RAPIDS LANDING LIFESTYLE COMMUNITY STRUCTURE PLAN

Lot 9014 John Archibald Drive, Margaret River

Prepared by:

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Date:	30 January 2024

Prepared for:

EDENLIFE COMMUNITIES PTY LTD

AHOLA PLANNING ABN 72 259 767 785

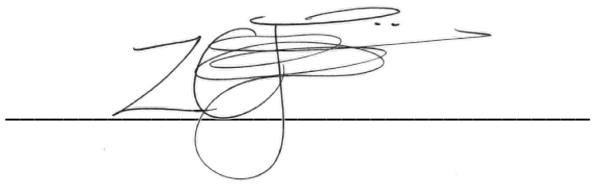
ENDORSEMENT PAGE

This Structure Plan is prepared under the provisions of the Shire of Augusta-Margaret River Local Planning Scheme No. 1

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

26 February 2024

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: 

Date: 27 February 2024

Date of Expiry: 27 February 2034

TABLE OF AMENDMENTS

Table 1 – Table of Amendments

Amendment No.	Summary of Amendment	Amendment Type	Date Approved by WAPC

Executive Summary

The Structure Plan has been prepared to support and guide future land use and development of a land lease community or modular home estate or (MHE) comprising grouped dwellings and associated community and recreation facilities located within Lester Group's Rapids Landing Estate, Margaret River.

It will facilitate for the development of a lifestyle community to support the development of age friendly infrastructure and affordable housing supply specifically aimed at catering for the needs of prospective residents in the over 50's age bracket, incorporating ageing in place requirements, within the relaxed ambience of a secure community setting.

Located within the north-west portion of Lot 9014 John Archibald Drive, Margaret River ('the land'), the area affected by the proposed Structure Plan represents a discrete parcel that is bordered by Bussell Highway to the west, John Archibald Drive to the north and significantly rehabilitated and highly valued foreshore open space on its southern and eastern boundaries.

Preparation of a Structure Plan for the Rapids Landing Lifestyle Community is a requirement of the previously approved Outline Development Plan for the overall Rapids Landing Estate that was endorsed by the Western Australian Planning Commission (WAPC) in November 2006.

This Structure Plan has been prepared in accordance with the Department of Planning Structure Plan Framework (August 2015) and the deemed provisions for local planning schemes of the Planning and Development (Local Planning Schemes) Regulations 2015 (the deemed provisions). It provides background and explanatory information. It also assesses the Structure Plan against the planning framework to demonstrate suitability in context with the layout and associated subdivision and development requirements. It will particularly guide future development in accordance with the Residential Design Codes as a grouped dwelling development for aged persons (older Australians aged 50 years and over) and operated according to the *Residential Parks (Long-stay Tenants) Amendment Act 2020* and supporting regulations.

AholaPlanning has been commissioned by Edenlife Communities Pty Ltd ('Edenlife') to prepare and submit the Structure Plan. Edenlife is a relatively new initiative of the Lester Group, a long standing, well-known and respected national property developer and investor with a responsible reputation for delivering on agreed commitments and in doing so, working closely with State and Local Government to achieve quality community assets. Edenlife brings a wealth of experience in the development of Lifestyle Communities.

Table 2 on the next page provides a summary of the land uses within the Structure Plan.

Structure Plan Summary Table

Table 2 – Table of Executive Summary

Item	Data	Structure Plan Ref (Section No.)
Total area covered by the Structure Plan	11.99 hectares	1.2.2
Area of each land use: • Residential • Parks and Recreation	Hectares/m^2 Lot Yield 7.17 hectares 1 4.82 hectares 2	3.1, 3.2 & Structure Plan
Total estimated lot yield	1	3.3
Estimated number of Dwellings (Grouped)	159	3.3
Estimated residential site density	13.26 dwellings per Site Hectare	
Estimated population	398 (@ 2.5 (based on average per household for Margaret River Locality)	
Number of High Schools	0	N/A
Number of Primary Schools	0	N/A
Estimated Commercial Floor Space	0	N/A
Estimated area and percentage of public open space given over to: • Regional Open Space • District Open Space • Neighbourhood Parks • Local Parks • Foreshore Reserve Open Space	 0 hectares 0% 0 hectares 0% 0 hectares 0% 0 hectares 0% 4.82 hectares 40.2%	 N/A N/A N/A N/A 3.2
Estimated percentage of natural area	1 hectare 10 %	

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PART ONE – IMPLEMENTATION

1.0 Structure Plan Area

This Structure Plan applies to portion of Lot 9014 on Deposited Plan 413998 John Archibald Drive, Margaret River as contained in Certificate of Title Volume 2959/ Folio 570 (refer to **Appendix 1**: Certificate of Title).

The Structure Plan area is bordered by John Archibald Drive to the north, Bussell Highway to the west, and significantly rehabilitated and highly valued foreshore public open space on its southern and eastern boundaries – with the Rapids Landing Estate residential development beyond.

2.0 Operation

The date the Structure Plan comes into effect is the date the Structure Plan is approved by the Western Australian Planning Commission ('WAPC').

3.0 Staging

The availability of essential infrastructure including reticulated water and sewer, stormwater, power and telecommunications means that the extension of such services can occur within the Structure Plan area.

Road access will connect with John Archibald Drive and is to be undertaken at the first Stage of Subdivision or Development as referenced on the Structure Plan.

4.0 Subdivision and Development Requirements

The Structure Plan outlines land use and zoning applicable within the Structure Plan area. The zone designated under this Structure Plan applies to the land consistent with the zone referenced in the Shire of Augusta-Margaret River Local Planning Scheme No.1 ('the Scheme').

4.1 Land Use Permissibility

Land use permissibility within the Structure Plan Area shall be in accordance with the corresponding zone identified on the Structure Plan. Land use permissibility is to also be in accordance with the provisions and requirements in Local Planning Scheme No. 1.

4.2 Subdivision

1. The following matters will be addressed via recommended conditions of subdivision -

    a) Subdivision shall be generally in accordance with this endorsed Structure Plan.

    b) The subdivider to prepare and implement an approved Landscape and Rehabilitation Management Plan for the Parks and Recreation/Drainage Reserve to the satisfaction and specification of Local Government that is to address the following –

        - Identification and protection of stands of remnant trees where practicable,

- Visual screening of future residential development from Bussell Highway and the corner of Bussell Highway and John Archibald Drive to mitigate visual impact and to also protect and enhance the amenity of future residents,
- propose planting of native species that require minimal watering, fertilizer and ongoing management,
- the type, density and extent of planting and vegetation to be protected within the Landscape Buffer /Linear Private Open space areas and public open space reserve identified on the Structure Plan Map,
- Establishing the dual use path network that link with the broader existing path network of Rapids Landing Residential Estate and the existing townsite.
- Establishing the riparian zone to the extent of waterlogged soil and constructing landscape amenities above to reduce construction effort.

c) The Parks and Recreation Reserve/s shown on the Structure Plan is to be ceded free of cost by the subdivider without any payment of compensation by the Local Government or the Crown in an agreed timeframe.

5.0 Local Development Plan

1. A Local Development Plan is to be prepared and approved for grouped dwelling and associated land uses applied to the land contained within the inner edge of the Residential R30/40 zone shown on the Structure Plan.

2. Grouped Dwellings and associated land uses that are consistent with the approved Local Development Plan are exempt for the requirement to obtain development approval in the area to which the plan relates.

3. The Local Development Plan is to set out site and development standards that are to apply to the development which will include the following –

a) Residential Design Code applicable to the grouped dwelling development;

b) Internal road design, dimensions construction standards;

c) Streetscape and dwelling orientation;

d) Building design elements;

e) Setback requirements;

f) Uniform permeable fencing and gated access located at the boundary between the Local Development Plan Area and surrounding public open space and road reserve areas;

g) Incidental development (storage/clothes drying/outbuildings/controls on caravan/ trailer/boat locations);

h) Private open space/site coverage for each grouped dwelling;

i) Private open space, landscape buffers (which also demonstrates retention of existing mature trees where practicable and protects/enhances visual amenity) and streetscape

treatments in accordance with a detailed landscape plan prepared and approved by the Local Government;

j) Grouped Dwelling model design options and associated buildings supporting the needs of its residents;

k) An Urban Water Management Plan prepared and approved by the Local Government;

l) Visitor car parking allocation and provision of landscaping (to include shade trees) to be planted and protected from damage by cars;

m) Servicing details for all land uses (including service areas, bin storage areas, and other mechanical plant equipment such as air conditioners), be screened from view from streets, car parks and private open space areas by enclosures consistent with the style and material of the building.

4. The Developer implementing the requirements of an approved Bushfire Management Plan applicable to the Structure Plan area which includes all dwellings to comply with AS 3959-1999 – Construction of Houses within Bushfire Prone Areas and other 'owner/occupier' responsibilities as prescribed.

5. A notification, pursuant to Section 165 of the Planning and Development Act 2005 is to be placed on the certificate(s) of title of the proposed lot and also included in the lease contract for each grouped dwelling that is impacted by a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor.

6. The Developer implementing the building construction recommendations for Grouped Dwellings adjacent Bussell Highway as provided in the Road Traffic Management Plan acoustic report provided at **Appendix 13** of this Structure Plan Report.

7. The Developer to implement a notification to be included in the lease contract for affected grouped dwellings located in an area exceeding the 55 dB(A) day target criteria require.

8. The developer preparing and implementing an approved comprehensive risk management plan for the ongoing management of all phases of the planning, construction and operation of the community. This includes traffic management and movement plan (construction phase and delivery and installation of homes) and dust and rubbish management during construction.

9. Engineering upgrades to the entrance intersection with John Archibald Drive to be constructed at the first stage of construction of the grouped dwelling development.

6.0 Other Requirements

1. The subdivider/developer is to make financial contributions on a per Grouped Dwelling basis to the Local Government towards the costs of providing community/or common infrastructure in accordance with the Shire of Augusta-Margaret River Local Planning Scheme No.1.

7.0 Additional Information

The Structure Plan does not require the submission of any additional information.

8.0 Structure Plan (Map)

The Structure Plan Map is provided on the next page.

PROPOSED DESIGN OF THE INTERSECTION TREATMENT TO JOHN ARCHIBALD DRIVE TO BE DETERMINED AT THE SUBDIVISION OR DEVELOPMENT STAGE.

BEECH DRIVE

JOHN ARCHIBALD DRIVE

WOODARD AVE

POS / DRAINAGE 1.50ha
(POS = 0.75ha)
(DRAINAGE = 0.75ha)

ROAD RESERVE

PRIVATE

15m

POS / DRAINAGE 3.32ha
(POS = 1.66ha)
(DRAINAGE = 1.66ha)

193

190

191

ALFERINK CRESCENT

THE PRIVATE LANDSCAPE BUFFER TO BE DETERMINED BY A COUNCIL APPROVED LANDSCAPE PLAN AT THE LOCAL DEVELOPMENT STAGE

BUSSELL HIGHWAY

3010

ALFERINK CRESCENT

3002

NO CONSTRUCTED ROAD ACCESS TO BE PROVIDED FROM RAPIDS LANDING AVENUE TO THE STRUCTURE PLAN.

280

3002

RAPIDS LANDING AVENUE

TONKIN BOULEVARD

PUBLIC OPEN SPACE PROVISION	
Total Structure Plan Area	11.99ha
Deductions - 50% Drainage - Landscape Buffer	 2.41ha 0.18ha
Total Deductions	2.59ha
Nett Subdivisible Area	9.4ha
10% Public Open Space Requirement	0.94ha
Total Public Open Space (Including 50% Credit for POS)	2.41ha (25.6%)

0 20 40 60 80 100m

NOTE:

Base Data supplied by Survey South / RPS

Areas and dimensions shown are subject to final survey calculations.

Revision	Date	Item
B	11/5/2022	Revise DUP alignments
A	11/12/2021	Initial Issue

LEGEND

- STRUCTURE PLAN BOUNDARY
- LOCAL DEVELOPMENT PLAN AREA
- SEASONAL CREEKLINE / SOAK / DAM
- DUAL USE FOOTPATH
- EMERGENCY ACCESS WAY
- EXISTING GAS STORAGE-TANK TO BE RELOCATED AND ASSOCIATED PIPE INFRASTRUCTURE TO BE MODIFIED TO SERVICE THE LIFESTYLE VILLAGE AND MAINTAIN GAS SUPPLY TO RAPIDS LANDING ESTATE.
- LANDSCAPE BUFFER / LINEAR PRIVATE OPEN SPACE
- EXISTING TREES

ZONES

- RESIDENTIAL R30/R40

RESERVES

- PARKS AND RECREATION AND DRAINAGE

STRUCTURE PLAN

Lot 9014 John Archibald Drive, MARGARET RIVER

Edenlife Communities Pty Ltd	:	CLIENT
A3@1:2,000	:	SCALE
12 May 2022	:	DATE
00100-2-9014-001	:	PLAN No
B	:	REVISION
G.A	:	PLANNER
B.L	:	DRAWN

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PART TWO – EXPLANATORY REPORT

1.0 Planning Background

1.1 Introduction and Purpose

Lot 9014 John Archibald Drive is owned by Balwyn Margaret River Pty Ltd and represents the balance undeveloped portion of the existing Rapids Landing Estate. Preparation of a separate Structure Plan is required for the north-west portion of Lot 9014 to guide future land use, subdivision and development as per the existing Outline Development Plan for the overall Rapids Landing Estate that was endorsed by the WAPC in November 2006.

This Structure Plan has been prepared in accordance with the Department of Planning Structure Plan Framework (August 2015). It provides background and explanatory information and assesses the Structure Plan against the planning framework to demonstrate suitability in context with the land use and associated subdivision and development requirements.

This Structure Plan will provide for the future development of a land lease community or modular home estate (MHE) comprising grouped dwellings and associated community and recreation facilities that cater for the needs of prospective residents in the over 50's age bracket. It will incorporate ageing in place requirements, within the relaxed ambience of a secure community setting that will be nestled amongst areas of rehabilitated foreshore reserves/public open space and mature trees to be retained.

1.2 Land Description

1.2.1 Location

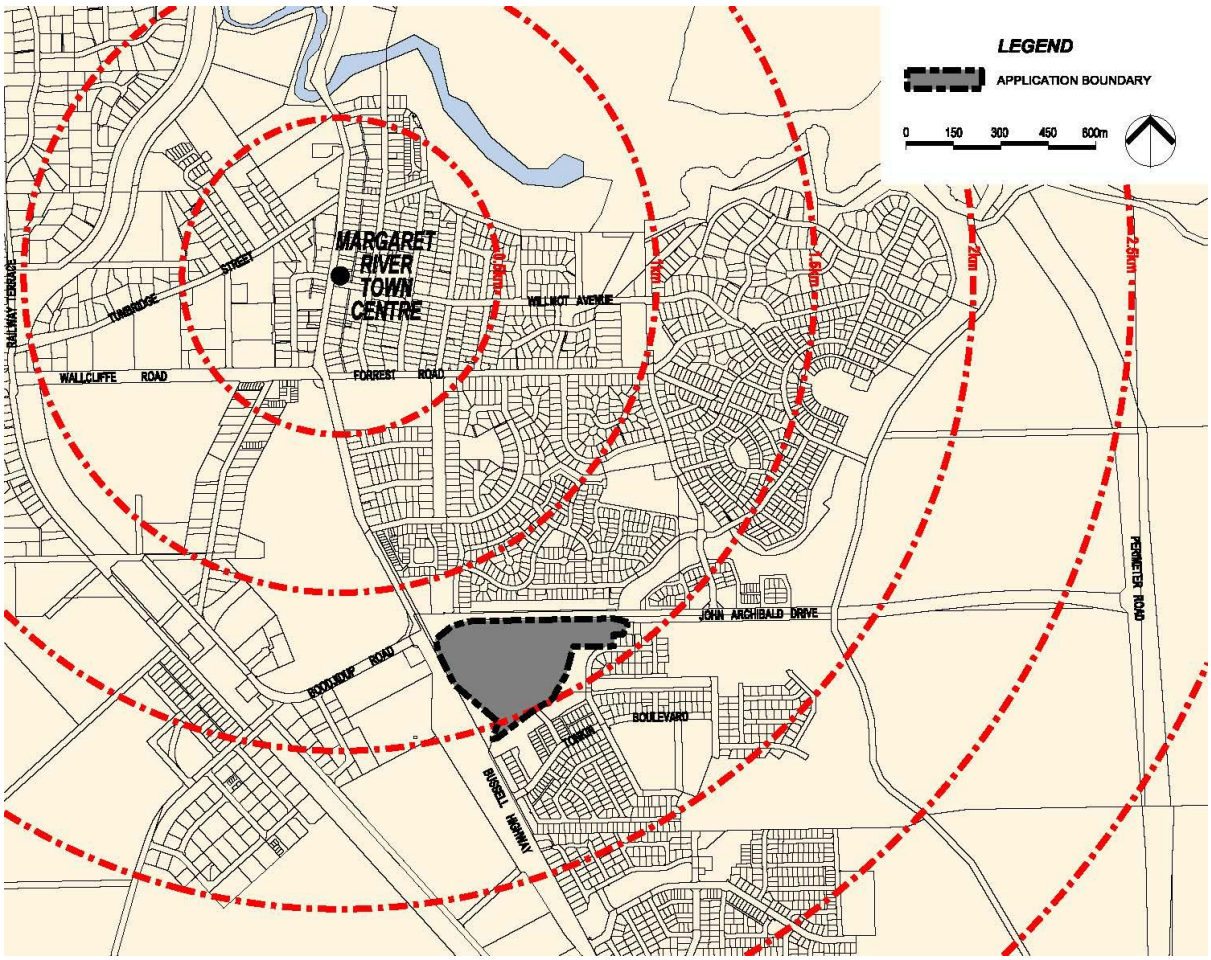
The land is situated 1.2 kilometres south of Margaret River town centre (refer **Figure 1** - Location Plan).

The north-west portion of Lot 9014, the area affected by this Structure Plan, lies to the south of John Archibald Drive, and east of Bussell Highway. The land abuts existing foreshore reserve/ public open space on its southern and eastern boundaries – with the existing Rapids Landing Residential Estate located beyond.

The land immediately north of John Archibald Drive has been developed for residential purposes.

John Archibald Drive provides a key east-west connection that links the site to the Margaret River townsite, the Margaret River Light Industrial /Service Commercial area to the west and broader rural residential and rural areas beyond. It also provides a key road link east to the Margaret River Perimeter Road - being the key regional road connecting the Margaret River townsite with various centres in the region.

Figure 1 – Location Plan



1.2.2 Area and Land Use

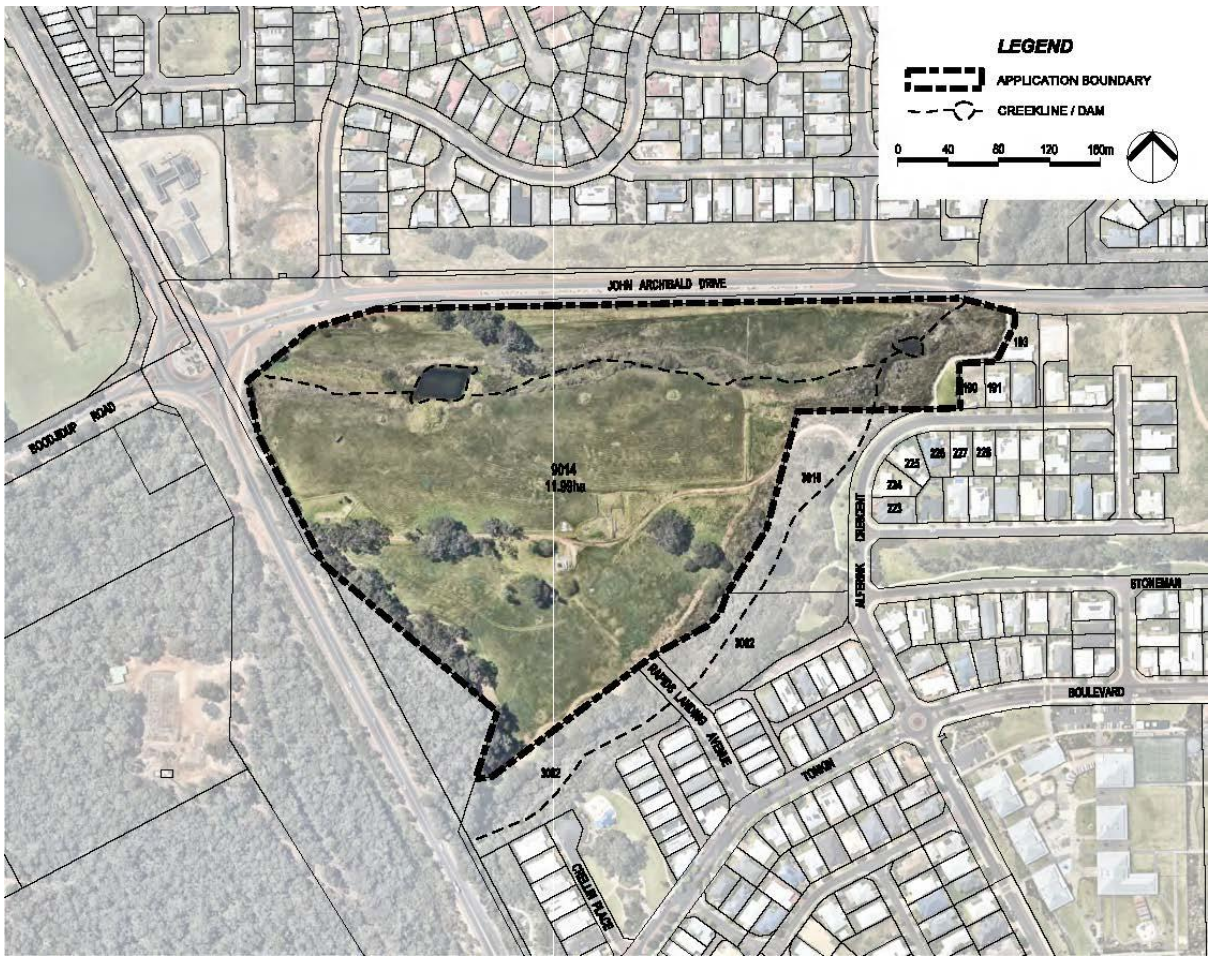
The land has an area of 11.99 hectares (refer **Figure 2** – Aerial Image). The developable land (area identified for future residential grouped dwelling purposes) has an area of 6.99 hectares and is predominantly cleared with only scattered paddock trees remaining. The land was historically cleared and used for cattle grazing and contains pasture grasses throughout. The northern portion of the land contains an existing soak and drainage line that feeds eastwards to a tributary that connects to the Darch Brook.

A widened area of Bussell Highway contains remnant vegetation that will screen future development from a significant portion of the road carriageway. The existing rehabilitated foreshore reserve located east and south of the land will also significantly screen future development from existing residential development located within Rapids Landing Estate.

A Gas Tank (Kleenheat Gas) is located central to the land, with a buried gas pipeline to Rapids Landing Avenue extending southwards. The land also contains associated fencing and a gravel access driveway that connects with Bussell Highway.

There are no topographic, environmental, servicing or cultural constraints that would hinder development of the land as identified on the Structure Plan.

Figure 2 – Aerial Image



1.2.3 Legal Description and Ownership

The land is legally described as Lot 9014 on Deposited Plan 413998 John Archibald Drive, Margaret River. **Table 3** below outlines the relevant ownership information associated with the land. The Certificate of Title is contained at **Appendix 1**.

Table 3 - Ownership Details

Landowner	Lot No.	Plan/ Diagram No.	Certificate of Title	Street Address	Easements/ Encumbrances
Balwyn Margaret River Pty Ltd	9014	413998	Volume 2959 Folio 570	John Archibald Drive, Margaret River	Service Easement burdens are provided on the Certificate of title at **Appendix 1** of this report

1.3 Planning Framework

1.3.1 Zoning

1.3.1.1 Shire of Augusta-Margaret River Local Planning Scheme No.1 (2010)

The land is zoned 'Future Development' in the Shire of Augusta-Margaret River Local Planning Scheme No.1 ('the Scheme'). The Scheme also designates the land within 'Structure Plan Area No.5' pursuant to Schedule 11 of the Scheme and is referenced in Table 4 below.

Table 4 – Local Planning Scheme No. 1 Schedule 11 – Structure Plan Areas

Area No. (SPA)	Description of Land Area	Land Use Expectation	Matters to be Addressed in Structure Plans (in addition to Part 4 of the Deemed Provisions	Associated Provisions
5	East Margaret River	Townsite Expansion	Generally in accordance with East Margaret River District Structure Plan 2015 or subsequent Structure Plan approved by the Western Australian Planning Commission in accordance with the process set out in Part 4 of the Deemed Provisions	Land use and development in accordance with the approved Structure Plan

Clause 16 of the Deemed Provisions for local planning schemes (included in the *Planning and Development (Local Planning Schemes) Regulations 2015*) outlines the information that a Structure Plan is to address. This Structure Plan has been tailored to address the information required in context with the proposal. The Structure Plan is also supported by relevant technical studies that are discussed further under Section 3 and 5 of this report. The technical studies are appended to this report for reference purposes.

1.3.2 Regional and Sub-regional Structure Plans

1.3.2.1 Shire of Augusta-Margaret River East Margaret River Structure plan (EMRDSP) (WAPC: October 2017)

The East Margaret River District Structure Plan (endorsed by the WAPC in October 2017)(EMRDSP) was prepared to guide the future development of more detailed Local Structure Plans and subsequent subdivision and development of East Margaret River. The EMRDSP identifies the key constraints and opportunities for the land, providing for residential, civic or education development taking into consideration environment, services, infrastructure, linkages, buffers and movement networks.

The Structure Plan provides the land use framework to support the future development of Rapids Landing Lifestyle Community. It will facilitate for a land lease community or modular home estate (MHE) comprising grouped dwellings and associated community and recreation facilities that cater for the needs of prospective residents in the over 50's age bracket.

The Structure Plan is therefore consistent with the EMRDSP noting it will provide for innovative and affordable housing options that will be supported by age friendly infrastructure, specifically aimed at assisting people to live in a high amenity and secure setting.

1.3.3 Planning Strategies

1.3.3.1 State Planning Strategy 2050

State Planning Strategy 2050 ('the Strategy') is the highest order planning instrument in the Western Australian planning system. The Strategy represents a guide from which public and local authorities can express or frame their legislative responsibilities in land-use planning, land development and related matters.

The Strategy offers an integrated whole-of-government view of strategic planning needed to respond to various challenges, including population growth, an ageing population, and an orientation towards sustainable living. The Strategy reinforces this where it states –

'The Western Australian population is ageing. Over the next 40 years the proportion of the population aged 65 or over is likely to increase from 13% to 22% and, in contrast, the proportion aged 15 or under is likely to decrease slightly from 19% to 18%.

Such a change in the State's demographics has direct impacts on planning directions and priorities (e.g. access to health care, mobility, labour pressures and internal migration).

The ageing of our population will increase the demand for dwellings such as apartments or units in suitable locations.

This demographic shift will impact on most aspects of the economy, in particular the composition of the labour force, healthcare requirements, education and social services, and the mix of dwelling types.'

The Strategy further recognizes that Western Australia's demographic and household structures are changing rapidly. Hence, in achieving a vision of sustained growth and prosperity, communities will require access to diverse housing and services that complement their values and lifestyle choice.

The Structure Plan proposes to provide a framework to implement an innovative community lifestyle model for the ageing population within Margaret River and its surrounds that offers diverse and affordable housing opportunities. The housing model tenure will see the landowner own the land with each resident owning their own home and protected by the *Residential Parks (Long-stay Tenants) Amendment Act 2020*. By separating land ownership and home ownership and introducing a unique long-term lease (60 years) for siting resident owned dwellings, the landowner can provide security of tenure and entry affordability to its residents, within a managed community environment.

This model structure also facilitates access by residents to Commonwealth rental assistance for eligible Centrelink benefit recipients which reduces resident land rents by about a third.

One of the Strategy's objectives is to 'encourage active lifestyles, community and betterment. In considering this objective the Strategy recognises that:

'An ageing population exhibits increasing demand for healthy recreation and experiences, presenting opportunities for emergent lifestyle services and facilities.'

The lifestyle community model will respond to these demands through the provision of facilities for residents that support sporting and leisure activities (including bowls and swimming), fitness centre, clubhouse, catering facilities, library, internet kiosk, outdoor facilities and entertaining. The design and range of facilities also assist greatly in establishing a sense of community, belonging and as a result, a significant reduction in social isolation.

1.3.3.2 Leeuwin-Naturaliste Sub-regional Strategy (WAPC: May 2019)

The Leeuwin-Naturaliste Sub-regional Strategy (LNSS) is an overarching strategic land use planning document outlining the WAPC's approach and guidance to implement State strategic priorities and inform local planning strategies and schemes. Its purpose is to manage and plan for growth within the sub-region and to inform a review of State Planning Policy 6.1- Leeuwin Naturalist Ridge.

A key strategic direction of the LNSS relevant to this Structure Plan is to 'promote the growth of the Margaret River townsite through consolidation of existing urban areas and urban expansion consistent with the East Margaret River District Structure Plan (2017), generally in the area bounded by the Margaret River, Bussell Highway and the Margaret River Perimeter Road.'

This Structure Plan reinforces the above strategic direction by providing the land use framework to support the future development of Rapids Landing Lifestyle Community – which is also consistent with the land uses identified for the land in the EMRDSP.

1.3.3.2 Shire of August-Margaret River Local Planning Strategy 2036 (January 2022)

The Margaret River Local Planning Strategy 2036 (LPS 2036) was recently endorsed by the WAPC in January 2022. The Margaret River Strategy Map provided within LPS 2036 identifies the land as Current Urban Growth Area M1. LPS 2036 outlines the proposed land use for the land to be residential, extensive areas of public open space and may include tourism and/or community uses.

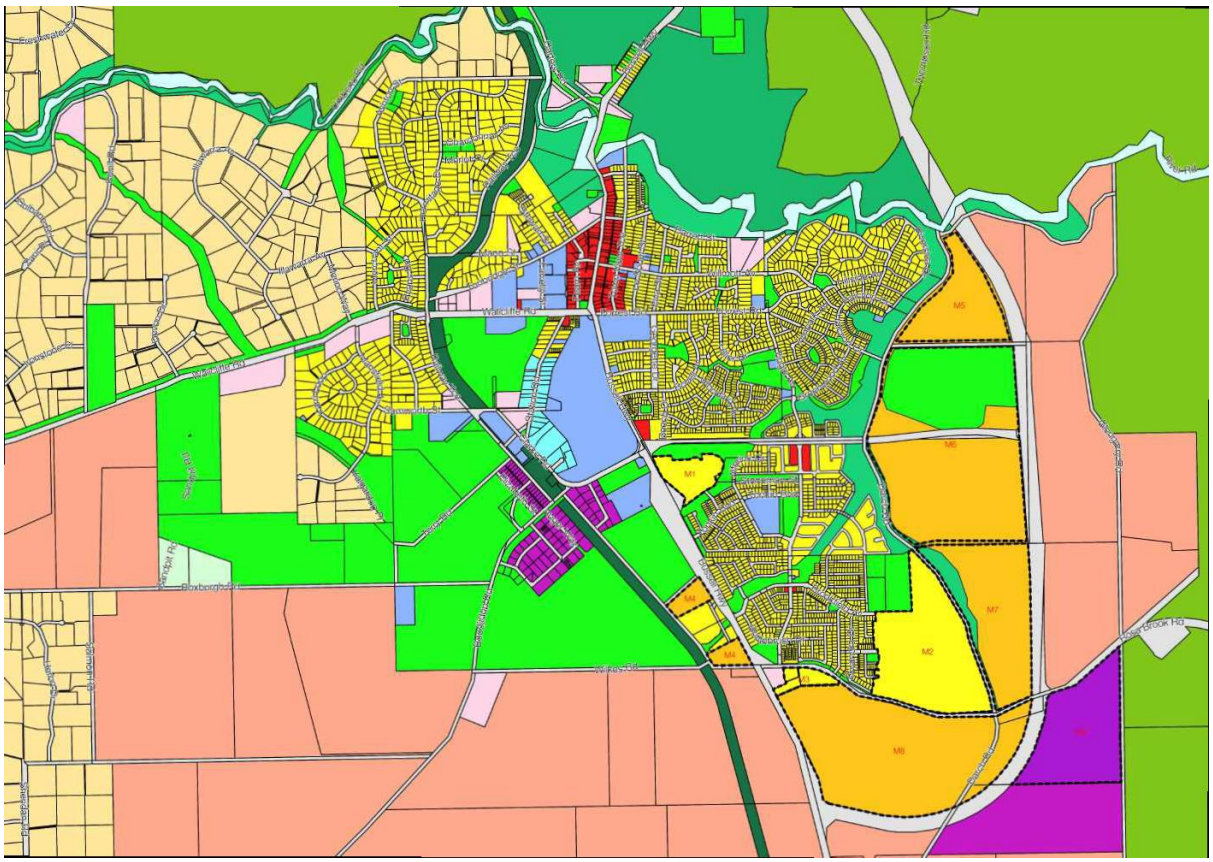
Table 5 on the next page depicts the associated Precinct Planning Requirements for the land.

Table 5 – Planning Precinct M1 Precinct Planning Requirements (LPS 2036)

Current Urban Growth Areas		
Planning Precinct	Precinct Planning Requirements	
M1	**Proposed Land Use**: Residential **Current Zoning**: Future Development **Proposed Use**: Extensive areas of POS together with residential and may include tourism and/or community uses.	**Development Timeframe**: Short Term **Structure Planning Status/Required**: Structure Plan Required **Estimated Lot Yield**: 75
	Planning matters to be addressed: Measures shall be included in the structure plan to address the visually sensitive nature of the site owing to its location near high traffic roads and vulnerability to undesirable development. Consideration of whether road connectivity through the site as per EMRDSP 2005 remains a requirement. Need or otherwise for community/cultural development.	

Figure 3 below shows the location of Planning Precinct M1. It identifies the land to fall within the 'residential' (being land which is or will be developed for housing) and 'public open space' Land Use Classifications'. The Shape of Planning Precinct M1 reflects that identified on the Rapids Landing Outline Development Plan endorsed by the WAPC in November 2006.

Figure 3 – Margaret River Current Urban Growth Area (LPS 2036)



LPS 2036 further identifies the land as a Visual Sensitive Site – being '*a site which is or will be subject to pressure for land use change which is visually prominent and which is traversed by a high traffic volume road.*'

Section 3 of this report addresses the planning matters identified for the site as set out in LPS 2036. The Structure Plan facilitates for the future development of a Lifestyle Community that provides for high quality, affordable housing options for people wanting to age in place and be located close to services, community facilities and surrounding vegetated open space offering high landscape/residential amenity.

1.3.4 Planning Policies

1.3.4.1 Statement of Planning Policy 6.1 – Leeuwin-Naturaliste Ridge (WAPC) (1998/2003)

In 1998 the WAPC adopted Statement of Planning Policy 6.1 – Leeuwin-Naturaliste Ridge (SPP 6.1) to provide the strategic framework for the Policy Area for the next 30 years through greater vision, guidance and certainty of land use. It promotes sustainable development, conservation and land resource management that will, amongst other things, provide direction to those managing land use change and give clear regional-level advice to proponents on subdivision and development.

SPP 6.1 identifies the Structure Plan area within the Margaret River Development Investigation Area. The Policy states '*that Development Investigation Areas are a guide to potential development but require detailed investigation prior to subdivision and development, including form, function and design.*'

This Structure Plan proposes to facilitate future urban development consistent with SPP 6.1. Moreover, it provides a detailed assessment of the land to be developed for grouped dwelling purposes consistent with the proposed land use intent for the land set out in Council's LPS 2036 and the EMRDSP.

1.3.4.2 Statement of Planning Policy No. 3.7 – Planning in Bushfire Prone Areas (December 2015)

Statement of Planning Policy No 3.7 Planning in Bushfire Prone Areas ('SPP 3.7') and the associated Guidelines for Planning in Bushfire Prone Areas (the 'Bushfire Guidelines') are relevant for the Structure Plan area. A Bushfire Management Plan ('BMP') has been prepared in accordance with SPP 3.7 and the Bushfire Guidelines and can be viewed at **Appendix 10** of this report.

The BMP includes a Bushfire Attack Level (BAL) assessment, identifies bushfire hazard issues and demonstrates that the bushfire protection criteria set out in the Bushfire Guidelines can be achieved as part of the subdivision and associated development process under this Structure Plan.

1.3.4.3 Statement of Planning Policy No. 3 – Urban Growth and Settlement (March 2006)

This Policy sets out the principles and considerations which apply to planning for urban growth and settlement in Western Australia. The policy aims to facilitate sustainable patterns of urban growth and settlement and should be given weight in statutory decision making in this regard.

The Structure Plan is consistent with the objectives of the Policy as it promotes a sustainable and well planned settlement that will provide for a range of lots to accommodate a variety of housing types and sizes, reduces energy and travel demand, provides safe and convenient access to facilities and to goods and services to be provided in the future Rapids landing Neighbourhood Centre and in the existing Margaret River town site.

1.3.4.4 Statement of Planning Policy 5.4 – Road and Rail Noise (September 2019)

The purpose of this Policy is to address the impact of transport noise on noise-sensitive land use or development. It provides a performance based approach to manage and mitigate transport noise on the amenity and quality of life for residents. This Structure Plan proposal has undertaken an acoustic assessment of noise received for the proposed internal layout of the Rapids Landing Lifestyle Community Masterplan. The review was undertaken by Herring Storer Acoustics and is provided at **Appendix 13**.

The Structure Plan accords with the requirements of the Policy and establishes noise attenuation standards for new applicable residential development where they are located closest to Bussell Highway. In this regard the Structure Plan notates the applicable grouped dwelling development to be developed in accordance with quiet house design packages and require notification on title and the lease contract for affected grouped dwellings relating to traffic noise.

1.3.5 Other Approvals and Decisions

1.3.5.1 Rapids Landing Outline Development Plan (WAPC Endorsed – November 2006)

The existing Outline Development Plan for the overall Rapids Landing Estate (which encapsulates the subject land in its north-west portion of the overall landholding) was endorsed by the WAPC in November 2006. It includes wording that states 'Area is to be subject of detailed design and separate ODP'. This means that the land is required to have a Structure Plan prepared to provide a planning framework to guide future land use, subdivision and development.

This Structure Plan has been prepared as per the Department of Planning Structure Plan Framework (August 2015) and Structure Plan requirements set out in the *Planning & Development (Local Planning Schemes) Regulations 2015.*

1.3.6 Pre-lodgement Consultation

February 2019 – Shire of Augusta-Margaret River

A Meeting was held with the Shire of Augusta-Margaret River then Acting Director of Development Services, the then Acting Manager of Planning and Development Services and the proponent to consider the matters to address as part of a proposed Structure Plan that would facilitate the development of a lifestyle community to provide for modular, affordable housing and associated amenities suited to middle aged and older residents.

Council provided the following feedback/information with respect to the land and the proposed land use/development direction are listed below:

- Early planning (including the 2002 Enquiry by Design Workshop and East Margaret River Structure Plan (WAPC endorsed - May 2005) outlined that neither Council nor the community had any fixed position on future proposed land use for the land.

- Hence given that there was no specific vision at that time, the list of land uses detailed in the 2005 East Margaret River Structure Plan was more a way of quarantining the types of uses that may be suitable for the land.

- The 2005 East Margaret River Structure Plan (2005) therefore notated the site to be suitable for medium density residential, community/cultural and tourist accommodation.

March 2019 – Shire of Augusta-Margaret River

Council's Acting Manager of Planning of Planning provided subsequent feedback to the proposed Lifestyle Community proposal outlining the following:

- Whether the proponent progresses with the park home model or with grouped dwellings, we request that you prepare a Local Development Plan (LDP) following the process outlined in the Deemed Provisions of LPS1. We come to this view for two reasons. The first is that the future use of the subject site as contemplated by the various plans which have been produced over time, has always been uncertain and therefore a comprehensive consultation process has not occurred. The second is that it is hard to imagine every derivation of park

home park/grouped dwelling which may occur on the site could be contemplated by the one Development Application. On the flip side a LDP can exempt compliant development from the need for a Development Application, so you might save some time by going down this route.

- Note that the Deemed Provisions require the WAPC to agree that a LDP is required and therefore the proponent should contact the DPLH in Bunbury before commencing down this path.

- We agree that the issues listed as 1-7 in the proponent's email will need to be addressed by way of your LDP application. This includes, fire, drainage, road design (is a public road connection through to John Archibald Drive required?) visual amenity and landscaping. Those listed items are provided below.

    - Development of a comprehensive risk management plan for the ongoing management of all phases of the planning, construction and operation of the community (assuming support and approval).
    - Visual amenity and landscaping (development of a detailed landscaping plan).
    - Stormwater and drainage management (onsite retention).
    - Required buffers including the enhancement and remediation works.
    - Traffic management and movement plan (construction phase and delivery and installation of homes).
    - Dust and rubbish management during construction.
    - Addressing and adhering to all BAL requirements (including home designs).

- We note that the existing line of trees, and access drive linking to the timber cattle yards is a distinctive feature of the site and request this be taken into consideration when arriving at a design.

- Should also consider the need for public footpaths which link to those that are existing.

- With respect to community consultation we note that there is a process for statutory advertising of a proposal within the Deemed Provisions. However we recommended that you conduct more interactive consultation with community in addition to this. We can suggest how and when you might be best to do this when we get closer to that time.

March 2019 - Department of Planning; Lands; Heritage

The following observations/ advice was provided by senior planning officer's from the Planning Manager at Department of Planning, Lands and Heritage (DPLH) with regard to the query by Council above:

- The proposal to support future development of a Lifestyle Community would be more suitable for the land to be identified appropriately through the structure plan amendment process, given the current plan does not show subdivision or zoning, nor has this land use been seriously entertained by the Commission. Should the local government wish for a local development plan to be prepared to guide the development of the land, that can then be stipulated as a condition of the structure plan.

May 2019 - Department of Planning; Lands; Heritage

The following subsequent advice was provided by senior planning officer's from the Planning Manager at DPLH with regard to the planning assessment process:

- If the local government is supportive of the preparation of a separate structure plan to the existing Rapids Landing Outline Development Plan, the Commission would likely be as well. Instead of undertaking a Local Development Plan (LDP), a basic amendment could then follow which inserts relevant provisions into the scheme to control the development of the site. However, I understand that an LDP may be beneficial for this type of development, given it can exclude the ongoing need to obtain development approval.

- Regarding removal of the road connection to John Archibald Drive, this may not be supported by the Commission, given it removes connectivity through and to the site. Should the developer wish it to be removed, this would have to be properly justified.

May 2019 – Shire of Augusta-Margaret River

Council's Acting Manager of Planning and Development Services provided subsequent feedback in response to feedback provided by Department of Planning, Lands and Heritage above:

- Given the direction provided by the DPLH/WAPC, it is suggested the proponent progress with the structure plan revision (including some direction for issues to be addressed in future stages) and, upon successful completion, lodge a DA.

August 2021 - Shire of Augusta-Margaret River

Council's Manager of Planning and Development Services confirmed, through discussions with DPLH Planning Manager, the advice remains the same that a Structure Plan is required as previously provided.

It was also noted that DPLH Officers did make a good suggestion that a Local Development Plan could exempt the need for lodgement of future Development Applications.

August 2021 - Department of Planning; Lands; Heritage

Senior Planning officers of DPLH confirm that, in line with *Part 9, Division 1, r80 of the Planning and Development (Local Planning Scheme) Regulations 2015*, an Outline Development Plan is construed as a 'Structure Plan', not a Local Development Plan.

Furthermore, given the relatively recent changes to the Regulations, the proponent may want to discuss with the Shire the option of preparing a Precinct Structure Plan to combine land use and built form controls.

March 2022 – Department of Water and Environmental Regulation

In relation to water management this approach to prepare an Urban Water Management Plan that is to be submitted with the Local Development Plan (LDP) is acceptable to the Department, noting that:

1. The UWMP is to cover the entire LDP area to avoid unintended consequences from staged construction.

2. The UWMP and Landscape and Rehabilitation Management Plan (L&RMP) for the Parks and Recreation/Drainage Reserve (which will be a condition of subdivision) are developed concurrently to ensure that outfalls from the LDP are appropriately taken into account in the design of the Recreation/Drainage Reserve.

I would however note that in view of a Bushfire Management Plan (BMP) being prepared to support the structure plan, it is unclear how this may limit the intent of the L&RMP at subdivision. This is deemed an important consideration, as while these areas are called drainage reserves they are waterways. The Department's preference is for them to be managed as waterways and they should therefore provide ecological function, which has been achieved in the reaches immediately downstream.

Aspects DWER will be checking for will include access both to and along the foreshore for maintenance, noting the gated facility, riparian vegetation extent and species, and ensuring that no stormwater infrastructure is proposed in the reserve, noting my earlier comment regarding having that located within the development footprint to support the structure plan.

2.0 Site Conditions and Constraints

2.1 Biodiversity and Natural Area Assets

The land has an area of 11.99 hectares and is predominantly cleared with only scattered paddock trees remaining. The land was historically used for cattle grazing and contains pasture grasses throughout. Hence the land has been assessed as highly degraded.

Based on the Council approved Foreshore Management Plan (October 2019) (refer to **Appendix 5**, the key management principles to be considered for the land, include:

- Design road access and / or appropriate landscaping between all creek-line vegetation and housing to achieve sufficient setbacks to keep the Bushfire Attack Level to less than BAL 29.
- Establishing the road and path network above the floodplain and waterlogged areas to reduce the requirements for fill and supplementary drainage.
- Protection of the hilltop spring and significant tree.
- Establishing the riparian zone to the extent of waterlogged soil and constructing landscape amenities above to reduce construction effort.
- Minimising any clearing of the forest on the western boundary to enhance screening of Bussell Highway and wildlife corridors

The Rapids Landing Lifestyle Community Master Plan (provided at **Appendix 2**) has duly considered the above key principles. Most notably it proposes to retain the existing endemic mature trees within private open space, public open space and within the front setback of proposed grouped dwelling allotments (where practicable). This approach reflects the recommendations set out in the Waterway Revegetation Plan (provided at **Appendix 6**) and Landscape Guide Plan (provided at **Appendix 7**).

The development footprint responds to the future indicative waterway reserve identified in the Foreshore Management Plan (refer **Appendix 5**) – which references 'Conservation, Rehabilitation/Restoration and Recreation Interface Zones.

There are no environmental constraints that would hinder development of the land as proposed.

2.2 Landform and Soils

2.2.1 Topography

The highest point of the land is located toward the south-western portion being 90m AHD. The land then descends from this high point to the east and north toward the creek line valley system of two separate tributaries that has its lowest point being 75m AHD in the north-east. The land ascends from the northern west-east creek line to 82m AHD where it abuts John Archibald Drive. The landform, associated tributaries and landscape features provides for an attractive setting and outlook for future residential development and for the surrounding community.

2.2.2 Soils and Land Capability

The Busselton Margaret River Augusta Land Capability Study (Prepared by Tille and Lantske :1990 at the Department of Agriculture) identifies the land to fall within the Cowaramup Uplands Land system.

Approximately 20% of the land is included within the Cowaramup Flats (C) sub-system and is located on the higher flatter central-west portion of land. This sub-system is referred to as flats (0-2% gradient) with gravelly duplex (Forest Grove) and pale grey mottled (Mungite) soils.

Approximately 80% of the land is included within the Cowaramup Wet Vales (Cvw) sub-system and forms the (side) slopes and (valley) floor. This sub-system is described as small, broad, U-shaped drainage depressions with swampy floors (which comprises the intermittent creek lines), Gravelly duplex (Forest Grove) soils on the side slopes and poorly drained alluvial soils on the valley floor.

The geotechnical study undertaken by Galt Geotechnics in October 2020 (refer **Appendix 8**). It concluded the subsurface soil conditions for the land to be broadly consistent across the land and be summarized to fall within two zones as follows:

Zone 1 - (Eastern part of the development land) Site Classification M (containing a thin layer of inert granular material overlaying medium to high plasticity clay (typically increasing with depth).

Zone 2 - (North-west and northern portion of the development land) Site Classification H1 (Shallow groundwater and clayey soils overlying medium to high plasticity (typically increasing with depth)

Target soil sampling depths to 2 metres were achieved across the majority of the land. Notably, the geotechnical report considers the site to be capable of supporting the proposed development.

2.2.3 Acid Sulfate Soils

The Department of Water and Environment Regulation (DWER) Acid Sulfate Soils (ASS) Risk Mapping indicates the higher flatter central-west portion of land (consistent with the approximate 20% land portion identified as the Cowaramup Flats sub-system) to have no known risk from ASS.

The balance (approximately 80%) portion of the land is mapped as having a 'medium to low risk of ASS within 3 metres of the natural soils surface'. These moderate to low risk ASS areas coincide with the creek line alignment located to the south of the site and the tributary that runs west-east across the northern portion of the land. Mapping showing the Medium to Low Risk (Class 2) area can be viewed in the Servicing Report prepared by McDowell Affleck Consultant Engineers at **Appendix 9**.

2.2.4 Contaminated Sites

The Structure Plan area is not reflected in the Department of Water and Environmental Regulation's Contaminated Sites database and is therefore not constrained from more intensive development in this regard.

2.3 Groundwater and Surface Water

2.3.1 Groundwater

The Structure Plan area forms part of the balance portion of Rapids Landing Estate which has not been developed, though it abuts other areas already constructed through various earlier stages. The Rapids Landing development was originally granted subdivision approval by the WAPC in January 2007 (WAPC Ref: 132030) which predates the establishment of the Better Urban Water Management Framework. As such, the site has not been subject to the requirement for a Local Water Management Strategy, but rather preparation of Urban Water Management Plans as a condition of subdivision approval.

GALT Geotechnics undertook drilling of boreholes, logged materials encountered, collected representative samples for laboratory testing and conducted penetrometer testing on the land during September 2020. Their assessment of groundwater conditions across the site concluded that shallow perched water (ranging in depth between 0.2m to 1.0m) was encountered across the site. The assessment did not encounter groundwater in the southwest corner of the land where testing depths ranged from 1.1m to 2m.

Preparation of an Urban Water Management Plan is included as a Local Development Plan requirement set out under Part 1 – Implementation of this report.

2.3.2 Surface Waterways

The land contains a surface waterway (intermittent tributary) that runs west to east across the northern portion of the land. The Aerial Image provided at Figure 2 identifies two earth dams/soaks to be located on the land. One dam is located toward the western portion of the land. The other is located where a separate creek line converges from within existing public open space reserves abutting the south-eastern edge of the land.

2.4 Bushfire Hazard

The site is located within a bushfire prone area, as declared by State Planning Policy 3.7: Planning in Bushfire Prone Areas. A Bushfire Management Plan (BMP) has been prepared for the land by Bushfire Perth Pty Ltd to address all applicable legislation, policy, standards and guidelines. It provides fire management methods and requirements that will be implemented within and around the land to reduce the threat to residents and fire fighters in the event of a fire.

The BMP is provided at **Appendix 10** of this report. The BMP:

- Includes a Bushfire Attack Level (BAL) assessment that concludes that all lots/development sites within the proposed development site can achieve BAL-29 or lower,
- identifies bushfire hazard matters to consider, and
- demonstrates that the bushfire protection criteria set out in the Bushfire Guidelines can be achieved as part of the subdivision and future development processes as guided by the Structure Plan.

2.5 Heritage

2.5.1 Indigenous Heritage

A review of the Department of Indigenous Affairs Heritage Inquiry System has outlined that there is one recorded Aboriginal Heritage site. The Registered Aboriginal Heritage Site 4495 aligns with the creek line system the tributary located to the northern portion of the land. Additionally, Other Heritage Place 21038 runs along the northern portion of the land. The Findings of the Heritage Enquiry are attached at **Appendix 11**.

The previous WAPC endorsed Rapids Landing Outline Development Plan (November 2006) included a heritage assessment under taken by Brad Goode & Associates. This report covered the Structure Plan area (which originally formed part of Lot 27 Bussell Highway, Margaret River) identified in this proposal. A *Section 18 (2) of the Aboriginal Heritage Act 1972* consent was granted in January 2005 to use the land for residential and public open space purposes. A copy of the Section 18 Consent letter is also provided at **Appendix 11.** Although the Section 18 Consent Letter identifies an entity "Greendene Development Corporation Pty Ltd", the owner of the land for the proposed development was and remains as the Lester Group (noting the Lester Group is the owner of Edenlife Communities Pty Ltd).

The proponent is mindful of the Conditions of Consent set out in the *Section 18 (2) of the Aboriginal Heritage Act 1972* consent letter with regard to undertaking works on the land.

2.5.2 Non-Indigenous Heritage

A search of the Heritage Council of WA's in Herit places database confirms there are no state registered heritage places on the subject land. Furthermore, the Shire of Augusta-Margaret River Heritage Inventory does not identify any sites located on the property.

2.6 Context and Other Land Use Constraints and Opportunities

The existing Rapids Landing Estate is serviced with all essential services including reticulated water and sewer, stormwater, power and telecommunications. The proposed Structure Plan area will benefit from the extension of these services for the future subdivision and development of the Rapids Landing Lifestyle Community Structure Plan area as required.

3.0 Land Use, Subdivision and Development Requirements

3.1 Land Use

The proposed Structure Plan (Ref: 00100-2-9014-001-Rev A), as provided in Part One of this report, aims to achieve the following Land Use and Design objectives:

1. Guide future development in accordance with the Residential Design Codes as a grouped dwelling development for aged persons (older Australians aged 50 years and over) and operated according to the *Residential Parks (Long-stay Tenants) Amendment Act 2020* and supporting regulations.

2. To accommodate the following land uses –

    - Grouped Dwellings located on allotments ranging between 180m^2 to 300m^2 at a Residential Density of R30/40;

    - Central Community Building providing facilities for the exclusive use of residents in the Lifestyle Community. Community facilities will include central management, foyer, cinema, indoor heated pool, bowling green, outside meeting and barbeque areas;

    - Public Open Space/Foreshore Reserve to be rehabilitated in accordance with a Landscape and Rehabilitation Plan and the recommendations set out in the Council approved Foreshore Management Plan; and

    - Private Open Space within the Lifestyle Community that will incorporate visual buffers to Bussell Highway, retention of existing endemic trees and passive recreation opportunities for residents.

3. Development to incorporate ageing in place requirements, within the relaxed ambience of a secure community setting that will be nestled amongst areas of rehabilitated foreshore reserves/public open space and mature trees to be retained.

4. Include a requirement for a Local Development Plan to be prepared and implemented that sets out specific and detailed guidance for the future development of the Grouped Dwellings and associated Structures and facilities and outlines exemptions from the requirement to obtain development approval for development where it is consistent with the approved Local Development Plan.

The land use and internal private road layout will generally reflect the Rapids Landing Lifestyle Community Masterplan provided at **Appendix 2** in this report.

3.2 Public Open Space

A substantial portion of the Structure Plan area is identified as public open space. The public open space calculation is illustrated on the Structure Plan and also within Table 6 below and demonstrates that a total of 2.41ha (includes 50% POS Allocation/Credit) or 25.6% of the total Structure Plan area is to be provided. Table 6 below also demonstrates that a total of 0.94ha or 10% of the net subdivisible area is to be provided. This is based on the net subdivisible area of 9.4ha - with deductions being made for the private landscape buffer and drainage requirements. The 50%

drainage reduction reflects that originally provided in the Outline Development Plan (Structure Plan) for the overall Rapids Landing Estate that was endorsed by the WAPC in November 2006.

Table 6 - Public Open Space Schedule

Public Open Space Schedule			
	Total Structure Plan Area		**11.99ha**
Deductions			
50% Drainage		2.41ha	
Private Landscape Buffer		0.18ha	
	Total Deductions	**2.59ha**	
	Net Subdivisible Area		**9.4ha**
	Required Public Open Space Contribution (10%)		**0.94ha**
	Total POS Provided (Includes 50% POS Allocation/Credit)		**2.41ha**
	POS Provision as a percentage of Net Subdivisible Area		**25.6%**

The vision for the public open space consists of passive recreation links utilising the drainage lines that traverse the northern portion of the land, which connect to existing foreshore public open space reserve areas already rehabilitated and providing footpath networks linking with the rest of Rapids Landing Estate.

The public open space area has also considered:

1. The POS allocation originally provided in the Outline Development Plan (Structure Plan) for the overall Rapids Landing Estate that was endorsed by the WAPC in November 2006;

2. The Council approved Foreshore Management Plan (October 2019) (refer to **Appendix 5)** and its key management principles discussed under Section 2.1 of this report;

3. Minor changes to the management zone boundaries allocated in the Council approved Foreshore Management Plan for the northern (west-east) tributary and inclusion of additional land to be consolidated with adjoining public open space reserves identified as Lot 3002 and 3010 on the Structure Plan.

4. The requirement to include a landscape buffer between Bussell Highway and the land to protect and enhance visual amenity between the proposed development and the surrounding public realm.

3.3 Residential

As indicatively depicted in the Rapids Landing Lifestyle Community Master Plan (refer **Appendix 2**), this Structure Plan aims to guide future land use, subdivision and development of the land to accommodate a high quality grouped dwelling development and associated community and recreation facilities. Edenlife's development model provides for a very high standard of modern and architecturally designed grouped dwellings with a range of housing types that cater for the needs of prospective residents in the over 50's age demographic.

The Structure Plan identifies the developable portion of the land to be Residential R30/40. This will be retained as one lot title and provide for grouped dwellings to accommodate a selection of 1, 2 and 3 bedroom dwelling designs within allotments. These grouped dwellings will be integrated into the landscape, address the internal privately maintained streets and incorporate good solar access and waterwise treatments. Typical residential built form typologies are provided at **Appendix 3**.

The appended Rapids Landing Lifestyle Community Concept Plan indicatively shows 159 grouped dwelling unit allotments, some of which are able to be developed in a duplex form. The Lifestyle Community cross-sections and referenced render locations shown on the Rapids Landing Lifestyle Community Masterplan) provided at **Appendix 4** detail context on how the proposed grouped dwellings will generally follow the land topography with limited benching and retaining. This is achieved through the use of either a screw pile system or steel portals whereby the home is counter levered using the concrete floor structure of the home.

The use of suitable planting to screen the lower side of homes is used to maintain the amenity of the community. Overall screening of homes and hence maintaining/enhancing community amenity, where required, will be assisted through the landscape design within the overall community spaces. This, along will the revegetation and landscaping within the public open space, will significantly screen and soften the built form impact when viewed from external roads and residential areas. This is evident through the Rapids Landing Lifestyle Community Landscape Renders also provided at **Appendix 4**.

3.3.1 Local Development Plan

This Structure Plan proposes to introduce the preparation and implementation of an approved Local Development Plan that aims to set out specific and detailed guidance for the future development of the Grouped Dwellings and associated structures and facilities. Such an approach would be consistent with *Schedule 2, Part 6 of the Planning and Development (Local Planning Schemes) Regulations 2015* wherein it outlines the Local Development Plan aims to include the following –

(a) site and development standards that are to apply to the development;

(b) specifying exemptions from the requirement to obtain development approval for development in the area to which the plan relates.

This approach reflects the pre-consultation feedback by DPLH and Council (refer Section 1.3.6 of this report) whereby it was suggested that a Local Development Plan could exempt the need for lodgement of future Development Applications. Such a process would ensure that the Local Development Plan would set out the approved development standards to be applied to the development and enable the proponent to seek building licenses for each respective stage of construction.

The Local Development Plan will address the development standards listed below. The listed development standards have been included under Part One of the Structure Plan.

- Residential Design Code
- Building design elements
- Internal road and grouped dwelling layout, and housing typologies
- Prepare and Implement and approved

- Streetscape/dwelling orientation
- Setback requirements
- Fencing controls between dwellings and also between the lifestyle community and surrounding Public Open Space
- Bushfire Management Plan requirements
- Private lot open space/site coverage
- Incidental development (storage/clothes drying/outbuildings/controls on caravan/ trailer/boat locations)

Urban Water Management Plan

- Visitor car parking allocation and provision of landscaping
- Servicing details for all land uses
- Retention of existing mature trees within private open space, landscape buffer to Bussell Highway and within the front of proposed grouped dwelling allotments addressing private roads
- A comprehensive risk management plan for the ongoing management of all phases of the planning, construction and operation of the community
- A detailed landscaping plan to address Visual amenity and landscaping

3.3.2 Land Tenure

The proposed lifestyle community will remain under the ownership of Edenlife Pty Ltd, with each grouped dwelling be provided under a lease arrangement with the home owner. Each resident will own their home while leasing the land and are protected by the *Residential Parks (Long-stay Tenants) Amendment Act 2020.* The landowner will retain full ownership and management control of the community facilities and maintenance the lifestyle community communal grounds.

The lease arrangement will see payments covering all outgoings including rates and taxes, maintenance of communal grounds, rubbish removal and access to all facility offerings in the lifestyle community. This model provides for a highly equitable arrangement which has received wide market acceptance. The lease arrangement is approved by the WAPC for a period of 60 years and is renewable upon request by Edenlife Pty Ltd.

Importantly, the community facilities (that will include the clubhouse) will cater for long term residents only (ie will cater for private use, with no public access without invitation).

3.4 Access and Movement Networks

The proposed Structure Plan maintains a legible and permeable private road network that will facilitate ease of movement for residents and visitors to the lifestyle community. Primary access to the land will be provided from John Archibald Drive, with an emergency access link provided to Bussell Highway. There is no vehicle access proposed from Rapids Landing Avenue road reserve or Alferink Crescent.

Donald Veal Consultants (DVC) was commissioned to undertake a Transport Impact Statement (TIS) report of the proposed Structure Plan that also considered the proposed internal layout of the Rapids Landing Lifestyle Community Masterplan provided at **Appendix 2** of this report. A summary of the TIS investigation's findings are provided below:

- The Structure Plan area is estimated to generate traffic flows of approximately 316 trips and 32 peak hour trips per day;
- The level of projected traffic flow shows less than one vehicle turning left out of the site every two minutes during the peak period. This level of demand will have no meaningful impact on the local road network, or the operation of key intersections;
- John Archibald Drive carries some 1,268 vpd (2018/19) and can readily absorb an additional 316 vpd without any issues;
- The intersection onto John Archibald Drive is likely to require a right turn in lane to be constructed in the median to enable turning movements to occur safely;
- Footpaths or shared paths are currently provided along Bussell Highway and in parts of the surrounding residential areas. A path along the north side of John Archibald Drive between Woodard Avenue and Tingle Avenue has been constructed;
- It is recommended that the detailed design ensures that the access road to the development is provided with a suitable link to the existing pedestrian network, with formal road crossings also provided where required;
- There are no public transport bus routes within the vicinity of the site;

The detailed findings of the Transport Impact Statement are provided at **Appendix 12**.

3.5 Infrastructure Coordination, Servicing and Staging

3.5.1 Essential Infrastructure

McDowell Affleck Consulting Engineers was commissioned to undertake an Engineering Servicing Report to support the proposed development of a Lifestyle Community in the north-west portion of Rapids Landing Estate.

The servicing report confirms that, from an engineering perspective the land can be serviced with sewer, stormwater/ drainage, underground power, communications and gas.

An existing Kleenheat storage tank is located on the land and currently services the existing Rapids Landing residential Estate). The proponent is currently in discussions with Kleenheat with regard to relocating their existing storage tank and modify the associated pipe infrastructure that will support access to the lifestyle community and maintain the provision of gas supply to Rapids Landing Estate.

The proposed development of the Lifestyle Community will be guided by a Local Development Plan that will detail land use, layout and development controls and will comprise more detailed engineering designs to connect the proposal to all essential services.

4.0 Conclusion

The proposal to establish a Lifestyle Community at Lot 9014 on the corner of Bussell Highway and John Archibald Drive is a response to the current significant shortfall of affordable and appropriate housing options in the Margaret River locality (and surrounding communities) for its ageing population. The proposal is consistent with the Shire's planning framework and approved uses for the land. It provides for a compatible, responsible and suitable use of the land that is going to meet the obvious needs of the community.

The land it is ideally located in close proximity to services, facilities and offerings provided by the Margaret River townsite. It is also located adjacent to existing and planned residential development and the future Rapids Landing Neighbourhood Centre that will provide for convenience shopping along with other specialty retail and non-retail services.

This report seeks endorsement of a Structure Plan that is consistent with the Shire's strategic planning framework that includes the development of the land for residential purposes. The Structure Plan provides the framework to guide future land use, subdivision and development of the land to deliver the Rapids Landing Lifestyle Community that will support grouped dwellings and associated community and recreation facilities that cater for the needs of prospective residents in the over 50's age bracket.

The Structure Plan responds appropriately to the land's key constraints and opportunities to promote future development nestled amongst expansive areas of public open space that will provide suitable and attractive pedestrian connections to the existing Rapids Landing Estate to the east and south and to established areas of Margaret River town site to the north of the land.

5.0 Technical Appendices

A range of technical assessments have been undertaken to inform the preparation of the Structure Plan. The technical assessments have assisted in identifying the actions and recommendations to inform and link the implementation provisions of the Structure Plan and provide further basis for the assessment of subsequent planning applications within the Structure Plan area.

The supporting Technical Documents are listed in the Table of Contents of this report and respectively appended.

Commentary relating to various specific technical assessments is discussed below.

5.1 Noise Management Plan

Herring Storer Acoustics was commissioned to undertake an acoustic assessment of noise received for the proposed internal layout of the Rapids Landing Lifestyle Community Masterplan prepared for the land that falls in the Structure Plan Area. A summary of the Noise management Plan findings are provided below:

- Determine by noise modelling the noise that would be received at proposed residences within this development from vehicles travelling on the roadway (Bussell Highway) for the Future;

- Acoustic modelling was undertaken considering the following scenarios;

    1. Future traffic volumes without any noise amelioration, and/or
    2. Future traffic volumes, with 1.8m wall;

- To comply with WAPC State Planning Policy 5.4 the following requirements are listed in the Noise management plan,

    - Noise Wall 1.8 m High or
    - Quiet House Design package A, B and C, and
    - Notifications to be included in the lease contract for each grouped dwelling.

- Quiet House Design requirements are likely to lessen for residential premises set back from the highway, as the façade residences will barrier those behind.

The detailed findings of the Noise Management Plan are provided at **Appendix 13**.

5.2 Waterway Revegetation Plan

A Waterway Revegetation Plan was prepared by Nicole Siemon & Associates is provided at **Appendix 6**. The plan aims to –

- Identify current vegetation communities and health,
- Detail revegetation areas, species selections, spacing, generalised numbers and anticipated plant height at maturity, and
- Provide for weed control and other management measures to protect the River and its banks for conservation into the future.

The plan also suggests a there to be a landscape interface between the revegetated creek line and the developable area, along with stormwater management considerations and river restoration approaches to enhance and restore the northern creek line.

5.3 Landscape Guide Plan

A Landscape Guide Plan was prepared by Bill James Landscape Architect to establish the principal landscape elements to be considered with development of the proposed Rapids Landing Lifestyle Community. The Landscape Guide Plan (provided at **Appendix 7**) was prepared taking into consideration:

- Site Analysis (including landscape character and visual internal and external aesthetic characteristics
- Identification of landscape challenges and opportunities
- Information derived from the site analysis, cross sections and associated Structure Diagram, and
- Key elements that include –
    - A significant number of trees on site to be retained/designed in to the development and those to be removed which are dead, dying, moribund, diseased or exotic,
    - New plantings to;
        - screen view from the Bussell Highway/John Archibald Drive roundabout,
        - filter views from neighbouring roads and residential areas,
        - provide shade and amenity to proposed houses, open spaces and community areas within the Lifestyle Community,
        - provide habitat for local fauna,
        - provide shared gardens for residents to utilise,
        - provide a range of trees, shrubs and groundcovers that hardy and provide minimal maintenance for gardens throughout the Lifestyle Community
    - A park to retain a substantial Marri Tree and large peppermints adjacent the creek line on the eastern boundary of the Lifestyle Community,
    - Landscaping to consider the recommendations of the Waterway Revegetation Plan that encapsulates the northern creek line and adjoining public open space

The Landscape Guide Plan demonstrates how landscape measures implemented as part of the future development of the Lifestyle Community address the visually sensitive nature of the land (noting its location near high traffic roads). Rehabilitation of the foreshore and landscaping of the balance areas identified as public open space on the Structure Plan will significantly screen and soften the impact of the proposed Lifestyle Community when viewed from John Archibald Drive, Bussell Highway and surrounding residential areas. It will provide an attractive natural landscape setting which will link with other rehabilitated creek line areas that can be enjoyed by residents within and outside the Structure Plan area through a series of connecting dual use pathways.

APPENDIX I

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
9014/DP413998	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**20/12/2018**

VOLUME **2959** FOLIO **570**

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.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 9014 ON DEPOSITED PLAN 413998

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

BALWYN MARGARET RIVER PTY LTD OF POST OFFICE BOX 1110 NEDLANDS WA 6009
(AF O039951) REGISTERED 28/11/2018

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 56165.
2. K344099 MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 14/9/2007.
3. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR DRAINAGE PURPOSES TO SHIRE OF AUGUSTA-MARGARET RIVER - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 67055.
4. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 67055.
5. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR DRAINAGE PURPOSES TO SHIRE OF AUGUSTA-MARGARET RIVER - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 405013.
6. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 405013.
7. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR ELECTRICITY PURPOSES TO ELECTRICITY NETWORKS CORPORATION - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 405013.
8. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 413998 AS CREATED ON DEPOSITED PLAN 406162.
9. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 413998

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.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

END OF PAGE 1 - CONTINUED OVER

SKETCH OF LAND:	DP413998
PREVIOUS TITLE:	2930-290
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF AUGUSTA-MARGARET RIVER

APPENDIX 2

Rapids Landing Community Village Master Plan
(Richard Hammond Architects)

JOHN ARCHIBALD DRIVE

APPLICATION BOUNDARY

DUAL USE PATH

PARKLAND - RE.VEGETATED

MAINTENANCE ACCESS GATE

EXTENT OF FORESHORE RESERVE TO BE FINALISED

MAINTENANCE ACCESS GATES

DUAL USE PATHWAY

SMALL BRIDGE

GATE

DEVELOPMENT BOUNDARY

PROPOSED REVISED DEVELOPMENT BOUNDARY

WORKS GATE

PEDESTRIAN ACCESS GATE

BUSSELL HWY

BOWLING GREEN

CLUBHOUSE

ARTS & CRAFTS

TRAFFIC CALMING 4m CARRIAGEWAY

PARK

EMERGENCY EXIT

SIGNIFICANT MARRI

CONNECTION TO ALFERINK CRESCENT

DUAL USE PATHWAY ACROSS EXISTING CULVERT

N

YIELD = 159

SIGNIFICANT PEPPERMINT TREES

MARRI BUSHLAND

WORKSHOP

THE MASTERPLAN IS INDICATIVE AND CONCEPTUAL ONLY

SCALE 1:1500

0m 30m 60m 90m 120m 150m

KEY

DUPLEX	D
VILLAGE OPEN SPACE	
P.O.S/DRAINAGE	
HOME LOT	
DUAL USE PATH	
EXISTING TREE	
NEW TREE	
APPLICATION BOUNDARY OF SUBJECT LAND	
PROPOSED REVISED DEVELOPMENT BOUNDARY	
DEVELOPMENT BOUNDARY FROM APPROVED STRUCTURE PLAN	

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1B LITTLE HOWARD ST, FREMANTLE, 6160

0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date
1	Amended Masterplan to satisfy BAL setbacks	22.04.21
2	Extra Maintenance gates added	10.05.22

EDENLIFE COMMUNITIES PTY LTD

RAPIDS LANDING LIFESTYLE COMMUNITY

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan

Project number	00	A.104
Date	10.05.2022	
Drawn by	RHA	
Checked by	RHA	Scale@A3 As indicated

30/01/2024 10:18:54 AM

APPENDIX 3

Residential Built Form Typologies (Edenlife)

The Ibis

2

2

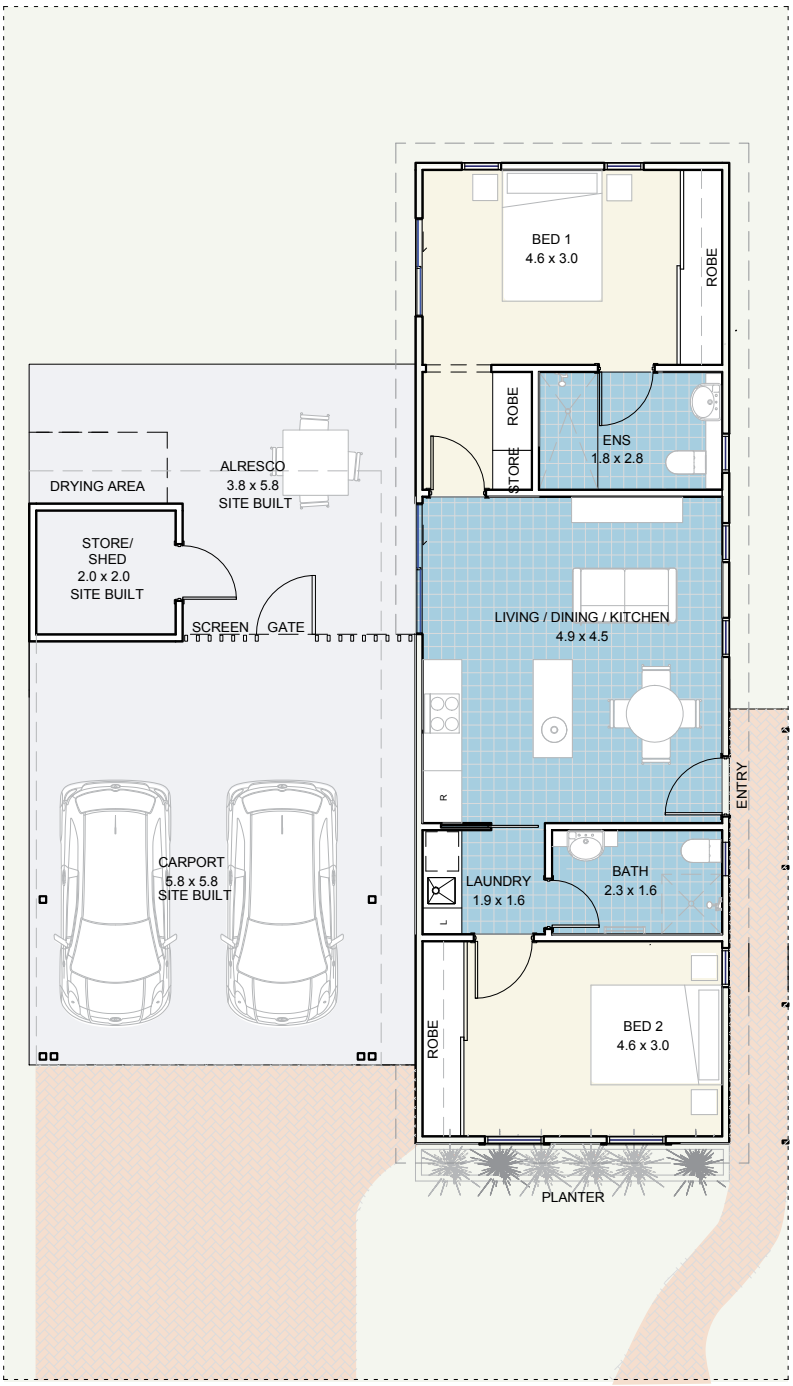
2

A place to call home

A compact and affordable home. The two bedrooms and two bathrooms at opposing ends of the home allow for comfortable living. The large kitchen, dining and living area rolling out to the alfresco create a modern open feel, perfect for inviting family and friends over.

EDENLIFE®
AUSTRALIND

The Ibis



Specifications

House 72m²
Alfresco 22m²
Carport 39m²
Store/shed 4m²

Features

- Reverse cycle air conditioning;
- Built in robes to all bedrooms;
- Natural gas hotplate and fan forced electric oven;
- Carpet to all bedrooms;
- Vinyl planking to living areas;
- Flyscreens to all windows;
- Blinds to all windows;
- LED lighting throughout;
- Tiled splashback to the kitchen;
- Soft-close drawers throughout;
- Stone benchtops;
- Waterwise, fully landscaped and maintained front garden;
- Alfresco entertaining area;
- Foldaway clothes line; and
- Full insulation throughout.

2 2 2

Updated 11th August 2020
Disclaimer: Edenlife reserves the right to change the information in this publication at any time without notice.

For further information:

T: 08 9423 5131
E: live@edenlife.com.au

edenlife.com.au

EDENLIFE AUSTRALIND

The Kingfisher

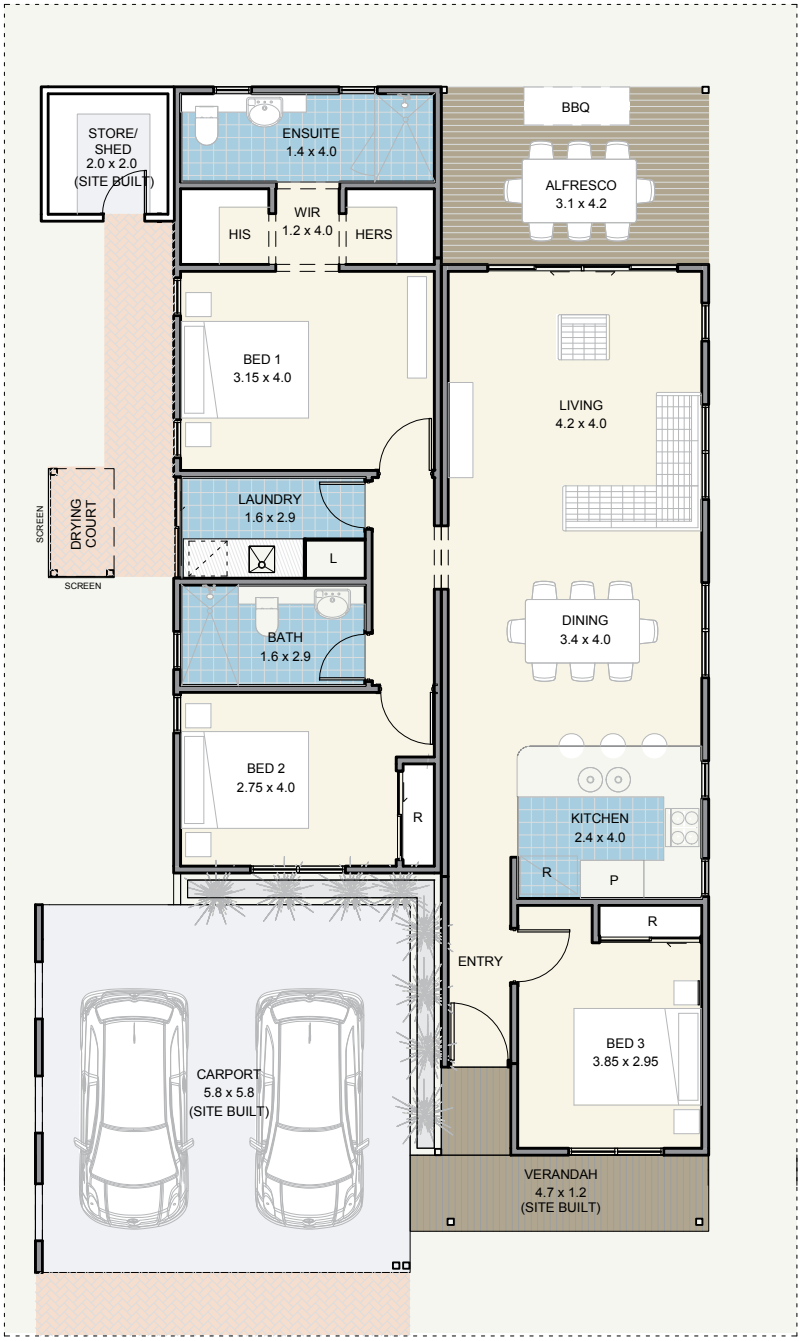
3
2
2

A place to call home

The Kingfisher is the most luxurious of the Edenlife homes with 3 bedrooms and 2 bathrooms spaced throughout the home and a large open plan living space. Entering through the front verandah, the layout then leads onto the kitchen, dining and living area which flows beautifully onto the alfresco outdoor area.

EDENLIFE®
AUSTRALIND

The Kingfisher



Specifications

House 111m²
Alfresco 13m²
Carport 34m²
Store/shed 4m²

Features

- Reverse cycle air conditioning;
- Built in robes to all bedrooms;
- Natural gas hotplate and fan forced electric oven;
- Carpet to all bedrooms;
- Vinyl planking to living areas;
- Flyscreens to all windows;
- Blinds to all windows;
- LED lighting throughout;
- Tiled splashback to the kitchen;
- Soft-close drawers throughout;
- Stone benchtops;
- Waterwise, fully landscaped and maintained front garden;
- Alfresco entertaining area;
- Foldaway clothes line; and
- Full insulation throughout.

3 2 2

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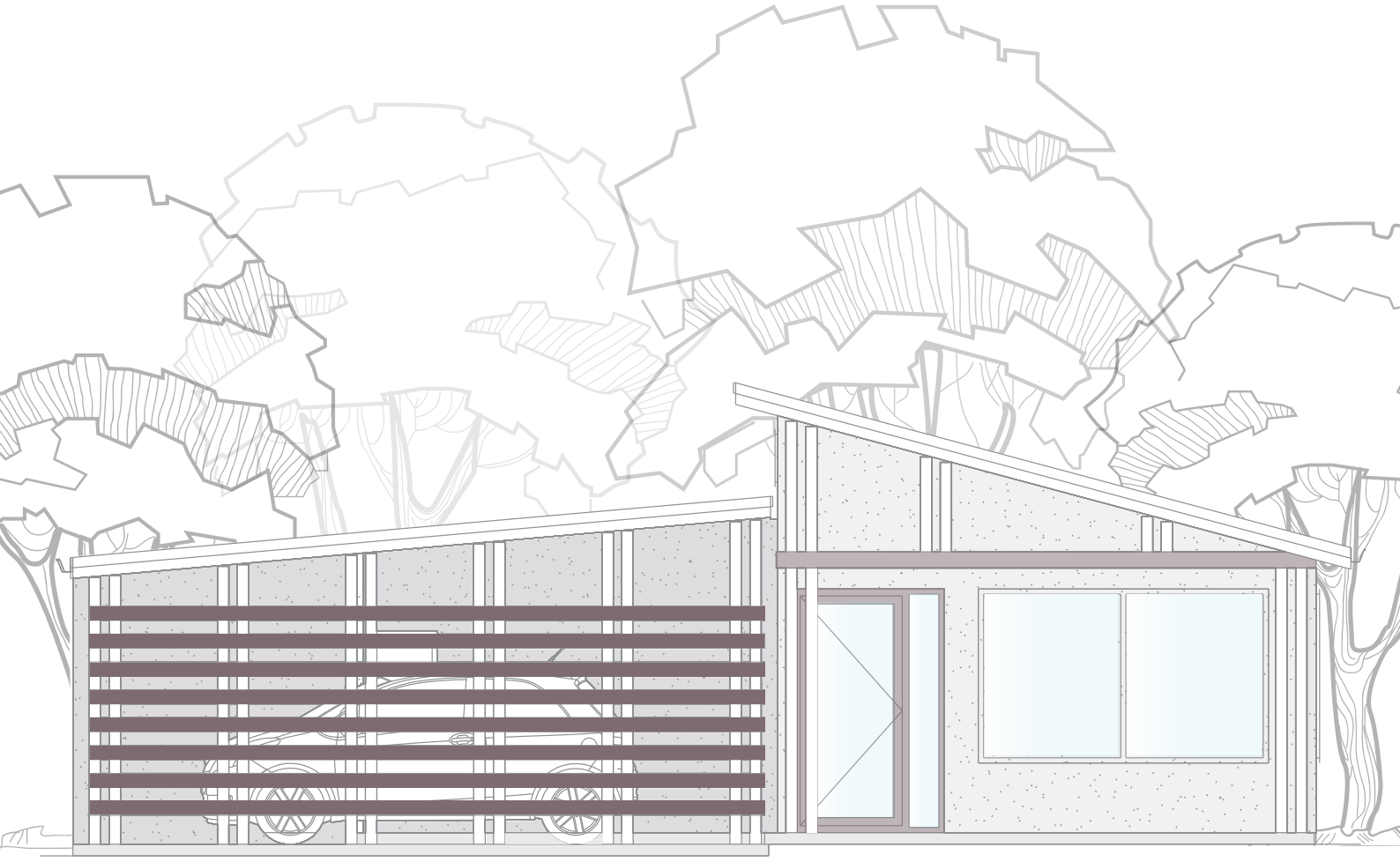
EDENLIFE AUSTRALIND

The Sandpiper

2
1.5
2
1

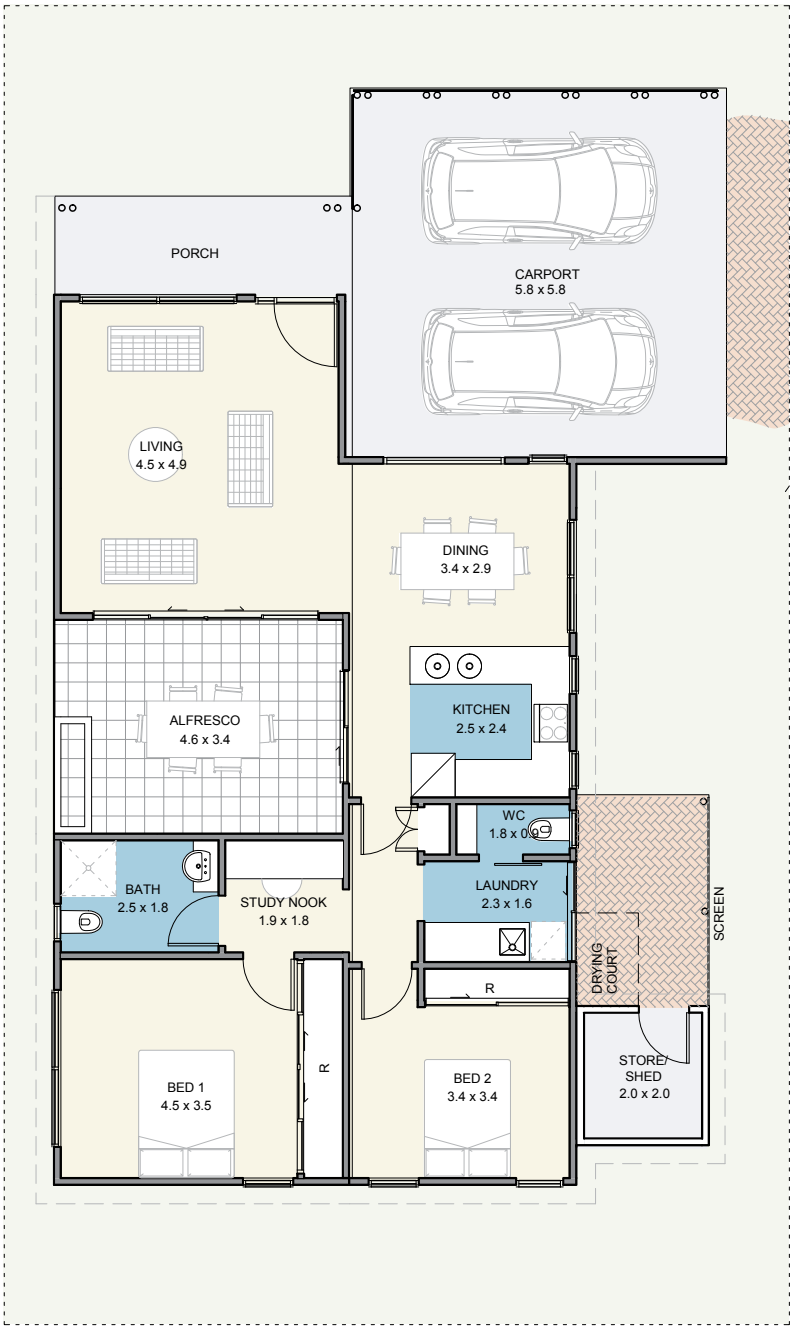


A place to call home

A compact but functional home, with two bedrooms and a walk through study. The living, kitchen and dining lead out to the alfresco area creating a large open plan living space.
The carport can house two cars and there is a separate large storage area. All the external walls and roof are insulated for protection from the heat and cold.

EDENLIFE® AUSTRALIND

The Sandpiper



Specifications

House 92m²
Alfresco 15m²
Carport 34m²
Store/shed 4m²

Features

- Reverse cycle air conditioning;
- Built in robes to all bedrooms;
- Natural gas hotplate and fan forced electric oven;
- Carpet to all bedrooms;
- Vinyl planking to living areas;
- Flyscreens to all windows;
- Blinds to all windows;
- LED lighting throughout;
- Tiled splashback to the kitchen;
- Soft-close drawers throughout;
- Stone benchtops;
- Waterwise, fully landscaped and maintained front garden;
- Alfresco entertaining area;
- Foldaway clothes line; and
- Full insulation throughout.

2 | 1.5 | 2 | 1

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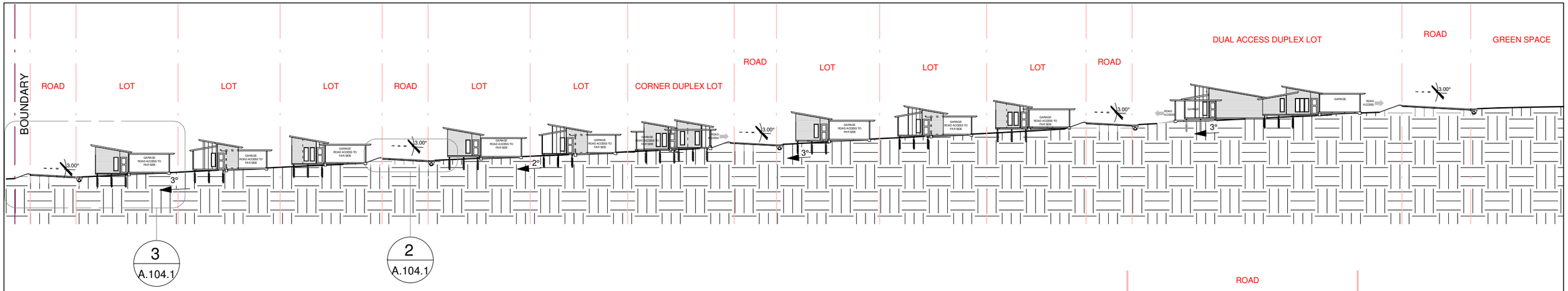
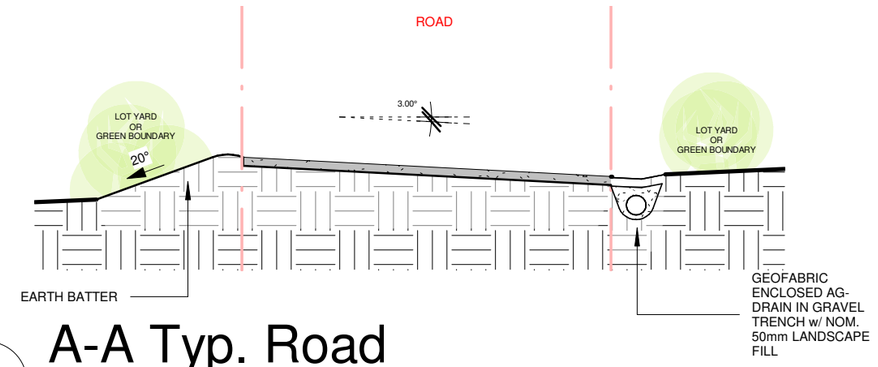
APPENDIX 4

Rapids Landing Lifestyle Community Cross-sections (Richard Hammond Architects),
Landscape Renders & Render Location Plan
(VT3D/ Richard Hammond Architects)



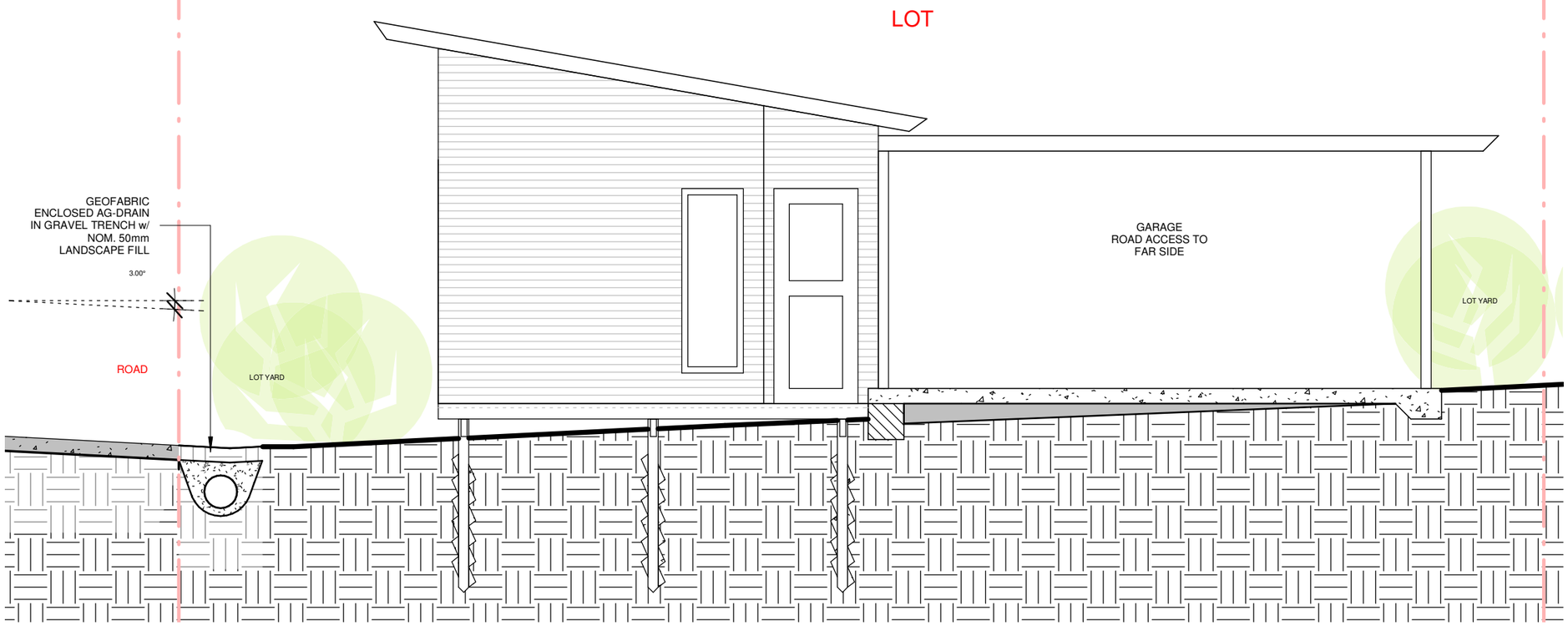
1 A-A Typ. Site Section

1 : 500



2 A-A Typ. Road

1 : 100



3 A-A Typ. Section Detail

1 : 50

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No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Typical Site Section A-A

Project number	00	A.104.1	
Date	14.12.21		
Drawn by	Author		
Checked by	Checker	Scale@A3	As indicated

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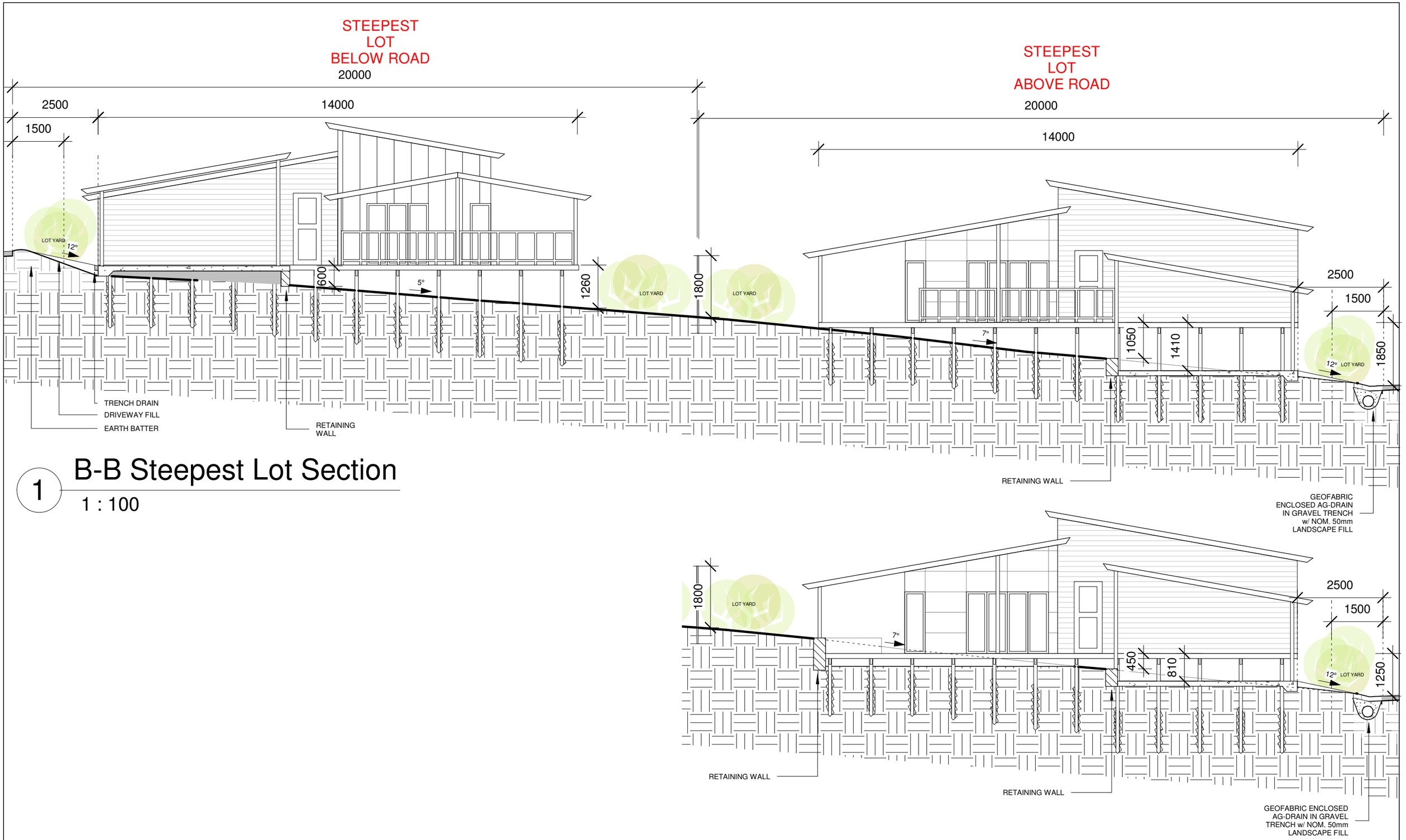

1 B-B Steepest Lot Section

1 : 100

RICHARD HAMMOND ARCHITECT
16/342 SOUTH TERRACE, SOUTH FREMANTLE

0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE
LOT 9012, BUSSELL HWY MARGARET RIVER

Steepest Site Section B-B

Project number	00	A.104.2	
Date	14.12.21		
Drawn by	Author		
Checked by	Checker	Scale@A3	1 : 100

24/02/2022 10:26:04 AM

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0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan - Marketing A3

Project number	00	A.104	
Date	25.02.2022		
Drawn by	RHA		
Checked by	RHA	Scale@A3	As indicated

25/02/2022 11:51:45 AM

Render View 1

Render View 2

Render View 3

Render View 4

Render View 5

APPENDIX 5

Rapids Landing – Stage 1 – 5B Foreshore Management Plan
(Nicole Siemon and Associates Pty Ltd)

BALWYN MARGARET RIVER PL

RAPIDS LANDING - STAGES 1 – 5B

FORESHORE MANAGEMENT PLAN

REPORT NO: BMR_02

NSA PL
OCTOBER 2019

Contents

1.0 INTRODUCTION

1.1 Background and location

Nicole Siemon and Associates PL is commissioned by Balwyn Margaret River Pty Ltd to revise and update a Creekline Rehabilitation Management Plan (CRMP, 2007) prepared by ATA Environmental for the Rapids Landing residential subdivision located at the former Lot 27 Bussell Highway, Margaret River (Map 1).

The land has been developed in accordance with the Western Australian Planning Commission (WAPC) subdivision approval in January 2007 (WAPC Ref. 132030) with all conditions met.

The majority of the foreshore reserve (R50413) has been vested in the Shire of Augusta-Margaret River. This occurred on the 13 November 2009 and is in accordance with Condition 18 that states:

> "The proposed reserve(s), Public Open Space and Buffer Reserves shown on the approved plan of subdivision being shown on the Deposited Plan as "Reserve for Recreation" and vested in the Crown under Section 152 of the Planning and Development Act 2005, such land to be ceded free of cost and without any payment of compensation to the Crown."

Balwyn Margaret River PL has managed and maintained the waterway since that time. This updated document is being developed to assist the Shire of Augusta-Margaret River to take over the management of the reserves into the future.

The management zones covered in this document include the buffer strip along Bussell Highway (including R49450 and R50413) and the high order tributary of Darch Brook which intersects with John Archibald Drive (Map 2). Future development planning is occurring for the north-western portion of the site, referred to as the Island Precinct.

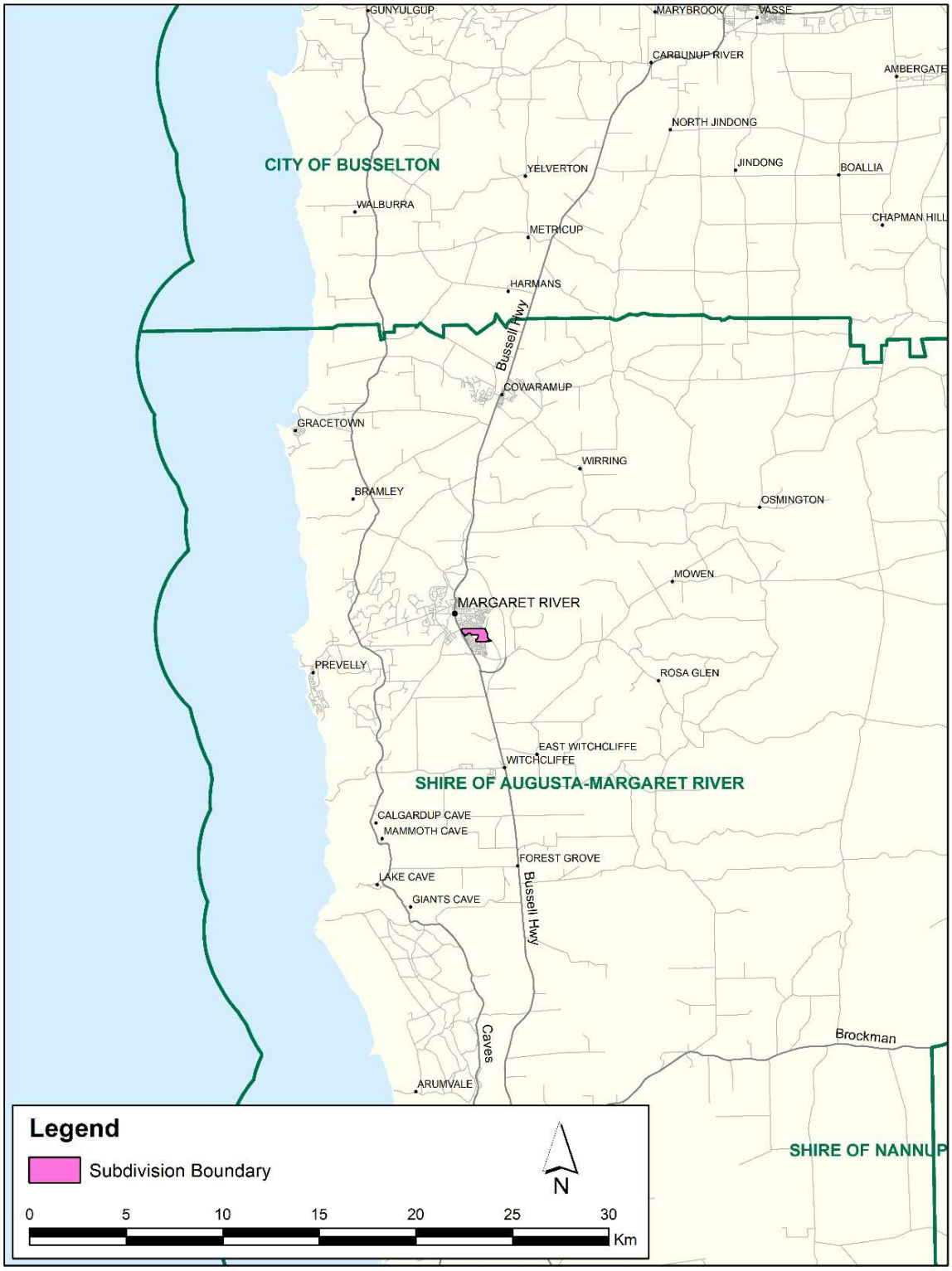
The Foreshore Management Plan (FMP) will detail the completed management actions that were outlined in the CRMP 2007, and detail current and future management requirements for the southwestern tributary associated with Stages 1 – 5B of Rapids Landing from Bussell Highway to the northern boundary of the subdivision of the Island Precinct.

1.2 Objectives

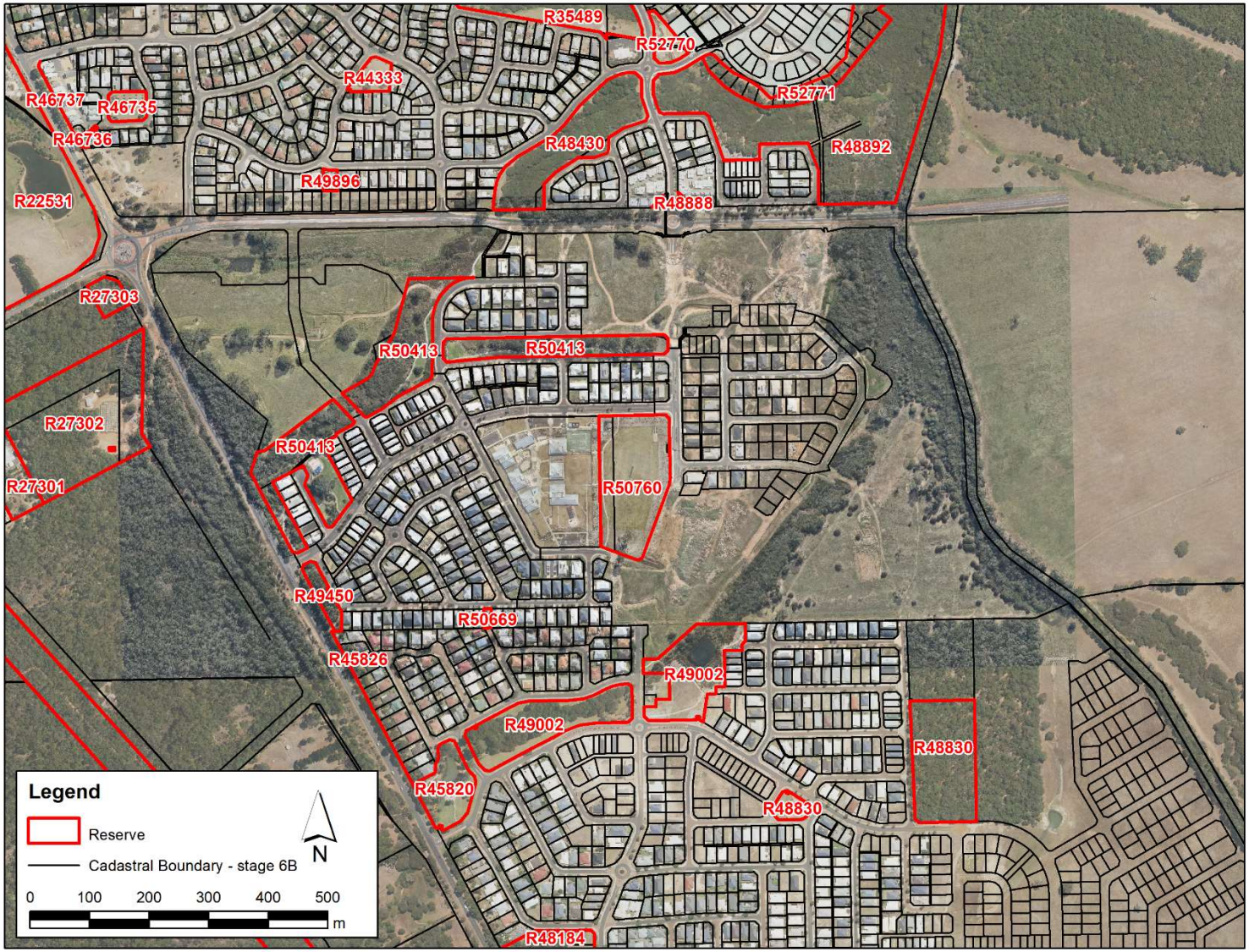
The primary aim is to manage the rehabilitated foreshore reserve while allowing for community recreational use in the adjacent parklands. The objectives of this FMP are to:

- Protect and conserve the natural values of the foreshore including vegetation, fauna habitats and water quality;
- Promote the foreshore as a conservation, recreation and education resource for the use and enjoyment of the community;
- Enhance access within the foreshore for passive recreational use;

Map 1: Locality map showing Rapid's Landing subdivision



Map 2: Subdivision stages and reserve locations



- Provide a long-term strategy for the management of existing vegetation; and
- Increase community awareness and understanding of the value of foreshores and the issues associated with their management.

2.0 EXISTING ENVIRONMENT

2.1 Geology, soil and landform

The site is located in the Land Systems of the Margaret River Plateau and is classified as the Cowaramup Upland Land System. This land system is characterised by undulating to rolling hills that formed where the main waterways of the region (i.e. Margaret River and Darch Brook) incised the Margaret River Plateau. The Plateau is formed on the laterised granitic and gneissic basement rock of the Leeuwin Block. This bedrock has weathered to depths of 40 m with a mixture of gravels, laterites, silty sands and clayey silty sands overlaying the parent rock (Tille and Lantze, 1990).

The two land units within the Cowaramup Upland Land System are:

- The valley of the Darch Brook that occupies the eastern portion of the site and the tributaries in the north western portion is in the Cowaramup Wet Vales Land Unit (Cvw): small, broad U-shaped drainage depressions with swampy floors. This land unit has gravelly duplex (Forest Grove) soils on side slopes and poorly drained alluvial soils on the valley floor.

- The ridge that occupies the central portion of the site is in the Cowaramup Flats (C): Flats (0-2% gradient) with yellow-brown, gravely duplex (Forest Grove) and pale grey mottled (Mungite) soils.

Forest Grove soils consist of yellowish brown sandy topsoil with a high gravel content overlying a brownish yellow clay subsoil. These soils are better drained than the Mungite soils, which are characterised by a greyed, mottled and impermeable clay subsoil. The topsoil is a greyish brown sandy loam. These soils are poorly drained in winter and often retain moisture in the summer (Tille and Lantzke, 1990).

Earthworks undertaken by BMR PL were in accordance with the approved structure plan and landscape/foreshore management plans. This has resulted in the foreshore margins being significantly modified.

2.2 Climate

The Margaret River region experiences a Mediterranean climate with cold wet winters and hot dry summers. Air temperature daily maximums vary from 23^{O}C in summer to 16.3^{O}C in winter, with mean daily minimum temperatures varying from 17.2^{O}C in summer to 11.1^{O}C in winter.

The average annual rainfall varies between 850 - 1200 mm, with rainfall occurring mostly during the winter months. The mean daily evaporation for the area ranges from 6.1mm/day in summer to 1.4mm/day in winter.

During the summer months the prevailing wind blows from the east to south-east in the morning and from the south-west in the afternoon, due to the local sea breeze. Winter is characterised by the north westerly storm winds that back to the west and south-west, interspersed with calmer periods. These storms are related to the passage of the low-pressure systems that affect the southwest portion of the state due to the northerly location of the anticyclone system (ATA Environmental, 2007).

2.3 Hydrology

The south western tributary of Darch Brook, associated with the foreshore reserve for Stages 1 – 5B of the Rapids Landing development, enters the subject land through a stone and concrete culvert beneath Bussell Highway. This tributary flows in a north easterly direction to join with the northern tributary that flows in an easterly direction. The confluence of the two tributaries is located in close proximity to the northern boundary, shortly after which the tributary exits the site. These tributaries are seasonal, broad, relatively flat channels.

Two earth dams are located along the tributary and three rock spillways were constructed to slow the flow during rehabilitation works until sufficient plant establishment was achieved.

Within the foreshore reserve there are also six stormwater detention ponds. The upstream basins were constructed using blue metal filled geotextile logs, clad with granite rocks extracted from the site during the development process.

The three lower detention ponds were constructed out of granite rocks to form a permeable barrier. Planting and selective natural regeneration processes have resulted in vegetation coverage in these basins.

The basins were last cleared of coarse sediment in March 2019.

There is a naturally occurring waterlogged zone running downslope from the large isolated Marri on the eastern side of the Island Precinct.

2.4 Vegetation and flora

Rapid's Landing is located in the Warren Bioregion (Thackway and Cresswell, 1995). Within this Bioregion, vegetation complex mapping by Mattiske and Havel (Regional Forestry Agreement, 1999), divided the vegetation into wetland (Cowaramup, Cw1) and surrounding higher land (Cowaramup, C1).

The Vegetation Complexes can be summarised as follows:

- Cowaramup (C1) is comprised of an Open to Tall Open Forest of Jarrah (*Eucalyptus marginata* spp*. marginata*) - Marri (*Corymbia calophylla*) - Bull Banksia (*Banksia grandis*) on lateritic uplands in the hyperhumid zone.

- Cowaramup (Cw1) is comprised of a mixture of Open Forest of *Eucalyptus diversicolor-Corymbia calophylla* and woodland of Jarrah (*Eucalyptus marginata subsp. marginata*)-*Corymbia calophylla* on slopes.

It should be noted that Karri (*Eucalyptus diversicolor*) does not occur within or adjoining the foreshore reserves in the Rapid's Landing site (a characteristic of Cw1), with Blackbutt (*Eucalyptus patens*) co-occurring with Jarrah and Marri.

A literature review was undertaken to determine if the remnant bushland had been identified as having significant ecological value as part of the South West Biodiversity Project (Molloy et al 2007). This project collated the findings of a number of documents to assign vegetation complexes and ecological communities and rate their relative protection status.

In this document and the Remnant vegetation strategy (Shire of AMR and the Cape to Cape Alliance 1999), the Cowaramup (C1) Vegetation Complex in the upland areas has less than 30% of pre-European extent remaining, with less than 10% being protected within the Swan Coastal Plain and Jarrah Forest IBRA regions. The Cw1 Vegetation complex has only 1500 ha or 15% or less protected for conservation in the Jarrah Forest IBRA-region. The Shire of Augusta-Margaret River has a retention target of 40%. Both characteristic vegetation types are therefore considered inadequately protected within the Shire boundary.

Prior to rehabilitation, the vegetation in the foreshore reserve associated with Stages 1 – 5B, consisted of stands of Peppermint (*Agonis flexuosa*), with scattered Marri (*Corymbia calophylla*), Blackbutt (*Eucalyptus patens*) and Jarrah (*Eucalyptus marginata* spp*. marginata*). The understorey vegetation consisted of isolated groups of Swamp Peppermint (*Taxandria linearifolia*) and patches of Pale rush (*Juncus pallidus*) and Angled sword sedge (*Lepidosperma tetraquetrum*). The understory in the majority of the site was dominated by kikuyu (*Pennisetum clandestinum*), Couch (*Cynodon dactylon*) and diverse pasture weeds.

A 10 year program of intensive rehabilitation and weed control of the foreshore occurred in accordance with the CRMP (ATA Environmental 2007), resulting in the eradication of the weed assemblage and re-introduction of more diverse mosaic of low to tall sedges and thickets of tea-tree (Map 3). Appendix 1 combines the species recorded from the 2004, 2006 and a 2018 survey.

2.5 Vegetation and flora significance

The Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance. A search of the Protected Matters database, administered by the Department of the Environment and Energy, was undertaken in February 2019.

The review in 2004 and field survey at the time did not identify any of these taxa being present due to prior farming activities that resulted in the site being highly degraded.

Further the subsequent development, infrastructure establishment and revegetation make potential colonization by these species highly unlikely. Monthly site surveys have occurred informally as the Rehabilitation Management contractor is a Professional Botanist. A desktop level 1 survey was deemed sufficient because of the nature of the site.

Map 3: Vegetation communities

Taxa identified in the Protected Matters Report are reported in Table 2:

Table 2: EPBC Act listed flora (February 2019)

TAXA	COMMON NAME	STATUS
Banksia nivea subsp. uliginosa	Swamp honeypot	Endangered
Banksia squarrosa subsp. argillacea	Whicher Range Dryandra	Vulnerable
Caladenia excelsa	Giant Spider-orchid	Endangered
Caladenia hoffmanii	Hoffman's Spider-orchid	Endangered
Caladenia huegelii	King Spider-orchid	Endangered
Caladenia lodgeana	Lodge's Spider-orchid	Critically Endangered
Drakaea micrantha	Dwarf Hammer-orchid	Vulnerable
Gastrolobium papilio	Butterfly-leaved Gastrolobium	Endangered
Lambertia echinata subsp. occidentalis	Western Prickly Honeysuckle	Endangered
Sphenotoma drummondii	Mountain Paper-heath	Endangered

At the State level, the Department of Biodiversity, Conservation and Attractions (formerly Department of Parks and Wildlife, DPAW) is responsible for determining the threat of extinction and, consequently, applying regulations intended to protect populations and species.

Species of flora and fauna are defined as having Declared, Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes (Table 3).

Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the Biodiversity Conservation Act 2016. It is an offence to "take" or damage rare flora or their critical habitats unless the person is authorized under Section 40 and complies with the conditions.

As the new regulations are being applied there will be a period of adjustment to the revised language in the Act. The conservation codes used below will be modified to reflect Part 2 Division 1 Subdivision 1 in due course. Priority Flora are taxa under consideration for declaration as 'Rare Flora' but are in need of further survey (Priority 1 to 3) or require monitoring every 5 to 10 years (Priority 4). Information was sought from the DBCA relating to known populations of Declared Rare Flora, Priority Species and Threatened Ecological Communities through NatureMap which includes a formal database search of (1) the Department's threatened (Declared Rare) Flora database, (2) the Western Australian Herbarium Specimen database for priority species opportunistically collected in the area of interest and (3) the Department's Declared Rare and Priority Flora List.

Table 3: Definitions of conservation codes

Conservation code	Category
Threatened flora (T)	"Is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora."
Critically endangered species (CR)	"Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora."
Endangered species (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable species (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Priority species Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.	

Conservation code	Category
Priority 1 - Poorly-known species	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 – Poorly-known species	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 – Poorly-known species	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 – Rare, Near Threatened and other species in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Threatened and priority species information from the DBCA was overlaid on relevant data, firstly to determine if any specimens were recorded on the site, and secondly to assess whether it was likely that habitat for adjacent threatened and priority species occurred within the study area.

NatureMap records indicate that there are nine endangered, two threatened flora, twenty-three Priority 3 and four Priority 4 plant species that have been previously recorded within 10 km radius of the site.

WA Herbarium records indicate that two Threatened Flora (formerly DRF), three Priority 1, three Priority 2 taxa, 23 Priority 3 and four Priority 4 plant species occur within 10 km.

None of the species of significant flora were identified in 2004 surveys or subsequent surveys. A professional botanist has been working on the site intensively, albeit intermittently, since 2007, and has not sighted any priority or significant flora in the 10 years (Author Pers. Comm). As the vegetation has been restored through intensive rehabilitation approaches, it is highly unlikely that any flora has colonized the site.

2.6 Vegetation condition

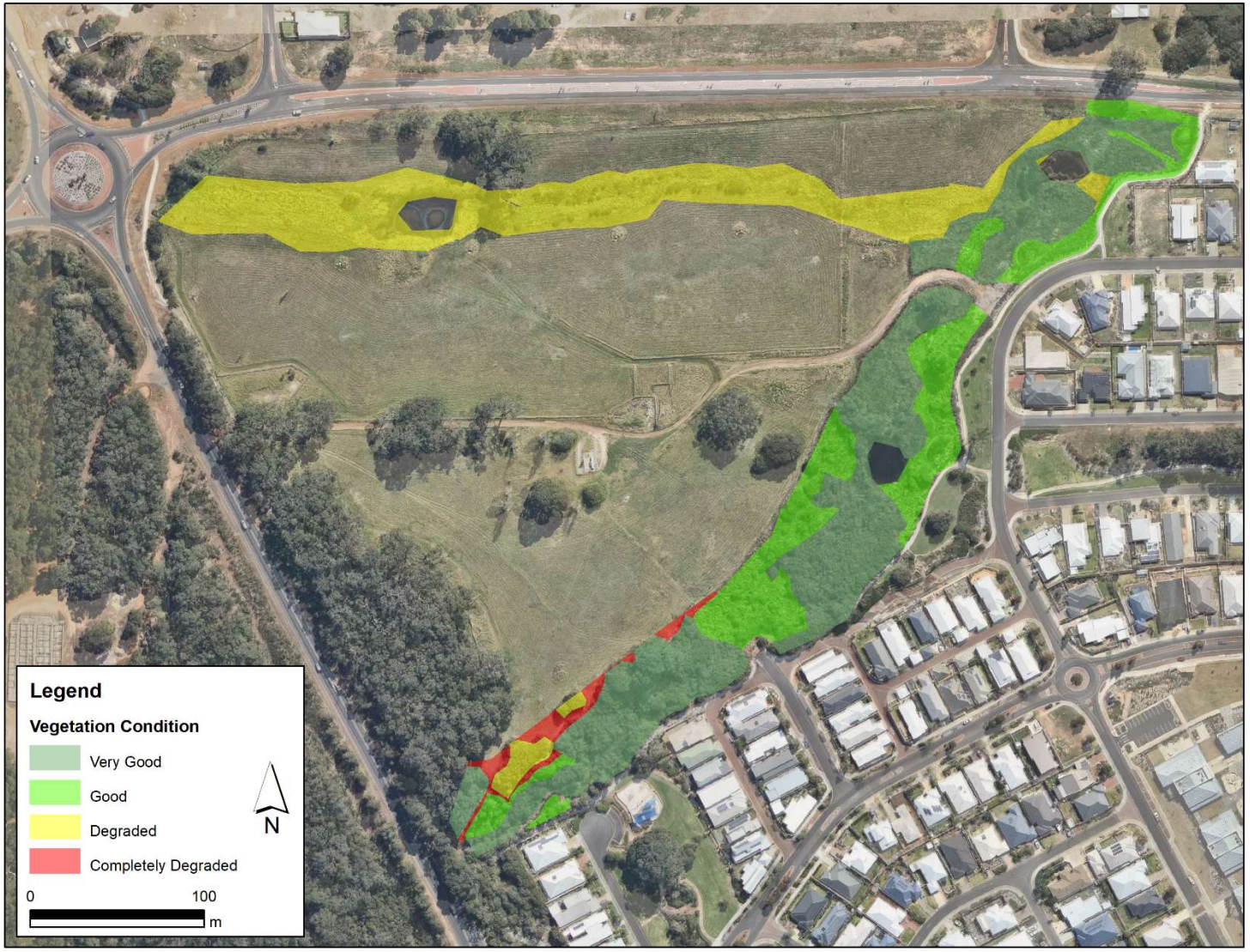
Vegetation condition classifications were assigned in accordance with Bush Forever Vegetation Condition Rating System (Government of Western Australia, 2000). The characteristics of each rating are provided below (Table 1).

Table 1: Vegetation condition assessment (Government of Western Australia, 2000)

Scale	Criteria
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or the ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Poor	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

In 2004, the foreshore areas in the western portion of the Lot were classified as Degraded. The subsequent rehabilitation efforts have resulted in a significant improvement in most areas from Good to Very Good (Map 4).

Map 4: Vegetation condition assessment (2018)



2.7 Fauna condition

A desktop review of fauna likely to occur in the area was undertaken (Environmental Appraisal, NSA PL, 2018) of information searches from the following sources:

- A search of DBCA's Threatened and Priority species within NatureMap to identify potential scheduled and threatened species within the region;
- A review of the Western Australian Museum database to identify potential vertebrate fauna within the area; and
- A search of the Commonwealth Department of Environment and Energy Protected Matters database to identify species of fauna of national environmental significance that potentially occur within the area, and are protected under the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999.*

The database searches were undertaken for a 2 km radius surrounding the site and the Protected Matters report is provided in Appendix 2. Of these, those that are known and/or may have suitable habitat within the site are listed in Table 4.

The EPBC Act report identifies seven bird species of which three are known to visit the area. The Critically Endangered Hairy Marron may have migrated into the area as a result of the improved environmental conditions. The Endangered White-bellied frog occurs in the vicinity although its calls have not been identified in the waterways at Rapid's Landing.

Four mammals are identified of which two are likely to pass through or visit the foreshore reserves. Carter's Freshwater Mussel is known to occur within 10 km however, it is unlikely that suitable habitat exists in the foreshore reserves.

In addition, one migratory marine bird and seven migratory wetland birds are listed. These species are unlikely to utilize the site due to a lack of suitable habitat.

Table 4: EPBC Act (1999) listed fauna that are known to forage (*) or may have suitable habitat at the site.

Scientific name	Common name	Schedule
Dasyurus geoffroii	Chuditch	Vulnerable
*Pseudocheirus occidentalis**	Western Ringtail Possum	Critically Endangered
*Calyptorhynchus baudinii**	Baudin's cockatoo	Endangered
*Calyptorhynchus banksii naso**	Forest Red-tailed Black-Cockatoo	Vulnerable

Scientific name	Common name	Schedule
*Calyptorhynchus latirostris**	Carnaby's Cockatoo	Endangered
Cherax tenuimanus	Hairy Marron	Critically Endangered
Geocrinia alba	White-bellied Frog	Endangered
Westralunio carteri	Carter's Freshwater Mussel	Vulnerable

Other matters protected by the EPBC Act listed in the report include Great Egret (*Ardea alba*) and Rainbow Bee-eater (*Merops ornatus*) that have been sighted very occasionally, feeding in the floodplain in the last 10 years.

The regional desktop search of the recognised State databases for a 2 km radius of the site identified a total of 50 species that may potentially occur on the site. This included 39 bird, 3 amphibian, 4 reptile and 4 mammal species. It was considered that due to micro-habitat requirements not all of these species will be present.

On-site fauna reconnaissance survey has included observations for Western Ringtail Possum scats, dreys in the WA peppermint and regular observations during monthly weed control activities by NSA PL. Scats have been found in the buffer along Bussell Highway. The habitat values for Western Ringtail Possum (*Pseudocheirus occidentalis*) are improving and the three species of Black cockatoo have been sighted foraging at the site. No suitable breeding hollows for Black cockatoo are present.

2.8 Foreshore condition changes

The purpose of the foreshore reserve on the site is to ensure protection and conservation of the watercourses and the ecosystems they support. Reserve R50413 is divided into parcels and ranges in width from 50 m, extending up to 100 m in width adjacent to the existing dam. The reserve encompasses the riparian zone, comprising the broad flat channel vegetated with scattered riparian native fringing vegetation, a buffer of adjacent woodland areas as well as stormwater bio-retention systems.

The original CRMP 2007, provided an assessment of the foreshore condition using the Pen-Scott method of riparian zone assessment. This system provides a graded description of the foreshore that runs from pristine (A grade) through to a ditch (D grade). The creekline foreshore assessment provides a useful gauge of the current condition of the streamline and provided a plan of action to address degradation. A summary of the grading system (Pen and Scott, 1995) is included in Appendix 4.

The Foreshore Creekline Reserve associated with Stages 1 – 5B Rapids Landing were classified generally as degraded, weed dominated and erosion prone. One small area of riparian vegetation of *Taxandria linearifolia* with a dense understorey of *Lepidosperma tetraquetrum* was classified as B2. The areas adjacent to the two existing dams are erosion prone and classified as C2/C3. A small section south of the dam near the northern boundary is actively eroding and has been classified as D1/D2. In 2007, the northern tributary was classified as B3/C1 with weeds dominating the understorey and very little native riparian vegetation remaining.

The CRMP (2007) identified a range of management activities to restore and enhance the southern waterway as required by the WAPC conditions.

This work included the construction of rock riffles for peak flow management for erosion reduction and planting 30 000 plants in the floodplain. Selective weed control also facilitated natural regeneration processes resulting in increased the vegetation density.

A foreshore condition assessment undertaken in October 2018 identified an improvement in foreshore condition, along the entire waterway to A3 – B3. It is a mosaic of low to tall sedgeland, tea-tree thicket and low woodland with relic *Eucalyptus patens* and WA peppermint (Map 4).

A mosaic of sedge and rush communities have been established across the floodplain including *Baumea vaginalis*, *Baumea juncea*, *Juncus kraussii*, *Juncus subsecundus* and *Juncus pallidus*. *Centella asiatica* provides low groundcover with *Isolepis setiformis* and *Centrolepis spp*. Isolated broadleaf weeds including Blackberry nightshade, *Lotus*, Spear thistle (*Cirsium vulgare*) and Common storksbill (*Erodium cicutarium*) occur and areas of the weedy rushes, *Isolepis prolifera* and *Juncus microcephalus*. The areas where weed rushes dominate were not planted in the revegetation program; rather the approach taken was selective weed control to support natural regeneration processes.

2.9 Dieback and other disease

The dieback risk area mapping can be used to inform the planning of activities in an area or managing priority conservation reserves. This data has been provided by the South Coast NRM through Project Dieback that is managing the Dieback Information Delivery and Management System (DIDMS). DIDMS has been designed to provide a mechanism for consistent recording, storing and sharing of information across the South West of WA.

The *Phytophthora* disease boundaries and categories portrayed in the dataset are a composite of survey data collected at varying times over 30 years. The survey intensity was variable and it is considered likely that the extent of infestations are underestimated, as not all areas have been surveyed and disease boundaries are likely to extend into mapped disease free areas since surveys were conducted.

To prevent the spread of the disease and keep bushland areas healthy, the following actions should be taken:

- Establish the presence or absence of the disease for the site
- Identify areas that will remain clean where human vectoring risks during development are managed;
- Develop and implement hygiene procedures to ensure that disease is:
    - Not introduced to clean sites (clean on entry);
    - Not introduced to clean areas within a development site (specific site hygiene plan;
    - Not vectored from an existing site (clean on exit)

The Island Precinct is within a dieback risk area with approximately 12 Ha likely infested with *Phytophthora*. The extensive earthmoving is likely to have impacted upon the distribution as are changes to soils as a result of the importation of fill in the remainder of Rapid's Landing.

It is not possible to determine the presence or absence of dieback due to the lack of indicator species.

Other potential threats to remnant vegetation are Myrtle rust and Marri canker and there is some evidence of the canker in Stoneman Park.

2.10 Acid sulfate soils

The waterways and floodplain have been identified as being a "high to moderate" or "moderate to low" Acid Sulfate Soil risk area.

2.11 Aboriginal heritage

The Aboriginal Heritage Inquiry System (AHIS) is an internet based search tool. The AHIS provides details about the location, extent and assessment status of each place under the Aboriginal Heritage Act 1972. The Department of Planning, Lands and Heritage (DPLH) holds the information about Aboriginal sites and other heritage places.

A review of the Department of Planning, Lands and Heritage AHIS was undertaken in February 2019 (NSA PL 2019). The ethnographic register identified the Margaret River as a registered mythological site (Place ID 4495). This includes all of the waterways within the Rapid's Landing subdivision.

All tributaries are seen as part of the larger river and are therefore afforded the same ethnographic significance as the main river itself (Goode, 2003). These watercourses are protected in the foreshore areas ranging from a minimum 50 m buffers to 150 m buffers along the Darch Brook. In recognition of the relationship between the Aboriginal community and the waterways, the early stages of waterway stabilization and revegetation activities along the waterway adjacent to Stages 1 – 5B were overseen by Aboriginal observers.

2.12 Relevant Shire policies and procedures

The Shire has considerable responsibilities in the management of numerous reserves, recreation areas and roadsides throughout the Municipal area. To improve the consistency of management actions and to provide accountability, the Shire staff have developed a number of management plans to guide their on-ground works.

This document is intended to assist the local government to assume responsibility for the revegetated portion of the foreshore reserve and existing landscape nodes. The future development may result in modifications to the current reserve boundary and this will be addressed in the detailed planning for the Island Precinct.

Other relevant Council documents include:

<u>Draft Weed Management Strategy (2014)</u>
This strategy provides a framework for the Shire of Augusta Margaret River to manage and control priority environmental weeds in designated reserves with recognised biodiversity conservation and community values. The report recommends potential strategies and methodologies for environmental weed management now and in the future.

Bush Fire Risk Policy

To provide a standard and consistent framework for the management of bushfire risk across all land tenures and vegetation types in the Shire in order to save lives, minimise risks to assets and protect natural and cultural heritage values. The policy includes risk management strategies for Shire and privately owned land, provision of emergency access, managing reserves and the removal of fallen trees.

Shire of AMR Management of Vegetation on Shire Reserves Policy (Infrastructure Policy 16)

The purpose of this policy is to ensure vegetation within Shire reserves is managed to provide for biodiversity protection, erosion control, fauna habitat, amenity and sense of place. The policy provides guidance for vegetation pruning, removal and retention.

Shire of AMR Asset Management Policy (Infrastructure Policy 1)

A consistent asset management improvement strategy shall be developed for implementing systematic and best practice asset management practices in all of the Shire's operations.

Shire of AMR Works on Public Land Policy (Infrastructure Policy 5)

This policy's object is to ensure that works (including landscaping but excluding mowing of grass) undertaken on land that is owned, or is vested in, or is under the care, control or management of the Shire does not impact on the land or the safe use of the land.

Shire of AMR Removal of Obstructions on Public Land (Infrastructure Policy 6)

The Shire's policy relates to having the capacity to effectively remove objects with a system of authorisation and payment for such works. This can relate to having a right to remove any objects, including works or trees, shrubs, plantings or landscaping etc., deemed to present a safety hazard and/or maintenance or construction problem, and the Shire shall not be responsible for reinstatement of items removed.

Shire of Augusta-Margaret River Erosion and Sediment Control Law 2018

The purpose of this local law is to provide for the regulation, control and management of erosion, sediment and pollutants on land within the district so as to protect the amenity of the area. This requires the all soil be stabilized and no soil, sediment or pollutant is released from or escapes from the land, whether by means of erosion, ground disturbing activity or any other cause and that no soil, sediment or pollutant is released or deposited directly or indirectly into any waterbody or watercourse.

A Guide to the Use of Pesticides in Western Australia (Dept. of Health 2010)

The Shire has a range of policies in relation to weed management and compliance with statutory obligations at a State and Federal government level.

3.0 CURRENT MANAGEMENT RECOMMENDATIONS

Reserve R50413 has been the subject of considerable rehabilitation throughout the development of Stages 1 – 5B. Beyond the foreshore, landscaping and recreational parks have been created to enhance the community's interaction with the natural foreshore area in Rapids Landing.

3.1 Vegetation management

3.1.1 Rehabilitation

The existing riparian vegetation along the tributary has been successfully revegetated with a significant improvement in the integrity of the natural system. The current management objectives are divided into three zones:

Zone 1: Conservation zone
Zone 2: Rehabilitation/Revegetation Zone, and
Zone 3: Recreational/Interface Zone (Map 5).

These zones vary in the management objectives of the zones and the intensity of weed control to be undertaken.

Zone 1: Conservation zone
The riparian zone directly adjacent to the creekline, including the channel bed, slopes and banks require regular weed control to enhance the long-term survival of the re-established native species. The management objective of Zone 1 is to protect the ecological function of the fringing vegetation. The restoration of the riparian vegetation through weed control and revegetation has improved biodiversity and wildlife habitat values, as well as providing bank stability, sediment and nutrient retention and improving water quality.

This zone is naturally regenerating and reinforcing itself, provided regular weed control is undertaken.

Regular targeted weed control is required to remove isolated thistle (*Cirsium vulgare*), the Declared weed Apple of Sodom (*Solanum linnaeanum*), Blackberry (*Rubus* spp.) and Blackberry nightshade (*Solanum nigrum*). Monitoring for new weed incursions that may be transported into the riparian zone through water and animal movement, is also important.

Kikuyu occurs in small areas generally less than 15 sq m patches and requires regular spraying with a grass specific herbicide to prevent it from smothering the adjoining remnant sedgeland.

Selective under-pruning and removal of dead Tea-tree and WA Peppermint may be necessary along the buffer with freehold properties to assist with bushfire compliance activities and to facilitate movement along the recreational path network.

Weed control is necessary for long-term sustainability of the riparian system and the recovery of native vegetation function.

Management Recommendations

M1 Continue quarterly weed control in the riparian, stormwater and landscape zones.
M2 Monitor for death and underpruning requirements at six monthly intervals and remove any excess dry fuel load in the riparian zone.

Zone 2 Rehabilitation/revegetation zone

The rehabilitation zones have been comprehensively planted and natural regeneration processes are reasonably well established. There is an area that was inadvertently slashed that requires more intense management just north of the dam, as weeds were able to re-establish with the loss of competition. Additional planting is not deemed necessary should regular weed control be achieved.

Management Recommendations

M3 Continue quarterly weed control in the rehabilitation/revegetation zones.

Zone 3 Recreational/interface zone

The higher areas in the foreshore reserve between the riparian environment and the residential zones have been created as interface areas and provide access along a dual use path and facilities, and appreciation of the natural creekline system. These areas have low, local shrubs to create a parkland cleared environment.

Weed control is minimal as the exotic grasses (mainly Kikuyu) can be controlled by mowing in these recreational areas, however selective pruning and shaping to manage the gardens may be required intermittently.

The north-west corner was sparsely planted in 2008 with a range of low to medium shrubs including Prickly moses (*Acacia pulchella*), (*Melaleuca incana*), *Chorizema ilicifolium*, *Tremandra stelligera* and Native wisteria (*Hardenbergia comptoniana*). Many of the plants had naturally senesced and their skeletons removed. This zone was replanted by students from Rapid's Landing Primary School in June 2019.

With the new bushfire regulations, it is suggested that any areas requiring re-planting be documented more fully in future recreation and landscape plans for the Island Precinct as the bushfire regulation environment is subject to considerable ongoing change.

The ongoing management of the extensive parks in the subdivision, bioretention swales and roadside gardens are addressed in a complementary report (Bill James 2019).

Management Recommendations

M4 Continue quarterly weed control in the recreational/interface zones.
M5 Remove dead material from the north west zone and plant to parkland cleared.

3.1.2 Weed management

Weed control is most effective when targeted on eradicating or controlling the introduced species that have the greatest potential to invade other areas and compete with native species. Examples of priority weeds in Reserve R50413 are Blackberry (*Rubus* spp), Kikuyu (*Pennisetum clandestinum*), Blackberry nightshade (*Solanum nigrum)*, Lotus and the Declared Plant, Apple of Sodom (*Solanum linnaeanum*).

Other weed taxa are unsightly and are unlikely to impact significantly on the natural regeneration processes including Sowthistle (*Sonchus asper* and *S. oleraceus*), Storksbill (*Erodium* spp), Bearded oats (*Avena barbata*) and Wild oats (*Avena fatua*). Fleabane (*Conyza bonariensis*), Bushy starwort (*Symphyotrichum subulatum*) and Jersey cudweed (*Helichrysum luteoalbum*) occur and have a rapid life cycle that can impact on the aesthetics of the site but again do not pose a long term threat to natural and assisted regeneration processes.

On-going weed control will be required along the foreshore to maintain the successful revegetation program, however the work undertaken in the last 10 years has minimized this commitment of resources.

Chemical control of weeds adjacent and along waterways requires careful management to ensure detrimental impacts of herbicides on native flora, fauna and water quality are avoided. Most weeds can be controlled by regular spot- spraying or removal by hand. Care should be taken not to spray over open water or disturb the natural vegetation unnecessarily as this encourages further weed invasion and may exacerbate soil erosion. Herbicides should be used in accordance with the manufacturers' requirements and Material Safety Data Sheets.

Quarterly monitoring of weed growth should be sufficient in the riparian zones and appropriate control methods implemented as necessary. More frequent maintenance will be necessary in the landscape and peripheral interfaces between the native vegetation and recreational areas.

The use of fire for the purpose of weed control is unacceptable, as regeneration following fire tends to favour weeds over natives, resulting in a diminished native vegetation cover and seed bank. Should a wildfire occur, then the opportunity for improved access should be used and intensive weed management undertaken to prevent the loss of native vegetation that responds more slowly.

The foreshore margins retain a range of exotic grasses and pasture weeds and will remain an ongoing management problem until future land development occurs on the northern side. The stormwater network also contributes weed seed from the road network and domestic gardens.

Isolated weeds that occur in the tea-tree thickets and sedgeland include small areas of Kikuyu (*Pennisetum clandestinum)*, Couch *(Cynodon dactylon)*, Paspalum (*Paspalum dilatatum*) and the population of annual Yorkshire fog grass (*Holcus lanatus*) varies from year to year. Management of the annual grasses can be extremely problematic as they germinate when the floodplain is inundated and can flower and seed within four weeks. When the prevailing weather conditions prevents spraying the juvenile plants, the population can explode.

Map 5: Management zones

Semi-aquatic and weed species located in waterlogged zones include *Juncus microcephalus*, *Isolepis prolifera* and *Juncus bufonius*. These provide habitat functions and control is problematic due to the duration of inundation. The SAMR invasive species prioritization process does not require control of these species unless in small populations and there is sufficient native vegetation to meet bank stability and habitat requirements.

Plant species that have been found in the foreshore reserve associated with Stages 1 – 5B since 2007 are listed in Appendix 1.

Introduced annual and perennial grasses should be sprayed at least quarterly, and preferably two-monthly, however, the seasonal conditions can reduce access within the floodplain for the safe application of grass specific herbicides. The floodplain itself may only be accessible twice a year for perennial grass control and then treatment should occur in Autumn, preferably after some rain and subsequent growth of grasses and again as the water recedes in late November. Areas dominated by exotic grasses and other weeds on the periphery of the riparian zone can be sprayed with Glyphosate Bioactive, provided sufficient due diligence is applied to avoid over-spraying onto native vegetation.

Grass specific herbicide must be used in areas of native vegetation, notably where introduced grasses are growing intertwined within and beneath sedges.

The appropriate methods to eradicate and control major weed species found within the foreshore area is provided in Appendix 1.

The most up to date information regarding herbicides and application rates should be sought from the Department of Agriculture Western Australia and Environmental Weeds Action Network prior to implementing weed control programs.

Management Recommendations

M6 Prioritise weed management in the floodplain in summer months and the landscape zones in winter months when foreshore access is limited.

M7 Maintain recreation and landscape areas in the Foreshore Reserve, including mowing or slashing of grass in parkland cleared and selective handweeding along the riparian interface.

3.2 Fauna management

The creekline vegetation has become an important habitat and refuge for native fauna. Wildlife observations by the author over 10 years include four species of frog, eighteen species of birds including Splendid and Red-winged wrens and visitation by Western Ringtail Possum and Black cockatoo.

The dense planting of local native species has discouraged access across most of the foreshore reserve. This ensures minimal disturbance to native fauna. Pedestrians are encouraged to stay on the dual-use path that divides the natural riparian environment from the more open recreational areas.

A former construction access provides a linkage to the Bussell Highway footpath from the eastern end of the subdivision. Pedestrian access to The Island Precinct can be achieved at this point and will allow for the observation of wildlife utilizing the diverse habitat. This crossing may be upgraded to provide access to the future development stages in the design and planning process for the Island Precinct.

Future protection of habitats and native fauna can be achieved through:

- Minimising any future native vegetation clearing;
- Maintaining the dense planting on the riparian side of the pathway;
- Continuing the weed control program;
- Increasing community awareness/education of the importance of keeping to the paths;
- Appropriate fire management; and
- Use of best practice dieback prevention measures.

Management Recommendations

M8 Discourage access to the revegetated riparian buffer along the foreshore reserve.

M9 Enhance native vegetation linkages between the foreshore reserve and the adjoining roadside remnant vegetation.

3.3.1 Domestic and Feral Animals

Predation by cats and foxes has an impact on the abundance and species of fauna occurring in the foreshore reserve.

Rabbits have the potential to hinder future revegetation efforts along the northern tributary as there is likely more suitable habitat as a result of the narrower floodplain. Their potential impact on the vegetation can be managed with the use of tree guards.

In regard to controlling pets, community involvement and awareness promoting control of pets such as cats and dogs is an important aspect of managing predation by introduced species. In keeping with the *Local Government Dog Act 1976* and *Dog Regulations 2013*, dogs should be prohibited from uncontrolled access to the foreshore reserve. Signs should be erected encouraging dog owners to keep their dogs on a lead and use the proposed dual-use path system. Owners of cats should be encouraged to keep them in at night, and preferably at all times as recommended in the *Cat Act 2011*.

Management Recommendations

M10 Install community awareness signs adjacent Marri Park and Alferink Park that highlight the impact of pets such as cats and dogs on fauna in the natural environment, if Shire officers deem it necessary in the future.

M11 Install tree guards on native seedlings if required to protect from kangaroo and rabbit damage in future plantings if deemed necessary.

3.4 Stormwater management

A Drainage Management Plan (Wood and Grieve Engineers) for all stages of the residential development at Rapids Landing aimed to minimise the pollution entering the tributaries of the Margaret River and mitigate the potential for flooding as a result of increased rates of flow which result from piped drainage systems in developments.

There is no direct discharge of stormwater into the creekline and it is treated using Water Sensitive Urban Design (WSUD) principles. The best planning practices focused on retention, treatment, use and environmental and cultural benefits from stormwater. Within the foreshore reserves, all sub-catchment outlets have been placed as far "upstream" on the existing creekline as possible in order to maximise exposure of stormwater to vegetation in the foreshore and along the rehabilitated creekline. In addition, the drainage basins have two components which enables the trapping of sediment, nutrient and hydrocarbon removal within the drainage system and then feeding the water into bio-retention swales and vegetated buffers, before spilling over into the creekline. The design also sought to minimise mosquito breeding areas.

The locations of stormwater structures are indicated on the plan (Map 6). The basins were cleared of sediment in March 2019. These will need monitoring annually for weeds, sediment and other management issues. It is considered unlikely that further sediment extraction will be required as the catchments are fully developed.

New designs will occur for stormwater management in the Island Precinct with their final location and basin floor being located above the maximum groundwater level. The results of groundwater monitoring may influence the proposed future reserve boundary alignment.

Management Recommendations

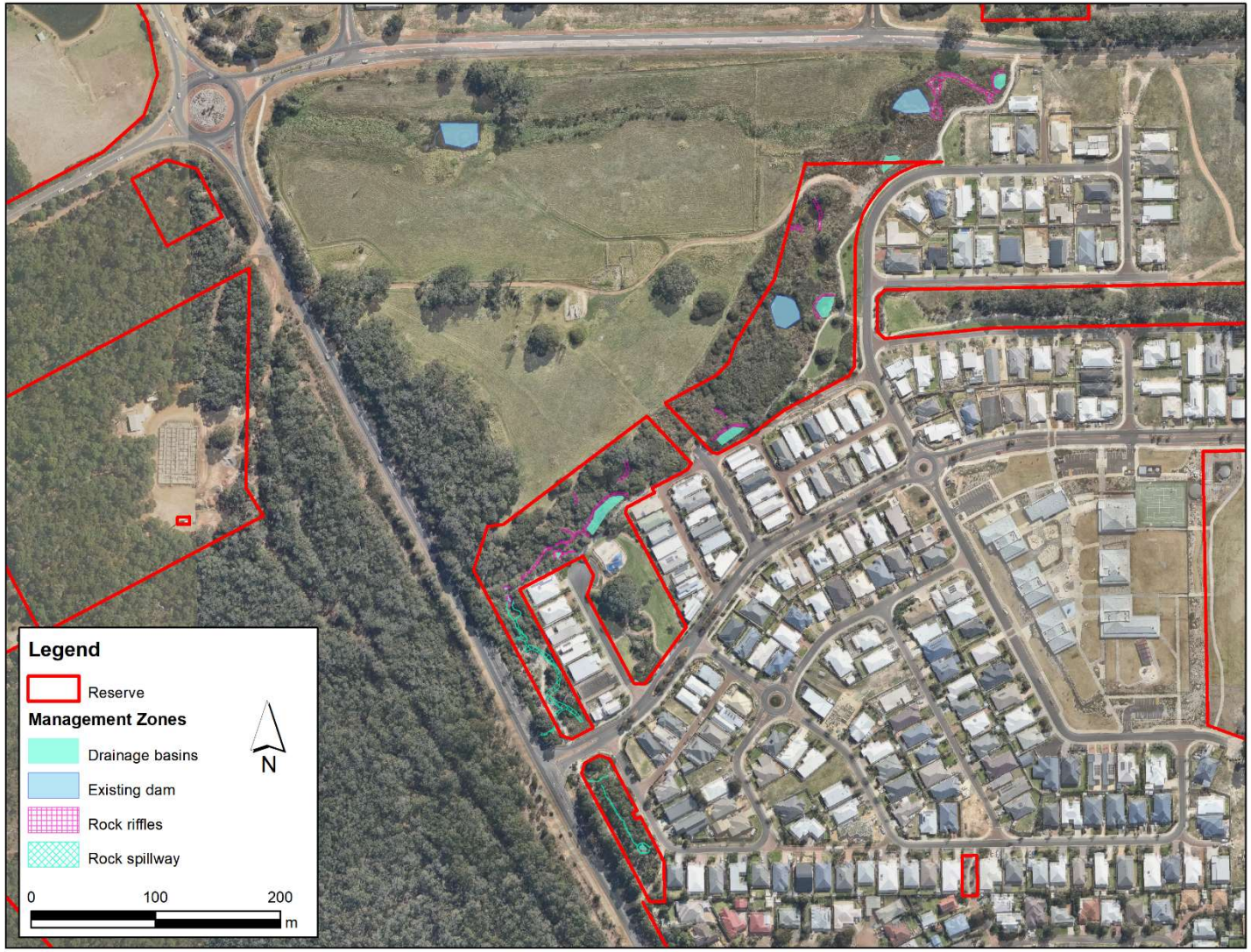
M12 Review basins on an annual basis to determine on-going maintenance requirements and to check and/or clear gross pollutant traps and bio-retention swales.

M13 Monitor, selectively remove and/or in-fill plant sedge/rush beds as required in the bio-retention swales, ensuring any vegetation removed is replaced within 10 months of sediment removal.

Local residents should be informed about the potential implications of their actions and encouraged to reduce possible impacts on the Darch Brook and Margaret River ecosystems. Nature Conservation Margaret River, with the support of the Lester Group, has held onsite environmental talks for the students of Rapid's Landing Primary School and involved the student group in planting part of the foreshore reserve.

The community is becoming more aware of the need to minimize the use of fertilisers and pesticides on gardens, appropriate disposal of paints and chemicals and sensible use of detergents. The Shire or Nature Conservation Margaret River may be interested in implementing a stenciling program adjacent to the roadside stormwater gullies, that highlights water that passes through the stormwater system enter Margaret River. This program may be a useful strategy to discourage dumping into the system. Pollutants that end up in the drainage system and local groundwater eventually impact on the water quality within the river catchment causing alterations in the ecosystem and contributing to problems such as algal growth. The school may be interested in participating in such a program.

Map 6: Stormwater management



Management Recommendations

M14 Encourage Nature Conservation and Shire Education Officers to increase awareness of local residents to minimise activities that could impact negatively on the creekline and river system through public awareness and education, such as drain stenciling.

3.5 Fire management and emergency access

Fire management requirements have changed substantially since development commenced. Fire hydrants have been installed in accordance with DFES requirements throughout the subdivision.

The established vegetation in the waterway poses a threat to the adjoining properties in the event of fire. The use of the Bushfire Attack Level rating (BAL) prior to construction of housing means that new houses should meet the Australian Standard AS 3959-2018.

Management actions that can assist with fuel load management is removal of the fine suspended woody debris, selected dead branches and under-pruning to 2 m to ensure fire-fighters can access the foreshore more readily. Weed control also plays an important role in reducing flammability.

A cost effective strategy is to ensure that all proposed future roads are located on the boundary of the foreshore reserve or parkland and housing, which provides an adequate firebreak, emergency access and fire-fighting access. Avoiding narrow passages between vegetation and private housing reduces future conflict in relation to waterway and vegetation management.

Setbacks from the final vegetation boundary should be determined as early as possible to avoid the need for clearing. This could ensure development on the northern side of the waterway can achieve adequate setbacks from housing to reflect BAL conditions.

It is a condition of subdivision that bushfire management requirements and setbacks are met and these will be applied to the Island Precinct.

Management Recommendations

M15 Reduce fuel loads by selectively removing dead branches, fine woody debris and under-pruning to 2 m in areas adjoining housing.

M16 Ensure future planning for the northern component of the subdivision considers bushfire management requirements and setbacks.

3.6 Recreation management

3.6.1 Landscaping and recreation areas

Considerable investment in landscaping has occurred in the parks on the southern side of the creekline associated with Stages 1 – 5B, Rapids Landing. These are linked to the foreshore reserve with a common Reserve number and PIN.

A comprehensive ongoing management plan for the majority of the landscaped areas is being developed in conjunction with this plan and should be referred to separately. The component considered to be more landscaping than remnant vegetation is the strip along the buffer which has a constructed stream/cascade water feature with rushes and sedges that forms part of the stormwater system. This has an aesthetic and stormwater management function (Map 6).

The northern side of the creekline does not yet have a detailed landscape master plan or landscaping design. A Development Guide Plan will be prepared for this area. However, the same general landscaping concepts will be implemented along the foreshore reserve including a dual-use path and recreational areas.

It is recommended that the current Reserve boundary be retained. Any revisions to the boundary alignment to John Archibald Drive can be identified on a future Deposited Plan once Structure Planning and associated subdivision and / or development approval is issued for the Islands precinct. Amending the current boundary in the future will facilitate handover of the current reserve to the Shire whilst enabling stormwater management, landscaping and infrastructure establishment on the northern side as part of the Development Guide Plans for the Island Precinct (Map 7).

Documentation detailing the ongoing management of the hard and soft landscape components is being prepared by William K James Landscape Architect (2019).

3.6.2 Access and facilities

The objective of retaining and enhancing the existing native vegetation within the foreshore reserve will be achieved by controlling access to designated paths. A dual use path (DUP) is built within the reserve above the flood level of the creekline and is constructed between the residential area and the foreshore reserve. It is a popular recreational feature of the subdivision. Most of the DUP alignment is visible on the key map (Map 7).

The DUP enables residents and visitors the opportunity to view and appreciate the river foreshore environment. The vegetation provides a natural barrier to the movement of people beyond the access path. The pathway also forms the boundary for weed control measures.

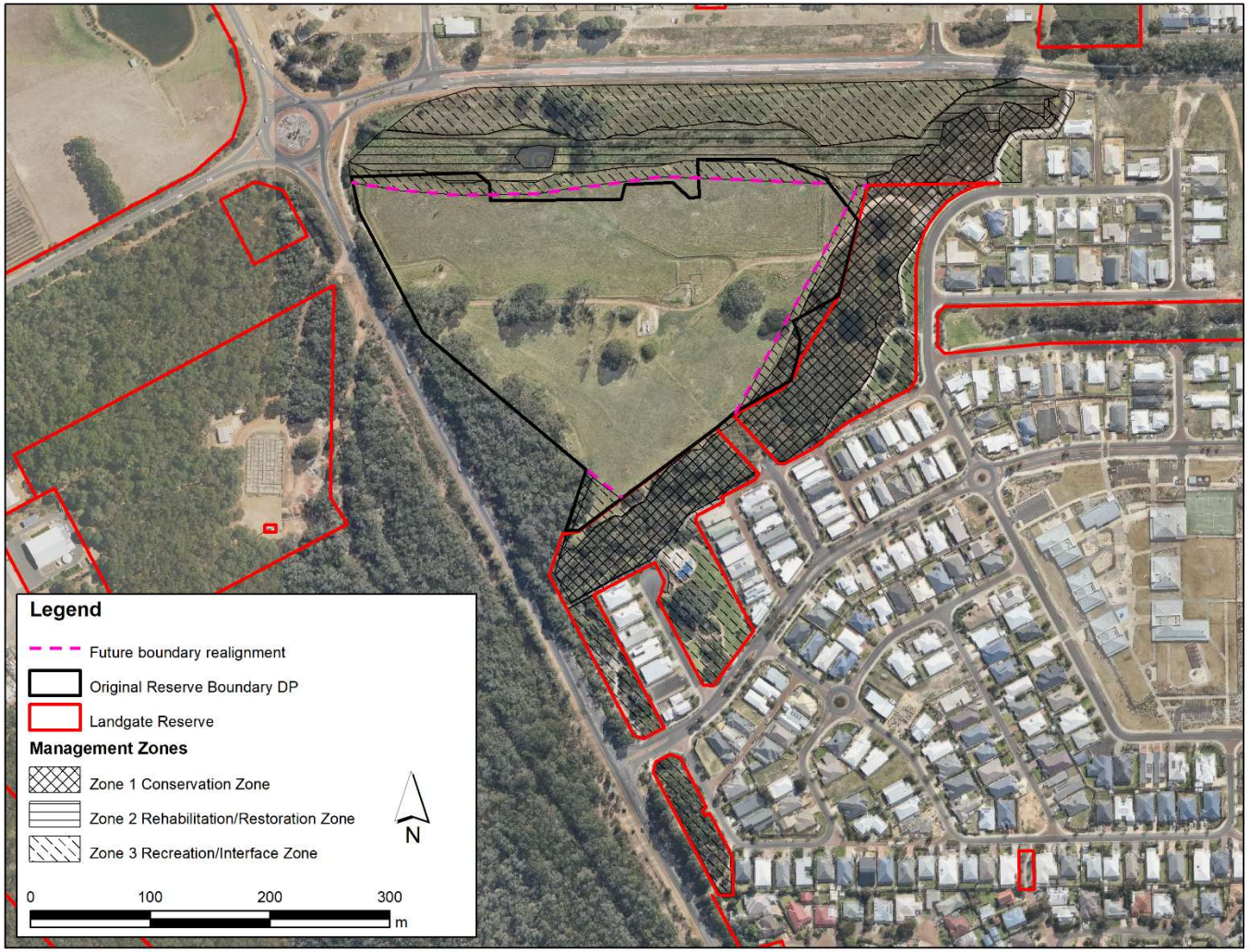
The DUP links to another on the western boundary. That path runs parallel with Bussell Highway and provides access into the Margaret River townsite (Map 8). A second crossing is a proposed timber boardwalk on the northern side of the existing farm dam that will be designed in the development of the Island Precinct. This would be an appropriate location for interpretative signage.

3.7 Community awareness, interpretation and safety

The proposed timber boardwalk over the creekline is an ideal location for interpretive and safety signage. Interpretative signs should be used to inform visitors of the revegetation works and weed control and identify key fauna that may be seen in the floodplain.

There could also be information on plaques of local plant, mammal, reptile or bird species including details of animal behaviour, habits and where it is likely to be observed. Safety signage should include a warning of any potential hazards including water safety and for child supervision.

Map 7: Future development implications



Signage should be clearly visible but should not detract from the aesthetic appeal of the viewing areas. Interpretative signs made of sturdy, anodized aluminium could be installed on the balustrade. Public safety signs should be clearly visible and may need to be taller and of more notable design on a separate post.

Some recreational users and residents of the Rapid's Landing recreation zones fail to control domestic cats and dogs in the floodplain and buffer vegetation, which detracts from the habitat values. There is some dumping of garden and other waste that increases fire risk and introduces weeds. Rubbish disposal is a common issue.

Anti-social behaviour occurs in the foreshore zone with drug paraphernalia, small fires and evidence of camping. This requires monitoring. Current management includes removal of materials as soon as they are found to discourage ongoing use.

Should these issues persist in the medium to long term, a letter drop or articles in the local paper may influence behaviour. Also, working with the school and use of the Shire web site to continue to increase environmental awareness will be of benefit.

Management Recommendations

M17 Install interpretive and safety signage as required within the Foreshore Reserve, without detracting the visual aesthetics of the area.

M18 Develop a uniform style for the signs that suits the environment.

M19 Provide educational and interpretative information to the residents by means such as leaflets and newsletters, if required.

M20 Continue to maintain the foreshore reserve, including rubbish collection and repairing any infrastructure in a timely manner.

3.8 Future development

The Island Precinct is the portion of the Rapid's Landing development site that adjoins the revegetated waterway alongside Stages 1 – 5B. It is bounded on the north by the second waterway. An artist's impression of the Rapid's Landing layout to support the sales process shows lots bounding the waterways to the north and south, however, considerable changes to planning, fire and other regulations have occurred since that document was prepared. A final decision about the type and scale of development for this private parcel of land has yet to be made.

Map 7 shows suggested modifications and potential future boundaries for public open space.

Suggested management principles include:

- Design road access and / or appropriate landscaping between all creek-line vegetation and housing to achieve sufficient setbacks to keep the Bushfire Attack Level to less than BAL 29.
- Establishing the road and path network above the floodplain and waterlogged areas to reduce the requirements for fill and supplementary drainage.
- Protection of the hilltop spring and significant tree.
- Establishing the riparian zone to the extent of waterlogged soil and constructing landscape amenities above to reduce construction effort.

- Minimising any clearing of the forest on the western boundary to enhance screening of Bussell Highway and wildlife corridors.

3.8.1 Future revegetation plan

The intensive revegetation and rehabilitation plan has resulted in considerable improvements to the foreshore reserve. These works have occurred over 10 years and have modified the previously degraded remnant vegetation with trees, shrubs, sedges, rushes and groundcovers.

The northern tributary and potential future public open space will require the development of a comprehensive revegetation and landscape plan. Table 5 lists some of the suite of species recommended for planting in the northern tributary. These species have been selected on the basis that they are local native species already growing at the site or in nearby similar environments. They are also likely to be available commercially from local plant nurseries.

Table 5: Species recommended for revegetation of the northern tributary

Scientific name	Common name	Planting density and arrangement
Agonis flexuosa	WA Peppermint	1 per 20 sq m grouped
Baumea articulata	Jointed sedge	1 per sq m in groups
Baumea vaginalis	Sheath twig rush	1 per sq m in groups of 5
Baumea juncea	Bare twig rush	6 per sq m in dense groups
Callistachyus lanceolata	Wonnich	1 per 20 sq m occasionally
Centella asiatica	Common centella	6 per sq m throughout
Eucalyptus diversicolor	Karri	1 per 20 sq m clustered
Eucalyptus patens	Blackbutt	1 per 20 sq m occasionally
Lobelia tenuior		6 per sq m throughout
Juncus kraussii	Shore rush	2 per sq m grouped
Juncus pallidus	Pale rush	1 per sq m occasionally
Juncus pauciflorus	Loose-flowered rush	3 per sq m grouped
Juncus subsecundus	Finger rush	2 per sq m grouped
Lepidosperma effusum	Spreading sword sedge	1 per 5 sq m
Lepidosperma tetraquetrum	Angled sword sedge	1 per 5 sq m
Meeboldina scariosa	Velvet rush	2 per sq m grouped
Melaleuca incana	Grey honeymyrtle	1 per 5 sq m randomly
Melaleuca densa		1 per 5 sq m in clusters
Schoenoplectus validus	Lake rush	1 per sq m clusters
Taxandria linearifolia	Common tea-tree	1 per 5 sq m in clusters

The principles that should be integrated into the future revegetation plan for the northern foreshore area are:

- Use native species seedlings of local provenance, where possible;
- Plant seedlings in the floodplain margins in late autumn to early winter to take advantage of the following winter rainfall after initial rainfall has thoroughly moistened the soil;
- Ensure seedlings are grown in soil that is free of weeds, dieback or other pathogens so that additional management issues are not introduced to the foreshore;

- Avoid the use of fertiliser in the riparian zone when planting native stock;

- Plant the riparian zone following at least six weed control treatments. Note, rock riffles will reduce the risk of erosion and facilitate a staged planting approach to maximize growth rates; and

- Plant clusters of the same species according to the appropriate micro-topography to achieve a natural effect.

Management Recommendations

M21 In conjunction with an endorsed Structure Plan, develop a landscape master plan and revegetation plan for the northern tributary at least two years prior to developing the adjoining subdivision using local native species and plant densities as outlined in Appendix 3.

M22 Undertake in-fill planting in the second year using local native species and densities as outlined in Appendix 3, as required.

M23 Implement an intensive weed control program prior to revegetation of the foreshore reserve, to ensure maximum survival and growth rates are achieved by planted stock.

3.8.2 River restoration

This section outlines river restoration approaches that may be useful in the management of the northern tributary associated with the future Island Precinct development. This waterway remains in private ownership. A technique used to enhance and restore degraded rivers consists of re-building the pool-riffle sequence, and is used where channel deepening, or incision, is the main cause of instability. This approach was used successfully on the southern tributary adjoining Stages 1 – 5B.

The description below applies from the waterway from Boodjidup Roundabout on Bussell Highway to the junction with previous revegetation works.

Erosion and sedimentation are naturally occurring riverine processes, but these processes can be accelerated when a channel becomes unstable. The primary cause of accelerated erosion and sedimentation is clearing of vegetation. Weed control to enable revegetation requires vegetation removal, predominantly Kikuyu.

As outlined in Section 2.7, the northern creekline is in a degraded condition with the classification using the Pen Scott method as generally B3/ C1: Degraded, weed dominated and erosion prone. The native vegetation watercourse is naturally regenerating without investment in weed control.

There are localised areas of more severe erosion (D1), where the tributary has a defined channel with steep, actively eroding river banks. The road network contributes peak flows and the small dam is likely to help reduce peak flows.

Pool-riffle sequences contribute to channel stability by controlling the velocity of flow and reducing the downstream movement of sediment into the creekline.

Stabilized bed material is important for the establishment of in-stream vegetation and habitat for aquatic fauna and through herbicide control of kikuyu and other weeds, the collapsed plant

biomass can help to accumulate sediment.

The process of locking the sediment and reducing flow velocities helps to remove nutrients from the water column through biological processes or they remain bound in the bed material. Water quality is also improved as the riffle creates turbulence that aerates the water, which in turn supports microbial activity that breaks down organic matter and assimilates nutrients. Riffle zones are often turbulent, well aerated areas and are favoured by filter-feeding macro-invertebrates that are able to exploit the current for gathering food (Waters and Rivers Commission, 2001a).

Granite extracted during the development of Stages 1 -5B were placed in strategic piles along the tributary to facilitate the construction of these riffles.

Management Recommendations

M24 Install rock riffles along the northern tributary prior to revegetation and weed control to avoid sediment mobilization and erosion.

M25 Construct riffles and align woody debris to reduce erosion as outlined in the River Restoration manual (Water and Rivers Commission 2001).

The existing dam on the northern tributary will require minor earthworks to batter the banks to a suitable slope. The preferred slope is 1:8 (vertical: horizontal aspect), preferably with benches to enable wide plantings of wetland species with the same preferred inundation tolerance. Any sediment removed in this process can be utilized to top dress future planting and/or landscaping areas.

Management Recommendations

M26 Batter the banks of the existing dams to a slope of 1:8 (vertical: horizontal) to enable revegetation works to proceed.

M27 Remove existing stockpiled soil adjacent to both dams away from the waterway.

The riparian environment has been highly modified due to the prior use of the land for farming, which has reduced its habitat value. Another habitat feature that could also be incorporated into the restoration of the creekline would be the incorporation of large woody debris into the system. Snags, or large woody debris play an important role in the river ecology by providing a range of flow conditions within the channel and by providing micro-habitats for animals and plants. They provide roosting sites for birds as well as shelter for burrowing animals such as gilgies and marron.

If trees are to be felled on the adjacent development area, trunks and large branches over 150 mm diameter could be used as habitat in the creekline. The logs should typically be installed against the outer bank, pointing downstream at an angle of approximately 30^{o}. This action will minimise the effect of the snag on the flow levels and direction, while maintaining the habitat available for plants and animals that benefit from low flow conditions.

Management Recommendations

M28 If feasible, place several logs in strategic locations (should trees need to be felled from the development area) to improve habitat values.

4.0 IMPLEMENTATION

4.1 Maintenance schedule and implementation of works

The Foreshore Management Plan provides for maintenance and will be undertaken in conjunction with the management of the landscape zones. Table 6 and 7 outlines the timing of management works for the implementation of the Foreshore Management Plan.

The implementation of measures outlined in this plan will be the responsibility of the Shire of Augusta-Margaret River once formal handover of the development is agreed.

Budget constraints will be the key factor for the Shire unless a community group can be formed, which would enable external grants to be applied for. Further liaison with Nature Conservation Margaret River may be useful to support these activities.

The developer currently spends about $20 000 per annum on the foreshore area for weed control, selective tree pruning and maintenance. Landscaping maintenance is separate and unrelated to foreshore maintenance.

4.2 Summary of works

The following table prioritises the management measures for the Foreshore Reserve with the recommendations divided into zones.

The following maps show the management measures for the Foreshore Reserve and buffer landscape areas. The management zones each have slightly different requirements. The majority of the reserve shown in Maps 9 – 11 will be passed to the Shire while future planning and design will occur in the area shown in Map 12.

Ongoing Shire management activities in the foreshore reserve are provided below (Table 6):

Table 6: Ongoing management requirements

MANAGEMENT ZONE	**ACTIONS**
Drainage basins	Monitor sediment load and excavate if required (Feb). Monitor vegetation cover within basins and selectively remove if required (Mar-Apr). Removed vegetation should be replaced with new tubestock. Manage weed infestation in the basins (6 - 8 weekly).
Landscape zone	Refer to detailed specifications prepared by William James Landscape Architect (2019). Monitor bridge and dual-use path condition and repair as required.

MANAGEMENT ZONE	ACTIONS
Remnant vegetation	Every two months, spot treat weeds using a combination of hand weeding, spraying and brushcutting.
Revegetation zone	Replace senescent plants if required. Every two months, spot treat weeds using a combination of hand weeding, spraying and brushcutting. Monitor for dead branches that increase fuel load or interference with dual-use paths and prune as required.
Rock riffles	Monitor for weed incursion and treat. Remove accumulated sediment if the water breaches the structures and results in erosion.
Rock spillway	Monitor for weed incursion and treat. Remove accumulated sediment if the water breaches the structures and results in erosion.

FUTURE ISLAND PRECINCT

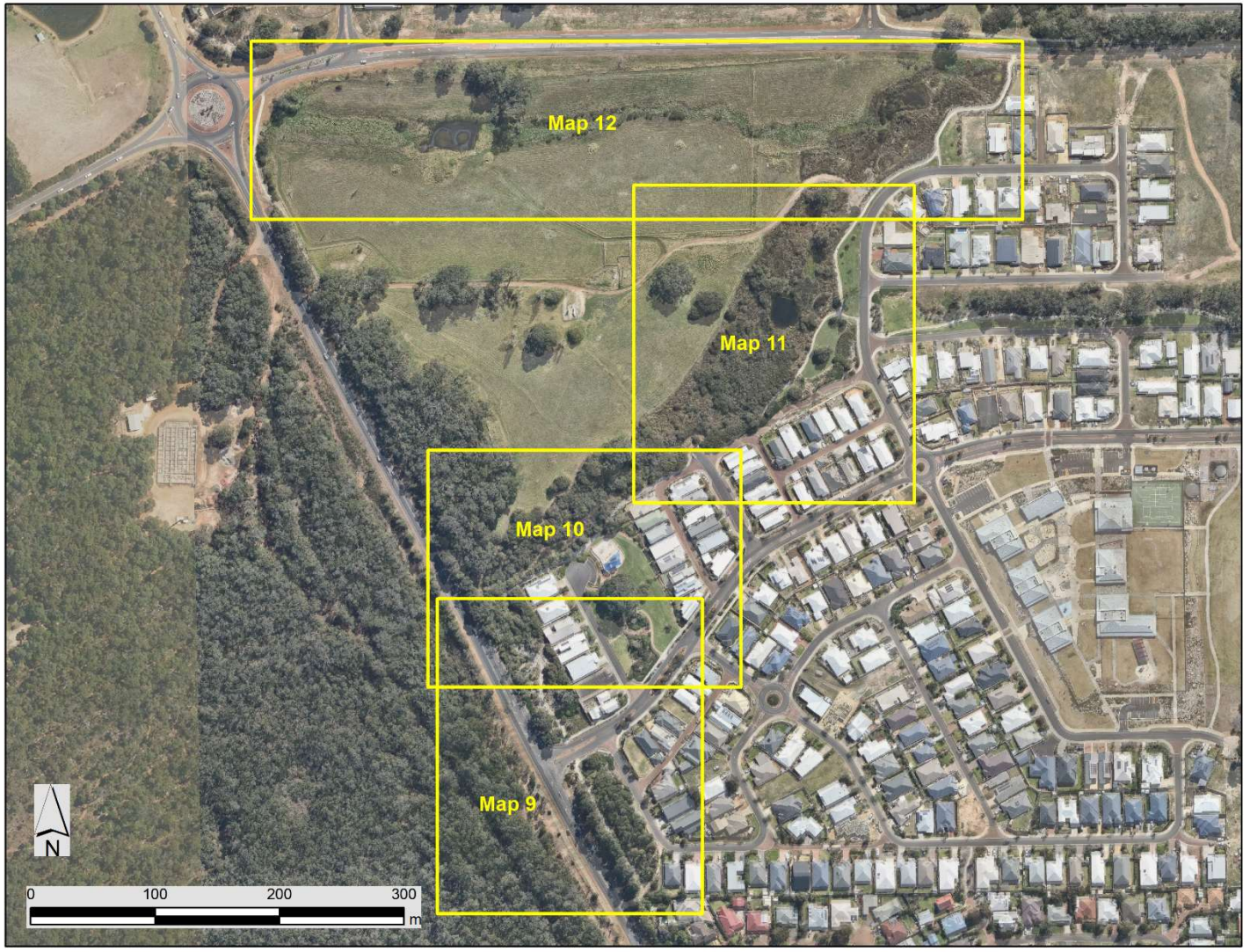
Balwyn Margaret River will retain responsibility for the development and implementation of guide plans, drainage management, landscape and rehabilitation master plans for the land that remains in private ownership (Table 7).

Table 7: Ongoing commitments for Balwyn Margaret River PL

MANAGEMENT ZONE	ACTIONS
Conservation and rehabilitation zones	Develop appropriate plans for the conservation, rehabilitation/restoration and recreational interface zones in consultation with the Shire and other agencies as required. Continue to manage serious and declared environmental weeds in the riparian zone between the foreshore reserve and future Island Precinct.
Existing dam (northern tributary)	Develop engineering designs for stormwater and drainage. Ensure the design includes re-contouring of the existing farm dams as part of the river restoration activities associated with the development of the Island Precinct.
Rock storage	Use the existing stockpiles along northern creek for future river restoration projects of the adjacent tributary.

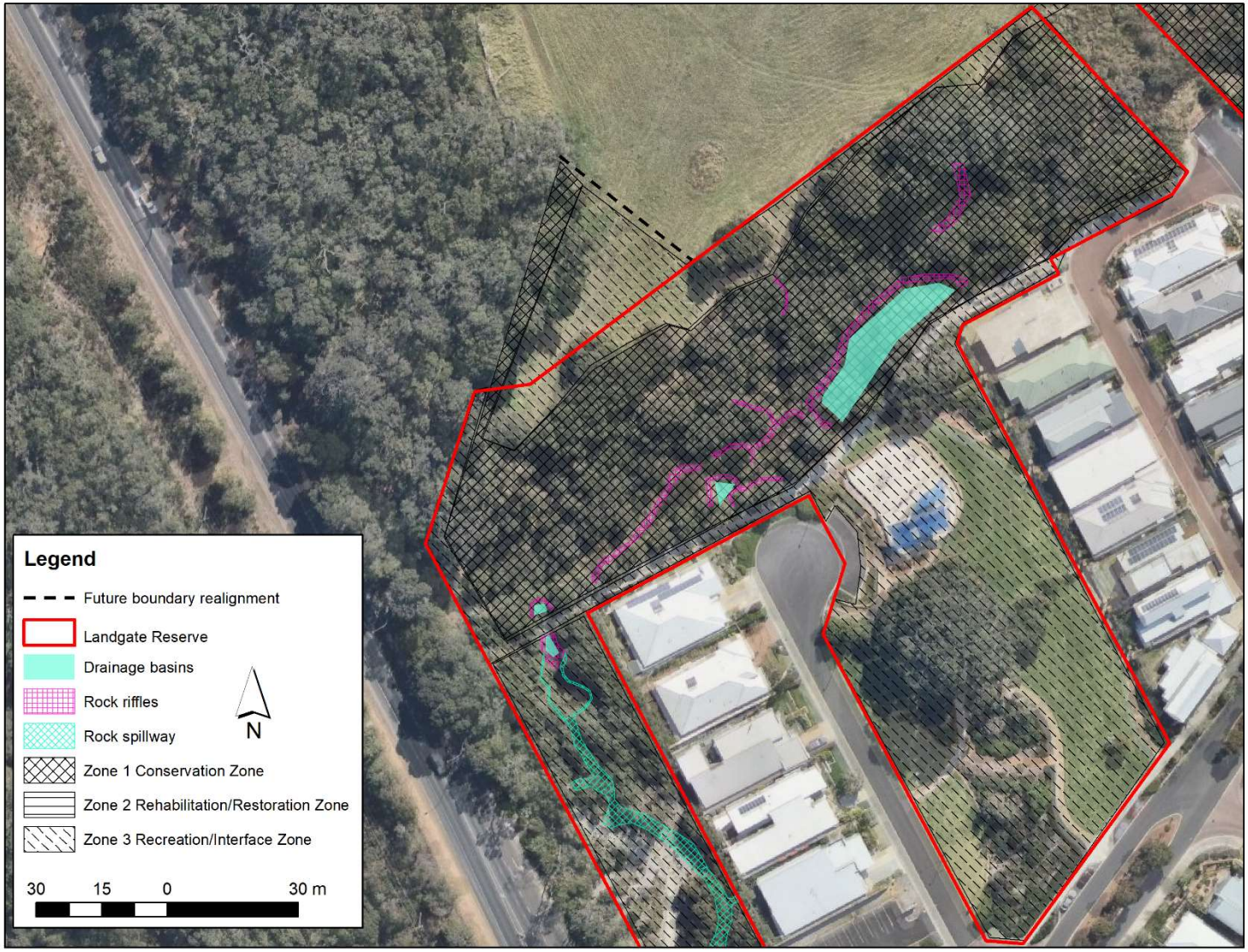
This plan will require review by the Shire in five years' time to ensure it provides adequate guidance as the development and waterways continue to evolve.

Map 8: Key map for detailed management



Map 9: Bussell Highway Buffer

Map 10: Marri Park and western creekline to future bridge



Map 11: Future bridge to end Stage 5A

Map 12: Future indicative waterway reserve

4.3 Allocation of responsibilities

Responsibility for the implementation of the recommendations and the on-going management and maintenance of the Foreshore Reserve from 1 January 2020 will lie with the Shire of Augusta-Margaret River.

It is anticipated that the developer will continue to manage the land outside of the Reserves and accept responsibility for the cost of any new construction of boardwalks or features that are associated with the planning, design and development of the Island Precinct.

Management agreements between the developer and the Shire may be needed where the interface between and within the existing reserve and future management boundaries are crossed.

4.4 Monitoring and review

The implementation of the management recommendations identified in this management plan will be an on-going process that should be flexible in responding to changes in the natural environment, the recreational demand and use of the foreshore, and in community values. As such, the management recommendations in this plan will be essential for the purposes of reviewing and updating the management of the area.

It is likely that the residents of the subdivision will be in regular contact with the Shire should issues arise within the foreshore reserves and landscape zones. A more ad-hoc approach to management is likely.

The implementation process and the adequacy of the management measures should be thoroughly reviewed on an annual basis. More frequent monitoring of on-going maintenance may be necessary to deal with weed management issues in particular.

An important objective of any conservation project is to monitor and evaluate changes at the site in order to keep track of progress and achievements. Photographs are a convenient method of recording landscape change over time, and offer an overall impression of the success or otherwise of the project's activities. Photopoints are cheap, effective and require no specialist equipment.

Photopoints are sites where a series of photos are taken regularly, from the same location at set intervals and using a standardised method; the photograph is taken at the same time of day, in the same direction each sampling time, at an estimated height and facing southwards to prevent glare (Hussey, 2002). There are a number of smartphone applications that can provide a transparent view to enable lining up key elements in future years.

Photographic evidence should be provided with the date and identification number clearly shown on the quadrat (Hussey 2002). A useful smartphone app is OpenCamera which records the geographic position.

Management Recommendation

M27 Review management measures on an annual basis to assess the effectiveness of measures and maintenance requirements.

M28 Undertake annual monitoring program using permanent photopoints to monitor the progress of natural regeneration and the success of weed management.

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APPENDICES

APPENDIX 1: Flora List Rapid's Landing, Bussell Highway, Margaret River (ATA Environmental 2004, 2008 and NSA PL, 2019)

Family	Species
PTERIDOPHYTA	
DENNSTAEDTIACEAE	*Pteridium esculentum*
MONOCOTYLEDONS	
CYPERACEAE	*Baumea articulata*
	Baumea juncea
	Baumea vaginalis
	Carex appressa
	Lepidosperma effusum
	Lepidosperma scabrum
	Lepidosperma tenue
	Lepidosperma tetraquetrum
	Mesomelaena tetragona
	**Isolepis prolifera*
	***Cyperus eragrostis*
HAEMODORACEAE	*Anigozanthos flavidus*
	Anigozanthos viridis
	Conostylis setigera
IRIDACEAE	**Gladiolus undulatus*
	Orthrosanthos laxus
	Patersonia occidentalis
	**Romulea rosea*
JUNCACEAE	*Juncus pallidus*
	Juncus pauciflorus
	Juncus subsecundus
POACEAE	**Avena barbata*
	**Avena fatua*
	**Briza maxima*
	**Briza minor*
	**Holcus lanatus*
	**Hordeum sp.*
	**Cynodon dactyon*
	**Lagurus ovatus*
	**Lolium perenne*
	**Paspalum dilatatum*
	**Poa annua*
	**Pennisetum clandestinum*
	Desmocladus flexuosus
RESTIONACEAE	*Loxocarya cinerea*
XANTHORRHOEACEAE	*Xanthorrhoea preissii*
DICOTYLEDONS	
APIACEAE	*Hydrocotyle sp.*
	Centella asiatica
ASTERACEAE	**Cirsium vulgare*
	**Conyza bonariensis*
	**Hypochaeris glabra*
	**Sonchus oleraceus*
	**Symphyotrichum subulatum*
	**Taraxacum officinale*
CENTROLEPIDACEAE	*Centrolepis sp.*
DILLENIACEAE	*Hibbertia hypericoides*
EPACRIDACEAE	*Astroloma ciliatum*
	Leucopogon verticillatus

FABACEAE	*Hovea chorizemifolia*
	Hovea trisperma
	Kennedia coccinea
	Kennedia prostrate
	**Trifolium campestre*
	Viminaria juncea
MIMOSACEAE	*Acacia divergens*
	Acacia myrtifolia
MYRTACEAE	*Agonis flexuosa*
	Corymbia calophylla
	Eucalyptus marginata subsp. marginata
	Eucalyptus patens
	Kunzea ericifolia
	Melaleuca densa
	Melaleuca hamulosa
	Melaleuca rhaphiophylla
	Taxandria juniperina
	Taxandria linearifolia
OXALIDACEAE	*Oxalis spp.*
PROTEACEAE	*Hakea amplexicaulis*
	Hakea lissocarpha
	Hakea varia
RANUNCULACEAE	*Clematis pubescens*
RHAMNACEAE	*Trymalium floribundum*
ROSACEAE	**Rubus discolor*
STERCULIACAEAE	*Lasiopetalum floribundum*
	Thomasia pauciflora
THYMELAEACEAE	*Pimelea rosea*

*denotes weed species

APPENDIX 2: FAUNA DATABASE SEARCHES

PREDICTED BIRD SPECIES AT LOT 27 BUSSELL HIGHWAY, MARGARET RIVER

E Represents species listed under the *Environment Protection and Biodiversity Conservation Act* 1999

EM Represents migratory bird species listed under the *Environment Protection and Biodiversity Conservation Act* 1999

S Represents species listed on the Department of Biodiversity, Conservation and Attractions Scheduled Fauna list

P Priority Fauna list

I Introduced species

Species	
Casuariidae (Emus and Cassowaries)	
Emu	*Dromaius novaehollandiae*
Phasianidae (Pheasants and Quails)	
Brown Quail	*Coturnix ypsilophora*
Anatidae (Ducks, Geese and Swans)	
Australian Shelduck	*Tadorna tadornoides*
Pacific Black Duck	*Anas superciliosus*
Grey Teal	*Anas gibberifrons*
Australian Wood Duck	*Chenonetta jubata*
Ardeidae (Herons and Egrets)	
White-faced Heron	*Egretta novaehollandiae*
White-necked Heron	*Ardea pacifica*
Great Egret	*Egretta alba*
Nankeen Night Heron	*Nycticorax caledonicus*
Plataleidae (Ibis and Spoonbills)	
Australian White Ibis	*Threskiornis molucca*
Straw-necked Ibis	*Threskiornis spinicollis*
Accipitridae (Kites, Hawks and Eagles)	
Black-shouldered Kite	*Elanus notatus*
Square-tailed Kite	*Lophoictinia isura*
Whistling Kite	*Haliastur sphenurus*
Swamp Harrier	*Circus approximans*
Brown Goshawk	*Accipiter fasciatus*
Collared Sparrowhawk	*Accipiter cirrhocephalus*
Wedge-tailed Eagle	*Aquila audax*
Little Eagle	*Hieraaetus morphnoides*
Falconidae (Falcons)	
Peregrine Falcon	*Falco peregrinus* **S**
Australian Hobby	*Falco longipennis*
Brown Falcon	*Falco berigora*
Nankeen Kestrel	*Falco cenchroides*
Turnicidae (Button-quails)	
Painted Button-quail	*Turnix varia*
Rallidae (Crakes and Rails)	
Buff-banded Rail	*Rallus philippensis*
Columbidae (Pigeons and Doves)	
Common Bronzewing	*Phaps chalcoptera*

Species	
Brush Bronzewing	*Phaps elegans*
Cacatuidae (Cockatoos)	
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii naso* **P**
Short-billed Black-Cockatoo	*Calyptorhynchus latirostris* **S E**
Long-billed Black-Cockatoo	*Calyptorhynchus baudinii* **S E**
Galah	*Cacatua roseicapilla*
Psittacidae (Lorikeets and Parrots)	
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*
Red-capped Parrot	*Purpureicephalus spurius*
Western Rosella	*Platycercus icterotis*
Australian Ringneck	*Barnardius zonarius*
Elegant Parrot	*Neophema elegans*
Cuculidae (Cuckoos)	
Pallid Cuckoo	*Cuculus pallidus*
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*
Strigidae (Hawk-owls)	
Barking Owl	*Ninox connivens* **P**
Southern Boobook Owl	*Ninox novaeseelandiae*
Tytonidae (Barn owls)	
Masked Owl	*Tyto novaehollandiae* **P**
Barn Owl	*Tyto alba*
Podargidae (Frogmouths)	
Tawny Frogmouth	*Podargus strigoides*
Aegothelidae (Owlet-nightjars)	
Australian Owlet-nightjar	*Aegotheles cristatus*
Halcyonidae (Forest kingfishers)	
Laughing Kookaburra	*Dacelo novaeguineae*
Sacred Kingfisher	*Todiramphus sanctus*
Meropidae (Bee-eaters)	
Rainbow Bee-eater	*Merops ornatus* **EM**
Climacteridae (Treecreepers)	
Rufous Treecreeper	*Climacteris rufa*
Maluridae (Fairy-wrens)	
Southern Emu-wren	*Stipiturus malachurus*
Splendid Fairy-wren	*Malurus splendens*
Red-winged Fairy-wren	*Malurus elegans*
Pardalotidae (Pardalotes)	
Spotted Pardalote	*Pardalotus punctatus*
Striated Pardalote	*Pardalotus striatus*
White-browed Scrubwren	*Sericornis frontalis*
Western Gerygone	*Gerygone fusca*
Weebill	*Smicrornis brevirostris*
Inland Thornbill	*Acanthiza apicalis*
Western Thornbill	*Acanthiza inornata*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Meliphagidae (Honeyeaters)	
Red Wattlebird	*Anthochaera carunculata*
Western Wattlebird	*Anthochaera lunulata*
Singing Honeyeater	*Lichenostomus virescens*
White-naped Honeyeater	*Melithreptus lunatus*
Brown Honeyeater	*Lichmera indistincta*

Species	
New Holland Honeyeater	*Phylidonyris novaehollandiae*
White-cheeked Honeyeater	*Phylidonyris nigra*
Western Spinebill	*Acanthorhynchus superciliosus*
Petroicidae (Australian robins)	
Scarlet Robin	*Petroica multicolor*
Western Yellow Robin	*Eopsaltria griseogularis*
White-breasted Robin	*Eopsaltria georgiana*
Hooded Robin	*Melanodryas cucullata*
Neosittidae (Sittellas)	
Varied Sittella	*Daphoenositta chrysoptera*
Pachycephalidae (Whistlers)	
Golden Whistler	*Pachycephala pectoralis*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Dicruridae (Flycatchers)	
Magpie-lark	*Grallina cyanoleuca*
Grey Fantail	*Rhipidura fuliginosa*
Willie Wagtail	*Rhipidura leucophrys*
Restless Flycatcher	*Myiagra inquieta*
Campephagidae (Cuckoo-shrikes)	
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Artamidae (woodswallows)	
Black-faced Woodswallow	*Artamus cinereus*
Dusky Woodswallow	*Artamus cyanopterus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Gymnorhina tibicen*
Corvidae (Ravens and Crows)	
Grey Currawong	*Strepera versicolor*
Australian Raven	*Corvus coronoides*
Passeridae (Finches)	
Red-eared Firetail	*Stagonopleura occulata*
Dicaeidae (Mistletoebird)	
Mistletoebird	*Dicaeum hirundinaceum*
Hirundinidae (Swallows)	
Welcome Swallow	*Hirundo neoxena*
Tree Martin	*Hirundo nigricans*
Motacillidae (Pipits and true wagtails)	
Richard's Pipit	*Anthus novaeseelandiae*
Zosteropidae (White-eyes)	
Silvereye	*Zosterops lateralis*

PREDICTED AMPHIBIAN SPECIES AT
LOT 27 BUSSELL HIGHWAY, MARGARET RIVER

E Represents species listed under the *Environment Protection and Biodiversity Conservation Act* 1999

S Represents species listed on the Department of Biodiversity, Conservation and Attractions Scheduled Fauna list

Species
Hylidae
Litoria adelaidensis
Litoria moorei
Myobatrachidae
Crinia georgiana
Crinia glauerti
Crinia insignifera
Crinia pseudinsignifera
Geocrinia alba **S**
Geocrinia leai
Heleioporus albopunctatus
Heleioporus eyrei
Heleioporus inornatus
Heleioporus psammophilus
Limnodynastes dorsalis
Metacrinia nichollsi
Pseudophryne guentheri

PREDICTED REPTILE SPECIES AT
LOT 27 BUSSELL HIGHWAY, MARGARET RIVER

E Represents species listed under the *Environment Protection and Biodiversity Conservation Act* 1999

S Represents species listed on the Department of Biodiversity, Conservation and Attractions Scheduled Fauna list

Species	
Agamidae (Dragons)	
	Pogona minor
Boidae (Pythons)	
Carpet Python	*Morelia spilota imbricata* **S**
Elapidae (Elapid Snakes)	
Bardick	*Echiopsis curta*
	Elapognathus coronatus
	Hydrophis elegans
Western Tiger Snake	*Notechis scutatus*
Gould's Snake	*Parasuta gouldii*
	Parasuta nigriceps
	Pelamis platura
Dugite	*Pseudonaja affinis*
	Rhinoplocephalus bicolor
Gekkonidae (Geckoes)	
Marbled Gecko	*Christinus marmoratus*
Pygopodidae (Legless Lizards)	
	Aprasia pulchella
	Aprasia repens
Burton's Legless Lizard	*Lialis burtonis*
Scaly Foot	*Pygopus lepidopodus*
Scincidae (Skinks)	
	Acritoscincus trilineatum
	Cryptoblepharus plagiocephalus
	Ctenotus catenifer
	Ctenotus delli
	Ctenotus impar
	Ctenotus labillardieri
King Skink	*Egernia kingii*
	Egernia luctuosa
	Egernia napoleonis
	Egernia pulchra pulchra
	Glaphyromorphus gracilipes
	Hemiergis peronii tridactyla
	Lerista distinguenda
	Lerista elegans
	Lerista microtis microtis
	Menetia greyii
	Morethia lineoocellata
	Morethia obscura
Bobtail	*Tiliqua rugosa*
Typhlopidae (Blind Snakes)	
	Ramphotyphlops australis
Varanidae (Goannas)	
Southern Heath Monitor	*Varanus rosenbergi*

PREDICTED AND RECORDED MAMMAL SPECIES AT LOT 27 BUSSELL HIGHWAY, MARGARET RIVER

I Represents introduced or feral species

E Represents species listed under the *Environment Protection and Biodiversity Conservation Act* 1999

S Represents species listed on the Department of Conservation and Land Management's Scheduled Fauna list

P Represents species listed on the Department of Conservation and Land Management's Priority Fauna list

Species	
Burramyidae (Pygmy Possums)	
Western Pygmy Possum	*Cercartetus concinnus*
Canidae (Dingos, Dogs)	
Fox	*Vulpes vulpes* I
Dasyuridae (Dunnarts, Quoll, Mardo, Wambengers)	
Mardo	*Antechinus flavipes leucogaster*
Chuditch	*Dasyurus geoffroii* S
Southern Brush-tailed Phascogale	*Phascogale tapoatafa tapoatafa* P
Gilbert's Dunnart	*Sminthopsis gilberti*
Grey-bellied Dunnart	*Sminthopsis griseoventer griseoventer*
Equidae (Horses)	
Horse	*Equus caballus*
Felidae (Cat)	
Cat	*Felis catus* I
Leporidae (Rabbits and hares)	
Rabbit	*Oryctolagus cuniculus* I
Macropodidae (Wallabies, Kangaroos)	
	Macropus eugenii derbianus
Western Grey Kangaroo	*Macropus fuliginosus*
Western Brush Wallaby	*Macropus irma*
Quokka	*Setonix brachyurus* S
Muridae (Rodents)	
Water Rat	*Hydromys chrysogaster* P
House Mouse	*Mus musculus*
Bush Rat	*Rattus fuscipes*
Black Rat	*Rattus rattus*
Peramelidae (Bandicoots and Bilbies)	
Southern Brown Bandicoot	*Isoodon obesulus fusciventer* S4
Phalangeridae (Brushtail Possums, Cuscuses)	
Common Brushtail Possum	*Trichosurus vulpecula*
Potoroidae (Potoroos, Bettongs)	
Brush-tail Bettong / Woylie	*Bettongia penicillata ogilbyi*
Long-nosed Potoroo	*Potorous tridactylus*
Pseudocheiridae (Ringtail Possums)	
Western Ringtail Possum	*Pseudocheirus occidentalis* S
Tarsipedidae (Honey Possum)	
Honey Possum	*Tarsipes rostratus*
Tachyglossidae (Echidna)	
Echidna	*Tachyglossus aculeatus*
Vespertilionidae (Evening Bats)	
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Wattled Bat	*Chalinolobus morio*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Greater Long-eared Bat	*Nyctophilus timoriensis timoriensis*
Southern Forest Bat	*Vespadelus regulus*

APPENDIX 3: PEN AND SCOTT FORESHORE CONDITION ASSESSMENT

A Grade Foreshore

A1: Pristine - The river embankment and/or channel are entirely vegetated with native species and there is no evidence of human presence, or livestock damage.

A2: Near Pristine - Native vegetation dominates but weeds are occasionally present in the understorey, though not to the extent that they displace native vegetation. Otherwise there is no human impact.

A3 Slightly disturbed - There are areas of localised human disturbance where the soil may be exposed and weed density is relatively heavy, such as along walking or vehicle tracks. Otherwise, native plants dominate and would quickly regenerate in disturbed areas should human activity decline.

B Grade Foreshore

B1: Degraded- Weed Infested - Weeds have become a significant component of the understorey vegetation. Although native species remain dominant, a few have probably been replaced or are being replaced by weeds.

B2: Degraded-Heavily Weed Infested - In the understorey, weeds are about as abundant as native species. The regeneration of some tree and large shrub species may have declined.

B3: Degraded-Weed Dominated - Weeds dominate the understorey, but many native species remain. Some tree and large shrub species may have declined or disappeared.

C Grade Foreshore

C1: Erosion Prone - While trees remain, possibly with some large shrubs or grass trees, the understorey consists entirely of weeds, mainly annual grasses. Most trees will be of only a few resilient long-lived species and their regeneration will be mostly negligible. In this state, where the soil is supported by short-lived weeds, a small increase in physical disturbance will expose the soil and render the river valley vulnerable to serious erosion.

C2: Soil Exposed - Here, the annual grasses and weeds have been removed through heavy livestock damage and grazing, or as a result of recreational activities. Low level soil erosion has begun, by the action of either wind or water.

C3: Eroded - Soil is being washed away from between tree roots, trees are being undermined and unsupported embankments are subsiding into the river valley.

D Grade Foreshore

D1: Ditch-Eroding - Fringing vegetation no longer acts to control erosion. Some trees and shrubs remain and act to retard erosion in certain spots, but all are doomed to be undermined eventually.

D2: Ditch-Freely Eroding - No significant fringing vegetation remains, and erosion is completely out of control. Undermined and subsided embankments are common, as are large sediment plumes along the river channel.

D3: Weed Dominated - The highly eroded river valley has been fenced off enabling colonisation by perennial weeds. The river has become a simple drain, similar if not identical to the typical major urban drain.

APPENDIX 4: Revegetation List for the Foreshore Reserve, Stage 1 Rapids Landing

Species	Location	Planting Density
Trees		
Corymbia calophylla	Channel slopes and banks	1-2 per 30 m^2
Eucalyptus diversicolor	Bank	1-2 per 50 m^2
Eucalyptus marginata	Bank	1-2 per 30 m^2
Eucalyptus patens	Bank	1-2 per 50 m^2
Agonis flexuosa	Bank	1-2 per 25 m^2
Melaleuca rhaphiophylla	Channel slopes and banks	1-2 per 10 m^2
Banksia grandis	Bank	1-2 per 10 m^2
Banksia littoralis	Channel slopes and banks	1-2 per 10 m^2
Shrubs		
Acacia alata	Bank	1-2 per m^2
Acacia extensa	Bank	1-2 per m^2
Acacia myrtifolia	Bank	1-2 per 5 m^2
Acacia pulchella	Bank	1-2 per m^2
Acacia saligna	Bank	1-2 per 5 m^2
Acacia uliginosa	Bank	1-2 per 5 m^2
Adenanthos obovatus	Bank	1-2 per m^2
Astartea scoparia	Channel slopes and banks	1-2 per 5 m^2
Beaufortia sparsa	Channel slopes and banks	1-2 per 5 m^2
Billardiera fusiformis	Channel slopes	1 per m^2
Boronia fastigiata	Channel slopes and banks	1-2 per m^2
Bossiaea linophylla	Bank	1-2 per 5 m^2
Bossiaea ornata	Bank	1-2 per 5 m^2
Callistachys lanceolata	Channel slopes and banks	1-2 per 15 m^2
Calothamnus lateralis	Channel slopes and banks	1-2 per 5 m^2
Chorizema cordata	Bank	1-2 per m^2
Dampiera alata	Bank	1-2 per m^2
Dampiera linearis	Bank	1-2 per m^2
Eutaxia virgata	Bank	1-2 per m^2
Gompholobium capitatum	Bank	1-2 per m^2
Grevillea diversifolia	Bank	1-2 per 5 m^2
Grevillea manglesioides	Bank	1-2 per 5 m^2
Grevillea trifida	Bank	1-2 per 5 m^2
Hakea amplexicaulis	Bank	1-2 per 5 m^2
Hakea lasianthoides	Bank	1-2 per 5 m^2
Hakea linearis	Bank	1-2 per 5 m^2
Hakea lissocarpha	Bank	1-2 per 5 m^2
Hakea ruscifolia	Bank	1-2 per 5 m^2
Hakea varia	Bank	1-2 per 5 m^2
Hibbertia cuneiformis	Bank	1-2 per m^2
Hibbertia hypericoides	Bank	1-2 per m^2
Hovea chorizemifolia	Bank	1-2 per m^2
Hovea elliptica	Bank	1-2 per m^2
Hovea pungens	Bank	1-2 per m^2
Hypocalymma angustifolium	Channel slopes and banks	1-2 per m^2
Hypocalymma cordifolium	Channel slopes and banks	1-2 per m^2
Hypocalymma robustum	Channel slopes and banks	1-2 per m^2
Kunzea ericifolia	Bank	1-2 per 5 m^2
Kunzea recurva	Bank	1-2 per 5 m^2
Melaleuca densa	Floodplain and lower bank	1 per 5 m^2
Melaleuca hamulosa	Channel slopes and banks	1-2 per 5 m^2
Melaleuca incana	Channel slopes and banks	1-2 per 5 m^2
Mirbelia dilatata	Bank	1-2 per 5 m^2

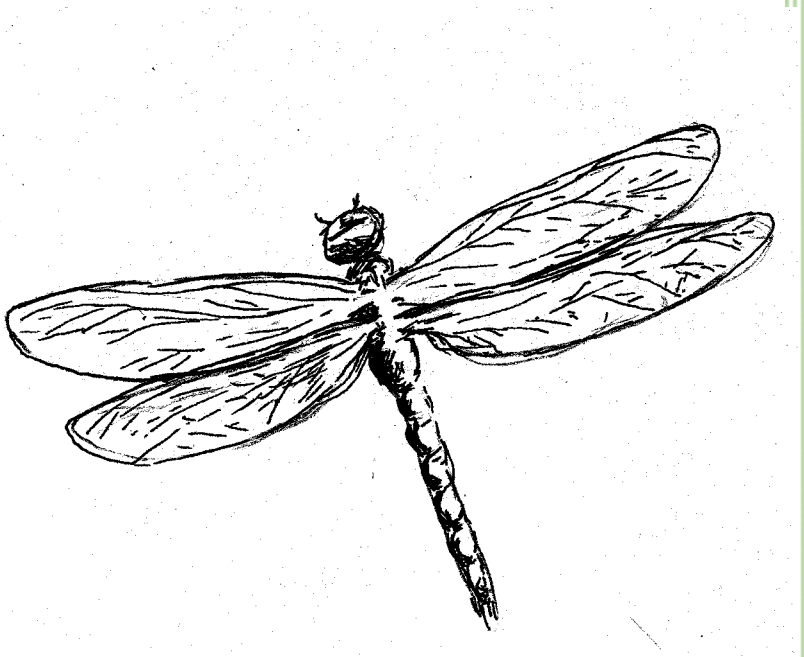
Species	**Location**	**Planting Density**
Pimelea rosea	Bank	1-2 per m^2
Taxandria linearifolia	Floodplain and lower bank	1-2 per 2 m^2
Taxandria parviceps	Floodplain and lower bank	1-2 per 2 m^2
Tremandra stelligera	Bank	1-2 per m^2
Trymalium floribundum ssp. floribundum	Bank	1-2 per 5 m^2
Trymalium floribundrum ssp. trifidum	Bank	1-2 per 5 m^2
Viminaria juncea	Channel slopes and banks	1-2 per 5 m^2
Climbers, Sedges, Herbs		
Anigozanthus flavidus	Floodplain and lower bank	1-2 per m2
Baumea articulata	Floodplain	1 per m2
Baumea juncea	Floodplain and lower bank	4 per m2
Baumea vaginalis	Floodplain	1 per 2m2
Centella asiatica	Floodplain	
Conostylis aculeata	Bank	4 per m2
Gahnia trifida	Channel slopes	1 per m2
Hardenbergia comptoniana	Bank	1-2 per m2
Juncus pallidus	Floodplain	1 per m2
Juncus pauciflorus	Floodplain	2 per m2
Juncus subsecundus	Floodplain	1 per m2
Kennedia coccinea	Bank	1-2 per 2m2
Kennedia prostrata	Bank	1 per 2m2
Lobelia alata	Bank	4 per m2
Lepidosperma effusum	Channel slopes	1 per 5m2
Lepidosperma squamatum	Channel slopes	2 per m2
Lepidosperma tetraquetrum	Channel slopes	1 per 5m2
Loxocarya cinerea	Channel slopes	2 per m2
Mesomelaena tetragona	Channel slopes	1 per m2
Patersonia occidentalis	Bank	1-2 per m2
Patersonia umbrosa	Bank	1-2 per 5m2
Scaevola microphylla	Bank	1-2 per 5m2
Scaevola calliptera	Bank	1-2 per 5m2

APPENDIX 6

Waterway Revegetation Plan
(Nicole Siemon & Associates Pty Ltd)

March 2022

Waterway revegetation plan



RAPID'S LANDING COMMUNITY VILLAGE

MARGARET RIVER

Nicole Siemon and Associates PL

V1

RAPID'S LANDING COMMUNITY VILLAGE

MARGARET RIVER

Waterway revegetation plan

Nicole Siemon and Associates PL
PO Box 529
Dunsborough 6281
March 2022

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EXECUTIVE SUMMARY

Nicole Siemon and Associates Pty Ltd (NSA) were commissioned by Edenlife to prepare a waterway revegetation plan for two tributaries of Darch Brook, which feeds into the Margaret River.

The purpose of the study was to:

- Identify current vegetation communities and health,
- Detail revegetation areas, species selections, spacing, generalised numbers and anticipated plant height at maturity, and
- Provide for weed control and other management measures to protect the River and its banks for conservation into the future.

The remnant vegetation along the northern tributary that runs parallel with John Archibald Drive is in variable condition with dense stands of Swamp peppermint (*Taxandria linearifolia*) over Angled sword sedge (*Lepidosperma tetraquetrum*) with juvenile WA Peppermint (*Agonis flexuosa*). Clusters of Sheath twig rush (*Baumea vaginalis*), *Dielsia stenostachya, Loxocarya scariosa*, Pale rush (*Juncus pallidus*) and Shore rush (*Juncus kraussii*) occur intermittently. The eastern tributary has been the subject of intensive revegetation and weed management works for 13 years and is in very good condition.

Dominant weeds in the understorey include *Juncus microcephalus*, Pennyroyal (*Mentha pulegium*) and Kikuyu (*Cenchrus clandestinus*).

The waterways and their buffer provide an important filtration function and with revegetation effort, will also increase the area's conservation value. Suggested management of weeds whilst minimising sediment loss from the channel banks is provided.

This plan aims to improve native vegetation coverage in and along the waterway floodplain to a target of 90% native plant species. The 90% target has been set in recognition of the fire management requirements and allowing for setback from the proposed future infrastructure.

The plan has been developed in accordance with advice provided by the Department of Water and Environmental Regulation (March 2022) that the majority of stormwater infrastructure, and containment, will be within the developable area rather than the public open space,

Any declared weeds will be controlled as required by law. Selective weed control using herbicides will maximise the survival of existing native species while protecting the soil from erosion processes.

1 INTRODUCTION

1.1 Background

Nicole Siemon and Associates PL is commissioned to prepare a Waterway Revegetation Plan to support a proposed Structure Plan. This Structure Plan is a precursor to preparing a Local Development Plan that will support the development of a Community Lifestyle Village on portion of Lot 9014 John Archibald Drive, Margaret River (Rapid's Landing).

The waterway and its floodplain that passes along the northern boundary of Lot 9014 John Archibald Drive, covers about 1.7 Ha of the site, has naturally regenerated from pasture following the removal of grazing cattle about 13 years ago. There are a small number of relic Marri in the foreshore and the waterway vegetation is a mosaic of completely degraded, weed dominated sedgeland and grasses through to patches of good condition native rushes, sedges and tea-tree.

The majority of the foreshore reserve (R50413) on the eastern boundary of the proposed Margaret River Lifestyle Village has been vested in the Shire of Augusta-Margaret River. This occurred on the 13 November 2009 and is in accordance with Condition 18 that states:

"The proposed reserve(s), Public Open Space and Buffer Reserves shown on the approved plan of subdivision being shown on the Deposited Plan as "Reserve for Recreation" and vested in the Crown under Section 152 of the Planning and Development Act 2005, such land to be ceded free of cost and without any payment of compensation to the Crown."

Balwyn Margaret River PL managed and maintained the waterway between 2009 and handed over management to the Shire of Augusta-Margaret River in 2019.

A narrow strip on the northern boundary of this tributary and the area adjacent Stage 5B and John Archibald Drive continues to be managed by Balwyn Margaret River.

The proposed Structure Plan provides an indicative boundary between the developable area and the future public open space/drainage area. It is this area that is the subject of this revegetation plan.

The indicative boundary was identified in the Rapid's Landing Stages 1 – 5 B Foreshore Management Plan (NSA PL 2019). The Structure Plan relates to the portion of the Rapid's Landing development site that adjoins the revegetated waterway alongside Stages 1 – 5B. It is bounded on the north by the second waterway.

The Rapid's Landing Stages 1 – 5 B Foreshore Management Plan suggested management principles should include:

- Designing road access and / or appropriate landscaping between all creek-line vegetation and housing to achieve sufficient setbacks to keep the Bushfire Attack Level to less than BAL 29.
- Establishing the road and path network above the floodplain and waterlogged areas to reduce the requirements for fill and supplementary drainage.
- Protecting the hilltop spring and significant tree.
- Establishing the riparian zone to the extent of waterlogged soil and constructing landscape amenities above to reduce construction effort.

This revegetation plan provides a more detailed breakdown of probable species selections, planting densities and indicative boundaries for each vegetation community than the foreshore management plan. This document will be informed and refined through the Local Development Plan process when urban stormwater management and the likely impact of the associated infrastructure on water flow, depth, retention and other factors can be determined.

1.2 Purpose

The purpose of this report is to inform the Shire of Augusta-Margaret River of the proposed revegetation actions by the Proponents and to achieve foreshore restoration; it includes information on weed control and revegetation.

Figure 1: Site plan

This plan will;

- Detail weed control requirements and actions to enhance foreshore condition,
- Identify indigenous flora that will enhance the conservation and/or corridor value of existing vegetation, and
- Detail revegetation works and ongoing management.

2 THE STUDY AREA

2.1 Site description

The proposed Rapid's Landing Community Lifestyle Village will be constructed on a portion of Lot 9014 John Archibald Drive, Margaret River (Rapid's Landing). Further information can be obtained from documents associated with this plan.

2.2 Vegetation

The remnant vegetation along the northern tributary that runs parallel with John Archibald Drive is in variable condition with dense stands of Swamp peppermint (*Taxandria linearifolia*) over Angled sword sedge (*Lepidosperma tetraquetrum*) with juvenile WA Peppermint (*Agonis flexuosa*). Clusters of Sheath twig rush (*Baumea vaginalis*), Pale rush (*Juncus pallidus*) and Shore rush (*Juncus kraussii*) occur intermittently with extensive stands of the small native herb Angled lobelia (*Lobelia alata*). The eastern tributary has been the subject of intensive revegetation and weed management works for 13 years and is in very good condition.

Dominant weeds in the wetland understorey include *Juncus microcephalus*, Pennyroyal (*Mentha pulegium*) and Kikuyu (*Cenchrus clandestinus*).

An opportunistic floristic survey identified the common species of native plant and weeds species present (Appendix A).

2.3 Landform and soils

Within the public open space portion of the site, the soil is rich silty loam and alluvial soils with compacted clay periodically along the waterway.

3 ENVIRONMENTAL ISSUES

3.1 Weed control

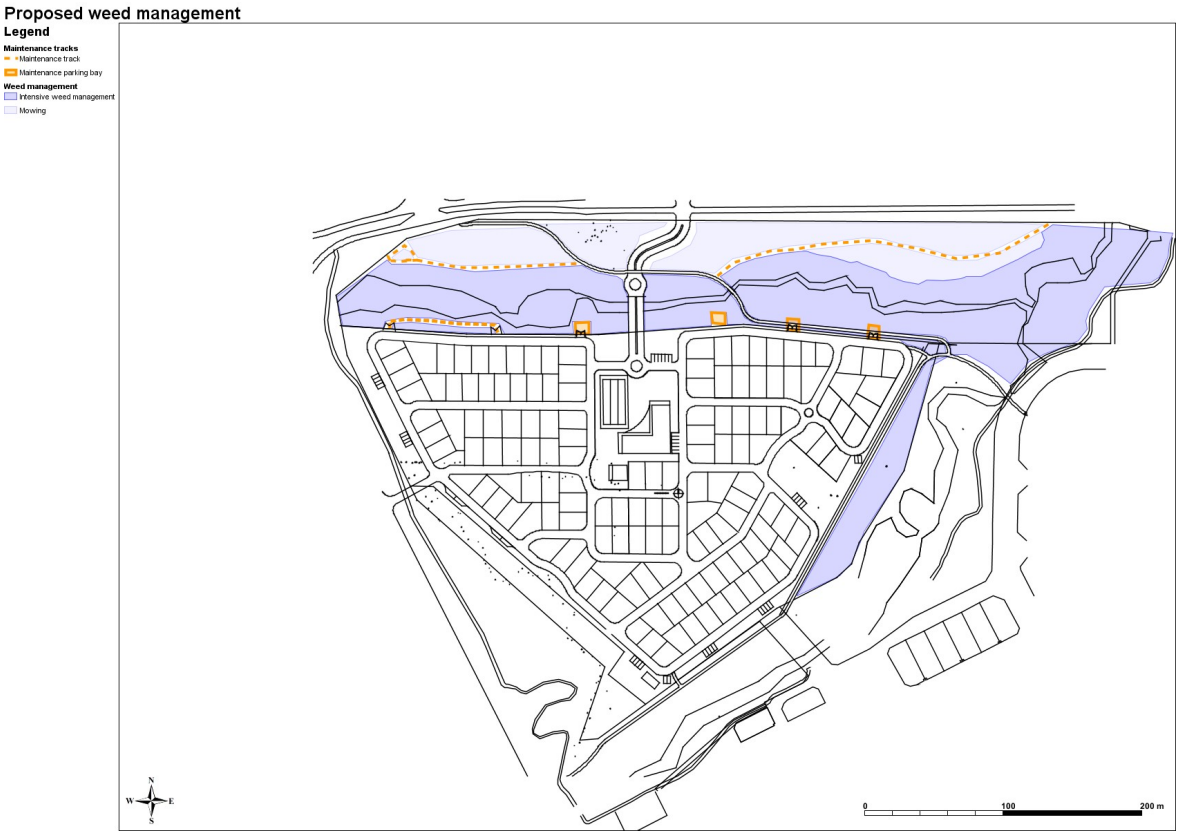
Weed control is most effective when targeted on eradicating or controlling the introduced species that have the greatest potential to invade other areas and compete with native species. Examples of priority weeds in Lot 9014 include Blackberry (*Rubus* spp), Kikuyu (*Cenchrus clandestinus*), Blackberry nightshade (*Solanum nigrum*), Slender birds foot trefoil (*Lotus angustissimus*) and the Declared Plant, Apple of Sodom (*Solanum linnaeanum*).

Other weed taxa are unsightly and are unlikely to impact significantly on the natural regeneration processes including Sow thistle (*Sonchus asper* and *S. oleraceus*), and Storks bill (*Erodium* spp). The former paddock areas retain a diverse range of agricultural weeds such as Bearded oats (*Avena barbata*) and Wild oats (*Avena fatua*). Fleabane (*Conyza bonariensis*), Bushy starwort (*Symphyotrichum subulatum*) and Jersey cudweed (*Helichrysum luteoalbum*) occur and have a rapid life cycle that can impact on the aesthetics of the site but again do not pose a long term threat to natural and assisted regeneration processes.

On-going weed control will be required along the waterways to maintain the successful revegetation program.

Chemical control of weeds adjacent and along waterways requires careful management to ensure detrimental impacts of herbicides on native flora, fauna and water quality are avoided. Most weeds can be controlled by regular spot-spraying or removal by hand. Care should be taken not to spray over open water or disturb the natural vegetation unnecessarily as this encourages further weed invasion and may exacerbate soil erosion. Herbicides should be used in accordance with the manufacturers' requirements and Material Safety Data Sheets.

Figure 2:



Monthly monitoring of weed growth should be sufficient in the riparian zones and appropriate control methods implemented as necessary. More frequent maintenance will be necessary in the landscape and peripheral interfaces between the native vegetation and recreational areas.

Regular mowing between the trees is suggested for the higher areas.

The use of fire for the purpose of weed control is unacceptable, as regeneration following fire tends to favour weeds over natives, resulting in a diminished native vegetation cover and seed bank. Should a wildfire occur, then the opportunity for improved access should be used and intensive weed management undertaken to prevent the loss of native vegetation that regrows more slowly.

The waterway margins retain a range of exotic grasses and pasture weeds and will remain an ongoing management problem until future land development

occurs. The existing stormwater network (Stages 1 – 5 B) contributes weed seed from the road network and domestic gardens.
Isolated weeds that occur in the tea-tree thickets and sedgeland include small areas of Kikuyu (*Cenchrus clandestinus*), Couch (*Cynodon dactylonI)* and the population of annual Yorkshire fog grass (*Holcus lanatus*) varies from year to year.

Management of the annual grasses can be extremely problematic as they germinate when the floodplain is inundated and can flower and seed within four weeks. When the prevailing weather conditions prevent spraying the juvenile plants, the population can explode.

Semi-aquatic and weed species located in waterlogged zones include *Juncus microcephalus, Isolepis prolifera* and *Juncus bufonius*. These provide habitat functions and control is problematic due to the duration of inundation. The Shire of Augusta-Margaret River invasive species prioritisation process does not require control of these species unless in small populations and there is sufficient native vegetation to meet bank stability and habitat requirements.

Plant species that have been found in the foreshore reserve associated with Stages 1 – 5B and in Lot 9014, since 2007 are listed in Appendix A.

Introduced annual and perennial grasses should be sprayed every six to eight weeks, however, the seasonal conditions can reduce access within the floodplain for the safe application of grass specific herbicides. Grass specific herbicide must be used in areas of native vegetation, notably where introduced grasses are growing intertwined within and beneath sedges.

The floodplain itself may only be accessible twice a year for perennial grass control. Treatment will then occur in autumn, preferably after some rain and subsequent growth of grasses and again as the water recedes in late November.

Areas dominated by exotic grasses and other weeds on the periphery of the riparian zone can be sprayed with Glyphosate Bioactive, provided sufficient due diligence is applied to avoid over-spraying onto native vegetation.

The appropriate methods to eradicate and control major weed species found within the foreshore area are provided in Appendix B. To confirm these methodologies, review of the most up to date information regarding herbicides and application rates should be sought from the Department of Primary Industries and Regional Development Western Australia and Environmental Weeds Action Network prior to implementing weed control programs.

Selective control of weeds will be undertaken using a combination of techniques including hand removal and selective herbicide application to protect the locally indigenous flora.

The proponents commit to eradicating the weeds from the public open space/drainage area and reducing the infestation of serious environmental weeds. Removal of 90% of the weed burden is planned to encourage both natural regeneration and assisted revegetation. The current proposed weed control program is:

MONTH	**ACTIVITY SCHEDULE**
Dec 21/Jan 22	Selective Fusilade Forte spraying, treatment of *Juncus microcephalus* and dominant broadleaf weeds as water level recedes.
Dec 21/Jan 22	Brush cutting seed heads of *Juncus microcephalus* prior to the seed ripening to avoid seed drop and reduce future effort.
February	Selective herbicide application around remnant vegetation, spot spraying broadleaf weeds and hand weeding subject to soil moisture and watercourse flow.
March	Selective herbicide application around remnant vegetation, spot spraying broadleaf weeds and hand weeding subject to soil moisture and watercourse flow.

MONTH	ACTIVITY SCHEDULE
April	Glyphosate follow-up where no non-target native plants are present and selective hand weeding if required. Brush cutting around surviving plants. Weather-dependent. Preparation of winter planting nodes on limited dryland areas near Boodjidup roundabout and other locations on the northern margin.
May	Spot spraying and Fusilade application if required to treat autumn germinants.
June	Weather-dependent but focused on the dryland margins.
July	Weather-dependent but focused on the dryland margins.
August/September	Selective herbicide application around germinating native plants and hand weeding subject to soil moisture and watercourse flow.
October	Selective herbicide application around germinating native plants and hand weeding subject to soil moisture and watercourse flow.
November	Selective herbicide application around any planted stock and hand weeding subject to soil moisture and watercourse flow. Intensive spraying of the buffer between future revegetation area on the western side and the Kikuyu will also be undertaken
December	It is anticipated that ongoing spraying will need to be highly selective to maximise the growth rates of any tubestock planted in the future.

The Proponents intend to continue the weed control program as required until the Local Development Plan and relevant Shire approvals for detailed revegetation and landscape implementation plans are approved by Shire.

The grass burden in the paddock areas will continue to be mowed/slashed to achieve bushfire compliance.

3.2 Revegetation of the riparian zone

The revegetation component of this waterway management plan is focused on increasing the density of native understorey particularly with small tussocks and low shrubs. In order to comply with fire management regulations, the height of the selected species to be planted has to be limited. This will avoid impacting upon the bushfire attack level (BAL) rating achieved in the Bushfire Management Plan that supported the proposed Structure Plan.

The plan also includes suggestions for the landscape node interface with the developable area.

Suggested species include those identified during the field survey, however the final breakdown will depend on natural regeneration following weed control, the final design and then at the time of implementation, plant availability from nurseries.

As mentioned previously, the intensive revegetation on the eastern tributary has resulted in considerable improvements to the vegetation condition in the foreshore reserve. The buffer will continue to be maintained and any future requirements for revegetation can be identified following civil works and the stormwater management design.

An indicative revegetation and landscape plan is provided below for the northern tributary and potential future public open space.

The principles that should be integrated into the future revegetation plan for the northern foreshore area are:

- Use native species seedlings of local provenance, where possible.

- Plant seedlings in the floodplain margins in late autumn to early winter to take advantage of the following winter rainfall after initial rainfall has thoroughly moistened the soil.
- Ensure seedlings are grown in soil that is free of weeds, dieback or other pathogens so that additional management issues are not introduced to the foreshore.
- Avoid the use of fertiliser in the riparian zone when planting native stock.
- Plant the riparian zone following at least six weed control treatments. Note, rock riffles will reduce the risk of erosion and facilitate a staged planting approach to maximize growth rates.
- Plant clusters of the same species according to the appropriate micro-topography to achieve a natural effect.

Table 1 lists some of the suite of species recommended for planting in the northern tributary (Figure 3). These species have been selected on the basis that they are local native species already growing at the site or in nearby similar environments. They are also likely to be available commercially from local plant nurseries.

Tubestock and stock up to 2L bags will be used depending on availability following approval by the Shire. Larger stock may be used if necessary.

Tree guards may be required to prevent grazing by rabbits or kangaroos and will also assist during follow-up herbicide treatment. These will be installed should evidence of herbivory arise.

Note: if weed control is effective and natural regeneration occurs, then less planting will be required.

Table 1: Species recommended for revegetation of the northern tributary (waterway)

Scientific name	**Common name**	**Planting density and arrangement**
Agonis flexuosa	WA Peppermint	1 per 20 sq m grouped
Anigozanthos flavidus	Tall kangaroo paw	0.8 m grouped
Anigozanthos cultivars	Kangaroo paw	0.8 m grouped
Banksia grandis	Bull banksia	Randomly
Banksia littoralis	Swamp banksia	Randomly
Baumea articulata	Jointed sedge	1 per sq m in groups
Baumea vaginalis	Sheath twig rush	1 per sq m in groups of 5
Baumea juncea	Bare twig rush	6 per sq m in dense groups
Billardiera fusiformis		0.8 m centres
Bossiaea linophylla	Common pea	Medium shrub at 1 m centres
Callistachys lanceolata	Wonnich	1 per 20 sq m occasionally
Casuarina obesa	Saltwater sheoak	Identified on plan
Centella asiatica	Common centella	6 per sq m throughout
Eucalyptus diversicolor	Karri	1 per 20 sq m clustered
Eucalyptus patens	Blackbutt	1 per 20 sq m occasionally
Lobelia tenuior		6 per sq m throughout
Juncus kraussii	Shore rush	2 per sq m grouped
Juncus pallidus	Pale rush	1 per sq m occasionally
Juncus pauciflorus	Loose-flowered rush	3 per sq m grouped
Juncus subsecundus	Finger rush	2 per sq m grouped
Kennedia carinata		3 per sq m
Lepidosperma effusum	Spreading sword sedge	1 per 5 sq m
Lepidosperma tetraquetrum	Angled sword sedge	1 per 5 sq m
Loxocarya scariosa	Velvet rush	2 per sq m grouped
Melaleuca densa		1 per sq m grouped
Melaleuca incana	Grey honeymyrtle	1 per 5 sq m randomly

Scientific name	Common name	Planting density and arrangement
Melaleuca rhaphiophylla	Freshwater paperbark	1 per 5 sq m clustered
Melaleuca preissiana	Modong	Occasional isolated trees
Taxandria linearifolia	Common tea-tree	1 per 5 sq m clustered
Thryptomene PF Margaret River form		2 per sq m clustered
Tremandra stelligera		2 per sq m clustered

Trees for screening

It is proposed that a mixture of tree strata be used to screen the development from John Archibald Drive (Figure 4) and that these include the following taxa:

Large trees

Marri	*Corymbia calophylla*
Karri	*Eucalyptus diversicolor*
Blackbutt	*Eucalyptus patens*

Medium trees

WA Peppermint	*Agonis flexuosa*
Saltwater sheoak	*Casuarina obesa*
Modong	*Melaleuca preissiana*

Small trees

Bull banksia	*Banksia grandis*
Swamp banksia	*Banksia littoralis*
Wonnich	*Callistachys lanceolata*
Grey honeymyrtle	*Melaleuca incana*
Freshwater paperbark	*Melaleuca rhaphiophylla*
	Melaleuca densa

Tree stock (from 2 – 45 L bags) will be used, supported by two jarrah stakes and sufficient soil conditioning prior to planting.

Figure 3: **Draft landscape and waterway rehabliitation plan**

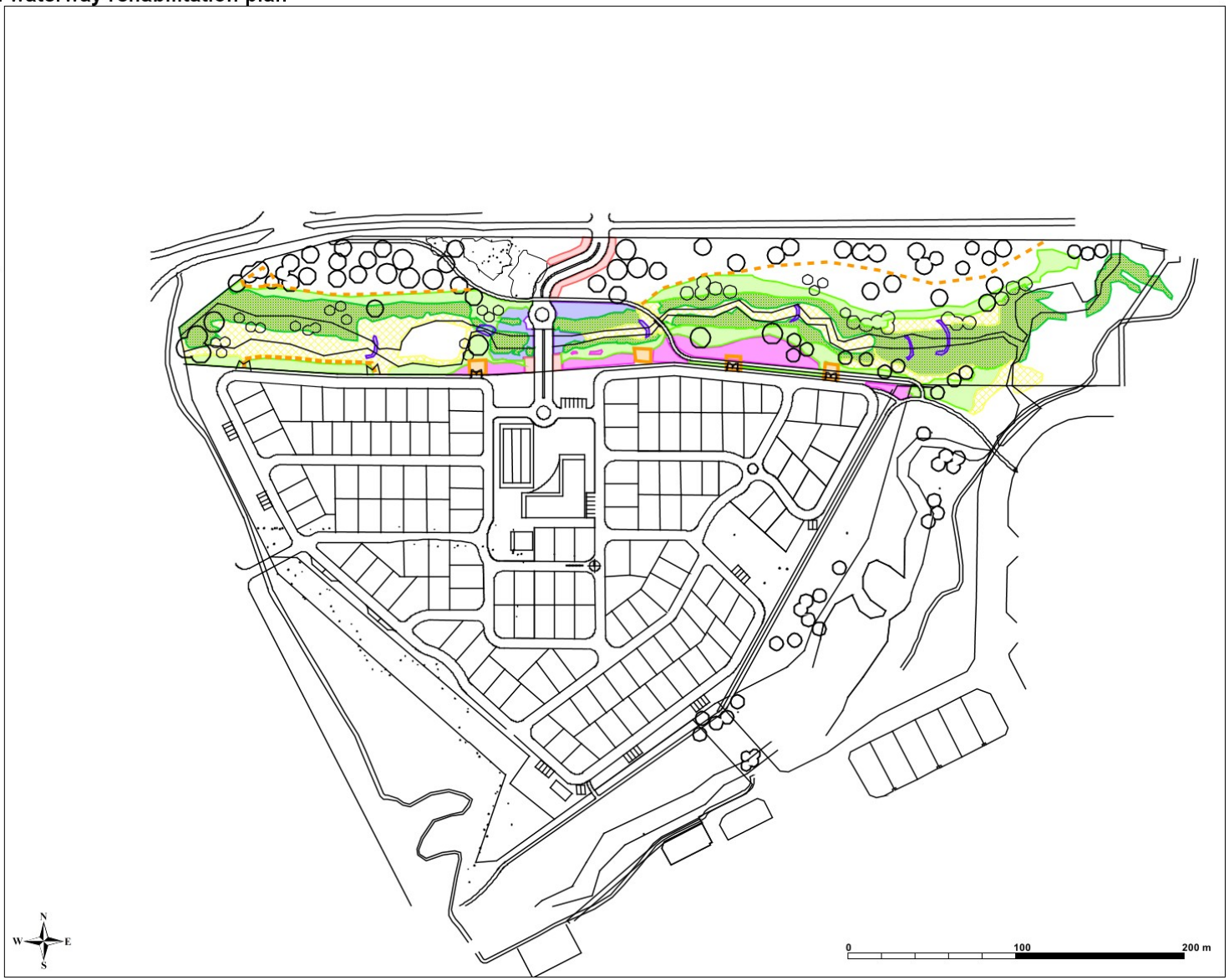


Figure 4: **Proposed tree planting**

3.3 Other management considerations

3.3.1 Stormwater management

Drainage management will be addressed as it has been for all prior stages of the development at Rapid's Landing. The water sensitive urban design principles that are applied will continue to aim to minimise the pollution entering the tributaries of the Margaret River and mitigate the potential for flooding as a result of increased rates of flow which result from piped drainage systems in developments.

There is no direct discharge of stormwater into the eastern creekline and it is treated using Water Sensitive Urban Design (WSUD) principles. The best planning practices focused on retention, treatment, use and environmental and cultural benefits from stormwater. Within the foreshore reserve (R50413), all sub-catchment outlets have been placed as far "upstream" on the existing creekline as possible in order to maximise exposure of stormwater to vegetation in the foreshore and along the rehabilitated creekline. In addition, the drainage basins have two components which trap sediment, nutrient and hydrocarbon removal within the drainage system, then feed the water into bio-retention swales and vegetated buffers, before spilling over into the creekline. The design also sought to minimise mosquito breeding areas.

New designs will occur for stormwater management in the Rapid's Landing Community Village with their final location and basin floor recommended to being located above the maximum groundwater level. The results of groundwater monitoring may influence the proposed future reserve boundary alignment.

Further, the Department of Water and Environmental Regulation identified that the site has high perched groundwater systems and the proposed development has a high degree of imperviousness due to its density.

The Department identifies that while these areas are called public open space/drainage reserves, they are waterways. The Department's preference is for them to be managed as waterways and they should therefore provide ecological function, which has been achieved in the reaches immediately downstream.

3.3.2 *River restoration*

This section outlines river restoration approaches that may be useful in the management of the northern tributary associated with the future Margaret River Community Village development. This waterway remains in private ownership.

A technique used to enhance and restore degraded rivers consists of re-building the pool-riffle sequence, and is used where channel deepening, or incision, is the main cause of instability. This approach was used successfully on the southern tributary adjoining Stages 1 – 5B.

The description below applies to the waterway from Boodjidup Roundabout on Bussell Highway to the junction with previous revegetation works.

Erosion and sedimentation are naturally occurring riverine processes, but these processes can accelerate when a channel becomes unstable. The primary cause of accelerated erosion and sedimentation is clearing of vegetation. Weed control to enable revegetation requires vegetation removal, predominantly Kikuyu. The native vegetation watercourse will continue to naturally regenerate with investment in weed control.

There are localised areas of more severe erosion where the tributary has a defined channel with steep, actively eroding river banks. The road network contributes peak flows and the small dam is likely to help reduce peak flows.

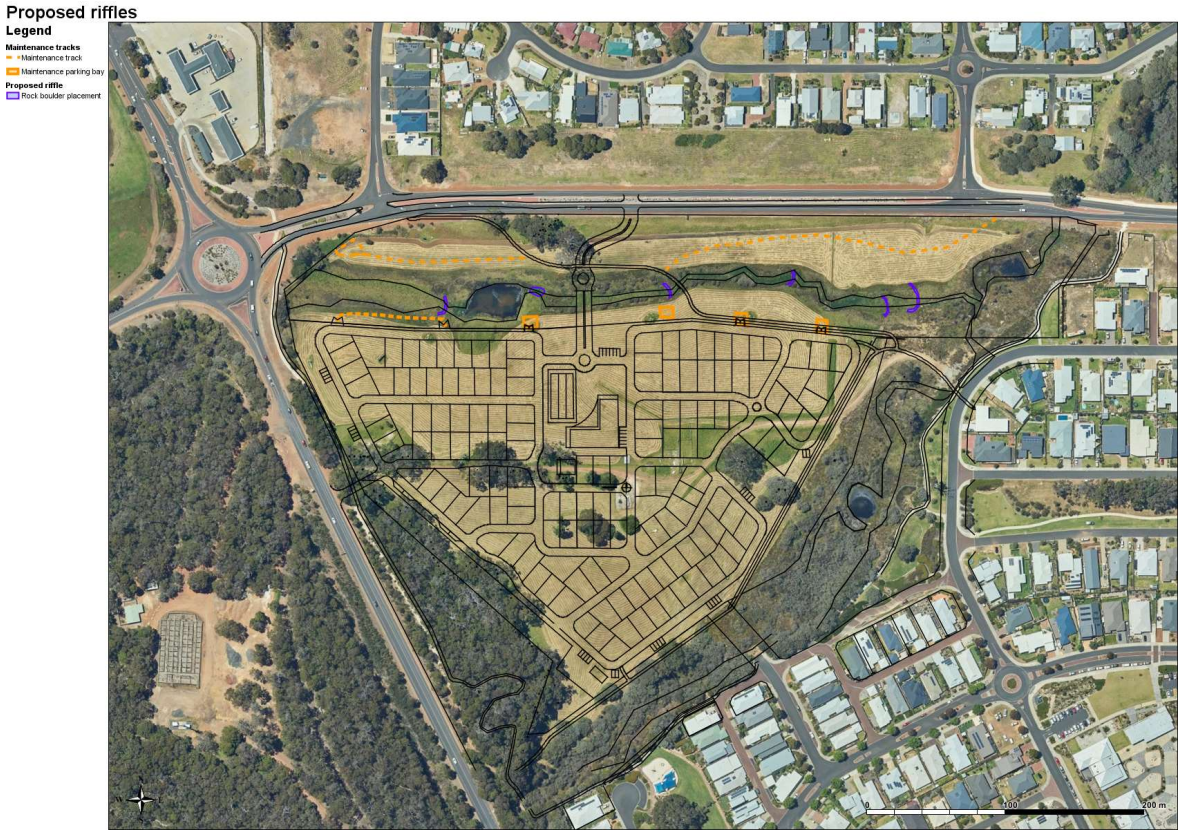
Pool-riffle sequences contribute to channel stability by controlling the velocity of flow and reducing the downstream movement of sediment into the creekline.

Stabilised bed material is important for the establishment of in-stream vegetation and habitat for aquatic fauna; and through herbicide control of kikuyu and other weeds, the collapsed plant biomass can help to accumulate sediment.
The process of locking the sediment and reducing flow velocities helps to remove nutrients from the water column through biological processes or they remain

bound in the bed material. Water quality is also improved as the riffle creates turbulence that aerates the water, which in turn supports microbial activity that breaks down organic matter and assimilates nutrients. Riffle zones are often turbulent, well aerated areas and are favoured by filter-feeding macro-invertebrates that are able to exploit the current for gathering food (Waters and Rivers Commission, 2001a).

Granite extracted during the development of Stages 1 - 5B were placed in strategic piles along the tributary to facilitate the construction of these riffles. Indicative locations for riffle installation is provided in Figure 5, however, their final position will depend upon future stormwater management and design.

Figure 5: Proposed riffles



The existing dam on the northern tributary will require minor earthworks to batter the banks to a suitable slope. The preferred slope is 1:8 (vertical:horizontal aspect), preferably with benches to enable at least 3 m wide plantings of wetland species with the same preferred inundation tolerance. Any sediment removed in this process can be used to top dress future planting and/or landscaping areas.

The riparian environment has been highly modified due to the prior use of the land for farming, which has reduced its habitat value. Another habitat feature that could also be incorporated into the restoration of the creekline would be the incorporation of large woody debris into the system. Snags, or large woody debris play an important role in the river ecology by providing a range of flow conditions within the channel and by providing micro-habitats for animals and plants. They provide roosting sites for birds as well as shelter for burrowing animals such as gilgies and marron.

If trees are to be felled on the adjacent development area, trunks and large branches over 150 mm diameter could be used as habitat in the creek line. The logs should typically be installed against the outer bank, pointing downstream at an angle of approximately 30^{O}.

This action minimises the effect of the snag on the flow levels and direction, while maintaining the habitat available for plants and animals that benefit from low flow conditions.

Allocation of responsibilities

The Proponents accept responsibility for the implementation of the recommendations presented in this revegetation plan.

Native vegetation enhancement is a realistic goal with regular weed control likely to encourage natural regeneration processes and selective supplementary planting, increasing native vegetation coverage to at least 90%.

The foreshore reserve (R50914) will continue to be managed by the Shire of Augusta-Margaret River and its buffer by Balwyn Margaret River PL.

APPENDIX A: Native species identified in the study area

Native species

Scientific name	**Common name**
Acacia pulchella	Prickly Moses
Agonis flexuosa	WA Peppermint
Anigozanthos flavidus	Green kangaroo paw
Billardiera heterophylla	Bluebell creeper
Bossiaea linophylla	
Callistachys lanceolata	Wonnich
Centella asiatica	Common Centella
Dielsia stenostachya	
Empodisma gracillimum	
Hardenbergia comptoniana	Native wisteria
Hibbertia cuneiformis	Cut leaf Hibbertia
Juncus kraussii	Shore rush
Juncus pallidus	Pale rush
Kennedia prostrata	Running postman
Kennedia coccinea	Coral vine
Lepidosperma effusum	Spreading sword sedge
Loxocarya scariosa	
Mirbelia dilatata	Holly-leaved Mirbelia
Paraserianthes lophantha	Native Albizia
Pteridium esculentum	Bracken fern
Scaevola calliptera	
Taxandria linearifolia	Swamp peppermint
Tremandra stelligera	
Trymalium odoratissimum	
Viminaria juncea	Swish bush

APPENDIX B: Weed species identified in the study area and their control

COMMON NAME	GENUS	SPECIES	Control suggestions
Pimpernel	*Lysimachia*	*Var. arvensis var. caerulea*	Spray metsulfuron methyl 0.1 g/15 L (2.5 g/ha) + wetting agent or glyphosate 0.2 %
Wild oats	*Avena*	*fatua*	Spray adult plants10 mL/L Fusillade Forte
Kikuyu	*Cenchrus*	*clandestinus*	Spray adult plants10 mL/L Fusillade Forte
Spear thistle	*Cirsium*	*vulgare*	Grub out or spray with Lontrel® at 6 mL/10 L.
Stinkwort	*Dittrichia*	*graveolens*	Grub out or spray with Lontrel® at 6 mL/10 L.
Gladiolus	*Gladiolus*	*spp.*	Spray metsulfuron methyl 0.1 g/15 L (2.5 g/ha) + wetting agent
Jersey cudweed	*Helichrysum*	*luteoalbum*	Grub out or spray with Lontrel® at 6 mL/10 L.
Yorkshire fog	*Holcus*	*lanatus*	Spray adult plants10 mL/L Fusillade Forte
Flat weed	*Hypochaeris*	*glabra*	Grub out or spray with Lontrel® at 6 mL/10 L.
	Isolepis	*prolifera*	Spray with 2% glyphosate
	Juncus	*microcephalus*	Spray with 2% glyphosate
Slender birdsfoot trefoil	*Lotus*	*angustissimus*	Spray with Lontrel® at 6 mL/10 L.
White lupin	*Lupinus*	*cosentinii*	Hand pull as small population
Pennyroyal	*Mentha*	*pulegium*	Spray metsulfuron methyl 0.1g/15 L (2.5 g/ha) + wetting agent
Jonquils	*Narcissus*	*tazetta*	Spray metsulfuron methyl 0.1g/15 L (2.5 g/ha) + wetting agent
Plantago	*Plantago*	*lanceolata*	Spray with Glyphosate 1%
Pigweed	*Portulaca*	*oleracea*	Spray with Glyphosate 1%
Sharp buttercup	*Ranunculus*	*muricatus*	Spray with Glyphosate 1%
Guildford grass	*Romulea*	*rosea*	Not a major competitor

COMMON NAME	***GENUS***	***SPECIES***	**Control suggestions**
Blackberry	*Rubus*	*fruticosus*	Spray metsulfuron methyl 0.1 g/15 L (2.5 g/ha) + wetting agent
Clustered dock	*Rumex*	*conglomeratus*	Spray with Lontrel® at 6 mL/10 L or hand pull.
Curled dock	*Rumex*	*crispus*	Spray with Lontrel® at 6 mL/10 L or hand pull.
Apple of Sodom	*Solanum*	*linnaeanum*	Spray with Lontrel® at 6 mL/10 L or hand pull.
Blackberry nightshade	*Solanum*	*nigrum*	Spray with Lontrel® at 6 mL/10 L or hand pull.
Prickly sow thistle	*Sonchus*	*asper*	Spray with Lontrel® at 6 mL/10 L or hand pull.
Bushy starwort	*Symphyotrichum*	*subulatum*	Spray with Lontrel® at 6 mL/10 L or hand pull.

APPENDIX 7

Landscape Guide Plan
(Bill James Landscape Architect)

EDENLIFE MARGARET RIVER LIFESTYLE COMMUNITY

LANDSCAPE GUIDE PLAN

Prepared for Edenlife Pty Ltd

by

William James Landscape Architect

Monday, 2 May 2022

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LIST OF FIGURES

1. INTRODUCTION

Edenlife Pty Ltd commissioned William James Landscape Architect to prepare a Landscape Guide Plan to accompany the Lifestyle Community Structure Plan to be submitted to the Shire of Augusta Margaret River.

The Landscape Guide Plan consists of five drawings and a report.

The five drawings are:

- Site Analysis
- Cross Sections
- Site Structure Diagram
- Landscape Guide Plan
- Detail Plan of Clubhouse Area

The Report includes the following Sections:

- Project description
- Site description, including environmental and physical attributes
- Landscape Character
- Visual Aesthetic Characteristics
- Challenges and Opportunities
- Landscape Plan
- Plant Selection
- Ongoing Maintenance

The Landscape Guide Plan is to be read in conjunction with the Lifestyle Community Structure Plan and its attached documents.

2. PROJECT DESCRIPTION

The project is a land lease or lifestyle community for active and independent people over fifty. Affordable living is a major focus. The project includes 159 homes, a Clubhouse, a Craft and Hobby Centre, a bowling green, shared community gardens, a children's playground and parkland. The Lifestyle Community will be fenced and gated. The land, Clubhouse and other community infrastrcuture will remain in the ownerhip of the Edenlife, with individual homes being owned by the residents.

Land lease, also referred to as modular home, estates differ from residential subdivisions in that the roads, parks, and landscape, including existing remnant trees and bushland, are managed by the developer. The local authority and the individual home owners are not responsible for the ongoing maintenance of this infrastructure.

The construction techniques also differ from subdivisions, with the roads, lots and homes requring significantly less cut and fill. Fourteen different house models are available The houses are factory built and transported to site or built on site. In both these cases they are mounted on piles. The floors are perched above the ground, requiring less cut and fill and allowing surface water to flow beneath the buildings.

The construction and management systems provide oportunities for the retention of existing remant trees that would not be availabe in normal subdivisions. The minimal cut and fill required for roads

and houses leads to less root disturbance, and the trees are managed by the developer to maintan health and vigour, and minimise safety issues.

3. SITE DESCRIPTION

The site is 11.99ha in area, lying to the southeast of the intersection of John Archibald Drive and Bussell Highway. It is bounded by major roads to the north and west and a creek line to the south and east.

The landscape is gently undulating grazing land with isolated remnant trees and a stand of remnant bushland on the western perimeter. A creek line runs east-west between the proposed Lifestyle Community and John Archibald Drive to the north.

The existing infrastructure consists of an old stockyard, a domestic LPG distribution tank, an underground gas distribution pipeline, and obsolete fencing.

FIGURE 1: SITE LOCATION

Landform and soils

The land slopes gently from the southwest to the northeast with a high point of RL 91 adjacent to Bussell Highway grading to a low point of RL 76. A low ridge line, or saddle, runs between these two points with the land grading gently away to the creeklines to the north and southeast.

The landscape is part of the Cowaramup Upland Land System as mapped in the Busselton Margaret River Augusta Land Capability Study (Tille and Lantzke 1990). The higher (southwest) portion of the site, adjacent to Bussell Highway is classified as Cowaramup Flats, described as "*Flats (0-2% gradient) with gravelly duplex (Forest Grove) soils and pale grey mottled (Mungite) soils".* The remainder, and greater part of the site is in the Cowaramup Wet Vales unit, *"Small broad U-shapes*

drainage depressions with swampy floors. Gravelly duplex (Forest Grove) soils on the side slopes and poorly drained alluvial soils on the valley floor. This unit can be subdivided in the (side) slopes and (valley) floors."

Vegetation

The site has been largely cleared of vegetation and converted to pasture. The remnant[1] vegetation is Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Peppermint (*Agonis flexuosa*) woodland with the remnant isolated trees being Marri and Jarrah on the higher portions and Marri, Peppermint and Blackbutt (*Eucalyptus patens*) on the lower portions adjacent to the creeks.

The creek line to the southeast was revegetated as part of the of the Rapids Landing residential development. In 2008 the creek was in the same condition as much of the creek line to the north of the Lifestyle Community site – matted Kikuyu grass with sporadic clumps of rushes and sedges and occasional shrubs (*Taxandria linearifolia*).

A planting of individual deciduous exotic trees remains on the site of an old (now removed) farmhouse near the gas tank. These include Poplars (*Populus nigra* 'Italica') and Indian Coral Tree (*Erythrina indica*).

Climate and Microclimate

The site experiences a Mediterranean climate with cool wet winters and hot dry summers. The annual rainfall averages of around 1100mm, most of it falling in the months May to October. The microclimate of the site is influenced by aspect, elevation, hydrology, and vegetation.

The site is exposed to winds from the east, northeast and north and less so to winds from the southwest and south. The landform and vegetation provide a degree of shelter from winds coming from the southwest, west and northwest. The predominant winds are from the east in the morning and from the west in the afternoon. Cold winds come from the south, winter storms from the northwest.

The land is relatively flat, but the eastern and northern slopes are more exposed to early morning and winter sunshine than the southern slopes.

Environment

The creek lines and remnant vegetation have significant inherent conservation values. The conservation values of the creeks are increased when rehabilitated using endemic plant species as has been undertaken in the southeast creek and its littoral fringes. A similar programme will be undertaken along the northern creek line.

The remnant trees and bushland provide habitat for endemic fauna and improved conditions and opportunities for a diversity of endemic plan species.

4. LANDSCAPE CHARACTER

The landscape is typical of farmland within the Cowaramup Upland Land System. It is *rural* in character with a strong presence of fringing remnant vegetation to the west, south and southeast.

[1] The term "remnant" refers in this report to vegetation and individual trees that are indigenous to the location.

Urban development in the form of individual detached residential dwellings is evident to the north south and east. Major roads to the west and north influence the character.

The existing character could be described as Rural with Settlement Influence. The proposed development will change the character to Settlement within a broader Urban context.

Visual Aesthetic Characteristics

Visual aesthetic characteristics are both internal and external.

The internal characteristics are:

- the gently convex landform, grading gently down from the southwest to northeast, made more evident by the absence of covering vegetation;
- the seasonal changes in the pasture grass ground cover – green in winter and spring, beige in summer and autumn;
- the twin rows of large remnant trees bordering an old access driveway from Bussell Highway to the old farmhouse site;
- the individual large remnant trees and introduced deciduous trees;
- the east-west pedestrian access through the centre of the site.

The external characteristics are:

- the solid wall of remnant bushland fringing the western perimeter and the remnant and restored vegetation in the creek line to the south and east;
- long views to the northeast and east over bushland and houses to a low, timbered ridge in the background;
- views north over a creek line to a major distributor road and houses;
- views southeast over a creek line to house roofs;
- views south over a creek line to house roofs among trees;
- views into the site from the external roads, houses, and future pathways.

FIGURE 2: LOOKING NORTH FROM MIDDLE OF SITE

FIGURE 3: LARGE REMNANT MARRI (CORYMBIA CALOPHYLLA) AND PEPPERMINTS (AGONIS FLEXUOSA)

FIGURE 4: LOOKING SOUTHWEST FROM MIDDLE OF SITE

FIGURE 5: GAS TANK AND OLD FARMHOUSE SITE

FIGURE 6: LOOKING WEST ALONG OLD ROADWAY

FIGURE 7: VIEW INTO SITE FROM NORTHEAST

FIGURE 8: VIEW INTO SITE FROM BUSSELL HIGHWAY ROUNDABOUT

FIGURE 9: VIEW EAST INTO SITE AT OLD ROADWAY

FIGURE 10: VIEW INTO SITE OVER CREEKLINE FROM FRY PLACE, RAPIDS LANDING

FIGURE 11: VIEW INTO SITE FROM ALFERINK CRESCENT

5. CHALLENGES AND OPPORTUNITIES

The landscape challenges to be addressed in the development of this Guide Plan are:

- views into site from the roundabout at the intersection John Archibald Drive and Bussell Highway, the objective is to completely screen these views in the medium and long term;
- the views into the site from John Archibald Drive and Bussell Highway, the objective is to filter these views in the medium and long term;
- views into the site from neighbouring houses and public open spaces, roads, and paths in Rapids Landing, the objective is to filter these views in the medium and long term;
- the traffic noise from the neighbouring major roads;
- the loss of the current east-west pedestrian access through the centre of the site, the objective is to replace this access with an alternative route to the north of the Lifestyle Community;
- views out of the site to the northern short section of Bussell Highway, John Archibald Drive the roundabout at the intersection of these two major roads;
- views over John Archibald Drive to the rear of houses on the north side of John Archibald Drive;
- new planting must comply with current bushfire regulations.

The opportunities include:

- retention of remnant vegetation within and on the edges of the site;
- retention of long views to the northeast;
- retention of the views to the creeklines;

- revegetation of the northern creek line under an approved Foreshore Management Plan;
- retention of significant remnant trees within the site;
- planting of the northern creek line and adjacent parkland will screen and filter views into and out of the site John Archibald Drive and the roundabout;
- planting in strategic locations to screen or filter views in the Lifestyle Community from adjacent houses and public spaces;
- the construction of an east-west pedestrian through the northern creek line will replace the existing access through the site;
- the planting of trees within the site;
- the planting of the vehicle entry;
- the planting of the Clubhouse Precinct.

Many of the above Challenges and Opportunities are graphically represented in the Site Analysis and Structure Diagram drawings included with this report.

6. THE LANDSCAPE GUIDE PLAN

The Landscape Guide Plan establishes the principal landscape elements of the proposed Lifestyle Community. The elements include both the existing vegetation and the proposed planting.

The Guide Plan represents the resolution of the challenges and the incorporation of the opportunities identified above. The challenges are represented graphically in the Site Analysis drawing. Cross Sections of the site from John Archibald Drive south through to Rapids Landing and from Bussell Highway east through to Rapids Landing illustrate the typical landform.

The Site Analysis is followed by a Structure Diagram, being a diagrammatic representation of the major features of the Landscape Plan. The Site Analysis, Cross Sections and Structure Diagram[2] inform the final Landscape Guide Plan.

The elements of Landscape Guide Plan include:

- Surveyed significant trees to be retained in the development of the Lifestyle Community. A following section identifies and maps the trees to be removed – except for one small Marri, *Corymbia calophylla*, all trees to be removed are dead, dying, moribund, diseased, or exotic species. Significant trees were surveyed in 2007 at the beginning of the Rapids Landing development.
- New plantings:
    - to screen the view from the roundabout at the intersection of Bussell Highway and Joh Archibald Drive (this planting is specified in detail in the Waterway Rehabilitation Plan)
    - to filter views from neighbouring roads and residential areas (this planting is specified in detail in the Waterway Rehabilitation Plan);
    - to provide shade and amenity to the houses, open spaces, and community areas within the Lifestyle Community;

[2] Note that the Site Analysis and the Structure Diagram were prepared using an earlier iteration of the final Lifestyle Community layout. Note also that the DUP through the northern waterway open space has been amended in the final Landscape Guide Plan.

- to provide habitat for local fauna, (for example, Peppermint, *Agonis flexuosa*, will be planted throughout the Lifestyle Community to provide food for Western Ringtail Possums);
- deciduous trees will be planted in gathering areas within the Clubhouse area to provide summer shade and allow the winter sun to enter;
- shared gardens for residents to come together and grow plants of their choosing;
- trees, shrubs, and groundcovers chosen for their hardiness, minimal maintenance inputs and amenity; inorganic mulch will be used in most gardens to reduce fire hazards and ongoing maintenance inputs; gardens will be either irrigated by subsoil systems or will be unirrigated - there will be no overhead irrigation sprays.

- A children's playground within the Clubhouse area – to a future design.
- A park to preserve a magnificent large Marri and large Peppermints adjacent to the creekline on the eastern boundary of the Lifestyle Community.
- The northern waterway and adjoining open space are the subject of a separate plan – the Waterway Rehabilitation Plan – included with the Structure Plan documents.
- There will be no irrigated lawns within the public areas of the Lifestyle Community or in the front of individual lots.

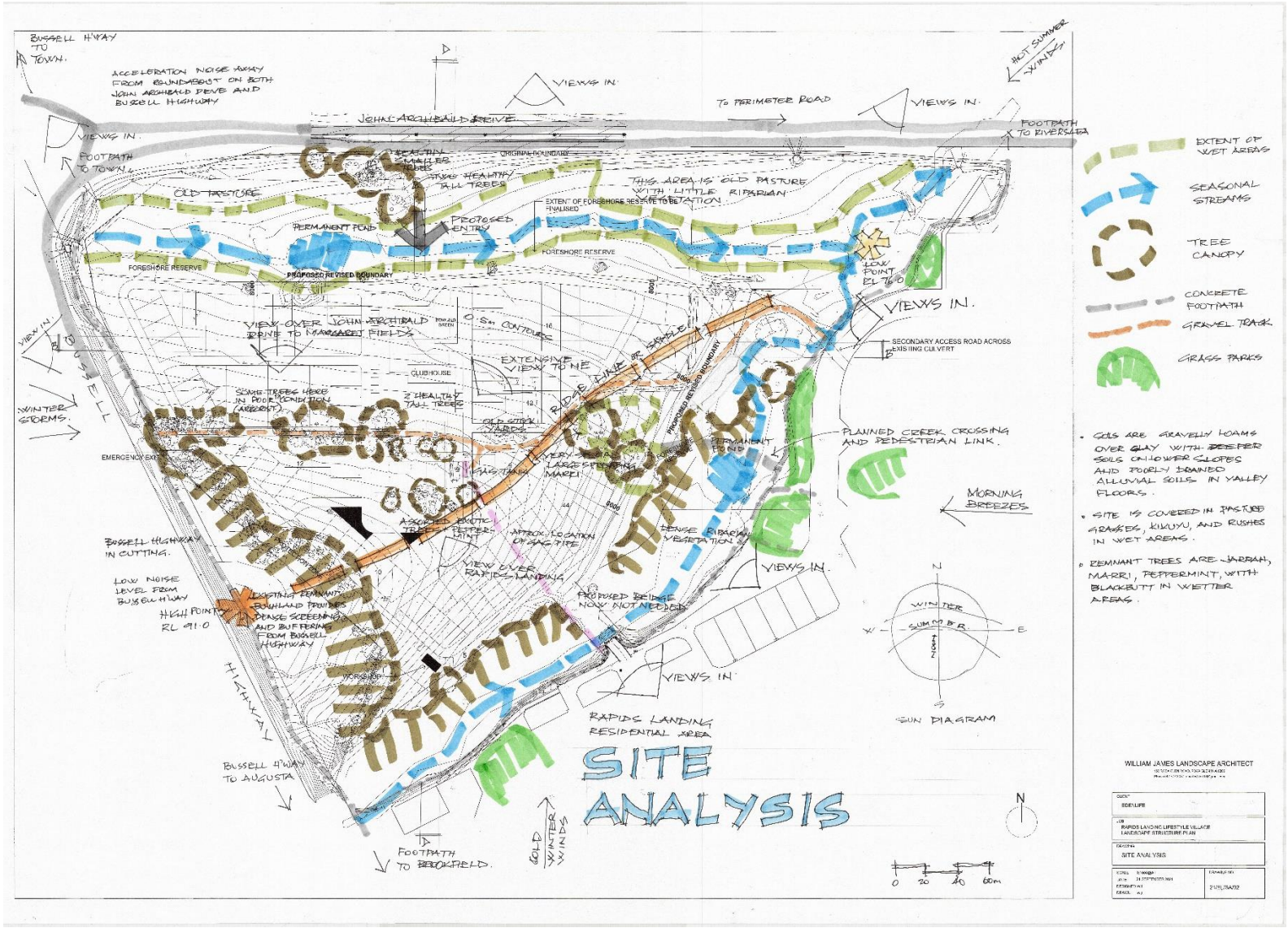

FIGURE 12: SITE ANALYSIS

FIGURE 13: SITE CROSS SECTIONS

FIGURE 14: STRUCTURE DIAGRAM

FIGURE 15: LANDSCAPE GUIDE PLAN

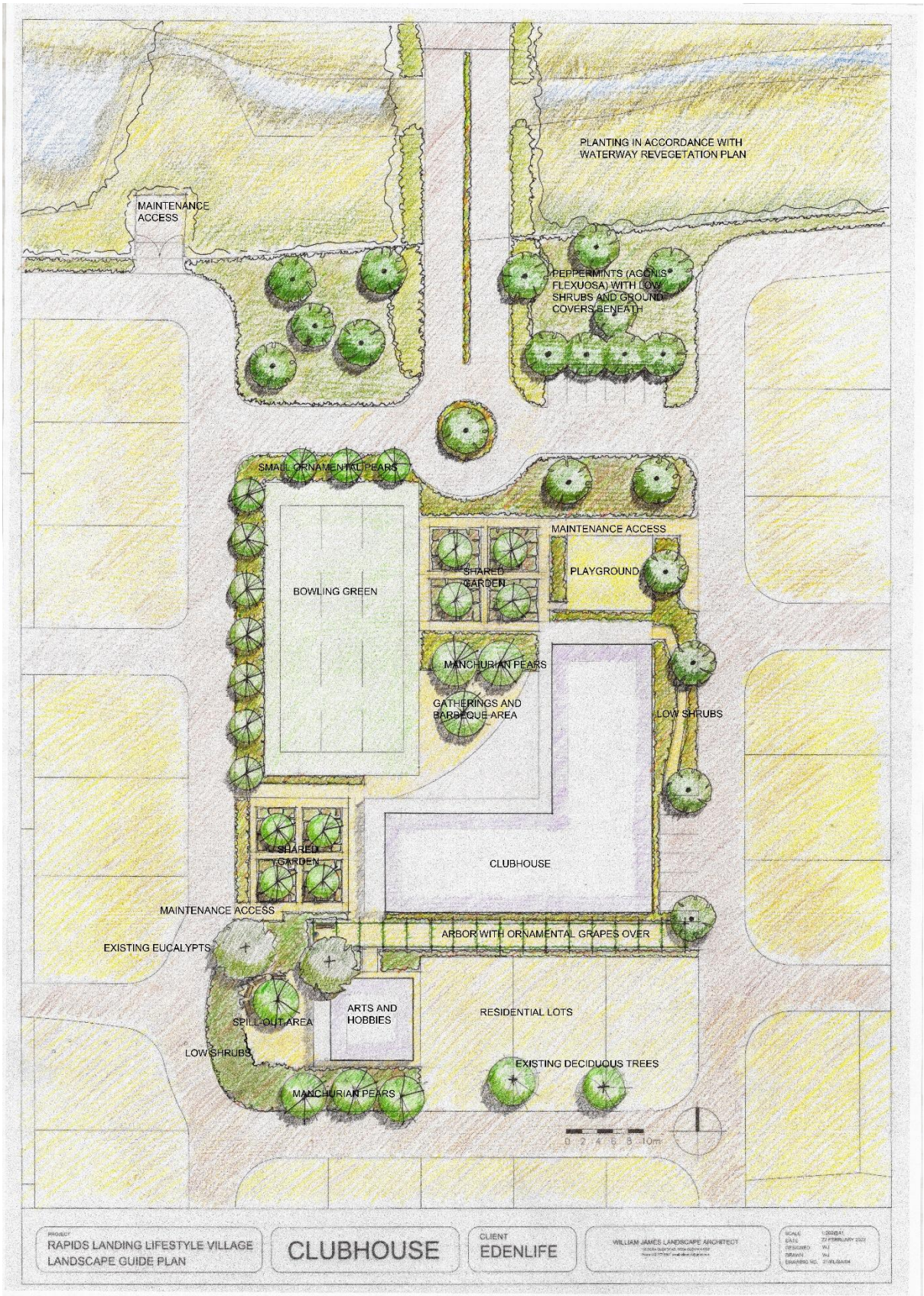

FIGURE 16: CLUBHOUSE LANDSCAPE GUIDE PLAN

7. TREE REMOVALS

The Lifestyle Community Structure Plan has been developed with the retention of significant trees as a major objective. All trees, to be removed, except for one small Marri, are either introduced exotic species or remnant trees in poor condition.

The location and photographs of trees to be removed are shown on Figure 17. The trees to be removed are named and described below, with the place of origin identified:

- Tree 1 – *Erythrina indica* (Indian Coral Tree, India
- Tree 2 – *Eucalyptus nicholii* (Willow-Leaf Peppermint, NSW, Qld)
- Tree 3 – *Eucalyptus viminalis* (Ribbon Gum, NSW, Vic, Tas)
- Tree 4 – *Populus nigra* "Italica (Lombardy Poplar, Northern Italy)
- Tree 5 – *Acacia baileyana* (Cootamundra Wattle, NSW)
- Trees 6 and 7 - *Populus nigra* "Italica (Lombardy Poplar, Northern Italy)
- Tree 8 – *Corymbia calophylla* (Marri, remnant local tree with significant canker infection)
- Trees 9 and 10 - *Populus nigra* "Italica (Lombardy Poplar, Northern Italy)
- Tree 11 - *Corymbia calophylla* (Marri, remnant tree, dead)
- Tree 12 - *Corymbia calophylla* (Marri, remnant local tree with significant canker infection)
- Tree 13 - *Corymbia calophylla* (Marri, remnant local tree, stump with one shoot)
- Tree 14 - *Corymbia calophylla* (Marri, remnant local tree, dead)
- Tree 15 - *Corymbia calophylla* (Marri, remnant local tree, small)
- Tree 16 - *Corymbia calophylla* (Marri, remnant local tree, moribund)

FIGURE 17: TREE REMOVALS

8. PLANTING PALETTE

New planting will be of local and Australian species with some introduced deciduous trees planted in the Clubhouse area. The waterway will be planted with local species in accordance with the approved Waterway Rehabilitation Plan prepared by NSA.

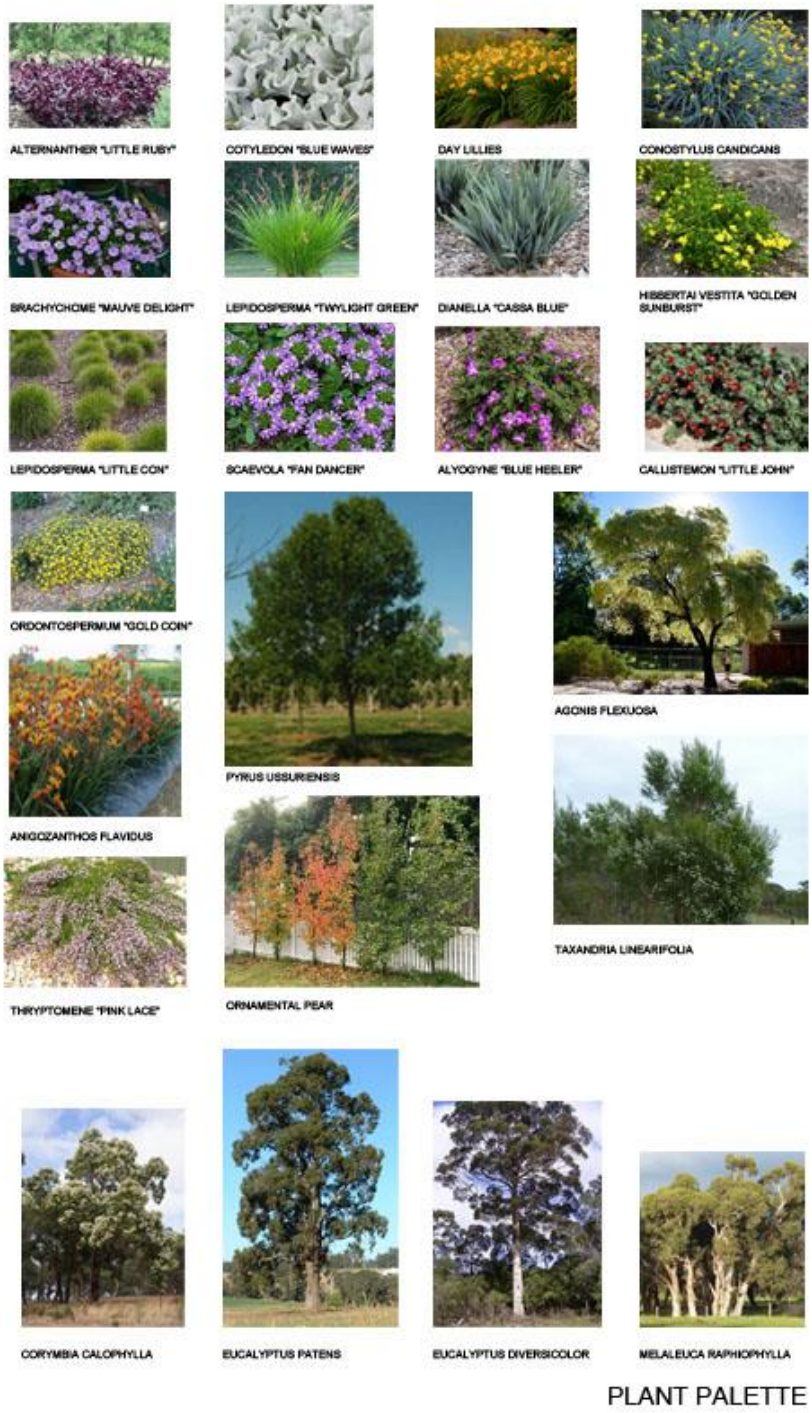

FIGURE 18: PLANT PALETTE

9. ONGOING MAINTENANCE

The hard and soft landscape elements of the Lifestyle Community will be maintained in perpetuity by Edenlife Pty Ltd, the developers and managers of the project.

The trees and shrubs will be regularly monitored for health, vigour and safety with remedial work carried out by skilled and qualified arborists and horticulturists as required. Trees will be regularly pruned to reduce risk of limb-drop.

The waterway to the north of the Lifestyle Community will be maintained by Edenlife for a two-year period from the time the public open space is transferred via a diagram of plan of survey (deposited plan) as a reserve for recreation, vested in the Crown in accordance with a WAPC subdivision approval. At the end of this two-year period the Local Authority will manage the public open space in accordance with an approved Management Plan.

Access to the adjacent waterways will be either from adjacent public roads or, where this is not possible, by gates through the Lifestyle Community fence allowing service vehicle to move between the internal Lifestyle Community roads and the waterways.

APPENDIX 8

Geotechnical Study
(Gault Geotechnics)

Report on

GEOTECHNICAL STUDY
EDENLIFE – MARGARET VILLAGE
LOT 9012 BUSSELL HIGHWAY
MARGARET RIVER

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J2001180 001 R Rev3

25 March 2022

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FIGURES

APPENDICES

1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics Pty Ltd.'s (Galt's) geotechnical study for the proposed Edenlife – Margaret Village on Lot 9012 Bussell Highway, Margaret River ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

This report has been revised with new figures overlain with the updated masterplan to account for recent changes in the subdivision layout and supersedes report referenced J2001180 001 R Rev2 dated 14 March 2022.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The site is bounded by creeks and small dams along the southeastern and northern boundaries, converging at the northeastern corner. Available surface contour information shows the surface elevation varies from a high point at about RL 90 m AHD on the western boundary falling to RL 76 m AHD at the northeastern corner.

At the time of our fieldwork (September 2020), the site was densely grassed with a spread of mature trees along the southern boundary and scattered trees in the middle. Small stockpiles of boulders were present along the southern end of the northern creek.

In the middle of the site is a gas tank (Kleenheat Gas) and a buried gas pipeline to Rapids Landing Avenue to the southeast.

The proposed masterplan for development comprises 159 residential lots, access roads, clubhouse and administration area, parking etc. No significant excavation is proposed. The supplied plans for the development are presented in Appendix A, Supplied Drawings.

3. PROJECT OBJECTIVES

The objectives of the study were to:

- assess subsurface soil and groundwater conditions across the site;
- provide recommendations on suitable footing systems for the proposed development;
- provide allowable bearing pressures and settlement estimates for shallow foundations;
- provide a site classification(s) in accordance with AS 2870-2011 "Residential Slabs and Footings";
- provide recommendations and geotechnical design parameters for earth retaining structures;
- recommend appropriate site preparation procedures including compaction criteria;
- assess the permeability of the soils at the site for potential on-site disposal of stormwater by infiltration; and
- evaluate the subgrade California bearing ratio (CBR) value/s for pavement design; and
- provide pavement and surfacing designs for the various access roads.

NOTE: Targeted investigation of the water-course crossings was not included in our scope. Further investigation and assessment is required for these areas of the site.

4. FIELDWORK

Fieldwork was carried out from 8 September to 10 September 2020 and comprised:

- site walkover by senior engineer;
- drilling of machine auger boreholes at 13 locations extending to depths of between 1.1 m and 2.0 m; and
- testing with a dynamic cone penetrometer adjacent to each borehole extending to 0.6 m and 1.0 m; and
- collection of soil samples for geotechnical laboratory testing.

General

A senior geotechnical engineer from Galt conducted the walkover survey of site. A geotechnical engineer from Galt selected and positioned the tests, drilled the boreholes, logged the materials encountered, collected representative soil samples for laboratory testing and conducted the penetrometer testing. The approximate test locations are shown on Figure 1 and Figure 2. Photographs of the site taken during the study are presented in Appendix B, Site Photographs. Details of the tests are presented in Table 1: Summary of Tests.

Table 1: Summary of Tests

Test Name	Test Depth (m)	Reason for Termination	Thickness of Sand/Gravel Layer (m)[2]	Depth to Groundwater (m)	Stratigraphy[2]
BH01	2.0	Target Depth	-	0.9	Clayey SAND overlying Gravelly SAND overlying Sandy CLAY
BH04	2.0		-	0.5	Clayey SAND overlying Sandy CLAY
BH05	1.5	Refusal	0.35	0.3	Sandy GRAVEL overlying Clayey SAND overlying Sandy CLAY
BH06	1.1		-	GNE	Clayey SAND overlying Sandy CLAY
BH07	2.0	Target Depth	0.45		Gravelly SAND overlying Sandy CLAY
BH08	2.0		0.3		Gravelly SAND overlying Sandy CLAY
BH09	2.0		0.3		Gravelly SAND overlying Sandy CLAY
BH10	2.0		0.5		Silty SAND overlying Sandy CLAY
BH11	2.0		0.4	0.5	Sandy GRAVEL overlying Sandy CLAY
BH12	2.0		0.3	0.4	Silty SAND overlying Sandy CLAY
BH13	2.0		-	1.0	Clayey SAND overlying
BH14	2.0		0.3	0.2	SAND overlying Clayey SAND overlying Sandy CLAY
BH15	2.0		-	0.9	Clayey SAND overlying Sandy CLAY

Notes: 1. GNE – Groundwater not encountered
2. A surface layer of topsoil was present across the site (typically 100 mm to 200 mm thick) – not included
3. BH02 & BH03 were not augered due to access constraints

Machine Auger Boreholes

Boreholes were drilled using a utility mounted EVH Scout drill rig equipped with a 90 mm solid-stem auger. Boreholes reports are presented in Appendix C, along with a list of notes and abbreviations and the method of soil description used in the reports.

At the time of the fieldwork, shallow perched water and soft topsoil layers prevented safe access for the drill rig to the northern part of the site (proposed boreholes BH02 & BH03).

Dynamic Cone Penetrometer Testing

Dynamic cone penetrometer (DCP) tests were carried out in accordance with AS 1289.6.3.2. Tests were carried out adjacent to each test pit and results of the tests are presented in Table 2, Dynamic Cone Penetrometer Test Results.

Table 2: Dynamic Cone Penetrometer Test Results

Location	BH01	BH04	BH05	BH06	BH07	BH08	BH09	BH10	BH11	BH12	BH13	BH14	BH15
Depth (m)	Blows per 0.1 m depth interval												
0.0 – 0.1	SET	SET	SET	SET	SET	SET	SET	SET	3	SET	SET	SET	SET
0.1 – 0.2	1	1	1	1	1	2	3	0	3	0	1	1	1
0.2 – 0.3	2	1	1	3	2	3	2	1	3	1	0	2	1
0.3 – 0.4	3	0	2	4	2	3	3	2	1	1	1	2	2
0.4 – 0.5	2	1	2	2	3	2	3	2	3	4	1	6	1
0.5 – 0.6	6	4	3	5	3	2	5	3	2	9 HB	1	9	1
0.6 – 0.7	10	4	5	7	4	4	9	9	3		4	8	1
0.7 – 0.8	10+	4	7	7	7	8	10	4	3		9 HB	5	1
0.8 – 0.9		3	10	5	9	10	10	2	3			4	1
0.9 – 1.0		4						2					1

Note: Highlighted values indicate soft / very soft / loose conditions

HB – Hammer bounce refusal

5. LABORATORY TEST RESULTS

Laboratory testing of soil samples was undertaken by Western Geotechnical Laboratory Services (WGLS) in their NATA accredited laboratory and comprised determination of:

- particle size distribution on 6 samples;
- Atterberg limits and linear shrinkage on 6 samples;
- dry density-moisture content relationship on 3 samples; and
- California bearing ratio (CBR) on 3 samples.

Laboratory results along with the test methods followed are presented in Appendix D, Laboratory Test Results and are summarised in Table 3, Summary of Laboratory Test Results.

Table 3: Summary of Laboratory Test Results

Test Name	Sample Depth (m)	Soil Class (AS 1726-2017)	% Gravel	% Sand	% Fines	LL (%)	PI (%)	LS (%)	MDD (t/m³)	OMC (%)	CBR (%)	CBR Swell (%)
BH04	0.1 – 0.5	Clayey SAND (SC)	9	64	27	37	9	5.0	1.70	18.5	3.5	0.5
BH09	1.5 - 2.0	CLAY (CH)	2	23	75	114	74	19.5				
BH11	0.1 – 0.5	Sandy GRAVEL (GP)	49	45	6	NO	NP	0	2.27	8.5	60	0
BH11	0.5 – 1.0	Sandy CLAY (CH)	23	39	38	51	28	11.0	1.79	17.0	5	1.5
BH13	0.4 – 0.9	Sandy CLAY (CI)	3	58	39	36	17	8.0				
BH14	1.0 – 2.0	Sandy CLAY (CH)	1	43	56	62	42	12.0				

LL – Liquid Limit **PI**: – Plasticity Index **LS** – Linear Shrinkage NO – Non-Obtainable

NP – Non-Plastic

OMC – optimum moisture content

MDD – maximum dry density:

- Modified – BH04 & BH11 (0.1 – 0.5 m)
- Standard – BH11 (0.5 – 1.0 m)

CBR – California Bearing Ratio:

- 95% MDD, 4.5kg surcharge, 4 day soak
- Samples prepared with Modified or Standard compaction as appropriate.

6. SITE CONDITIONS

6.1 Geology

The Busselton sheet of the 1:250,000 scale Geology series map indicates that the area is underlain by "laterite and associated quartz sand (undifferentiated)".

6.2 Subsurface Conditions

The subsurface soil conditions are broadly consistent across the site and can be summarised as follows:

Zone 1 - Eastern Part of Site

- TOPSOIL: Clayey SAND (SC)/ Silty SAND (SM), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying
- Gravelly SAND/Sandy GRAVEL (locally Silty SAND): fine to medium grained lateritic gravel, sub-angular to rounded, brown, 30 – 50% fine to coarse grained sand, with fines, typically loose (locally dense), extending from 0.1 m to depths of between 0.4 m to 0.6 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red, 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m

Zone 2 - Balance of Site

- TOPSOIL: Clayey SAND (SC), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying
- Clayey SAND (SC): fine to coarse grained, brown, 15 -35% low to medium plasticity fines, typically soft - firm extending from 0.1 m to depths of between 0.5 m and 0.9 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red, 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m.

Indicative soil zones are shown on Figure 2.

6.3 Groundwater

We do not have groundwater information for this area, however, we expect that the permanent groundwater level is close to the level of the creeks.

Shallow perched water was encountered across the site, particularly in the northern half of the site. This perched water was at depths of around 0.2 m to 1.0 m in these areas. Surface flow was also noted on the access tracks at the time of the investigation.

We did not encounter groundwater in the southwest corner of site.

7. GEOTECHNICAL ASSESSMENT

7.1 Site Classification

We consider the site to be geotechnically capable of supporting the proposed development.

We have assessed the site in accordance with AS 2870-2011 "Residential Slabs and Footings" which defines the site classes as summarised in Table 4.

Table 4: Summary of Site Classification (AS 2870-2011)

Class	Description	Characteristic Surface Movement (y_s)
A	Most sand and rock site with little or no ground movement from moisture change	Not Defined (typically <5 mm)
S	Slightly reactive clay sites with only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay sites, which may experience moderate ground movements from moisture change	20 – 40 mm
H1	Highly reactive sites, which may experience high ground movements from moisture change	40 – 60 mm
H2	Highly reactive sites, which may experience very high ground movements from moisture change	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movements from moisture change	>75 mm
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise	Not Defined

Under current conditions, we consider the site classifications to be as follows:

Zone 1 – Class M (thin layer of inert granular material overlying high plasticity clay)

Zone 2 -Class H1 (shallow groundwater and clayey soils overlying high plasticity clay)

If required, the site classifications can be improved by placement and compaction of inert fill material. The thicknesses required in each zone are summarised in Table 5. The indicative soil zones are shown on Figure 2.

Table 5: Required Thickness of Inert Fill (m)

Zone	Current Site Class	Improvement to Class M	Improvement to Class S	Improvement to Class A
Zone 1	M	-	0.5	1.5
Zone 2	H1	0.5	0.9	1.5

The improved classification is subject to the site preparation procedures outlined in Section 7.2 are followed.

Note: AS 2870 is limited to single to double storey residential structures with a maximum bearing pressure of 100 kPa for shallow footings.

We refer you to the CSIRO's pamphlet BTF18-2011: Foundation Maintenance and Footing Performance: A Homeowner's Guide. This provides practical advice to reduce the risk of future heave moments. This pamphlet is presented in Appendix E, CSIRO Pamphlet.

7.2 Site Preparation

The site preparation measures outlined below are aimed at the general preparation of the site prior to the construction of buildings and pavements. Landscaped areas will not require this preparation.

The following site preparation measures must be followed:

- Demolish and remove timber fence posts, buried structures, rubbish, concrete and obsolete services. Stockpiles of loose boulders scattered across the site should be removed off site (where inside the site boundaries). The approximate rock stockpile locations are shown on Figure 1.
- Remove vegetation and topsoil, including grubbing out of roots. In general, we expect that a 100 mm to 200 mm strip will be required for most of the site, although locally deeper excavations could be required.
- Remove trees, where required, including grubbing out roots. Deep excavations will be required to remove tree root systems. The holes formed must be backfilled and compacted in controlled layers with approved compacted clayey fill.
- Excavations into clayey soils (including excavations for tree removals) must be backfilled in an engineered manner with similar clayey soil (minimum 30% fines). This is to prevent storm water run-off potentially infiltrating granular backfill and perching on and softening the in-situ clayey soils.
- Moisture condition and compact the exposed soil to the density specified in Section 7.3 to a depth of at least 0.3 m below all foundations and slabs.
- Where any rutting occurs, excavate and replace with approved fill (Refer Section 7.5) and compact to the density specified in Section 7.3. Any areas of loose/soft ground or unsuitable material must be removed and replaced with approved fill as outlined in Section 7.5.
- Where fill is required, use approved granular fill, placed and compacted in layers no greater than 0.3 m loose thickness. Each layer must be placed and compacted to achieve the minimum level of compaction specified in Section 7.4.
- Excavate for proposed footings and slab to required depths.
- Moisture condition and compact the exposed foundation excavations with suitable compaction plant (i.e. plate compactor for smaller footings or padfoot roller for larger areas) to the density specified in Section 7.3.

Notes

1. Where deep soft soils are encountered during the works, a geotechnical engineer must be engaged to inspect the material.
2. We note that the required compaction can be difficult to achieve when the groundwater level is within about 1 m of the surface being compacted. Further advice should be sought if the required density cannot be achieved. To help alleviate this potential problem, we recommend site preparation works occur in summer, preferably late summer, when the groundwater table can be expected to be at or near its seasonal low.
3. Where sand pads are constructed below individual houses, the pads must extend at least 1 m beyond the edge of the footprint.
4. Clayey soils may be stabilised with lime to improve their workability.

7.3 Construction Issues and Drainage

In addition to the site preparation measures outlined in Section 7.2, we recommend careful control of surface water and stormwater to minimise the likelihood of clayey soils decreasing in strength and affecting the installed infrastructure. These measures include:

- The surface should be graded (to a minimum crossfall of 1%) such that water is diverted away from any footings, structures and pavements.
- Pavements should be sealed to minimise water ingress.
- Stormwater disposal swales should be located at least 10 m away from buildings, retaining walls and pavements.
- Runoff from hardstanding areas and pavements must either be collected and discharged via pipes into discrete locations (via swales) at least 10 m away from structures and pavements or alternatively discharged over a wide area, but not allowed to collect and discharge into concentrated areas, particularly near structures and pavements.
- Spoon drains should be used to capture and collect surface runoff at the crest of slopes and direct it away and avoid running directly down slopes or seeping into the ground behind slopes.
- Similarly, subsoil drains should be installed to capture shallow subsurface flows and direct water away from pavements, houses etc.

7.4 Compaction

7.4.1 General

Over-excavation and replacement of loose/soft materials must be done where the minimum dry density ratio cannot be achieved.

Care will need to be taken when compacting in the vicinity of existing structures. This is particularly important if vibratory compaction is being carried out. Tynan (1973)[1] provides assistance with the selection of compaction equipment for use adjacent to structures.

Large compaction equipment (self-propelled vibrating rollers, etc.) must not be used within 2 m behind retaining walls. Hand compaction plant (e.g. plate compactors) must be used.

[1] Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.

Testing Frequency

After compaction, verify that the required level of compaction has been achieved by testing at the base of excavation and through the full depth of any fill and to a minimum depth of 0.9 m (0.3 m for clayey soils).

The frequency of testing should be as follows:

- on each lift of fill at the rate of 1 test per 500 m^3 or at least 2 tests per layer (4 tests per layer below the building footprint), whichever is greater;
- At each spread footing location;
- at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- at 10 m centres below on-ground slabs; and
- at 20 m centres below pavements.

Further to this, we recommend footings be inspected by a geotechnical engineer prior to blinding.

7.4.2 Cohesionless Soils

Approved granular fill must be compacted using suitable compaction equipment to achieve a dry density ratio (DDR) of at least 95% MMDD (maximum modified dry density) as determined in accordance with AS 1289.5.2.1 at a moisture content within 2% of optimum moisture content (OMC).

Where clean sand (<5% gravel, <5% fines) is used as fill, a Perth sand penetrometer (PSP) may be used for compaction control in accordance with AS 1289.6.3.3.

A site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. The correlation must:

- be done on site;
- use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- be plotted on a chart of PSP blow count vs DDR.

If gravel is used as fill, compaction testing must be done using a nuclear density gauge (NDG) in accordance with AS1289.5.8.1.

Granular fill must be placed in horizontal layers of not greater than 0.3 m loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Over-excavation and replacement of loose materials may be required where the minimum dry density ratio cannot be achieved.

7.4.3 Cohesive Soils

The *in situ* silty/clayey soils and clay fill must be compacted using suitable compaction equipment (i.e. padfoot roller) to a minimum dry density ratio of 95% SMDD (standard maximum dry density) as determined in accordance with AS1289.5.1.1.

The *in situ* clay and clay fill requires careful moisture conditioning so that the moisture content of the material is within 2% of optimum moisture content (OMC) at the time of placement and compaction. We note that compaction to specification 95% SMDD can be difficult to achieve for the clayey in situ material when not appropriately moisture conditioned.

For clayey soils, compaction testing must be done using a nuclear density gauge (NDG) in accordance with AS1289.5.8.1.

The clayey soils on the site will drain poorly when inundated during the wetter times of the year and result in saturated conditions that may inhibit compaction of the soil. If difficulties are encountered during compaction due to water, further advice should be sought from a geotechnical engineer.

The addition of lime may be considered to improve the workability of the clay.

Cohesive fill must be placed in horizontal layers of not greater than 0.2 m loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Over-excavation and replacement of soft/firm materials may be required where the minimum dry density ratio cannot be achieved.

7.5 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".

We recommend the use of quarry-derived, clean imported sand (<5% fines (<0.075 mm) and <1% organics) for bulk filling of the site and / or forming sand pads below house footprints.

The in-situ sandy gravel, gravelly sand and silty sand is generally suitable for re-use as low permeability inert granular fill, provided that any over-sized materials (> 0.2 m in diameter) or large putrescible particles (large fragments of wood, root matter, etc) are removed.

We recommend that re-use of the lower clayey sand/sandy clay is limited to shaping the clayey horizon and/or backfilling deep excavations in the clayey profile to prevent stormwater runoff infiltrating the backfilled excavation. Re-use of clayey soil as structural fill is not recommended as:

- the materials will likely be difficult to moisture condition and compact; and
- there will likely be adverse implications on site classification and drainage if used as structural fill.

7.6 Footings

We consider that the proposed houses may be supported on shallow footings founded on the *in situ* sand or approved compacted sand fill provided that the site preparation procedures in Section 7.2 are undertaken.

Footings must be designed in accordance with AS2870 (2011) according to the appropriate site classification. Estimated total surface movements (settlement / heave) will depend on the whether the site is kept its current condition or the site classification improved using inert granular fill.

We recommend improving the site to at least "Class S" with expected total surface movements of less than 20 mm.

All foundation excavations, including for retaining walls, must be assessed by a competent person prior to blinding.

7.7 Earth Retaining Structures

Retaining structures may be designed in accordance with AS 4678-2002 "Earth Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (imported free draining sand fill with less than 5% fines).

We understand that it would be preferable to use the materials available at the site. **NOTE**: if clayey soils are used for backfill behind the retaining walls, then the walls must be designed to accommodate full hydrostatic pressure, unless a geosynthetic drain or other drainage layer is used (we can provide further advice if this is required).

For the design of retaining structures, the parameters in Table 6 are considered appropriate for compacted sand and gravel backfill behind retaining walls.

Table 6: Geotechnical Design Parameters for Retaining Structures

Layer Description	γ_b (kN/m^3)	ϕ' (°)	c' (kPa)	ϕ_u (°)	c_u (kPa)
Compacted imported inert sand fill	18	34	-	N/A	N/A
Compacted imported inert gravel fill and in-situ sandy gravel/ gravelly sand	18	36	-	N/A	N/A
Compacted clay (site-derived material)	16	20	5	N/A	50

Notes: γ_b – bulk unit weight (kN/m^3) ϕ' – effective soil friction angle
c' – effective cohesion ϕ_u – undrained soil friction angle c_u – undrained cohesion

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement will occur behind any soil retaining system, including gravity retaining walls.

Where granular backfill is to be used, a 300 mm minimum wide layer of free-draining granular fill is to be installed. A slotted drain (wrapped in a geotextile) should be used at the base of the granular backfill to collect seepage and direct it to a collection point (either discharging by gravity away from the retaining wall or collecting at a sump fitted with an automatic pump system to ensure that it remains dry).

Retaining walls can move and rotate under imposed soil loading resulting in settlement behind the wall. This must be considered in the design and during construction of the retaining walls in order that adjacent infrastructure is not adversely affected.

Mass gravity retaining walls must be designed such that groundwater does not collect below the base of the wall and is directed away to the drainage system.

7.8 Excavations and Slopes

Boreholes were drilled with a utility mounted EVH Scout 1750 drill rig equipped with a 90 mm diameter solid auger. The auger drilling generally progressed with ease through the upper layers of sandy gravel and clayey sand and reduced to a slow to moderate rate through the deeper clayey soils.

We consider that excavations in the in-situ sandy and clayey soils will be readily achieved to a depth of about 2 m using standard earthmoving equipment (i.e. 10 tonne or larger excavator with a rock bucket). Deeper excavations will likely require a larger 20 to 30 tonne excavator equipped with a rock bucket.

Note: there is possible rock outcrop (possibly large buried boulders) in the northeastern part of the site. Allowance should therefore be made for rock excavation. In addition, the stockpiles of large boulders may also need to be removed.

Where significant groundwater inflows are encountered, we consider that dewatering will be achieved by shaping the base of excavations to a perimeter drain and/or sump and removing the water with a pump.

Excavations in the upper Clayey SAND, Sandy GRAVEL and Silty SAND at the site must be battered at slopes no steeper than 1V:2H for temporary slopes and 1:3H for permanent slopes above the water table. Even at these slope angles, erosion and rilling is likely to occur especially during significant rainfall events. In the underlying Sandy CLAY, slopes should be no steeper than 1V:1H above the water table (for temporary slopes open less than a week). Surcharges (such as plant and soil stockpiles) must not be placed at or near the crest of excavations.

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.

7.9 Stormwater Disposal

Infiltration testing was not carried out due to the presence of shallow groundwater and clayey soils at shallow depths.

Based on the soil profile, we do not consider that disposal of stormwater by infiltration is appropriate for the site. Stormwater should instead be diverted using drains or otherwise to a disposal area or similar located away from structures (refer to Section 7.3 for further details).

8. PAVEMENT DESIGNS

8.1 General

The pavement design methodology is in general accordance with the empirical design method outlined in the 2012 edition of the Austroads Guide to Pavement Technology Part 2, Structural Pavement Design (AGPT02-12) and Main Roads Western Australia Engineering Road Note 9 (MRWA ERN9, 2013) Procedure for Design of Road Pavements.

Mechanistic-empirical analyses of asphalt fatigue has also been undertaken using CIRCLY 6.0 by Mincad Systems.

NOTE: The following designs do not apply to any water-course crossings which must be further investigated and assessed.

8.2 Subgrade Evaluation

We note that the subgrade profile for flexible pavements typically comprises:

- Zone 1 - Central and south-eastern part of site - 0.4 m to 0.7 m of SAND/Gravelly SAND/Sandy GRAVEL over Sandy CLAY/CLAY.
- Zone 2 - Northern and western part of site – 0.5 m to 0.8 m of Clayey SAND over Sandy CLAY/CLAY

Laboratory testing indicates that:

- The in-situ Clayey SAND in the upper profile has a CBR of 3.5% with a CBR Swell of 0.5%.
- The in-situ Sandy CLAY in the upper profile has a CBR of 5% with a CBR Swell of 1.5%.
- The in-situ Sandy GRAVEL in the upper profile has a CBR of 60% with a CBR Swell of 0%.
- The Sand CLAY/CLAY at depth is highly expansive (probably CBR swell > 2.5%).

MRWA ERN9 requires the following minimum cover of inert material above reactive subgrade materials

- 150 mm inert material is required for CBR swell ranging from 0.5% to 2.5% and
- 600 mm inert material is required for CBR swell ranging from 2.5% to 5.0%.

Based on the results of our investigation, we consider the subgrade will have a sufficient cover of low reactivity material provided that pavement subgrades are not lowered any more than the required pavement thickness and adequate drainage is provided.

We consider that a subgrade design CBR of 5% may be assumed for the in-situ clayey subgrade in well drained conditions.

The subgrade design CBR may be improved to 10% by either:

- Ensuring a minimum 0.3 m thick layer of approved granular fill (Refer to Section 7.5) forms the pavement subgrade above the clayey soils. The material must have a minimum 4 day soaked CBR of 10% and CBR swell less than 0.5%; OR
- A minimum 0.3 m thick layer of lime stabilised clayey soil forms the pavement subgrade above the clayey soils. Lime stabilisation of the clayey soils will improve the material strength, reduce moisture sensitivity and improve conditions for pavement construction. Lime stabilisation must achieve a minimum 4 day soaked CBR of 10% and CBR swell less than 0.5%

It must be noted that lime stabilisation of the clayey subgrade soils will require laboratory stabilisation trials to confirm that:

- There are silica and alumina clay components to react with the lime.
- A suitable proportion of lime is used to satisfy Lime Demand and achieve long term strength gain.
- A suitable proportion of lime is used to achieve a minimum soaked CBR of 10% and CBR swell less than 0.5%.

It must be understood that the subgrade improvement recommendation assumes that the subsurface material along the edge of the pavement shoulders is relatively impermeable and is shaped to drain away from the pavement. Subsoil drains are required to drain the pavement edges where this is not possible.

8.3 Design Traffic

We assume that the Shire of Augusta-Margaret River follows the IPWEA (2017) Local Government Guidelines for Subdivisional Development for design of road highway pavements. IPWEA (2017) requires that pavements are designed for a life of 40 years for permanent deformation of the subgrade and 15 years for asphalt fatigue.

We have not been provided any design traffic information and have therefore referred to the Austroads indicative design traffic values for lightly trafficked roads as shown on Inline Figure 1 and Table 7: AGPT02-17 Indicative Design Traffic for Lightly Trafficked Roads.

Inline Figure 1: AGPT02-17 Lightly Trafficked Street Categories

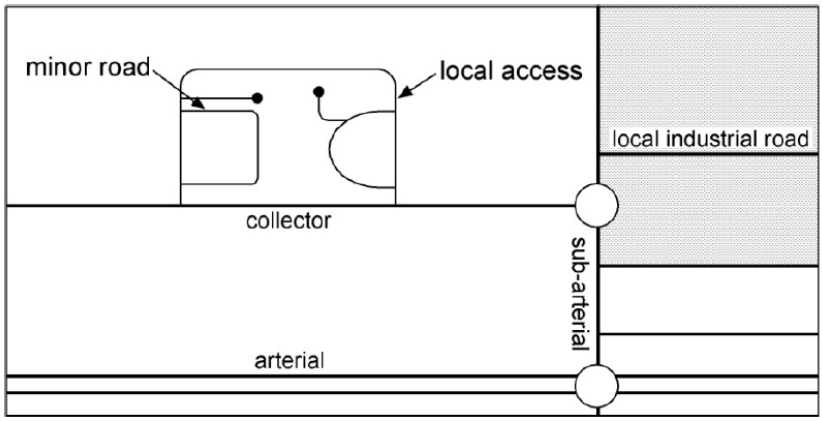


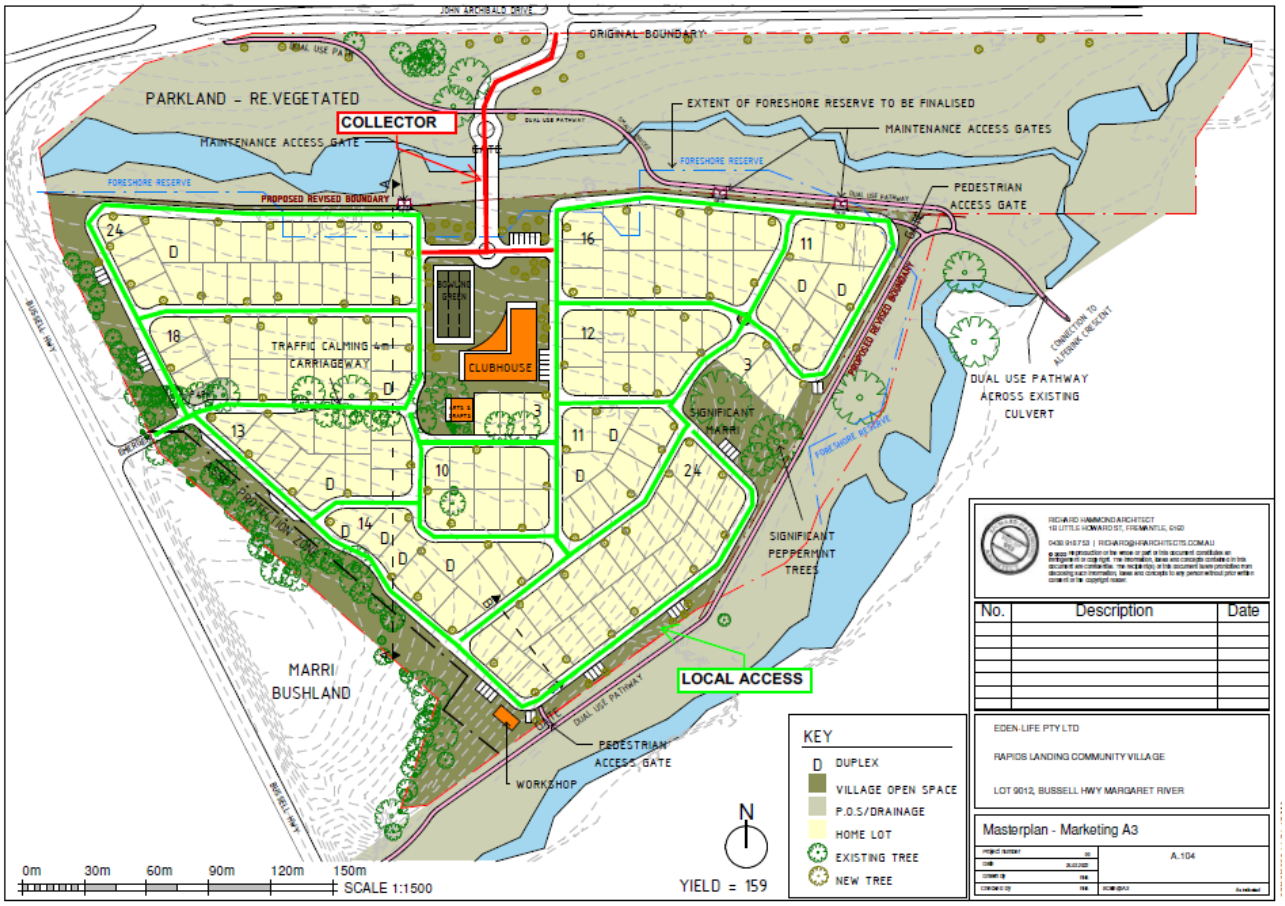
Table 7: AGPT02-17 Indicative Design Traffic for Lightly Trafficked Roads

Type of Road	AADT	%HV/100	Design Period (years)	HV Annual Growth Rate (%)	CGF	Axle groups per heavy vehicle	Cumulative HVAG over design period	ESA/ HVAG	Indicative design traffic (ESA)
Minor with two lane traffic	90	3	40	0	40	2.0	39,420	0.2	8×10^3
Local Access with Buses	500	6	40	1	48.9	2.1	535,455	0.3	1.5×10^5
Collector	2000	7	40	1.5	54.3	2.2	2,774,730	0.6	2×10^6

Notes: AADT – Annual Average Daily Traffic (2 way);
%HV/100 – Average percentage of heavy vehicles
CGF – Cumulative growth factor
ESA/HVAG – Equivalent standard axles per heavy vehicle axle group

Based on the above, we have categorised the roads within the subdivision as shown on Inline Figure 2.

Inline Figure 2: Assessment of Road Categories within Subdivision



We have also reviewed MRWA online traffic data for Tonkin Boulevard (MRWA Site 52841, dated 2017/2018) which is the collector road for traffic on the adjoining residential estate and school to the south. This MRWA data is presented in Appendix F.

We note that:

- The average annual daily traffic movements is about 2037 per day (both directions).
- The proportion of heavy vehicles ranges from 7.1% in the eastbound direction to 29.1% in the westbound direction (mainly Austroads Class 3 heavy vehicles). The high variability in heavy vehicle traffic is expected to be due to construction traffic movements (which are noted to be temporary).
- We have assumed axle equivalency factors according to MRWA ERN9, Other Important Urban Arterial Roads.
- We estimate the design traffic as follows:
  - Eastbound – 2.69 X 10^6 ESA
  - Westbound – 5.62 X 10^6 ESA

We note that the above traffic is higher than estimated for the collector road on the current estate. Consideration should be made in assuming a design traffic consistent with Tonkin Boulevard for the collector road on the proposed estate (this has not been adopted in our current designs).

Traffic impact assessments and further traffic data from the Augusta-Margaret River would be required to further refine the expected vehicle movements and estimated design traffic.

8.4 Pavement Materials

We have assumed the following material properties in our mechanistic-empirical analyses for the collector roads. This analysis was not undertaken for the lower category of roads as the traffic volumes are not critical to asphalt fatigue.

Table 8: Summary of Pavement Material Assumptions

Material	Design Modulus (MPa)	Poisson's Ratio	Assumptions
10 mm dense graded asphalt	2,310	0.4	WMAPT - 24°C, Vehicle Speed 50 km/hr, In-situ voids 9%
14 mm dense graded intersection mix asphalt	3,300	0.4	WMAPT - 24°C, Vehicle Speed 50 km/hr, In-situ voids 9%
Cement modified gravel basecourse	500	0.35	UCS 0.6 - 1.0 MPa at 28 days curing.
Crushed Igneous Rock Basecourse	500	0.35	High quality crushed rock basecourse
Gravel Basecourse	300	0.35	Soaked CBR 80%. CBR Swell < 0.5%
Crushed Limestone Subbase	250	0.35	Soaked CBR 50%. CBR Swell < 0.5%
Gravel Subbase	190	0.35	Soaked CBR 30%. CBR Swell < 0.5%
Approved granular fill or lime stabilised clayey soil.	100	0.35	Soaked CBR 10%. CBR Swell < 0.5%
In-situ subgrade	50	0.45	CBR 5% - well drained conditions.

Notes: 1. Assume MRWA Specification 504 compliant granular pavement materials

2. WMAPT – Weighted Mean Average Pavement Temperature

8.5 Pavement Thickness Design

Pavement designs have been provided according the design traffic presented in Table 7.

8.5.1 Collector Roads

The following pavement thickness designs are provided for the Collector roads.

Table 9: Collector Road Roundabouts and North-South Aligned Approach

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	40		14 mm dense graded intersection mix asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal (Substitute with 10/5 mm Double/Double Seal if significant trafficking required)
Base-course	180	180	Crushed Igneous Rock Basecourse or Cement Modified Gravel Basecourse MRWA Specification 504
Sub-base	110	280	Crushed Limestone or Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

Table 10: Collector Road – West-East Aligned

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	30		10 mm dense graded asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal (Substitute with 10/5 mm Double/Double Seal if significant trafficking required)
Base-course	155	155	Crushed Igneous Rock Basecourse or Cement Modified Gravel Basecourse MRWA Specification 504
Sub-base	135	305	Crushed Limestone or Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

Note: Crushed igneous rock basecourse is preferred to cement modified gravel basecourse as it carries a much lower risk of shrinkage and/or block cracking.

8.5.2 Local Access Roads

The following pavement thickness designs are provided for the Local Access Roads.

Table 11: Local Access Roads

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	30		10 mm dense graded asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal
Base-course	115	115	Crushed Igneous Rock Basecourse or Gravel Basecourse MRWA Specification 504
Sub-base	100	205	Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

8.6 Surfacing and Seals

8.6.1 Surface Preparation and Prime

Prior to sealing or surfacing, the prepared granular base must be compacted and dried back (except cement modified basecourse which must be cured) to ensure a tightly bound surface and swept with a rotary broom or similar to remove any surface dust and loose particles.

The surface must be primed and sealed to waterproof the granular base and provide a strong bond between the base and the surfacing. MRWA Specification 503 requires application of a prime comprising 40% Class 170 bitumen/60% Medium curing cutter oil prime at a rate of 0.6 L/m^2.

The prime must be applied in dry and warm conditions, with no rainfall forecast within the following 3 days. The prime must be allowed to cure for a period of 3 to 7 days prior to application of the surfacing as per MRWA Specification 503.

Notwithstanding the nominal application rates, the prime should be adjusted:

- to ensure a uniform and even coating;
- to account for the porosity of the pavement surface;
- to account for the pavement moisture content and prevailing conditions; and
- if the seal or surfacing is applied immediately after the primer.

8.6.2 Preliminary Spray Seal Design below Surfacing

Preliminary seal designs have been performed in general accordance with Austroads AGPT04K-18, MRWA ERN15 (2017) and MRWA Specification 503.

The following preliminary seal designs are provided.

Table 12: Preliminary Seal Design

Applications	Seal Type	Aggregate Size (mm)	Binder	Total Binder Application Rate (@ 15°C) L/m²	Aggregate Spread Rate (m²/m³)
All	Prime	-	Cutback primer	0.6	-
Little to no traffic	Single/single seal	7 mm	CRS170/60 emulsion	1.3	150-200
Significant construction traffic and/or turning movements	Double/double seal	10 mm	CRS170/60 emulsion	0.9	140
		5 mm		1.1	180-220

The following assumptions have been made and must be reviewed by the sealing contractor:

- Double/double seal based on MRWA recipe-based seal design with proven performance in highway applications.
- Assumed Average Least Dimension (ALD) of 4 mm for the 7 mm aggregate and Flakiness Index (FI) 25-35%.
- No adjustments for surface texture, embedment, or absorption assuming suitable basecourse preparation and priming.
- Design based on no trafficking between prime and seal applications.

8.6.3 Recommended Pavement Surfacings

We generally recommend that 10 mm dense graded asphalt is used for the road excluding the main entrance road and roundabouts which will be subject to heavy traffic and turning movements. We recommend that 14 mm dense graded intersection mix asphalt is used in these areas.

MRWA Specifications 504 Section 504.26 and Tables 504.B1 and 504.B2 must be used for the mix design. The asphalt job mix must be trialled and laboratory tested to ensure it conforms with the specification.

The asphalt must be compacted to a minimum characteristic density ratio of 93% of the 75 blow Marshall Density as outlined in the MRWA Specification 504.

9. PAVEMENT SPECIFICATION AND CONSTRUCTION

9.1 Fill Materials

The following MRWA Specifications are applicable to imported pavement materials and construction:

- MRWA Specification 501 – Pavements.
- MRWA Specification 503 – Bituminous Surfacing.
- MRWA Specification 504 – Asphalt Wearing Course.
- MRWA Specification 511 – Materials for Bituminous Treatments.

9.2 Stabilisation

We note that:

- Cement modification of imported gravel basecourse fill may be required for the basecourse in order to provide a high modulus material that will prevent asphalt fatigue at the main entrance roads/roundabouts.
- Lime stabilisation of the clayey subgrade soils may be considered to improve the subgrade design strength and manage the reactivity of the clayey subgrade materials.

Laboratory stabilisation trials are required to confirm the required proportion of cement and lime for the design parameters assumed in the pavement design. The following laboratory testing is recommended as a minimum:

Cement Modification of Basecourse

- Particle size distribution and Atterberg Limits on 3 representative samples of unmodified gravel basecourse.
- Dry density-moisture content relationship using Modified compactive effort on samples stabilised with 1%, 1.5% and 2% General Purpose Portland Cement (GP Cement). Recommend testing 3 representative samples for each cement content (total 9 tests).
- Unconfined compressive strength (UCS) on samples stabilised with 1%, 1.5% and 2% GP Cement, compacted to 98% MMDD and cured for 28 days. Recommend testing 3 representative samples for each cement content (total 9 tests).

The target 28-day UCS value is in the range of 0.6 MPa to 1.0 MPa. Further advice can be provided upon review of the test results.

Lime Stabilisation of Subgrade Materials

- Particle size distribution and Atterberg Limits - 3 representative samples of the clayey subgrade materials to be stabilised.
- Lime Demand tests to determine the minimum proportion of quicklime to maintain a permanent reaction and stabilisation. Recommend testing 3 representative bulk samples.
- Modified compaction tests on at least 3 samples (1 for each lime content) stabilised to the Lime Demand and 2% greater than the Lime Demand (total 6 tests).
- 4 day soaked CBR tests on 6 samples stabilised to the Lime Demand and 2% greater than the Lime Demand (i.e. 3 tests for each lime content). Stabilised samples to be compacted to 92% MMDD and cured for 7 days prior to CBR soak. Further geotechnical advice is required to confirm appropriate design subgrade CBR and pavement design for stabilised material.

Further testing of stabilised material is also recommended during construction to ensure the design value is achieved and any adjustments are made as required.

9.3 Moisture Conditioning, Compaction and Dryback

It is essential that all granular pavement layers are suitably moisture conditioned, compacted and dried back. Stabilised materials must be adequately cured and not prematurely dried back. The requirements are outlined in Table 13.

Table 13: Compaction and Dryback Requirements

Pavement Layer	Moisture Content for Compaction	Characteristic DDR	Characteristic Maximum Moisture Content for Dryback
Cement Modified Basecourse	90 to 110% of MOMC	98% MMDD	80-100% MOMC 7 days cured
Crushed Igneous Rock Basecourse		98% MMDD	60% of MOMC
Gravel Basecourse		98% MMDD	70% of MOMC
Gravel Sub-base		95% MMDD	85% of MOMC
Subgrade Fill or In-situ Subgrade (Granular)		95% MMDD	85% of MOMC (Upper 300 mm)
Subgrade (Cohesive)		92% MMDD	Do not dry back Target 80-100% MOMC

Note: MOMC – Modified Optimum Moisture Content

Quality control testing of pavement and subgrade materials must be undertaken at the frequencies outlined in MRWA Specification 201.

9.4 Pavement Joints

Pavement joints with existing pavements should be formed in accordance with MRWA standards.

9.5 Drainage

The pavement designs are based on the assumption that suitable drainage control measures have been implemented to prevent moisture ingress into the pavement layers. We recommend that, as a minimum, the clayey soil horizons and finished surfaces of pavements are crowned to direct storm-water run-off away from the pavements and towards drainage systems.

10. CLOSURE

We draw your attention to Appendix G of this report, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on how to minimise risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Piravin Anandacoomaraswamy

Geotechnical Engineer

Rick Piovesan CPEng

Geotechnical Engineer

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Figures

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

Legend

- Site Boundary
- Stockpiles of loose rock boulders
- Borehole
- Borehole not conducted due to access constraints

N

0 40 80 120 160 200
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:2,500	(A3)
DRAWN	DAC	
DATE DRAWN	25/03/2022	
CHECKED	RP	
DATE CHECKED	25/03/2022	
PROJECTION	GDA 1994 MGA Zone 50	

Galt Geotechnics Pty Ltd
ACN : 138 490 865
Tel : +61 (0)8 6272-0200
Address : 50 Edward Street
Osborne Park WA 6017

CLIENT	**MCDOWALL AFFLECK PTY LTD**
PROJECT	EDENLIFE - MARGARET VILLAGE
LOCATION	LOTS 280, 3002 & 3010 BUSSELL HIGHWAY MARGARET RIVER
TITLE	SITE & LOCATION PLAN

Job No	Fig No	Rev
J2001180	FIGURE 1	**A**

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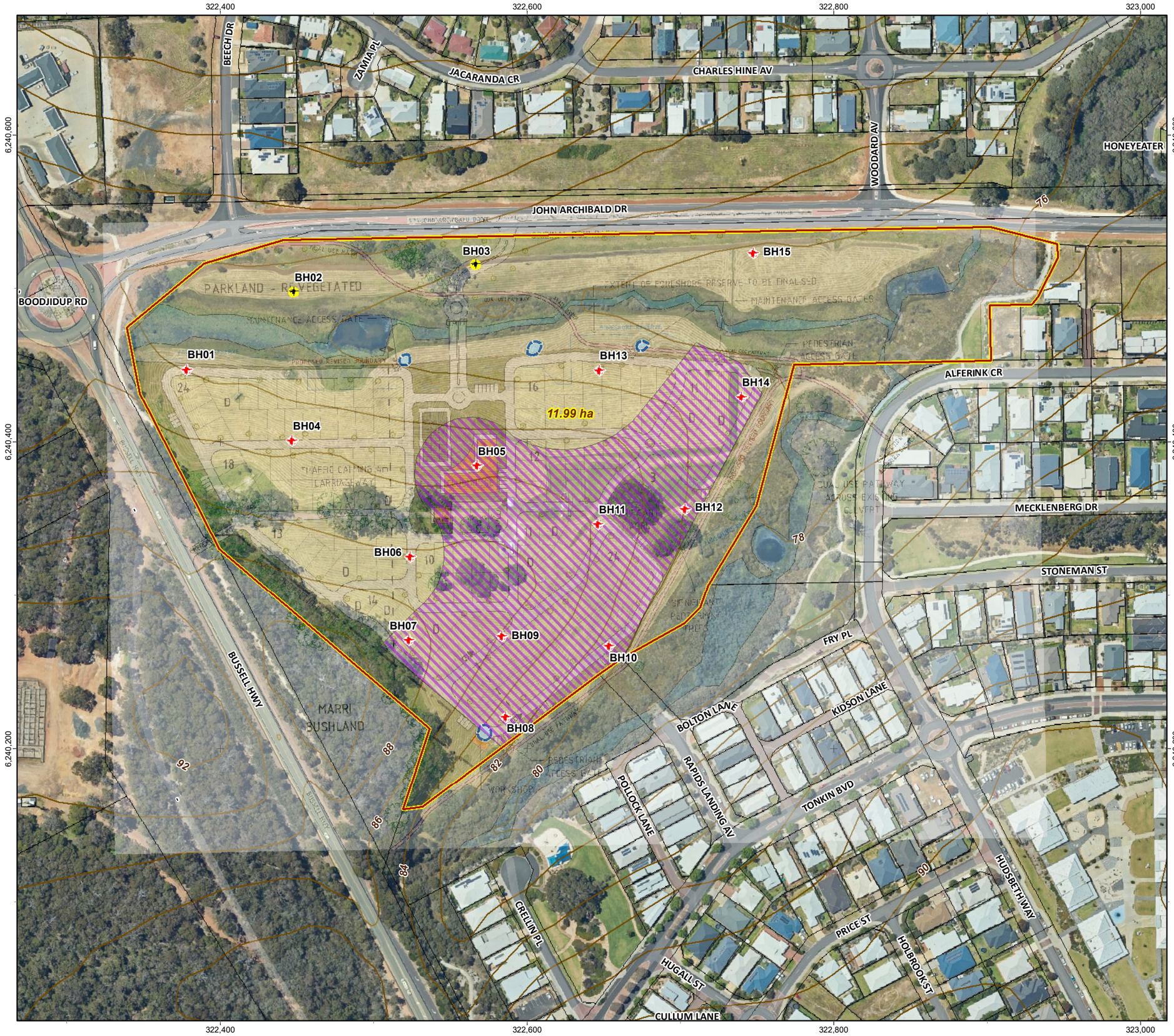

Legend

- Site Boundary
- Stockpiles of loose rock boulders
- 0.4 - 0.7m SAND/GRAVEL overlying clayey strata
- Borehole
- Borehole not conducted due to access constraints

N

0 40 80 120 160 200
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:2,500	(A3)
DRAWN	DAC	
DATE DRAWN	25/03/2022	
CHECKED	RP	
DATE CHECKED	25/03/2022	
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CLIENT	**MCDOWALL AFFLECK PTY LTD**
PROJECT	EDENLIFE - MARGARET VILLAGE
LOCATION	LOTS 280, 3002 & 3010 BUSSELL HIGHWAY MARGARET RIVER
TITLE	INDICATIVE SOIL ZONES
Job No	J2001180
Fig No	FIGURE 2
Rev	**A**

Appendix A: Supplied Drawings

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50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

JOHN ARCHIBALD DRIVE

ORIGINAL BOUNDARY

DUAL USE PATH

PARKLAND - RE.VEGETATED

EXTENT OF FORESHORE RESERVE TO BE FINALISED

MAINTENANCE ACCESS GATES

DUAL USE PATHWAY

SMALL BRIDGE

MAINTENANCE ACCESS GATE

GATE

FORESHORE RESERVE

PROPOSED REVISED BOUNDARY

WORKS GATE

DUAL USE PATHWAY

PEDESTRIAN ACCESS GATE

GATE

PROPOSED REVISED BOUNDARY

CONNECTION TO ALFERINK CRESCENT

DUAL USE PATHWAY ACROSS EXISTING CULVERT

BUSSELL HWY

24

D

16

11

D

D

BOWLING GREEN

18

TRAFFIC CALMING 4m CARRIAGEWAY

12

CLUBHOUSE

3

D

PARK

ARTS & CRAFTS

3

SIGNIFICANT MARRI

EMERGENCY EXIT

13

11

D

10

D

D

24

ASSET PROTECTION ZONE

D

14

D

D

D

FORESHORE RESERVE

SIGNIFICANT PEPPERMINT TREES

MARRI BUSHLAND

DUAL USE PATHWAY

GATE

PEDESTRIAN ACCESS GATE

WORKSHOP

BUSSELL HWY

0m 30m 60m 90m 120m 150m

SCALE 1:1500

N

YIELD = 159

KEY

- D DUPLEX
- VILLAGE OPEN SPACE
- P.O.S/DRAINAGE
- HOME LOT
- EXISTING TREE
- NEW TREE

RICHARD HAMMOND ARCHITECT
1B LITTLE HOWARD ST, FREMANTLE, 6160

0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan - Marketing A3

Project number	00	A.104	
Date	25.02.2022		
Drawn by	RHA		
Checked by	RHA	Scale@A3	As indicated

25/02/2022 11:51:45 AM

PUBLIC OPEN SPACE PROVISION	
Total Structure Plan Area	11.99ha
Deductions - 50% Drainage - Landscape Buffer	 2.41ha 0.18ha
Total Deductions	2.59ha
Nett Subdivisible Area	9.4ha
10% Public Open Space Requirement	0.94ha
Total Public Open Space (Including 50% Credit for POS)	2.41ha (25.6%)

0 20 40 60 80 100m

NOTE:

Base Data supplied by Survey South / RPS

Areas and dimensions shown are subject to final survey calculations.

A	11/12/2021	Initial Issue
Revision	Date	Item

LEGEND

- STRUCTURE PLAN BOUNDARY
- LOCAL DEVELOPMENT PLAN AREA
- SEASONAL CREEKLINE / SOAK / DAM
- DUAL USE FOOTPATH
- EMERGENCY ACCESS WAY
- EXISTING GAS STORAGE-TANK TO BE RELOCATED AND ASSOCIATED PIPE INFRASTRUCTURE TO BE MODIFIED TO SERVICE THE LIFESTYLE VILLAGE AND MAINTAIN GAS SUPPLY TO RAPIDS LANDING ESTATE.
- LANDSCAPE BUFFER / LINEAR PRIVATE OPEN SPACE
- EXISTING TREES

ZONES

- RESIDENTIAL R30/R40

RESERVES

- PARKS AND RECREATION AND DRAINAGE

STRUCTURE PLAN

Lot 9014 John Archibald Drive, MARGARET RIVER

Edenlife Communities Pty Ltd	:	CLIENT
A3@1:2,000	:	SCALE
25 January 2022	:	DATE
00100-2-9014-001	:	PLAN No
A	:	REVISION
G.A	:	PLANNER
B.L	:	DRAWN

AHOLAPLANNING
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Appendix B: Site Photographs

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

Photograph 1: General view – looking south from northeastern part

Photograph 2: General view – eastern edge of site

Photograph 3: Eastern part of site – looking north

Photograph 4: Southern part of site – Bussell Highway on right of photo

Photograph 5: Northwestern part of site – looking northwest

Photograph 6: Access road from Bussell Highway (looking south)

Photograph 7: Northern part of site along creek

Photograph 8: Typical rock stockpiles on southern side of creek

Photograph 9: Soft surface conditions and shallow perched groundwater in middle of site

Photograph 10: Rock pile in southern part of site

Appendix C: Borehole Reports

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

METHOD OF SOIL DESCRIPTION
BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG & SOIL CLASSIFICATION SYMBOLS

Graphic	USCS	Soil Name
		FILL (various types)
		COBBLES / BOULDERS
	GP	GRAVEL (poorly graded)
	GW	GRAVEL (well graded)
	GC	Clayey GRAVEL
	GM	Silty GRAVEL
	SP	SAND (poorly graded)
	SW	SAND (well graded)
	SC	Clayey SAND

Graphic	USCS	Soil Name
	SM	Silty SAND
	ML	SILT (low liquid limit)
	MH	SILT (high liquid limit)
	CL	CLAY (low plasticity)
	CI	CLAY (medium plasticity)
	CH	CLAY (high plasticity)
	OL	Organic SILT (low liquid limit)
	OH	Organic SILT (high liquid limit)
	Pt	PEAT

NOTE: Dual classification given for soils with a fines content between 5% and 12%.

SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

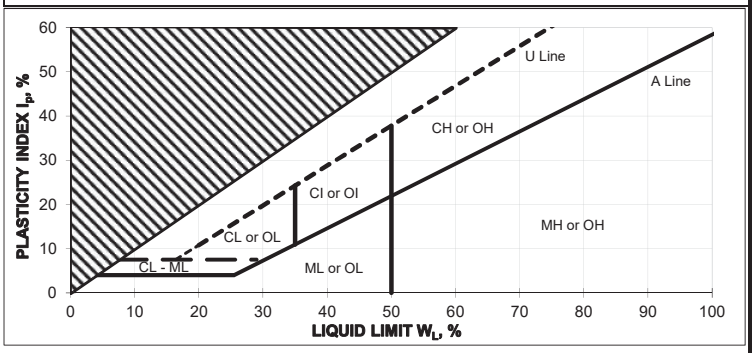
Soil descriptions are based on AS1726-2017. Material properties are assessed in the field by visual/tactile methods in combination with field and laboratory testing techniques (where used).

NOTE: AS 1726-2017 defines a fine grained soil where the total dry mass of fine fractions (<0.075 mm particle size) exceeds 35%.

PARTICLE SIZE

Soil Name		Particle Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	19 to 63
	Medium	6.7 to 19
	Fine	2.3 to 6.7
SAND	Coarse	0.6 to 2.36
	Medium	0.21 to 0.6
	Fine	0.075 to 0.21
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY - MODIFIED CASAGRANDE CHART - AS1726-2017



RESISTANCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION

Symbol	Term
D	Dry
M	Moist
W	Wet

CEMENTATION

Cementation	Description
Weakly cemented	Soil may be easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate the soil by hand in air or water

CONSISTENCY

Symbol	Term	Undrained Shear Strength (kPa)
VS	Very Soft	0 to 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very Stiff	100 to 200
H	Hard	>200

ORGANIC SOILS

Material	Organic Content % of dry mass
Inorganic soil	<2%
Organic soil	2% to 25%
Peat	>25%

DENSITY

Symbol	Term	Density Index (%)
VL	Very Loose	<15
L	Loose	15 to 35
MD	Medium Dense	35 to 65
D	Dense	65 to 85
VD	Very Dense	>85

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS

METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

SUPPORT

T	Timbering

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

WATER

►	Water Inflow	▼	Water Level
◄	Water Loss (complete)		
◁	Water Loss (partial)		

SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%) $= \frac{CRL}{TCL} \times 100$

RQD = Rock Quality Designation (%) $= \frac{ALC>100}{TCL} \times 100$

TCL	Length of Core Run
CRL	Length of Core Recovered
ALC>100	Total Length of Axial Lengths of Core Greater than 100 mm Long

BOREHOLE: BH01

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, trace organics	M	L - MD	Perched groundwater
								SC	Clayey SAND: fine to coarse grained, orange-brown, 25-35% medium plasticity fines			
			0.5					SP	Gravelly SAND: fine to coarse grained, orange-brown, 30-40% fine to coarse grained gravel, with fines	W	D - VD	
	F		1.0					CI	Sandy CLAY: medium to high plasticity, grey mottled brown, 40-60% fine to coarse grained sand, trace gravel	D - M		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.9 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH04

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0		B(BH04-1)			SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics			Perched groundwater
								SC	Clayey SAND: fine to coarse grained, orange-brown, 15-30% medium plasticity fines, trace gravel	M	VL - L	
			0.5						With gravel	W	D	
	F		1.0					CH	Sandy CLAY: high plasticity, grey mottled red, 40-50% fine to coarse grained sand	D - M	St	
			1.5						Becoming medium plasticity, grey, with silt fines			
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.5 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH05

Sheet 1 OF 1

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SP-SC	TOPSOIL: Clayey SAND/SAND: fine to coarse grained, dark brown, 5-15% low plasticity fines, with organics	M	L	Perched groundwater
								GP	Sandy GRAVEL: fine to medium grained, sub-angular to sub-rounded, lateritic, brown, 35-45% fine to coarse grained sand, with fines			
	E-F		0.5					SC	Clayey SAND: fine to coarse grained, pale brown, 10-20% low to medium plasticity fines, trace gravel	W	MD - D	
	F							CI	Sandy CLAY: medium to high plasticity, brown mottled grey, 50-60% fine to coarse grained sand, trace gravel	D - M	VSt	
	F-H		1.0									
			1.5						Hole terminated at 1.50 m Refusal on stiff clay Groundwater encountered at 0.3 m			
			2.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH06

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SC	TOPSOIL: Clayey SAND, fine to coarse grained, dark brown, 10-15% low plasticity fines, with organics		L	
									Clayey SAND: fine to coarse grained, orange brown, 15-25% low to medium plasticity fines, with gravel	D - M	MD	
			0.5					SC		M	D	
	F-H								Sandy CLAY: medium plasticity, orange-brown, 50-60% fine to coarse grained sand, trace gravel	D	VSt	
			1.0					CI				
									Hole terminated at 1.10 m Refusal on very stiff clay Groundwater not encountered			
			1.5									
			2.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH07

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics	D - M	L	
								SP	Gravelly SAND: fine to coarse grained, orange brown, 30-40% fine to medium grained, lateritic gravel, with fines		MD	
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand	D	VSt	
	F-H		1.0									
			1.5					CH	High plasticity			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH08

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-15% non-plastic fines, with organics	D - M	MD	
								SP	Gravelly SAND: fine to coarse grained, brown, 35-45% fine to medium grained, lateritic gravel, with fines			
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand	D	F - St	
											VSt	
			1.0									
	F-H		1.5					CH	High plasticity, grey mottled red			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH09

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-15% non-plastic fines, with organics	D - M	L - MD	
								SP	Gravelly SAND: fine to coarse grained, brown, 35-45% fine to medium grained, lateritic gravel, with fines			
	F		0.5		B(BH09-01)			CI	Sandy CLAY: medium plasticity, orange brown, 40-50% fine to coarse grained sand	D	St	
											VSt	
	F-H		1.0					CH	CLAY: high plasticity, red mottled grey, with sand			
			1.5		B(BH09-02)							
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH10

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics		VL	
	F		0.5					SM	Silty SAND: fine to coarse grained, orange-brown, 10-20% non-plastic to low plasticity fines, trace gravel	D - M	L - MD	
										M		
			1.0					Cl	Sandy CLAY: medium plasticity, orange, 40-50% fine to coarse grained sand	D	F - St	
	F-H		1.5					CH	CLAY: high plasticity, red mottled grey, with sand			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH11

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	10/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0		B(BH11-01)			SM	TOPSOIL: SAND, fine to coarse grained, sub-angular to sub-rounded, black, with organics, with fines	W	MD	Perched groundwater
								GP	Sandy GRAVEL: fine to coarse grained lateritic gravel, sub-angular to sub-rounded, brown, 30-40% fine to coarse grained sand, with fines			
			0.5		B(BH11-02)			CI	Sandy CLAY: high plasticity, orange-brown, 50-60% fine to coarse grained sand, trace gravel		F - St	
	F		1.0		B(BH11-03)			CH	High plasticity, 30-40% fine to coarse grained sand, trace gravel	M		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.5 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH12

Sheet 1 OF 1

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SP-SM	TOPSOIL: Silty SAND/SAND, fine to coarse grained, dark brown, 5-15% non-plastic to low plasticity fines, with organics	M	VL - L	Perched groundwater
								SP-SM	Silty SAND/SAND: fine to coarse grained, orange brown, 5-15% non-plastic to low plasticity fines	M - W		
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand		VSt	
	F-H		1.0					CH	High plasticity, grey mottled red	D - M		
	F		1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.4 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH13

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SP-SC	TOPSOIL: Clayey SAND/SAND, fine to coarse grained, dark brown, 5-15% low plasticity fines, with organics	M	L	Possibly perched groundwater
									Sandy CLAY: medium plasticity, 60% fine to medium grained sand, orange brown			
	E-F		0.5		B(BH13-01)			CI		M - W	D	
	F		1.0					CH	Sandy CLAY: high plasticity, grey mottled red, 45-55% fine to coarse grained sand	M		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 1 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH14

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SP	TOPSOIL: SAND, fine to coarse grained, dark brown, with fines, with organics	M	L	Perched groundwater
								SP	SAND: fine to coarse grained, brown, with fines	W		
	E-F		0.5					SC	Clayey SAND: fine to coarse grained, orange brown mottled red, 15-30% medium plasticity fines	D - M	D	
											St	
	F		1.0		B(BH14-01)			CH	Sandy CLAY: high plasticity, grey mottled red, 40% fine to coarse grained sand, trace gravel			
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.2 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH15

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	10/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, pale brown, 10-15% non-plastic fines, with organics			
									Clayey SAND: fine to coarse grained, orange brown, 15-30% low plasticity fines	M	L	
			0.5					SC				
									Medium plasticity fines			
	F		1.0					CI	Sandy CLAY: high plasticity, orange brown, 50% fine to coarse grained sand, trace gravel	W		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.9 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Appendix D: Laboratory Test Results

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

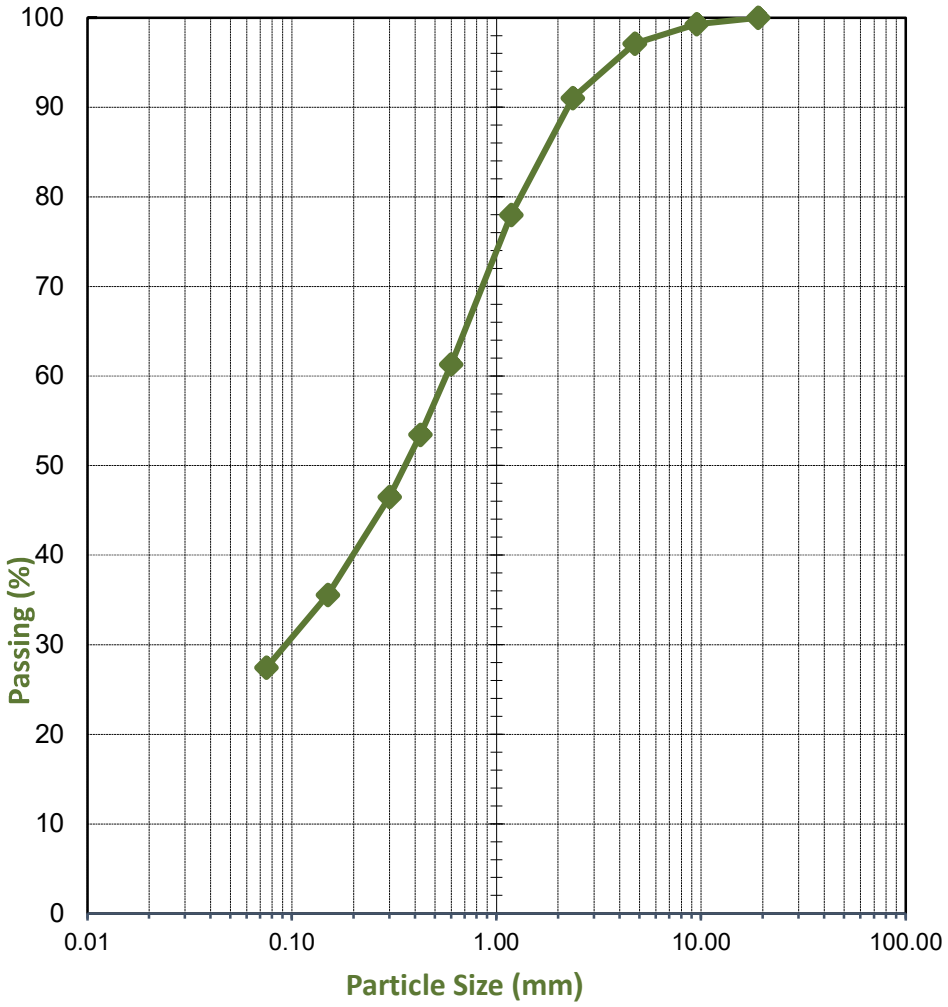
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/297_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	99
4.75	97
2.36	91
1.180	78
0.600	61
0.425	53
0.300	46
0.150	36
0.075	27



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/297_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**37**
AS 1289.3.2.1	**Plastic Limit (%)**	**28**
AS 1289.3.3.1	**Plasticity Index (%)**	**9**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**5.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/297_1_MMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Modified Maximum Dry Density

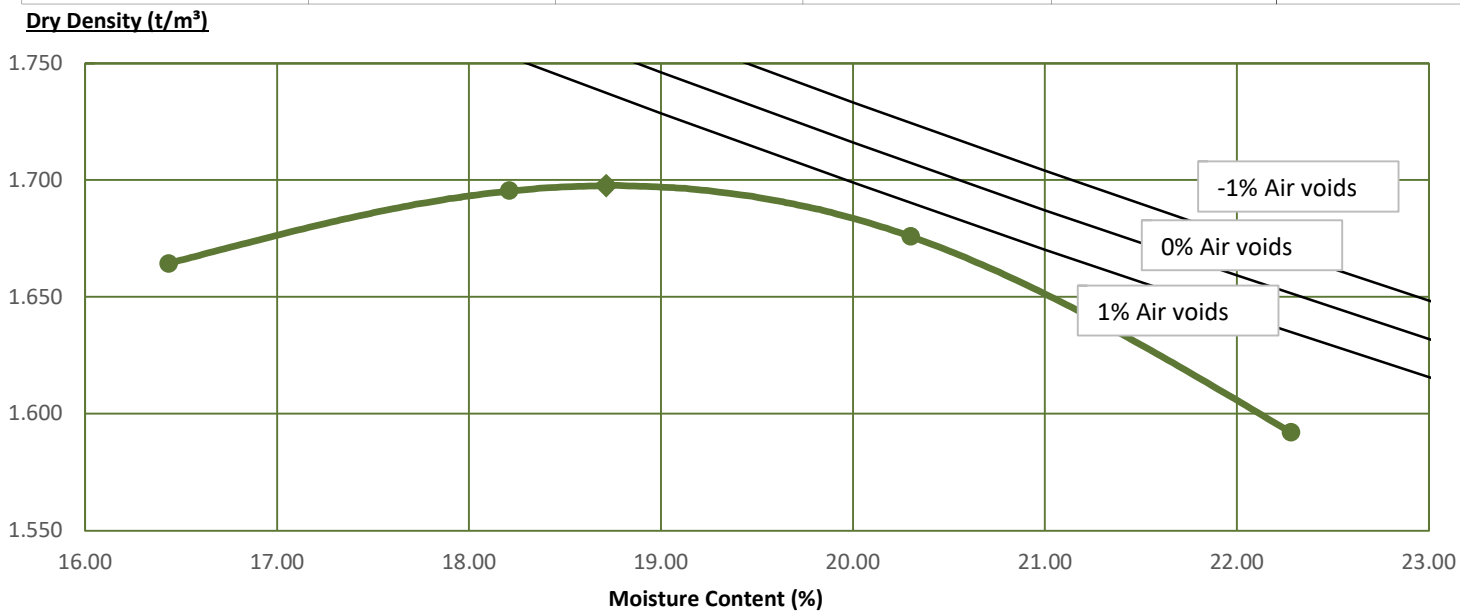
Sampling Method: Sampled by Client, Tested as Received

Sample Curing Time: 96hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 0 **Material + 37.5mm (%)** 0

Moisture Content (%)	18.2	20.3	22.3	16.4	
Dry Density (t/m³)	1.695	1.676	1.592	1.664	



Modified Maximum Dry Density (t/m³) **1.70**

Optimum Moisture Content (%) **18.5**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.613 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

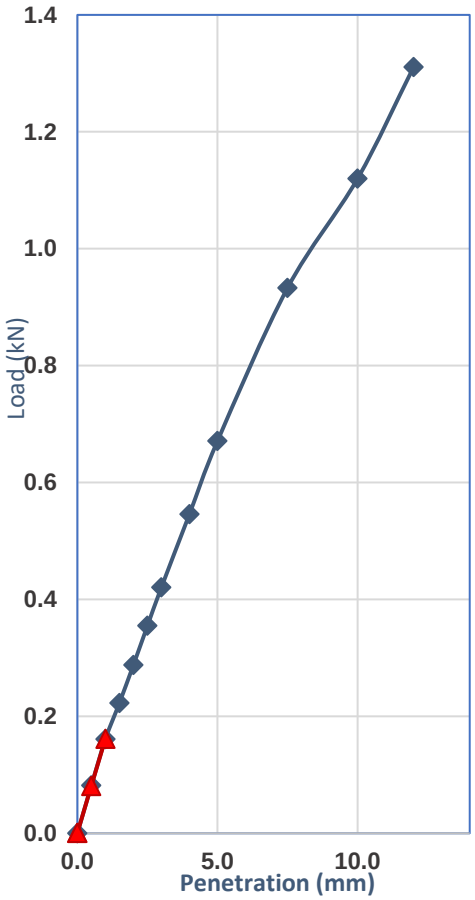
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8850_1_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8850
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/297 - BH04 - 0.1m - 0.5m	*Date Tested:*	16/09-21/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Silty Sand with Clay

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2 h
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	1.70	Optimum Moisture (%)	18.5
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	1.62	Moisture Content (%)	18.3
Density Ratio (%)	95.5	Moisture Ratio (%)	99.0

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.5
Dry Density (t/m³)	1.62	Dry Density Ratio (%)	95.0
Moisture Content (%)	21.7	Moisture Ratio (%)	117.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	21.9	Remaining Depth (%)	20.8

Correction applied to Penetration: 0mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 3.5%

Comments: MMDD & OMC values supplied by client - Bunbury Geotechnical Laboratory Services - NATA Accreditation No.20660, report No.BG20/297_1_MMDD.

Approved Signatory:

Name: Brooke Elliott

Date: 22-September-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

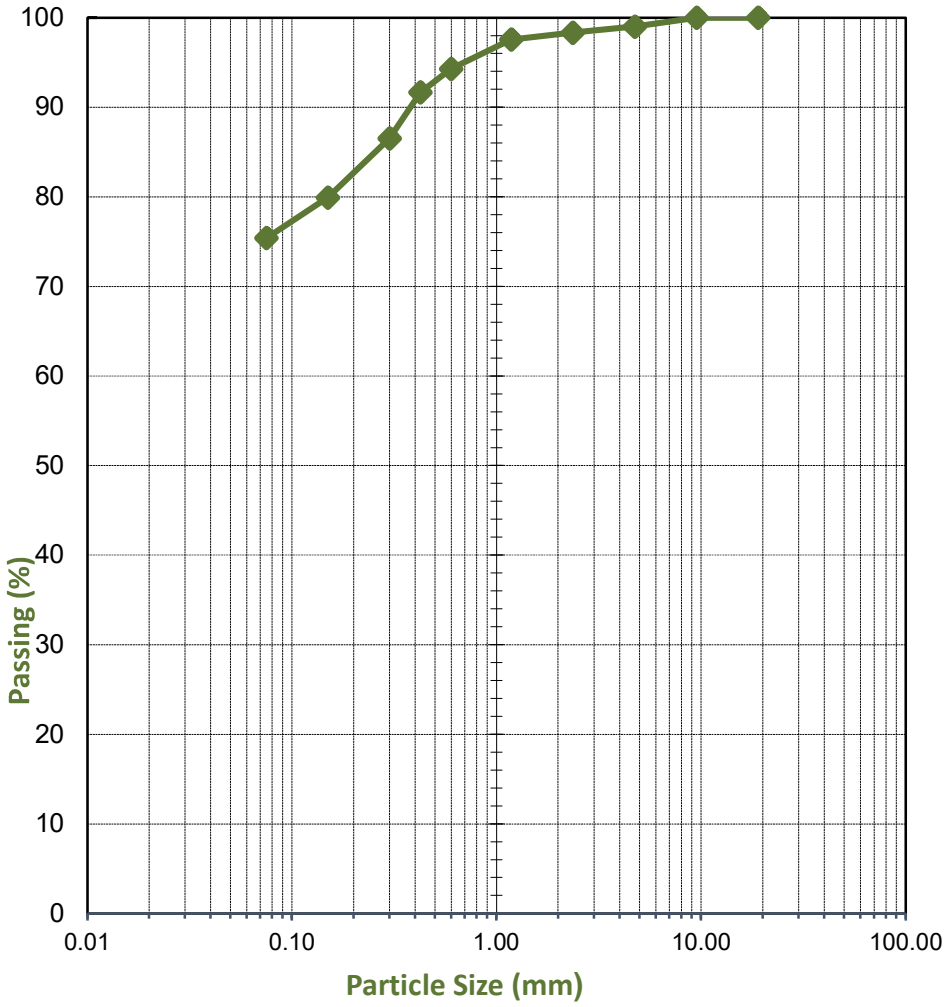
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/298_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/298
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH09 - 1.5m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	100
4.75	99
2.36	98
1.180	98
0.600	94
0.425	92
0.300	87
0.150	80
0.075	75



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

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TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/298_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/298
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH09 - 1.5m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**114**
AS 1289.3.2.1	**Plastic Limit (%)**	**40**
AS 1289.3.3.1	**Plasticity Index (%)**	**74**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**19.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

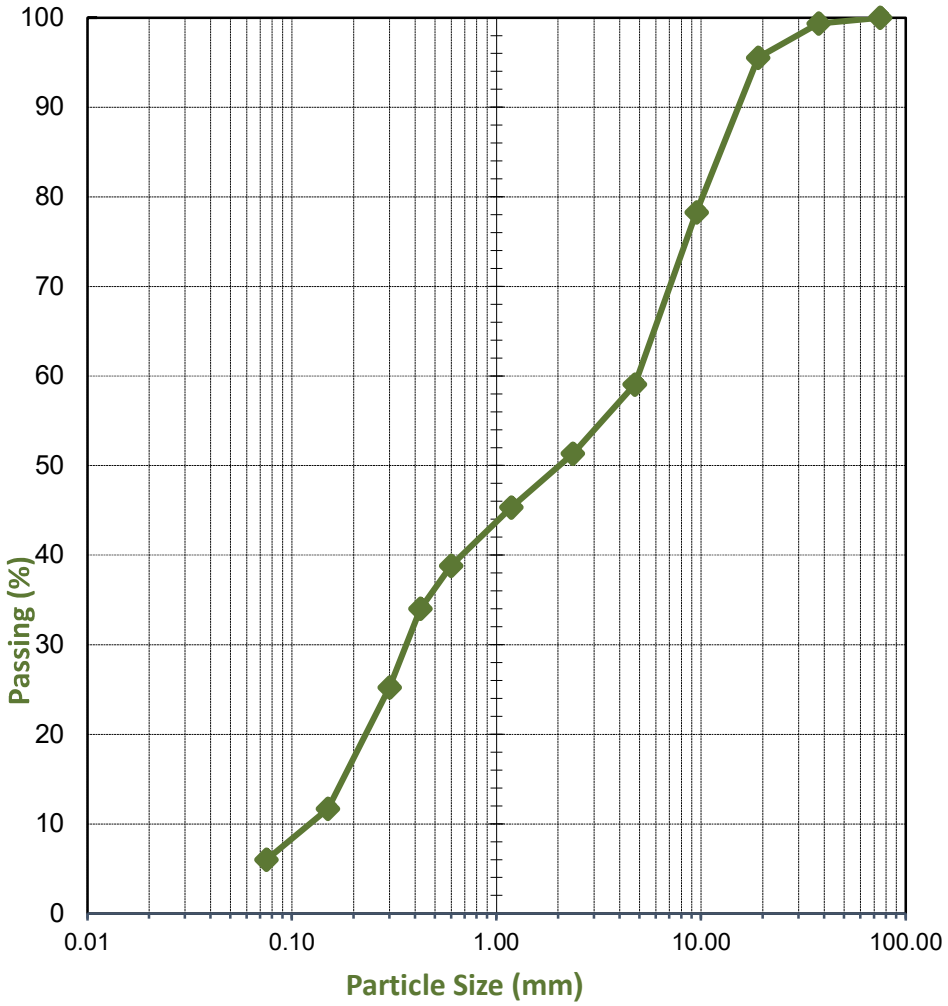
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/299_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	100
37.5	99
19.0	96
9.50	78
4.75	59
2.36	51
1.180	45
0.600	39
0.425	34
0.300	25
0.150	12
0.075	6



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/299_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50^{o}**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/299_1_MMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

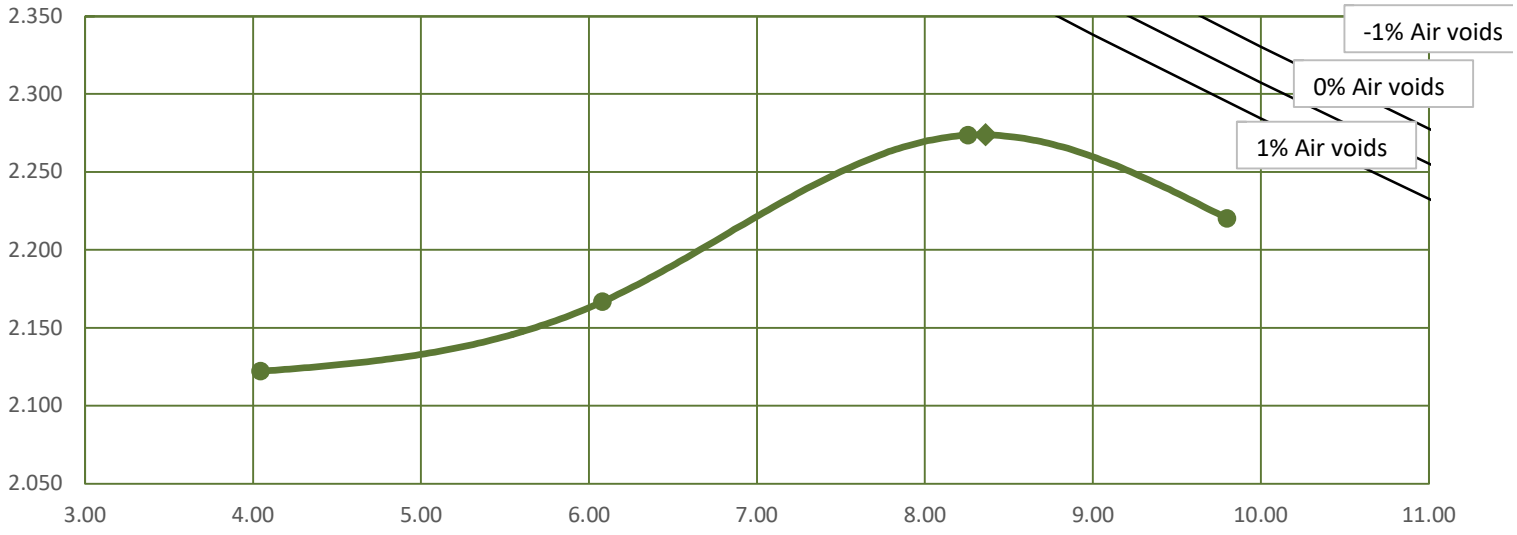
Sample Curing Time: 96hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 4 **Material + 37.5mm (%)** 1

Moisture Content (%)	4.0	6.1	8.3	9.8	
Dry Density (t/m³)	2.122	2.167	2.274	2.220	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.27**

Optimum Moisture Content (%) **8.5**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.999 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 18/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

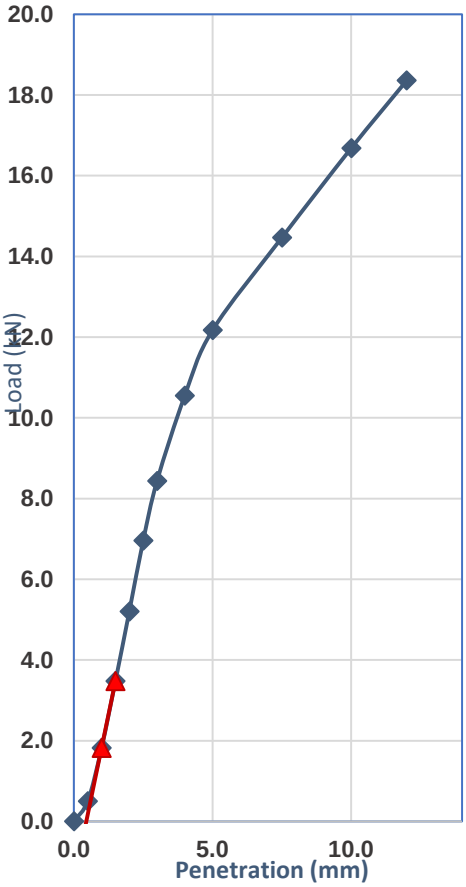
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8851_1_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8851
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/299 - BH11 - 0.1m - 0.5m	*Date Tested:*	16/09-21/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2 h
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	2.27	Optimum Moisture (%)	8.5
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	2.16	Moisture Content (%)	8.1
Density Ratio (%)	95.5	Moisture Ratio (%)	95.0

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.0
Dry Density (t/m³)	2.16	Dry Density Ratio (%)	95.5
Moisture Content (%)	10.7	Moisture Ratio (%)	125.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	11.5	Remaining Depth (%)	11.0

Correction applied to Penetration: 0.4mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 60%

Comments: MMDD & OMC values supplied by client - Bunbury Geotechnical Laboratory Services - NATA Accreditation No.20660, report No.BG20/299_1_MMDD.

Approved Signatory:

Name: Brooke Elliott

Date: 22-September-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

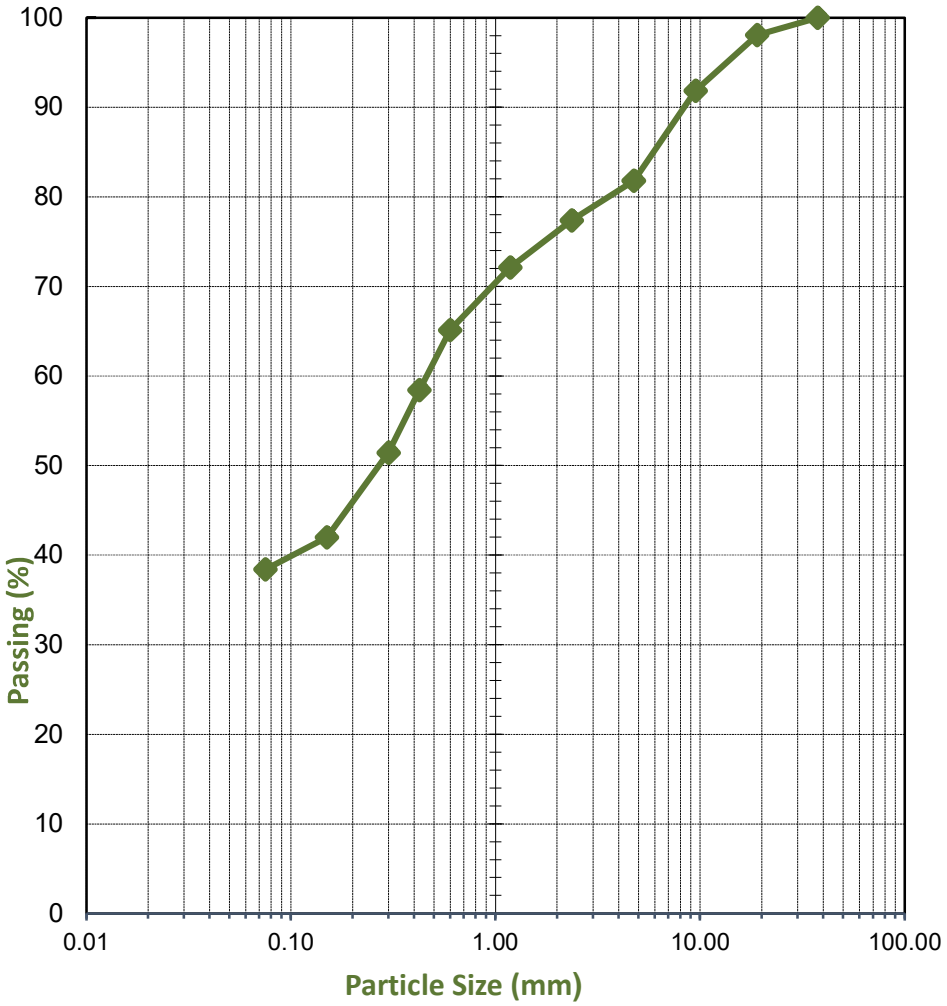
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/300_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	100
19.0	98
9.50	92
4.75	82
2.36	77
1.180	72
0.600	65
0.425	58
0.300	51
0.150	42
0.075	38



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

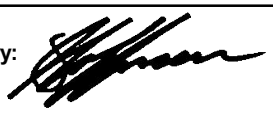
Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/300_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**51**
AS 1289.3.2.1	**Plastic Limit (%)**	**23**
AS 1289.3.3.1	**Plasticity Index (%)**	**28**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**11.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory: 

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.1.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/300_1_SMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Standard Maximum Dry Density

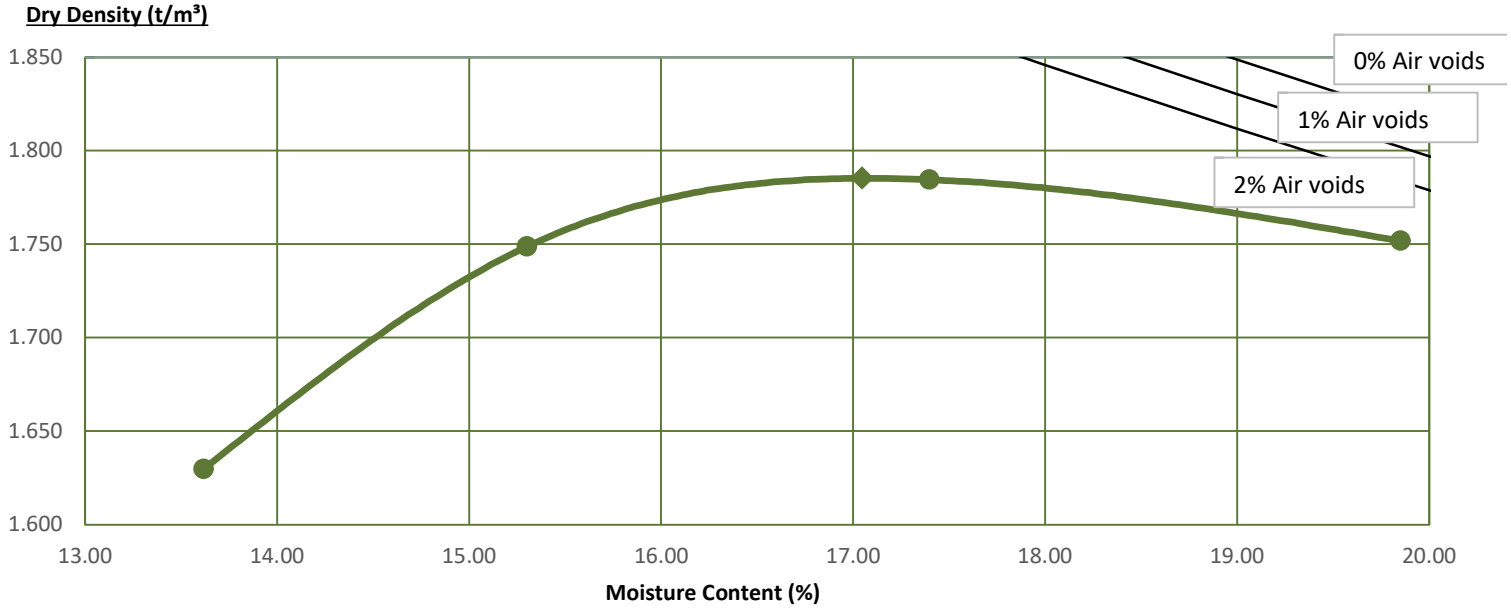
Sampling Method: Sampled by Client, Tested as Received

Sample Curing Time: 48hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 2 **Material + 37.5mm (%)** 0

Moisture Content (%)	**13.6**	**15.3**	**17.4**	**19.9**	
Dry Density (t/m³)	**1.630**	**1.749**	**1.784**	**1.752**	



Standard Maximum Dry Density (t/m³) **1.79**

Optimum Moisture Content (%) **17.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.849 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 24/September/2020

NATA WORLD RECOGNISED ACCREDITATION
Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.2.1.1, 6.1.1

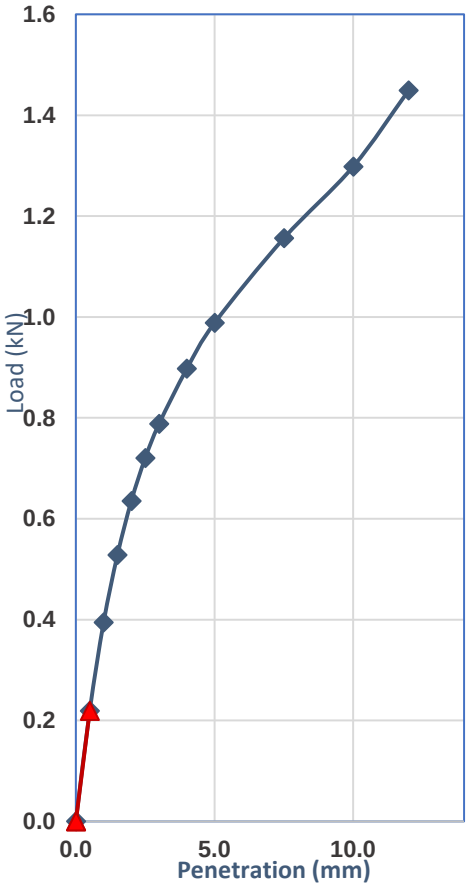
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8852_2_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8852
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/300 - BH11 - 0.5m - 1.0m	*Date Tested:*	16/09-22/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy Clay with Gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.1.1	Hammer Type	Standard
Plasticity Determined by	Estimated	*Curing Time (Hours)	24 Hours
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	1.79	Optimum Moisture (%)	17.0
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	1.70	Moisture Content (%)	17.2
Density Ratio (%)	95.0	Moisture Ratio (%)	101.5

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	1.5
Dry Density (t/m³)	1.68	Dry Density Ratio (%)	93.5
Moisture Content (%)	23.0	Moisture Ratio (%)	135.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	23.4	Remaining Depth (%)	20.8

Correction applied to Penetration: 0mm

Determined at a Penetration of: 2.5mm

California Bearing Ratio (CBR): 5%

*Comments: *Deviation from test method Clause 5 (f) -table 1. Insufficient curing time as per test method requirements. NATA Accreditation does not cover the performance of this service. Tested as per clients request. This report replaces WG20/8852_1_SCBR, sample identification updated as per clients request.*

Approved Signatory:

Name: Brooke Elliott

Date: 24-September-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

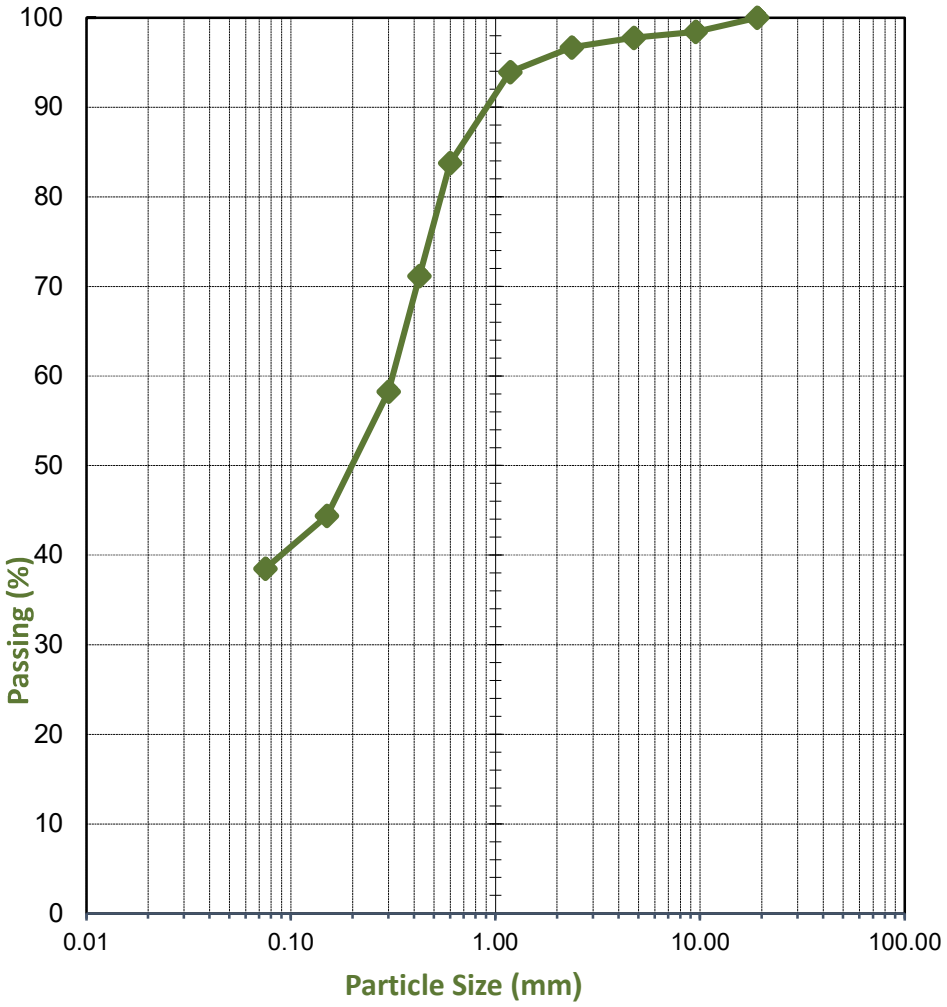
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/301_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/301
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH13 - 0.4m - 0.9m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	98
4.75	98
2.36	97
1.180	94
0.600	84
0.425	71
0.300	58
0.150	44
0.075	39



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/301_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/301
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH13 - 0.4m - 0.9m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**36**
AS 1289.3.2.1	**Plastic Limit (%)**	**19**
AS 1289.3.3.1	**Plasticity Index (%)**	**17**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**8.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

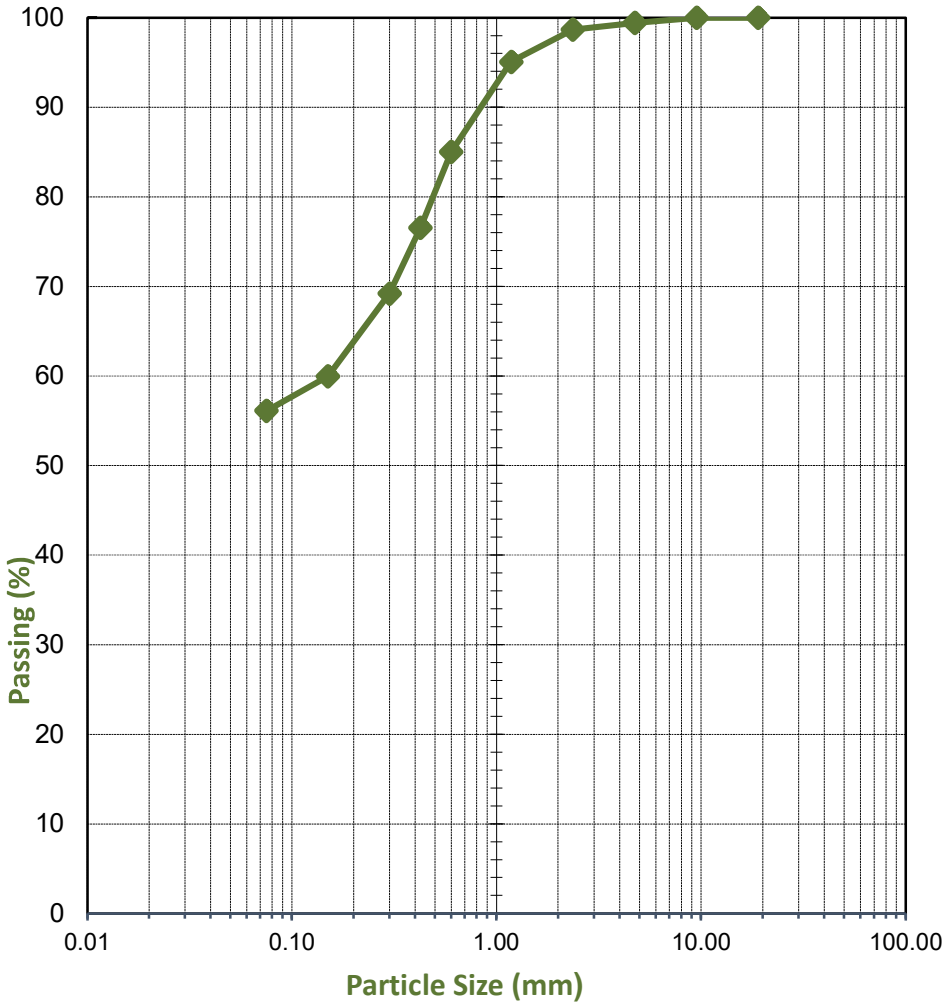
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/302_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/302
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH14 - 1.0m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	100
4.75	99
2.36	99
1.180	95
0.600	85
0.425	77
0.300	69
0.150	60
0.075	56



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/302_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/302
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH14 - 1.0m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**62**
AS 1289.3.2.1	**Plastic Limit (%)**	**20**
AS 1289.3.3.1	**Plasticity Index (%)**	**42**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**12.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

Appendix E: CSIRO Pamphlet

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

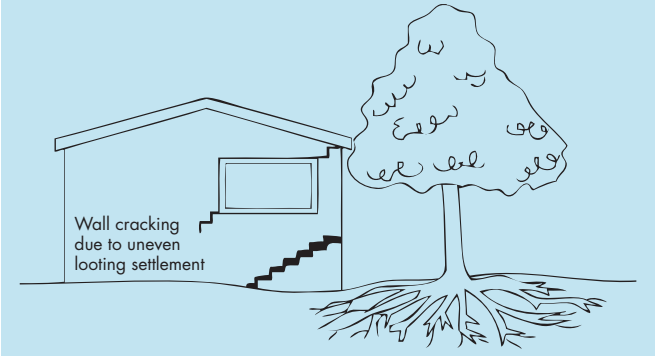
The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Trees can cause shrinkage and damage



Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

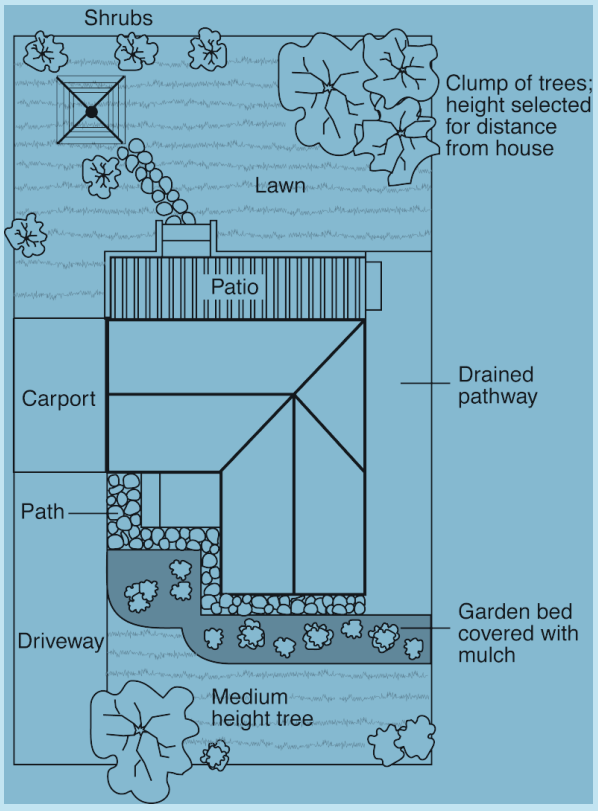
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Appendix F: MRWA Site 52841 2017/2018

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

mainroads WESTERN AUSTRALIA

SITE 52841

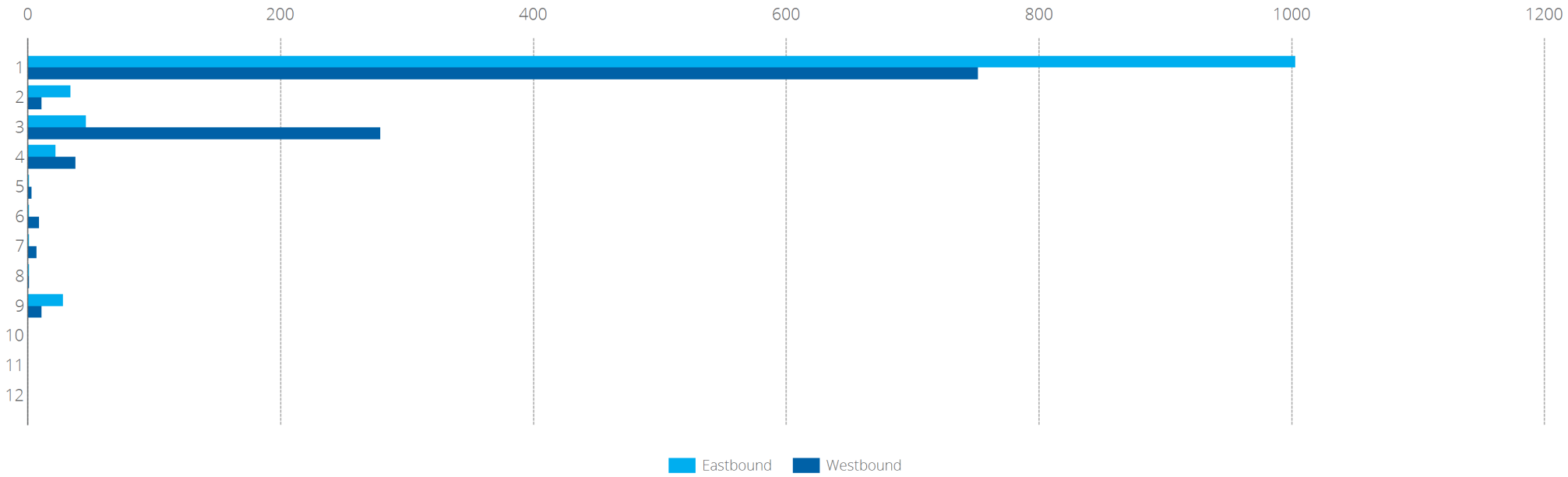
Vehicle Type

Tonkin Bvd (2010620)

East of Old Bussell Hwy (SLK 0.05)

2017/18

Monday to Friday



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	1003	34	46	22	1	1	1	1	28	0	0	0	100	1137
%	88.2	3.0	4.0	1.9	0.1	0.1	0.1	0.1	2.5	0.0	0.0	0.0	8.8	
W	752	11	279	38	3	9	7	1	11	0	0	0	348	1111
%	67.7	1.0	25.1	3.4	0.3	0.8	0.6	0.1	1.0	0.0	0.0	0.0	31.3	
E W	1755	45	325	60	4	10	8	2	39	0	0	0	448	2248
%	78.1	2.0	14.5	2.7	0.2	0.4	0.4	0.1	1.7	0.0	0.0	0.0	19.9	

SITE 52841

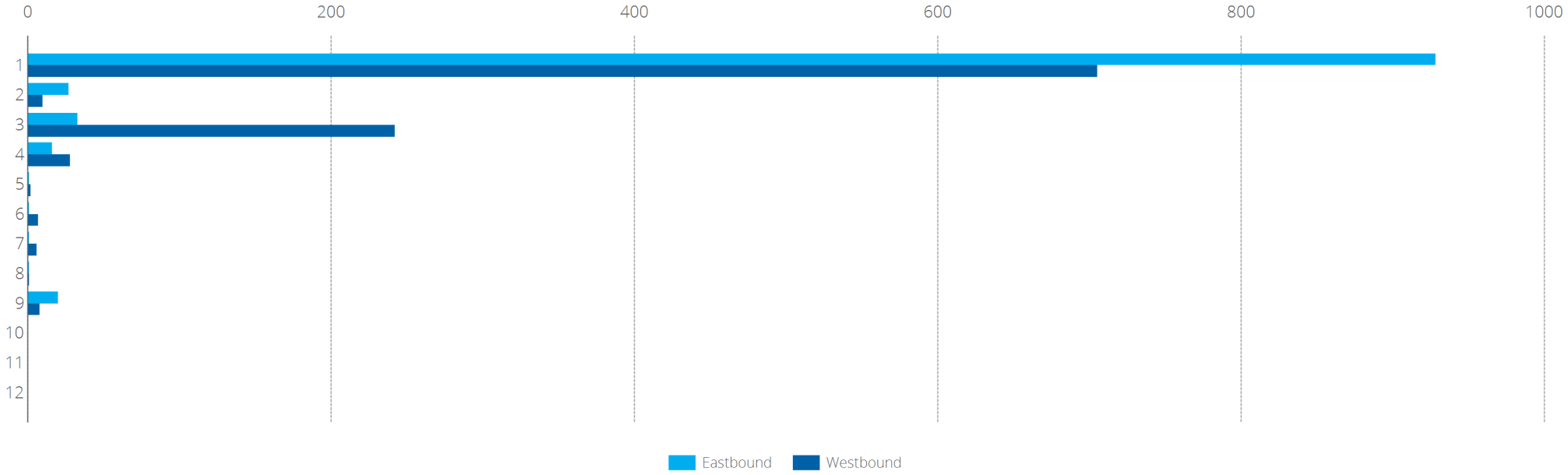
Vehicle Type

Tonkin Bvd (2010620)

East of Old Bussell Hwy (SLK 0.05)

2017/18

Monday to Sunday



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	928	27	33	16	1	1	1	1	20	0	0	0	73	1028
%	90.3	2.6	3.2	1.6	0.1	0.1	0.1	0.1	1.9	0.0	0.0	0.0	7.1	
W	705	10	242	28	2	7	6	1	8	0	0	0	294	1009
%	69.9	1.0	24.0	2.8	0.2	0.7	0.6	0.1	0.8	0.0	0.0	0.0	29.1	
E W	1633	37	275	44	3	8	7	2	28	0	0	0	367	2037
%	80.2	1.8	13.5	2.2	0.1	0.4	0.3	0.1	1.4	0.0	0.0	0.0	18.0	

SITE 52841

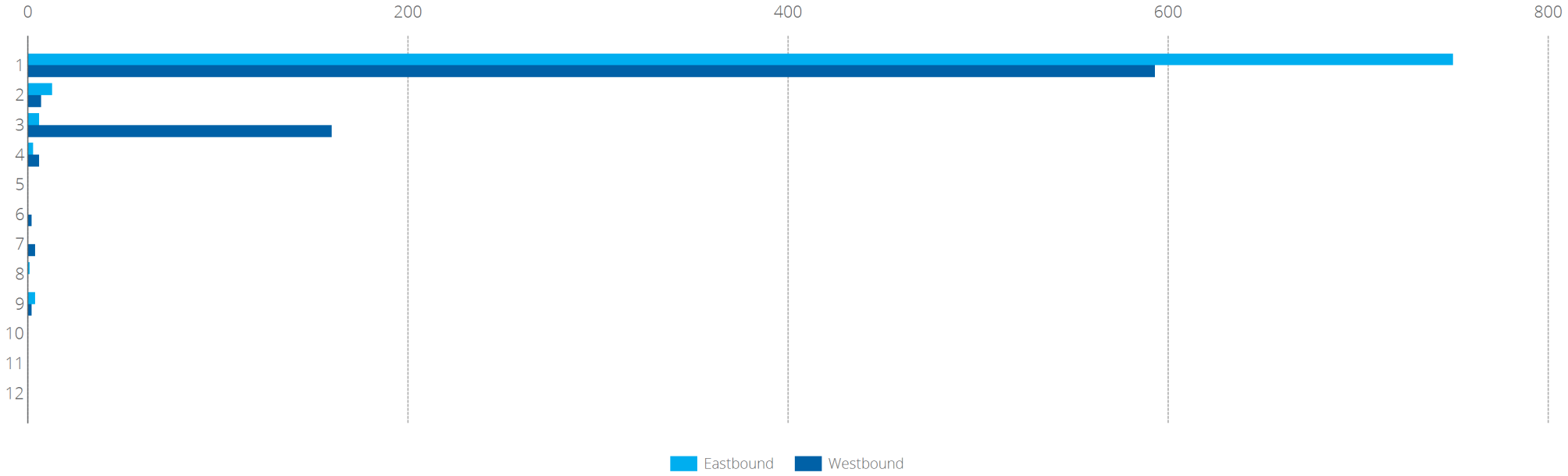
Vehicle Type

2017/18

Weekend

Tonkin Bvd (2010620)

East of Old Bussell Hwy (SLK 0.05)



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	750	13	6	3	0	0	0	1	4	0	0	0	14	777
%	96.5	1.7	0.8	0.4	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	1.8	
W	593	7	160	6	0	2	4	0	2	0	0	0	174	774
%	76.6	0.9	20.7	0.8	0.0	0.3	0.5	0.0	0.3	0.0	0.0	0.0	22.5	
E W	1343	20	166	9	0	2	4	1	6	0	0	0	188	1551
%	86.6	1.3	10.7	0.6	0.0	0.1	0.3	0.1	0.4	0.0	0.0	0.0	12.1	

Appendix G: Understanding Your Report

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

APPENDIX 9

Engineering Servicing Report
(McDowell Affleck Consulting Engineers)

McDowall Affleck Pty Ltd
(ACN 009 033 345) (ABN 23 009 033 345)
Bureau Veritas Certification AS/NZS ISO 9001

McDowall Affleck
CONSULTING ENGINEERS | PROJECT MANAGERS
Responsive. Reliable. Results.

ENGINEERING SERVICING REPORT

RAPIDS LANDING, MARGARET RIVER

EDENLIFE

REVISION DATE: 14 MARCH 2022

MCDOWALL AFFLECK PTY LTD
69 GREAT NORTHERN HIGHWAY, MIDLAND, WA 6056

Table of Contents

1. INTRODUCTION

McDowall Affleck Pty Ltd have been commissioned by Edenlife to conduct an Engineering Servicing Assessment and Report to support the application for development for the proposed Lifestyle Village, Lot 9014 Bussell Highway, Margaret River (herein referred to as "the Site") to progress the planning, and ultimately the design and construction of development.

The total area of the site is approximately 12.2 hectares and is bounded by the Bussel Highway to the east, John Archibald Drive to the north and public reserve to the southeast.

Edenlife have provided a proposed master plan for the site **(Appendix 1),** therefore this assessment will cover the proposed layout.

This report is based on the findings from a desktop study of available information from records and from discussions with relevant statutory authorities.

2. EXISTING FEATURES

2.1. Surface Features

The site is situated within the boundaries of the Shire of Augusta Margaret River and is located approximately 1.2km south of the Margret River town centre.

The Site is generally clear with the exception of a scattering a mature trees in the centre of the site and on the southern boundary. The site is situated directly adjacent to a drainage channel which follows the southern boundary from Bussell Highway to John Archibald Drive.

A drainage channel also exists within the northern portion of the site which accepts flows from a culvert at the intersection of the Bussell Hwy and John Archibald Drive and flows to the east to join the drainage channel to the south of the site before.

There is a large gas storage tank (Kleenheat Gas) located approximately in the centre of the site and associated buried pipelines to Rapids Landing Avenue.

Figure 1- MetroMap Aerial Image Capture

2.2. Topography

Based on a feature survey completed by Ascon Survey and Drafting (Oct 2020), the site levels range from 91m AHD in the southwestern portion of the lot falling to 76m AHD in the northeast portion of the site. A drainage feature exists to the north of the site, adjacent to John Archibald Dr which flows to the east (82.5m AHD to 76m AHD).

2.3. Wetlands & Hydrology

The site has no identified wetlands, or wetlands in close proximity to the site. The site is situated directly adjacent to the Darch Brook which is a tributary of the Margaret River. The site drains to the Darch Brook. The open drain located in the north of the site has inflows via a culvert near the intersection of Bussell Highway and John Archibald Dr.

2.4. Existing Groundwater

Regional groundwater mapping is not available for site; however, it is noted in the geotechnical report for the site completed by Galt geotechnics (Oct 2020).

> *We do not have groundwater information for this area; however, we expect that the permanent groundwater level is close to the level of the creeks.*
>
> *Shallow perched water was encountered across the site, particularly in the northern half of the site. This perched water was at depths of around 0.2 m to 1.0 m in these areas. Surface flow was also noted on the access tracks at the time of the investigation.*
>
> *We did not encounter groundwater in the southwest corner of site.*

2.1. Acid Sulphate Soils

A review of the available information from Landgate's SLIP Portal indicates that the subject Site has a low to medium risk (class 2) of acid sulphate soils associated with the Darch Brook to the south of the site and Darch Brook tributary within the north of the site (Figure 2)

Figure 2- Slip Locate Acid Sulphate Soil Risk (Low to Medium)

An acid sulphate investigation will be required should site works require lowering the water table (either temporary or permanent) or where earthworks require excavation beyond 3 meters below natural ground surface.

3. EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

3.1. Site Classification

The Busselton sheet of the 1:250,000 scale Geology series map indicates that the area is underlain by "laterite and associated quartz sand (undifferentiated). A Geotechnical Study (**Appendix 2**) was carried out by Galt Geotechnics in Oct 2020, which identified two distinct site classifications (Figure 3).

Zone 1 - Eastern Part of Site (Class M)

- TOPSOIL: Clayey SAND (SC)/ Silty SAND (SM), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying
- Gravelly SAND/Sandy GRAVEL (locally Silty SAND): fine to medium grained lateritic gravel, sub-angular to rounded, brown, 30 – 50% fine to coarse grained sand, with fines, typically loose (locally dense), extending from 0.1 m to depths of between 0.4 m to 0.6 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red,
- 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m

Zone 2 - Balance of Site (Class H1)

- TOPSOIL: Clayey SAND (SC), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying Clayey
- SAND(SC): fine to coarse grained, brown, 15 -35% low to medium plasticity fines, typically soft - firm extending from 0.1 m to depths of between 0.5 m and 0.9 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red, 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m.

Figure 3 – Site Classification Zones

The Geotechnical Study identifies that the site is capable of supporting the proposed development, however if there is a need to improve the site classifications as shown above, the importation and compaction of inert fill material will be required. Refer to **Appendix 2**, section 7.1 for full details on the required fill to achieve improved site classifications.

3.2. Site Preparation

The site preparation measures outlined below are aimed at the general preparation of the site prior to the construction of buildings and pavements. Landscaped areas will not require this preparation.

The following site preparation measures must be followed:

- Demolish and remove timber fence posts, buried structures, rubbish, concrete and obsolete services.
- Stockpiles of loose boulders scattered across the site should be removed off site (where inside the site boundaries).
- Remove vegetation and topsoil, including grubbing out of roots. In general, it is expected that a 100 mm to 200 mm strip will be required for most of the site, although locally deeper excavations could be required.
- Remove trees, where required, including grubbing out roots. Deep excavations will be required to remove tree root systems. The holes formed must be backfilled and compacted in controlled layers with approved compacted clayey fill.
- Excavations into clayey soils (including excavations for tree removals) must be backfilled in an engineered manner with similar clayey soil (minimum 30% fines). This is to prevent storm water run-off potentially infiltrating granular backfill and perching on and softening the in-situ clayey soils.
- Moisture condition and compact the exposed soil to the density specified in **Appendix 2** to a depth of at least 0.3 m below all foundations and slabs.
- Where any rutting occurs, excavate and replace with approved fill and compact to the density specified in **Appendix 2** (section 7.3). Any areas of loose/soft ground or unsuitable material must be removed and replaced with approved fill.
- Where fill is required, use approved granular fill, placed and compacted in layers no greater than 0.3 m loose thickness. Each layer must be placed and compacted to achieve the minimum level of compaction specified in **Appendix 2.**
- Excavate for proposed footings and slab to required depths. Moisture condition and compact the exposed foundation excavations with suitable compaction plant (i.e. plate compactor for smaller footings or padfoot roller for larger areas) to the density specified in **Appendix 2**.

Where deep soft soils are encountered during the works, a geotechnical engineer must be engaged to inspect the material. We note that the required compaction can be difficult to achieve when the groundwater level is within about 1 m of the surface being compacted. Further advice should be sought if the required density cannot be achieved. To help alleviate this potential problem, it is recommended site preparation works occur in summer, preferably late summer, when the groundwater table can be expected to be at or near its seasonal low.

Where sand fill is used for bulk earthworks, Level 2 site supervision should be applied to the earthwork's construction with AS3798-2007: "Guidelines on Earthworks for Commercial and Residential Developments".

Excavations in the upper Clayey SAND, Sandy GRAVEL and Silty SAND at the site must be battered at slopes no steeper than 1V:2H for temporary slopes and 1:3H for permanent slopes above the water table. Even at these slope angles, erosion and rilling is likely to occur especially during significant rainfall events. In the underlying Sandy CLAY, slopes should be no steeper than 1V:1H above the

water table (for temporary slopes open less than a week). Surcharges (such as plant and soil stockpiles) must not be placed at or near the crest of excavations.

4. ROADS

Primary access to the proposed lots would be via John Archibald Drive with secondary access from Alferink Cr (See Appendix A – Master Plan). An emergency exit is proposed on the western boundary to the Bussell Highway.

4.1. Pavement Subgrades

The road formations are likely to be founded directly on in situ ground conditions and will need to be prepared in accordance with geotechnical advice (**Appendix 2**). The Geotechnical study notes that the subgrade as sufficient properties to consider a subgrade CBR of 5% assuming well drained conditions. Further geotechnical advice should be sought should the subgrade exhibits saturation or evidence of high groundwater levels

4.2. Pavement Profile

It is expected all road pavements will typically be a minimum 5.5- 6m wide sealed pavement surface for two-way roads in private developments. The speed limit is expected to be 8 km/hr. Figure 4 shows a preliminary road hierarchy based on expected traffic volumes. Table 1 details the required pavement thicknesses based on a subgrade CBR of 5%. Reductions of pavement layer thicknesses are possible where the in-situ subgrade is lime stabilised to a minimum of 300mm depth. Refer to Appendix 2 for further details.

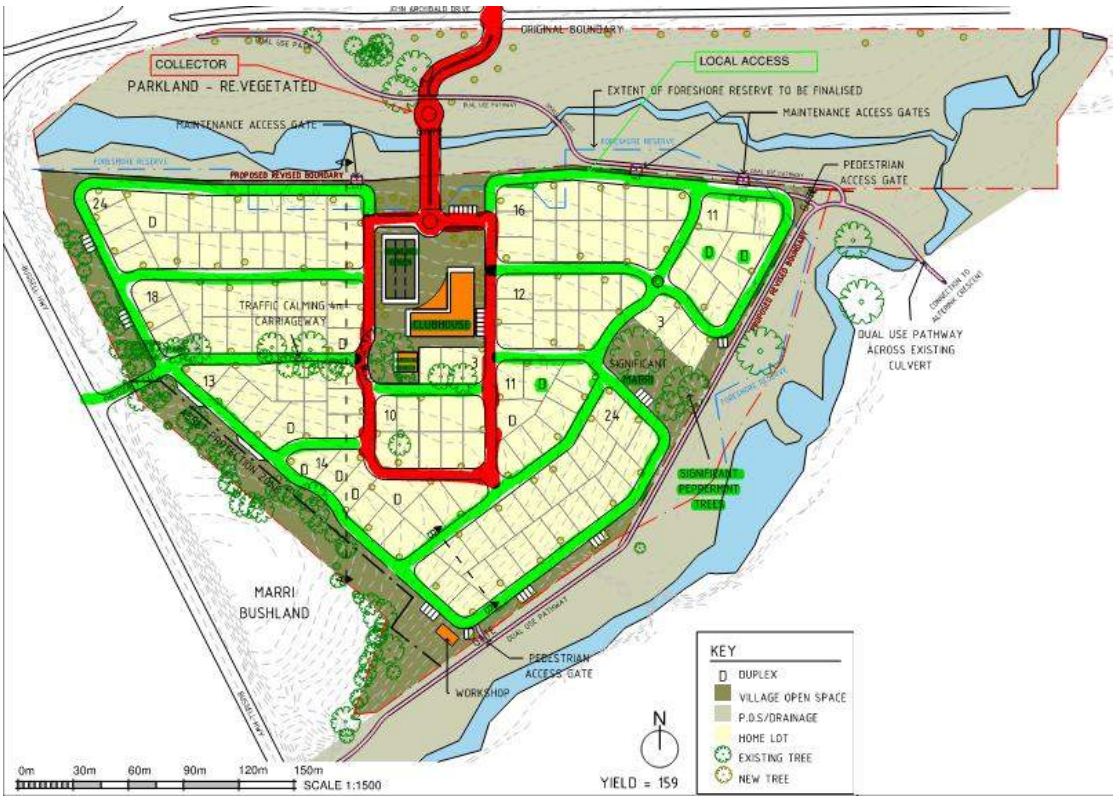


Figure 4- Road Classification

Table 1 - Pavement Designs based on 5% CBR

	Collector Road - Roundabout & North-South Aligned Approach	**Collector Road-North -South Aligned**	**Pavement Design - Local Access Road**	**Pavement Design Minor Access Roads**
Wearing Surface	40mm DGA14	30mm DGA10	30mm DGA10	30mm DGA10
Seal	7mm Single/Single Seal	7mm Single/Single Seal	7mm Single/Single Seal	7mm Single/Single Seal
Base Course	180mm Igneous rock basecourse	155mm Igneous rock basecourse	115mm Igneous rock basecourse	100mm Igneous rock basecourse
Sub-base	280 mm Crushed Limestone	305 mm Crushed Limestone	205 mm Crushed Limestone	105 mm Crushed Limestone

5. STORMWATER DRAINAGE

The site is located directly adjacent to the Darch Brook to the south-east, and to a tributary of the Darch Brook directly to the north. The site has sufficient grade to easily drain to these drainage features. The site will generally conform to the following stormwater requirements.

- Water Quality – Treat all flows up to the 1 exceedance per year (EY) in accordance with best practice WSUD practices prior to discharge from the site.
- Minor storm events (0.2 EY) – limit flows to pre-development flow rates
- Major storm events (1% AEP) – Ensure expected flows do not pose a threat to property or life.
- Flood management – Ensure all finished levels are a minimum 300mm above the estimated 1%AEP flood levels for the Darch Brook and adjacent tributary.
- Extreme Events greater than 1% AEP – ensure the site has safe overland flows to the Darch Brook and associated tributary.

It is expected that the site can adequately manage stormwater, and a detailed Local Water Management Strategy will address the above stormwater requirements.

6. SEWER RETICULATION

Water Corporation ESInet mapping indicates that site has access to reticulated sewer within John Archibald Dr (225 PVC-U) which has an invert level (78.6 mAHD). This will allow the site to be gravity fed to the sewer connection point based on existing site levels. Should the southern area of the site not be able to be serviced by gravity sewer due to changes in levels post development, a second connection will be able to be made on Alferink Cr which has an reticulated sewer (150PVC-U) invert of approximaltey 74.5m AHD which will be able to service the southern lots. Water Corporation has confirmed that the sewer has sufficent capacity, and connections will be allowed to either sewer mains on John Archibald Dr or Alferink Dr. (**Appendix 3**).

7. WATER RETICULATION

The Water Corporation has confirmed that there are no issues servicing this development from the potable water network. The prime feed into the development should be off the 375P12 main running along John Archibald Dr (**Appendix 3**).

8. UNDERGROUND ELECTRICAL POWER

Overhead and Underground Power Network mapping supplied by Western Power indicates the following:

- Existing overhead power lines on the east side of Bussell Highway (**Appendix 4**).

The Western Power Network Capacity Mapping Tool indicates that The Site's remaining capacity for is between 20 and 25 MVA. This remaining capacity forecast reduces to between 15 and 20 MVA according to the latest forecasting available in 2036. (**Appendix 4**).

The site can ultimately be serviced with electrical power.

9. COMMUNICATIONS

The NBN rollout map also indicates that the entire Site can be served by a NBN Fixed Wireless service. Existing Telstra cables and ducts are located on Alferink Cr. The site can ultimately be serviced with communications services and NBN.

10. NATURAL GAS RETICULATION

Kleenheat Distribution Network mapping shows existing services on Alferink Crs that the development could connect to should natural gas be a requirement for the Village. There is an existing Kleenheat storage tank (Figure 5) located on the site which is currently servicing the adjacent residential development which will require decommissioning or relocating. It is understood the Edenlife are discussing relocating the storage tank with Kleenheat. There may be an opportunity to modify the existing pipe infrastructure to service the village.

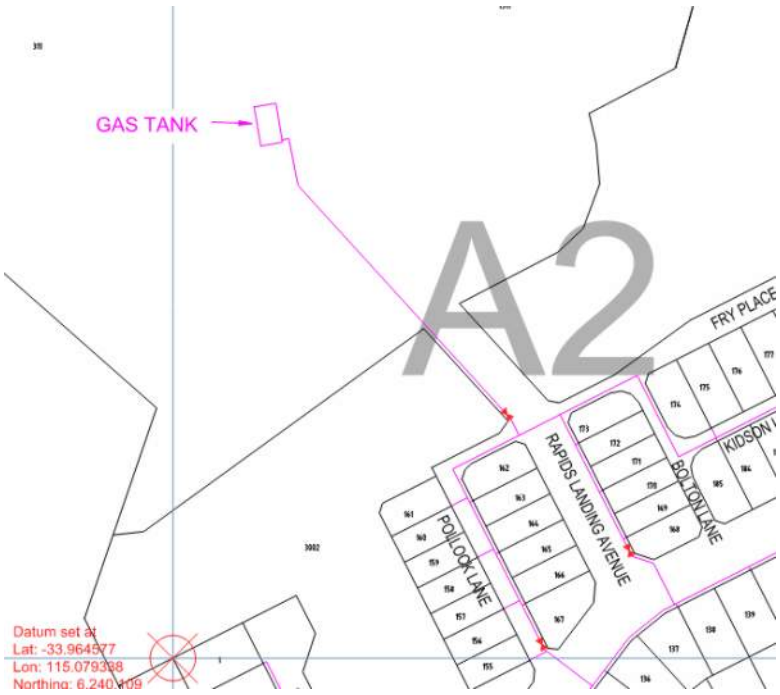


Figure 5 -Kleenheat Gas Storage tank and associated buried pipe detail (DBYD)

11. APPENDIX 1 – MASTER PLAN AND TYPICAL SECTIONS

JOHN ARCHIBALD DRIVE

ORIGINAL BOUNDARY

DUAL USE PATH

PARKLAND - RE.VEGETATED

EXTENT OF FORESHORE RESERVE TO BE FINALISED

MAINTENANCE ACCESS GATES

DUAL USE PATHWAY

SMALL BRIDGE

MAINTENANCE ACCESS GATE

GATE

FORESHORE RESERVE

PROPOSED REVISED BOUNDARY

WORKS GATE

DUAL USE PATHWAY

PEDESTRIAN ACCESS GATE

GATE

PROPOSED REVISED BOUNDARY

CONNECTION TO ALFERINK CRESCENT

DUAL USE PATHWAY ACROSS EXISTING CULVERT

BUSSELL HWY

24

D

16

11

D

D

BOWLING GREEN

18

TRAFFIC CALMING 4m CARRIAGEWAY

12

CLUBHOUSE

3

D

PARK

ARTS & CRAFTS

3

SIGNIFICANT MARRI

EMERGENCY EXIT

13

11

D

ASSET PROTECTION ZONE

10

D

24

D

D

14

D

D

D

FORESHORE RESERVE

SIGNIFICANT PEPPERMINT TREES

MARRI BUSHLAND

DUAL USE PATHWAY

GATE

PEDESTRIAN ACCESS GATE

WORKSHOP

BUSSELL HWY

0m 30m 60m 90m 120m 150m

SCALE 1:1500

N

YIELD = 159

KEY

- D DUPLEX
- VILLAGE OPEN SPACE
- P.O.S/DRAINAGE
- HOME LOT
- EXISTING TREE
- NEW TREE

RICHARD HAMMOND ARCHITECT
1B LITTLE HOWARD ST, FREMANTLE, 6160

0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan - Marketing A3

Project number	00	A.104	
Date	25.02.2022		
Drawn by	RHA		
Checked by	RHA	Scale@A3	As indicated

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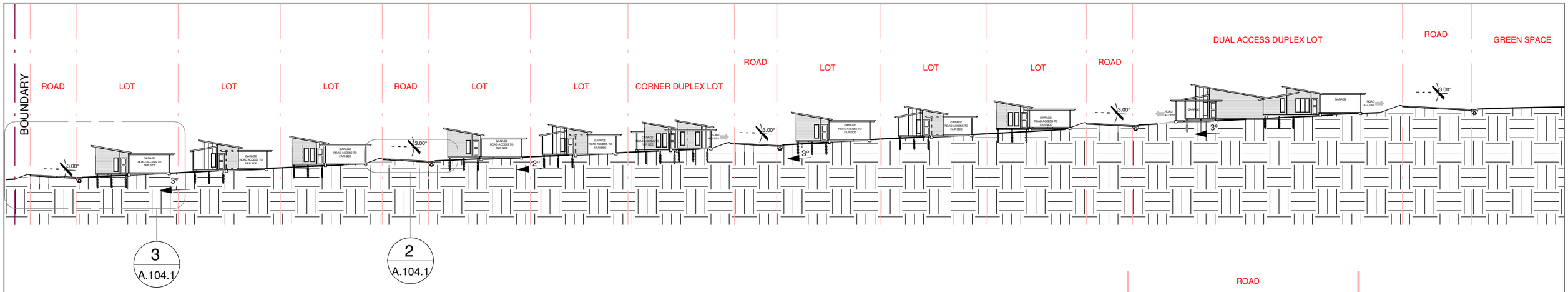

1 A-A Typ. Site Section

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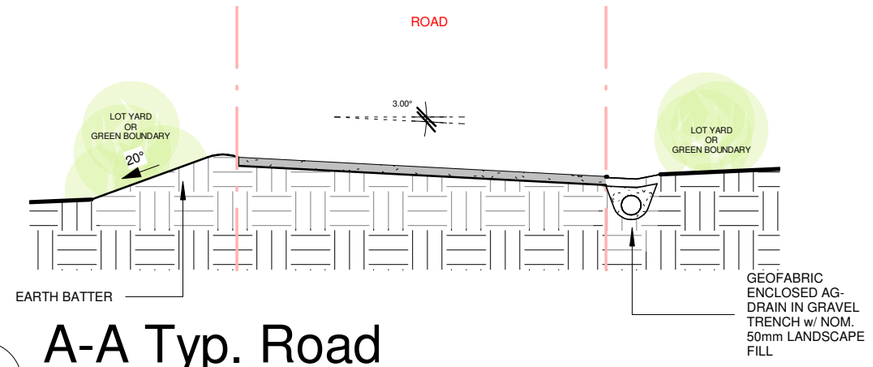
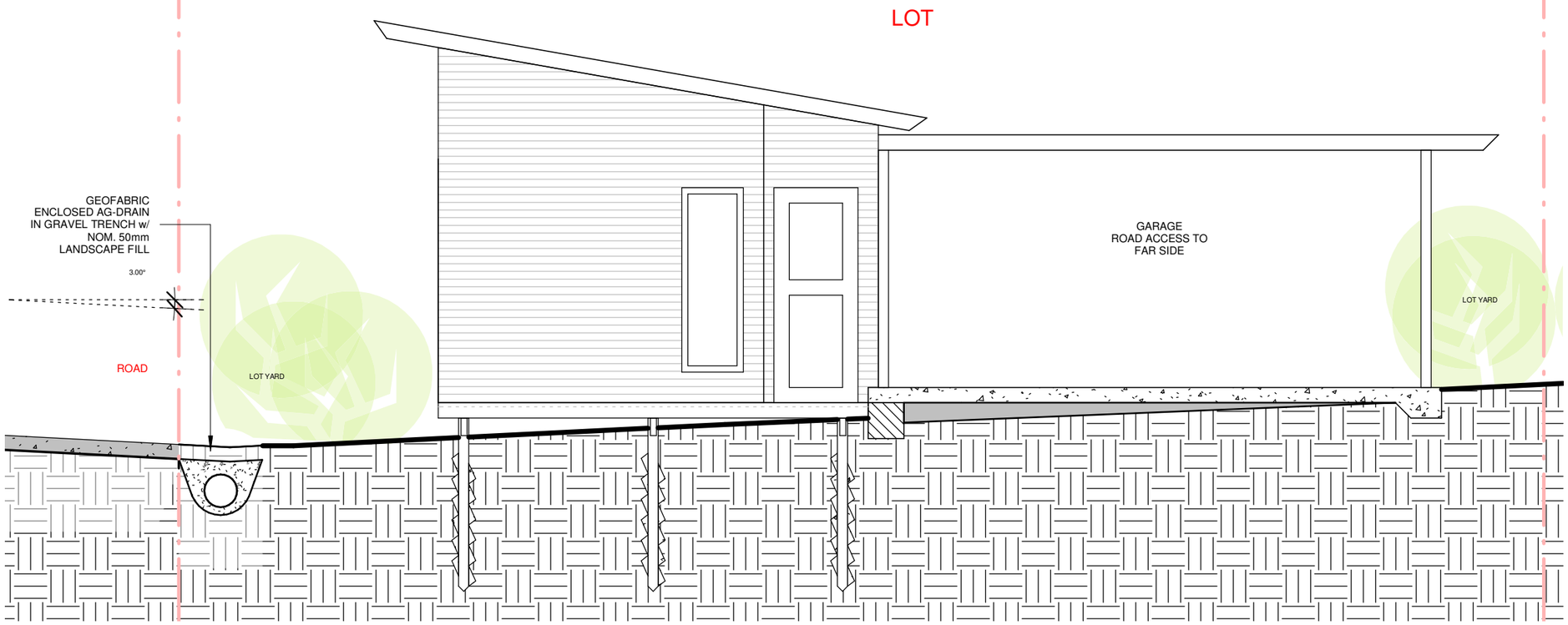


2 A-A Typ. Road

1 : 100



3 A-A Typ. Section Detail

1 : 50

RICHARD HAMMOND ARCHITECT
1B LITTLE HOWARD ST, FREMANTLE, 6160

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No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Typical Site Section A-A

Project number	00	A.104.1	
Date	14.12.21		
Drawn by	Author		
Checked by	Checker	Scale@A3	As indicated

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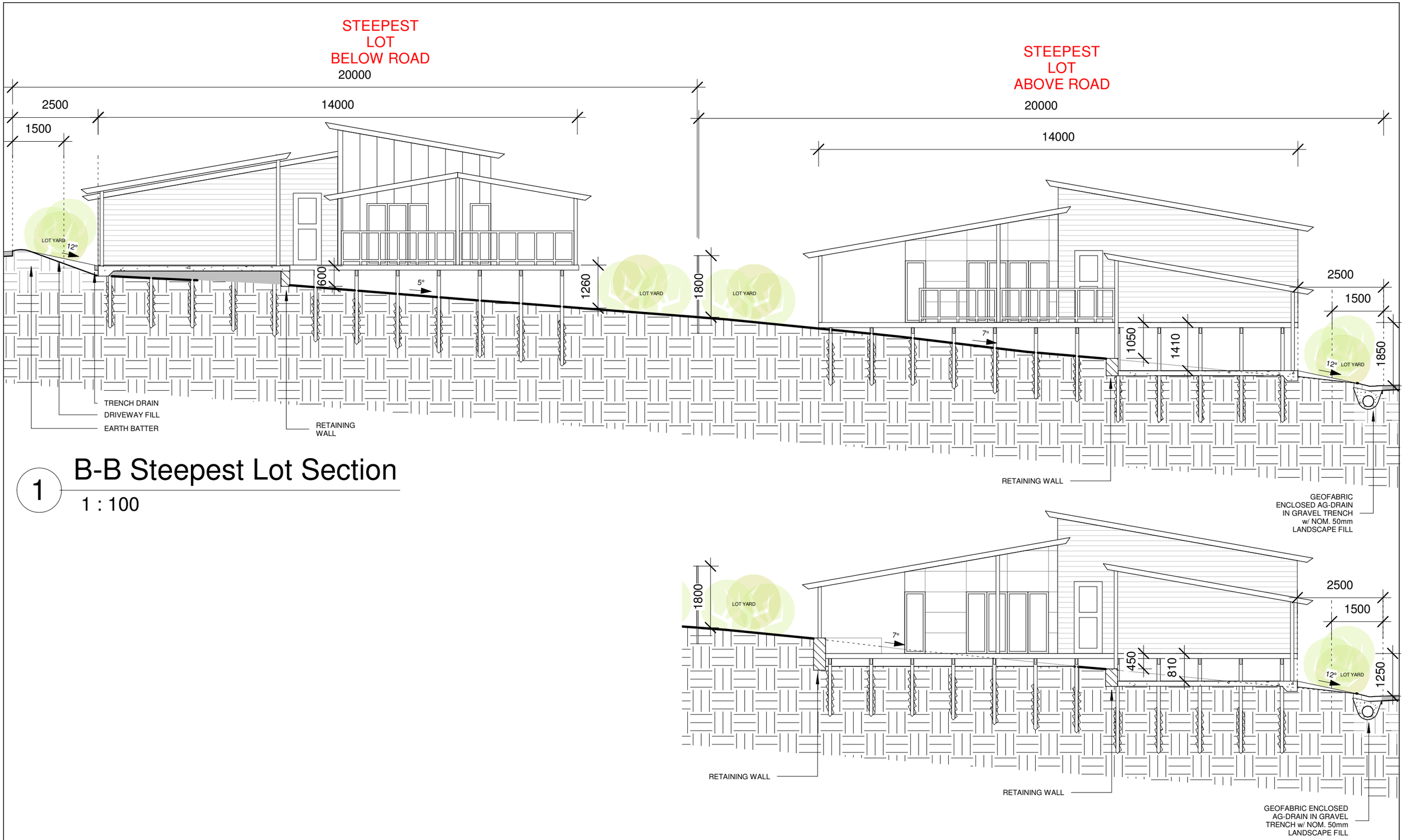

1 B-B Steepest Lot Section

1 : 100

RICHARD HAMMOND ARCHITECT
16/342 SOUTH TERRACE, SOUTH FREMANTLE

0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE
LOT 9012, BUSSELL HWY MARGARET RIVER

Steepest Site Section B-B

Project number	00	A.104.2	
Date	14.12.21		
Drawn by	Author		
Checked by	Checker	Scale@A3	1 : 100

24/02/2022 10:26:04 AM

12. APPENDIX 2 – GEOTECHNICAL REPORT

Report on

GEOTECHNICAL STUDY

EDENLIFE – MARGARET VILLAGE

LOT 9012 BUSSELL HIGHWAY, MARGARET RIVER

Submitted to:

McDowall Affleck

69 Great Northern Highway

MIDLAND WA 6056

www.galtgeo.com.au
50 Edward Street
OSBORNE PARK WA 6017
T: +61 (8) 6272-0200

J2001180 001 R Rev0

03 October 2020

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TABLES

FIGURES

APPENDICES

1. INTRODUCTION

This report presents the outcomes of Galt Geotechnics Pty Ltd.'s (Galt's) geotechnical study for the proposed Edenlife – Margaret Village on Lot 9012 Bussell Highway, Margaret River ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The site is bounded by creeks and small dams along the southeastern and northern boundaries, converging at the northeastern corner. Available surface contour information shows the surface elevation varies from a high point at about RL 90 m AHD on the western boundary falling to RL 76 m AHD at the northeastern corner.

At the time of our fieldwork (September 2020), the site was densely grassed with a spread of mature trees along the southern boundary and scattered trees in the middle. Small stockpiles of boulders were present along the southern end of the northern creek.

In the middle of the site is a gas tank (Kleenheat Gas) and a buried gas pipeline to Rapids Landing Avenue to the southeast.

The proposed masterplan for development comprises 160 residential lots, access roads, clubhouse and administration area, parking etc. No significant excavation is proposed. The supplied plans for the development are presented in Appendix A, Supplied Drawings.

3. PROJECT OBJECTIVES

The objectives of the study were to:

- assess subsurface soil and groundwater conditions across the site;
- provide recommendations on suitable footing systems for the proposed development;
- provide allowable bearing pressures and settlement estimates for shallow foundations;
- provide a site classification(s) in accordance with AS 2870-2011 "Residential Slabs and Footings";
- provide recommendations and geotechnical design parameters for earth retaining structures;
- recommend appropriate site preparation procedures including compaction criteria;
- assess the permeability of the soils at the site for potential on-site disposal of stormwater by infiltration; and
- evaluate the subgrade California bearing ratio (CBR) value/s for pavement design; and
- provide pavement and surfacing designs for the various access roads.

NOTE: Targeted investigation of the water-course crossings was not included in our scope. Further investigation and assessment is required for these areas of the site.

4. FIELDWORK

Fieldwork was carried out from 8 September to 10 September 2020 and comprised:

- site walkover by senior engineer;
- drilling of machine auger boreholes at 13 locations extending to depths of between 1.1 m and 2.0 m; and
- testing with a dynamic cone penetrometer adjacent to each borehole extending to 0.6 m and 1.0 m; and
- collection of soil samples for geotechnical laboratory testing.

General

A senior geotechnical engineer from Galt conducted the walkover survey of site. A geotechnical engineer from Galt selected and positioned the tests, drilled the boreholes, logged the materials encountered, collected representative soil samples for laboratory testing and conducted the penetrometer testing. The approximate test locations are shown on Figure 1 and Figure 2. Photographs of the site taken during the study are presented in Appendix B, Site Photographs. Details of the tests are presented in Table 1: Summary of Tests.

Table 1: Summary of Tests

Test Name	Test Depth (m)	Reason for Termination	Thickness of Sand/Gravel Layer (m)[2]	Depth to Groundwater (m)	Stratigraphy[2]
BH01	2.0	Target Depth	-	0.9	Clayey SAND overlying Gravelly SAND overlying Sandy CLAY
BH04	2.0		-	0.5	Clayey SAND overlying Sandy CLAY
BH05	1.5	Refusal	0.35	0.3	Sandy GRAVEL overlying Clayey SAND overlying Sandy CLAY
BH06	1.1		-	GNE	Clayey SAND overlying Sandy CLAY
BH07	2.0	Target Depth	0.45		Gravelly SAND overlying Sandy CLAY
BH08	2.0		0.3		Gravelly SAND overlying Sandy CLAY
BH09	2.0		0.3		Gravelly SAND overlying Sandy CLAY
BH10	2.0		0.5		Silty SAND overlying Sandy CLAY
BH11	2.0		0.4	0.5	Sandy GRAVEL overlying Sandy CLAY
BH12	2.0		0.3	0.4	Silty SAND overlying Sandy CLAY
BH13	2.0		-	1.0	Clayey SAND overlying
BH14	2.0		0.3	0.2	SAND overlying Clayey SAND overlying Sandy CLAY
BH15	2.0		-	0.9	Clayey SAND overlying Sandy CLAY

Notes: 1. GNE – Groundwater not encountered
2. A surface layer of topsoil was present across the site (typically 100 mm to 200 mm thick) – not included
3. BH02 & BH03 were not augered due to access constraints

Machine Auger Boreholes

Boreholes were drilled using a utility mounted EVH Scout drill rig equipped with a 90 mm solid-stem auger. Boreholes reports are presented in Appendix C, along with a list of notes and abbreviations and the method of soil description used in the reports.

At the time of the fieldwork, shallow perched water and soft topsoil layers prevented safe access for the drill rig to the northern part of the site (proposed boreholes BH02 & BH03).

Dynamic Cone Penetrometer Testing

Dynamic cone penetrometer (DCP) tests were carried out in accordance with AS 1289.6.3.2. Tests were carried out adjacent to each test pit and results of the tests are presented in Table 2, Dynamic Cone Penetrometer Test Results.

Table 2: Dynamic Cone Penetrometer Test Results

Location	BH01	BH04	BH05	BH06	BH07	BH08	BH09	BH10	BH11	BH12	BH13	BH14	BH15
Depth (m)	Blows per 0.1 m depth interval												
0.0 – 0.1	SET	SET	SET	SET	SET	SET	SET	SET	3	SET	SET	SET	SET
0.1 – 0.2	1	1	1	1	1	2	3	0	3	0	1	1	1
0.2 – 0.3	2	1	1	3	2	3	2	1	3	1	0	2	1
0.3 – 0.4	3	0	2	4	2	3	3	2	1	1	1	2	2
0.4 – 0.5	2	1	2	2	3	2	3	2	3	4	1	6	1
0.5 – 0.6	6	4	3	5	3	2	5	3	2	9 HB	1	9	1
0.6 – 0.7	10	4	5	7	4	4	9	9	3		4	8	1
0.7 – 0.8	10+	4	7	7	7	8	10	4	3		9 HB	5	1
0.8 – 0.9		3	10	5	9	10	10	2	3			4	1
0.9 – 1.0		4						2					1

Note: Highlighted values indicate soft / very soft / loose conditions

HB – Hammer bounce refusal

5. LABORATORY TEST RESULTS

Laboratory testing of soil samples was undertaken by Western Geotechnical Laboratory Services (WGLS) in their NATA accredited laboratory and comprised determination of:

- particle size distribution on 6 samples;
- Atterberg limits and linear shrinkage on 6 samples;
- dry density-moisture content relationship on 3 samples; and
- California bearing ratio (CBR) on 3 samples.

Laboratory results along with the test methods followed are presented in Appendix D, Laboratory Test Results and are summarised in Table 3, Summary of Laboratory Test Results.

Table 3: Summary of Laboratory Test Results

Test Name	Sample Depth (m)	Soil Class (AS 1726-2017)	% Gravel	% Sand	% Fines	LL (%)	PI (%)	LS (%)	MDD (t/m³)	OMC (%)	CBR (%)	CBR Swell (%)
BH04	0.1 – 0.5	Clayey SAND (SC)	9	64	27	37	9	5.0	1.70	18.5	3.5	0.5
BH09	1.5 - 2.0	CLAY (CH)	2	23	75	114	74	19.5				
BH11	0.1 – 0.5	Sandy GRAVEL (GP)	49	45	6	NO	NP	0	2.27	8.5	60	0
BH11	0.5 – 1.0	Sandy CLAY (CH)	23	39	38	51	28	11.0	1.79	17.0	5	1.5
BH13	0.4 – 0.9	Sandy CLAY (CI)	3	58	39	36	17	8.0				
BH14	1.0 – 2.0	Sandy CLAY (CH)	1	43	56	62	42	12.0				

LL – Liquid Limit **PI**: – Plasticity Index **LS** – Linear Shrinkage NO – Non-Obtainable

NP – Non-Plastic

OMC – optimum moisture content

MDD – maximum dry density:

- Modified – BH04 & BH11 (0.1 – 0.5 m)
- Standard – BH11 (0.5 – 1.0 m)

CBR – California Bearing Ratio:

- 95% MDD, 4.5kg surcharge, 4 day soak
- Samples prepared with Modified or Standard compaction as appropriate.

6. SITE CONDITIONS

6.1 Geology

The Busselton sheet of the 1:250,000 scale Geology series map indicates that the area is underlain by "laterite and associated quartz sand (undifferentiated)".

6.2 Subsurface Conditions

The subsurface soil conditions are broadly consistent across the site and can be summarised as follows:

Zone 1 - Eastern Part of Site

- TOPSOIL: Clayey SAND (SC)/ Silty SAND (SM), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying
- Gravelly SAND/Sandy GRAVEL (locally Silty SAND): fine to medium grained lateritic gravel, sub-angular to rounded, brown, 30 – 50% fine to coarse grained sand, with fines, typically loose (locally dense), extending from 0.1 m to depths of between 0.4 m to 0.6 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red, 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m

Zone 2 - Balance of Site

- TOPSOIL: Clayey SAND (SC), fine to coarse grained, dark brown, 10-15% low plasticity, organic-rich fines, dense rootlets; typically 0.1 m to 0.2 m thick; overlying
- Clayey SAND (SC): fine to coarse grained, brown, 15 -35% low to medium plasticity fines, typically soft - firm extending from 0.1 m to depths of between 0.5 m and 0.9 m; overlying
- Sandy CLAY (CI-CH): medium to high plasticity (typically increasing with depth), brown to grey mottled red, 40-60% fine to coarse grained sand, trace gravel, stiff to very stiff, extending to maximum investigated depth of 2.0 m.

Indicative soil zones are shown on Figure 2.

6.3 Groundwater

We do not have groundwater information for this area, however, we expect that the permanent groundwater level is close to the level of the creeks.

Shallow perched water was encountered across the site, particularly in the northern half of the site. This perched water was at depths of around 0.2 m to 1.0 m in these areas. Surface flow was also noted on the access tracks at the time of the investigation.

We did not encounter groundwater in the southwest corner of site.

7. GEOTECHNICAL ASSESSMENT

7.1 Site Classification

We consider the site to be geotechnically capable of supporting the proposed development.

We have assessed the site in accordance with AS 2870-2011 "Residential Slabs and Footings" which defines the site classes as summarised in Table 4.

Table 4: Summary of Site Classification (AS 2870-2011)

Class	Description	Characteristic Surface Movement (y_s)
A	Most sand and rock site with little or no ground movement from moisture change	Not Defined (typically <5 mm)
S	Slightly reactive clay sites with only slight ground movement from moisture changes	0 – 20 mm
M	Moderately reactive clay sites, which may experience moderate ground movements from moisture change	20 – 40 mm
H1	Highly reactive sites, which may experience high ground movements from moisture change	40 – 60 mm
H2	Highly reactive sites, which may experience very high ground movements from moisture change	60 – 75 mm
E	Extremely reactive sites, which may experience extreme ground movements from moisture change	>75 mm
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise	Not Defined

Under current conditions, we consider the site classifications to be as follows:

Zone 1 – Class M (thin layer of inert granular material overlying high plasticity clay)

Zone 2 -Class H1 (shallow groundwater and clayey soils overlying high plasticity clay)

If required, the site classifications can be improved by placement and compaction of inert fill material. The thicknesses required in each zone are summarised in Table 5. The indicative soil zones are shown on Figure 2.

Table 5: Required Thickness of Inert Fill (m)

Zone	Current Site Class	Improvement to Class M	Improvement to Class S	Improvement to Class A
Zone 1	M	-	0.5	1.5
Zone 2	H1	0.5	0.9	1.5

The improved classification is subject to the site preparation procedures outlined in Section 7.2 are followed.

Note: AS 2870 is limited to single to double storey residential structures with a maximum bearing pressure of 100 kPa for shallow footings.

We refer you to the CSIRO's pamphlet BTF18-2011: Foundation Maintenance and Footing Performance: A Homeowner's Guide. This provides practical advice to reduce the risk of future heave moments. This pamphlet is presented in Appendix E, CSIRO Pamphlet.

7.2 Site Preparation

The site preparation measures outlined below are aimed at the general preparation of the site prior to the construction of buildings and pavements. Landscaped areas will not require this preparation.

The following site preparation measures must be followed:

- Demolish and remove timber fence posts, buried structures, rubbish, concrete and obsolete services. Stockpiles of loose boulders scattered across the site should be removed off site (where inside the site boundaries). The approximate rock stockpile locations are shown on Figure 1.
- Remove vegetation and topsoil, including grubbing out of roots. In general, we expect that a 100 mm to 200 mm strip will be required for most of the site, although locally deeper excavations could be required.
- Remove trees, where required, including grubbing out roots. Deep excavations will be required to remove tree root systems. The holes formed must be backfilled and compacted in controlled layers with approved compacted clayey fill.
- Excavations into clayey soils (including excavations for tree removals) must be backfilled in an engineered manner with similar clayey soil (minimum 30% fines). This is to prevent storm water run-off potentially infiltrating granular backfill and perching on and softening the in-situ clayey soils.
- Moisture condition and compact the exposed soil to the density specified in Section 7.3 to a depth of at least 0.3 m below all foundations and slabs.
- Where any rutting occurs, excavate and replace with approved fill (Refer Section 7.5) and compact to the density specified in Section 7.3. Any areas of loose/soft ground or unsuitable material must be removed and replaced with approved fill as outlined in Section 7.5.
- Where fill is required, use approved granular fill, placed and compacted in layers no greater than 0.3 m loose thickness. Each layer must be placed and compacted to achieve the minimum level of compaction specified in Section 7.4.
- Excavate for proposed footings and slab to required depths.
- Moisture condition and compact the exposed foundation excavations with suitable compaction plant (i.e. plate compactor for smaller footings or padfoot roller for larger areas) to the density specified in Section 7.3.

Notes

1. Where deep soft soils are encountered during the works, a geotechnical engineer must be engaged to inspect the material.
2. We note that the required compaction can be difficult to achieve when the groundwater level is within about 1 m of the surface being compacted. Further advice should be sought if the required density cannot be achieved. To help alleviate this potential problem, we recommend site preparation works occur in summer, preferably late summer, when the groundwater table can be expected to be at or near its seasonal low.
3. Where sand pads are constructed below individual houses, the pads must extend at least 1 m beyond the edge of the footprint.
4. Clayey soils may be stabilised with lime to improve their workability.

7.3 Construction Issues and Drainage

In addition to the site preparation measures outlined in Section 7.2, we recommend careful control of surface water and stormwater to minimise the likelihood of clayey soils decreasing in strength and affecting the installed infrastructure. These measures include:

- The surface should be graded (to a minimum crossfall of 1%) such that water is diverted away from any footings, structures and pavements.
- Pavements should be sealed to minimise water ingress.
- Stormwater disposal swales should be located at least 10 m away from buildings, retaining walls and pavements.
- Runoff from hardstanding areas and pavements must either be collected and discharged via pipes into discrete locations (via swales) at least 10 m away from structures and pavements or alternatively discharged over a wide area, but not allowed to collect and discharge into concentrated areas, particularly near structures and pavements.
- Spoon drains should be used to capture and collect surface runoff at the crest of slopes and direct it away and avoid running directly down slopes or seeping into the ground behind slopes.
- Similarly, subsoil drains should be installed to capture shallow subsurface flows and direct water away from pavements, houses etc.

7.4 Compaction

7.4.1 General

Over-excavation and replacement of loose/soft materials must be done where the minimum dry density ratio cannot be achieved.

Care will need to be taken when compacting in the vicinity of existing structures. This is particularly important if vibratory compaction is being carried out. Tynan (1973)[1] provides assistance with the selection of compaction equipment for use adjacent to structures.

Large compaction equipment (self-propelled vibrating rollers, etc.) must not be used within 2 m behind retaining walls. Hand compaction plant (e.g. plate compactors) must be used.

[1] Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11.

Testing Frequency

After compaction, verify that the required level of compaction has been achieved by testing at the base of excavation and through the full depth of any fill and to a minimum depth of 0.9 m (0.3 m for clayey soils).

The frequency of testing should be as follows:

- on each lift of fill at the rate of 1 test per 500 m^3 or at least 2 tests per layer (4 tests per layer below the building footprint), whichever is greater;
- At each spread footing location;
- at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- at 10 m centres below on-ground slabs; and
- at 20 m centres below pavements.

Further to this, we recommend footings be inspected by a geotechnical engineer prior to blinding.

7.4.2 Cohesionless Soils

Approved granular fill must be compacted using suitable compaction equipment to achieve a dry density ratio (DDR) of at least 95% MMDD (maximum modified dry density) as determined in accordance with AS 1289.5.2.1 at a moisture content within 2% of optimum moisture content (OMC).

Where clean sand (<5% gravel, <5% fines) is used as fill, a Perth sand penetrometer (PSP) may be used for compaction control in accordance with AS 1289.6.3.3.

A site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. The correlation must:

- be done on site;
- use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- be plotted on a chart of PSP blow count vs DDR.

If gravel is used as fill, compaction testing must be done using a nuclear density gauge (NDG) in accordance with AS1289.5.8.1.

Granular fill must be placed in horizontal layers of not greater than 0.3 m loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Over-excavation and replacement of loose materials may be required where the minimum dry density ratio cannot be achieved.

7.4.3 Cohesive Soils

The *in situ* silty/clayey soils and clay fill must be compacted using suitable compaction equipment (i.e. padfoot roller) to a minimum dry density ratio of 95% SMDD (standard maximum dry density) as determined in accordance with AS1289.5.1.1.

The *in situ* clay and clay fill requires careful moisture conditioning so that the moisture content of the material is within 2% of optimum moisture content (OMC) at the time of placement and compaction. We note that compaction to specification 95% SMDD can be difficult to achieve for the clayey in situ material when not appropriately moisture conditioned.

For clayey soils, compaction testing must be done using a nuclear density gauge (NDG) in accordance with AS1289.5.8.1.

The clayey soils on the site will drain poorly when inundated during the wetter times of the year and result in saturated conditions that may inhibit compaction of the soil. If difficulties are encountered during compaction due to water, further advice should be sought from a geotechnical engineer.

The addition of lime may be considered to improve the workability of the clay.

Cohesive fill must be placed in horizontal layers of not greater than 0.2 m loose thickness. Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Over-excavation and replacement of soft/firm materials may be required where the minimum dry density ratio cannot be achieved.

7.5 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".

We recommend the use of quarry-derived, clean imported sand (<5% fines (<0.075 mm) and <1% organics) for bulk filling of the site and / or forming sand pads below house footprints.

The in-situ sandy gravel, gravelly sand and silty sand is generally suitable for re-use as low permeability inert granular fill, provided that any over-sized materials (> 0.2 m in diameter) or large putrescible particles (large fragments of wood, root matter, etc) are removed.

We recommend that re-use of the lower clayey sand/sandy clay is limited to shaping the clayey horizon and/or backfilling deep excavations in the clayey profile to prevent stormwater runoff infiltrating the backfilled excavation. Re-use of clayey soil as structural fill is not recommended as:

- the materials will likely be difficult to moisture condition and compact; and
- there will likely be adverse implications on site classification and drainage if used as structural fill.

7.6 Footings

We consider that the proposed houses may be supported on shallow footings founded on the *in situ* sand or approved compacted sand fill provided that the site preparation procedures in Section 7.2 are undertaken.

Footings must be designed in accordance with AS2870 (2011) according to the appropriate site classification. Estimated total surface movements (settlement / heave) will depend on the whether the site is kept its current condition or the

site classification improved using inert granular fill.

We recommend improving the site to at least "Class S" with expected total surface movements of less than 20 mm.

All foundation excavations, including for retaining walls, must be assessed by a competent person prior to blinding.

7.7 Earth Retaining Structures

Retaining structures may be designed in accordance with AS 4678-2002 "Earth Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (imported free draining sand fill with less than 5% fines).

We understand that it would be preferable to use the materials available at the site. **NOTE**: if clayey soils are used for backfill behind the retaining walls, then the walls must be designed to accommodate full hydrostatic pressure, unless a geosynthetic drain or other drainage layer is used (we can provide further advice if this is required).

For the design of retaining structures, the parameters in Table 6 are considered appropriate for compacted sand and gravel backfill behind retaining walls.

Table 6: Geotechnical Design Parameters for Retaining Structures

Layer Description	γ_b (kN/m^3)	ϕ' (°)	c' (kPa)	ϕ_u (°)	c_u (kPa)
Compacted imported inert sand fill	18	34	-	N/A	N/A
Compacted imported inert gravel fill and in-situ sandy gravel/ gravelly sand	18	36	-	N/A	N/A
Compacted clay (site-derived material)	16	20	5	N/A	50

Notes: γ_b – bulk unit weight (kN/m^3) ϕ' – effective soil friction angle
c' – effective cohesion ϕ_u – undrained soil friction angle c_u – undrained cohesion

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement will occur behind any soil retaining system, including gravity retaining walls.

Where granular backfill is to be used, a 300 mm minimum wide layer of free-draining granular fill is to be installed. A slotted drain (wrapped in a geotextile) should be used at the base of the granular backfill to collect seepage and direct it to a collection point (either discharging by gravity away from the retaining wall or collecting at a sump fitted with an automatic pump system to ensure that it remains dry).

Retaining walls can move and rotate under imposed soil loading resulting in settlement behind the wall. This must be considered in the design and during construction of the retaining walls in order that adjacent infrastructure is not adversely affected.

Mass gravity retaining walls must be designed such that groundwater does not collect below the base of the wall and is directed away to the drainage system.

7.8 Excavations and Slopes

Boreholes were drilled with a utility mounted EVH Scout 1750 drill rig equipped with a 90 mm diameter solid auger. The auger drilling generally progressed with ease through the upper layers of sandy gravel and clayey sand and reduced to a slow to moderate rate through the deeper clayey soils.

We consider that excavations in the in-situ sandy and clayey soils will be readily achieved to a depth of about 2 m using standard earthmoving equipment (i.e. 10 tonne or larger excavator with a rock bucket). Deeper excavations will likely require a larger 20 to 30 tonne excavator equipped with a rock bucket.

Note: there is possible rock outcrop (possibly large buried boulders) in the northeastern part of the site. Allowance should therefore be made for rock excavation. In addition, the stockpiles of large boulders may also need to be removed.

Where significant groundwater inflows are encountered, we consider that dewatering will be achieved by shaping the base of excavations to a perimeter drain and/or sump and removing the water with a pump.

Excavations in the upper Clayey SAND, Sandy GRAVEL and Silty SAND at the site must be battered at slopes no steeper than 1V:2H for temporary slopes and 1:3H for permanent slopes above the water table. Even at these slope angles, erosion and rilling is likely to occur especially during significant rainfall events. In the underlying Sandy CLAY, slopes should be no steeper than 1V:1H above the water table (for temporary slopes open less than a week). Surcharges (such as plant and soil stockpiles) must not be placed at or near the crest of excavations.

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.

7.9 Stormwater Disposal

Infiltration testing was not carried out due to the presence of shallow groundwater and clayey soils at shallow depths.

Based on the soil profile, we do not consider that disposal of stormwater by infiltration is appropriate for the site. Stormwater should instead be diverted using drains or otherwise to a disposal area or similar located away from structures (refer to Section 7.3 for further details).

8. PAVEMENT DESIGNS

8.1 General

The pavement design methodology is in general accordance with the empirical design method outlined in the 2012 edition of the Austroads Guide to Pavement Technology Part 2, Structural Pavement Design (AGPT02-12) and Main Roads Western Australia Engineering Road Note 9 (MRWA ERN9, 2013) Procedure for Design of Road Pavements.

Mechanistic-empirical analyses of asphalt fatigue has also been undertaken using CIRCLY 6.0 by Mincad Systems.

NOTE: The following designs do not apply to any water-course crossings which must be further investigated and assessed.

8.2 Subgrade Evaluation

We note that the subgrade profile for flexible pavements typically comprises:

- Zone 1 - Central and south-eastern part of site - 0.4 m to 0.7 m of SAND/Gravelly SAND/Sandy GRAVEL over Sandy CLAY/CLAY.
- Zone 2 - Northern and western part of site – 0.5 m to 0.8 m of Clayey SAND over Sandy CLAY/CLAY

Laboratory testing indicates that:

- The in-situ Clayey SAND in the upper profile has a CBR of 3.5% with a CBR Swell of 0.5%.
- The in-situ Sandy CLAY in the upper profile has a CBR of 5% with a CBR Swell of 1.5%.
- The in-situ Sandy GRAVEL in the upper profile has a CBR of 60% with a CBR Swell of 0%.
- The Sand CLAY/CLAY at depth is highly expansive (probably CBR swell > 2.5%).

MRWA ERN9 requires the following minimum cover of inert material above reactive subgrade materials

- 150 mm inert material is required for CBR swell ranging from 0.5% to 2.5% and
- 600 mm inert material is required for CBR swell ranging from 2.5% to 5.0%.

Based on the results of our investigation, we consider the subgrade will have a sufficient cover of low reactivity material provided that pavement subgrades are not lowered any more than the required pavement thickness and adequate drainage is provided.

We consider that a subgrade design CBR of 5% may be assumed for the in-situ clayey subgrade in well drained conditions.

The subgrade design CBR may be improved to 10% by either:

- Ensuring a minimum 0.3 m thick layer of approved granular fill (Refer to Section 7.5) forms the pavement subgrade above the clayey soils. The material must have a minimum 4 day soaked CBR of 10% and CBR swell less than 0.5%; OR
- A minimum 0.3 m thick layer of lime stabilised clayey soil forms the pavement subgrade above the clayey soils. Lime stabilisation of the clayey soils will improve the material strength, reduce moisture sensitivity and improve conditions for pavement construction. Lime stabilisation must achieve a minimum 4 day soaked CBR of 10% and CBR swell less than 0.5%

It must be noted that lime stabilisation of the clayey subgrade soils will require laboratory stabilisation trials to confirm that:

- There are silica and alumina clay components to react with the lime.
- A suitable proportion of lime is used to satisfy Lime Demand and achieve long term strength gain.
- A suitable proportion of lime is used to achieve a minimum soaked CBR of 10% and CBR swell less than 0.5%.

It must be understood that the subgrade improvement recommendation assumes that the subsurface material along the edge of the pavement shoulders is relatively impermeable and is shaped to drain away from the pavement. Subsoil drains are required to drain the pavement edges where this is not possible.

8.3 Design Traffic

We assume that the Shire of Augusta-Margaret River follows the IPWEA (2017) Local Government Guidelines for Subdivisional Development for design of road highway pavements. IPWEA (2017) requires that pavements are designed for a life of 40 years for permanent deformation of the subgrade and 15 years for asphalt fatigue.

We have not been provided any design traffic information and have therefore referred to the Austroads indicative design traffic values for lightly trafficked roads as shown on Inline Figure 1 and Table 7: AGPT02-17 Indicative Design Traffic for Lightly Trafficked Roads.

Inline Figure 1: AGPT02-17 Lightly Trafficked Street Categories

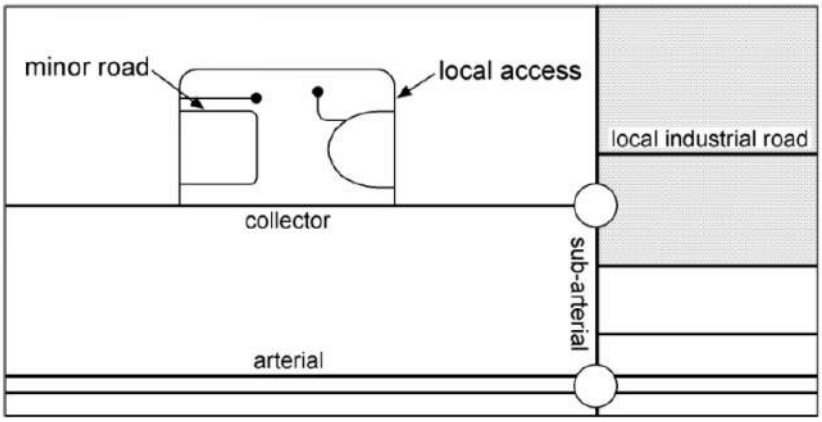


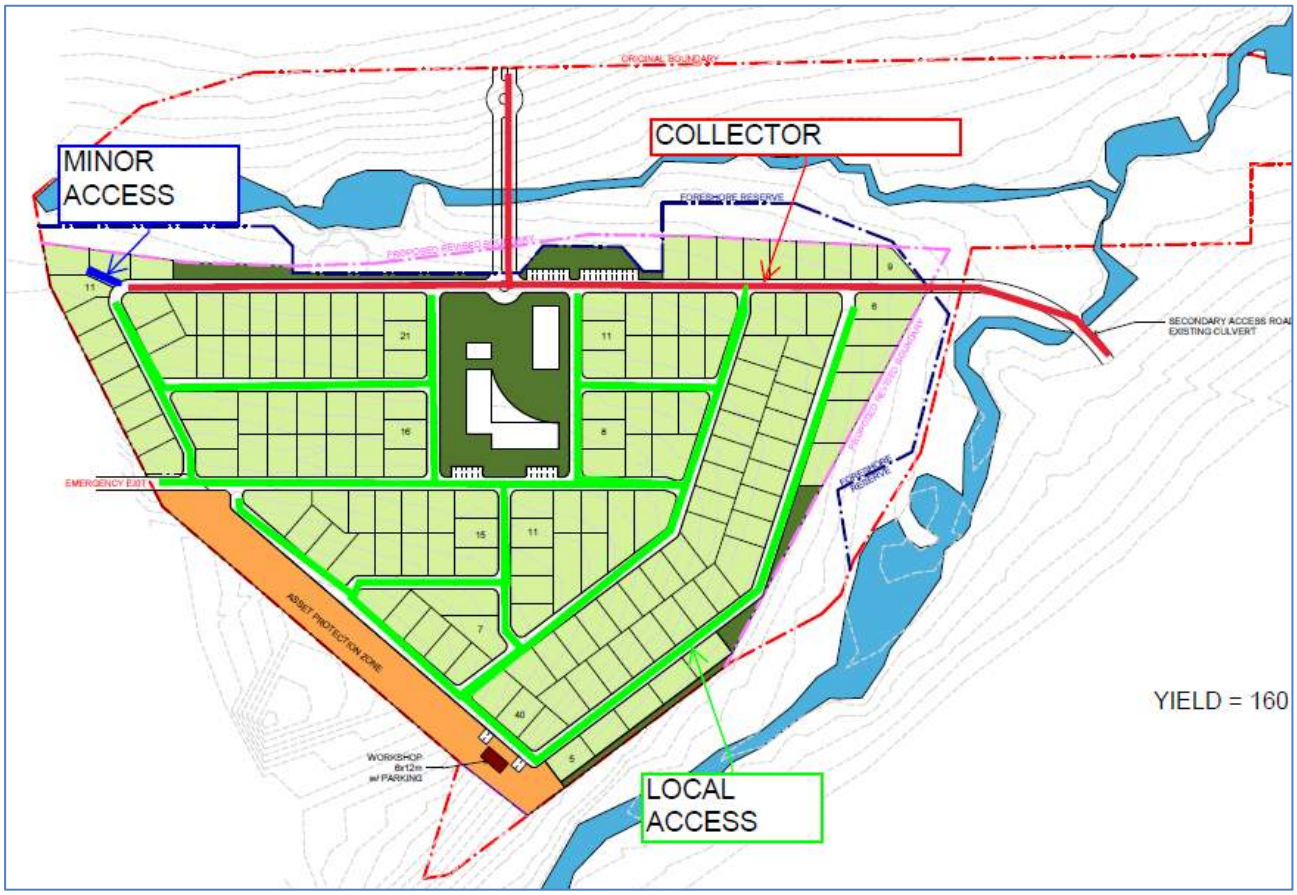
Table 7: AGPT02-17 Indicative Design Traffic for Lightly Trafficked Roads

Type of Road	AADT	%HV/100	Design Period (years)	HV Annual Growth Rate (%)	CGF	Axle groups per heavy vehicle	Cumulative HVAG over design period	ESA/ HVAG	Indicative design traffic (ESA)
Minor with two lane traffic	90	3	40	0	40	2.0	39,420	0.2	8×10^3
Local Access with Buses	500	6	40	1	48.9	2.1	535,455	0.3	1.5×10^5
Collector	2000	7	40	1.5	54.3	2.2	2,774,730	0.6	2×10^6

Notes: AADT – Annual Average Daily Traffic (2 way);
%HV/100 – Average percentage of heavy vehicles
CGF – Cumulative growth factor
ESA/HVAG – Equivalent standard axles per heavy vehicle axle group

Based on the above, we have categorised the roads within the subdivision as shown on Inline Figure 2.

Inline Figure 2: Assessment of Road Categories within Subdivision



We have also reviewed MRWA online traffic data for Tonkin Boulevard (MRWA Site 52841, dated 2017/2018) which is the collector road for traffic on the adjoining residential estate and school to the south. This MRWA data is presented in Appendix F.

We note that:

- The average annual daily traffic movements is about 2037 per day (both directions).
- The proportion of heavy vehicles ranges from 7.1% in the eastbound direction to 29.1% in the westbound direction (mainly Austroads Class 3 heavy vehicles). The high variability in heavy vehicle traffic is expected to be due to construction traffic movements (which are noted to be temporary).
- We have assumed axle equivalency factors according to MRWA ERN9, Other Important Urban Arterial Roads.
- We estimate the design traffic as follows:
  - Eastbound – 2.69 X 10^6 ESA
  - Westbound – 5.62 X 10^6 ESA

We note that the above traffic is higher than estimated for the collector road on the current estate. Consideration should be made in assuming a design traffic consistent with Tonkin Boulevard for the collector road on the proposed estate (this has not been adopted in our current designs).

Traffic impact assessments and further traffic data from the Augusta-Margaret River would be required to further refine the expected vehicle movements and estimated design traffic.

8.4 Pavement Materials

We have assumed the following material properties in our mechanistic-empirical analyses for the collector roads. This analysis was not undertaken for the lower category of roads as the traffic volumes are not critical to asphalt fatigue.

Table 8: Summary of Pavement Material Assumptions

Material	Design Modulus (MPa)	Poisson's Ratio	Assumptions
10 mm dense graded asphalt	2,310	0.4	WMAPT - 24°C, Vehicle Speed 50 km/hr, In-situ voids 9%
14 mm dense graded intersection mix asphalt	3,300	0.4	WMAPT - 24°C, Vehicle Speed 50 km/hr, In-situ voids 9%
Cement modified gravel basecourse	500	0.35	UCS 0.6 - 1.0 MPa at 28 days curing.
Crushed Igneous Rock Basecourse	500	0.35	High quality crushed rock basecourse
Gravel Basecourse	300	0.35	Soaked CBR 80%. CBR Swell < 0.5%
Crushed Limestone Subbase	250	0.35	Soaked CBR 50%. CBR Swell < 0.5%
Gravel Subbase	190	0.35	Soaked CBR 30%. CBR Swell < 0.5%
Approved granular fill or lime stabilised clayey soil.	100	0.35	Soaked CBR 10%. CBR Swell < 0.5%
In-situ subgrade	50	0.45	CBR 5% - well drained conditions.

Notes: 1. Assume MRWA Specification 504 compliant granular pavement materials

2. WMAPT – Weighted Mean Average Pavement Temperature

8.5 Pavement Thickness Design

Pavement designs have been provided according the design traffic presented in Table 7.

8.5.1 Collector Roads

The following pavement thickness designs are provided for the Collector roads.

Table 9: Collector Road Roundabouts and North-South Aligned Approach

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	40		14 mm dense graded intersection mix asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal (Substitute with 10/5 mm Double/Double Seal if significant trafficking required)
Base-course	180	180	Crushed Igneous Rock Basecourse or Cement Modified Gravel Basecourse MRWA Specification 504
Sub-base	110	280	Crushed Limestone or Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

Table 10: Collector Road – West-East Aligned

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	30		10 mm dense graded asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal (Substitute with 10/5 mm Double/Double Seal if significant trafficking required)
Base-course	155	155	Crushed Igneous Rock Basecourse or Cement Modified Gravel Basecourse MRWA Specification 504
Sub-base	135	305	Crushed Limestone or Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

8.5.2 Local Access Roads

The following pavement thickness designs are provided for the Local Access Roads.

Table 11: Local Access Roads

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	30		10 mm dense graded asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal
Base-course	115	115	Gravel Basecourse MRWA Specification 504
Sub-base	100	205	Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

8.5.3 Minor Access Roads

The following pavement thickness designs are provided for the Minor Access Roads

Table 12: Minor Access Roads

Pavement Layer	Minimum Thickness (mm)		Suggested Materials
	CBR10	CBR5	
Wearing Surface	30		10 mm dense graded asphalt MRWA Specification 504
Seal	Nominal		Prime and 7 mm Single/Single Seal
Base-course	140	100	Gravel Basecourse MRWA Specification 504
Sub-base	-	105	Gravel Subbase MRWA Specification 504
Subgrade Fill/Stabilised Subgrade	Minimum 300	-	Lime stabilised clayey soil; OR Approved granular fill
Subgrade	-	-	In-situ subgrade

8.6 Surfacing and Seals

8.6.1 Surface Preparation and Prime

Prior to sealing or surfacing, the prepared granular base must be compacted and dried back (except cement modified basecourse which must be cured) to ensure a tightly bound surface and swept with a rotary broom or similar to remove any surface dust and loose particles.

The surface must be primed and sealed to waterproof the granular base and provide a strong bond between the base and the surfacing. MRWA Specification 503 requires application of a prime comprising 40% Class 170 bitumen/60% Medium curing cutter oil prime at a rate of 0.6 L/m^2.

The prime must be applied in dry and warm conditions, with no rainfall forecast within the following 3 days. The prime must be allowed to cure for a period of 3 to 7 days prior to application of the surfacing as per MRWA Specification 503.

Notwithstanding the nominal application rates, the prime should be adjusted:

- to ensure a uniform and even coating;
- to account for the porosity of the pavement surface;
- to account for the pavement moisture content and prevailing conditions; and
- if the seal or surfacing is applied immediately after the primer.

8.6.2 Preliminary Spray Seal Design below Surfacing

Preliminary seal designs have been performed in general accordance with Austroads AGPT04K-18, MRWA ERN15 (2017) and MRWA Specification 503.

The following preliminary seal designs are provided.

Table 13: Preliminary Seal Design

Applications	Seal Type	Aggregate Size (mm)	Binder	Total Binder Application Rate (@ 15°C) L/m²	Aggregate Spread Rate (m²/m³)
All	Prime	-	Cutback primer	0.6	-
Little to no traffic	Single/single seal	7 mm	CRS170/60 emulsion	1.3	150-200
Significant construction traffic and/or turning movements	Double/double seal	10 mm	CRS170/60 emulsion	0.9	140
		5 mm		1.1	180-220

The following assumptions have been made and must be reviewed by the sealing contractor:

- Double/double seal based on MRWA recipe-based seal design with proven performance in highway applications.
- Assumed Average Least Dimension (ALD) of 4 mm for the 7 mm aggregate and Flakiness Index (FI) 25-35%.
- No adjustments for surface texture, embedment, or absorption assuming suitable basecourse preparation and priming.
- Design based on no trafficking between prime and seal applications.

8.6.3 Recommended Pavement Surfacings

We generally recommend that 10 mm dense graded asphalt is used for the road excluding the main entrance road and roundabouts which will be subject to heavy traffic and turning movements. We recommend that 14 mm dense graded intersection mix asphalt is used in these areas.

MRWA Specifications 504 Section 504.26 and Tables 504.B1 and 504.B2 must be used for the mix design. The asphalt job mix must be trialled and laboratory tested to ensure it conforms with the specification.

The asphalt must be compacted to a minimum characteristic density ratio of 93% of the 75 blow Marshall Density as outlined in the MRWA Specification 504.

9. PAVEMENT SPECIFICATION AND CONSTRUCTION

9.1 Fill Materials

The following MRWA Specifications are applicable to imported pavement materials and construction:

- MRWA Specification 501 – Pavements.
- MRWA Specification 503 – Bituminous Surfacing.
- MRWA Specification 504 – Asphalt Wearing Course.
- MRWA Specification 511 – Materials for Bituminous Treatments.

9.2 Stabilisation

We note that:

- Cement modification of imported gravel basecourse fill may be required for the basecourse in order to provide a high modulus material that will prevent asphalt fatigue at the main entrance roads/roundabouts.
- Lime stabilisation of the clayey subgrade soils may be considered to improve the subgrade design strength and manage the reactivity of the clayey subgrade materials.

Laboratory stabilisation trials are required to confirm the required proportion of cement and lime for the design parameters assumed in the pavement design. The following laboratory testing is recommended as a minimum:

Cement Modification of Basecourse

- Particle size distribution and Atterberg Limits on 3 representative samples of unmodified gravel basecourse.
- Dry density-moisture content relationship using Modified compactive effort on samples stabilised with 1%, 1.5% and 2% General Purpose Portland Cement (GP Cement). Recommend testing 3 representative samples for each cement content (total 9 tests).
- Unconfined compressive strength (UCS) on samples stabilised with 1%, 1.5% and 2% GP Cement, compacted to 98% MMDD and cured for 28 days. Recommend testing 3 representative samples for each cement content (total 9 tests).

The target 28-day UCS value is in the range of 0.6 MPa to 1.0 MPa. Further advice can be provided upon review of the test results.

Lime Stabilisation of Subgrade Materials

- Particle size distribution and Atterberg Limits - 3 representative samples of the clayey subgrade materials to be stabilised.
- Lime Demand tests to determine the minimum proportion of quicklime to maintain a permanent reaction and stabilisation. Recommend testing 3 representative bulk samples.
- Modified compaction tests on at least 3 samples (1 for each lime content) stabilised to the Lime Demand and 2% greater than the Lime Demand (total 6 tests).
- 4 day soaked CBR tests on 6 samples stabilised to the Lime Demand and 2% greater than the Lime Demand (i.e. 3 tests for each lime content). Stabilised samples to be compacted to 92% MMDD and cured for 7 days prior to CBR soak. Further geotechnical advice is required to confirm appropriate design subgrade CBR and pavement design for stabilised material.

Further testing of stabilised material is also recommended during construction to ensure the design value is achieved and any adjustments are made as required.

9.3 Moisture Conditioning, Compaction and Dryback

It is essential that all granular pavement layers are suitably moisture conditioned, compacted and dried back. Stabilised materials must be adequately cured and not prematurely dried back. The requirements are outlined in Table 14.

Table 14: Compaction and Dryback Requirements

Pavement Layer	Moisture Content for Compaction	Characteristic DDR	Characteristic Maximum Moisture Content for Dryback
Cement Modified Basecourse	90 to 110% of MOMC	98% MMDD	80-100% MOMC 7 days cured
Crushed Igneous Rock Basecourse		98% MMDD	60% of MOMC
Gravel Basecourse		98% MMDD	70% of MOMC
Gravel Sub-base		95% MMDD	85% of MOMC
Subgrade Fill or In-situ Subgrade (Granular)		95% MMDD	85% of MOMC (Upper 300 mm)
Subgrade (Cohesive)		92% MMDD	Do not dry back Target 80-100% MOMC

Note: MOMC – Modified Optimum Moisture Content

Quality control testing of pavement and subgrade materials must be undertaken at the frequencies outlined in MRWA Specification 201.

9.4 Pavement Joints

Pavement joints with existing pavements should be formed in accordance with MRWA standards.

9.5 Drainage

The pavement designs are based on the assumption that suitable drainage control measures have been implemented to prevent moisture ingress into the pavement layers. We recommend that, as a minimum, the clayey soil horizons and finished surfaces of pavements are crowned to direct storm-water run-off away from the pavements and towards drainage systems.

10. CLOSURE

We draw your attention to Appendix G of this report, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on how to minimise risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Piravin Anandacoomaraswamy

Geotechnical Engineer

Rick Piovesan CPEng

Geotechnical Engineer

O:\Jobs\2020\J2001180 - MAPL SI Bussell Hwy Margaret River\03 Correspondence\J2001180 001 R Rev0- HWC.docx

Figures

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

Legend

- Site Boundary
- Stockpiles of loose rock boulders
- 0.4 - 0.7m SAND/GRAVEL overlying clayey strata
- Borehole
- Borehole not augered due to access constraints

N

0 40 80 120 160 200
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:2,500 (A3)
DRAWN	DAC
DATE DRAWN	29/09/2020
CHECKED	RP
DATE CHECKED	29/09/2020
PROJECTION	GDA 1994 MGA Zone 50

Galt Geotechnics Pty Ltd
ACN : 138 490 865
Tel : +61 (0)8 6272-0200
Address : 50 Edward Street
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CLIENT	**MCDOWALL AFFLECK PTY LTD**
PROJECT	EDENLIFE - MARGARET VILLAGE
LOCATION	LOTS 280, 3002 & 3010 BUSSELL HIGHWAY MARGARET RIVER
TITLE	INDICATIVE SOIL ZONES

Job No	Fig No	Rev
J2001180	FIGURE 2	**A**

Legend

- Site Boundary
- Stockpiles of loose rock boulders
- Borehole
- Borehole not augered due to access constraints

N

0 40 80 120 160 200
Meters

NOTES

Aerial Imagery and Cadastre sourced from Landgate/SLIP

SCALE	1:2,500 (A3)
DRAWN	DAC
DATE DRAWN	29/09/2020
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CLIENT	**MCDOWALL AFFLECK PTY LTD**
PROJECT	EDENLIFE - MARGARET VILLAGE
LOCATION	LOTS 280, 3002 & 3010 BUSSELL HIGHWAY MARGARET RIVER
TITLE	SITE & LOCATION PLAN

Job No	Fig No	Rev
J2001180	FIGURE 1	**A**

Appendix A: Supplied Drawings

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50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

YIELD = 160

N

RICHARD HAMMOND ARCHITECT
16/342 SOUTH TERRACE
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No.	Description	Date
3	Masterplan D - Revision 1	20.08.04

LESTER GROUP

MARGARET RIVER VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan - D

Project number	00
Date	20.08.04
Drawn by	RHA
Checked by	RHA
A - 304	
Scale @ A1	1 : 1000

Appendix B: Site Photographs

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ABN: 64 625 054 729

Photograph 1: General view – looking south from northeastern part

Photograph 2: General view – eastern edge of site

Photograph 3: Eastern part of site – looking north

Photograph 4: Southern part of site – Bussell Highway on right of photo

Photograph 5: Northwestern part of site – looking northwest

Photograph 6: Access road from Bussell Highway (looking south)

Photograph 7: Northern part of site along creek

Photograph 8: Typical rock stockpiles on southern side of creek

Photograph 9: Soft surface conditions and shallow perched groundwater in middle of site

Photograph 10: Rock pile in southern part of site

Appendix C: Borehole Reports

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ABN: 64 625 054 729

METHOD OF SOIL DESCRIPTION
BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG & SOIL CLASSIFICATION SYMBOLS

Graphic	USCS	Soil Name
		FILL (various types)
		COBBLES / BOULDERS
	GP	GRAVEL (poorly graded)
	GW	GRAVEL (well graded)
	GC	Clayey GRAVEL
	GM	Silty GRAVEL
	SP	SAND (poorly graded)
	SW	SAND (well graded)
	SC	Clayey SAND

Graphic	USCS	Soil Name
	SM	Silty SAND
	ML	SILT (low liquid limit)
	MH	SILT (high liquid limit)
	CL	CLAY (low plasticity)
	CI	CLAY (medium plasticity)
	CH	CLAY (high plasticity)
	OL	Organic SILT (low liquid limit)
	OH	Organic SILT (high liquid limit)
	Pt	PEAT

NOTE: Dual classification given for soils with a fines content between 5% and 12%.

SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

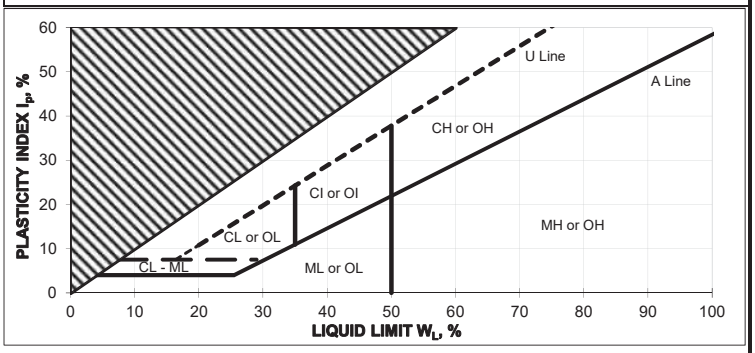
Soil descriptions are based on AS1726-2017. Material properties are assessed in the field by visual/tactile methods in combination with field and laboratory testing techniques (where used).

NOTE: AS 1726-2017 defines a fine grained soil where the total dry mass of fine fractions (<0.075 mm particle size) exceeds 35%.

PARTICLE SIZE

Soil Name		Particle Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	19 to 63
	Medium	6.7 to 19
	Fine	2.3 to 6.7
SAND	Coarse	0.6 to 2.36
	Medium	0.21 to 0.6
	Fine	0.075 to 0.21
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY - MODIFIED CASAGRANDE CHART - AS1726-2017



RESISTANCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION

Symbol	Term
D	Dry
M	Moist
W	Wet

CEMENTATION

Cementation	Description
Weakly cemented	Soil may be easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate the soil by hand in air or water

CONSISTENCY

Symbol	Term	Undrained Shear Strength (kPa)
VS	Very Soft	0 to 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very Stiff	100 to 200
H	Hard	>200

ORGANIC SOILS

Material	Organic Content % of dry mass
Inorganic soil	<2%
Organic soil	2% to 25%
Peat	>25%

DENSITY

Symbol	Term	Density Index (%)
VL	Very Loose	<15
L	Loose	15 to 35
MD	Medium Dense	35 to 65
D	Dense	65 to 85
VD	Very Dense	>85

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS

METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

SUPPORT

T	Timbering

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

WATER

►	Water Inflow	▼	Water Level
◄	Water Loss (complete)		
◁	Water Loss (partial)		

SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%) $= \frac{CRL}{TCL} \times 100$

RQD = Rock Quality Designation (%) $= \frac{ALC>100}{TCL} \times 100$

TCL	Length of Core Run
CRL	Length of Core Recovered
ALC>100	Total Length of Axial Lengths of Core Greater than 100 mm Long

BOREHOLE: BH01

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, trace organics			Perched groundwater
								SC	Clayey SAND: fine to coarse grained, orange-brown, 25-35% medium plasticity fines	M	L - MD	
			0.5						Gravelly SAND: fine to coarse grained, orange-brown, 30-40% fine to coarse grained gravel, with fines	W	D - VD	
								SP				
	F		1.0						Sandy CLAY: medium to high plasticity, grey mottled brown, 40-60% fine to coarse grained sand, trace gravel	D - M		
			1.5					CI				
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.9 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH04

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▽	0.0		B(BH04-1)			SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics	M	VL - L	Perched groundwater
								SC	Clayey SAND: fine to coarse grained, orange-brown, 15-30% medium plasticity fines, trace gravel			
			0.5						With gravel	W	D	
	F							CH	Sandy CLAY: high plasticity, grey mottled red, 40-50% fine to coarse grained sand	D - M	St	
			1.0									
			1.5						Becoming medium plasticity, grey, with silt fines			
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.5 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH05

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SP-SC	TOPSOIL: Clayey SAND/SAND: fine to coarse grained, dark brown, 5-15% low plasticity fines, with organics	M	L	Perched groundwater
	E-F							GP	Sandy GRAVEL: fine to medium grained, sub-angular to sub-rounded, lateritic, brown, 35-45% fine to coarse grained sand, with fines	W		
			0.5					SC	Clayey SAND: fine to coarse grained, pale brown, 10-20% low to medium plasticity fines, trace gravel		MD - D	
	F							CI	Sandy CLAY: medium to high plasticity, brown mottled grey, 50-60% fine to coarse grained sand, trace gravel	D - M	VSt	
	F-H		1.0									
			1.5						Hole terminated at 1.50 m Refusal on stiff clay Groundwater encountered at 0.3 m			
			2.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH06

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SC	TOPSOIL: Clayey SAND, fine to coarse grained, dark brown, 10-15% low plasticity fines, with organics	D - M	L	
								SC	Clayey SAND: fine to coarse grained, orange brown, 15-25% low to medium plasticity fines, with gravel		MD	
			0.5							M	D	
	F-H							CI	Sandy CLAY: medium plasticity, orange-brown, 50-60% fine to coarse grained sand, trace gravel	D	VSt	
			1.0						Hole terminated at 1.10 m Refusal on very stiff clay Groundwater not encountered			
			1.5									
			2.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH07

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics	D - M	L	
								SP	Gravelly SAND: fine to coarse grained, orange brown, 30-40% fine to medium grained, lateritic gravel, with fines		MD	
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand	D	VSt	
	F-H		1.0									
			1.5					CH	High plasticity			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH08

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-15% non-plastic fines, with organics	D - M	MD	
								SP	Gravelly SAND: fine to coarse grained, brown, 35-45% fine to medium grained, lateritic gravel, with fines			
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand	D	F - St	
											VSt	
			1.0									
	F-H		1.5					CH	High plasticity, grey mottled red			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH09

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-15% non-plastic fines, with organics	D - M	L - MD	
								SP	Gravelly SAND: fine to coarse grained, brown, 35-45% fine to medium grained, lateritic gravel, with fines			
	F		0.5		B(BH09-01)			CI	Sandy CLAY: medium plasticity, orange brown, 40-50% fine to coarse grained sand	D	St	
											VSt	
	F-H		1.0					CH	CLAY: high plasticity, red mottled grey, with sand			
			1.5		B(BH09-02)							
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH10

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, dark brown, 10-20% non-plastic fines, with organics		VL	
	F		0.5					SM	Silty SAND: fine to coarse grained, orange-brown, 10-20% non-plastic to low plasticity fines, trace gravel	D - M	L - MD	
										M		
			1.0					Cl	Sandy CLAY: medium plasticity, orange, 40-50% fine to coarse grained sand	D	F - St	
	F-H		1.5					CH	CLAY: high plasticity, red mottled grey, with sand			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH11

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	10/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0		B(BH11-01)			SM	TOPSOIL: SAND, fine to coarse grained, sub-angular to sub-rounded, black, with organics, with fines	W	MD	Perched groundwater
								GP	Sandy GRAVEL: fine to coarse grained lateritic gravel, sub-angular to sub-rounded, brown, 30-40% fine to coarse grained sand, with fines			
			0.5		B(BH11-02)			CI	Sandy CLAY: high plasticity, orange-brown, 50-60% fine to coarse grained sand, trace gravel		F - St	
	F		1.0		B(BH11-03)			CH	High plasticity, 30-40% fine to coarse grained sand, trace gravel	M		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.5 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH12

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	09/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SP-SM	TOPSOIL: Silty SAND/SAND, fine to coarse grained, dark brown, 5-15% non-plastic to low plasticity fines, with organics	M	VL - L	Perched groundwater
								SP-SM	Silty SAND/SAND: fine to coarse grained, orange brown, 5-15% non-plastic to low plasticity fines	M - W		
	F		0.5					CI	Sandy CLAY: medium to high plasticity, orange brown, 40-50% fine to coarse grained sand		VSt	
	F-H		1.0					CH	High plasticity, grey mottled red	D - M		
	F		1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.4 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH13

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E		0.0					SP-SC	TOPSOIL: Clayey SAND/SAND, fine to coarse grained, dark brown, 5-15% low plasticity fines, with organics	M	L	Possibly perched groundwater
									Sandy CLAY: medium plasticity, 60% fine to medium grained sand, orange brown			
	E-F		0.5		B(BH13-01)			CI		M - W	D	
	F		1.0					CH	Sandy CLAY: high plasticity, grey mottled red, 45-55% fine to coarse grained sand	M		
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 1 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH14

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	08/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SP	TOPSOIL: SAND, fine to coarse grained, dark brown, with fines, with organics	M	L	Perched groundwater
								SP	SAND: fine to coarse grained, brown, with fines	W		
	E-F		0.5					SC	Clayey SAND: fine to coarse grained, orange brown mottled red, 15-30% medium plasticity fines	D - M	D	
											St	
	F		1.0		B(BH14-01)			CH	Sandy CLAY: high plasticity, grey mottled red, 40% fine to coarse grained sand, trace gravel			
			1.5									
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.2 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

BOREHOLE: BH15

Job Number:	J2001180	**Contractor:**	Galt	**Date:**	10/09/2020
Client:	McDowall Affleck Pty Ltd	**Drill Rig:**	EVH Scout	**Logged:**	PA
Project:	Edenlife - Margaret Village	**Inclination:**	-90°	**Checked Date:**	25/09/2020
Location:	Lot 9012 Bussell Highway, Margaret River	**Hole Dia:**	90 mm	**Checked By:**	RP

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	E	▼	0.0					SM	TOPSOIL: Silty SAND, fine to coarse grained, pale brown, 10-15% non-plastic fines, with organics			
									Clayey SAND: fine to coarse grained, orange brown, 15-30% low plasticity fines			
			0.5					SC		M	L	
									Medium plasticity fines			
	F		1.0						Sandy CLAY: high plasticity, orange brown, 50% fine to coarse grained sand, trace gravel			
			1.5					CI		W		
			2.0						Hole terminated at 2.00 m Target depth Groundwater encountered at 0.9 m			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Appendix D: Laboratory Test Results

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

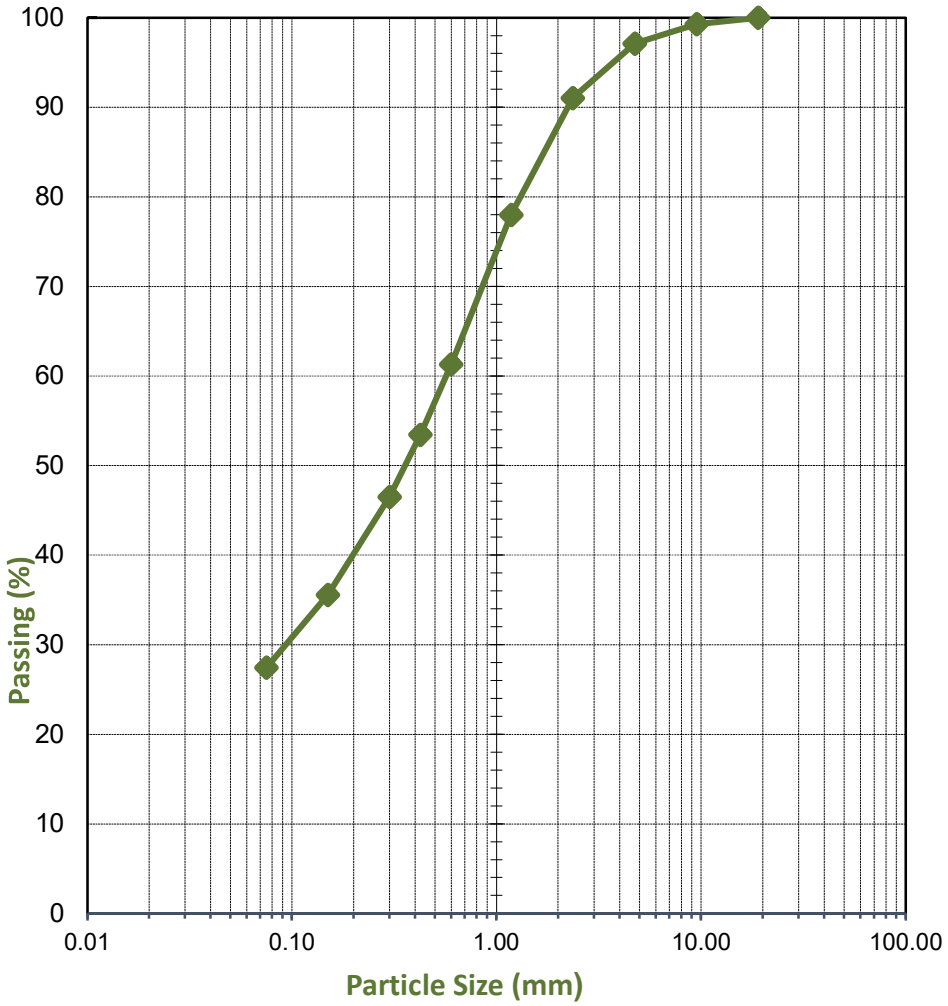
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/297_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	99
4.75	97
2.36	91
1.180	78
0.600	61
0.425	53
0.300	46
0.150	36
0.075	27



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA
Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/297_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**37**
AS 1289.3.2.1	**Plastic Limit (%)**	**28**
AS 1289.3.3.1	**Plasticity Index (%)**	**9**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**5.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.5.2.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/297_1_MMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/297
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH04 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Modified Maximum Dry Density

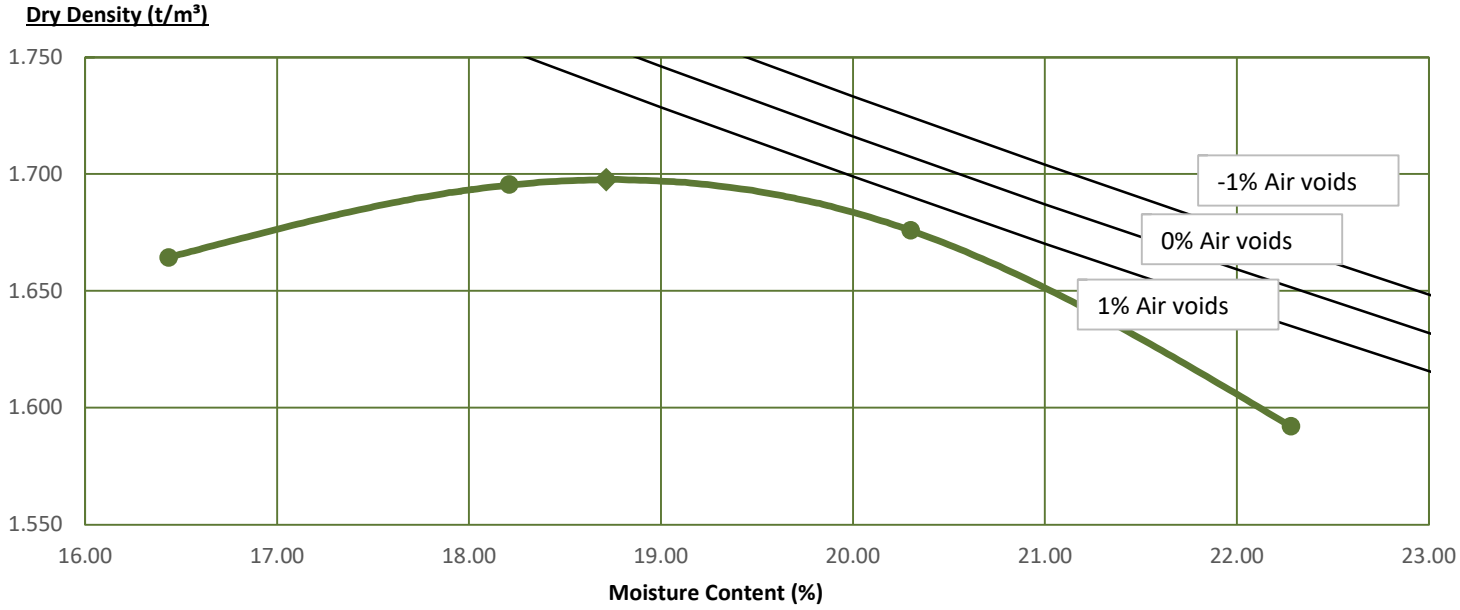
Sampling Method: Sampled by Client, Tested as Received

Sample Curing Time: 96hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 0 **Material + 37.5mm (%)** 0

Moisture Content (%)	18.2	20.3	22.3	16.4	
Dry Density (t/m³)	1.695	1.676	1.592	1.664	



Modified Maximum Dry Density (t/m³) **1.70**

Optimum Moisture Content (%) **18.5**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.613 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

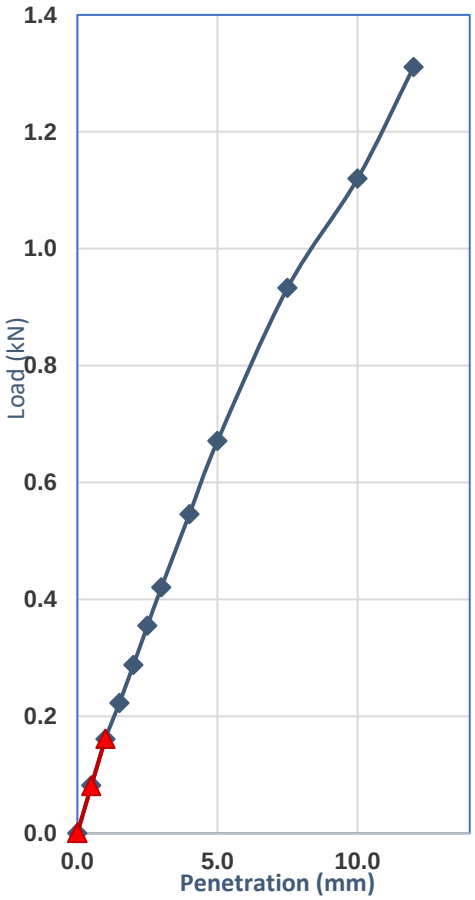
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8850_1_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8850
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/297 - BH04 - 0.1m - 0.5m	*Date Tested:*	16/09-21/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Silty Sand with Clay

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2 h
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	1.70	Optimum Moisture (%)	18.5
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	1.62	Moisture Content (%)	18.3
Density Ratio (%)	95.5	Moisture Ratio (%)	99.0

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.5
Dry Density (t/m³)	1.62	Dry Density Ratio (%)	95.0
Moisture Content (%)	21.7	Moisture Ratio (%)	117.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	21.9	Remaining Depth (%)	20.8

Correction applied to Penetration: 0mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 3.5%

Comments: MMDD & OMC values supplied by client - Bunbury Geotechnical Laboratory Services - NATA Accreditation No.20660, report No.BG20/297_1_MMDD.

Approved Signatory:

Name: Brooke Elliott

Date: 22-September-2020

NATA Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

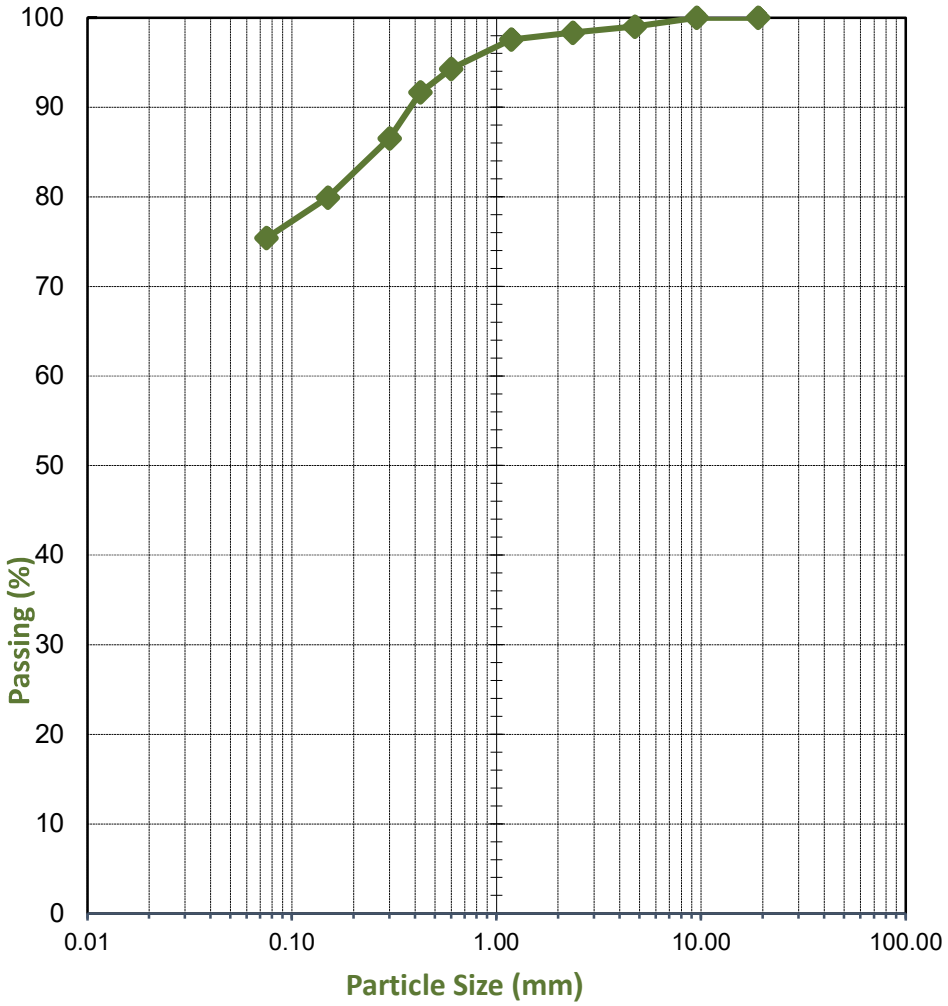
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/298_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/298
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH09 - 1.5m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	100
4.75	99
2.36	98
1.180	98
0.600	94
0.425	92
0.300	87
0.150	80
0.075	75



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA
Accreditation No. 20660
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BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/298_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/298
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH09 - 1.5m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**114**
AS 1289.3.2.1	**Plastic Limit (%)**	**40**
AS 1289.3.3.1	**Plasticity Index (%)**	**74**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**19.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

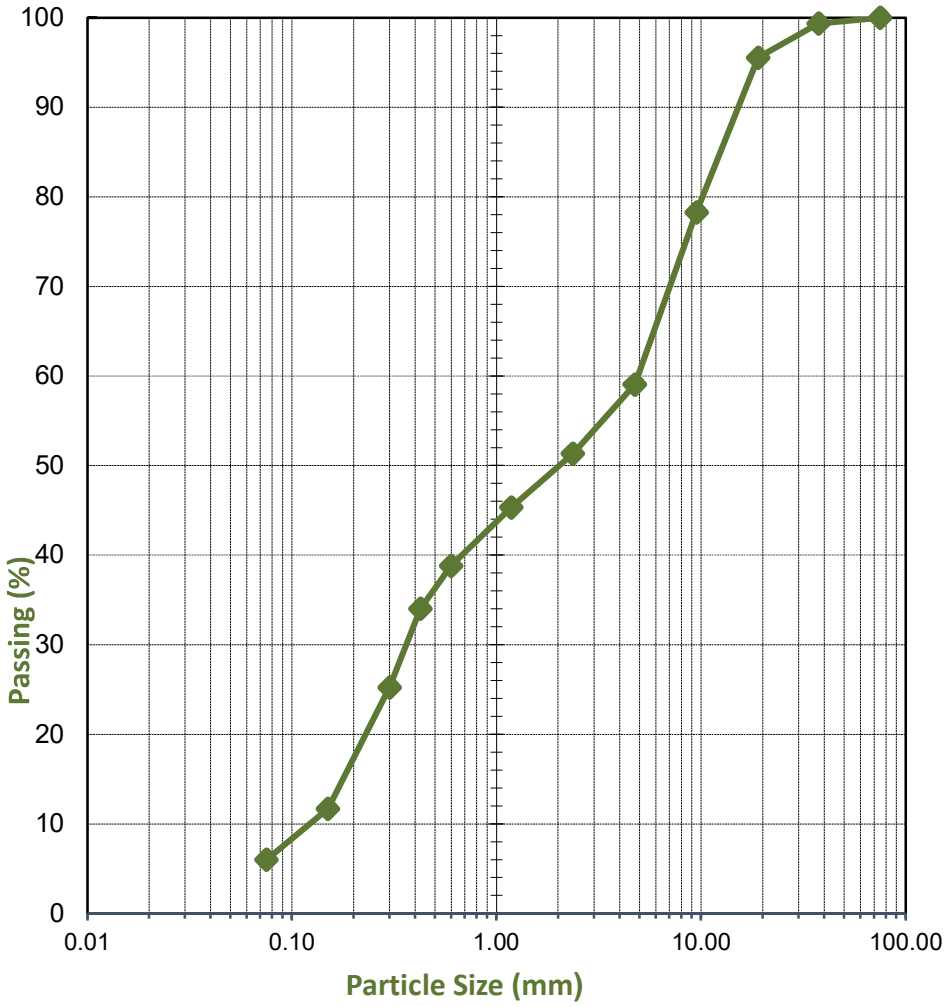
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/299_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: **Sampled by Client, Tested as Received**

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	100
37.5	99
19.0	96
9.50	78
4.75	59
2.36	51
1.180	45
0.600	39
0.425	34
0.300	25
0.150	12
0.075	6



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA
Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/299_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50^{o}**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/299_1_MMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/299
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.1m - 0.5m	*Date Tested:*	10/09/2020

TEST RESULTS - Modified Maximum Dry Density

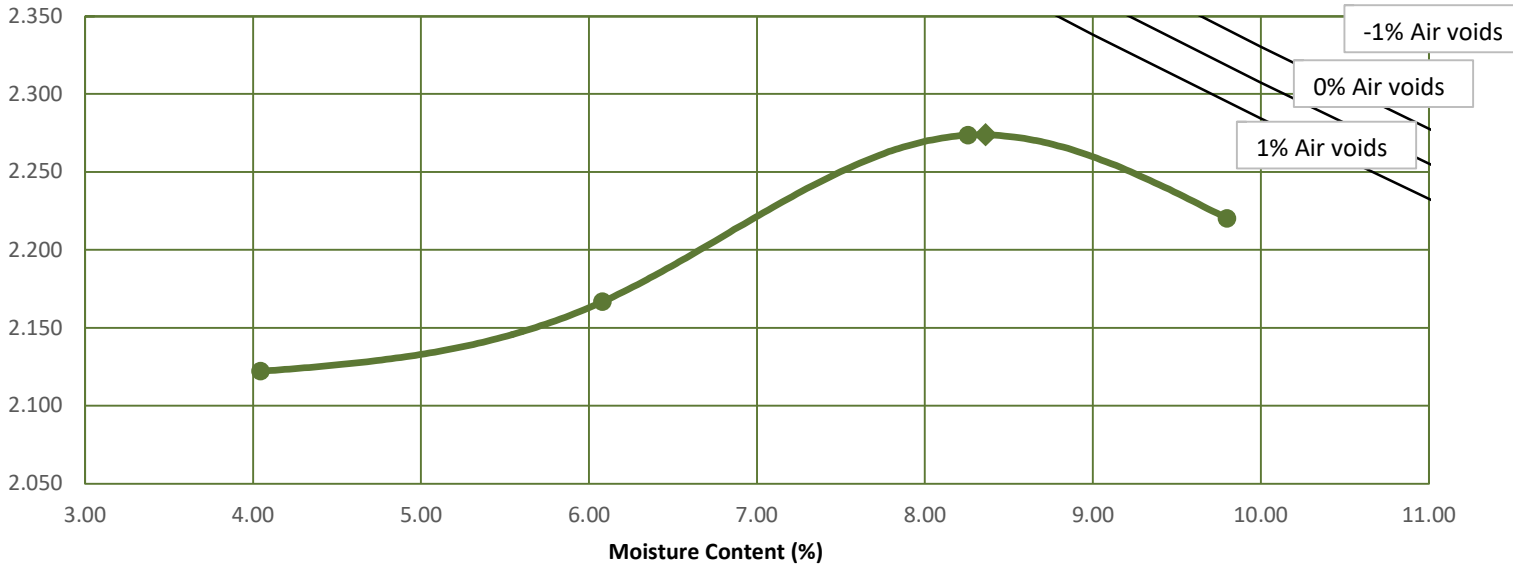
Sampling Method: Sampled by Client, Tested as Received

Sample Curing Time: 96hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 4 **Material + 37.5mm (%)** 1

Moisture Content (%)	4.0	6.1	8.3	9.8	
Dry Density (t/m³)	2.122	2.167	2.274	2.220	



Modified Maximum Dry Density (t/m³) **2.27**

Optimum Moisture Content (%) **8.5**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.999 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 18/September/2020

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

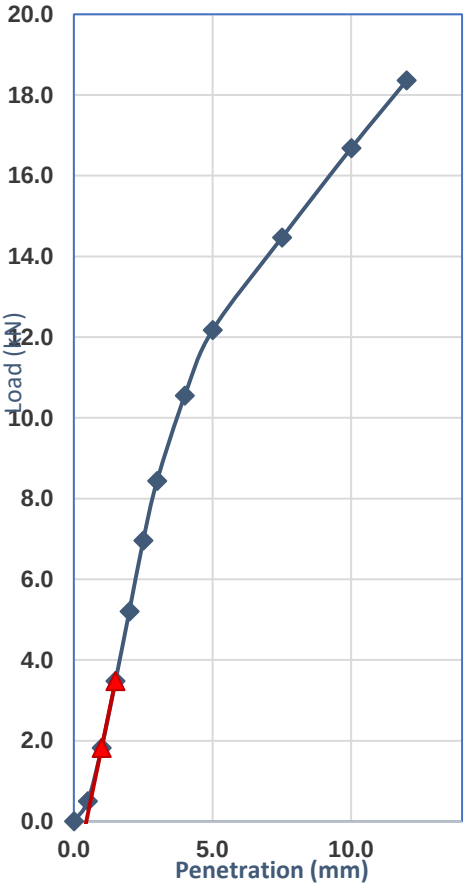
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8851_1_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8851
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/299 - BH11 - 0.1m - 0.5m	*Date Tested:*	16/09-21/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2 h
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	2.27	Optimum Moisture (%)	8.5
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	2.16	Moisture Content (%)	8.1
Density Ratio (%)	95.5	Moisture Ratio (%)	95.0

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.0
Dry Density (t/m³)	2.16	Dry Density Ratio (%)	95.5
Moisture Content (%)	10.7	Moisture Ratio (%)	125.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	11.5	Remaining Depth (%)	11.0

Correction applied to Penetration: 0.4mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 60%

Comments: MMDD & OMC values supplied by client - Bunbury Geotechnical Laboratory Services - NATA Accreditation No.20660, report No.BG20/299_1_MMDD.

Approved Signatory:

Name: Brooke Elliott

Date: 22-September-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

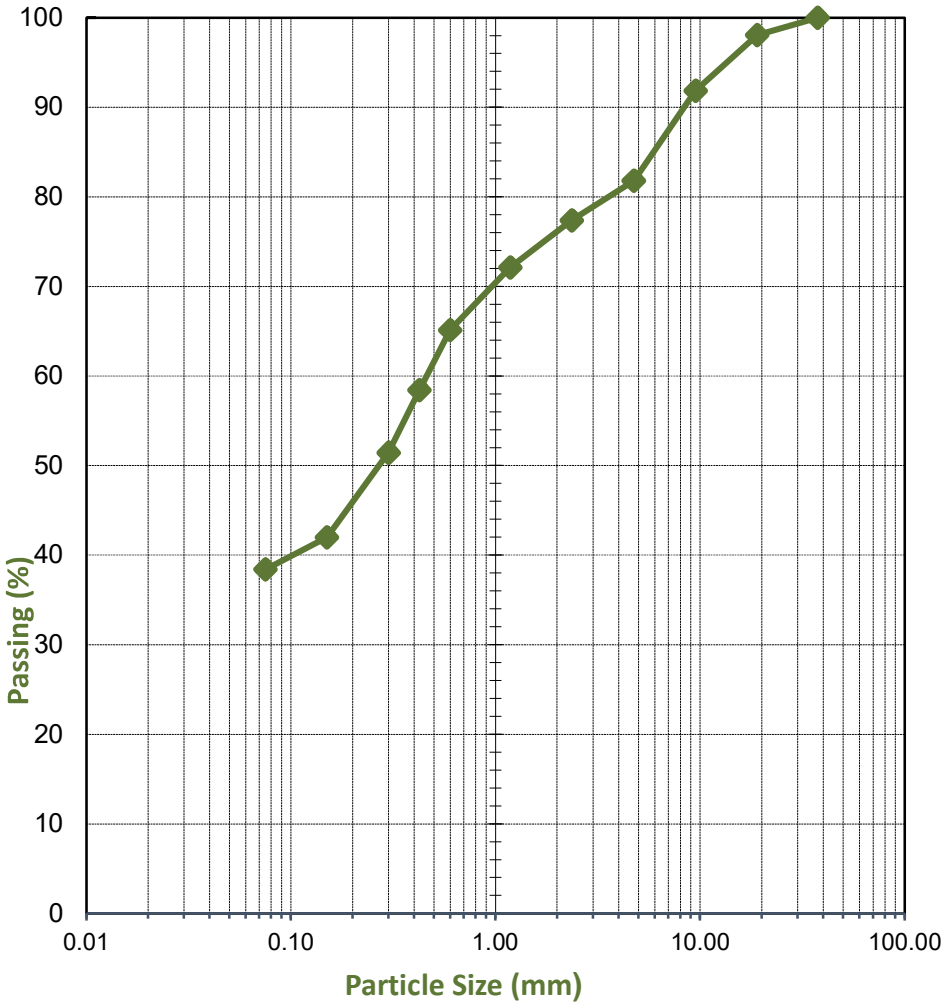
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/300_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	100
19.0	98
9.50	92
4.75	82
2.36	77
1.180	72
0.600	65
0.425	58
0.300	51
0.150	42
0.075	38



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

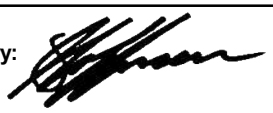
Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/300_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**51**
AS 1289.3.2.1	**Plastic Limit (%)**	**23**
AS 1289.3.3.1	**Plasticity Index (%)**	**28**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**11.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory: 

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.1.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/300_1_SMDD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/300
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH11 - 0.5m - 1.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Standard Maximum Dry Density

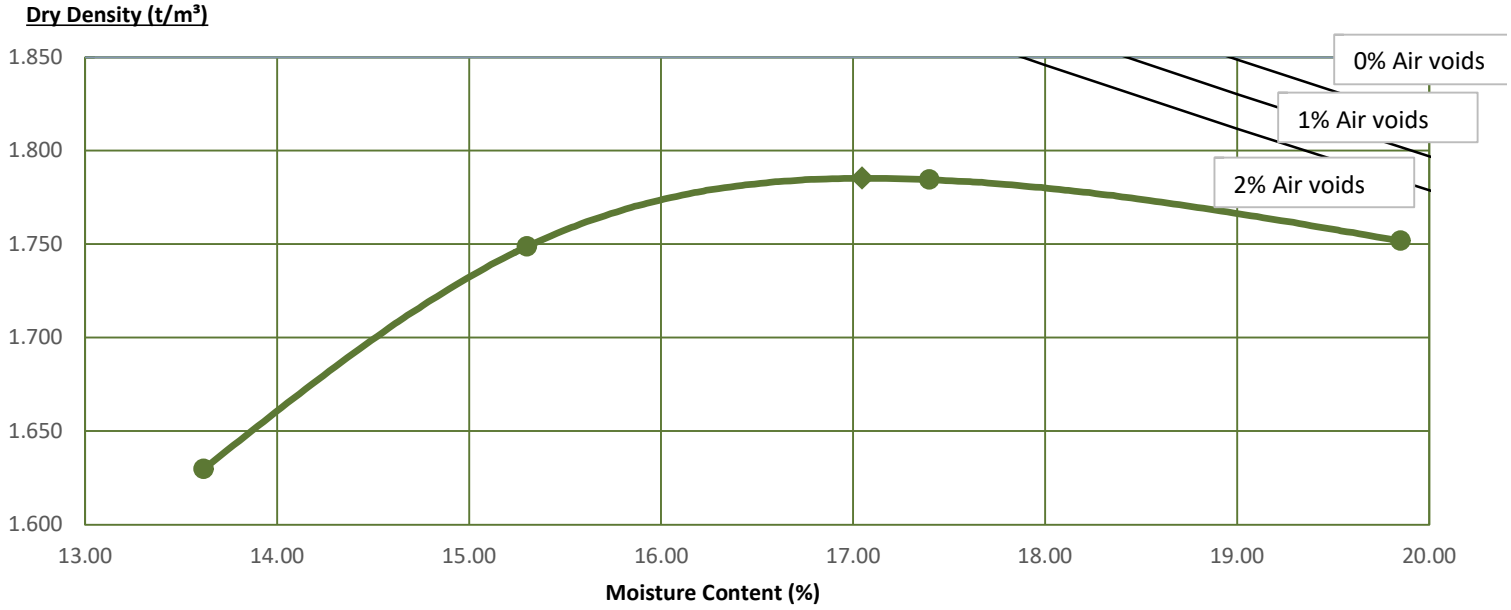
Sampling Method: Sampled by Client, Tested as Received

Sample Curing Time: 48hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 2 **Material + 37.5mm (%)** 0

Moisture Content (%)	13.6	15.3	17.4	19.9	
Dry Density (t/m³)	1.630	1.749	1.784	1.752	



Standard Maximum Dry Density (t/m³) **1.79**

Optimum Moisture Content (%) **17.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.849 t/m³*

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 24/September/2020

NATA ACCREDITATION **Accreditation No. 20660**
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.2.1.1, 6.1.1

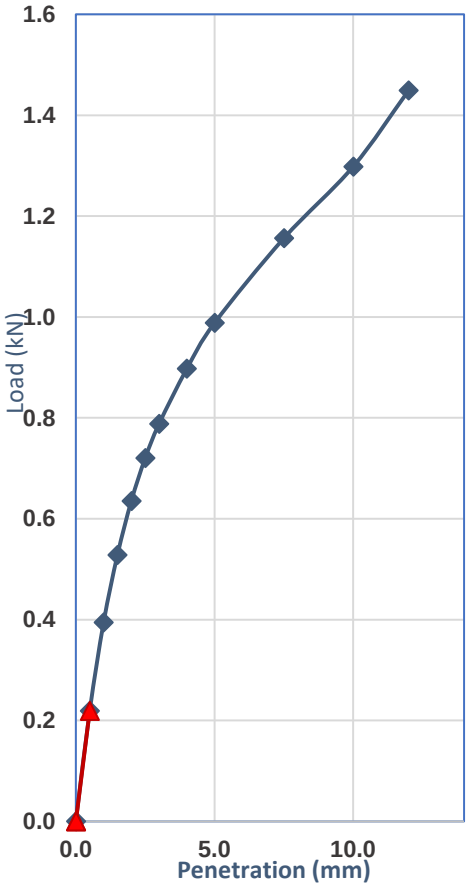
Client:	Galt Geotechnics	*Ticket No.*	S1750
Client Address:	-	*Report No.*	WG20/8852_2_SCBR
Project:	Eden Life - Margaret Village	*Sample No.*	WG20/8852
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	Not Specified
Sample Identification:	BG20/300 - BH11 - 0.5m - 1.0m	*Date Tested:*	16/09-22/09/2020

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy Clay with Gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.1.1	Hammer Type	Standard
Plasticity Determined by	Estimated	*Curing Time (Hours)	24 Hours
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	1.79	Optimum Moisture (%)	17.0
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	1.70	Moisture Content (%)	17.2
Density Ratio (%)	95.0	Moisture Ratio (%)	101.5

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	1.5
Dry Density (t/m³)	1.68	Dry Density Ratio (%)	93.5
Moisture Content (%)	23.0	Moisture Ratio (%)	135.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	23.4	Remaining Depth (%)	20.8

Correction applied to Penetration: 0mm

Determined at a Penetration of: 2.5mm

California Bearing Ratio (CBR): 5%

*Comments: *Deviation from test method Clause 5 (f) -table 1. Insufficient curing time as per test method requirements. NATA Accreditation does not cover the performance of this service. Tested as per clients request. This report replaces WG20/8852_1_SCBR, sample identification updated as per clients request.*

Approved Signatory:

Name: Brooke Elliott

Date: 24-September-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

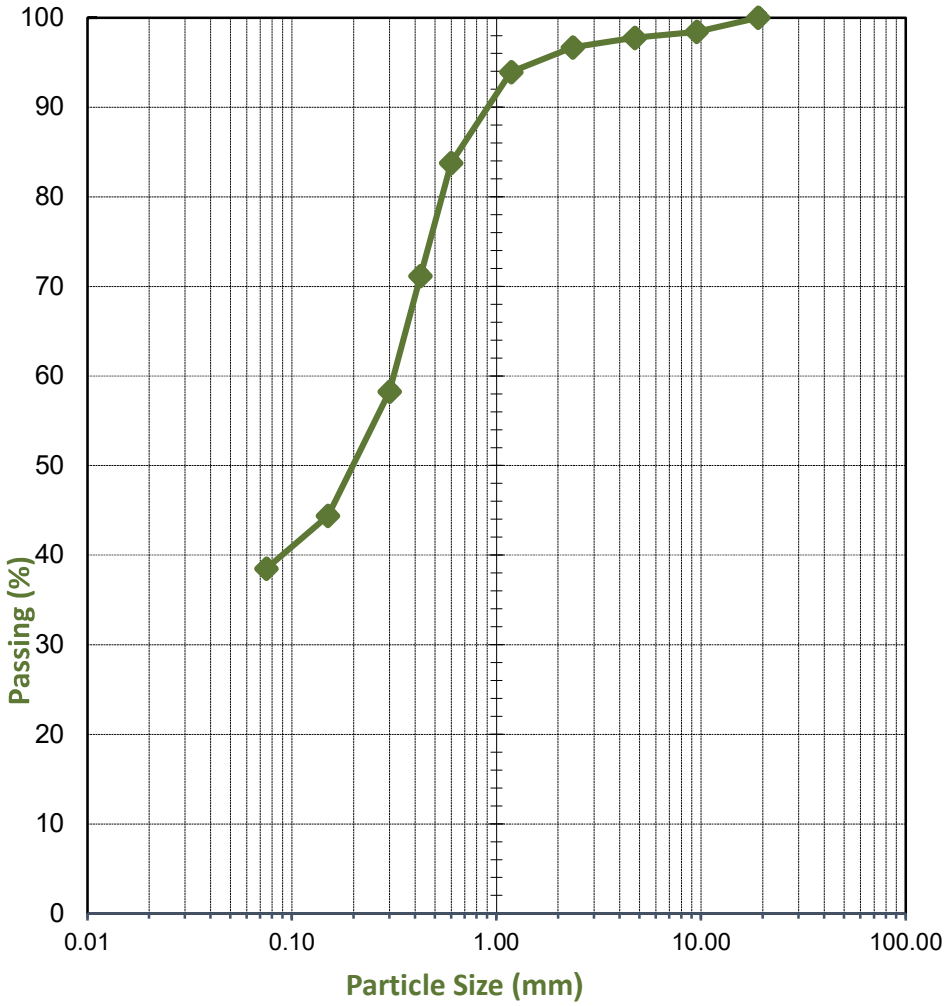
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/301_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/301
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH13 - 0.4m - 0.9m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	98
4.75	98
2.36	97
1.180	94
0.600	84
0.425	71
0.300	58
0.150	44
0.075	39



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/301_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/301
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH13 - 0.4m - 0.9m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**36**
AS 1289.3.2.1	**Plastic Limit (%)**	**19**
AS 1289.3.3.1	**Plasticity Index (%)**	**17**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**8.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

BUNBURY GEOTECHNICAL
& LABORATORY SERVICES

SOIL | AGGREGATE | CONCRETE | CRUSHING

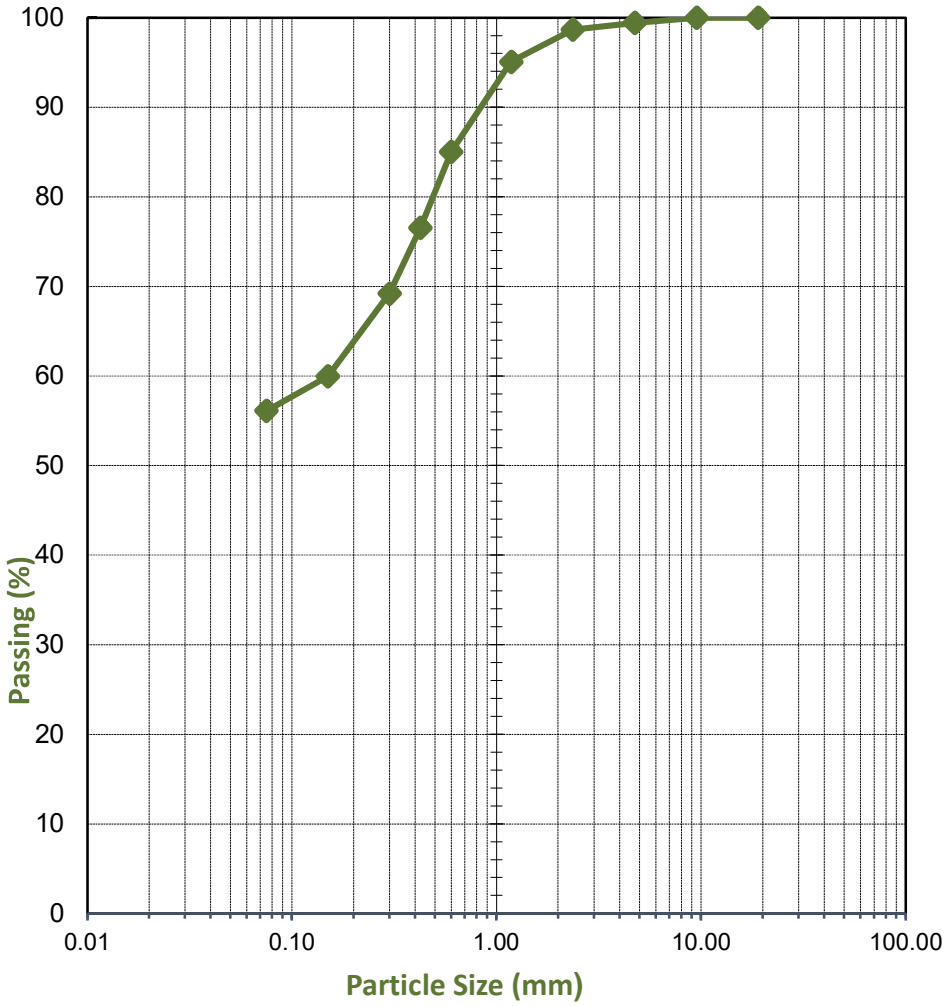
TEST REPORT - AS 1289.3.6.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6107	*Report No.*	BG20/302_1_PSD
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/302
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH14 - 1.0m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
200.0	
150.0	
100.0	
75.0	
37.5	
19.0	100
9.50	100
4.75	99
2.36	99
1.180	95
0.600	85
0.425	77
0.300	69
0.150	60
0.075	56



Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	Galt Geotechnics	*Ticket No.*	B083
Client Address:	50 Edward Street, Osborne Park WA 6017	*Report No.*	BG20/302_1_PI
Project:	Eden Life - Margaret Village	*Sample No.*	BG20/302
Location:	Lot 9012 Bussell Highway	*Date Sampled:*	10/09/2020
Sample Identification:	BH14 - 1.0m - 2.0m	*Date Tested:*	10/09/2020

TEST RESULTS - Consistency Limits (Cone)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.2	**Liquid Limit (%)**	**62**
AS 1289.3.2.1	**Plastic Limit (%)**	**20**
AS 1289.3.3.1	**Plasticity Index (%)**	**42**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**12.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**-**

Comments:

Approved Signatory:

Name: Steve Hoffman
Function: Operations / Business Manager
Date: 17/September/2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20660
Accredited for compliance with ISO/IEC 17025 - Testing

Appendix E: CSIRO Pamphlet

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

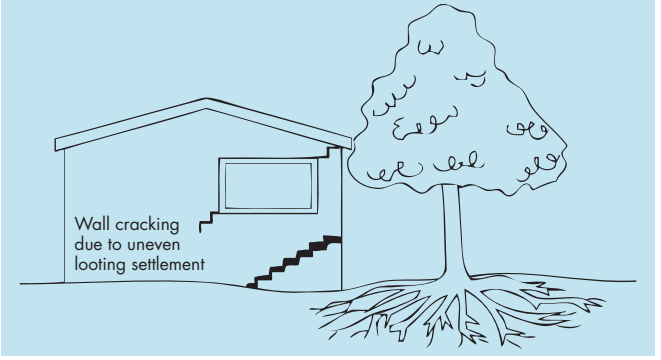
The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Trees can cause shrinkage and damage



Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

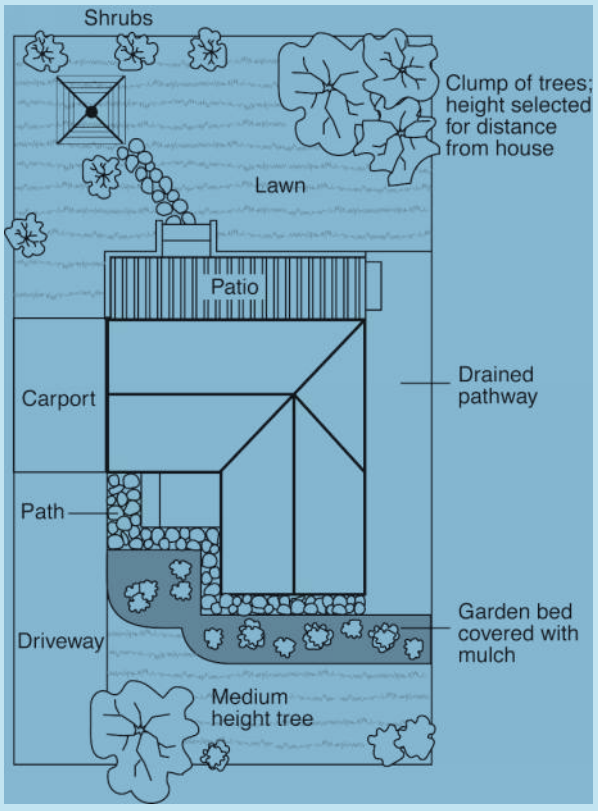
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Appendix F: MRWA Site 52841 2017/2018

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

mainroads WESTERN AUSTRALIA

SITE 52841

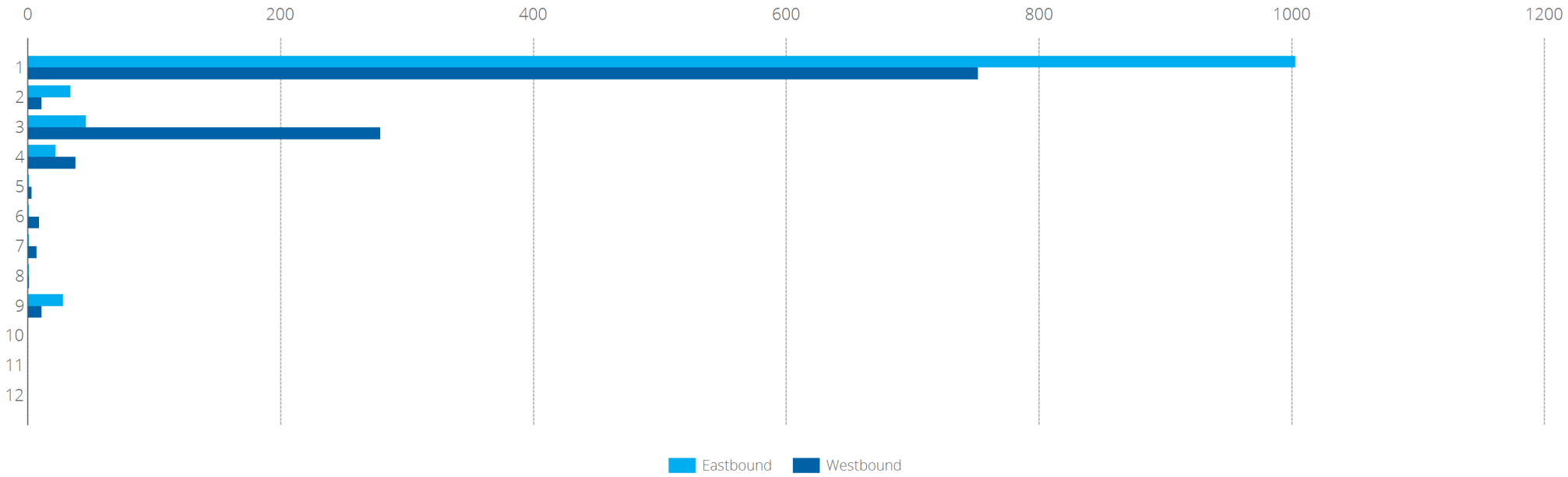
Vehicle Type

Tonkin Bvd (2010620)

East of Old Bussell Hwy (SLK 0.05)

2017/18

Monday to Friday



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	1003	34	46	22	1	1	1	1	28	0	0	0	100	1137
%	88.2	3.0	4.0	1.9	0.1	0.1	0.1	0.1	2.5	0.0	0.0	0.0	8.8	
W	752	11	279	38	3	9	7	1	11	0	0	0	348	1111
%	67.7	1.0	25.1	3.4	0.3	0.8	0.6	0.1	1.0	0.0	0.0	0.0	31.3	
E W	1755	45	325	60	4	10	8	2	39	0	0	0	448	2248
%	78.1	2.0	14.5	2.7	0.2	0.4	0.4	0.1	1.7	0.0	0.0	0.0	19.9	

SITE 52841

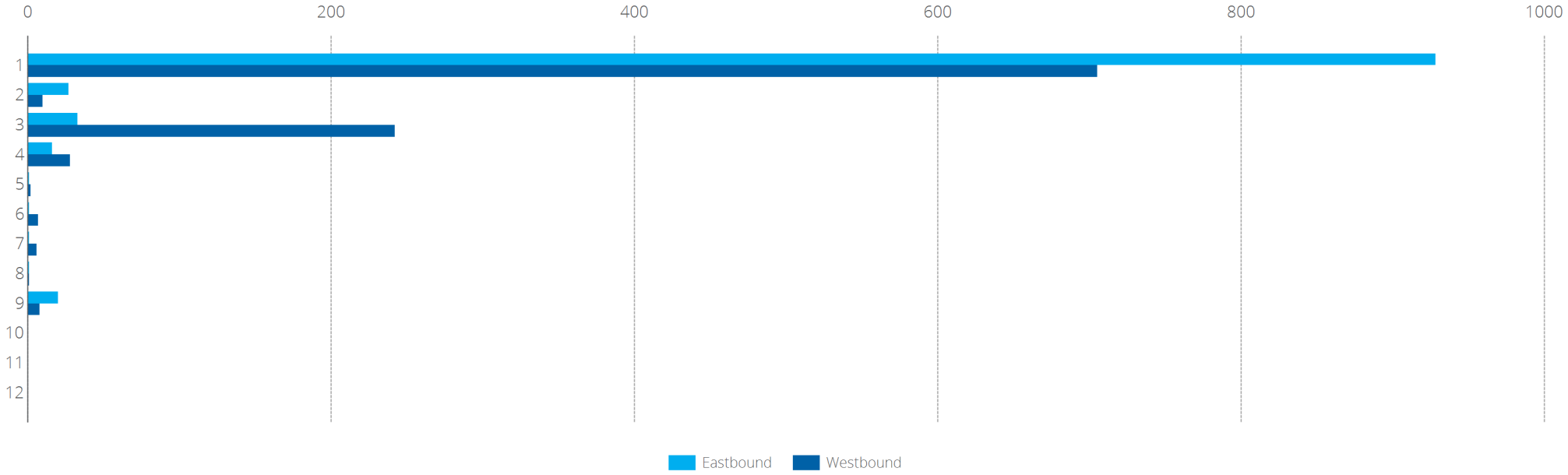
Vehicle Type

2017/18

Tonkin Bvd (2010620)

Monday to Sunday

East of Old Bussell Hwy (SLK 0.05)



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	928	27	33	16	1	1	1	1	20	0	0	0	73	1028
%	90.3	2.6	3.2	1.6	0.1	0.1	0.1	0.1	1.9	0.0	0.0	0.0	7.1	
W	705	10	242	28	2	7	6	1	8	0	0	0	294	1009
%	69.9	1.0	24.0	2.8	0.2	0.7	0.6	0.1	0.8	0.0	0.0	0.0	29.1	
E W	1633	37	275	44	3	8	7	2	28	0	0	0	367	2037
%	80.2	1.8	13.5	2.2	0.1	0.4	0.3	0.1	1.4	0.0	0.0	0.0	18.0	

SITE 52841

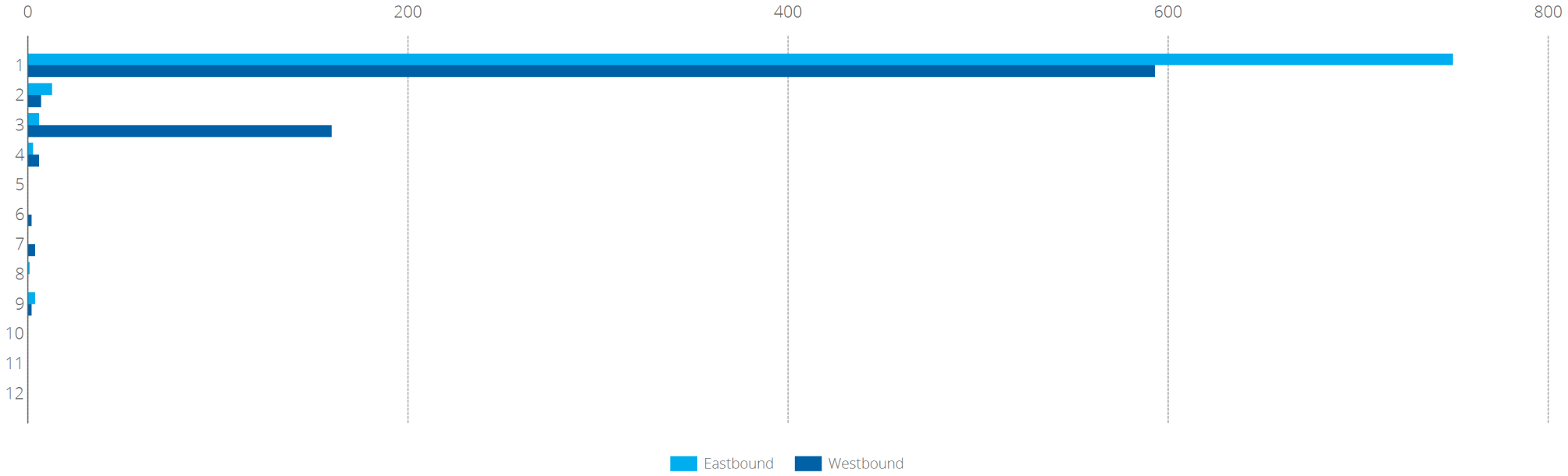
Vehicle Type

2017/18

Weekend

Tonkin Bvd (2010620)

East of Old Bussell Hwy (SLK 0.05)



	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
E	750	13	6	3	0	0	0	1	4	0	0	0	14	777
%	96.5	1.7	0.8	0.4	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	1.8	
W	593	7	160	6	0	2	4	0	2	0	0	0	174	774
%	76.6	0.9	20.7	0.8	0.0	0.3	0.5	0.0	0.3	0.0	0.0	0.0	22.5	
E W	1343	20	166	9	0	2	4	1	6	0	0	0	188	1551
%	86.6	1.3	10.7	0.6	0.0	0.1	0.3	0.1	0.4	0.0	0.0	0.0	12.1	

Appendix G: Understanding Your Report

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017
ABN: 64 625 054 729

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev3

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

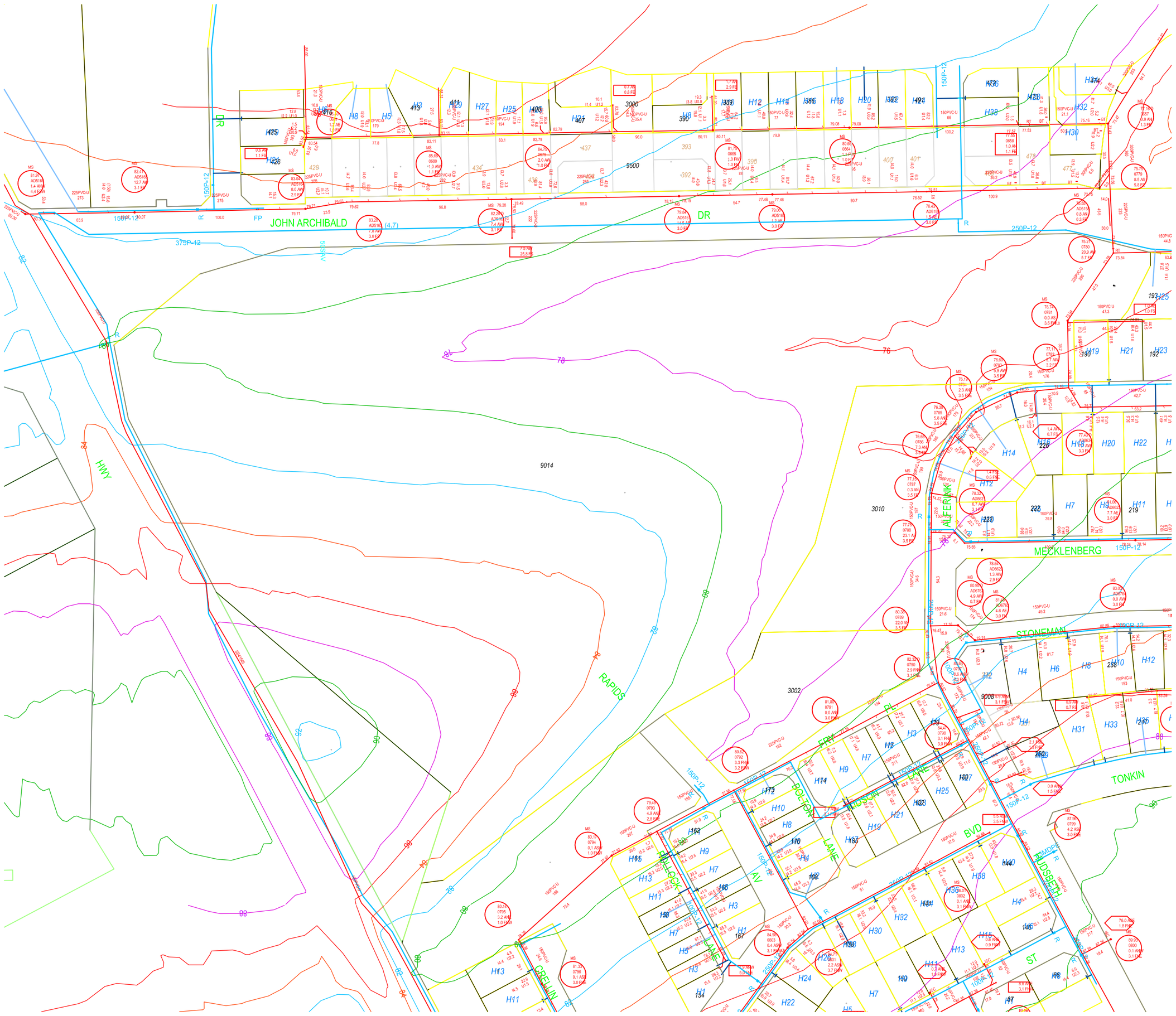
7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

13. APPENDIX 3 – WATER CORPORATION MAPS AND CORRESPONDENCE


JOHN ARCHIBALD
MECKLENBERG
STONEMAN
TONKIN
RAPIDS
ALTERNIK
HUDSON
BOLTON
FRY
PULLOCK
GRELLIN
HWY
150P-12
250P-12
375P-12
225PVC-U
150PVC-U
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9014
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3002
3010

Mathew Tapscott

From: Michael Hoglin <Michael.Hoglin@watercorporation.com.au>
Sent: Wednesday, 27 October 2021 9:05 AM
To: Mathew Tapscott
Subject: RE: Lot 9014 #10 Bussell Hwy Margaret River - SF0009186

Good morning Mathew,

Thank you for your patience with this enquiry.

Please note the following responses:

Water:
There are no issues servicing this development from the potable water network. The prime feed into the development should be off the 375P12 main running along John Archibald Dr.

Sewer:
There is capacity for 160 lots.
The connection should be made to a DN225 gravity sewer, and there are two options – the DN225 along John Archibald Dr, or the DN225 between Alferink Cres and John Archibald Dr. We feel you are going to struggle to get under the water courses, and connect to these existing sewers. Have you given this any thought yet, as we may need to discuss further once you have done some survey and detailed retic layout.

I trust the above assists, but if we can assist further, please contact us.

Kind Regards,

Michael Hoglin
Advisor – Infill Development
Development Services
Assets Planning and Delivery Group.

E Michael.Hoglin@watercorporation.com.au
T (08) 9420 3147

watercorporation.com.au

From: Mathew Tapscott <mtapscott@mapl.net.au>
Sent: Thursday, 21 October 2021 2:00 PM
To: Michael Hoglin <Michael.Hoglin@watercorporation.com.au>
Subject: RE: Lot 9014 #10 Bussell Hwy Margaret River - SF0009186

Thanks Michael, appreciate the update

| Mathew Tapscott | Senior Civil Engineer | McDowall Affleck Pty Ltd |

| ABN: 23 009 033 345 | M: +61 433 850 109 | T: +61 8 9274 6444 | F: +61 8 9250 3433 | www.mcdowallaffleck.com.au |

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From: Michael Hoglin <Michael.Hoglin@watercorporation.com.au>
Sent: Thursday, 21 October 2021 1:32 PM
To: Mathew Tapscott <mtapscott@mapl.net.au>
Subject: FW: Lot 9014 #10 Bussell Hwy Margaret River - SF0009186

Good afternoon Matthew,

This is just a quick email to let you know that the requested feedback should be available very shortly. I will update you as soon as it is forthcoming.

Kind Regards,

Michael Hoglin
Advisor – Infill Development
Development Services
Assets Planning and Delivery Group.

E Michael.Hoglin@watercorporation.com.au
T (08) 9420 3147

watercorporation.com.au

From: Michael Hoglin
Sent: Wednesday, 6 October 2021 2:10 PM
To: mtapscott@mapl.net.au
Subject: Lot 9014 #10 Bussell Hwy Margaret River - SF0009186

Good afternoon Mathew,

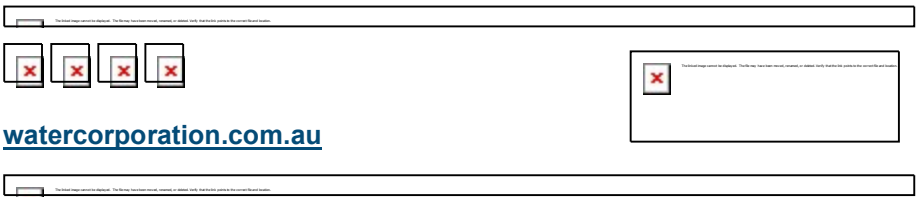
Thank you for your enquiry. I do need to ask if you have an anticipated Flow Rate for the 160 lots proposed. Also as there is sewer in the area, could we request your sewer discharge from the lot also for us to consider.

Upon receipt of this information, I can look into it further with our Planning Dept.

Kind Regards,

Michael Hoglin
Advisor – Infill Development
Development Services
Assets Planning and Delivery Group.

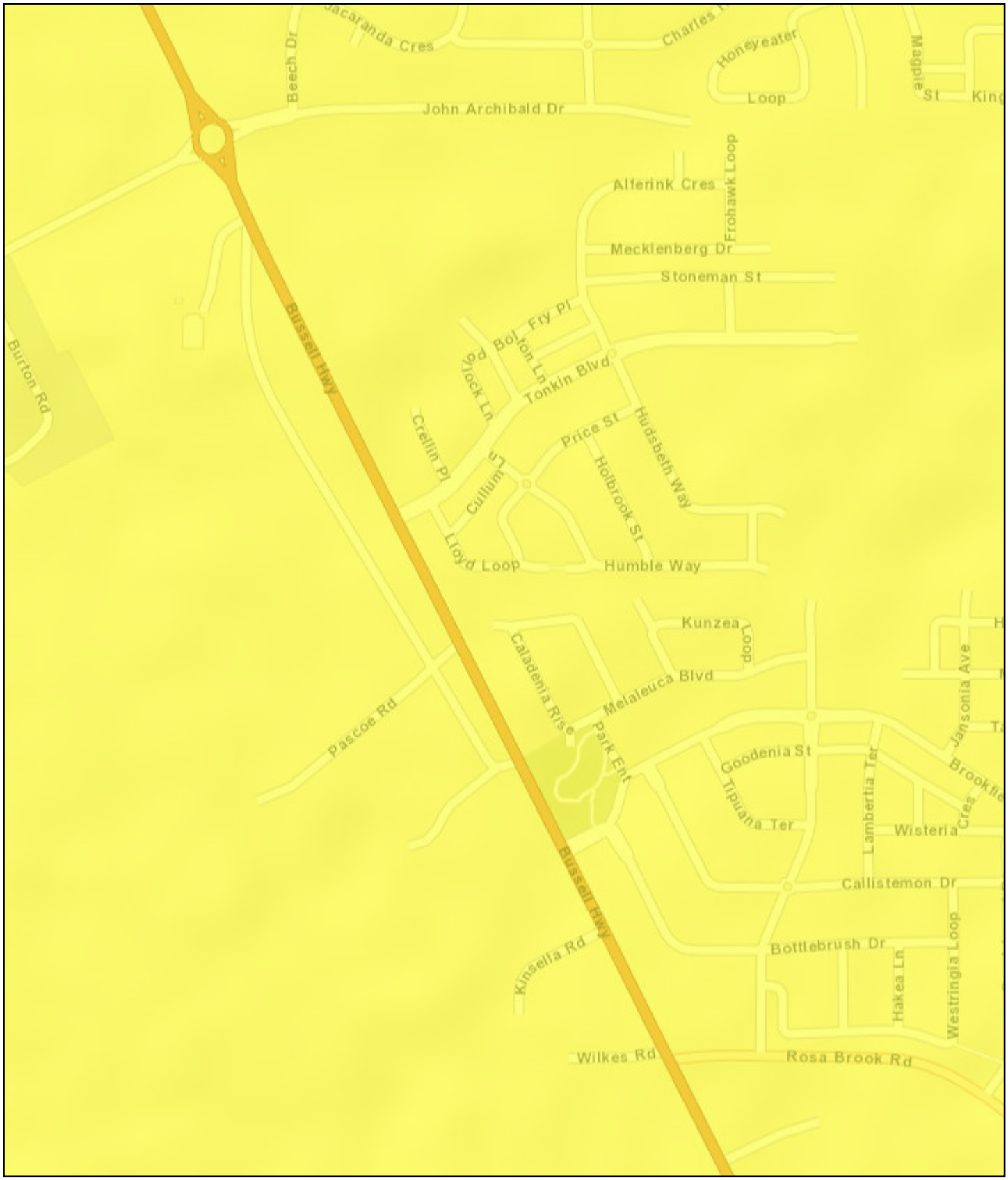
E Michael.Hoglin@watercorporation.com.au
T (08) 9420 3147



watercorporation.com.au

14. APPENDIX 4 – WESTERN POWER NETWORK CAPACITY MAP AND UNDERGROUND AND OVERHEAD MAPS

Network Capacity Mapping Tool



3/13/2022, 11:14:14 PM

1:9,028

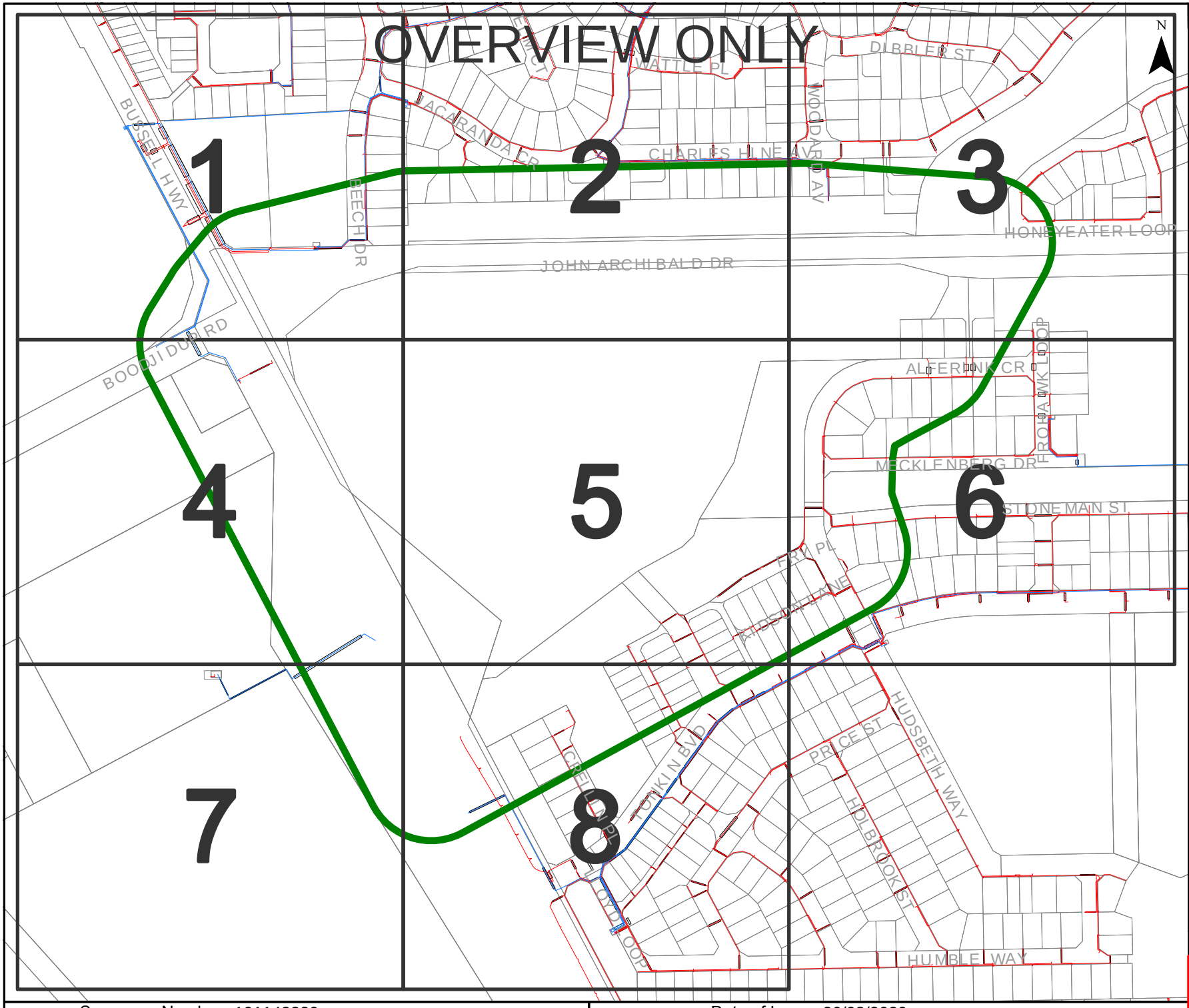
0 0.05 0.1 0.2 mi

0 0.1 0.2 0.4 km

Forecast Remaining Capacity 2036 : WP-028

15 <= x < 20 MVA

Esri, HERE, Garmin, NGA, USGS



westernpower

UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

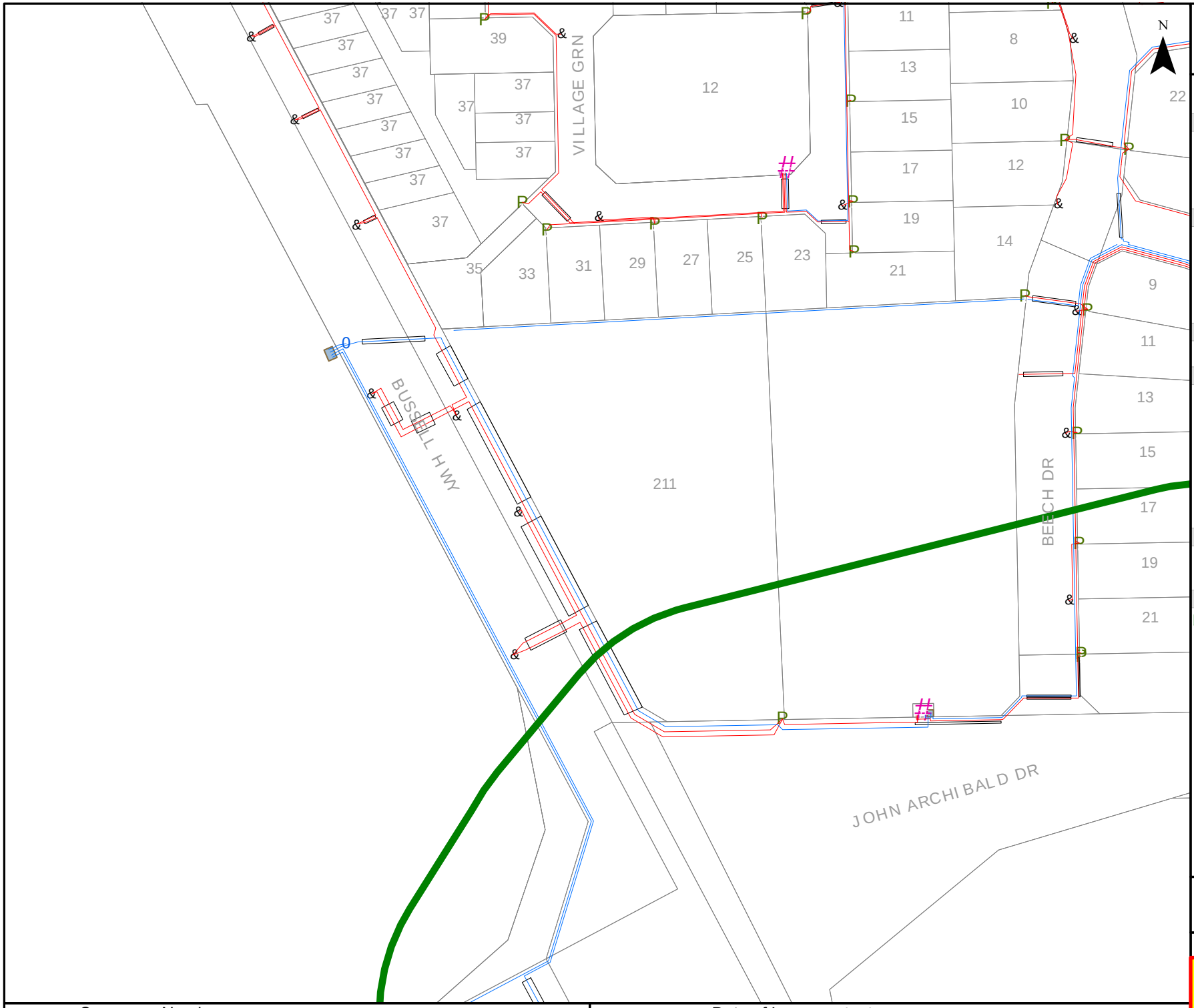
Information valid for 30 days from date of issue

A4	Scale : 1:4612

WARNING! Look out for overhead power lines

Sequence Number: 101142320

Date of Issue: 26/08/2020



westernpower

UNDERGROUND LEGEND

Structures

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- Metal Pole
- Transformer Site
- UG Crossing *
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Distribution Cables

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- Pillar
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- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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A4	Scale : 1:1500

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Sequence Number: 101142320

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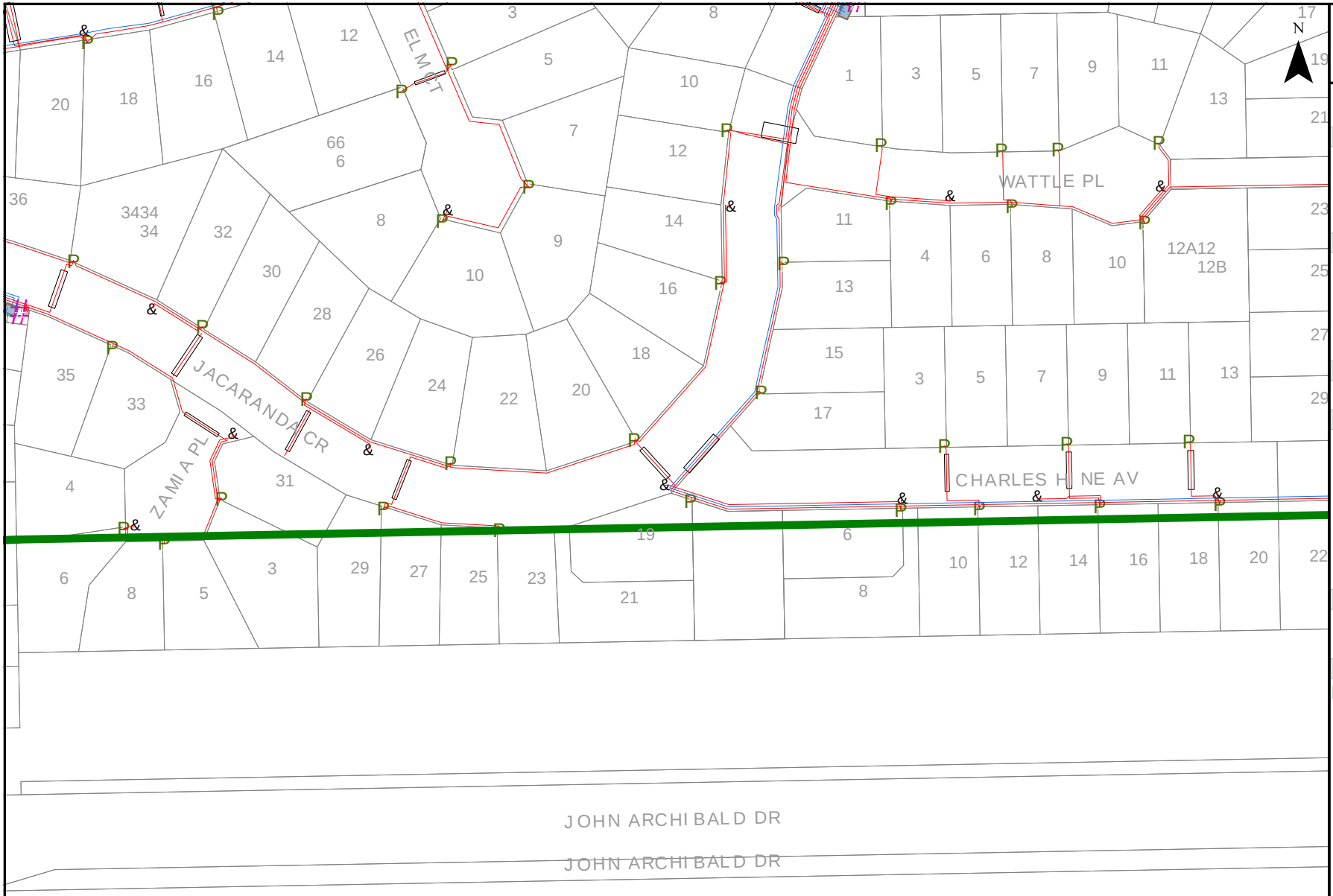

UNDERGROUND LEGEND

Structures

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- Metal Pole
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- UG Crossing *
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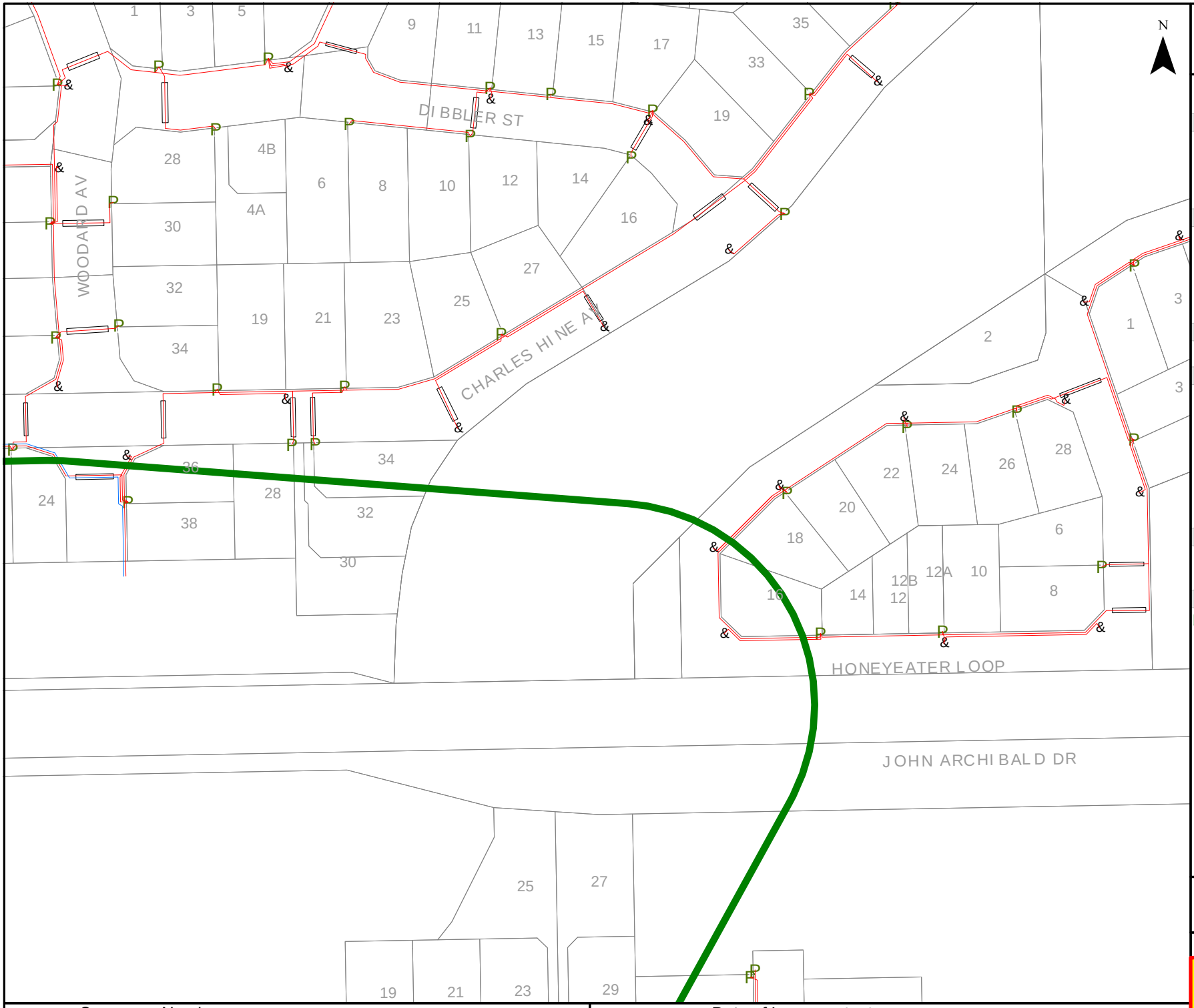

westernpower

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State Underground Power Project

- CURRENT Work Area *
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Feature

- Area of Interest

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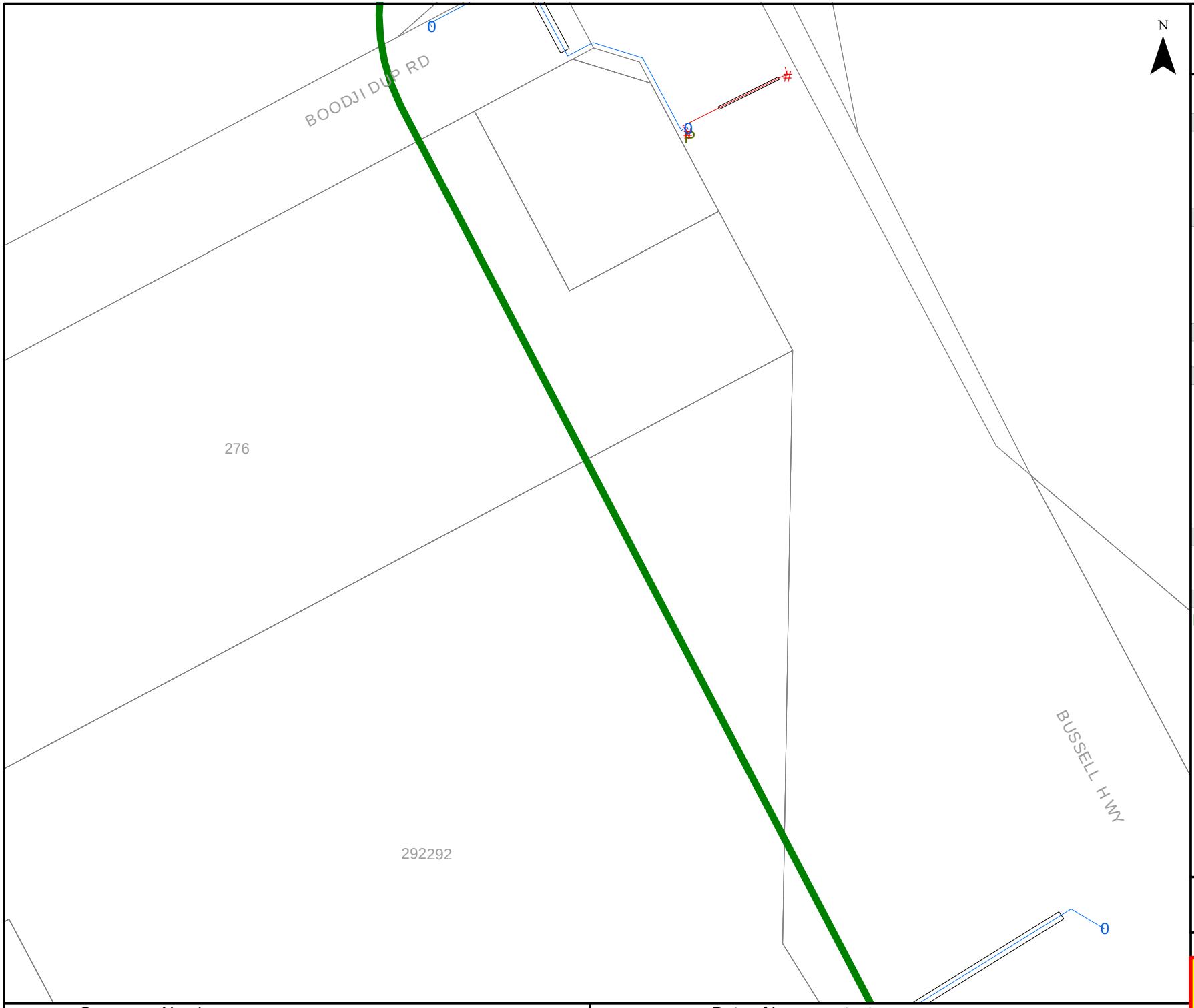

westernpower

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westernpower

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- LV Termination

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- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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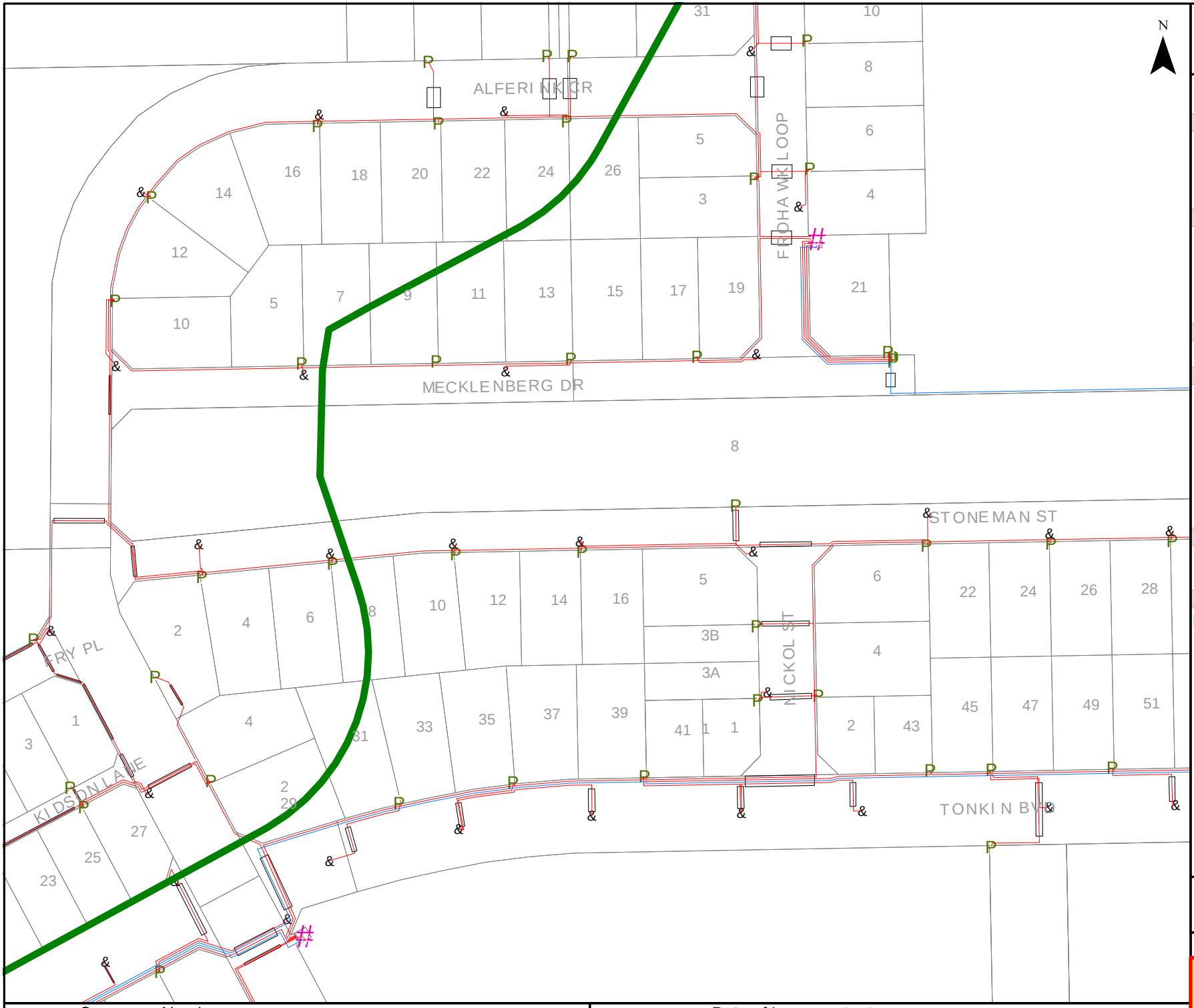

N

westernpower

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Feature

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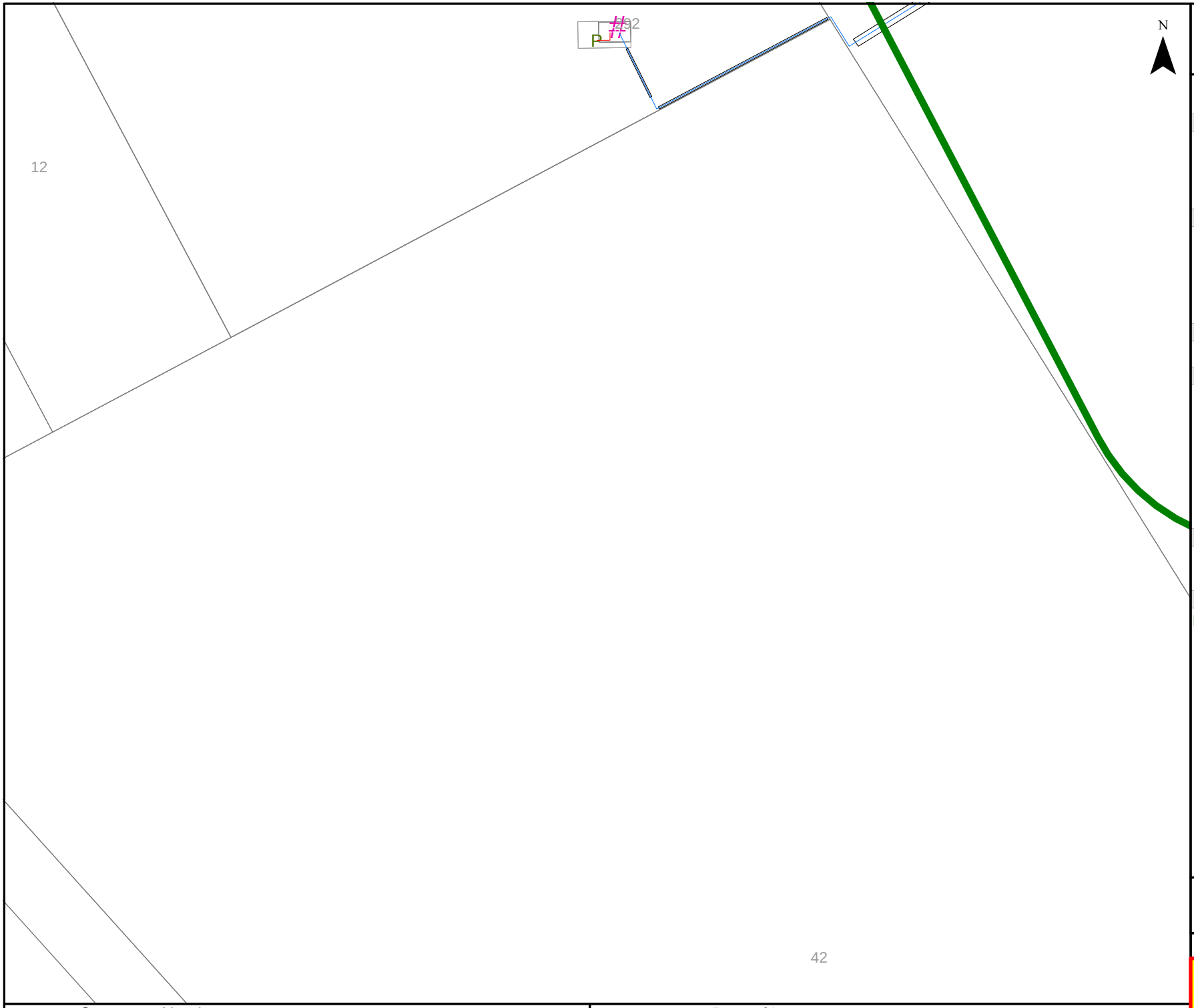

westernpower

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Feature

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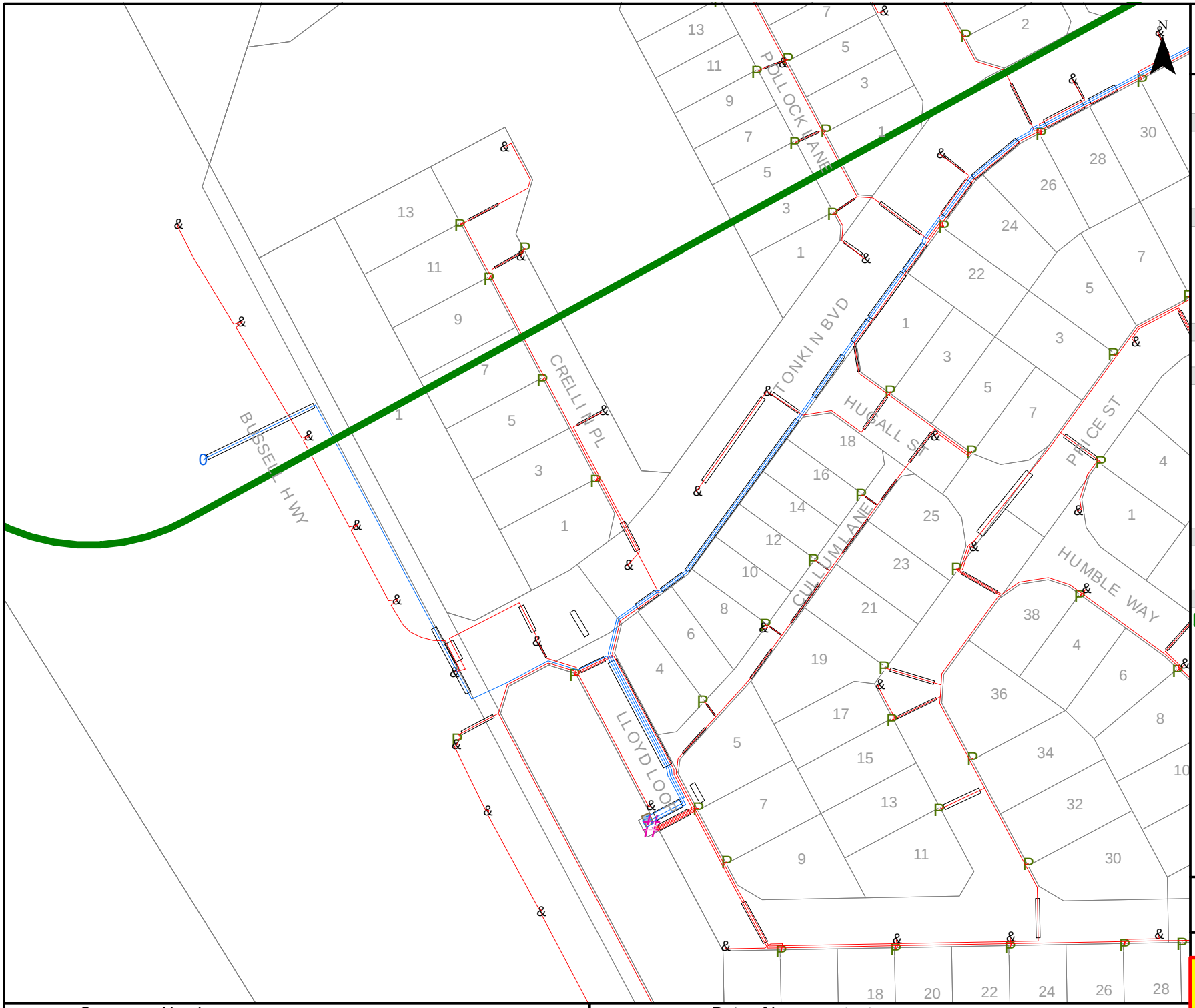

westernpower

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State Underground Power Project

- CURRENT Work Area *
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- Area of Interest

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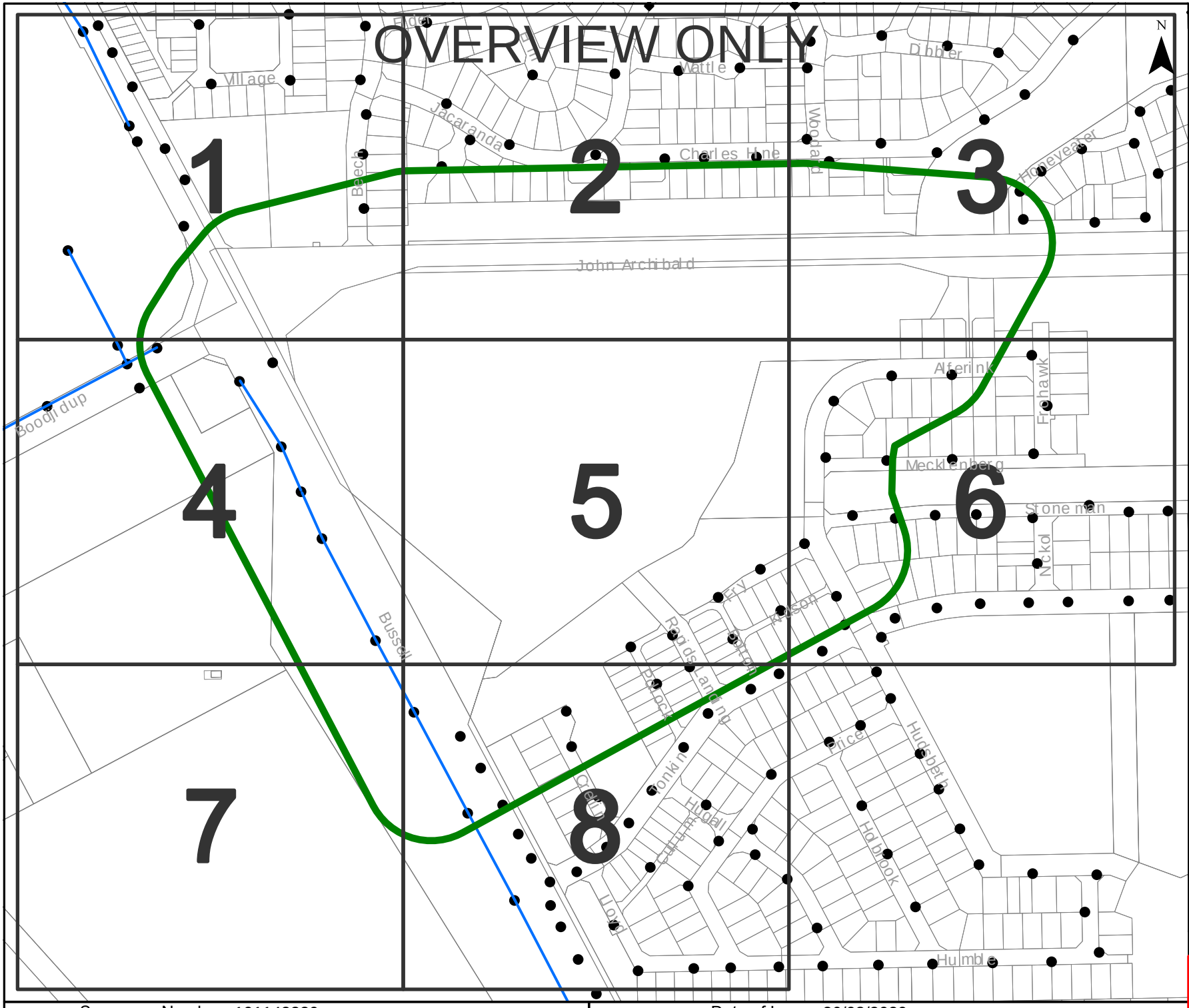

westernpower

OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

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A4	Scale : 1:4612

WARNING! Look out for overhead power lines

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westernpower

OVERHEAD LEGEND

Structures

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Transmission Overhead Powerline

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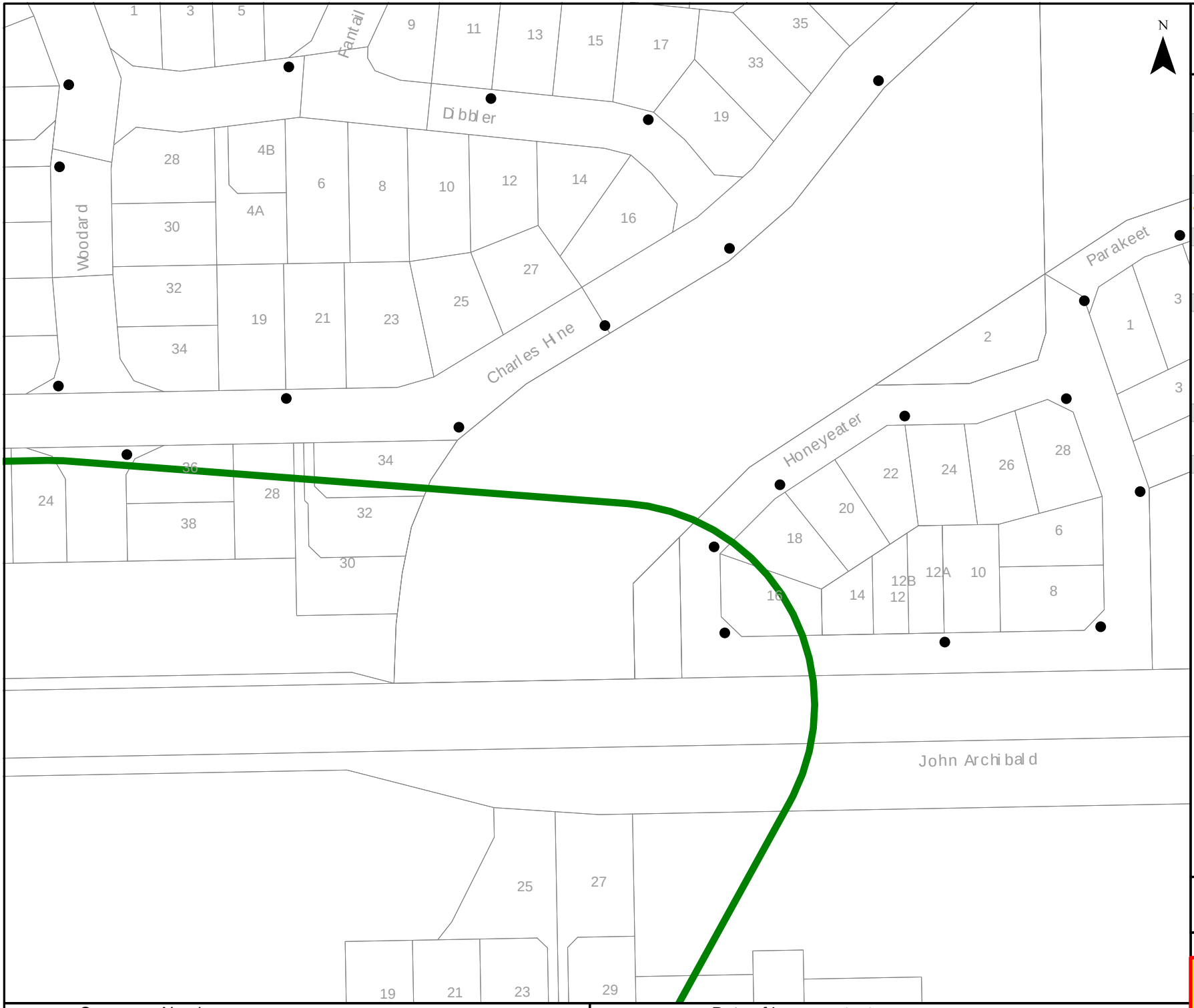

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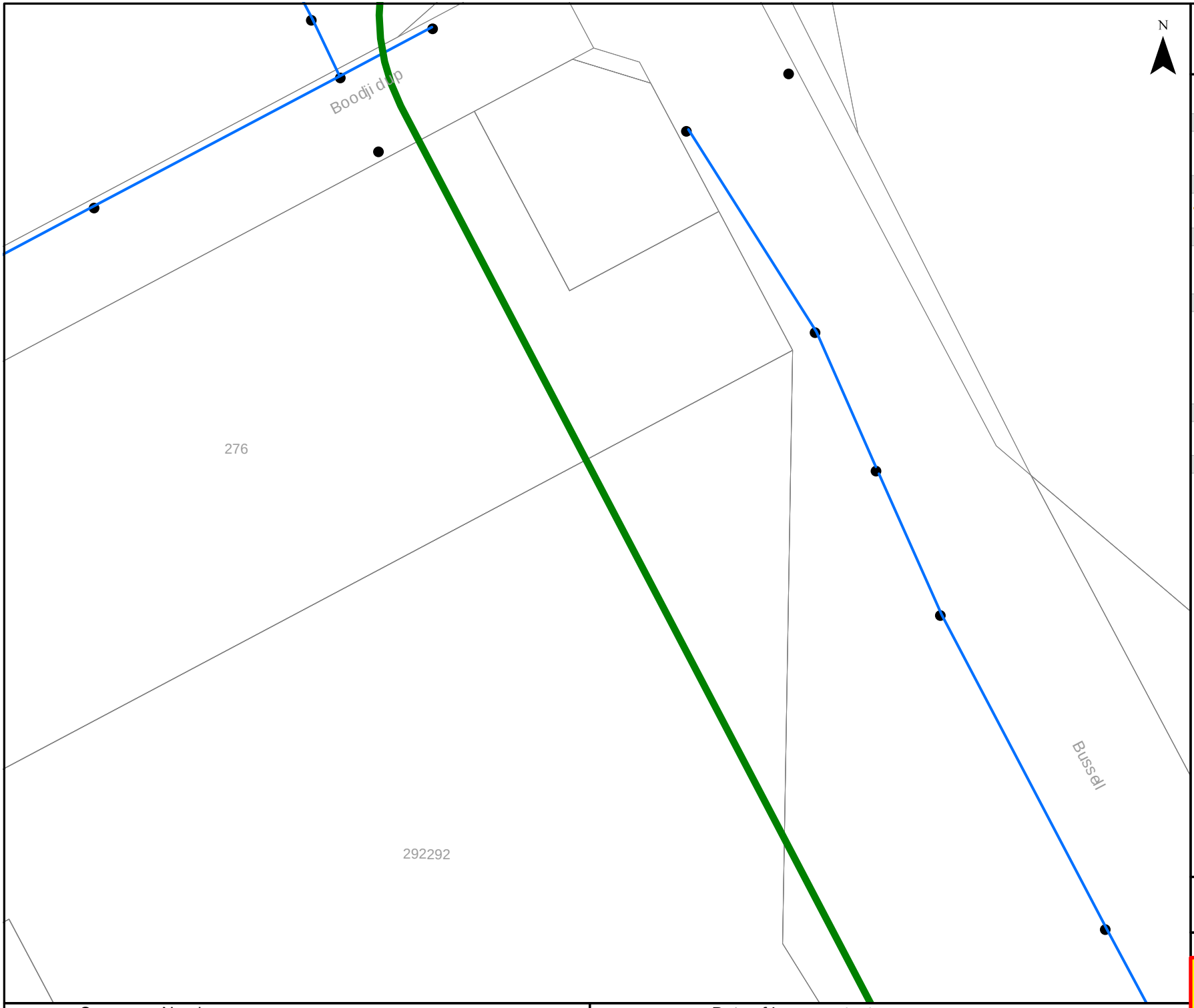

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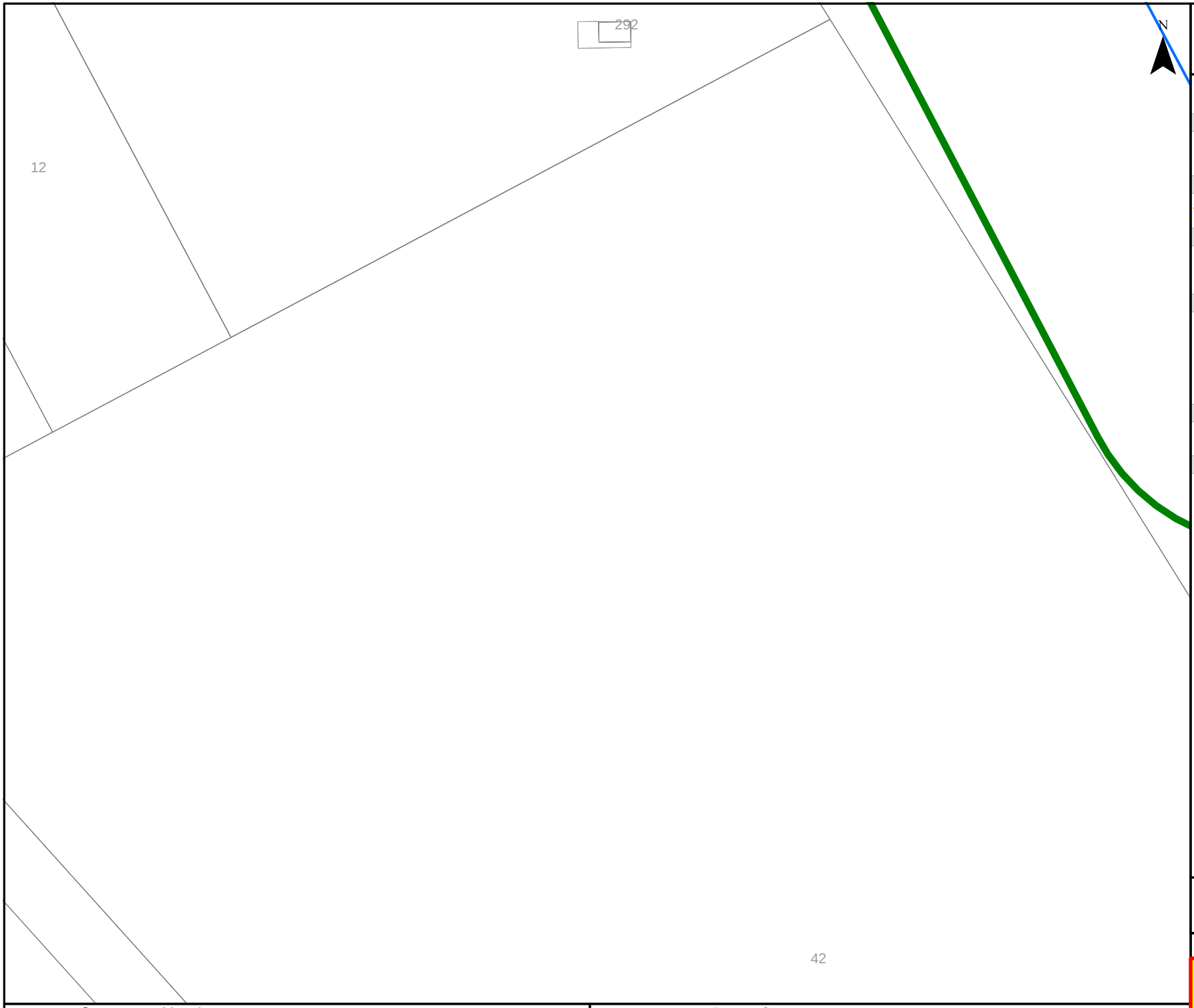

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APPENDIX 10

Bushfire Management Plan
(Bushfire Perth Pty Ltd)

Bushfire Management Plan/Statement addressing the Bushfire Protection

Criteria Coversheet

Site Visit: Yes☒ No☐

		YES	NO
Has the BAL been calculated by a method other than method 1 as outlined in *AS3959* (tick no if *AS3959* method 1 has been used to calculate the BAL)?		☐	☒
Have any of the bushfire protection criteria elements been addressed using a performance principle (tick no if only acceptable solutions have been used to address all the bushfire protection criteria elements)?		☐	☒
Is the proposal any of the following (see SPP 3.7 for definitions)?			
Unavoidable development (in BAL-40 or BAL-FZ)		☐	☒
Strategic planning proposal (including rezoning applications)		☐	☒
High risk land-use		☐	☒
Vulnerable land-use		☐	☒

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

If then why has it been given one of the above listed classifications (E.g. Considered vulnerable land- use as the development is for accommodation of the elderly, etc.)?

The information provided within this bushfire management plan to the best of my knowledge is true and correct

Author: Roderick Cameron BPAD37279 - Date: Thursday, 31 March 2022

BUSHFIRE MANAGEMENT PLAN

Rapids Landing
Lifestyle Community
Margaret River

Project Number: #MP2323

Project Name: RAPID'S LANDING

GPS Address: -33.962114,115.079977

Project Purpose: Structure Plan

Author: Natalia Smirnova

Accreditation No: 43924

Accreditation Expiry Date: 31/10/2022

Bushfire Perth Pty Ltd

Review and Approval Roderick Cameron

Accreditation No: BPAD37279

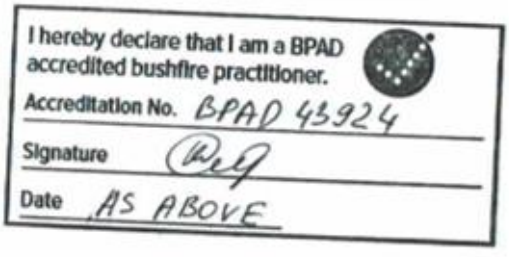
Accreditation Expiry Date: 30/4/2023

Accreditation level: BPAD level 2

Bushfire Perth Pty Ltd

Version: 1

Date of issue: 31 March 2022



Author: Natalia Smirnova

In signing the above, the author declares that this Bushfire Management Plan meets the requirements of State Planning Policy 3.7. This report supersedes all previous Bushfire Management Plans for the site.

DISCLAIMER AND LIMITATION

This report is prepared solely for (the 'proponent') and any future landowners of the subject lot(s)and is not for the benefit of any other person and may not be relied upon by any other person.

The mitigation strategies contained in this Bushfire Management Plan are considered to be prudent minimum standards only, based on the writer's experience as well as standards prescribed by relevant authorities. It is expressly stated that Bushfire Perth.Pty.Ltd and the writer do not guarantee that if such standards are complied with or if a property owner exercises prudence, that a building or property will not be damaged or that lives will not be lost in a bush fire.

Fire is an extremely unpredictable force of nature. Changing climatic factors (whether predictable or otherwise) either before or at the time of a fire can also significantly affect the nature of a fire and in a bushfire prone area it is not possible to completely guard against bushfire.

Further, the growth, planting or removal of vegetation; poor maintenance of any fire prevention measures; addition of structures not included in this report; or other activity can and will change the bushfire threat to all properties detailed in the report. Further, the achievement of the level of implementation of fire precautions will depend on the actions of the landowner or occupiers of the land, over which Bushfire Perth.Pty.Ltd has no control. If the proponent becomes concerned about changing factors then a new Fire Risk Management Plan should be requested.

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2. errors or omissions in this report except where grossly negligent; and

the proponent expressly acknowledges that they have been made aware of this exclusion and that such exclusion of liability is reasonable in all the circumstances.

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Bushfire Perth.Pty.Ltd

Contents Page

1.0 Summary

This Bushfire Management Plan (the Plan) has been prepared to accompany the Structure Plan to support the future application for Rapid's landing lifestyle community to be located on the north-west portion of Lot 9014 Bussell Highway Margaret River (the site'), located in the Shire of Augusta-Margaret River authority area.

The site is has an area of 11.99ha and will be accessed from John Archibald Drive. The site is within a designated bushfire prone area and the proposal requires the application of State Planning Policy No. 3.7: Planning in Bushfire Prone Areas (SPP3.7).

The assessed bushfire risk is considered to be manageable and will be achieved by the identified stakeholders implementing and maintaining the bushfire risk management measures that are presented in this Plan. It has been determined that a maximum radiant heat level of 29KW/m2 or lower is achievable. The Proposal, as set out in this Plan, has addressed all applicable bushfire legislation, policy, standards and guidelines including the four elements of the Bushfire Protection Criteria as follows:

1.1 Aims and Objectives

The aim of this Bushfire Management Plan is to identify issues, requirements and provide bushfire risk mitigation measures for the proposed development. Aims for this site include:

- avoid increasing the threat to people, property and infrastructure
- reduce the developments vulnerability from extreme bushfire behaviour
- allow ingress and egress for fire and emergency services
- consider and minimize environmental impacts.

The objectives of this Bushfire Management Plan are to:

- demonstrate suitability for development
- display bushfire risk levels, fuels, vegetation types and the impact before and after
- show Bushfire management strategies recommended for the site
- demonstrate compliance with the bushfire protection criteria and the use of acceptable solutions for the site.

Key management responsibilities

Developer – Install Roads, Asset Protection Zone and fire hydrants.

Landowner/Occupier – Maintain asset protection zone, comply with local firebreak notices,

Local government – Administration of firebreak notices

2.0 Proposal Details

2.1 Subject Site

The site the subject of this report is located at the north-west portion of Lot 9014 Bussell Highway Margaret River and is located in the Shire of Augusta-Margaret River authority area. Figure 2A illustrates the Structure Plan that is to be considered with the BMP for the subject site. Figure 2B shows the Rapids Landing Lifestyle Community Concept Plan (Prepared by Richard Hammond Architect).

The site is identified as being Bushfire Prone on the Map of Bush Fire Prone Areas 2019 (OBRM, 2019), as illustrated in Figure 2D. This can be confirmed by viewing the state bushfire prone area map at https://maps.slip.wa.gov.au/landgate/bushfireprone/

2.2 Description

The assessed bushfire risk is considered manageable and will be achieved by the identified stakeholders implementing and maintaining the bushfire risk management measures that are presented in this Plan.

The Proposal, as set out in this Plan, has addressed all applicable bushfire legislation, policy, standards and guidelines including the four elements of the Bushfire Protection Criteria

2.3 Previous Bushfire Assessments

No previous BAL assessments have been completed at this location.

This assessment has taken into consideration the Waterway revegetation plan undertaken by Nicole Siemon and Associates PL and the Bill James Landscape Guide Plan.

Figure 2a: *Structure Plan.*

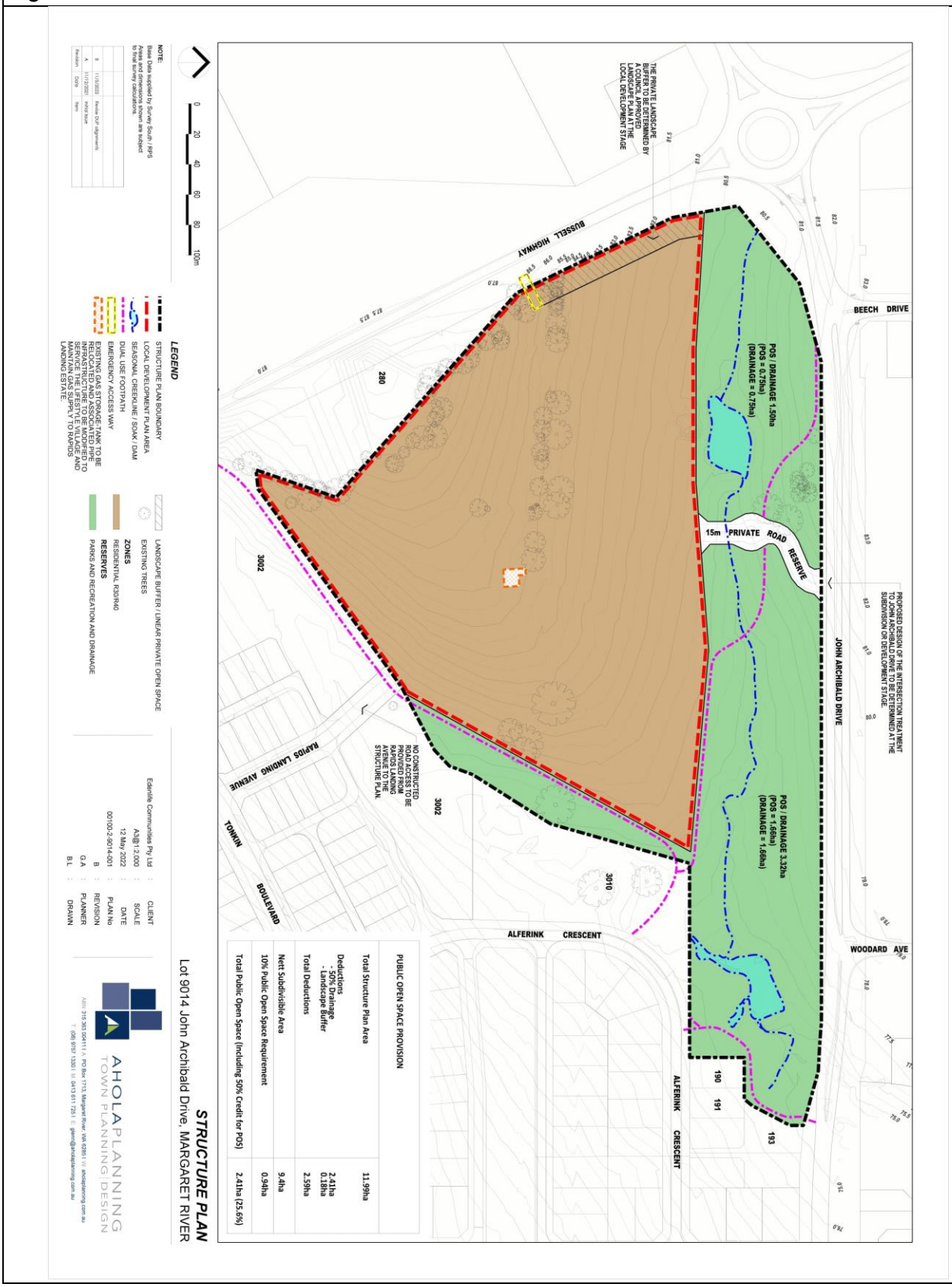


Figure 2B: *Site plan*

Figure 2C: *Subject site and immediate surrounds.*

Legend

Lot - Proposed Revised Boundary
Lot

Existing Lot Boundary
Existing Lot Boundary

Image
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

Cadastre Address (LGATE-002)

Cadastre (No Attributes) (LGATE-001)

Populated Places (Geoscience Australia)

Local Government Authority

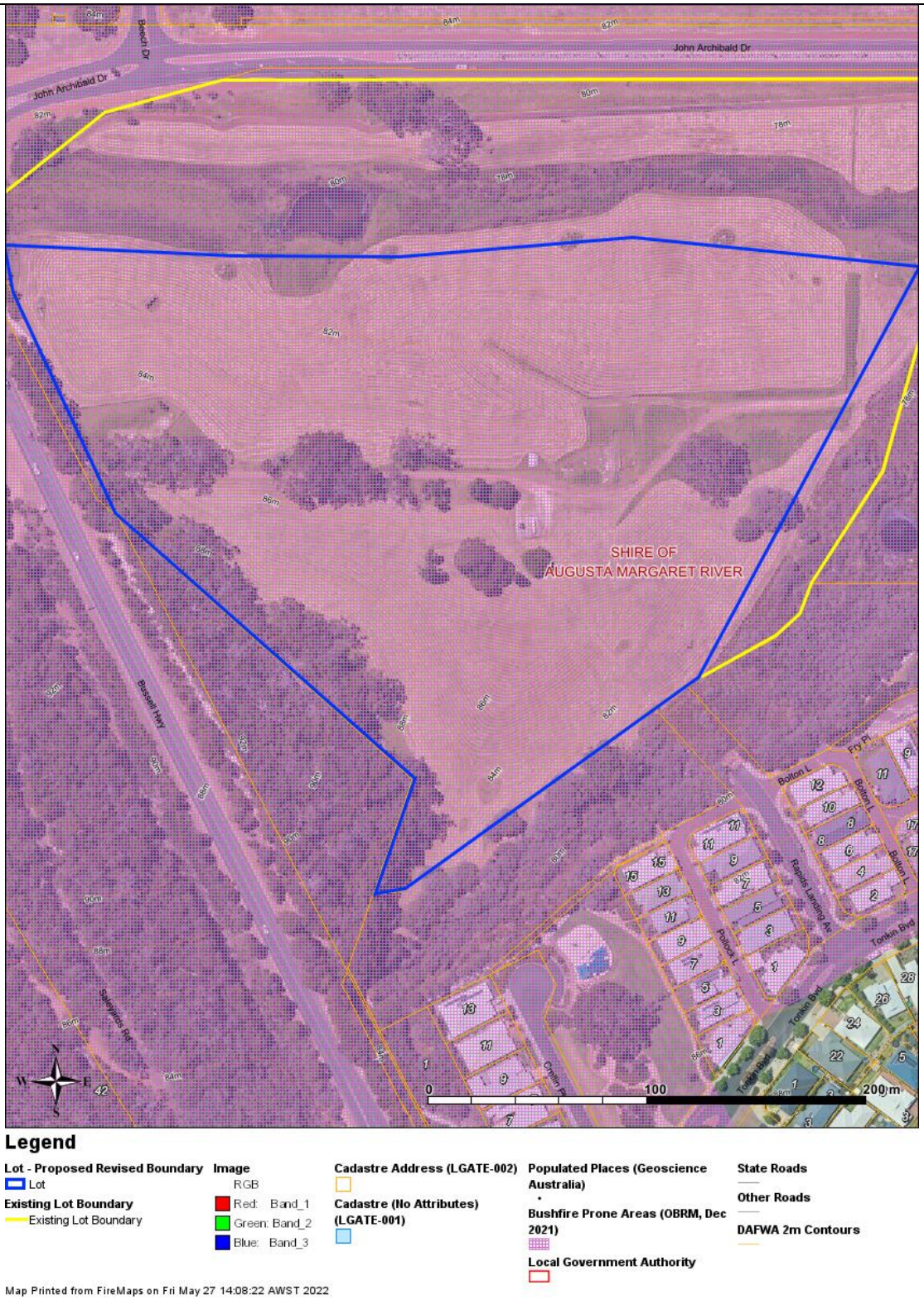
State Roads

Other Roads

DAFWA 2m Contours

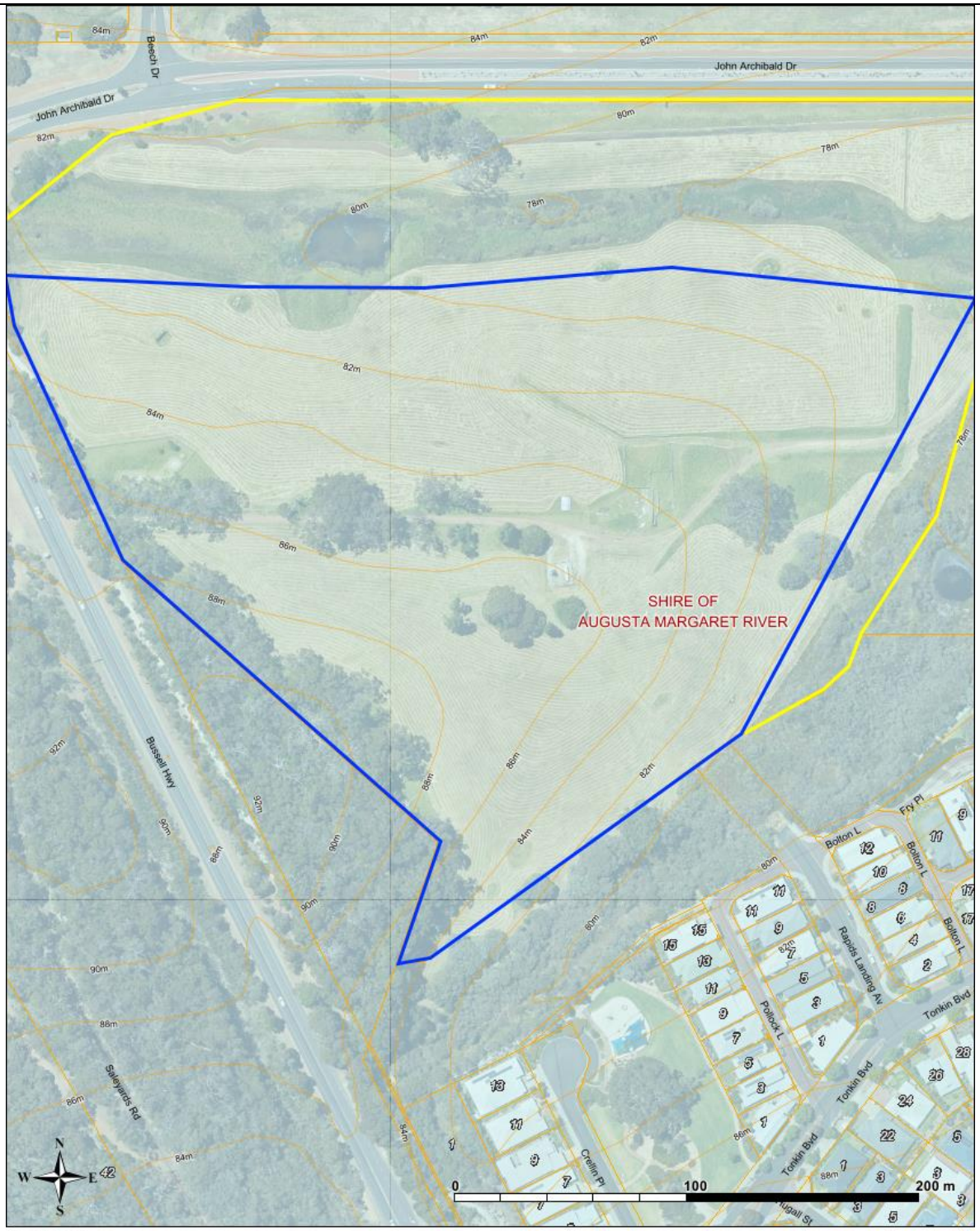
Map Printed from FireMaps on Fri May 27 14:07:06 AWST 2022

Figure 2D: *Designated Bushfire Prone Area (2020) Landgate / SLIP | Landgate/SLIP/OBRM (https://maps.slip.wa.gov.au/landgate/bushfireprone/)*



Designated bush fire prone areas (coloured pink on the map) have been identified by the Fire and Emergency Services Commissioner as being subject, or likely to be subject, to bushfire attack. This site has been in a designated bush fire prone area for longer than four months.

Figure 2E: *2m Contour Lines*



Legend

Lot - Proposed Revised Boundary
Lot

Existing Lot Boundary
Existing Lot Boundary

Image
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

Cadastre Address (LGATE-002)

Cadastre (No Attributes) (LGATE-001)

Populated Places (Geoscience Australia)

Local Government Authority

State Roads

Other Roads

DAFWA 2m Contours

Map Printed from FireMaps on Fri May 27 14:09:16 AWST 2022

3.0 Environmental Considerations

The following environmental considerations have been addressed with the aid of the Firemaps and Australia's NationalMap.

Minimal clearing of vegetation will be required to install Asset Protection Zones. Revegetation and landscaping is proposed as per the Waterway Revegetation Plan (Nicole Siemon & Associates Pty Ltd) and Landscape Guide Plan (Bill James Landscape Architect)

Figure 3A illustrates the identified environmental considerations for the application. The proponent has not identified any additional environmental considerations located within the site.

3.1 Native Vegetation

The site is within an area designated as Native Vegetation Extent. The data used to undertake this map is been progressively updated by the Department of Agriculture post-NLWRA with assistance the Department of conservation and Land Management.

Figure 3A: *Native Vegetation Extent (DPIRD-005)*

3.2 Environmentally Sensitive Areas

The subject site is not located within a environmental sensitive area as per the national map – https://nationalmap.gov.au/

3.3 Re-vegetation & Landscaping

The site will require the installation and maintenance of Asset Protection Zones, areas of the site are known to require re-vegetation and landscaping as outlined in the Waterway Revegetation Plan (Nicole Siemon & Associates Pty Ltd) and Landscape Guide Plan (Bill James Landscape Architect) that will impact the future bushfire threat and as such have been taken into consideration when considering vegetation types within this document.

The following databases have been reviewed for environmental considerations

RAMSAR wetlands (DBCA-010), Threatened and priority flora (DBCA-036) Threatened Ecological Communities (DBCA-038), Bush Forever areas 2000 (DOP-071), Clearing regulations – Environmentally Sensitive Areas (DWER-046), Swan Bioplan Regionally Significant Natural Areas 2010 (DWER-070), Threatened Ecological Communities (DBCA-038), Conservation Covenants Western Australia (DPIRD-023)

Department of Biodiversity, Conservation and Attractions	Known issues
RAMSAR wetlands (DBCA-010)	n/a
Threatened and priority flora (DBCA-036)	n/a
Threatened Ecological Communities (DBCA-038)	n/a

If any databases are found to areas of concern within or nearby the assessment area full size maps will be included within this report for review by decision markers. All databases and online maps used within this report are outside of the control of another of this document and are taken to be correct and available at the time of review.

Figure 3b: *Threatened and priority flora (DBCA-036)*

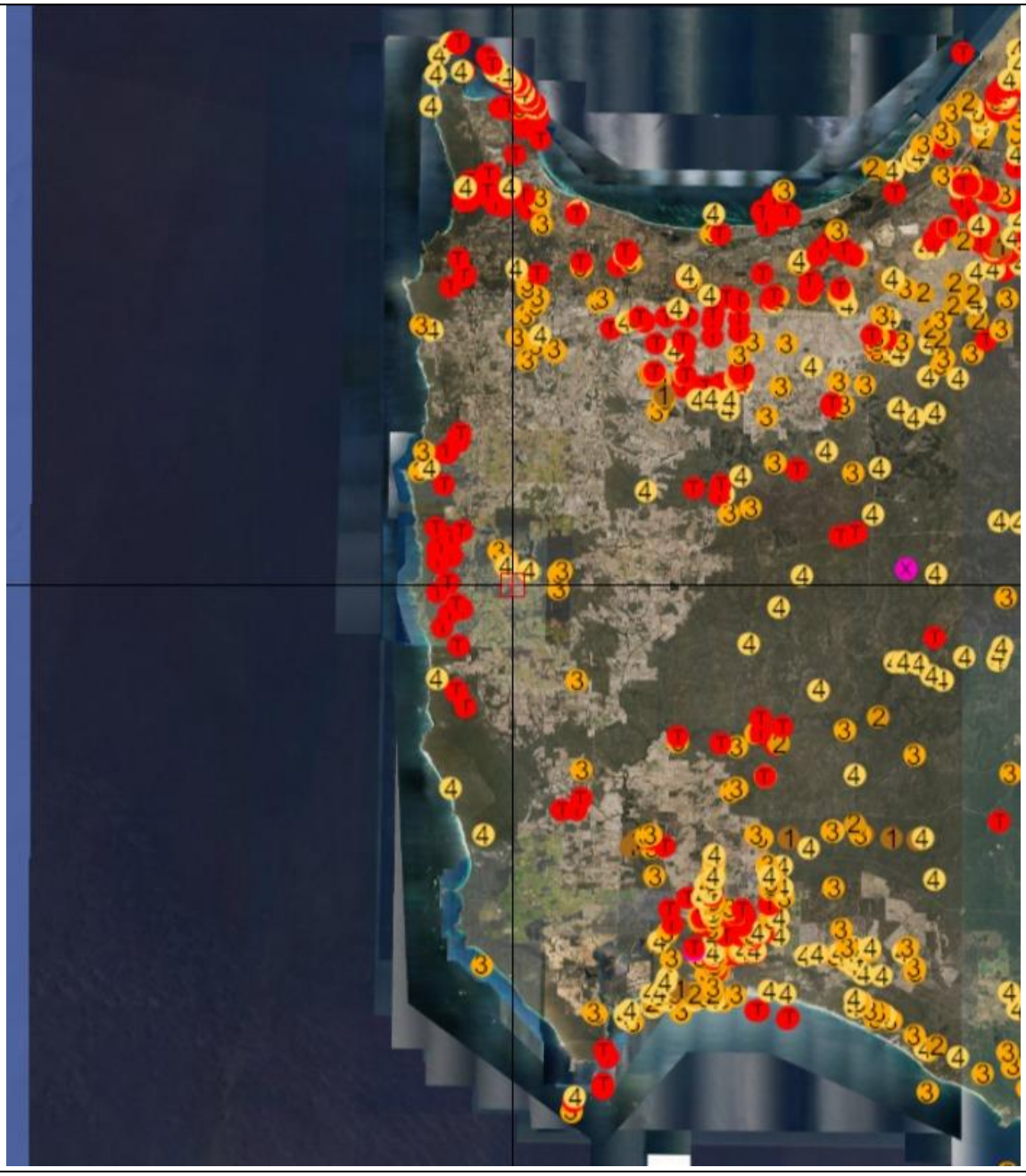


Figure 3c: *Threatened Ecological Communities (DBCA-038)*

Department of Planning, Lands and Heritage	Known issues
Bush Forever areas 2000 (DOP-071)	n/a

Department of Water and Environmental Resources (DWER)	Known issues
Clearing regulations – Environmentally Sensitive Areas (DWER-046)	n/a
Swan Bioplan Regionally Significant Natural Areas 2010 (DWER-070)	n/a

Department of Primary Industries and Regional Development (DPIRD)	Known issues
Conservation Covenants Western Australia (DPIRD-023)	n/a

4.0 Bushfire Threat Assessment

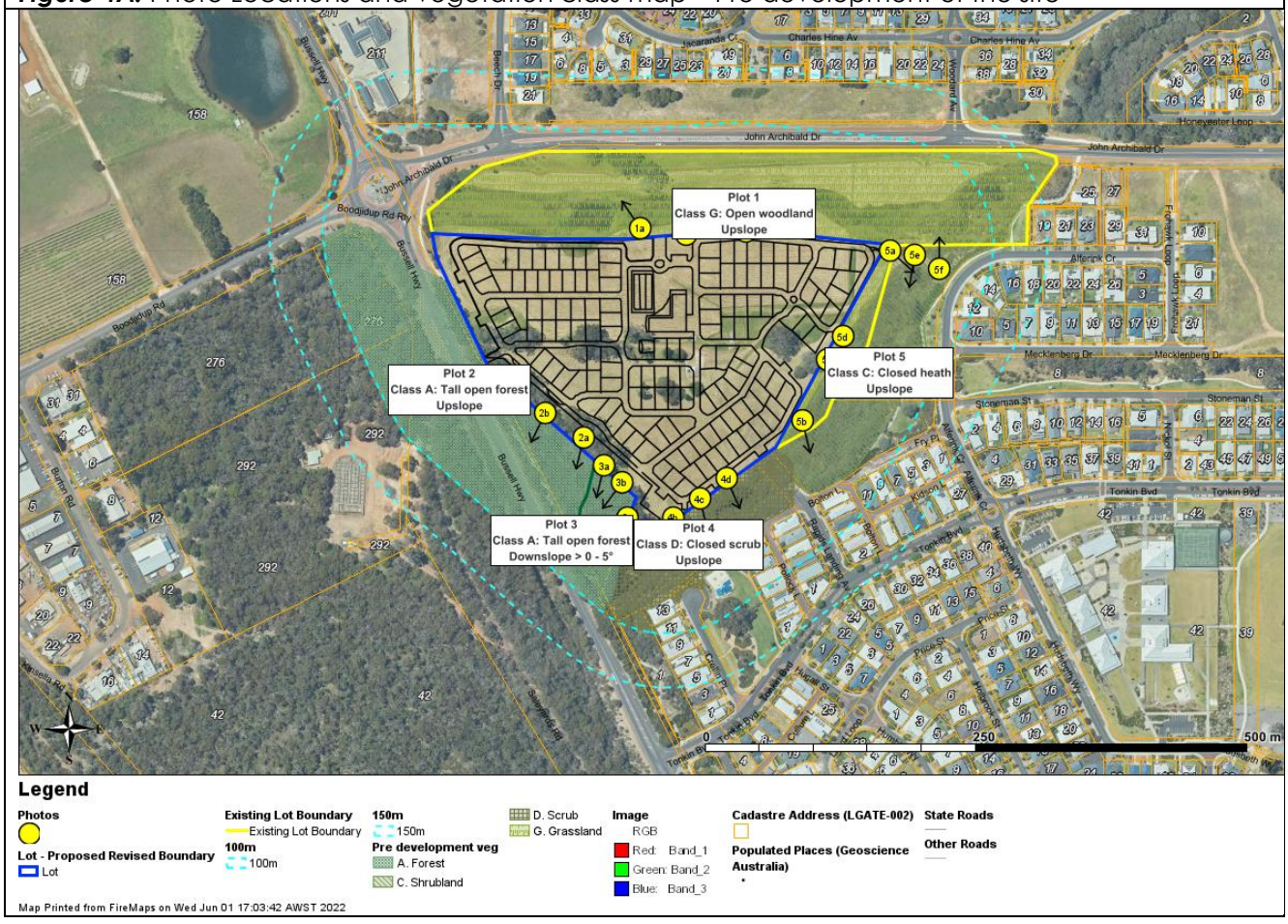
4.1 Effective Slope

Effective slope under each vegetation plot was assessed in accordance with the methodology detailed in AS3959-2018 Construction of buildings in bushfire prone areas (AS3959) (Standards Australia, 2018. The effective slope of each vegetation plot is listed in the tables provided in Section 4.2 below in Table 4A.

4.2 Bushfire Fuels

The location and extent of AS3959-2018 vegetation structures, including Clause 2.2.3.2 exclusions, within 150 metres of the site are mapped in Figures 4A & 4B and illustrated in the photos below. All bushfire structures and fuel loads are assessed in their mature states (including revegetation and rehabilitation areas) unless otherwise identified. The areas of classified vegetation are summarised in Table 4A.
Where relevant, the requirements of the Shire of Augusta-Margaret River (Annual Firebreak and Fuel Load Notice have been referenced to support the classification and/or Exclusion of vegetation as a bushfire threat. A copy of the 2021Annual Firebreak and Fuel Load Notice is included in Appendix 2.

Figure 4A: Photo Locations and vegetation class map – Pre development of the site



Plot 1	
Existing	Class G Grassland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	1a

Class C Shrubland *– area to be revegetated to Waterway Revegetation Plan (Nicole Siemon & Associates Pty Ltd) and Landscape Guide Plan (Bill James Landscape Architect)*

Plot 1	
Existing	Class G Grassland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	1b

Class C Shrubland *– area to be revegetated to Waterway Revegetation Plan (Nicole Siemon & Associates Pty Ltd) and Landscape Guide Plan (Bill James Landscape Architect)*

Plot 1	
Existing	Class G Grassland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	1c

Class C Shrubland *– area to be revegetated to Waterway Revegetation Plan (Nicole Siemon & Associates Pty Ltd) and Landscape Guide Plan (Bill James Landscape Architect)*

Plot 2	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Upslope/0
Photo ID	2a

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 2	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Upslope/0
Photo ID	2b

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 2	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Upslope/0
Photo ID	2c

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 2	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Upslope/0
Photo ID	2d

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 3	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Downslope/4
Photo ID	3a

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 3	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Downslope/4
Photo ID	3b

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 3	
Existing	Class A Forest
Post Development	Class A Forest
Effective Slope	Downslope/4
Photo ID	3c

Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Plot 4	
Existing	Class D Scrub
Post Development	Class D Scrub
Effective Slope	Upslope/0
Photo ID	4a

Scrub vegetation typically with continuous horizontal and vertical vegetation structures, greater than 2 metres high.

Plot 4	
Existing	Class D Scrub
Post Development	Class D Scrub
Effective Slope	Upslope/0
Photo ID	4b

Scrub vegetation typically with continuous horizontal and vertical vegetation structures, greater than 2 metres high.

Plot 4	
Existing	Class D Scrub
Post Development	Class D Scrub
Effective Slope	Upslope/0
Photo ID	4c

Scrub vegetation typically with continuous horizontal and vertical vegetation structures, greater than 2 metres high.

Plot 4	
Existing	Class D Scrub
Post Development	Class D Scrub
Effective Slope	Upslope/0
Photo ID	4d

Scrub vegetation typically with continuous horizontal and vertical vegetation structures, greater than 2 metres high.

Plot 4	
Existing	Class D Scrub
Post Development	Class D Scrub
Effective Slope	Upslope/0
Photo ID	4e

Scrub vegetation typically with continuous horizontal and vertical vegetation structures, greater than 2 metres high.

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5a

Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5b
Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.	

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5c

Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5d

Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5e

Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.

Plot 5	
Existing	Class C Shrubland
Post Development	Class C Shrubland
Effective Slope	Upslope/0
Photo ID	5f

Shrubs <2 m high; greater than 30% foliage cover with overstorey tree coverage less than 10%.

Table 4A *Areas of classified vegetation (post-development):*

Vegetation Plot	Vegetation Classification	Effective Slope
Plot 1	Exclusion 2.2.3.2 (F)	N/A
Plot 2	Class A Forest	Upslope/0
Plot 3	Class A Forest	Downslope/4
Plot 4	Class D Scrub	Upslope/0
Plot 5	Class C Shrubland	Upslope/0

* Asset protection zone to be installed to standard stated in this fire management plan

Figure 4B: *Vegetation Classifications (post-development)*

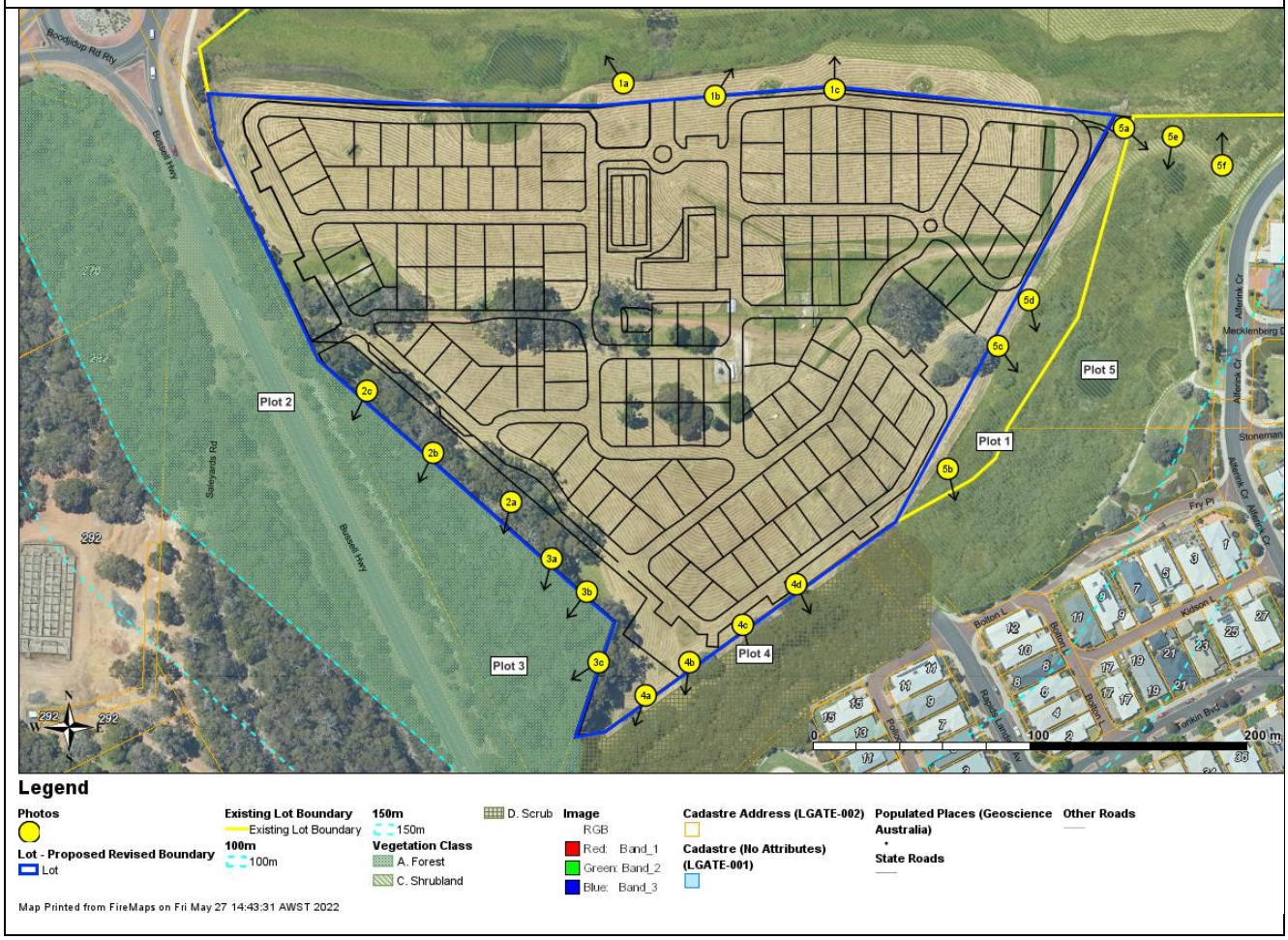


Figure 4C: *Vegetation Classifications – including Photo Points*

5.0 Bushfire Hazard Issues

5.1 Potential Bushfire Impact

Potential bushfire impact analysis was undertaken in accordance with AS3959-2018 Methodology 1 (Basic BAL assessment) to determine the potential worst-case scenario radiant heat impact on each lot within the proposed application.

In accordance with SPP 3.7, BAL Contour Maps have been prepared to illustrate the potential radiant heat impacts and associated BAL ratings for the assessment area after the application is completed (see Figures 5A & 5B). The resulting ***maximum*** BAL ratings for each proposed lot are presented in the following table (Table 5A).

MAP 1

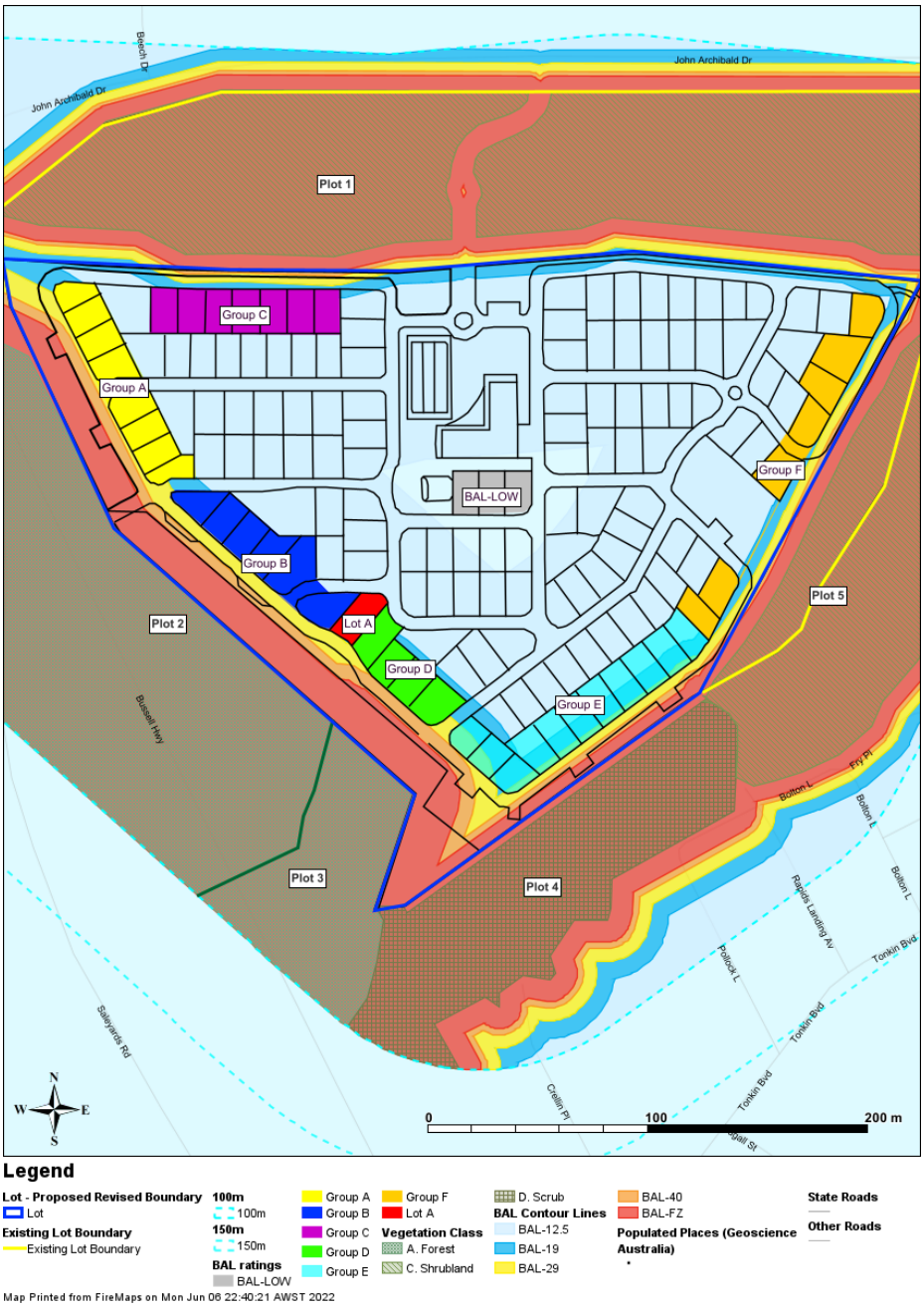


Table 5A: *Maximum BAL rating assessed at the proposed lot boundaries (AS3959-2018 Method 1)*

Sites	Vegetation Classification	Effective Slope	Vegetation Separation	Maximum BAL
Group A	Class A Forest	Upslope/0	21m	Bal 29
Group B	Class A Forest	Upslope/0	26m (5m setback)	BAL-19
Group C	Class A Forest	Upslope/0		BAL-29
Group D	Class A Forest	Downslope/-4	27m	BAL-29
Group E	Class A Forest	Upslope/0	18m	BAL-29
Group F	Class C Shrubland	Upslope/0	14m	BAL-19
Lot A	Class A Forest	Upslope/0	31m	BAL-19

All lots within the estate are BAL-29 or less with 3 lots located in the centre BAL-LOW as per map 1

Bushfire attack level (BALs) have been assessed using method 1 as per AS3959-2018. All lots within the proposed development site can achieve BAL-29 or lower.

Figure 5A: *BAL Contour Map (overview)*

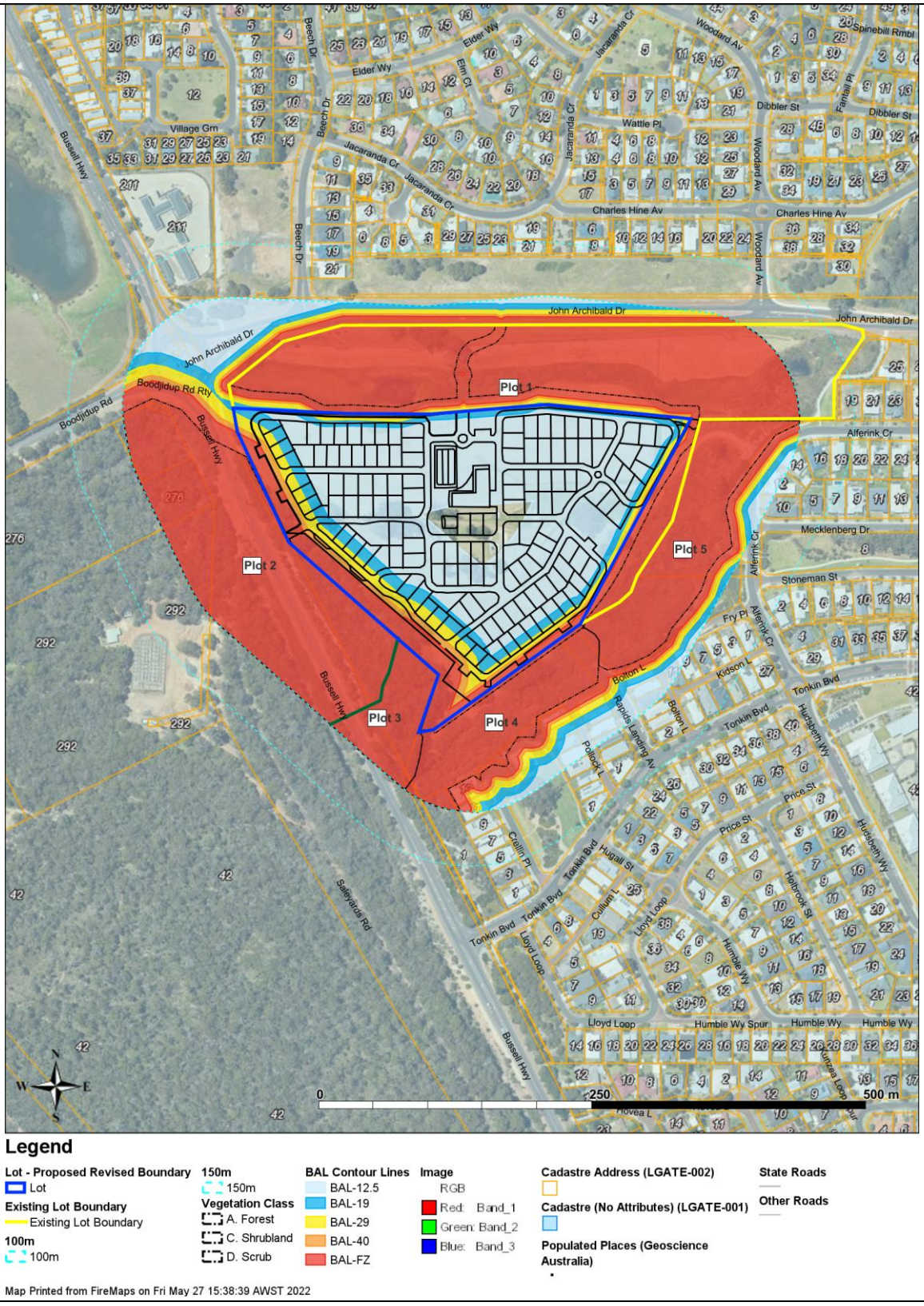
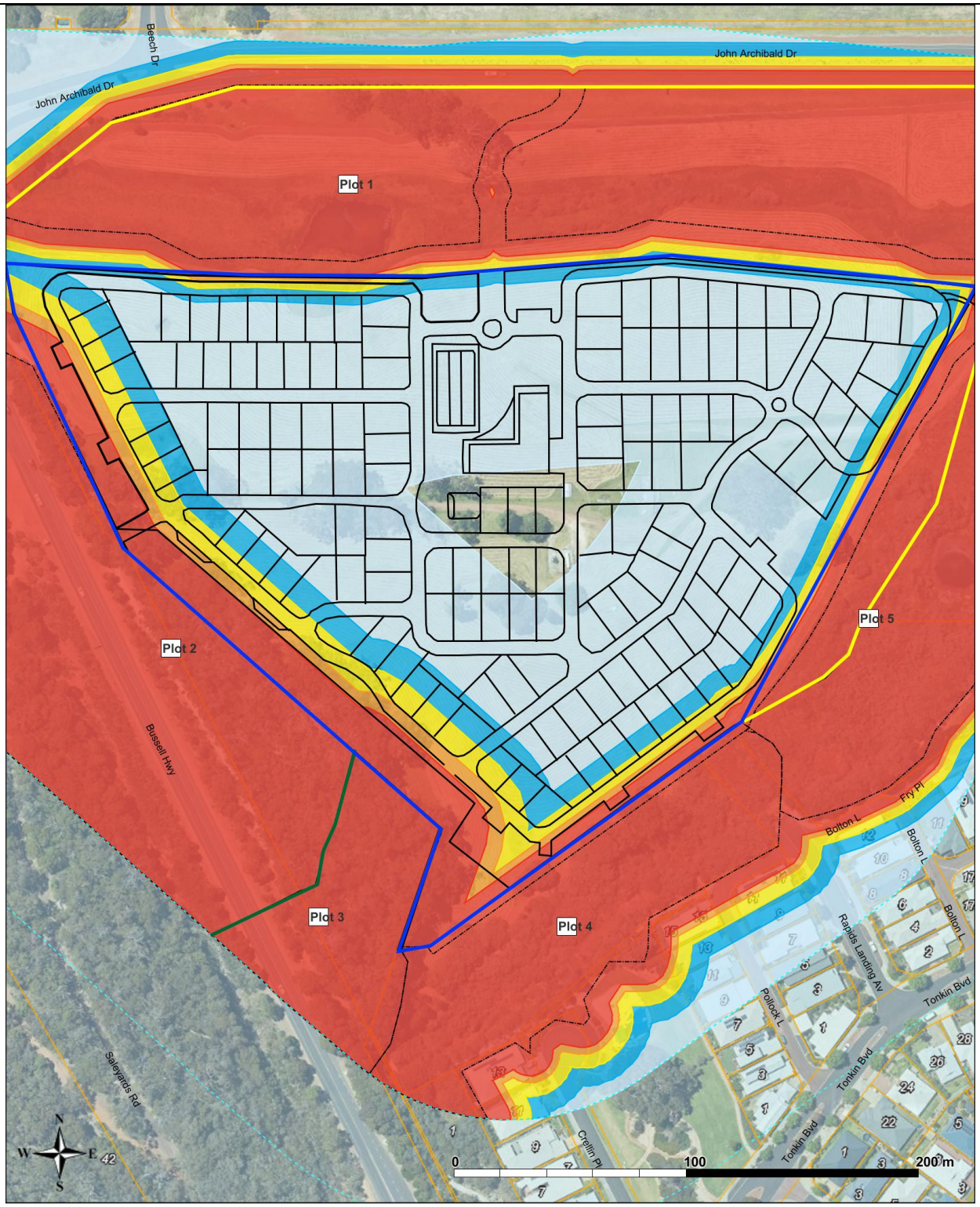


Figure 5B: *BAL Contour Map (detailed view)*



Legend

Lot - Proposed Revised Boundary
Lot

Existing Lot Boundary
Existing Lot Boundary

100m
100m

150m
150m

Vegetation Class
A. Forest
C. Shrubland
D. Scrub

BAL Contour Lines
BAL-12.5
BAL-19
BAL-29
BAL-40
BAL-FZ

Image
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

Cadastre Address (LGATE-002)

Cadastre (No Attributes) (LGATE-001)

Populated Places (Geoscience Australia)

State Roads

Other Roads

Map Printed from FireMaps on Fri May 27 15:38:19 AWST 2022

5.2 Bushfire Hazard Issues

The intent of State Planning Policy (SPP) 3.7 Planning in Bushfire Prone Areas (Department of Planning and Western Australian Planning Commission, 2015) is to ensure that bushfire risks are considered in a timely manner and that planning documents demonstrate the appropriate application of the various policy measures. Table 3 summarises the intent and objectives of SPP 3.7 and provides evidence of how the site complies.

From the BAL Assessment and BAL Contour Maps, the following bushfire hazard issues have been identified:

- The proposed lots are subject to a rating of BAL 29 or less when assessed subject to appropriate siting.
- Asset Protection Zones are required to be maintained to ensure the BAL ratings for future applicable buildings are not impacted by any onsite vegetation. This is addressed in Section 6 of this report.
- The BAL ratings provided in the BAL Contour Maps and associated tables are indicative only and are for the purposes of demonstrating compliance with the bushfire protection criteria of SPP 3.7. Individual BAL assessments are required to determine the final BAL ratings for applicable buildings prior to the issuance of building permits.
- Future residential buildings and any associated Class 10a buildings are to be constructed to the applicable construction standard of AS3959.
- Due to the proposed development being subject to a rating above BAL-LOW the relevant bushfire protection criteria apply and are addressed in Section 6 of this report.

6.0 Bushfire Protection Criteria

6.1 Guidelines for Planning in Bushfire Prone Areas Version 1.4 (the Guidelines)

The Guidelines apply to applications located within designated bushfire prone areas. The Guidelines provide supporting information for implementation of SPP 3.7. Specifically, they provide the Bushfire Protection Criteria to be address for all applications.

6.2 Proposal Assessment

Table 6A provides an assessment against the bushfire protection criteria detailed in appendix4 of the Guidelines, including the applicable Acceptable Solutions for each element.

Table 6A: *Assessment against the bushfire protection criteria of the Guidelines*

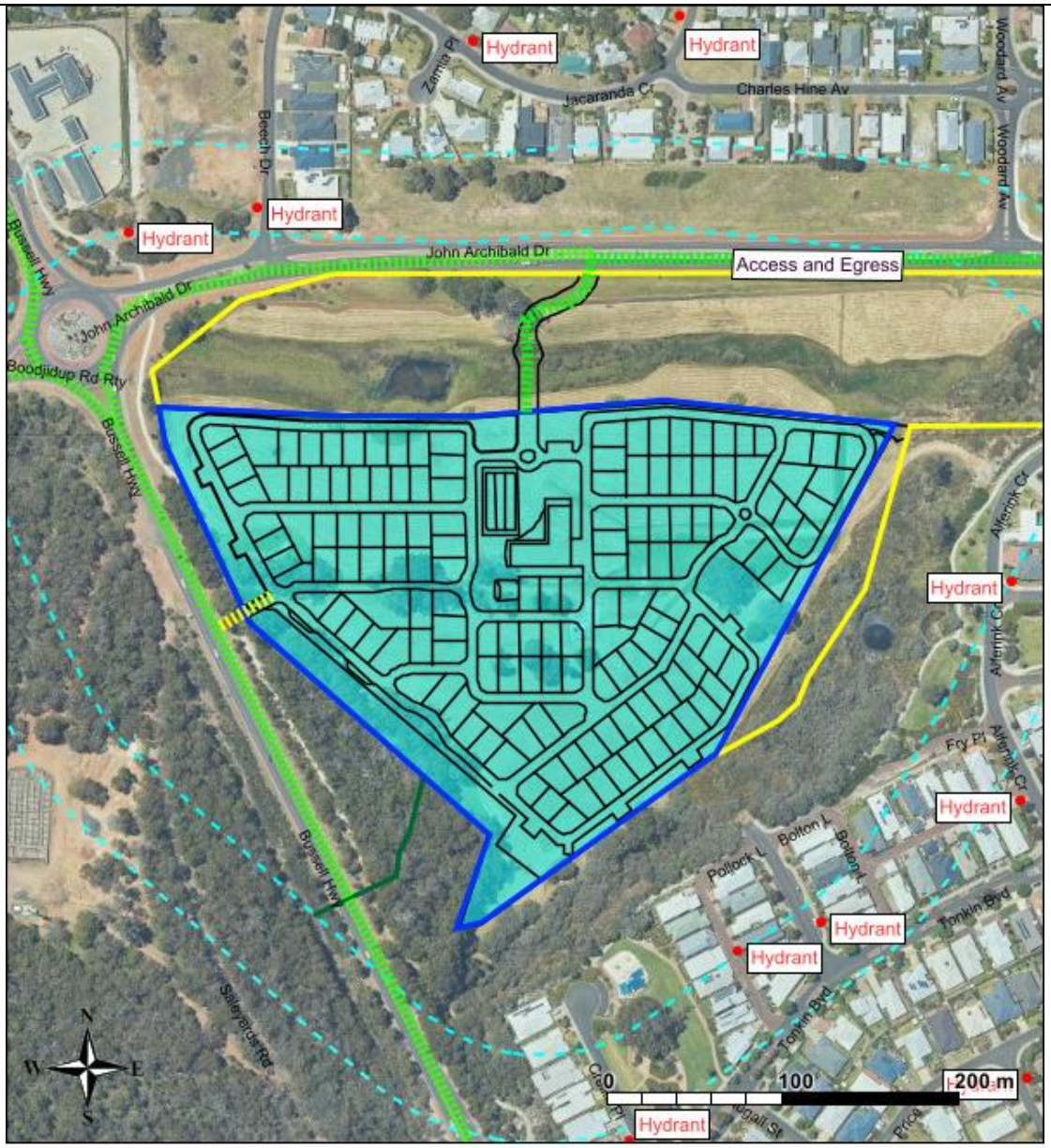
Element	Acceptable Solution (A)	Compliance	Notes
1. Location	A1.1 Development location	**YES**	The development location is assessed as capable of achieving a maximum BAL-29 for dwellings subject to appropriate siting.
2. Siting of Development	A2.1 Asset Protection Zone	**YES**	APZs to be implemented prior to the clearance of the site for affected lots in accordance with Figure 6A and is to be maintained in accordance with the specifications detailed in Appendix 1.
3. Vehicular Access	A3.1 Public road	**YES**	Public roads are required to comply to the standard as outlined in Appendix 3 "Public Roads"
	A3.2a Multiple access routes	**YES**	The estate can be directly accessed from John Archibald Drive to the North of the site and Bussell Hwy (to be used as emergency access) to the West allowing access and egress the greater area public road network providing access in multiple directions.
	A3.2b Emergency access way	**YES**	No emergency access ways are required.
	A3.3 Through-roads	**YES**	Site requires all roads within the site are through-roads.
	A3.4a Perimeter roads	**YES**	Site is required to have perimeter roads more information can be found in Appendix 4
	A3.4b Fire service access route	**YES**	No fire service access routes are required as part of this site

Element	Acceptable Solution (A)	Compliance	Notes
	A3.5 Battle-axe access legs	**N/A**	Battle-axes are not part of this application.
	A3.3 Cul-de-sac	**N/A**	No cul-de-sacs are part of this application.
	A3.6 Private driveways longer than 50m	**N/A**	No driveways are required for this application.
	A3.6 Emergency access way	**N/A**	No emergency access ways are required.
	A3.7 Fire service access routes	**N/A**	No fire service access routes are required as part of this application.
4. Water	A4.1 Identification of future water supply	**YES**	The area is required to have fire hydrants installed that meet the specifications of the water corporation design standard DS 63 and DFES.
	A4.2 Provision of water for firefighting purposes	**N/A**	The area is required to have fire hydrants installed that meet the specifications of the water corporation design standard DS 63 and DFES.

6.3 Bushfire Management Strategies

The required risk management measures, as detailed in Table 6A, are illustrated in the following Bushfire Management Strategies Map (Figure 6A)

Figure 6A: *Bushfire Management Strategies Map*



Legend

Access and Egress
Access and Egress
Emergency access

Lot - Proposed Revised Boundary
Lot

Existing Lot Boundary
Existing Lot Boundary

Asset Protection Zone
Asset Protection Zone

Hydrants
Abandoned
Existing
Inactive

100m
100m

150m
150m

Road Access
Road Access

Image
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

Populated Places (Geoscience Australia)

State Roads

Other Roads

Map Printed from FireMaps on Mon Jun 06 23:02:46 AWST 2022

Table 7A: *Schedule of Required Works*

Developer	
No.	**Management Action**
1	Install asset Protection Zone (APZ) to the standards stated in the Bushfire Management Plan.
2	Make this report available to all new occupiers.
3	Install Roads within the estate as outlined in Appendix 3
4	Hydrants required "The area is required to have fire hydrants installed that meet the specifications of the water corporation design standard DS 63 and DFES.
5	Maintain Public Open Space in accordance with the approved Waterway revegetation Plan and Landscape Guide Plan, i.e. in a low fuel state until handed over to local government or management after 2 years or as agreed with the local government;
6	Lodging a section 70A Notification on each Certificate of Title proposed development lot. The notification shall alert purchasers of land and successors in Title of the responsibilities of this Bushfire Management Plan;

Landowner/Occupier	
No.	**Management Action**
1	On an ongoing basis, maintain the Asset Protection Zones (APZ) to the standards stated in the Bushfire Management Plan
2	Each year, comply with the relevant local government Annual Firebreak and Fuel Load Notice issued under s33 of the Bush Fires Act 1954.

Local Government	
No.	**Management Action**
1	Administration of firebreak notices and asset protection zones
2	Maintain Public Open Space in accordance with the approved Foreshore Management Plan and Landscape Management Plan, i.e. in a low fuel state, after 2 years of management by the developer or as otherwise agreed.
3	Maintain public roads to appropriate standards ensuring compliance with standards.

4	Maintaining, in good order, the condition of the district water tanks and fire hydrants and the apparatus for firefighting purposes.
5	Provision of fire prevention and preparedness advice to landowners upon request

7.0 References

Shire of Augusta-Margaret River. Annual Firebreak and Fuel Load Notice 2021 Shire of Augusta-Margaret River, WA.

OBRM. (2019). Map of Bush Fire Prone Areas 2019. Office of Bushfire Risk Management. Perth, WA.

Standards Australia. (2009). AS3959-2018 Construction of buildings in bushfire prone areas. SAI Global.

WAPC. (2015). State Planning Policy 3.7 Planning in Bushfire Prone Areas. Western Australian Planning Commission & Department of Planning.

WAPC. (2016). Planning Bulletin 111/2016 Planning in Bushfire Prone Areas. Western Australian Planning Commission.

WAPC. (2022). Guidelines for Planning in Bushfire Prone Areas Version 1.4. Western Australian Planning Commission, Department of Planning & Department of Fire and Emergency Services.

Table A1: Abbreviations- General terms

APZ	Asset Protection Zone
AS3959	*Australian Standard AS3959-2018 Construction of buildings in bushfire prone areas*
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
FDI	Fire Danger Index
FZ	Flame Zone
MRS	Metropolitan Regional Scheme
POS	Public Open Space

Appendix 1 – Asset Protection Zone Specifications

Source: Guidelines for Planning in Bushfire Prone Areas (DoP/DFES v1.4 2022)

Landscaping and design of an asset protection zone

Landscaping, design, and maintenance of an APZ in a bushfire prone area can significantly improve the bushfire resilience of a building. An APZ should not be seen as an area entirely cleared of vegetation, but as a strategically designed space that gives holistic consideration to how existing or proposed vegetation or non-combustible features interact with, or affect the building's bushfire resilience.

A well designed APZ provides a greater level of vegetation management within the first few metres of a building with, for example, less vegetation or inclusion of non-combustible materials. The vegetation within the remainder of an APZ can increase further away from the building with carefully considered plant selection and landscaping techniques.

Strategic landscaping measures can be applied, such as replacing weeds with low flammability vegetation (refer to E2 Plant Flammability) to create horizontal and vertical separations between the retained vegetation. The accumulation of fine fuel load from different plants is an important consideration for ongoing maintenance in accordance with Schedule 1. For example, when planting ground covers under deciduous trees within an APZ, the total fine fuel load prescribed in Schedule 1 will include any dead plant material from ground covers and leaf litter from the trees.

Plant density and final structure and form of mature vegetation should be considered in the initial landscaping stages. For example, clumps of sapling shrubs planted at a density without consideration of future growth, may increase the bushfire risk as a clump will quickly grow to exceed 5m2. It should be noted that in some cases, a single shrub in a mature state may be so dense as to fill a 5m2 clump alone.

The location of plants within an APZ is a key design technique. Separation of garden beds with areas of low fuel or non-combustible material, will break up fuel continuity and reduce the likelihood of a bushfire running through an APZ and subjecting a dwelling to radiant heat or direct flame contact. It is important to note, where mature trees are separated from a building by six metres, but the canopy has grown to extend or overhang a building, maintenance and pruning to remove the overhanging branches should be undertaken without the entirety of the tree being removed.

Mulches used within the APZ should be non-combustible. The use of stone, gravel, rock and crushed mineral earth is encouraged. Wood mulch >6mm in thickness may be used, however it is recommended that it is used in garden beds or areas where the moisture level is higher by regular irrigation. These materials could be sourced from non-toxic construction and demolition waste giving the added benefit of reducing the environmental impact of any 'hard landscaping' actions.

Combustible objects, plants, garden supplies such as mulches, fences made from combustible material, should be avoided within 10 metres of a building. Vines or climbing plants on pergolas, posts or beams, should be located away from vulnerable parts of the building, such as windows and doors. Non-flammable features can be used to provide hazard separation from classified vegetation, such as tennis courts, pools, lawns and driveways or paths that use inorganic mulches (gravel or crushed rock). Consider locating firewood stacks away from trees and habitable buildings.

Incorporation of landscaping features, such as masonry feature walls can provide habitable buildings with barriers to wind, radiant heat and embers. These features can include noise walls or wind breaks. Use of Appendix F of AS 3959 for bushfire resistant timber selection within areas of 29kW/m² (BAL-29) or below, or the use of non-combustible fencing materials such as iron, brick, limestone, metal post and wire is encouraged.

In addition to regular maintenance of an APZ, further bushfire protection can be provided at any time by:

- ensuring gutters are free from vegetation;
- installing gutter guards or plugs;
- regular cleaning of underfloor spaces or enclosing them to prevent gaps;
- trimming and removing dead plants or leaf litter;
- pruning climbing vegetation (such as vines) on a trellis, to ensure it does not connect to a building, particularly near windows and doors;
- removing vegetation in close proximity to a water tank to ensure it is not touching the sides of a tank;
- and/or
- following the requirements of the relevant local government section 33 fire break notice, which may include additional provisions such as locating wood piles more than 10 metres from a building.

Fences: Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).

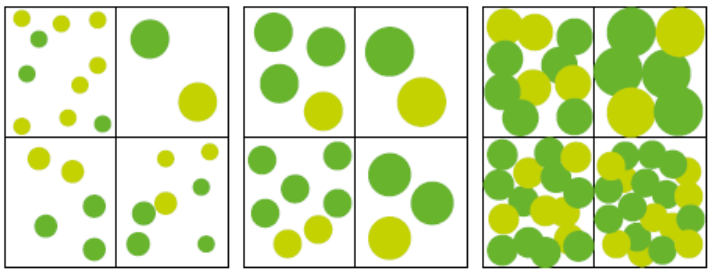
Objects: within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.

Fine Fuel Load: Should be managed and removed on a regular basis to maintain a low threat state. Should be maintained at <2 tonnes per hectare (on average). Mulches should be non-combustible such as stone, gravel or crushed mineral earth

or wood mulch >6 millimetres in thickness.

Trees (> 6 metres in height): Trunks at maturity should be a minimum distance of six metres from all elevations of the building. Branches at maturity should not touch or overhang a building or powerline. Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. Canopy cover within the APZ should be should be <15 per cent of the total APZ area. Tree canopies at maturity should be at least five metres apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ.

Tree canopy cover – ranging from 15 to 70 per cent at maturity



Shrubs (0.5 metres to 5 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.

Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 mm in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.

Grass: Grass should be maintained at a height of 100 millimetres or less, at all times. Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.

Defendable space: Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and noncombustible mulches as prescribed above.

LP Gas Cylinders: Should be located on the side of a building furthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building.

- The pressure relief valve should point away from the house.
- No flammable material within six metres from the front of the valve.
- Must sit on a firm, level and non-combustible base and be secured to a solid structure.

Preparation of a property prior to the bushfire season

There are certain plant characteristics that are known to influence flammability, such as moisture or oil content and the presence and type of bark. Plants with lower flammability properties may still burn during a bushfire event, but may be more resistant to burning and some may regenerate faster post-bushfire.

There are many terms for plant flammability that should not be confused, including:

- Fire resistant – plant species that survive being burnt and will regrow after a bushfire and therefore may be highly flammable and inappropriate for a garden in areas of high bushfire risk.
- Fire retardant – plants that may not burn readily or may slow the passage of a bushfire.
- Fire wise – plants that have been identified and selected based on their flammability properties and linked to maintenance advice and planting location within a garden.

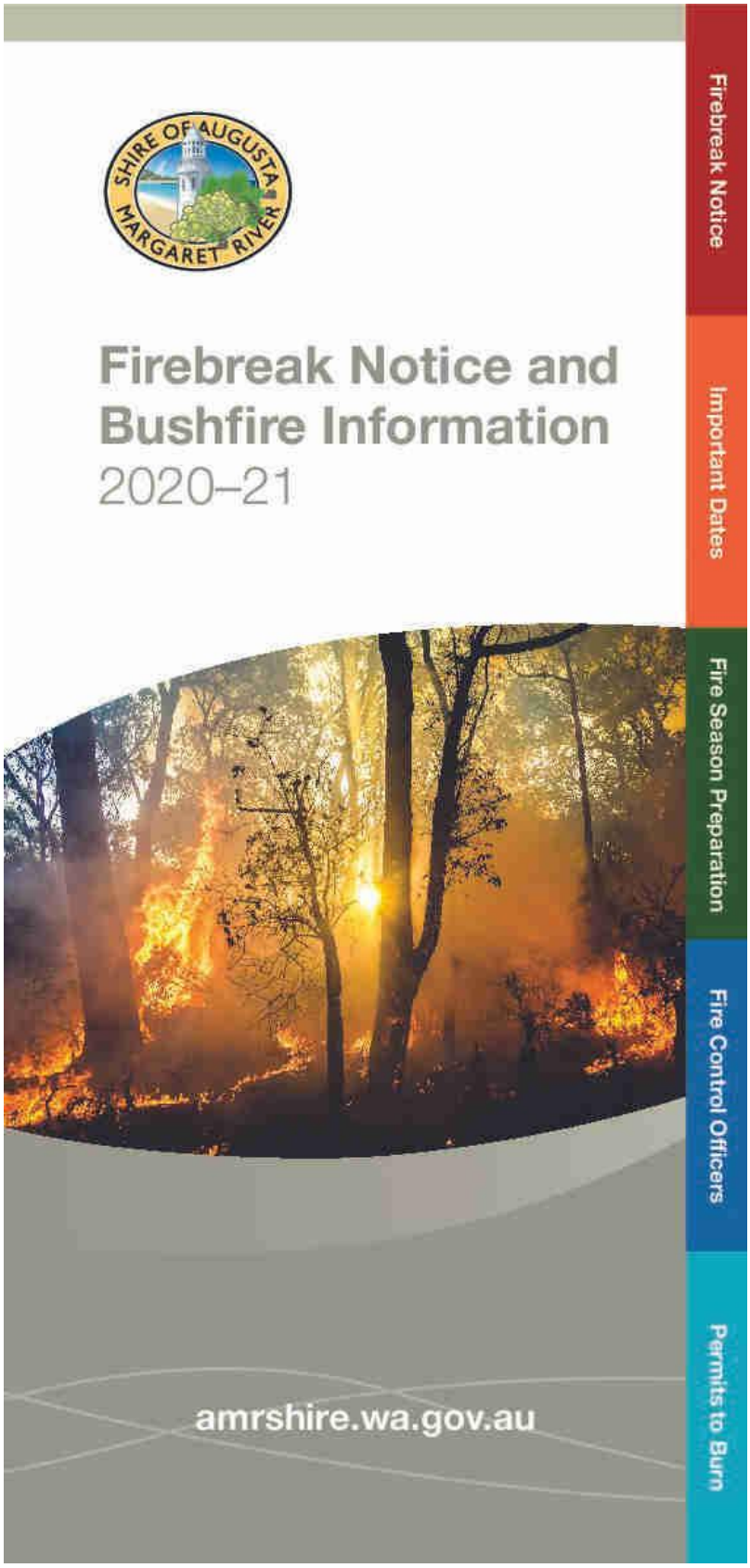
Although not a requirement of these Guidelines, local governments may develop their own list of fire wise or fireretardant plant species that suit the environmental characteristics of an area. When developing a recommended plant species list, local governments should consult with ecologists, land care officers or environmental authorities to ensure the plants do not present a risk to endangered ecological communities, threatened, or endangered species or their habitat.

When selecting plants, private landholders and developers should aim for plants within the APZ that have the following characteristics

- grow in a predicted structure, shape and height;
- are open and loose branching with leaves that are thinly spread;
- have a coarse texture and low surface-area-to-volume ratio;
- will not drop large amounts of leaves or limbs, that require regular maintenance;
- have wide, flat, and thick or succulent leaves;
- trees that have bark attached tightly to their trunk or have smooth bark;
- have low amounts of oils, waxes, and resins (which will often have a strong scent when crushed);
- do not produce or hold large amounts of fine dead material in their crowns; and/or
- will not become a weed in the area.

Refer to the WAPC Bushfire and Vegetation Fact Sheet for further information on clearing and vegetation management and APZ landscaping, design and plant selection reference material.

Appendix 2 – Local Government Firebreak and Fuel Load Notice



Definitions

For the purpose of this notice the following definitions apply:

Firebreak means an area of land that has been cleared of all trees, bushes, grasses, and any other object or thing which may be flammable, leaving a bare, trafficable surface to the prescribed width as outlined in the table on page 6, and with a four (4) metre high vertical clearance.

Trafficable means a firm, stable surface that a 4WD fire appliance is able to travel along, from one point to another, unhindered and without obstruction. A firebreak must not terminate or lead to a dead end without provision for egress to a safe place or a cleared turnaround area of not less than a 10-metre radius.

Asset Protection Zone (APZ) means the area of land within 20 metres from the external walls of any habitable building. The fuel loading (flammable material) in the APZ is to be reduced and maintained to less than two (2) tonnes per hectare. Trees must not be closer than two (2) metres to a building, and trees must not overhang a building within four (4) metres of the external roof. **APZ requirements apply to all properties (excluding vacant lots), regardless of size, and must be maintained all year round*.**

Flammable Material means any plant, tree, grass or other vegetation, substance, object, thing or material that may or is likely to catch fire and burn.

Driveway / Access Way means the access route from the road to your main dwelling. This should be a minimum of four (4) metres wide with a minimum four (4) metre vertical clearance to allow emergency vehicles to access your property.

Bushfire Management Plan means a plan that has been developed and approved by the Shire to reduce and mitigate fire hazards within a subdivision, lot or other area of land within the district.

Plantation means any area of planted pines, eucalypt, hardwood or softwood trees exceeding three (3) hectares in area.

**If your property is subject to an approved Fire Management Plan, and there is a discrepancy between the Fire Management Plan and this Notice, the Fire Management Plan is to apply.*

2

Firebreak Notice

Bush Fires Act 1954

The following Notice is hereby given to all owners and/or occupiers of land within the Shire of Augusta Margaret River:

Pursuant to the powers contained in section 33 of the *Bush Fires Act 1954*, you are hereby required and therefore ordered by the local government to carry out fire prevention work in accordance with the requirements of this Notice, on or before **30 November 2020**.

All land is to be maintained up to and including **12 May 2021** as specified in this Notice. All previous versions of this document are hereby cancelled. Properties subject to an approved Bushfire Management Plan must comply with the requirements of their Plan.

Rangers will be inspecting properties for compliance from **1 December 2020**. Persons who fail to comply with the requirements of this Notice may be issued with an infringement notice ($250) or prosecuted with a modified penalty (up to $5,000). The Shire of Augusta Margaret River may carry out the required work on the land at cost to the owner/occupier.

3

Can We Access Your Property?

DID YOU KNOW?

In order for fire appliances to access your property safely, firebreaks must be three (3) metres wide and have at least four (4) metres vertical clearance. Fire appliances must be able to fit through gates on your property. The average fire appliance is nine (9) metres in length.

DON'T FUEL FIRES

× Don't have thick vegetation near your home.

✓ Clear all flammable material from around all structures.

✓ Store firewood, timber, petrol, kerosene and all flammable liquids well away from the house.

✓ Clear all dead leaves out of gutters regularly.

✓ Remove dead trees and branches which, when burning, could drop on your roof.

✓ Rake up leaves, twigs and dead material regularly.

✓ Burn off dry grass and vegetation at the approved times and in the approved manner or consider using alternative methods to burning.

Up to 1 cubic metre (a 6x4 trailer load) of uncontaminated green waste can be disposed of at the Davis Road Waste Management Facility at no cost to Shire residents. Check the Shire website for Green Waste Open Days.

4

Important Dates

Spring/Summer Restricted Burning Period

Permits Required
9 November 2020 to 22 December 2020

Deadline for Prevention Works

Installed on or before 30 November 2020
Maintained up to and including 12 May 2021

Prohibited Burning Period

Burning Prohibited
23 December 2020 to 14 March 2021

Autumn Restricted Burning Period

Permits Required
15 March 2021 to 12 May 2021

PLEASE NOTE

- These dates can change at short notice due to variable weather conditions so you should always call your area FCO or the Shire Rangers to check prior to lighting up.
- Burning is prohibited on days where the Fire Danger Rating is VERY HIGH or above.
- **A TOTAL FIRE BAN** may be declared by the DFES Commissioner at any time. If declared, a person must not light any fire or undertake any activity that may cause a fire.
- Fire Danger Ratings change daily. To check the Fire Danger Rating go to www.emergency.wa.gov.au or contact Shire Rangers on 9780 5695.

5

Important Dates

Fire Season Preparation

All land owners/occupiers must carry out fire prevention work in accordance with the requirements of this Notice on or before **30 November 2020**. All land is to be maintained up to and including **12 May 2021**.

Please Note: Asset Protection Zone (APZ) requirements apply to all properties (excluding vacant lots), regardless of size, and must be maintained all year round.

Property Type	Firebreak Requirements
All Lots 4000m² and under	• 2-metre wide firebreaks around all piles of garden refuse and/or wood stacks
Residential/ Rural Residential Lots 4001m² and over	• Minimum 3-metre wide trafficable firebreaks inside all boundaries • 2-metre wide firebreaks around all piles of garden refuse/wood stacks, fuel and fodder
Rural Lots (excluding plantations, vineyards, orchards and olive groves)	• Minimum 3-metre wide trafficable firebreak required within 100 metres of a boundary that abuts a road reserve • Where land is actively grazed or maintained to less than 10cm, a 2-metre firebreak is required • 2-metre wide firebreaks around all piles of garden refuse/wood stacks, fuel and fodder
Plantations	• 10-metre wide mineral earth firebreak around each cell or block - minimum 3 metres must be trafficable • 2-metre wide firebreaks around all piles of garden refuse/wood stacks, fuel and fodder
Vineyards, Orchards and Olive Groves	• 5-metre wide mineral earth firebreak around each cell or block - minimum 3 metres must be trafficable • 2-metre wide firebreaks around all piles of garden refuse/wood stacks, fuel and fodder

6

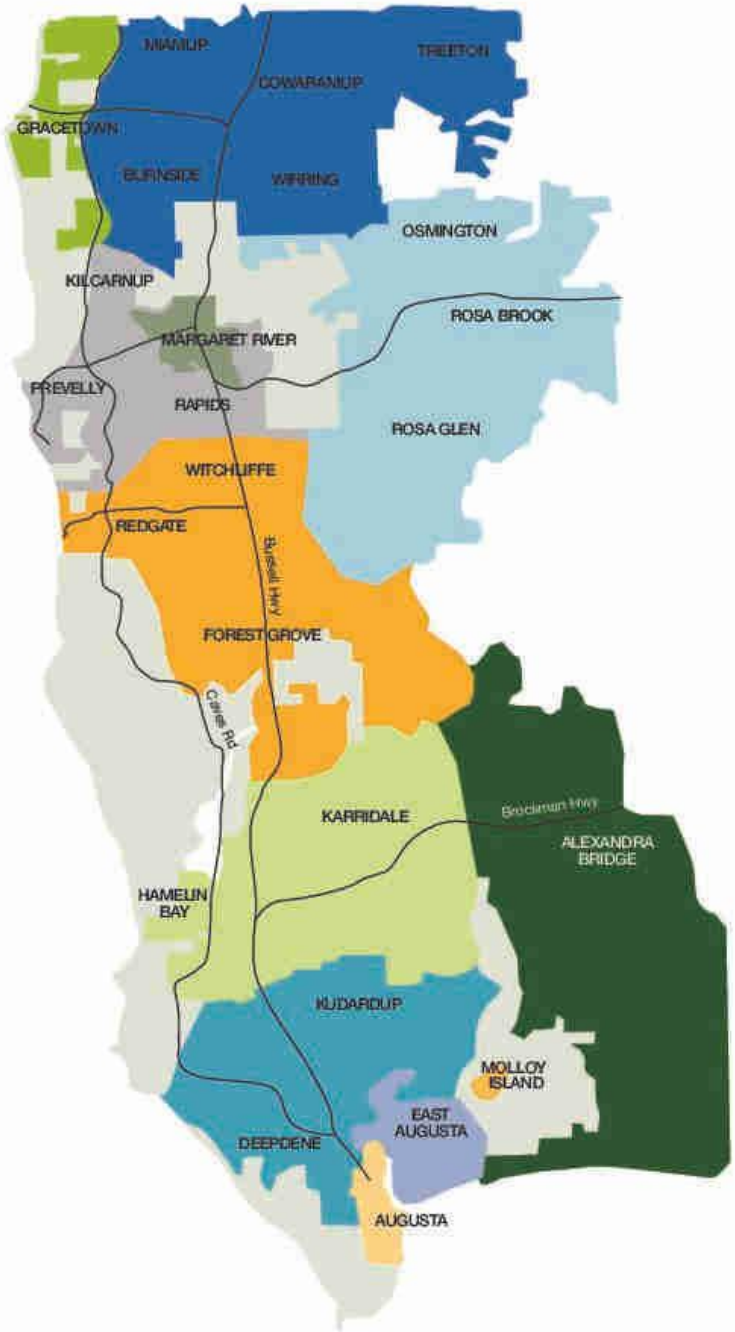
If it is considered impractical to clear firebreaks or to carry out any other works as required by this Notice, you may apply to the Shire of Augusta Margaret River for a **Variation to the Firebreak Notice**. Applications must be completed on the approved form, which is available upon request or can be downloaded via the Shire's website, and must be submitted to the Shire of Augusta Margaret River no later than **16 November 2020.**

Asset Protection Zone (APZ)	Grass slashed/ mowed to less than 10cm	Driveway/ Access way	Gutters and rooftops free of debris
✓	✓	✓	✓
✓	Vacant/ cleared land that is not being actively grazed	✓	✓
✓	Vacant/ cleared land that is not being actively grazed	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓

7

Fire Season Preparation

Fire Control Officer Area Map



8

Fire Control Officer Contact Details

Brigade	Fire Control Officer(s)
Alexandra Bridge	**Alexandra Bridge** Tony Mostert: 0428 461 388
Augusta	**Augusta** Brendan Jordan: 0477 970 415
Cowaramup	**Burnside** Tim Garstone: 0428 555 292 **Cowaramup** Ian Earl: 0418 932 847 **Miamup** Billy Pascoe: 0405 965 447 **Treeton** Geoff Jenkins: 0407 776 920 **Wirring** Greg Tennant: 0487 677 062
East Augusta	**East Augusta** Peter Brindley: 0439 869 680
Gracetown	**Gracetown** Peter Delfs: 0427 555 491
Karridale	**Hamelin Bay** Simon Hanson: 0428 147 001 **Karridale** Paul Vanzetti: 0447 929 057
Kudardup	**Deepdene** Scott Hamilton: 0427 778 840 **Kudardup** Matthew Nield: 0427 772 719
Margaret River	**Margaret River** Leith Jones: 0417 960 514
Molloy Island	**Molloy Island** John Matten: 0427 440 620
Rosa Brook	**Osmington** Shaun Palmer: 0448 979 041 **Rosa Brook** Mark Ridge: 0408 945 684 **Rosa Glen** Andrew Newnham: 0491 313 968
Wallcliffe	**Kilcarnup** Ian Dowling: 0419 969 642 **Prevelly** Rodney Dilkes: 0428 321 865 **Rapids** David Kelly: 0428 387 286
Witchcliffe	**Forest Grove** Larry Brennan: 0419 938 923 **Redgate** Richard Nash: 0419 951 511 **Witchcliffe** Diane Holland: 0427 930 735

9

Fire Control Officers

General Information

BURNING OF GARDEN REFUSE

Spring/Summer Restricted Burning Period
You may burn one small heap of up to one (1) cubic metre of garden refuse during the Spring/Summer Restricted Burning Period without a Permit. It cannot be lit before 6pm and must be fully extinguished by 11pm. A courtesy call to your area FCO is recommended.

Autumn Restricted Burning Period
A Permit is required to burn all garden refuse during the Autumn Restricted Burning Period.

Burning is PROHIBITED on days where the Fire Danger Rating is VERY HIGH or above.

WOOD/SOLID FUEL BBQS AND PIZZA OVENS

The use of wood/solid fuel BBQs and pizza ovens is prohibited on days where the fire danger rating is VERY HIGH or above. The use of any wood/solid fuel BBQ or pizza oven is prohibited during a TOTAL FIRE BAN.

CAMPFIRES AND FIREPITS

Campfires and firepits are NOT permitted;

- at any time during the PROHIBITED Burning Period
- on days where the fire danger rating is VERY HIGH or above
- on public land, unless purpose built campfire pits have been provided by the owner of the land and permission to use them has been given

Campfires and firepits are permitted on private property during the RESTRICTED Burning Periods without a Permit, but cannot be lit before 6pm and must be fully extinguished by 11pm. A Permit is required outside of these times. Consent from the land owner must be given (and proof of consent available if requested by an Authorised Person).

Make sure you check the Burning Period dates and the Fire Danger Rating before lighting up.

For the current Fire Danger Rating visit www.emergency.wa.gov.au or contact Shire Rangers on 9780 5695.

10

Permits to Burn

A Permit to burn is required during the RESTRICTED Burning Periods.

To obtain a Permit, contact your area Fire Control Officer (FCO) by referring to the FCO map in this notice. Where the FCO is unavailable the Chief Bush Fire Control Officer or the Shire Rangers can also issue Permits. **Please allow up to 72 hours for your Permit to be issued.**

When contacting the FCO to request a Permit, have the following information ready to provide;

- the size of your burn
- what you are burning
- the address of the burn
- the name and contact number of the Permit holder

You must notify your adjoining land owners 24 hours in advance of your intention to burn.

Prior to burning, you MUST register your Permit with the Shire, DBCA and DFES. To do this call the numbers on the Permit and have your Permit handy as the operator will need the Permit details.

Failure to;

- obtain a Permit
- comply with all Permit conditions
- burn without a Permit, or
- burn in contravention to any information provided in this Notice

may result in a modified penalty of $250 and up to $5,000 should the matter go before the courts.

BE PREPARED!

The preparedness of your property can make all the difference between minor damage and devastation.

For advice on preparing your property for the fire season, please call your local Bushfire Ready Facilitator Gordon Temby (North) on 0419 954 658 or Georgina Thiele (South) on 0417 998 461.

11

Permits to Burn

Key Contacts

Chief Bush Fire Control Officer
0419 525 843

Deputy Chief Bush Fire Control Officer
0419 628 465

Shire Rangers
9780 5695

DFES Emergency Info Line
13 DFES (133 337)
Follow DFES on Twitter and Facebook
or listen to ABC Radio South West WA

DIAL 000

TO REPORT ALL FIRES OR LIFE THREATENING EMERGENCIES

PO Box 61, Margaret River, Western Australia 6285
T (08) 9780 5255 | F (08) 9757 2512
amrshire@amrshire.wa.gov.au | amrshire.wa.gov.au

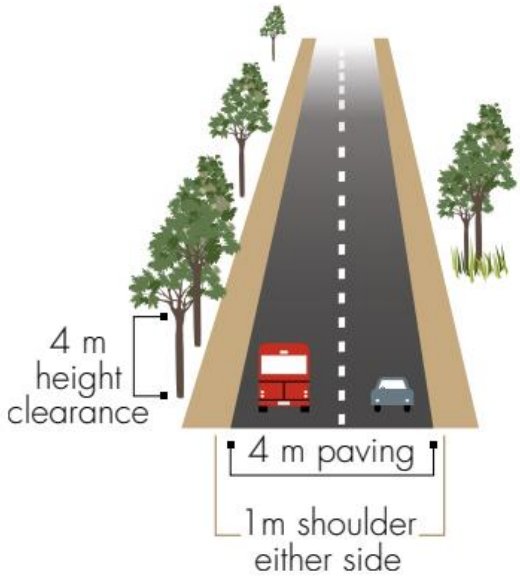
Appendix 3- Public road

Trafficable surface

The bushfire Guidelines do not prescribe values for the trafficable (carriageway/pavement) width of public roads as they should be in accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards and/or any applicable standard in the local government area.

The IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards do not prescribe a horizontal clearance. However, it is recommended that a traversable verge is provided to allow for emergency services vehicles to stop and operate on the side of the public road, specifically where the public road may traverse large areas of classified vegetation.

Where local government roads are proposed to be widened by the proponent, they must obtain approval from the local government.



Public road design

All roads should allow for two-way traffic to allow conventional two-wheel drive vehicles and fire appliances to travel safely on them.

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.

Appendix 4 - Perimeter roads

A perimeter road should be in accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards and/or any applicable standard in the local government area as per the requirements of a public road in Table 6, Column 1.

As the road is likely to function as a key neighbourhood distributor, or similar, consideration should be given to the provision of additional width to allow for emergency services vehicles to stop and operate on the side of the perimeter road, whilst simultaneously proving for the evacuation of the community.

When designing a strategic planning proposal and/or subdivision, creating a large setback between classified vegetation and proposed lots with a perimeter road, and orientating habitable buildings to front onto (rather than back onto) areas of vegetation has many benefits,

- including: passive surveillance;
- defendable space for firefighting and emergency management purposes;
- reducing the potential radiant heat that may impact a habitable building in a bushfire event; reducing the need for battle-axe lots;
- and unconstrained public access/egress for the community in the event of a bushfire.

In developments where no perimeter road exists, property defence in a bushfire event is difficult and can be impossible.

APPENDIX 11

Aboriginal Heritage Enquiry System (DPLH)
&
Section 18(2) Aboriginal Heritage Act 1972 Consent Letter

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

1 Registered Aboriginal Sites in Certificate of Title - 2959/570

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land within or adjacent to the following Indigenous Land Use Agreement(s): South West Boojarah #2 Indigenous Land Use Agreement.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at https://www.wa.gov.au/organisation/department-of-the-premier-and-cabinet/south-west-native-title-settlement.

Further advice can also be sought from the Department of Planning, Lands and Heritage at AboriginalHeritage@dplh.wa.gov.au.

Copyright

Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

Status:

- Registered Site: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- Other Heritage Place which includes:
  - Stored Data / Not a Site: The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - Lodged: Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:

- File Restricted = No: Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- File Restricted = Yes: Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact AboriginalHeritage@dplh.wa.gov.au.
- Boundary Restricted = No: Place location is shown as accurately as the information lodged with the Registrar allows.
- Boundary Restricted = Yes: To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- Restrictions:
  - No Restrictions: *Anyone* can view the information.
  - Male Access Only: Only *males* can view restricted information.
  - Female Access Only: *Only* females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

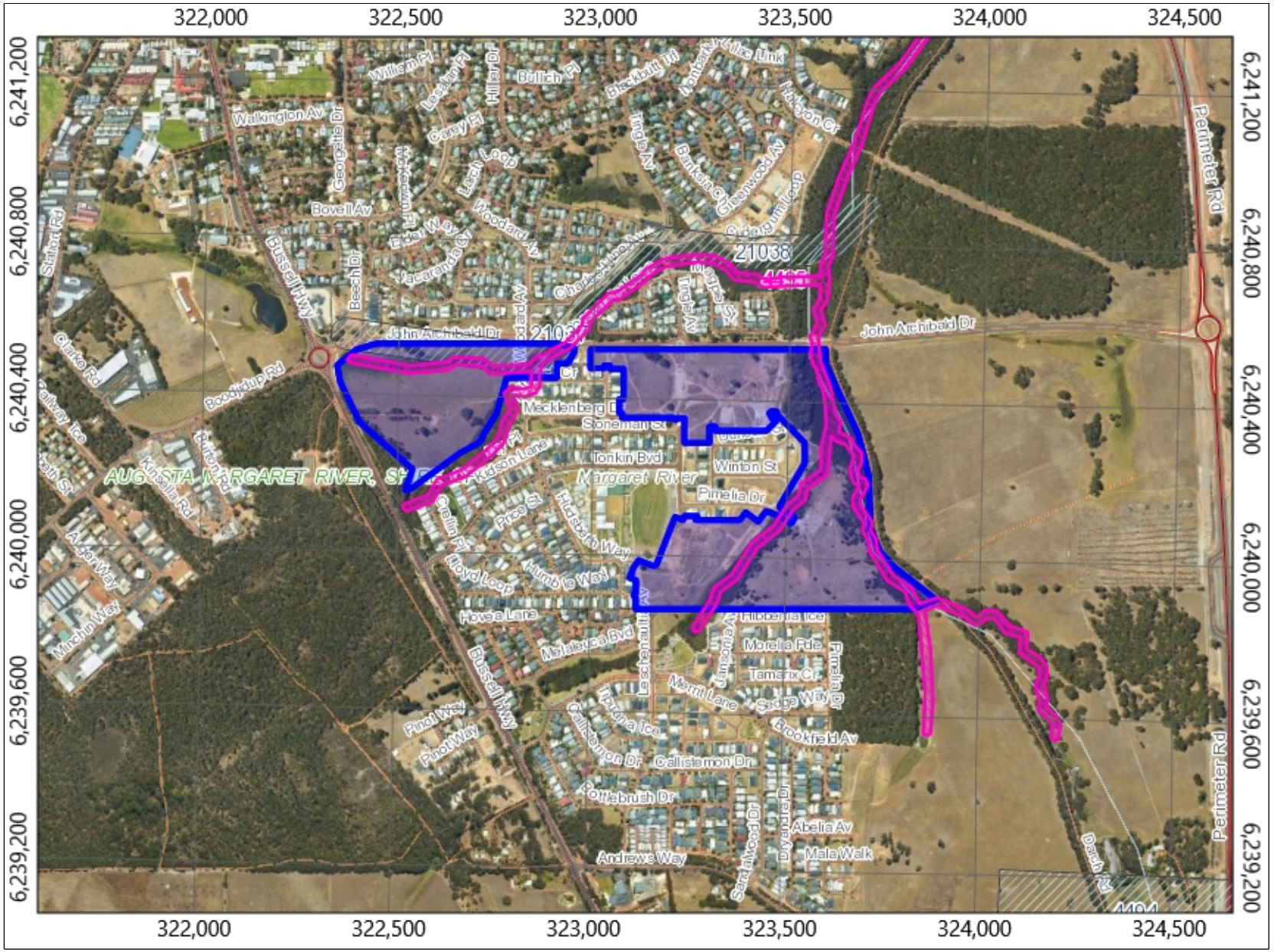
ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
4495	MARGARET RIVER.	No	No	No Gender Restrictions	Registered Site	Mythological, Other: WAUGAL (FORMER	*Registered Knowledge Holder names available from DAA	334424mE 6245429mN Zone 50 [Reliable]	S02614

Department of Planning, Lands and Heritage

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



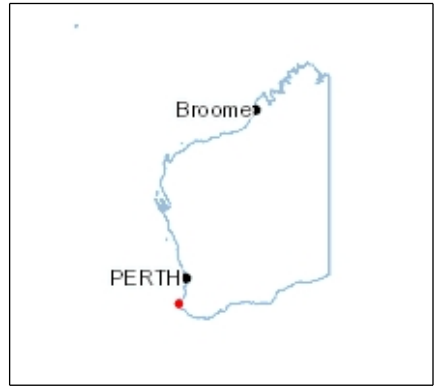
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

0.59 kilometres

Map Scale 1 : 17,900

MGA Zone 50 (GDA94)



Minister for Consumer and Employment Protection; Indigenous Affairs;
Minister Assisting the Minister for Public Sector Management;
Leader of the House in the Legislative Assembly

Our Ref: 0426317

Mr Peter Gleed
Koltasz Smith - Town Planners and Project Managers
PO Box 749
BUSSELTON WA 6285

Dear Mr Gleed

I refer to the Notice of 26 October 2004 given by HE Harris, MC Johnson, EM Green and Greendene Development Corporation Pty Ltd ("the Landowner") to the Aboriginal Cultural Material Committee ("ACMC") pursuant to section 18(2) of the *Aboriginal Heritage Act 1972* ("AHA") advising that you require to use the land described in Schedule 1 of the Notice as Lot 27 Bussell Highway, Margaret River; Vol 2213, Folio 522 on DP 26553; Lot 9107 Bussell Highway, Margaret River; Vol 2544, Folio 952 DP 37465 ("the Land"), for the purpose described in Schedule 2 of the Notice as development for residential purposes, public open space, school site and local commercial ("the Purpose").

In accordance with my powers under section 18(3) of the AHA and following consideration of recommendations from the ACMC, I hereby grant consent to the use of the Land for the Purpose subject to the conditions set out below.

On current knowledge the Purpose will impact upon one site (DIA 4495) within the meaning of section 5 of the AHA ("Sites") on the Land and will impact upon areas that Aboriginal people have described as being associated with Aboriginal mythology and cultural activity on the Land.

Conditions of Consent:

That the Landowner:

1. In consultation with South West Boojarah and Harris Family Native Title Claimant Groups engage an agreed number of appropriately experienced representatives from South West Boojarah and Harris Family Native Title Claimant Groups ("the Consultants") to monitor all and any activities related to the Purpose that involve disturbance to the surface of the Land or any part of the Land ("the Works") in the following situations:

   a. where the Works are disturbing the surface of the Land for the first time or what appears to be the first time; and

20th Floor, 197 St George's Terrace, Perth, Western Australia 6000 Telephone: (08) 9222 9211 Facsimile: (08) 9321 6003
Email: jkobelke@dpc.wa.gov.au Internet: www.ministers.wa.gov.au/kobelke

b. where any heritage consultant engaged in respect of the Purpose has indicated that there is a likelihood of finding any objects within the meaning of section 6 of the *Aboriginal Heritage Act 1972* ("AHA") ("Objects") during the Works.

2. In consultation with the Consultants, appoint a suitably qualified archaeologist ("the Archaeologist") if any Objects are found during the Works, such archaeologist to assist the Consultants to make decisions about salvaging the Objects and about future monitoring requirements in respect of the Works.

3. Mitigatively salvage any Objects found during the monitoring of the Works, manage the Objects in accordance with the wishes of the Consultants and the Archaeologist, and report the whereabouts of the Objects to the Western Australian Museum and the Department of Indigenous Affairs ("DIA").

4. Immediately cease all Works if skeletal remains ("Remains") are found and report the matter to the Western Australia Police Service and local DIA office. Where it is determined that the Remains are Aboriginal in origin and not a police matter, they must remain *in situ* until a decision is made about how to proceed in respect of the Remains at an on-site meeting with a DIA representative, the Consultants and any Archaeologist engaged pursuant to paragraph 2 above. The Landowner must at its expense manage the Remains in accordance with the wishes of the Consultants and report the whereabouts of the Remains to the Western Australian Museum and DIA.

5. Ensure that all persons employed or engaged in respect of the Purpose and the Works are made aware of their obligations under the AHA, including by inserting into all and any relevant contracts, project plans, scopes of works, tenders and other similar documents a requirement that such persons be provided with a copy of a document prepared by DIA and entitled "Advice to Developers" and/or an electronic copy of a document prepared by DIA and the Department of Housing and Works and entitled "the Aboriginal Heritage Procedures Manual", both of which can be found at:

- http://www.dia.wa.gov.au/Heritage/IntroForDevelopers.aspx ; and
- http://www.dia.wa.gov.au/Heritage/HeritageManual/default.aspx

respectively.

6. Provide to the Registrar of Aboriginal Sites ("the Registrar") annually or at the completion of the Purpose a written report advising the Registrar whether and to what extent the Purpose has impacted on all or any Sites or Objects that may be located on the Land, including a detailed description of:

a. whether such Sites or Objects have been partially or entirely impacted by the Purpose;

b. the level, type and effect of any such impact (including, where possible, the provision of photographs taken during and after the impact);

c. where Sites or Objects have been mitigatively salvaged, when and how such salvage took place, who was present at the salvage and, subject to issues of cultural confidentiality, to where the material was re-located.

Nothing in this condition should be construed as preventing the proponent from advising the Registrar in writing of all or any of the matters outlined above at any time prior to the completion of the development. The Registrar and the ACMC welcome comprehensive and ongoing information about Sites and Objects in Western Australia.

Failure to comply with these conditions may constitute an offence under section 55 of the AHA. DIA carries out routine checks on the extent to which conditions of ministerial consents have been or are being complied with.

This consent can only be relied upon by the applicant Landowner. Any subsequent 'owner' of the land within the meaning of the AHA must make its own application under the Act.

In addition to the conditions set out herein, the ACMC has requested that the Landowner give due consideration to other requests made by Aboriginal people about the protection of Aboriginal heritage and the recognition of Aboriginal culture and history during consultations about the Purpose including:

- use of native vegetation
- modification of development plans to avoid DIA 21037 and allow its in-situ preservation.

If you have any queries in relation to your application, please contact Ms Annabelle Davis, Senior DIA Heritage Officer on telephone 92358114.

Yours sincerely

John Kobelke

JOHN KOBELKE MLA
MINISTER FOR INDIGENOUS AFFAIR

11 JAN 2005

APPENDIX 12

Transport Impact Assessment
(Donald Veal Consultants)

March 2022

Final Rev.2

Edenlife Margaret River

Prepared For:

Edenlife

Transport Impact Statement Report

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DOCUMENT ISSUE AUTHORISATION

Issue	Rev	Date	Description	Prepared By	Checked By	Approved By
0	0	20/09/2021	Draft Report	KL	DNV	DNV
1	0	1/10/2021	Final Report	KL	DNV	DNV
1	1	21/10/2021	Final Report Rev 1	KL	DNV	DNV
1	2	04/03/2022	Final Report Rev 2	KL	DNV	DNV

Donald Veal Consultants Pty Ltd

TABLE OF CONTENTS

PAGE

1. INTRODUCTION

1.1 BACKGROUND

Edenlife has commissioned Donald Veal Consultants (DVC) to prepare this Transport Impact Statement report to support its Development Application for a residential development comprising of 158 retirement home sites in a lifestyle community at Lot 9012 Bussell Highway, Margaret River.

1.2 SCOPE OF THIS REPORT

The structure and scope of this Transport Statement are in accordance with Volume 4 (Individual Developments) of the Western Australian Planning Commission's Transport Impact Assessment Guidelines (2016). The internal layout details of the site have been assessed under the Residential Design Codes.

This report focuses primarily on the external impacts of the proposed development. Where appropriate, certain internal aspects have been considered and measured against the relevant clauses of the above Design Codes, whilst other aspects will be discussed and agreed directly between the Applicant and the approving authority as part of the Local Development Plan/DA process.

2. EXISTING SITE CONDITIONS

2.1 LOCATION

The development site is located east of Bussell Highway, just south of John Archibald Drive, in Margaret River. The general locality is shown in **Figure 2.1**, with the site location shown in more detail in **Figure 2.2.**

Figure 2.1: General Locality Plan ***Source: MetroMap***

Figure 2.2: Site Location ***Source: MetroMap***

2.2 CURRENT LAND USES

The subject site is presently vacant. See **Figure 2.3**.

Figure 2.3: The Site is currently undeveloped ***Source: Streetview***

Other land uses in the general vicinity of the site include residential properties and Rapids Landing Primary School to the southeast.

2.3 ACCESS ARRANGEMENTS

The site has one existing formal access onto Bussell Highway to the west. Provision has been made for an additional access connection to the south onto Rapids Landing Avenue as shown in **Figure 2.4**.

Figure 2.4: Access link prepared off Rapids Landing Avenue ***Source: Streetview***

2.4 ADJACENT ROAD NETWORK

The road network adjacent the site consists of Bussell Highway, John Archibald Drive, Alferink Crescent, Fry Place, Rapid Landing Avenue and Tonkin Boulevard. Bussell Highway is classified as a Regional Distributor Road in Main Roads WA's (MRWA) Metropolitan Road Hierarchy as shown in **Figure 2.5**. All of the other roads mentioned are categorised as Access Roads, although John Archibald Drive functions as a local distributor and may be re-categorised as such in the future.

Tonkin Boulevard has an intersection with Bussell Highway and links through to Leschenaultia Avenue, which in turn is planned to be connected to John Archibald Drive.

Bussell Highway has a posted speed limit of 60 km/h in the vicinity of the site and changes to 80 km/h to the south of its roundabout with John Archibald Drive. It is constructed as an un-kerbed single carriageway, with one lane in each direction.

John Archibald Drive has a posted speed limit of 60 km/h in the vicinity of the site. It is constructed as an unkerbed dual carriageway, with one lane in each direction and a landscaped median. All other roads in the vicinity are subject to the urban default speed limit of 50 km/h.

Posted speed limits on these roads are shown in **Figure 2.6.**

Figure 2.5: MRWA Functional Road Hierarchy *Source: MRWA*

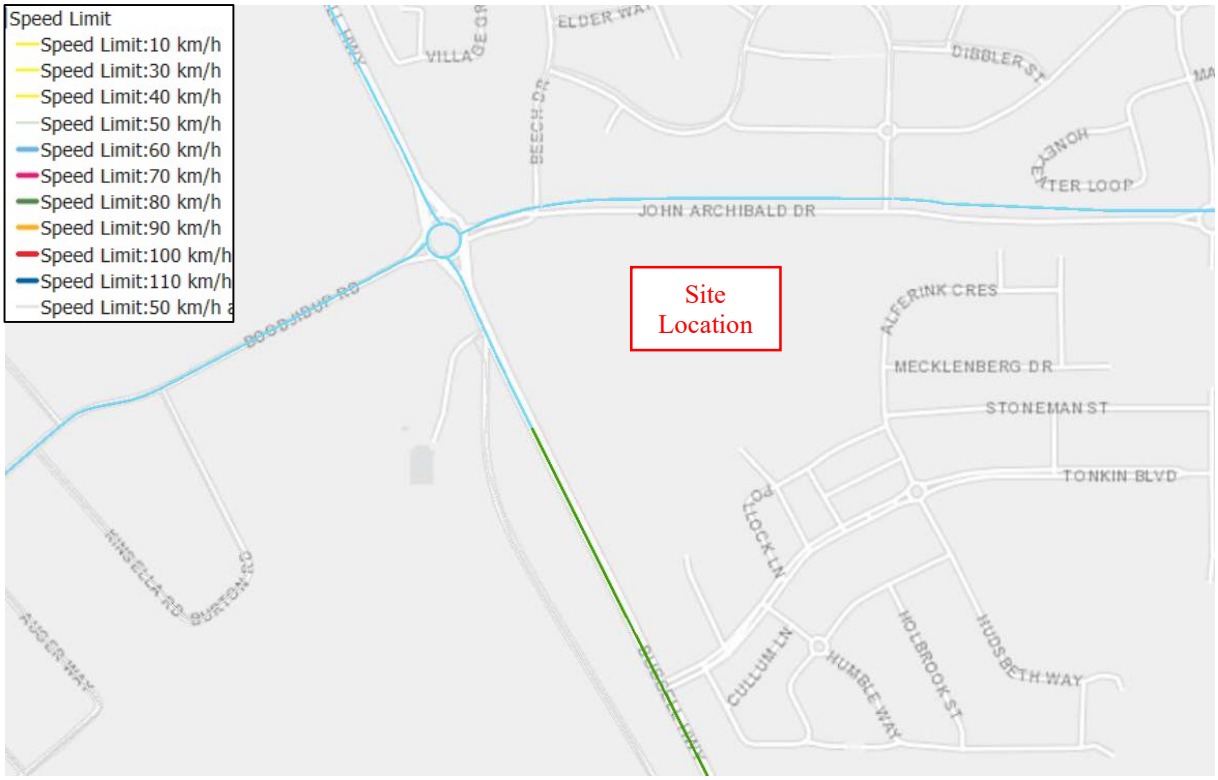


Figure 2.6: Posted Speed limits *Source: MRWA*

2.5 EXISTING TRAFFIC VOLUMES

The latest traffic flow data available for the roads near the site was extracted from MRWA's Traffic Map. See **Figure 2.5**. No counts were available on Alferink Crescent or Rapids Landing Avenue.

The traffic data shows the volume along the John Archibald Drive was recorded 1,268 vehicles per day (vpd) with 11.1 % of heavy vehicles on daily average in 2018/19. The AM peak was 109 vehicles per hour (vph) at 08:00 hours whilst the PM peak was 119 vph at 15:00 hours.

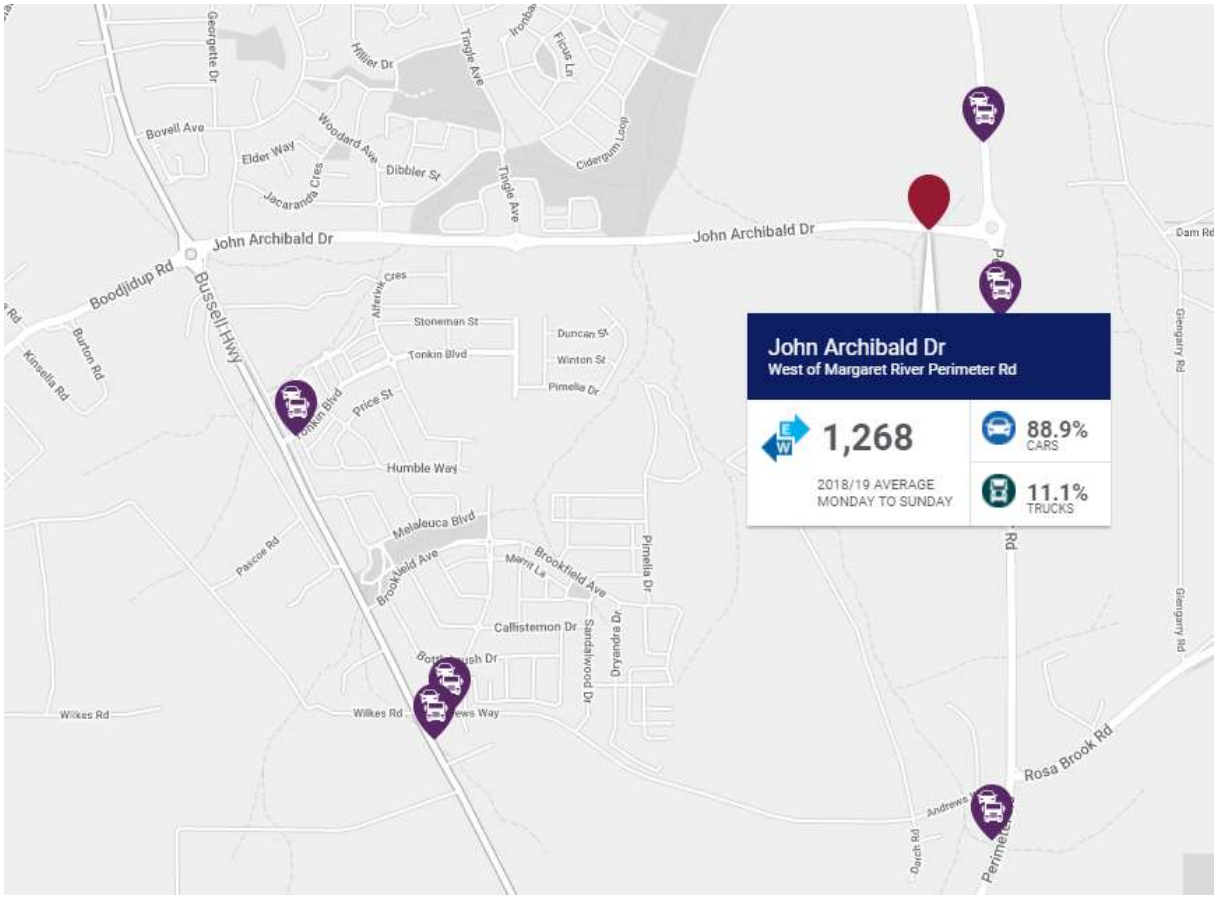


Figure 2.7: Traffic Count data ***Source: MRWA***

2.6 CRASH HISTORY

The MRWA Crash Analysis Reporting System (CARS) was interrogated for crash data along the road sections adjacent the site, for the latest five- year period from January 2016 to December 2020.

The results of the search showed a total of two recorded crashes in this area, in the last 5 years. Those two crashes both involved minor property damage only. One crash occurred at the Boodjidup Road roundabout and another at intersection of Alferink Crescent with Stoneman Street.

2.7 PLANNED CHANGES TO THE ROAD NETWORK

We are not aware of any planned changes to the road network in the immediate vicinity of the site.

3. PROPOSAL

3.1 PROPOSED DEVELOPMENT

The proposed development will consist of 159 home sites, based on a land lease arrangement, with a minimum entry eligibility age of 50 years. Eleven of these home sites are duplex referenced. The development will include a clubhouse and other shared facilities.

It should be noted that the internal layout details of the site will be assessed based on a grouped dwelling land use under Council's Local Planning Scheme No.1, the Residential Design Codes and an approved Local Development Plan.

Figure 3.1 shows the finalised Rapids Landing Community Lifestyle Village Concept Plan.

Figure 3.1: Rapids Landing Community Lifestyle Village Concept Plan

3.2 INTERNAL ROAD NETWORK

The internal roads will be two-way, and generally a minimum of 6m in width.

3.3 DRIVEWAY ACCESS

The concept plan shows one general vehicular access point to the site from John Archibald Drive, mid-way along the northern site boundary. An emergency access point to Bussell Highway is also proposed, located along the western site boundary.

The John Archibald Drive access will be the main entry and exit point for residents, deliveries and visitors. The concept plan shows two roundabouts along this entry statement road.

3.4 PARKING

All car parking for the development has been accommodated within the site boundary. Most of the residences are expected to have a garage or car port to store their vehicle(s), with most maintaining only one car, depending upon the size of the dwelling and household.

State Planning Policy 7.3 Residential Design Codes Volume 1 requires 1 bay per aged person's dwelling and 1 additional bay for every 4 dwellings or part thereof (for 17+ dwellings). Thus, the development application requires 40 visitor parking bays. Visitor parking can readily be accommodated on street close to the residential property being visited if not on the property itself. With 6m wide internal roads and speeds limited to 10 km/h, on street parking will not pose any issues. In any case, there are 44 parking bays provided on the concept plan thus complying with the Residentil Design Code requirements. These comprise 6 bays in the vicinity of the Clubhouse, 6 bays near the internal roundabout, four parallel bays and 28 90-degree parking bays distributed throughout the site.

Some bike racks should be considered close to the clubhouse for those residents who choose to cycle.

4. TRAFFIC IMPACT

4.1 TRIP GENERATION

The trip generation of the proposed facility has been estimated based on rates for 'Housing for aged and disabled persons' published by the RTA in NSW.

This gives:

- Daily vehicle trips = 1 - 2 per dwelling; and
- Evening peak hour vehicle trips = 0.1 - 0.2 per dwelling.

For this site we have adopted the higher end of the range, being 2 trips per day and 0.2 trips in the peak hour. With 159 residences, this equates to about 318 daily trips and 32 peak hour trips.

The estimated peak hour trip generation is therefore above 10 trips in the peak hour, but well below 100 trips. WAPC's Transport Assessment Guidelines suggest that a development generating this level of traffic only needs a brief, non-technical transport impact statement, with no requirement for in depth traffic analysis.

4.2 TRIP DISTRIBUTION

During the morning peak typically 80% of movements would be expected to exit the site and 20% be inbound. This might reasonably be expected to be reversed for the afternoon peak period.

Given the location of the main access point to the site, and the layout of the immediate road network, it is expected that the majority of vehicles leaving the site in the AM peak would do so by turning left onto John Archibald Drive to head into the centre of the town or towards the beaches. The resulting AM and PM peak hour trip distribution scenario might therefore be as shown in **Figure 4.1**.

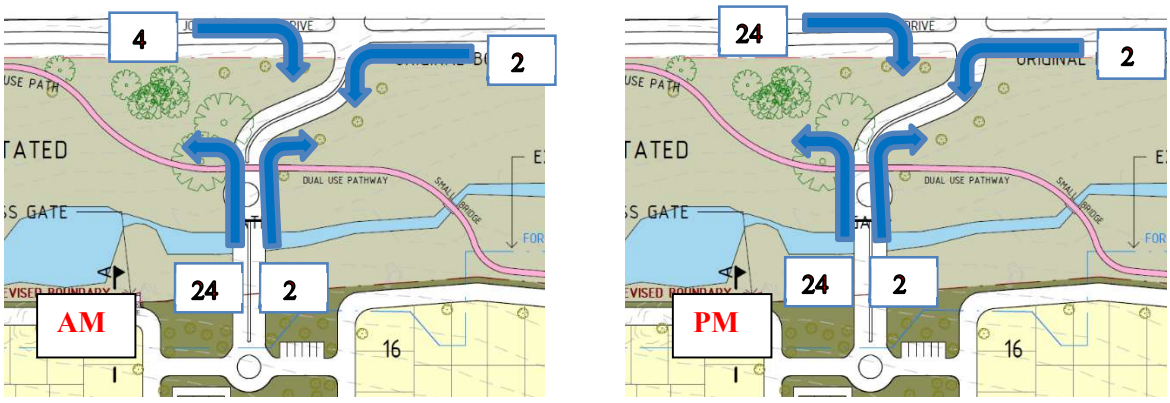


Figure 4.1: AM and PM Peak Hour trip distribution

4.3 IMPACT ON THE ADJACENT ROAD NETWORK

Figure 4.1 shows less than one vehicle turning left out of the site every two minutes during the peak period. This level of demand will have no meaningful impact on the local road network, or the operation of key intersections.

John Archibald Drive carries some 1,268 vpd (2018/19) and can readily absorb an additional 316 vpd without any issues. The intersection onto John Archibald Drive is likely to require a right turn in lane to be constructed in the median to enable turning movements to occur safely.

4.4 SERVICE VEHICLES

It is not expected that many service vehicle trips will be generated by the development, other than the weekly refuse collection truck, likely to be by a private contractor and small service delivery vehicles to the clubhouse.

4.5 INTERSECTION DESIGN

The intersections of Beech Drive and Woodard Avenue on the north side of John Archibald Drive are approximately 420m apart and both have right turn pockets in the median. That for Beech Drive measures approximately 108m in length, whilst that for Woodward Avenue measures some 75m.

The site access is proposed on the south side of John Archibald Drive some 190 m east of Beech Drive. There is some 80m space in the median to provide back-to-back right turn pockets.

Austroads Design Part 4A (Table 5.2) requires a pocket length (deceleration Lane length) of 70m including diverge taper for a design speed of 70 km/h (posted speed of 60 km/h plus 10 km/h) and a design exit curve speed of 20 km/h. Hence, the location of the proposed access point would be adequate to provide the right turn pocket into the site to be used by vehicles towing caravans.

Ideally, the internal site should be designated as a 10 km/h shared zone for the safety of all occupants and visitors.

5. SUSTAINABLE TRANSPORT ACCESS

5.1 PEDESTRIANS AND CYCLISTS

Footpaths or shared paths are currently provided along Bussell Highway and in parts of the surrounding residential areas. A path along the north side of John Archibald Drive between Woodard Avenue and Tingle Avenue has been constructed.

The concept plan shows dual use pathways proposed along the west and north sides of the site. These pathways are shown as connecting to the existing footpaths along Bussell Highway, Alferink Crescent and onto John Archibald Drive. See **Figure 3.1**.

There is excellent internal connectivity for residents with good connections through to the communal facilities and clubhouse. In addition, there are a number of pedestrian and cycle connections between the site and the external paths.

5.2 PUBLIC TRANSPORT

There are no bus routes available within the vicinity of the site.

6. SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

Edenlife has commissioned Donald Veal Consultants (DVC) to prepare this Transport Impact Statement report to support its Development Application for a residential development comprising of 158 retirement home sites in a lifestyle community at Lot 9012 Bussell Highway, Margaret River.

The development site is located east of Bussell Highway, just south of John Archibald Drive, in Margaret River and will consist of 159 home sites, based on a land lease arrangement, with a minimum entry eligibility age of 50 years. The development will include a clubhouse and other shared facilities.

The site is expected to generate some 318 vpd and 32 vph at peak times. This magnitude of traffic can be readily accommodated onto John Archibald Drive. The intersection onto John Archibald Drive is likely to require a right turn in lane to be constructed in the median to enable turning movements to occur safely.

The internal layout details of the site have been assessed under the Residential Design Codes.

All proposed parking is contained within the site, with most residences having a garage or covered parking bay. Visitors will be able to park on street close to the residential property they are visiting if not at the property itself. A further 44 bays have been provided, which more than satisfies the 40 required by the Residential Design Codes.

The number of peak hour vehicle trips to be generated by the development is estimated to be a maximum of around 32. As such, the forecast trip generation falls well below the threshold for warranting any detailed analysis of traffic impact.

Refuse collection is likely to be carried out by a private contractor on a weekly basis. Other service vehicles are expected to be limited to small delivery vans.

6.2 RECOMMENDATIONS

We support the development proposal in terms of traffic and transport impacts on the adjacent road network, subject to the following recommendations being adopted at the detailed design stage, namely:

1. Designate the internal road network as a 10 km/h shared zone; and
2. Provide some bike racks at the Clubhouse.

APPENDIX A: CONCEPT PLAN


JOHN ARCHIBALD DRIVE
ORIGINAL BOUNDARY
DUAL USE PATH
PARKLAND - RE.VEGETATED
DUAL USE PATHWAY
EXTENT OF FORESHORE RESERVE TO BE FINALISED
MAINTENANCE ACCESS GATES
MAINTENANCE ACCESS GATE
GATE
FORESHORE RESERVE
PROPOSED REVISED BOUNDARY
PEDESTRIAN ACCESS GATE
BOWLING GREEN
CLUBHOUSE
TRAFFIC CALMING 4m CARRIAGEWAY
ARTS & CRAFTS
SIGNIFICANT MARRI
CONNECTION TO ALFERINK CRESCENT
DUAL USE PATHWAY ACROSS EXISTING CULVERT
BUSSELL HWY
ASSET PROTECTION ZONE
SIGNIFICANT PEPPERMINT TREES
MARRI BUSHLAND
WORKSHOP
PEDESTRIAN ACCESS GATE
0m 30m 60m 90m 120m 150m
SCALE 1:1500
N
YIELD = 159
KEY
D DUPLEX
VILLAGE OPEN SPACE
P.O.S/DRAINAGE
HOME LOT
EXISTING TREE
NEW TREE
RICHARD HAMMOND ARCHITECT
15 LITTLE HOWARD ST, FREMANTLE, 6160
0438 918 753 | RICHARD@HRARCHITECTS.COM.AU
No. Description Date
EDEN-LIFE PTY LTD
RAPIDS LANDING COMMUNITY VILLAGE
LOT 9012, BUSSELL HWY MARGARET RIVER
Masterplan - Marketing A3
A.104

APPENDIX 13

Road Traffic Noise Management Plan
(Herring Storer Acoustics)

HERRING STORER ACOUSTICS

EDENLIFE COMMUNITIES PTY LTD

PROPOSED SUBDIVISION
LOT 9014 BUSSELL HIGHWAY, MARGARET RIVER

ROAD TRAFFIC (SPP 5.4)
NOISE MANAGEMENT PLAN

OCTOBER 2021

OUR REFERENCE: 28598-4-21356

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
HERRING STORER ACOUSTICS
P.O. Box 219, Como, W.A. 6952
(08) 9367 6200
hsa@hsacoustics.com.au

DOCUMENT CONTROL PAGE

ACOUSTIC ASSESSMENT

PROPOSED SUBDIVISION PLAN
MARGARET RIVER

Job No: 21356

Document Reference: 28598-4-21356

FOR
EDENLIFE COMMUNITIES PTY LTD

DOCUMENT INFORMATION			
Author:	Paul Daly	**Checked By:**	Tim Reynolds
Date of Issue:	1 November 2021		

REVISION HISTORY

Revision	Description	Date	Author	Checked
1	Clarification of Notifications on titles for leased Lots	9/12/2021	PLD	
2	Revised plan	14/02/2022	PLD	
3	Revised plan	11/03/2022	PLD	

DOCUMENT DISTRIBUTION

Copy No.	Version No.	Destination	Hard Copy	Electronic Copy
1	1	Edenlife Attn: Bill Marshall Email: bmarshall@edenlife.com.au		✓
1	2	Edenlife Attn: Bill Marshall Email: bmarshall@edenlife.com.au		✓
1	3	Edenlife Attn: Bill Marshall Email: bmarshall@edenlife.com.au		✓
1	4	Edenlife Attn: Bill Marshall Email: bmarshall@edenlife.com.au		✓

CONTENTS

APPENDICIES

EXECUTIVE SUMMARY

Herring Storer Acoustics were commissioned by Edenlife Communities Pty Ltd to carry out an acoustical assessment of noise received for the proposed development located at Lot 9014 Bussell Highway, Margaret River.

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 "Road and Rail Noise" (SPP 5.4), the appropriate criteria for assessment for this development are:

EXTERNAL

$L_{Aeq(Day)}$ of 55 dB(A);
$L_{Aeq(Night)}$ of 50 dB(A).

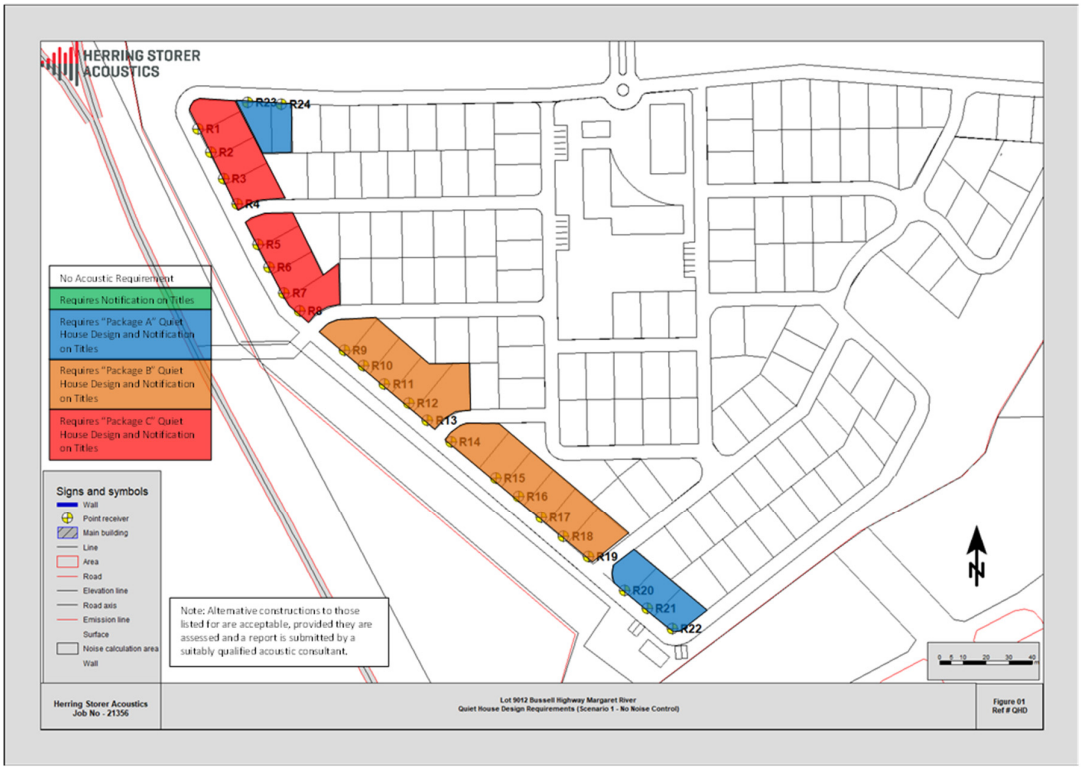
INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas; and
$L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

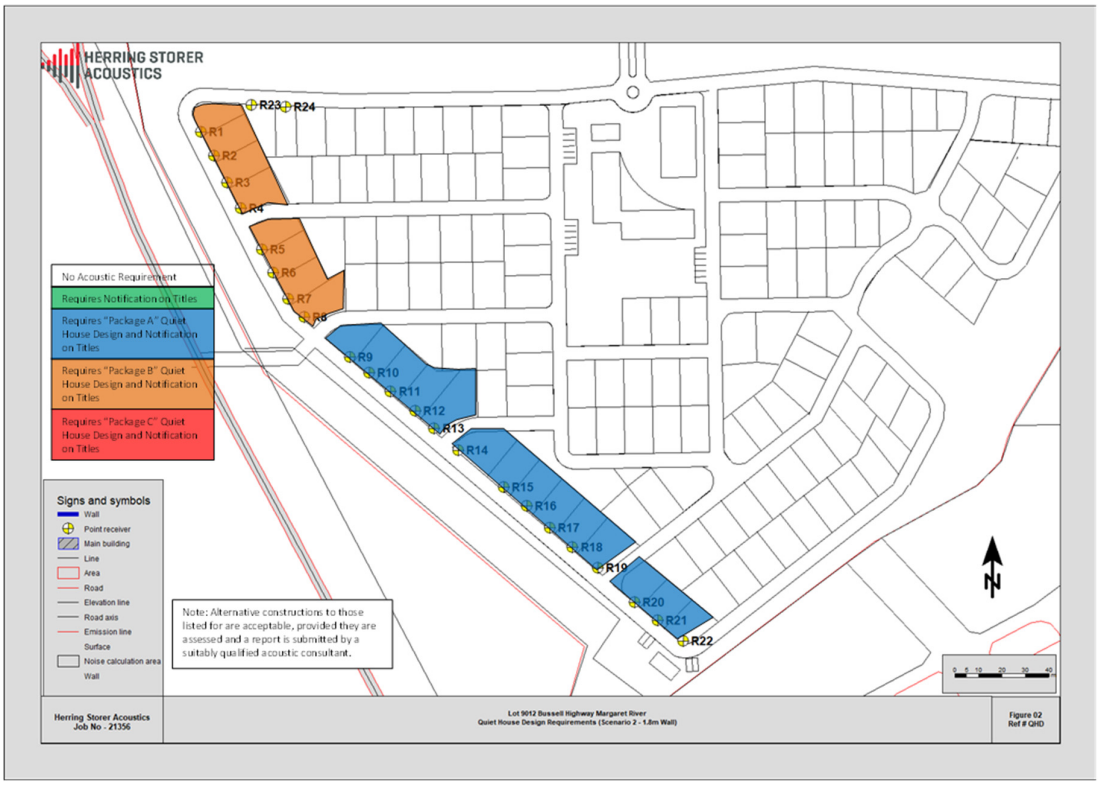
Additional to the above, noise received at an outdoor living area should also be reduced as far as practicable, with an aim of achieving an L_{Aeq} of 50 dB(A) during the night period.

To comply with the Policy, as shown below, the following have been provided:

- No Noise control and Quiet House Design Package C, B, and A as shown below; OR



- Noise Wall 1.8m High, and Quiet House Design Package A, and B as shown below



Any lots exceeding the 55 dB(A) day target criteria would, under SPP 5.4, require Notification on Titles. However, as the Lots are leased to clients, with no Title issued, the form of notification in these instances would be included in the lease contract.

1. INTRODUCTION

Herring Storer Acoustics were commissioned by Edenlife Communities Pty Ltd to carry out an acoustical assessment of noise received for the proposed development located at Lot 9014 Bussell Highway, Margaret River.

The proposed subdivision contains residential land use, being a Lifestyle Community for over 50s.

As part of the study, the following was carried out:

- Measurement of the existing (2021) road traffic noise levels at the proposed development.
- Determine by noise modelling the noise that would be received at proposed residences within this development from vehicles travelling on the roadway (Bussell Highway) for the future.
- Assess the predicted noise levels for compliance with the appropriate criteria.
- Provide detailed information as to noise control requirements such as quiet house design, noise walls and notification on titles.

2. CRITERIA

2.1 ROAD TRAFFIC NOISE

The Western Australian Planning Commission (WAPC) released on 6th September 2019 State Planning Policy 5.4 *"Road and Rail Noise".* The requirements of State Planning Policy 5.4 are outlined below.

POLICY APPLICATION (Section 4)

When and where it applies (Section 4.1)

SPP 5.4 applies to the preparation and assessment of planning instruments, including region and local planning schemes; planning strategies, structure plans; subdivision and development proposals in Western Australia, where there is proposed:

*a) noise-sensitive land-use within the policy's trigger distance of a transport corridor as specified in **Table 1**;*

*b) New or major upgrades of roads as specified in **Table 1** and maps **(Schedule 1,2 and 3);** or*

*c) New railways or major upgrades of railways as specified in maps (**Schedule 1, 2 and 3);** or any other works that increase capacity for rail vehicle storage or movement and will result in an increased level of noise.*

Policy trigger distances (Section 4.1.2)

***Table 1** identifies the State's transport corridors and the trigger distances to which the policy applies.*

*The designation of land within the trigger distances outlined in **Table 1** should not be interpreted to imply that land is affected by noise and/or that areas outside the trigger distances are un-affected by noise.*

*Where any part of the lot is within the specified trigger distance, an assessment against the policy is required to determine the likely level of transport noise and management/ mitigation required. An initial screening assessment (**guidelines: Table 2: noise exposure forecast**) will determine if the lot is affected and to what extent."*

TABLE 1: TRANSPORT CORRIDOR CLASSIFICATION AND TRIGGER DISTANCES

Transport corridor classification	***Trigger distance***	***Distance measured from***
Roads		
Strategic freight and major traffic routes *Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume*	*300 metres*	*Road carriageway edge*
Other significant freight/traffic routes *These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meet the criteria of either >=23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)*	*200 metres*	*Road carriageway edge*
Passenger railways		
	100 metres	*Centreline of the closest track*
Freight railways		
	200 metres	*Centreline of the closest track*

Proponents are advised to consult with the decision making authority as site specific conditions (significant differences in ground levels, extreme noise levels) may influence the noise mitigation measures required, that may extend beyond the trigger distance.

POLICY MEASURES (Section 6)

The policy applies a performance-based approach to the management and mitigation of transport noise. The policy measures and resultant noise mitigation will be influenced by the function of the transport corridor and the type and intensity of the land-use proposed. Where there is risk of future land-use conflict in close proximity to strategic freight routes, a precautionary approach should be applied. Planning should also consider other broader planning policies. This is to ensure a balanced approach takes into consideration reasonable and practical considerations.

Noise Targets (Section 6.1)

***Table 2** sets out noise targets that are to be achieved by proposals under which the policy applies. Where exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.*

In the application of the noise targets the objective is to achieve:

- *indoor noise levels as specified in **Table 2** in noise sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and*

- *a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and child care centres the design of outdoor areas should take into consideration the noise target.*

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

TABLE 2: NOISE TARGETS

Proposals	***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} (Day) 40(Living and work areas)* *L_{Aeq} (Night) 35 (bedrooms)*
Roads	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*
Railways	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*

Notes:

- *The noise target is to be measured at one metre from the most exposed, habitable façade of the proposed building, which has the greatest exposure to the noise-source. A habitable room has the same meaning as defined in State Planning Policy 3.1 Residential Design Codes.*

- *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.*

- *The 5dB difference in the criteria between new and upgrade infrastructure proposals acknowledges the challenges in achieving noise level reduction where existing infrastructure is surrounded by existing noise-sensitive development.*

- *Outdoor targets are to be met at all outdoor areas as far as is reasonable and practical to do so using the various noise mitigation measures outlined in the guidelines. For example, it is likely unreasonable for a transport infrastructure provider to achieve the outdoor targets at more than 1 or 2 floors of an adjacent development with direct line of sight to the traffic.*

Noise Exposure Forecast (Section 6.2)

*When it is determined that SPP 5.4 applies to a planning proposal as outlined in Section 4, proponents and/or decision makers are required to undertake a preliminary assessment using **Table 2**: noise exposure forecast in the guidelines. This will provide an estimate of the potential noise impacts on noise-sensitive land-use and/ or development within the trigger distance of a specified transport corridor. The outcomes of the initial assessment will determine whether:*

- *no further measures is required;*
- *noise-sensitive land-use and/or development is acceptable subject to deemed-to- comply mitigation measures; or*
- *noise-sensitive land-use and/or development is not recommended. Any noise-sensitive land-use and/ or development is subject to mitigation measures outlined in a noise management plan."*

3. MONITORING

Noise monitoring was undertaken at the boundary of the proposed development between the 17th and 29th September 2021. From these measurements, the noise received at the development from vehicles travelling along the Bussell Highway was determined.

The results of the noise data logging are summarised in Table 3.1.

TABLE 3.1 – DETERMINATION OF TRANSPORTATION NOISE AT LOGGER, dB(A)

Location	$L_{A10\ 18hr}$	$L_{Aeq(day)}$	$L_{Aeq(night)}$
Boundary of Development (15 metres from the road edge)	69.1	65.8	53.5

Based on the noise monitoring, the calculated difference between the $L_{A10,18hour}$ and $L_{Aeq,8hour}$, and the $L_{Aeq10,18hr}$ and $L_{Aeq,16\ hr}$ is -15.6 and -3.3 dB. As the difference between day and night L_{Aeq} noise levels is greater than 5 dB(A) (i.e. 12.3 dB(A)), the day period is the critical period for compliance.

For information, the results of the monitoring are shown graphically in Appendix E, with Figure 3.1 showing the location map, Figure 3.2 showing the monitor insitu and Figure 3.3 showing the road surface.

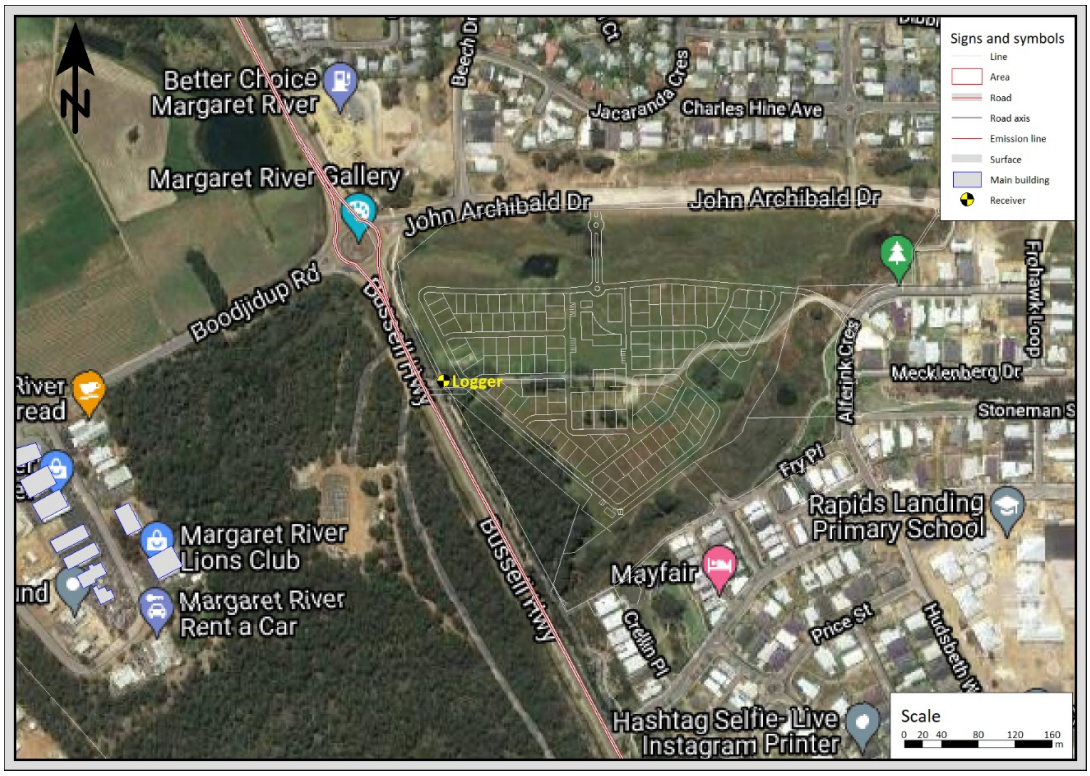


FIGURE 3.1 - NOISE MONITOR LOCATION PLAN

FIGURE 3.2 NOISE MONITOR INSITU

FIGURE 3.3 – ROAD SURFACE

4. MODELLING

To determine the requirements of any noise amelioration, acoustic modelling was carried out using the computer program 'SoundPlan'. Acoustic modelling was carried out for road traffic flows 20 years in the future.

TABLE 5.1 - NOISE MODELLING INPUT DATA

Parameter	Current Count 2016/17 (2021)	Future (2041)
Traffic flows VPD Bussell Highway	11,258 (11,950)	15,170
Heavy Vehicles (%)	7.9%	7.9%
Traffic Speed km/hr	60/80	60/80
Road Surface	Chipseal	Chipseal
Façade Correction	+2.5	+2.5

The future road traffic volumes were based on information provided by the MRWA traffic maps and by the MRWA ROM Department. Advice from the department was as follows for future traffic volumes:

> *Our State Wide Model suggests that the projected compound growth rate is in the order of 1.2% per annum. Please applied the observed counts from :*
>
> https://trafficmap.mainroads.wa.gov.au/map

Other input data for the model included:

- Traffic data from MRWA (https://mrapps.mainroads.wa.gov.au/TrafficMap/)
- Noise source heights for the three road source strings (Passenger Vehicles, Heavy Vehicles Engine and Heavy Vehicle Exhausts) are +0.5, +1.5 and +3.6m, with a noise correction of -0.8 and -8.0 applied to the heavy vehicles engine and exhaust noise sources.
- Topographical data, with the ground level within the development based on natural ground levels as per surveys conducted.
- A +2.5 dB adjustment to allow for façade reflection.
- Development receiver heights at 1.4m above ground level.
- Future buildings located on the boundary of Bussell Highway (assumed to be present for future road traffic volumes).
- Calculations based on CoRTN algorithms.
- Other parameter listed in SPP 5.4 as to guidance for modelling road traffic noise / assessment.

To determine the noise that would be received within the development from the surrounding road network, acoustic modelling was carried out using the computer program 'SoundPlan'.

The following scenarios were modelled:

1. Future traffic volumes, without any noise amelioration.
2. Future traffic volumes, with 1.8m noise wall.

Based on the above, the noise contours plots for day period for the above modelling scenario 2 (ie: recommended option) are attached in Appendix B, with the resultant noise levels discussed further in the next section.

5. TRAFFIC NOISE ASSESSMENT

Under the WAPC State Planning Policy 5.4, for this development, the Noise Targets as listed in Table 2 are the appropriate noise levels to be achieved. Based on the noise monitoring, the difference between the $L_{Aeq(16hr)}$ and the $L_{Aeq(8hr)}$ would be greater than 5 dB(A). Therefore, the day period would be the critical period for compliance and if compliance with the day period noise limit is achieved, then compliance with the night period noise limits would also be achieved. The policy states that the outdoor criteria applies to the ground floor level only, however, it also states that noise mitigation measures should be implemented with a view to achieving the target levels in least one outdoor living area.

For residential premises, the Policy states that residence should be designed to meet the following acceptable internal noise levels:

Living and Work Areas	$L_{Aeq(Day)}$ of 40 dB(A)
Bedrooms	$L_{Aeq(Night)}$ of 35 dB(A)

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to Bussell Highway, could exceed the above Noise Target acoustic criteria. In the worst-case location, the level of exceedance would be approximately 9 dB(A). Table 4.1 details the noise level at the building envelop for each proposed development Lot and the "Quiet House" design package required to achieve compliance. Figure 4.1 showing the location map of the receivers.

FIGURE 4.1 - RECEIVER LOCATION PLAN

TABLE 4.1 – DEVELOPMENT NOISE LEVELS

Location	Scenario 1 Future Traffic Volumes with No Noise Control	Scenario 1 Package Requirements (Based on Concept Lot Design)	Scenario 2 Future Traffic Volumes with 1.8m High Noise Wall	Scenario 2 Package Requirements (Based on Concept Lot Design)
	L_{AeqDay}		L_{AeqDay}	
R1	64	C,N	61	B, N
R2	63	C,N	61	B, N
R3	63	C,N	60	B, N
R4	63	C,N	60	B, N
R5	63	C,N	60	B, N
R6	63	C,N	60	B, N
R7	63	C,N	59	B, N
R8	62	C,N	59	B, N
R9	61	B, N	58	A, N
R10	61	B, N	58	A, N
R11	61	B, N	57	A, N
R12	60	B, N	57	A, N
R13	60	B, N	57	A, N
R14	60	B, N	58	A, N
R15	60	B, N	57	A, N
R16	59	B, N	57	A, N
R17	59	B, N	58	A, N
R18	59	B, N	58	A, N
R19	59	B, N	58	A, N
R20	58	A, N	58	A, N
R21	58	A, N	58	A, N
R22	58	A, N	57	A, N
R23	57	A, N	57	A, N
R24	56	A, N	56	A, N

Nil No Requirements
N Notification on Title
A Package A Quiet House Design
B Package B Quiet House Design
C Package C Quiet House Design

To comply with the Policy, the following have been provided:

- Noise Wall 1.8 m High.
- Quiet House Design Package A, B.

Any lots exceeding the 55 dB(A) day target criteria would, under SPP 5.4, require Notification on Titles. However, as the Lots are leased to clients, with no Title issued, the form of notification in these instances would be included in the lease contract.

Information on the deemed to satisfy constructions for the various “Quiet House Design” packages are contained in Appendix D.

Notes:

1 Given the location of the development and the projected market, we understand that 2 storey residences are unlikely, hence the “Quiet House” Design packages stated are for single storey residence only. If double storey residences are proposed, then it is recommended that specialist acoustic advice be sought by the proponent.

2 We understand that the proposal is at the Structure Plan Stage, whereby future grouped dwelling development will be guided by a Council approved Local Development Plan..

3 The summary of the Quiet House Design Packages attached in Appendix C and D, are “Deemed to Satisfy” constructions. Alternative constructions would be acceptable, provided they are supported by an acoustic report prepared by a suitably qualified acoustic consultant.

4 Quiet House Design requirements are likely to lessen for residential premises set back from the highway, as the façade residences will barrier those behind.

5 Additionally, these residences also require Notifications on Titles or included in the lease contract.

APPENDIX A

PROPOSED SUBDIVISION PLAN

RICHARD HAMMOND ARCHITECT
1B LITTLE HOWARD ST, FREMANTLE, 6160
0438 918 753 | RICHARD@HRARCHITECTS.COM.AU

No.	Description	Date

EDEN-LIFE PTY LTD

RAPIDS LANDING COMMUNITY VILLAGE

LOT 9012, BUSSELL HWY MARGARET RIVER

Masterplan - Marketing A3

Project number	00	A.104
Date	25.02.2022	
Drawn by	RHA	
Checked by	RHA	Scale@A3 As Indicated

25/02/2022 11:51:45 AM

APPENDIX B

NOISE CONTOUR PLOTS

Herring Storer Acoustics
Job No - 21356

Lot 9012 Bussell Highway Margaret River
Future Traffic Volumes No Noise Control
LAeq (16hour) Day Noise Level Contour

Figure 01
Ref # 004

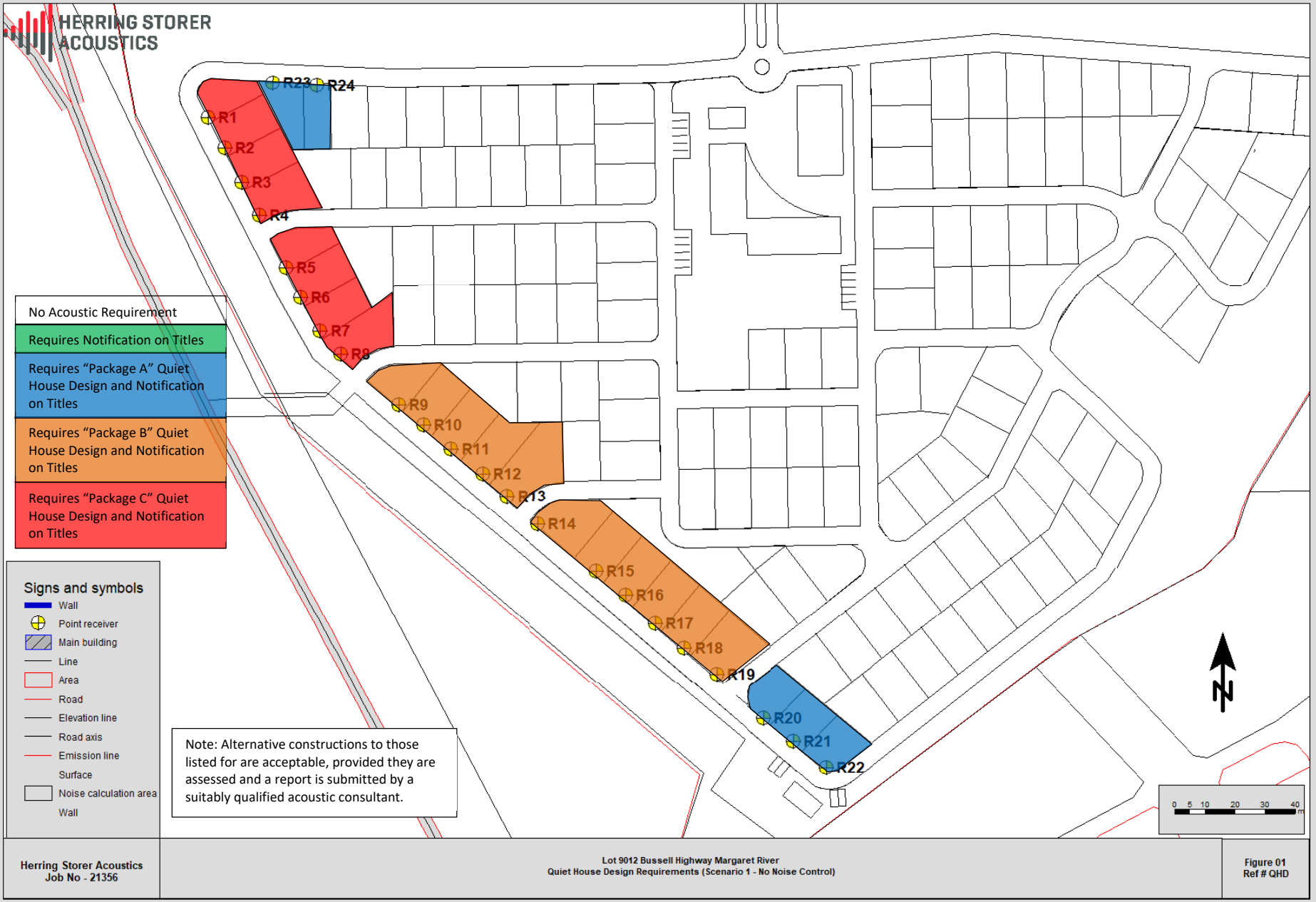
Herring Storer Acoustics
Job No - 21356

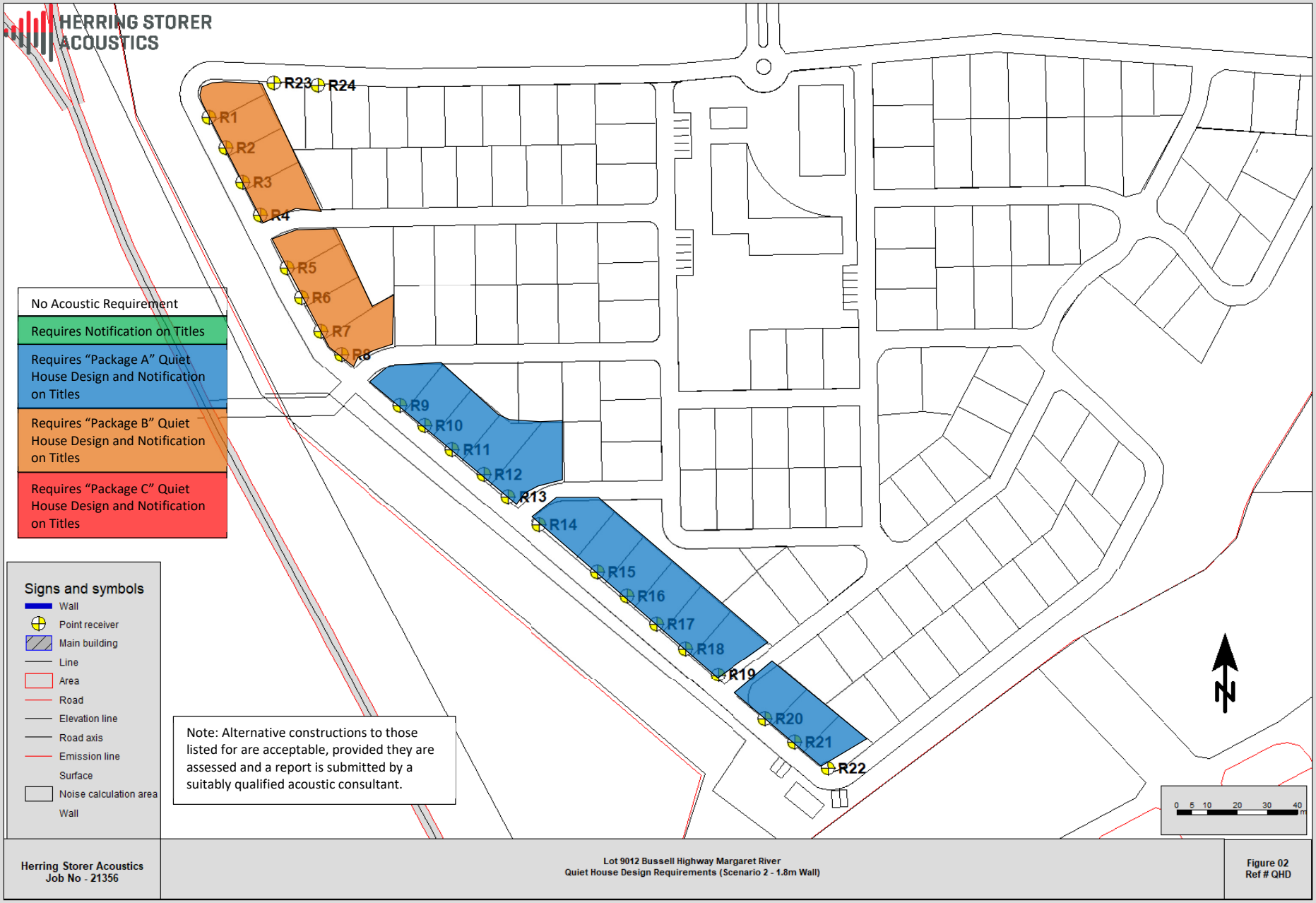
Lot 9012 Bussell Highway Margaret River
Future Traffic Volumes- With 1.8m Wall
LAeq (16hour) Day Noise Level Contour

Figure 02
Ref # 006

APPENDIX C

"QUIET HOUSE" DESIGN REQUIREMENTS


HERRING STORER ACOUSTICS
R23
R24
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
No Acoustic Requirement
Requires Notification on Titles
Requires "Package A" Quiet House Design and Notification on Titles
Requires "Package B" Quiet House Design and Notification on Titles
Requires "Package C" Quiet House Design and Notification on Titles
Signs and symbols
Wall
Point receiver
Main building
Line
Area
Road
Elevation line
Road axis
Emission line
Surface
Noise calculation area
Wall
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
N
0 5 10 20 30 40 m
Herring Storer Acoustics
Job No - 21356
Lot 9012 Bussell Highway Margaret River
Quiet House Design Requirements (Scenario 1 - No Noise Control)
Figure 01
Ref # QHD


HERRING STORER ACOUSTICS
R23
R24
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
No Acoustic Requirement
Requires Notification on Titles
Requires "Package A" Quiet House Design and Notification on Titles
Requires "Package B" Quiet House Design and Notification on Titles
Requires "Package C" Quiet House Design and Notification on Titles
Signs and symbols
Wall
Point receiver
Main building
Line
Area
Road
Elevation line
Road axis
Emission line
Surface
Noise calculation area
Wall
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
N
0 5 10 20 30 40 m
Herring Storer Acoustics
Job No - 21356
Lot 9012 Bussell Highway Margaret River
Quiet House Design Requirements (Scenario 2 - 1.8m Wall)
Figure 02
Ref # QHD

APPENDIX D

"QUIET HOUSE" DESIGN PACKAGES

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
A **Quiet House A**	**Facing**	**Bedroom and Indoor Living and work areas to Rw + Ctr 45dB** **Stud Frame Walls** ➢ One row of 92mm studs at 60mm centres with: ➢ Resilient steel channels fixed to the outside of the studs; and ➢ 9.5mm hardboard or 9mm fibre cement weatherboards or one layer of 19mm board cladding fixed to the outside of the channels; and ➢ 75mm glass wool (11kg/m3) or 75mm polyester (14kg/m3) insulation, positioned between the studs; and ➢ -Two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs. **Brick Walls** ➢ Single leaf of 150mm brick masonry with 13mm cement render on each face: **OR** ➢ Double brick: two leaves of 90 mm clay brick masonry with a 20mm cavity between leaves.	**Bedrooms**: ➢ Fully glazed hinged door with certified R_w+C_{tr} **28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (R_w+C_{tr} **28 dB**). Sealed awning or casement windows may use 6 mm glazing instead**: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} **31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (R_w+C_{tr} **25dB**)**: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB : OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} **31 dB**).	**To R_w+C_{tr} 35dB** ➢ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling	➢ At least one outdoor living area located on the opposite side of the building from the transport corridor and/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	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of **Rw 40dB** 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
	Side On	As per "Facing" above, except R_w+C_{tr} values may be 3dB less, e.g. glazed sliding door with 10 mm glass and weather seals for bedrooms	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%				
	Opposite	No specific requirements	No specific requirements				

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

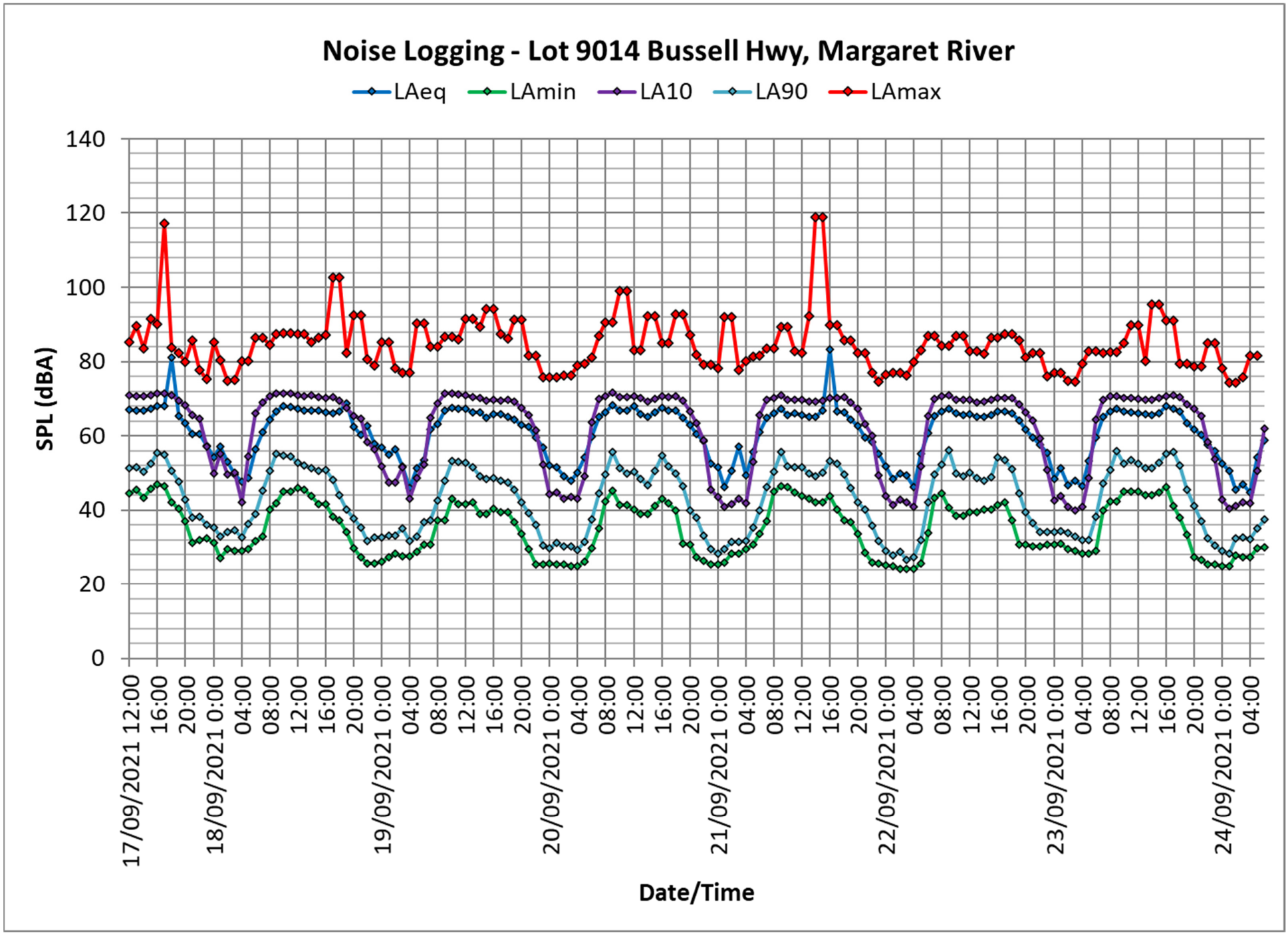
Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
B **Quiet House B**	**Facing**	**Bedroom and indoor living and work areas to R_w+C_{tr} 50dB** **Single leaf of 90 mm clay brick masonry with:** ➢ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➢ A cavity of 25 mm between leaves; ➢ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and ➢ One layer of 10mm plasterboard fixed to the inside face ➢ 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 **Double brick: two leaves of 90mm clay brick masonry with:** ➢ A 50mm cavity between leaves ➢ 50mm glass wool or polyester cavity insulation (R2.0+) ➢ Resilient ties where required to connect leaves **Double brick: two leaves of 110mm clay brick masonry with** ➢ 50mm cavity between leaves and R2.0+ cavity insulation	**Bedrooms** ➢ Fully glazed hinged door with certified **R_w+C_{tr} 31dB** rated door and frame including seals and 10mm glass **Indoor Living and work areas** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor areas: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulted glazing (**Rw+Ctr 31dB**). ➢ Up to 60% floor area: as per above but must be minimum10mm single or 6mm-12mm-10mm double insulated glazing (**Rw+Ctr 34dB**) **Indoor Living and work areas** ➢ Up to 40% floor area; Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (R_w+C_{tr} 28dB). Sealed awning or casement windows may use 6mm glazing instead. **: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**R_w+C_{tr} 31dB**). **: OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 34dB).**	**To R_w+C_{tr} 35dB** ➢ Concrete or terracotta tile sarking and at least 10mm plasterboard ceiling, R3.0+ insulation **OR** ➢ Metal sheet roof, sarking and at least 10mm plasterboard ceiling, R3.0+ insulation	➢ At least one outdoor living area located on the opposite side of the building from the corridor and/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	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of **Rw 40dB** 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
	Side-On		**Bedrooms**: ➢ Fully glazed hinged door with certified **R_w+C_{tr} 28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 28 dB**). Sealed awning or casement windows may use 6 mm glazing instead. **: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (**R_w+C_{tr} 31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 25dB**). **: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB**) **: OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 31 dB**).			
	Opposite		As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%			

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	**Mechanical ventilation/air conditioning considerations**
C **Quiet House C**	**Facing**	**Bedroom and indoor living and work areas to R_w+C_{tr} 50dB** **Single leaf of 90 mm clay brick masonry with:** ➢ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➢ A cavity of 25 mm between leaves; ➢ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and ➢ One layer of 10mm plasterboard fixed to the inside face ➢ 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	**Bedrooms** ➢ External doors to bedrooms facing the corridor are not recommended. **Indoor Living and work areas** ➢ Fully glazed hinged door with certified **Rw+Ctr 31dB** rated door and frame including seals and 10mm glass**: OR** 40mm solid core timber frame and door (without glass or with glass inserts not less than 6mm), side hinged with certified **Rw 32dB** acoustically rated door and frame system including seals	**Bedrooms**: ➢ Total external door and window system area up to 20% of room floor area: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 31dB): OR** ➢ Up to 40% floor area; as per above but must be minimum 10mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 34dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (**R_w+C_{tr} 31dB**). Sealed awning or casement windows may use 6mm glazing instead**: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr 34dB)**	**To R_w+C_{tr} 40dB** ➢ To al bedrooms, 2 layers of 10mm plasterboard, or one layer 13mm high density sealed plasterboard (minimum surface density of 12.5 kg/m2), affixed using steel furring channels beneath ceiling rafters/supports**: and** ➢ R3.0+ insulation batts laid in cavity **: and** ➢ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibre insulation between steel sheeting and roof battens	➢ At least one outdoor living area located on the opposite side of the building from the corridor and/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	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces. ➢ Evaporative systems require attenuated ceiling air cents 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, close or relocated to building sides facing away from the corridor where practicable.
	Side-on		**Bedrooms** ➢ Fully glazed hinged door with certified **R_w+C_{tr} 31dB** rated door and frame including seals and 10mm glass **Indoor Living and work areas** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals				
	Opposite	**Double brick: two leaves of 90mm clay brick masonry with:** ➢ A 50mm cavity between leaves ➢ 50mm glass wool or polyester cavity insulation (R2.0+) ➢ Resilient ties where required to connect leaves **Double brick: two leaves of 110mm clay brick masonry with** ➢ 50mm cavity between leaves and R2.0+ cavity insulation	**Bedrooms**: ➢ Fully glazed hinged door with certified **R_w+C_{tr} 28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 28 dB**). Sealed awning or casement windows may use 6 mm glazing instead**: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (**R_w+C_{tr} 31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 25dB): OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB : OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 31 dB**).			

APPENDIX E

MONITORING DATA


Noise Logging - Lot 9014 Bussell Hwy, Margaret River
LAeq
LAmin
LA10
LA90
LAmax
SPL (dBA)
140
120
100
80
60
40
20
0
17/09/2021 12:00
16:00
20:00
18/09/2021 0:00
04:00
08:00
12:00
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19/09/2021 0:00
04:00
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20:00
23/09/2021 0:00
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12:00
16:00
20:00
24/09/2021 0:00
04:00
Date/Time