEN STREETS

BRIEF DESCRIPTION

The Green Street is a widened road reserve to create a sense of space and connectivity throughout the estate. This promotes legibility via creation of a landmark and establishes a hierarchy within the streets. It offers the opportunity for stormwater and bio-filtration within widened road reserves

SIZE (Verge) 70,886 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Path network
- Historical and cultural character
- Landmark and feature planting
- Habitat corridors
- Passive recreation opportunities

ENVIRONMENTAL CONSIDERATIONS

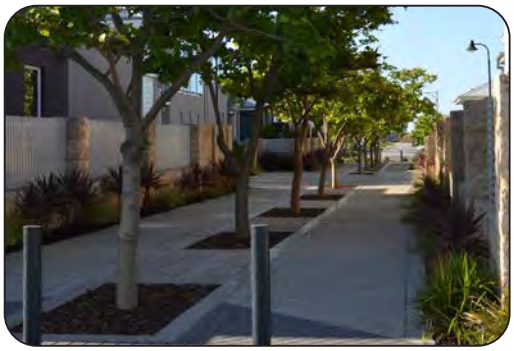
- Waterwise native planting
- Planting design to be zoned according to irrigation requirement
- Consider stormflows and drainage requirements











10. POS STRATEGY - LINEAR POS/ RIPARIAN CORRIDORS

BRIEF DESCRIPTION

Located between the development and the proposed strata titled village, the the linear POS/ riparian corridor incorporates drainage requirements with pedestrian and bicycle networks. While drainage is the predominant function for this space there will also be informal turf areas, path networks, crossings, shelters and picnic nodes etc.

SIZE (Excluding Verges) 154,256.2 sq.m



FUNCTIONS

- Native, water wise planting. Deciduous species used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting
- Living stream

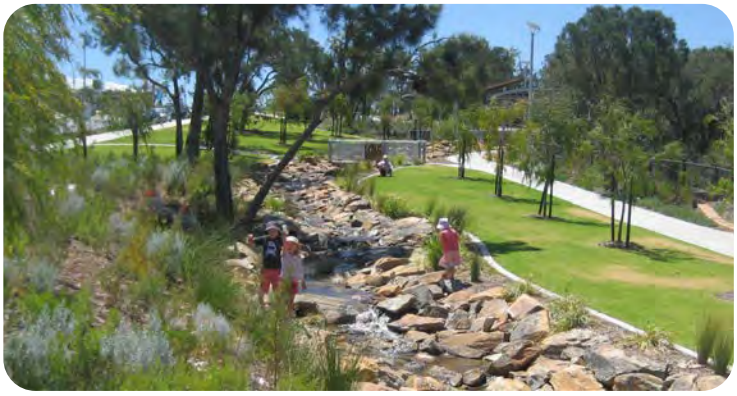
ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials



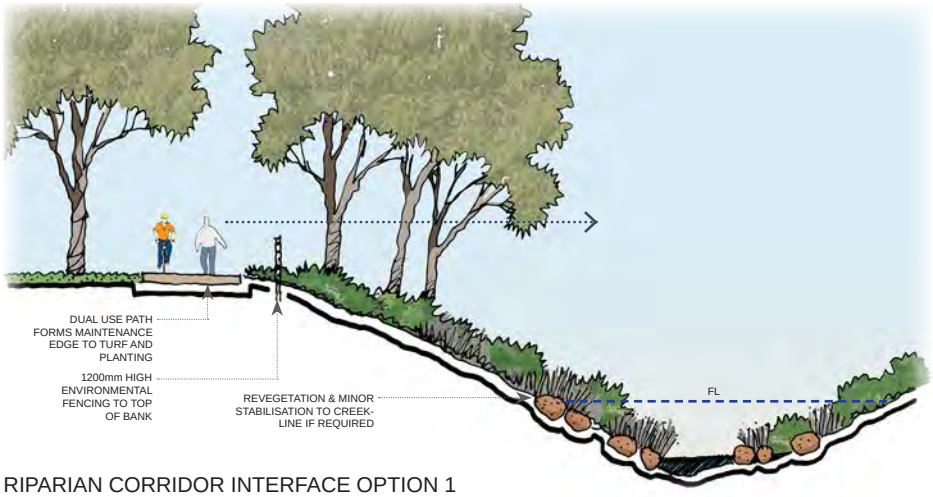




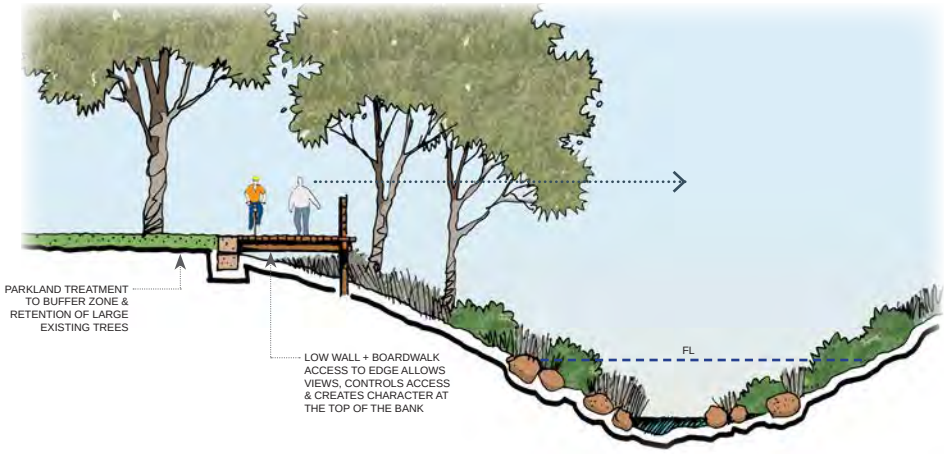


10.1. **CONCEPT SECTIONS**

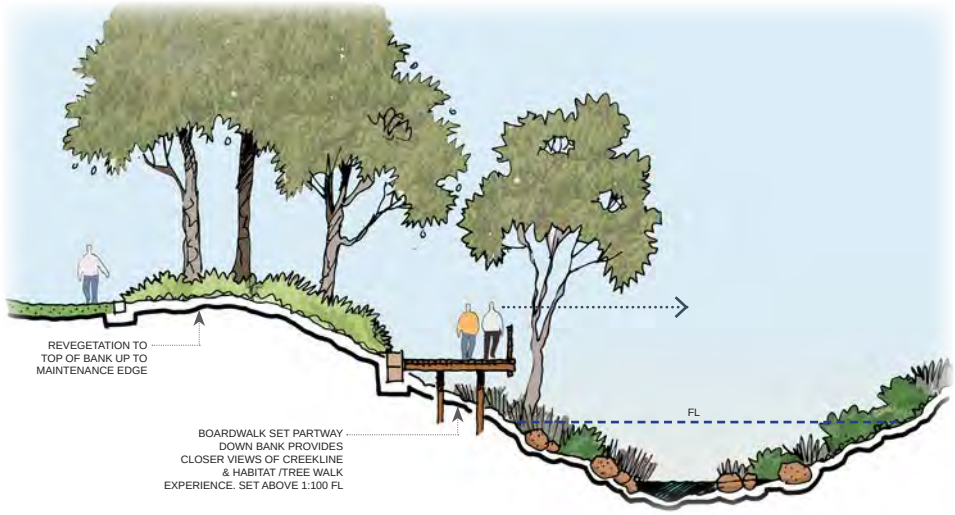
The following sections are concept diagrams exploring design opportunities along the enhanced riparian corridor.



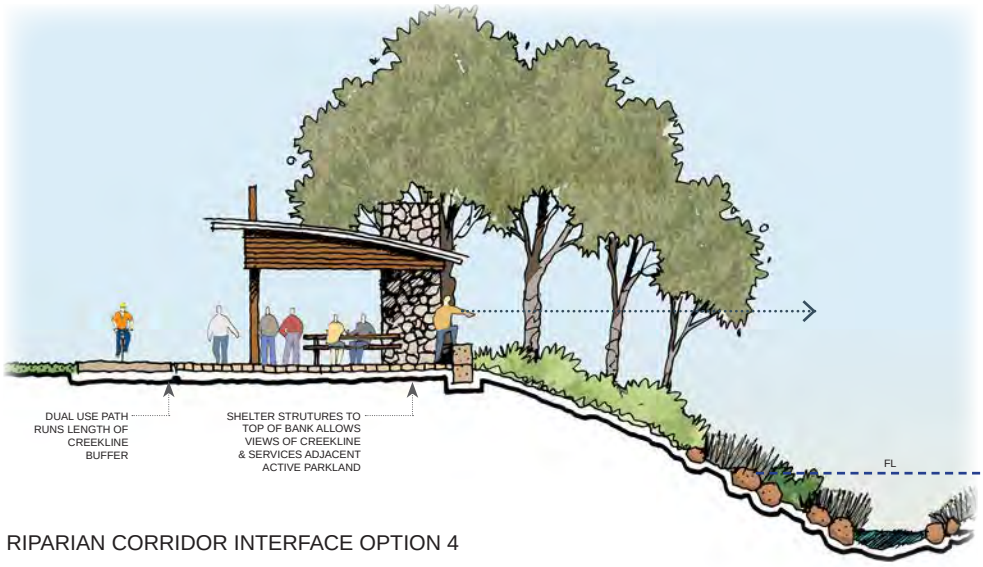
RIPARIAN CORRIDOR INTERFACE OPTION 1



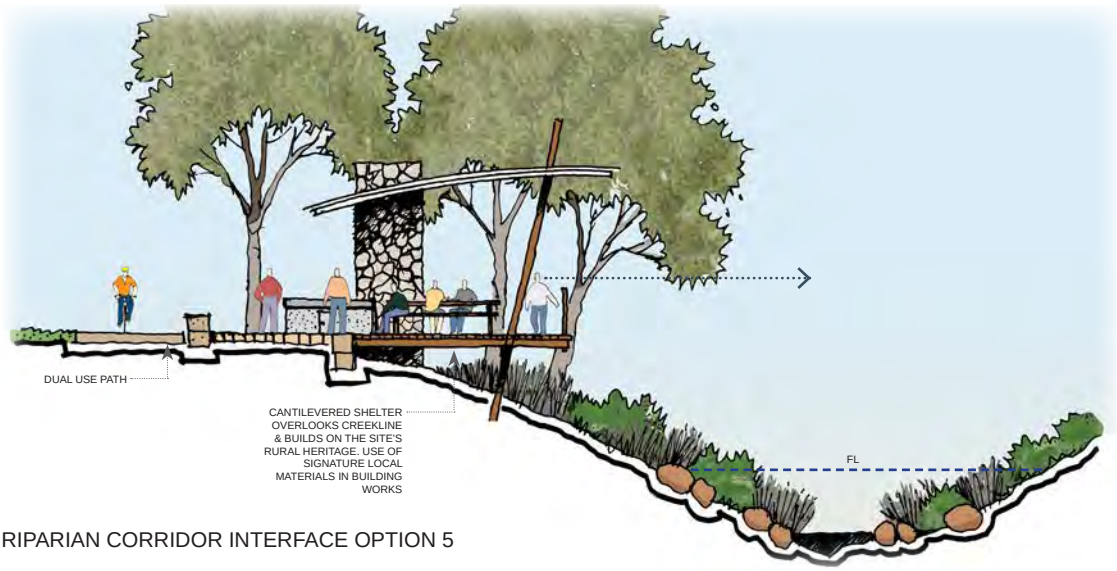
RIPARIAN CORRIDOR INTERFACE OPTION 2



RIPARIAN CORRIDOR INTERFACE OPTION 3



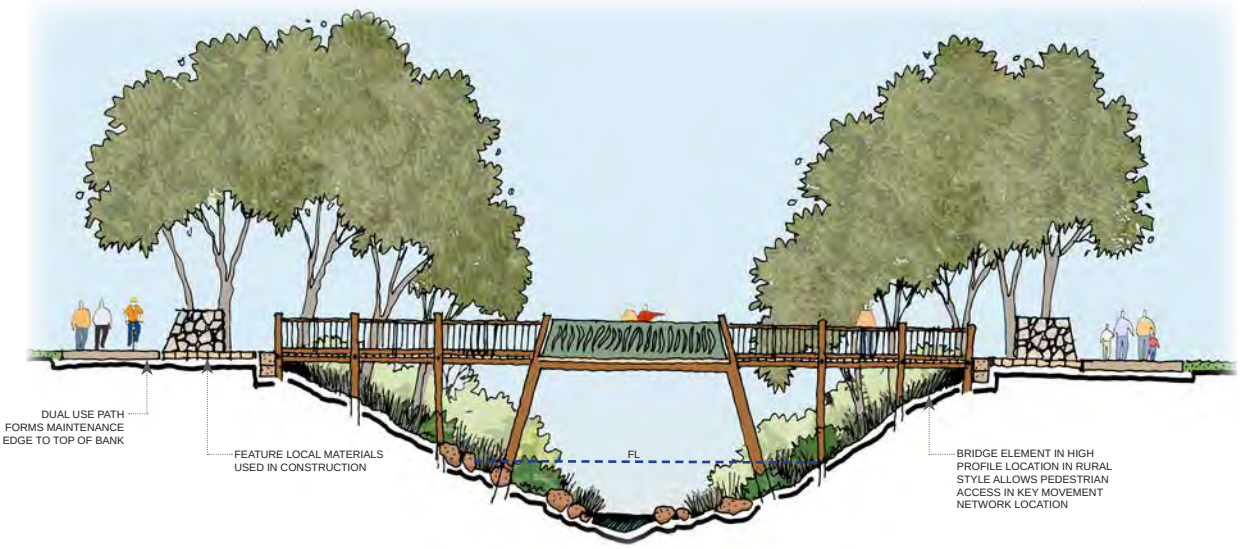
RIPARIAN CORRIDOR INTERFACE OPTION 4



RIPARIAN CORRIDOR INTERFACE OPTION 5



RIPARIAN CORRIDOR INTERFACE OPTION 6



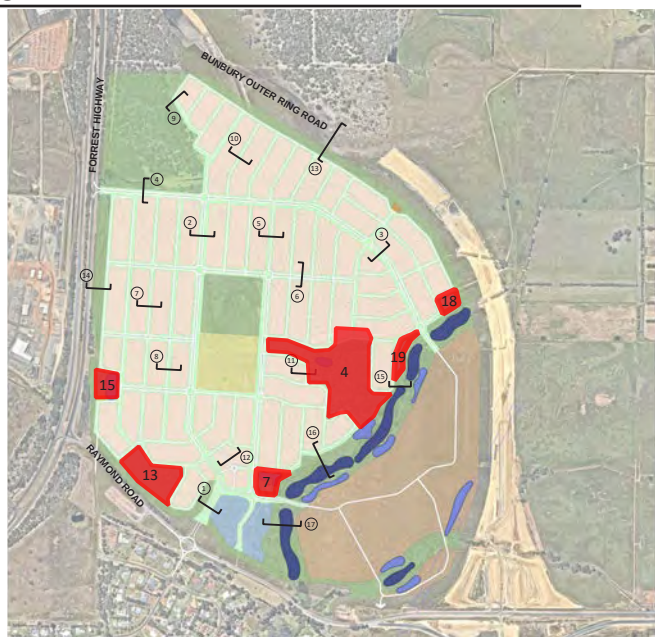
RIPARIAN CORRIDOR INTERFACE OPTION 7

11. POS STRATEGY - NEIGHBORHOOD PARKS

BRIEF DESCRIPTION

Located throughout the development, the Neighbourhood POS provides residents with open space in close proximity to their dwellings. The parks have areas of turf for passive play and informal kick-about area with nodes of seating and shelter either provided by trees or built structure. A path network through and around the POS allows footpath connection to surrounding streets and other POS. Drainage will be incorporated within these areas.

SIZE (Excluding Verges)
POS 4: 63,637.6 sq.m
POS 7: 5,948.2 sq.m
POS 13: 19,892.3 sq.m
POS 15: 8,592.3 sq.m
POS 18: 3,696.1 sq.m
POS 19: 3,796.2 sq.m



FUNCTIONS

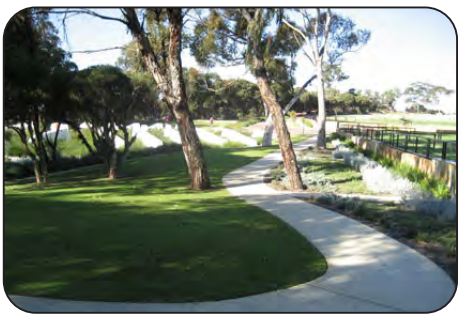
- Native, water wise planting. Deciduous used when and where appropriate
- Maximise shade trees with emphasis on native species
- Limited picnic facilities
- Internal path network
- Path network connecting into the broader path network
- Playground
- Drainage
- Passive solar
- Historical and cultural character
- Landmark and feature planting

ENVIRONMENTAL CONSIDERATIONS

- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing area
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







12. POS STRATEGY - PLAYING FIELDS

BRIEF DESCRIPTION

- Landmark/destination for residents and community groups
- Opportunity to co-locate facilities (i.e. playing fields, junior ovals and hardcourts for future school and community)
- Provide shared amenities (i.e. shelters, BBQ areas, play and exercise nodes)
- Distinct active/passive zones amongst activities and age groups
- Promote accessibility and usage by community
- Pedestrian and cycle path along perimeter to connect into broader path network
- Playing fields with capacity for organised sporting and large scale community events
- Potential for viewing grandstand
- Allow for drainage and stormwater flows
- Allow for access and carparking

SIZE POS 3 (Excluding Verges) = 40,045.1 sq.m



FUNCTIONS

- Service diverse range of passive and active recreational activities
- Open area for informal/formal sports and events
- Predominantly irrigated turf for sporting fields
- Maximise shade trees
- Play elements for all ages
- Drainage
- Connection/Colocation with education facilities

ENVIRONMENTAL CONSIDERATIONS

- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the formal turf sporting fields
- Consider stormflows and drainage requirements
- Source local materials where possible
- Consider the long term maintenance requirements for all materials







13. POS STRATEGY - CIVIC POS

BRIEF DESCRIPTION
- Civic landscape predominantly hardscape for events
- Shared pedestrian and vehicle town centre streetscape

SIZE (Excluding Verges)
POS 12: 3, 391.8 sq.m
Access Street D: 3,240 sq.m
POS 9: 1,960 sq.m

FUNCTIONS
- Village centre acting as central 'heart' of greater masterplan
- Neighbourhood hub for formal and informal public gatherings
- Open hardscaped areas to host local events, markets and food trucks
- Maximise shade trees with native and/or deciduous species where appropriate
- Community engagement & connection
- Path network connecting between activity centre buildings and into broader path network
- Landmark & feature planting

ENVIRONMENTAL CONSIDERATIONS
- Formal planting
- Trees for shade
- Designed with CPTED principles















14. POS STRATEGY - CONSERVATION POS

BRIEF DESCRIPTION

- Existing vegetation to be retained
- Revegetate and enhance
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with adjacent neighbourhood or linear POS recreational nodes.
- Boardwalks/interpretive/signage/educational opportunities

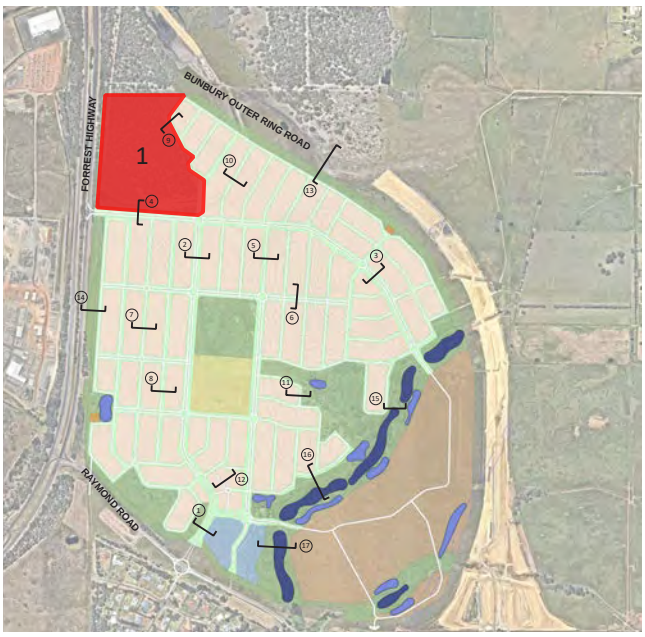
SIZE (Excluding Verges) = 120,696.6 sq.m

FUNCTIONS

- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader path network
- Ecological function
- Habitat
- Education
- Connection

ENVIRONMENTAL CONSIDERATIONS

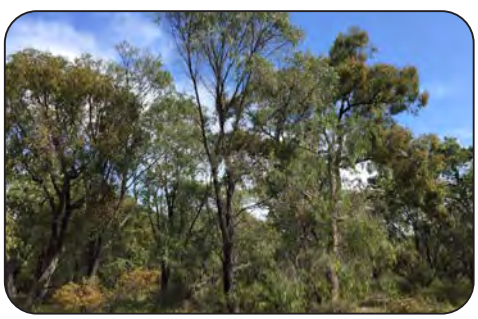
- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, unirrigated where possible.
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing site













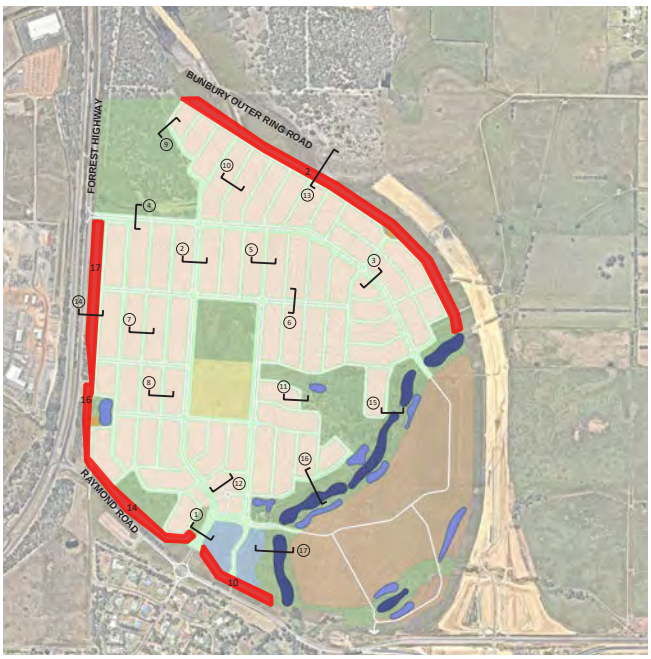
15. POS STRATEGY - BUFFER POS

BRIEF DESCRIPTION
- Provides a buffer to adjacent high use roads
- Vegetation corridors
- Promote accessibility and usage by community
- Pedestrian and cycle paths interconnecting with recreational nodes along linear route/network.
- Allow for drainage and stormwater flows

SIZE (Excluding Verges)
POS 2: 37,679 sq.m
POS 10: 8,154.9 sq.m
POS 14: 13,406.7 sq.m
POS 16: 2,370.4 sq.m
POS 17: 19,759.9 sq.m

FUNCTIONS
- Buffer to adjacent high use roads
- Native waterwise vegetation
- Maximise shade trees
- Path network connecting into broader development
- Drainage
- Ecological function
- Habitat
- Connection

ENVIRONMENTAL CONSIDERATIONS
- Waterwise native planting
- Planting design to be zoned according to irrigation requirements, with full irrigation requirements to the informal turf playing areas
- Source local materials where possible
- Consider the long term maintenance requirements for all materials
- Consider stormflows and drainage requirements
- Revegetation
- Respect geomorphology of existing and historic creekline













16. PROPOSED PLANT PALETTE

15.1 DRAINAGE CORRIDOR VEGETATION

Inundated - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree

Trees

Melaleuca rhaphiophylla	Swamp Paperbark

Lower Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Baumea vaginalis	Sheath Twig Rush
Bolboschoenus caldwellii	Marsh Club Rush
Gahnia trifida	Coast Saw Sedge
Hypocalymma angustifolium	White Myrtle
Juncus subsecundus	Finger Rush
Juncus pallidus	Pale Rush
Lepidosperma longitudinale	Pithy Sword Sedge
Leptocarpus laxus	
Lepyrodia glauca	
Meeboldina coangustata	
Pericalymma elipticum	Swamp Teatree
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Melaleuca preissiana	Moonah
Melaleuca rhaphiophylla	Swamp Paperbark
Taxandria linearifolia	

Mid Slope - Bank Edge

Shrubs/Sedges/Herbs/Groundcovers

Species Name	Common Name
Anigozanthus bicolour	Little Kangaroo Paw
Astartea scoparia	
Dasypogon bromefolius	Pineapple Bush
Kunzea glabrescens	
Hypocalymma angustifolium	White Myrtle
Leucopogon tenuis	

Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	
Regelia ciliata	
Scholtzia involucrata	Spiked Scholtzia

Trees

Eucalyptus rudis	Flooded Gum
Melaleuca preissiana	Moonah
Taxandria linearifolia	

Upper Slope - Foreshore

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Astartea scoparia	
Kunzea glabrescens	
Leucopogon tenuis	
Melaleuca incana	Grey Honeymyrtle
Melaleuca thymoides	

Trees

Corymbia calophylla	Marri
Euclayptus lane-poolei	Salmon White Gum
Eucalyptus marginata	Jarrah
Eucalyptus wandoo	Wandoo
Melaleuca preissiana	Moonah
Taxandria linearifolia	
Xanthorrhoea preissii	Grass Tree

Dryland Revegetation

Shrubs/Sedges/Herbs/Groundcovers

Species Name	**Common Name**
Acacia divergens	
Acacia pulchella	Prickly Moses
Acacia saligna	Orange Wattle
Allocasuarina humilis	Dwarf Sheoak
Anigozanthos manglesii	Mangles Kangaroo Paw
Conostylis aculeata	Prickly Conostylis
Dampiera linearis	Common Dampiera
Dianella revoluta	Dianella
Dryandra nivea	Honeypot Dryandra
Ficinia nodosa	Knotted Club Rush
Grevillea pilulifera	Woolly Flowered Grevillea
Hakea ceratophylla	Norned Leaf Hakea
Hakea lissocarpha	Honey Bush
Hakea prostrata	Harsh Hakea
Hakea stenocarpa	Narrow Fruited Hakea
Hakea trifurcata	Two Leaf Hakea
Hypocalymma angustifolium	White Myrtle
Hypocalymma robustum	Swan River Myrtle
Kunzea micrantha	
Melaleuca laterifolia	Gorada
Patersonia occidentalis	Purple Flag

Eremophila glabra	Tar Bush
Grevillea crithmifolia	

Trees	
Allocasuarina fraseriana	Sheoak
Corymbia calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus wandoo	Wandoo
Nuytsia floribunda	Christmas Tree

15.2 PARKLAND PLANTING (POS AREAS/BUFFERS/BOULEVARDS)

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	**Common Name**
Acacia cognata 'Limelight'	Limelight
Acacia cognata	
Adenanthos sericea	Albany Woolly Bush
Agonis flexuosa 'Nana'	
Anigozanthus ssp.	Kangaroo Paw
Carex comans	
Dianella ssp.	Dianella
Dryandra nivea	Honeypot Dryandra
Eremophila 'Carramar Grey'	
Ficinia nodosa	Knotted Club Rush
Grevillea crithmifolia	
Grevillea obtusifolia 'Gin Gin Gem'	Gin Gin Gem
Grevillea 'Golden Lyre'	Golden Lyre
Grevillea 'Lollypops'	Lollypops
Grevillea thelemanniana	Spidernet Grevillea
Lomandra ssp	Lomandra
Pattersonia occidentalis	Purple Flag
Olearia axillaris	Coastal Daisy Bush
Phormium tenax 'Purpurea'	Phormium
Westringia fruticosa	Coastal Rosemary

Trees	
Agonis flexuosa	Native Peppermint
Brachychiton acerifolius	Illawarra Flame Tree
Corymbia calophylla	Marri
Corymbia maculata	Spotted Gum
Erythrina indica	Coral Tree
Eucalyptus marginata	Jarrah
Fraxinus raywoodii	Claret Ash
Liquidambar styraciflua	Liquidambar
Platanus acerifolia	London Plane Tree
Xanthorrhoea preissii	Grass Tree

15.3 TREE SPECIES SELECTION

15.3.1 NATIVE SPECIES



Agonis flexuosa
Willow Myrtle



Allocasuarina fraseriana



Callistemon 'Kings Park Special'



Casuarina obesa
Swamp Sheoak



Corymbia calophylla
Marri



Eucalyptus lane-poolei
Salmon White Gum



Eucalyptus marginata
Jarrah



Eucalyptus rudis
Flooded Gum



Eucalyptus todtiana
Prickly bark



Eucalyptus wandoo
White Gum



Melaleuca preissiana
Modong



Melaleuca rhaphiophylla
Swamp Paperbark



Nuytsia floribunda
WA Christmas Tree



Taxandria linearifolia



Xanthorrhoea preissii
Grasstree

15.3.2 EXOTIC SPECIES



Brachychiton acerifolius
Illawara Flame Tree



Corymbia maculata
Spotted Gum



Eucalyptus camaldulensis
River Red Gum



Erythrina indica
Coral Tree



Fraxinus Raywoodii



Jacaranda mimosifolia
Jacaranda



Liquidambar styraciflua
Sweet Gum



Platanus acerifolia
London Plane Tree



Ulmus parvifolia
Chinese Elm

17. IMPLEMENTATION

17.1. APPROVALS

As part of an ongoing process, once the Local Structure Plan has been endorsed by the LGA and the sub division approvals received, each POS landscape and irrigation design will be submitted as a detailed documentation package to the Shire for review and approval.

The landscape design will incorporate recreation and environmental requirements, while focusing on maintenance minimisation principles and techniques.

The developer is committed to working with the local council to deliver long term outcomes in this process to reflect best practice throughout the development.

17.2. PRACTICAL COMPLETION

Upon reaching Practical Completion of the landscape and irrigation works, a meeting shall be arranged and attended by the consulting landscape architect and the relevant council officers to inspect the completed landscape works.

Following this inspection the Developer's representative shall issue to council the following:

- A list of items requiring completion
- As-constructed landscape and irrigation drawings
- Details including capital costs of all physical assets for inclusion in the Councils asset register

Following Practical Completion the Developer shall organise to:

- Carry out any remedial works noted during the Practical Completion inspection without delay
- Undertake maintenance of the POS as agreed with council

17.3. LANDSCAPE MAINTENANCE RESPONSIBILITY

The developer funded and managed landscape and irrigation maintenance period of two years will apply to all public open space areas following completion of landscape construction works.

The maintenance period commences on the date of Practical Completion. Typically the first year is an establishment period, followed by a year of landscape maintenance.

After the two year period the POS landscape and irrigation maintenance will be handed over to the Local Government Authority to control, fund and manage.

17.4. SCHEDULED HANDOVER

Three months prior to the expiration of the maintenance period (from practical completion), the Developer shall contact the relevant Council officer to initiate the handover process, which will commence with an inspection of the POS.

At the handover inspection, the Developer shall provide to the Officer:

- Details of the areas maintained
- As-constructed irrigation drawings to include changes made to the system during the maintenance period
- Warranties, manuals and logbooks.

Following handover inspection and prior to the handover date, the Developer shall:

- Rectify all defects noted during the handover inspection and others that may emerge before the handover date
- The Council shall provide written confirmation that Council accepts responsibility for maintenance and liability for the location involved.


emerge
ASSOCIATES
Integrated Science & Design

Appendix 6.
Engineering Servicing Report

TAYCOT PTY LTD

TREENDALE EAST STRUCTURE PLAN

ENGINEERING SERVICING REPORT







MAY 2025

WML
Consulting Engineers

Distribution Record

Revision	Reviewed By	Date Issued	Purpose of Issue	Issued To
A	L Rusconi	13/10/2021	Client Review	TAYCOT PTY LTD
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Prepared by:	Luke Rusconi
Signed:	
Date:	01/05/2025
WML Name:	9723-C-R-001_Engineering Service Report
WML Project No:	9723

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WML Consultants Pty Ltd
ABN 36 092 471 531
PO Box 2023 Bunbury WA 6231
First Floor, 62 Wittenoom Street Bunbury WA 6230
(08) 9722 3544 wml@wml.com.au
wml.com.au

Contents

1. EXECUTIVE SUMMARY 2

2. PROJECT SUMMARY 3

3. SITE DESCRIPTION 4

4. GEOTECHNICAL AND HYDROLOGY 4

4.1 EXISTING SITE SUMMARY 4

4.2 GROUNDWATER 5

4.3 ACID SULPHATE SOILS 5

5. ROAD NETWORK SUMMARY 6

6. STORMWATER MANAGEMENT 6

7. SITE EARTHWORKS REQUIREMENTS 8

8. SERVICES 9

8.1 SEWER 9

8.2 WATER 10

8.3 POWER 10

8.4 TELECOMMUNICATIONS 10

8.5 Gas Reticulation 11

9. SUMMARY 12

APPENDIX A – Road Hierarchy 13

APPENDIX B – Cross Sections 14

APPENDIX C – WC WASTEWATER SCHEME 15

AUSTRALIND – SD087 15

APPENDIX D – SEWER CONCEPT 16

1. EXECUTIVE SUMMARY

This Engineering Service Report (ESR) summarises the availability of services to the planned Treendale East Estate, as well as commenting on required service upgrades, road network and drainage management concept. The site is bound by Forrest Highway to the west, Raymond Road to the south and Bunbury Outer Ring Road (BORR) to the East (Refer to Figure No. 1).

The site is well placed regarding service availability with power, water and communication services readily available. Sewer reticulation will be challenging with the requirement for sewer to connect under Forrest Highway into the existing Water Corporation infrastructure in Treendale. At a conceptual level, there are workable solutions for all servicing and infrastructure needs for the estate. Solutions for all civil infrastructure can be achieved by standard industry required methodologies. However, a strong focus will be placed on achieving desired outcomes through the use of sustainable technologies and evolving, environmentally friendly construction products.

The information contained herein has been provided to assist in the understanding of the potential engineering issues and constraints involved in the development of the LSP. It is noted that the advice contained herein is general in nature, as WML has not undertaken detailed engineering, environmental or other design works as part of this report. WML has not undertaken detailed discussions with the local authority or servicing agencies (unless otherwise specifically noted within where an issue was deemed to require additional clarification due to its effect on the potential for development).

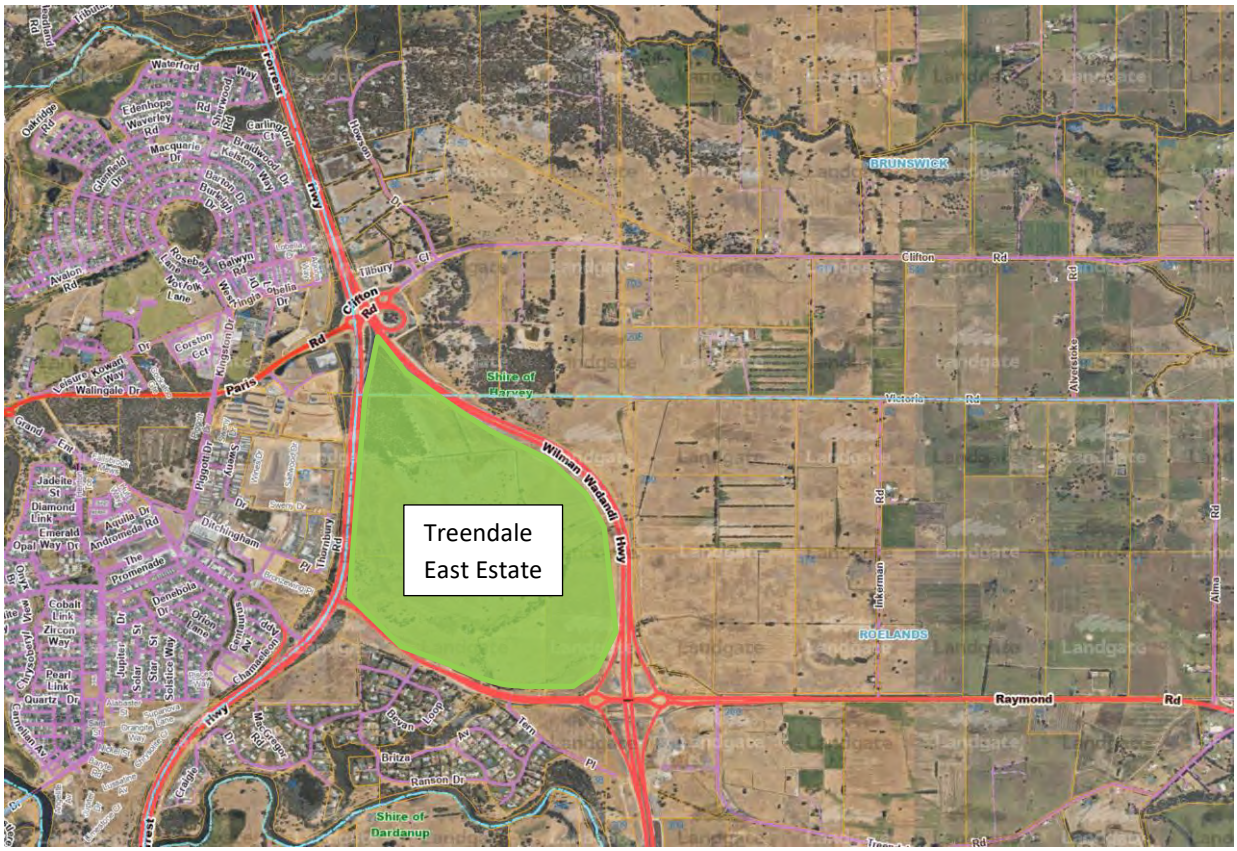


Figure 1. Locality Plan (May 2025, Landgate Map Plus)

2. PROJECT SUMMARY

WML have been engaged to undertake preliminary engineering investigations into the serviceability of the Treendale East Concept Structure Plan shown in Figure No.2 below. The site is located within the Shire of Harvey.



Figure 2. Treendale East Estate Concept Structure Plan (May 2025, CDP Town Planning)

3. SITE DESCRIPTION

The Development site is made up of three lots, 50 in the southwest, 152 in the southeast, and 151 in the northern half of the site. All lots are currently used as paddocks for cattle and have been used for similar purposes for three generations. Historical aerial imagery shows the site appears largely unchanged since 2005. The site generally comprises open ground, with short grass covering most of the site. Isolated clusters of tall trees are spaced across the area, generally near drainage channels and at the intersection of the three lots. The northwest corner of Lot 151 is covered with dense trees and bushes. A mix of shallow hills and flat, level areas make up Lots 50 and 152 in the southern half of the site, while Lot 151 is generally flat. Natural and manmade drainage channels run through isolated sections of each lot. Stockpiled materials from some of the manmade drainage channels form large windrows that run parallel to the channel. A shed near the centre of Lot 50, and two derelict corrugated metal buildings in the southeast of Lot 151 are the only structures on site.

4. GEOTECHNICAL AND HYDROLOGY

4.1 EXISTING SITE SUMMARY

The 1:50,000 scale Geological Map 'Bunbury-Burekup' indicates the site comprises three different general soil types. The majority of the site is comprised of "Guildford formation: mainly alluvial sandy clay" and "Bassendean sand: low rounded dunes" to probable depths of 20m and 15m respectively. A smaller area of "Alluvium – older river terraces" is present towards the southeast of the site.

A suite of test pits was undertaken as part of an investigation undertaken by WML in March 2021. The site was described as having three distinctive zones as shown in the figure below. These are broadly described as Sand, Sand above Clay and Clay.

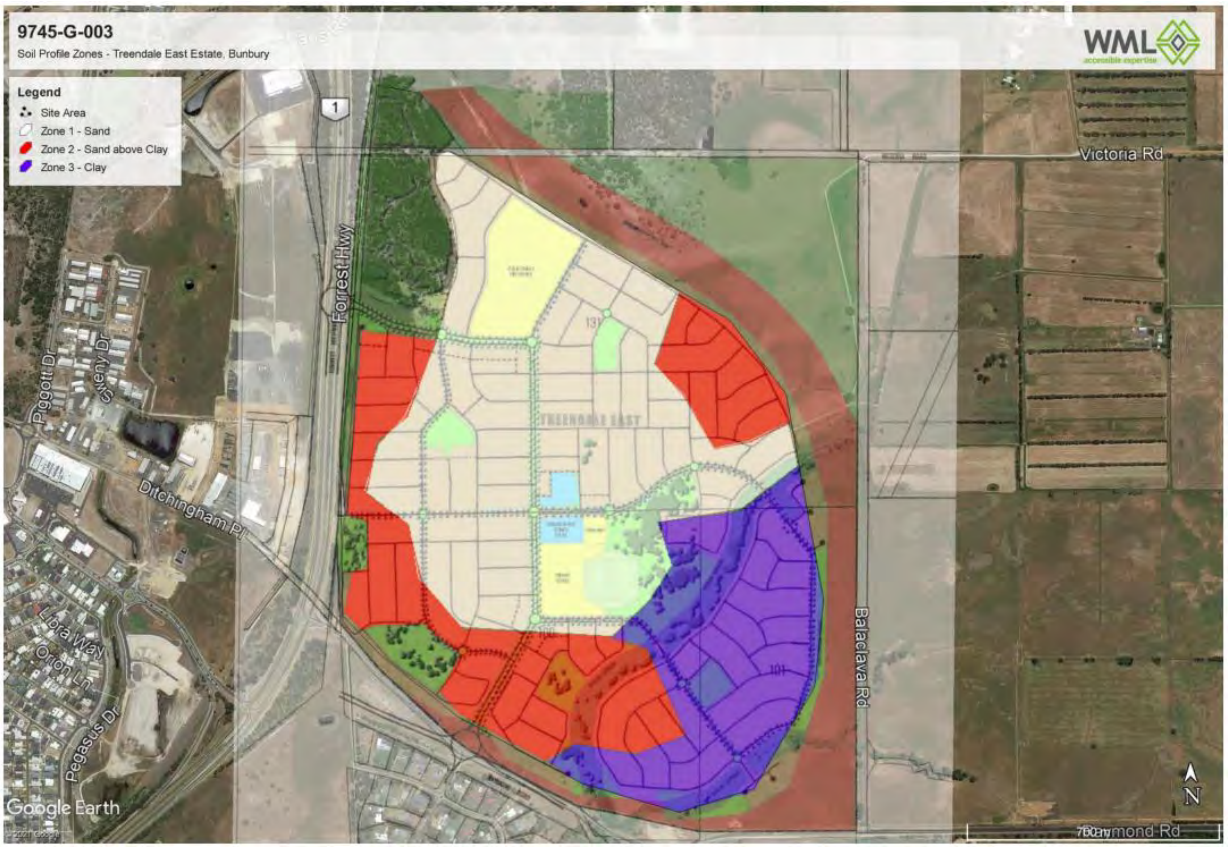


Figure 3. Geotechnical Zoning

Figure 2: Geotechnical Zones

4.2 GROUNDWATER

Groundwater was identified in 16 of the 72 test pits completed as part of the geotechnical investigation. This groundwater was identified at depths ranging between 0.65-1.90m. It is expected that of these 16, at least 11 were a perched or seasonal groundwater table due to the permeable sands above coffee rock or clays, with no groundwater identified below these low permeability layers. It should be noted that the investigation was conducted during the middle of autumn, when groundwater levels are near their lowest. Further groundwater monitoring has been undertaken from installed groundwater monitoring wells and this data will be included in the LWMS. In general, the western side of the site adjacent to Forrest Highway is known to flood during winter, with water frequently ponding above the ground surface following consistent rainfall.

4.3 ACID SULPHATE SOILS

The entirety of the site has been identified as having a moderate to low risk of ASS within 3m of the natural soil surface, as shown in yellow in the Figure below. This is based on information available from the Department of Water and Environmental Regulations.



Figure 4. Acid Sulphate Soil Mapping

A specific ASS investigation and development of an ASS management plan will likely be required for the development. WML undertook preliminary testing during their Geotech report, from the 79 field tests undertaken none were found to have Actual Acid Sulphate Soils as no results had a pHf less than 4.

5. ROAD NETWORK SUMMARY

The proposed access to the development will be from Raymond Road and the Forrest Highway. These are both Main Roads WA (MRWA) assets and as such the new access intersections will require their approval. The intersection proposed for Raymond Road is a roundabout located centrally to existing roads - Raymond Road and Ranson Drive. The proposed Forrest Highway Intersection is intended to be a secondary intersection and will be a left in left out intersection.

The intended road hierarchy is shown on the concept subdivision plan in Appendix A. There are eight different categories of road suggested on the concept plan ranging from Integrator Arterial B roads through to Access Streets and Lane Ways. Typical cross sections detailing lane widths, road reserve widths median treatments etc are attached in Appendix B.

The road network for the development is primarily structured around Integrator Arterial B Class roads, which provide access from the southern side of the development at the Raymond Road access point. Additionally, the Neighbourhood Connector B from Forrest Hwy plays a key role in linking the area.

These main arterial roads are connected by a north/south central avenue road, featuring cap roads with parking designed to service the lots that front the road.

Connections between these primary arterial roads are facilitated by Boulevard streets, which incorporate central medians used for both drainage and landscaping. These are further linked to lower category Avenue and Access streets, which help to distribute traffic and provide additional access points.

The Roads have been given generous road reserve widths with a focus on streetscape and landscaping and pedestrian/cyclist connectivity.

Pedestrian dual use paths will be provided on the major road links throughout the development as well as through the pos foreshores and landscape buffers.

6. STORMWATER MANAGEMENT

Emerge Associates has prepared a Local Water Management Strategy to support the structure plan submission. The site has two distinct Water Corporation drainage lines that run east – west through the southern portion of the site. There are also a series of rural drains that direct stormwater under the Forrest Hwy to the West. The Western portion of the site is subject to inundation in the winter months due to stormwater perching on the underlying clays.

Below is a catchment plan showing the broad drainage catchments. The overall basis for the drainage design is to direct flows to swale drains located around the perimeter of the site. These swale drains will convey stormwater south to the Water Corporation drainage lines. The perimeter swales are multi-purpose, they will convey stormwater drainage, provide storage, and allow free draining outlets for subsoil drainage as well provide a buffer to the Forrest Highway and BORR. Additional storage areas have been indicated within the reserve for the Water Corporation drainage lines as well as a small storage in the Northern Reserve prior to water discharging under the Forrest Hwy. Throughout the development bioretention will be incorporated into central median swale drainage as well as on-street rain gardens as required. On the western portion of the site where groundwater is at surface the intention is to incorporate individual lot subsoil drainage to control groundwater mounding beneath lots and to control the fill requirements for the site.

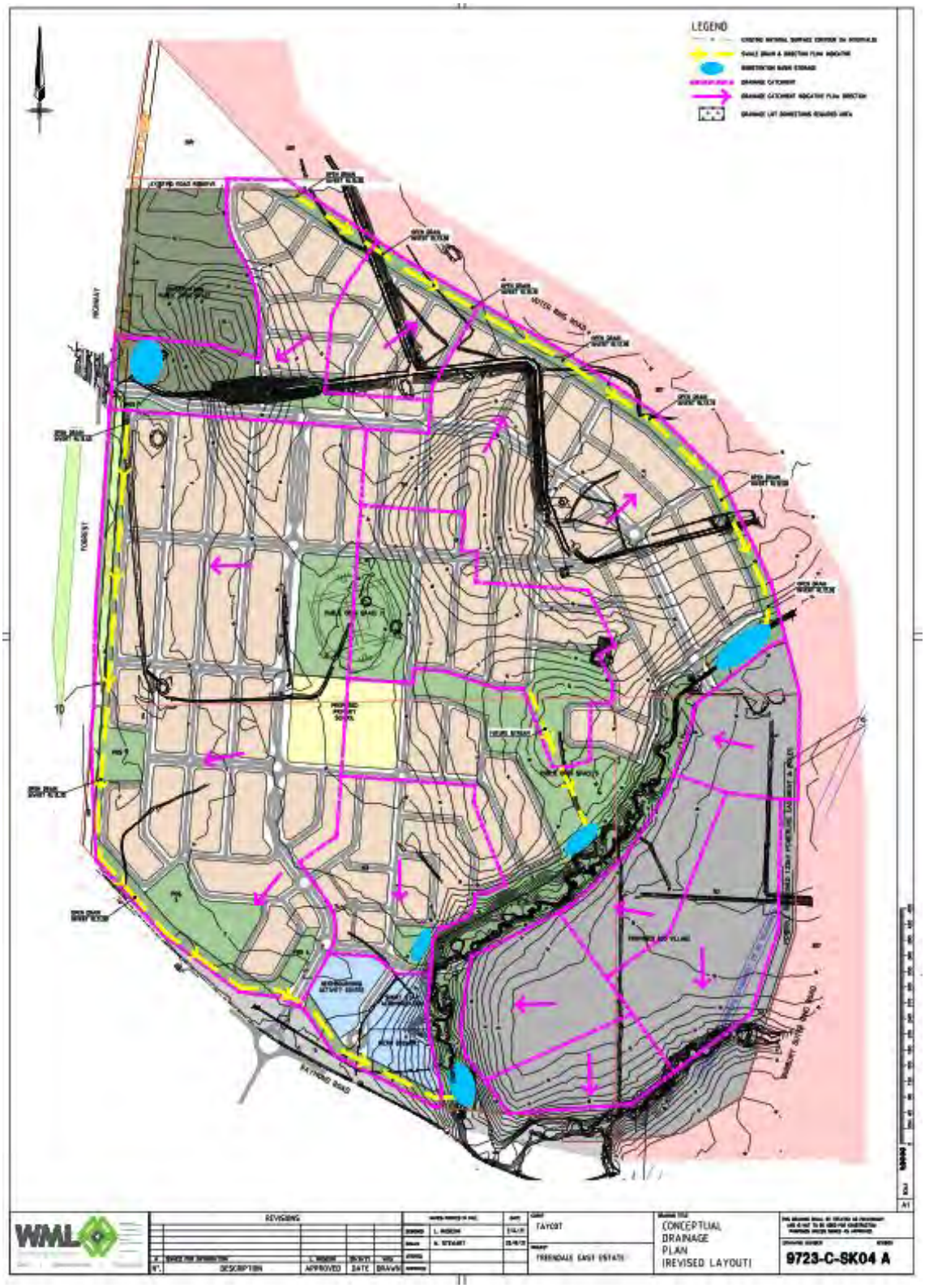


Figure 5. Concept Drainage Plan

7. SITE EARTHWORKS REQUIREMENTS

The western portion of the site will require significant imported fill due to the high groundwater levels perched on the clay. The central raised area of the site consists of good quality clean sand. Some minimal cutting is proposed through this area to generate some fill for the wetter portions of the site. The intention is to maintain the undulation of the site and to tie finished levels into the natural ground levels at the POS and drainage foreshore locations.

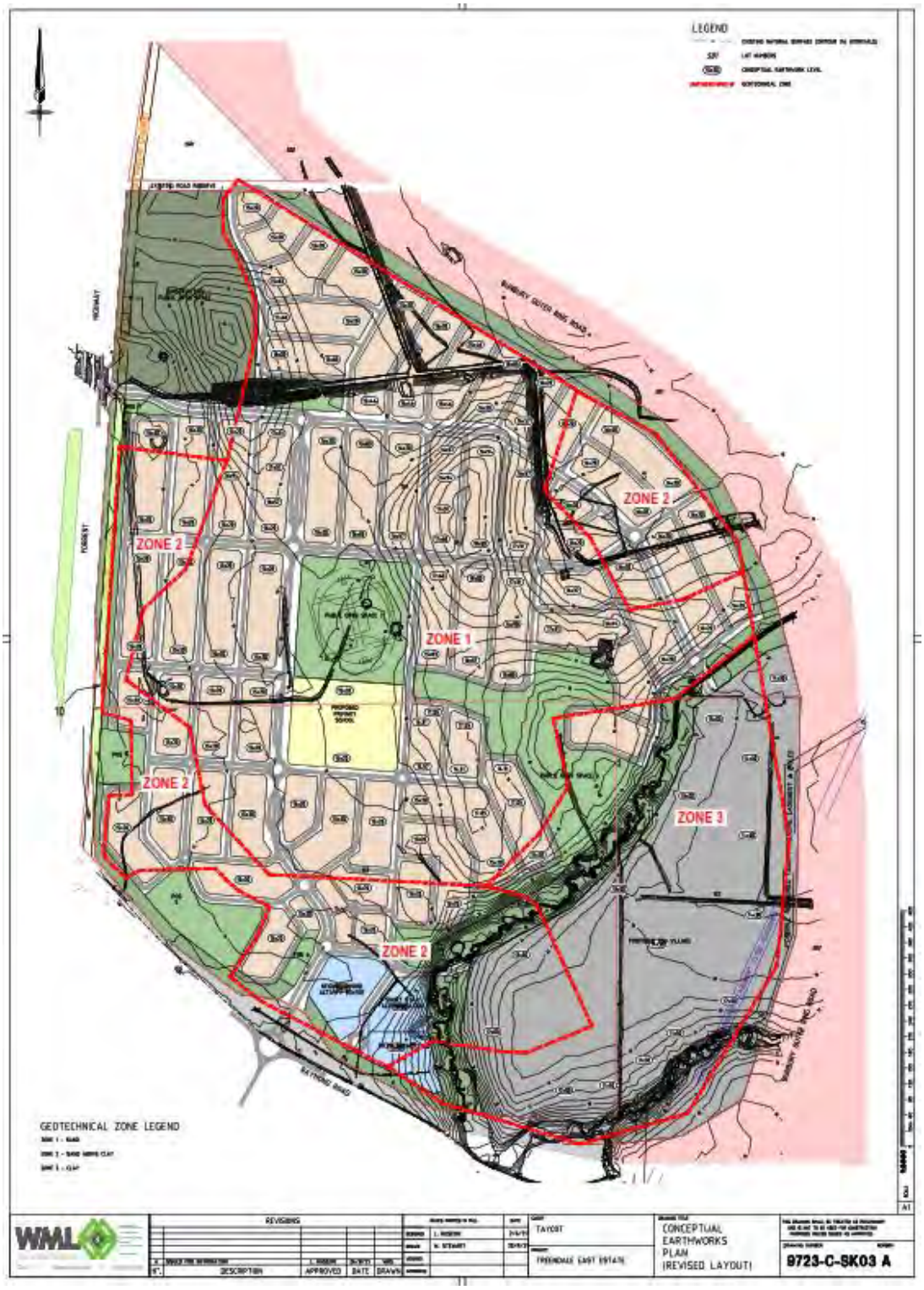


Figure 6. Earthworks Concept Plan

8. SERVICES

The below outlines existing services within the immediate area along with likely service requirements for the development.

8.1 SEWER

At the time of writing this report, the development area falls within the Water Corporation's sewer catchment planning area, as outlined in Appendix C. A conceptual sewer catchment plan for the development has been prepared and is included in Appendix D.

To service the site, two sewer pump stations will be required due to the undulating nature of the terrain and the need to meet the minimum depth requirements for gravity mains and pump stations, as stipulated by the Water Corporation. These requirements are in place to ensure proper functioning and compliance with local water and sewage infrastructure regulations. And Water Corporation has advised that the type 40 WWPS is currently in the 5 year CIP and can be considered for activation once we have certainty on the discharge location at WWPS Australind WWPS C. The type 10 WWPS will remain outside of the program until such time as the type 40 WWPS catchment is nearing completion.

The ultimate pumped discharge point for the sewer system will be located on the western side of Forrest Highway. The precise location of the discharge point will need to be confirmed by the Water Corporation in collaboration with the project planning team, to ensure compliance with regional infrastructure plans and environmental considerations.

However, there are several technical challenges and considerations related to the sewer infrastructure, specifically:

1. **Forrest Highway Crossing:**
    - The requirement to cross Forrest Highway, a major arterial route managed by **Main Roads WA (MRWA)**, presents a significant challenge. Coordination with MRWA will be essential to ensure that all necessary permits, clearances, and protection measures are in place prior to commencing works. This is critical to avoid disruptions to traffic flow and comply with highway safety regulations.
2. **Presence of Underground Services:**
    - There is significant underground infrastructure, including ATCO Gas lines, within or near the proposed alignment of the sewer mains. These utilities must be carefully navigated to prevent disruption or damage. Early and ongoing communication with ATCO Gas and other relevant utility providers will be crucial to secure the necessary approvals and mitigate risks during construction.

In light of these considerations, proactive engagement with both Main Roads WA and ATCO Gas is recommended to ensure the timely resolution of any issues related to permits, utility clearances, and safety protocols. Addressing these challenges early in the planning and design phases will help minimise delays and cost overruns during the construction phase.

8.2 WATER

According to Water Corporation's Esinet system there is an existing 200 P-12 main in Raymond Road to the south of the site and a 250 P-12 within the undeveloped road reserve of Vittoria Road to the North. It is likely that a link will need to be created between these two mains through the estate. This will likely be via a north/south main 250 in size. Smaller mains will then service the development off this central line. This is subject to future planning to be completed by the Water Corporation.

Harvey Water owned irrigation channels are present within the area. Preliminary discussions with Harvey Water have indicated that water could be supplied from their assets for the purpose of irrigation within the site. The intention is to irrigate the site and provide a secondary supply via a non-potable pipe network within the estate. This is subject to commercial arrangements and detailed design.

8.3 POWER

Western Power have provided a feasibility assessment (DIP SS012083). The assessment advises that a conceptual initial 50 lots can be connected to the existing HV network without the requirement for any HV reinforcement. An additional 12km HV supply maybe required in the future subject to timing and stage rollout of the development. The Stage 1 of the development will be supplied via the Raymond Road HV supply.

8.4 TELECOMMUNICATIONS

Dial Before You Dig plans show we can service this subdivision with pit and pipe infrastructure via a P100 pipe installed at the intersection of Treendale Road and Raymond Road.

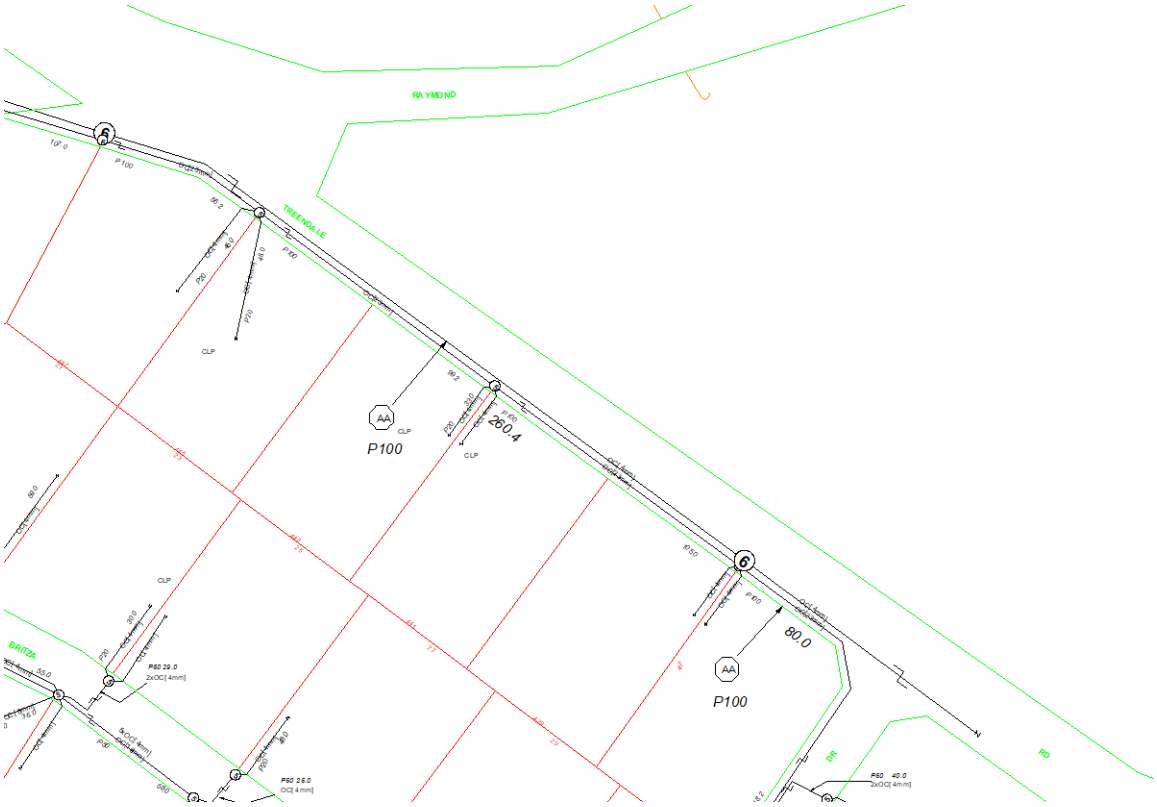


Figure 7. Communications Connction

The NBN rollout map shows construction had started on NBN fibre in Grand Entrance within the existing Treendale Estate. The communication network can be extended to cross the Forrest highway and into the subdivision, via the roundabout at Forrest Highway.

As this Development is within 1km of the area where NBN have deployed their network there should be no back haul charge. Should the developer decide to start in an area where we are exceeding
1km then a back haul charge may be required.

8.5 Gas Reticulation

There is an existing High Pressure Gas line that traverses the western boundary of the site and is covered by an easement. Initial consultation with ATCO Gas has not identified any major restrictions on the development. Any construction works proposed in the vicinity of this Gas line will need to be approved by Atco Gas and appropriate clearance to works will be required by the contractor prior to construction.

9. SUMMARY

The structure plan area identified in this report is capable of being serviced by the essential infrastructure required for residential development. Some headworks extensions will be required for water, power, sewer and communications. No logistical reasons have been identified as to why the site cannot be serviced with the required services. Nevertheless, a connection point for the discharge of sewer has not yet been established with the Water Corporation. The viability of servicing the site will be subject to more detailed design and cost feasibility analysis.

APPENDIX A – Road Hierarchy

STRUCTURE PLAN LEGEND

LOCAL SCHEME ZONES

- RESIDENTIAL
- NEIGHBOURHOOD CENTRE
- PS — PUBLIC PURPOSES PS (PRIMARY SCHOOL)
- RECREATION (PUBLIC OPEN SPACE)
  - (C) CONSERVATION VALUES
  - (L) LOCAL
  - (N) NEIGHBOURHOOD
  - (D) DISTRICT
  - (*) DRAINAGE

GREATER BUNBURY REGION SCHEME ZONES

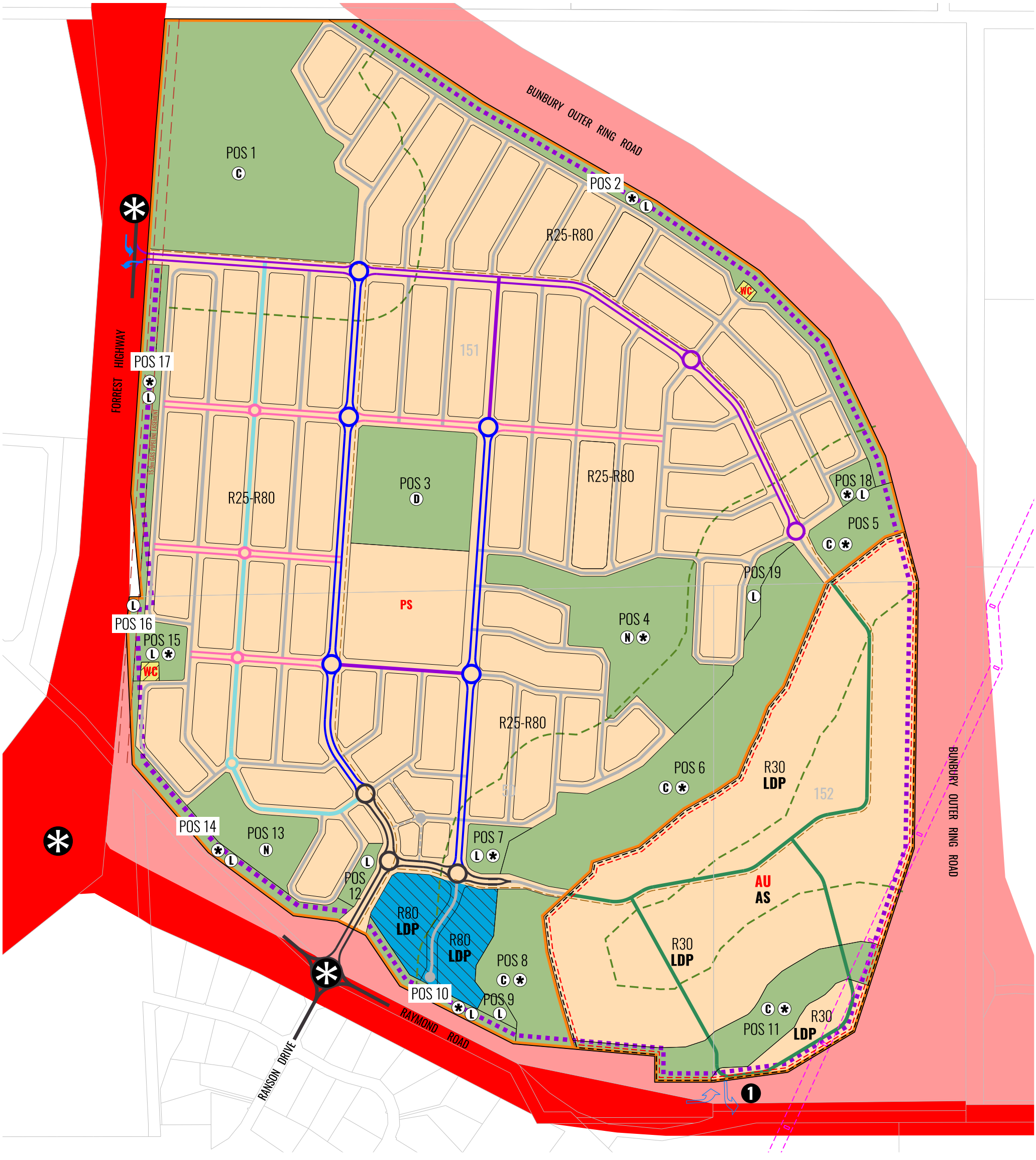
- PRIMARY REGIONAL ROADS
- FUTURE PRIMARY REGIONAL ROADS
- WC — PUBLIC PURPOSES WC (WATERCORP)

LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN

- STRUCTURE PLAN BOUNDARY
- RESIDENTIAL DENSITY RANGE BOUNDARIES
- PRINCIPAL SHARED PATH
- LOCAL DEVELOPMENT PLAN REQUIRED
- EXISITNG GAS PIPELINE EASEMENT
- 132kV POWERLINE EASEMENT, PYLONS
- CONSTRUCTION OR CONTRIBUTION TOWARDS INTERSECTION UPGRADE
- LEFT IN/LEFT OUT INTERSECTION
- TEMPORARY LEFT IN/LEFT OUT INTERSECTION
- ACOUSTIC CONSIDERATIONS (SPP 5.4)
- LOTS WITHIN 100m OF "CLASSIFIED VEGETATION" AND SUBJECT TO BUSHFIRE ATTACK LEVEL ASSESSMENT. REFER BUSHFIRE MANAGEMENT PLAN AND ANY SUBSEQUENT BAL ASSESSMENTS.
- AU — ADDITIONAL USE
- AS — ADDITIONAL SITE REQUIREMENTS

ROAD HIERARCHY

- INTEGRATOR ARTERIAL B
- NEIGHBOURHOOD CONNECTOR A
- NEIGHBOURHOOD CONNECTOR B
- ACCESS STREET A
- ACCESS STREET C
- ACCESS STREET D
- LANEWAY
- VILLAGE - COMMUNAL ROAD B



TREENDALE EAST STRUCTURE PLAN - PLAN 1

Lots 151, 152 & 153 Raymond Road, TREENDALE

A Taycot Development Project

NORTH

Scale: 1:6500 @ A3

0 60 120 180m

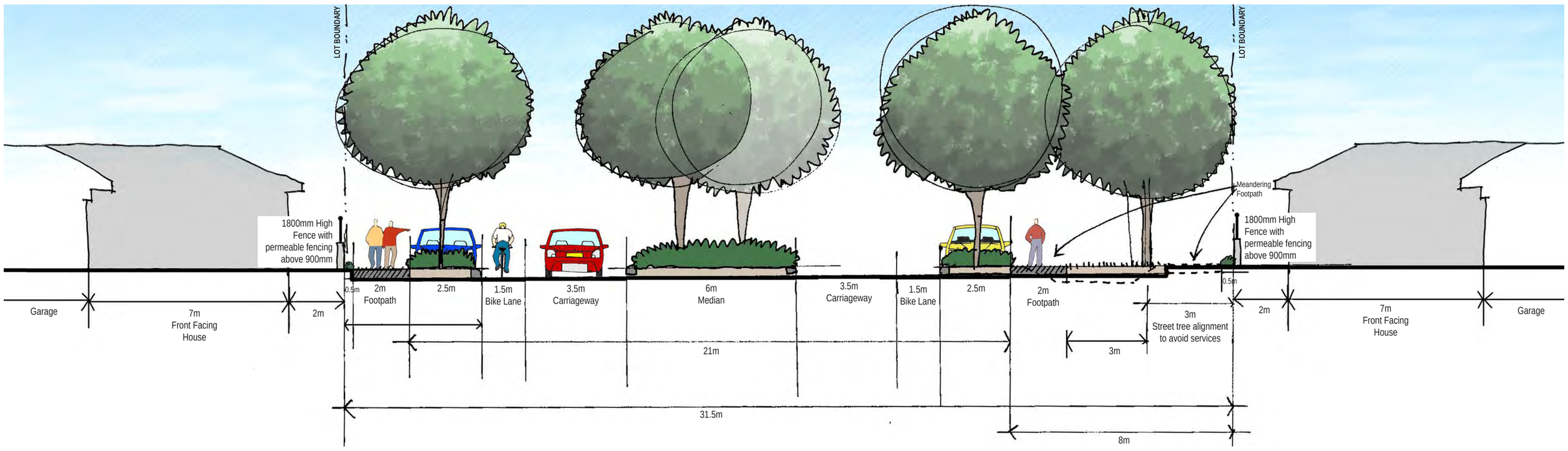
PLAN: TAYTE-2-002 REVISION: E
DATE: 19/03/2025 DRAWN: JP
PROJECTION: PCG 2020 PLANNER: DM
DATUM: AHD CHECK: CM

cdp
Town Planning & Urban Design

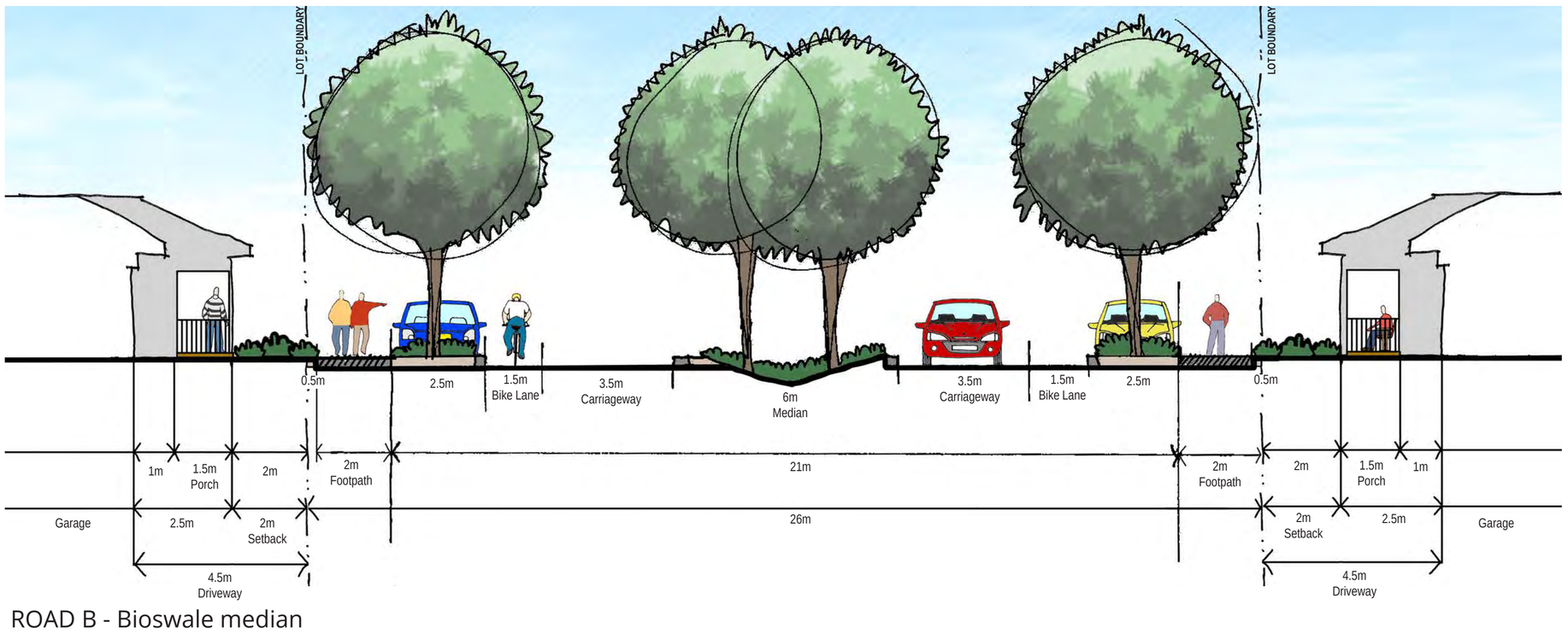
Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

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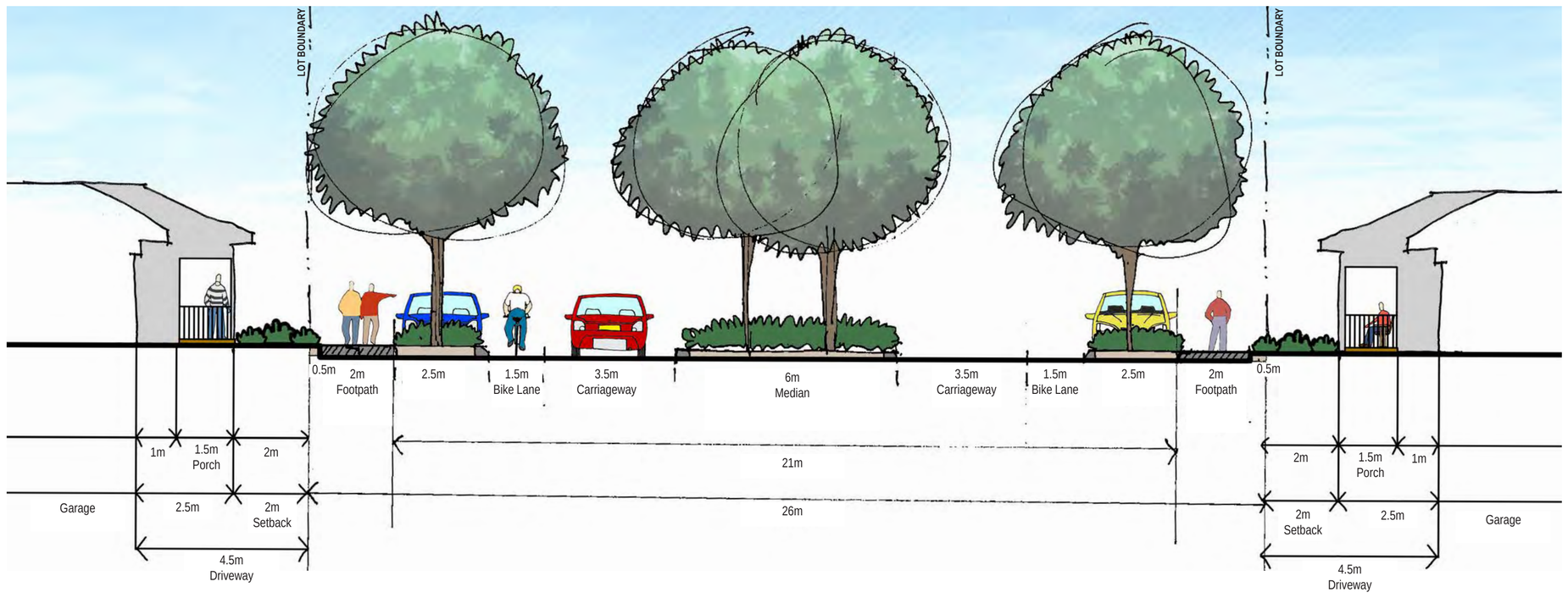
APPENDIX B – Cross Sections



ROAD A - Meandering path (median or verge could be bioswale)



ROAD B - Bioswale median



ROAD C - Separate carraigeways

ROAD D - 2 Rows of street trees

TREENDALE EAST

STREET SECTIONS

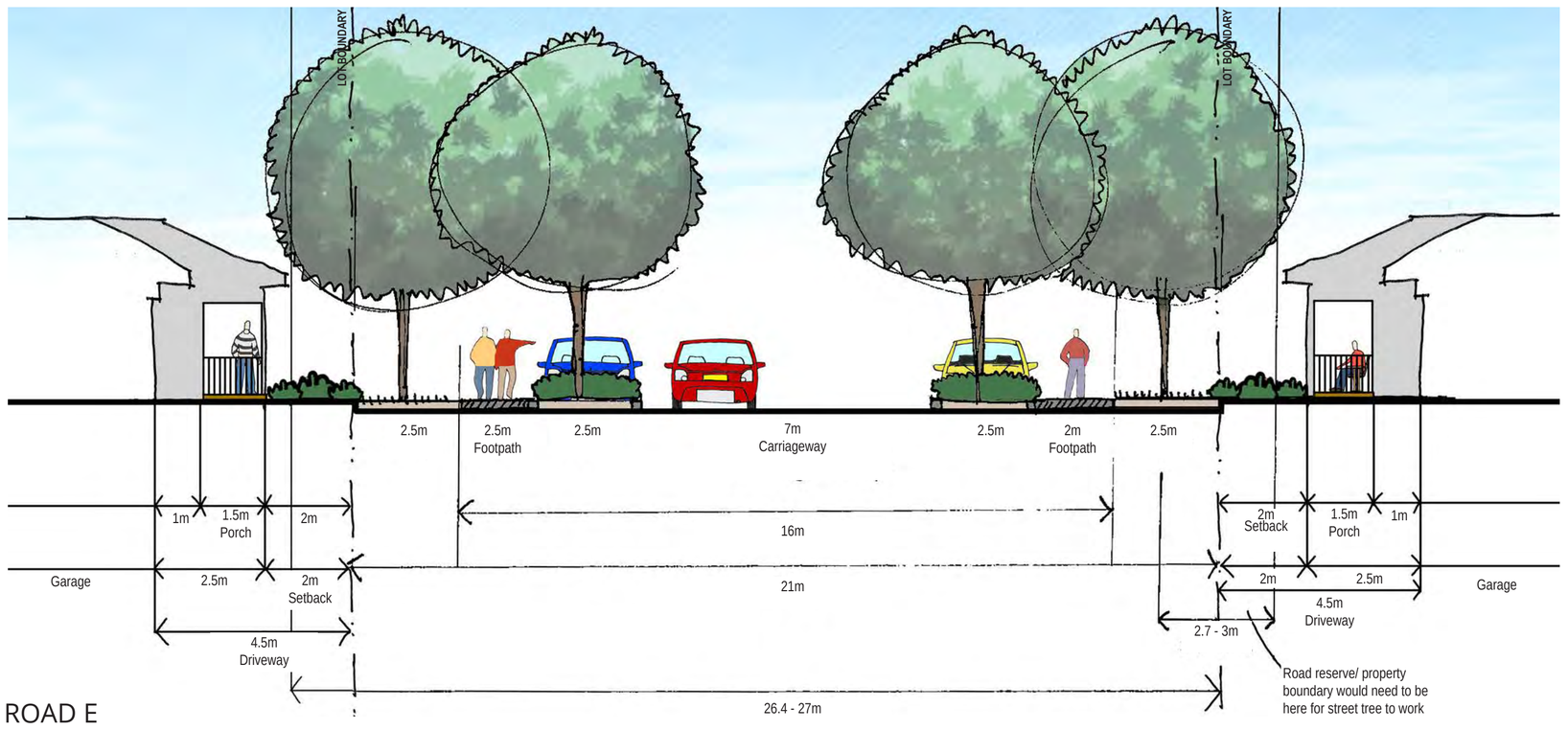
DWG **XX-XX-XX**
REV **C**
DATE **14-07-21**

0 1 2 3 4 5 m

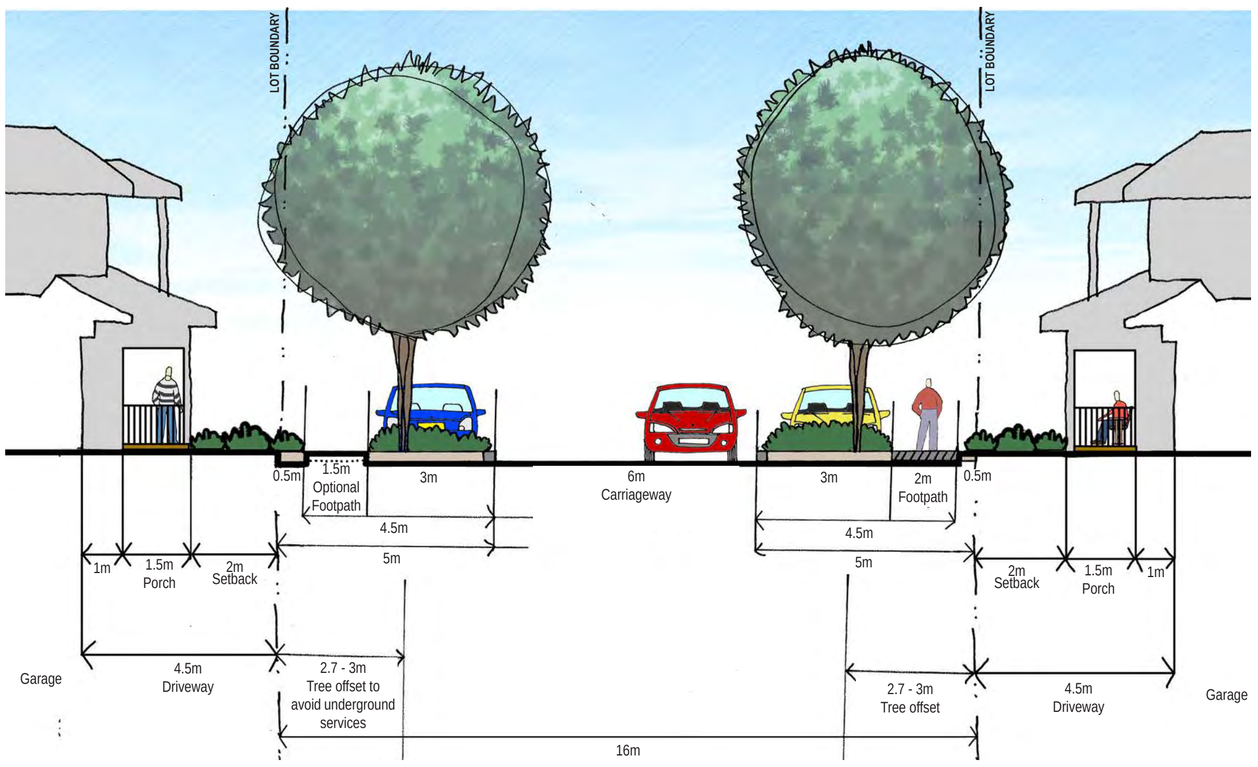
SCALE **1 : 100 @ A1**

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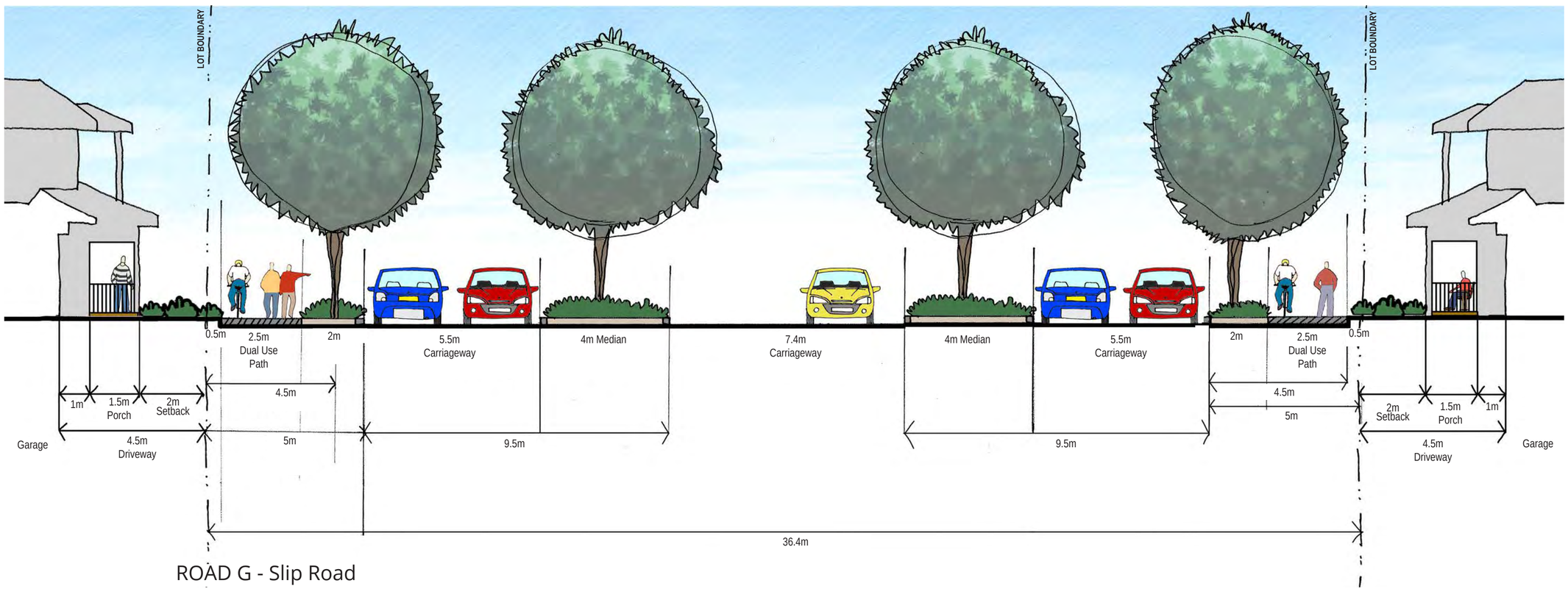
emerge ASSOCIATES



ROAD E



ROAD F



ROAD G - Slip Road

ROAD H - BORR/Forrest Hwy Acoustic Bund TBC

TREENDALE EAST

STREET SECTIONS

DWG **XX-XX-XX**
REV **C**
DATE **14-07-21**

0 1 2 3 4 5 m

SCALE **1 : 100 @ A1**

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emerge ASSOCIATES

APPENDIX C – WC WASTEWATER SCHEME

AUSTRALIND – SD087

AUSTRALIND - SD087
Root Node at WWTP is ROOT
Total Catchment inflow = 195.2 L/s
Total Injected flow - 0.00 L/s
Total Outflow = 195.2 L/s

AUSTRALIND P.S. 8
BRAIDWOOD DR
PUMP STN. 'PS8 - 087'
REDUCTION '075 - 087'
SEWER DESIGN FLOW - 38.4 L/s
EXISTING PUMP RATE - 39.3 L/s
LONG TERM PUMP RATE - 51.2 L/s

AUSTRALIND P.S.
LESCHENAULT PD
PUMP STN. 'PS' - 087'
REDUCTION '0036 - 087'
SEWER DESIGN FLOW - 5.9 L/s
EXISTING PUMP RATE - 11.4 L/s
LONG TERM PUMP RATE - 7.9 L/s

AUSTRALIND P.S. 6
WAKEFIELD CR
PUMP STN. '066 - 087'
REDUCTION '0066 - 087'
SEWER DESIGN FLOW - 1.6 L/s
EXISTING PUMP RATE - 6.8 L/s
LONG TERM PUMP RATE - 6.0 L/s

AUSTRALIND P.S. 2
GARFIELD DR
PUMP STN. 'PS2 - 087'
REDUCTION '0034 - 087'
SEWER DESIGN FLOW - 4.7 L/s
EXISTING PUMP RATE - 16.1 L/s
LONG TERM PUMP RATE - 7.9 L/s

AUSTRALIND P.S. 5
ABSOLON CR
PUMP STN. 'PS5 - 087'
REDUCTION '0177 - 087'
SEWER DESIGN FLOW - 3.3 L/s
EXISTING PUMP RATE - 6.5 L/s
LONG TERM PUMP RATE - 6.0 L/s

AUSTRALIND P.S. 4
OLD COAST RD
PUMP STN. 'PS4 - 087'
REDUCTION '0086 - 087'
SEWER DESIGN FLOW - 13.8 L/s
EXISTING PUMP RATE - 16.6 L/s
LONG TERM PUMP RATE - 25.7 L/s

AUSTRALIND P.S. 10
ROTHESAY CR
PUMP STN. 'PS10 - 087'
REDUCTION '0234 - 087'
SEWER DESIGN FLOW - 3.9 L/s
EXISTING PUMP RATE - 16.6 L/s
LONG TERM PUMP RATE - 6.0 L/s

AUSTRALIND P.S. 1
BEDDINGFIELD WY
PUMP STN. 'PS1 - 087'
REDUCTION '075 - 087'
SEWER DESIGN FLOW - 15.4 L/s
EXISTING PUMP RATE - 47.3 L/s
LONG TERM PUMP RATE - 61.6 L/s

AUSTRALIND P.S 11
OPAL DR
PUMP STN. 'PS11 - 087'
REDUCTION '075 - 087'
SEWER DESIGN FLOW - 44.4 L/s
EXISTING PUMP RATE - 92.8 L/s
LONG TERM PUMP RATE - 72.1 L/s

AUSTRALIND P.S. 7
BARNES AVE
PUMP STN. 'PS7 - 087'
REDUCTION '0034 - 087'
SEWER DESIGN FLOW - 6.1 L/s
EXISTING PUMP RATE - 11.5 L/s
LONG TERM PUMP RATE - 10.2 L/s

AUSTRALIND P.S. E
PUMP STN. 'PS E - 087'
REDUCTION '0417 - 087'
SEWER DESIGN FLOW - 1.0 L/s
LONG TERM PUMP RATE - 6.0 L/s

AUSTRALIND P.S. 15
CARNELIAN AVE
PUMP STN. 'PS15 - 087'
REDUCTION '0845 - 087'
SEWER DESIGN FLOW - 12.9 L/s
EXISTING PUMP RATE - 19.5 L/s
LONG TERM PUMP RATE - 17.1 L/s

AUSTRALIND P.S. C
PUMP STN. 'PSC - 087'
REDUCTION '100 - 087'
SEWER DESIGN FLOW - 9.9 L/s
LONG TERM PUMP RATE - 198.5 L/s

AUSTRALIND P.S.G
PUMP STN. 'PSG - 087'
REDUCTION '075 - 087'
SEWER DESIGN FLOW - 13.1 L/s
LONG TERM PUMP RATE - 37.5 L/s

'T3 - 087'
SDF - 0.0 L/s
PUMP STN. 'PSH - 087'
REDUCTION 'T13 - 087'
SEWER DESIGN FLOW - 8.2 L/s
LONG TERM PUMP RATE - 10.9 L/s

'T47 - 087'
SDF - 11.8 L/s

'0552 - 087'
SDF - 4.4 L/s

'0546 - 087'
SDF - 35.0 L/s

'1094 - 087'
SDF - 5.4 L/s

'0602 - 087'
SDF - 3.9 L/s

'0611 - 087'
SDF - 7.1 L/s

'1168 - 087'
SDF - 5.1 L/s

'0599 - 087'
SDF - 6.5 L/s

'0662 - 087'
SDF - 2.1 L/s

'0615 - 087'
SDF - 3.3 L/s

'0319 - 087'
SDF - 1.6 L/s

'0774 - 087'
SDF - 3.0 L/s

'0088 - 087'
SDF - 3.2 L/s

'0176 - 087'
SDF - 6.4 L/s

'0470 - 087'
SDF - 2.3 L/s

'0576 - 087'
SDF - 4.5 L/s

'0721 - 087'
SDF - 3.9 L/s

'19 - 087'
SDF - 1.0 L/s

'0034 - 087'
SDF - 5.6 L/s

'0824 - 087'
SDF - 5.2 L/s

'0827 - 087'
SDF - 5.2 L/s

'1410 - 087'
SDF - 0.2 L/s

'1270 - 087'
SDF - 6.4 L/s

'029 - 087'
SDF - 2.8 L/s

'075 - 087'
SDF - 9.9 L/s

'1035 - 087'
SDF - 5.1 L/s

'T11 - 087'
SDF - 7.6 L/s

'T34 - 087'
SDF - 5.5 L/s

'T21 - 087'
SDF - 4.2 L/s

'T20 - 087'
SDF - 4.0 L/s

'A18 - 087'
SDF - 2.4 L/s

'AF7224 - 087'
SDF - 3.1 L/s

'AF7237 - 087'
SDF - 0.7 L/s

'059 - 087'
SDF - 4.1 L/s

DN250 PM FROM BEDDINGFIELD WY P.S. 1 AND DN300 PM FROM OPAL DR P.S. 11 IN THE LONG TERM DISCHARGE INTO THE CATCHMENT OF P.S. C.

DN250 PM FROM BEDDINGFIELD WY P.S. 1 CURRENTLY MERGES INTO A DN300 PM ALONG WITH THE DN200 PM FROM BRAIDWOOD DR P.S. 8.

ACCESS CHAMBER AE5821 IS THE TEMPORARY DISCHARGE POINT FOR THE INTERIM TYPE 40 WWPS

NO WATER CORPORATION INFRASTRUCTURE WILL BE CONSTRUCTED WITH IN THE STRATA VILLAGE. PRIVATE PUMP STATION IS CONCEPTUAL ONLY. SERVICING ARRANGEMENTS TO BE DISCUSSED WITH WATER CORPORATION AS THE DEVELOPMENT PROPOSAL PROGRESSES.

NO FLO AREA, PRIVATE P.S. WILL BE REQUIRED TO SERVICE DOMESIC WASTE IF REQUIRED.

EXISTING DN300 PM FROM MONASH BLVD P.S. 4 (EATON SD097) "NOT IN USE"

TO KEMERTON WWTP

DRAFT

DESIGN FILE: PCID

THE INFORMATION ON THIS PLAN IS BASED ON THE BEST DATA AVAILABLE AT DATE OF PRINTING AND IS SUBJECT TO ONGOING REVIEW AND AMENDMENT. NO RESPONSIBILITY IS ACCEPTED BY THE WATER CORPORATION FOR ACCURACY OF DATA SUPPLIED BY EXTERNAL AGENCIES.

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LEGEND

- EXISTING PUMPING STATION
- EXISTING PRESSURE MAIN
- EXISTING GRAVITY SEWER
- PROPOSED PUMPING STATION
- PROPOSED PRESSURE MAIN
- PROPOSED GRAVITY SEWER
- PARKS AND PUBLIC OPEN SPACE
- EXISTING SEWERED AREAS
- SEWERED BY PRIVATE PS
- NODE CATCHMENT
- PS AND SEWER CATCHMENTS
- SEWER DISTRICT CATCHMENT
- WWTP CATCHMENT

NOTATION

'7001 - 121'
- 121 = SEWER DISTRICT NUMBER
- 7001 = CATCHMENT NODE

SDF = 1.5 x AVERAGE DAILY FLOW RATE

SHEET INDEX

AQUA NO.

AQUA VERSION

ISSUED WITH THE AUTHORITY OF THE MANAGER ASSET PLANNING GROUP
629 NEWCASTLE STREET, LEEDERVILLE 6007
WESTERN AUSTRALIA.
TELEPHONE (08) 9420 2420, FAX (08) 9420 3179

WASTEWATER SCHEME PLANNING SERIES

AUSTRALIND - SD087
CONCEPTUAL PLANNING
LONG TERM SCHEME

PLANNING BY	COMPILED BY	ACCEPTED BY
APG PLANNERS	W. CALLANAN	C. CALLAGHAN
SCALE	FULL REVIEW	AQUAVISION NO.
1:11,000	FEB 2024	JT1 2006 11266 V01

A1

DRAFT

APPENDIX D – SEWER CONCEPT

LEGEND

- 15x20 — LOT FFL
- GRAVITY SEWER
- PRESSURE MAIN
- GRAVITY MAIN - CONTROL LINE
- ALTERNATE PUMP STATION - PSG LOCATION

EXISTING ROAD RESERVE

15.9m GAS PIPELINE EASEMENT

BUNBURY OUTER RING ROAD

PUBLIC OPEN SPACE 1

PUMP STATION AUSTRALIND PSC
SEWER DESIGN FLOW: 9.9L/s
LONG TERM PUMP RATE: 198.5L/s

POS 2

PUMP STATION No. 1
SEWER DESIGN FLOW: 8.2L/s
LONG TERM PUMP RATE: 10.9L/s
DEPTH TO INVERT 6.0m

PUMP STATION

FORREST HIGHWAY

POS 17

PUBLIC OPEN SPACE 3

PUBLIC OPEN SPACE 5

PROPOSED PRIMARY SCHOOL

PUBLIC OPEN SPACE 4

DISCHARGE POINT

POS 16

POS 15

PUMP STATION AUSTRALIND PSG
SEWER DESIGN FLOW: 13.1L/s
LONG TERM PUMP RATE: 37.5L/s
DEPTH TO INVERT 7.0m

PUMP STATION

PUBLIC OPEN SPACE 13

POS 14

POS 12

NEIGHBOURHOOD ACTIVITY CENTRE

COMMERCIAL (SHORT STAY ACCOMMODATION & MICRO BREWERY)

PROPOSED 60m RIPARIAN CORRIDOR

POS 7

PUBLIC OPEN SPACE 8

POS 9

POS 10

PUBLIC OPEN SPACE 6

PUMP STATION PRIVATE???
SEWER DESIGN FLOW: 11.8L/s

PUMP STATION

PROPOSED 60m RIPARIAN CORRIDOR

STRATA TITLED VILLAGE

POSSIBLE REALIGNED 132kV POWERLINE EASEMENT & POLES

EXISTING 132kV POWERLINE EASEMENT TO BE REALIGNED

PUBLIC OPEN SPACE 11

STRATA TITLED VILLAGE

BUNBURY OUTER RING ROAD

RAYMOND ROAD

RANSON DRIVE

SCALE 1:3000

A1

WML Consulting Engineers
Civil | Geotechnical | Structural

BUNBURY +61 8 9722 3544
KALGOORLIE +61 8 9021 1811
PERTH +61 8 9722 3566
wml.com.au

REVISIONS

N°.	DESCRIPTION	APPROVED	DATE	DRAWN
C	LAYOUT UPDATED/ISSUED FOR REVIEW	L. RUSCONI	21/08/24	NT
B	LAYOUT UPDATED/ISSUED FOR INFORMATION	L. RUSCONI	7/10/21	WRS
A	ISSUED FOR INFORMATION	L. RUSCONI	26/8/21	WRS

NAMES PRINTED IN FULL		DATE
DESIGNED	L. RUSCONI	2/6/21
DRAWN	W. STEWART	24/8/21
VERIFIED		
APPROVED		

CLIENT: TAYCOT

PROJECT: TREENDALE EAST ESTATE

DRAWING TITLE: CONCEPTUAL SEWER PLAN (REVISED LAYOUT)

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DRAWING NUMBER: 9723-C-SK05

REVISION: C

Appendix 7.
Geotechnical Investigation

TAYCOT Pty Ltd

TREENDALE EAST ESTATE





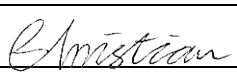


TREENDALE EAST ESTATE URBAN DEVELOPMENT – PRELIMINARY GEOTECHNICAL INVESTIGATION

May 2021
9745-G-R-001.docx

WML
Consulting Engineers

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Signed:	
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WML Consultants Pty Ltd
ABN 36 092 471 531
PO Box 2023 Bunbury WA 6231
First Floor, 62 Wittenoom Street Bunbury WA 6230
(08) 9722 3544 wml@wml.com.au
wml.com.au

CONTENTS

1 INTRODUCTION 5

1.1 Site description 5
1.2 Available information 6
1.3 Objectives of this report 6
1.4 Geotechnical Risk and Issues 6

2 FIELD PROGRAMME 7

2.1 Fieldwork 7
2.2 Personnel 7
2.3 Test Pits 7
2.4 Penetrometer Testing 7

3 LABORATORY TESTING 8

3.1 Geotechnical Testing 8
3.2 Acid Sulfate Soil Testing 8

4 SUBSURFACE CONDITIONS 10

4.1 Sub-surface Profile 10
4.2 Groundwater 10

5 GEOTECHNICAL DISCUSSION 11

5.1 Zone Specific Site Classifications and Improvement Recommendations 11
5.2 Generic Site Wide Site Classification Improvement Recommendations 11
5.3 Site Preparation 12

6 ACID SULFATE SOILS 13

6.1 Result interpretation 13
6.1.1 Further Testing 13

7 FUTURE INVESTIGATIONS 14

7.1 Geotechnical Investigation 14
7.2 ASS Investigation 14
7.3 Groundwater 14

8 REFERENCES 15

TABLES

Table 3.1. Laboratory Testing Summary 8
Table 3.2. ASS Laboratory Testing Summary 9
Table 4.1: Sub-surface soil profile 10

FIGURES

Figure 1.1. ASS Risk Map from DWER.

APPENDICES

LIMITATIONS

APPENDIX A

Site Maps

APPENDIX B

Soil Logs

APPENDIX C

Geotechnical Laboratory Test Results

APPENDIX D

ASS Laboratory Test Results

1 INTRODUCTION

TAYCOT (Client) engaged WML Consultants (WML) to undertake a preliminary geotechnical and acid sulfate soil (ASS) investigation for a large scale urban development, including new residential lots, schools, parks and a community centre. This report presents the results of the investigation.

1.1 Site description

The site is irregular in shape, covering approximately 182.9 hectares, and is bound by Forrest Highway, Raymond Road, Victoria Road and Balaclava Road. The Bunbury Outer Ring Road will enclose the northern and eastern edges of the development upon its completion. The site is made up of three lots, 100 in the south west, 101 in the south east, and 131 in the northern half of the site. All lots are currently used as paddocks for cattle, and have been used for similar purposes for three generations. Historical aerial imagery shows the site appears largely unchanged since 2005.

The site generally comprises open ground, with short grass covering most of the site. Isolated clusters of tall trees are spaced across the area, generally near drainage channels and at the intersection of the three lots. The north west corner of Lot 131 is covered with dense trees and bushes. A mix of shallow hills and flat, level areas make up Lots 100 and 101 in the southern half of the site, while Lot 131 is generally flat. Natural and manmade drainage channels run through isolated sections of each lot. Stockpiled materials from some of the manmade drainage channels form large windrows that run parallel to the channel. A shed near the centre of Lot 100, and two derelict corrugated metal buildings in the south east of Lot 131 are the only structures on site.

The 1:50,000 scale Geological Map 'Bunbury-Burekup' indicates the site comprises three different general soil types. The majority of the site is comprised of "Guildford formation: mainly alluvial sandy clay" and "Bassendean sand: low rounded dunes" to probable depths of 20m and 15m respectively. A smaller area of "Alluvium – older river terraces" is present towards the southeast of the site. A map of the site geology is found attached in Appendix A.

The entirety of the site has been identified as having a moderate to low risk of ASS within 3m of the natural soil surface, as shown in yellow in Figure 1.1 below. This is based on information available from the Department of Water and Environmental Regulations.

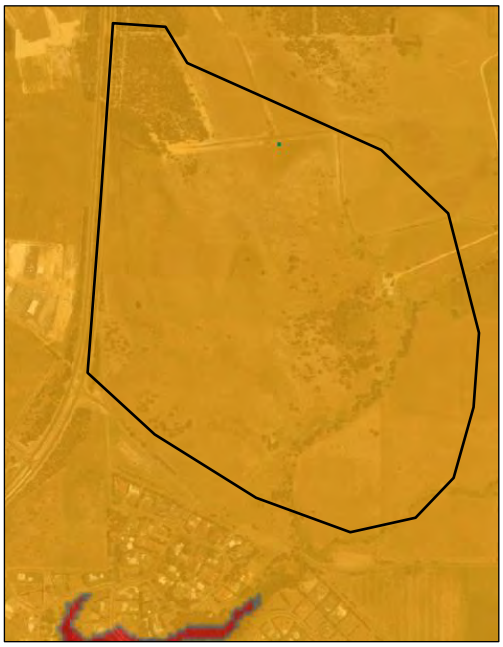


Figure 1.1. ASS Risk Map from DWER.

1.2 Available information

The following information was made available by TAYCOT for the purpose of this report.

- CDP Town Planning & Urban Design – Concept master plan (8/12/2020)

1.3 Objectives of this report

The objectives of the preliminary geotechnical investigation were to:

- Assess the sub-surface soil conditions across the site;
- Provide preliminary site preparation and remediation recommendations;
- Locate areas of potential acid sulfate soil (ASS) recommendations and provide comment on remediation and requirement for further study options;
- Inform future detailed geotechnical investigations.

1.4 Geotechnical Risk and Issues

The following issues/risks were addressed during the intrusive ground investigation:

- Assessment of the sub-surface profile to determine soil strength across site;
- Assessment of soil types to determine suitability for development.

2 FIELD PROGRAMME

2.1 Fieldwork

Fieldwork was carried out across four days from the 30th of March to the 6th of April 2021, with the fieldwork comprised:

- 72 machine excavated test pits, extending to depths of 1.3-2.0m;
- 72 Perth Sand Penetrometer (PSP) or Dynamic Cone Penetrometer (DCP) tests to a target depth of 1.0m or refusal adjacent to each test pit;
- The collection of soil samples from test pits for geotechnical laboratory testing;
- Sampling of soil at 500mm intervals for ASS field testing.

2.2 Personnel

A geotechnical engineer from WML positioned the test locations, logged the soil encountered in the test pits, carried out the PSP/DCP testing and collected samples for laboratory testing.

2.3 Test Pits

Test pits were excavated using a 4.7 ton Terex TC 48 excavator equipped with a 600mm toothed GP bucket, supplied by PE Civil. Test pits were excavated, logged, photographed and backfilled. When backfilling each test pit, the fill was tamped down with the back of the bucket every 0.5-1.0m, and back-tracked when filled. The test pit locations are shown on the site map in Appendix A. Field shear vane testing was performed when clays were encountered to determine undrained shear strength of the layer.

2.4 Penetrometer Testing

Perth Sand Penetrometer (PSP) or Dynamic Cone Penetrometer (DCP) testing was undertaken adjacent to each test pit based on the soil type identified. The target depth of the penetrometer testing was 1.0m, however, where a significant layer of loose soil was identified near 1.0m from the surface, the tests were continued until firm ground or a depth of 2.0m was reached. DCP testing was undertaken in accordance with AS1289.6.3.2, and PSP testing in accordance with AS 1289.6.3.3. Results from the penetrometer testing are shown on the test pit logs in Appendix B.

3 LABORATORY TESTING

3.1 Geotechnical Testing

To assist in the evaluation of geotechnical design parameters and for confirmation of the visual classification of the soils, laboratory testing was carried out by Construction Sciences, a NATA accredited laboratory. The testing comprised the following:

- Particle size distribution on 10 samples (AS 1289 3.6.1)
- Atterberg limits on 10 samples (AS 1289 3.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1)

The results of the testing are presented in below in Table 3.1, with the laboratory test certificates are presented in Appendix C.

Table 3.1. Laboratory Testing Summary

Location	Site Zone	Depth (m)	Test	PSD			Atterberg's Limits		
				Fines (%)	Sand (%)	Gravel (%)	PI (%)	LL (%)	LS (%)
TP 4	3	0.5 – 1.5	PSD/PI	36	62	2	29	49	12.5
TP 11	3	1.6 – 2.0	PSD/PI	71	26	3	50	67	16.5
TP 13	2	0.3 – 0.7	PSD/PI	21	75	4	6	20	2.5
TP 13	2	0.7 – 1.3	PSD/PI	42	54	4	41	57	15.5
TP 17	2	0.1 – 0.5	PSD/PI	12	88	0	NP	NO	1.0
TP 21	1	1.65	PSD/PI	4	96	0	NP	NO	0.5
TP 26	2	1.70	PSD/PI	53	46	1	46	62	11.0
TP 36	3	0.8 – 1.5	PSD/PI	80	18	2	47	64	16.0
TP 39	1	1.7 – 2.0	PSD/PI	13	82	5	NP	NO	1.0
TP 67	1	1.0 – 1.5m	PSD/PI	2	98	0	NP	NO	0.0

Note: PSD – Particle Size Distribution; PI – Plasticity Index; LL – Liquid Limit; LS – Linear Shrinkage; NP – Non-Plastic; NO – Not Obtainable;

3.2 Acid Sulfate Soil Testing

Sampling was conducted at 0.5m intervals from 20 test pits, placed on ice and kept frozen until delivery to Eurofins, a NATA accredited laboratory, for acid sulfate field testing. The results of the testing are found attached in Appendix D, and summarised below in Table 3.2.

Table 3.2. ASS Laboratory Testing Summary

Test Pit	Depth	pH_F	pH_{Fox}	ΔpH	Reaction	Test Pit	Depth	pH_F	pH_F	ΔpH	Reaction
6	0.5	6.2	5	1.2	Moderate	40	0.5	7	5.8	1.2	No Reaction
	1	5.7	4.1	1.6	Moderate		1	7.9	5.9	2	Strong
	1.5	5.4	4.2	1.2	Moderate		1.5	7.2	6.4	0.8	Moderate
	2	5.6	4.6	1	Moderate		2	7	6.5	0.5	Moderate
7	0.5	6.4	5.5	0.9	No Reaction	44	0.5	6.8	3	3.8	Strong
	1	6.3	5.4	0.9	Moderate		1	6.9	4.6	2.3	Moderate
	1.5	6	4.7	1.3	Moderate		1.5	6.5	4.1	2.4	Moderate
	2	5.8	4.7	1.1	No Reaction	46	0.5	4.9	4	0.9	No Reaction
13	0.5	6.3	5.3	1	Moderate		1	5.1	4.2	0.9	No Reaction
	1	6.5	5.6	0.9	Moderate		1.5	6.2	3.7	2.5	Moderate
	1.5	6.2	4.7	1.5	Moderate		2	6.2	3.5	2.7	Moderate
15	0.5	6.2	4.7	1.5	Moderate	48	0.5	4.6	4.3	0.3	No Reaction
	1	6	3.3	2.7	Moderate		1	6.1	3.6	2.5	Extreme
	1.5	6.9	4.8	2.1	Moderate		1.5	6.8	3.2	3.6	Strong
	2	7	4.2	2.8	Moderate		2	6.5	2.9	3.6	Strong
17	0.5	6.6	4.8	1.8	Strong	53	0.5	5.5	4.6	0.9	No Reaction
	1	6.3	4.8	1.5	Moderate		1	5	4.3	0.7	No Reaction
	1.5	6.3	4.8	1.5	Moderate		1.5	5	4.5	0.5	No Reaction
	1.8	6.3	4.6	1.7	Extreme		2	5.6	3.7	1.9	Moderate
	2	6.5	5.4	1.1	Moderate	55	0.5	4.7	4.2	0.5	No Reaction
19	0.5	5	4.1	0.9	No Reaction		1	6	5	1	Moderate
	1	5.7	3	2.7	Moderate		1.5	6	4.5	1.5	No Reaction
	1.5	5.4	3.7	1.7	Moderate		2	5.4	3.9	1.5	No Reaction
20	0.5	5	4.2	0.8	Moderate	58	0.5	6.6	5.8	0.8	No Reaction
	1	6	4.4	1.6	Moderate		1	6.5	6.3	0.2	No Reaction
	1.5	5.2	3.6	1.6	Moderate		1.5	8.5	7.3	1.2	Moderate
	2	5.3	3.6	1.7	Moderate		2	7.9	7.2	0.7	Strong
23	0.5	4.2	3.3	0.9	Moderate	62	0.5	5.6	4.2	1.4	Moderate
	1	4.8	3.8	1	Moderate		1	4.9	4.5	0.4	No Reaction
	1.5	5.8	3.3	2.5	Moderate		1.5	4.8	4.3	0.5	No Reaction
	2	7.3	4.2	3.1	Extreme		1.8	5.5	4.7	0.8	No Reaction
28	0.5	5.5	4.5	1	No Reaction	65	0.5	6.5	5.2	1.3	Moderate
	1	5.1	4.3	0.8	No Reaction		1	6	5.1	0.9	No Reaction
	1.5	5.6	4.5	1.1	No Reaction		1.5	6.2	5.2	1	No Reaction
	2	5.7	4.1	1.6	No Reaction		2	6.6	5.3	1.3	Moderate
34	0.5	6.2	5.2	1	Moderate	67	0.5	5.8	4.6	1.2	No Reaction
	1	5.9	5.1	0.8	Moderate		1	5.9	4.8	1.1	No Reaction
	1.5	6	5.3	0.7	Moderate		1.5	6.1	5	1.1	No Reaction
	2	6.4	5.1	1.3	Moderate		2	6.1	5.2	0.9	No Reaction
?	?	7.3	5	2.3	Moderate						

Note: pH_f – pH field test; pH_{fox} – pH field peroxide test; red text highlights results that indicate Potential Acid Sulfate Soils (PASS).

4 SUBSURFACE CONDITIONS

4.1 Sub-surface Profile

The site can be broken down into 3 distinct areas with similar sub-surface profile. Table 4.1 below presents the typical sub-surface profile encountered across the site. A map of these zones is attached in Appendix A.

Table 4.1: Sub-surface soil profile

Zone	Soil layer	Depth Identified (m)	Description
1	**Sand with silt**	0.0 – 2.0	Moist, grey to yellow, loose to medium dense, fine to medium grained SAND with a variable percentage of silt and a trace of fine roots.
	Coffee Rock	1.1 – 2.0	Moist, black slightly mottled brown, very dense, fine to medium grained indurated SAND with some silt and some organics. Generally no thicker then 150mm.
2	**Sand / silty sand**	0.0 – 1.25	Dry to moist, pale grey to yellow/orange, loose to dense, fine to medium grained SAND, with a variable percentage of silt and a trace of fine to medium roots.
	Clay / sandy clay	0.7 – 2.0	Moist to wet, grey mottled orange to brown mottled grey, CLAY, with a variable percentage of fine to coarse sand and roots.
3	**Clay / sandy clay**	0.0 – 0.6	Dry to moist, stiff to hard, CLAY with a variable percentage of fine to medium grained sand and a trace of fine roots.
	Clay	0.4 – 2.0	Moist, stiff to hard, CLAY with a variable percentage of fine to medium grained sand and fine to coarse grained gravel, and a trace of relic tree roots. Gravels were often ironstone. *Approximately half of the test pits performed in zone 3 observed a clay layer between 0.5-1.5m thick of medium to highly reactive soils with linear shrinkage values between 12.5-16.5%.*

4.2 Groundwater

Groundwater was identified in 16 of the 72 test pits, at depths ranging between 0.65-1.90m. It is expected that of these 16, at least 11 were a perched or seasonal groundwater table due to the permeable sands above low permeability coffee rock or clays, with no groundwater identified below these low permeability layers. It should be noted that the investigation was conducted during the middle of autumn, when groundwater levels are near their lowest. We expect peak groundwater levels during winter to be much higher. The western side of the site adjacent to Forrest Highway is known to flood during winter, with water frequently ponding above the ground surface following consistent rainfall.

Groundwater monitoring wells should be installed to collect accurate measurements through the wettest months of the year to obtain maximum groundwater levels, so that subsoil drainage and earthworks can be designed accordingly.

5 GEOTECHNICAL DISCUSSION

5.1 Zone Specific Site Classifications and Improvement Recommendations

Based upon the investigations results, the site may be classified in accordance with AS 2870:2011 - "Residential Slabs and Footings" which requires an estimation of the expected surface movement due to the wetting and drying of a foundation.

The three zones can be classified based on the soil profile.

- Zone 1 (sands with silt often above coffee rock) – Class P due to deep loose sands. Can be improved to S class with deep compaction.
- Zone 2 (sands above clays) – Class M
- Zone 3 (sandy clay above clay) – Class H.

Zone 1 can be improved to an S class by compacting the top 1.5m of soil by using a dynamic compactor or similar.

Zone 2 can be improved to an S class if there is at least 700mm of natural sands or inert fill above the clay layer. The thickness of the sandy layer varies in zone 2. After topsoil stripping, this 700mm layer can be achieved by placing approximately 300mm of clean sand fill across this zone. This may be optimised with further investigation and testing.

Zone 3 can be improved to an M class following topsoil stripping with the addition of 300mm of clean sand, or an S class with the addition of 700mm of clean sand fill.

5.2 Generic Site Wide Site Classification Improvement Recommendations

- All zones can be improved to an A class if 1.8m of inert soils (natural sand soils and clean sand fill) is present above the clay.
- All zones can be improved to an S class if 700m of inert soils (natural sand soils and clean sand fill) is present above the clay.
- All zones can be improved to an M class if 400mm of inert soils (natural sand soils and clean sand fill) is present above the clay.

CLASSIFICATION BY CHARACTERISTIC SURFACE MOVEMENT (y_s)

Characteristic surface movement (y_s) mm	Site classification in accordance with Table 2.1
$0 < y_s \leq 20$	S
$20 < y_s \leq 40$	M
$40 < y_s \leq 60$	H1
$60 < y_s \leq 75$	H2
$y_s > 75$	E

Figure 2: Extract from AS2870:2011 (Table 2.3)

Sites with inadequate bearing strength or where ground movement may be significantly affected by factors other than reactive soil movements due to normal moisture conditions shall be classified as Class P. Class P sites include: the site contains uncontrolled or controlled fill as identified in AS 2870 Clause 2.5.3, soft or unstable foundations such as soft clay or silt or loose sands, landslip, mine subsidence, collapsing soils and soils subject to erosion, reactive sites subject to abnormal moisture conditions and sites that cannot be classified in accordance with AS 2870 Clause 2.1.2.

Provided the site preparation recommendations are adhered to in Section 5.3 below, the site classification should remain valid post-construction, assuming that clean, cohesionless, controlled sand fill be placed over the natural soil surface (if required).

5.3 Site Preparation

This is a preliminary geotechnical investigation, and thus WML have kept our site improvement recommendations appropriate to the level of investigation undertaken. The below recommendations are considered minimum requirements, however they may improve with further geotechnical investigation. This report should not be used as a basis of specification for construction.

Where deep sands (greater than 0.5m) are found across site, they are generally in a loose to medium dense state down to a depth of 1-1.6m. This material is unsuitable for founding residential developments and the assumed single story school buildings as significant and differential settlement is likely. WML recommend these soils are improved using one or a combination of the following actions.

- Remove trees, vegetation, topsoil and organic matter. Stripped topsoil can be stockpiled for use as landscaping material if required or removed from site. The depth of material to be stripped from the site should generally be about 100-200 mm. However, the actual stripping depth will vary across the site. All tree roots, and any deleterious materials shall be grubbed out and removed. Depressions formed by the removal of vegetation and tree roots should be remediated and suitably compacted.
- The density of natural sands across the site needs to be improved to a depth of 1.5m. This can be achieved by several methods listed below.
    - Dynamic compaction;
    - Rapid impact compaction;
    - Excavate, proof roll and replace in compacted lifts.
- Prior to placement of fill, the exposed sand or clay subgrade should be moisture conditioned (if required) and proof-compacted.
    - Each area should be given a number of passes with a vibrating roller compactor or equivalent to achieve the required level of compaction.
    - Any loose/soft areas identified should be excavated, replaced in lifts and recompacted.
- The exposed subgrade and remediated sandy subgrade should be tested to ensure 95% MMDD has been achieved.
- It should be noted that rapid impact compaction and dynamic compaction can be utilized across the whole site while there are no existing structures, however these improvement techniques are not suitable for use near any significant structures or services.
- Additional fill should consist of clean, site won or imported sands, and be compacted in lifts no greater than 300mm. Each lift should be tested to ensure a compaction of 95% MMDD is achieved.
- The highest level of seasonal groundwater is unknown, as such it is recommended to undertake construction related to earthworks and pavements within the summer months. Shallow groundwater can cause compactive effort to become ineffective.
- If the existing drainage channels are to be removed and developed over, they should be suitably remediated. Unsuitable sediment layers and deleterious materials should be removed, and the exposed subgrade proof compacted. The drainage channels can then be backfilled using suitable site won sands or clean imported fill, following the same methodology as above. It should be noted that the sediments within the drainage channels are likely to be acid sulfate soils, and should be suitably investigated.

6 ACID SULFATE SOILS

6.1 Result interpretation

The 79 field tests were assessed using the following criteria;

- pH_f less than 4;
- pH_{fox} less than 3;
- The change in pH was greater than 1;
- There was a strong reaction following addition of hydrogen peroxide;
- A sulfurous smell was present during sampling;
- Dominant vegetation on site is characteristic of vegetation tolerant to salt, acid and/or waterlogging.

pH_f less than 4 indicates the presence of Actual Acid Sulfate Soils (AASS). The results of this investigation did not identify any samples with a pH_f less than 4 requiring the assessment of further ASS indicators to determine if Potential Acid Sulfate Soils (PASS) are present on site.

One sample at TP 48 had a pH_{fox} less than 3, however this was at a depth of 2.0m, and will likely not be disturbed during the works required to construct the public/private high school proposed for this location.

6.1.1 Further Testing

21 samples from 9 test pits indicated that Potential Acid Sulfate Soils may be present at the site. It is recommended that chromium reducible sulphur testing is performed on the following samples, should testing at this preliminary investigation stage be undertaken:

- TP 15: 1.0m, 1.5m;
- TP 17: 0.5m;
- TP 20: 1.5m, 2.0m;
- TP 23: 1.5m, 2.0m;
- TP 44: 0.5m, 1.0m;
- TP 46: 1.5m, 2.0m;
- TP 48: 1.0m;

7 FUTURE INVESTIGATIONS

7.1 Geotechnical Investigation

The spacing of the investigations and the amount of geotechnical testing performed can be considered suitable for a preliminary investigation. If these sites are to be developed, we recommend further geotechnical investigations are to be undertaken on a lot by lot basis to gather data suitable for detailed design and recommendations. The extent of the highly reactive expansive clays in zone 3 is unknown. A detailed investigation including test pits/boreholes and soil testing should be conducted through this area to determine the extent of the reactive clay zone.

7.2 ASS Investigation

At the time of writing, WML currently have ASS samples in freezer storage. These can be tested using chromium reducible sulfur testing to further identify if ASS is present at the site. Initial field testing indicates Acid sulfate soils at depths of 1.0m or greater, and may be an issue for deep sewer installation. Soils around and within drainage channels are likely to be ASS. If either deep sewer or the soils around or in the drainage channels are to be disturbed during development, we recommend detailed ASS testing and study is undertaken.

7.3 Groundwater

Groundwater monitoring should be conducted across the site through winter, for a period of at least 8 months. Particular focus should be applied to the western half of the site, which is known to flood during winter months. The Handbook of Geotechnical Investigation and Design Tables (2014) suggests approximately 20 groundwater observation points for a site in the magnitude of 100ha. Based on this recommendation, approximately 10 groundwater monitoring wells should be placed west of the proposed primary school, with the remaining 10 placed to the east of the primary school.

8 REFERENCES

1. Geological Series Map 1:50,000 Scale 'Bunbury-Burekup';
2. AS 1726:1993 – Geotechnical Site Investigations;
3. Acid Sulfate Soils Risk Map 50k (DWER-049) – Department of Water and Environmental Regulations
4. Handbook of Geotechnical Investigation and Design Tables – Burt G. Look

LIMITATIONS

REPORT LIMITATIONS

WML have undertaken investigations, performed consulting services, and prepared this report based on the Client's specific requirements, documents and information supplied, and previous experience. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the Client to transmit the information and recommendations of this report to the appropriate organisations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers.

We performed our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty, expressed or implied, is made as to the professional advice included in this report.

Any data provided by third parties including, but not limited to: sub-consultants, published data, and the Client, may not be verified and WML assumes no responsibility for the adequacy, incompleteness, inaccuracies, or reliability of this information. WML does not assume any responsibility for assessments made partly or entirely based on information provided by third parties.

This repot has been prepared based on investigation locations which are explicitly representative of the specific sample or test points. Interpretation of conditions between such points cannot be assumed to represent actual subsurface information and there are unknowns or variations in ground conditions between test locations that cannot be inferred or predicted.

This report is based upon field and other conditions encountered at the time of report preparation. If unexpected subsurface conditions are encountered, WML shall be notified immediately to review those conditions and provide additional and/or modified recommendations, as necessary.

Our services did not include any contamination or environmental assessment of the site or adjacent sites. The nature of geotechnical investigation differs from the environmental investigation practice. If you require any environmental considerations to be applied to your project, WML can advise on further steps to be undertaken.

Geotechnical assessments are typically based on judgment of the investigation data and visual observations of the site and materials.

This document must not be subject to unauthorised use that is, reusing without written authorisation of WML. Such authorisation is essential because it requires WML to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

APPENDIX A

SITE MAPS

9745-G-001

Geotechnical Test Locations - Treendale East Estate, Bunbury

WML accessible expertise

Legend

- Site Area
- Test Pit

Victoria Rd

TP 49 TP 50 TP 48 TP 47 TP 51 TP 46 TP 43 TP 52 TP 53 TP 54 TP 68 TP 45 TP 42 TP 41 TP 69 TP 44 TP 40 TP 56 TP 55 TP 60 TP 61 TP 67 TP 38 TP 39 TP 57 TP 59 TP 62 TP 66 TP 70 TP 58 TP 72 TP 63 TP 64 TP 65 TP 71 TP 37 TP 26 TP 27 TP 28 TP 29 TP 31 TP 32 TP 20 TP 25 TP 23 TP 19 TP 30 TP 33 TP 36 TP 24 TP 22 TP 21 TP 18 TP 34 TP 35 TP 15 TP 16 TP 17 TP 11 TP 10 TP 9 TP 14 TP 12 TP 6 TP 8 TP 13 TP 5 TP 1 TP 2 TP 4 TP 7 TP 3

Sweny Dr

Ditchingham Pl

Pegasus Dr

Raymond Rd

Warburton St

Balaclava Rd

1

131

100

101

TREENDALE EAST

Google Earth

© 2021 Google

N

600 m

9745-G-002

Site Geology Map - Treendale East Estate, Bunbury

WML accessible expertise

Legend

Site Area

Qpb

Qpa

Sd

Paris Rd

1

Forrest Hwy

Victoria Rd

Harbour Flatt

Piggott Dr

Sweeny Dr

TREENDALE

Ditchingham Pl

Orion Ln

Pegasus Dr

BS 17

Balaclava Rd

Inkerman Rd

Raymond Rd

N

800 m

Google Earth

© 2021 Google

9745-G-003

Soil Profile Zones - Treendale East Estate, Bunbury

WML accessible expertise

Legend

- Site Area
- Zone 1 - Sand
- Zone 2 - Sand above Clay
- Zone 3 - Clay

Paris Rd
1
Forrest Hwy
Victoria Rd
VICTORIA ROAD
Piggott Dr
Downey Dr
Ditchingham Pl
Libra Way
Orion Ln
Pegasus Dr
TREENDALE EAST
131
100
101
Balaclava Rd
RAYMOND ROAD
Raymond Rd
N
700 m
Google Earth
© 2021 Google

APPENDIX B

SOIL LOGS

WML accessible expertise	**TRIAL PIT: TP1**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6316078.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 18 0.35 - 0.50 19 0.50 - 0.65 29 0.65 - 0.80 31 0.80 - 0.95 25 0.95 - 1.10 25		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CL	Dry, pale grey, firm, fine to medium grained, **sandy CLAY** with a trace of silt and a trace of fine roots.
	0.5			CH	Dry, orange slightly mottled grey, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
				CH	Dry, pale grey mottled red, very stiff, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP2

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384638.0 m E 6316066.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 9 0.35 - 0.50 12 0.50 - 0.65 12 0.65 - 0.80 9 0.80 - 0.95 6 0.95 - 1.10 6 0.50m In-situ VS P=120kPa		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			CI	Dry, pale yellow, firm, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0			CL	Moist, yellow, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel and a trace of coarse roots.
	1.5			CH	Moist, grey banded red yellow, stiff, **CLAY** with a trace of fine roots. *Relic roots.*
	2.0				Hole Terminated at 1.60 m Hard Digging

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP3

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384833.0 m E 6315970.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 6 0.20 - 0.35 10 0.35 - 0.50 15 0.50 - 0.65 10 0.65 - 0.80 17 0.80 - 0.95 25 0.95 - 1.10 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	1.0			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.5	1.50m In-situ VS P>120kPa		SP	Moist, orange, dense, fine to medium grained, **clayey SAND** with a trace of boulders and a trace of fine to medium gravel. *Ironstone boulders present at 1.7m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP4

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316091.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 13 0.20 - 0.35 5 0.35 - 0.50 4 0.50 - 0.65 10 0.65 - 0.80 13 0.80 - 0.95 13 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CI	Dry, grey brown, stiff, **silty CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	0.5	0.50m PSD / PI		CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5	1.50m		CH	Moist, orange slightly mottled pale grey, stiff, fine to medium grained, **sandy CLAY** with a trace of cobbles. *Ironstone boulder around 1.8m.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP5

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384734.0 m E 6316138.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 9 0.35 - 0.50 3 0.50 - 0.65 10 0.65 - 0.80 12 0.80 - 0.95 12 0.95 - 1.10 13		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of fine to medium roots.
	0.5			CH	Moist, orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP6

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384846.0 m E 6316210.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 9 0.20 - 0.35 5 0.35 - 0.50 3 0.50 - 0.65 3 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.50m		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.50m ASS			
		1.00m			Moist, brown mottled red grey, very stiff, **CLAY**.
	1.0	1.00m ASS		CH	
		1.30m In-situ VS P>120kPa			
		1.50m			
	1.5	1.50m ASS			
		2.00m		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0	2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP7

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385010.0 m E 6316074.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 16 0.20 - 0.35 17 0.35 - 0.50 20 0.50 - 0.65 12 0.65 - 0.80 8 0.80 - 0.95 8 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, pale grey, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5			CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5			CH	Moist, brown mottled red grey, very stiff, **CLAY**.
	2.0			CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP8

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385071.0 m E 6316207.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 14 0.35 - 0.50 10 0.50 - 0.65 10 0.65 - 0.80 10 0.80 - 0.95 11 0.95 - 1.10 12		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, grey brown, hard, **CLAY** with a trace of fine to medium grained sand.
	0.5	0.60m In-situ VS P>120kPa		CH	Moist, brown orange, very stiff, **CLAY** with a trace of fine to medium grained sand.
	1.0				
	1.5				
		1.90m In-situ VS P>120kPa		CH	Moist, dark grey banded red, hard, **CLAY** with a trace of fine to medium gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

TRIAL PIT: TP9

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385168.0 m E 6316359.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 20 0.20 - 0.35 20 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 14 0.95 - 1.10 13		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				CH	Dry, brown, very stiff, **CLAY** with a trace of fine roots and a trace of fine to medium grained sand.
	0.5			CH	Dry, brown mottled grey, hard, **CLAY**.
	1.0				
	1.5				
				CH	Moist, dark grey mottled red, very stiff, **CLAY** with a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP10**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385011.0 m E 6316369.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 7 0.35 - 0.50 9 0.50 - 0.65 5 0.65 - 0.80 4 0.80 - 0.95 4 0.95 - 1.10 4 1.10 - 1.25 4 1.25 - 1.40 3 1.40 - 1.55 5 1.55 - 1.70 4 1.70 - 1.85 5 1.85 - 2.00 5 2.00 - 2.15 5		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				ML	Dry, brown slightly mottled red, hard, **SILT** with some fine to medium grained sand and a trace of fine roots. *Iron content adding to material strength.*
	0.5			CI	Moist, orange, stiff, fine to medium grained, **CLAY** with some fine to medium grained sand and a trace of fine to medium gravel.
	1.0				
	1.5			CI	Dry, orange brown mottled grey, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots. *Relic tree roots.*
				CI	Moist, orange brown slightly mottled red grey, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:43 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP11**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384847.0 m E 6316364.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 13 0.35 - 0.50 20 0.50 - 0.65 24 0.65 - 0.80 18 0.80 - 0.95 12 0.95 - 1.10 10		CI	Dry, pale yellow grey, firm, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m In-situ VS P>120kPa			
	1.5	1.60m PSD / PI		CH	Moist, red mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine gravel and a trace of fine roots. *Relic tree roots.*
	2.0	2.00m			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP12

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384619.0 m E 6316208.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 7 0.20 - 0.35 5 0.35 - 0.50 12 0.50 - 0.65 14 0.65 - 0.80 13 0.80 - 0.95 9 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND**.
	0.5			CI	Moist, orange, stiff, fine to coarse grained, **sandy CLAY** with a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.0			SP	Moist, orange, dense, fine to coarse grained, **clayey SAND** with a trace of cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles present, some weakly cemented.*
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP13**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384520.0 m E 6316176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 27 0.20 - 0.35 23 0.35 - 0.50 19 0.50 - 0.65 21 0.65 - 0.80 17 0.80 - 0.95 11 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
		0.30m PSD / PI		SP	Dry, pale grey, medium dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of fine to medium gravel.
		0.70m PSD / PI		CH	Moist, grey mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel.
	1.0	1.30m			
	1.5	1.30m In-situ VS P=85kPa 1.40m In-situ VS P>120kPa		CH	Moist, grey mottled orange, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine gravel.
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP14**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316250.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
		Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 7 0.35 - 0.50 6 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 3		SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5	0.95 - 1.10 3 1.10 - 1.25 3 1.25 - 1.40 2 1.40 - 1.55 3 1.55 - 1.70 5 1.70 - 1.85 10 1.85 - 2.00 26		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			CI	Moist, yellow, firm, fine to medium grained, **sandy CLAY**. *Moist to wet.*
	1.5	1.60m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0			CI	Moist, grey mottled red, very stiff, fine to coarse grained, **sandy CLAY** with a trace of fine roots.
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP15**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384300.0 m E 6316357.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
1m	1.0			SP	Wet, grey mottled pale orange, medium dense, fine to medium grained, **SAND** with some silt.
	1.5			Cl	Moist, grey blue slightly mottled orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0			Cl	Moist, banded brown green, stiff, fine to medium grained, **sandy CLAY**.
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP16**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384452.0 m E 6316358.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 6 0.45 - 0.60 5 0.60 - 0.75 4 0.75 - 0.90 4 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
1.4m				SP	Moist, grey, medium dense, fine to medium grained, **clayey SAND** with a trace of silt. *Most to wet.*
	1.5	1.70m In-situ VS P=90kPa		CI	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP17

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384617.0 m E 6316337.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows PSD / PI 0.00 - 0.15 3 0.15 - 0.30 5 0.30 - 0.45 4 0.45 - 0.60 7 0.60 - 0.75 11 0.75 - 0.90 16 0.90 - 1.05 13 0.50m		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium roots.
	1.0			SP	Moist, grey brown, dense, fine to coarse grained, **clayey SAND** with a trace of fine gravel and a trace of fine roots.
	1.5			CI	Moist, grey mottled brown, very stiff, **CLAY** with a trace of fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
				CI	Moist, brown mottled grey, very stiff, **CLAY** with some fine to coarse grained sand and a trace of fine to medium roots. *Relic tree roots.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP18

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384581.0 m E 6316507.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 2 0.60 - 0.75 3 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 3 1.95 - 2.10 4		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.0			SP	Moist, yellow orange, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP19**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384504.0 m E 6316594.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 6 1.65 - 1.80 25		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots. *Medium root at 0.4m.*
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP20**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384408.0 m E 6316619.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5	0.90m ASS		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
		1.80m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP21**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384403.0 m E 6316495.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 5 1.50 - 1.65 14		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.65m 1.65m PSD / PI		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.70 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP22**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384233.0 m E 6316503.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 3 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 20		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP23**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384166.0 m E 6316581.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 6 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 5 1.05 - 1.20 13 1.20 - 1.35 22		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
1m	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.90m In-situ VS P=60kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP24**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384080.0 m E 6316519.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 6 0.15 - 0.30 8 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 3 1.05 - 1.20 8 1.20 - 1.35 12		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5	1.50m In-situ VS P=110kPa		Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP25**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384018.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 5 0.15 - 0.30 7 0.30 - 0.45 5 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 5 0.90 - 1.05 6		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey brown, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0			SP	Moist, orange, medium dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt.
				CI	Moist, pale green blue, stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			SP	Moist, pale yellow, medium dense, fine to medium grained, **clayey SAND**. *Clayey sand with clods of sandy clay.*
				CH	Dry, grey, hard, **CLAY** with a trace of fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP26**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384021.0 m E 6316722.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 10 0.20 - 0.35 6 0.35 - 0.50 3 0.50 - 0.65 6 0.65 - 0.80 14 0.80 - 0.95 12 0.95 - 1.10 9		ML	Moist, grey, soft, **SILT** with some fine to medium grained sand and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale grey yellow, medium dense, fine to medium grained, **clayey SAND** with a trace of cobbles. *Clods of clay.*
	1.0	1.00m In-situ VS P>120kPa		CH	Moist, orange grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Clods of clay.*
	1.5	1.70m 1.70m PSD / PI		CH	Moist, yellow mottled grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots. *Small to large lumps of clay with sand among clayey sand.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP27**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384165.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 4 0.30 - 0.45 4 0.45 - 0.60 4 0.60 - 0.75 4 0.75 - 0.90 6 0.90 - 1.05 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.5				Hole Terminated at 1.30 m Refusal
	2.0				

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP28**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384392.0 m E 6316711.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 5 1.65 - 1.80 10		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP29**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384515.0 m E 6316703.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 3 0.30 - 0.45 3 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 5 1.35 - 1.50 5 1.50 - 1.65 5 1.65 - 1.80 6 1.80 - 1.95 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
0.8m ▽	1.0			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
					Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP30**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384711.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 1 0.45 - 0.60 1 0.60 - 0.75 2 0.75 - 0.90 1 0.90 - 1.05 3 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 4 1.50 - 1.65 3 1.65 - 1.80 3 1.80 - 1.95 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP31

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6316710.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 4 0.95 - 1.10 6		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	0.90m In-situ VS P>120kPa		CL	Moist, dark grey, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine roots.
	1.5			CI	Moist, orange yellow slightly mottled grey, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP32

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385068.0 m E 6316709.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 12 0.20 - 0.35 7 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 7 0.80 - 0.95 7 0.95 - 1.10 7		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m In-situ VS P>120kPa			
	1.5			CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP33**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385035.0 m E 6316604.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 8 0.20 - 0.35 6 0.35 - 0.50 5 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 6		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.60m In-situ VS P>120kPa		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0				
	1.5	1.90m In-situ VS P>120kPa		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP34**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384988.0 m E 6316476.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered		9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 11 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 9 0.65 - 0.80 7 0.80 - 0.95 8 0.95 - 1.10 9		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.50m 0.50m ASS		CI	Moist, orange, very stiff, fine to medium grained, **CLAY** with a trace of fine to medium gravel and a trace of fine gravel.
	1.0	1.00m ASS		CI	Moist, grey mottled red, very stiff, **CLAY** with some fine to medium grained sand.
	1.5	1.50m		CI	Moist, grey mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots. *Relic tree roots, minor cementation.*
	2.0	2.00m 2.00m ASS			Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP35**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385166.0 m E 6316488.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 6 0.35 - 0.50 6 0.50 - 0.65 5 0.65 - 0.80 5 0.80 - 0.95 5 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0				
	1.5			CH	Moist, brown red, very stiff, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP36**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385173.0 m E 6316591.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	9 kg Dynamic Cone Penetrometer Depth (m) Blows 0.05 - 0.20 21 0.20 - 0.35 15 0.35 - 0.50 10 0.50 - 0.65 8 0.65 - 0.80 5 0.80 - 0.95 4 0.95 - 1.10 5		ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5	0.80m PSD PI In-situ VS P>120kPa		CH	Moist, brown, hard, **CLAY** with a trace of fine to medium grained sand and a trace of fine roots.
	1.0			CH	Moist, brown mottled grey orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	1.5	1.50m		CH	Moist, brown mottled red orange, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to coarse gravel. *Ironstone gravel as excavated.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP37

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384967.0 m E 6316845.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 2 0.30 - 0.45 3 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 1 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 4 1.95 - 2.10 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP38**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384956.0 m E 6316978.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 7 0.30 - 0.45 7 0.45 - 0.60 6 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 6 1.05 - 1.20 11		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to medium grained sand and a trace of cobbles. *Ironstone cobbles around 1.1m at top of clay layer.*
				Cl	Moist, pale grey blue mottled orange, stiff, **CLAY** with some fine to coarse grained sand.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP39**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 385090.0 m E 6316960.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 7 0.30 - 0.45 8 0.45 - 0.60 6 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 4 1.65 - 1.80 4 1.80 - 1.95 5 1.95 - 2.10 5		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5	1.70m			
		PSD / PI		SP	Moist, yellow orange, medium dense, fine to medium grained, **clayey SAND**.
	2.0	2.00m			
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP40

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384944.0 m E 6317071.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 7 0.90 - 1.05 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			CH	Moist, grey brown mottled orange, very stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	1.5			CH	Dry, grey mottled orange, hard, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP41

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384972.0 m E 6317189.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 4 0.15 - 0.30 6 0.30 - 0.45 7 0.45 - 0.60 7 0.60 - 0.75 9 0.75 - 0.90 11 0.90 - 1.05 21		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, grey brown mottled orange, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium gravel and a trace of fine to medium roots. *Weakly cemented gravel and cobbles.*
		1.70m In-situ VS P=100kPa 1.90m In-situ VS P>120kPa		CI	Moist, grey mottled orange, very stiff, fine to coarse grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP42

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384828.0 m E 6317175.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 3 0.15 - 0.30 8 0.30 - 0.45 6 0.45 - 0.60 4 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 4		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, pale yellow grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey brown mottled red orange, very dense, fine to medium grained, **clayey SAND** with some cobbles and a trace of fine to coarse gravel. *Ironstone gravel and cobbles as excavated.*
	1.5			CH	Moist, grey orange, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP43**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384761.0 m E 6317336.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 2 0.20 - 0.35 4 0.35 - 0.50 5 0.50 - 0.65 2 0.65 - 0.80 4 0.80 - 0.95 5 0.95 - 1.10 6		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP44

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384778.0 m E 6317062.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 11 0.15 - 0.30 17 0.30 - 0.45 13 0.45 - 0.60 7 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 4 1.05 - 1.20 3 1.20 - 1.35 4 1.35 - 1.50 6 1.50 - 1.65 10 1.65 - 1.80 15		ML	Dry, brown, very stiff, **SILT** with some fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0				
	1.5			SP	Moist, black, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots and a trace of fine to medium gravel. *Wet to moist, water seeping in at 1.5m, likely from drainage channel.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP45

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384694.0 m E 6317164.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 2 0.35 - 0.50 4 0.50 - 0.65 6 0.65 - 0.80 6 0.80 - 0.95 7 0.95 - 1.10 7		SP	Dry, grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP46**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384710.0 m E 6317361.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 5 0.90 - 1.05 4 1.05 - 1.20 4 1.20 - 1.35 3 1.35 - 1.50 5 1.50 - 1.65 7 1.65 - 1.80 5 1.80 - 1.95 7 1.95 - 2.10 7		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.4m	1.0				
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to coarse gravel.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP47**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384463.0 m E 6317461.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
		Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 2 0.15 - 0.30 4 0.30 - 0.45 5 0.45 - 0.60 5 0.60 - 0.75 5 0.75 - 0.90 4 0.90 - 1.05 10		SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5			SP	Moist, grey brown, medium dense, fine to medium grained, **SAND** with some silt.
	1.0	1.35m		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
		PSD / PI		SP	Moist, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
▽ 1.65m	1.5	1.65m		SP	Wet, brown slightly mottled grey brown, loose, fine to medium grained, **silty SAND** with a trace of fine to medium gravel. *Silty sand with clods of sandy silt.*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP48**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384382.0 m E 6317549.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 3 0.20 - 0.35 3 0.35 - 0.50 4 0.50 - 0.65 3 0.65 - 0.80 3 0.80 - 0.95 2 0.95 - 1.10 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	1.0			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
▽ 1.3m				SP	Wet, black brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to medium gravel.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP49

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384214.0 m E 6317679.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.05 - 0.20 1 0.20 - 0.35 3 0.35 - 0.50 3 0.50 - 0.65 4 0.65 - 0.80 3 0.80 - 0.95 3 0.95 - 1.10 3 1.10 - 1.25 2		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.60 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP50

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384247.0 m E 6317579.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 3 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 4 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 3 1.65 - 1.80 17		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Refusal

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP51**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384336.0 m E 6317411.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 4 0.45 - 0.60 3 0.60 - 0.75 4 0.75 - 0.90 3 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 1 1.35 - 1.50 2 1.50 - 1.65 2 1.65 - 1.80 7		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
▽ 1.6m				SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP52**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384276.0 m E 6317317.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 1 0.60 - 0.75 1 0.75 - 0.90 2 0.90 - 1.05 2 1.05 - 1.20 2 1.20 - 1.35 3 1.35 - 1.50 3 1.50 - 1.65 5 1.65 - 1.80 5 1.80 - 1.95 4 1.95 - 2.10 5		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots.
	0.5			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP53

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384400.0 m E 6317280.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 3 0.60 - 0.75 3 0.75 - 0.90 3 0.90 - 1.05 3 1.05 - 1.20 2 1.20 - 1.35 2 1.35 - 1.50 3 1.50 - 1.65 2 1.65 - 1.80 3 1.80 - 1.95 3 1.95 - 2.10 3		SP	Dry, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.0			SP	Moist, pale grey tending grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
1.5m	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP54

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384177.0 m E 6317176.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0	Perth Sand Penetrometer Depth (m) Blows 0.00 - 0.15 1 0.15 - 0.30 2 0.30 - 0.45 2 0.45 - 0.60 2 0.60 - 0.75 2 0.75 - 0.90 2 0.90 - 1.05 3 1.05 - 1.20 3 1.20 - 1.35 3		SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	1.5			SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP55**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384144.0 m E 6317045.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.0			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5	1.50m In-situ VS P>120kPa			
		1.90m In-situ VS P=70kPa		SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP56

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384014.0 m E 6317030.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, brown, dense, fine to medium grained, **silty SAND** with a trace of fine roots.
	0.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.0				
	1.5			CI	Moist, yellow mottled grey, very stiff, **CLAY** with some fine to medium grained sand and a trace of fine to medium roots.
				CI	Moist, grey mottled yellow, stiff, **CLAY** with some fine to medium grained sand and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP57**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384054.0 m E 6316913.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to coarse roots. *Large root at 0.4m.*
	0.5				
▽ 0.65m				SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	1.0			SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown, medium dense, fine to medium grained, **silty SAND** with a trace of fine to coarse gravel.
	1.5			CH	Moist, pale green grey slightly mottled yellow, stiff, fine to medium grained, **sandy CLAY** with a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP58

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384016.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			ML	Dry, brown, very stiff, **SILT** with a trace of fine to medium grained sand and a trace of fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse gravel and a trace of cobbles.
	0.5			SP	Moist, pale brown, dense, fine to medium grained, **clayey SAND** with some fine to medium gravel and a trace of fine roots. *Clods of clay within the clayey SAND.*
				SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel. *Strongly cemented layer.*
	1.0			SP	Moist, yellow, very dense, fine to medium grained, **SAND** with some clay and a trace of fine to medium gravel.
	1.5			CI	Moist, yellow mottled grey, stiff, fine to medium grained, **sandy CLAY**.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP59**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384239.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
1.4m	1.0				
	1.5			SP	Wet, dark grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.90 m Refusal; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP60**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384266.0 m E 6317055.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
1.5m	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 1.80 m Dry Collapse; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP61**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384397.0 m E 6317054.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
	0.5				
	1.0				
	1.5				
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP62**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384368.0 m E 6316926.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine to coarse roots. *TOPSOIL.*
	0.5			SP	Moist, dark grey, medium dense, fine to medium grained, **SAND** with some silt and some fine to coarse roots.
	1.0				
	1.5			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP63**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384357.0 m E 6316825.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.2			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine roots.
▽ 1.2m	1.0			SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Wet, dark brown, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Strongly cemented.*
	1.7			SP	Wet, grey yellow, very dense, fine to medium grained, **SAND** with a trace of fine to medium gravel and a trace of silt and a trace of fine roots. *Cemented.*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP64**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384525.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale yellow, medium dense, fine to medium grained, **SAND** with some silt.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP65

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384647.0 m E 6316816.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5	0.50m 0.50m ASS			
	1.0	1.00m 1.00m ASS		SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5	1.50m 1.50m ASS			
	2.0	2.00m 2.00m ASS		SP	Moist, yellow, dense, fine to medium grained, **SAND** with some fine to coarse gravel and a trace of cobbles and a trace of clay. *Ironstone and weakly cemented SAND gravel/cobbles.*
					Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP66**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384625.0 m E 6316951.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, grey banded orange, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP67

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384492.0 m E 6317032.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5				
	1.0	1.00m PSD / PI		SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt.
	1.5	1.50m			
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

TRIAL PIT: TP68

SHEET: 1 OF 1

CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384510.0 m E 6317165.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, white, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.0				
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP69**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384603.0 m E 6317072.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with some silt and a trace of fine to medium roots.
	1.5				
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP70**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384773.0 m E 6316944.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
Not Encountered	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
	0.5			SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Dry, pale grey yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Dry, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine roots.
	1.5			SP	Moist, yellow, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP71**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384754.0 m E 6316812.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
	0.0			SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0			SP	Moist, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
▽ 1.9m				SP	Wet, pale grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	2.0				Hole Terminated at 2.00 m Target depth

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

WML accessible expertise	**TRIAL PIT: TP72**	SHEET: 1 OF 1
CLIENT: TAYCOT	CONTRACTOR: WML Consultants	LOGGED: ZC
PROJECT: Treendale East Estate	MACHINE: Excavator	LOGGED DATE: 30/03/2021
LOCATION: Raymond Rd, Roelands	CO-ORD SYSTEM: MGA94 Zone 50	SURFACE RL:
JOB NO.: 9745	POSITION: 384265.0 m E 6316815.0 m N	CHAINAGE:

WATER	DEPTH (m)	SAMPLES OR FIELD TEST	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION
				SP	Moist, dark grey, loose, fine to medium grained, **SAND** with some silt and some fine roots. *TOPSOIL.*
				SP	Dry, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	0.5			SP	Moist, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
	1.0				
1.4m					
	1.5			SP	Wet, grey, medium dense, fine to medium grained, **SAND** with a trace of silt and a trace of fine to medium roots.
				SP	Moist, black slightly mottled brown, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
				SP	Moist, brown mottled black, very dense, fine to medium grained, **SAND** with some organics and a trace of silt. *Indurated sands (coffee rock).*
	2.0				Hole Terminated at 2.00 m Target Depth; Perched groundwater table

WML LIB 1.08.GLB Log WML SOIL 9745 SOIL LOGS.GPJ <<DrawingFile>> 17/05/2021 06:44 10.0.000 Developed by Datgel

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 1



Figure 1: Test Pit 1 Excavation



Figure 2: Test Pit 1 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 2



Figure 3: Test Pit 2 Excavation



Figure 4: Test Pit 2 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 3



Figure 5: Test Pit 3 Soil Profile



Figure 6: Test Pit 3 Soil Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 4

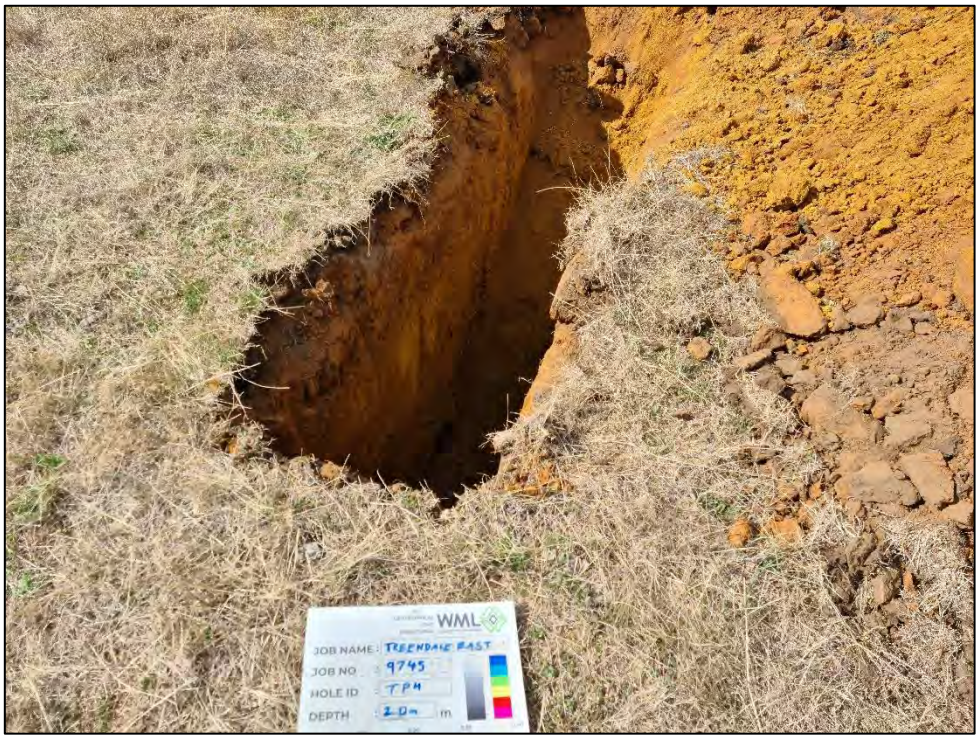


Figure 7: Test Pit 4 Excavation



Figure 8: Test Pit 4 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 5



Figure 9: Test Pit 5 Excavation Site and Arisings



Figure 10: Test Pit 5 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 6



Figure 11: Test Pit 6 Excavation



Figure 12: Test Pit 6 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 7

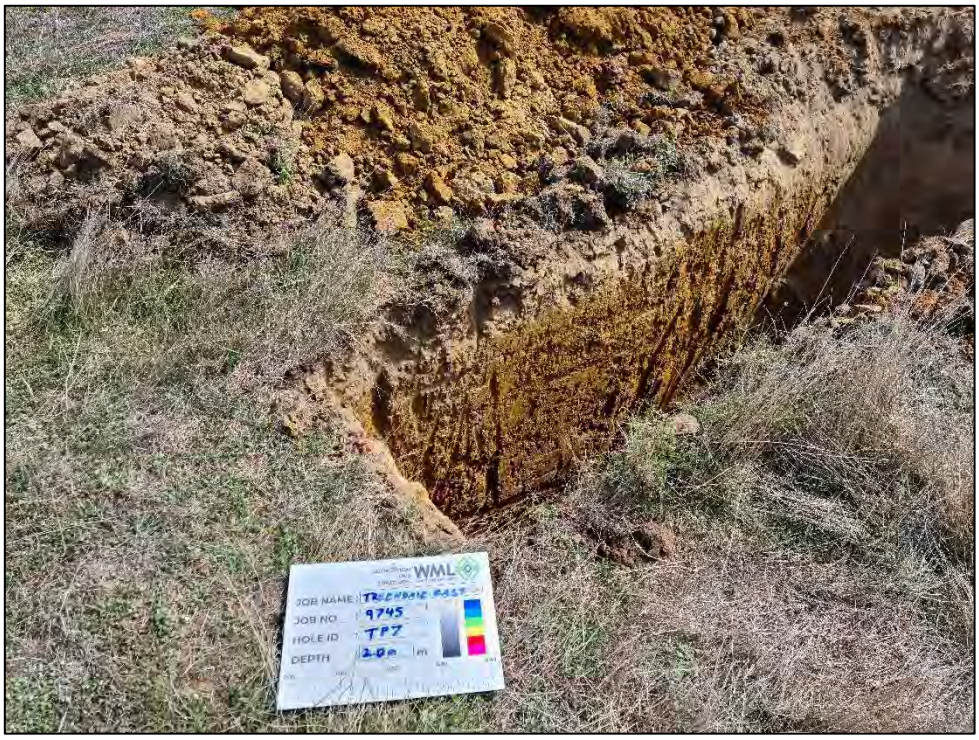


Figure 13: Test Pit 7 Excavation



Figure 14: Test Pit 7 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 8

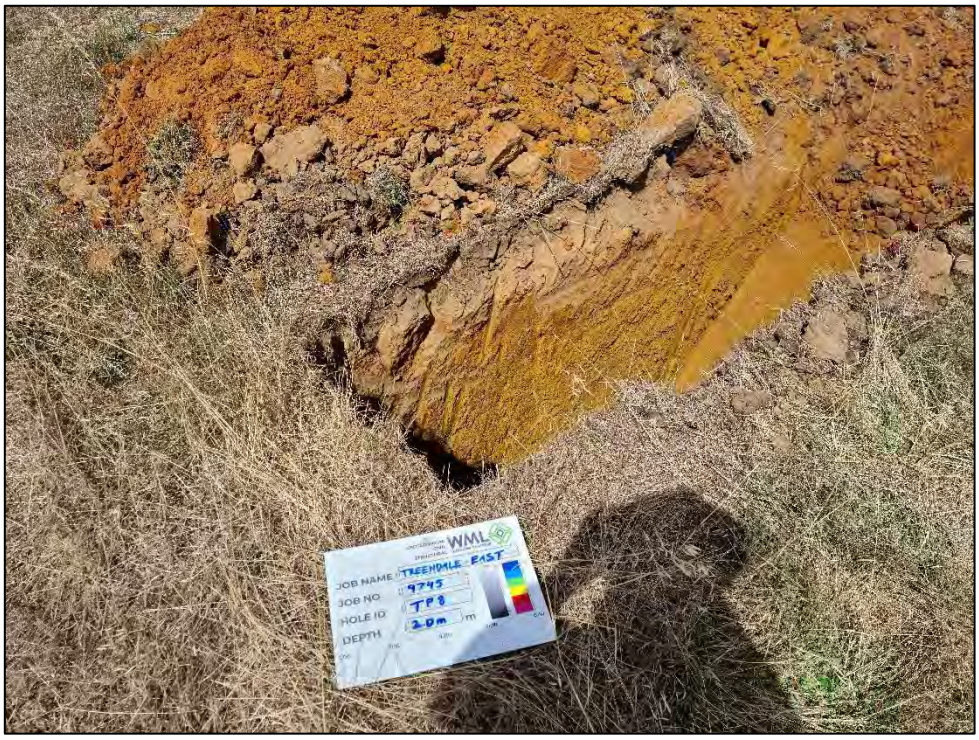


Figure 15: Test Pit 8 Excavation



Figure 16: Test Pit 8 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 9



Figure 17: Test Pit 9 Excavation



Figure 18: Test Pit 9 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 10



Figure 19: Test Pit 10 Excavation



Figure 20: Test Pit 10 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 11



Figure 21: Test Pit 11 Excavation



Figure 22: Test Pit 11 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 12



Figure 23: Test Pit 12 Excavation



Figure 24: Test Pit 12 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 13



Figure 25: Test Pit 13 Excavation



Figure 26: Test Pit 13 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 14



Figure 27: Test Pit 14 Soil Profile



Figure 28: Test Pit 14 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 15



Figure 29: Test Pit 15 Soil Profile



Figure 30: Test Pit 15 Soil Arisings

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 16



Figure 31: Test Pit 16 Excavation and Arisings



Figure 32: Test Pit 16 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 17



Figure 33: Test Pit 17 Excavation



Figure 34: Test Pit 17 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 18



Figure 35: Test Pit 18 Excavation



Figure 36: Test Pit 18 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 19



Figure 37: Test Pit 19 Excavation



Figure 38: Test Pit 19 Soil Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 20



Figure 39: Test Pit 20 Excavation



Figure 40: Test Pit 20 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 21



Figure 41: Test Pit 21 Excavation



Figure 42: Test Pit 21 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 22



Figure 43: Test Pit 22 Excavation



Figure 44: Test Pit 22 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 23



Figure 45: Test Pit 23 Excavation



Figure 46: Test Pit 23 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 24



Figure 47: Test Pit 24 Excavation



Figure 48: Test Pit 24 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 25



Figure 49: Test Pit 25 Excavation



Figure 50: Test Pit 25 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 26



Figure 51: Test Pit 26 Excavation



Figure 52: Test Pit 26 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 27



Figure 53: Test Pit 27 Excavation



Figure 54: Test Pit 27 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 28



Figure 55: Test Pit 28 Excavation



Figure 56: Test Pit 28 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 29



Figure 57: Test Pit 29 Excavation



Figure 58: Test Pit 29 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 30



Figure 59: Test Pit 30 Excavation



Figure 60: Test Pit 30 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 31



Figure 61: Test Pit 31 Excavation



Figure 62: Test Pit 31 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 32



Figure 63: Test Pit 32 Excavation



Figure 64: Test Pit 32 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 33



Figure 65: Test Pit 33 Excavation



Figure 66: Test Pit 33 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 34



Figure 67: Test Pit 34 Excavation



Figure 68: Test Pit 34 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 35



Figure 69: Test Pit 35 Excavation



Figure 70: Test Pit 35 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 36



Figure 71: Test Pit 36 Excavation



Figure 72: Test Pit 36 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 37



Figure 73: Test Pit 37 Excavation



Figure 74: Test Pit 37 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 38



Figure 75: Test Pit 38 Excavation



Figure 76: Test Pit 38 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 39



Figure 77: Test Pit 3 Soil Profile



Figure 78: Test Pit 3 Soil Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 40



Figure 79: Test Pit 40 Excavation



Figure 80: Test Pit 40 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 41



Figure 81: Test Pit 41 Excavation



Figure 82: Test Pit 41 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 42



Figure 83: Test Pit 42 Excavation



Figure 84: Test Pit 42 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 43

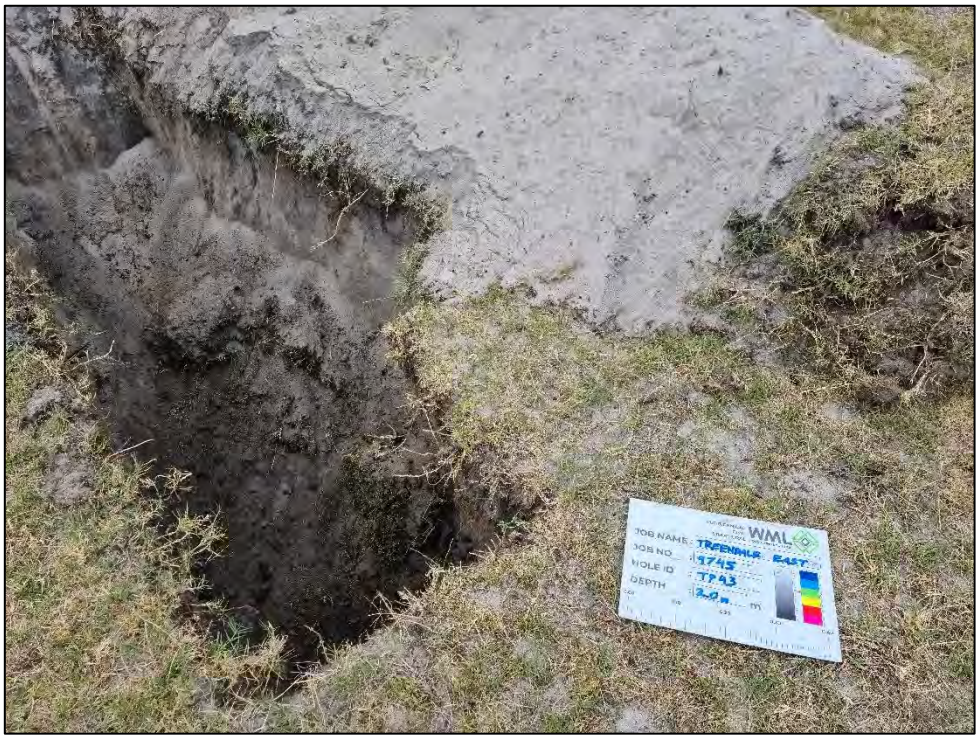


Figure 85: Test Pit 43 Excavation



Figure 86: Test Pit 43 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 44



Figure 87: Test Pit 44 Excavation



Figure 88: Test Pit 44 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 45

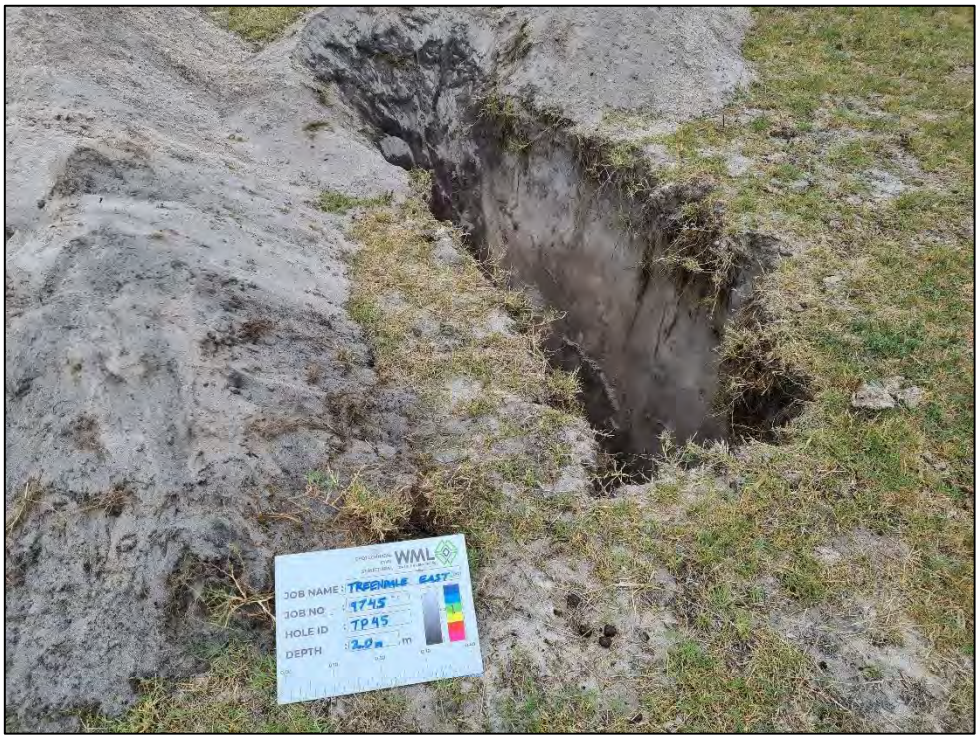


Figure 89: Test Pit 45 Excavation



Figure 90: Test Pit 45 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 46



Figure 91: Test Pit 46 Excavation



Figure 92: Test Pit 46 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 47



Figure 93: Test Pit 47 Excavation



Figure 94: Test Pit 47 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 48



Figure 95: Test Pit 48 Excavation



Figure 96: Test Pit 48 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 49



Figure 97: Test Pit 49 Excavation



Figure 98: Test Pit 49 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 50

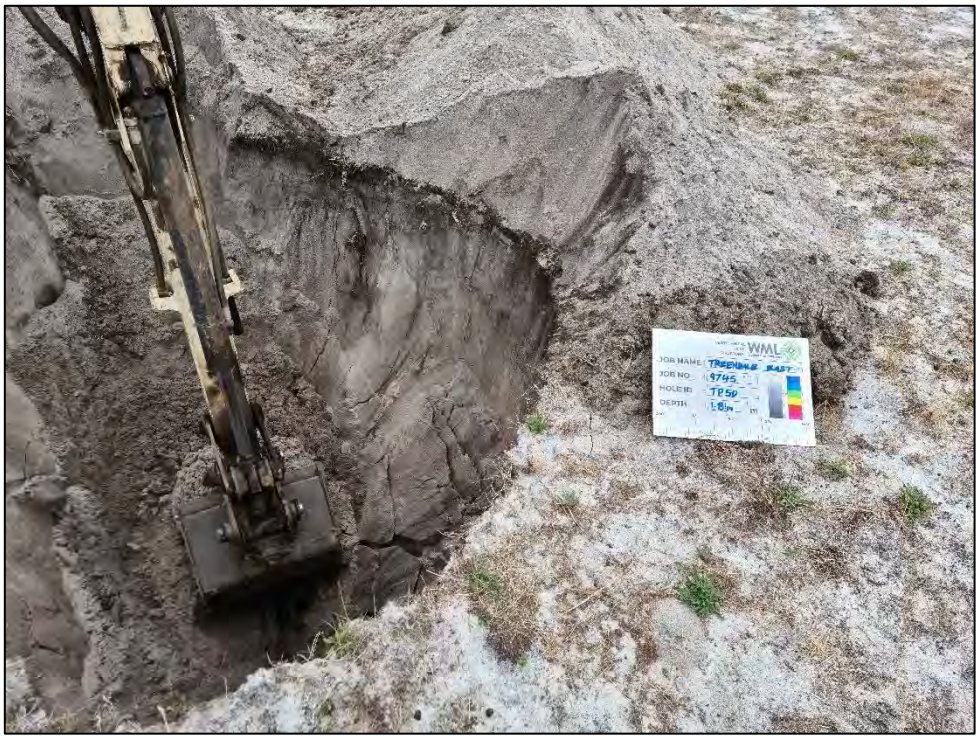


Figure 99: Test Pit 50 Excavation



Figure 100: Test Pit 50 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 51



Figure 101: Test Pit 51 Excavation



Figure 102: Test Pit 51 Soil Arisings

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 52

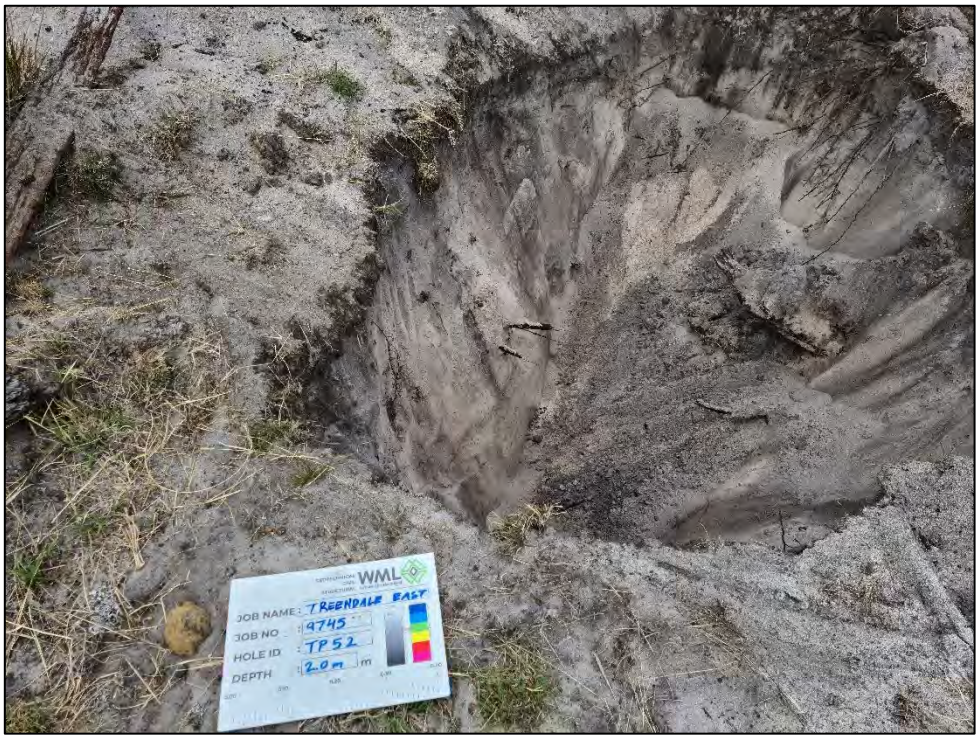


Figure 103: Test Pit 52 Excavation



Figure 104: Test Pit 52 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 53



Figure 105: Test Pit 53 Excavation



Figure 106: Test Pit 53 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 54



Figure 107: Test Pit 54 Excavation



Figure 108: Test Pit 54 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 55



Figure 109: Test Pit 55 Excavation



Figure 110: Test Pit 55 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 56



Figure 111: Test Pit 56 Excavation



Figure 112: Test Pit 56 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 57



Figure 113: Test Pit 57 Excavation



Figure 114: Test Pit 57 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 58



Figure 115: Test Pit 58 Excavation



Figure 116: Test Pit 58 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 59



Figure 117: Test Pit 59 Excavation



Figure 118: Test Pit 59 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 60



Figure 119: Test Pit 60 Excavation



Figure 120: Test Pit 60 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 61



Figure 121: Test Pit 61 Excavation



Figure 122: Test Pit 61 Arisings

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 62



Figure 123: Test Pit 62 Excavation



Figure 124: Test Pit 2 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 63



Figure 125: Test Pit 63 Excavation



Figure 126: Test Pit 63 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 64



Figure 127: Test Pit 64 Excavation



Figure 128: Test Pit 64 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 65

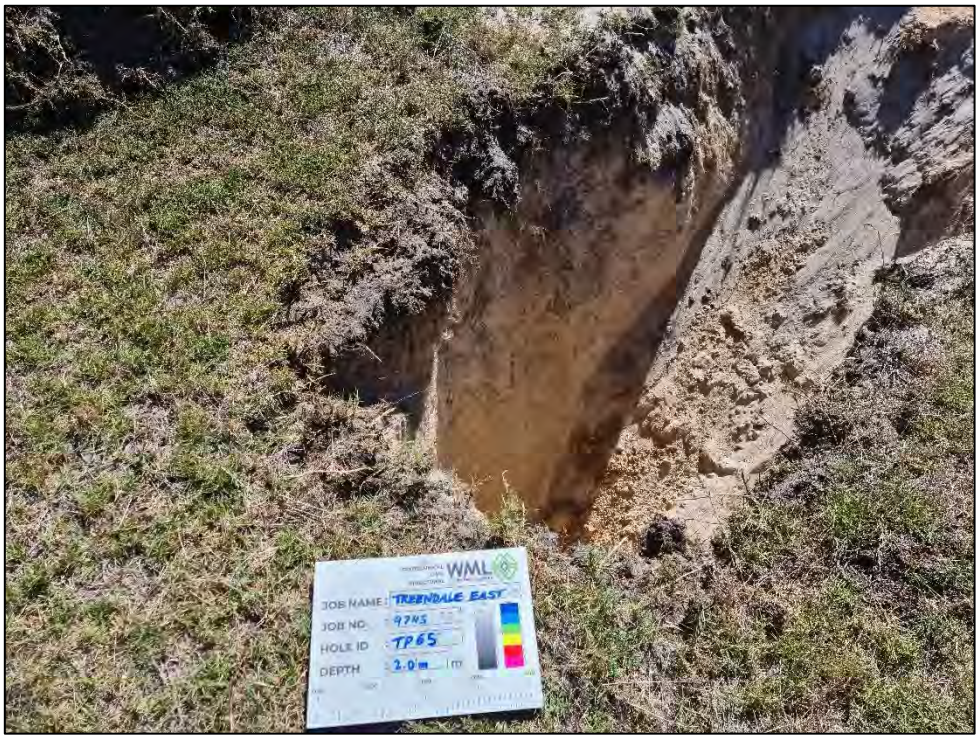


Figure 129: Test Pit 65 Excavation



Figure 130: Test Pit 65 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 66



Figure 131: Test Pit 66 Excavation



Figure 132: Test Pit 66 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 67



Figure 133: Test Pit 67 Excavation



Figure 134: Test Pit 67 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 68



Figure 135: Test Pit 68 Excavation



Figure 136: Test Pit 68 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 69

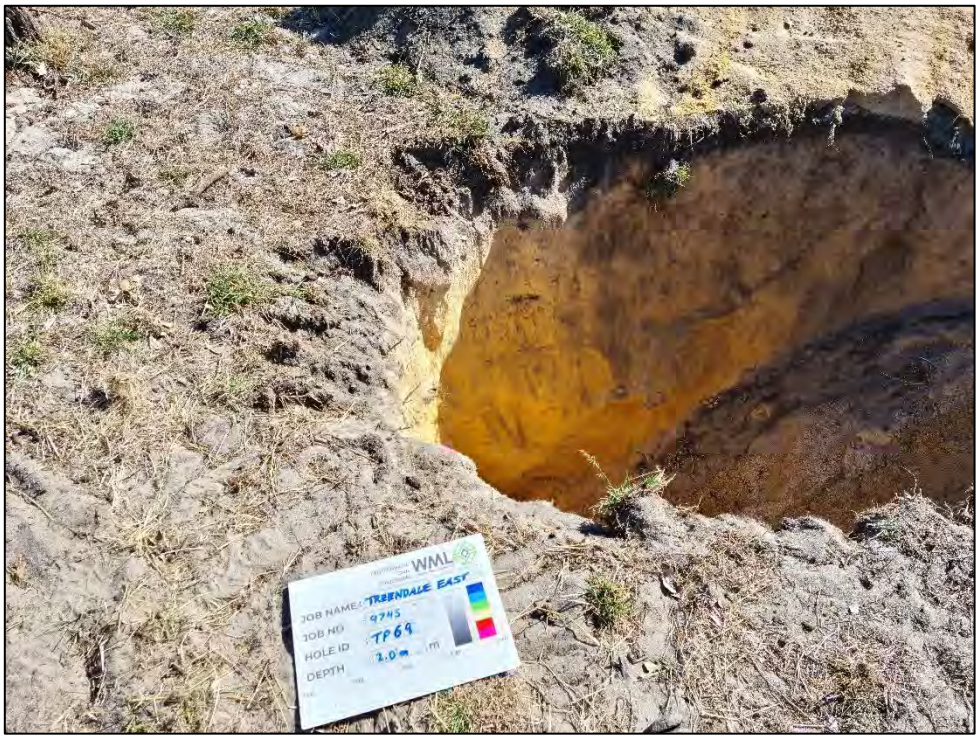


Figure 137: Test Pit 69 Excavation



Figure 138: Test Pit 69 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 70



Figure 139: Test Pit 70 Excavation



Figure 140: Test Pit 70 Soil Profile

PHOTOGRAPHIC RECORD

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 71



Figure 141: Test Pit 71 Excavation



Figure 142: Test Pit 71 Soil Profile

Client:	TAYCOT Pty Ltd
Job Number:	9745
Job Description:	Treendale East Estate Preliminary Geotechnical Investigation
Location ID:	Test Pit 72



Figure 143: Test Pit 72 Excavation



Figure 144: Test Pit 72 Soil Profile

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

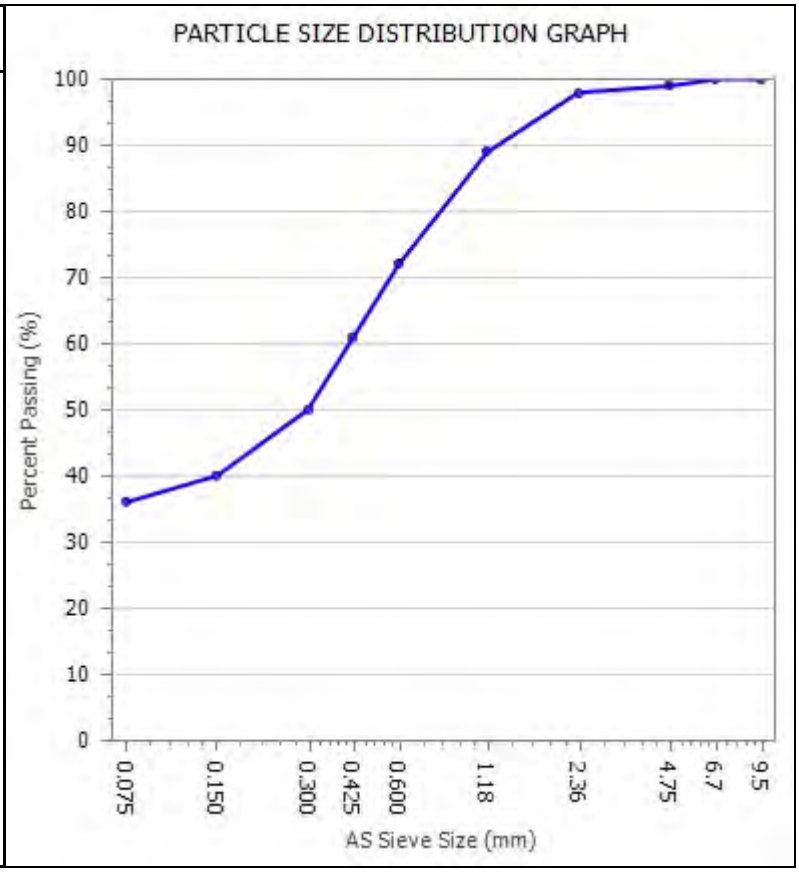
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45720-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 4 Depth 0.5-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76404	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Yellow Clay

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
6.7		**100**	
4.75		**99**	
2.36		**98**	
1.18		**89**	
0.600		**72**	
0.425		**61**	
0.300		**50**	
0.150		**40**	
0.075		**36**	



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

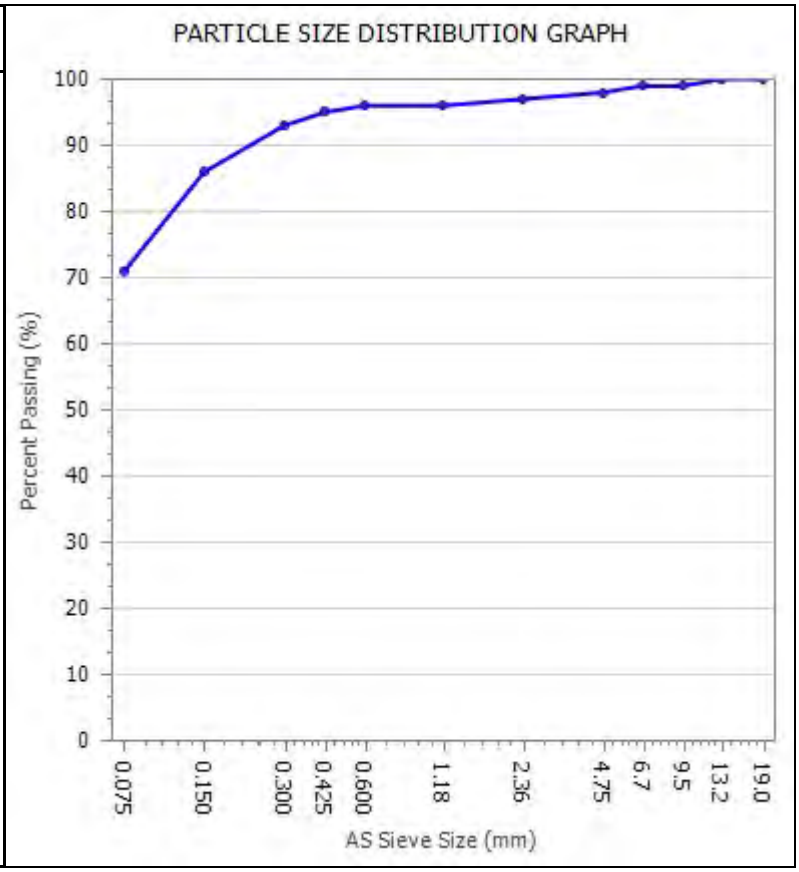
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45721-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 11 Depth 1.6-2.0m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76408	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Brown mottled grey CLAY

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
19.0		**100**	
13.2		**100**	
9.5		**99**	
6.7		**99**	
4.75		**98**	
2.36		**97**	
1.18		**96**	
0.600		**96**	
0.425		**95**	
0.300		**93**	
0.150		**86**	
0.075		**71**	



Remarks	Results apply to the sample/s as received.

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

PARTICLE SIZE DISTRIBUTION REPORT

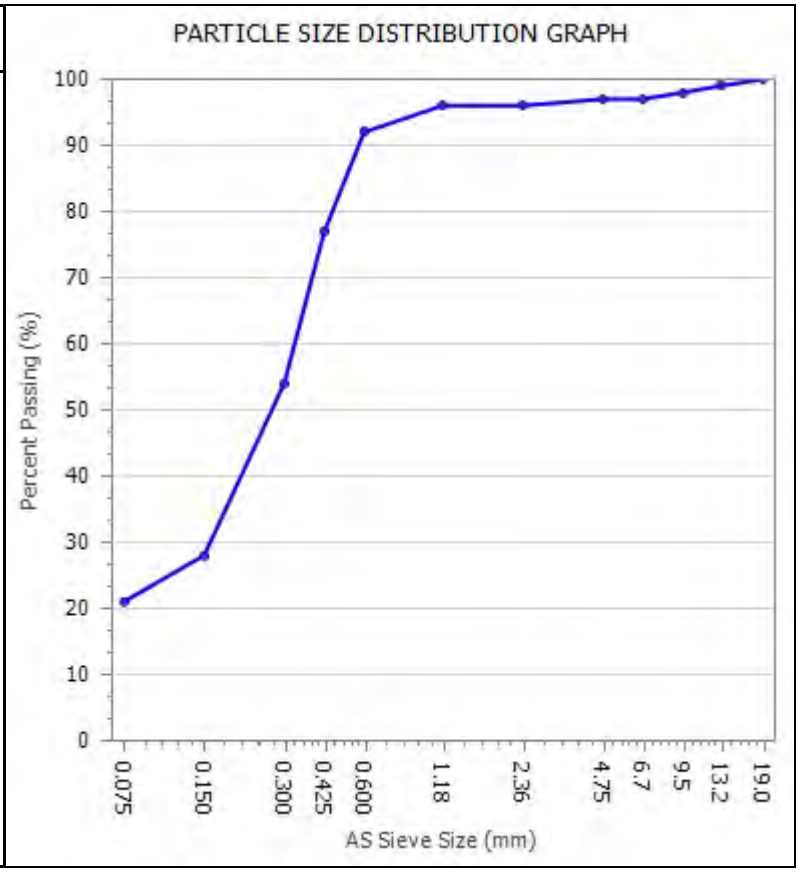
Client:	WML Consultants	Report Number:	5022/R/45722-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 13 Depth 0.3-0.7m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1
Sample Number	5022/S/76409
Sampling Method	Tested As Received
Date Sampled	30/03/2021
Sampled By	Client Sampled
Date Tested	12/04/2021
Material Source	Test Pit

Sample Location

Test Pit No.	
Depth	m
Material Type	Yellow Clayey SAND

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
19.0		**100**	
13.2		**99**	
9.5		**98**	
6.7		**97**	
4.75		**97**	
2.36		**96**	
1.18		**96**	
0.600		**92**	
0.425		**77**	
0.300		**54**	
0.150		**28**	
0.075		**21**	



Remarks: Results apply to the sample/s as received.

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

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ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

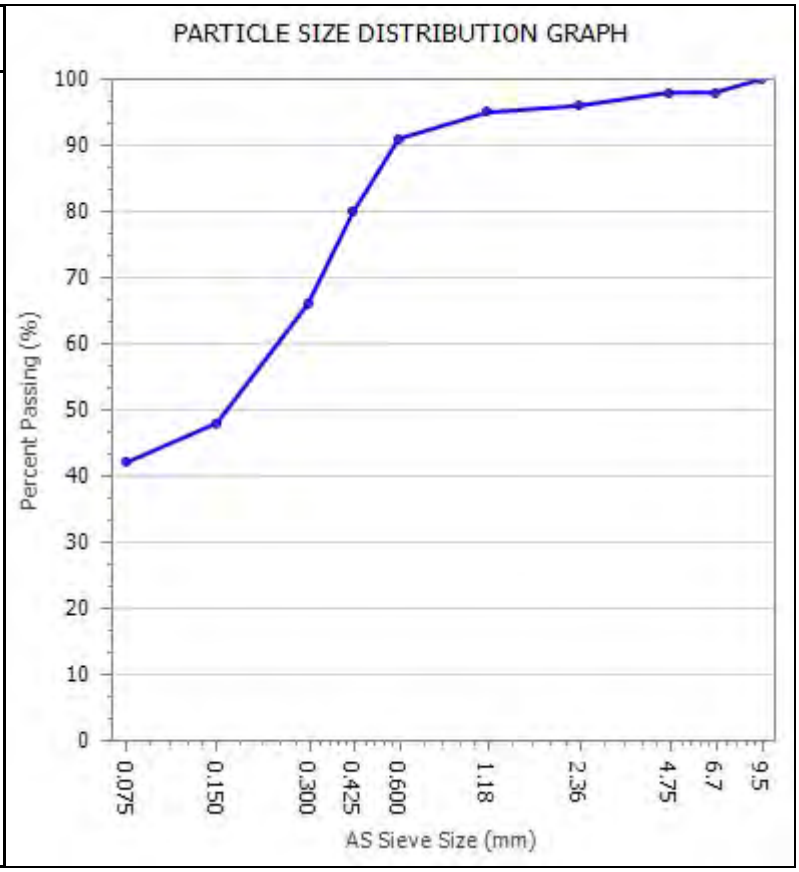
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45724-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 13 Depth 0.7-1.3m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76410	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Yellow Sandy CLAY

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
6.7		**98**	
4.75		**98**	
2.36		**96**	
1.18		**95**	
0.600		**91**	
0.425		**80**	
0.300		**66**	
0.150		**48**	
0.075		**42**	



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

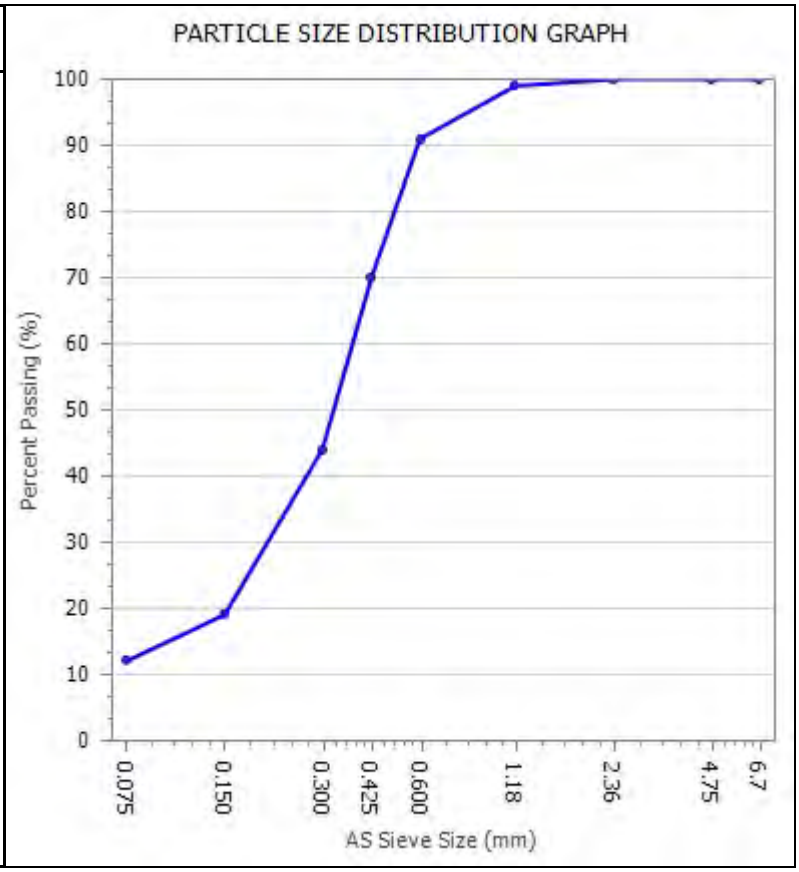
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45725-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 17 Depth 0.5-1.9m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76411	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Yellow silty SAND

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**99**	
0.600		**91**	
0.425		**70**	
0.300		**44**	
0.150		**19**	
0.075		**12**	



Remarks	Results apply to the sample/s as received.

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

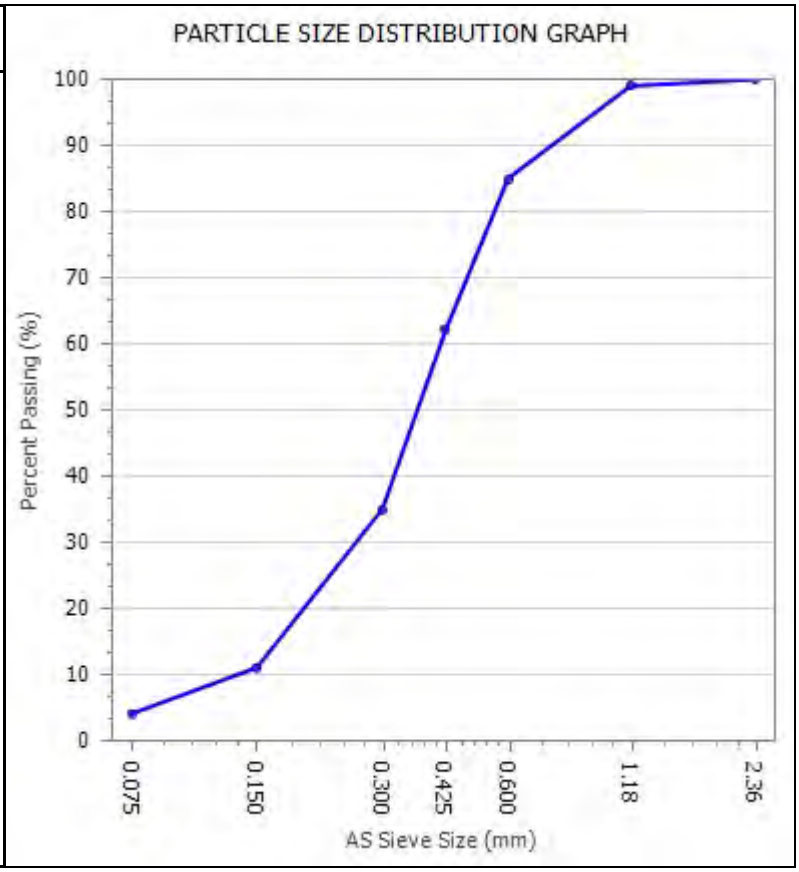
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45726-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 21 Depth 1.65m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76412	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Grey SAND

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
2.36		**100**	
1.18		**99**	
0.600		**85**	
0.425		**62**	
0.300		**35**	
0.150		**11**	
0.075		**4**	



Remarks	Results apply to the sample/s as received.

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Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

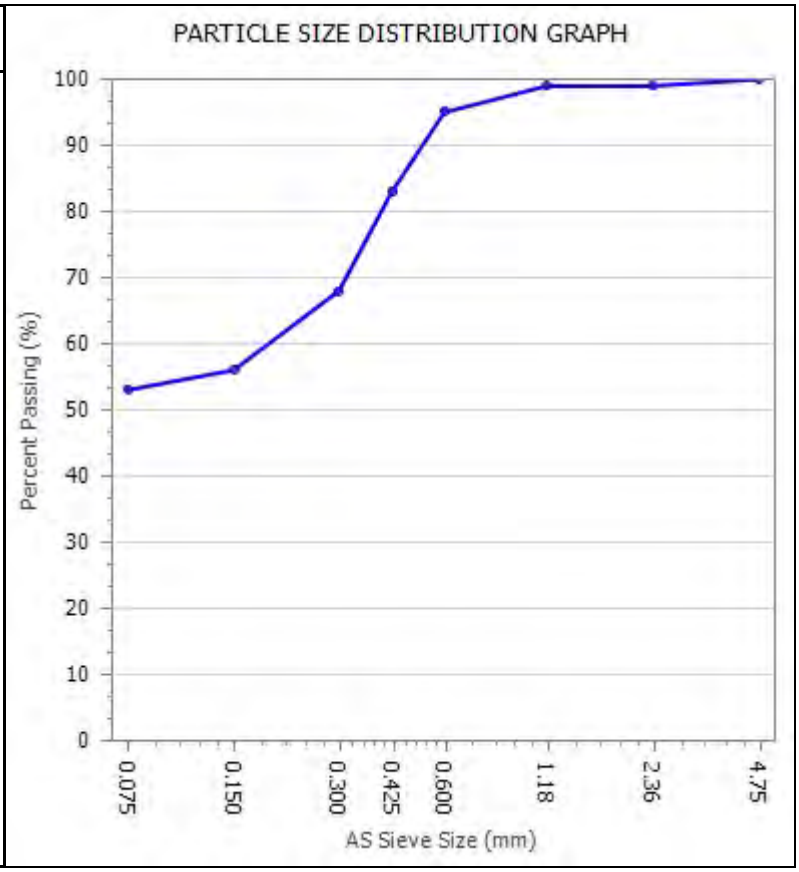
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45727-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 26 Depth 1.7m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

		Sample Location	
Sample Number	5022/S/76414		
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Grey Sandy CLAY

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
4.75		**100**	
2.36		**99**	
1.18		**99**	
0.600		**95**	
0.425		**83**	
0.300		**68**	
0.150		**56**	
0.075		**53**	



Remarks	Results apply to the sample/s as received.

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NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

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ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
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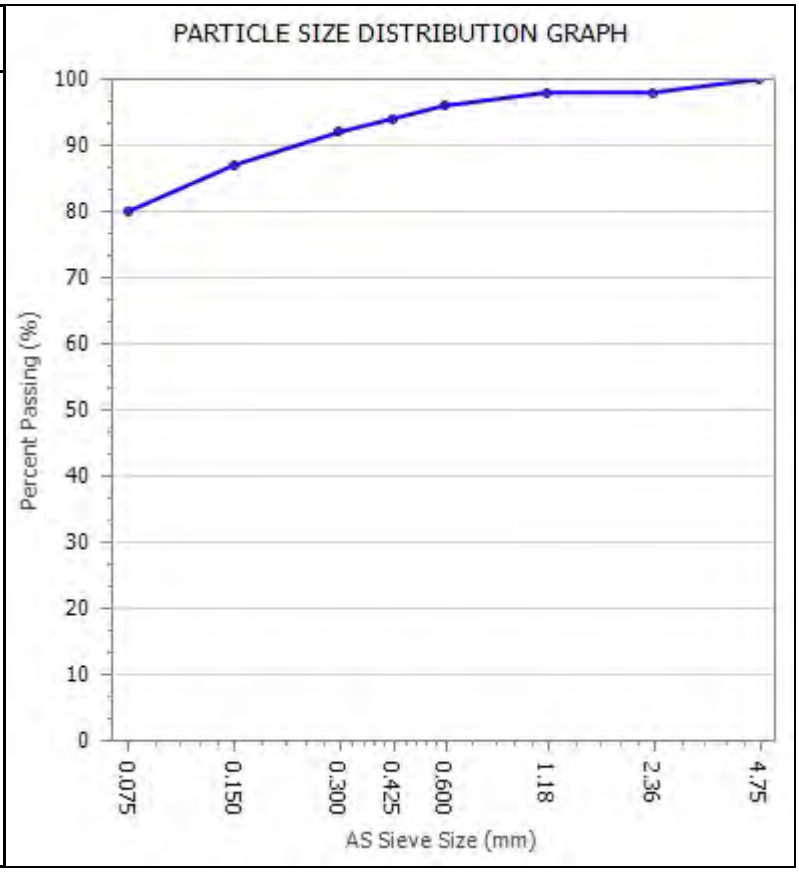
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45728-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 36 Depth 0.8-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76415	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Grey CLAY

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
4.75		**100**	
2.36		**98**	
1.18		**98**	
0.600		**96**	
0.425		**94**	
0.300		**92**	
0.150		**87**	
0.075		**80**	



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

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ABN: 74 128 806 735

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Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
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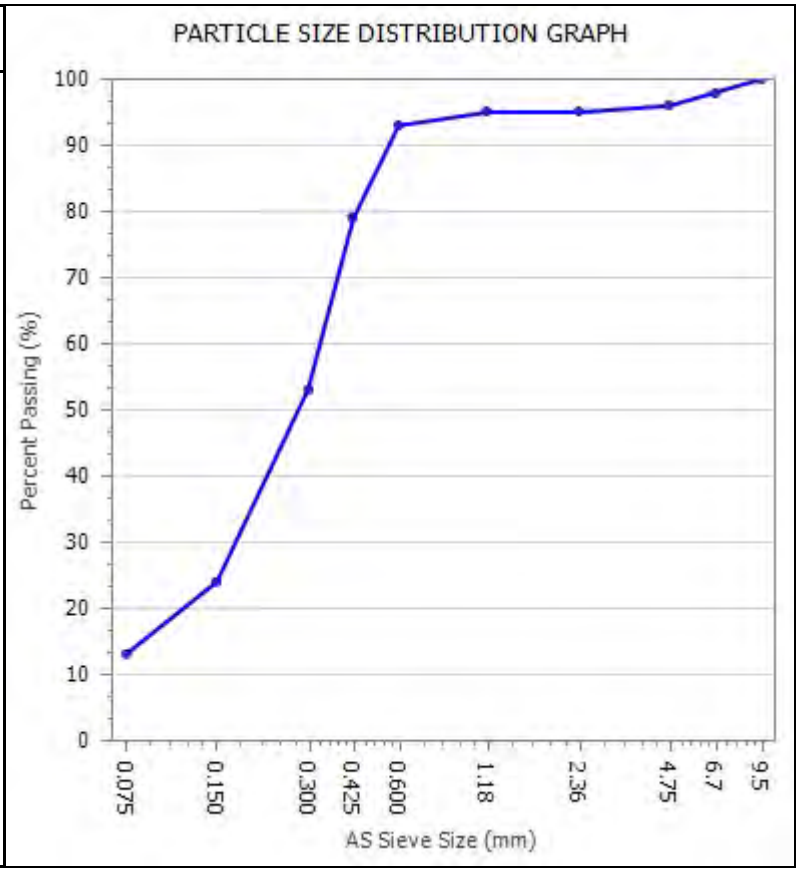
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45729-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 39 Depth 1.7-2.0m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76416	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Yellow SAND

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
6.7		**98**	
4.75		**96**	
2.36		**95**	
1.18		**95**	
0.600		**93**	
0.425		**79**	
0.300		**53**	
0.150		**24**	
0.075		**13**	



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

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ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
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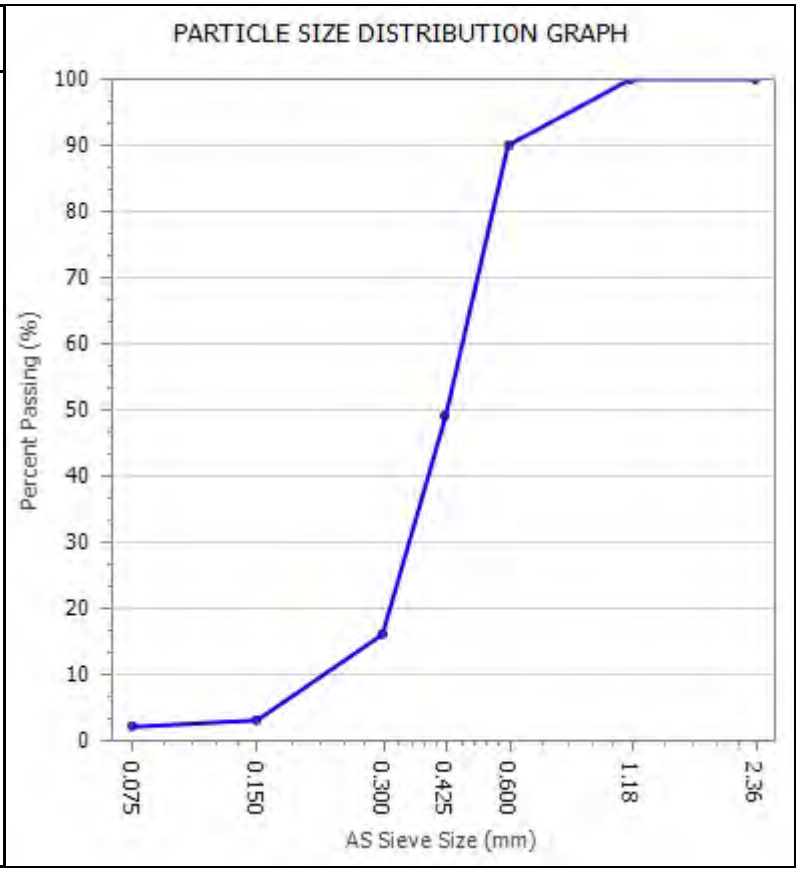
PARTICLE SIZE DISTRIBUTION REPORT

Client:	WML Consultants	Report Number:	5022/R/45730-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 67 Depth 1.0-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.6.1

Sample Number	5022/S/76417	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	12/04/2021		
Material Source	Test Pit	Material Type	Pale Grey SAND

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
2.36		**100**	
1.18		**100**	
0.600		**90**	
0.425		**49**	
0.300		**16**	
0.150		**3**	
0.075		**2**	



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

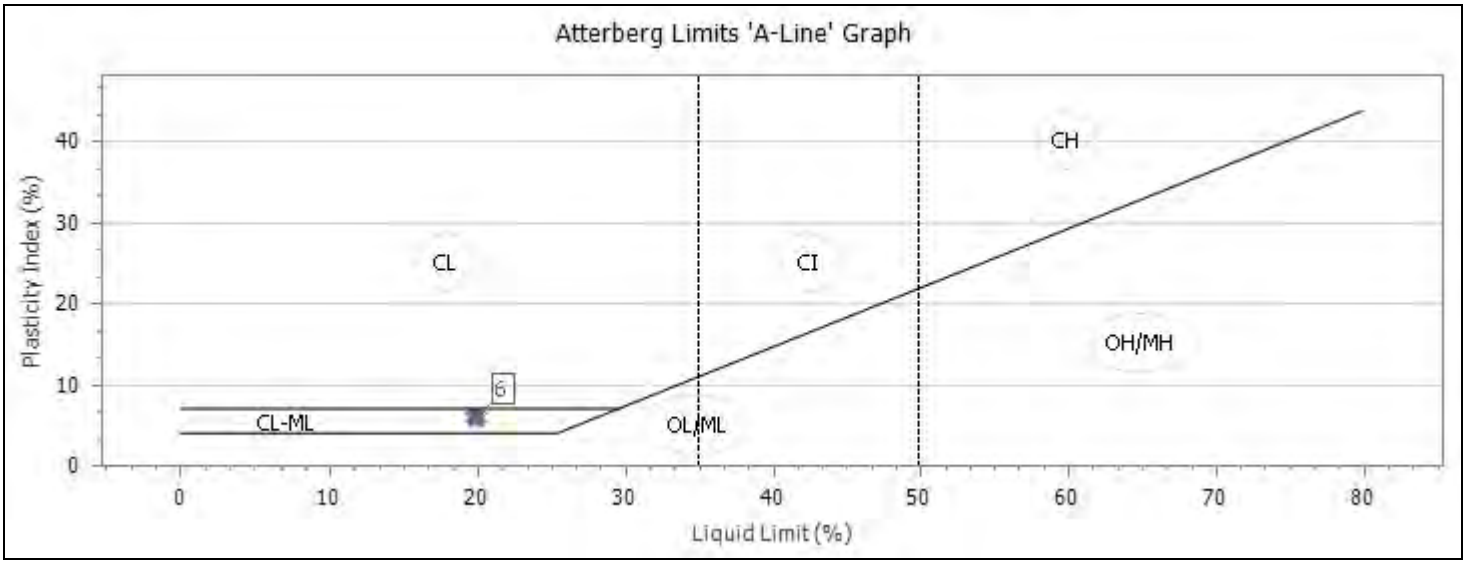
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45723-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 13 Depth 0.3-0.7m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76409	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	13/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Yellow Clayey SAND
Material Description	Dark Yellow Clayey SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**20**	
Plastic Limit (%)		**14**	
Plasticity Index (%)		**6**	
Linear Shrinkage (%)		**2.5**	
Linear Shrinkage Defects:	Curl		



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W11Rep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45731-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 67 Depth 1.0-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	14/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76417	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	13/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Pale Grey SAND
Material Description	Light Grey SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**0.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / -		

Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5022

Approved Signatory: Janine Fischer
Form ID: W11Rep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

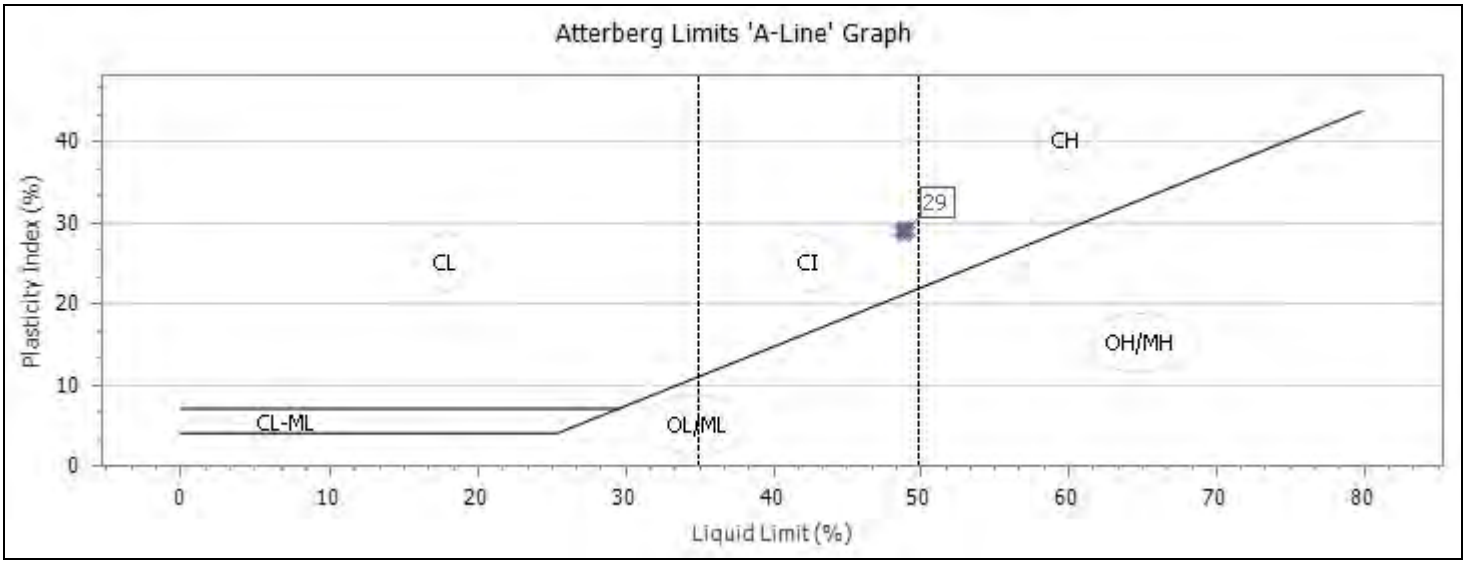
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45757-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 4 Depth 0.5-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76404	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Yellow Clay
Material Description	Orange Yellow Slightly Silty CLAY		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**49**	
Plastic Limit (%)		**20**	
Plasticity Index (%)		**29**	
Linear Shrinkage (%)		**12.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / Curl		



Remarks	Results apply to the sample/s as received.

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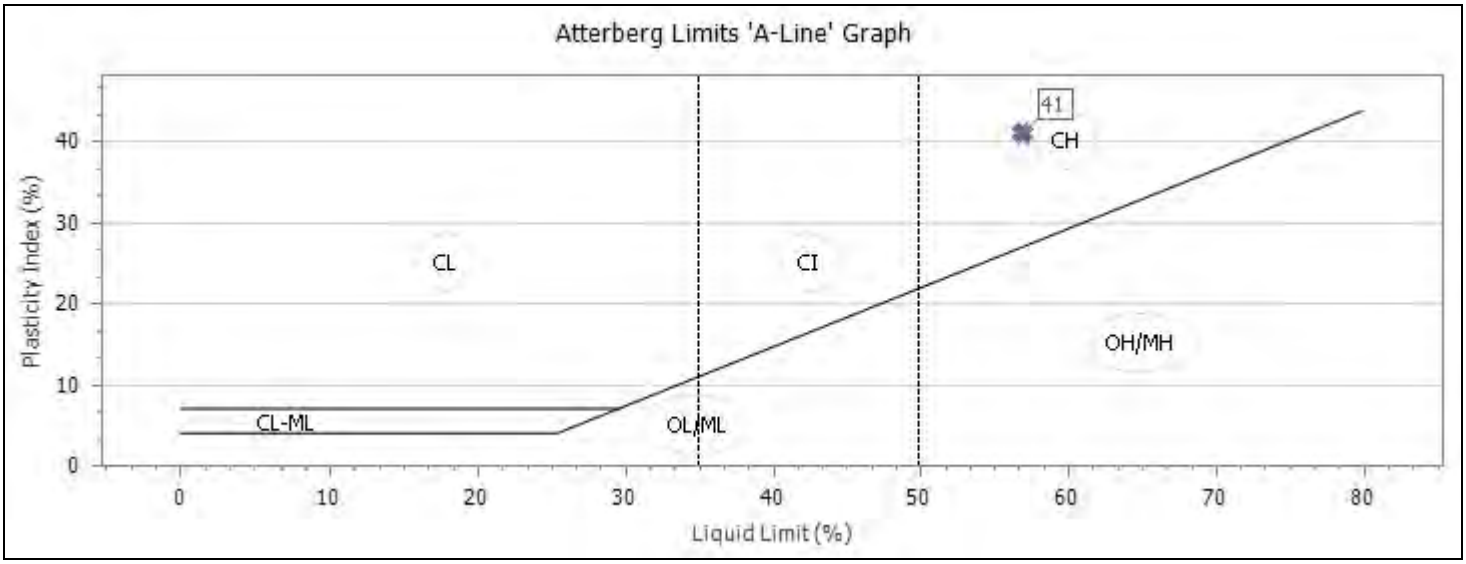
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45758-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 13 Depth 0.7-1.3m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76410	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Yellow Sandy CLAY
Material Description	Yellow Sandy CLAY		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**57**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**41**	
Linear Shrinkage (%)		**15.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / Curl		



Remarks	Results apply to the sample/s as received.

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Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45759-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 17 Depth 0.5-1.9m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76411	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Yellow silty SAND
Material Description	Dark Yellow Silty SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**1.0**	
Linear Shrinkage Defects:	-		

Remarks	Results apply to the sample/s as received.

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72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45760-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 21 Depth 1.65m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76412	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Grey SAND
Material Description	Organic Grey SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**0.5**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / -		

Remarks	Results apply to the sample/s as received.

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Davenport WA 6230

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Phone: 08 9726 2187
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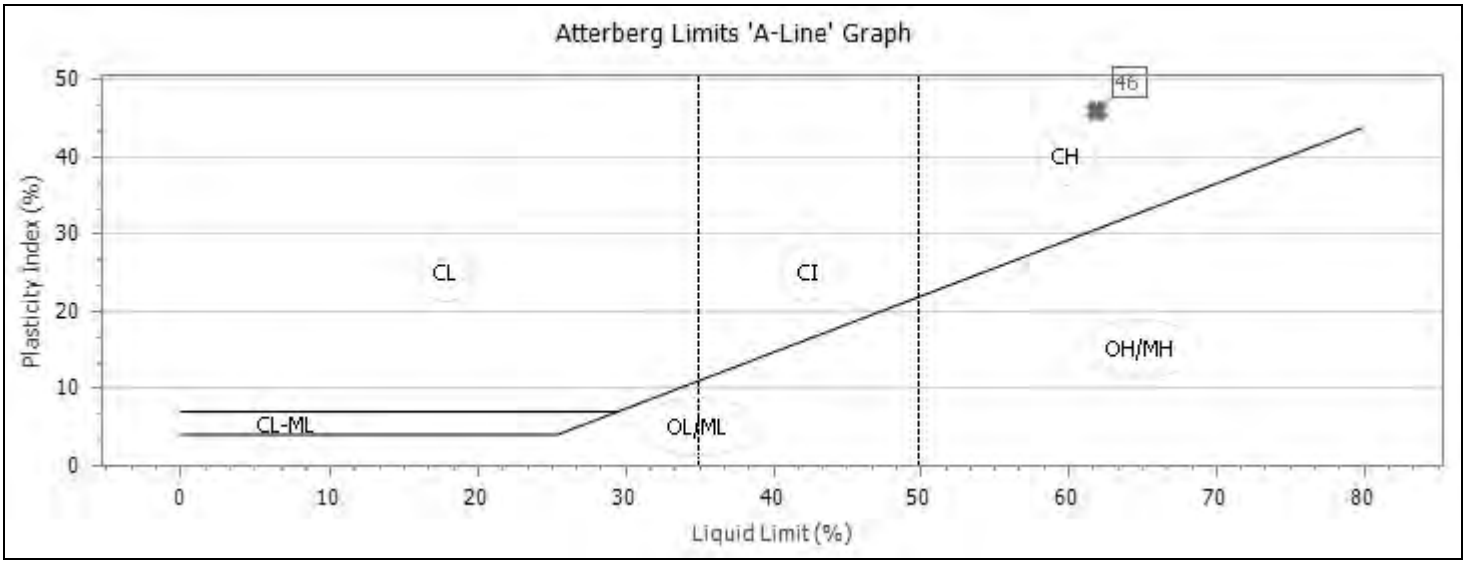
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45761-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 26 Depth 1.7m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76414	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Grey Sandy CLAY
Material Description	Grey Sandy CLAY		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**62**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**46**	
Linear Shrinkage (%)		**11.0**	
Linear Shrinkage Defects:	Curl		



Remarks	Results apply to the sample/s as received.

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Form ID: W11Rep Rev 1

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Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45762-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 39 Depth 1.7-2.0m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	15/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76416	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	14/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Yellow SAND
Material Description	Yellow Slightly Silty SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**1.0**	
Linear Shrinkage Defects:	-		

Remarks	Results apply to the sample/s as received.

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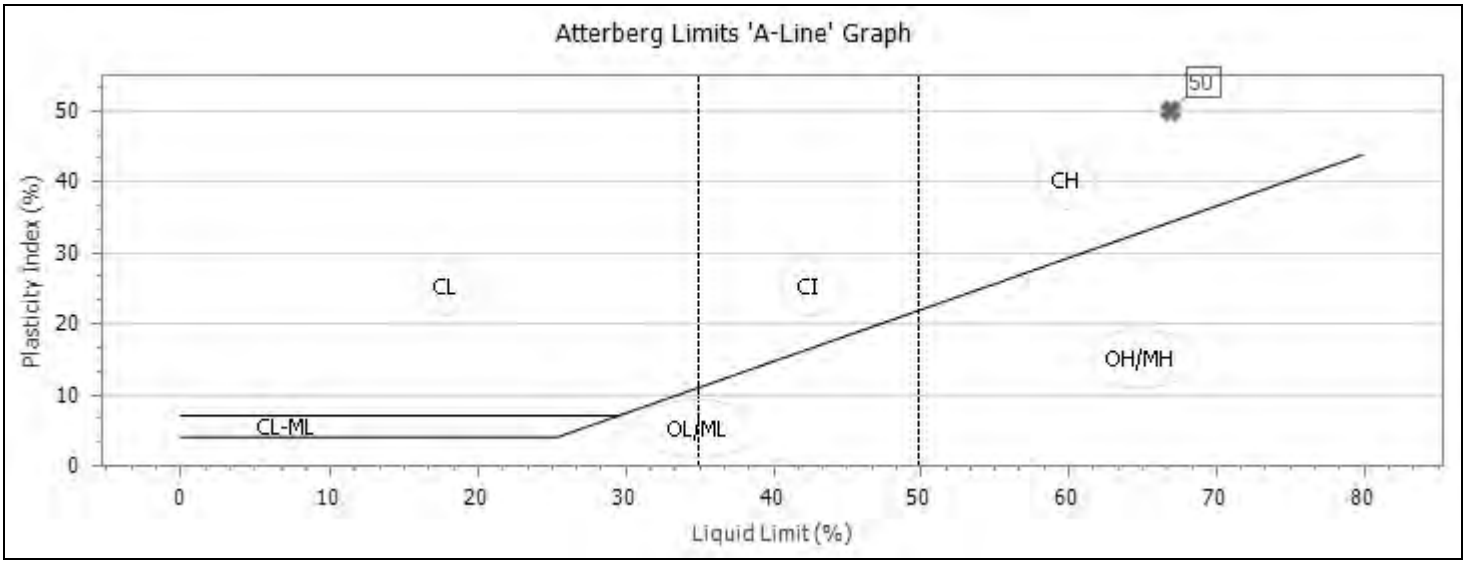
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45784-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 11 Depth 1.6-2.0m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	19/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76408	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	15/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Brown mottled grey CLAY
Material Description	Mottled reddish brown and grey CLAY		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**67**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**50**	
Linear Shrinkage (%)		**16.5**	
Linear Shrinkage Defects:	Curl		



Remarks	Results apply to the sample/s as received.

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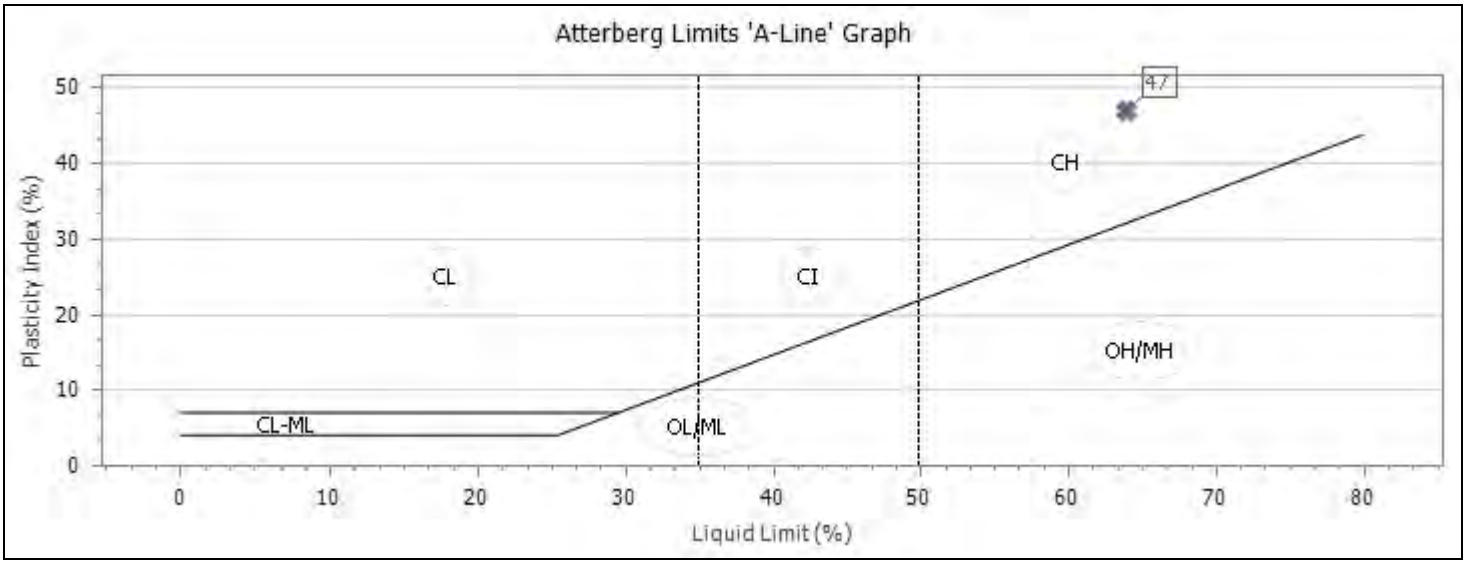
ATTERBERG LIMITS REPORT

Client:	WML Consultants	Report Number:	5022/R/45785-1
Client Address:	1st Floor 62 Wittenoom Street, Bunbury	Project Number:	5022/P/1661
Project:	Treendale East Development	Lot Number:	TP 36 Depth 0.8-1.5m
Location:	South West WA	Internal Test Request:	5022/T/14182
Supplied To:	n/a	Client Reference/s:	Job No. 9745
Area Description:		Report Date / Page:	19/04/2021 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS1726 (Tables 9/10)		
Sample Number	5022/S/76415	Sample Location	
Sampling Method	Tested As Received	Test Pit No.	
Date Sampled	30/03/2021	Depth	m
Sampled By	Client Sampled		
Date Tested	15/04/2021		
Att. Drying Method	Oven Dried	Material Source	Test Pit
Atterberg Preparation	Dry Sieved	Material Type	Grey CLAY
Material Description	Grey CLAY		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**64**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**47**	
Linear Shrinkage (%)		**16.0**	
Linear Shrinkage Defects:	Curl, Cracks		



Remarks	Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing

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Approved Signatory: Janine Fischer
Form ID: W11Rep Rev 1

APPENDIX D

ASS LABORATORY TEST RESULTS

WML Consultants Pty Ltd
PO Box 2023
Bunbury
WA 6231

Attention: **Aleksandra Gorczynska**

Report **789321-S**
Project name TREENDALE EAST - ASS INVESTIGATION
Project ID 9745
Received Date Apr 20, 2021

Client Sample ID			TP6 0.5	TP6 1.0	TP6 1.5	TP6 2.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37547	P21-Ap37548	P21-Ap37549	P21-Ap37550
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.2	5.7	5.4	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.0	4.1	4.2	4.6
Reaction Ratings*[S05]	-	comment	2.0	2.0	2.0	2.0

Client Sample ID			TP7 0.5	TP7 1.0	TP7 1.5	TP7 2.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37551	P21-Ap37552	P21-Ap37553	P21-Ap37554
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.4	6.3	6.0	5.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.5	5.4	4.7	4.7
Reaction Ratings*[S05]	-	comment	1.0	2.0	2.0	1.0

Client Sample ID			TP13 0.5	TP13 1.0	TP13 1.5	TP15 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37555	P21-Ap37556	P21-Ap37557	P21-Ap37558
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.3	6.5	6.2	6.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.3	5.6	4.7	4.7
Reaction Ratings*[S05]	-	comment	2.0	2.0	2.0	2.0

Client Sample ID			TP15 1.0	TP15 1.5	TP15 2.0	TP17 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37559	P21-Ap37560	P21-Ap37561	P21-Ap37562
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	6.9	7.0	6.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.3	4.8	4.2	4.8
Reaction Ratings*[S05]	-	comment	2.0	2.0	2.0	3.0

Client Sample ID			TP17 1.0	TP17 1.5	TP17 1.8	TP17 2.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37563	P21-Ap37564	P21-Ap37565	P21-Ap37566
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.3	6.3	6.3	6.4
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.8	4.8	4.6	5.4
Reaction Ratings*[S05]	-	comment	2.0	2.0	4.0	2.0

Client Sample ID			TP19 0.5	TP19 1.0	TP19 1.5	TP20 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37567	P21-Ap37568	P21-Ap37569	P21-Ap37570
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	5.7	5.4	5.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.1	3.0	3.7	4.2
Reaction Ratings*[S05]	-	comment	1.0	2.0	2.0	2.0

Client Sample ID			TP20 1.0	TP20 1.5	TP20 2.0	TP23 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37571	P21-Ap37572	P21-Ap37573	P21-Ap37574
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	5.2	5.3	4.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.4	3.6	3.6	3.3
Reaction Ratings*[S05]	-	comment	2.0	2.0	2.0	2.0

Client Sample ID			TP23 1.0	TP23 1.5	TP23 2.0	TP28 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37575	P21-Ap37576	P21-Ap37577	P21-Ap37578
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	4.8	5.8	7.3	5.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.8	3.3	4.2	4.5
Reaction Ratings*[S05]	-	comment	2.0	2.0	4.0	1.0

Client Sample ID			TP28 1.0	TP28 1.5	TP28 2.0	TP34 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37579	P21-Ap37580	P21-Ap37581	P21-Ap37582
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.1	5.6	5.7	6.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.5	4.1	5.2
Reaction Ratings*[S05]	-	comment	1.0	1.0	1.0	2.0

Client Sample ID			TP34 1.0	TP34 1.5	TP34 2.0	TP40 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37583	P21-Ap37584	P21-Ap37585	P21-Ap37586
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	6.0	6.4	7.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.1	5.3	5.1	5.8
Reaction Ratings*[S05]	-	comment	2.0	2.0	2.0	1.0

Client Sample ID			TP40 1.0	TP40 1.5	TP40 2.0	TP44 0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37587	P21-Ap37588	P21-Ap37589	P21-Ap37590
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.9	7.2	7.0	6.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.9	6.4	6.5	3.0
Reaction Ratings*[S05]	-	comment	3.0	2.0	2.0	3.0

Client Sample ID			TP44 1.0	TP44 1.5	TP46 0.5	TP46 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37591	P21-Ap37592	P21-Ap37593	P21-Ap37594
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.9	6.5	4.9	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.6	4.1	4.0	4.2
Reaction Ratings*[S05]	-	comment	2.0	2.0	1.0	1.0

Client Sample ID			TP46 1.5	TP46 2.0	TP48 0.5	TP48 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37595	P21-Ap37596	P21-Ap37597	P21-Ap37598
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.2	6.2	4.6	6.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.7	3.5	4.3	3.6
Reaction Ratings*[S05]	-	comment	2.0	2.0	1.0	4.0

Client Sample ID			TP48 1.5	TP48 2.0	TP53 0.5	TP53 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37599	P21-Ap37600	P21-Ap37601	P21-Ap37602
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.8	6.5	5.5	5.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.2	2.9	4.6	4.3
Reaction Ratings*[S05]	-	comment	3.0	3.0	1.0	1.0

Client Sample ID			TP53 1.5	TP53 2.0	TP55 0.5	TP55 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37603	P21-Ap37604	P21-Ap37605	P21-Ap37606
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	5.6	4.7	6.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.5	3.7	4.2	5.0
Reaction Ratings*[S05]	-	comment	1.0	2.0	1.0	2.0

Client Sample ID			TP55 1.5	TP55 2.0	TP58 0.5	TP58 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37607	P21-Ap37608	P21-Ap37609	P21-Ap37610
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.0	5.4	6.6	6.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.5	3.9	5.8	6.3
Reaction Ratings*[S05]	-	comment	1.0	1.0	1.0	1.0

Client Sample ID			TP58 1.5	TP58 2.0	TP62 0.5	TP62 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37611	P21-Ap37612	P21-Ap37613	P21-Ap37614
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	8.5	7.9	5.6	4.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.3	7.2	4.2	4.5
Reaction Ratings*[S05]	-	comment	2.0	3.0	2.0	1.0

Client Sample ID			TP62 1.5	TP62 1.8	TP65 0.5	TP65 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			P21-Ap37615	P21-Ap37616	P21-Ap37617	P21-Ap37618
Date Sampled			Apr 06, 2021	Apr 06, 2021	Apr 06, 2021	Apr 06, 2021
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	4.8	5.5	6.5	6.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.7	5.2	5.1
Reaction Ratings*[S05]	-	comment	1.0	1.0	2.0	1.0

Client Sample ID			TP65 1.5	TP65 2.0	TP67 0.5	TP67 1.0
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**P21-Ap37619**	**P21-Ap37620**	**P21-Ap37621**	**P21-Ap37622**
Date Sampled			**Apr 06, 2021**	**Apr 06, 2021**	**Apr 06, 2021**	**Apr 06, 2021**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.2	6.6	5.8	5.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.2	5.3	4.6	4.8
Reaction Ratings*[S05]	-	comment	1.0	2.0	1.0	1.0

Client Sample ID			TP67 1.5	TP67 2.0	unlabelled bag
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**P21-Ap37623**	**P21-Ap37624**	**P21-Ap37625**
Date Sampled			**Apr 06, 2021**	**Apr 06, 2021**	**Apr 06, 2021**
Test/Reference	LOR	Unit			
Acid Sulfate Soils Field pH Test					
pH-F (Field pH test)*	0.1	pH Units	6.1	6.1	7.3
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.0	5.2	5.0
Reaction Ratings*[S05]	-	comment	1.0	1.0	2.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Acid Sulfate Soils Field pH Test	Perth	Apr 22, 2021	7 Days

- Method: LTM-GEN- 7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests

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ABN: 50 005 085 521 web: www.eurofins.com.au email: EnviroSales@eurofins.com

Australia

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: WML Consultants Pty Ltd
Address: PO Box 2023
Bunbury
WA 6231

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Project ID: 9745

Order No.:
Report #: 789321
Phone: 08 9722 3544
Fax:

Received: Apr 20, 2021 9:40 AM
Due: Apr 28, 2021
Priority: 5 Day
Contact Name: Aleksandra Gorczynska

Eurofins Analytical Services Manager : Rhys Thomas

Sample Detail						Acid Sulfate Soils Field pH Test
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**	
1	TP6 0.5	Apr 06, 2021		Soil	P21-Ap37547	X
2	TP6 1.0	Apr 06, 2021		Soil	P21-Ap37548	X
3	TP6 1.5	Apr 06, 2021		Soil	P21-Ap37549	X
4	TP6 2.0	Apr 06, 2021		Soil	P21-Ap37550	X
5	TP7 0.5	Apr 06, 2021		Soil	P21-Ap37551	X
6	TP7 1.0	Apr 06, 2021		Soil	P21-Ap37552	X
7	TP7 1.5	Apr 06, 2021		Soil	P21-Ap37553	X
8	TP7 2.0	Apr 06, 2021		Soil	P21-Ap37554	X
9	TP13 0.5	Apr 06, 2021		Soil	P21-Ap37555	X

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Australia

Melbourne
6 Monterey Road
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Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
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NATA # 1261 Site # 18217

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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
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Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
10	TP13 1.0	Apr 06, 2021		Soil	P21-Ap37556	X
11	TP13 1.5	Apr 06, 2021		Soil	P21-Ap37557	X
12	TP15 0.5	Apr 06, 2021		Soil	P21-Ap37558	X
13	TP15 1.0	Apr 06, 2021		Soil	P21-Ap37559	X
14	TP15 1.5	Apr 06, 2021		Soil	P21-Ap37560	X
15	TP15 2.0	Apr 06, 2021		Soil	P21-Ap37561	X
16	TP17 0.5	Apr 06, 2021		Soil	P21-Ap37562	X
17	TP17 1.0	Apr 06, 2021		Soil	P21-Ap37563	X
18	TP17 1.5	Apr 06, 2021		Soil	P21-Ap37564	X
19	TP17 1.8	Apr 06, 2021		Soil	P21-Ap37565	X
20	TP17 2.0	Apr 06, 2021		Soil	P21-Ap37566	X

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Melbourne
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Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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Murarrie QLD 4172
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NATA # 1261 Site # 20794

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
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Rolleston, Christchurch 7675
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Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
21	TP19 0.5	Apr 06, 2021		Soil	P21-Ap37567	X
22	TP19 1.0	Apr 06, 2021		Soil	P21-Ap37568	X
23	TP19 1.5	Apr 06, 2021		Soil	P21-Ap37569	X
24	TP20 0.5	Apr 06, 2021		Soil	P21-Ap37570	X
25	TP20 1.0	Apr 06, 2021		Soil	P21-Ap37571	X
26	TP20 1.5	Apr 06, 2021		Soil	P21-Ap37572	X
27	TP20 2.0	Apr 06, 2021		Soil	P21-Ap37573	X
28	TP23 0.5	Apr 06, 2021		Soil	P21-Ap37574	X
29	TP23 1.0	Apr 06, 2021		Soil	P21-Ap37575	X
30	TP23 1.5	Apr 06, 2021		Soil	P21-Ap37576	X
31	TP23 2.0	Apr 06, 2021		Soil	P21-Ap37577	X

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Melbourne
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Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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NATA # 1261 Site # 20794

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46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
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Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
32	TP28 0.5	Apr 06, 2021		Soil	P21-Ap37578	X
33	TP28 1.0	Apr 06, 2021		Soil	P21-Ap37579	X
34	TP28 1.5	Apr 06, 2021		Soil	P21-Ap37580	X
35	TP28 2.0	Apr 06, 2021		Soil	P21-Ap37581	X
36	TP34 0.5	Apr 06, 2021		Soil	P21-Ap37582	X
37	TP34 1.0	Apr 06, 2021		Soil	P21-Ap37583	X
38	TP34 1.5	Apr 06, 2021		Soil	P21-Ap37584	X
39	TP34 2.0	Apr 06, 2021		Soil	P21-Ap37585	X
40	TP40 0.5	Apr 06, 2021		Soil	P21-Ap37586	X
41	TP40 1.0	Apr 06, 2021		Soil	P21-Ap37587	X
42	TP40 1.5	Apr 06, 2021		Soil	P21-Ap37588	X

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Melbourne
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Site # 1254 & 14271

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Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
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Welshpool WA 6106
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4/52 Industrial Drive
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NATA # 1261 Site # 25079

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Auckland
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Penrose, Auckland 1061
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IANZ # 1327

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Rolleston, Christchurch 7675
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Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
43	TP40 2.0	Apr 06, 2021		Soil	P21-Ap37589	X
44	TP44 0.5	Apr 06, 2021		Soil	P21-Ap37590	X
45	TP44 1.0	Apr 06, 2021		Soil	P21-Ap37591	X
46	TP44 1.5	Apr 06, 2021		Soil	P21-Ap37592	X
47	TP46 0.5	Apr 06, 2021		Soil	P21-Ap37593	X
48	TP46 1.0	Apr 06, 2021		Soil	P21-Ap37594	X
49	TP46 1.5	Apr 06, 2021		Soil	P21-Ap37595	X
50	TP46 2.0	Apr 06, 2021		Soil	P21-Ap37596	X
51	TP48 0.5	Apr 06, 2021		Soil	P21-Ap37597	X
52	TP48 1.0	Apr 06, 2021		Soil	P21-Ap37598	X
53	TP48 1.5	Apr 06, 2021		Soil	P21-Ap37599	X

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Australia

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
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IANZ # 1327

Christchurch
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Rolleston, Christchurch 7675
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Bunbury
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Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
54	TP48 2.0	Apr 06, 2021		Soil	P21-Ap37600	X
55	TP53 0.5	Apr 06, 2021		Soil	P21-Ap37601	X
56	TP53 1.0	Apr 06, 2021		Soil	P21-Ap37602	X
57	TP53 1.5	Apr 06, 2021		Soil	P21-Ap37603	X
58	TP53 2.0	Apr 06, 2021		Soil	P21-Ap37604	X
59	TP55 0.5	Apr 06, 2021		Soil	P21-Ap37605	X
60	TP55 1.0	Apr 06, 2021		Soil	P21-Ap37606	X
61	TP55 1.5	Apr 06, 2021		Soil	P21-Ap37607	X
62	TP55 2.0	Apr 06, 2021		Soil	P21-Ap37608	X
63	TP58 0.5	Apr 06, 2021		Soil	P21-Ap37609	X
64	TP58 1.0	Apr 06, 2021		Soil	P21-Ap37610	X

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Dandenong South VIC 3175
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NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

New Zealand

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: WML Consultants Pty Ltd
Address: PO Box 2023
Bunbury
WA 6231

Project Name: TREENDALE EAST - ASS INVESTIGATION
Project ID: 9745

Order No.:
Report #: 789321
Phone: 08 9722 3544
Fax:

Received: Apr 20, 2021 9:40 AM
Due: Apr 28, 2021
Priority: 5 Day
Contact Name: Aleksandra Gorczynska

Eurofins Analytical Services Manager : Rhys Thomas

Sample Detail						Acid Sulfate Soils Field pH Test
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
65	TP58 1.5	Apr 06, 2021		Soil	P21-Ap37611	X
66	TP58 2.0	Apr 06, 2021		Soil	P21-Ap37612	X
67	TP62 0.5	Apr 06, 2021		Soil	P21-Ap37613	X
68	TP62 1.0	Apr 06, 2021		Soil	P21-Ap37614	X
69	TP62 1.5	Apr 06, 2021		Soil	P21-Ap37615	X
70	TP62 1.8	Apr 06, 2021		Soil	P21-Ap37616	X
71	TP65 0.5	Apr 06, 2021		Soil	P21-Ap37617	X
72	TP65 1.0	Apr 06, 2021		Soil	P21-Ap37618	X
73	TP65 1.5	Apr 06, 2021		Soil	P21-Ap37619	X
74	TP65 2.0	Apr 06, 2021		Soil	P21-Ap37620	X
75	TP67 0.5	Apr 06, 2021		Soil	P21-Ap37621	X

eurofins | Environment Testing

ABN: 50 005 085 521 web: www.eurofins.com.au email: EnviroSales@eurofins.com

Australia

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
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Auckland
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Perth Laboratory - NATA Site # 23736						X
Mayfield Laboratory - NATA Site # 25079						
External Laboratory						
76	TP67 1.0	Apr 06, 2021		Soil	P21-Ap37622	X
77	TP67 1.5	Apr 06, 2021		Soil	P21-Ap37623	X
78	TP67 2.0	Apr 06, 2021		Soil	P21-Ap37624	X
79	unlabelled bag	Apr 06, 2021		Soil	P21-Ap37625	X
Test Counts						79

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37547	CP	pH Units	6.2	6.3	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37547	CP	pH Units	5.0	5.0	pass	30%	Pass	
Reaction Ratings*	P21-Ap37547	CP	comment	2.0	2.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37557	CP	pH Units	6.2	6.1	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37557	CP	pH Units	4.7	4.5	pass	30%	Pass	
Reaction Ratings*	P21-Ap37557	CP	comment	2.0	2.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37567	CP	pH Units	5.0	4.8	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37567	CP	pH Units	4.1	4.2	pass	30%	Pass	
Reaction Ratings*	P21-Ap37567	CP	comment	1.0	1.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37577	CP	pH Units	7.3	7.0	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37577	CP	pH Units	4.2	4.0	pass	30%	Pass	
Reaction Ratings*	P21-Ap37577	CP	comment	4.0	4.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37587	CP	pH Units	7.9	7.8	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37587	CP	pH Units	5.9	6.0	pass	30%	Pass	
Reaction Ratings*	P21-Ap37587	CP	comment	3.0	3.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37597	CP	pH Units	4.6	4.7	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37597	CP	pH Units	4.3	4.2	pass	30%	Pass	
Reaction Ratings*	P21-Ap37597	CP	comment	1.0	1.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37607	CP	pH Units	6.0	5.8	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37607	CP	pH Units	4.5	4.4	pass	30%	Pass	
Reaction Ratings*	P21-Ap37607	CP	comment	1.0	1.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	P21-Ap37617	CP	pH Units	6.5	6.2	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	P21-Ap37617	CP	pH Units	5.2	5.1	pass	30%	Pass	
Reaction Ratings*	P21-Ap37617	CP	comment	2.0	2.0	pass	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

Rhys Thomas	Analytical Services Manager
Rhys Thomas	Senior Analyst-SPOCAS (WA)



Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Appendix 8.
Acoustic Assessment

Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770
www.lgacoustics.com.au

Transportation Noise Assessment

Treendale East Structure Plan

Reference: 23098357-01A

Prepared for:
Treendale East Land Owners Group C/- Taycot

Reference: 23098357-01A

Lloyd George Acoustics Pty Ltd
ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923
www.lgacoustics.com.au

Contacts	General	Daniel Lloyd	Terry George	Matt Moyle
E:	info@lgacoustics.com.au	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	matt@lgacoustics.com.au
P:	9401 7770	0439 032 844	0400 414 197	0412 611 330
Contacts	Rob Connolly	Daryl Thompson	Hao Tran	Matt Nolan
E:	rob@lgacoustics.com.au	daryl@lgacoustics.com.au	hao@lgacoustics.com.au	matt.nolan@lgacoustics.com.au
P:	0410 107 440	0420 364 650	0438 481 207	0448 912 604

This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

Date	Rev	Description	Author	Verified
6-Oct-23	0	Issued to Client	Terry George	Rob Connolly
17-Oct-23	A	Updated with comments to include noise contours with bund along BORR	Terry George	-

CONTENTS

1. INTRODUCTION 1

2. CRITERIA 3

3. METHODOLOGY 4

3.1. Ground Topography 4

3.2. Road Surface 4

3.3. Vehicle Speed 5

3.4. Traffic Volumes 5

3.5. Ground Absorption 5

4. RESULTS 6

5. ASSESSMENT 8

List of Tables

Table 2-1: Noise Targets for Noise Sensitive Land-Use 3

Table 3-2: Noise Relationship Between Different Road Surfaces 4

Table 3-3: Modelled Existing Traffic Volumes 5

Table 3-4: Modelled Future (2041) Traffic Volumes 5

List of Figures

Figure 1-1: Subdivision Location (Source: DPLH PlanWA) 1

Figure 1-2: Draft Structure Plan 2

Figure 4-1: Future $L_{Aeq(Day)}$ Noise Contour Plot – Ground Floor Level 7

Figure 5-1: Future $L_{Aeq(Day)}$ Noise Contour Plot with 4m Bund – Ground Floor Level 10

Appendices

Appendix A – Quiet House Packages 11

Appendix B – Terminology 17

1. INTRODUCTION

It is proposed to subdivide land referred to as Treendale East Structure Plan (refer *Figure 1-1*) with the draft plan shown in *Figure 1-2*. The site is surrounded by Forrest Highway, future Bunbury Outer Ring Road (BORR) and Raymond Road, which are all assessable roads in accordance with *State Planning Policy No. 5.4 Road and Rail Noise*.

Lloyd George Acoustics is involved in the BORR project and as such this report uses the same methodology as that Study.

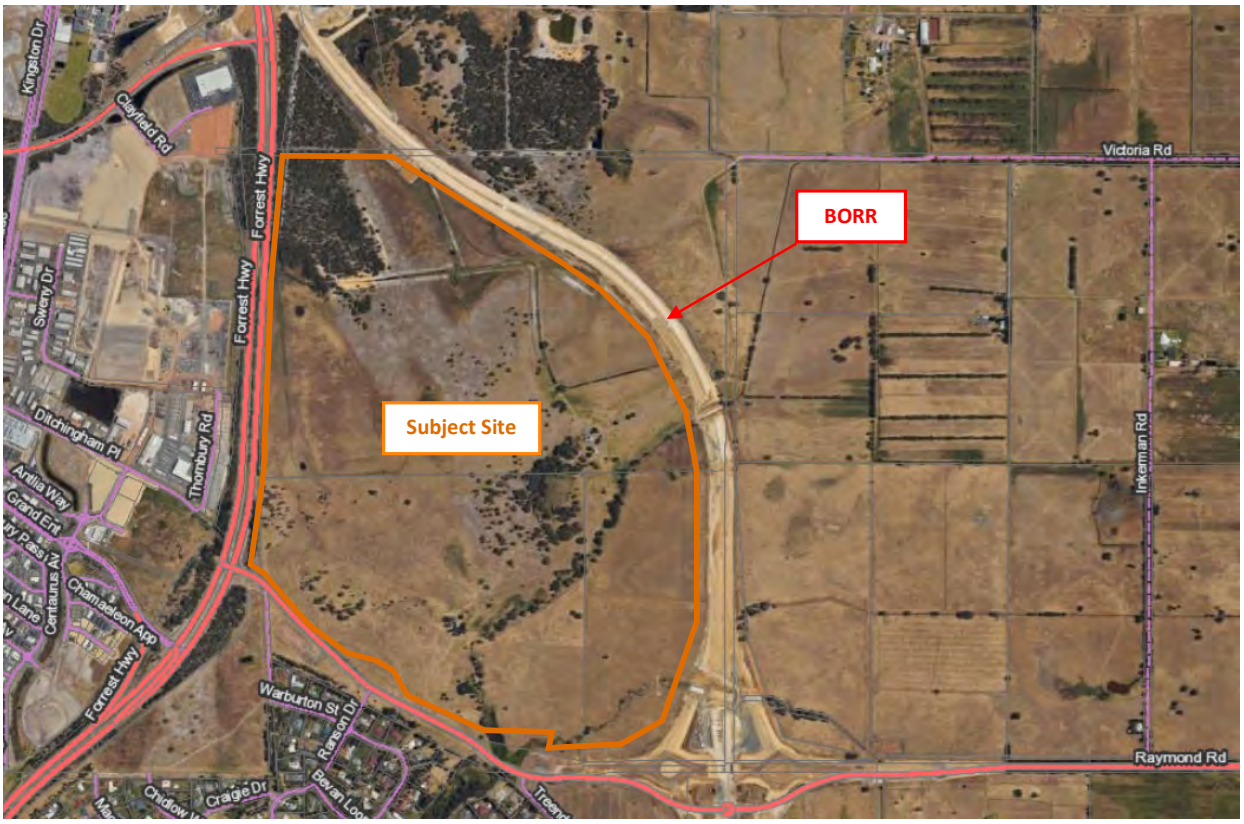


Figure 1-1: Subdivision Location (Source: DPLH PlanWA)

Appendix B contains a description of some of the terminology used throughout this report.

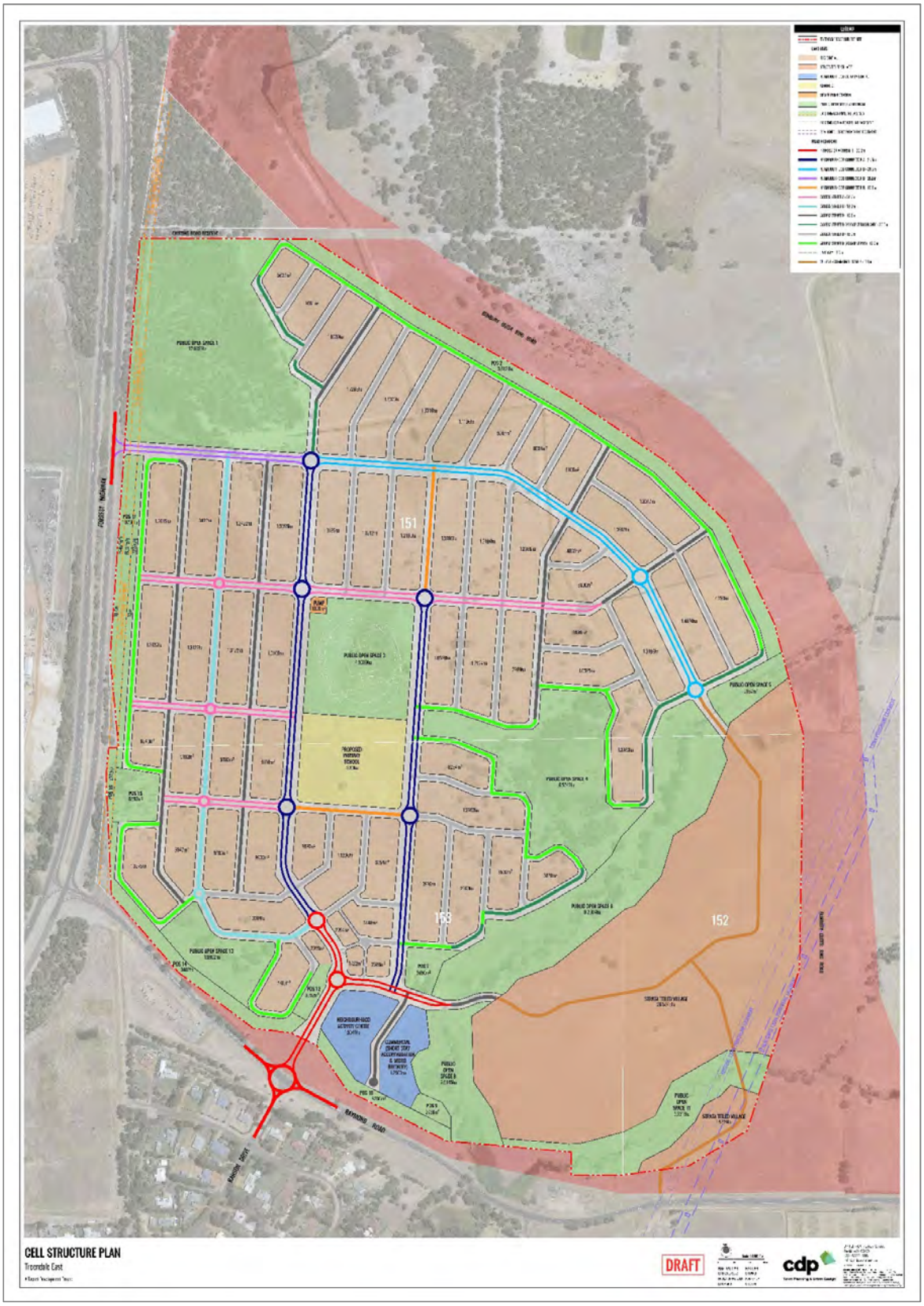


Figure 1-2: Draft Structure Plan

2. CRITERIA

The criteria relevant to this project is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the *Road and Rail Noise Guidelines* (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1: Noise Targets for Noise Sensitive Land-Use

Scenario	Outdoor Noise Target		Indoor Noise Target	
Noise-sensitive land-use and/or development	55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of a noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment has been undertaken.

[1] *A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.*

3. METHODOLOGY

The computer program *SoundPLAN 8.1* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Class 1 and 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two source heights at 1.5 metres and 3.6 metres above road level;
- A -0.8 dB correction has been applied to the lower level heavy vehicle noise source and -8.0 dB to the higher level noise source based on the *Transportation Noise Reference Book*; Paul Nelson (1987), so as to provide consistent results with the CoRTN algorithms;
- An adjustment of -1.7 dB has been applied to the predicted levels for the 'at façade' case, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Predictions are made at heights of 1.4 metres above ground floor level and include a + 2.5 dB correction due to reflected noise from an assumed building facade.

Various input data are included in the modelling and these are discussed in *Section 3.1* to *Section 3.5*.

3.1. Ground Topography

From the BORR project, Landgate data was on file as well as the road design information for BORR and Raymond Road.

Given this is structure plan only, no finished lot levels are available and future buildings within the study area have yet to be included, both of which would be updated at subdivision stage.

3.2. Road Surface

The corrections applied for different road surface finishes are provided in *Table 3-1*.

Table 3-1: Noise Relationship Between Different Road Surfaces

Chip Seal				Asphalt			
14mm	10mm	5mm	Slurry	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	+1.0 dB	0.0 dB	-0.2 dB	-1.5 dB	-2.5 dB

The following road surfaces are used in the noise modelling:

- Forrest Highway – 14mm Chip Seal existing and slurry seal in the future;
- BORR Main Carriageway – 14mm Chip Seal;
- BORR Ramps – Dense Graded Asphalt
- Raymond Road – 14mm Chip Seal existing, changing to Dense Graded Asphalt.

3.3. Vehicle Speed

The following posted speeds were used in the noise modelling:

- Forrest Highway – 100 km/hr with 80 km/hr southbound near Raymond Road and 70 km/hr northbound, near Raymond Road
- BORR Main Carriageway – 110 km/hr;
- BORR Ramps – 70 – 110 km/hr;
- Raymond Road – 80 km/hr.

3.4. Traffic Volumes

Table 3-3 and *Table 3-4* provide the traffic volumes used in the noise model, taken from the BORR Study.

Table 3-2: Modelled Existing Traffic Volumes

Road	Section	Average Annual Daily Traffic	Average Vehicles Per Hour (6am to 10pm)	% Heavy Vehicles
Forest Highway	Northbound (NB)	12,573	718	11
	Southbound (SB)	12,770	746	14
Raymond Road	West of BORR	4,464	245	20

Table 3-3: Modelled Future (2041) Traffic Volumes

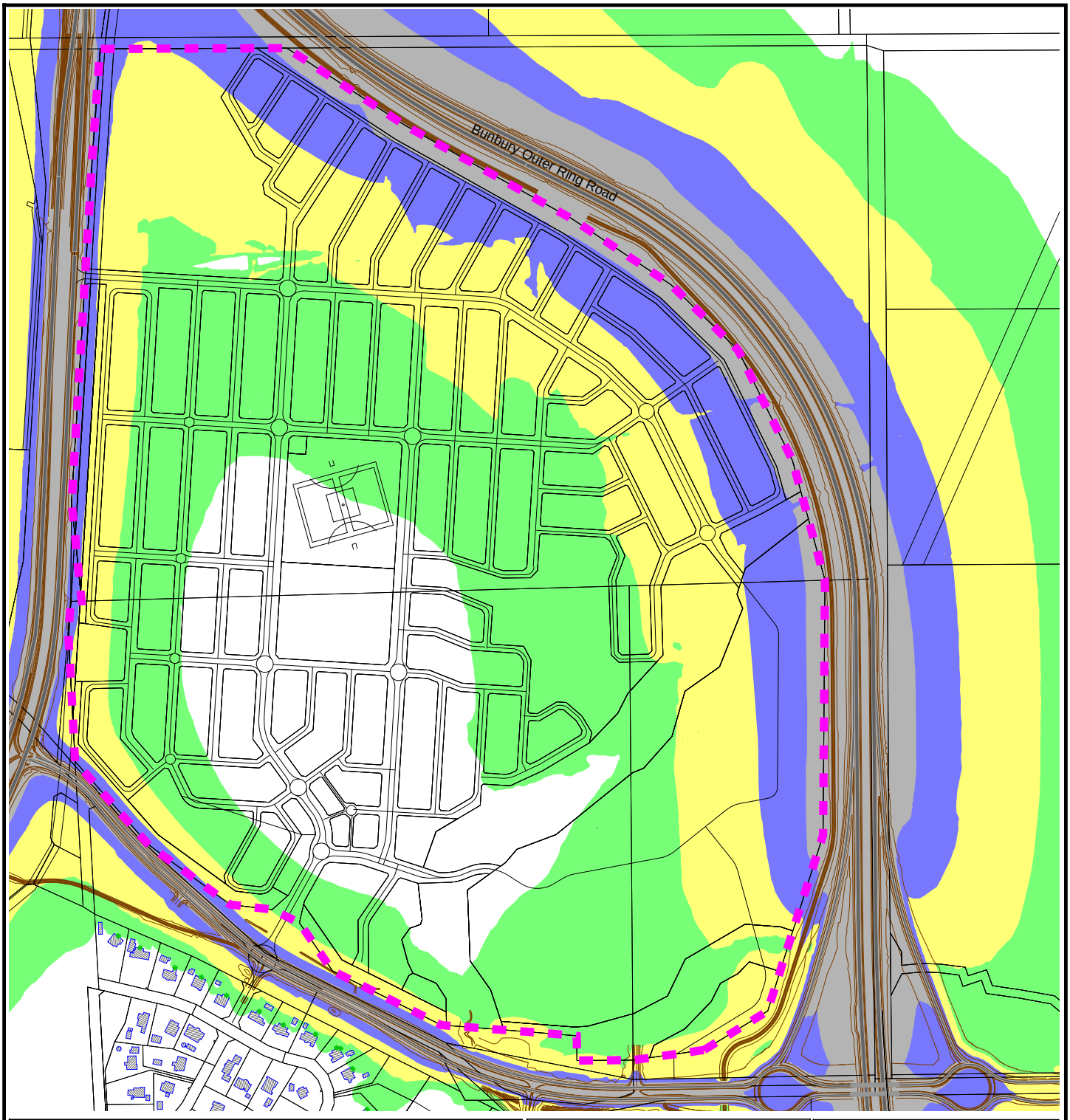
Road	Section	Average Annual Daily Traffic	Average Vehicles Per Hour (6am to 10pm)	% Heavy Vehicles
Forest Highway	NB / SB	5,800	335	15
Raymond Road	West of BORR	7,388	430	15
BORR	North of Raymond Interchange (NB/SB)	10,747	623	15
	Through Raymond Interchange (NB/SB)	10,700	620	15
	NB on-Ramp from Raymond Road	64	4	15
	SB off Ramp to Raymond Road	64	4	15

3.5. Ground Absorption

The ground absorption has been assumed to be 0.0 (0%) for the roads, 0.5 (50%) outside of the roads and 1.0 (100%) for public open spaces, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

4. RESULTS

The calibration applied to the BORR noise model is -2.7 dB such that this has also been applied in this Study. The predicted future noise levels across the Structure Plan are shown as a noise level contour plot in *Figure 4-1*.



Treendale East Structure Plan
Future $L_{Aeq(Day)}$ Noise Level Contours

Future Traffic on Future Road
Ground Floor Level

SoundPLAN v8.1
CoRTN Algorithms

6 October 2023

Signs and symbols

- Road
- Building
- Subject Site

N

Noise levels $L_{Aeq(Day)}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Lloyd George Acoustics
PO Box 717
HILLARYS WA 6923
(08) 9401 7770

Length Scale 1:10000

0 50 100 200 300 400 m

Figure 4-1

5. ASSESSMENT

The objectives of SPP 5.4 are to achieve:

- Indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- A reasonable degree of acoustic amenity for outdoor living areas on each residential lot.

Where the outdoor noise targets of *Table 2-1* are achieved, no further noise controls are necessary. With reference to *Section 4*, it is evident with the cumulative noise from all roads, the outdoor noise target will be exceeded. It should be noted that once buildings are incorporated into the noise model, these will also minimise the extent of noise mitigation into the site as these also act as barriers. This would be undertaken at subdivision stage once lot layouts are known and finished lot levels.

SPP 5.4 applies only to noise sensitive areas being residential, the village and short stay accommodation, with no mitigation required to public open space (POS) or commercial parts.

Where noise sensitive development is to occur in Exposure A, B or C, the deemed to comply quiet house packages of SPP 5.4 (refer *Appendix A*), can be adopted, noting that the cost of Exposure C is more than Exposure B, which is more than Exposure A. As such, there is benefit in constructing bunds or walls in such circumstances. Where noise levels are above Exposure C, then such noise walls/bunds must be considered. For Raymond Road, the proposed road surface is dense graded asphalt and therefore relatively quiet. The road surfaces for Forrest Highway and BORR are 14mm chip seal, being the noisiest and therefore it may be possible to negotiate with Main Roads WA to improve the road surface and therefore minimise the noise impacts.

With the Study being preliminary only, each road is discussed below along with potential noise mitigation. It is noted that the location of the school is such that this is below the outdoor noise target.

For the noise sensitive areas alongside Forrest Highway:

- Forrest Highway north of Raymond Road is expected to be slurry seal and further changes to the road surface are unlikely;
- The closest noise sensitive premises will be within Exposure B;
- Preference can be given to lots fronting Forrest Highway such that whilst the lot will be Exposure B, the architectural upgrades will be manageable with some of the front façade being garage. Where lots are side on to Forrest Highway, a 2.4-metre high wall may need to be provided to protect the outdoor living areas (OLA), or alternatively, the OLA is to be located on the side of the house opposite the road;
- Noise walls/bunds are unlikely to be practicable given the high pressure gas pipeline easement.

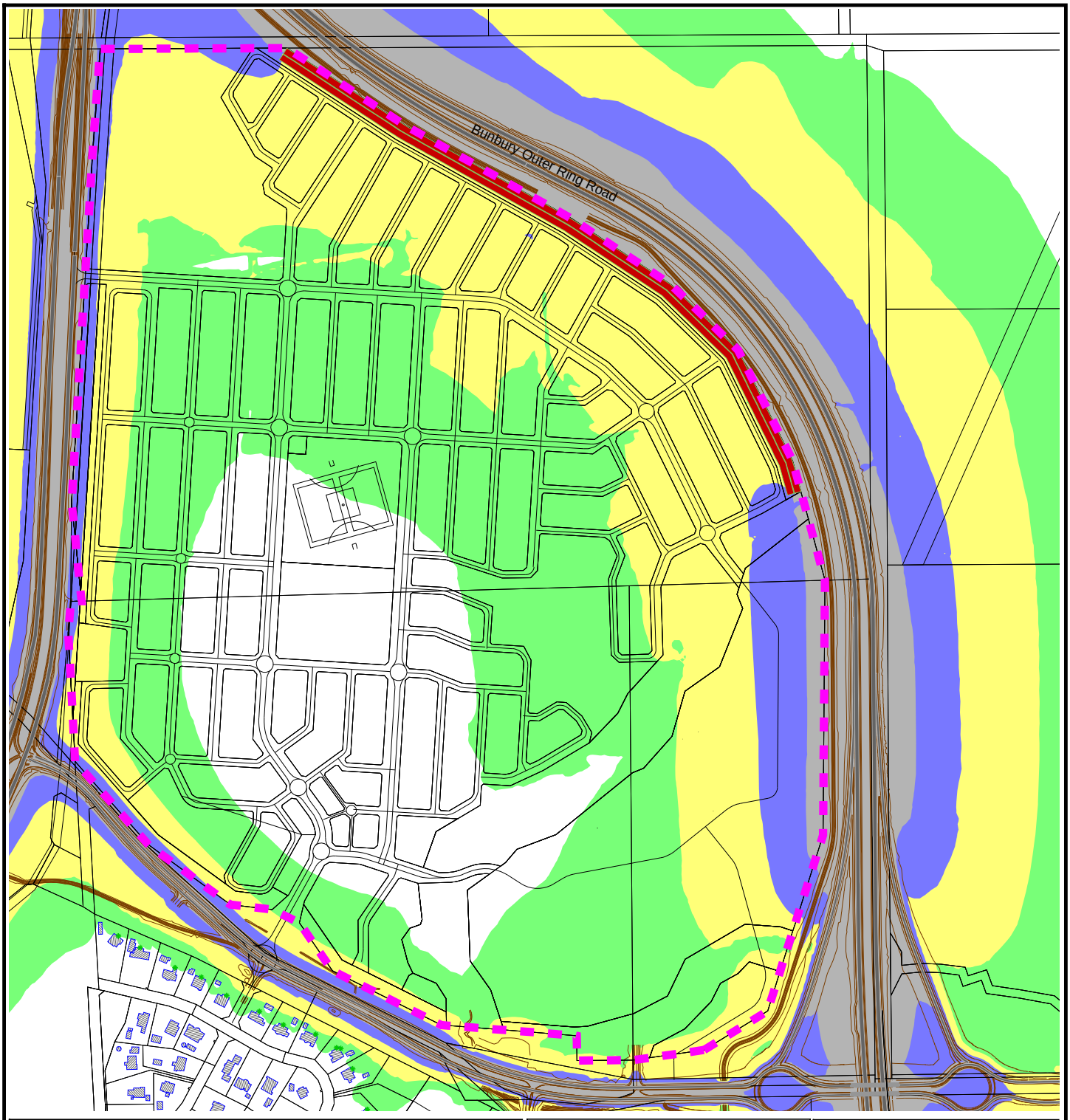
For the noise sensitive areas alongside Raymond Road:

- Raymond Road is already proposed to be dense graded asphalt and therefore it is unlikely this road surface would be changed;
- The closest noise sensitive premises will be within Exposure Level A.
- Whilst noise walls/bunds could be considered, given the Exposure A result, it is likely noise mitigation would be via Quiet House Package A to nominated lots.

For the noise sensitive areas alongside BORR:

- BORR is modelled as 14mm chip seal. It may be worth having discussions with Main Roads WA to assess if slurry seal, stone mastic or open graded asphalt (quieter road surfaces) could be used to minimise the noise impacts;
- The residential area to the north will be within Exposure C;
- Preference can be given to lots fronting BORR such that whilst the lot will be Exposure C, the architectural upgrades may be manageable with some of the front façade being garage. Where lots are side on to BORR, a 2.4-metre high wall may need to be provided to protect the OLA, or alternatively, the OLA is to be located on the side of the house opposite the road;
- Depending on the levels of the subdivision, BORR has been constructed nominally 2.0-metres higher than existing ground. This means that where noise walls/bunds are to be considered, these would be most effective alongside the road since it is elevated. Where noise walls/bunds are constructed on the road reserve, the first 2.0-metres of height will only be level with the road such that substantial walls/bunds would be required to be effective. *Figure 5-1* provides a noise contour plot as an example of the benefit of a 4-metre bund within the development. Equally, the bund could also be a bund combined with a noise wall if preferred.
- Part of the Strata Titled Village is shown to be above Exposure C, such that an improved road surface or noise bunds/walls would be required to enable noise sensitive development in this area. Alternatively, this area is left as buffer with no noise sensitive development. The approach for this area will be considered subject to final land uses interfacing with BORR.

Whilst preliminary in nature, the Study shows that noise can be managed in accordance with SPP 5.4, noting the above comments. As the project progresses, further analysis will be required to identify affected lots and finalise the noise mitigation strategy.



Treendale East Structure Plan
Future $L_{Aeq(Day)}$ Noise Level Contours
Includes 4m High Bund Along BORR

Future Traffic on Future Road
Ground Floor Level

SoundPLAN v8.1
CoRTN Algorithms

13 October 2023

Signs and symbols

- Road
- Building
- Subject Site
- Noise protection berm

N

Noise levels $L_{Aeq(Day)}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Lloyd George Acoustics
PO Box 717
HILLARYS WA 6923
(08) 9401 7770

Length Scale 1:10000

0 50 100 200 300 400 m

Figure 5-1

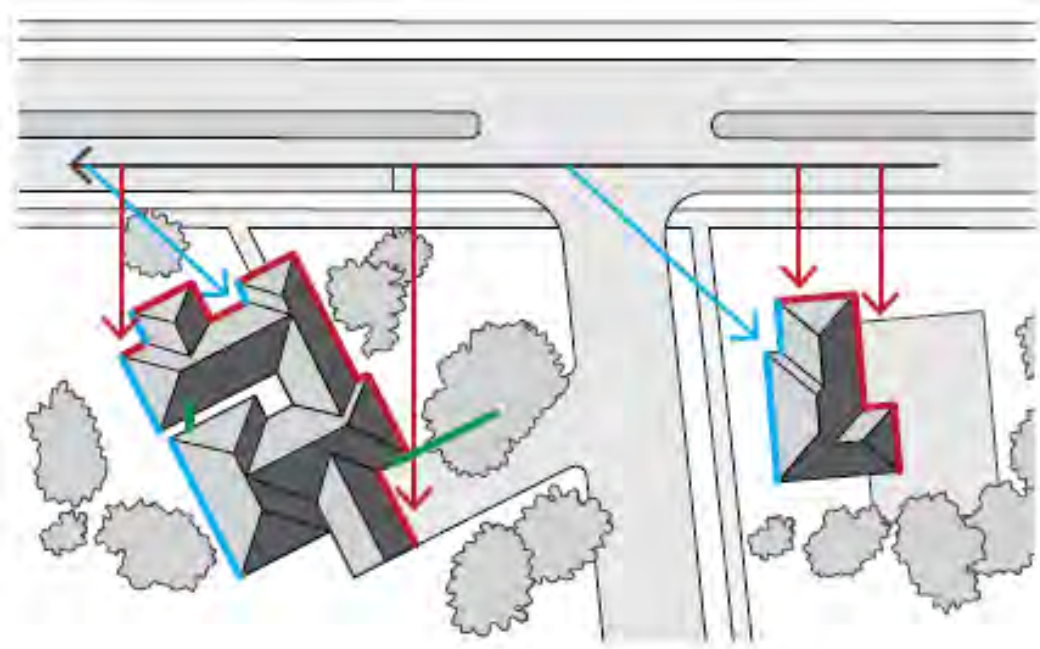
Appendix A – Quiet House Packages

The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy's noise target, implementation of quiet house requirements is an acceptable solution.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor (red): Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor (blue): Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor (green): Neither 'side on' nor 'facing', as defined above.



Quiet House Package A

56-58 dB $L_{Aeq(Day)}$ & 51-53 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$): – Sealed awning or casement windows with minimum 6mm glass.	• Up to 40% floor area ($R_w + C_{tr} \geq 25$): – Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing; • Up to 60% floor area ($R_w + C_{tr} \geq 28$); • Up to 80% floor area ($R_w + C_{tr} \geq 31$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	No specific requirements	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.	• Doors to achieve $R_w + C_{tr} \geq 25$: – 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals; – Glazed sliding door with 10mm glass and weather seals.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less.	
	Opposite	No specific requirements	
External Walls	All	• $R_w + C_{tr} \geq 45$: – Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or – Single leaf of 150mm brick masonry with 13mm cement render on each face; or – One row of 92mm studs at 600mm centres with: ▪ Resilient steel channels fixed to the outside of the studs; and ▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside; ▪ 75mm thick mineral wool insulation with a density of at least 11kg/m^3; and ▪ 2 x 16mm fire-rated plasterboard to inside.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: • Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level.	

Quiet House Package B

59-62 dB $L_{Aeq(Day)}$ & 54-57 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$); • Up to 80% floor area ($R_w + C_{tr} \geq 34$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass.	• Doors to achieve $R_w + C_{tr} \geq 28$: – 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; – Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m³). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: – Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling with R3.0+ fibrous insulation.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Quiet House Package C

63-66 dB $L_{Aeq(Day)}$ & 58-61 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 20% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 40% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Not recommended.	• Doors to achieve $R_w + C_{tr} \geq 30$: – Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass; – 40mm Solid timber core side hinged door, frame and seal system certified to R_w 32 including seals. Any glass inserts to be minimum 6mm.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 40$: – Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens; – R3.0+ insulation batts above ceiling; – 2 x 10mm plasterboard ceiling or 1 x 13mm sound-rated plasterboard affixed using steel furring channel to ceiling rafters.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Mechanical Ventilation requirements

In implementing the acceptable treatment packages, fresh air requirements of the National Construction Code must be satisfied on the basis of windows closed. Whilst not the only solution, the most common is mechanical ventilation / air-conditioning is installed with the following considerations:

- Acoustically rated openings and ductwork to provide a minimum sound reduction performance of R_w 40 dB into sensitive spaces;
- Evaporative systems require attenuated ceiling air vents to allow closed windows;
- Refrigerant based systems need to be designed to achieve National Construction Code fresh air ventilation requirements;
- Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable.

Notification

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations.

The Notification is to state as follows:

This lot is in the vicinity of a transport corridor and is affected, or may in the future be affected, by road and rail transport noise. Road and rail transport noise levels may rise or fall over time depending on the type and volume of traffic.

Appendix B – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **L_{eq}**

The L_{eq} level represents the average noise energy during a measurement period.

- **L_1**

The L_1 level represents the noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{10}**

The L_{10} level represents the noise level exceeded for 10 percent of the measurement period and is considered to represent the "intrusive" noise level.

- **L_{90}**

The L_{90} level represents the noise level exceeded for 90 percent of the measurement period and is considered to represent the "background" noise level.

- **$L_{Aeq(Day)}$**

The $L_{Aeq(Day)}$ level is the logarithmic average of the L_{Aeq} levels from 6.00am to 10.00pm.

- **$L_{Aeq(Night)}$**

The $L_{Aeq(Night)}$ level is the logarithmic average of the L_{Aeq} levels from 10.00pm to 6.00am.

- **$L_{A10,18hour}$**

The $L_{A10,18hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00am and midnight.

- **$L_{Aeq,24hour}$**

The $L_{Aeq,24hour}$ level is the logarithmic average of the L_{Aeq} levels from over an entire day.

- **Noise-sensitive land use and/or development**

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, child care premises, hospital, nursing home, corrective institution or place of worship.

- **R_w**

This is the weighted sound reduction index. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

- **C_{tr}**

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of – 4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -12 dB.

- **About the Term 'Reasonable'**

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

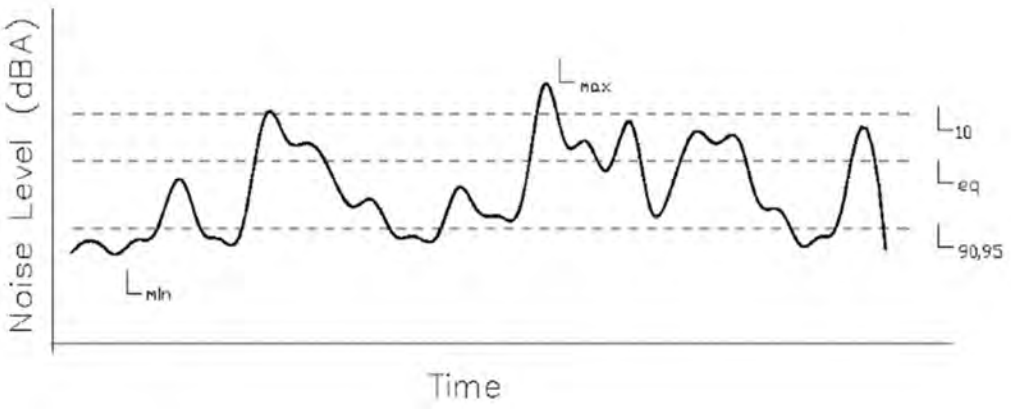
- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic amenity and visual impacts;
- Compatibility with other planning policies;
- Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
- Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
- Differences between Greenfield and infill development;
- Differences between freight routes and public transport routes and urban corridors;
- The impact on the operational capacity of freight routes;
- The benefits arising from the proposed development;
- Existing or planned strategies to mitigate the noise at source.

- **About the Term 'Practicable'**

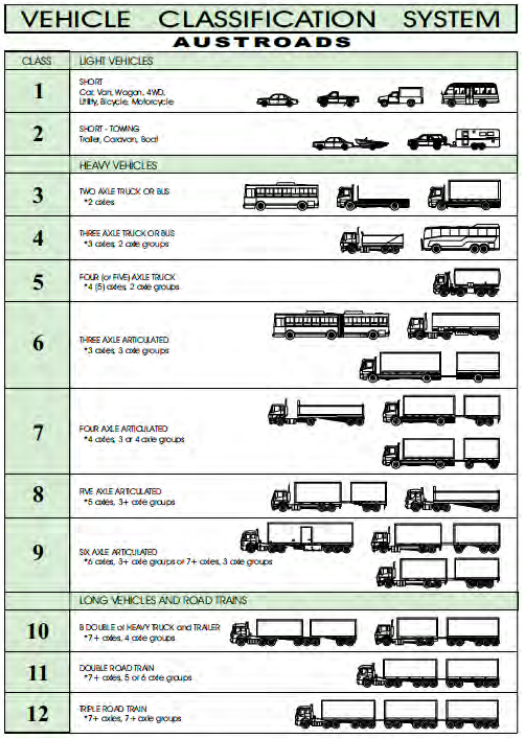
'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

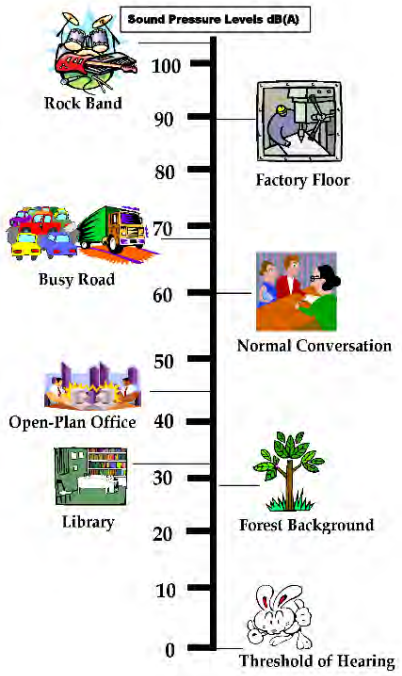
- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**



Appendix 9. Retail & Market Sustainability Assessment

REPORT

Treendale East

Retail and Market Sustainability Assessment

Prepared by:	**RPS AUSTRALIA EAST PTY LTD** Level 2, 27-31 Troode Street West Perth, WA 6005 Australia PO Box 170 West Perth WA 6872	**Prepared for:**	**TREENDALE EAST OWNERS GROUP** PO Box 559 Bunbury WA 6231
T:	+61 8 9211 1111	**T:**	+61 8 9791 5511
E:	tim.connoley@rpsgroup.com.au	**E:**	travis@taycot.com.au
		W:	www.taycot.com.au
Author:	Dermott Carr		
Reviewed:	Mark Wallace		
Approved:			
No.:	PR139TC		
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Approval for issue

Name	Signature	Date
Mark Wallace		28/05/2018

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Contents

FINDINGS AND RECOMMENDATIONS **1**
Background and Purpose **1**
Land Supply Findings **2**
Retail Need Findings **3**
Net Community Benefit **3**

1 INTRODUCTION **4**
1.1 Study Structure **4**

2 LAND SUPPLY ASSESSMENT **5**
2.1 Population Trends **5**
2.1.1 Historical Population Growth 5
2.1.2 Forecast Population Growth 6
2.2 Residential Land Supply **8**
2.2.1 Planning Framework 8
2.2.2 Land Subdivisions 10
2.2.3 Future Supply 11
2.2.4 Land Demand Modelling 12

3 RETAIL NEEDS ASSESSMENT **15**
3.1 Treendale District Centre **15**
3.1.1 Subject Site 15
3.1.2 Site Characteristics 17
3.1.3 Trade Area Definition 20
3.1.4 Catchment Profile 22
3.1.5 Retail Expenditure Profile 26
3.1.6 Catchment Floorspace Requirements 29
3.1.7 District Centre Retail Demand 31
3.2 Treendale East **32**
3.2.1 Approach and Purpose 32
3.2.2 Modelled Findings 32

4 COMMUNITY BENEFIT ASSESSMENT **33**
4.1 Approach **33**
4.1.1 Purpose 33
4.1.2 Assessment Philosophy 33
4.1.3 Impacts Methodology 34
4.1.4 Assessment Assumptions 35
4.2 Results **35**
4.2.1 Construction Impacts 35
4.2.2 Ongoing Expenditure Impacts 36

RPS

Tables

Table 1 Adopted Population Forecast, Greater Bunbury, 2016-36 2
Table 2 Average Household Sizes, Greater Bunbury 6
Table 3 Population Forecast, Greater Bunbury, 2016-26 7
Table 4 Alternative Population Forecast, Greater Bunbury, 2016-31 7
Table 5 Adopted Population Forecast, Greater Bunbury, 2016-36 7
Table 6 Residential Land Developments, Greater Bunbury 10
Table 7 Housing Typology, Greater Bunbury, 2011-16 12
Table 8 Housing Typology Comparison, 2016 12
Table 9 Detached Dwelling Projections, Greater Bunbury, 2016-36 13
Table 10 Proposed Land Uses, Treendale District Centre Structure Plan 16
Table 11 Eaton Fair Activity Centre Floorspace 19
Table 12 Population Forecasts, forecast.id 23
Table 13 Catchment Population Forecasts, Base Case, 2016-36 24
Table 14 Catchment Population Forecasts, Treendale East Scenario, 2016-36 24
Table 15 Catchment Socio-Economic Profile, 2011 25
Table 16 Catchment Retail Spending Forecasts, Base Case, 2016-36 28
Table 17 Catchment Retail Forecasts by Store Type, Base Case, 2016-36 28
Table 18 Catchment Retail Spending Forecasts, Treendale East Scenario, 2016-36 28
Table 19 Catchment Retail Forecasts by Store Type, Treendale East Scenario, 2016-36 28
Table 20 Retail Floorspace Demand, 2016-2036 30
Table 21 Retail Floorspace Demand by Type 30
Table 22 Retail Floorspace Demand, 2016-2036 30
Table 23 Retail Floorspace Demand by Type 31
Table 24 Average Market Shares Assumptions, 2016-36 31
Table 25 Floorspace Demand, Treendale District Centre, 2016-36 31
Table 26 High Level Retail Need, Treendale East 32
Table 27 Dwelling Construction Impacts, Annual Impacts 2022 to 2031 - 150 Dwellings Constructed Per Year 35
Table 28 Dwelling Construction Impacts, Annual Impacts 2032 to 2036 - 300 Dwellings Constructed Per Year 36
Table 29 Additional Retail Expenditure, Treendale East Centres ($m), 2036 36
Table 30 Additional Retail Expenditure, Treendale District Centre ($m) 36

Figures

Figure 1 Estimated Resident Population, Greater Bunbury, 2006-2016 6
Figure 2 Land Uses, Greater Bunbury Strategy 9
Figure 3 Land Ownership, Wanju District Structure Plan Area 11
Figure 4 Residential Lot Demand, Great Bunbury Norther Corridor and Treendale East Capacity. 14
Figure 5 Aerial of Treendale District Centre 15
Figure 6 Treendale District Centre Structure Plan 16
Figure 7 Map of Competitive Centres 19

Figure 8 Catchment Areas, Treendale District Centre 22
Figure 9 Retail Spending per Capita, 2016 26
Figure 10 Retail Spending per Capita by Store Type, 2016 27
Figure 11 Retail Sales Densities, 2016 29

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Findings and Recommendations

Background and Purpose

Greater Bunbury is a significant and growing region in Western Australia. It covers an area of 464,000 hectares and comprises four local government areas – Bunbury, Capel, Dardanup and Harvey. The region was home to approximately 90,000 residents in 2016 and acts as the regional city for the wider South West region[1].

In recognition of historical and forecast growth, the State Government and regional local governments are promoting the Greater Bunbury sub-region to be developed as the 'second city' of Western Australia.

To guide land use planning in line with this vision, the State Government prepared the *Greater Bunbury Strategy 2013*. This non-statutory document endeavoured to provide the land use framework for accommodating future growth within existing urban zoned land round hinterland towns and within existing development areas and identified urban expansion and investigation areas. The plan identified one 'urban expansion area' – the Wanju District Structure Plan Area – and numerous 'urban investigation areas' that it deemed appropriate to accommodate future growth.

Subsequent to this plan, the *Bunbury Geographe Growth Plan* has been published. This document guides economic and policy decision making against the backdrop of developing Greater Bunbury into a second city of 300,000 residents.

Growth targets adopted in these documents reflect the steady growth Greater Bunbury has experienced over recent decades and forecast growth. According to the latest State Government projections, Greater Bunbury's populations is expected to grow to between 108,500 and 117,000 residents within a decade[2].

Whilst medium term growth planning adopted by the State Government's *Greater Bunbury Strategy 2013* is for a population of 150,000 residents, a target of 300,000 persons adopted by the *Bunbury Geographe Growth Plan* is recognition of fast growth experienced by second cities across Australia such as Greater Geelong, Gold Coast and Sunshine Coast.

At the forefront of the growth plan however is the importance of diverse housing options and affordability to ensure the region can play a key role in de-centralising Western Australia's population and economic growth. Historically, Greater Bunbury has accommodated growth in its northern and southern corridors.

A key area that has accommodated growth to date is the northern corridor of Eaton, Millbridge, Australind and Leschenault. Unlike Perth metropolitan expansion areas (and Greater Bunbury's southern corridor), this northern corridor is well positioned between expanding employment hubs, transport infrastructure and amenity.

Importantly, the corridor is the most proximate urban area to the Kemerton Strategic Industrial Area – an employment precinct expected to be home to more than 5,000 jobs[3] - and the Waterloo and Preston industrial areas.

Industrial employment is complemented by a hierarchy of activity centres, including the Treendale District Centre which has undergone significant growth in the past eight years and has considerable opportunities for

[1] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra
[2] Planning (2015) <https://www.planning.wa.gov.au/publications/6194.aspx> [accessed November 1, 2017]
[3] LandCorp (2012) <http://www.landcorp.com.au/Documents/Projects/Industrial/Kemerton%20Industrial%20Park/Kemerton%20Public%20Consultation/Kemerton%20Strategic%20Industrial%20Area-%20Economic%20and%20Social%20Analysis.pdf> [accessed November 1, 2017]

future retail, entertainment, ancillary office, medical and light industry/service commercial employment growth.

Employment opportunities within activity centres and industrial areas are complemented by the proximity to the Bunbury CBD. Most properties in the northern corridor can access the CBD by road in less than 15 minutes.

Within this northern corridor, future urban growth is however considered limited. Major land sub-divisions are nearing completion and there are few readily-available options for affordable housing near these expanding employment precincts.

The identified urban expansion area of Wanju has developed a draft District Structure Plan however timing for this urban development is unknown and uncertain.

Given this context, the Treendale East Owners Group is seeking an understanding whether its land holdings may be a viable option to cater for future growth and/or complement the future development of Wanju and the Treendale District Centre.

RPS Group has been engaged by the Treendale East Owners Group to prepare a study that seeks to understand the economic development and commercial implications of developing the Treendale East precinct in the short/medium term. The study includes land supply and retail needs assessments in order to understand the economic development outcomes associated with the status quo versus a more immediate development of Treendale East.

Land Supply Findings

- Growth within Greater Bunbury has largely been captured within the local governments of Harvey and Capel. Both of these local government areas are home to the major growth corridors in Greater Bunbury – the northern and southern corridors respectively.
- Looking forward, for the purposes of this study, RPS Group demographers have extrapolated State Government forecasts to understand future lot demand.

Table 1 Adopted Population Forecast, Greater Bunbury, 2016-36

	RPS Group Assumption	Dwelling Estimates	Additional Dwellings (previous 5-years)
2011	84,369	34,812	-
2016	91,622	38,566	3,754
2021	103,920	43,901	5,335
2026	112,650	47,688	3,787
2031	120,628	51,149	3,461
2036	129,171	54,855	3,706

- There are seven developments marketing and several more planned that are estimated to have remaining supply equivalent to 7,696 lots.
- Within the northern corridor however, there are an estimated 1,444 lots remaining within urban zoned areas. Furthermore, numerous current developments are in their final stages and will likely be complete over the next 3-7 years.
- Future residents will therefore have a lack of available and diverse land options in Greater Bunbury (and

within each growth corridor). This can lead to poor outcomes in terms of affordability and housing choice; and ultimately undermine population attraction and economic development outcomes.

- Additionally, timing for the Wanju District Structure Plan area is unknown. Whilst it is planned to be delivered in the short term, multiple land ownership is likely to be a constraint to coordinated lot and associated infrastructure delivery.
- Based on the land supply analysis, lot supply in the northern corridor (defined by Eaton, Millbridge, Australind and Leschenault) is equivalent to less than seven years of demand. Overall, based on observed market shares, long term demand in the corridor equates to 4,372 lots over the 2016 to 2036 period. A higher market share due to its proximity to expanding employment areas would translate into higher land requirements.
- Overall, the identified 1,400 lots in the northern corridor is expected to be insufficient to cater for medium term demand and the delivery of the investigation area at Treendale East should be pursued at an earlier stage than currently planned. At 380 hectares, Treendale East could yield approximately 3,000 lots. It is our understanding that the development area is cleared rural property that could be delivered to the market within five years, dependent on planning decisions.

Retail Need Findings

- Treendale District Centre in Australind is planned to accommodate 20,000sqm of shop retail floor space along with a range of medical, commercial, fast food/tavern, community and mixed use activities.
- The catchment of Treendale District Centre is home to over 19,800 people, with the strongest growth coming from the Primary Catchment. Growth is expected to accelerate out to 2036 reach 27,500.
- The addition of Treendale East would result in the total population of the Treendale District Centre catchment increase to over 31,000 in 2036.
- The addition of Treendale East households would also see the total demand for retail floor space in the catchment increase from 62,800 to 71,250.
- Treendale East households will comfortably support a medium size Neighbourhood Centre with a full-line supermarket (totally 5,400sqm), while resulting in 3,000sqm of floor space being also required/supported at the Treendale District Centre.

Net Community Benefit

- RPS has estimated the following benefits using a industry standard Input/Output assessment model:
  - » Construction expenditure impacts for housing and associated civil works
  - » Household expenditure impacts on the potential Treendale East Local and Neighbourhood Centres; and
  - » Household expenditure impacts on the Treendale District Centre.
- Annual economic output from construction is expected to increase between 2022 and 2036 as development rates increase to 300 dwellings per year in Treendale East. At its peak, this will support 529 direct and indirect jobs per year.
- Household expenditure captured by local and neighbourhood centres in Treendale East will support 691 a year jobs by 2036 with a further 384 direct and indirect jobs supported by expenditure captred by Treendale District Centre.

1 Introduction

1.1 Study Structure

A transparent and robust objective analysis has been undertaken. This report documents the study's findings and is comprised of the following key sections.

- **Introduction** – overview of the purpose and background to the study.
- **Land Supply Assessment** – analysis of the population and development trends in the area, focussing on historical and future residential land demand.
- **Retail Needs Assessment** – analysis of future retail requirements for the Treendale District Centre and the retail within Treendale East over a 20-year horizon for several growth scenarios.
- **Community Benefit Assessment** – assessment of the net benefits of enabling the development of East Treendale in the short/medium term.

2 Land Supply Assessment

- Greater Bunbury is a fast growing second city for Western Australia, experiencing growth of approximately 24.8% over the past decade.
- Greater Bunbury's population is projected to grow 41.0% to 2036 years or 622 residential lots per annum.
- The region has only two growth corridors supporting population growth (northern and southern corridors), with lot supply in the northern corridor equivalent to less than 10 years of demand.
- Future planned supply in the northern corridor is limited, with the timing of development in the Wanju District Structure Plan area unknown and uncertain.
- Looking forward, the non-delivery of additional urban zoned land in the northern corridor will limit choice and affect affordability outcomes, mobility and the achievement of population targets.
- Treendale East has the potential to add approximately 3,000 residential lots the region, which will assist meet the medium term land needs for Greater Bunbury.

2.1 Population Trends

2.1.1 Historical Population Growth

Greater Bunbury includes the four local government areas of Bunbury, Capel, Dardanup and Harvey. The region has experienced strong growth over the past 60 years. Its population has increased from around 19,600 in 1956 to approximately 90,000 residents as of 2016[4].

[4] Bunburygeographe (2016) <http://bunburygeographe.com.au/wp-content/uploads/sites/190/2017/01/BunGeo-Part-3-BACKGROUND_Appx-2-Demographics.pdf> [accessed November 1, 2017] & ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra

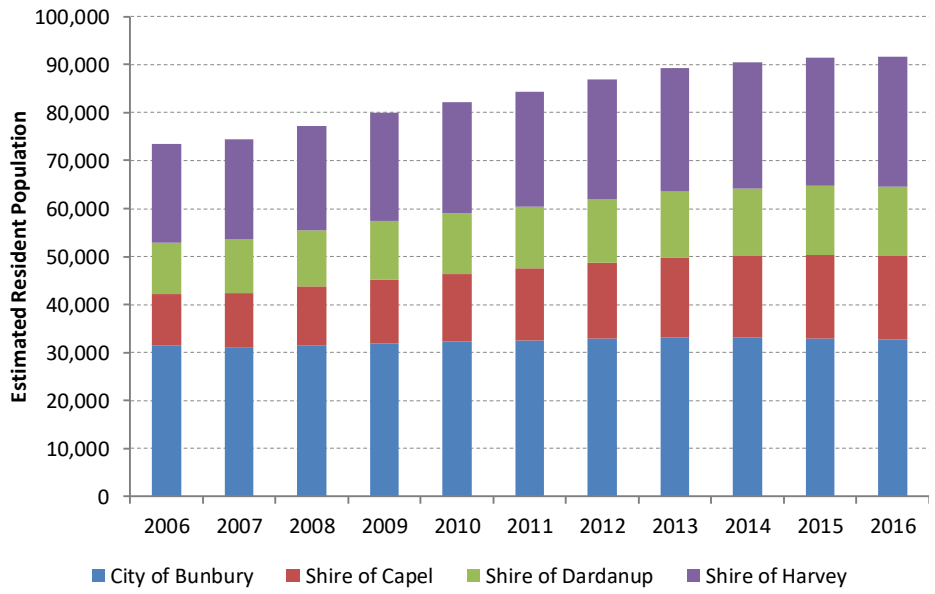


Figure 1 Estimated Resident Population, Greater Bunbury, 2006-2016[5]

Growth within Greater Bunbury has largely been captured within the local governments of Harvey and Capel. Both of these local government areas are home to the major growth corridors in Greater Bunbury – the northern and southern corridors respectively.

Infill development has also occurred within the City of Bunbury, particularly in areas near the coastline and waterfront. Many apartment developments are proposed within the Bunbury waterfront to help delivery more diverse housing products. Additionally, infill and diverse housing products are being delivered within activity centre areas within the growth corridors.

The changing housing mix is in recognition of an ageing population and smaller household sizes in Greater Bunbury. Over the past ten years, housing sizes have declined from across all local council areas.

Table 2 Average Household Sizes, Greater Bunbury[6]

Local Government Area	2006	2016
City of Bunbury	2.4	2.3
Shire of Capel	2.9	2.8
Shire of Dardanup	2.8	2.6
Shire of Harvey	2.8	2.7

2.1.2 Forecast Population Growth

Looking forward, population forecasts for short to medium term have been developed by the State Government. According to *WA Tomorrow*, the region's population is expected to increase approximately

[5] ABS (2017) <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3218.02016?OpenDocument> [accessed November 1, 2017]
[6] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra

23.0% over the decade to 2026 (based on base case scenario – Band C). This compares to a growth rate of 24.8% over the 2006 to 2016 period.

Table 3 Population Forecast, Greater Bunbury, 2016-26[7]

	Low	Base Case	High
2016		91,622	
2021	100,570	103,920	107,380
2026	108,530	112,650	116,920

Complementing these forecasts, a study was developed as part of the growth planning for Greater Bunbury in 2016. This study has developed forecasts for 2031 based on business as usual and an expansion of amenity and manufacturing based employment and attraction. These forecasts have been summarised below.

Table 4 Alternative Population Forecast, Greater Bunbury, 2016-31[8]

	Business as Usual	Median	Amenity & Manufacturing Expansion
2016		91,622	
2031	111,860	120,628	129,396

For the purposes of this study, RPS Group demographers have extrapolated these forecasts to cover the next 20 years. Associated dwelling estimates have also been developed. These dwelling estimates assumed that the proportion of unoccupied dwellings for 2016 (11.3%) will remain unchanged over the assessment period. Household sizes have also been assumed to remain constant at 2016 rates (2.6). These assumptions are considered conservative given trends towards small household sizes (as noted in Section 2.1.1.1).

Table 5 Adopted Population Forecast, Greater Bunbury, 2016-36[9]

	RPS Group Assumption	Dwelling Estimates	Additional Dwellings (previous 5-years)
2011	84,369	34,812	-
2016	91,622	38,566	3,754
2021	103,920	43,901	5,335
2026	112,650	47,688	3,787
2031	120,628	51,149	3,461

[7] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra & Planning (2015) <https://www.planning.wa.gov.au/publications/6194.aspx> [accessed November 1, 2017]
[8] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra & Bunburygeographe (2016) <http://bunburygeographe.com.au/wp-content/uploads/sites/190/2017/01/BunGeo-Part-3-BACKGROUND_Appx-2-Demographics.pdf> [accessed November 1, 2017]
[9] Population estimates for 2036 have been based on extrapolation of the growth rate of 7.1% assumed for the 2026 to 2031 period (based on growth plan and WA Tomorrow estimates). Overall, the rate of growth assumed is below historical observed rates.

	RPS Group Assumption	Dwelling Estimates	Additional Dwellings (previous 5-years)
2036	129,171	54,855	3,706

2.2 Residential Land Supply

2.2.1 Planning Framework

The *Greater Bunbury Strategy 2013* is a non-statutory document which sets the framework for land use planning. According to this document, it addresses the requirements for the growth of Greater Bunbury to 150,000 residents.

To achieve this target, the strategy was prepared to identify new growth areas for the short, medium and long-term, whilst also encouraging infill consolidation. The strategy will inform changes to the *Greater Bunbury Regional Scheme* which has been in operation since 2007. It will also inform local scheme updates.

Of relevance, the strategy identifies one 'urban expansion area' and numerous 'investigation areas.' Investigation areas are considered medium to long term development opportunities. According to the strategy, '[t]hese areas are considered to have planning merit as they provide a logical extension of existing urban areas, bound by a defining boundary.'

RPS

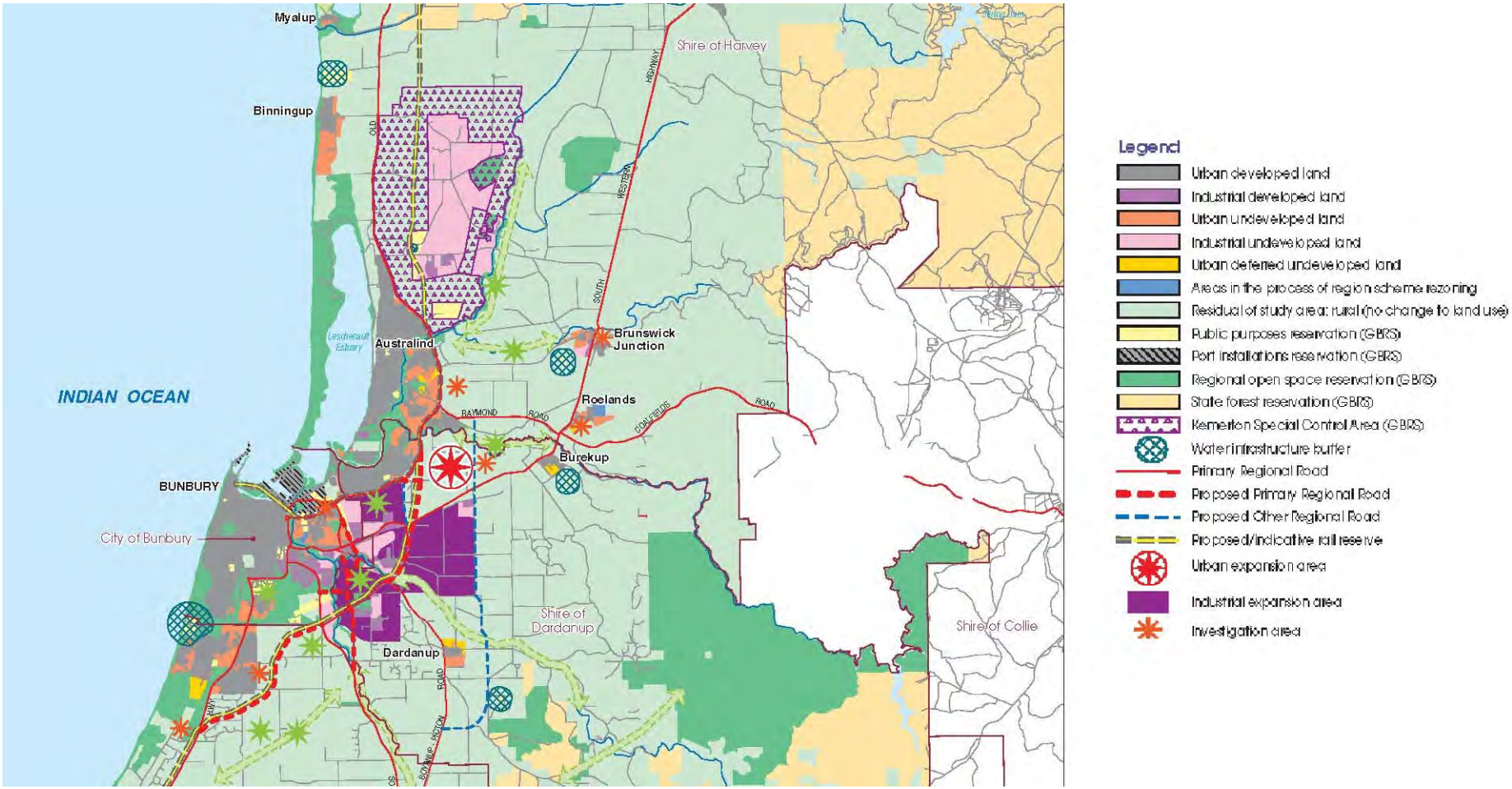


Figure 2 Land Uses, Greater Bunbury Strategy

The relevant Treendale East area is identified as an investigation area. According to the strategy, '[d]evelopment [is] to be staged so that it is not commenced before significant development has occurred within the urban expansion area east of Eaton

2.2.2 Land Subdivisions

There are a number of residential land subdivisions underway in Greater Bunbury in the northern and southern corridors. The table below summarises the main developments and estimates of lots remaining based on a combination of sales data and structure plan yield estimates. Whilst due care has been taken in developing these estimates, they may not recognise changes to development plans and lots that have been contracted for sale but not settled.

Table 6 Residential Land Developments, Greater Bunbury

Location Name	Status	Estimates Lots Remaining
Dalyellup Beach	Final stages of development are released.	50
Dalyellup East	Several stages still to be released to the market.	150
Tuart Brook	Undeveloped. Not marketing.	1,142
Kingston Estate	Rural and peri-urban lots still to be released.	134
Treendale Farm	Nearing completion.	65
East Millbridge	Late stages of development.	190
South Treendale	Early stages of development.	535
Eaton North	Undeveloped	520[10]
Roseland at Dardanup	Early stages.	472
Bunbury South & Old Bunbury Regional Hospital	Undeveloped	406[11]
Boyanup Townsite	Undeveloped.	2,985
Capel Townsite	Undeveloped.	1,050
TOTAL		**7,696**

Overall, our analysis found that there are seven developments marketing and several more planned that are estimated to have remaining supply equivalent to 7,696 lots. Within the northern corridor, there are an estimated 1,444 lots remaining within urban zoned areas.

Furthermore, numerous current developments are in their final stages and will likely be complete over the next 3-7 years. Future residents will therefore have a lack of available and diverse land options in Greater Bunbury (and within each growth corridor). This can lead to poor outcomes in terms of affordability and housing choice; and ultimately undermine population attraction and economic development outcomes.

[10] Based on 10 dwellings/gross hectare.
[11] Includes small lot and strata lot products. This estimate has been excluded from the total.

2.2.3 Future Supply

As noted in Section 2.1.2.1, major future planned supply in the northern corridor has been planned to be accommodated by the Wanju District Structure Plan area (the 'urban expansion area' defined by the regional strategy). A draft district structure plan for the 1,245 hectare area notes that the development could yield up to 20,000 lots over several decades. The area is also expected to have over 110,000 square metres (sqm) of commercial floorspace and 110,000sqm of retail floorspace across several local centres and one district activity centre located on Clifton Road. Lots in the area are expected to be varied, ranging from R30 detached houses and townhouses, through to R60 apartments and terrace houses.

There are many different private family land owners and government agency land owners, as well as a precinct which is of Aboriginal cultural and biodiversity significance in the area. The map below shows the land ownership composition of the district.



Figure 3 Land Ownership, Wanju District Structure Plan Area

Timing for the Wanju District Structure Plan area is unknown. Whilst it is planned to be delivered in the short term, multiple land ownership is likely to be a constraint to coordinated lot and associated infrastructure delivery. Following the public consultation period, it is the author's understanding that scheme amendments will need to be adopted to re-zone the area as urban.

In addition to the Wanju precinct, numerous investigation areas have been identified in Greater Bunbury. In the northern corridor, the only investigation area is Treendale East. ***At 380 hectares, Treendale East could yield approximately 3,000 lots.*** Liaison indicates that the development area is cleared rural property that could be delivered to the market within five years, dependent on planning decisions.

2.2.4 Land Demand Modelling

2.2.4.1 Greater Bunbury

To accommodate dwelling requirements for a growing population, a range of housing and lot products will be required. This section has explored the likely dwelling demand mix and associated residential land demand over the 20-year assessment period.

As of 2016, 86.8% of households lived in a detached dwelling in Greater Bunbury[12]. The housing preferences and mix is however changing. Looking at the change in housing mix over the 2011 to 2016 period, 78.7% of the net additional dwellings were detached houses[13].

Table 7 Housing Typology, Greater Bunbury, 2011-16[14]

	Detached Dwellings	Non-Detached Dwellings	Total Dwellings
2011	30,507	4,305	34,812
2016	33,464	5,070	38,566
Net Additional Dwellings	2,957	797	3,716
Proportion of Net Additional Dwellings	78.7%	21.3%	100%

In comparison to other cities of comparable size, housing mix in Greater Bunbury is comparable to Greater Rockhampton (a moderately smaller area) and Greater Geelong (a region of nearly 250,000 residents).

Table 8 Housing Typology Comparison, 2016[15]

	Resident Population	Proportion Detached Dwellings
Greater Rockhampton (QLD)	76,985	87.3%
Greater Mackay (QLD)	78,685	80.9%
Greater Bunbury	**91,622**	**86.8%**
Greater Townsville (QLD)	173,815	80.3%
Greater Geelong (VIC)	247,459	85.5%

[12] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra
[13] Ibid.
[14] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra
[15] Ibid.

Based on the above comparison, this study has assumed that the dwelling mix will continue to diversify (that is, the proportion of detached will decline over time). As such, demand for detached housing will decline proportionally over the assessment period. The following table details the implications for demand by housing type.

Table 9 Detached Dwelling Projections, Greater Bunbury, 2016-36

	Additional Dwellings Required	Proportion Detached	Additional Detached Dwellings Required
2016-21	5,335	79.0%	4,214
2021-26	3,787	77.0%	2,916
2026-31	3,461	75.0%	2,896
2031-36	3,706	73.0%	2,705
2016-36	**16,337**	**76.3%**	**12,432**

Converting the above projections into land requirements is a complex and uncertain task given changing lot sizes, public open space requirements and infrastructure requirements, amongst others. This study has instead projected residential lot requirements for detached dwellings. Based on a 1:1 ratio, Greater Bunbury will require 622 additional lots per annum on average over the 20-year assessment period to achieve population levels (based on the aforementioned assumptions).

It is important to note that this assessment excludes lot requirements for non-detached housing. Non-detached housing (e.g. townhouses, terrace homes and apartments) are likely to be delivered in both existing and new suburbs. Additionally, the redevelopment of detached housing lots into other housing products will require a net additional detached dwelling to be developed elsewhere. This aspect has not been calculated and thus the lot requirements should be considered as minimum requirements.

2.2.4.2 Northern Corridor

Based on the land supply analysis, lot supply in the northern corridor (defined by Eaton, Millbridge, Australind and Leschenault) is equivalent to less than seven years of demand based on historical demand of 208 lots per annum (based on historical lot settlement data)[16]. Historically, the northern corridor has attracted approximately 35.2% of residential lot demand across Greater Bunbury[17].

Going forward, the Northern Corridor may see its role in the Greater Bunbury residential land supply increase. Firstly, the proximity of the Northern Corridor to expanding employment areas will likely translate into higher residential land requirements as workers seek to locate conveniently close to work. Additionally, the role of other Corridors is expected to diminish over time. The Southern Corridor for example has a limited supply of urban zoned land to accommodate future growth.

To ensure the results are conservative, RPS has applied the Northern Corridor's current 35.2% of share to Greater Bunbury future residential lot requirements. This equates to long term needs equivalent to 219 lots per annum – 4,372 lots over the 2016 to 2036 period (based on estimates detailed in Section 2.2.4.1).

With the proposed Treendale East area possessing capacity to accommodate only 3,000 of these lots, RPS estimates that there will continue to be a shortfall in residential land supply in the Northern Corridor in the long-term, to be accommodate by the Wanju Structure Plan Area.

[16] Historical lot sales between 1 January 2011 and 1 January 2017 (source: RPData).
[17] As per Section 2.1.2, Greater Bunbury experienced growth in detached housing equivalent to 2,957 dwellings (591 per annum).

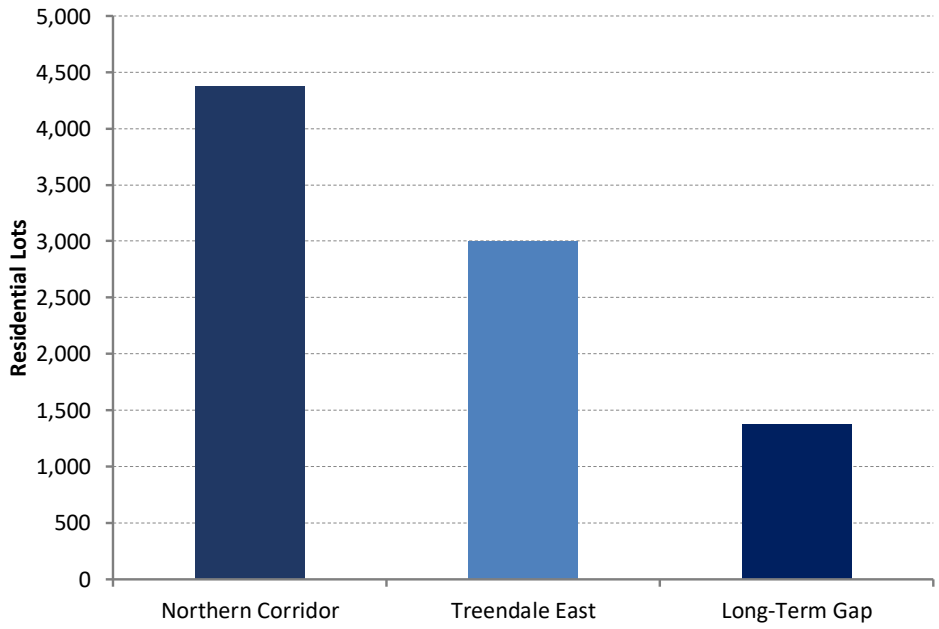


Figure 4 Residential Lot Demand, Great Bunbury Norther Corridor and Treendale East Capacity.

3 Retail Needs Assessment

- Treendale District Centre in Australind is planned to accommodate 20,000sqm of shop retail floor space along with a range of medical, commercial, fast food/tavern, community and mixed use activities.
- The catchment of Treendale District Centre is home to over 19,800 people, with the strongest growth coming from the Primary Catchment. Growth is expected to accelerate out to 2036 reach 27,500.
- The addition of Treendale East would result in the total population of the Treendale District Centre catchment increase to over 31,000 in 2036.
- The addition of Treendale East households would also see the total demand for floor space in the catchment increase from 62,800 to 71,250.
- Treendale East households will comfortably support a medium size Neighbourhood Centre with a full-line supermarket (totally 5,400sqm), while resulting in 3,000sqm of floor space being also required/supported at the Treendale District Centre.

3.1 Treendale District Centre

3.1.1 Subject Site

3.1.1.1 Location

Treendale District Centre is a growing activity centre in central Australind. The district centre forms part of the Treendale land estate. Australind is a suburb in Greater Bunbury's northern growth corridor.



Figure 5 Aerial of Treendale District Centre

Further to the east of the district centre (east of Ditchingham Place) is a significant light industrial area that has been established for over a decade. Relevant land uses in this area are auto mechanics, panel beaters and landscaping suppliers.

3.1.1.2 Land Uses

Developed in 2008, the Treendale District Centre Structure Plan guides land use and built form outcomes in the district centre. The centre has been planned as a mixed-use employment precinct, home to shop and bulky goods retail, office medical, mixed use and medium density/small lot product residential.



Figure 6 Treendale District Centre Structure Plan

The district centre structure plan indicatively assumed that the centre would accommodate 20,000sqm of shop retail floorspace (NLA) at build-out, in addition to medical, fast food, showroom, office and mixed-use employment areas. Based on the mix of uses proposed, the district centre would accommodate at least approximately 1,060 jobs.

Table 10 Proposed Land Uses, Treendale District Centre Structure Plan

Land Use	Floorspace (NLA)	Employment Estimate
Shop Retail	20,000	660
Office Medical	2,800	110
Mixed Use	10,000	200
Fast Food	750	30
Restaurant/Tavern	1,500	30

Land Use	Floorspace (NLA)	Employment Estimate
Community	1,500	30
Showroom Nursery	Not Estimated	-
Office	Not Estimated	-

Fast forward to today and the centre has developed into a retail hub. Constructed in 2011, the Treendale Shopping Centre is home to a Woolworths supermarket, a number of specialty stores and food vendors and discount retailers such as Best & Less and The Reject Shop.

To the east of the centre, there is a newly developed Bunnings hardware store, a number of fast food restaurants, and a substantial portion of land that is currently being developed as a light commercial and bulky goods area, with a petrol station, Tyrepower and Whitey's Tackle & Camping opening in the area.

There was approximately 11 hectares of vacant and unsold land available within the district centre, as of November 2017. Many of these land uses are planned for shop retail, mixed use, office and medium density residential. The delivery of such uses is dependent on future growth within the wider catchment.

3.1.2 Site Characteristics

3.1.2.1 Access

Access is an important determinant of the potential trade area of a retail centre. A well-located site is generally able to attract a greater share of passing traffic, with poor location decisions difficult and expensive to overcome.

RPS has undertaken an overview of the local transport context for the site. The key findings are summarised below.

- **Ditchingham Place**: Ditchingham Place is one of the key access roads connecting Paris Road to the Australind Bypass Road. The road is also key to accessing the centre for residents living in the western portion of Australind, as it is connected to Paris Road. Ditchingham Place experiences approximately 1,370 vehicles per day, peaking at 123 vehicles an hour on a weekday[18].
- **The Boulevard**: The Boulevard is a main connecting road through the Treendale area. Residents use this road to travel to the western portion of Australind and it is a key access road for the district centre as it runs alongside the centre. There are multiple access points to the centre from The Boulevard, and accessibility is quite high, with multiple roundabouts on constellation drive allowing for safe access to the centre. The Boulevard sees approximately 6,124 vehicles per day, peaking at 577 per hour on a weekday[19].
- **Public Transport Provision**: Along The Boulevard there are multiple bus stops, with the 841 bus route offering transport from the district centre to the Bunbury CBD.
- **Physical Barriers**: There are two barriers that may prevent patronage of the centre. Residents that live west of the stream that separates west and east Australind would need to travel to Paris Road, drive across the bridge, and then using grand entrance to travel to the centre. This lack of access may reduce the likelihood that these residents will travel to the centre. Residents in western Australind have access to the minor district centre Australind Village. The second barrier is the Collie River to the south, which similarly requires residents to the south to travel to Forrest Highway to cross the river, though a bridge is

[18] MRWA (2017) <https://www.mainroads.wa.gov.au/OurRoads/Facts/TrafficData/Pages/default.aspx> [accessed November 1, 2017]
[19] Ibid.

under construction that will link Eaton Drive to The Boulevard and provide a more efficient route of travel to the centre.

It is important to note that travel time is a more important consideration than physical distance when considering the extent of the catchment area. From a travel time perspective, the subject site has few retail options within the sub-five minute range which is supports its role as a convenience centre for Treendale residents. There are however numerous district centres within a ten-minute drive. Nearby centre travel times include[20]:

- Australind Village District Centre (3.7km – 6 minutes by car);
- Spudshed, Australind (3.3km – 5 minutes);
- Eaton Fair District Centre (7.7km – 8 minutes); and
- Bunbury Forum Shopping Centre (12.4km – 12 minutes).

Overall, the subject site is characterised as being relatively accessible to current and future residents within the suburbs of Australind, though there may be some accessibility issues for residents to the south of the region.

3.1.2.2 Urban Development Context

The centre is located in the fast-growing suburb of Australind. The area has experienced a significant level of development and population growth over the past decade, with the resident population growing from 8,717 residents in 2006 to 14,539 residents in 2016 (an average annual increase of 6.6%)[21]. This population has been supported by 2,384 new dwellings built during this period[22].

As noted in Section 2.2.2, the major development area of Treendale is near build-out but short-term growth will be supported within the southern adjacent development area (Treendale South).

In the broader corridor, there are an estimated 2,024 lots remaining at identified urban developments. This supply would support an additional 5,500 residents.

Looking further ahead, the Treendale East 'investigation area' is the only potential urban development in the catchment of the district centre.

3.1.2.3 Retail Competition

Historically, Greater Bunbury has had above average retail supply given its role as a regional centre for hinterland towns and coastal towns further south and east. There are currently six significant retail centres that have at least one major supermarket in the Bunbury area. In addition to this, there is a stand-alone Spudshed supermarket in the Australind region.

The immediate retail competition for the Treendale District Centre includes The Village and Eaton Fair. Both centres are defined as district centres[23].

[20] Informed by Google Maps transport time model
[21] ABS (2017) Census of Population and Housing, 2016, Australian Bureau of Statistics, Canberra
[22] Ibid.
[23] Planning (2014) <https://www.planning.wa.gov.au/publications/6297.aspx> [accessed November 1, 2017]

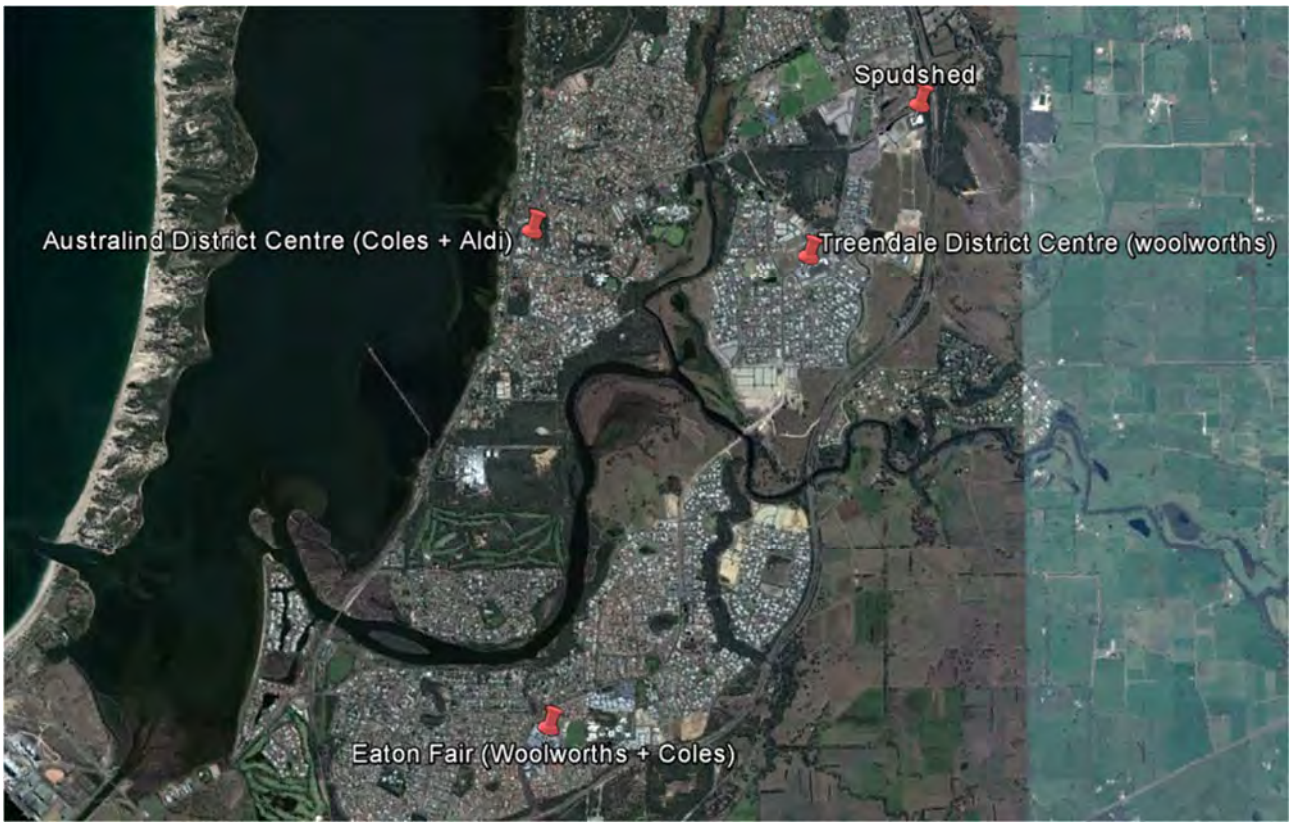


Figure 7 Map of Competitive Centres

Eaton Fair is located within the suburb of Eaton. The centre underwent a significant expansion which tripled the size of the centre in 2014. The centre is home to two full-line supermarkets, a 24/7 Kmart and 75 specialty stores. The centre is co-located with a range of community and recreation facilities which broaden its appeal and patronage.

According to the Eaton Fair Activity Centre Plan, the catchment for the centre extends northwards past Harvey, eastward to Collie and southward past Donnybrook and Capel. The centre includes approximately 15,100sqm of shop retail uses and food and beverage and bulky goods showroom uses equivalent to 2,300sqm. The table below summarises the floorspace existing and proposed within the activity centre.

Table 11 Eaton Fair Activity Centre Floorspace[24]

Land Use	Existing	Proposed
Shop/Retail	15,100sqm	15,100sqm
Food/Beverage	1,825sqm	2,400sqm
Office	0sqm	4,000sqm
Tavern	350sqm	350sqm

[24] Planning (2017) <https://www.planning.wa.gov.au/StructurePlans/DATA/Dardanup%20Shire/Eaton%20Fair%20Activity%20Centre%20Plan%20WAPC%20ref%20SPN2019.pdf> [accessed November 1, 2017]

Land Use	Existing	Proposed
Bulky Goods	450sqm	2,000sqm
Cinema	0sqm	2,000sqm

The Village is a centre located in Australind. The centre includes a central component home to a Coles supermarket and specialty stores and a stand-alone Aldi supermarket. The centre opened in 1982 but has undergone a number of expansions. Most recently, the Aldi replaced a retail showroom. The shopping centre has an estimated retail floorspace of 6,185sqm (GLA)[25]. The Aldi comprises an additional 1,500sqm (GLA)[26].

3.1.3 Trade Area Definition

This section defines a catchment based on current retail provision at the subject site and examines the future socio-economic and retail expenditure characteristics of the trade area.

3.1.3.1 What is a Trade Area?

A current or proposed centre will have a trade area which shows where the centre will draw most of its trade. Whilst trade areas can be drawn for a variety of land uses, the main purpose for trade area analysis is to derive the retail floorspace potential for a specific site. Trade area analysis can also be used to understand the likely impact of a development or expansion on surrounding competitive retail floorspace both inside and surrounding the trade area.

Trade areas are usually divided into primary and secondary catchments:

- **Primary catchment**: Depending on the scale of the centre, the primary catchment will typically draw between 50% and 75% of the total trade for the centre. Market shares of resident retail spending levels within this area are higher than in the secondary catchment as residents will typically frequent centres that are closer to their home base. The primary catchment is the most important area to consider in terms of the demographics, future sales growth and marketing strategies for the subject centre. The spatial distance of primary catchments differ based on a range of factors including centre size and location.
- **Secondary catchments**: Between 10% and 25% of the centre's trade will typically be drawn from a secondary catchment. This area will generally have a higher degree of competitive choice for the resident population and there are also a higher degree of factors which lead to these residents making the choice of which centre to frequent. The secondary catchments will generally not reach beyond 10km of the subject site, but they may extend further in lower density areas and where there are less competitive centres.

Centres may also receive trade from tertiary 'beyond' trade. This can include trade from other areas outside the catchment, including passing vehicle trade, the nearby working and tourism population and co-located uses such as sporting ovals and community facilities.

3.1.3.2 Defining the Trade Area

Trade areas can vary significantly based on a range of factors including centre size, role, competition, travel times including an understanding of future infrastructure (new roads and public transport) which may make it

[25] Property Council Shopping Directory (unpublished)
[26] Harvey (2015) <http://www.harvey.wa.gov.au/wp-content/uploads/sites/161/2015/08/12-Ordinary-Council-Meeting-Minutes-16.12.14.pdf> [accessed November 1, 2017]

easier to travel to the site, as well as physical and manmade barriers (parklands, rivers, railway lines) which may make it harder to access the site. Future residential areas should also be considered.

The trade area for the proposed floorspace at the subject site has been defined taking into account the following key considerations analysed in the previous sections:

- **Size and composition of centre** – the Treendale activity centre is an emerging district centre which currently only offers one full-line supermarket, a small number of specialty stores and food outlets, and several bulky goods retails, and as such it is primarily a convenience centre;
- **Access and travel patterns** – the centre is relatively accessible, though it is separated from the western portion of Australind and residents to the south by natural barriers, though it is near major roads such as the Australind Bypass, which may produce tertiary trade opportunities;
- **Local competition** – two significant centres, Eaton Fair in particular, are within a 10-minute drive from the centre and as such trade would be limited in these areas; and
- **Development trends** – developments nearing completion or underway will support population growth in the short term, though there are no medium-term developments in the vicinity.

3.1.3.3 Trade Area

Based on the above considerations, this study has identified five catchments. These have been illustrated in the figure over the page and described below.

- **Primary Catchment**: The primary trade catchment for the centre covers the area bounded by the Collie River to the south, the Australind Bypass to the east, the Brunswick River to the west, and the Kingston Estate to the north. There is expected to be a significant level of future growth within the primary catchment in the short-term, with the southern area currently undergoing development. The only retail provision within the catchment is within the Treendale District Centre itself.
- **(Secondary) West Catchment**: The western catchment covers the area to the west of the Brunswick River. The catchment is home to The Village which serves a convenience role and is home to a Coles supermarket. Market shares are likely relatively low given the existence of The Village and a natural barrier.
- **(Secondary) North Catchment**: The northern catchment covers the Kingston Estate development and a substantial portion of the lower density residential areas of Leschenault. There is no retail provision in the catchment and residents from the Kingston Estate are likely to travel to the Treendale centre for convenience needs. However, the residents of Leschenault may likely travel to The Village given its proximity. Overall, market shares in this catchment are likely to be relatively high.
- **(Secondary) South Catchment**: The southern catchment covers the residential area to the south of the Collie River, in the suburb of Eaton. The catchment is separated from the Treendale district centre by the Collie River and residents must travel over the bridge on Forrest Highway to access the centre. There is no retail centre in the catchment however it is in close proximity to the Eaton Fair centre which has a greater retail choice. Due to this, market shares are likely to be low.
- **(Secondary) East Catchment**: The eastern catchment is currently sparsely development. Residents in this catchment have convenient access to the Treendale centre given its location 500 metres from the Australind Bypass.

The catchment regions have been based on Australian Bureau of Statistics ‘Statistical Area Level 1’ boundaries which are the smallest areas for which statistical data required for a retail report is provided and

therefore represent the most detailed and accurate method in explaining the retail market within a small area[27].

Moreover, it is important to note that the site is expected to also generate 'tertiary trade' due to worker movements past the site. This is subsequently explored in more detail.

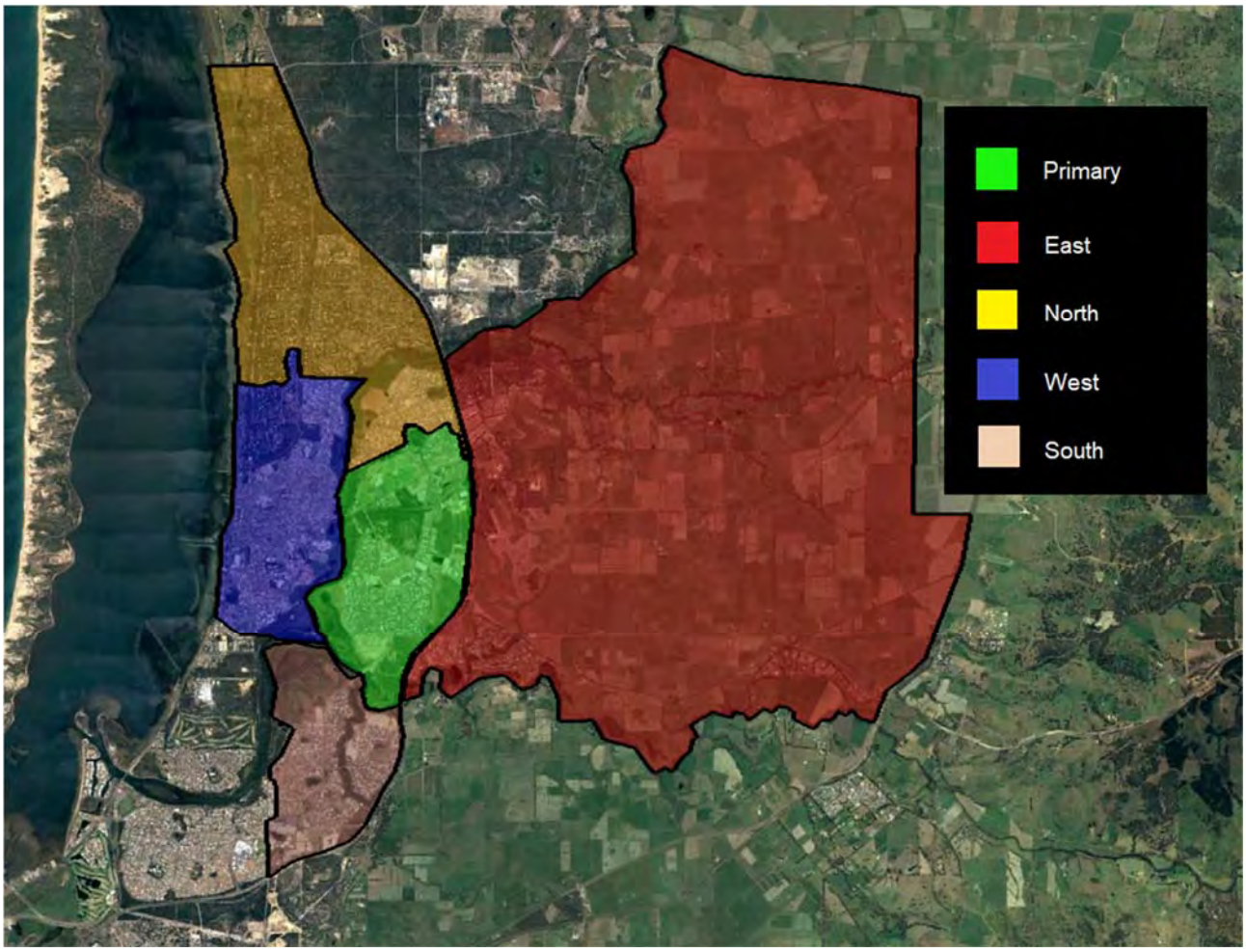


Figure 8 Catchment Areas, Treendale District Centre

3.1.4 Catchment Profile

3.1.4.1 Historical and Forecast Population

The resident population of the total trade area has increased considerably over the last 15 years, with growth equivalent to 126% between 2001 and 2016 (equivalent to an additional 11,376 persons)[28].

[27] The 'East Catchment' is comprised of a portion of two SA1 areas, with the number of residents within each area being estimated by RPS Group based on property data. The two SA1s are: 5101402 and 5101403.
[28] ABS (2017) Small Area Population Estimates (unpublished), Australian Bureau of Statistics, Canberra

The primary catchment – the main driver of expenditure at the centre – experienced a very large increase in residents, increasing from 264 residents in 2005 to 3,010 in 2016[29]. In the next 10 years, it is expected that the population will continue to expand with the completion of the Kingsto

n estate development and the development of Treendale South.

After increasing 49.9% over the past decade, growth within the secondary catchments is expected to be more subdued[30]. The secondary catchment which has seen the highest level of growth has been the South Catchment which grew by approximately 3,965 residents over the past decade[31].

Looking forward, population forecasts are not readily available for the catchment areas. The State Government has developed forecasts for the wider area however these are based on historical trends rather than land availability.

Demographers at forecast.id have developed forecasts for the Shire of Harvey for Australind and Leschenault. These forecasts are detailed below.

Table 12 Population Forecasts, forecast.id

Area	2016	2021	2026	2031	2036
Australind	14,842	16,583	18,135	19,367	19,871
Leschenault	2,992	3,082	3,165	3,220	3,277
Total	**17,834**	**19,665**	**21,300**	**22,587**	**23,148**
Growth (p.a.)	-	2.0%	1.6%	1.2%	0.5%

Within the South Catchment, future land development is limited to the north-western portion and remaining lots in the north-eastern portion. As per structure planning and yield estimates, these urban areas could provide 520 lots and 190 lots respectively. Historically, Millbridge and Eaton has had approximately 85 residential vacant land sales per annum over the 2011 to 2016 period[32]. This rate implies that population in the South Catchment would increase by approximately 220 residents per annum over the next eight to ten years.

Based on above, RPS Group has developed population estimates for the catchment areas. These estimates include the following assumptions.

- **Primary Catchment**: The primary catchment's population is forecast to grow in line with forecast.id estimates above.
- **(Secondary) West Catchment**: The western catchment does not have any identified urban land. Its population is forecast to remain stable.
- **(Secondary) North Catchment**: The northern catchment is expected to grow in line with the percentage growth rate assumed by forecast.id for Leschenault.
- **(Secondary) South Catchment**: The southern catchment is expected to experience growth of 220 residents per annum over the 2016 to 2026 period and remain stable thereafter.
- **(Secondary) East Catchment**: The eastern catchment is forecast to have stable growth under the business as usual scenario.

[29] Ibid.
[30] ABS (2017) Small Area Population Estimates (unpublished), Australian Bureau of Statistics, Canberra
[31] Ibid.
[32] RPData (unpublished)

Table 13 Catchment Population Forecasts, Base Case, 2016-36

Area	2016	2021	2026	2031	2036
Primary	3,010	4,267	5,525	6,782	8,039
East	575	575	575	575	575
North	4,301	4,430	4,550	4,629	4,711
West	6,913	6,913	6,913	6,913	6,913
South	5,094	6,194	7,294	7,294	7,294
Total Trade Area	**19,893**	**22,379**	**24,857**	**26,193**	**27,532**

In addition to above, this assessment has explored the potential impact of the development of Treendale East. This land area is assumed to deliver 3,000 lots. At 60 lots per annum, the area's population is forecast to increase by 175 residents per annum over the next two decades.

Table 14 Catchment Population Forecasts, Treendale East Scenario, 2016-36

Area	2016	2021	2026	2031	2036
Primary	3,010	4,267	5,525	6,782	8,039
East	575	575	1,450	2,325	4,075
North	4,301	4,430	4,550	4,629	4,711
West	6,913	6,913	6,913	6,913	6,913
South	5,094	6,194	7,294	7,294	7,294
Total Trade Area	**19,893**	**22,379**	**25,732**	**27,943**	**31,032**

3.1.4.2 Socio-Economic Characteristics

In order to understand retail need, it is important to understand demographic and socio-economic factors of the local area. The trade area assessment revealed that residents within the primary catchment are characterised by relatively high incomes. Additionally, residents in the primary catchment were more likely to be family households.

Broadly, the wider trade area was found to be characterised by relatively high unemployment which suggested a lack of local employment opportunities.

A summary of the socio-economic characteristics of the trade area compared to regional Western Australia and the whole of Western Australia is illustrated in the table over the page[33].

[33] ABS (2012) Census of Population and Housing, 2011, Australian Bureau of Statistics, Canberra

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Table 15 Catchment Socio-Economic Profile, 2011

	Primary Catchment	Secondary Catchment	Outback WA	WA
Med. weekly h/hold income	$2,249	$1,714	$1,253	$1,415
Med. annual h/hold income	$116,969	$89,122	$65,156	$73,580
Var. from Outback WA benchmark	79.5%	36.8%	0.0%	12.9%
Avg. household size	3.1	2.7	2.5	2.5
Avg. persons per bedroom	1.1	1.0	1.1	1.1
Housing Payments				
Med. weekly loan repayment	$546	$442	$375	$450
Med. weekly rent repayment	$363	$254	$180	$300
Loan to income ratio	24.3%	25.8%	30.0%	31.8%
Rent to income ratio	16.1%	14.8%	14.4%	21.2%
Housing status (% of households)				
Owned outright	8.8%	28.0%	31.3%	30.2%
Being purchased	65.3%	48.0%	31.3%	38.7%
Renter	25.9%	22.4%	36.4%	29.9%
Other	0.0%	1.6%	1.1%	1.1%
Age distribution (% of population)				
Aged 0-14	32.2%	23.7%	21.3%	19.7%
Aged 15-24	12.8%	12.6%	11.8%	13.7%
Aged 25-34	21.6%	12.6%	13.7%	14.5%
Aged 35-44	16.1%	14.3%	15.0%	14.7%
Aged 45-54	8.9%	14.4%	14.7%	13.9%
Aged 55-64	5.8%	10.9%	11.9%	11.4%
Aged 65+	2.5%	11.4%	11.5%	12.3%
Med. Age	**27.4**	**37.0**	**37.0**	**36.0**
Dwelling Type				
Separate house	89.1%	82.4%	69.4%	70.7%
Semi-detached and townhouse	0.0%	5.0%	4.7%	9.3%
Flat, unit, apartment	0.0%	1.2%	3.0%	7.0%
Other dwelling	0.0%	0.9%	2.3%	0.8%
Not stated	0.0%	0.0%	0.2%	0.1%
Total Occupied Private Dwellings	**89.1%**	**89.5%**	**79.5%**	**87.9%**
Unoccupied Private Dwellings	10.9%	10.5%	20.5%	12.1%
Total Private Dwellings	**789**	**5,337**	**210,163**	**903,487**
Motor Vehicles Per Dwelling				
No vehicle	1.6%	2.9%	6.1%	6.3%
1 vehicle	18.9%	25.8%	31.5%	33.5%
2 vehicles	58.5%	44.5%	38.8%	39.6%
3+ vehicles	21.0%	26.8%	23.6%	20.6%
Average vehicle number	**2.04**	**2.06**	**1.90**	**1.83**

3.1.5 Retail Expenditure Profile

3.1.5.1 Retail Expenditure Trends

RPS Group has derived retail expenditure using MarketInfo 2012 (the latest version available). MarketInfo is an independently formulated model and is used by the majority of retail economists in understanding the retail floorspace needs of an area. This model estimates an area's propensity to spend on retail goods based on a range of socio-economic characteristics.

Across regional WA, each person generally spends around $14,060 on retail goods per annum. This analysis suggests that retail spending in the trade area is approximately $13,660 per capita per annum, which is in line with the average for outback WA, but lower than the state average (2.8% below the WA average).

Although household incomes in the primary catchment were found to be high, the average per capita retail spending is likely a reflection of households in the primary catchment being larger than average households with more children age residents. For instance, the application of below to household sizes would imply that households in the primary catchment have annual retail expenditure 25% above regional WA averages.

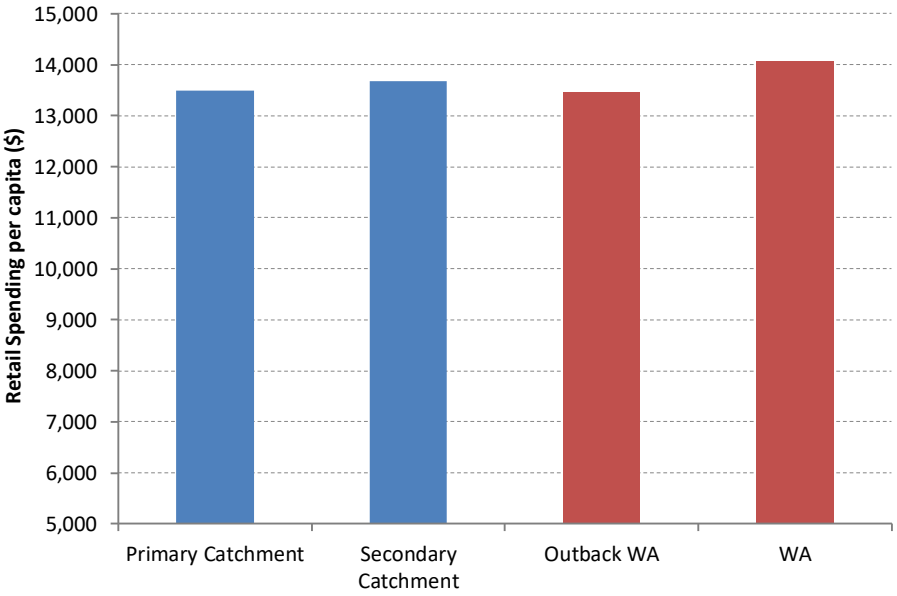


Figure 9 Retail Spending per Capita, 2016

The above per capita retail spending has been broken down further into the levels of spending at retail centres by major store type. Due to a range of demographic and socio-economic factors, supermarket spending per capita was found to be higher for the secondary catchments and specialty retail spending was found to be higher for primary catchment residents.

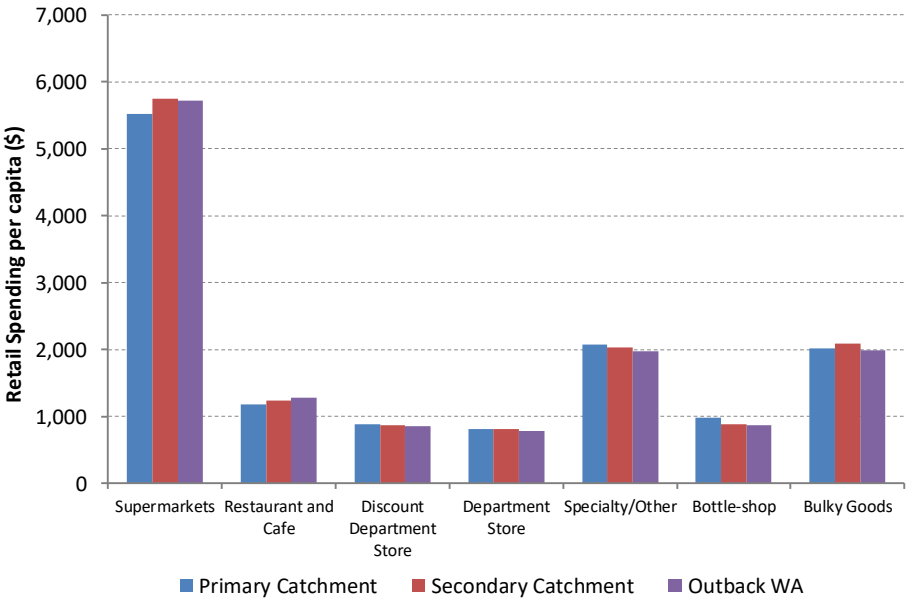


Figure 10 Retail Spending per Capita by Store Type, 2016

3.1.5.2 Forecast Considerations

It is important to note that the retail market is not immune to structural changes that are occurring in the economy and society. The retail sector in Australia is being tested by numerous factors, including, but not limited to:

- **Changing consumers** – consumers are altering their trading patterns, with higher levels of spending devoted to experiential items such as sporting events, concerts, restaurants and cafes;
- **Online trading** – online trading is increasing much faster than traditional 'bricks and mortar' stores, though there is still a strong preference to frequent stores as online retail expenditure accounts for only 6.5% of retail expenditure (additionally, retail outlets are devoting more resources to accommodating both online and in-store customers); and
- **Regulatory changes** – WA is playing catch up to more mature retail markets, with trading law changes activating centres for longer hours.

In order to consider the changing patterns in the retail sector, RPS Group has applied current growth rates by expenditure category and population projections to arrive at the total spending profile of the catchment residents. The growth in expenditure categories is based on growth rates derived from Deloitte Access Economics forecasts[34]. These forecasts are considered conservative, with per capita growth rates well below observed levels over the past five years across Australia (equivalent to 1.3% per annum versus historical growth of 2.4% per annum between March 2011 and March 2016[35]).

[34] Deloitte (2014) Retail Forecasts, 2014, Deloitte Access Economics, Melbourne
[35] ABS (2016) Retail Trade, Australia, May 2016, Australian Bureau of Statistics, Canberra

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3.1.5.3 Retail Expenditure Projections

3.1.5.3.1 Base Case

Over the next 20 years, retail spending for trade area residents is expected to increase by an average of 4.0% per annum (equivalent to an average of $10.8 million per annum) to approximately $487.4 million by 2036, with growth within the primary catchment equivalent to 4.0% per annum during this period. This reflects a combination of population-based and real expenditure per capita growth.

Table 16 Catchment Retail Spending Forecasts, Base Case, 2016-36

Catchment	2016	2021	2026	2031	2036
Primary	40.6m	61.4m	85.0m	111.6m	141.4m
Secondary	230.5m	263.7m	300.3m	322.3m	346.1m
Total Trade Area	**271.1m**	**325.2m**	**385.4m**	**433.9m**	**487.4m**

Expenditure for uses aligned with the district centre have been summarised within the table below.

Table 17 Catchment Retail Forecasts by Store Type, Base Case, 2016-36

Catchment	2016	2021	2026	2031	2036
Supermarkets	113.6m	137.2m	163.8m	185.7m	210.0m
Restaurant/Café	24.5m	29.7m	35.6m	40.5m	46.0m
Specialty Retail	40.6m	48.2m	56.5m	63.0m	70.0m
Bulky Goods	41.3m	49.0m	57.5m	64.2m	71.4m

3.1.5.3.2 Treendale East Scenario

Over the next 20 years, retail spending for trade area residents is expected to increase by an average of 5.2% per annum (equivalent to an average of $14.1 million per annum) to approximately $552.7 million by 2036, with growth within the primary catchment equivalent to 12.4% per annum during this period. This reflects a combination of population-based and real expenditure per capita growth.

Table 18 Catchment Retail Spending Forecasts, Treendale East Scenario, 2016-36

Catchment	2016	2021	2026	2031	2036
Primary	40.6m	61.5m	85.0m	111.6m	141.4m
Secondary	230.5m	263.7m	314.6m	352.9m	411.3m
Total Trade Area	**271.1m**	**325.2m**	**400.0m**	**464.4m**	**552.7m**

Expenditure for uses aligned with the district centre have been summarised within the table below.

Table 19 Catchment Retail Forecasts by Store Type, Treendale East Scenario, 2016-36

Catchment	2016	2021	2026	2031	2036
Supermarkets	113.6m	137.2m	169.7m	198.5m	237.7m

Catchment	2016	2021	2026	2031	2036
Restaurant/Café	24.5m	29.7m	40.0m	43.6m	52.8m
Specialty Retail	40.6m	48.2m	58.6m	67.3m	79.1m
Bulky Goods	41.3m	49.0m	59.7m	68.7m	90.0m

3.1.6 Catchment Floorspace Requirements

3.1.6.1 Approach

RPS has applied sales densities to each retail category to estimate how the retail spending of residents in the catchment translates into demand for retail floorspace need. Sales densities are the dollar sales per square metre of Gross Floor Area (GFA) required to sustainably operate that floorspace in the catchment. For example, an average supermarket would need $8,000 of sales per square metre per annum to continue to operate that space at a commercially viable level as of 2016. This is a broad average, with some supermarkets in inner metropolitan markets requiring $8,500 of sales per square metre per annum to operate viably and region areas requiring lower spending of approximately $7,500 per square metre.

Industry standard sales densities by retail category for the subject site are outlined in the figure below. These sales densities have been assumed to increase 0.5% per annum over the assessment period.

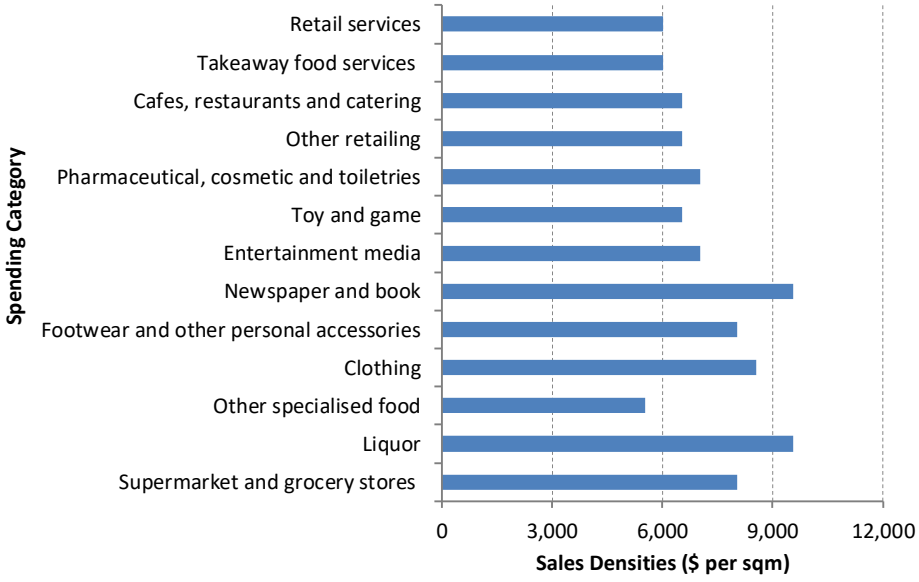


Figure 11 Retail Sales Densities, 2016

3.1.6.2 Catchment Floorspace Need

3.1.6.2.1 Base Case

The following table illustrates the projected growth in supportable retail floorspace across the trade area.

Table 20 Retail Floorspace Demand, 2016-2036

Square Metres	2016	2026	2036
Primary Catchment	5,787	11,520	18,197
Secondary Catchments	32,942	40,789	44,665
Total Trade Area	**38,728**	**52,310**	**62,861**

Whilst the aforementioned analysis illustrates the considerable growth potential across all retail categories in the trade area over the coming decade, this report is largely concerned with uses that align with the district centre.

The table below represents the total amount of relevant retail floorspace that the expenditure of the trade area residents can support. However, this demand will not be met entirely from centres within the trade area. Consumers travel across cities and regions to different retail centres for different reasons, including convenience, size and extent of offering and built form quality. Nonetheless, relevant floorspace demanded in the trade area is expected to increase by 62% over the next two decades.

Table 21 Retail Floorspace Demand by Type

	2016	2026	2036
Supermarkets	15,384	21,066	25,658
Restaurant/Café	3,827	5,298	6,528
Specialty Retail	6,090	8,109	9,600
Bulky Goods	6,297	8,339	9,825
Total (selected categories)	**31,598**	**42,812**	**51,611**

3.1.6.2.2 Treendale East Scenario

The following table illustrates the projected growth in supportable retail floorspace across the trade area.

Table 22 Retail Floorspace Demand, 2016-2036

Square Metres	2016	2026	2036
Primary Catchment	5,787	11,520	18,197
Secondary Catchments	32,943	42,724	53,068
Total Trade Area	**38,729**	**54,244**	**71,265**

As per above, estimates by relevant floorspace types have been detailed below. Overall, relevant floorspace demanded in the trade area is expected to increase 84% over the next two decades (compared to 62% for the base case) – representing an additional 8,400sqm of floorspace demand due to development of Treendale East earlier than otherwise planned.

Table 23 Retail Floorspace Demand by Type

	2016	2026	2036
Supermarkets	15,384	21,830	29,028
Restaurant/Café	3,827	5,509	7,471
Specialty Retail	6,090	8,402	10,852
Bulky Goods	6,297	8,649	11,143
Total (selected categories)	**31,598**	**44,390**	**58,494**

3.1.7 District Centre Retail Demand

3.1.7.1 Market Shares

Previous sections of this report have highlighted the potential need for retail provision in the trade area if certain conditions are met. This section highlights the market shares that the Treendale District Centre is expected to receive over the forecast period, given its location geographically and in context of other centres, and how sustainable the future expansion of the centre would be given these market shares.

Table 24 Average Market Shares Assumptions, 2016-36

	Primary	North Catchment	East Catchment	South Catchment	West Catchment
Supermarkets	35%	20%	35%	15%	10%
Restaurant/Café	30%	15%	30%	10%	10%
Specialty Retail	30%	20%	30%	10%	5%
Bulky Goods	30%	20%	30%	10%	15%

3.1.7.2 Modelling Results

Based on the above assumptions, future floorspace demand growth over the 2016 to 2036 period has been estimated for the base case and Treendale East scenarios. Note, this assessment does not calculate current unmet demand due to recent growth.

Table 25 Floorspace Demand, Treendale District Centre, 2016-36

	Primary	North Catchment	East Catchment	South Catchment	West Catchment	Trade Area
Base Case						
Supermarkets	1,677	217	97	983	119	1,566
Restaurant/Café	390	45	31	271	33	302
Specialty Retail	550	55	89	789	31	550
Bulky Goods	483	57	87	781	41	428
Total	3,738	439	414	3,853	264	3,576

	Primary	North Catchment	East Catchment	South Catchment	West Catchment	Trade Area
Treendale East Scenario						
Supermarkets	1,677	217	1,180	983	119	4,175
Restaurant/Café	390	45	292	271	33	1,032
Specialty Retail	550	55	384	789	31	1,810
Bulky Goods	483	57	409	781	41	1,771
Total	3,738	439	2,754	3,853	264	11,047
Difference						

3.2 Treendale East

3.2.1 Approach and Purpose

This section summarises a high-level assessment of retail need within the Treendale East precinct based on a yield of 3,000 lots.

This assessment has been based on spending attributes observed for the Treendale District Centre catchment. This assessment excludes real growth in incomes and what effect real wage growth would have on retail need. In other words, the assessment explores what 3,000 lots delivered today would equate to in terms of retail need in the precinct.

3.2.2 Modelled Findings

The following table details the modelling inputs and outputs.

Table 26 High Level Retail Need, Treendale East

	Assumption/ Output	Note
Lot Yield	3,000	At 8 dwellings per hectare
Resident Population	8,700	Based on 2.9 persons per dwelling
Total Annual Retail Expenditure	$116.6 million	At $13,400 per capita per annum
Local and Neighbourhood Centre Demand in Treendale East	$40.8 million	At 35% of total retail expenditure
	5,440sqm	At $7,500 per square metre

Based on the findings, the Treendale East precinct is expected to accommodate a medium sized neighbourhood centre with a full-line supermarket. Whilst wage growth would likely support a greater level of retail provision, increased retail costs and changing shopping patterns (e.g. online shopping) would lessen the need for additional retail. Additionally, any shortfall in local retail, floor space is likely to be met through expenditure flows to the Treendale District Centre.

It is the author's view that a neighbourhood centre should be accommodated on a site of approximately 2-2.5 hectares. An activity node – for small retail provision, community uses (e.g. childcare), petrol station etc. – should also be supported as part of planning for the precinct (co-location with a school and/or POS should be considered).

4 Community Benefit Assessment

- Housing construction, including civil works, will generate approximately $83.4 million in economic output per year between 2022 and 2031. This will support 264 direct and indirect jobs.
- These impacts are expected to increase post 2031 as dwelling take up accelerates to 300 dwellings per year. This will see annual economic output and supported jobs double between 2032 and 2036.
- The additional retail expenditure generated by residential development in Treendale East will be partly captured by Neighbourhood and Local Centres in the area. This will support $98.5m in Economic Output and almost 700 jobs every year in 2036.
- Further expenditure captuired by Treendale District Centre will generate a further $54m of economic output per year in 2036, including a total of 384 direct and indirect jobs.

4.1 Approach

4.1.1 Purpose

This section assesses the economic and social benefits of developing the Treendale East precinct. Benefits identified include:

- Construction expenditure benefits from house construction and associated civil works;
- Retail expenditure captured by the potential Treendale East Neighbourhood Centre;
- Increased retail development at the Treendale District Centre; and
- Ongoing employment opportunities within Treendale East.

4.1.2 Assessment Philosophy

RPS has undertaken the following stages of analysis to inform the reader of the expected economic and social impacts of the project:

- **Defining the scope and objectives** – the first stage of an economic evaluation requires an investigation of the project and context, outlining key objectives and beneficiaries;
- **Defining the baseline scenario and counterfactual cases** – the evaluation only measures the incremental benefits and costs of the project scenario which occur over and above the 'business as usual' scenario and thus requires an examination of what could be expected to occur in the absence of the project compared to the potential incremental impacts of the project itself;
- **Identifying the various costs and benefits** – the evaluation requires an understanding of the chain of causation of the investment program in order to examine the benefits expected to flow from the program and its costs to society; and
- **Quantifying the various costs and benefits, where possible** – a fundamental component to the assessment is the utilisation of economic models, industry standards, published literature and project examples to quantify and, where possible, assign monetary values to costs and benefits.

A major challenge in undertaking an economic evaluation involves the quantification of all relevant costs and benefits. Unlike a narrower financial evaluation, cost benefit and social impact studies cover a much wider range of impacts. Quantification of some of those impacts can be difficult, especially where they relate to indirect, non-market, environmental and social impacts (such as increases in community wellbeing), where

the data required undertaking a comprehensive quantification exercise may not exist or be readily obtainable. The quantified impacts have thus been limited to those where a reasonable level of confidence in the data and the valuation techniques can be demonstrated. Where it was not feasible to robustly quantify costs, including social and intangible aspects, these have been explored in a qualitative sense.

Moreover, uncertainty regarding the benefits and costs necessarily involves a high degree of judgement in conducting an analysis of this type. A common analytical flaw is that inherent optimism bias systemically underestimates costs and overstates benefits. Therefore, where assumptions were required, RPS has adopted a more conservative approach to the analysis.

The approach undertaken has been guided by a range of principles which have been appended to this study.

4.1.3 Impacts Methodology

RPS has used an Economic Impact Assessment (EIA) based approach to estimating the impact of the project stages on the Western Australian economy. At the core of EIAs are Input–Output (IO) tables. IO tables are part of the national accounts by the ABS and provide detailed information about the supply and use of products in the Australian economy, and the structure of and inter–relationships between Australian industries[36]. IO tables are converted, through statistical analysis, into a series of economic multipliers. These multipliers represent the relationship between the direct expenditure associated with a project.

The results of an EIA are generally presented as both direct effects – that is effects from the direct expenditure of the project or event – and indirect effects (Type I) which are additional effects from further rounds of spending in the supply chain. A third or consumption effect (Type II) resulting from consumer spending generated by the additional income in the region has also been calculated. The EIA assessed:

- **Output** – the actual dollar amount spent on the project;
- **Income** – the amount of wages and salaries paid to labour;
- **Employment** – the full-time equivalent per annum employment generated by the project; and
- **Value Added** – the value added to materials and labour expended on the project.

For this Study, the following steps were undertaken in running the EIA:

a. Transaction tables were developed from IO tables for the Western Australian economy by applying employment-based location quotients for the state based on the results of the 2011 Census of Population and Housing. This has the effect of excluding spending on imports to the state since they generate no local economic activity.

b. Economic multipliers were then generated for the economy across 114 industry categories;

c. Construction expenditure associated with each stage was distributed across the 114 industry categories; and

d. Economic impacts associated with the project were calculated.

Project expenditure items have been aligned with the corresponding 2 Digit ANZSIC 2011 sectors below.

- Residential construction;
- Non-residential construction;
- Construction services; and

[36] See ABS (2016) Australian National Accounts: Input-Output Tables, 20012-13, Cat No. 5209.0.55.001, Australian Bureau of Statistics, Canberra

- Professional, scientific and technical services.

RPS has undertaken several steps and made appropriate adjustments to the EIA methodology to address concerns raised about biasness of estimates based on IO-tables.

a. Firstly, this study does not rely solely on the EIA and the use of economic multipliers to inform the recommendations for the project. The EIA represents one of several technical economic, industry and social assessments, allowing the results of the EIA to be appropriately contextualised.

b. Secondly, adjustments have been made to national economic multipliers to calculate the impacts on the Western Australian economy only through the development of a regional transaction table.

c. Thirdly, RPS has reviewed results against published multipliers from case studies.

RPS regards the use of economic multipliers as appropriate and measured and the results of the assessment as conservative, defensible and suitable for informing decision making.

4.1.4 Assessment Assumptions

A range of assumptions have been made in the development of the benefits assessment results below:

- Commencement of residential lot construction in 2021 for first house construction in 2022.
- Delivery of 150 dwellings per year to 2031 then 300 dwellings per year to 2036.
- Raw civil works cost of $45,000 per residential lot.
- House construction cost of $180,000 per detached dwelling.

4.2 Results

4.2.1 Construction Impacts

Between 2022 and 2031, housing construction will yield an average annual impact of $83.4m of economic output and support 264 jobs per year.

Table 27 Dwelling Construction Impacts, Annual Impacts 2022 to 2031 - 150 Dwellings Constructed Per Year

Impacts	Output ($M)	GVA ($M)	Income ($M)	Employment (FTE)
Direct Impact	$33.0	$9.5	$5.0	67
Indirect Impact (Type I)	$28.4	$11.5	$6.5	94
Sub-Total	*$61.4*	*$21.0*	*$11.5*	*161*
Indirect Impact (Type II)	$22.1	$12.5	$5.4	103
Total Impact	**$83.4**	**$33.5**	**$16.9**	**264**

These annual impacts are expected to increased post 2031 as assumed dwelling construction rates double to 2036. As a result of the annual impacts will also double to $166.8m of economic output and 529 jobs.

Table 28 Dwelling Construction Impacts, Annual Impacts 2032 to 2036 - 300 Dwellings Constructed Per Year

Impacts	Output ($M)	GVA ($M)	Income ($M)	Employment (FTE)
Direct Impact	$66.0	$18.9	$10.0	134
Indirect Impact (Type I)	$56.7	$23.1	$12.9	188
Sub-Total	$122.7	$42.0	$22.9	322
Indirect Impact (Type II)	$44.1	$25.0	$10.8	207
Total Impact	**$166.8**	**$67.0**	**$33.7**	**529**

4.2.2 Ongoing Expenditure Impacts

In addition to construction impact, the development of Treendale East will generate additional retail expenditure in the wider catchment. Approximately $98.5m of economic output from this expenditure will be captured by the potential Neighbourhood and Local Centres in Treendale East by 2036, supporting a total of 691 direct and indirect jobs.

Table 29 Additional Retail Expenditure, Treendale East Centres ($m), 2036

Impacts	Output ($M)	GVA ($M)	Income ($M)	Employment (FTE)
Direct Impact	$40.5	$23.9	$15.5	434
Indirect Impact (Type I)	$18.9	$9.3	$4.8	75
Sub-Total	$59.4	$33.1	$20.3	508
Indirect Impact (Type II)	$39.0	$22.1	$9.5	183
Total Impact	**$98.5**	**$55.2**	**$29.8**	**691**

A further $54.7m of economic output will be captured by the Treendale District Centre per year in 2036. This will support an additional 384 jobs.

Table 30 Additional Retail Expenditure, Treendale District Centre ($m)

Impacts	Output ($M)	GVA ($M)	Income ($M)	Employment (FTE)
Direct Impact	$22.5	$13.3	$8.6	241
Indirect Impact (Type I)	$10.5	$5.2	$2.7	42
Sub-Total	$33.0	$18.4	$11.3	282
Indirect Impact (Type II)	$21.7	$12.3	$5.3	102
Total Impact	**$54.7**	**$30.7**	**$16.6**	**384**

Appendix 10. Alignment with SPP 4.2 Activity Centres

Memo

TREENDALE EAST STRUCTURE PLAN (SPN 2373) - SPP 4.2 ALIGNMENT

Town Planning & Urban Design

p. 08 6333 1888

e. info@cdpaus.com.au

a. 2/464 Murray St, Perth WA 6000

PO Box 8002 Cloisters Square 6850

cdpaus.com.au

To.	Kim Muste, Senior Planning Officer, DPLH Bunbury
From.	CDP Town Planning & Design
Date.	25 October 2024
Job Code.	TAYTELSP

Further to your email request dated 9 October 2024, CDP has prepared the following information, in lieu of an updated Retail and Market Sustainability Assessment, to demonstrate broad alignment with the objectives and principles of *State Planning Policy 4.2 – Activity Centres* (July 2023).

This information is intended to supplement the Retail and Market Sustainability Assessment for Treendale East prepared by RPS, lodged with the Structure Plan.

1. Background

Planning for Treendale East commenced in earnest early in 2017. The area was identified in the *Greater Bunbury Strategy 2013* as a major 'Urban Investigation area' but the strategy recommended that this urban investigation area should not be rezoned until the urban expansion area 'east of Eaton' (now known as Wanju) had been significantly developed. However, by 2017, the constraints to development of Wanju, not least its highly fragmented ownership, had become clear.

A Retail and Market Sustainability Assessment for Treendale East was prepared by RPS in 2017. At that time, the final alignment of the BORR had not yet been confirmed and the assessment assumed a development area of 380 hectares with a lot yield of approximately 3,000 and a population of 8,700 (based on 2.6 persons per dwelling).

On behalf of the landowners, CDP and Taycot successfully made a case for urban development of Treendale East to be brought forward.

The alignment of the BORR has since been confirmed and in 2022 was reflected in the *Bunbury-Geographe Sub-regional Strategy* which also identified Treendale East as an urban expansion area. Detailed planning on the smaller urban expansion area of 188.5 hectares and reflected in the lodged Local Structure Plan for Treendale East, projects a yield of approximately 2,200 lots and a population of 5,720, based on 2.6 persons per dwelling.

1.1. Land Supply

The RPS assessment highlighted that in 2017, residential land supply in the northern corridor of Greater Bunbury represented less than seven years of demand, which has proven correct. Six years later in 2024, residential land within the Treendale development west of Forrest Highway is 100% sold out, and there is only very limited availability remaining in other land developments. Treendale East is the only planned residential development in the Greater Bunbury area capable of delivering significant new supply in the short to medium term.

RPS highlighted that a lack of supply would lead to poor affordability and housing choice, undermine population attraction and economic development outcomes. These effects are already being felt in Greater Bunbury and beyond.

1.2. Retail Need

Treendale East is within the Primary Catchment of the Treendale District Structure Plan. RPS estimated that development of Treendale East would increase demand for floorspace within the District Centre and would 'comfortably' support a medium sized Neighbourhood Centre on a site approximately 2 – 2.5 hectares, inclusive of a full line supermarket (5,400m^2) as well as an additional 3,000m^2 for the Treendale District Centre.

SPP 4.2 identifies the catchment population for a Neighbourhood Centre as between 2,000 and 15,000. Hence, although the forecast population is less than was envisaged in 2017, 5,720 people will still comfortably support a Neighbourhood Centre.

Treendale East will be more self-contained than other residential estates for shopping trips due to the psychological and physical barrier formed by the BORR and Raymond Road primary regional roads, which limit access options and are likely to deter external trips for daily shopping needs. RPS noted that travel time is a more important consideration than physical distance when considering the extent of a retail catchment area.

Access to the Treendale District Centre by Treendale East residents will be via Raymond Road and Forrest Highway from the south or left out onto Forrest Highway from the north.

The proposed Neighbourhood Centre is located in a position that will be highly visible to traffic travelling on Raymond Road so will also capture some of that passing traffic. The proposed roundabout intersection with Raymond Road will make it easy to enter Treendale East from either direction to access the Neighbourhood Centre.

1.3. Community Benefit

The community benefits of Treendale East outlined by RPS remain valid:

- Construction expenditure impacts for housing and associated civil works.
- Household expenditure impacts on the potential Treendale East Neighbourhood Centre.
- Household expenditure impacts on the Treendale District Centre.
- Economic output from construction and direct and indirect related jobs.
- Direct and indirect jobs within the District and Neighbourhood Centres.

2. Activity Centre Hierarchy

The SPP 4.2 *Implementation Guidelines* suggest an indicative land area for neighbourhood centres of between 7,500m^2 and 30,000m^2. The proposed centre for Treendale East is 2.75 hectares. It will comprise two street blocks (approximately 1.48 and 1.27 hectares), with development either side of central 'main street'.

Table 1 demonstrates how the proposed centre complies with the roles and characteristics of a Neighbourhood Centre as set out in Appendix 1 of SPP 4.2.

Table 1. Neighbourhood Centre Roles & Characteristics

State Planning Policy 4.2	Proposed
Main role and typical attributes	
Neighbourhood centres are important local focal points that provide for daily to weekly household shopping needs, community facilities and a small range of other convenience services. They are also a focus for medium density housing. These centres	The proposed Neighbourhood Centre will provide for the daily household needs of Treendale East residents. It will be the only centre within the development, which is surrounded on all sides by major regional roads. It will be the key focal point

State Planning Policy 4.2	Proposed
play an important role in providing walkable access to services and facilities for local communities.	for this community. Located adjacent to the main vehicle entrance, it will be easily accessible from within the estate by road, cycle or foot.
Future indicative service population (trade) area	
2,000 – 15,000 persons	5,700+ (within Treendale East) plus Meadow Landing plus passing trade.
Typical transport connectivity and accessibility	
Stopping / transfer point for bus network	The internal Neighbourhood Connector road loop and main entry road from Raymond Road will provide a suitable road alignment for a future bus route within the structure plan area when required. The centre is located on this route. It will be visible to traffic travelling along Raymond Road and easily accessible internally for Treendale East residents by car, bike, or on foot.
Desired land uses	
All local centre land uses: Convenience store, shop – small, liquor store – small, fast food outlet / lunch bar, restaurant/café, small bar; plus neighbourhood centre land uses: Shop – large, liquor store – large, market, restricted premises, amusement parlour, educational establishment, recreation – private, small bar, tavern, office – small, medical centre, art gallery	The neighbourhood centre is expected to include a core retail area including a full line supermarket (western side) complemented by entertainment/hospitality and residential or short-term accommodation uses overlooking the amenity of the restored creek and riparian corridor (eastern side). These may include a micro-brewery/tavern, holiday accommodation/serviced apartments.
Typical urban form	
A compact and cohesive urban form that complements the surrounding built form character in scale and style.	A compact and cohesive urban form that complements the surrounding built form character in scale and style.
New development should contribute to the public realm by enhancing and activating the streetscape and contributing to creating a distinct and appealing character for the centre.	The centre will include a pedestrian-friendly two-sided street that will be activated by well-scaled built form and landscaped public realm.
Average residential density (dwellings per gross Urban Zone hectare within the walkable catchment)	
25+ (200m)	R25+ The minimum density is R25, ranging to R60 for medium density. Immediately north of the proposed Neighbourhood Centre zone, a cell of rear-loaded narrow lot product will provide higher density housing. Residential or mixed-use development within the centre will be permitted to R80.
30+ (800m) where there is an existing or proposed train station within 400m of the centre	There is no existing or proposed train station.
Preferred residential dwelling types	
Low to medium-rise apartments/multiple dwellings Townhouses / grouped dwellings	Residential or short-term accommodation development within the neighbourhood centre is intended to be in the form of multiple dwellings oriented towards the amenity of the public open space and public realm. An R80 code is proposed.

3. SPP 4.2 Outcomes

In terms of the intended policy outcomes, the proposed Neighbourhood Centre:

a) The activity centre network meets different levels of community need and enables employment, housing, goods and services to be accessed efficiently and equitably by the community.

The Neighbourhood Centre is located at the main entrance to Treendale East, off Raymond Road. Due to the nature of the regional road network that defines the boundaries of Treendale East, almost all traffic, including pedestrians and cyclists, will be obliged to use this entry or the proposed left-in-left-out access off Forrest Highway in the north-west corner of the development.

The centre will be well connected to local vehicle, cycle and pedestrian traffic by a highly permeable street network and an extensive and well-connect public open space network.

It will be visible to traffic travelling along Raymond Road as well as being highly accessible to the residents of the Meadow Landing rural residential estate, south of Raymond Road, via the proposed four-way intersection with Ranson Drive. It is expected that these residents will use the centre for their regular shopping needs.

b) **The primacy of activity centres is reinforced, and out-of-centre development does not undermine the hierarchy of activity centres.**

The Neighbourhood Centre will be the focal point for all retail and commercial development in Treendale East, with only very minor non-residential development associated with the coordinated development of the Village Precinct being a possibility outside the centre.

To the extent that land uses suitable for location within a centre are proposed within the Village Precinct, they will be strictly limited in scale and location. They will be provided either as incidental uses to another land use (for example, resident-only amenities as part of an independent living complex), members-only (for example, as part of a Treendale East Community Club), or of a very small scale (for example, a small café adjacent to POS 6, overlooking Treendale Gully). Refer to **Table 1**.

c) New activity centres or the intensification of existing activity centres does not unreasonably undermine existing centres.

The population of Treendale East, estimated to be approximately 5,720 at completion, will be sufficient to support the proposed Neighbourhood Centre and will add to the Treendale District Centre trade area population.

d) Sufficient development intensity and appropriate land use mix is provided, that supports the role and function of activity centres, promotes economic growth, provides employment opportunities and enhances consumer choice.

The proposed Neighbourhood Centre is expected to support a full-line supermarket and complementary retail and services to support the new Treendale East community.

A hospitality land use such as a micro-brewery or tavern is proposed east of the main street and situated to overlook the rehabilitated Treendale Gully riparian corridor, to provide a destination for locals and visitors. This would incorporate family-friendly elements and outdoor areas.

In addition, it is anticipated that holiday accommodation would also be suited for this location, due to its location at the 'gateway' to Bunbury and the Ferguson Valley. Low rise apartments are also an option.

e) **The density and diversity of housing in and around activity centres is maximised to improve land efficiency, housing choice and housing affordability, and assists with delivering the urban consolidation objectives and outcomes of the strategic planning framework for the applicable region.**

In addition to provisions allowing residential or mixed-use development to R80 within the Neighbourhood Centre, residential development within the walkable catchment of the centre is expected to achieve the required R25 as a minimum. The minimum R-Code across the whole of the Structure Plan area is R25, with R30 in the Village Precinct and R80 within the Neighbourhood Centre.

A cell of small lot laneway housing product is proposed oppose the Neighbourhood Centre.

f) Activity centres and development within them are well-designed, cohesive and functional, provide for the needs of their community and capitalise on the sustainable use of existing and planned infrastructure.

As outlined in Part Two of the draft Structure Plan, a Local Development Plan for the neighbourhood centre zoned land will address:

a) The creation of a main street environment that encourages pedestrian movement through carriageway treatments, continuous tree canopy on both sides for shade, good lighting of the public realm, and embayed on-street parking.
b) Provision of a plaza/civic space, appropriate to the neighbourhood scale, adjacent to the main street.
c) Built form that appropriately addresses and frames surrounding streets and public realm by providing:
    i. Nil setbacks (including two storeys or equivalent height parapet walls) or minimal setbacks to the street boundary.
    ii. Active frontages with windows and building entrances accessible and/ or visible from the public realm, maximum use of glazing to provide visual engagement with the street, and no blank facades.
    iii. Pedestrian weather protection in the form of continuous awnings and/or colonnades along public frontages.
    iv. Visually interesting buildings that address all publicly visible frontages and incorporate contextually appropriate architectural features and materials and address corners where applicable.
d) Car parking that is provided within on street and off-street parking areas located behind buildings so as not to visually dominate the streetscape or interrupt pedestrian traffic flow.
e) Appropriate interface with adjoining residential areas through the use of landscaping and/or other design measures to avoid negative visual, acoustic or other negative impacts on residential amenity.

g) Activity centres have a compact urban form with pedestrian-dominant streetscapes and public realm based around a main street(s) and public open spaces.

The proposed Neighbourhood Centre is located on the east side of the main entry road, which is not suited for two-sided development as it intersects with Raymond Road, a primary regional road, via a large roundabout. This and the expected volume of traffic it will carry (c. 11,500vpd) is not conducive to street-based development. Instead, the centre will provide a 'main street' roughly parallel with the main entry road.

h) Street design and the urban structure is conducive to and prioritises access to and within activity centres by walking, cycling and public transport.

The proposed estate is designed to be highly permeable by pedestrians and cyclists, including a linear POS with path network that connects all areas of POS and the Neighbourhood Centre. All streets will have a minimum of one footpath, and the proposed Green Streets treatments will enhance the pedestrian environment further.

The Neighbourhood Connector and main entry road will be suitable to accommodate a bus service in future.

i) Private vehicle trips to and within activity centres are minimised, reducing the demand for parking.

The movement network is designed to enhance the pedestrian and cycling environment and facilitate access to the Neighbourhood Centre using alternatives to private vehicles. On and off-street car parking will be provided within the centre according to the requirements of the Shire of Harvey for the land uses proposed.

j) Planning and development of activity centres balances the environmental, social, health, economic and cultural values of activity centres to provide a net positive benefit to local communities.

The Neighbourhood Centre will provide a range of opportunities for the local community.

4. Out of Centre Development

Within the Village Precinct, additional uses within the Residential zone may include limited small (less than 250m^2 NLA) Category A shop uses in the form of a café/restaurant.

A small convenience store (Category B shop) may be proposed either in combination with a café or on its own, to provide limited day-to-day goods to local residents in the manner of a traditional corner store. The scheme definition already limits convenience stores to a maximum of 300m^2 NLA, however should a convenience store be proposed, it would be limited to half this.

4.1. Proposed limitations

Café/Restaurant

- No more than two individual establishments.
- No greater than 225m^2 NLA combined.
- No closer than 200 metres to the nearest Neighbourhood Centre cadastral boundary.

Convenience Store

- No more than one individual establishment.
- No greater than 150m^2 NLA, or 300m2 NLA if combined with a café.
- No closer than 200 metres to the nearest Neighbourhood Centre cadastral boundary.

5. Benefits

The following assessment is based on the Net Benefit Assessment Template in the SPP 4.2 Implementation Guidelines.

Criteria	Current Situation	Proposal	Comment
Strategic Alignment			
Is the proposal consistent with the strategic planning for the area? Is it aligned with the relevant regional strategy and approved local planning strategy?	Treendale East is identified in the Bunbury Geographe Sub-regional Strategy as an Urban Expansion Area. It is zoned Urban Deferred in the GBRS.	The Neighbourhood Centre is proposed to support residential development of the land.	The proposal is consistent with strategic plans.
Is the proposal consistent with the objectives and outcomes of SPP 4.2?	The existing Retail and Market Sustainability assessment pre-dates SPP 4.2.	Refer to the body of this report.	The proposal is consistent with the objectives and outcomes of SPP 4.2
What are the potential impacts on the activity centre hierarchy? Is the size and scale of the proposal consistent with the level of the hierarchy?	The closest existing centre is the Treendale District Centre.	The proposed Neighbourhood Centre will be 3.14 hectares and comprise approximately 3,000m^2 shopping NLA.	The proposal is consistent with the hierarchy of centres in the area.
Productivity			
Does the proposal provide new jobs in addition to any that may be lost elsewhere – net additional jobs?	The site is currently used for grazing.	The Neighbourhood Centre will provide local employment within businesses that will locate within it.	The proposal will provide population-driven employment.
Does the proposal contribute to diversifying local jobs – creating more strategic employment versus population-driven employment?	The site is currently used for grazing. It is located south of the emerging Kemerton Industrial Area, which is driving demand for additional housing.	The Neighbourhood Centre will provide local employment within businesses that will locate within it.	The proposal will provide population-driven employment.
For retail proposals, how is the proposal expected to impact upon the current and expected turnover and role of relevant activity centres?	The closest existing activity centre is the Treendale District Centre.	The forecast population of Treendale East justifies provision of a new Neighbourhood Centre and will add to the trade area population of the district centre.	The proposal will have a positive impact on turnover within the Treendale District Centre.
Will the proposal increase the choice and availability of goods and services in the area?	Treendale District Centre and Bunbury CBD provide the widest range of goods and services in the area.	The proposal will serve the daily and local shopping and service needs of the local population.	The proposed tavern/microbrewery will add to the diversity of goods/services in the area.
Quality of Life			
Is the proposal compatible with surrounding land uses? Will there be an	The site is currently cleared rural land used for grazing.	The proposal is separated from surrounding land uses by the BORR. It will	The proposal is compatible with surrounding land uses.

Criteria	Current Situation	Proposal	Comment
improvement in the level of amenity and vibrancy that benefits the wider community?		provide a significant increase in amenity and vibrancy for the local and wider community, including rehabilitation of Treendale Gully.	
Does the proposal include land uses such as healthcare, education and community facilities?	Treendale District Centre accommodates a range of services. The area is served by Australind SHS and several primary schools and a private college.	A new primary school and district open space will be provided within the structure plan area. Health and community facilities may locate within the Neighbourhood Centre.	The Neighbourhood Centre will provide neighbourhood level facilities
Environmental Sustainability			
Would the proposal have an impact on overall vehicle trips? Would car-based net trips (by distance) increase or reduce as a result of the proposal?	The site is surrounded by regional roads. Its current use for grazing generates few trips. Site access has been severely limited by construction of the BORR.	The TIA for the wider Structure Plan area includes traffic generated by proposed Neighbourhood Centre uses (approx. 461 vpd).	
Does the proposal contribute to improved air and water quality – such as incorporating water sensitive urban design (WSUD), or walking and cycling infrastructure that reduces emissions from vehicles?	The site is currently cleared rural land used for grazing. Treendale Gully is degraded.	The Neighbourhood Centre will overlook a rehabilitated Treendale Gully and is situated within the	The estate including the Neighbourhood Centre will be developed on WSUD principles.
Does the proposal protect or enhance remnant vegetation or contribute to improving the urban tree canopy?	The site is largely degraded, cleared of remnant vegetation.	The Neighbourhood Centre will include new tree canopy on streets and on site.	The proposal will enhance urban tree canopy.
Does the proposal help reduce energy consumption and emissions – for example through sustainable construction methods and/or incorporating renewable energy systems?	The site is currently cleared rural land used for grazing.	The development will incorporate renewal energy systems where feasible.	It is intended that sustainable energy and construction methods will be incorporated into the development.
Infrastructure and Services			
Is there significant government investment in services, infrastructure or development in the area or nearby centres that may be affected by the proposal? Will the proposal impact patronage/viability of the investment and	No government services will be impacted by the proposed Neighbourhood Centre.	The development of the Neighbourhood Centre will not impact government services. Treendale East will be self-funding.	The proposal will not adversely impact government investment in services elsewhere.

Criteria	Current Situation	Proposal	Comment
what is the expected impact?			
Does the proposal include new, or improvements to existing transport infrastructure, particularly walking, cycling and public transport, that increases access and helps manage congestion?	The development site is bounded by regional roads controlled by Main Roads WA.	The development of Treendale East will fund a new four-way roundabout intersection with Raymond Road. It will provide pedestrian and cycling facilities. The road layout will allow for future provision of bus routes.	The Neighbourhood Centre is part of the overall development of Treendale East, which includes transport infrastructure.
Does the proposal include enhancements to utilities that benefit the local area?	The site is currently cleared rural land used for grazing.	The proposed Neighbourhood Centre and Treendale East estate will be fully serviced.	The proposal will be fully serviced.
Equity and Social Inclusion			
Does the proposal have the potential to improve access to economic opportunity for minority and vulnerable groups?	The site is currently cleared rural land used for grazing.	The Neighbourhood Centre will provide local employment opportunities.	The Neighbourhood Centre will provide local employment opportunities.

We trust that the foregoing is sufficient to clarify what is proposed and demonstrates broad alignment with the principles of SPP 4.2.

Appendix 11.
Certificates of Title

WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
4022	**561**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 50 ON DEPOSITED PLAN 421006

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ROBERT LINDSAY TAYLOR OF 7 CORONATION DRIVE BINNINGUP WA 6233
(AF P215847) REGISTERED 13/7/2022

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. C788466 EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA FOR GAS SUPPLY PURPOSES. SEE DEPOSITED PLAN 421006 AS CREATED ON PLAN 14044. REGISTERED 8/6/1984.
   H510366 NOTIFICATION. THE GRANTEES OF EASEMENT C788466 ARE NOW THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA ALINTAGAS NETWORKS PTY. LTD. PURSUANT TO SECTION 16 OF THE GAS CORPORATION (BUSINESS DISPOSAL) ACT 1999. REGISTERED 25/7/2000.
2. P215843 EASEMENT BURDEN FOR RIGHT OF CARRIAGEWAY PURPOSES - SEE DEPOSITED PLAN 421006 AS CREATED ON DEPOSITED PLAN 419119. REGISTERED 13/7/2022.
3. P215848 NOTIFICATION SECTION 165 PLANNING & DEVELOPMENT ACT 2005 LODGED 13/7/2022.
4. P628941 CAVEAT BY COMMISSIONER OF MAIN ROADS AS TO PORTION ONLY LODGED 18/7/2023.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP421006
PREVIOUS TITLE:	2995-606
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF HARVEY

NOTE 1: P479022 DEPOSITED PLAN 424777 LODGED

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WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
2996	**4**

RECORD OF CERTIFICATE OF TITLE

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 151 ON DEPOSITED PLAN 418088

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PEARSON NOMINEES PTY LTD OF 43 DITCHINGHAM PLACE AUSTRALIND WA 6233
IN 1/2 SHARE
GEOFFREY THOMAS PEARSON OF 48 STIRLING STREET BUNBURY WA 6230
IN 1/2 SHARE
AS TENANTS IN COMMON

(TO O585569) REGISTERED 14/12/2020

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. C798501 EASEMENT TO STATE ENERGY COMMISSION OF WESTERN AUSTRALIA FOR GAS PURPOSES - SEE DEPOSITED PLAN 418088. REGISTERED 22/6/1984.
   H510366 NOTIFICATION. THE GRANTEES OF EASEMENT C798501 ARE NOW ALINTAGAS NETWORKS PTY LTD PURSUANT TO SECTION 16 OF THE GAS CORPORATION (BUSINESS DISPOSAL) ACT 1999. REGISTERED 25/7/2000.
2. M636153 MORTGAGE TO RURAL BANK LTD REGISTERED 13/5/2014.
3. P215843 EASEMENT BENEFIT FOR RIGHT OF CARRIAGEWAY PURPOSES - SEE DEPOSITED PLAN 419119. REGISTERED 13/7/2022.
4. P229795 CAVEAT BY THE REGISTRAR OF TITLES AS TO THE 1/2 SHARE OF PEARSON NOMINEES PTY LTD ONLY. LODGED 27/7/2022.
5. P229797 CAVEAT BY THE REGISTRAR OF TITLES AS TO THE 1/2 SHARE OF GEOFFREY THOMAS PEARSON ONLY. LODGED 27/7/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

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REGISTER NUMBER: 151/DP418088 VOLUME/FOLIO: 2996-4 PAGE 2

SKETCH OF LAND:	DP418088
PREVIOUS TITLE:	1920-973
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF HARVEY

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Landgate
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WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
2995	**604**

RECORD OF CERTIFICATE OF TITLE

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 152 ON DEPOSITED PLAN 418089

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ELIZABETH ELLEN TAYLOR OF POST OFFICE BOX A87, AUSTRALIND

(TO O585570) REGISTERED 14/12/2020

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP418089
PREVIOUS TITLE:	2806-418
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF HARVEY

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Appendix 12. PB112/2016 Medium Density Single Houses

Western Australian Planning Commission

Planning Bulletin 112/2016
Medium-density single house development standards – Development Zones

112/2016

April 2016

1. Purpose

To outline acceptable variations to the deemed-to-comply provisions of the Residential Design Codes (R-Codes) for medium-density single houses in development areas, and to identify methods for implementation, to ensure consistent application across Western Australia.

2. Background

R-MD Codes

Residential densities have increased in recent years in response to a number of factors including the implementation of the key policy initiatives of Directions 2031, market demand for smaller lots, and efforts to improve housing affordability. In some cases, development on smaller lots using the standard R-Codes has resulted in built form outcomes that do not fit comfortably on the subject lot or relate well to the existing streetscape.

The ability to vary deemed-to-comply requirements is prescribed in Part 7 of the R-Codes. Variations to the deemed-to-comply requirements outlined in clause 7.3.1 do not require WAPC approval, however, variations to any other deemed-to-comply requirements are subject to WAPC approval.

A number of different planning instruments can be used to vary the R-Codes, including local planning scheme provisions, local development plans, and local planning policies. The different instruments apply the variations to different scales of development, from select sites to entire residential estates. Over time, the introduction of variations to the R-Codes via these different planning instruments has increased, and as a result there are now many variations to the R-Codes that apply in different local government areas across the State.

The WAPC's operational design policy, Liveable Neighbourhoods, recommends the use of limited local development plans for 'constrained' sites where it needs to be demonstrated that a single house can be constructed on the proposed lot and meet the performance requirements of the R-Codes.

In order to achieve this, local development plans may be used to vary the deemed-to-comply requirements of the R-Codes in order to facilitate development.

Over time, however, their use for this purpose has extended such that some local development plans now apply R-Code variations across entire development areas rather than being used for specific constrained sites as intended. In other cases, local development plans substantially amend some deemed-to-comply requirements (e.g. open space – minimum total percentage of site) to facilitate the development of large dwellings on small lots.

In order to respond to this increased use of R-Codes variations, a working group of key government, development and building industry stakeholders was formed to discuss the resulting issues and to identify potential solutions.

3. Medium-density single house development standards (R-MD Codes)

The medium-density single house development standards (R-MD Codes) at **Appendix 1** are based on contemporary housing typologies and incorporate existing R-Codes variations that have been applied to date in approved planning instruments.

The R-MD Codes can be used as a variation to existing deemed-to-comply requirements for building and garage setbacks (clauses 5.1.2, 5.1.3 and 5.2.1), open space (clause 5.1.4), parking (clause 5.3.3), visual privacy (clause 5.4.1) and solar access (clause 5.4.2).

All other relevant R-Codes standards will continue to apply.

Lot width for double garages

The R-MD Codes establish a minimum 10.5 metre lot width for single houses with double garages, where sole access is from a primary street.

This increase in minimum lot width will not be applied retrospectively and does not apply to subdivision applications lodged or approved prior to 8 May 2015. Where an approved structure plan or local development plan has a 10 metre lot for a single house with double garage, this approved plan will be used by the WAPC or the local government to determine the subdivision or development application.

4. Implementation

R-MD Codes

The R-MD Codes can be adopted as a local planning policy that varies the deemed-to-comply requirements of the R-Codes, and can be applied in development zones.

Under the *Planning and Development (Local Planning Schemes) Regulations 2015* (the Regulations), the deemed-to-comply requirements of the R-Codes can be varied via a scheme amendment, local planning policy, activity centre plan or local development plan.

As such, implementation of the R-MD Codes can be either through incorporation into a local planning scheme via a scheme amendment, or by the adoption of a local planning policy.

Under Schedule 2, Part 7, Clause 61(4)(c) of the deemed provisions of the Regulations, the deemed-to-comply requirements of the R-Codes can be amended or replaced by local planning policy. Any development outlined in 61(1)(c) and (d) that is in accordance with a local planning policy adopted under this provision (and which also achieves compliance with all other R-Code provisions), is exempt from the requirement to obtain development approval.

Implementation of the R-MD Codes via local planning policies will allow local development plans to again be used for their intended purpose, of facilitating development on smaller constrained sites.

The R-MD Codes are contained in **Appendix 1**. A model local planning policy to adopt the R-MD Codes is contained in **Appendix 2**.

The WAPC will not generally support further variations to the provisions outlined at **Appendix 1**. However, variations that provide for innovative housing typologies (not considered in the specified typical lot size / type) and that deliver positive community outcomes may be considered at the WAPC's discretion.

The WAPC has resolved in accordance with Schedule 2, Part 2, Clause 4(1) of the Regulations that adoption of the R-MD Codes (as contained in **Appendix 1**) as a local planning policy does not require public advertising.

Upon adoption of such a local planning policy, the local government must notify the WAPC of the resolution. The WAPC will then confirm that the policy is in accordance with this planning bulletin.

5. Review and future R-Codes amendment

The WAPC will monitor the implementation of the R-MD Codes following implementation, and will conduct reviews at six monthly intervals with a view to ultimate inclusion in the R-Codes.

6. Further information

Enquiries or correspondence on this planning bulletin should be sent by email to rcodesreview@planning.wa.gov.au or by post to:

Planning Manager, Urban Policy
Policy and Priority Initiatives
Department for Planning
Gordon Stephenson House
140 William Street
Perth, WA, 6000

Please quote reference DP/15/00045/1

Information relevant to this Planning Bulletin is published at www.planning.wa.gov.au

Appendix 1

Single house standards for medium density housing in development zones (R-MD Codes)

R-Code	Lot type and size	Street setback and front fences		Lot boundary setback		Open space		Garage setback and width and vehicular access		Parking		Overshadowing		Privacy	
		R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision
R-MD – R60	Rear load 5m x 30m – 150m^2 6m x 30m – 180m^2 Front load 8.5m x 20m – 170m^2 7.5m x 25m – 187.5m^2	2m	2m minimum, no average 1m to porch / veranda no maximum length 1m minimum to secondary street Front fences within the primary street setback area being a maximum height of 900mm above natural ground level, measured from the primary street side of the front fence	Boundary setbacks 1 to 1.5m for wall height 3.5m and less (subject to wall length and major openings) Boundary walls 2/3 length one side boundary, max 3.5m high and 3m average height	Boundary setbacks 1.2m for wall height 3.5m or less with major openings 1m for wall height 3.5 or less without major openings Boundary walls No maximum length to both side boundaries	40% open space (60% site cover) 16m^2 courtyard 1/3 required outdoor living area (OLA) may be covered Minimum dimension 4m	An outdoor living area (OLA) with an area of 10% of the lot size or 20m^2, whichever is greater, directly accessible from a habitable room of the dwelling and located behind the street setback area At least 70% of the OLA must be uncovered and includes areas under eaves which adjoin uncovered areas The OLA has a minimum 3m length or width dimension No other R-Codes site cover standards apply	Rear load Nil – provided laneway is minimum of 6m wide Front load 4.5m or 0.5m behind dwelling alignment subject to averaging requirements Garage width limited to maximum 50% of lot frontage where garage in front of or within 1m of building	Rear load 0.5m garage setback to laneway Front load 4.5m garage setback from the primary street and 1.5m from a secondary street The garage setback from the primary street may be reduced to 4m where an existing or planned footpath or shared path is located more than 0.5m from the street boundary For front loaded lots with street frontages between 10.5 and 12m, a double garage is permitted to a maximum width of 6m as viewed from the street subject to: - Garage setback a minimum of 0.5m behind the building alignment - A major opening to a habitable room directly facing the primary street - An entry feature consisting of a porch or veranda with a minimum depth of 1.2m; and - No vehicular crossover wider than 4.5m where it meets the street Lots with a frontage less than 10.5m or not compliant with above require single or tandem garaging	Two on-site bays	One on-site bay where dwelling has two bedrooms or less	50% of the adjoining site area	No maximum overshadowing	3m to bedrooms and studies 4.5m to all other major openings 6m to balconies or similar	No privacy provisions apply
R-MD – R40	Rear load 7.5m x 30m – 225m^2 Front load 8.5m x 30m – 255m^2 8.5m x 25m – 212.5m^2 10 x 20m – 200m^2 10 x 25m – 250m^2 12.5m x 20m – 250m^2	4m	2m minimum, no average 1.5m to porch / veranda no maximum length 1m minimum to secondary street Front fences within the primary street setback area being a maximum height of 900mm above natural ground level, measured from the primary street side of the front fence	Boundary setbacks 1 to 1.5m for wall height 3.5m and less (subject to wall length and major openings) Boundary walls 2/3 length one side boundary, maximum 3.5m high and 3m average height	Boundary setbacks As per R-MD – R60 Boundary walls To both side boundaries subject to: No maximum length to one side boundary, 2/3 max length to second side boundary for wall height 3.5m or less	45% open space (55% site cover) 20m^2 courtyard 1/3 required OLA area may be covered Minimum dimension 4m	As per R-MD – R60	Rear load Nil – provided laneway is minimum of 6m wide Front load 4.5m or 0.5m behind dwelling alignment subject to averaging requirements	As per R-MD – R60	Two on-site bays	As per R-Codes	35% of the adjoining site area	No maximum overshadowing for wall height 3.5m or less No maximum overshadowing for wall height greater than 3.5m where overshadowing is confined to the front half of the lot. If overshadowing intrudes into rear half of the lot, shadow cast does not exceed 35%	4.5m to bedrooms and studies 6m to all other major openings 7.5m to balconies or similar	R-Codes clause 5.4.1 C1.1 applies, however the setback distances are 3m to bedrooms and studies, 4.5m to major openings to habitable rooms other than bedrooms and studies and 6m to unenclosed outdoor active habitable spaces

Appendix 1

Single house standards for medium density housing in development zones (R-MD Codes)

R-Code	Lot type and size	Street setback and front fences		Lot boundary setback		Open space		Garage setback and width and vehicular access		Parking		Overshadowing		Privacy	
		R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision	R-Codes	R-MD provision
R-MD – R30	Rear load 10m x 30m – 300m² Front load 10m x 30m – 300m² 15m x 20m – 300m²	4m	2m minimum, no average 1.5m to porch / veranda no maximim length 1m minimum to secondary street Front fences within the primary street setback area being a maximum height of 900mm above natural ground level, measured from the primary street side of the front fence	Boundary setbacks 1 to 1.5m for wall height 3.5m and less (subject to wall length and major openings) Boundary walls 2/3 length one side boundary, maximum 3.5m high and 3m average height	Boundary setbacks As per R-MD – R60 Boundary walls To both side boundaries subject to: 2/3 length to one side boundary, 1/3 max length to second side boundary for wall height 3.5m or less	45% open space (55% site cover) 24m² courtyard 1/3 required OLA area may be covered Minimum dimension 4m	As per R-MD – R60	Rear load Nil – provided laneway is minimum of 6m wide Front load 4.5m or 0.5m behind dwelling alignment subject to averaging requirements	As per R-MD – R60	Two on-site bays	As per R-Codes	35% of the adjoining site area	As per R-MD – R40	4.5m to bedrooms and studies 6m to all other major openings 7.5m to balconies or similar	As per R-MD – R40
R-MD – 25	Front load 12.5m x 25m – 312.5m² 15m x 25m – 375m² 12.5m x 30m – 375m²	6m	3m 1.5m to porch / veranda no maximum length 1.5m minimum to secondary street Front fences within the primary street setback area being a maximum height of 900mm above natural ground level, measured from the primary street side of the front fence	Boundary setbacks 1 to 1.5m for wall height 3.5m and less (subject to wall length and major openings) Boundary walls 2/3 length one side boundary, max 3.5m high and 3m average height to one side boundary	Boundary Setbacks As per R-MD – R60 Boundary walls As per R-MD – R30	50% open space (50% site cover) 30m² courtyard 1/3 required OLA area may be covered Minimum dimension 4m	As per R-MD – R60	Rear load Nil – provided laneway is minimum of 6m wide Front load 4.5m or 0.5m behind dwelling alignment subject to averaging requirements	As per R-MD – R60	Two on-site bays	As per R-Codes	25% of the adjoining site area	As per R-MD – R40, however if overshadowing intrudes into rear half of the lot, shadow cast does not exceed 25%	4.5m to bedrooms and studies 6m to all other major openings 7.5m to balconies or similar	As per R-MD – R40

Appendix 2

Model Local Planning Policy

Variation to deemed-to-comply requirements of the R-Codes - Medium-density single house development standards (R-MD Codes)

Purpose

To replace the deemed-to-comply requirements of following clauses of the Residential Design Codes with those set out in the provisions of this policy:

Building and garage setbacks – clauses 5.12, 5.13 and 5.21
Open space – clause 5.1.4
Parking – clause 5.3.3
Visual privacy – clause 5.4.1
Solar access – clause 5.4.2

Definitions / abbreviations

Approved Structure Plan	A structure plan or activity centre plan that has been approved by the WAPC under Part 4 or Part 5 of the City / Town / Shire of …… Local Planning Scheme No...
Front load	Lots where the primary vehicle access is via the front of the lot and the garage / carport is located at the front of the dwelling
Medium density	R25–R60 density codes
Rear load	Lots where the primary vehicle access is via the rear of the lot, from a street or right of way (ROW) and the garage / carport is located at the back of the dwelling
R-MD / R-MD Codes	Single house standards for medium density housing

Statutory provisions

Development approval will not be required for a single dwelling that complies with the provisions of this policy (and all other deemed-to-comply requirements of the R-Codes), in accordance with clause 61(4)(c) of the deemed provisions of the Scheme.

Application

This policy will apply:

1. in the following structure planning areas: (Insert details of structure plan areas / names); or
2. where the approved structure plan identifies that the R-MD Codes local planning policy applies.

Policy provisions

(Insert the Single House Standards for Medium-density Housing from Appendix 1 of Planning Bulletin 112/2015)

Disclaimer

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website: www.planning.wa.gov.au
email: corporate@planning.wa.gov.au

tel: 08 6551 9000
fax: 08 6551 9001
National Relay Service: 13 36 77
infoline: 1800 626 477

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GOVERNMENT OF WESTERN AUSTRALIA



cdp

Town Planning & Urban Design

p. 08 6333 1888

e. info@cdpaus.com.au

a. 2/464 Murray St,
Perth WA 6000

PO Box 8002
Cloisters Square 6850

cdpaus.com.au