Structure Plan

'Anstey Keane Urban Development Precinct'
Armadale and Allen Roads, Forrestdale



ROWE GROUP DESIGN

OUR REF: 9269 07/04/2026

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OUR REF: 9269_20260407_R_Armadale_LSPV7_SB 7/04/2026

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Record of Endorsement

This Structure Plan is prepared under the provisions of the *City of Armadale Town Planning Scheme No. 4*.

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

30 JUNE 2026

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:

Anne Woodin

..... Witness

.....07 JULY 2026..... Date

.....07 JULY 2036..... Date of Expiry

Table of Amendments

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

Executive Summary

This Structure Plan applies to Lots 1, 4-7, 9, 11-17, 19-23, 88-93 and 529 Armadale Road and Lots 37-38 Allen Road, Forrestdale (**Structure Plan area**).

The Structure Plan area comprises approximately 5.23 hectares of land and is situated to the immediate south of the approved Anstey Keane Urban Development Precinct East Structure Plan (**AKUDPESP**) area. The Structure Plan area is zoned 'Urban' under the provisions of the *Metropolitan Region Scheme* (**MRS**) and 'Urban Development' under the provisions of the City of Armadale (**City**) *Town Planning Scheme No. 4* (**TPS 4**).

The Structure Plan area is located approximately 22.5 kilometres south of the Perth Central Business District, 7 kilometres west of the Armadale District Centre, and 8.3 kilometres east of the Cockburn District Centre.

The objectives of this Structure Plan are to:

- Provide a framework to guide and coordinate the use, subdivision, and development of the Structure Plan area; and
- Provide for appropriate residential development that responds to its surrounds, including the future service station, childcare centre, and mixed-use development site to the west, Armadale Road to the south, and the developing AKUDPESP area to the north.

This Structure Plan is therefore prepared to satisfy the requirements of TPS 4 and the *Planning and Development (Local Planning Schemes) Regulations 2015* (**Regulations**) to facilitate future subdivision and development of the land contained within the Structure Plan Area.

This Structure Plan will provide the basis for the logical extension of the residential estate under development to the north of the subject land.

Structure Plan Summary

Item	Data		Section number referenced in Part 2 of report
Total area covered by the Structure Plan	5.23 hectares		1.2.2
Area of each land use proposed: - Residential	4.74 hectares	118 lots	4.2
Total estimated lot yield	118 lots		4.2
Estimated number of dwellings	118 dwellings		4.2
Estimated residential site density	25 dwellings per site hectare		4.2
Estimated population	319 people		4.2

Note: All information and areas are approximate only and are subject to survey and detailed design.

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Technical appendices

Appendix Number	Document Title	Nature of Document	Referral/Approval Agency	Approval status and Modifications
1	Certificates of Title	Supporting	-	-
2	Opportunities and Constraints Plan	Supporting	-	-
3	Anstey Keane Urban Development Precinct East Structure Plan Amendment Report	Supporting	City of Armadale and Western Australian Planning Commission	Awaiting approval
4	Subdivision Concept Plans	Supporting	-	-
5	Local Water Management Strategy	Requires Approval	Department of Water and Environmental Regulation and City of Armadale	Awaiting approval
6	Bushfire Management Plan	Requires Approval	Department of Fire and Emergency Services and City of Armadale	Awaiting approval
7	Acoustic Assessment	Requires Approval	City of Armadale	Awaiting approval
8	Preliminary Tree Assessment	Supporting	-	-
9	Environmental Assessment Report	Supporting	-	-
10	Transport Impact Assessment	Supporting	-	-
11	Main Roads WA Plans	Supporting	-	-
12	Engineering Servicing Report	Supporting	-	-

Part One

Implementation



1. Structure Plan Area and Operation

The Structure Plan area includes Lots 1, 4-7, 9, 11-17, 19-23, 88-93 and 529 Armadale Road and Lots 37-38 Allen Road, Forrestdale.

The Structure Plan area is the land contained within the inner edge of the line denoting the Structure Plan boundary on the Local Structure Plan map (Refer Plan 1 situated at the end of Part 1 of this Structure Plan report).

In accordance with Schedule 2, Part 4 of the Regulations, this Structure Plan shall come into operation when it is approved by the Western Australian Planning Commission (**WAPC**). This Structure Plan is in effect from the date stated on the cover and for a period of 10 years (or for any other period approved by the WAPC).

2. Purpose

The purpose of this Structure Plan is to facilitate the subdivision and development of the subject land for residential purposes. This Structure Plan has been prepared in accordance with the City's TPS 4, the Structure Planning (Schedule 8) provisions of TPS 4, the Regulations and the WAPC's Liveable Neighbourhoods operational policy.

3. Subdivision & Development Requirements

3.1 Land Use And Zones

3.1.1 Zones

Plan 1 designates the 'Residential' zone across the Structure Plan. Land use permissibility within the Structure Plan area shall be in accordance with the 'Residential' zone under TPS 4.

3.1.2 Road Reserves

3.1.2.1 Armadale Road Slip Road Upgrade

The existing Armadale Road slip lane is currently constructed to a rural standard. It is intended that the slip lane will ultimately be upgraded to an urban standard as development within the locality progresses.

The upgrade will be delivered through the subdivision process by the relevant landowners/developers and is expected to include appropriate drainage infrastructure, consistent with the recommendations of the Local Water Management Strategy (**LWMS**). In this regard, the upgrade of the Armadale Road slip lane may be required as a condition of subdivision approval.

Given the fragmented land ownership within the Structure Plan area, the upgrade of the slip lane may occur in stages. Where the full drainage network cannot be delivered at the initial stage of subdivision, temporary drainage measures may be required to ensure stormwater is appropriately managed until the ultimate drainage infrastructure is completed.

3.1.2.2 Future Armadale Road Widening and Access

No additional crossovers to Armadale Road will be permitted. Provision is required for the future widening of Armadale Road, with the extent of land required to be determined at subdivision stage in consultation with Main Roads Western Australia (**MRWA**).

The existing left-in/left-out access to and from Armadale Road is considered temporary and may be removed in the future, subject to the requirements of MRWA.

3.1.3 Open Space

No public open space is proposed within the Structure Plan area. Given the fragmented land ownership and the limited land area available, the provision of consolidated public open space within the Structure Plan area is not considered feasible. Accordingly, a cash-in-lieu contribution toward the provision of public open space will be required as part of the subdivision process, in accordance with the relevant provisions of the *Planning and Development Act 2005* (**PD Act**) and the Liveable Neighbourhoods policy framework. Further consideration of public open space provision within the locality is provided in Part 2 of this report.

3.2 Density and Development

3.2.1 Dwelling Target

In accordance with the Liveable Neighbourhoods and Directions 2031 targets, the Structure Plan area shall provide for a minimum average of 22 dwellings per site hectare and 15 dwellings per gross urban hectare. As outlined in the Structure Plan Summary, the proposed R25 density coding will enable the development of approximately 118 new dwellings, resulting in an estimated population increase of around 319 people within the Structure Plan area.

3.2.2 Density

The Structure Plan map applies a residential density coding of R25 to the land within the Structure Plan area. This density coding will guide future subdivision and development and has been fixed for all lots within the Structure Plan area, with no further allocation of lot-specific densities required at subdivision stage.

3.2.3 Built Form

The Structure Plan proposes built form requirements which address:

- Dwelling orientation to front Rathbone Drive, Armadale Road and the slip Road;
- Limit of one (1) crossover per street frontage;
- Garage/carparking for grouped housing development to be accessed from communal street; and
- Consolidation of crossovers.

3.2.4 Local Development Plans

Local Development Plans (**LDP**) may be prepared and implemented pursuant to Part 6 of Schedule 2 of the Regulations for lots subject to a 'Quiet House Design' package, as identified in the Acoustic Assessment.

3.3 Other Requirements

3.3.1 Contamination Investigation

Prior to any development occurring within the Structure Plan area, appropriate soil and groundwater investigations must be undertaken to identify any potential land contamination resulting from historical land uses. The findings of these investigations will determine whether any remediation is required.

3.3.2 Access Arrangements

Vehicle access to the public road network shall be limited to existing crossovers to Armadale Road. Where access is proposed, consideration should be given to:

- Co-locating crossovers between lots where possible;
- Locating crossovers as far as practicable from any intersection; and
- Aligning crossovers to abut the boundary of Lot 99 (formerly Lot 800) where appropriate.

3.3.3 Fire Management

This Structure Plan is supported by a Bushfire Management Plan (**BMP**). Any development on land within the Structure Plan area shall be constructed in accordance with the recommendations outlined in the BMP and shall comply with the requirements of Australian Standard 3959 – Construction of Buildings in Bushfire Prone Areas.

3.3.4 Notifications on Title

With respect to applications to subdivide land within the Structure Plan area, the City may recommend to the WAPC that a condition be imposed as part of the subdivision approval for a notification to be placed on Certificates of Title(s) to advise the following (where applicable):

a) Land or lots deemed to be affected by road traffic noise as identified in the Acoustic Assessment (contained within Attachment 8 to this Report);

b) Land or lots deemed to be affected by bushfire risk and subject to the management practices set out in the BMP (contained within Attachment 7 to this Report); and/or

c) Land or lots deemed to be affected by mosquito breed habitats that can experience substantial numbers of nuisance mosquitoes after certain environmental conditions.

3.3.5 Development Contributions

This Structure Plan is subject to contribution to the costs of common infrastructure in accordance with Development Contribution Plan No. 4 (**DCA 4**) and Cost Apportionment Schedule prepared pursuant to Part 5A and Schedule 9B Development Contribution Plans under TPS 4.

4. Additional Details

The following technical reports/strategies are required to be prepared, submitted and implemented as a condition of subdivision/development approval (where applicable):

Additional Information	Approval Stage	Consultation Required
Bushfire Management Plan	Subdivision Application	Department of Fire and Emergency Services and City of Armadale
Local Development Plan	Condition of Subdivision or Development Approval	City of Armadale
Urban Water Management Plan	Condition of Subdivision or Development Approval	Department of Water and Environmental Regulation and City of Armadale
Noise Management Plan	Condition of Subdivision or Development Approval	City of Armadale
Arborist Reporting and Tree Retention Plan	Subdivision / Development Application	City of Armadale
Landscaping Plans	Condition of Subdivision or Development Approval	City of Armadale
Dewatering and Acid Sulphate Soil Management Plan	Condition of Subdivision or Development Approval	Department of Water and Environmental Regulation and City of Armadale
Soil and Groundwater Investigation	Condition of Subdivision or Development Approval	City of Armadale

ANSTEY KEANE URBAN DEVELOPMENT EAST STRUCTURE PLAN

PLAN No. 3068-68H-01

LEGEND

- LOTS SUBJECT TO STRUCTURE PLAN
- DWELLING ORIENTATION
- PREFERRED CROSSOVER LOCATION
- 16m WIDE LAND PROTECTION AREA

LOCAL SCHEME ZONES

- RESIDENTIAL - R25

MOVEMENT NETWORK

- ACCESS STREET

ANSTEY ROAD
OSTROM STREET
SEACOLE ROAD
BOUDICCA DRIVE
EDERLE STREET
MISTRAL COURT
AQUITAINE BOULEVARD
HURSTON STREET
HYPATIA LOULEVARD
ALLEN ROAD
RATHBONE DRIVE
SLIP ROAD
ARMADALE ROAD
WIRTH ROAD
DUMSDAY DRIVE

LOCAL STRUCTURE PLAN

VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N

0 50 m
SCALE @ A3: 1:2500

9269-LSP-01-F

DRAWN: JS
DATE CREATED: 2026.04.07
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

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Part Two

Explanatory Section

ROWE GROUP DESIGN

1. Planning Background

1.1 Introduction and Purpose

This Structure Plan is prepared on behalf of Armadale Road Development, the developer of various lots along Armadale Road, Forrestdale (between Anstey Road and Allen Road). The Structure Plan Area is bound by Lot 800 (No. 799) to the west, residential land encapsulated by the AKUDPESP to the north, Allen Road to the east, and Armadale Road to the south.

The purpose of this Structure Plan is to facilitate the subdivision and development of the subject land for residential purposes. This Structure Plan has been prepared in accordance with the City's TPS 4, the Structure Planning provisions of TPS 4 (Schedule 8), the Regulations, and the WAPC's Liveable Neighbourhoods operational policy.

The objectives of this Structure Plan are to:

- Provide a framework to guide the use, subdivision, and development of the fragmented Structure Plan area; and
- Provide for appropriate residential development that responds to its surrounds, including the future service station, childcare centre, and mixed-use development site to the west, Armadale Road to the south, and the developing AKUDPESP area to the north.

The following multidisciplinary project team has been engaged by the proponent to progress the preparation of this Structure Plan:

Discipline	Consultant
Town Planning and Urban Design	Rowe Group
Civil Engineering	JDSi Consulting Engineers
Hydrology	Oversby Consulting
Traffic & Access	Transcore
Acoustic	Herring Storer Acoustics
Bushfire	Bushfire Safety Consulting
Arborist	Arboribus Consulting
Environment	Western Environmental

Table 1 – Project Team.

Rowe Group is the primary contact for all matters relating to this Structure Plan submission.

1.2 Site Context

1.2.1 Location

The Structure Plan area is located approximately 22.5 kilometres south of the Perth Central Business District, 7 kilometres west of the Armadale District Centre, and 8.3 kilometres east of the Cockburn District Centre. Armadale Road, which is reserved as a 'Primary Regional Road' under the MRS, is located immediately south of the subject land.

Refer Figure 1 – Regional Location.

The Structure Plan area is bound by Lot 800 (No. 799) to the west, future residential land encapsulated by the AKUDPESP area to the north, Allen Road to the east and Armadale Road to the south. The subject land forms part of the broader 'Anstey Keane Precinct', and is being progressively developed by individual proponents for urban/residential land uses.

Refer Figure 2 – Local Location.

1.2.2 Legal Description and Ownership

The Structure Plan area comprises multiple land holdings with a total land area of approximately 5.23 hectares, legally described in **Table 2** below.

Refer Attachment 1 – Certificates of Title.

Lot	Address	Plan/Diagram	Vol	Folio	Landowner
4	No. 801 Armadale Road, Forrestdale	P 3347	1804	398	NR Ellement
5	No. 803 Armadale Road, Forrestdale	P 3347	177	82A	CF Fisher and DC Fisher
6	No. 805 Armadale Road, Forrestdale	P 3347	126	142A	EL Bramwell
7	No. 807 Armadale Road, Forrestdale	P 3347	116	131A	F Pinto and MG Scarvaci
529	No. 809 Armadale Road, Forrestdale	DP 188682	2116	260	PA Parris
9	No. 811 Armadale Road, Forrestdale	P 3347	377	19A	A Arena and SM Miller
88	No. 813 Armadale Road, Forrestdale	D 54269	1510	718	A Arena and SM Arena
89	No. 815 Armadale Road, Forrestdale	D 54269	1510	719	NA Manno and BG Manno
90	No. 817 Armadale Road, Forrestdale	D 54269	1510	720	JE Della Bona
91	No. 819 Armadale Road, Forrestdale	D 54269	1510	721	PS Martin
92	No. 821 Armadale Road, Forrestdale	D 54269	1510	722	GR Carpenter and RA Carpenter
93	No. 823 Armadale Road, Forrestdale	D 54269	1510	723	GR Carpenter and RA Carpenter
11	No. 825 Armadale Road, Forrestdale	P 3347	1484	653	JC Burgess and MD Burgess
12	No. 827 Armadale Road, Forrestdale	P 3347	304	145A	CM Burgess
13	No. 829 Armadale Road, Forrestdale	P 3347	533	15A	DG Burge
14	No. 831 Armadale Road, Forrestdale	P 3347	518	192A	BM Brouns
15	No. 833 Armadale Road, Forrestdale	P 3347	1772	599	MJ Ritchie
16	No. 835 Armadale Road, Forrestdale	P 3347	1746	636	MA Pippen
17	No. 837 Armadale Road, Forrestdale	P 3347	1761	746	RH Stevens
1	No. 839 Armadale Road, Forestdale	DP 416054	2965	820	SG Burgess
19	No. 841 Armadale Road, Forrestdale	P 3347	2136	305	TB Vemuru
20	No. 843 Armadale Road, Forrestdale	P 3347	611	74A	G Vasile
21	No. 845 Armadale Road, Forrestdale	P 3347	1330	988	DJC Horn
22	No. 847 Armadale Road, Forrestdale	P 3347	1330	989	JM Kazimierczak

Lot	Address	Plan/Diagram	Vol	Folio	Landowner
23	No. 849 Armadale Road, Forrestdale	P 3347	391	184A	TJ Macdonald
37	No. 7 Allen Road, Forrestdale	P 3347	1369	306	CV Bebbington
38	No. 15 Allen Road, Forrestdale	P 3347	313	95A	VK Gundapaneni and S Gundapaneni

Table 2 – Summary of Land.

1.2.3 Area and Land Use

The Structure Plan area has historically been used for residential purposes. The Structure Plan area currently accommodates a total of 27 dwellings. There is remnant vegetation located in the eastern portion of the subject land. This Structure Plan seeks to facilitate infill development through the subdivision and development of the subject land for continued residential purposes at medium residential density. This is consistent with the surrounding development and current planning framework relevant to this locality.

Refer Figure 3 – Site Plan.



0 3750 m

SCALE @ A4: 1:150,000

FIGURE 1

REGIONAL LOCATION

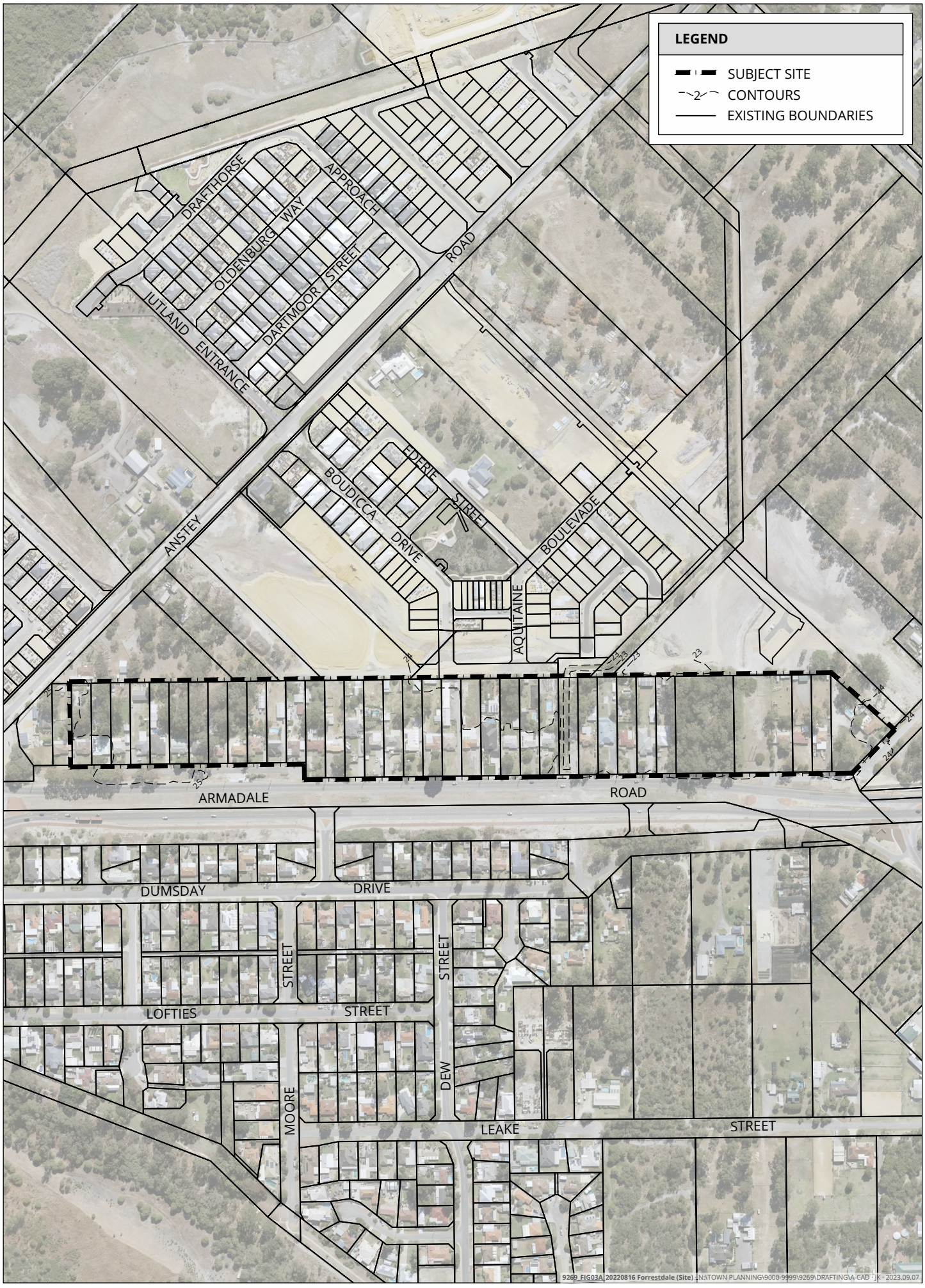


0 1000 m

SCALE @ A4: 1:40,000

FIGURE 2

LOCAL LOCATION



0 125 m

SCALE @ A4: 1:5000

FIGURE 3

SITE PLAN

1.3 Background / Opportunities and Constraints

As previously outlined in this Report, the AKUDPESP area directly abuts the Structure Plan area to the north. The AKUDPESP area has since been subdivided to create a number of medium-density residential lots, areas of public open space, and public road reserves. The majority of the AKUDPESP area has already been subdivided and developed.

The Structure Plan area is located within Development Area 51 (**DA 51**) 'Anstey Keane Precinct' under the provisions of TPS 4. DA 51 requires the preparation of a Structure Plan to facilitate future development of the area.

This Structure Plan seeks to facilitate the subdivision and development of the subject land for residential purposes in accordance with all the relevant planning framework, including the requirements of DA 51 under TPS 4.

Refer Attachment 2 – Opportunities and Constraints Plan.

1.4 Pre-Lodgement Consultation

Prior to the lodgement of this Structure Plan, the proponent undertook a number of pre-lodgement consultation meetings and discussions with Planning Officers at the City and various landowners within the Structure Plan area. Landowners of the lots not included within this Structure Plan (located along the same strip of land) were also engaged and notified of this proposal as part of the pre-lodgement consultation process.

2. Planning Framework

2.1 Zoning and Reservations

2.1.1 Metropolitan Region Scheme

The Structure Plan area is zoned 'Urban' under the provisions of the MRS, which is consistent with the land to the south located on the opposite side of Armadale Road, and the land to the north located within the boundaries of the AKUDPESP area. Armadale Road is reserved as a 'Primary Regional Road' under the provisions of the MRS.

Refer Figure 4 – Metropolitan Region Scheme Zoning Plan.

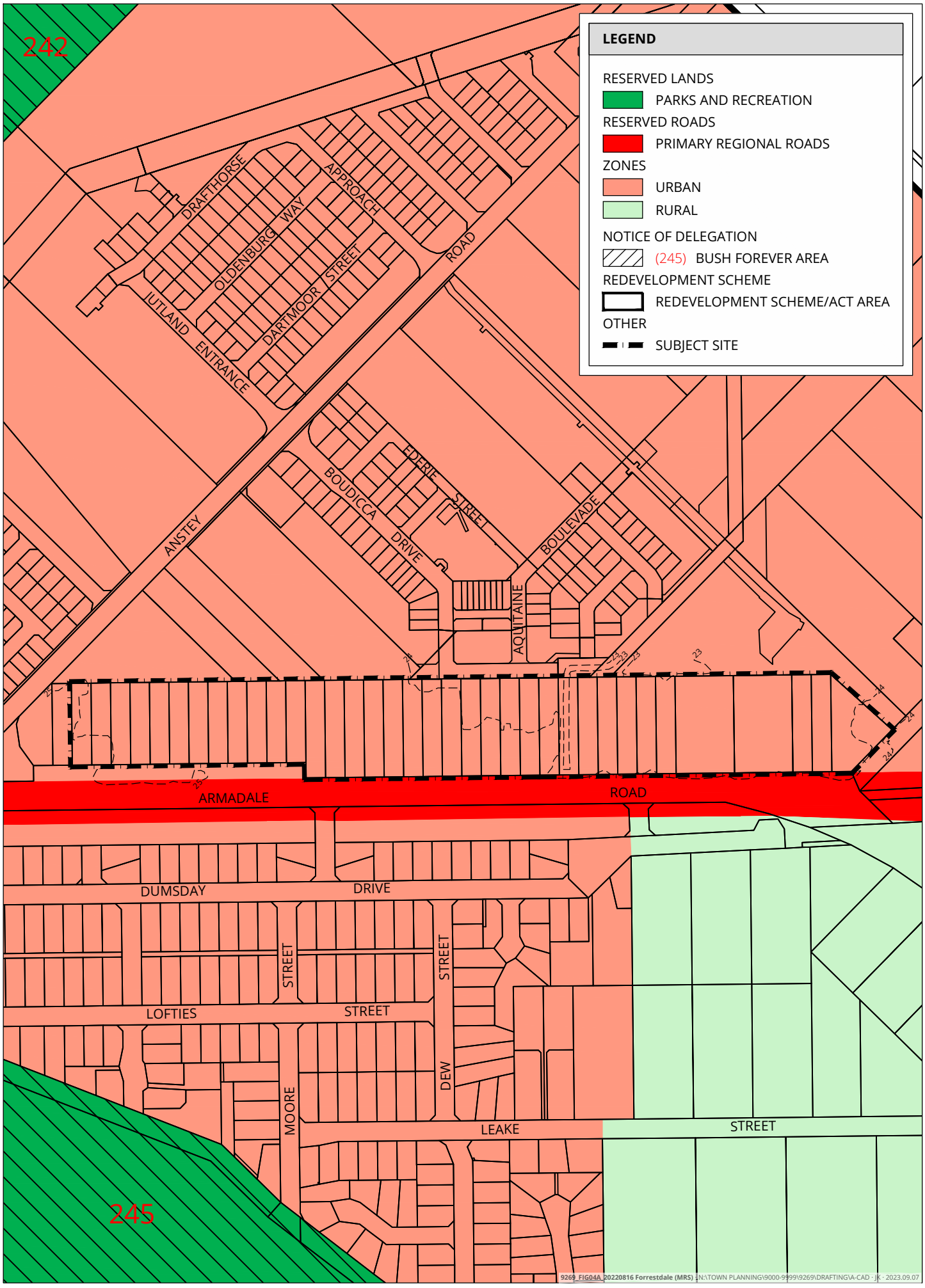
As aforementioned, the subject land forms a portion of the 'Anstey Keane Precinct'. The 'Anstey Keane Precinct' is bound by Keane Road to the north-east, Armadale Road to the south, and Bush Forever Site No. 342 to the north-west. The entirety of the 'Anstey Keane Precinct' is zoned 'Urban' under the MRS.

2.1.2 City of Armadale Town Planning Scheme No. 4

The Structure Plan area is currently zoned 'Urban Development' under the provisions of the City's TPS 4, which is consistent with the landholdings located to the immediate north and east. Lot 800 and Lot 400 which border the Structure Plan area to the west have been rezoned to 'Local Centre' under the provisions of TPS 4. Much of the land contained to the south of Armadale Road is zoned 'Residential' under the provisions of TPS 4.

In addition to the above, future development within the Structure Plan area will be subject to the provisions of DA 51, as set out in Schedule 8 of TPS 4, and Development Contribution Area No. 4 (**DCA 4**), as set out in Schedule 9B of TPS 4.

Refer Figure 5 – Town Planning Scheme No. 4 Zoning Plan.

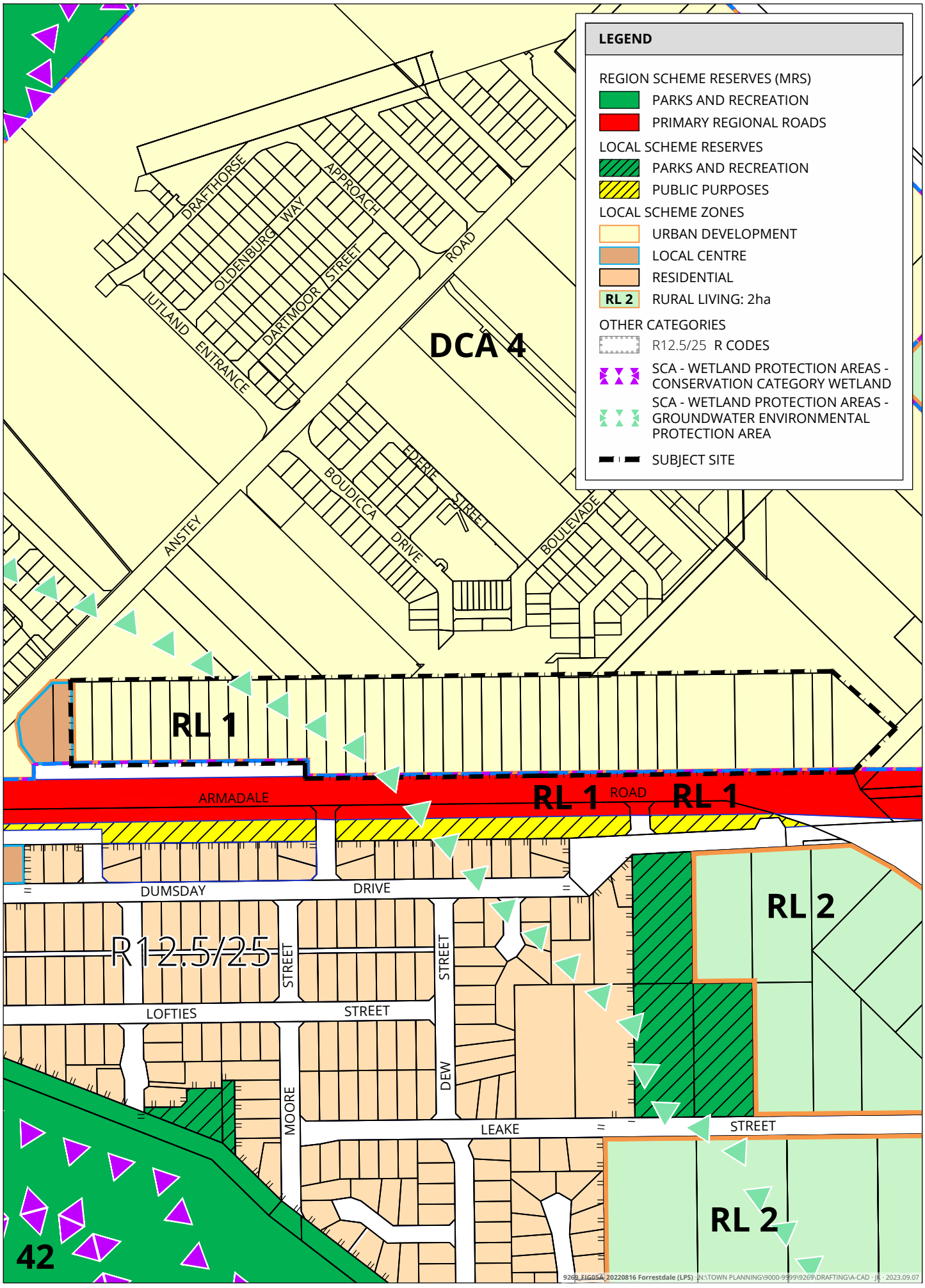


0 125 m

SCALE @ A4: 1:5000

FIGURE 4

METROPOLITAN REGION SCHEME ZONING



0 125 m

SCALE @ A4: 1:5000

FIGURE 5

CITY OF ARMADALE TOWN PLANNING SCHEME NO.4 ZONING

2.1.3 Anstey Keane Urban Development Precinct East Structure Plan

The land directly abutting the Structure Plan area to the north is contained within the boundaries of the AKUDPESP, which was approved by the WAPC on 5 November 2020. The AKUDPESP allows for the creation of a residential neighbourhood that responds to the surrounding land use context, as well as drawing on key elements of the Southern River / Forrestdale / Brookdale / Wungong District Structure Plan which provides a high-level framework for future land use and development in the area. The AKUDPESP establishes an interconnected interface for both existing and future development of the surrounding land and proposes residential densities which range from R30 to R60. The majority of the land contained within the AKUDPESP area has already been subdivided and developed.

In September 2024, the WAPC approved an amendment to the AKUDPESP to rezone Lot 500 (No. 16) Anstey Road, Forrestdale, from 'Residential R25' to 'Local Centre'. This amendment provides justification for higher-density residential redevelopment within the Structure Plan area, ensuring that the proposed R25 density will effectively service any future land uses at this property and in the locality.

Refer Attachment 3 – Anstey Keane Urban Development Precinct East Structure Plan.

2.2 Planning strategies

2.2.1 South Metropolitan Peel Sub-Regional Planning Framework

The South Metropolitan Peel Sub-Regional Planning Framework (**the Framework**) represents a whole of State Government approach to managing the future urban form within the South Metropolitan Sub-Region and identifies sufficient land to meet the increased demand for residential dwellings. The Sub-Region is proposed to accommodate more than 1.26 million people, over 507,000 homes and approximately 430,000 jobs, with a projected additional dwelling target of 15,020 (33,040 people) within the City.

The Structure Plan area is identified for 'Urban Expansion' under the Framework, having regard to its strategic location (the rounding out of an existing urban area) and limited environmental or physical constraints.

The proposed Structure Plan proposes a residential land use over the subject land and is therefore consistent with the Framework.

2.2.2 City of Armadale Local Planning Strategy

The City's Local Planning Strategy (**the Strategy**) was endorsed by the WAPC in December 2016, for the purpose of setting out the long-term planning and land use direction for the City. The Strategy identifies the subject land and the broader Anstey Keane Precinct as an 'Urban Development Area'.

One of the key aspects of the Strategy is the City's Housing Strategy. Having regard to the rapid growth and development in the municipality, the Strategy sets out the following key objectives:

- Provide for a range of housing and opportunities for home businesses in neighbourhoods that are developed to good design principles;
- Meeting the housing targets identified for the City of Armadale set out in Directions 2031, including influencing a greater mix of housing product;
- Increased density for greenfield development to more than 15 dwellings per site hectare;
- Future urban growth to be focussed on employment centres, transit oriented developments and high frequency pubic transport corridors;
- Higher densities applied to localities with close proximity to community facilities and services; and

- New facilities, infrastructure and service provision assisted by appropriate forms of contributions from new developments.

This Structure Plan seeks to provide for residential development at the R40, R50, and R60 density code, which will effectively 'round out' the established Anstey Keane Precinct residential area. The proposed density codes are considered appropriate to addresses the State Government's density target of at least 15 dwellings per site hectare, while demonstrating consistency with the developing residential estate contained within the AKUDPESP area to the north. This Structure Plan will therefore achieve the outcomes set out in the City's Housing Strategy.

Notwithstanding the above, the City is currently preparing a new Local Planning Strategy (2024) that will guide future planning, development, and land use change over the next 20 years and beyond. It will also set out the City's approach to managing its environmental land resources to cater for the 60,000 new residents expected to live in the City over the next 29 years.

The new Strategy will set out the City's strategies, objectives and actions and guide its future planning directions. By 2051, the State Government's planning frameworks and policies are expected to see the City's population swell from the current 98,000 to over 151,000 residents.

Following Council's adoption and Certification by the WAPC, the new Strategy will be advertised for public review and submissions. Following State Government endorsement of the new Strategy, the City will then prepare and advertise its new Local Planning Scheme.

The proposed Structure Plan will be consistent with the intent of the new Strategy and will assist in achieving and developing affordable housing options for the City's growing population.

2.3 State Planning Policies

2.3.1 Draft State Planning Policy 2.9 – Planning for Water

State Planning Policy 2.9 – Water Resources (**SPP 2.9**) aims to protect significant environmental, recreational and cultural values of water resources and sets out the following objectives:

- Protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values;
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources; and
- Promote and assist in the management and sustainable use of water resources.

The WAPC has prepared the draft *State Planning Policy 2.9 – Water Resources* (**draft SPP 2.9**) and supporting Guidelines which were advertised for public comment in 2021. Draft SPP 2.9 and the associated Guidelines seek to consolidate and replace a number of existing State Planning Policies, including *SPP 2.3 – Jandakot Groundwater Protection* (**SPP 2.3**), *SPP 2.7 – Public Drinking Water Source Policy* (**SPP 2.7**), and the existing SPP 2.9.

As with SPP 2.3, draft SPP 2.9 provides for a general presumption against the intensification of land uses in Priority 1 and 2 Water Source Protection Areas, and notes that proposals to reclassify land will only be considered where the land is located within the MRS and has been identified for development through a strategic planning document prepared by the WAPC, such as a sub-regional planning framework or sub-regional structure plan.

The subject land is classified as a Priority 3* Water Source Protection Area. An LWMS has been prepared in support of the proposed Structure Plan to examine the site's hydrological conditions and recommends a strategy for managing existing and future stormwater on site. The LWMS demonstrates the site can be developed as proposed in accordance with the objectives of draft SPP 2.9 and without compromising any of the groundwater protection principles. Water management is further discussed in Section 4.5.

2.3.2 State Planning Policy 3 – Urban Growth and Settlement

State Planning Policy 3.0 – Urban Growth and Settlement (**SPP 3.0**) sets out the principles and considerations which apply to planning for urban growth and settlement. SPP 3.0 recognises:

> *The orderly planning of urban growth and settlement should be facilitated by structure plans, which should take into account the strategic and physical context of the locality, provide for the development of safe, convenient and attractive neighbourhoods which meet the diverse needs of the community, and facilitate the logical and timely provision of infrastructure and services. Structure Plans may consist of a hierarchy of plans ranging from broad district structure plans to more detailed plans for neighbourhoods and precincts.*

Proposals for future urban growth will be determined having regard to:

- The State Planning Strategy, relevant statements of planning policy and regional and sub-regional strategies in the State Planning Framework;
- Population projections provided by the Department of Planning, Lands and Heritage (DPLH);
- Land release plans published by the Commission; and
- Local planning strategies prepared by local government and endorsed by the Commission.

This Structure Plan is consistent with the abovementioned objectives for future urban growth. Consideration of the strategic and physical context of the subject site is discussed further within this Report and more detailed design is to be addressed and considered at subdivision stage.

2.3.3 State Planning Policy 3.7 – Bushfire

State Planning Policy 3.7 – Bushfire **SPP 3.7**) seeks to guide the implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. The entire Structure Plan area is identified by the Department of Fire and Emergency Services (**DFES**) Map of Bush Fire Prone Areas as being 'bushfire prone', with the mapped bushfire risk coming from the areas of remnant vegetation located on the eastern portion of the subject land.

Due to the Structure Plan area being identified as 'bushfire prone', the principles and objectives of SPP 3.7 are required to be considered as part of the structure planning process. A BMP has therefore been prepared by Bushfire Safety Consulting in support of the proposed Structure Plan and is discussed in Section 3.4 of this Report.

Refer Attachment 6 – Bushfire Management Plan.

2.3.4 State Planning Policy 5.4 – Road and Rail Noise

State Planning Policy 5.4 – Road and Rail Noise (**SPP 5.4**) seeks to mitigate and manage road and rail noise attributed to import freight/travel routes within the state, through the use of appropriate land use planning and acoustic requirements. Armadale Road is an identified 'Strategic freight and major traffic route' within SPP 5.4, and accordingly, the provisions of SPP 5.4 are applicable to future sensitive (residential) development of the site.

Accordingly, an Acoustic Assessment has been prepared by Herring Storer Acoustics in support of the proposal and is discussed in detail at Section 3.6 of this report.

Refer Attachment 7 – Acoustic Assessment.

2.3.5 Liveable Neighbourhoods

Liveable Neighbourhoods represents the WAPC's primary policy to guide the design and assessment of residential structure plans and subdivision. The underlying objective of Liveable Neighbourhoods is to create safe, sustainable, and attractive neighbourhoods with a strong site responsive identity that reduces dependency on private vehicles and are more energy and land efficient. As such, Liveable Neighbourhoods seeks to promote an urban structure based on walkable, mixed-use neighbourhoods with interconnected street patterns. It functions by drawing together key policy aspects into a single 'integrated planning and assessment policy' to provide for a performance-based approach to planning assessment. These aspects include:

- Community;
- Movement;
- Lot Layout;
- Urban Water Management;
- Public Open Space; and
- Schools.

Liveable Neighbourhoods identifies a series of objectives and requirements for structure plans that, when met, demonstrate compliance with the overall outcomes sought by Liveable Neighbourhoods. These objectives and requirements relate to items such as road layout, relationship of housing to open space and schools, school location and distribution, public open space layout and location and housing densities.

Working with the site constraints, this Structure Plan has been prepared to satisfy the various objectives and requirements of Liveable Neighbourhoods to ensure more detailed proposals at subdivision stage are also capable of satisfying the relevant criteria.

2.3.6 Development Control Policy 4.3 - High Pressure Gas Pipelines

The WAPC's draft *Development Control Policy 4.3 – Planning for High Pressure Gas Pipelines* (**DCP 4.3**) was prepared to provide guidance for planning within the vicinity of high-pressure gas pipelines in Western Australia. Draft DCP 4.3 was advertised for public comment in February 2017 and is awaiting final approval.

The majority of the Structure Plan area is contained within the trigger distances of the high-pressure ATCO gas pipeline and the Dampier Bunbury Natural Gas Pipeline (**DBNGP**).

The development of land within a pipeline licence area or the DBNGP corridor is subject to restrictions originating with the *Petroleum Pipelines Act 1969*, the *Energy Coordination Act 1994* and (for the DBNGP corridor) the *Dampier to Bunbury Pipeline Act 1997*. These restrictions seek to:

- Protect the pipeline from direct damage;
- Preserve line of sight along the pipeline;
- Provide unrestricted access to the pipeline for the pipeline owner/operator for maintenance and emergency response purposes; and

- Maintain the topography of the land.

With respect to the above, future subdivision and development within the Structure Plan area will be consistent with these restrictions. A Pipeline Risk Management Plan (**PRMP**) will be prepared at detailed subdivision design stage, should it be required.

2.3.7 Development Control Policy 5.1 – Regional Roads (Vehicular Access)

The WAPC's *Development Control Policy 5.1 – Regional Roads (Vehicular Access)* (**DCP 5.1**) sets out the principles to be applied when considering proposals for vehicle access to or from developments abutting regional roads. The Structure Plan abuts Armadale Road which is designated as a 'Primary Regional Road' under the MRS, and therefore DCP 5.1 is applicable.

In considering proposals involving access to regional roads, DCP 5.1 requires consideration to be given to traffic flow and road safety, and as a general principle, seeks to minimise the creation of new driveways on regional roads and rationalise existing access arrangements. The Structure Plan recognises the intention to extend the Armadale Road slip road to rationalise access and thereby improve upon traffic flow and road safety.

2.4 Local Planning Policies

2.4.1 Local Planning Policy 2.4 – Landscape Feature and Tree Preservation

The City's Local Planning Policy 2.4 (**LPP 2.4**) was prepared for the purpose of providing a framework to promote the retention of significant trees or landscape features throughout the development process, and in particular within public open space, drainage corridors and road reserves. LPP 2.4 recognises the importance of significant trees and landscape features on the character of the area.

In this regard, a Preliminary Tree Assessment was undertaken by Arboribus Consulting to identify whether any 'significant' trees (trees with trunk diameter of greater than 300mm) are worthy of retention. A total of 264 trees located in the Structure Plan area were identified and assessed against key retention criteria (age status, useful life expectance, canopy health, canopy structure and pest and diseases). The report concludes that 74 per cent of these trees were categorised as 'Optimal' or 'Acceptable' for retention and incorporation into the Structure Plan area. The remaining 26 per cent of tress located at the subject site were identified as being unsuitable for retention.

Notwithstanding the above, additional arborist reporting will be undertaken as part of the detailed subdivision design stage to confirm which trees are capable of retention.

Refer Attachment 8 – Preliminary Tree Assessment.

2.4.2 Local Planning Policy 2.9 – Landscaping

The City's Local Planning Policy 2.9 (**LPP 2.9**) has been prepared for the purpose of ensuring future development sites positively contribute to the landscape amenity of the City. Clause 3 sets out the objectives of the policy, as follows:

- To conserve and enhance the natural environmental and biodiversity attributes of the district by incorporating environmental principles into public and private decision making.
- To provide applicants with guidance and requirements on landscaping design and appropriate tree/plant selection in accordance with the City's Urban Forest Strategy.

- To provide a common theme for landscaping throughout the City that encourages the enhancement of biodiversity in accordance with the City's Urban Forest and Biodiversity Strategies.
- To provide for climate change adaption by using native plants that use less water and which provide cooler microclimates.

With respect to the above, suitable landscaping plans will be prepared in accordance with LPP 2.9 to accompany future subdivision/development applications within the Structure Plan area at the detailed design stage.

2.4.3 Local Planning Policy 3.10 – Residential Design Codes Variations

The City's Local Planning Policy 3.10 – Residential Design Codes Variations and R-MD Codes (**LPP 3.10**) sets out variations to the deemed to comply requirements of Part 5 of the Residential Design Codes (**R-Codes**) for land zoned 'Urban Development' and identified for residential development between R25 – R60 on structure plans. LPP 3.10 provides variations for setbacks, open space, garage widths, front fences, visual privacy and solar access, as specified in the WAPC's Planning Bulletin 112/2016 – Medium Density Single House Development Standards – Development Zones (**PB 112**).

In this regard, the development of single houses and grouped dwellings within the Structure Plan area will be subject to the provisions of LPP 3.10.

Notwithstanding the above, it is noted the DPLH has since released a new version of the R-Codes, which came into effect on 1 March 2024. The provisions relevant to any future subdivision and development within the Structure Plan area are contained in Part B and Part D of the R-Codes.

2.4.4 Local Planning Policy 5.1 – Highway Development

The City's Local Planning Policy 5.1 – Highway Development (**LPP 5.1**) applies to development, structure plans and scheme amendments on land abutting those roads identified as a 'Primary Distributor Road' or on roads likely to achieve this status in the road hierarchy. Armadale Road is classified as 'Primary Distributor Roads', and therefore LPP 5.1 applies.

The objectives of LPP 5.1 are as follows:

- To encourage the uninterrupted movement of traffic;
- To minimise conflicts between traffic passing, entering or leaving a property; and
- To minimise conflicts between pedestrians and motor vehicles.

LPP 5.1 outlines that before the City determines an application, it must consider a number of factors regarding vehicle access and movement, including whether vehicular access to a property could be provided from an alternative road or route to the highway, and whether it would be desirable to so require.

In the context of this Structure Plan, the newly constructed Rathbone drive to the north, the existing Armadale Road slip road, and Allen Road will all facilitate motor vehicle access to new residential land within the Structure Plan area. The Structure Plan is not necessarily reliant upon the proposed extension of the Armadale Road slip road for access, however, it would better distribute traffic and provide accessibility.

3. Site Constraints

3.1 Biodiversity and Natural Assets

3.1.1 Flora and Vegetation

As previously outlined in this Report, the Preliminary Tree Assessment undertaken by Arboribus Consulting identified whether any of the existing mature trees on site (those with a trunk diameter greater than 300mm) are capable of retention. A total of 264 trees on the subject land were surveyed, with the majority being considered to be in 'good' or 'reasonable' health and classified as 'optimal' for retention and incorporation into the Structure Plan area. The results of this assessment have been incorporated into the civil/construction strategy and water management strategy.

Notwithstanding the above, additional arborist reporting will be undertaken as part of the detailed subdivision design stage to confirm which trees are capable of retention.

Furthermore, the Environmental Assessment Report prepared by Western Environmental concluded that due to the absence of intact vegetation and the mapped absence of threatened flora species and threatened ecological communities, a Spring Survey is not required to support the proposed Structure Plan. It was identified that most of the upper stratum is planted and the mid and ground stratum is parkland cleared.

Refer Attachment 8 – Preliminary Tree Assessment and Attachment 9 - Environmental Assessment Report.

3.1.2 Fauna

Given the lack of significant, in-tact vegetation across the Structure Plan area, it is considered unlikely that any significant habitat exists for native fauna within the Structure Plan area.

3.1.2.1 Black Cockatoo Breeding Habitat

In terms of Black Cockatoo breeding habitat, the Environmental Assessment Report outlined that none of the trees outlined in the Preliminary Tree Assessment were likely to comprise breeding habitat (possessing suitable hollows). There are only two (2) tree species located within the Structure Plan area that are known to have the potential of supporting breeding hollows, which include the *Corymbia Calophylla* and the *Eucalyptus Rudis*. It typically takes between 100-200 years for eucalyptus trees to form a suitable hollow, where trees with a Diameter at Breast Height (**DBH**) of > 500 mm are typically considered large enough to potentially support hollow development.

3.1.2.2 Black Cockatoo Roosting Habitat

The Environmental Assessment Report outlined that most of the eucalyptus species located within the Structure Plan area could potentially be utilised for roosting of all the Black Cockatoo species. In total, 36 trees within the Structure Plan area were identified as being potential roosting trees.

3.1.2.3 Black Cockatoo Foraging Habitat

The Environmental Assessment Report outlined that the overall foraging habitat value was assessed as being low for all Black Cockatoo species. The extent of species comprising suitable foraging habitat within the Structure Plan Area does not form a significant portion of habitat available in the local area. Areas containing significant foraging habitat are located outside of the Structure Plan area within regions of natural, remnant bushland in the broader locality.

Refer Attachment 9 – Environmental Assessment Report.

3.2 Landform and Soils

The surface of the Structure Plan area is generally flat in elevation, ranging between approximately 24m Australian Height Datum (**AHD**) in the east to 25m AHD in the west.

The surface geology of the subject land consists of varying soils, including predominantly Bassendean Sand with some Guildford Formation (low plasticity clay and silty sand with traces of lateritic gravel) to the eastern corner of the Structure Plan area.

3.2.1 Acid Sulphate Soils

The geology and soil types that exist within the Structure Plan area are consistent with a 'low risk' of Acid Sulphate Soil (**ASS**) occurrence. Mapping compiled by the Department of Water and Environmental Regulation (**DWER**) supports this and identifies the Structure Plan area as being in a medium low risk of ASS within 3m of the surface.

It is recommended in the Engineering Servicing Report prepared by JDSi Consulting Engineers that investigations into the occurrence of ASS should be included in future geotechnical and/or environmental studies to ensure any risks of encountering ASS are mitigated. There may be a subdivisional requirement for preparation of a Dewatering and ASS Management Plan. If so, this may require more detailed ASS investigations and analysis during development of the detailed engineering design which will assist in determining the risk of encountering and management of ASS.

Refer Attachment 12 – Engineering Servicing Report.

3.2.2 Contamination

The DWER Contaminated Sites Database does not list any sites within the Structure Plan Area as being a known or suspected contaminated site. On this basis, no assessment of contamination is required to support future subdivision and/or development in this locality.

3.3 Groundwater and Surface Water

3.3.1 Groundwater

A Local Water Management Strategy (**LWMS**) has been prepared by Oversby Consulting in support of the proposed Structure Plan. Groundwater information contained within the LWMS is based on investigations undertaken for the Anstey–Keane Urban Development Precinct East Structure Plan, supplemented by recent monitoring and site validation data.

The Structure Plan area directly abuts the AKUDP East SP to the north, and no wetland or hydromorphic soil characteristics have been identified within the site. Accordingly, the groundwater information collected for the adjoining precinct provides a reliable and representative dataset for this level of planning.

Groundwater monitoring undertaken across the broader AKUDP East area (over an 18-month period, including two winter seasons) and corroborated against long-term DWER bores has established a maximum recorded groundwater level (AAMGL) ranging between 21.6m AHD and 22.1m AHD across the Structure Plan area.

Groundwater generally rises gradually from south to north toward the Baileys Branch Drain.

For the purposes of the Structure Plan, conservative groundwater assumptions have been adopted to ensure adequate design flexibility. Further monitoring and refinement of groundwater levels will be undertaken during the subdivision design phase and documented within the Urban Water Management Plan (**UWMP**).

3.3.2 Surface Water

There are no natural watercourses or wetlands present within the Structure Plan area. Surface water drainage is primarily controlled through a combination of roadside swales, constructed drains, and the regional Baileys Branch Drain.

The Baileys Branch Drain traverses the site from Armadale Road through to the adjoining AKUDP East SP to the north. This open drain has a trapezoidal cross-section and a base invert level of approximately 21.57 m AHD, consistent with the Forrestdale Main Drain Arterial Drainage Study. The drain serves as the main surface and groundwater outflow pathway for the local area, ultimately discharging into the Forrestdale Main Drain network. Run-off from Armadale Road and the slip road currently drains via side entry pits and kerb inlets into the Baileys Branch Drain, with overland flow along grassed verges and shallow swales providing pre-treatment through infiltration.

Similarly, Allen Road conveys flows eastward into its own local drainage system, which then connects to the wider Armadale Road network. Lots fronting the Armadale Road slip road are generally graded toward the verge, allowing for on-site infiltration in smaller rainfall events and controlled overflow into the swale or drain in larger events.

As urban development proceeds northward, finished lot levels within the Structure Plan area will tie into the raised grades established in the adjoining developments, maintaining effective drainage and stormwater control.

Refer Attachment 5 – Local Water Management Strategy.

3.4 Bushfire Hazard

The Structure Plan area is identified as 'Bushfire Prone' on the DFES Map of Bushfire Prone Areas. Accordingly, this Structure Plan is supported by a BMP prepared by Bushfire Safety Consulting. The BMP has been prepared in accordance with SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas.

Refer Attachment 6 – Bushfire Management Plan.

The BMP confirms that bushfire risk within and surrounding the Structure Plan area can be effectively managed to achieve compliance with the intent and objectives of SPP 3.7 and the Guidelines. The principal bushfire management considerations are summarised in Table 3 below.

Bushfire Protection Criteria	Proposed Bushfire Management Strategies
Element 1: Location	The Structure Plan area is situated within a landscape that presents an overall low and acceptable bushfire hazard. Vegetation to the west and north-west influences part of the site, but the development footprint allows all future dwellings to be located where Bushfire Attack Level (BAL) ratings do not exceed BAL-29. A temporary internal Asset Protection Zone (APZ) will be maintained along the north-western interface until the adjoining land is cleared or developed, preventing exposure to BAL-40 or BAL-FZ conditions.
Element 2: Siting and Design	Lot layout and road alignment have been configured so that each lot contains a compliant building area capable of achieving BAL-29 or lower. The design allows for defensible space between buildings and adjacent vegetation, and any lots within 100 metres of classified vegetation will be required to meet APZ standards consistent with the Guidelines and AS 3959. The temporary APZ will be removed once the adjoining land to the north-west is cleared and permanently managed.
Element 3: Vehicular Access	The Structure Plan provides at least two (2) public road connections in different directions - via Armadale Road, Anstey Road, and future internal links - ensuring safe and convenient access

Bushfire Protection Criteria	Proposed Bushfire Management Strategies
	for residents and emergency services. All new roads will be constructed to meet the technical standards of the Guidelines, including minimum sealed widths, passing and turning provisions. Short no-through road sections will incorporate compliant turnaround areas suitable for firefighting appliances. If required during staging, temporary Emergency Access Ways (EAWs) will be implemented to maintain dual access until full road connectivity is achieved.
Element 4: Water	The future subdivision will be connected to a reticulated water supply. Fire hydrants will be installed by the developer in accordance with Water Corporation Design Standard DS63 and DFES requirements, ensuring reliable water availability for firefighting operations throughout the development.

Table 3 – Bushfire Protection Criteria Compliance Table.

Having regard to the above, the BMP concludes that the bushfire hazards within and adjacent to the Structure Plan area are readily manageable through the application of standard management measures in accordance with the Guidelines and AS 3959. These measures have informed the design of the Structure Plan to ensure a compliant, practical and effective bushfire management outcome that safeguards future life, property and environmental assets.

3.5 Heritage

3.5.1 Aboriginal Heritage

A search of the DPLH Aboriginal Inquiry system identified no registered Aboriginal Heritage Sites within the Structure Plan area.

3.5.2 European Heritage

A search of the Council of Western Australia's Register of Heritage Places identified no sites of State heritage significance within the Structure Plan area or immediate surrounds.

A search of the City's Municipal Heritage List identified no sites of local heritage significance within the Structure Plan area or immediate surrounds.

3.6 Transport Noise

The Structure Plan area is located within the *State Planning Policy 5.4 – Road and Rail Noise* (**SPP 5.4**) trigger distance for Armadale Road. Accordingly, an Acoustic Assessment was undertaken by Herring Storer Acoustics to determine compliance with the noise targets and limits prescribed under SPP 5.4 and to confirm the suitability of the land for future residential development.

Refer Attachment 7 – Acoustic Assessment.

The updated assessment determined that noise levels received at the proposed residential lots adjacent to Armadale Road are capable of achieving compliance with the "Noise Target" set out in SPP 5.4, being LAeq 55 dB(A) day and LAeq 50 dB(A) night for outdoor areas. Compliance is achieved primarily as a result of the existing residential development situated between Armadale Road and the future lots, which provides sufficient barrier attenuation to reduce road traffic noise to acceptable levels.

The report notes that, should the existing dwellings fronting Armadale Road ever be removed or redeveloped, additional measures - such as a standard 1.8m boundary fence - would be sufficient to maintain compliance

with the outdoor noise targets. In this regard, the projected levels of noise impact do not warrant or necessitate the construction of a full noise wall within the Structure Plan area.

All properties within the Structure Plan area are therefore capable of achieving the required indoor and outdoor noise targets, consistent with the objectives of SPP 5.4.

4. Land Use and Subdivision Requirements

4.1 Land Use

This Structure Plan sets out the land use, residential densities, public open space, vehicle and pedestrian access, environmental considerations, hydrological and servicing requirements associated with the redevelopment of the Structure Plan area.

The following sections describe the design responses underpinning this Structure Plan and address the relevant elements of Liveable Neighbourhoods. Refer to the Land Use Summary Table provided within the Executive Summary to this report.

Refer Plan 1 – Structure Plan.

4.2 Residential

This Structure Plan proposes a residential density code of R25 across the Structure Plan area. The proposed density is considered appropriate as it meets the State Government's density target of at least 22 dwellings per residential site hectare, while maintaining consistency with the developing residential estates within the AKUDPESP area to the north.

Based on the indicative subdivision design, reflecting current market conditions for the subject land, the Structure Plan is likely to achieve a density of 25 dwellings per residential site hectare. With an indicative maximum dwelling yield of 118 dwellings, the Structure Plan area is expected to accommodate approximately 319 persons, based on an average household size of 2.7 persons (2021 Census data).

The projected uplift in residential density within the Structure Plan area will adequately support the future mixed-use development located immediately west at Lot 99 (No. 12) Anstey Road, Forrestdale, which has recently been approved and is currently under construction.

In September 2024, the WAPC approved an amendment to the AKUDPESP to rezone Lot 500 (No. 16) Anstey Road, Forrestdale, from 'Residential R25' to 'Local Centre'. This amendment provides justification for higher-density residential redevelopment within the Structure Plan area, ensuring that the proposed R25 density will effectively service any future land uses at this property and in the locality.

Furthermore, a new childcare centre has been constructed at Lot 700 (No. 30) Anstey Road, Forrestdale. The proposed medium-density development within the Structure Plan area will help activate and support this facility.

The R25 density code is proposed in response to the subdivision concept plans prepared to support this Structure Plan. These concept plans are designed to achieve an efficient lot configuration, with dimensions consistent with current market standards for project home builders, providing a diversity of lot products that are easier and more affordable to develop. Notwithstanding the above, the subdivision concept plans are indicative only and will be further refined and confirmed at the detailed subdivision and development application stage.

Refer Attachment 4 – Subdivision Concept Plans.

4.3 Public Open Space

No public open space is proposed within the Structure Plan area. Given the fragmented land ownership and limited land area available, the provision of a consolidated public open space area within the Structure Plan area is not considered feasible.

Given that public open space cannot reasonably be provided within the Structure Plan area, it is anticipated that cash-in-lieu contributions will be required at subdivision stage, in accordance with the PD Act and the Liveable Neighbourhoods policy framework.

Notwithstanding the above, the Structure Plan directly adjoins the broader AKUDPESP area, which provides a coordinated network of neighbourhood parks intended to service future residential development within the locality.

Table 2 of the AKUDPESP confirms that approximately 4.4 hectares of public open space is provided within this area (to the immediate north of the Structure Plan). This represents approximately 10.8% of the gross subdivisible area within the AKUDPESP, which is consistent with the requirements of Liveable Neighbourhoods.

Neighbourhood parks within this network include Mahala Park, located immediately north of the Structure Plan area, which provides landscaped recreation areas and play facilities. In addition, future residents will also have convenient access to nearby regional recreational destinations, including the Forrestdale Sporting Association facilities and the Forrestdale Lake Nature Reserve. Accordingly, the existing and planned public open space areas within the locality is considered sufficient to service the future residents of the Structure Plan area.

Refer Figure 6 – Public Open Space Distribution.

Relevantly, the Water Corporation drainage corridor located at Lot 24 Armadale Road was considered as a potential opportunity for enhancement as part of a broader public open space or "living stream" environment. However, advice from the Water Corporation indicates that this infrastructure forms part of the regional drainage network and is managed by the Water Corporation. As such, the opportunity to upgrade the drain to a landscaped living stream has not been formally investigated or confirmed with the Water Corporation at this stage. Accordingly, the Structure Plan does not rely on this drainage corridor to deliver public open space.



FIGURE 6 - PUBLIC OPEN SPACE DISTRIBUTION

VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N

0 125 m
SCALE @ A3: 1:5000

9269-FIG-10-A

DRAWN: WC
DATE CREATED: 2026.03.18
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: METROMAP 20260217

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ROWE GROUP DESIGN

4.4 Movement Network

A Transport Impact Assessment (**TIA**) has been prepared by Transcore in support of this Structure Plan in accordance with the WAPC's Transport Impact Assessment Guidelines. The key findings of the assessment are summarised below.

Refer Attachment 10 – Transport Impact Assessment.

4.4.1 Existing Road Network

4.4.1.1 Armadale Road

Armadale Road is a Primary Distributor under the care and control of MRWA and is reserved as Primary Regional Roads under the MRS. It is constructed as a dual carriageway (two (2) lanes each direction) with a posted speed limit of 80 km/h.

Recent upgrades have delivered median treatments and turning facilities between Anstey Road and Allen Road, with a continuous shared path along both sides. Armadale Road functions as a major east–west regional connector linking to Tonkin Highway and Kwinana Freeway.

4.4.1.2 Armadale Road (slip road)

An existing left-in / left-out service road runs parallel to the northern side of Armadale Road for approximately 300 metres east of Anstey Road. It provides access to several existing residential lots that front Armadale Road.

The slip road remains within the Armadale Road road reserve and is controlled by MRWA, though it is outside the formal 'Primary Regional Road' reservation.

4.4.1.3 Anstey Road

Anstey Road is classified as a District Distributor B road in MRWA's Functional Road Hierarchy. It is constructed as a two-lane rural standard road connecting Armadale Road to Keane Road and Ranford Road, with posted speed limits of 60 km/h north of Keane Road and 80 km/h to the south. The corridor provides important access for both the Forrestdale Business Park West and residential areas.

4.4.1.4 Allen Road

Allen Road functions as an Access Road in the MRWA hierarchy. It is currently constructed as a two-lane road terminating in a cul-de-sac near the eastern boundary of the Structure Plan area. The former connection between Allen Road and Armadale Road has been closed to prevent industrial traffic movements through this locality. A short section of Allen Road parallel to Armadale Road remains open and provides driveway access to a small number of dwellings.

4.4.1.5 MacFarlane Road

MacFarlane Road (previously Keane Road West) provides the realigned link between Armadale Road and Allen Road. It is classified as an Access Road but is constructed to a dual-carriageway cross-section with wide turning lanes to accommodate large vehicles associated with Forrestdale Business Park West.

4.4.2 Proposed Road Network

No new internal public roads are proposed as part of this Structure Plan. Future development within the Structure Plan area will rely on the existing external road network and the future extension of the Armadale Road slip road. Detailed subdivision design will address local access, turning movements, and any shared driveway or reciprocal access arrangements as required.

4.4.3 Changes to Surrounding Road Network

The Anstey–Keane Urban Development Precinct East Structure Plan and the adjoining Mahala Estate provide for the long-term reconfiguration of local connections between Anstey Road, Allen Road and Rathbone Drive, ensuring that industrial traffic from Forrestdale Business Park West is diverted away from the residential area.

MRWA has prepared a concept plan for the future extension of the Armadale Road slip road eastwards from Anstey Road to Allen Road, parallel to Armadale Road. This extension would ultimately provide alternative access for the residential lots fronting Armadale Road once redevelopment occurs. However, MRWA has confirmed that this project is not included in its four-year forward construction program and remains a long-term planning concept only.

The existing MRWA Plan (Ref 1460-132) designates this section of Armadale Road as Control of Access, which restricts the creation of any new driveways or crossovers directly onto Armadale Road. Accordingly, future development must obtain vehicle access from the slip road or internal local streets as part of subdivision and redevelopment.

Tonkin Highway is planned to be upgraded to freeway standard, with grade-separated interchanges progressively replacing existing signalised intersections (including the Tonkin Highway / Armadale Road junction).

Refer Attachment 11 – Main Roads WA Plans.

4.4.4 Pedestrian and Cycle Network

Armadale Road currently accommodates a 3 metre-wide shared path along both sides, connecting to the Armadale–Kwinana Freeway Principal Shared Path. Recent development north of the Structure Plan area (Mahala Estate) has delivered a network of 1.5 metre footpaths on one side of local streets and shared paths on both sides of Neighbourhood Connector roads.

The Department of Transport's (**DoT**) Perth Bicycle Network (PBN) identifies Anstey Road, Allen Road and Keane Road as providing a good-quality on-road cycling environment. Consistent with Liveable Neighbourhoods, footpaths will be provided on at least one side of all roads, and shared paths will be constructed along Anstey Road, Allen Road, and any future Neighbourhood Connector roads within the adjoining precincts.

4.4.5 Public Transport

Transperth Bus Route 519 currently operates along Armadale Road between Murdoch Station and Armadale Station, with services running hourly off-peak and half-hourly during peak periods on weekdays. There are presently no weekend services.

The Public Transport Authority (**PTA**) has advised that any future bus routes through Forrestdale Business Park West or the AKUDP East Structure Plan area will depend on the level of urban development in the locality. A potential future alignment could extend along Anstey Road and Keane Road, ultimately connecting to Ranford Road and Armadale Road, providing a logical route through the future residential precinct.

4.5 Water Management

4.5.1 Local Water Management Strategy

A Local Water Management Strategy (**LWMS**) has been prepared by Oversby Consulting in support of this Structure Plan. The LWMS provides a comprehensive framework for the sustainable management of

stormwater, surface water and groundwater within the Structure Plan area, and establishes key design parameters to guide future subdivision design and urban water management.

Consistent with the principles of Better Urban Water Management (**BUWM**), an Urban Water Management Plan (**UWMP**) will be required to be prepared and implemented as a condition of subdivision approval.

Refer Attachment 5 – Local Water Management Strategy.

4.5.2 Stormwater Management Strategy

The LWMS confirms that the Structure Plan area can effectively accommodate both minor (20% AEP) and major (1% AEP) rainfall events without adverse impacts on downstream infrastructure or the Baileys Branch Drain. The stormwater management approach is based on water-sensitive urban design principles and seeks to maintain pre-development flow rates while improving discharge quality.

Key elements of the proposed strategy include:

- Run-off from lots and roads up to the 1-year EY event will be treated through on-site infiltration and roadside bio-retention systems to remove sediments and nutrients prior to discharge.
- Each residential or grouped-dwelling development will incorporate on-lot detention systems capable of retaining and infiltrating the 1% AEP 1-hour event, consistent with the City of Armadale's design standards.
- New roads will include grassed swales and infiltration structures to detain the 20% AEP event and maintain pre-development discharge rates. Controlled overflow from the major event will discharge into the existing Armadale Road network and Baileys Branch Drain.
- Peak discharge from the Structure Plan area will not exceed pre-development flows for all events up to and including the 1% AEP storm.
- Finished floor levels will be set a minimum of 300mm above the adjacent road gutter and at least 500mm above the 1% AEP flood level (approx. 23.73m AHD) to safeguard habitable buildings.

Collectively, these measures demonstrate that the Structure Plan area is capable of achieving water-sensitive, low-impact stormwater management consistent with the Forrestdale Main Drain Arterial Drainage Strategy and the City of Armadale's local water management guidelines.

4.5.3 Groundwater Management Strategy

Groundwater across the Structure Plan area will continue to be managed through the Baileys Branch Drain and a system of subsoil drains incorporated at subdivision stage. The objective is to maintain groundwater at levels similar to existing conditions while ensuring adequate separation from infrastructure and improving overall water quality.

4.5.3.1 Infrastructure Separation

A suitable vertical separation will be maintained between significant infrastructure and the controlled groundwater level (CGL) to ensure long-term performance and protection of both the stormwater and groundwater systems.

The LWMS identifies that a minimum separation of 1.5 metres is to be provided between the CGL and the underside of key infrastructure, although this may be refined at the detailed design stage where site-specific groundwater monitoring supports an alternative depth.

Separation will be achieved through the use of porous, clean fill and a subsoil drainage system installed near the annual maximum groundwater level. The subsoil network will be designed to discharge via a free-flowing outlet to the existing or future road drainage system or directly into the Baileys Branch Drain, ensuring adequate groundwater control across all development parcels.

Fill materials used across roads and lots are to be free-draining sands compacted to relevant engineering standards, with a minimum permeability of 5 m/day at 95 % compaction. This will promote infiltration and reduce the risk of prolonged waterlogging. For design purposes, the LWMS conservatively modelled infiltration rates at 3 m/day to account for short-term saturation and potential clogging.

Groundwater within the locality is primarily influenced by the Baileys Branch Drain, which will continue to provide the regional drainage outlet. As the drain's invert levels are to remain unchanged, no adverse alteration to the existing groundwater regime is anticipated.

4.5.3.2 Quality Management

Surface water runoff from public roads, car parks and driveways will be directed to bio-infiltration or vegetated treatment areas designed to capture and treat stormwater prior to infiltration. These structures will reduce the export of nutrients, hydrocarbons and suspended solids to the underlying groundwater.

To further enhance groundwater protection, landscaping within the Structure Plan area will use low-nutrient, slow-release fertilisers and native or drought-tolerant species, minimising nutrient loading and reducing maintenance requirements.

The combination of local infiltration treatment and sustainable landscape management practices will ensure that the post-development groundwater quality meets the objectives of the City of Armadale and the Department of Water and Environmental Regulation (DWER), consistent with the requirements for development within a Priority 3 Water Source Protection Area*.

4.5.4 Urban Water Management Plan

In accordance with Better Urban Water Management, a UWMP will be required as a condition of subdivision approval. Given the Structure Plan area is located within a Priority 3 Water Source Protection Area*, the UWMP will be referred to the Department of Water and Environmental Regulation (DWER) for review and endorsement prior to implementation.

The UWMP will expand upon the LWMS by providing:

- Confirmation of compliance with LWMS objectives and DWER requirements;
- Updated subdivision and landscape plans;
- Detailed stormwater modelling and drainage design for the 1 EY, 20% AEP and 1% AEP events;
- Engineering drawings for drainage, earthworks and roadworks;
- Groundwater management measures including fill levels and subsoil layout;
- Construction-phase erosion and sediment control measures;
- An implementation and maintenance schedule; and
- A post-development monitoring and reporting program.

4.6 Infrastructure Coordination, Servicing, and Staging

An Engineering Servicing Report has been prepared by JDSi Consulting Engineers to support this Structure Plan. The report confirms that all essential services - including power, water, sewer, gas, and telecommunications - can be extended and upgraded as required to support development of the Structure Plan area.

Refer Attachment 12 – Engineering Servicing Report.

4.6.1 Power

The Structure Plan area is serviced by existing Western Power infrastructure, including 22 kV high-voltage and low-voltage overhead lines along Armadale Road and Allen Road. A 132 kV transmission line also traverses adjacent Lot 24 to the east within a registered easement. Existing low-voltage underground network infrastructure within the constructed portion of Rathbone Drive in the adjoining Mahala Estate can be extended to service new development. While some undergrounding of existing overhead assets along Armadale Road and Allen Road may be required, these works would be addressed through subdivision conditions and detailed design.

The total estimated demand for the Structure Plan area is approximately 380 kVA, and at least one transformer and switchgear installation is expected. Western Power's preliminary capacity mapping indicates available capacity within the Southern River Zone Substation, though final connection and augmentation requirements will need confirmation through a formal Feasibility Request or Design Information Package.

4.6.2 Water

The Water Corporation operates reticulated mains within and around the site, including a 100 CI main along Armadale Road and Allen Road, and a DN250 poly main extending north through the Bailey's Branch Drain corridor into the Mahala Estate.

The existing network has adequate capacity to service the Structure Plan area, with connections expected via short extensions from these mains. Any necessary upgrades to older 100 CI assets would be determined by the Water Corporation at subdivision design stage. Fire hydrants will be provided in accordance with Design Standard DS63 and DFES requirements.

4.6.3 Reticulated Sewer

The site lies within the Balannup L Wastewater Pump Station (WWPSL) catchment, located north-east of the site within the Mahala Estate. Sewer flows from the Structure Plan area are intended to connect to this system.

Existing dual sewer mains (a DN 300 deep sewer and DN 150 shallow sewer) within Rathbone Drive will provide the primary connection points for future lots. This configuration enables the site to be serviced without significant fill requirements. For western portions of the Structure Plan area, new connections may traverse private lots and would be protected by easements until Rathbone Drive is extended. The eastern lots can connect to the existing DN 225 main in Allen Road.

Preliminary assessment indicates a peak design flow of approximately 1.66 L/s, which can be readily managed by a DN 150 reticulation network. Final connection points and service details will be confirmed with the Water Corporation's Planning Branch during subdivision and detailed design.

4.6.4 Reticulated Gas

Information from Before You Dig Australia (BYDA) identifies an existing 80 PVC medium-pressure gas main along Anstey Road and Armadale Road, continuing to Allen Road. A 110 PE gas main within Lot 24 connects to the same corridor and supplies the Mahala Estate.

In addition, a 200 ST (1900 kPa) high-pressure main runs along the western side of Anstey Road and southern side of Armadale Road. This is a critical asset, and any construction within 15 metres will require approval from ATCO Gas and the presence of an accredited gas spotter. There is no major servicing constraints identified for gas supply. Gas reticulation is typically laid within common service trenches at no cost to the developer, though the developer would be responsible for any trenching required to connect to a high-pressure main.

4.6.5 Telecommunications

Existing communications infrastructure by Telstra, NBN and Vocus runs along Armadale Road, Anstey Road, and Allen Road, servicing the existing properties. Additional infrastructure, including Optus cabling along Armadale Road and Opticomm network assets within the Mahala Estate, provides multiple potential connection points.

Future development can be serviced through extension of these existing networks via a standard pit-and-pipe system, designed to accommodate the chosen service provider's specifications for single and multiple dwelling units. Back-haul requirements are expected to be minimal given the site's proximity to established fixed-line networks.

4.6.6 Sitework and Earthworks

The Structure Plan area comprises generally flat terrain ranging between RL 24.0 m AHD (east) and 25.0 m AHD (west). A detailed geotechnical investigation will be required to confirm soil classification, groundwater separation, and compaction parameters prior to subdivision.

Proposed lot levels will maintain appropriate tie-ins to Rathbone Drive, Allen Road and Armadale Road, ensuring adequate overland flow paths and 1.5 metre groundwater clearance. Indicative finished lot levels range from 23.7 m AHD (east) to 25.3 m AHD (west).

Minor cut-to-fill balancing is anticipated, with up to 0.5 metres of imported fill required locally to achieve drainage and servicing levels. Staging considerations will influence temporary retaining or battering works between lots. Where development occurs in isolation, adjoining owners may need to authorise temporary tie-in works; however, consolidated staging of contiguous lots is the preferred and most efficient approach.

Furthermore, no significant geotechnical or drainage constraints are expected, and siteworks will be guided by AS 3798 – Guidelines on Earthworks for Commercial and Residential Developments and the outcomes of the forthcoming geotechnical investigation.

4.7 Developer Contribution Arrangements

The Structure Plan area is situated within DCA 4 under the provisions TPS 4.

DCA 4 requires landowners within DCA 4 to contribute financially towards the provision of key infrastructure, including road and drainage infrastructure, urban water management initiatives and multi-use community/sporting facilities.

The requirement to contribute arises upon undertaking any subdivision or development and will be imposed as a requirement through a condition of approval.

ATTACHMENT 1

Certificates of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
4/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	27/11/2014

VOLUME 1804 FOLIO 398

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 4 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

NEVILLE ROBERT ELLEMENT OF 801 ARMADALE ROAD, FORRESTDALE

(T G875656) REGISTERED 13/8/1998

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

1. TITLE EXCLUDES THE LAND SHOWN ON DIA 84270.

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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1804-398 (4/P3347)
PREVIOUS TITLE:	1364-194
PROPERTY STREET ADDRESS:	801 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

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WESTERN AUSTRALIA

REGISTER NUMBER	
5/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	31/1/2007

VOLUME 177 FOLIO 82A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 5 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CARL FRED FISHER
DINA CATHARINA FISHER
BOTH OF 803 ARMADALE ROAD, FORRESTDALE
AS JOINT TENANTS

(T D647262) REGISTERED 11/1/1988

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

1. TITLE EXCLUDES THE LAND SHOWN ON D84270.

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:

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SKETCH OF LAND:	177-82A (5/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	803 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING K659824

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WESTERN AUSTRALIA

REGISTER NUMBER	
6/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	17/1/2013

VOLUME 126 FOLIO 142A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 6 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

EMMA LOUISE BRAMWELL OF 805 ARMADALE ROAD, FORRESTDALE

(T G755820) REGISTERED 2/4/1998

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

1. TITLE EXCLUDES THE LAND SHOWN ON DIAGRAM 84270.
2. M152855 MORTGAGE TO POLICE & NURSES LIMITED REGISTERED 9/1/2013.

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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	126-142A (6/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	805 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

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WESTERN AUSTRALIA

REGISTER NUMBER	
7/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	6/9/2001

VOLUME 116 FOLIO 131A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 7 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

FRANCO PINTO
MARIA GRAZIA SCARVACI
BOTH OF 807 ARMADALE ROAD, FORRESTDALE
AS JOINT TENANTS

(T M144952) REGISTERED 27/12/2012

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

1. TITLE EXCLUDES THE LAND SHOWN ON DIAGRAM 84270.
2. *M144953 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 27/12/2012.

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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 116-131A (7/P3347)
PREVIOUS TITLE: 1226-614
PROPERTY STREET ADDRESS: 807 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY: CITY OF ARMADALE

NOTE 1: A000001A PENDING SURVEY - DIAGRAM 84270.
NOTE 2: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING L599894

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WESTERN AUSTRALIA

REGISTER NUMBER	
529/DP188682	
DUPLICATE EDITION **2**	DATE DUPLICATE ISSUED **3/11/2005**

VOLUME **2116** FOLIO **260**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 529 ON DEPOSITED PLAN 188682

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PHILLIPA ANN PARRIS OF 809 ARMADALE ROAD, FORRESTDALE

(T N089570) REGISTERED 11/8/2015

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

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE.
2. *N089571 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 11/8/2015.

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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	2116-260 (529/DP188682)
PREVIOUS TITLE:	1827-361
PROPERTY STREET ADDRESS:	809 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF JANDAKOT AGRICULTURAL AREA LOT 529 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 529 ON DEPOSITED PLAN 188682 ON 27-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

END OF PAGE 1 - CONTINUED OVER

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WESTERN AUSTRALIA

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9/P3347	
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VOLUME 377 FOLIO 19A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 9 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ANTONY ARENA
SHARON MAREE MILLER
BOTH OF 28B/62 GREAT EASTERN HIGHWAY, RIVERVALE
AS JOINT TENANTS

(T J807911) REGISTERED 29/6/2006

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

1. TITLE EXCLUDES THE LAND SHOWN ON DIAGRAM 84270.
2. J858939 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 3/8/2006.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	377-19A (9/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	811 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

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NOTE 3: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N089571

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WESTERN AUSTRALIA

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3	28/4/2008

VOLUME 1510 FOLIO 718

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 88 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ANTONY ARENA
SHARON MAREE ARENA
BOTH OF 66 LEAKE STREET, FORRESTDALE
AS JOINT TENANTS

(T K572330) REGISTERED 21/4/2008

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

1. *M912458 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 13/2/2015.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-718 (88/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	813 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M912458

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Landgate
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WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
1510	**719**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 89 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

NEVILLE ANTHONY MANNO
BARBARA GAIL MANNO
BOTH OF 8 WATTLE COURT, BIBRA LAKE
AS JOINT TENANTS

(T K921430) REGISTERED 28/4/2009

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-719 (89/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	815 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

LANDGATE COPY OF ORIGINAL NOT TO SCALE 02/07/2025 04:19 PM Request number: 68425753

Landgate
www.landgate.wa.gov.au

WESTERN AUSTRALIA

REGISTER NUMBER	
90/D54269	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	11/5/2015

VOLUME 1510 FOLIO 720

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 90 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

JONATHON EDWARD DELLA BONA OF 3224 ALBANY HIGHWAY, MOUNT NASURA
(T N042167) REGISTERED 26/6/2015

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

1. *N042168 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 26/6/2015.

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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-720 (90/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	817 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N042168

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:27 AM Request number: 65229849

Landgate
www.landgate.wa.gov.au

WESTERN AUSTRALIA

REGISTER NUMBER	
91/D54269	
DUPLICATE EDITION **N/A**	DATE DUPLICATE ISSUED **N/A**

VOLUME **1510** FOLIO **721**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 91 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PETER STEWART MARTIN OF 819 ARMADALE ROAD, FORRESTDALE

(ND L429042) REGISTERED 16/9/2010

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-721 (91/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	819 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING L429043

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:27 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
92/D54269	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	15/1/2002

VOLUME 1510 FOLIO 722

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 92 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

GAVIN ROY CARPENTER
RENEE ANN CARPENTER
BOTH OF 104 LINTON STREET NORTH BYFORD WA 6122
AS JOINT TENANTS

(T P151871) REGISTERED 20/5/2022

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

1. *P151872 MORTGAGE TO AFSH NOMINEES PTY LTD REGISTERED 20/5/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-722 (92/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	821 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING P151870

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:27 AM Request number: 65229849

Landgate
www.landgate.wa.gov.au

WESTERN AUSTRALIA

REGISTER NUMBER	
93/D54269	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

VOLUME **1510** FOLIO **723**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 93 ON DIAGRAM 54269

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

GAVIN ROY CARPENTER
IN 20/100 SHARE
RENEE ANN CARPENTER
IN 80/100 SHARE
BOTH OF 104 LINTON STREET NORTH BYFORD WA 6122
AS TENANTS IN COMMON

(T O765876) REGISTERED 11/6/2021

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

1. *O765877 MORTGAGE TO MACQUARIE BANK LTD REGISTERED 11/6/2021.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1510-723 (93/D54269)
PREVIOUS TITLE:	264-114A
PROPERTY STREET ADDRESS:	823 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING O094632

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:28 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
11/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	12/11/2002

VOLUME 1484 FOLIO 653

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 11 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

JAN CHRISTINE BURGESS
MICHAEL DENNIS BURGESS
BOTH OF 5 CULTURE LINK PIARA WATERS WA 6112
AS JOINT TENANTS

(T O137774) REGISTERED 26/4/2019

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

1. *O728477 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 10/5/2021.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	1484-653 (11/P3347)
PREVIOUS TITLE:	573-80
PROPERTY STREET ADDRESS:	825 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING K788148

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Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
12/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	10/1/2006

VOLUME 304 FOLIO 145A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 12 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CHRISTEN MICHAEL BURGESS OF 732 FORREST ROAD FORRESTDALE WA 6112
(T P248057) REGISTERED 11/8/2022

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

1. *P248058 MORTGAGE TO PERPETUAL TRUSTEE COMPANY LIMITED OF LEVEL 13 123 PITT STREET SYDNEY NSW 2000 REGISTERED 11/8/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	304-145A (12/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	827 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING J836145

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:27 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
13/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	25/5/2010

VOLUME 533 FOLIO 15A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 13 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

DAYNE GARETH BURGE OF 829 ARMADALE ROAD FORRESTDALE WA 6112
(T N213830) REGISTERED 24/12/2015

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

1. *N213831 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 24/12/2015.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	533-15A (13/P3347)
PREVIOUS TITLE:	177-81A
PROPERTY STREET ADDRESS:	829 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N213831

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:28 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
14/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	29/1/2008

VOLUME 518 FOLIO 192A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 14 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

BRODIE MICHAEL BROUNS OF 831 ARMADALE ROAD, FORRESTDALE

(T M719803) REGISTERED 29/7/2014

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

1. *M719804 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 29/7/2014.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	518-192A (14/P3347)
PREVIOUS TITLE:	177-81A
PROPERTY STREET ADDRESS:	831 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M719804

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Landgate
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WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
1772	**599**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts
REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 15 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MARK JAMES RITCHIE OF 833 ARMADALE ROAD, FORRESTDALE

(T M543904) REGISTERED 7/2/2014

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

1. M543905 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 7/2/2014.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	1772-599 (15/P3347)
PREVIOUS TITLE:	144-50A
PROPERTY STREET ADDRESS:	833 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

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Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
16/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
6	16/11/2011

VOLUME 1746 FOLIO 636

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 16 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MICHAEL ANTHONY PIPPEN OF 835 ARMADALE ROAD FORRESTDALE WA 6112
(T O940636) REGISTERED 12/11/2021

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

1. *P447776 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 10/2/2023.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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:

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SKETCH OF LAND:	1746-636 (16/P3347)
PREVIOUS TITLE:	82-103A
PROPERTY STREET ADDRESS:	835 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N405291

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Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
17/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	10/5/2005

VOLUME 1761 FOLIO 746

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 17 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

RONALD HARVEY STEVENS OF 837 ARMADALE ROAD, FORRESTDALE

(T J260289) REGISTERED 22/4/2005

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

1. *L084497 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 24/9/2009.

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:

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SKETCH OF LAND: 1761-746 (17/P3347)
PREVIOUS TITLE: 46-321A
PROPERTY STREET ADDRESS: 837 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY: CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING L084497

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Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
1/DP416054	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

VOLUME 2965 FOLIO 820

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 1 ON DEPOSITED PLAN 416054

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SHAYLA GRACE BURGESS OF 839 ARMADALE ROAD FORRESTDALE WA 6112
(T P245203) REGISTERED 9/8/2022

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

1. *P245204 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 9/8/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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:

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SKETCH OF LAND:	DP416054
PREVIOUS TITLE:	1503-386
PROPERTY STREET ADDRESS:	839 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M489588

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:28 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
2136	**305**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 19 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THARUN BABA VEMURU OF 152 MASON ROAD PIARA WATERS WA 6112

(T Q166950) REGISTERED 9/10/2024

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

1. Q166951 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 9/10/2024.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	2136-305 (19/P3347)
PREVIOUS TITLE:	611-76A
PROPERTY STREET ADDRESS:	841 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

LANDGATE COPY OF ORIGINAL NOT TO SCALE 02/07/2025 04:19 PM Request number: 68425753

Landgate
www.landgate.wa.gov.au

WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
611	**74A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 20 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

GIUSEPPE VASILE OF 29 DUMSDAY DRIVE, FORRESTDALE

(T L864232) REGISTERED 22/2/2012

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

1. L864233 MORTGAGE TO BANK OF WESTERN AUSTRALIA LTD REGISTERED 22/2/2012.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	611-74A (20/P3347)
PREVIOUS TITLE:	46-322A
PROPERTY STREET ADDRESS:	843 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

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WESTERN AUSTRALIA

REGISTER NUMBER	
21/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	8/5/2008

VOLUME 1330 FOLIO 988

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 21 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

DIRK JOHANNES CRAFFORD HORN OF 845 ARMADALE ROAD, FORRESTDALE
(T K154699) REGISTERED 13/4/2007

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

1. K579241 MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 29/4/2008.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	1330-988 (21/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	845 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:28 AM Request number: 65229849

Landgate
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WESTERN AUSTRALIA

REGISTER NUMBER	
22/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

VOLUME 1330 FOLIO 989

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 22 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

JAYDE MICHELLE KAZIMIERCZAK OF 847 ARMADALE ROAD FORRESTDALE WA 6112
(T O406652) REGISTERED 14/5/2020

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

1. *O406653 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 14/5/2020.

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.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1330-989 (22/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	847 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING L570179

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WESTERN AUSTRALIA

REGISTER NUMBER	
23/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	12/6/2015

VOLUME 391 FOLIO 184A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 23 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THOMAS JAMES MACDONALD OF 849 ARMADALE ROAD, FORRESTDALE

(T L238001) REGISTERED 22/2/2010

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

1. *P446608 MORTGAGE TO WESTPAC BANKING CORPORATION REGISTERED 10/2/2023.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

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SKETCH OF LAND:	391-184A (23/P3347)
PREVIOUS TITLE:	1226-614
PROPERTY STREET ADDRESS:	849 ARMADALE RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING P446608

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WESTERN AUSTRALIA

REGISTER NUMBER	
37/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	2/4/2001

VOLUME 1369 FOLIO 306

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 37 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CHRISTINE VEIGAN BEBBINGTON OF 3 ARMADALE ROAD, FORRESTDALE

(T H701994) REGISTERED 23/3/2001

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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:

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SKETCH OF LAND:	1369-306 (37/P3347)
PREVIOUS TITLE:	1-188A
PROPERTY STREET ADDRESS:	7 ALLEN RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

LANDGATE COPY OF ORIGINAL NOT TO SCALE 16/06/2023 11:28 AM Request number: 65229849

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WESTERN AUSTRALIA

REGISTER NUMBER	
38/P3347	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
4	17/1/2011

VOLUME 313 FOLIO 95A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 38 ON PLAN 3347

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

VAMSI KRISHNA GUNDAPANENI
SWETHA GUNDAPANENI
BOTH OF 15 ALLEN ROAD FORRESTDALE WA 6112
AS JOINT TENANTS

(T P019762) REGISTERED 24/1/2022

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

1. *P019763 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 24/1/2022.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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SKETCH OF LAND:	313-95A (38/P3347)
PREVIOUS TITLE:	1-188A
PROPERTY STREET ADDRESS:	15 ALLEN RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

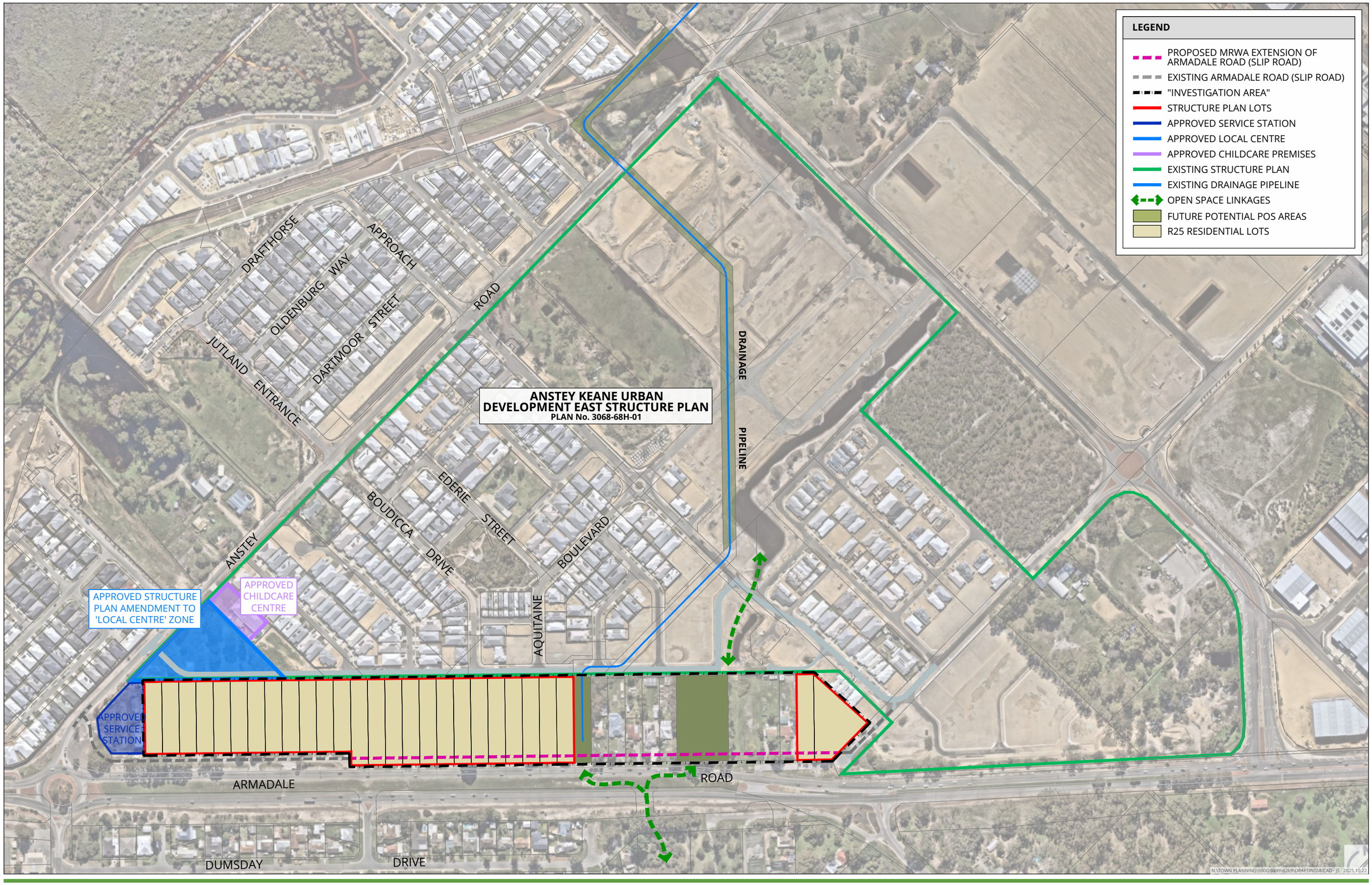
NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M469440

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ATTACHMENT 2

Opportunities and Constraints Plan



OPPORTUNITIES AND CONSTRAINTS

VARIOUS LOTS, ARMADALE ROAD

FORRESTDALE

N

0 75 m

SCALE @ A3: 1:4000

9269-FIG-08-C

DRAWN: JS
DATE CREATED: 2025.10.22
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

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ROWE GROUP DESIGN

ATTACHMENT 3

Anstey Keane Urban Development Precinct East Structure Plan

Anstey-Keane Urban Development Precinct East Structure Plan

Part One - Implementation

DOCUMENT CONTROL

DESCRIPTION	DATE
230309 22-086 LSP amendment - Anstey Keane East (rev0).docx	9 March 2023
240722 22-086 LSP amendment - Anstey Keane East (rev1).docx (WAPC modifications)	22 July 2024

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

05-Nov-2020
..... Date

Signed for and on behalf of the Western Australian Planning Commission:



.....

an officer of the Commission duly authorised by the Commission pursuant to section 16 of the Planning and Development Act 2005 for that purpose, in the presence of:



..... Witness

09-Nov-2020
..... Date

05-Nov-2030
..... Date of Expiry

TABLE OF AMENDMENTS

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC
1	Change zoning of Lot 500 (16) Anstey Road from 'Residential R25' to Local Centre, and amend structure plan map by introducing the Local Centre zone	Minor	13 September 2024

EXECUTIVE SUMMARY

The Anstey-Keane Urban Development Precinct East Structure Plan comprises approximately 48ha of land, generally bound by Armadale Road, Anstey Road and Keane Road, Forrestdale. The structure plan area is zoned Urban under the Metropolitan Region Scheme and Urban Development under the City of Armadale Local Planning Scheme No.4.

The Structure Plan (originally produced by CLE Town Planning & Design) allows for the creation of a residential neighbourhood that responds to the surrounding land use context, as well as drawing on key elements of the Southern River / Forrestdale / Brookdale / Wungong District Structure Plan which provides a high level framework for future land use and development in the area.

The Structure Plan is also consistent with the strategic planning for the area as set out by Perth and Peel @ 3.5 million, the South Metropolitan Peel Sub-regional Framework and the City of Armadale Local Planning Strategy which all identify the Structure Plan area for urbanisation and residential development.

Amendment 1 incorporates the following modification to the existing approved Anstey-Keane Urban Development Precinct East Structure Plan:

- Zoning change for Lot 500 (16) Anstey Road from 'Residential R25' to 'Local Centre'.

The amendment to the approved structure plan provides for the future establishment of a 'local centre' on the amendment site to provide a local shopping facility for the residents of the Anstey-Keane Urban Development Precinct.

The proposed change in zoning would facilitate the future development a local shopping facility of maximum 1,500sqm shop-retail floorspace and additional non-retail uses on the site, which would build upon the provision of local urban support services for the Anstey-Keane Urban Development Precinct.

The following table is an updated summary of the Anstey-Keane Urban Development precinct East Structure Plan which incorporates Amendment 1.

TABLE 1: LAND USE SUMMARY

ITEM	STRUCTURE PLAN	SECTION NUMBER REFERENCED IN EXPLANATORY REPORT
Total area covered by the structure plan	48.03 hectares	1
Area of each land use proposed: Zones (as per LPS4) - Residential - Industrial Business - Local Centre Reserves (as per LPS4 and the MRS) - Road reserves - Parks and Recreation - Public Purpose (Primary School) - Public Purpose (Drainage)	 - 24.3ha - 1.7ha - 0.88ha - 12.2ha - 4.6ha - 4.0ha - 0.35ha	3
Total estimated lot yield	650 lots	3
Estimated number of dwellings	675 dwellings	3
Estimated residential site density - Dwellings per gross urban zoned hectare (as per Perth & Peel @ 3.5 million and Liveable Neighbourhoods)	27.5 dwellings per residential site hectare	3
Estimated population	1,890 people @ 2.8 people per household	3
Number of Primary Schools	1	3
Number of Secondary Schools	None	3
Public Open Space	4.1ha (gross) 2.2ha (unrestricted) 88% 0.8ha (restricted) 12%	3

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PART ONE

IMPLEMENTATION

1 STRUCTURE PLAN AREA

This Structure Plan applies to the land within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map.

The Structure Plan is identified as the Anstey-Keane Urban Development Precinct East Structure Plan.

2 STRUCTURE PLAN CONTENT

This Structure Plan comprises:

- Part One – Implementation Section.
- Part Two – Explanatory Report.
- Appendices – Technical Reports.
- Addendum to Part Two forming the justification for Amendment 1.

Part One of the Structure Plan comprises the structure plan map and planning provisions. Part Two of the Structure Plan is the planning report component which can be used to interpret and implement the requirements of Part One. The addendum to Part Two is a report setting out the justification / explanation for Amendment 1.

3 OPERATION

The Anstey-Keane Urban Development Precinct East Structure Plan comes into effect on the date that it is endorsed by the Western Australian Planning Commission.

4 INTERPRETATION AND RELATIONSHIP WITH STATUTORY PLANNING FRAMEWORK

The Anstey-Keane Urban Development Precinct East Structure Plan constitutes a Local Structure Plan pursuant to Part 4E of the City of Armadale Town Planning Scheme 4 and the *Planning and Development (Local Planning Schemes) Regulations 2015 Schedule 2 - Deemed provisions for local planning schemes.* The Structure Plan Map outlines future land use, zones and reserves applicable within the structure plan area.

Pursuant to the *Planning and Development (Local Planning Schemes) Regulations 2015 Schedule 2 - Deemed provisions for local planning schemes*, a decision maker of an application for development approval or subdivision approval is to have due regard to the provisions of this Structure Plan, including the Structure Plan Map, Implementation Report, Explanatory Report and Technical Appendices.

5 STAGING

Development staging will follow an orderly sequence and shall not exceed the extension of essential service infrastructure or constructed road access.

6 LAND USE AND SUBDIVISION

6.1 LAND USE AND ZONES

The subdivision and development of land is to generally be in accordance with the Structure Plan. Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the Scheme.

The following land uses are not compatible with adjacent residential uses and should not be located within the structure plan area:

- Bulky Goods Showroom.
- Motor Vehicle, Boat and Caravan Sales.
- Light Industry.
- Restricted Premise.
- Storage.
- Transport Depot.
- Warehouse.

6.2 RESIDENTIAL

6.2.1 DWELLING TARGET

Subdivision and development within the structure plan is to achieve a dwelling target of 22 dwellings per site hectare.

6.2.2 DENSITY

Residential densities applicable to the Structure Plan shall be those residential densities shown on the Structure Plan map.

6.3 PUBLIC OPEN SPACE

The provision of public open space being provided generally in accordance with the Structure Plan Map.

6.4 ENVIRONMENTAL

Prior to the lodgement of a subdivision application a Botanical and Fauna survey is to be undertaken for the lots subject to the application. Where a survey has been conducted to support the structure plan, those lots already surveyed would not be subject to a further survey.

6.5 MOVEMENT NETWORK

(i) The Allen Road/Keane Road roundabout is subject to further detailed design at subdivision stage accounting for industrial traffic and the 132kv transmission line alignment.

(ii) Detailed cross sections for Allen Road are to be determined in consultation with the City of Armadale and Western Power prior to the lodgement of a subdivision application abutting Allen Road.

6.6 PRIMARY SCHOOL

(i) Development of the primary school is to ensure that school buildings and classrooms are located outside of the 200m buffer to the Dampier to Bunbury Natural Gas Pipeline.

(ii) A Notification on the Certificate of Title of the primary school site advising that the school is within 200m of the Dampier to Bunbury Natural Gas Pipeline is required at the subdivision stage.

6.7 LOCAL CENTRE

The development of the Local Centre site shall provide for:

(i) The connection and construction of Rathbone Drive through to Anstey Road.

(ii) An active frontage to Anstey Road with no more than 2 rows of parking between the local centre and Anstey Road setback.

(iii) An aesthetically pleasing frontage to Rathbone Drive with all servicing areas along Rathbone Drive being suitably screened to mitigate visual impact.

(iv) High quality landscaping along both Rathbone Drive and Anstey Road frontages.

(v) An outdoor plaza at or adjacent to the main entrance containing soft and hard landscaping and seating with a minimum size of 25sqm and a minimum dimension of 5 metres.

(vi) Screening of bin storage and mechanical plant.

(vii) A Traffic Impact Assessment prepared in accordance with the WAPC Transport Impact Assessment Guidelines relating to the local centre development is to be provided at the development application stage.

7 DEVELOPMENT

7.1 LOCAL DEVELOPMENT PLANS

A Local Development Plan to be required by the Western Australian Planning Commission (**WAPC**), on the advice of the City of Armadale, as a condition of subdivision approval where deemed necessary for land comprising, but not limited to:

(i) Lots abutting areas of Public Open Space.

(ii) Lots subject to 'Quiet House Design' requirements as identified in the Road Traffic Acoustic Assessment.

(iii) Prior to the lodgement of a development application and/or as a condition of subdivision approval, a Local Development Plan is to be prepared for all lots located within the Industrial Business zone to address the following:

- Reciprocal rights of access between lots;
- Design and interface with residential areas.

(iv) Lots affected by the 132Kv powerlines along Allen Road.

7.2 NOTIFICATIONS ON TITLE

In respect of applications for the subdivision of land the Council shall recommend to the WAPC that a condition be imposed as part of a subdivision approval for a notification to be placed on the Certificate(s) of Title(s) to advise of the following: -

(i) Land or lots deemed to be affected by road traffic noise as identified in the Road Traffic Acoustic Assessment prepared for the Structure Plan.

7.3 BUSHFIRE MANAGEMENT

This Structure Plan is supported by a Bushfire Management Plan. Regardless of whether the land has been formally designated as bushfire prone, any building to be erected on land identified as falling within 100 metres of a bushfire hazard is designated as bushfire prone land and shall comply with the requirements of Australian Standard 3959 under the Building Code of Australia.

8 OTHER REQUIREMENTS

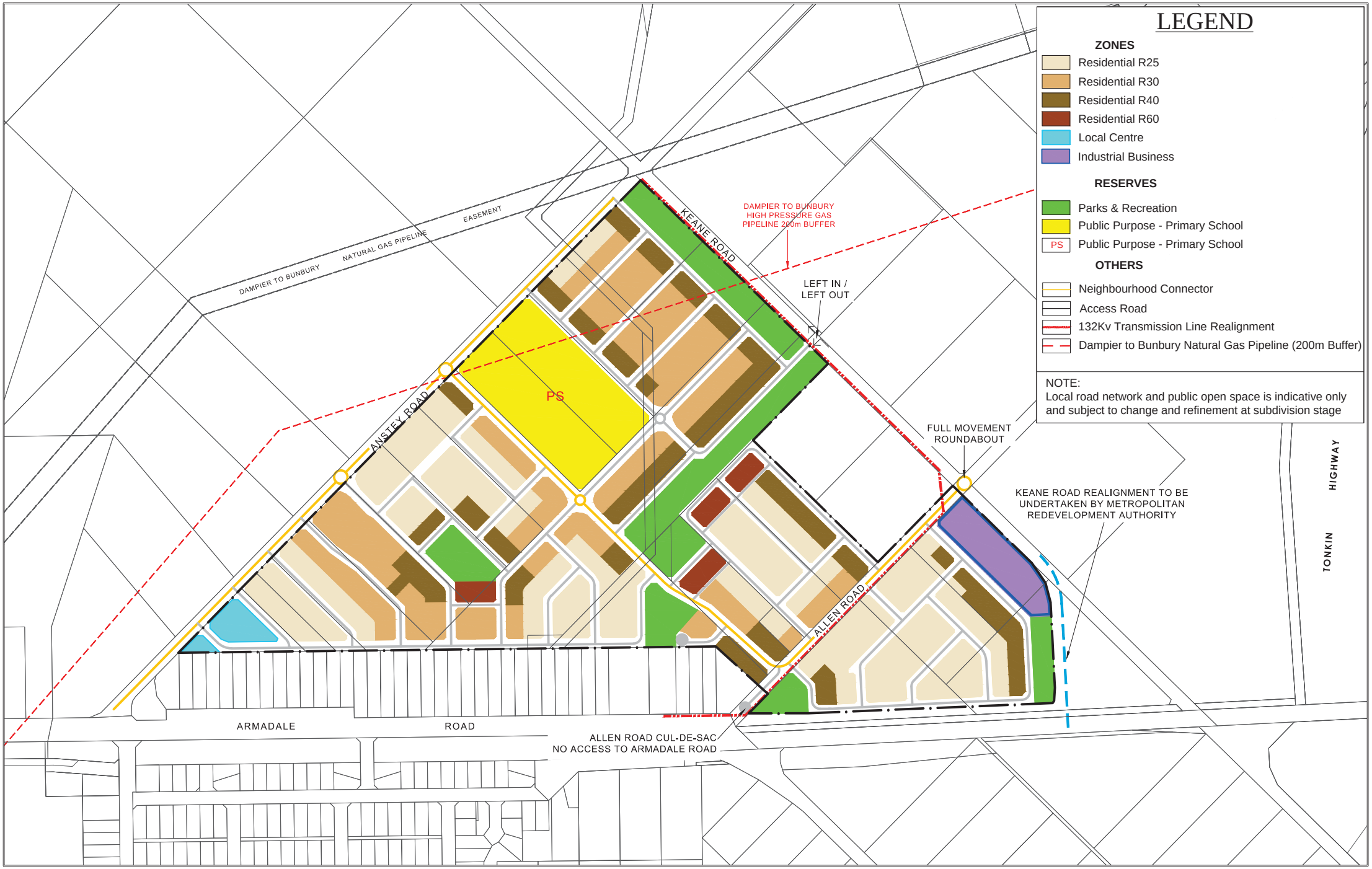
8.1 CONDITIONS OF SUBDIVISION APPROVAL

The following technical reports / strategies are to be prepared and submitted as a condition of subdivision approval (where applicable):

- Urban Water Management Plan.
- Bushfire Management Plan.
- Acid Sulphate Soils Management Plan.
- Environmental Management Plan for subdivision abutting Lots 43 and 44 Keane Road.
- Fauna Management Plan.

8.2 DEVELOPMENT CONTRIBUTIONS

The LSP is subject to contribution to the costs of common infrastructure in accordance with a Development Contribution Plan and Cost Apportionment Schedule prepared pursuant to Part 5A and Schedule 9B Development Contribution Plans.



ANSTEY KEANE URBAN DEVELOPMENT PRECINCT EAST STRUCTURE PLAN (WITH AMENDMENT 1)

ISSUE	DATE	INFORMATION INCORPORATED INTO ISSUE
1	21/12/20	Initial Version
2	15/07/24	Amendment 1

SCALE : Not to Scale

Base plan source City of Armadale

Anstey-Keane Urban Development Precinct East Structure Plan

Justification report (addendum to Part Two)

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ANSTEY-KEANE URBAN DEVELOPMENT PRECINCT EAST STRUCTURE PLAN
(ADDENDUM TO PART TWO)

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1 PLANNING BACKGROUND

1.1 INTRODUCTION AND PURPOSE

Apex Planning has formulated this structure plan amendment on behalf of Cedarville Pty Ltd, the landowner of Lot 500 (16) Anstey Road, Forrestdale (hereafter referred to as the **amendment site**).

It is proposed to amend the Anstey-Keane Urban Development Precinct East Structure Plan by changing the zoning of the amendment site from Residential R25 to Local Centre. No other changes are proposed to the structure plan, except for this change in zoning to the amendment site.

The purpose of the amendment is to facilitate the establishment of a local centre (maximum 1,500sqm shop-retail floorspace) on land which is appropriately sized and suitably located to cater for the daily shopping needs of the growing population of the Anstey-Keane Urban Development Precinct in the City of Armadale.

The site forms part of a rapidly growing urban area and adjoins land undergoing development for service commercial purposes (local fast food and fuel/convenience services) and a local childcare facility, and will build upon the provision of essential urban support services for the emerging residential estates in the locality.

This structure plan amendment is supported by an expert retail needs analysis, hydrological assessment, and traffic impact assessment.

1.2 LAND DESCRIPTION

1.2.1 LOCATION

The structure plan area is in the City of Armadale, located approximately 6km west of the Armadale Strategic Centre and 8km east of the Cockburn Strategic Centre.

The structure plan area is generally bound by Keane Road to the north-east, Anstey Road to the north-west, and Armadale Road to the south.

The structure plan area comprises approximately 48ha. The area pertaining to this amendment comprises Lot 500 (16) Anstey Road, a lot of approximately 8,797sqm.

Refer to **Figure 1 – Regional Context** and **Figure 2 – Local Context**.

1.2.2 DESCRIPTION OF CONTEXTUAL CONSIDERATIONS

The amendment site has frontage to Anstey Road, currently identified as a Distributor B road under the Main Roads hierarchy. Anstey Road currently links to Ranford Road further north-east, where it provides vehicular connectivity with the Crossroads Industrial Estate. This linkage will be terminated once the ultimate movement network of the structure plan is realised.

Anstey Road connects to Armadale Road via a full movement roundabout intersection located approximately 120m south-west of the subject site.

Armadale Road is a key regional transport route which offers a link between Armadale (east) and Cockburn Central (west), connecting the key suburbs of Treeby, Forrestdale, Haynes, and Piara Waters in between.

The amendment site forms part of the Anstey-Keane Urban Development Precinct, which is divided into three separate structure planning areas (east, north-west and south-west). The Anstey-Keane area contains the following emerging residential estates:

- Mahala Estate
- Solaris Estate
- Anstey Grove Estate

The planning framework for the area is fully established, with each local structure plan guiding the urbanisation of what was formerly rural land. The area is currently in a state of transition, with significant residential subdivision and urbanisation occurring in accordance with the established structure plans. A vision plan depicting the site in context of the nearby structure plans is provided as **Appendix 1** of this report.

The local structure plans encompassing the above estates allocate predominantly residential zoning at densities ranging from R25 to R60, with associated parks & recreation and public purpose reserves. None of the structure plans make allowance for local activity centres or shopping facilities.

The amendment site forms part of the Anstey Keane East structure plan, which currently allocates a Residential R25 zoning to the lot, as well as two local road reserves with independent access points to Anstey Road. The two local roads planned within the lot converge to a single local road leading eastward into the Mahala Estate.

The amendment site adjoins land which will be developed for non-residential purposes, depicted on the vision plan provided at **Appendix 1**. These include:

- Adjoining Lot 700 (30) Anstey Road, which is approved for a 92-place childcare facility. The landowner of this lot is actively progressing the delivery of the childcare facility.
- Adjoining Lot 400 (12) Anstey Road & Lot 800 (799) Armadale Road, which are approved for a service commercial development comprising a drive-through fast food outlet and service station. The landowner of these lots is actively progressing the delivery of this development.

The Anstey Keane East structure plan includes a designated public purposes reserve catering for a future primary school along Anstey Road, approximately 500m north-east of the site.

On the northern side of Anstey Road adjacent the subject site, land is allocated residential zoning with densities of R25-R30 under the Anstey Keane South-West structure plan. A large Public Open Space (**POS**) reserve is also planned fronting Anstey Road, with that structure plan indicating it would ultimately contain an "active senior sized playing field and community facility".

Anstey Road is in the process of upgrade from rural standard to urban standard in accordance with Development Contribution Plan No.4 (**DCP4**). At the time of preparing this report, land acquisition associated with road widening for Anstey Road has been completed for numerous sites in the area (including the subject site). As part of the Anstey Road upgrade, it will terminate at Solaris Estate to create separation between the Anstey Keane Urban Development Precinct and the industrial areas further north-east.

In terms of existing local conditions, the Mahala Estate, Anstey Grove Estate and Solaris Estate are all well underway with urbanisation at the time of preparing this report. Site works, subdivision works, dwelling construction and local road construction is substantially progressed. The subject lot is still semi-rural in nature, containing an existing dwelling, outbuildings and large open space with existing trees/vegetation.

1.2.3 LEGAL DESCRIPTION AND OWNERSHIP

The amendment site comprises a single landholding of approximately 8,797sqm, identified as Lot 500 (16) Anstey Road, Forrestdale. Lot 500 is legally described as follows:

Lot	Deposited Plan	Volume	Folio	Lot area	Ownership
500	421600	4021	400	8,797sqm	Cedarville Pty Ltd

The Certificate of Title (**CT**) is provided at **Appendix 2**.



Figure 1: Regional Context



Figure 2: Local Context

1.3 PLANNING FRAMEWORK

1.3.1 ZONING AND RESERVATIONS

The structure plan area and amendment site are zoned Urban under the Metropolitan Region Scheme. Refer to **Figure 3 – MRS Zoning.**

The structure plan area and amendment site are zoned Urban Development and located within Development Area 51 (**DA51**) and Development Contribution Area 4 (**DCA4**) under Local Planning Scheme No. 4. Refer to **Figure 4 – LPS4 zoning**.

1.3.2 DISTRICT STRUCTURE PLAN

The structure plan area and amendment site are located within the Southern River / Forrestdale / Brookdale / Wungong District Structure Plan (**DSP**), which was endorsed by the WAPC in 2001.

The DSP set out the broad district-level planning arrangements throughout the Southern River, Forrestdale, Brookdale, Wungong areas, indicating key features such as high-level land use, major roads, commercial and community infrastructure and public open space.

The DSP included provision of a local activity centre within the structure plan area, shown at the rear of the amendment site (based on a formerly planned alignment of Anstey Road which never eventuated).

The proposed amendment is broadly consistent with the DSP, noting it proposes a smaller scale local centre in roughly the same location.

The DSP is illustrated on Page 8 of the original structure plan report prepared by CLE, shown as Figure 4 in that document.

1.3.3 PERTH AND PEEL @ 3.5 MILLION AND SOUTH METROPOLITAN PEEL SUB-REGIONAL PLANNING FRAMEWORK

Perth and Peel @ 3.5 million is a high level strategic plan which sets a framework for the Metropolitan and Peel regions to manage population growth through density targets and the identification of areas suitable to sustain growth through housing, infrastructure and key services.

The suite of documents includes four sub-regional planning frameworks. The structure plan area and amendment site are located within the South Metropolitan Peel region.

The structure plan area is zoned Urban, broadly consistent with the ‘urban expansion’ area allocated to it under the framework.

A key element of Perth and Peel @ 3.5 million was a residential density target of 26 dwellings per site hectare, which was achieved by the original structure plan and is maintained by Amendment 1.

1.3.4 CITY OF ARMADALE LOCAL PLANNING STRATEGY

The City's local planning strategy was endorsed in 2016 and is currently under review. Preparation of a draft local planning strategy occurred between May-November 2022, with Council consideration of the new draft strategy set to occur in the first half of 2023.

The strategy identified the structure plan area as an urban development area, in recognition of its strategic location and capability to support population growth through urbanisation. The structure plan is consistent with the strategy. The amendment would further support population growth by delivering essential support services on land which is suitably located and of an appropriate size.

The local planning strategy contains a retail needs assessment for the municipality, which was reviewed and updated as part of the Armadale Retail (Commercial) Centres Strategy in 2020. The updated retail strategy is addressed in the subsequent section of this amendment report.

1.3.5 ARMADALE RETAIL (COMMERCIAL) CENTRES STRATEGY 2020

The City's Retail (Commercial) Centres Strategy was prepared in 2019 and adopted in 2020, and outlines the City's framework for activity centres within the municipality.

The strategy identifies a local centre on Anstey Road (38 – Anstey Road), associated with land which is now approved for the development of a drive-through fast food outlet and service station at Lot 400 (12) Anstey Road & Lot 800 (799) Armadale Road which adjoin the subject site. The strategy provides an upper limit of 500sqm for shop-retail floorspace for this local centre.

The objectives outlined in Section 4.1 of the strategy have been given due consideration in formulating this amendment, with the most important objectives being *4.1.1 Retail Hierarchy* and *4.1.2 Activity*, which are extracted below:

4.1.1 Retail Hierarchy - Ensure centres are appropriately distributed to meet community needs.

1. Distribute activity centres to meet different levels of community need and enable employment, goods and services to be accessed efficiently and equitably by the community.
2. Apply the activity centre hierarchy as part of a long-term and integrated approach by public authorities and private stakeholders to the development of economic and social infrastructure.
3. Plan activity centres to support a wide range of retail and commercial premises and promote a sustainable retail and commercial market.

4.1.2 Activity - Support centres to transition from a transactive platform to an experienced one.

4. Increase the range of employment in activity centres and contribute to the achievement of sub-regional employment self-sufficiency targets.
5. Increase the density and diversity of housing in and around activity centres to improve land efficiency, housing variety and support centre facilities.
6. Ensure activity centres provide sufficient development intensity and land use mix to support high-frequency public transport.

A comparison between the strategy and the retail analysis prepared as part of this amendment (**Appendix 5**) shows some key differences which are likely a result of:

- The strategy providing a broader City-wide evaluation of demographic data which informed the resultant outcomes of activity centre performance.
- The point in time that the strategy was prepared (pre-March 2020), which may not have been able to consider the transitional nature of the Anstey-Keane

Urban Development precinct (noting most of the structure planning was endorsed shortly after the strategy).

- The localised examination provided by the RNA and Impact Test for this amendment, which also had the benefit of completed structure plans and more up-to-date data which may have been influenced by changes in economic activity since early 2020.

The strategy characterises the area surrounding Centre 38 – Anstey Road as being surrounded by *"Residential R12.5/25, Rural Living 1 and 4 and large areas of Parks and Recreation Regional"*, which was likely indicative of the situation at the time the strategy was prepared. However, the three structure plans encompassing the Anstey-Keane Urban Development Precinct were endorsed by the WAPC in 2020, and have set greater densities ranging from R25-R60 affording more urbanised and concentrated population growth throughout the area.

The RNA and Impact Test provides an examination which is more localised with detailed consideration of the characteristics of the defined trade area, and is based on some data which was from after 2020 (referring to the source citations throughout the RNA and Impact Test report). The results of the RNA and Impact Test determine that a local centre of up to 1,500sqm shop-retail floorspace on the subject site is supportable both in the immediate term, and after 2027 when other centres in the trade area are either expanded or fully developed. Key observations as part of the retail assessment which underpin retail demand projections include:

- An age profile encompassing a noticeably higher concentration of working-age adults with young children within the trade area, compared to the Greater Perth average. The difference is considerable, with 0-4 year olds at 12% versus 6.5% and 29-34 year olds at 13% versus 8%.
- A significant increase in house sales within Forrestdale at 170% in 2021, with the median sales price of houses decreasing by 20%.
- Dwelling delivery projections for Forrestdale showing continued delivery of housing after 2023, with forecast development peaking in 2031. The total number of dwellings within the defined trade area is expected to increase steadily between 2022 and 2037, from 10,314 to 17,000.
- Trade area income demographics indicating 14% higher 'fourth quintile' income than the Greater Perth average.

The RNA and Impact Test included consideration of impacts to other centres in the defined 5km trade area, and included the small mixed commercial development at Lot 400 (12) Anstey Road & Lot 800 (799) Armadale Road. The assessment demonstrates that the amendment site is entirely capable of supporting 1,500sqm of shop-retail floorspace independent of the adjoining land. At 1,500sqm of shop-retail floorspace, the proposed local centre at the site was shown to be viable over the 15 year horizon with centre productivity remaining above benchmarks between 2022 and 2037.

The proposed amendment meets the key objectives outlined in Section 4.1 of the strategy.

1.3.6 STATE PLANNING POLICY 3.7 PLANNING IN BUSHFIRE PRONE AREAS

State Planning Policy 3.7 Planning in Bushfire Prone Areas seeks to implement risk-based land use planning and development practices to preserve life and reduce the impact of bushfire on property and infrastructure.

The structure plan area is identified as 'bushfire prone'. A bushfire management plan was prepared as part of the original structure plan for the area which remains relevant/applicable. The proposed change in zoning does not affect the implementation of asset protection zones, interface treatments or create additional bushfire risk for the construction of dwellings within 100m of bushfire prone vegetation.

A more detailed bushfire management plan will be prepared at development application stage when the development layout is formalised, which further addresses SPP3.7 and the associated guidelines.

1.3.7 STATE PLANNING POLICY 4.2 ACTIVITY CENTRES

SPP4.2 aims to ensure planning and development adequately considers the distribution, function and broad land use options for activity centres to meet local community needs, and provide social, economic and environmental benefits to the community.

The WAPC undertook a review of SPP4.2 in 2020. A key change resulting from the updated policy is guidance on the preparation and assessment of Needs Assessments and Impact Tests.

In accordance with the policy measures of SPP4.2, a proposal to amend a structure plan involving an increase of shop-retail floorspace should be assessed against policy objectives and ensure it delivers *"net community benefit and does not lead to a loss of service to the community"*.

As the proposal seeks to change the zoning of the amendment site to Local Centre with a maximum shop-retail floorspace allocation of 1,500sqm, Needs Assessment and Impact Test assessments are required in accordance with Section 7.8 and 7.9 of SPP4.2.

The Needs Assessment and Impact Test prepared by Pracsys addresses the key requirements of SPP4.2 and associated implementation guidelines, demonstrating the viability and supportability of a local centre on the site with 1,500sqm shop-retail floorspace.

A range of policy measures associated with land-use mix, employment, urban form, movement and access are also set out within Section 7 of the policy. These measures appear to be focused on larger scale activity centres, though the key principles can be applied to a local centre. In this regard:

- Land uses - the land use mix for the subject site is likely to be comprised of an anchoring shopping facility with associated non-retail uses complementing the anchor use. An example of such a mix could be a small shopping facility with

speciality stores, café and medical uses. The land use mix will be confirmed once the development vision is properly formulated.

- Employment – the establishment of a local centre on the site will create a local employment hub for local residents, complementing the approved childcare facility and other non-residential uses approved near the site and this would be strengthened by the fact the site is within convenient walking distance of the surrounding communities.
- Urban form – the urban form of the proposed local centre aligns with the local road network originally formulated as part of the local structure plan for the area. The layout, development typology, and built form approach for the ultimate development on the site will give due consideration to the neighbouring properties, the public realm, and the ten principles set out by *State Planning Policy 7.0 Design of the Built Environment*.
- Movement and access – the positioning of the proposed local centre and its co-location with other approved urban support services is likely to create multi-use trips on the surrounding road network and reduce vehicle dependence by establishing a local facility for the residents of the Anstey-Keane Urban Development Precinct in a highly accessible and well-connected setting.

In view of the above, the proposed change in zoning to facilitate a local centre on the site is consistent with the policy measures of SPP4.2.

1.3.8 OTHER APPROVALS AND DECISIONS

The amendment site adjoins land which is approved and will be developed for non-residential purposes, depicted on the vision plan provided at **Appendix 1**. These include:

- Adjoining Lot 700 (30) Anstey Road, which is approved for a 92-place childcare facility. The landowner of this lot is actively progressing the delivery of the childcare facility.
- Adjoining Lot 400 (12) Anstey Road & Lot 800 (799) Armadale Road, which are approved for a service commercial development comprising a drive-through fast food outlet and service station. The development approval process followed a scheme amendment process, whereby the zoning of the land was changed to Local Centre. The landowner of these lots is actively progressing the delivery of this development.

The co-location of a local centre on the amendment site with the approved developments explained above is appropriate, as the uses are complementary and can offer an integrated/vibrant urban setting for local residents.

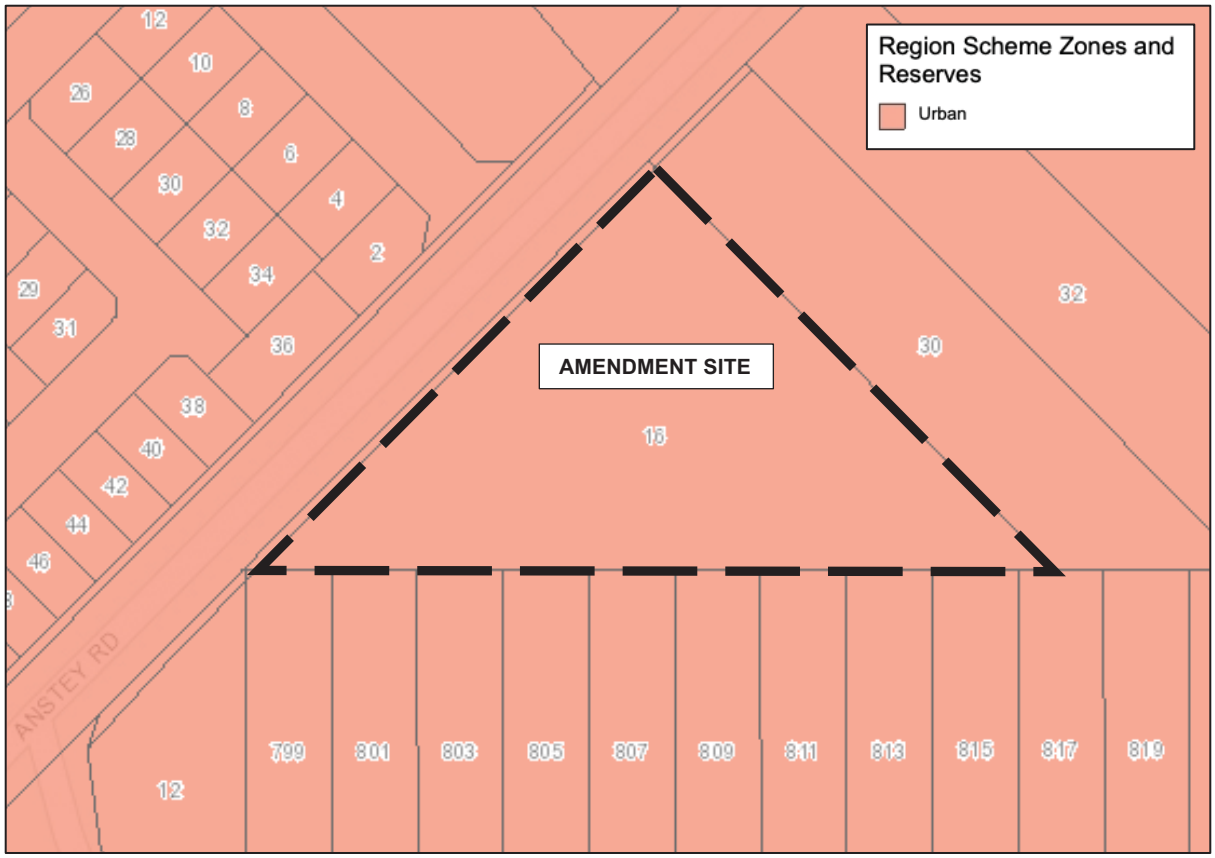


Figure 3: MRS zoning

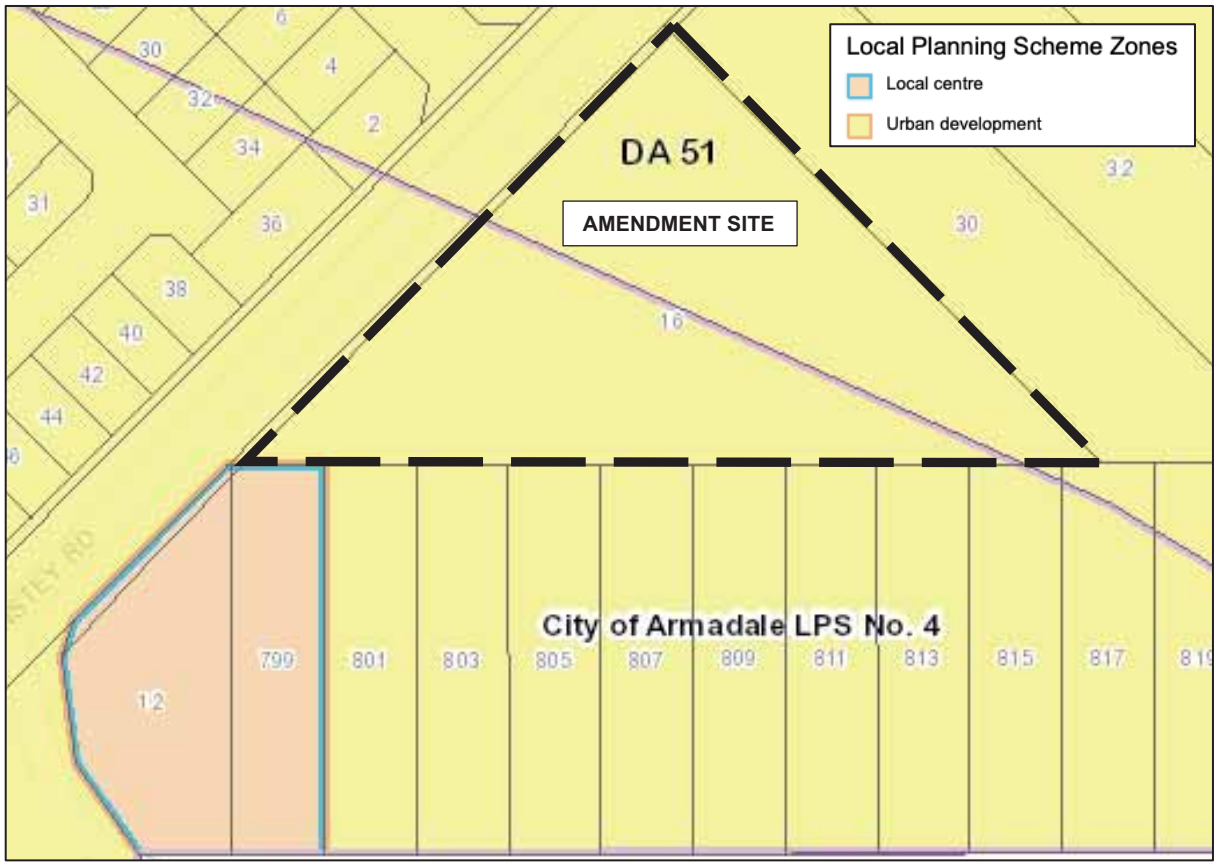


Figure 2: LPS4 zoning

2 SITE CONDITIONS AND CONSTRAINTS

The information presented in relation to site conditions and constraints within Section 2 of the explanatory report of the original structure plan remain relevant/applicable, demonstrating the structure plan area and amendment site are suitable for urban development.

Additional information is provided in the following sections as relevant to Amendment 1 and its relationship to the structure plan.

2.1 HYDROLOGY

The management of ground and surface water was addressed within a Local Water Management Strategy (**LWMS**) as part of the original structure plan. The LWMS demonstrated that hydrology is not a constraint to urban development.

Pentium Water was engaged to consider any changes to hydrology/drainage as a result of a local centre on the site, and to document this in an addendum to LWMS previously prepared for the Anstey-Keane East area. The addendum is provided at **Appendix 3**.

The addendum demonstrates that rainfall runoff, drainage, and treatment of runoff associated with the local centre will be consistent with the Residential R25 scenario originally considered for the amendment site. As a result, the stormwater management detailed in the original LWMS will not be impacted by the proposed amendment.

2.2 BUSHFIRE

A bushfire management plan was prepared for the structure plan, in accordance with the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* and its guidelines.

The proposed change in zoning does not affect the implementation of asset protection zones, interface treatments or create additional bushfire risk for the construction of dwellings within 100m of bushfire prone vegetation.

A more detailed bushfire management plan will be prepared at development application stage when the development layout is formalised, which further addresses SPP3.7 and the associated guidelines.

3 LAND USE AND SUBDIVISION REQUIREMENTS

3.1 LAND USE

The original structure plan report sets out the land use, residential densities, POS, public and private transport provision, environmental considerations, and servicing requirements.

The structure plan comprises primarily Residential development with density codes ranging from R25 to R60, with a projected yield of approximately 650-670 dwellings across the structure plan area. The structure plan also comprised various Parks & Recreation reserves, a Public Purposes reserve (Primary School), and land at the eastern end of the area allocated as Industrial Business.

The amendment site (a single landholding identified as Lot 500 of approximately 8,797sqm) is proposed to be rezoned from Residential R25 to Local Centre with a maximum shop-retail floorspace allocation of 1,500sqm. A vision plan is provided at **Appendix 1** of this report which illustrates the proposed amendment in relation to the planned surroundings of the amendment site.

The rezoning of the amendment site to Local Centre is intended to facilitate the establishment of a small shopping facility with maximum 1,500sqm of shop-retail floorspace and some non-retail support uses to meet the day-to-day needs of the local area, consistent with those uses contemplated in the Local Centre zone under LPS4.

The Local Centre zone is appropriate for the site, noting it is a zone which is intended to be integrated within an urban neighbourhood setting to ensure it has strong links with the community it is intended to serve.

3.2 LOCAL CENTRE ZONE

The purpose of this structure plan amendment is to facilitate a future local centre development on the amendment site. The objectives of the Local Centre zone as set out by Clause 3.2.5 of LPS4 are extracted below for reference:

> 3.2.5 *Local Centre*
>
> a) To provide for a limited range of shopping and community services to meet the day-to-day needs of individual neighbourhoods.
>
> b) To ensure the design and landscaping of development provides a high standard of safety and amenity and contributes towards a sense of place and community within the local neighbourhood.

The proposed rezoning of the site to Local Centre is intended to facilitate the establishment of a small shopping facility with 1,500sqm of shop-retail floorspace and some non-retail support uses to meet the day-to-day needs of the local area. The ultimate design, landscaping and built form approach of the local centre will give regard to the Local Centre zone objectives and strengthen the fabric of the Anstey-Keane Precinct.

The establishment of a local centre on the site will provide residents of the Anstey-Keane area with a local shopping facility, preventing the need to drive out of the precinct to access daily shopping needs in other areas. The locality will contain district dual use paths and footpaths throughout the local road network, enhancing opportunities for residents to walk to the local centre. The amendment site is appropriately located to accommodate a local centre, noting it is:

- Located along a planned Neighbourhood Connector A/B road with good connectivity to the wider Anstey Keane area via a network of neighbourhood connector and local access streets. In this regard, the subject site has the advantage of containing future local roads connecting eastward into the Mahala Estate.
- Approximately 120m from the roundabout intersection of Anstey Road and Armadale Road, with good accessibility to the regional road network.
- Co-located with approved non-residential developments on both sides of the site, building upon the provision of key urban support services for the growing community.
- Adjacent to a large, planned POS area on the northern side of Anstey Road.
- Within convenient walking distance of the Mahala Estate, Anstey Grove Estate, and Solaris Estate.

3.3 RESIDENTIAL

Based on the range of densities (R25-R60) and the extent of residential land allocated throughout the structure plan area, the original structure plan had the potential to create approximately 650-670 residential lots.

The estimated lot yield resulted in approximately 26.6 dwellings per residential site hectare, which exceeds the minimum required by Perth and Peel @ 3.5 million (being 26 dwellings per residential site hectare).

The change in zoning from Residential R25 to Local Centre as part of this amendment would only marginally change the estimated yields under the original structure plan, originally estimated as 650-670 lots and 675-695 dwellings.

The resulting estimated residential site density is approximately 27.5 dwellings per residential site hectare.

3.4 PUBLIC OPEN SPACE

The structure plan creates a framework for the delivery of public open space serving a range of functions within the structure plan, balancing active and passive recreational pursuits and delivering key drainage objectives. The public open space areas for the structure plan are depicted on Plan 1. No changes are proposed to the public open space arrangements under the structure plan as part of this amendment.

With the proposed change in zoning from Residential R25 to Local Centre in relation to a 0.88ha site, the total public open space provision of 4.4ha represents 10.8% of gross subdivisible area (if the Local Centre zone is taken as being 'commercial land'). **Table 2** below contains a public open space schedule with the slightly adjusted figures.

Gross site area (within structure plan boundary)			**48.03**
Less			
Commercial land	2.07		
Primary school site	4.00		
Drainage reserve (Keane Road)	0.35		
1 year storm event (district flows – Bailey Brance Drain)	0.70		
Total		**7.12**	
Net Site Area			**40.91**
Deductions			
Total drainage area up to 1:1 year event	0.23		
Total		0.23	
Gross subdividable area			**40.68**
POS @ 10%		**4.068**	
POS contribution			
Minimum 80% unrestricted POS	3.25		
Maximum 20% restricted POS able to be credited	0.82		
Unrestricted open space			
Local park 1	0.34		
Local park 2	0.52		
Living stream corridor	2.74		
Total unrestricted use		**3.58**	
Restricted open space			
Drainage area between 1:1 and 1:5 year events not exceeding 20% of total open space area	0.82		
Total restricted use open space		**0.82**	
Summary of POS			
Minimum unrestricted open space required	3.25		
Unrestricted open space provided	3.55		
Maximum restricted open space required	0.82		
Restricted open space provided	0.82		
Total POS provision			**4.40**
Total POS provision as % of gross subdividable area			**10.8%**

3.5 BUSHFIRE MANAGEMENT

The structure plan was supported by a bushfire management plan which included a post-development bushfire hazard assessment. The original structure plan report provided a description of the bushfire risk reduction strategies for the area.

The proposed change in zoning from Residential R25 to Local Centre does not change the outcomes of the bushfire assessment, and does not prevent the ability for any of the risk reduction measures to be completed or adhered to on an ongoing basis.

A more detailed bushfire management plan will be prepared at the development application stage, once a development proposal is formulated for the local centre site.

3.6 MOVEMENT NETWORK

The structure plan was supported by a Traffic Impact Assessment, which forecast traffic volumes and set out a recommended road network hierarchy to support the growth of the structure plan area.

Insofar as relevant to the amendment site, Anstey Road is proposed to operate as a Neighbourhood Connector A offering a linkage to Armadale Road, transitioning to a Neighbourhood Connector B and creating connectivity through the structure plan area via an internal spine road (also Neighbourhood Connector B) which leads to Allen Road. The planned local road network includes two future local roads connecting eastward into the Mahala Estate to ensure strong linkages to the wider structure plan area. A district dual use path and series of footpaths throughout the road network will create pedestrian connectivity to the site, allowing inhabitants of the Anstey-Keane area to walk to the local centre site.

The proposed change in zoning for the amendment site has been considered in a revised TIA, which is provided at **Appendix 4.**

No changes are proposed to the movement network set out by the structure plan as part of this amendment. The revised TIA considers the proposed rezoning in context of the ultimate road network conditions for the locality and assesses the estimated change in traffic generation from what was formerly Residential R25 to a local centre with a conservative assumption of 1,500sqm shop-retail and 500sqm of non-retail commercial.

The traffic generation assessment contained in the TIA indicates the expected future total traffic volumes are expected to:

- Remain the same on Armadale Road (west of Anstey Road).
- Decrease by 300vpd on Armadale Road (east of Keane Road).
- Decrease by 200vpd on Keane Road (south).
- Increase by 100vpd on Anstey Road (north of the site).
- Decrease by 600vpd on Anstey Road (south of the site).

The TIA therefore demonstrates an improved outcome on the road network as a result of the proposed change in zoning from Residential R25 to Local Centre for the amendment site.

3.7 WATER MANAGEMENT

The structure plan was designed to accommodate the principles of best practice urban water management through the integration of stormwater detention and infiltration within areas of POS, as well as converting the existing Baileys Branch Drain to a living stream within a multiple use corridor as a feature of the locality.

A LWMS was prepared for the structure plan, which has been reviewed based on the proposed change in zoning from Residential R25 to Local Centre for the amendment site.

An addendum to the LWMS has been prepared by Pentium Water (provided at **Appendix 3**), which confirms no change to the LWMS strategies would result from the change in zoning.

3.8 ACTIVITY CENTRES

The change of zoning from Residential R25 to Local Centre would facilitate the establishment a small local activity centre on the amendment site, with a shop-retail floorspace allocation of 1,500sqm.

It is noted that the Southern River / Forrestdale / Brookdale / Wungong District Structure Plan provided for a local activity centre within the Anstey Road precinct (located roughly in the same location as the amendment site), and noted that the amount of retail floorspace would require definition at the detailed planning stage.

A Retail Needs Assessment (**RNA**) and Impact Test has been produced by Pracsys, provided at **Appendix 5**.

The RNA and Impact Test was prepared in accordance with the requirements of draft *State Planning Policy 4.2 Activity Centres* to consider whether there is sufficient demand for a local centre at the subject site, and the level of shop-retail floorspace which would be supportable based on surrounding activity centre distribution and future population growth.

The local population is likely to expand significantly within the catchment around the proposed local centre over the 10 year horizon due to the ongoing urbanisation of these areas. The trade area population was found to have relatively high incomes that are likely to support increased disposable expenditure.

The RNA conservatively considers planned expansions of existing centres and new retail developments within the defined trade area which would also contribute toward meeting the demand of the trade area population, although this particular local centre is strategically positioned to cater for the daily shopping needs of the Anstey-Keane area.

The RNA identified that up to 1,500sqm of shop-retail floorspace would be supportable at the site in the immediate term, with this level of floorspace remaining viable once competing centres are either expanded or developed by 2027. This assessment included the fast food and service station development on the land immediately to the west.

The Impact Test has shown that estimated impacts are well below the "significant impact" thresholds set out by draft *State Planning Policy 4.2*, and that the sustainability of the centre hierarchy will be preserved.

3.9 SERVICING

The structure plan is supported by an engineering servicing report which outlined the servicing arrangements associated with earthworks, sewer, water, gas, and telecommunications. This included servicing for the amendment site.

The delivery of essential services infrastructure is a key component of the development contribution framework for the structure plan area, which is addressed in the subsequent section of this amendment report.

3.10 DEVELOPMENT CONTRIBUTION PLAN 4 (**DCP4**)

In accordance with the City of Armadale LPS4, the structure plan area is within Development Contribution Area No.4 (**DCA4**).

Development Contribution Plan 4 (**DCP4**) was incorporated into the Scheme by virtue of Amendment 102 which was gazetted in February 2021, which sets out the development contribution arrangements for the structure plan area for various infrastructure items, including:

- Community infrastructure (sporting and community)
- Movement network items (Anstey Road, Keane Road, shared path network)
- Baileys Branch Drain and surrounds
- Wastewater pump station
- ATCO high pressure gas pipeline

The proposed amendment does not alter or change the arrangements under DCP4.

APPENDIX 1

VISION PLAN



Vision Plan (Amendment – Anstey-Keane Urban Development Precinct East Structure Plan)	NORTH	**Drawn:** Alessandro Stagno **Rev:** 0
Lot 500 (16) Anstey Road, Forrestdale		**Source:** MNG Access **Date:** 9 March 2023 apex planning

APPENDIX 2

CERTIFICATE OF TITLE

WESTERN AUSTRALIA

REGISTER NUMBER	
500/DP421600	
DUPLICATE EDITION **1**	DATE DUPLICATE ISSUED **22/6/2022**

VOLUME **4021** FOLIO **400**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 500 ON DEPOSITED PLAN 421600

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CEDARVILLE PTY LTD OF 19 EZE TERRACE HILLARYS WA 6025

(AF P175738) REGISTERED 9/6/2022

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP421600
PREVIOUS TITLE:	513-141A
PROPERTY STREET ADDRESS:	16 ANSTEY RD, FORRESTDALE.
LOCAL GOVERNMENT AUTHORITY:	CITY OF ARMADALE

LANDGATE COPY OF ORIGINAL NOT TO SCALE 20/07/2022 08:34 PM Request number: 63886521

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APPENDIX 3

ADDENDUM TO LOCAL WATER MANAGEMENT STRATEGY

PENTIUM WATER

ANSTEY-KEANE EAST, FORRESTDALE

Local Water Management Strategy Addendum

CEDANST_01

09/12/2022



Document Status

Version	Purpose of document	Authored by	Reviewed by	Review Date
Rev 0	Final	GerEdw	ShaMcS	1/11/2022
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Approval for Issue

Name	Signature	Date
Shane McSweeney		9/12/2022

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1. Introduction

Cedarville Pty Ltd are the current landowners of Lot 500, 16 Anstey Road, Forrestdale ("the site") (Figure 1 and Appendix A).

The site is 0.88 ha in size, located within the Anstey-Keane East Structure Plan (SP) and the nominated landuse zoning is Residential R25 and road reserve (Figure 2).

Cedarville seek an amendment to the SP to support a change in landuse zoning within the site from Residential R25 to Local Centre. The intent of the amendment is to facilitate a small-scale shopping centre development. A vision plan which shows the new zoning allocation of the site and includes information from the other surrounding structure plans in the locality is attached as Appendix C.

To support the SP amendment the City of Armadale have requested a high-level drainage assessment be undertaken to evaluate any change or impact to the approved Local Water Management Strategy (LWMS) that the proposed change in landuse zoning may have.

This LWMS addendum was prepared to support the SP amendment application and demonstrates that the proposed change in landuse zoning will not have any impact to the stormwater management that is proposed in the LWMS.



Figure 1: Site location

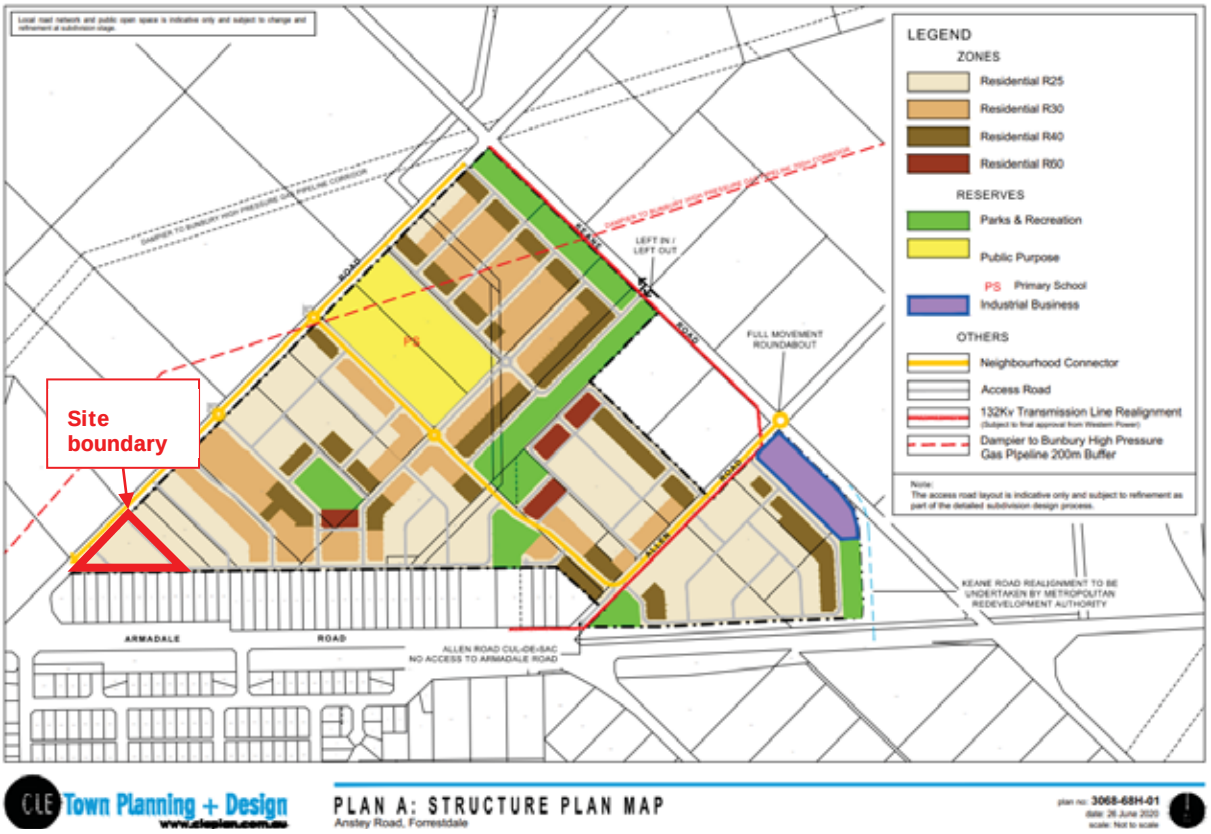


Figure 2: Approved structure plan

2. Local Water Management Strategy

The *Anstey Road East, Forrestdale, Local Water Management Strategy* was prepared by Hyd2o (2019) on behalf of PRM Property Group to support the SP application (Appendix B).

The site is located within subcatchment 1a, which is 2.61 ha in size and consists of 0.79 ha of road reserve, 1.51 ha of R25 residential lots and 0.31 ha of Public Open Space (POS) (Figure 3).

The LWMS detailed stormwater management aspects including subcatchment areas, stormwater management and bioretention treatment. Key stormwater management proposed in the LWMS are summarised below.

First 15 mm of rainfall

The first 15 mm of rainfall runoff generated from road reserve areas located within subcatchment 1a is proposed to drain into the bioretention basin located in the POS. The location of the bioretention area is shown to be in the east of subcatchment 1a and not within the site (Figure 3).

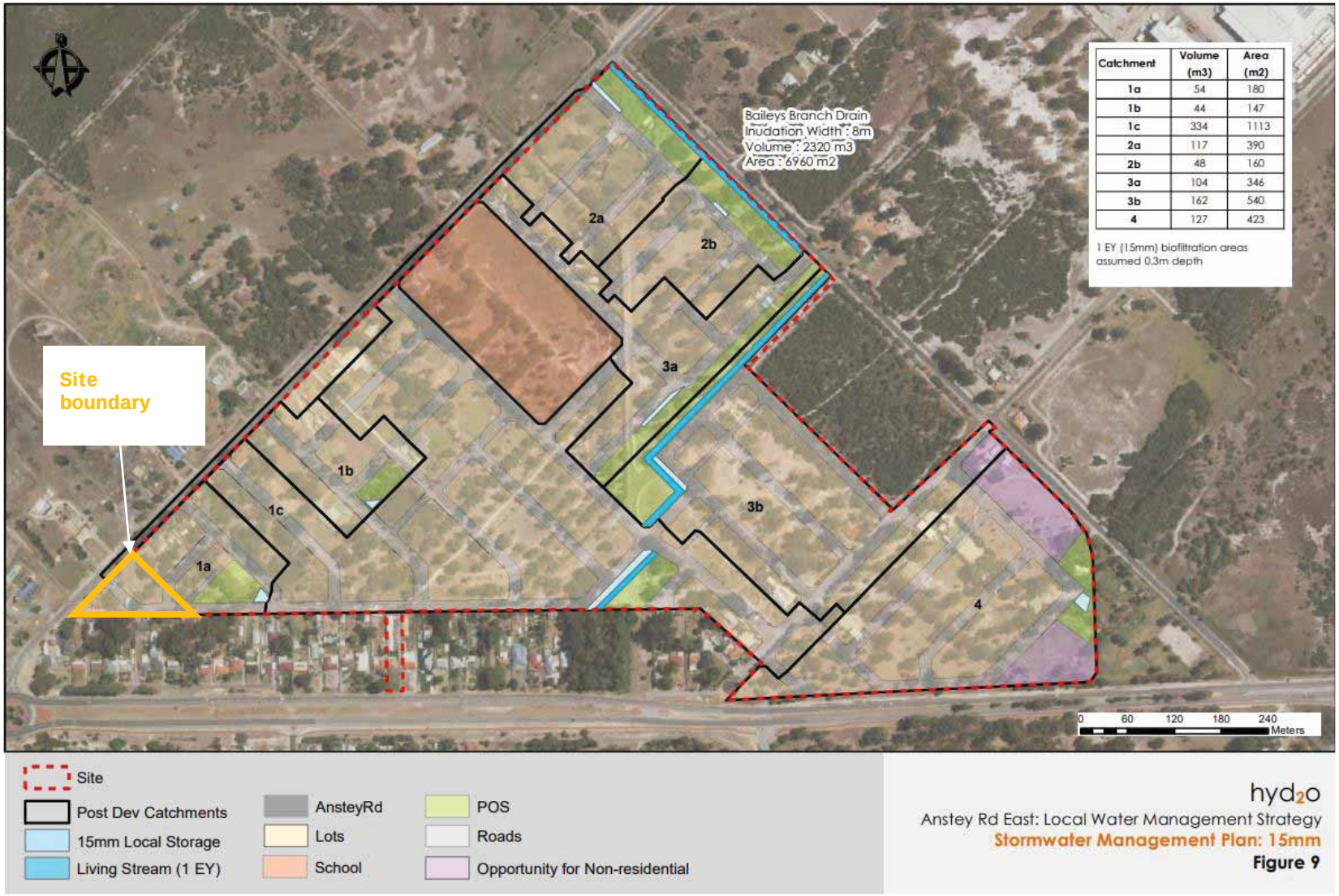
The first 15 mm or rainfall runoff generated within R25 residential lots within the site is proposed to be infiltrated via soakwells within each lot.

20% AEP event

In larger storm events, up to the 20% Annual Exceedance Probability (AEP) event, runoff from road reserve areas and R25 residential lots is proposed to be conveyed via the roadside pipe and pit network, and discharge directly into Baileys Branch Drain (Figure 4).

1% AEP event

In the 1% AEP storm event, additional runoff from road reserve and R25 residential lots is proposed to be conveyed within the road reserves and discharge directly into Baileys Branch Drain (Figure 5).



Catchment	Volume (m3)	Area (m2)
1a	54	180
1b	44	147
1c	334	1113
2a	117	390
2b	48	160
3a	104	346
3b	162	540
4	127	423

1 EY (15mm) biofiltration areas assumed 0.3m depth

Figure 3: First 15 mm of rainfall runoff to local storage area detailed in the LWMS (Hyd2o 2019)



Figure 4: 20% AEP pipe and pit drainage detailed in the LWMS (Hyd2o 2019)



Figure 5: 1% AEP overland flow detailed in the LWMS (Hyd2o 2019)

3. Amendment to the SP and LWMS

The proposed amendment to the SP seeks to change the zoning of R25 residential lots within the site to Local Centre. No change is proposed to road reserve zoned landuse types within the site.

Rainfall runoff generated within Local Centre areas will be managed consistent with that proposed for R25 residential areas as detailed in the LWMS, and is summarised below:

- Soakwells will be installed within each lot that are sized to infiltrate the first 15 mm of rainfall runoff.
- In larger storm events, up to the 20% AEP event, runoff will be conveyed via the roadside piped drainage network and discharge directly into the Baileys Branch Drain.
- In the 1% AEP event, additional runoff will be conveyed within the road reserves and discharge directly into Baileys Branch Drain.

Drainage and treatment of runoff generated within road reserve zoned landuse areas will be consistent with the LWMS and will not be impacted by the proposed SP amendment.

Similarly, drainage and treatment of runoff generated within Local Centre zoned areas will be consistent with that proposed for R25 residential lots, and therefore the stormwater management detailed in the LWMS will not be impacted by the proposed SP amendment.

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Appendix A: Structure Plan Map (CLE Town Planning and Design 2020)



CLE Town Planning + Design
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PLAN A: STRUCTURE PLAN MAP

Anstey Road, Forrestdale

plan no: **3068-68H-01**
date: 26 June 2020
scale: Not to scale

N

Appendix B: Local Water Management Strategy (Hyd2o 2019)

Anstey Rd East, Forrestdale

Local Water Management Strategy

October 2019



Client: PRM Property Group

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Disclaimer

This document is published in accordance with and subject to an agreement between Hyd2o and the Client for whom it has been prepared, and is restricted to those issues that have been raised by the Client in its engagement of Hyd2o. It has been prepared using the skill and care ordinarily exercised by hydrologists in the preparation of such documents.

Hyd2o recognise site conditions change and contain varying degrees of non-uniformity that cannot be fully defined by field investigation. Measurements and values obtained from sampling and testing in this document are indicative within a limited timeframe, and unless otherwise specified, should not be accepted as conditions on site beyond that timeframe.

Any person or organisation that relies on or uses the document for purposes or reasons other than those agreed by Hyd2o and the Client does so entirely at their own risk. Hyd2o denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence of relying on this document for any purpose other than that agreed with the Client.

Executive Summary

Hyd2o was commissioned by PRM Property Group to compile this Local Water Management Strategy (LWMS) to support the Metropolitan Region Scheme and Town Planning Scheme amendment and development concept plan proposed for 26 landholdings along Anstey Road and Keane Road in the suburb of Forrestdale (the site).

The site is approximately 49 ha in size and located approximately 21 km south east of the Perth CBD in the City of Armadale (Figure 1).

The conceptual subdivision plan for the site has been prepared by CLE Town Planning & Design. The proposed development of the site has considered the predevelopment environment, and this information has been used to inform and guide concept planning.

A key element of water management post development will be the realignment and establishment of Baileys Branch Drain as a living stream within a multiple use corridor.

This document has been prepared in accordance with the principles and objectives of Better Urban Water Management (Western Australian Planning Commission, 2008) and the Department of Water's Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b).

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of urban water management plans for individual stages of development within the site.

1. Introduction

Hyd2o was commissioned by PRM Property Group to prepare this Local Water Management Strategy (LWMS) to support the Metropolitan Region Scheme and Town Planning Scheme amendment and development concept plan proposed for the following lots (herein referred to as the site):

- Lots 48-55, 84, 86 and 87 Anstey Rd,
- Lots 10, 43, 44, 47, 60, 80 and 81 Keane Rd,
- Lots 5-8, 39, 41, 42 and 57 Allen Rd,
- Lot 58 Armadale Rd.

The site is approximately 49 ha in size and located approximately 21 km south east of the Perth CBD in the City of Armadale (Figure 1). The site is bordered by Keane Rd to the north east, Anstey Rd to the north west and a number of small residential lots fronting Armadale Rd to the south.

The development concept plan for the site has been prepared by CLE Town Planning & Design and is included as Figure 2. The proposed development is predominately urban residential consisting of residential lots, associated roads, public open space and stormwater management areas. The plan also provides some areas to the east for non-residential opportunities.

The proposed development of the site has considered the predevelopment environment and used this information to inform the development of the concept subdivision plan.

This LWMS provides an integrated total water cycle management approach to the development of the subdivision guide plan, with an assessment of the pre-development environment, development of water use sustainability initiatives, a stormwater management strategy, a groundwater management strategy and a plan for implementation.

A copy of the Better Urban Water Management (WAPC, 2008) LWMS Checklist for Developers is included as Appendix A to assist the Department of Water and Environmental Regulation (DWER) and City of Armadale (CoA) in review of this document.

1.1 Planning Context

The site is currently zoned 'Urban' under the Metropolitan Region Scheme and zoned as 'Rural Living' under the City of Armadale Town Planning Scheme Number 4 (Department of Planning, 2005).

The site is located with the Southern River District Structure Plan (DSP) area. The DSP covers a 6,500 ha area and proposes residential, industrial and neighbourhood centre development, as well as retention of existing rural and conservation areas.

The urban water management planning process for the site is shown in Table 1. This LWMS supports the proposed application for a City of Armadale Town Planning Scheme amendment to 'Urban'.

Table 1: Urban Water Management Process

Planning Phase	Planning Document	Urban Water Management Documents
District	MRS Scheme Amendment	Anstey/Keane Rd Forrestdale District Water Management Strategy (Hyd2o, 2017) **APPROVED**
Local	Town Planning Scheme Amendment	Anstey/Keane Rd Forrestdale Local Water Management Strategy **THIS DOCUMENT**
Subdivision	Subdivision Application	Urban Water Management Plan **FUTURE PREPARATION**

1.2 Key Documents

This LWMS uses the following key documents to define its principles, criteria, objectives, and implementation responsibilities:

- Anstey/Keane Road District Water Management Strategy (Hyd2o, 2017)
- Decision Process for Stormwater Management in WA (DWER, 2017)
- Draft Perth-Peel Green Growth Plan (Department of Planning, 2016)
- Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b)
- Southern River Integrated Land & Water Management Plan (DoW, 2009a)
- Developing a Local Water Management Strategy (DoW, 2008)
- Better Urban Water Management (WAPC, 2008)
- Stormwater Management Manual for WA (DoW, 2007)
- Liveable Neighbourhoods Edition 4 (WAPC, 2007)
- Southern River/Forrestdale/Brookdale/Wungong Structure Plan – Urban Water Management Strategy (JDA, 2002)
- Southern River/Forrestdale/Brookdale/Wungong District Structure Plan (WAPC, 2001)

2. Proposed Development

The proposed development concept plan is shown in Figure 2.

The proposed development is predominately urban residential consisting of residential lots, associated roads, public open space (POS) and stormwater management areas. The site also contains a proposed primary school along Anstey Rd.

The plan also provides some areas to the east for non-residential opportunities.

The majority of POS has been proposed as a linear multiple use corridor to facilitate the redevelopment of the Water Corporation's Baileys Branch Drain as a living stream and provide regional flood storage requirements as specified as being required within the site in the Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b).

The proposed realignment of the drain from its current location has been established with regard to other services constraints within the site, and to assist in providing a buffer between the site and the Forrestdale Business Park West to be located north of Keane Rd.

Discussions with agencies (CoA, DWER) and the downstream landowner (Cedar Woods) with regard to the realignment have been constructive and supportive, and will ensure the redeveloped drain will become a future community asset within the site. Further discussions regarding land matters for the drain and its transition from a rural drain to a living stream are discussed in Section 10 Implementation.

It is acknowledged and appreciated the drain will need to function without loss of performance across staged development. An indicative stage plan showing all stages of development is included with engineering drawings in Appendix Q. Specific details of any temporary measures will be provided at the relevant UWMP stage.

3. Design Criteria

Key design criteria for the site are shown in Table 2 and have been established consistent with criteria specified in the key reference documents previously detailed in Section 1.2. These design criteria are used to formulate the water management strategy for the site within the identified constraints and opportunities of the pre-development environment.

Table 2: Design Criteria

Strategy Elements	LWMS Method & Approach
Water Use Sustainability	
Water Efficiency	• 6 Star Building Standards (water efficient fixtures and fittings). • Maximising infiltration of stormwater where possible. • Use of superficial groundwater for POS irrigation.
Water Supply	• Rainwater tanks and Water Corporation IWSS for lots. • Irrigation bore for POS.
Wastewater	• Water Corporation reticulated sewerage.
Stormwater	
Flood Protection	• Post development flows and flood levels within Baileys Branch Drain to be consistent with Forrestdale Main Drain Arterial Drainage strategy (DoW, 2009b) for events up to 1% AEP event. • Provision of regional flood storage within Baileys Branch Drain as per Forrestdale Main Drain Arterial Drainage strategy (DoW, 2009b). • Flood storage to be integrated within POS. • Establish minimum habitable floor levels at 0.5m above the 1% AEP flood levels. • Overland flow paths within road reserves identified for safe conveyance of flows exceeding pipe drainage system capacity.
Serviceability	• Road drainage system to be designed so that roads will be passable in the 0.2 EY event. Opportunities for modified serviceability of piped drainage infrastructure to be assessed during civil design in consultation with CoA.
Ecological Protection	• Use of soak wells at lot scale to infiltrate the first 15 mm rainfall event. • Bioretention storages to retain first 15mm of road runoff. • Establishment of storage invert levels above seasonal maximum groundwater levels.
Nuisance Insect Management	• To reduce health risks from mosquitos, retention and detention treatments should be designed to ensure that immobile stormwater is fully infiltrated within a 96 hour time period.
Groundwater	
Fill Requirement & Subsoil Drainage	• Habitable floor levels to have clearance to groundwater and flood levels to be achieved by imported fill for building pads. • Subsoil drainage to manage groundwater post development. • Treatment for subsoil discharge to be provided either in situ or at the outlet prior to discharge.
Acid Sulphate Soils & Contamination	• If required, management of Acid Sulphate Soils to be handled as a separate process to LWMS consistent with DoE (2004) requirements.

4. Pre-Development Environment

4.1 Site Conditions

Figure 3 shows an aerial photograph with existing land use and topography.

The 49 ha site is located approximately 21 km south east of the Perth CBD. The site is largely cleared and used as rural lifestyle landholdings. There are two blocks characterised by native vegetation along Keane Rd, however both of these lots are excluded from the site.

There are small remaining patches of vegetation, a number of homes, sheds and small farm structures present across the site (Figure 3).

The site is traversed from south to north by Water Corporation's Baileys Branch Drain which forms part of the Forrestdale Main Drain Arterial Drainage System (DoW, 2009b). The drain's easement is approximately 15 m wide and 730 m in length.

The site is flat with topographic mapping for the site showing elevations ranging from 22 mAHD in the north of the site near the corner of Anstey Rd and Keane Rd to 24 mAHD in the south (Figure 3).

4.2 Geotechnical

Environmental geology mapping on the Armadale Part Sheet 2033 I and 2133 IV (Jordan, 1986) indicates the site is characterised by:

- S10 – SAND : white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals of eolian origin. Over sandy clay to clayey sand of the Guildford Formation.
- Sp1 – PEATY SAND : grey to black, fine to medium-grained, moderately sorted quartz sand, slightly peaty, of lacustrine origin.

The majority of the site is mapped as sand, with some localised patches of peaty sand in the north of the site (correlated with multiple use wetland mapping) and in the south east of the site.

A geotechnical investigation was undertaken by JDSi Ground Engineering in May 2018 and is included as Appendix B. On 19 & 20 April, 2018 JDSi undertook a site investigation within the site. The investigation consisted of the excavation of 20 test pits, 20 sand penetrometer tests, four permeability tests and collection of soil samples for laboratory testing.

The test pits were excavated to a depth of 0.8m to 2.5 m below existing ground level. The location of the test pits are shown in Figure 4. Groundwater was only encountered in TP12, at approximately 1.9 m below ground surface. The subsurface conditions encountered in the test pits can generally be described as follows from natural surface to increasing depth:

- TOPSOIL : Ground surface to 0.3 m- A layer of topsoil or fill.
- SAND : 0.2m - >2m- Comprising of fine to medium grained, sub- rounded quartz. This layer was found in all locations.

- COFFEE ROCK : 0.8m-2.2m- This layer was encountered at test pits: TP6, TP8, TP14, TP15, TP16, and TP18. Test pits were refused above target depths.
- SILTY SAND : 0.5m- 1.8m- A silty sand layer interpreted as the Guildford Formation and comprising fine to medium grained sand and low plasticity clay fines and/or silt fines and traces of lateritic gravels. This was encountered in test pits TP1-TP4, TP7-TP10, TP13, and TP20.

Infiltration testing was undertaken using a falling head permeameter at four sites at a depth of 0.9m. Estimated minimum permeability was measured between 1.7 m/day and >10m/day across the site.

The preliminary classification of the site was "Class A" on sites where sand was present and "Class S" where sands were over Guildford Formation soils, alluvial soils or coffee rock.

In addition to geotechnical testing, Hyd2o installed seven groundwater monitoring bores on 5 April, 2016 across the site (Figure 4). Bores were installed to a depth of 4-5m below ground surface with the subsurface profile generally consistent with Jordan 1986.

Hyd2o lithological logs are included in Appendix C. The profile of all bores was sand with a fine to coarse texture, with the exception of AK4, which exhibited a number of layers of coffee rock, and bore AK2, which had sand to 1m, clayey sand to 1.5m and sandy clay to the end of hole at 3m depth.

4.3 Acid Sulphate Soils

Acid Sulphate Soil (ASS) is the common name given to naturally occurring soil and sediment containing iron sulfides. These naturally occurring iron sulfides are generally found in a layer of waterlogged soil or sediment, and are benign in their natural state.

When disturbed and exposed to air, however, they oxidise and produce sulfuric acid, iron precipitates, and concentrations of dissolved heavy metals such as aluminium, iron and arsenic. Release of acid and metals as a result of the disturbance of ASS can cause significant harm to the environment and infrastructure.

The presence of ASS has been a recognised issue of concern in Western Australia since 2003. The Department of Environment and Conservation (now DBCA) and the WAPC have released guidance notes on ASS, covering the requirement for assessing sites and the management of sites where ASS are identified.

ASS mapping is shown in Figure 4. Western Australian Planning Commission mapping identifies the site as having a moderate to low risk of ASS occurring within 3m of natural soil surface, with the exception of a portion in the northern corner and eastern portion of the site which have a high to moderate risk of ASS occurring within 3m of natural surface.

Should an ASS investigation be required to be undertaken at the site, this will be prepared separately to this LWMS.

4.4 Contaminated Sites

A search of the Department of Water and Environmental Regulation's Contaminated Sites database (accessed September 2018) indicates no known contaminated sites within the site.

4.5 Aboriginal Heritage Sites

A search of the Aboriginal Heritage Inquiry System (accessed September 2018) indicates that no Registered Aboriginal Heritage Sites are located within the site.

4.6 Wetlands

The Department of Biodiversity, Conservation and Attractions' mapping of Geomorphic Wetlands of the Swan Coastal Plain indicates that a portion of the site is classified as multiple use wetland (MUW) (Figure 5).

There are no Resource Enhancement Wetlands (REW) or conservation category wetlands (CCW) within the site.

Forrestdale Lake is located approximately 400 m south of the site. Forrestdale Lake a conservation category wetland and a Ramsar listed wetland, however both surface water and groundwater flow in a northerly direction away from the lake.

4.7 Surface Water

The major surface water feature of the site is the Water Corporation's Baileys Branch Drain which flows from north the south across the site (Figure 6). The drain is a tributary of the Forrestdale Main Drain which it joins approximately 2.3 km downstream of the site.

The Baileys Branch Drain is a steep sided trapezoidal drain located within a 15m wide strip of land owned by the Water Corporation. The drain is very flat with little grade and is inundated with groundwater during the winter period. Flow velocities within the drain are very low even during storm events (< 0.2 m/s).

The construction of the drain occurred sometime between 1965 and 1974, coinciding with the development of the Forrestdale townsite on the northern boundary of Lake Forrestdale. The drain conveyed stormwater from the urban developed area away from the lake and through rural land to Forrestdale Main Drain. The Baileys Branch Drain also currently acts as a groundwater control and will continue to do so post development. This is reflected in the site groundwater contours as detailed in Section 4.8.

By June 1977, the Dumsday Compensating Basin on the southern side of Armadale Rd was constructed, and some realignment of the Bailey Branch Drain to its current alignment also occurred at that time.

The Dumsday Compensating Basin then moved to its current location in 2005 to accommodate the widening of Armadale Rd. At the time of its relocation, its capacity was reduced despite an increase in the impervious catchment area contributing to the basin due to the Armadale Rd widening.

The Dumsday Compensating Basin has a contributing catchment of approximately 58 ha, including Armadale Rd and the Forrestdale town site urban area. The area of the Dumsday Compensating Basin is 0.2 ha, representing only 0.3% of its total catchment area, an order of magnitude less in size than would be normally be expected for a catchment of this size.

DoW (2009b) identifies Dumsday Basin as a Water Corporation asset, therefore it is understood maintenance is and will continue to be a Water Corporation responsibility.

This results in regional flood storage being required within the site post development. The requirements for stormwater management of the site post development are outlined in the Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b).

4.7.1 Forrestdale Main Drain Arterial Drainage Strategy

The Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b) provides modelling of the Baileys Branch Drain for both existing and ultimate development scenarios, and identifies drainage upgrade requirements in the vicinity of Anstey Rd.

Although the document is 10 year old, DoW (2009b) still represents the overarching strategy document governing design of stormwater in the area. Key extracts from the strategy relevant to this report are included in Appendix D.

Water levels within the drain at key locations during storm events as modelled in DoW (2009b) are summarised in Table 3. These levels are used by Hyd2o to develop and calibrate an XP-Storm stormwater model of the area in Section 6.

It should be noted that recent updates to Australian Rainfall and Runoff (Ball et al, 2016) have resulted in changes in terminology being recommended to describe design rainfalls. Generally, Exceedance per Year (EY) terminology is recommended to be used for very frequent design rainfalls, Annual Exceedance Probability (AEP, %) terminology used for frequent and infrequent design rainfalls, and AEP (1 in x) terminology used for rare design rainfalls. For the purpose of this report, Average Rainfall Interval (ARI) terminology used in DoW (2009b) has therefore been replaced with the updated terminology as follows:

- 1 Year ARI – replaced with 1 EY
- 5 Year ARI – replaced with 0.2 EY
- 10 Year ARI – replaced with 10% AEP
  (note this is approximate only as 10% AEP is equivalent to a 9.49 Year ARI)
- 100 Year ARI – replaced with 1% AEP

For ultimate development DoW (2009b) specifies a widening of the Baileys Branch Drain from its current 5.5m width to 50m within the site for approximately 490m. These requirements are largely due to the shortfall in storage at the Dumsday Compensating Basin as detailed in Section 4.7.

Hyd2o note that the water levels within the Baileys Branch Drain for ultimate development shown in Table 3 at most locations are slightly lower than the existing system, which is a result of the additional storage provided in the 50m widening of the drain.

It is not clear why the Dumsday compensating basin levels are increased at ultimate development, as this appears to be counterintuitive on the basis that levels downstream are reduced and its outflow has increased.

The DoW (2009b) strategy was based on individual developments all providing separate offline local stormwater storages to attenuate flows from developed areas to specified allowable flow rates prior to discharging to the drain. This is further discussed in Section 6.

Table 3: Baileys Branch Drain Flood Levels and Flows at Key Locations

Location	Invert mAHD	10% AEP Flow m^3/s	10% AEP HGL mAHD	1% AEP Flow m^3/s	1% AEP HGL mAHD	Natural Surface mAHD
Keane Rd Culvert Upstream Existing System Ultimate Development	21.06	1.00 0.65	22.41 22.28	1.29 0.81	22.84 22.70	22.88
Anstey Rd Culvert Upstream Existing System Ultimate Development	21.19	0.65 0.81	22.50 22.30	0.75 1.02	23.04 22.76	23.10
Armadale Rd Culvert Downstream Existing System Ultimate Development	21.57	0.86 1.00	22.53 22.32	1.11 1.34	23.05 22.77	23.65
Dumsday Compensating Basin Existing System Ultimate Development	21.65	0.81 0.94	23.09 23.32	1.08 1.27	23.74 24.16	23.65

4.7.2 Surface Water Quality

Surface water quality samples were taken from Baileys Branch Drain from the upstream site entry (Armadale Rd, SW1) and downstream site exit locations (Anstey Rd, SW2).

Samples were taken over winter when the drain was observed to be flowing resulting in samples collected in June, July and August 2016 and July, August and October 2017.

Each sample was analysed in situ for physical parameters (temperature, electrical conductivity (EC) and pH), with samples sent to a NATA approved laboratory for analysis of nutrients and heavy metals.

Detailed surface water quality results are included in Appendix F with laboratory reports contained in Appendix G. Surface water quality results are summarised in Table 4 and below, with comparison to ANZECC (2000) guidelines:

- Mean pH at SW1 and SW2 were 6.46 and 6.63, respectively. Results are close to within the ANZECC guideline range of 6.5 to 8.0 pH.
- Mean EC at SW1and SW2 were 0.50 mS/cm and 0.74 mS/cm, respectively. Results are slightly above the ANZECC guideline range of 0.12 mS/cm to 0.30 mS/cm.
- Mean TN at SW1 and SW2 were 2.68 mg/L and 3.90 mg/L, respectively. These values exceed the ANZECC guideline concentration of 1.2 mg/L.
- Mean TP at SW1 and SW2 were 0.46 mg/L and 1.54 gl/L. These values also exceed the ANZECC guideline concentration of 0.065 mg/L.

Given the semi-rural land use across the site, including horse agistment and sheep grazing, it is not unusual that the downstream TN and TP concentrations are higher than upstream.

The mean results for all heavy metals were within the 99% trigger levels of protection for freshwater species at both monitoring sites.

Table 4: Predevelopment Surface Water Quality

Parameter	ANZECC	SW1 (upstream)	SW2 downstream)
EC (mS/cm)	0.12 – 0.30	0.50	0.74
pH	6.5 – 8.0	6.46	6.63
TN (mg/L)	1.2	2.68	3.90
TP (mg/L)	0.065	0.46	1.54
TKN (mg/L)	-	1.88	3.73
Ammonia (mg/L)	0.08	0.09	0.06
Nitrite as N (mg/L)	-	0.01	0.04
Nitrate as N (mg/L)	-	0.80	0.19

4.8 Groundwater

4.8.1 Groundwater Levels

Seven groundwater monitoring bores were installed at the site on 5th April 2016 (Figure 7). The bores were installed by Edrill Environmental via a drill rig, overseen by Hyd2o. The bores were constructed suitable for water level and water quality monitoring.

The monitoring program was undertaken over an 18 month period, commencing in April 2016, with the final monitoring occasion in October 2017 – capturing two winters. Water level monitoring was undertaken monthly at the onsite bores and an additional three nearby DWER bores (T115, T80 (O), 602). A summary of water levels recorded during the monitoring program are presented in Table 5 and Appendix E.

Minimum groundwater levels for the site bores were recorded in April 2016 and ranged from 19.77 mAHD at AK2 to 21.63 mAHD at AK5. Maximum groundwater levels over the monitoring period were recorded in September 2016 ranging from 22.16 mAHD at AK2 to 23.25 mAHD at AK7. Groundwater flow is generally north towards the intersection of Anstey Rd and Keane Rd.

All three DWER bores monitored show a historical annual variation of between 1.5 m – 2.5 m between winter and summer levels with long-term hydrographs showing a general decline in groundwater levels since the 1970s.

The recorded groundwater levels were broadly consistent with the Perth Groundwater Map. The online DWER Perth Groundwater Map shows May 2003 groundwater levels across the site ranging from 21 mAHD and 22 mAHD, which represent a typical minimum groundwater level at the end of summer. The Map also provides groundwater contours showing the historical maximum groundwater levels across the site being between 23 mAHD and 24 mAHD, approximately 2 m above the May 2003 levels.

The monitoring of long term DWER bores allowed for onsite groundwater measurements to be referenced to long term local groundwater records for consistency and the calculation of an average annual maximum groundwater level (AAMGL) and maximum groundwater level (MGL) for the site.

It is important to note the LWMS only uses the terminology AAMGL to represent a valid statistical property of groundwater in the area, and not as a concept as per previous DWER policies. This LWMS presents details of the groundwater's seasonal variation, AAMGL, and MGL all as measures of its seasonal, annual, and interannual behaviour. Simply presenting an MGL is not considered adequate to represent the groundwater characteristics and behaviour of the site.

Tables 6 and 7 detail the calculation of the AAMGL and MGL for the site based on long term DWER records correlated against readings from the September 2016 peak groundwater levels (the highest site groundwater levels recorded). The calculation also considers the proximity of some of the bores to the Baileys Branch Drain in limiting the groundwater rise in these bores.

AAMGL mapping is shown in Figure 7. Note that bore AK4 was not used in mapping due to the potential impact of coffee rock layers on recorded water levels at this location.

Goundwater mapping shows the impact of Baileys Branch Drain, with groundwater broadly flowing toward Baileys Branch Drain from either side of the drain. A small area of the site near the corner of Anstey and Armadale Rd is considered likely to flow toward the Forrestdale Main Drain located east of the site.

The AAMGL is estimated to range between a maximum of 23.8 mAHD in the south western corner, and a minimum of 21.9 mAHD in Baileys Branch Drain adjacent to Anstey Rd. The MGL for the site is estimated to range between 22.4 mAHD and 24.4 mAHD.

Recent maintenance undertaken by Water Corporation in July 2019 within the Baileys Branch Drain downstream of the site removed a considerable 1m deep blockage in the drain which has resulted in reductions in groundwater levels in the drain at the site.

An overall 0.3 m reduction in peak groundwater levels at Anstey Rd as a result of the blockage removal is expected based on monitoring outcomes to date. This impact is currently continuing to be monitored by both Hyd2o and Water Corporation, and will be factored into future planning and design for the site.

Table 5: Predevelopment Groundwater Levels

	Site Groundwater Bores							DWER Bores		
	AK1	**AK2**	**AK3**	**AK4**	**AK5**	**AK6**	**AK7**	**T115**	**T80(O)**	**602**
Top of Casing (mAHD)	24.83	23.02	24.46	25.02	24.27	24.22	24.21	24.91	27.60	25.26
Natural Surface (mAHD)	24.23	22.42	23.96	24.47	23.67	23.62	23.61	24.32	27.16	24.68
Groundwater Levels (mAHD)										
07/04/16	20.82	19.77	20.79	20.58	21.63	20.53	20.81	21.39	23.69	20.57
13/05/16	20.94	19.92	21.87	20.72	21.87	20.57	20.62	21.51	24.19	21.26
26/06/16	21.56	20.91	22.35	21.12	22.26	21.13	22.64	22.04	24.87	22.14
29/07/16	22.47	21.65	22.72	21.97	22.65	21.96	22.89	22.90	25.41	22.88
22/08/16	22.63	21.79	22.79	22.17	22.79	22.10	23.06	23.16	25.37	23.03
30/09/16	23.09	22.16	23.06	22.63	23.07	22.61	23.25	23.72	25.50	23.11
20/10/16	22.93	22.04	22.97	22.57	23.02	22.50	23.07	23.53	25.13	22.97
21/11/16	22.58	21.47	22.70	22.13	22.72	22.12	22.78	22.94	24.59	22.69
20/12/16	22.21	20.91	22.52	21.69	22.52	21.80	22.52	22.39	24.15	22.22
02/02/17	21.66	20.24	22.26	21.20	22.18	21.17	22.02	21.86	23.90	21.24
28/02/17	21.98	20.73	22.50	21.41	22.40	21.51	22.51	21.97	24.89	22.24
22/03/17	21.98	20.72	22.39	21.52	22.27	21.52	22.42	21.99	24.28	21.73
20/04/17	21.56	20.34	22.22	21.23	22.22	21.42	22.29	21.81	Not accessible	21.42
24/05/17	21.51	20.45	22.27	21.21	22.13	21.31	22.46	21.87	24.37	22.04
26/06/17	21.67	20.67	22.33	21.32	22.26	21.28	22.58	21.95	24.42	22.37
17/07/17	22.11	21.27	22.58	21.68	22.50	21.68	22.80	22.30	24.70	22.82
18/08/17	23.00	22.01	23.04	22.40	22.97	22.42	23.13	23.43	25.23	23.16
29/09/17	22.99	22.04	23.07	22.49	23.00	22.41	23.11	23.36	25.03	23.14

Table 6: AAMGL and MGL – DWER Bores

Bore	Period of Record	Groundwater Leve (mAHD) 30/09/16	AAMGL (mAHD)	Correction Factor (m)	MGL (mAHD)	Correction Factor (m)
T115	1975-2004, 2013-2016	23.72	23.90	0.18	24.72	1.00
T80 (O)	1973-2016	25.50	25.96	0.46	26.47	0.97
602	1996-2016	23.11	23.19	0.08	23.59	0.48
Correction Factors for Site Bores				**0.24**		**0.81**

Table 7: AAMGL and MGL - Site Bores

Bore	Natural Surface (mAHD)	Groundwater Level (mAHD) 30/09/16	Applied Correction Factor (m)	AAMGL (mAHD)	Depth Below Natural Surface (m)	Applied Correction Factor (m)	MGL (mAHD)	Depth Below Natural Surface (m)
AK1	24.23	23.09	0.24	23.33	0.90	0.81	23.90	0.33
AK2	22.42	22.16	0.14 [1]	22.30	0.12	0.71 [1]	22.42 [2]	0.00
AK3	23.96	23.06	0.24	23.30	0.66	0.81	23.87	0.09
AK4	24.47	22.63	0.24	22.87	1.60	0.81	23.44	1.03
AK5	23.67	23.07	0.24	23.31	0.36	0.81	23.67 [2]	0.00
AK6	23.62	22.61	0.14 [1]	22.75	0.87	0.71 [1]	23.32	0.30
AK7	23.61	23.25	0.14 [1]	23.39	0.22	0.71 [1]	23.61 [2]	0.00

1. Reduced correction factor applied for these bores due to proximity to Baileys Branch Drain
2. Corrected to natural surface

4.8.2 Groundwater Quality

Groundwater quality samples were taken from all site bores quarterly, commencing in May 2016 with the last samples collected in August 2017. A total of six groundwater quality sampling occasions were undertaken. Detailed groundwater quality results are included in Appendix F with laboratory reports contained in Appendix G.

Groundwater quality results are summarised in Table 7 and below, with comparison to ANZECC (2000) guidelines for lowland rivers in the southwest of Australia:

- Mean pH ranged from 4.05 at AK5 to 6.66 at AK1, being below to within the ANZECC guideline range of 6.5 to 8.0 pH.
- Mean EC ranged from 0.33 mS/cm at AK4 to 23.3 mS/cm at AK2, above the ANZECC guideline range of 0.12 mS/cm to 0.30 mS/cm. This ranges from fresh to relatively saline across the site.
- Mean TN ranged from 2.9 mg/L at AK2 to 24.7 mg/L at AK5, above the ANZECC guideline concentration of 1.2 mg/L.
- Mean TP ranged from 0.05 mg/L at AK2 to 13.5 mg/L at AK5. These values range from within to exceeding the ANZECC guideline of 0.065 mg/L.

Whilst TN and TP concentrations are above the ANZECC guidelines, they represent typical groundwater nutrient values for the Swan Coastal Plain for land that has been historically used for farming purposes.

Across all bores, the mean results for all metals were within the 99% trigger level of protection for freshwater species (see Appendix F).

Table 8: Predevelopment Groundwater Quality

		Mean Groundwater Quality Results						
Parameter	**ANZECC**	**AK1**	**AK2**	**AK3**	**AK4**	**AK5**	**AK6**	**AK7**
EC (mS/cm)	0.12 – 0.30	1.79	23.33	5.49	0.33	3.50	0.94	4.90
pH	6.5 – 8.0	6.66	5.61	4.98	5.68	4.05	5.27	6.33
TN (mg/L)	1.2	23	2.9	12.1	3.5	24.7	7.9	9.5
TP (mg/L)	0.065	0.66	0.05	0.20	0.27	13.5	0.13	1.04
TKN (mg/L)	-	12.1	2.8	12.1	1.6	25.2	7.9	9.5
Ammonia (mg/L)	0.08	0.33	0.31	0.24	0.36	2.87	0.82	0.28
Nitrite as N (mg/L)	-	0.05	0.11	0.03	0.005	<0.005	0.03	0.01
Nitrate as N (mg/L)	-	11.02	0.04	0.11	0.43	0.03	0.10	0.02

5. Water Use Sustainability Initiatives

5.1 Water Efficiency Measures

Water conservation measures will be implemented within the development and will be consistent with Water Corporation's Waterwise land development criteria, and include:

- Promotion of use of waterwise practices including water efficient fixtures and fittings (taps, showerheads, toilets and appliances, rainwater tanks, waterwise landscaping).
- All houses to be built to 6 star building standards.
- Use of water wise plantings, including native plants, in POS areas.
- Use of groundwater bores for irrigation of POS.
- Maximising on site retention of stormwater.
- Use of higher density residential zonings and smaller lots to reduce garden (ex-house) use of water and nutrient application areas.

5.2 Water Supply

Domestic water supply will be provided via extension of the Water Corporation's Integrated Water Supply System (IWSS). Rainwater tanks will not be implemented/mandated at estate scale to supplement the domestic water supply scheme. Residents who wish to supplement scheme water supply with rainwater tanks will be provided for by individual builders during the building application process.

Landscape concept plans for the site prepared by Emerge Associates are shown in Appendix H. Landscaping has been designed with recognition of the generally low availability of water in the area, with local species incorporated to minimise water use.

DWER have issued two groundwater licences with allocation from the superficial aquifer – GWL 201253 (50,558 kL) and GWL 153126 (7,500 kL). These licence allocations have been granted for use for irrigation of up to 8.49 ha of public open space and also cover use for construction purposes. The water use allocation for the GWL was determined by DWER via POS areas provided and application by DWER of standard irrigation rates. An indicative irrigation schedule prepared by Emerge Associates is included in Appendix H.

Copies of licences are included as Appendix I and summarised in Table 9.

Table 9: Groundwater Resource and Existing Licence Allocation

GW Area	Subarea	Aquifer	Licence No.	Allocation	Expiry
Perth	City of Armadale	Superficial	201253	50,558	3/5/2028
			152126	7,500	26/4/2028

5.3 Wastewater Management

Wastewater will be reticulated sewerage with management by the Water Corporation.

6. Stormwater Management Strategy

Stormwater management will be undertaken consistent with DWER water sensitive design practices. The system will consist of lot soakwells, subsoil drainage, piped road drainage system, biofiltration areas, and Baileys Branch Drain realigned and reconfigured as a living stream to provide water quantity and quality treatment for stormwater generated from the proposed development. Given the size of the site, the LWMS has focussed on providing detail associated with modelling of the arterial drainage system and ensuring space requirements for drainage are adequately provided in POS. There will be opportunities for median swales and other WSUD measures in wider road reserves and these measures will be appropriately investigated at UWMP stage as detailed engineering progresses.

The proposed system refines the strategy detailed in DoW (2009b) as follows :

- Within the site it is proposed to provide online storage and attenuation of flows within the living stream without separate offline storages. No local storages will therefore be provided other than biofiltration areas for water quality treatment of the first 15mm of runoff. This is possible by increasing the length (and hence storage capacity) of the Baileys Branch Drain and using this capacity to provide combined regional and local storage requirements. The combination of regional and local flood storage within the living stream is proposed to minimise the overall stormwater imprint on POS and improve MUC characteristics and the living stream configuration. Given the low gradient of the Bailey Branch Drain (and flow velocities), this configuration is also considered to enable better flushing of the system during storm events.
- With respect to the DoW (2009b) proposed 1.0 ha compensating basin (Baileys CB) in Cedar Woods land (Appendix D), it is considered problematic in that location to efficiently achieve the required storage due to excavation restrictions within the Dampier to Bunbury Natural Gas Pipeline Corridor. This is proposed to be replaced by a living stream within a 40m multiple use corridor (MUC) adjacent to the Keane Rd road reserve as a continuation of the living stream from the site. Any loss of storage as a result of the change will effectively be accommodated within the sites MUC south of Anstey Rd.
- With respect to the Baileys Branch Drain configuration, DoW (2009b) specifies a living stream of 50 m top width, 1:8 side slopes, and 1.9m deep (implying a 20m base width). Given the high groundwater conditions in the area a narrower base channel is preferred to minimise the extent of open water within the MUC and maximise amenity and useable POS. A ~12m wide main channel for events up to the 0.2 EY is proposed, with larger event permitted to flood into the wider MUC corridor. The proposed design is consistent with the Water Corporations Drainage for Liveability Fact Sheet, Living Streams in Water Corporation Assets (Water Corporation 2016).

This stormwater management concept and post development catchment mapping for the site is shown in Figure 8. Eight main stormwater catchments have been identified in consultation with project engineers JDSi, seven of which will drain to the Baileys Branch Drain. The eighth catchment east of Allen Rd (Catchment 4) is part of the Forrestdale Main Drain catchment as identified in DoW (2009b), and will continue to drain in this direction post development in accordance with DoW (2009b).

This approach is considered the most efficient for the site in terms of maximising usable POS within the established multiple use corridors within the site and has been agreed in principle with Water Corporation.

For Baileys Branch Drain, relocation of the drain will require a new crossing at Anstey Rd and this relocation is supported by the downstream developer Cedar Woods. Advice from project engineers JDSi and Water Corporation plans (Appendix J) indicate this proposed alignment will not clash with existing services.

It is important to note the multiple use corridor width varies from approximately 30m to 70m within the site along its 800 m length. DoW (2009b) previously recommended a 50m living stream of 490m length in the site post development. The realignment of the drain, extending its length through the site, and adopting a variable width in different areas have been implemented as a result of a site responsive design. It is important to note the variable widths still maintain DoW(2009b) requirements for flood storage.

DWER and Water Corporation living stream guidelines do not prescribe designated widths for MUC's and recommend site responsive design, however the narrower 30m section is compliant with City of Armadale minimum width requirements for multiple use corridors (City of Armdale Local Planning Policy PLN 2.6).

The Water Corporation have indicated they are committed to working collaboratively with local government and DWER regarding responsibilities and establishing partnership agreements for management of drainage assets for areas where multiple use characteristics apply and rural drains are transitioned to living streams. Correspondence with the Water Corporation to date is attached as Appendix K.

With respect to the catchment draining to Forrestdale Main Drain (Catchment 4), Hyd2o have had previous discussions with Calibre, who are responsible for undertaking the design of the Keane Rd upgrade for Forrestdale Business Park West, to ensure a discharge from the site is accommodated within any stormwater upgrades in this area. Correspondence with Calibre on this matter is included as Appendix L. While the Calibre design is being assessed as a separate process to this LWMS this information has been included in this report is to demonstrate the designers of that infrastructure are aware of the requirements to accept drainage from the site.

It is important to note the outfall from this catchment is not depended on the development of Forrestdale Business Park, only the Keane Rd upgrade in this area. While the development the catchment draining to Forrestdale Main Drain is the final stage of development (refer Appendix Q staging), ilf the Keane Rd upgrade has not occurred by this time, as a contingency the area can continue to discharge via the existing culvert under Keane Rd which currently drains flow from this area into the adjacent resource enhancement wetland. Some additional temporary storage may be required to be provided depending on the existing culvert capacity. Other alternative temporary open drain connections to Forrestdale Main Drain may also be possible is required.

Opportunities for modified serviceability in piped drainage infrastructure for minor events will be assessed during civil design and UWMP development in consultation with the City of Armadale. This will consider allowing lesser design events to increase pit spacing and reduce infrastructure whilst still maintaining required gutter flows.

With respect to the living stream configuration this has been designed to account for a range of factors including high and variable groundwater table, Water Corporation desire to minimise baseflow channel, maintaining POS usability, providing major flood storage, and other infrastructure considerations (powerlines etc). The final configuration of the living stream will be subject to further refinement during detailed design of the POS corridor within the key parameters of the LWMS, and will consider opportunities for tree retention within this space via the establishment of appropriate levels.

Anstey Rd runoff is proposed to be managed by both LWP (eastern portion) and by CWP (western portion) and accommodated within subdivisional stormwater areas. This is likely be managed via piped drainage, subject to detail design of Anstey Rd.

6.1 Stormwater Modelling

Stormwater modelling for the site was performed using XP-Storm to determine flood storage requirements and provide an assessment of areas required for drainage purposes.

It should be noted Australian Rainfall and Runoff 1987 (IEAust, 1987) was used in the stormwater modelling for this report rather than the recently released Australian Rainfall and Runoff 2016 (Ball et al., 2016). This approach has been adopted as flows and levels from the Forrestdale Main Drain Arterial Drainage Strategy (DoW, 2009b) were based on Australian Rainfall and Runoff 1987 (IEAust, 1987) in its preparation.

The design storms modelled by XP-Storm were based on methodology in Australian Rainfall & Runoff (Institution of Engineers Australia, 1987) and the Bureau of Meteorology Computerised Design IFD Rainfall System. The rainfall temporal pattern was assumed to be spatially uniform, and storm durations modelled ranged from 1 to 72 hours.

6.1.1 Model Establishment & Validation

An initial model of the ultimate stormwater system was established in XP-Storm based on DoW (2009b) parameters for validation purposes.

The model was based on all hydrology and hydraulic parameters as specified in DoW (2009b) for the adopted strategy. This included all catchment areas, storage configurations, land use, runoff rates and parameters. The model was extended downstream of Baileys Wetland approximately 1.7 km downstream of the site to ensure modelling results were not adversely affected by assumed tailwater conditions.

With respect to groundwater, an initial groundwater level of 21.9 mAHD within the drain was adopted at the commencement of the storm for modelling purposes. This water level is approximately equivalent to the culvert obvert under Anstey Rd, and was selected as representative of a maximum winter condition in the drain for modelling purposes based on Hyd2o (2018). It should be noted that this is a conservative assumption, given recent maintenance works on the drain downstream of the site by Water Corporation (as discussed in Section 4.8.1) have removed a considerable blockage, and an overall 0.3 m reduction in peak groundwater levels at Anstey Rd has been observed. Once confirmed this change will factor into the future planning and design.

Calibration results are summarised at key locations in Table 10, demonstrating a good agreement with DoW (2009b) modelling, and providing confidence in the model to then

assess changes in land use and the stormwater management approach since the original DoW (2009b) modelling was performed using the Infoworks model.

It should be noted that the Dumsday Basin top water level was lower in Hyd2o modelling than DoW (2009b), however the peak outflow was the similar. Storage characteristics for this basin were provided via the City of Armadale based on design drawings. The design drawing for the Dumsday Bain is contained in Appendix K.

Table 10: XP-Storm Model Validation Results

Location	1% AEP HGL DoW(2009) via Infoworks Model mAHD	1% AEP HGL Calibrated Hyd2o XP-STORM Model mAHD
Keane Rd Culvert Upstream Ultimate Development	22.70	22.73
Anstey Rd Culvert Upstream Ultimate Development	22.76	22.79
Armadale Rd Culvert Downstream Ultimate Development	22.77	22.79
Dumsday Compensating Basin Ultimate Development	24.16 (1.27 m^3/s peak outflow)	23.95 (1.26 m^3/s peak outflow)

6.2 Flood Protection (1% AEP Event)

Based on the development concept plan (Figure 2), the calibrated XP-Storm model of the site was then modified to reflect refinements in land use and changes to the stormwater management strategy as previously detailed in Section 6 and Figure 8.

Key stormwater modelling parameters are shown in Table 11, with the runoff coefficients adopted for modelling purposes for various events and durations calculated in detail in Appendix M using Hyd2o's CURRV runoff rate estimator based on various individual land use characteristics. Note all land use area breakdowns used to estimate runoff rates detailed in Appendix M are based on CoA's Water Resource Management for Land Development position paper (Essential Environmental, 2015).

With respect to the adopted runoff rates for design, Hyd2o understand the City requires drainage for lots less than 350m^2 to be managed by provision of interconnected soak wells linked to a grated pit installed in the driveway of the lot. The grated pit will provide a "bubble out" function allowing an indirect connection to City's drainage system via overland flow down the driveway. Lots larger than 350 m^2 are required to control water on-site via interconnected soak wells.

Appendix N details the standard living stream section applied for post development modelling purposes, comprising a main channel and wider floodplain for major event storage. A Mannings n of 0.035 was assumed. It is important to note that given the low velocity of flow due to the very low grades and the considerable influence of groundwater, the living stream behaviour within the site is not that of a typical stream. For example, the depth of water due to groundwater each year will be a higher level than a 50% AEP event when groundwater is low. Further iteration of the living stream design will

be undertaken as detailed planning of the MUC corridor progresses in consultation with key agencies. This design refinement will include consideration of providing a gentle downward slope towards the main channel enough to generate overland flow and avoid water ponding on the wider floodplain area.

Schematics of the XP–Storm model are contained as Appendix O. Modelled flood protection storage volumes and areas are detailed in Table 11 and Figures 9 to 11 show the extent of inundation of POS area for various flood management events. Note that impact of the TWL is shown accurately and to scale in all figures relative to the total POS area and plans based on the cross sections of the living stream provided in the LWMS.

Figure 11 shows the extent of inundation for the 1% AEP event, with modelled long sections of the Baileys Branch Drain contained in Appendix P. The total area within the site required for flood storage up to the 1% AEP event is approximately 3.98 ha of the total site area, with a total detention storage volume of approximately 27,172 m^3.

Modelling results for the 1% AEP event are summarised in Tables 12 and 13 in comparison to DoW (2009b) results. While the proposed stormwater management strategy changes results in minor increases in water levels in the 1% AEP event at all locations, all levels remain below the existing natural surface at these locations and these surface levels will rise post development (by up to 1.5m). It is also important to note that the revised modelling ultimate levels are below the levels detailed in Table 1 as modelled in DoW (2009b) for the existing system performance.

Note that storage shapes shown in Figures 9 to 11 are indicative only for determination of area requirements and representation of storage areas required in relation to POS areas allocated in the development concept plan. It is not the intent to construct a linear trapezoidal drain within this space, and it is intended the final form will represent a meandering living stream. The final flood attenuation area configuration, location, and elevations will be documented in future UWMPs and will be dependent on final earthworks, drainage, and road design levels for the development.

The developer is aware of the requirement for the Baileys Branch Drain to maintain an uninterrupted drainage function during the realignment process. To this end a preliminary strategy sketch for the upgrade of the drain has also been developed by project engineers JDSi and included in Appendix Q. Further refinement of this strategy will be reported during the UWMP process.

Refinements to catchment areas in this report are likely to occur as detailed design proceeds, and modelling will be updated accordingly during the UWMP process.

The minimum building floor levels will comply with DWER and City of Armadale requirements for a 0.5m clearance above estimated 1% AEP flood levels.

6.3 Serviceability (0.2 EY Event)

Modelled storage volumes, areas, flood rise and inverts are detailed in Table 11 and Figure 10 for the 0.2 EY flood event, showing the extent of inundation of POS area. The total area required for the 0.2 EY event is approximately 1.58 ha of the total site area with a total detention storage volume of approximately 8182 m^3.

6.4 Ecological Protection (1 EY Event, 15 mm)

Storm volumes for ecological protection based on the first 15 mm event are provided in Table 11 to provide a guide for storage requirements. Volumes will be refined at UWMP stage on the basis of more detailed modelling in parallel with engineering design, with final adopted batters and ultimate configurations to be determined in consultation with CoA.

The total estimated area required for management of the first 15mm of site runoff (excluding Baileys Branch Drain) is 0.33 ha (990 m^3 at 0.3m assumed depth). The Baileys Branch Drain 1 EY Area of Inundation is estimated as 0.70 ha (based on 8.0m channel inundation width) with a storage volume of 2320 m^3.

Note that Hyd2o's current estimate of what would be termed the base flow channel is based on the area which would be expected to be inundated every year (ie effectively a 1 EY inundation level) - which given the depth of the drain post development, allowable batter slopes, and acknowledging the significant influence of groundwater inundation in winter, is estimated at 8 m. If ultimately a lower groundwater level can be adopted within the drain for design purposes (for example due to blockages or lack of downstream maintenance) this will be a positive outcome for the development and likely reduce drainage land take and constraints within the POS corridor. As none of the early stages of development will include works on the drain, this issue is not considered a critical path issue for progressing structure planning approvals and will be assessed as the project progresses.

All biofiltration systems will be designed consistent with the Adoption Guidelines for Stormwater Biofiltration Systems (CRC for Water Sensitive Cities, 2015). Note that in some instances alternative technologies such as stormtech cells and amended soils may be used for treatment rather than surface based biofiltration systems, to maximum POS useability outcomes. The detailed design of treatment areas will be undertaken compliant with CoA requirement at UWMP stage, and designs of these areas provided in the relevant UWMP's for CoA approval.

Note that the sizing and depth presented in this LWMS is for 15mm storage has been performed without considering further distributed opportunities for infiltration and treatment at local scale (eg road reserves), and are therefore likely to be conservative. Further detailed modelling at UWMP stage will refine these requirements for use in engineering design.

Table 14 details a summary from the Stormwater Management Manual for Western Australia (DoW, 2007) of expected pollutant removal efficiencies for various WSUD measures in relation to water quality design criteria contained in WAPC (2008). While DoW (2007) does not provide expected pollutant removal efficiencies for all best management practices (BMPs), application of a treatment train approach using a combination of the non-structural and structural measures will therefore clearly achieve the design objectives for water quality for the site.

Table 11: Stormwater Management Sizing

Sub Catchments	1a	1b	1c	2a	2b	3a	3b	4
Residential (ha)	1.51	1.25	9.35	2.56	1.41	1.93	4.10	3.98
Road Reserve (ha)	0.79	0.61	4.61	1.62	0.66	1.43	2.24	1.75
POS (ha)	0.31	0.21	0.46	0.67	0.70	0.73	1.08	0.43
Non Res Opportunity (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.18	1.59
Total Area (ha)	2.61	2.07	14.43	4.85	2.77	4.09	7.60	7.74
1 EY (15mm) EIA (ha)	0.54	0.42	3.18	1.12	0.45	0.98	1.55	1.21
0.2 EY EIA (ha)	1.05	0.83	6.20	2.00	0.95	1.67	3.03	3.26
1% AEP EIA (ha)	1.37	1.08	7.97	2.57	1.28	2.15	3.94	4.22
1 EY Event (15mm) Biofiltration Areas for Local Stormwater								
AAMGL (m AHD)	23.5	23.4	22.3	22.2	22.6	22.6	22.4	23.2
Nominal Invert (mAHD)	23.8	23.7	22.6	22.5	22.9	22.9	22.7	23.2
Volume Runoff (m^3)	82	63	477	168	68	148	232	181
Storage Reqd (m^3) (considering infiltration/subsoil)	54	44	334	117	48	104	162	127
Top Water Level (mAHD)	24.1	24.0	22.9	22.7	23.2	23.2	23.0	23.5
Flood Rise (m)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
TWL Area (m^2)	180	147	1113	390	160	346	540	423
0.2 EY Event – All Catchments to Baileys Branch Drain (except Catchment 4) [1]								
Invert (mAHD)	21.19 at Anstey Rd 21.38 at u/s end of Living Stream Living Stream length : 870 m							23.50 (above bioretention)
Configuration	Refer Indicative Section, Appendix N							2,500 m^2 base area 1:6 side slopes
AAMGL (mAHD)	21.9 conservatively assumed in drain at Anstey Rd (at storm commencement) – actual of 21.6 mAHD TBC							23.2 (Calibre CGL @ 22.9)
Top Water Level (mAHD)	22.30 at Anstey Rd 22.36 at u/s end of Living Stream							23.80
Flood Rise (m)	1.11 at Anstey Rd 0.98 at u/s end of Living Stream							0.30
TWL Area (m^2)	10,440 (12m wide main channel)							2,880
Volume (m^3)	5,960							800 (above 1 yr)
Flow (m^3/s)	1.13 at Anstey Rd 1.74 at u/s end of Living Stream							0.019
Velocity (m/s)	0.15 at Anstey Rd 0.22 at u/s end of Living Stream							1.06
Critical Storm (hr)	6							24
1% AEP Event								
Top Water Level (mAHD)	22.89 at Anstey Rd 22.91at top of Living Stream							24.27
Flood Rise (m)	1.70 at Anstey Rd 1.53 at u/s end of Living Stream							0.77
TWL Area (m^2)	33,800 (variable 30-50 wide floodplain)							3,510
Volume (m^3)	23,470							2,280 (above 1 yr)
Flow (m^3/s)	0.94 at Anstey Rd 1.09 at u/s end of Living Stream							0.036
Velocity (m/s)	0.13 at Anstey Rd 0.18 at u/s end of Living Stream							1.98
Critical Storm (hr)	6							24

1. Bailey Branch Drain 1 EY Area of Inundation (21.9mAHD at Anstey Rd) estimated as 6960 m^2 (8.0m channel inundation width) with a storage volume of 2320 m^3

Table 12: Comparison to DoW(2009b) : Levels & Flows

Location	1% AEP HGL DoW(2009) mAHD	1% AEP HGL Calibrated Hyd2o XP-Storm Model mAHD	1% AEP HGL Proposed Strategy XP-Storm Model mAHD
Keane Rd Culvert Upstream Ultimate Development	22.70	22.73	22.79
Anstey Rd Culvert Upstream Ultimate Development	22.76	22.79	22.89
Armadale Rd Culvert Downstream Ultimate Development	22.77	22.79	22.94
Dumsday Compensating Basin Ultimate Development	24.16 (1.27m/s peak outflow)	23.95 (1.26 m3/s peak outflow)	24.19 (1.17 m3/s peak outflow)

Table 13: Comparison to DoW(2009b) : Baileys Catchments Volumes & Areas

	Area (m^2)		Volume (m^3)	
Event	**DoW(2009)**	**Proposed Strategy XP-Storm Mode**	**DoW(2009)**	**Proposed Strategy XP-Storm Mode**
1 EY	na	2876 : Local 6960 : Baileys	na	863 : Biofilter 2320 : Baileys
0.2 EY	na	2876 : Local 10440 : Baileys	na : Local 4550 : Baileys	863 : Biofilter 5960 : Baileys
10% AEP	na	na	8660 : Local 5150 : Baileys	na
1% AEP	12700: Local 28080: Baileys	2876 : Local 33800 : Baileys	10920: Local 12100 : Baileys	863 : Biofilter 23470 : Baileys

Note : "Local Drainage" specified in the table above for DoW (2009) refers to the combined storage for the Keane Road South Compensation Basin and Anstey Road Compensation Basin.
Catchment 4 excluded in above table to enable direct comparison of results.
na : modelling result not available

Table 14: BMP Water Quality Performance in Relation to Design Criteria

Water Quality Parameter	WAPC (2008) Design Criteria (required removal as compared to a development with no WSUD)	Structural Controls Nutrient Output Reduction [1]		
		Bioretention Systems	Vegetated Swales	Living Streams
Total Suspended Solids	80%	80%	60-80%	90%
Total Phosphorus	60%	60%	30-50%	50-100%
Total Nitrogen	45%	50%	25-40%	50-100%
Gross Pollutants	70%	-	>90%	-

1. Typical Performance Efficiencies via DoW (2007)

7. Groundwater Management Strategy

7.1 Fill and Subsoil Drainage

Groundwater management within the site will be undertaken consistent with the Department of Water publication Water Resource Considerations when Controlling Groundwater Levels in Urban Development (DoW, 2013a).

Development levels in the site will be largely dominated by fill requirements to achieve adequate separation to groundwater, given the proximity of groundwater levels to natural surface. Current available engineering earthworks drawings are included as Appendix Q.

Minimum separation between building floor levels for development and groundwater will be achieved by a combination of fill and subsoil drainage to provide protection against any post development groundwater rise. It is important to note development staging will be done over many years and ongoing post development groundwater monitoring will be undertaken and outcomes used will inform the engineering design of future stages as they develop.

All subsoil drainage is proposed to be located at a controlled groundwater level (CGL) set at the AAMGL. Lots will achieve an adequate clearance above the invert of the subsoil drains through the use of imported fill. Ongoing management of subsoil drainage will be required to ensure its ongoing performance in accordance with design.

All subsoil drainage will be free draining in accordance with DWER requirements and treated for water quality prior to discharge. The intent is that subsoil drainage will be treated within 1 EY bioretention areas whose locations are shown in Figure 9. Opportunities for insitu treatment of subsoil flow via use of special media around the subsoil will also being examined as an alternative to minimise fill. Subsoil drainage design will be undertaken at UWMP stage.

Finished lot levels and fill requirements are a detailed design issue to be addressed during the preparation of detailed engineering design drawings and preparation of the UWMP and will be ultimately submitted for council approval at that stage. Future POS levels will be also be established at this time compliant with CoA requirements for clearance to groundwater.

Groundwater/subsoil modelling will be performed at UWMP stage in accordance with the IPWEA (2016) Draft Specification on Separation Distances for Groundwater Controlled Urban Development. This guideline recommends the establishment of development levels on the basis of detailed modelling of subsoil drainage utilising a 30 year daily rainfall record obtained from DWER based on a future median rainfall scenario as outlined in Selection of Future Climate Projections for Western Australia (DoW, 2015).

IPWEA (2016) requires the provision of a minimum 0.3m of coarse sand in the rear of lots above the 50% AEP phreatic surface for residential lots of size 400-800m^2, and a 0.15m clearance for lots <400 m^2. This criteria will be used as the basis for establishing fill requirements for the site, in consultation with CoA.

This LWMS recognised that the CoA has previous experiences with poor infiltration of imported fill, and permeability rates suggested within water management documents

have not been met. As a result some recent developments in Forrestdale and Wungong have encountered groundwater management issues. As requested by CoA, on-site confirmation via testing of permeability rates will therefore be undertaken, with a minimum three tests per stage. Further specific details of this testing will be appropriately defined at UWMP stage.

With respect to POS areas, the separation from phreatic crest to finished surface level will be undertaken based on CoA requirements for clearance to groundwater in these areas.

7.2 Acid Sulphate Soils

As discussed in Section 4.3, a detailed soil and groundwater study is recommended to be undertaken in accordance with the Department of Environment Regulation guidelines to fully characterise the nature and extent of ASS across the site.

This will be conducted appropriately as a separate process to this LWMS.

All assessment and management of ASS will be conducted in accordance with the Acid Sulphate Soil Guideline Series Identification and Investigation of Acid Sulphate Soils (DoE, 2004).

8. Monitoring

8.1 Pre Development Monitoring

No need is anticipated need for additional predevelopment monitoring for the purpose of informing the UWMP and subdivision process.

If any further monitoring is required this will serve to inform engineering design rather than to satisfy government agency requirements.

8.2 Post Development Monitoring

Post development groundwater monitoring locations and parameters are detailed in Figure 12 and Table 15.

Department of Water (2012) indicates a minimum of 3 years post development monitoring is required, and defines post development as "*from completion of first subdivision to five years after 80 per cent of the development (by land area) has been completed*".

The program is therefore designed to operate over a three year post development period, with the timing for commencement of the program to be negotiated at UWMP stage with DWER and the City of Armadale with consideration of development staging.

The program may need to be modified as data is collected to increase or decrease the monitoring effort in a particular area, or to alter the scope of the program itself. Any modification to the program would be identified through review of the collected data and would require the agreement of all parties (DWER, City of Armadale, and developer).

All water quality testing will be conducted by a NATA approved laboratory.

Based on monitoring outcomes, a contingency action plan is shown in Table 16. Specific monitoring target values and contingency trigger values will be based on predevelopment monitoring data and defined as development proceeds based on staging and additional data collected prior to the commencement of development.

Table 15: Post Development Monitoring Program

Monitoring	Parameter	Location	Method	Frequency and Timing
Groundwater	Water Level (m AHD)	4 bore within the site + nearby DWER bores	Electrical depth probe or similar	Quarterly
	pH, EC, Nitrogen, Phosphorus	4 bores within the site	Pumped bore sample	Quarterly (Jan, Apr, Jul & Oct)
Surface water	pH, EC, TSS Nitrogen Phosphorus	2 location in Baileys Branch Drain (upstream & downstream)	Collected grab sample	Nominally 4 times per year when/if water present, typically June to October.

Table 16: Contingency Planning

Monitoring Type	Criteria for Assessment	Criteria Assessment Frequency	Contingency Action
			1. Assess if an isolated, development area or regional occurrence. 2. Determine if due to the development or other external factors. 3. Perform appropriate contingency action as required (examples provided below) 4. Record and report any breach and action taken. 5. If necessary, inform residents of any required works and their purpose. 6. Inform and provide monitoring data to DoW and CoA upon breach of any trigger value(s).
Surface Water and Groundwater Quality	**Water Quality** Water quality from the Study Area compared to : a) predevelopment surface water and groundwater quality monitoring results b) typical urban stormwater quality on the Swan Coastal Plain (Martens et al 2004) TN : 1.1 mg/l TP : 0.21 mg/l with reference to ANZECC guidelines [1]	annual review and reporting	1. Identify and remove any point sources of pollution. 2. Review operational and maintenance (eg fertilising) practices. 3. Consider alterations to POS areas including landscape regimes and soil amendment. 4. Consider modifications to the stormwater system. 5. Consider initiation of community based projects.

1. ANZECC guidelines to be used as a reference point only. ANZECC guidelines state that guidelines values are not intended to be directly applied to stormwater quality, however are applicable where the stormwater system are regarded as having conservation value. ANZECC guideline values are derived for unmodified or slightly modified ecosystems. ANZECC recommends the values only be applied where site specific values do not exist, or site specific targets cannot be derived.

9. Urban Water Management Plans

Consistent with processes defined in WAPC (2008), an Urban Water Management Plan (UWMP) will be developed and submitted to support subdivision applications for various stages of development within the site. UWMPs will address:

- Demonstrated compliance with LWMS criteria and objectives to the satisfaction of CoA and DWER.
- Agreed/approved measures to achieve water conservation and efficiencies of water use.
- Detailed stormwater management design including refining stormwater modelling detailed in the LWMS.
- Specific structural and non-structural BMPs and treatment trains to be implemented including their function, location, maintenance requirements, expected performance and agreed on going management arrangements.
- Management of groundwater levels including proposed fill levels.
- Management of subdivision works including development of a strategy for sediment control during construction, and insitu permeability testing.
- Implementation plan including roles, responsibilities, funding and maintenance arrangements.
- Specific monitoring and reporting to be undertaken post development.
- Contingency plans (where necessary).

More detail of the POS and stormwater storage integration will be provided during the development of the UWMP, including refinement of stormwater modelling, preparation of landscape plans (species selection and treatments), and detailed design drawings.

Preparation of the UWMP will be the responsibility of the developer.

10. Implementation

Table 17 details the roles, responsibilities and funding to implement the LWMS for this site. This LWMS will be implemented by the developer, CoA, and DWER based on the roles, responsibilities and funding as detailed in Table 17. Any modification required to the LWMS would be identified through the UWMP process and require the agreement of all parties.

Monitoring outcomes will be used in a continual improvement capacity to review the implemented WSUD within the site with outcomes used to inform future planning and design approaches for subsequent developments in the area.

Specific maintenance responsibilities will be detailed at UWMP stage. It is envisaged that the schedule for maintenance works will be consistent with typical requirements of CoA, and include the need for ongoing management of subsoil drainage to ensure its ongoing performance in accordance with design.

With respect to construction, the contractor will be responsible for preparing and implementing appropriate best management practices during construction. Construction management will be undertaken consistent with the Local Government Guidelines for Subdivision Development (Institute of Public Works Engineering Australia 2011).

These actions will be further refined, where appropriate, at UWMP stage.

With respect to the Baileys Branch Drain, negotiations between the CoA and Water Corporation with regard to a maintenance agreement are ongoing. A transition process framework has been established (identifying processes, sequencing and responsibilities) and the developer has provided associated documentation to the Water Corporation to assist in the resolution of land matters for the drains reconfiguration (Appendix K).

Both Water Corporation and CoA will need to share responsibility for maintaining the multiple use corridor and a maintenance agreement will need to be established between the agencies for this purpose, similar to other transitioning drains in the Forrestdale area.

Table 17: Implementation Responsibilities

	Responsibility & Funding			
Implementation Action	**Developer**	**CoA**	**DWER**	**W Corp**
Finalise maintenance agreement	☑	☑		☑
Urban Water Management Plans				
Preparation of a UWMP for individual development stages	☑			
Review & approval of UWMPs		☑	☑	
Stormwater System				
Construction within the site	☑			
Post development monitoring program	☑			
Operation & Maintenance				
a) Prior to Handover	☑			
b) Following Handover		☑		☑

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FIGURES

Date:1/10/2018 Job No. H17064



Site

hyd2o

Anstey Rd East: Local Water Management Strategy

Location Plan

Figure 1

Date: 1/11/2018 Job No H17064



Source : CLE Town Planning + Design (2018)

hyd$_2$o

Anstey Road East : Local Water Management Strategy

Development Concept Plan

Figure 2

Date: 1/10/2018 Job No. H17064Av1



Site

Topography (mAHD)

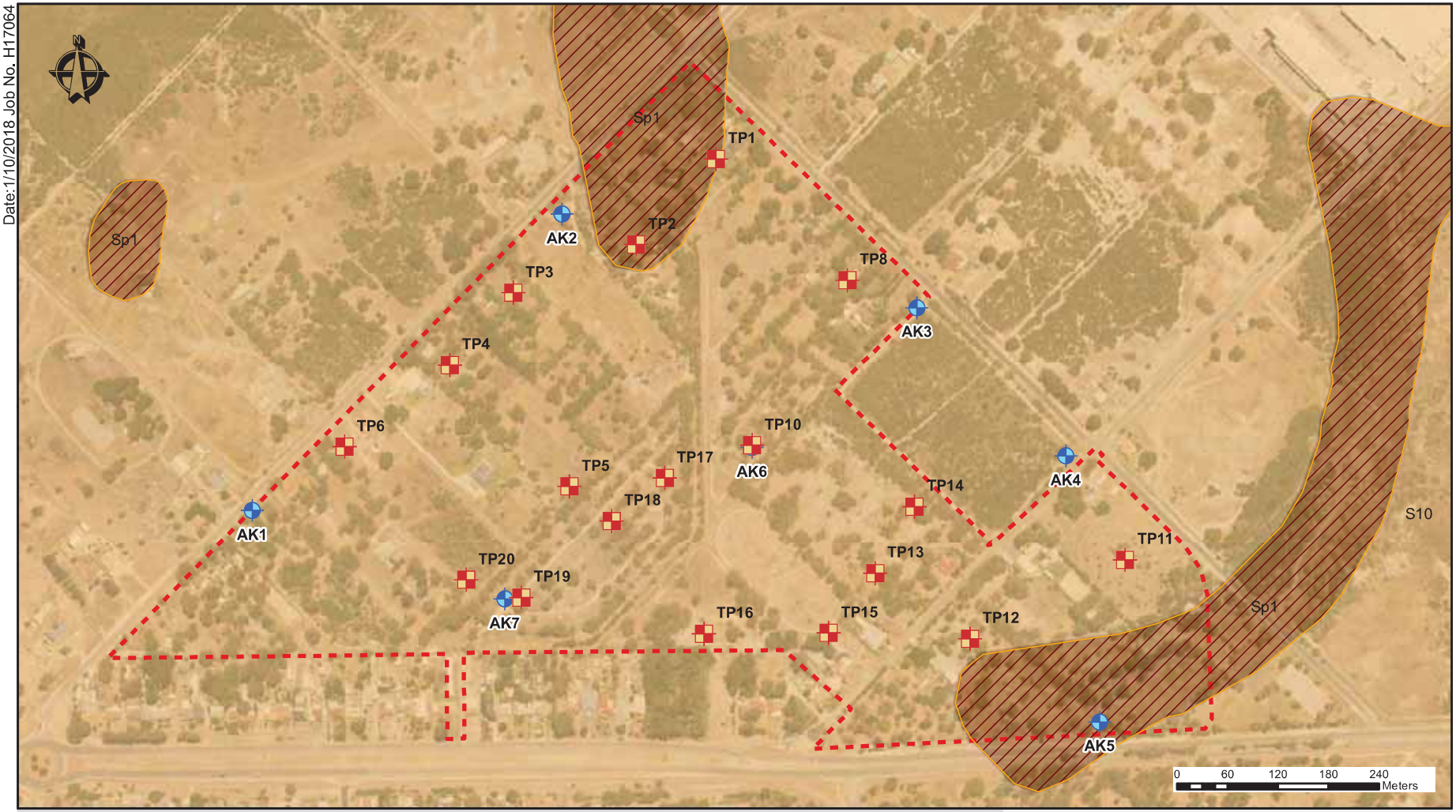
hyd2o

Anstey Rd East: Local Water Management Strategy

Site Conditions Plan

Figure 3

Date:1/10/2018 Job No. H17064



Site

Environmental Geology

S10-Sand

Sp1-Peaty Sand

High to moderate risk of ASS

Test Pits (JDSI, 2018)

Groundwater Bores

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Anstey Rd East: Local Water Management Strategy

Geotechnical Plan

Figure 4

Date: 1/10/2018 Job No. H17064



Site

Baileys Branch Drain

Wetlands

Conservation

Multiple Use

Resource Enhancement

hyd2o

Anstey Rd East: Local Water Management Strategy

Wetlands Plan

Figure 5

Date: 1/10/2018 Job No. H17064



Site

Baileys Branch Drain

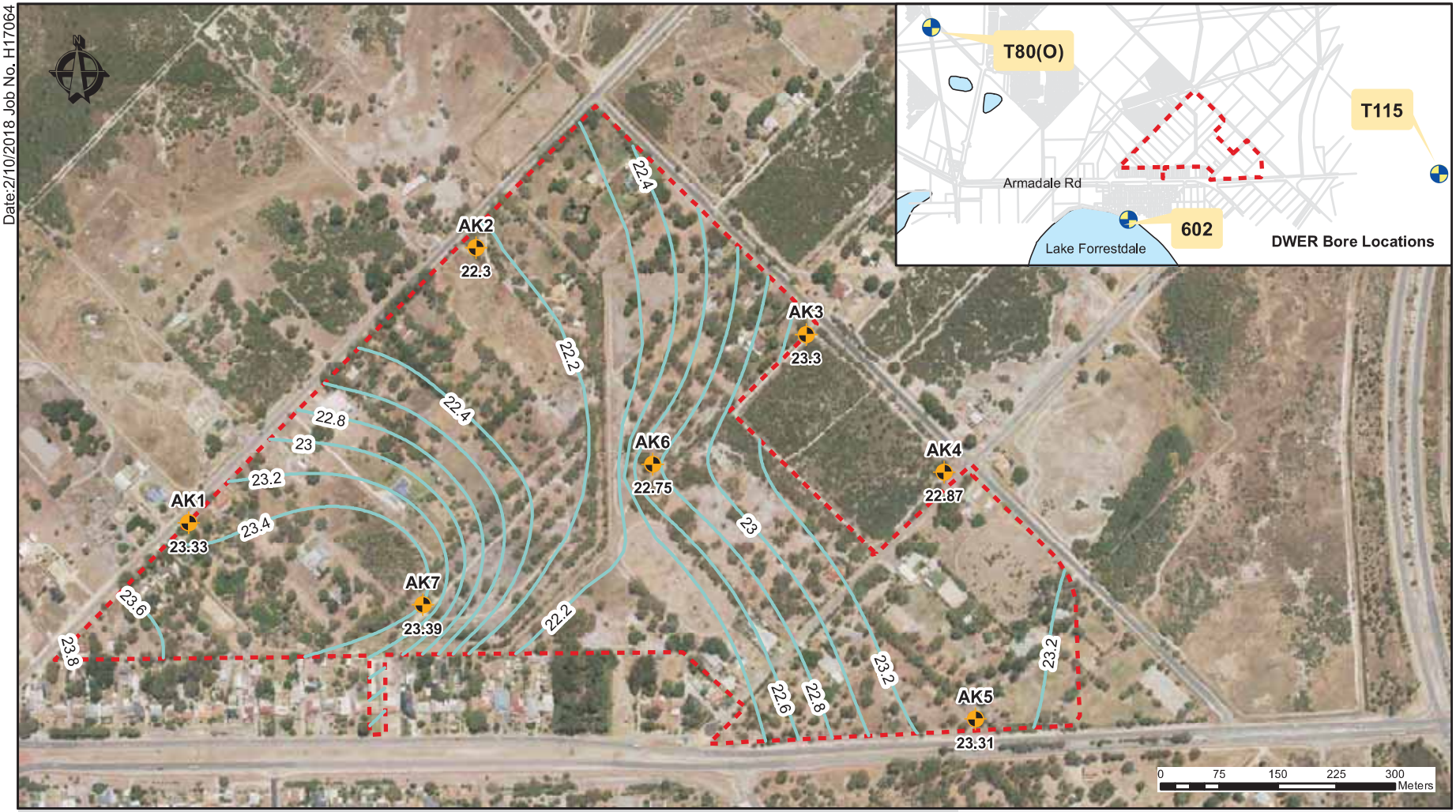
hyd2o

Anstey Rd East: Local Water Management Strategy

Surface Water Plan

Figure 6

Date:2/10/2018 Job No. H17064



Site

Groundwater Monitoring Bores (AAMGL, mAHD)

DWER Groundwater Monitoring Bore

hyd2o

Anstey Rd East: Local Water Management Strategy

Groundwater Plan

Figure 7

Date: 1/11/2018 Job No. H17064



AnsteyRd
Lots
Opportunity for Non Residential
POS
Roads
School
Post Development Catchments
Realigned Baileys Branch Drain as a Living Stream

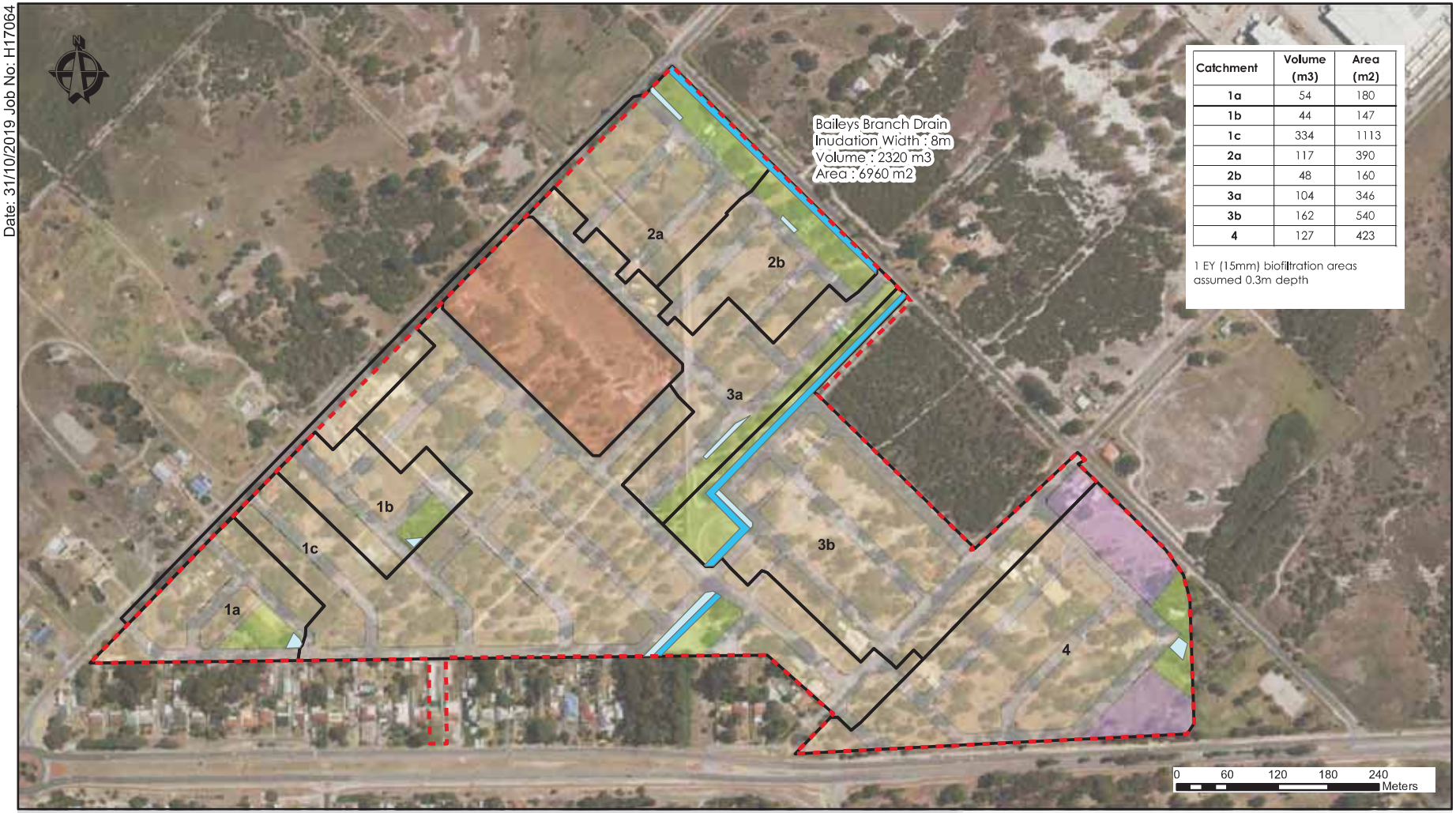
hyd2o

Anstey Rd East: Local Water Management Strategy

Stormwater Concept Plan and Catchments

Figure 8

Date: 31/10/2019 Job No: H17064



Catchment	Volume (m3)	Area (m2)
1a	54	180
1b	44	147
1c	334	1113
2a	117	390
2b	48	160
3a	104	346
3b	162	540
4	127	423

1 EY (15mm) biofiltration areas assumed 0.3m depth

Site
Post Dev Catchments
15mm Local Storage
Living Stream (1 EY)
AnsteyRd
Lots
School
POS
Roads
Opportunity for Non-residential

hyd2o

Anstey Rd East: Local Water Management Strategy

Stormwater Management Plan: 15mm

Figure 9

Date: 03/07/2019 Job No. H17064



AnsteyRd
Lots
Opportunity for Non Residential
POS
Roads
School
Post Development Catchments
0.2 EY Inundation Area

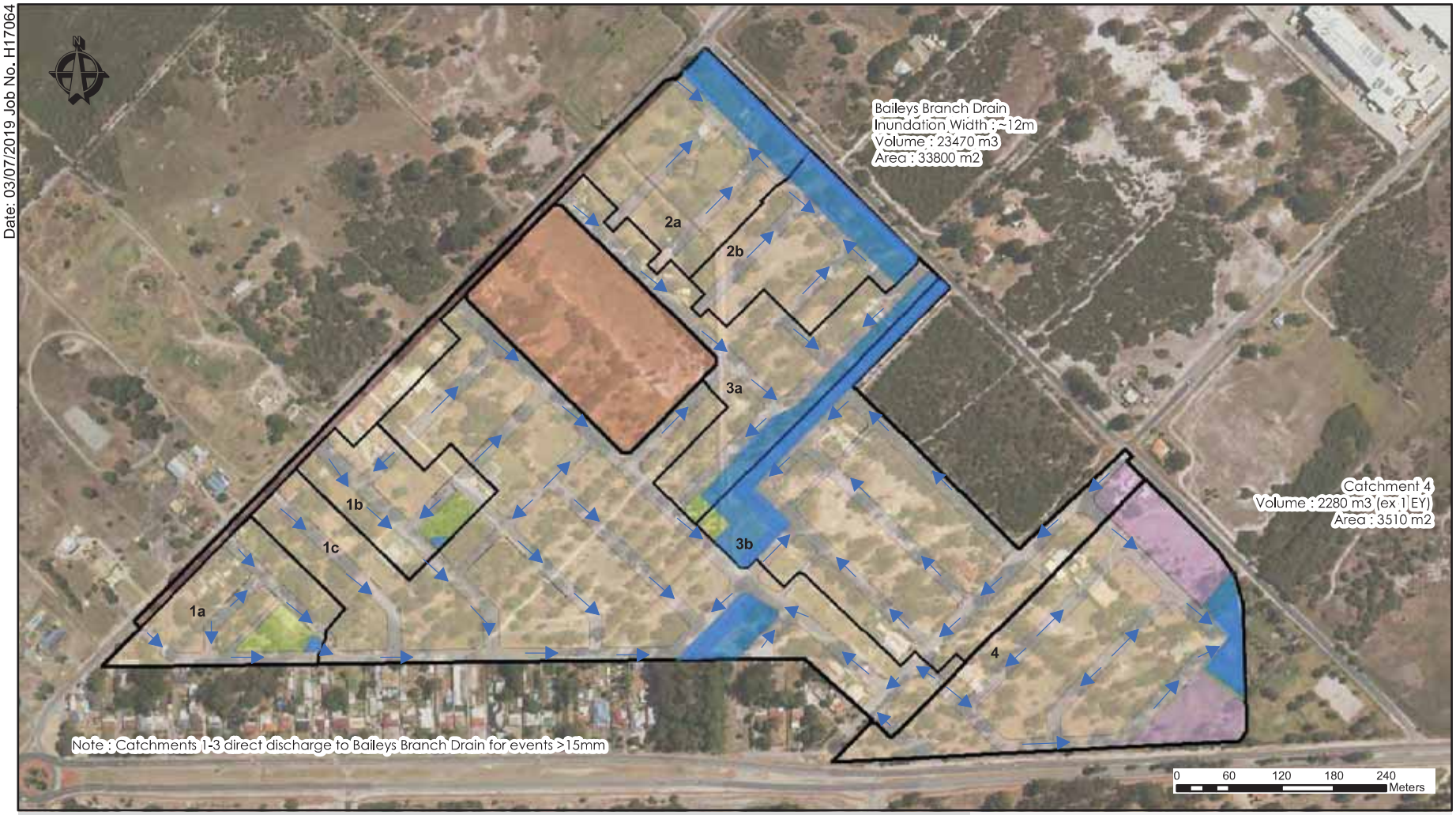
hyd2o

Anstey Rd East: Local Water Management Strategy

Stormwater Management Plan: 0.2 EY

Figure 10

Date: 03/07/2019 Job No. H17064



AnsteyRd
Lots
Opportunity for Non Residential
POS
Roads
School
Post Development Catchments
1% AEP Inundation Area

hyd2o

Anstey Rd East: Local Water Management Strategy

Stormwater Management Plan: 1% AEP

Figure 11

Date: 2/10/2018 Job No. H17064



Site
Groundwater Site
Surface Water Site

AnsteyRd
Lots
Roads
POS

Non Residential Opportunity
School
Post Development Catchments

hyd2o

Anstey Rd East: Local Water Management Strategy

Post-Development Monitoring Sites

Figure 12

Appendix C: Vision Plan (Apex Planning 2022)



Vision Plan (Amendment 1 – Anstey-Keane Urban Development Precinct East Structure Plan)	NORTH	**Drawn:** Alessandro Stagno **Rev:** 0
Lot 500 (16) Anstey Road, Forrestdale		**Source:** MNG Access **Date:** 7 November 2022 apex planning

APPENDIX 4

REVISED TRAFFIC IMPACT ASSESSMENT

transcore
20 years anniversary

transport planning
traffic engineering
modelling

Proposed LSP Amendment

Lot 500 (16) Anstey Road, Forrestdale

Transport Impact Assessment

PREPARED FOR:
Cedarville Pty Ltd

December 2022

Document history and status

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Author: Roger Bajwa

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Client: Cedarville Pty Ltd

Project: Lot 500 (16) Anstey Road, Forrestdale

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Project number: t22.217

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1 Introduction

This Transport Impact Assessment has been prepared by Transcore on behalf of Cedarville Pty Ltd with regard to a proposed amendment to the Anstey Keane Urban Development Precinct - East Structure Plan (LSP) for land at Anstey Road, Forrestdale in the City of Armadale.

As part of the proposed amendment to the Anstey-Keane East Precinct LSP, the zoning of Lot 500 (16) Anstey Road, Forrestdale is proposed to be changed from Residential (R25) to Local Centre (commercial).

The subject site is located on the southeastern side of Anstey Road in Forrestdale. It is occupied by Anstey Road to the northwest, and existing residential developments to the northeast as well as to the south as shown in **Figure 1**.



Figure 1: Site location

Transcore prepared a Transport Impact Assessment for Anstey-Keane East Precinct LSP in July 2020.

It should also be noted that in separate development applications a service station with fast food outlets has been approved and a childcare facility has been proposed in the vicinity of the proposed local centre. However, these developments have not

been constructed yet. The service station with fast food outlets is located to the southwest of the proposed local centre and the childcare centre is located to the northeast of the proposed local centre as shown in **Figure 2**.



Figure 2: Location of the subject site, proposed childcare centre and approved service station and fast-food outlets

This Transport Impact Assessment report focuses on the impact of the proposed Amendment rather than revising the assessment of the whole Anstey Keane Urban Development Precinct - East Structure Plan. Accordingly, this report should be read in conjunction with the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP.

2 Proposed Amendment To Local Structure Plan

Transcore prepared a Transport Impact Assessment for Anstey-Keane East Precinct LSP in July 2020. In that previous TIA report, the Anstey-Keane East Precinct area was proposed to be subdivided for residential development, a primary school site and potential non-residential development sites along the western side of Keane Road opposite Forrestdale Business Park West. It was anticipated to yield approximately 650-670 residential lots and two group housing sites. A total dwelling yield of approximately 675-695 dwellings was assumed.

The draft concept plan for the previous LSP is shown in **Figure 5**. For further details please refer to the TIA prepared by Transcore for Anstey-Keane East Precinct.

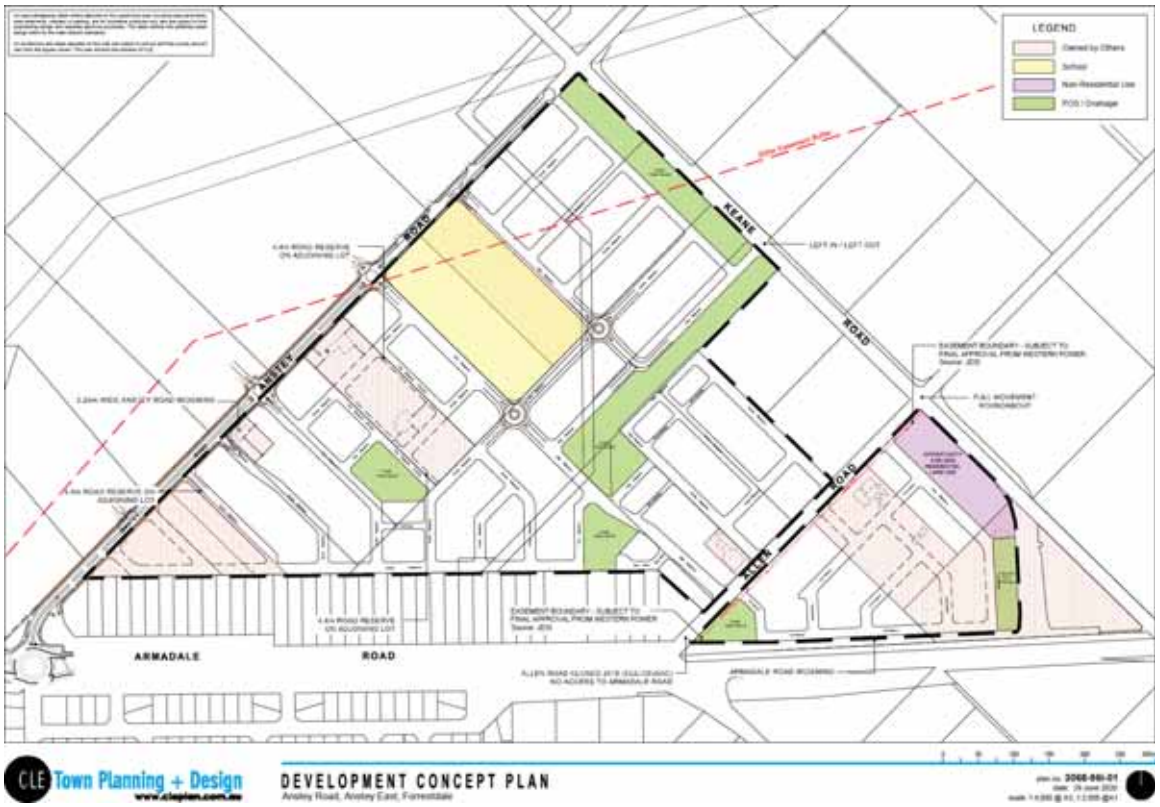


Figure 3: Concept plan for previous LSP

As part of the proposed amendment to the Anstey Keane Urban Development Precinct - East Structure Plan, the zoning of Lot 500 (16) Anstey Road, Forrestdale is proposed to be changed from Residential (R25) to Local Centre (commercial) as shown in **Appendix A**. The area of the lot is 8,797m^2 and considering an average lot area of 300m^2 for a residential dwelling, it was anticipated to yield 29 residential dwellings. These dwellings are proposed to be replaced by a local centre with a floor area of 2,000m^2 including 1,500m^2 for retail shops and an additional 500m^2 for non-retail.

3 Existing Situation

3.1 Existing Land Use

The subject site is currently a rural-residential property with one house, as shown in **Figure 4**.



Figure 4: Existing land use

In the City of Armadale Local Planning Scheme No 4, the site is currently zoned as 'Urban Development' as shown in **Figure 5**. As shown in **Appendix B,** the site is currently indicated as Residential (R25) in the structure plan.



Figure 5: Existing zoning

3.2 Existing Road Network

Armadale Road is a Primary Distributor road under the care and control of Main Roads WA and is covered by a Primary Regional Roads reservation in the Metropolitan Region Scheme (MRS), as shown in **Figure 5**. It is currently constructed as a dual carriageway 2-lane divided rural road (two 3.5m traffic lanes and approximately 1.2m of the shoulder sealed on each side of the road) in the vicinity of the subject site. An 80km/h speed limit applies on Armadale Road in this area. Existing weekday traffic volumes on Armadale Road (east of Nicholson Road) were around 19,400 vehicles per day (vpd) in 2017/18 with heavy vehicles forming 11.3% of this traffic. At the eastern end of the LSP area, Armadale Road (east of Forrest Road) carried around 29,700vpd in 2021/2022 with heavy vehicles forming 9.3% of this traffic.

The proportion of average weekday traffic (AWT) flows that occur during morning and afternoon peak hours on Armadale Road is illustrated in **Table 1** based on the information obtained from the Main Roads WA website.

Table 1: Existing Peak Period Traffic Flows

Road	Date	7-8AM	8-9AM	3-4PM	4-5PM	5-6PM	AWT
Armadale Rd (E of Nicholson Rd)	2017/18	1455	1366	1424	1499	1366	19,377
		7.5%	7.0%	7.3%	7.7%	7.0%	
Armadale Rd (W of Forrest Rd)	2017/18	950	949	1048	1082	961	13,185
		7.2%	7.2%	7.9%	8.2%	7.3%	
Armadale Rd (E of Forrest Rd)	2017/18	1351	1363	1405	1451	1298	18,747
		7.2%	7.3%	7.5%	7.7%	6.9%	
Armadale Rd (W of Forrest Rd)	2021/22	1928	1959	2085	2078	1837	23,901
		8.1%	8.2%	8.7%	8.7%	7.7%	
Armadale Rd (E of Forrest Rd)	2021/22	2411	2577	2644	2496	2120	29,733
		8.1%	8.7%	8.9%	8.4%	7.1%	

Anstey Road is currently classified as a *District Distributor B* in the Main Roads WA functional road hierarchy, providing local access within this area. It is constructed as a single-carriageway, two-lane rural road. Anstey Road currently links through from Armadale Road to Ranford Road. It has a posted speed limit of 60km/h from Armadale Road to Keane Road (adjacent to this site) and 80km/h from Keane Road to Ranford Road. Anstey Road carried 1,708vpd north of Armadale Road in 2017/18 with 13.1% of this traffic being heavy vehicles.

The Armadale Rd / Anstey Rd / Weld St intersection is constructed as a 4-arm roundabout accommodating two through lanes in each direction on Armadale Road.

3.3 Public Transport

Bus Route No. 519 runs on Armadale Rd and Nicholson Rd from Murdoch Train Station to Armadale Train Station, as shown in **Figure 6**.

This route provides an hourly service Monday to Friday with more frequent service (4 per hour) in the AM and PM peak periods. There is currently no service on weekends or public holidays.

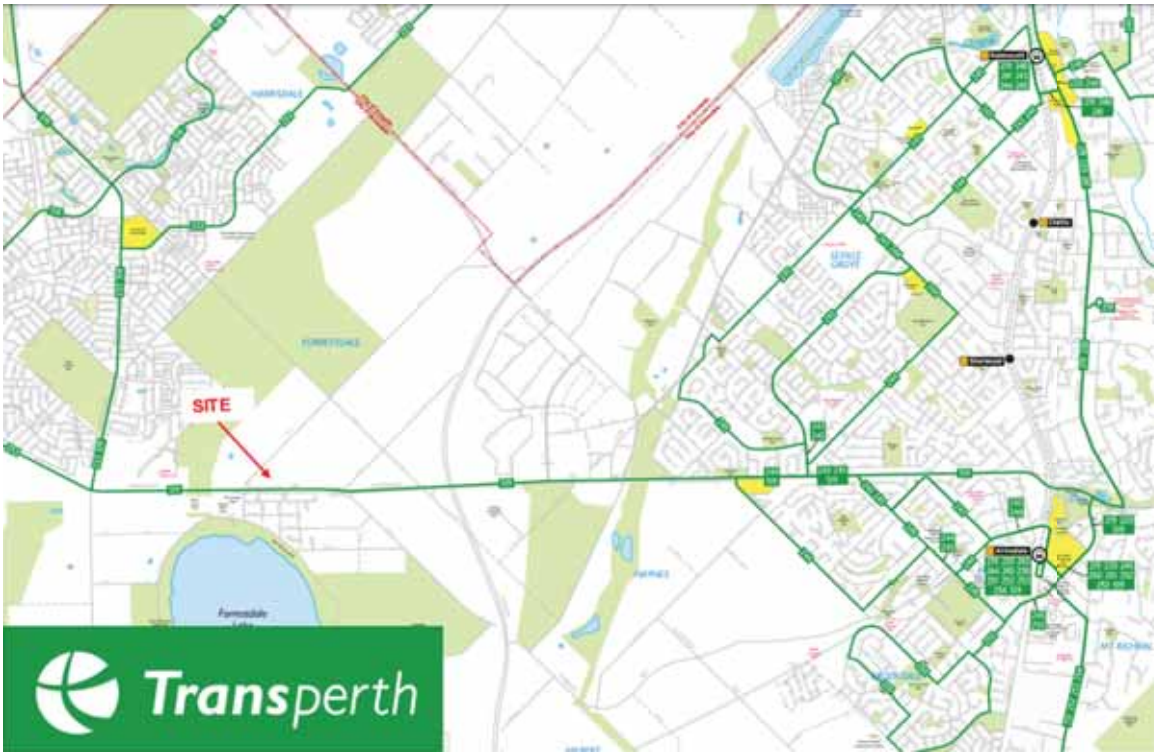


Figure 6: Existing bus routes

3.4 Pedestrian and Cyclist Facilities

There is a 1.5m wide footpath on the southern side of Armadale Road from Nicholson Road to Weld Street. East of Weld Street there is a 3m shared path instead.

The Department of Transport's Perth Bike Map series (see **Figure 7**) shows that Anstey Road, Allen Road and Keane Road are considered good road riding environments.

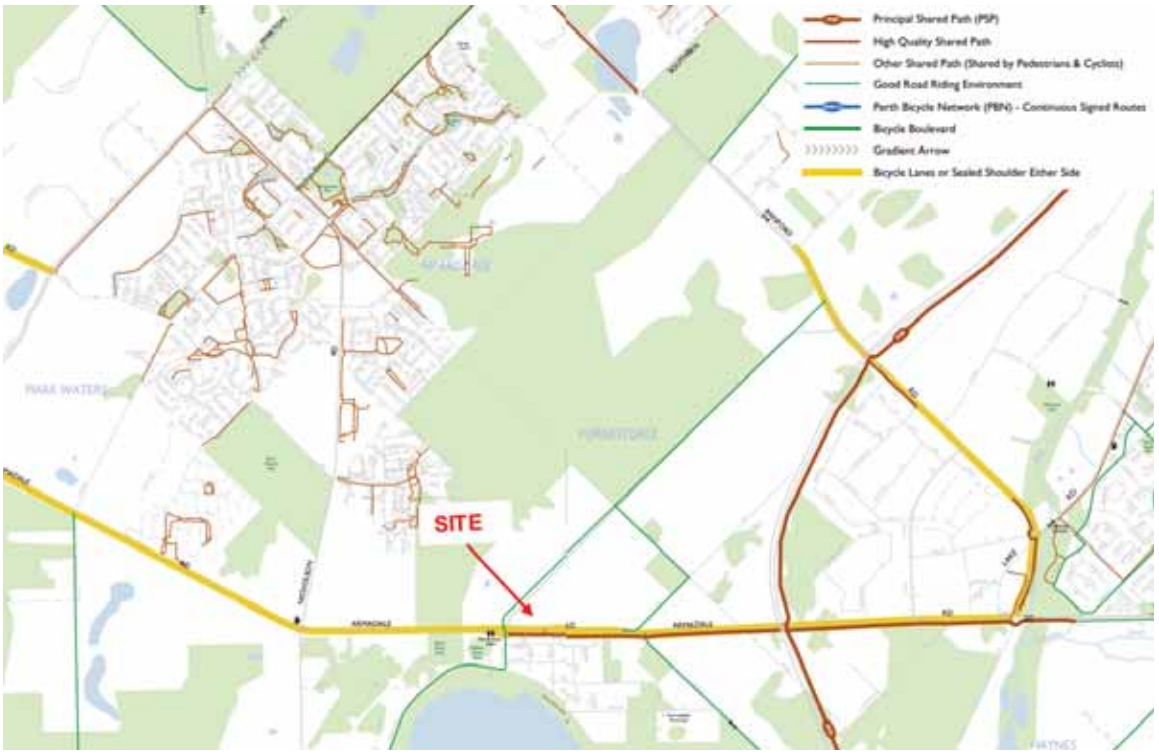


Figure 7: Bike map

3.5 Changes to Surrounding Road Network

Refer to the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP. The main change to the existing road network that is relevant to the subject site is the treatment of Anstey Road as already planned in the Anstey Keane Urban Development Precinct - East Structure Plan, is that Anstey Road will be closed off on the southwest side of Keane Road to avoid industrial traffic travelling through this the Anstey Keane Urban Development Precinct.

3.6 Public Transport Network Planning

The Department of Transport plan, *Public Transport for Perth in 2031*, envisages a future bus rapid transit route from Armadale to Cockburn Central providing a cross-suburban link between the Mandurah and Armadale railway lines. However, this is part of the ultimate network for a city of 3.5 million people and is indicated as beyond 2031.

4 Proposed Transport Network

4.1 Road Hierarchy

The proposed hierarchy of roads in and around the LSP area is illustrated in **Figure 8** using the road hierarchy defined in the Western Australian Planning Commission *Liveable Neighbourhoods* (LN) policy.

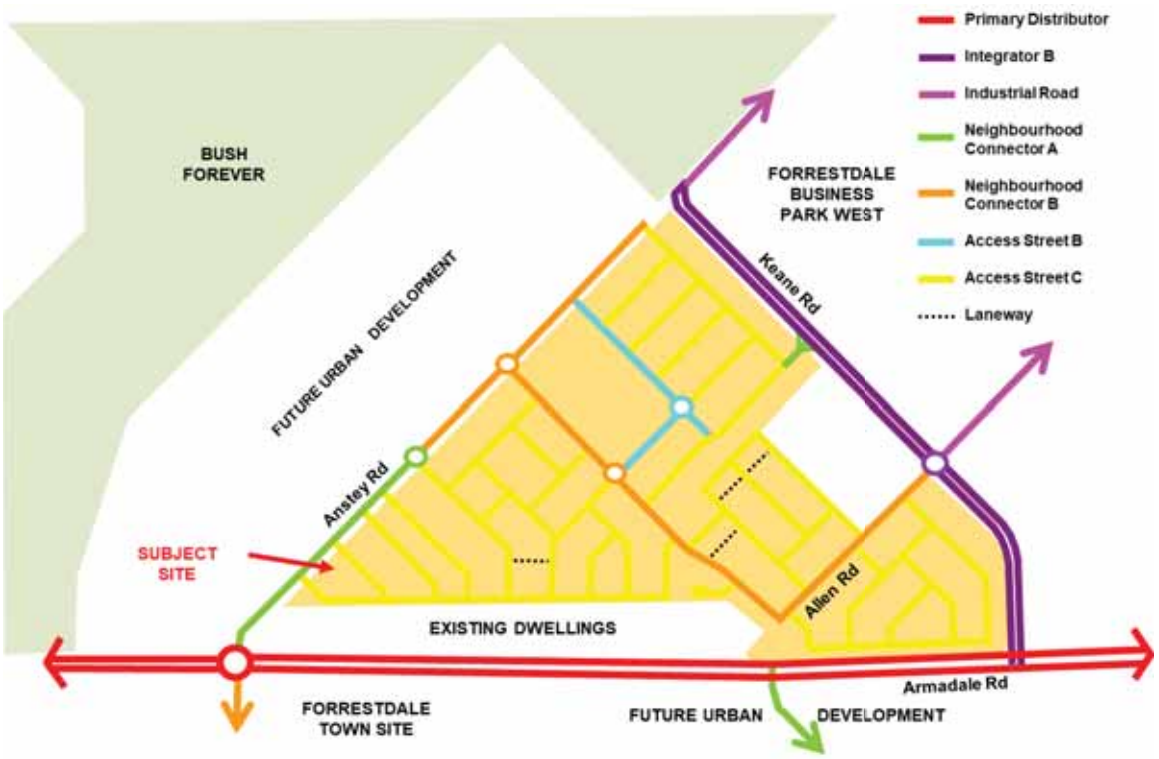


Figure 8: Road hierarchy

Some key characteristics of the relevant road classifications for neighbourhood connectors and access streets have been summarised in **Table 2** below. These are generally based on Liveable Neighbourhoods guidelines although the proposed widths do vary slightly from the standard Liveable Neighbourhoods cross-section diagrams.

Table 2: Road hierarchy

Road Classification	Indicative upper volume	Indicative road reserve width	Indicative road pavement width
Neighbourhood Connector A	7,000 vpd	24.4m	2 x 5m (incl. cycle lanes), 2m median & embayed parking
Neighbourhood Connector B	3,000 vpd	19.4m to 20m (18m min)	7m (plus embayed parking)
Access Street A	3,000 vpd	24m typical	2 x 3.5m, 6m median & embayed parking
Access Street B	3,000 vpd	18m typical	6m (plus embayed parking)
Access Street C	3,000 vpd	15.4m to 16m	7.2m
Access Street D	1,000 vpd	14.2m to 15m	6m
Laneway	300 vpd	6m typical	6m

4.1.1 Neighbourhood Connector Roads

The Anstey Keane Urban Development Precinct - East Structure Plan plans for Anstey Road to be closed off on the southwest side of Keane Road to avoid industrial traffic travelling through this Anstey Keane Urban Development Precinct.

The future traffic flows in **Section 6.3** of this report indicate that about half the length of Anstey Road north of Armadale Road would be likely to carry more than 3,000vpd, so it would be appropriate for that section to be constructed to Neighbourhood Connector A road standard. Current planning for that section of Anstey Road (as agreed with the City of Armadale) is based on a 24.6m Neighbourhood Connector road reserve width including a 3.6m median.

The future neighbourhood connector from Anstey Road to Allen Road and the section of Allen Road through to Keane Road would carry traffic volumes of less than 3,000vpd, so it would be appropriate for the rest of Anstey Rd and the neighbourhood connector route including Allen Road to Keane Road) to be constructed to a Neighbourhood Connector B road standard, as indicated in **Figure 8**. Therefore the section of Anstey Road adjacent to the northern half of the LSP area can be designed as a Neighbourhood Connector B within the existing 20.1m road reserve. The same applies to Allen Road within the LSP area.

4.1.2 Access Streets

The basic access street width required by the City of Armadale is the 15.4m Access Street C of *Liveable Neighbourhoods.* This standard is able to accommodate traffic volumes of up to 3,000vpd.

Two roads within the LSP area adjacent to the primary school site are proposed to have 18m widths and will include embayed parking for the primary school. The road servicing the Industrial Business zone is also proposed to have an 18m width. They are indicated as Access Street B in **Figure 8**.

4.1.3 Laneways

In Liveable Neighbourhoods, the standard road reserve width of laneways is 6.0 metres. These would typically be designed with flush kerbing (i.e. at the same level as the laneway pavement) and central drainage, and can accommodate two-way vehicle movement and rubbish collection. Visitor car parking is typically constructed in the road reserve adjacent to proposed lots serviced by laneways at a typical rate of one bay per every two dwellings.

However, for laneways that provide the only public road frontage for lots abutting public open space in the proposed concept plan a 9.0m wide road reserve is proposed for these laneways to accommodate services as well. This width is able to accommodate a 6m carriageway and parking on one side, where required. The only laneway of this type in the proposed concept plan is the southwestern one shown in **Figure 8**.

4.2 Public Transport

The existing bus service along Armadale Road adjacent to the site is noted in **Section 3.3** and long-term potential upgrade of bus services along Armadale Road is noted in **Section 3.6**.

Previous advice from the Public Transport Authority (PTA) indicates any potential bus service through Forrestdale Business Park West would be in the longer term and would be related to the level of development of the surrounding areas. A likely alignment for a potential bus service would be along Ranford Road, to provide a strategic connection to Armadale. Anstey Road and Keane Road are also possibilities due to connections to adjacent areas, although a Ranford Road service would likely be of a higher priority.

The potential future link road east of Anstey Road to Allen Road to connect to Keane Road (shown in orange in **Figure 8** as a Neighbourhood Connector B road) would provide a suitable route for future bus service through this area if and when the PTA decides to provide a bus service through this area.

4.3 Pedestrian and Cyclist Facilities

The proposed pedestrian and cyclist network within and adjacent to the LSP area is outlined in **Figure 9**.

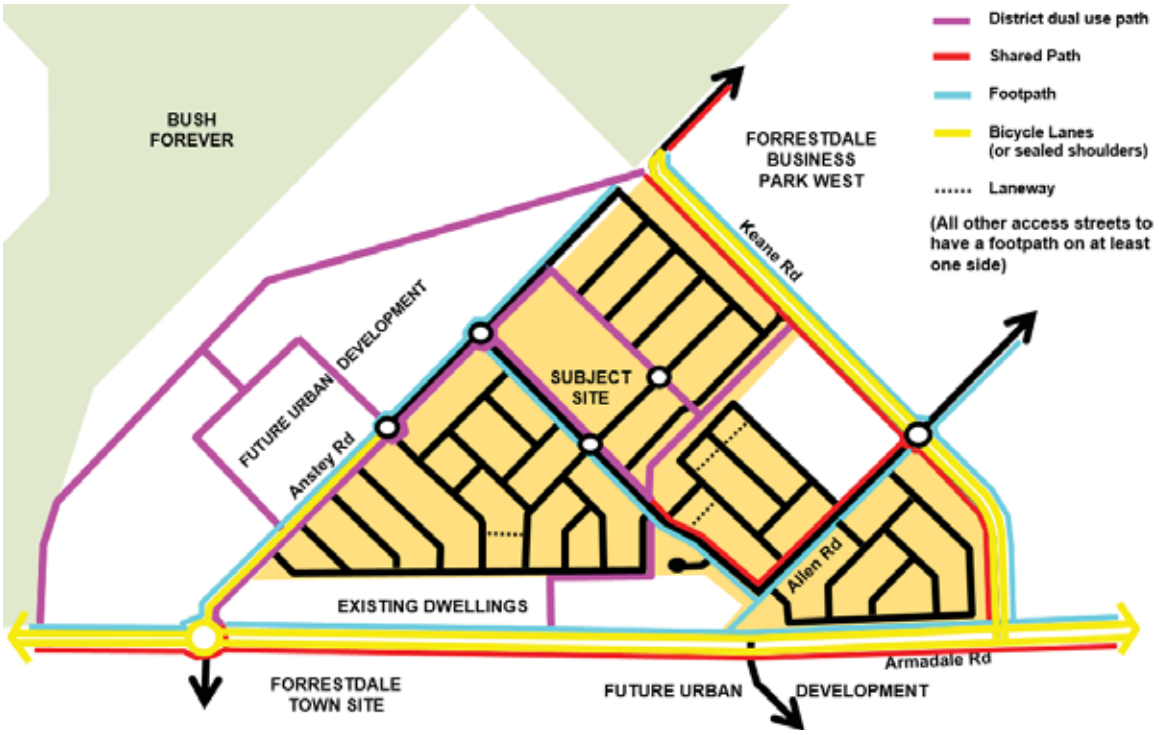


Figure 9: Pedestrian and cyclist facilities

In accordance with Liveable Neighbourhoods guidelines paths will be provided on at least one side of all roads. There would be paths on both sides on all Neighbourhood Connector roads, including a shared path at least 2m wide on one side of Anstey Road, Allen Road and the proposed neighbourhood connector road link between them.

A network of district dual use paths has been identified as part of the development contribution plan for this precinct and those paths are also shown on **Figure 9**.

On-street cycle lanes are normally included only on Neighbourhood Connector A roads and above, as indicated in the details of the road hierarchy listed in **Table 1**. This principle is reflected in **Figure 9**.

Note that the paths shown in **Figure 9** have not changed from what was shown in the 2020 TIA report. Exact details of internal road and path networks within the future local centre are currently unknown but it is assumed that the path network connectivity through the subject site to Anstey Road would be maintained through this future local centre site.

5 Integration with Surrounding Area

Refer to the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP.

The proposed amendment to rezone the subject site for a local centre does not have any significant impact on the surrounding areas.

6 Analysis of the Transport Network

6.1 Assessment Period

The traffic assessment previously undertaken for the Anstey Keane Urban Development Precinct - East Structure Plan nominally indicated an assessment year of 2031 but actually reflects the full development of this precinct and surrounding areas. The actual timeframe for the full development of this precinct and surrounding areas is currently not known but it is anticipated to be at least 10 years into the future.

6.2 Traffic generation

Transcore prepared the Transport Impact Assessment for Anstey-Keane East Precinct LSP in July 2020. In that previous TIA report, the LSP area was proposed to be subdivided for residential development, a primary school site and potential non-residential development sites along the western side of Keane Road opposite Forrestdale Business Park West. It was anticipated to yield approximately 650-670 residential lots and two group housing sites. A total dwelling yield of approximately 675-695 dwellings was assumed.

Some of this traffic was expected to remain internal within the site with trips between the local facilities, primary school and residential areas.

As part of the proposed amendment to the Anstey Keane Urban Development Precinct - East Structure Plan, the zoning of Lot 500 (16) Anstey Road, Forrestdale is proposed to be changed from Residential (R25) to Local Centre (commercial). The area of the lot is 8,797m^2 and considering an average lot area of 300m^2 for a residential dwelling, the residential yield of this site is estimated as 29 residential dwellings.

The daily traffic generation rate used in the subject site for this transport report is 10 vehicle trips per day (vpd) per dwelling, which is consistent with the traffic generation of the previous report and as generally required by the City of Armadale for structure planning in this area.

The anticipated 29 residential lots of the Amendment area were therefore estimated to generate approximately 290vpd. Since these residential lots will now be replaced by the local centre the traffic generation for these residential lots is replaced by the traffic generation for the local centre.

Traffic generation from nearby areas that are also anticipated to be subdivided in future has also been included in the traffic modelling undertaken for this transport report.

The distribution of these trips in the previous LSP report was determined by the traffic model in proportion to the location of trip productions and attractors for work trips,

education trips and other trips (shopping, social, recreational, etc.) among all the land uses in the traffic model. The distribution of trips to and from the LSP area is summarised in **Table 3**.

Table 3: External trip distribution in the previous LSP report

Approach Road	Percentage of Trips
Armadale Road (west)	42%
Armadale Road (east)	24%
Anstey Road (northeast)	12%
Allen Road (northeast)	18%
Weld Street (south)	2%
Forrest Road (south)	2%
Total	**100%**

Transcore prepared a Transport Impact Assessment for the nearby service station and fast food outlets development in February 2021. The distribution of trips to and from the service station is summarised in **Table 4**. For further information please refer to the TIA prepared by Trasncore.

Table 4: Trip distribution for service station

Approach Road	Percentage of Trips
Armadale Road (west)	25%
Armadale Road (east)	25%
Anstey Road (northeast)	30%
Weld Street (south)	20%
Total	**100%**

Transcore prepared a Transport Impact Statement for the nearby childcare centre on Anstey Road in June 2021. It is assumed that the traffic generated by the childcare centre will consist of all local traffic from the Anstey Keane Urban Development Precinct. The distribution of trips to and from the childcare centre is summarised in **Table 5**. For further information please refer to the TIS prepared by Trasncore.

Table 5: Trip distribution for the childcare centre

Approach Road/Area	Percentage of Trips
Anstey Keane Urban Development Precinct	100%
Total	**100%**

The traffic volumes likely to be generated by the proposed local centre (commercial) were estimated in accordance with the *ITE Trip Generation Manual (11th Edition)*.

The trip rates which were used to estimate the proposed development traffic generation are as follows:

Strip Retail Plaza (822) – 1000 Sq. Ft. GFA

- Weekday daily: 54.45vpd per 1000sqft GFA/ 0.929 = 58.61vpd/ 100m^2 GFA;
- Weekday AM peak hour: 2.36vph per 1000sqft GFA/ 0.929 = 2.54vph/ 100m^2 GFA; and,
- Weekday PM peak hour: 6.59vph per 1000sqft GFA/ 0.929 = 7.09vph/ 100m^2 GFA.

Accordingly, it is estimated that the traffic generations for the proposed local centre (2000m^2 GFA) are:

- Weekday daily: [58.61 x 2,000/100] = 1,172vpd; and,
- Weekday AM peak hour: [2.54 x 2,000/100] = 51vph; and,
- Weekday PM peak hour: [6.59 x 2,000/100] = 132vph.

Further, the distribution of trips to and from the local centre is summarised in **Table 6**. As shown in the table, 30 percent of the traffic is anticipated to be generated from future urban development to the west of Anstey Road and 50 percent of the traffic is anticipated to be generated from the Anstey Keane East LSP area. The local centre is anticipated to generate 20 percent of the external traffic from Armadale Road and Weld Street.

Table 6: Trip distribution for the proposed local centre

Approach Road/Area	Percentage of Trips
Future Urban Development	30%
Anstey Keane Residental Precinct	50%
Armadale Road (west)	5%
Armadale Road (east)	5%
Weld Street (south)	10%
Total	**100%**

6.3 Traffic Flow Forecasts

The future total daily traffic flows on the road network around the subject site have been modelled for the future scenario of full development of this area as discussed above.

Figure 10 illustrates future total weekday anticipated traffic flows for the previous 2020 TIA report for Anstey-Keane East Precinct LSP.

These figures show the total future traffic flows on the major roads within this LSP area and surrounding area and also, in brackets, the component of these future traffic flows that would be generated by the future urban development of the LSP area. The figure of 43,00vpd on Armadale Road west of Anstey Road was obtained from Main Roads WA transport model results provided for the City of Armadale in 2016. Main Roads WA has also previously advised that traffic flows on Armadale Road may be significantly higher in the long term and these volumes are shown in **Figure 10** in square brackets on Armadale Road.

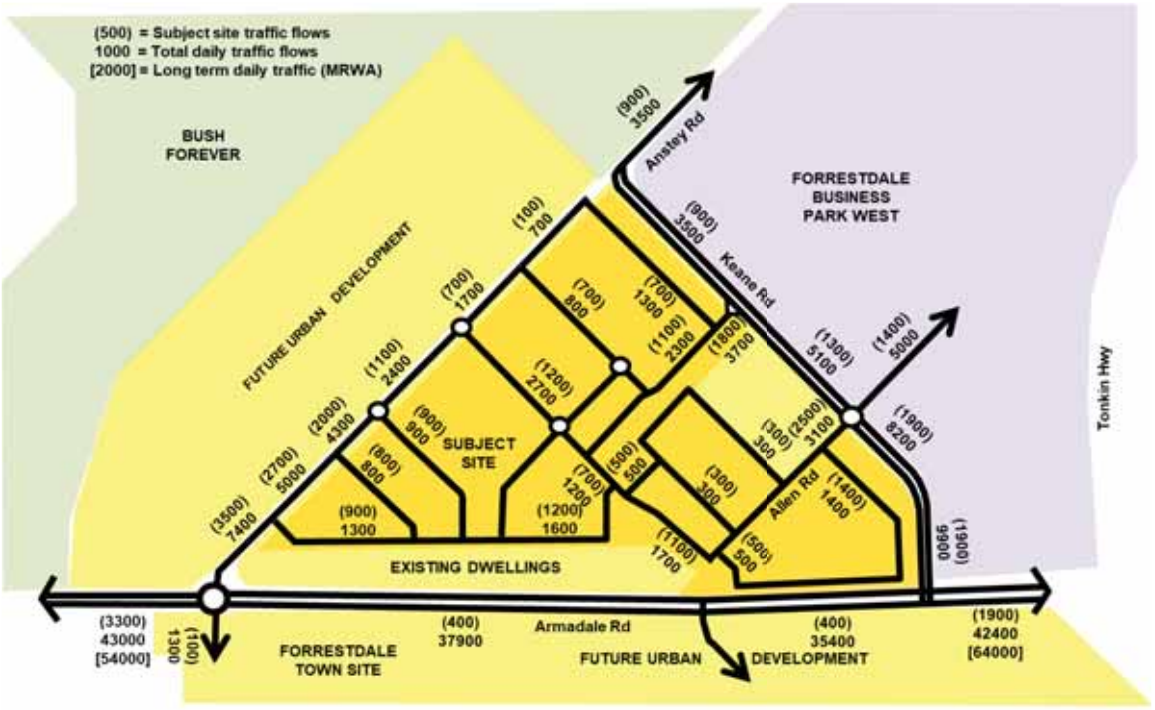


Figure 10: Daily traffic volumes from the previous LSP report

The daily traffic flows were adjusted to include the approved service station with fast food outlets and the proposed childcare facility and updated traffic volumes are shown in **Figure 11**.

Almost all the childcare facility traffic is expected to be generated with the Anstey Keane Urban Development Precinct. The net effect of the childcare centre on the LSP traffic is expected to be negligible because residential trip generation of 10vpd already accounts for these trips and people would have to travel outside this area to another childcare centre if there was no childcare facility in the precinct.

The service station and fast food development is expected to generate 2,500vpd per day which includes 1,400vpd passing-trade and 1,100vpd non-passing trade trips. The service station and fast food development will generate approximately 300vpd from both east and west on Armadale Road. Further, it will generate approximately 200vpd on Weld Street. The traffic volume will increase by 1,500vpd on the section of Anstey Road between Armadale Road and the service station crossover on Anstey Road. However, the traffic flow from Anstey East LSP area will decrease by 100vpd on Armadale Road (west) as the service station / fast food trips that were supposed to go out of LSP area will now finish within the area.

However, it must be noted that there won't be any increase in the traffic flow within the Anstey Keane Urban Development Precinct because residential trip generation of 10vpd already accounts for these trips and people would have to travel outside if there was no service station /fast food development in the precinct.

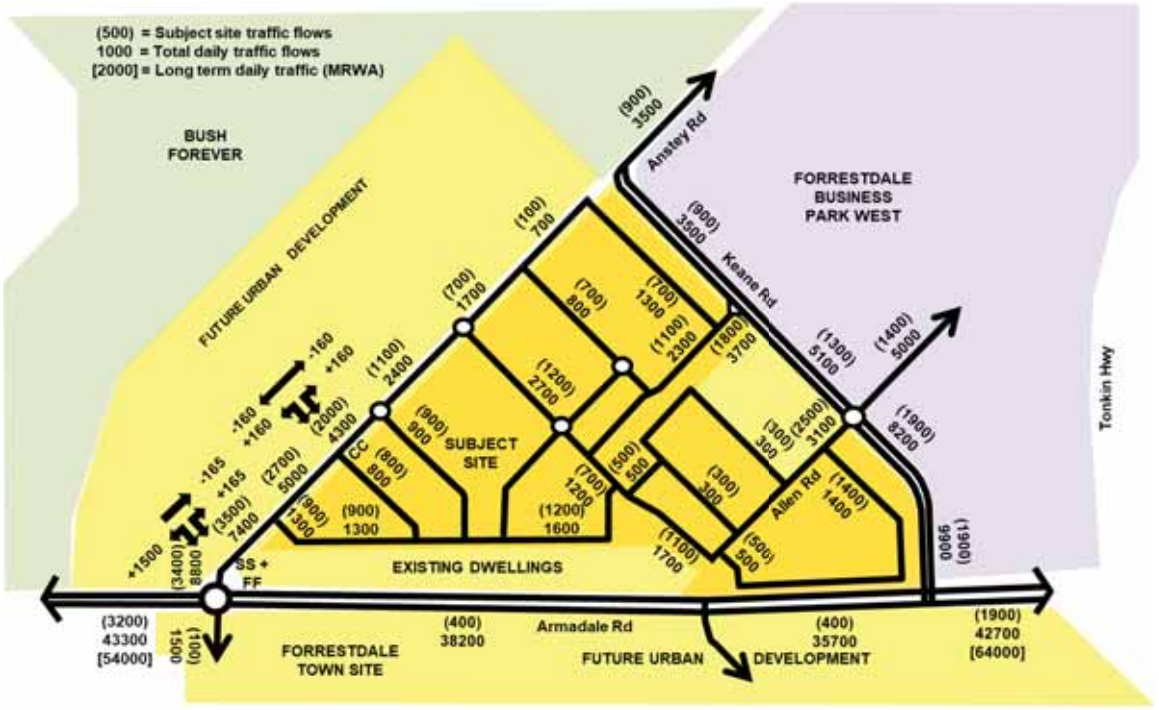


Figure 11: Daily traffic volumes including the service station and childcare traffic

As part of the proposed amendment to the Anstey-Keane East Precinct LSP, the zoning of Lot 500 (16) Anstey Road, Forrestdale is proposed to be changed from Residential (R25) to Local Centre(commercial). The area of the lot is 8,797m^2 and considering an average lot area of 300m^2 for a residential dwelling, it was supposed to occupy 29 residential dwellings.

The daily traffic generation rate used in the subject site for this transport report is 10 vehicle trips per day (vpd) per dwelling, which is consistent with the traffic generation of the previous report and as generally required by the City of Armadale for structure planning in the North Forrestdale area.

The anticipated 29 residential lots of the LSP area were therefore supposed to generate approximately 290vpd. Since these residential lots will now be replaced by the local centre, the traffic volumes in **Figure 12** are adjusted to discount the traffic generation for 29 residential lots.

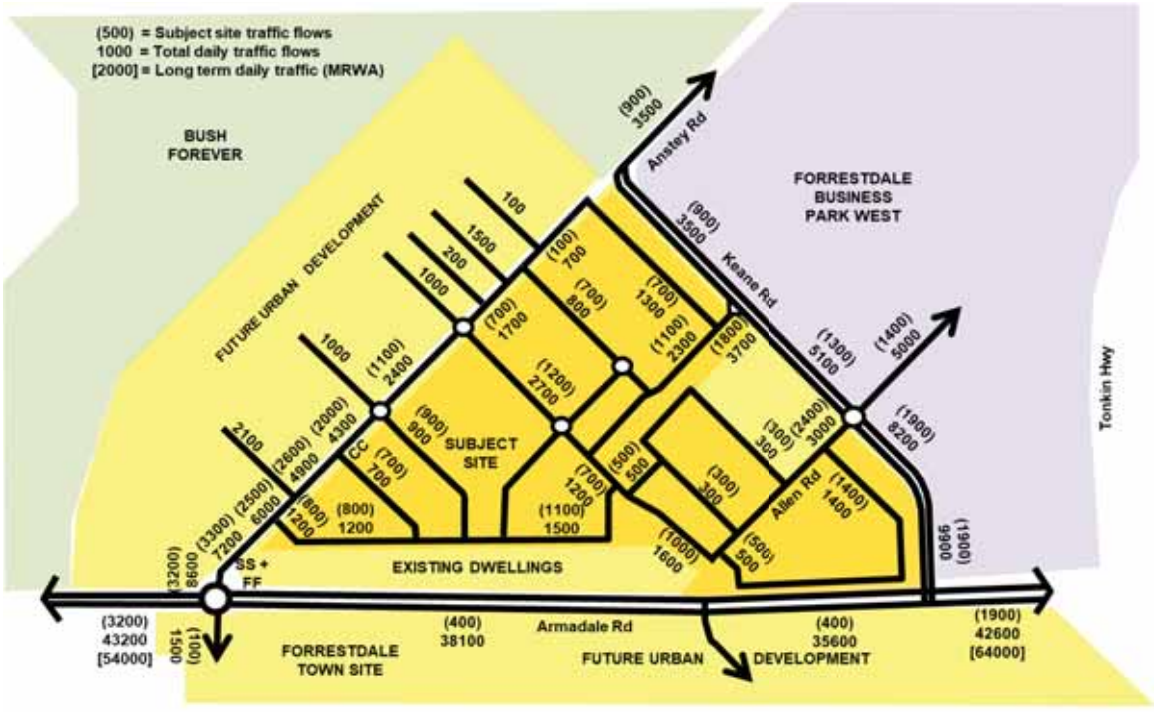


Figure 12: Daily traffic volumes including the service station and childcare traffic and subtracting the residential traffic for the subject site

Further, as detailed in **Section 6.2**, the local centre is expected to generate 1,172 trips per day. These trips are distributed on the surrounding road network in **Figure 13** as per the traffic distribution assumed in **Table 6**.

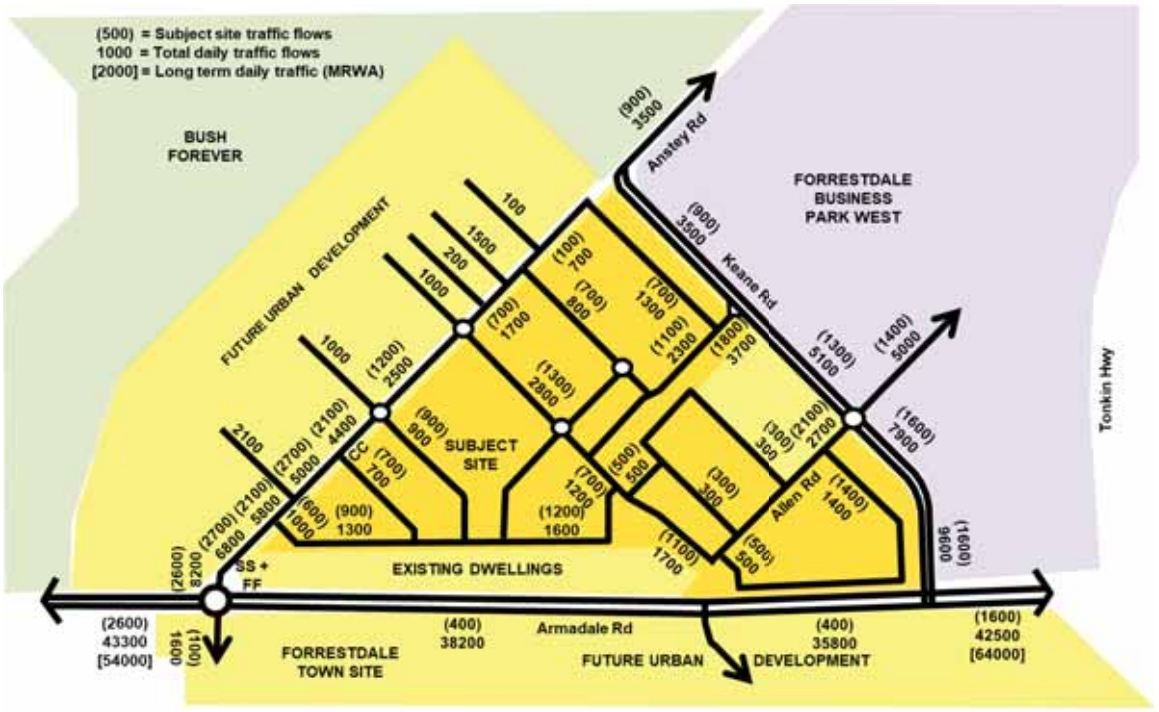


Figure 13: Daily traffic volumes including the service station and childcare traffic and replacing the residential traffic for the subject site with the local centre traffic

Overall, comparing the existing expected total traffic volumes (including the expected traffic of the approved service station / fast food development and proposed childcare centre) (i.e. **Figure 11**) with the total traffic volumes after the amendment (**Figure 13**), traffic volumes are expected to remain the same on Armadale Road (west of Anstey Road), decrease by 300vpd on Armadale (east of Keane Road), and decrease by 200vpd on Keane Road (south). Traffic volumes will increase by 100vpd on Anstey Road (north of the local centre) but decrease by 600vpd on Anstey Road (south of the local centre) because of shopping trips by residents in the Anstey Keane Urban Development Precinct that would be able to be done locally instead of having to drive out of the Precinct.

6.4 Traffic on Surrounding Roads

The WAPC Transport Impact Assessment Guidelines (2016) provides the following guidance on the assessment of traffic impacts:

"As a general guide, an increase in traffic of less than 10 percent of capacity would not normally be likely to have a material impact on any particular section of road, but increases over 10 percent may. All sections of the road with an increase greater than 10 percent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 percent of capacity. Therefore, any section of road where development traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis."

The proposed amendment in LSP will not increase traffic flows on any roads adjacent to the subject site by the quoted WAPC threshold of +100vph to warrant further analysis. Therefore, the impact of development traffic on the surrounding road network will not be significant.

6.5 Intersection Analysis

Intersection analysis has not been undertaken as part of this TIA. The intersection analysis was previously undertaken for TIA issued for the approved service station / fast food development and the previous TIA for the LSP report. As noted in **Section 6.4** the small change in peak-hour traffic flows as a result of the proposed Amendment does not warrant further detailed analysis.

It is understood that intersection analysis of the driveways for the proposed local centre would be required as part of the traffic impact report for the development application of the local centre.

6.6 Access to Frontage Properties

Refer to the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP. There are no changes as a result of the proposed LSP Amendment.

6.7 Pedestrian / Cycle Networks

Refer to the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP. There are no significant changes as a result of the proposed LSP Amendment. Exact details of internal road and path networks within the future local centre are currently unknown but it is assumed that the path network connectivity through the subject site to Anstey Road would be maintained through this future local centre site.

6.8 Access to Public Transport

Refer to the 2020 Transport Impact Assessment for Anstey-Keane East Precinct LSP. There are no changes as a result of the proposed LSP Amendment.

7 Conclusions

This Transport Impact Assessment has been prepared by Transcore on behalf of Cedarville Pty Ltd with regard to a proposed amendment to the Anstey Keane Urban Development Precinct - East Structure Plan for land at Anstey Road, Forrestdale in the City of Armadale.

The LSP area is located on the southeast side of Anstey Road in Forrestdale and extends from Keane Road in the northeast to Armadale Road in the south, excluding existing dwellings fronting Armadale Road.

The Amendment area (Lot 500 (16) Anstey Road, Forrestdale) is located on the southeastern side of Anstey Road in Forrestdale. at the southwest corner of the LSP area.

In separate development applications, a service station with fast food outlets has been approved and a childcare facility has been proposed along Anstey Road adjacent to the proposed local centre. However, these developments have not been constructed yet. The service station with fast food outlets is located to the southwest of the proposed local centre and the childcare centre is located to the northeast of the proposed local centre. The changes in future daily traffic flows as a result of these planned developments have been taken into account in this transport impact assessment to establish the future traffic flows that would exist in this area without the proposed LSP Amendment.

As part of the proposed amendment to the Anstey Keane Urban Development Precinct - East Structure Plan, the zoning of Lot 500 (16) Anstey Road, Forrestdale is proposed to be changed from Residential (R25) to Local Centre(commercial). The net yield of this Amendment area is estimated to be 29 residential dwellings within the current structure plan. These dwellings are proposed to be replaced by a local centre with a floor area of 2000m^2 including 1500m^2 for retail shops and an additional 500m^2 for non-retail.

The local centre is expected to generate 1,172 trips per day with approximately 80% of these trips are expected to be from within the Anstey Keane Urban Development Precinct and 20 percent expected to be external trips from Armadale Road and Weld Street.

Overall, comparing the expected future total traffic volumes (including the expected traffic approved service station and proposed childcare) with the total future traffic volumes after the amendment, traffic volumes are expected to remain the same on Armadale Road (west of Anstey Road), decrease by 300vpd on Armadale (east of Keane Road), and decrease by 200vpd on Keane Road (south). Traffic volumes will increase by 100vpd on Anstey Road (north of the local centre) but decrease by 600vpd on Anstey Road (south of the local centre) because of shopping trips by residents in the Anstey Keane Urban Development Precinct that would be able to be done locally instead of having to drive out of the Precinct.

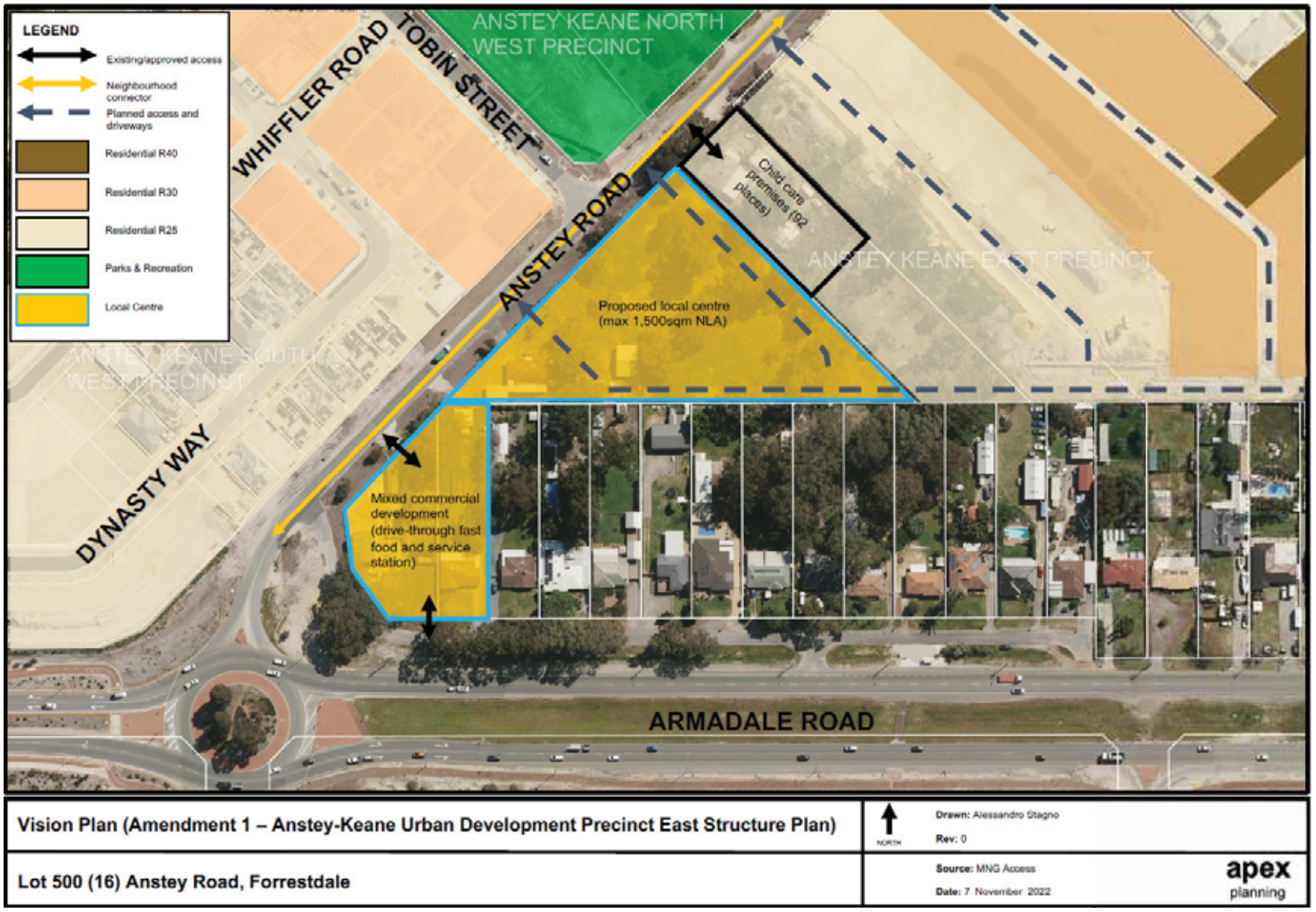
Thus, the proposed LSP amendment will not result in significant increases in traffic flows on any roads adjacent to the site. Any increases on individual roads will be less than 100vph and do not warrant further detailed analysis.

It is therefore concluded that the impact of the proposed LSP Amendment on the surrounding road network will not be significant.

Appendix A

VISION PLAN

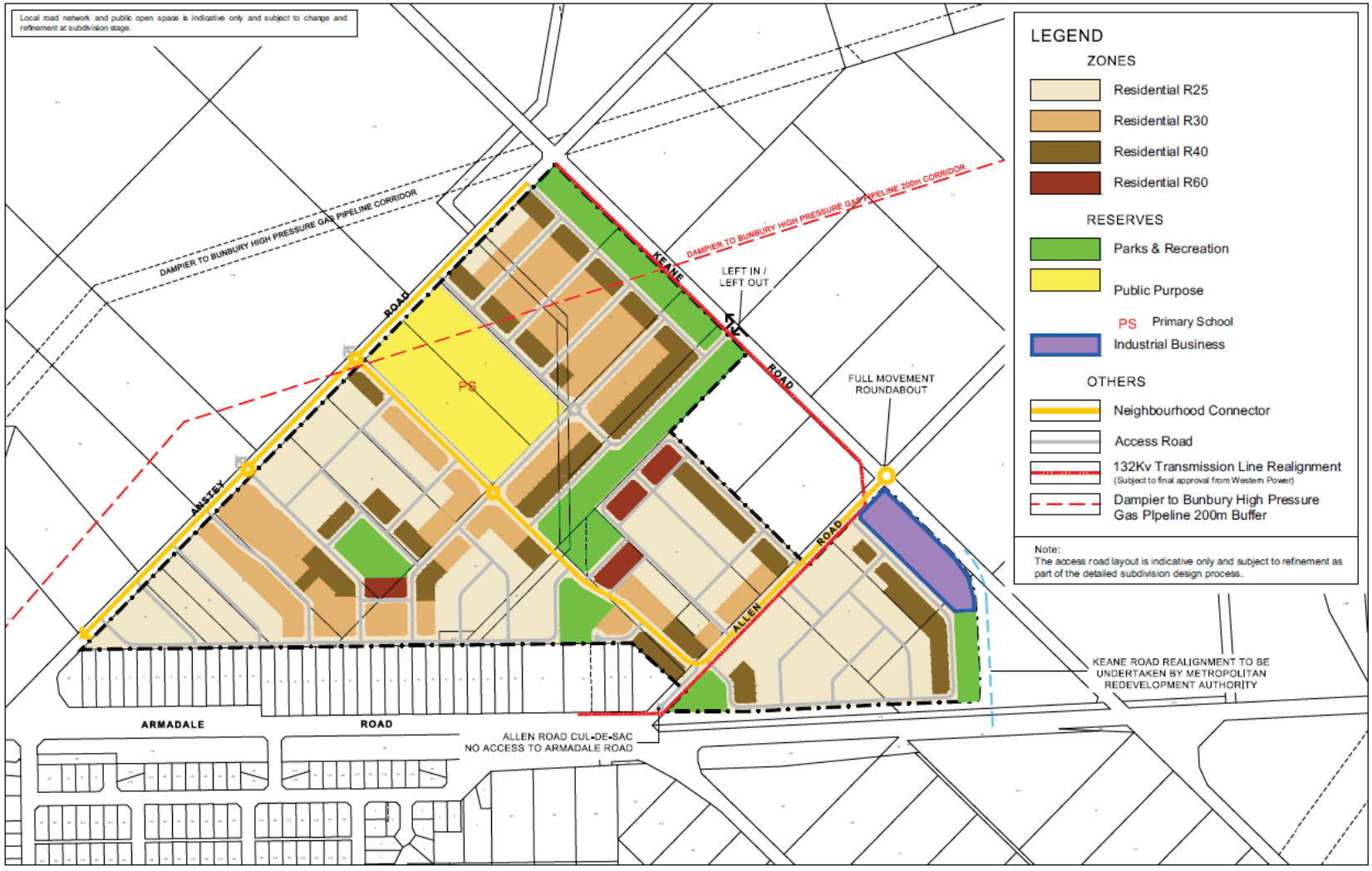
20 years anniversary
transcore
transport planning
traffic engineering
modelling


LEGEND
Existing/approved access
Neighbourhood connector
Planned access and driveways
Residential R40
Residential R30
Residential R25
Parks & Recreation
Local Centre
ANSTEY KEANE NORTH WEST PRECINCT
WHIFFLER ROAD
TOBIN STREET
ANSTEY ROAD
Child care premises (92 places)
ANSTEY KEANE EAST PRECINCT
Proposed local centre (max 1,500sqm NLA)
ANSTEY KEANE SOUTH WEST PRECINCT
DYNASTY WAY
Mixed commercial development (drive-through fast food and service station)
ARMADALE ROAD
Vision Plan (Amendment 1 – Anstey-Keane Urban Development Precinct East Structure Plan)
Lot 500 (16) Anstey Road, Forrestdale
NORTH
Drawn: Alessandro Stagno
Rev: 0
Source: MNG Access
Date: 7 November 2022
apex planning

Appendix B

Approved Structure Plans

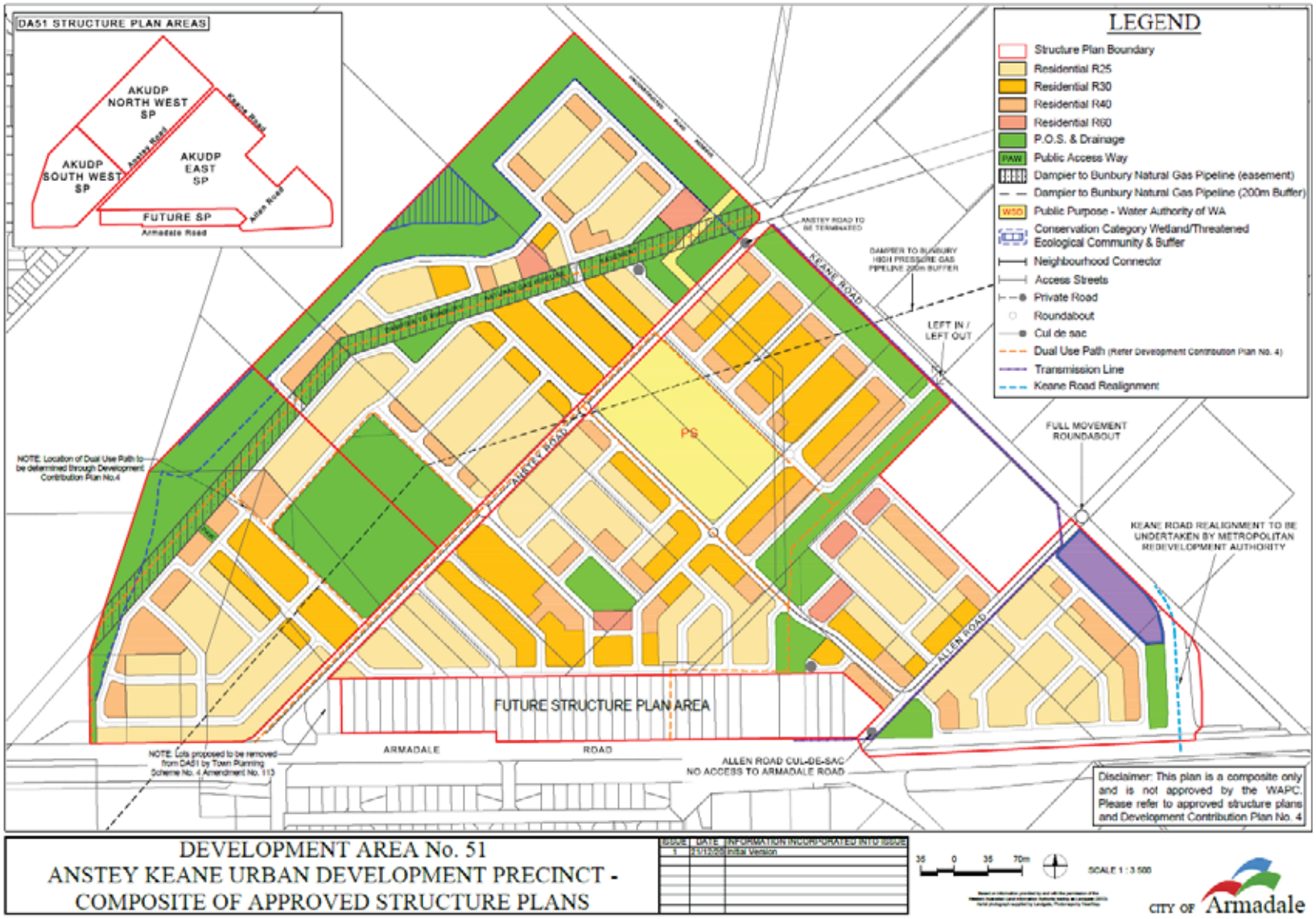
20 years anniversary
transcore
transport planning
traffic engineering
modelling



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PLAN A: STRUCTURE PLAN MAP
Anstey Road, Forrestdale

plan no: 3068-68H-01
date: 26 June 2020
scale: Not to scale


DA51 STRUCTURE PLAN AREAS
AKUDP NORTH WEST SP
AKUDP SOUTH WEST SP
AKUDP EAST SP
FUTURE SP
Armadale Road
Keane Road
Anstey Road
Allen Road
LEGEND
Structure Plan Boundary
Residential R25
Residential R30
Residential R40
Residential R60
P.O.S. & Drainage
Public Access Way
Dampier to Bunbury Natural Gas Pipeline (easement)
Dampier to Bunbury Natural Gas Pipeline (200m Buffer)
Public Purpose - Water Authority of WA
Conservation Category Wetland/Threatened Ecological Community & Buffer
Neighbourhood Connector
Access Streets
Private Road
Roundabout
Cul de sac
Dual Use Path (Refer Development Contribution Plan No. 4)
Transmission Line
Keane Road Realignment
ANSTEY ROAD TO BE TERMINATED
DAMPIER TO BUNBURY HIGH PRESSURE GAS PIPELINE 200m BUFFER
KEANE ROAD
LEFT IN / LEFT OUT
FULL MOVEMENT ROUNDABOUT
PS
ANSTEY ROAD
ALLEN ROAD
KEANE ROAD REALIGNMENT TO BE UNDERTAKEN BY METROPOLITAN REDEVELOPMENT AUTHORITY
NOTE: Location of Dual Use Path to be determined through Development Contribution Plan No.4
FUTURE STRUCTURE PLAN AREA
ARMADALE ROAD
NOTE: Lots proposed to be removed from DA51 by Town Planning Scheme No. 4 Amendment No. 113
ALLEN ROAD CUL-DE-SAC NO ACCESS TO ARMADALE ROAD
Disclaimer: This plan is a composite only and is not approved by the WAPC. Please refer to approved structure plans and Development Contribution Plan No. 4
DEVELOPMENT AREA No. 51
ANSTEY KEANE URBAN DEVELOPMENT PRECINCT -
COMPOSITE OF APPROVED STRUCTURE PLANS
ISSUE
DATE
INFORMATION INCORPORATED INTO ISSUE
1
21/12/05
Initial Version
35 0 35 70m
SCALE 1 : 3 500
CITY OF Armadale

APPENDIX 5

RETAIL NEEDS ASSESSMENT AND IMPACT TEST

pracsys.

Cedarville Pty Ltd

Retail Needs Assessment and Impact Test for Lot 84, 16 Anstey Road Forrestdale

Final Report

September 2023

Document Control				
Document Version	**Description**	**Prepared By**	**Approved By**	**Date Approved**
v1.0	Retail Needs Assessment	Reid Quekett	Dawson Demassiet-Huning	31 March 2022
v2.0	Retail Needs Assessment	Reid Quekett	Dawson Demassiet-Huning	30 May 2022
v3.0	Edits & Impact Test	Atle Edgar	Dawson Demassiet-Huning	24 November 2022
v4.0	Final Needs Assessment and Impact Test	Atle Edgar	Dawson Demassiet-Huning	14 December 2022
V5.0	Final Needs Assessment and Impact Test – Updates	Sudhara Weerakoon	Dawson Demassiet-Huning	09 September 2023

Disclaimer

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1 INTRODUCTION

1.1 Background

This report provides a Needs Assessment to consider whether there is sufficient demand for a Shop/Retail (SHP) development at Lot 84, 16 Anstey Road Forrestdale, in the City of Armadale. Cedarville Pty Ltd has identified the need for an independent Retail Needs Assessment to assess the level of demand for SHP uses at the planned centre. Pracsys has been engaged to undertake the Needs Assessment and estimate the level of SHP floorspace which would be supportable at the centre, with consideration of the surrounding activity centre distribution and future population growth.

1.2 Retail Needs Assessment and Impact Test Purpose and Objectives

The draft State Planning Policy 4.2 (draft SPP4.2) states the following relating to needs assessments: *'The need for activity centre uses refers to the scale and mix of residential and non-residential uses likely to be needed within a catchment area over the plan period (10 years for Precinct Structure Plans).'*

The needs assessment should measure demand for the area and identify the scale of supply necessary to appropriately accommodate this demand in square metres Net Lettable Area (NLA).

The draft SPP 4.2 also provides guidance regarding Impact Tests: *'Specifically, the Impact Test will ensure major development proposals will not unreasonably impact upon the activity centre hierarchy, result in loss of services to the community and/or impact upon existing, committed and planned public and private infrastructure investment.'* It states further that *'Competition between businesses in and of itself is not considered a relevant planning consideration.'* This means that decisions should not be based on the impact on, or viability of, individual tenants. Only the potential impact on the centres and the effects on the catchment community should be considered under an impact test.

This needs assessment and impact test follows the requirements of draft SPP 4.2 Implementation Guidelines to consider and assess demand for activity centres uses and measure the impact on the activity centre hierarchy. The assessment should be based on facts and unbiased evidence[1].

The key objectives of the report are to:

- Define the catchment area of the proposed scheme amendment request
- Review drivers of floorspace, including forecast population growth and socio-economic characteristics, employment, changing expenditure patters, and property market profile
- Evaluate the competitive environment including existing and planned floorspace supply (including expansions and new developments)

[1] Draft SPP 4.2 Implementation Guidelines

- Develop a net demand assessment
- Assess the level of Shop/Retail floorspace supportable at the site
- Assess the impact of the proposed development on the viability of the activity centre hierarchy

1.3 Gravity Model Methodology

Pracsys uses a proven retail gravity model methodology to examine the supply of and demand for retail floorspace within a defined catchment and estimate the potential impact of proposed retail developments. The Retail Gravity Model (also known as Huff's Gravity Model) is a modified version of Sir Isaac Newton's Law of Gravitation. The Gravity Model is a popular model widely used in international trade modelling, transport modelling and regional planning. Retail Gravity modelling studies retail supply, and the probability of a customer (demand) visiting a particular centre. The model accounts for the distribution and attractiveness of competing centres, along with the distance a customer will have to travel to each centre. Floorspace quantum (m^2) is used to represent the attractiveness of retail centres. Customers are willing to travel farther to shop at large centres, representing a higher level of attraction (they can generally satisfy multiple needs in one trip to a larger centre, which also contains a higher proportion of comparison goods).

The model provides an objective method of distributing expenditure among centres. Calibration is used to match the calculated distribution of expenditure to actual published turnover levels, optimising the model outputs. Having established a benchmarked current distribution of expenditure, new floorspace can be introduced and changes in expenditure distribution across time can be examined, allowing for various retail centre transformations such as planned expansions and new developments. This comprehensive approach creates a distribution of expenditure that is fundamentally unbiased, as it is based on mathematical rules. It is a widely used approach that has been accepted by the Department of Planning, Lands and Heritage and Western Australian Planning Commission (WAPC) through the review of a wide range of Structure Plans, Local Commercial Strategies and Retail Sustainability Assessments.[2] For more information on the gravity modelling methodology, please see **Appendix 1: Gravity Modelling Methodology.**

1.4 Shop Uses

The "shop" land use is an "A" classification land use that can be approved in the Industrial Business zone. It should be noted the City would aim to only approve "shop" uses in the Industrial Business zone that are considered incidental to the predominant/primary use on a property or where they are considered to be logical and complementary to an industrial area (e.g. shops selling work wear or safety clothing, small convenience stores, etc.). Shops such as supermarkets or liquor stores, etc. would be unlikely to be approved in an Industrial Business zone and it is not expected that any future Shop uses on this type of land within the catchment would affect the demand for the proposed uses.

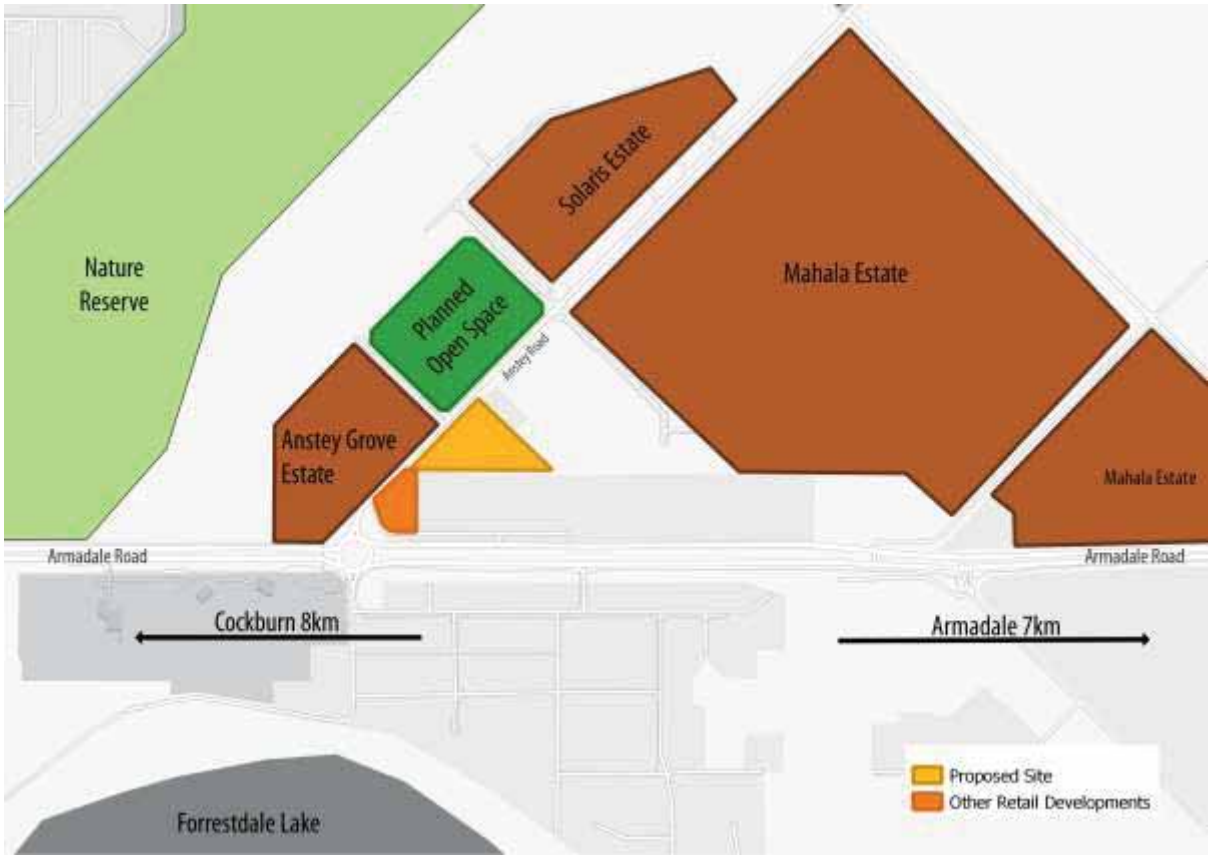
[2] For example, in April 2014, the West Australian Planning Commission approved the Melville City Centre Structure Plan, which proposed the expansion of the Garden City shopping centre. The RSA prepared by Pracsys in support of the application was based on gravity modelling. Please see Melville City Structure Plan 2015.

2 DEVELOPMENT CONTEXT

2.1 Site Location

The subject site is located proximate to the intersection of Anstey Road and Armadale Road. The lot is bordered by multiple current residential developments to the north, east and west, and proximate to many large nature reserves and a planned district open space. Armadale Road serves as the connecting route between Armadale to the east and Cockburn to the west. The following map identifies the approximate location of the proposed development (Figure 1).

Figure 1. Subject Site Context



Source: Google Maps 2022, Yolk Property Group 2022, LWP Property 2022

The site is located within an area which is predominantly residential in nature. A number of residential developments (Anstey Grove Estate, Solaris Estate and Mahala Estate) have been identified and accounted for in modelling based on the Urban Land Development Outlook 2020/21 (ULDO). The ULDO identifies a total development potential of approximately 1,156 additional dwellings by 2030 for the three estates, equating to approximately 3,468 residents if an average 3 person per dwelling estimate is applied. The inclusion of these developments provides an understanding of the demand for a local centre from population directly adjacent to the centre. The additional dwellings have been removed from the broader dwelling forecasts used in the modelling to ensure there is no double counting of dwellings.

2.2 Trade Area Definition

A trade area is the spatial boundary from which a commercial floorspace generates the majority of its customers. The trade area definition allows for the measurement of the number of potential customers, their demographics and expenditure potential, as well as an assessment of the competitive environment.

SPP 4.2 states that local centres provide for the day to day needs of local communities, playing an important role in the activity centre hierarchy by providing walkable access to services and facilities for local communities. The modelled trade area of the prospective centre is comprised of a five-kilometre catchment area. The 5km catchment is used in the gravity model and ensures that all centres which could reasonably influence the viability of the prospective centre are included in the RNA (Figure 2).

Figure 2. Modelled Trade Area of Prospective Development



Source: Positron 2022

The modelled trade area encompasses Haynes to the west, Forrestdale and Hilbert to the south, Harrisdale and Piara Waters to the north, and Banjup to the east. The supply catchment extends up to five kilometres from the centre and includes shopping centres such as Harrisdale District Centre and ERADE Village Local Centre (see Figure 9. Trade Area Current & Future **Retail Supply Network** for an illustration of the trade area's competitive environment). The site's location at the corner of Armadale Road and Anstey provides high levels of passing traffic that will increase the level of supportable floorspace, particularly once the nearby estate developments are completed (see Figure 1).

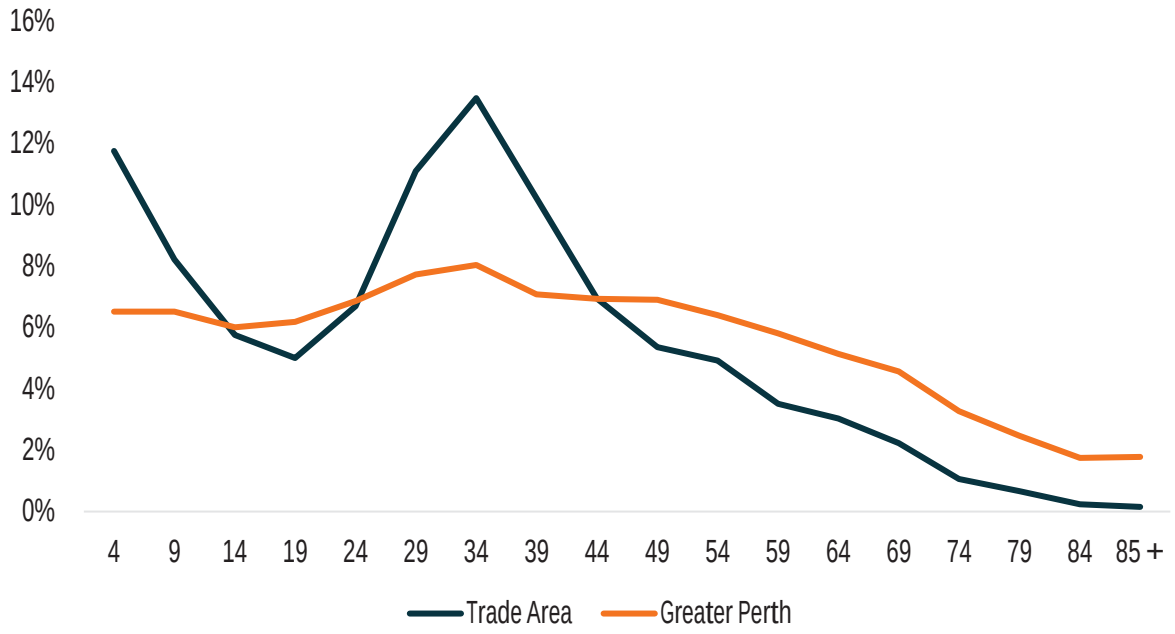
3 RETAIL DEMAND

Understanding local demographics and expected market growth is key in the assessment of the need for retail floorspace in the defined trade area. This section provides an overview of demographics, current and future dwellings and the expenditure profile of the trade area.

3.1 Age Profile

The trade area exhibits a noticeably different demographic profile to the Greater Perth benchmark (Figure 3), with a slightly lower proportion of people aged 15 to 19 (5% versus 6%) and a higher proportion of both 0- to 4-year-olds (12% versus 6.5%) and 29- to 34-year-olds (13% versus 8%) than in Greater Perth. This reflects that the trade area is comprised of a higher concentration of working-age adults with young children than the Greater Perth average. This may indicate increased expenditure on childcare and certain convenience retail goods and services.

Figure 3. Trade Area Demographic Profile

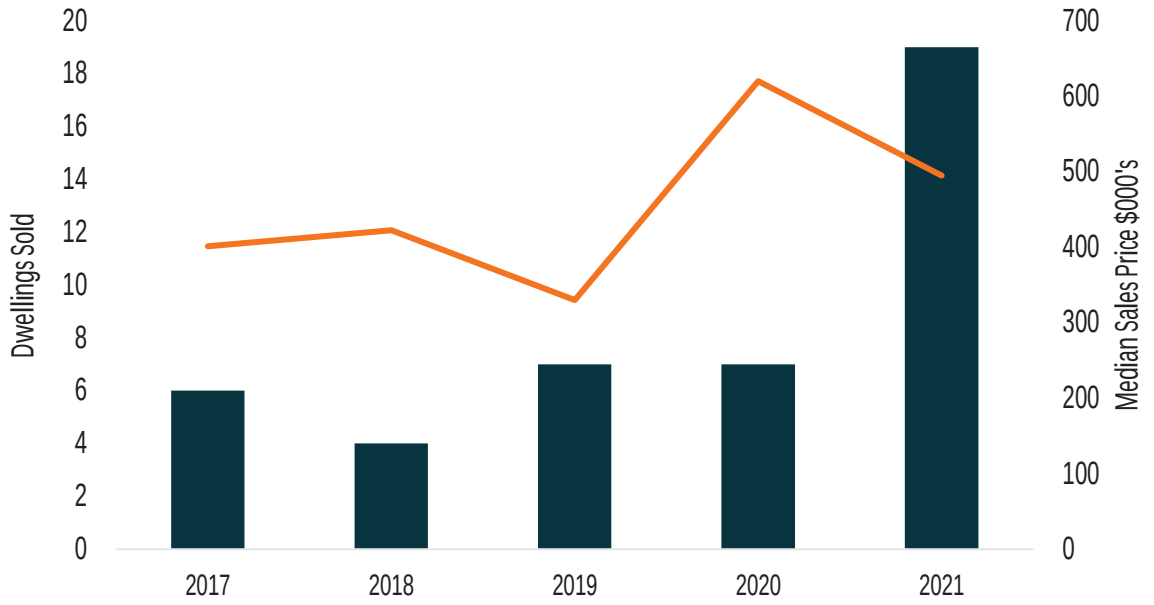


Source: ABS 2016, Pracsys 2022

3.2 Property Market

Property market data helps to create an understanding of current property and development trends. In 2021, the number of house sales in Forrestdale increased by approximately 170% and the median sales price of houses decreased by 20% (Figure 4).[3]

Figure 4. Dwelling Sales Trends Forrestdale



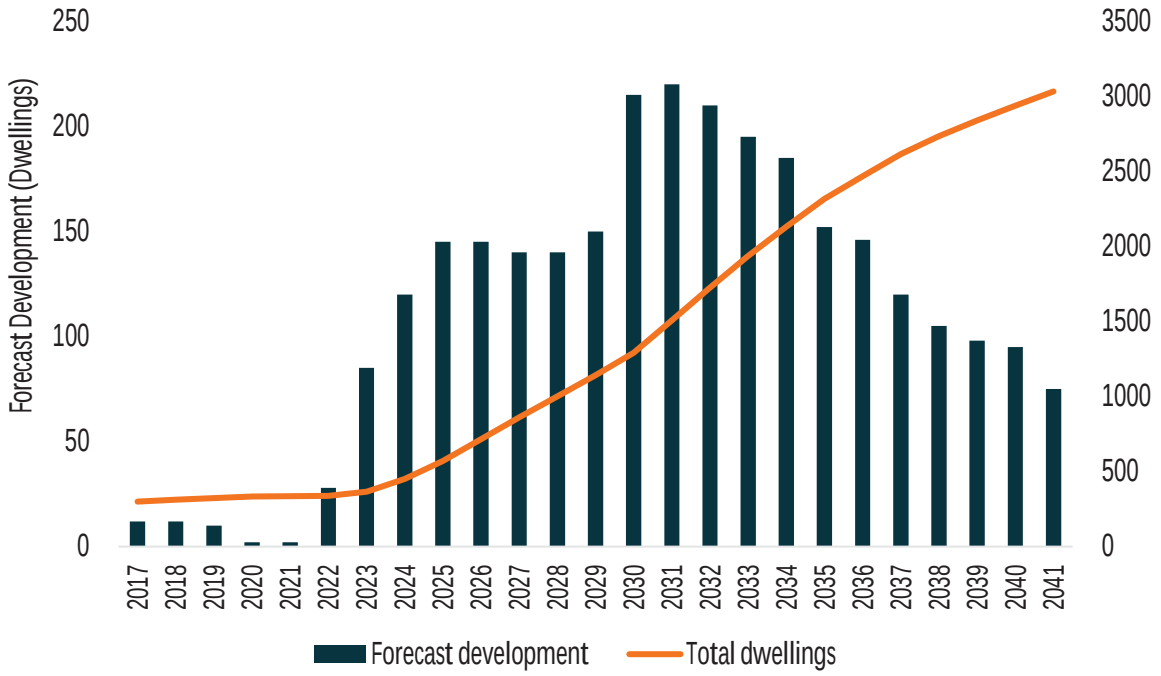
Source: REIWA 2022

This demonstrates a large increase in the supply of dwellings, which will likely increase the need for retail and other population driven goods and services in the area. This increase in supply has been generated by an increase in residential estate developments in the Forrestdale area, which is likely to continue for the near future.

Dwelling projections show that the supply of new housing developments in Forrestdale is expected to rise after 2023 (Figure 5); however, sales data from Figure 4 suggests that the projected dwelling developments begun slightly earlier than expected, with a large increase in dwellings expected to occur over the next few years.

[3] REIWA 2021, Suburb Profile Forrestdale. Available from: https://reiwa.com.au/suburb/forrestdale/

Figure 5. Forecast Residential Development in Forrestdale



Source: Forecast ID 2021, Pracsys 2022

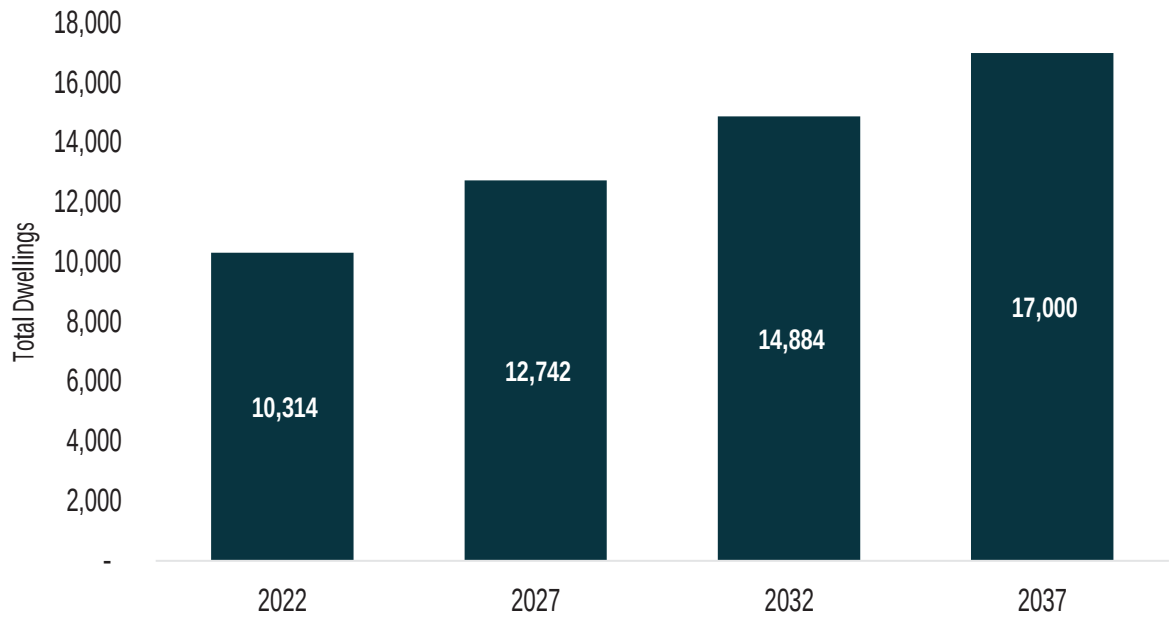
The development of a Local Centre at Anstey Road would support the development of the suburb through increased liveability and access to employment. Providing an appropriate scale of amenity will ensure the liveability is maintained as new population moves into the area.

3.3 Trade Area Dwellings

The trade area of the proposed development is estimated to contain 10,314 dwellings in 2022 (Figure 6).[4] Based on dwelling growth forecasts, the number of dwellings in the trade area is expected to grow to 14,884 by 2032, reflecting a forecast increase in dwellings of 44 per cent. By 2037, the number of dwellings in the trade area is projected to reach 17,000 reflecting a 65 per cent increase from the current level.

[4] The ABS Census 2016 dwelling count by SA1 areas was used to estimate the 2016 number of dwellings in the catchment. *WA Tomorrow* population projections (median band) were used to forecast dwellings beyond 2016 (Department of Planning, Lands and Heritage 2018).

Figure 6. Trade Area Dwelling Growth Forecast

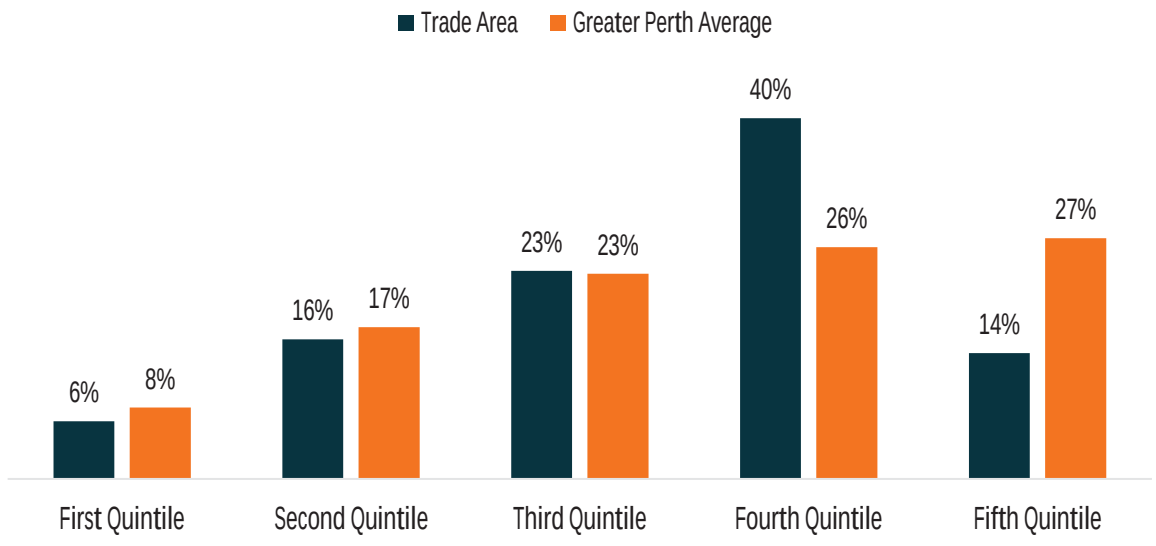


Source: ABS 2016, DPLH WA Tomorrow 2018, Forecast.id 2020, Pracsys 2022

3.4 Trade Area Income

Trade area income demographics play an important role in the success of retail developments, as the level of spending on retail goods and services is primarily determined by household income. Generally, lower income quintiles spend a higher proportion of their income on basic goods and services; upper income quintiles have more disposable income available to spend on non-essential retail items. ABS Census data has been used to assess the distribution of household income within the trade area (Figure 7).

Figure 7. Trade Area Population Weekly Income Profile



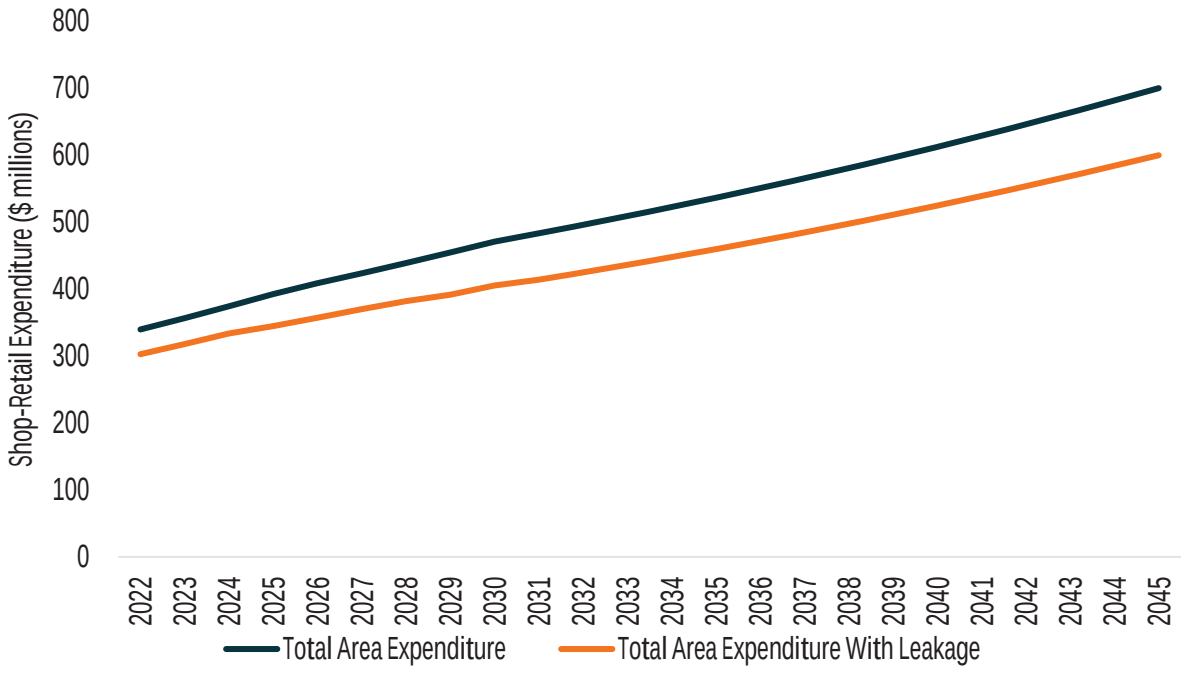
Source: ABS 2016, ABS HHES Survey 2015/2016, Pracsys 2022

Incomes in the trade area are on similar to the Greater Perth benchmark across the three lowest quintiles, with a higher proportion of households in the fourth quintile (40% versus 26%) and a lower proportion in the fifth (14% versus 27%). This is likely reflective of the higher proportion of residents in the 29-34 age bracket compared to Greater Perth and the prevalence of young families in the area who have not yet achieved their highest earning potential. However, the relatively high number of fourth quintile income households in the catchment indicates that there remains a strong potential for high levels of discretionary spend within the catchment, which will support greater levels of goods and service provision.

3.5 Retail Expenditure

ABS Household Expenditure Survey data was used to estimate the average spend per household by income quintile, from which the total expenditure pool of the catchment has been derived. The model combines propensity to spend on commodities based on household income quintiles to derive the total Shop/Retail expenditure in the area. Given projected household growth, Shop/Retail expenditure is estimated to increase from $339 million in 2022 to $495 million in 2032, reflecting growth of 46 per cent (Figure 8). By 2037, trade area shop-retail expenditure is predicted to reach $565 million – an increase of 66 per cent from current levels. This large increase in catchment expenditure reflects the significant expansion in residential dwellings expected to occur in Forrestdale over the next 10 years. Some of this turnover is projected to be lost to online leakage; however, this is expected to be less prominent in respect to convenience retail than other types, such as comparison retailing. The effect of online leakage on the viability of the proposed development is expected to be minimal.

Figure 8. Catchment Area Shop/Retail Expenditure Pool, 2022 to 2045



Source: ABS Census 2016, ABS HHES Survey 2015/2016, Pracsys 2022

4 RETAIL SUPPLY

4.1 Current Supply

This section provides an overview of the competitive environment facing the proposed development at Anstey Road. Being a local centre, the proposed centre is likely to compete principally with those centres in close proximity.

Existing retail floorspace supply within the trade area has been derived through data from multiple sources, including:

- The Department of Planning Land Use Survey (2015/17)
- Property Council Shopping Centre Directory (2018)
- Secondary Research (various structure plans, property manager websites etc.)

A total of six developments containing Shop/Retail floorspace within five kilometres of the proposed development were included in the analysis to ensure a comprehensive assessment of current local retail supply. Two additional large centres with a wider catchment located outside of the 5km area were included in the gravity modelling to ensure the retail supply is accurately represented. A selection of centres within the supply network are illustrated below (Figure 9). The trade area and surrounding area includes a wide range of retail offerings, from Strategic and Secondary centres such as Armadale and Cockburn Gateway, to mixed-used industrial business areas, and various neighbourhood and local level centres. Most centres within the 5km trade area are neighbourhood and local centres that provide for daily and weekly household shopping needs.

Figure 9. Trade Area Current & Future Retail Supply Network



Source: DPLH Land Use and Employment Survey 2015/17, Armadale Retail (Commercial) Centres Strategy 2020

The total current Shop/Retail offering within the 5km trade area and surrounds has been estimated at 137,214m^2 (Figure 10).

Figure 10. Trade Area Shop-Retail Floorspace Supply 2021

Centre	Shop-Retail Floorspace (m^2)
On the Map	
Wright Road / Ranford Road Neighbourhood Centre (City of Armadale Component)	1,438
Harrisdale District Centre	12,200
Wright Road / Ranford Road Neighbourhood Centre (City of Gosnells Component)	6,192
Piara Waters Neighbourhood Centre	550
ERADE Village Local Centre	370
Strawberry Drive	100
Cockburn Gateway	51,322
Armadale T Centre	60,261
Haynes Neighbourhood Centre	4,781
Total Floorspace	**137,214**

Source: Armadale Local Commercial Strategy 2020, DPLH Land Use and Employment Survey 2015/17

4.2 Expansions and Planned Developments

There has been an increase in the number and scale of planned retail expansions since the State government has relaxed its restrictions on retail floorspace development in 2010. A desktop analysis and review of planning documentation within the City of Armadale and City of Gosnells local government areas was undertaken to identify any planned future Shop-Retail floorspace developments within the trade area and surrounds (Figure 9. Trade **Area Current & Future Retail Supply Network**. This review identified 10 future retail developments or expansions in the region (Figure 11). A conservatively high estimate of additional Shop/Retail and Other Retail floorspace owing to these expansions has been used to consider the long-term ability of the catchment to support the proposed centre size.

Figure 11. Trade Area Shop-Retail Floorspace Expansions and Developments

Centre	Previous NLA (m^2)	Expanded NLA (m^2)	Additional NLA (m^2)	Year of Expansion
Piara Waters Neighbourhood Centre	550	5,709	5,159	4,298 in 2026 5,709 in 2026
Harrisdale District Centre	12,200	25,000	12,800	22,000 in 2026 25,000 in 2031
ERADE Village Local Centre	370	2,170	1,800	2,170 in 2025
Forrestdale	0	500	500	2026
Haynes Southwest	0	200	200	2026
Haynes Neighbourhood Centre	4,781	6,200	2,538	2026
Haynes North	0	400	400	2026
Hilbert	0	20,000	20,000	5,000 in 2026 20,000 in 2031
Hilbert North	0	700	700	2026
Cockburn Gateway	51,322	90,000	38,668	72,300 in 2026 90,000 in 2036
Armadale T Centre	60,261	100,000	39,739	70,000 in 2026 90,000 in 2036 100,000 in 2041
Anstey Rd (Lot 3 and 301)	0	180	180	2025

Source: Armadale Retail (Commercial) Strategy 2020, element 2020

5 RETAIL NEEDS ASSESSMENT AND IMPACT TEST

This section identifies the potential supportable retail floorspace at the proposed site and then measures the potential impact of the proposed uses on the activity centre hierarchy.

5.1 Gravity Modelling and Model Calibration

The retail needs assessment uses gravity modelling to estimate the quantity of Shop/Retail floorspace supportable at the project site. The retail gravity model incorporates the most up to date data on household expenditure from the ABS, retail floorspace supply from the Department of Planning, Lands and Heritage and retail floorspace from secondary sources to identify recent expansions and planned centres.

Gravity model estimates of centre turnover were calibrated against known or modelled turnover data where possible. Key centres used to calibrate the model are listed below, with their respective turnover levels (Figure 12. Centres with Available Turnover Data or Published Productivity Estimates). Where centres were near the border or outside of the trade area, the approximate proportion of their expenditure expected to be derived from the trade area was used to adjust their turnover.

Figure 12. Centres with Available Turnover Data or Published Productivity Estimates

Centre	Turnover ($)	% Turnover from Catchment
Cockburn Gateway[5]	431,790,000	12%
Armadale T Centre	404,170,527	15%
Harrisdale[6] District Centre	109,600,000	90%
Wright Road / Ranford Road Neighbourhood Centre (City of Armadale Component)	9,347,000	50%
Piara Waters Neighbourhood Centre	4,275,700	90%
ERADE Village Local Centre	2,665,590	75%
Haynes Neighbourhood Centre	36,950,000	40%

Source: Cockburn Gateway 2019, Stockland 2019-20, Armadale Retail (Commercial) Centres Strategy 2020

Retail productivity benchmarks or modelled productivity estimates from the Armadale Retail (Commercial) Centres Strategy were used to calibrate centre turnover where actual data was not available (Figure 14).

5.2 Supportable Turnover

Shop/Retail Assessment

The Anstey Rd centre is planned as a local centre; SPP4.2 (2010) identified local centres as supporting approximately 1,500m^2 Shop/Retail floorspace Net Lettable Area (NLA).[7] The supportable Shop/Retail

[5] Cockburn Gateway Shopping Centre 2019, 'Asset Profile Flyer' Available from: https://specialtymallleasing.com.au/ctrpdf/30/PCG316_Asset_Profile_Flyer-SML_COCKBURN.pdf
[6] Stockland 2019, 'Property Portfolio'. Available from: https://www.stockland.com.au/investor-centre/our-portfolio
[7] All floorspace estimates are in Net Lettable Area terms

floorspace at the site was therefore tested by assessing whether the turnover available at 500m^2, 1,000m^2 and 1,500m^2 of Shop/Retail floorspace was sufficient for the centre to be viable over the next 15 years (Figure 13). All testing included the Fast food and Service station developments on lot 3 and 301 Anstey Rd (180m^2 retail NLA proposed) that could be viewed as an extension of the Anstey Rd local centre; although the uses are more likely to cater for the needs of passing traffic rather than local residents. The expected floorspace productivity of each development size in five-year increments was then compared to benchmark floorspace productivity levels for a range of uses and productivity estimates for similar developments from the Armadale Retail (Commercial) Centres Strategy 2020 (the ARC Strategy) (Figure 14 and Figure 15).

Figure 13. Proposed Centre Productivity ($/m^2)

Floorspace m^2	2022	2027	2032	2037
680 (500m^2 proposed site)	9,663	8,047	8,468	8,573
1,180 (1,000m^2 proposed site)	9,397	7,903	8,336	8,453
1,680 (1,500m^2 proposed site)	9,152	7,765	8,209	8,338

Source: Pracsys 2022

Figure 14. Retail Benchmark Productivity

Retail Category	Productivity ($/m^2)	Note
Take Home Food	10,749	Grocery
Take Home Liquor	9,674	Bottle shop
Convenience Retail	7,524	Deli / pharmacy
Dine Out Food	6,987	Restaurant
Clothing/Footwear	5,374	Comparison

Source: Colliers 2017

Figure 15. Retail Centre Productivity Benchmarks

Local Centres	2021	2026	2031	2036
Forrestdale	$7,497	$7,395	$7,614	$7,890
Haynes South West	-	$7,097	$7,282	$7,642
Hilbert North	-	$6,796	$7,030	$7,393

Source: Armadale Retail (Commercial) Centres Strategy 2020

Note: A productivity estimate for the Anstey Road centre was not identified in the Armadale Retail (Commercial) Centres Strategy 2020.

The floorspace productivity of a Shop/Retail development at Anstey Road is predicted to be very high in 2022, reaching almost $9,700m^2 for a 500m^2 development and $9,200m^2 for a 1,500m^2 development. It is assumed that several centres in the trade area will be developed or expand by 2026 and onwards. With these centres considered, the expected floorspace productivity of Lot 84 is reduced, particularly in 2027; the proposed centre still achieves higher turnover than most benchmarks even at 1,500m^2. As the catchment

population continues to grow after 2027, the centre's performance improves and performs better than benchmarks at all sizes tested. This means the proposed centre is expected to be viable at up to 1,500m^2, even when the fuel station and takeaway food uses proposed at Lot 3 and 301 Anstey Rd are included to make a total of 1,680m^2.

The predicted floorspace productivity of Lot 84 in 2032 is high enough to support a mix of floorspace types that could include Take Home Food (e.g. supermarket), Dining Out Food (e.g. restaurant) and / or Clothing/Footwear (e.g. comparison) retail, up to the identified 1,500m^2. It could also support a total of 1,300m^2 supermarket only floorspace (front of house)[8] based on the identified viable floorspace productivity level. While the model identifies a dip in productivity in 2027 due to the significant assumed floorspace expansions, it is temporary, with strong recovery regardless of the size of the proposed centre.

It is recommended that the Lot 84 development is supportable at 1,500m^2 of Shop/Retail floorspace (excluding the Lot 3 and 301 Anstey Road uses). It is also likely that the demand addressed by Lot 3 and 301 Anstey Road uses will come from outside the local area and the supportable floorspace required to meet community need will be greater than 1,500m^2 (excluding the 180m^2 of retail NLA at Lot 3 and 301 Anstey Road).

The results should be seen as complementary to the ARC Strategy. The findings of this assessment provide a more granular investigation of the population growth being proposed in close proximity to the Anstey Rd local centre and the demand that this population creates locally. The smaller model and specific timing and quantum of development provided by the ULDO indicate that the supportable floorspace at the location is greater than what was identified in the ARC Strategy. It should be noted that the proposed centre on its own is within the size expected of a local centre under the State Planning Framework. The proposed 180m^2 of retail uses at Lots 3 and 301 Anstey Rd are uses that derive expenditure from passing traffic (fuel and takeaway food). The analysis has conservatively included these as part of the centre for modelling purposes. While these are technically within the same centre according to the City's Strategy, they do not address the role of a local centre in providing walkable access to daily shopping needs.

5.3 Modelling Impacts

Market Share

The impact is calculated using the estimated floorspace productivity of the development in 2025. All new centres and centre expansions included in 2027 have been included in 2025 to provide a complete assessment of impact. In 2025 the proposed development is expected to turnover approximately $5 million at 680m^2, up to $12 million at 1,680m^2. Turnover relative to the catchment's total Shop/Retail expenditure is insignificant, making up approximately 1% of total catchment turnover at 680m^2 and 3% at 1,680m^2.

[8] Back of house floorspace is additional to the Net Lettable Area

Impact Assessment

Turnover impact represents the reduction in a centre's turnover resulting from new competition. Two scenarios are modelled, one with the proposed development and one without. The two levels of turnover across relevant centres are then compared to estimate the impact the proposed development is expected to have.

Impact Assessment Steps[9]

- Define first year of proposed development operation; estimated to be 2025
- Model shop-retail turnover for all centres, including expansions and new centres, in 2025 (to be conservative all expansions by 2027 were included)
- Include proposed development shop-retail floorspace in model for years 2025, 2027 & 2032
- Model shop-retail turnover for all centres including proposed development in 2025, 2027 & 2032
- Calculate the change in shop-retail turnover for all centres in 2025 and analyse change by 2027 & 2032
- Estimate % change in shop-retail turnover for each centre and compare to draft SPP4.2 impact levels and how they change over time

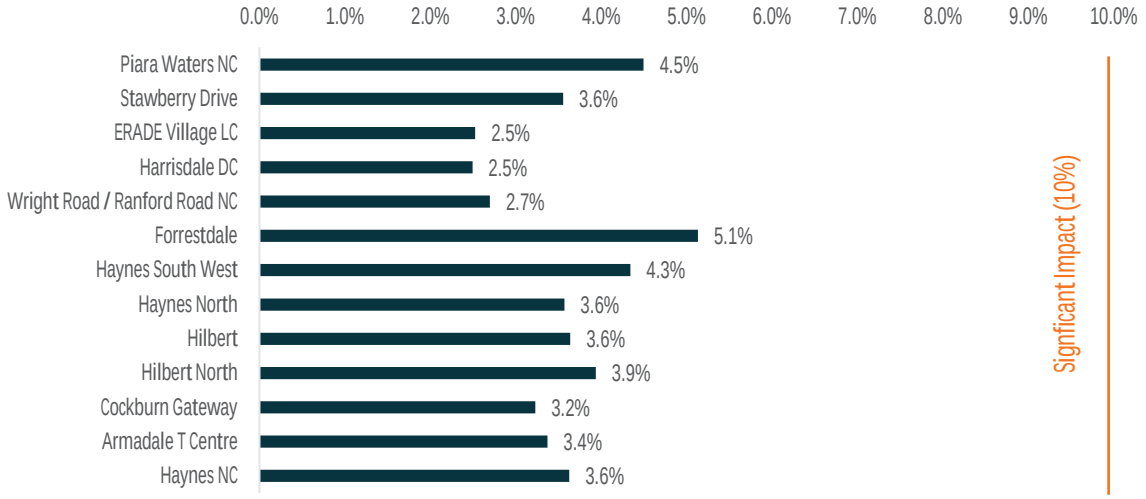
The impact on individual centres will depend on many factors, including current performance levels, the degree of dependence of one store on another and the competitive response. The impact assessment is therefore representative and an indication of likely turnover declines.

The sustainability of a centre is typically considered significantly impacted when its turnover is reduced by more than 10%.[10] Figure 16. Selected Centres – displays the results of the impact test for the proposed development at Anstey Road using a gravity model approach. The results reveal the difference in retail turnover owing to the development of the Anstey Road local centre at different floorspace amounts.

The impact test has been conducted at a proposed size of 1,680m^2 in 2025, against turnovers of the same centre's in 2025 with the proposed 180m^2 retail floorspace at the Anstey centre (Figure 16).

[9] For more details on Gravity Modelling specifically, please see Section 8, Appendix 1: Gravity Modelling Methodology
[10] As defined by the draft SPP4.2 Implementation Guidelines

Figure 16. Selected Centres – Impact Test Results



Source: Pracsys 2022

The impacts should be interpreted as the change in turnover at a centre based on the turnover drawn from the identified study area. For instance it is assumed that the Armadale Town Centre draws 15% of its turnover from the trade area; this is the impact on that 15% of turnover, not the total turnover of the Armadale Town Centre.

The impact on all centres is below the 10% significant impact and moderate impact thresholds identified in the draft SPP4.2 guidelines (and the revised SPP4.2 (2023) Impact Guidelines). This reflects the small scale of the development. Over time the identified impacts are wholly mitigated by population growth and additional expenditure in the trade area and all centres achieve increases in turnover to baseline by 2027 and significant increases in turnover compared to the baseline by 2032. This reflects the increase expenditure at the proposed development drawing largely from the significant population increase from surrounding residential developments (Figure 17).

Figure 17. Turnover Impact in 2025, 2027 and 2032

Centre	Change in Turnover from 2025 Baseline (%)		
	2025	2027	2032
Piara Waters NC	-4.5%	3.3%	42.5%[11]
Strawberry Drive	-3.6%	3.9%	3.9%
ERADE NC	-2.5%	2.9%	10.1%
Harrisdale DC	-2.5%	3.3%	11.2%
Wright Road / Ranford Road NC	-2.7%	3.2%	10.2%
Forrestdale	-5.1%	3.9%	8.9%
Haynes South West	-4.3%	5.1%	6.3%
Haynes North	-3.6%	4.4%	1.6%

[11] Large jump due to assumed stage 2 expansion in 2031

Centre	Change in Turnover from 2025 Baseline (%)		
Hilbert	-3.6%	4.5%	308.1%[12]
Hilbert North	-3.9%	4.7%	2.3%
Cockburn Gateway	-3.2%	3.2%	9.3%
Armadale T Centre	-3.4%	3.9%	3.3%
Haynes NC	-3.6%	5.5%	11.0%

Source: Pracsys 2022

The impacts show that the proposed uses will not affect the viability of surrounding centres, both current and planned.

5.4 Competitive Response

Whether actual impacts on retail centres are similar to estimated impacts largely depends on the competitive response. The competitive response is usually targeted at improving the foot traffic and therefore turnover of a centre and can be affected at a centre level or an individual tenant level. At the centre level, the response can include but is not limited to: centre refurbishment and redevelopment, tenancy re-mixing and marketing events. At the tenant level, the response may involve store refurbishment, improving the level of customer service, improving in-store management, advertising and pricing. How competitors respond will naturally affect the level of impact that is experienced as a result of the proposed development. All these factors have a potential to significantly reduce the impact of the proposed development at Anstey Road.

[12] Centre now assumed to expand from 5,000m^2 to 20,000m^2 in 2031

6 IMPACT ON COMMUNITY

6.1 Economic Benefits

The proposed development at Anstey Rd will provide ongoing employment benefits resulting from operations of the proposed retail offerings. It is estimated that by 2032 the proposed development will support 90 Full Time Equivalent jobs based on an additional 1,500m^2. Some of this employment will be a transfer from within the trade area while some will reflect new employment opportunities for locals.

6.2 Community Benefits

The proposed development will support walkable access to Shop/Retail uses for the significant population being supported by neighbouring residential developments. The proposed development will offer a variety of different retail offerings and encourage healthy competition in the area, all of which will benefit customers. This creates balance and equity of access as larger numbers of people are able to access the goods and services they desire in a timelier fashion.

The proposed development aligns with objectives in the draft SPP4.2 and the ARC Strategy. Specifically, it provides access to daily shopping needs for future residents within a walkable catchment, addresses community need efficiently and equitably and reduces the need for private car trips. The additional 3,470 persons directly adjacent to the centre will create significant demand for daily shopping trips. The proposed centre is located centrally to all of the surrounding residential developments with approximately 50% of the proposed developable area within 400m of the centre, providing high levels of walkability.

Without the proposed development the objectives identified above could not be met, specifically: the current uses proposed at Lot 3 and 301 Anstey would not address daily shopping needs; the Forrestdale local centre has not progressed with any planning and is not of sufficient scale to meet daily shopping demand (particularly as it shares a boundary with residential dwellings); and, the nearest offering to provide for daily shopping needs is over 1.4 km to the west (the future Nicholson Road North centre) and almost 5km to the east (Haynes Neighbourhood Centre). The proposed development will provide appropriate activity centre uses to create a liveable community and address Local and State planning objectives.

The benefits associated with the proposed development are likely to be a welcome addition from both and economic and community benefit perspective by providing employment, reducing travel time, providing variety, encouraging healthy competition and creating a case for equitable access.

7 CONCLUSION

This report assesses the proposed development at Lot 84, 16 Anstey Road Forrestdale, in the City of Armadale, its trade area and competition to estimate the need for and potential impacts of the development on the retail network.

Retail Needs Assessment

Population is likely to expand significantly in the 5km catchment around the proposed site over the next 10 years and beyond due to significant residential developments, and the trade area population has relatively high incomes that are likely to support increased disposable expenditure for retail items.

There are also many proposed expansions and developments to be completed in the trade area over the next 10 years which will meet the demand of the Trade Area population. Anstey Rd local centre is strategically positioned to address the daily shopping needs of directly adjacent residential developments.

Retail demand was assessed through gravity modelling, accounting for all centres identified in the trade area, as well as new developments and expansions. The analysis identified that up to an additional 1,500m^2 of Shop/Retail floorspace would be supportable at the site currently with this level of floorspace remaining viable once competing centres are completed by 2027. This accounted for the nearby fast food and service station developments on lot 3 and 301 Anstey Road, which amounts to 180m^2 of retail floorspace. Population-driven demand will continue to expand in the trade area, supporting the viability of the site through the fifteen-year timeframe of the analysis.

Impact Test

Modelling has shown that the estimated impacts are less than the moderate (5%, apart from Forrestdale at 5.1%) and well below the 10% significant impact threshold identified by the draft SPP4.2 (2020) and current SPP4.2 (2023); the sustainability of the centre hierarchy will be preserved. A number of factors contribute to this finding, including:

- The development is small and would not achieve a concentration that would draw customers away from larger surrounding centres, relying predominantly on local expenditure
- The development is in an expanding residential area that will have high population levels mitigating the impact on nearby centres
- There are few centres in immediate proximity to the proposed development
- A profitable competitive environment

Overall, the development is expected to be a positive contribution to the retail network as it will create significant economic and community benefit. Local residents will benefit through walkable access to daily shopping amenity, reduced travel times for daily shopping trips, increased variety and healthy competition that will not undermine the activity centre hierarchy. This benefits all households and allows a larger share of income to be directed to other activities.

The Proposed Development aligns with draft SPP4.2 and ARC Strategy objectives and can be recommended for approval.

8 APPENDIX 1: GRAVITY MODELLING METHODOLOGY

Gravity models allow for the measurement of spatial interaction as a function of distance to determine the probability of a given customer shopping at a centre and provide an approximation of trade area and sales potential for a development. This modelling technique uses the distance between a household and each centre, and a measure of 'attractiveness' to define the probability model. The 'attractiveness' of a centre has been defined by total floorspace and the distance has been calculated by measuring straight-line distances between each centre and population. The gravity model probability formula is shown in Figure 18.

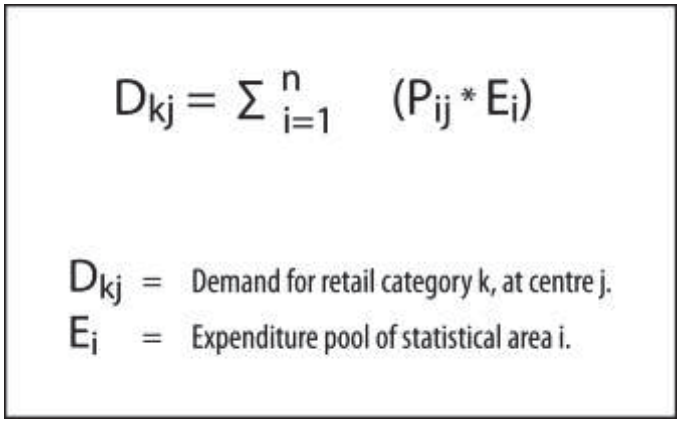
Figure 18. Gravity Model Probability Formula

$$P_{ij} = \frac{\frac{A_{jk}^{a}}{D_{ij}^{ß}}}{\sum_{j=1}^{m} \frac{A_{jk}^{a}}{D_{ij}^{ß}}}$$

P_{ij}	=	Probability of customer living/working in statistical area i shopping at complex j.
A_i	=	Area of floorspace in centre, j in square metres, according to the type of supply, k.
D_{ij}	=	Distance between statistical area of households, i and complex j.
a	=	Area exponent
ß	=	Distance exponent
k	=	Type of supply or expenditure, either Convenience or Comparison
i	=	Statistical area (i=1,...,n)
j	=	Complexes (j=1,...,m)

Source: Carter, C (1993) 'Assumptions Underlying the Retail Gravity Model', *Appraisal Journal,* Vol 61, No 4, pp510; Pracsys (2020)

Figure 19. Gravity Model Demand Formula



Source: Carter, C (1993) 'Assumptions Underlying the Retail Gravity Model', *Appraisal Journal,* Vol 61, No 4, pp510; Pracsys (2020)

Figure 19 shows that the demand for retail category k[13], at centre j, is equal to the sum of the probabilities of customers living in statistical areas i to n, multiplied by the expenditure pool of statistical area i. In other words, the demand for retail is a function of the probability of customer from particular statistical area attending the centre multiplied by the expenditure pool of that statistical area. The expenditure is pool is derived through the population multiplied by its income distribution.

In its core form gravity modelling provides a clearer, reproducible outcome that can be easily assessed. However, it does not consider local factors, including:

- The comparative value proposition of centres (e.g. the presence of an 'anchor' attractor that draws significant market share);
- The brand preference of users; or
- The efficiency of transport networks, as well as geographical barriers (e.g. in some cases it may be easier for customers to access a centre that lies physically further away).

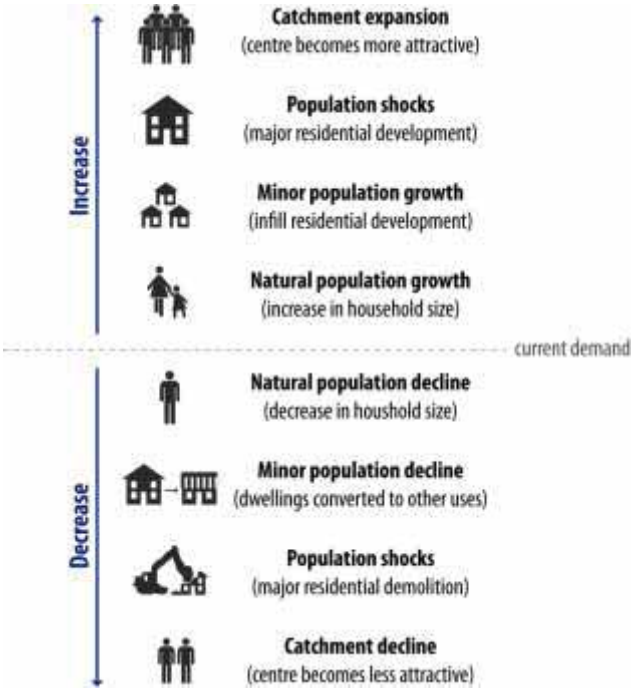
8.1 Drivers of Retail Floorspace Supply and Demand

Demand changes can result in increased or decreased expenditure. The potential causes of demand changes are shown in Figure 20. These largely show that an increasing population increases demand, and vice versa. There are significant amounts of commercial floorspace, especially office floorspace, flagged for the central sub-region of Perth and beyond. There will also be significant numbers of new dwellings provided across Perth. This increase in residents has the potential to boost demand for goods and services in the area.

[13] Retail categories are determined by their PLUC code and whether they are convenience or comparison goods. Convenience goods are day-to-day items such as groceries, pharmaceuticals and fast food. Comparison goods are items where consumers are willing to travel further distances, and are bought less frequently such as clothing, furniture, electronics, or other household items.

Demand can also increase from rising incomes, or wealth, because people have more disposable income to spend on retail. Demand can also be increased by reducing leakage. Leakage for retail is largely caused by online retail, as well as travelling.

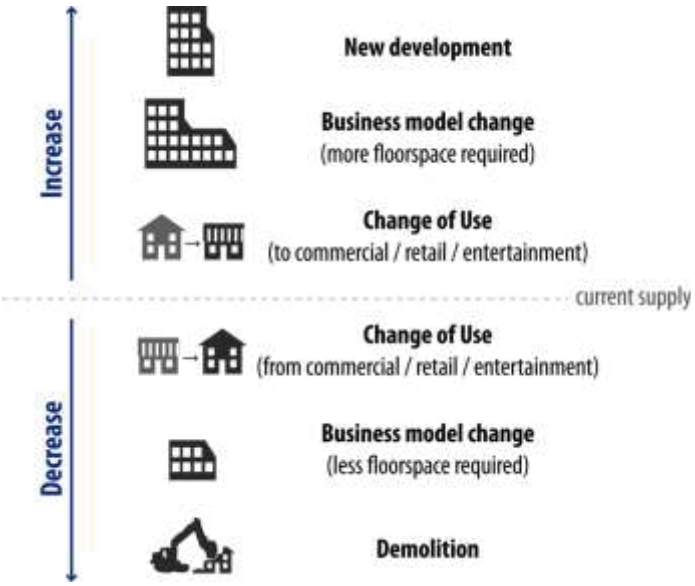
Figure 20. Drivers of Retail Floorspace Demand



Source: Pracsys 2020

Supply changes can result in increased or decreased retail floorspace. The potential causes of supply changes are shown in Figure 19.

Figure 21. Drivers of Retail Floorspace Supply



Source: Pracsys 2020

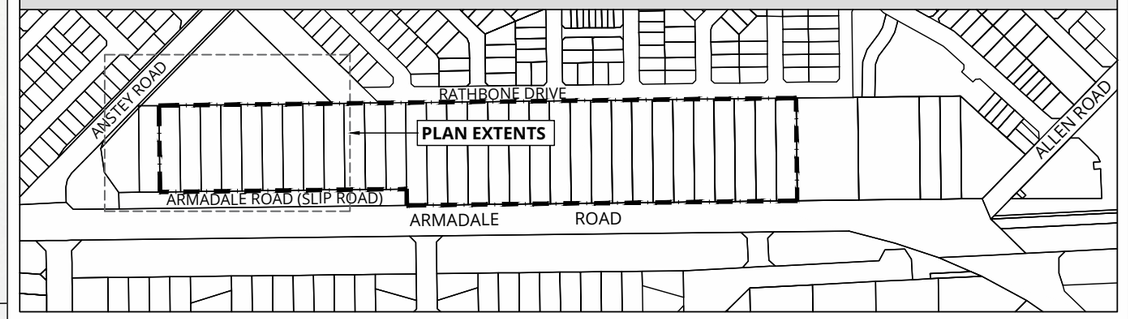
ATTACHMENT 4

Subdivision Concept Plans

LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



ANSTEY ROAD

FUTURE LOCAL CENTRE

RATHBONE DRIVE

117

116

115

99

1 499m² | **1** 499m² | **1** 424m² | **1** 370m² | **1** 370m² | **1** 436m² | **1** 436m² | **1** 478m² | **1** 478m²

CP 110m² | CP 97m² | CP 97m² | CP 113m² | CP 113m² | CP 124m² | CP 124m²

2 404m² (4) | **2** 404m² (5) | CP 243m² | CP 242m²

2 534m² (6) | **2** 468m² (7) | **2** 467m² (529) | **2** 549m² (9) | **2** 550m² (88) | **2** 601m² (89) | **2** 601m² (90)

BALANCE LOT 4 554m² | **BALANCE LOT 5** 554m² | **BALANCE LOT 6** 633m² | **BALANCE LOT 7** 766m² | **BALANCE LOT 529** 766m² | **BALANCE LOT 9** 602m² | **BALANCE LOT 88** 602m² | **BALANCE LOT 89** 498m² | **BALANCE LOT 90** 498m²

SLIP ROAD (ARMADALE ROAD)

LEFT IN /LEFT OUT

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CONCEPT PLAN - R25 DENSITY (PAGE 1 OF 3)

VARIOUS LOTS - ARMADALE ROAD

FORRESTDALE

N

0 20 m

SCALE @ A3: 1:600

9269-CON-14-D

DRAWN: WC
DATE CREATED: 2026.04.07
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

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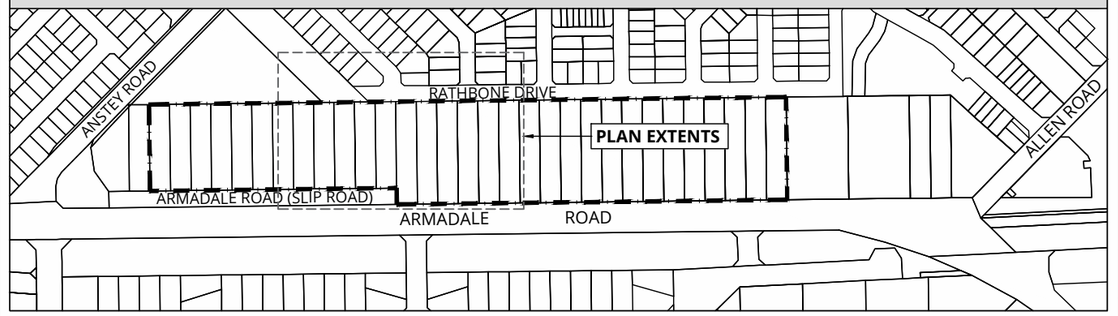
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



618 617 616

RATHBONE DRIVE

RATHBONE DRIVE

RATHBONE

ARMADALE ROAD (SLIP ROAD)

| | | |

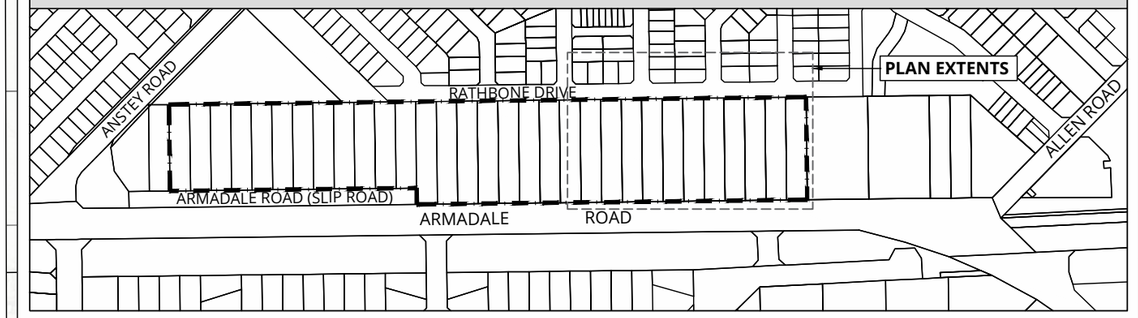
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



RATHBONE DRIVE RATHBONE DRIVE

DRAINAGE 24

CONCEPT PLAN - R25 DENSITY (PAGE 3 OF 3)

VARIOUS LOTS - ARMADALE ROAD
FORRESTDALE

N

0 20 m
SCALE @ A3: 1:600

9269-CON-14-D

DRAWN: WC
DATE CREATED: 2026.04.07
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

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ATTACHMENT 5

Local Water Management Strategy

Various Lots, Armadale Road, Forrestdale

LOCAL WATER MANAGEMENT STRATEGY





B23017
September 2025
V3

DOCUMENT QUALITY CONTROL

Project Reference		B23017
Ver No.	Purpose	Date
Draft – V1	Client Review	July 2023
V2	Submission for Approval	August 2023
V3	Resubmission for Approval with revised layout	September 2025

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Appendix A Servicing report

Appendix B Forestdale main drain arterial strategy

1 EXECUTIVE SUMMARY

This Local Water Management Strategy (LWMS) has been developed to accompany the structure planning for the subject land.

The subject land is composed on 23 lots along Armadale Road, Forrestdale in the City of Armadale. The subject land sits within the investigation area that includes a further 14 lots. The investigation area has been defined as a logical area of analysis to support water management within the subject land. The investigation area's southern boundary is the Armadale Road while Anstey Road and Allen Road form the western and eastern boundaries respectively. The northern boundary is composed of a currently developing area within the Anstey Keane Urban Development East area. The subject area and investigation area can be seen in Figure 2 and 3, with the location shown in Figure 1.

The subject land is relatively flat. A Water Corporation drain (Baileys Branch Drain) traverses the subject land from south to north with a drainage reserve. The current landuse is composed of single dwellings on large lots. There are no wetlands or natural waterways within or adjoining the subject land.

The Armadale Road runoff is generally contained as gutter flow with a pit over the Water Corporation Drain. On lot water is generally dealt with on a lot by lot basis.

The objective of this LWMS is to detail the best management practices approach to water management that will be undertaken for the development. This will include managing, protecting and conserving the total water cycle of the local environment and the greater catchment. The practices will involve:

- Stormwater management that incorporates the water sensitive urban design practices;
- Flood protection from localised and regional flood levels;
- Groundwater resource management;
- Protection of ecosystems dependent on water resources from the subject land; and
- Sustainable water servicing

The effectiveness, efficiency and benefits provided by the best management practices require a collaborative effort between local governments, developers and relevant regulatory authorities. The developers are committed to the concepts and outcomes outlined within the approved LWMS for the subject land. This includes the implementation, monitoring and maintenance of the best management practices for stormwater designed specifically for this site.

1.1 PLANNING SUMMARY

This LWMS has been produced to support the structure planning process for the subject land. The land comprises 23 landholdings within the subject land that are the focus of this LWMS, within a further 14 lots that form the overall investigation areas identified in Figure 2. There is a proposed 4.45ha of developable area within the subject land.

The subject land is currently zoned Urban Development. The proposed development seeks to increase the density of the subject land lots to R40-R60. This is to be primarily achieved through development of localised strata developments or potentially small lot green title developments.

1.2 SUPPORTING DOCUMENTATION

This LWMS has been compiled using information contained within the detailed assessments and reports undertaken for the subject land and from the Antsey Road Forrestdale Structure Plan. For further information relating to the water management on the subject land please refer to these supporting documents:

- *Western Environmental* (2023) Letter – Structure Plan- Various Lots, Armadale Road Forrestdale (Flora and fauna)
- *JDSI* (2023), Servicing Report Forrestdale Structure Plan
- *Hyd2o* (2019) Anstey Road East, Forrestdale Local Water Management Strategy
- *Department of Water* (2009) Forrestdale main drain arterial drainage strategy

Existing site showing Baileys Branch Drain and associated reserve





Figure 1 Location Plan

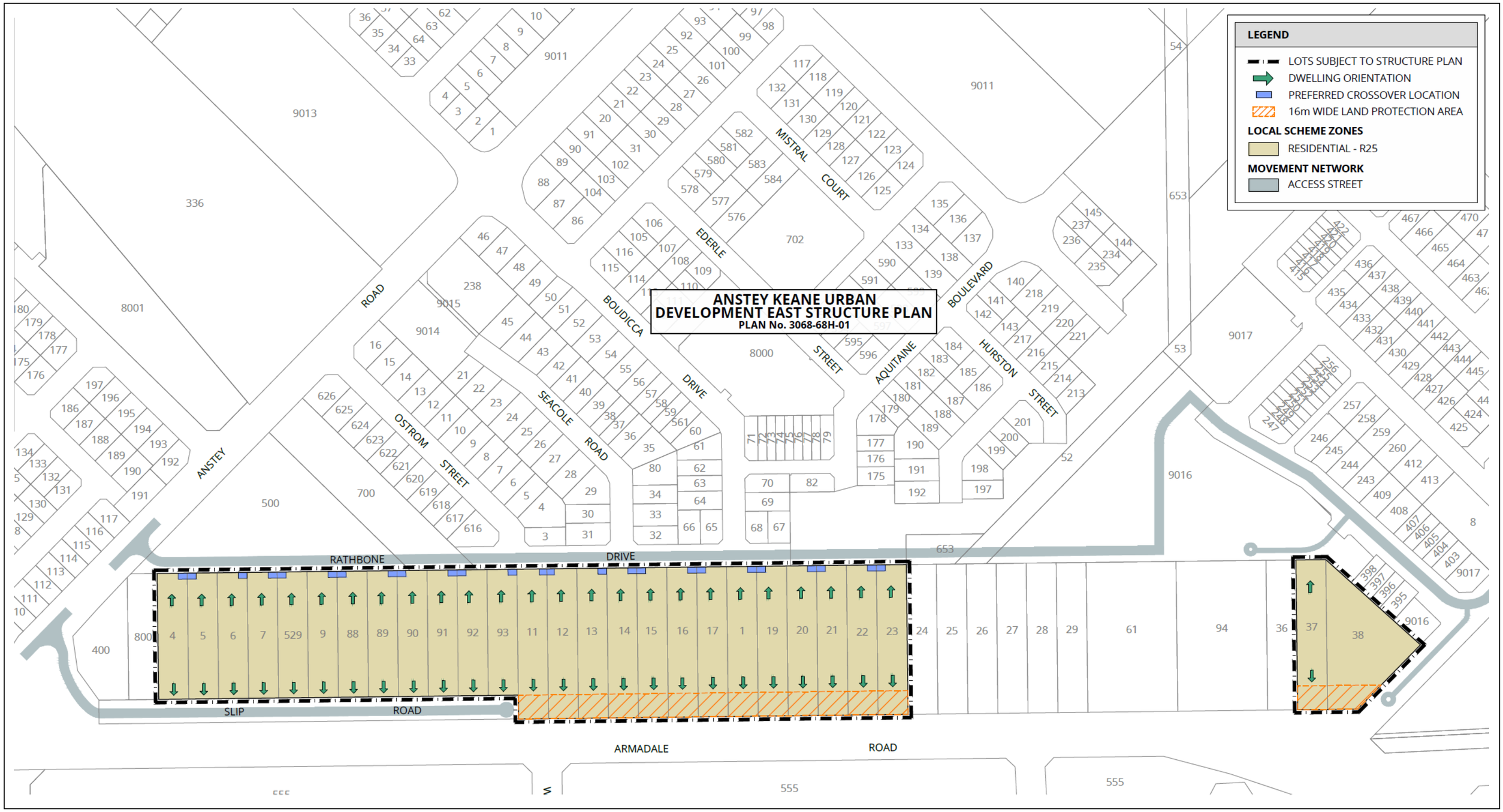


Figure 2 Local Structure Plan showing proposed density

2 KEY ELEMENTS PLAN

Water management strategies for the subject land are based on best practice water sensitive urban designs that integrate sustainability and the provision of attractive communities. The strategies will be achieved through the synthesis of planning and designs to manage, protect and conserve the total water cycle. The plans and designs for the development are appropriate for the subject land's commercial and residential development, surrounding environment and local drainage characteristics.

A summary of the WSUD elements that will be implemented within the development to achieve best management practices are outlined below. The general strategies can also be seen in Figure 3:

Water Conservation and Servicing

- The site is to be serviced with potable water from Water Corporation.
- Sewer is to be gravity fed to the Water Corporation sewer main
- Landscaping is to be waterwise to reduce irrigation requirements.

Stormwater Management

- 1EY treatment is achieved through on lot detention and roadside soakwell infiltration.
- Each strata development is to implement on lot detention systems that store and infiltrate the 1% AEP 1 hour event as set out in the City of Armadale guidelines as well as the additional storage to achieve pre development lot runoff rates.
- New road detention in to be in roadside soakwells or other detention structures as agreed with the City.
- Flows off site in events up to and including the 1%AEP will be at or below pre development rates.

Flood Protection

- All finished floor levels will be designed to be a minimum 300mm above the internal gutter flow and adjoining road gutter flows.
- All finished floor levels will be designed to maintain a minimum separation clearance of 500mm between the habitable floor levels and the 1% AEP flood levels of Baileys Branch Water Corporation Drain flood level.

Ecosystem Protection

- Water sensitive urban designs (WSUD) will utilise swale systems and onsite infiltration to capture sediments, large debris and nutrients from all water runoff from impervious surfaces, reducing impacts on downstream wetland systems.
- Any landscaping is to utilise nutrient and waterwise practices to minimise contamination of the groundwater.

Groundwater Management

- Groundwater levels are to be controlled via subsoil networks to minimise groundwater rise post development, with the outlet set to be free draining.

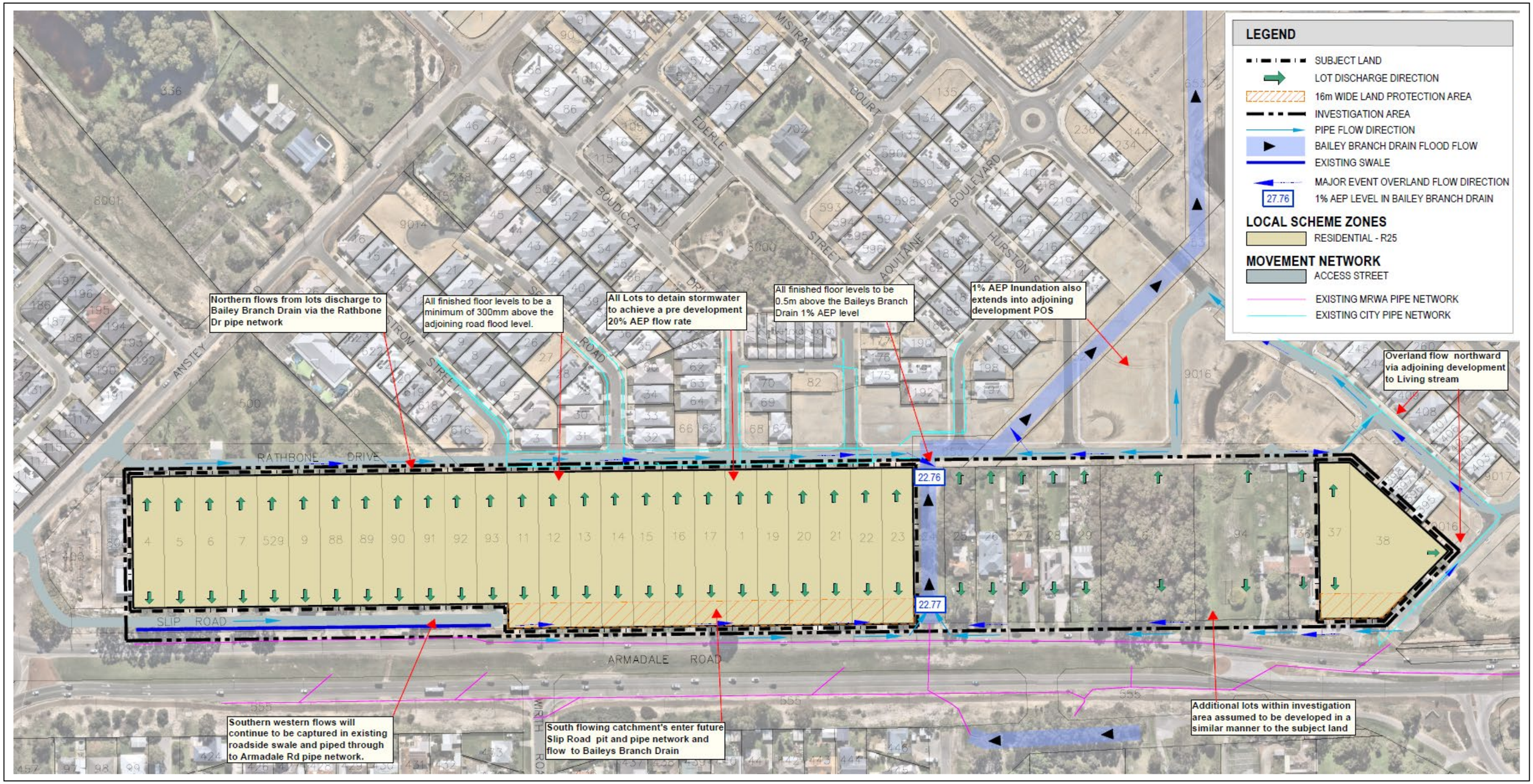


Figure 3 Key Elements Plan

3 GEOTECHNICAL

GEOTECHNICAL CONDITIONS

Mapping by the Geological Survey of Western Australia (1986), Armadale Geology Sheets and other available information indicates that the surface geology for the Site consists of varying soils including predominantly Bassendean Sand with some Guildford Formation (low plasticity clay and silty sand with traces of lateritic gravel) to the eastern corner of the study area.

Geotechnical investigation directly to the north show grey Bassendean sands to over 1m at the test pits closest to the subject land

On site investigations geotechnical investigations have not currently been undertaken , however the surface appears to be a grey sand , which would support the Bassendean Sand mapping. This can be seen in the adjoining photo.

ACID SULPHATE SOILS

Acid Sulphate Soils (ASS) mapping shows that the site is considered to have a low to medium chance of ASS within the subject land. The mapping can be seen in Figure 4.

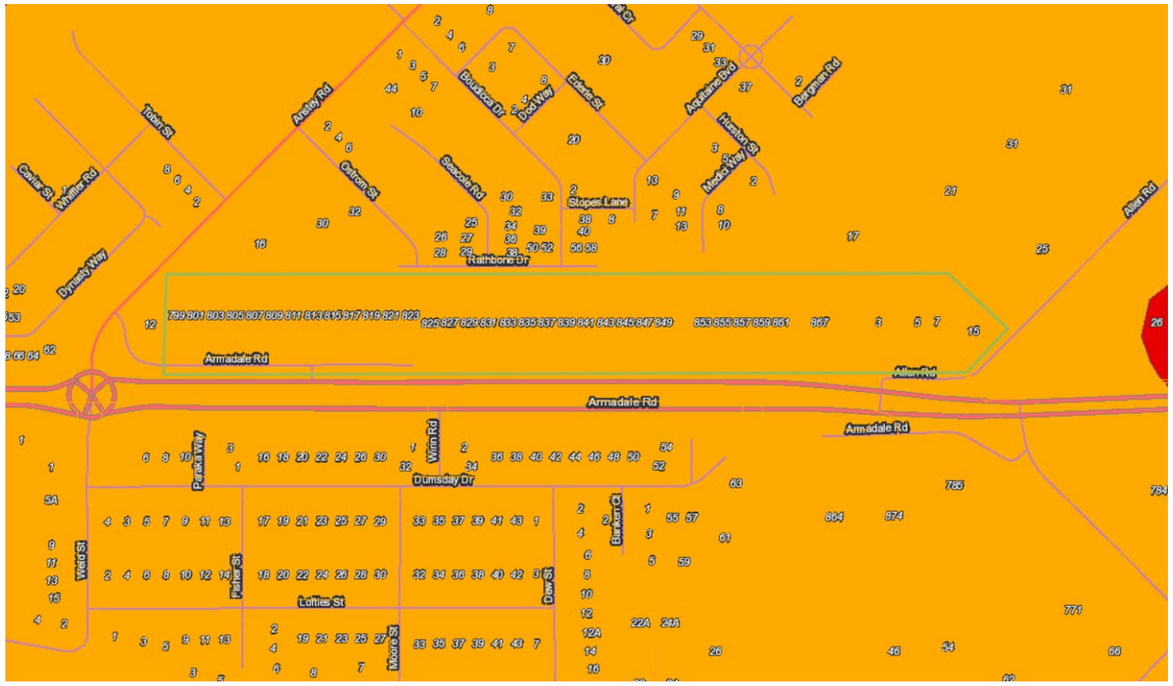


Figure 4 ASS mapping

CONTAMINATED SITES

The Department of Water and Environmental Regulation (DWER) contaminated sites database was searched for known contaminated sites (sites classified as Contaminated-restricted use, remediated for restricted use or Contaminated- remediation required) in proximity to the site. To date, the site has not been reported to DWER as a known or suspected contaminated site either prior to or after the commencement of the *Contaminated Sites Act* 2003.

PERMEABILITY

No permeability testing has been undertaken for the subject land. Permeability testing undertaken within the development directly to the north found results between 1.7m/day and >10m/day. The closest reading, which borders the site was for 1.7m/day. The highest reading was the furthest in a lower wetter location. Based on this, and the likely sandy nature of the soil, a conservative average of 1.5m/day has been assumed as the permeability for the subject land. This will need to be refined for each portion of the development as part of detailed design.



Grey sand noted within undeveloped areas.

4 LANDFORM AND ENVIRONMENTAL CONDITIONS

4.1 LANDFORM

The subject area is a flat sand plain. The land falls from approximately 26m on the western edge to the Baileys Branch Drain, where the top level of the drain is approximately 23.65mAHD. The site also falls from approximately 25mAHD near the eastern border back to Baileys Branch Drain as well. The very far eastern portion is likely to fall eastward to Allen Road. The southern border for the lots are generally lower than Armadale Road, where they join directly, with the actual lots then generally rising slightly upwards where the buildings are located.
On the Armadale Road slip road, there is a grassed swale approximately 0.5m deep. This falls eastward to a drainage headwall.

The landforms can be seen in Figure 5.

4.2 ENVIRONMENTAL

An environmental investigation was undertaken by Western Environmental with advice provided in letter format. This included a desk top survey of flora and fauna and an arborist Report (Tree Survey). The investigation found no threatened flora or fauna or ecological communities. There is no intact native vegetation and no evidence of riparian species.

The current Water Corporation Drain provides very limited habitat for generalist riparian fauna. The flora along the drain is predominately introduced weeds which are periodically cleaned out.

4.3 WETLANDS

The site contains no wetlands. A Multiple Use Wetland, as defined in the Swan Coastal Plain Geomorphic Wetland Dataset (DBCA), is located just to the north. This area is currently being developed and filled. There are no other wetlands within 50m of the subject land.

The wetlands and waterbodies can be seen in Figure 6.

4.4 WATERWAYS

No natural waterways occur on the subject land.

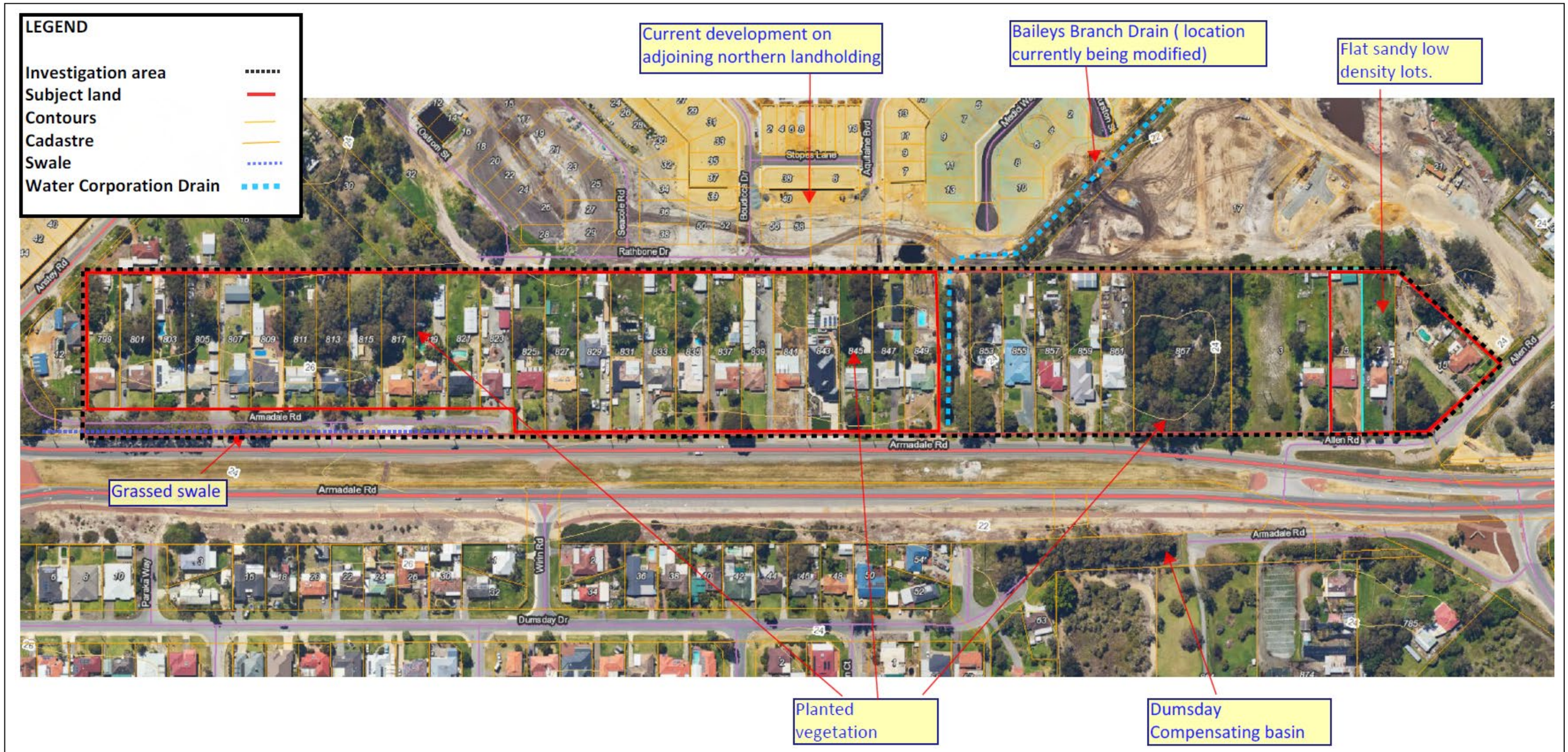


Figure 5 Current landform and characteristics



Figure 6 Wetlands

5 PRE DEVELOPMENT SURFACE WATER SITUATION

5.1 SURFACE WATER CHARACTERISTICS

There are no defined significant natural watercourses on the subject land.

The Baileys Branch Drain traverses the subject land through from Armadale Road to the adjoining northerly development area. The invert of the pipe entering the subject land was noted as 21.57mAHD in the Forestdale Main Drain Arterial Drainage Study. The Drain is currently trapezoidal in nature as can be seen in the adjoining photo.

Armadale road has extended gutter flow before discharging via a side entry pit directly to the Baileys Branch Drain.

Along the western slip road, that adjoins Armadale Rd, the water predominantly sheets off into the grassed swales where it infiltrates. In larger events it enters the pipe network at the eastern end, before flowing to the Baileys Branch Drain.

Along the Allen Road portion that adjoins the subject land, the gutter flow heads enters side entry pit near the eastern end. This then enters the Armadale Rd drainage network, which flows to Baileys Branch Drain. In larger events, that exceeds the pipe network, flows will generally pond then flow north eastward along Allen Road.

The lots that directly front Armadale Road are generally lower between the house and the verge. As the area to the north is being raised as part of current development, lot stormwater in this portion will generally infiltrated on site in smaller events. In larger events water will tend to pond then flow overland to Baileys Branch Drain.

For the lots that front the slip road, lots generally fall to the slip road for the southern portion. The northern portions tend to flow north or north eastward ward as sheet flow, where in large storm events it would eventually enter the Baileys Branch Drain downstream and to the north of the subject land. The filling of the adjoining development to the north means that this water will now be directed eastward to the Baileys Branch Drain.

Figure 7 shows the general flow of surface water on the subject land and the connection through to the Baileys Branch Drain and downstream Living Stream currently being developed to replace a portion of this drain.



Baileys Branch Drain from Armadale Road looking downstream

5.2 SURFACE WATER QUALITY

Surface water quality samples were taken from Baileys Branch Drain from Armadale Rd,(SW1) as part of the Anstey Rd East, Forrestdale LWMS. The following is a summary of this information.

Samples were taken over winter when the drain was observed to be flowing resulting in samples collected in June, July and August 2016 and July, August and October 2017.

Each sample was analysed in situ for physical parameters (temperature, electrical conductivity (EC) and pH), with samples sent to a NATA approved laboratory for analysis of nutrients and heavy metals.

Surface water quality results are summarised in Table 1 and below, with comparison to ANZECC (2000) guidelines:

- Mean pH at SW1 was 6.46. Results are close to within the ANZECC guideline range of 6.5 to 8.0 pH.
- Mean EC at SW1 was 0.50 mS/cm and 0.74 mS/cm. Results are slightly above the ANZECC guideline range of 0.12 mS/cm to 0.30 mS/cm.
- Mean TN at SW1 was 2.68 mg/L. These values exceed the ANZECC guideline concentration of 1.2 mg/L.
- Mean TP at SW1 was 0.46 mg/L. These values also exceed the ANZECC guideline concentration of 0.065 mg/L.

The results are relatively typical of main drain systems draining urban and semi-rural areas on the eastern Swan Coastal Plain.

The mean results for all heavy metals were within the 99% trigger levels of protection for freshwater species.

Table 1 Surface Water Quality sampling

Parameter	ANZECC	SW1 (upstream – Armadale Road)
EC (mS/cm)	0.12 – 0.30	0.50
pH	6.5 – 8.0	6.46
TN (mg/L)	1.2	2.68
TP (mg/L)	0.065	0.46
TKN (mg/L)	-	1.88
Ammonia (mg/L)	0.08	0.09
Nitrite as N (mg/L)	-	0.01
Nitrate as N (mg/L)	-	0.80

5.3 BAILEYS BRANCH DRAIN MODELLING

Flow modelling has been undertaken for Baileys Branch Drain by Water Corporation. The flows and levels were refined through the Forestdale Main Drain Arterial Drainage Strategy (FMDADS) (*DOW 2009b*) assessment. This includes the creation of a Living Stream within the development downstream of the subject land, which is currently under construction. The determined levels for the Baileys Branch Drain where it flows through the Investigation area are as follows:

Existing system (as at 2009)

- The 10 year ARI flood level of the drain north or Armadale Road and through the subject land was set as 22.53mAHD. The 100 year ARI level was 23.05mAHD
- All of these values are below the top of the current drain (approximately 23.65mAHD) meaning there is no overtopping.
- The 10 year ARI flow rate of the drain was determined as 0.0.86m^3/s, with the 100year ARI rate being 1.1m^3/s.

Modelled Adopted Strategy (Option A)

- The 10 year ARI flood level of the drain north or Armadale Road and through the subject land drops from 22.31mAHD to 22.30mAHD. The 100 year ARI level drops from 22.77mAHD to 22.76mAHD.
- These values are lower then ethe existing and also below the top of the current drain (approximately 23.65mAHD), meaning there is no overtopping.
- The 10 year ARI flow rate of the drain was determined as 0.99m3/s, with the 100 year ARI rate being 1.31m^3/s.

It should be noted that recent updates to Australian Rainfall and Runoff (Ball et al, 2016) have resulted in changes in terminology being recommended to describe design rainfalls. The following is a summary of the closest event and changed terminology:. For the purpose of this report, Average Rainfall Interval (ARI) terminology used in DoW (2009b) has therefore been replaced with the updated terminology as follows:

- *1 Year ARI – replaced with 1 EY*
- *10 Year ARI – replaced with 10% AEP*
- *101 Year ARI – replaced with 1% AEP*

(note this is approximate only, as 10% AEP is equivalent to a 9.49 Year ARI)

For the purpose of this report, Average Rainfall Interval (ARI) terminology used in DoW (2009b) has therefore been replaced with the updated terminology for current subject land modelling.

Further details can be seen in Appendix B.

5.4 PRE-DEVELOPMENT MODELLING FOR THE SUBJECT LAND

A predevelopment model was constructed in DRAINS. The subject land areas were divided into separate sub catchments. The current slip road was also designated as a sub catchment. The remaining areas within the investigation area were also divided into sub catchments. The majority of the area is assumed to drain to the Baileys Branch Drain based on the following:

- General broad contours (Esinet) show a fall to the drain either currently or historically, noting that this includes overland flow paths across adjoining land to the north
- The filling of the development to the north means that the historical longer flow path has now been halted and instead water will flow along the northern boundary to the drain
- The FMDADS, show the entire subject land being within the same catchment (Cat B2 in the FMDADS), with this catchment discharging through to the Baileys Branch Dain.
- The pipe network in Armadale Rd picks up flows from the slip lane and southern discharges off the subject land, with the flows discharging outlet to the Baileys Branch Drain.

The exception to this maybe a very small area at the far eastern end that may flow north eastward along Allen Road, once the pipe capacity is exceeded. It is noted however that the development of the adjoining land shows this area eventually being directed back to the drain. For these reasons the entire site has been modelled as flowing to the Bailey Branch Drain.

To assist with determining future discharges, the subject land and wider Investigation Area have been divided into sub catchment. These can be seen in Figure 7.

The key pre development modelling assumptions included:

- Soil Factor 1.5 was assumed to reflect the Bassendean Sand present with some potential for groundwater at 300mm below the surface impeding infiltration in larger events.
- Lots are assumed to be 30% impervious (5% directly connected to the outside drainage networks and 25% disconnected so that the water has to flow over pervious areas first). Impervious areas include rooves, driveways and paved areas.
- Impervious areas were assumed to have a retardance coefficient of 0.01 for disconnected impervious areas and 0.013 for connected areas.
- Pervious areas were assumed to have a retardance coefficient of 0.1 to reflect the rough vegetated surface.
- Overland flow paths to Baileys Branch Drain that are not within a current road reserve were assumed to have a be along the front and rear boundaries of the lots (respectively for the south and north portions of each lot).
- Existing lots were assumed to have on site detention at a rate of half of the current City requirements, due to the age of the dwellings (eg half of the 1 hour 1% AEP event) but not have a lot connection. All flow from lots was assumed to leave as overland flow.
- In the 1% AEP event, no back water effect was assumed, as the peak of the Baileys Branch Drain will generally happen after the subject land peak and the flood level does not reach to the natural surface.
- The Baileys Branch Drain has an assumed impervious area of 30% to reflect the standing water during wet winter periods.

The final storms modelled were the 5min,10min,15min, 20min,25min, 30min, 1 hr, 2hr, 3hr, 4.5hr, 6 hr, 9hr, 12hr, 18 hr and 24 hour. Longer events were not modelled as the peak events off all areas were generally between less than 12 hours. These events were modelled for the 20% AEP and 1%AEP.

It is noted that FMDADS assumed a nil Fi (fraction impervious) within the subject land, for the Existing Situation modelling. The presence of roads, houses and other infrastructures currently within the subject land and wider Investigation Area means that this assumption is erroneous. As such, the pre development modelling has utilised the above impervious assumptions which better represent the current situation.

The results from this modelling are outlined in Table 2. It is noted that there is minimal flow in the 1EY and 20% AEP, with a large increase in the 1% AEP. This is typical of sandy areas with moderately high initial infiltration.

Table 2 Predevelopment flow summary

Sub catchment	20% AEP		1% AEP		End destination/Comments
	Flow rate (m^3/s)	Critical event	Flow rate (m^3/s)	Critical event	
Lots					
NW	0.018	10min	0.553	15min	Flows to Rathbone Dr then Baileys Branch Drain (north)
SW	0.01	5min	0.26	15min	Flows to existing Slip road swale then MRWA pipe to Baileys Branch Drain
NC	0.02	10min	0.613	15min	Flows to Rathbone Dr then Baileys Branch Drain (north)
SC & W Rd	0.017	10min	0.456	15min	Flows south then overland to Baileys Branch Drain (south)
RN	0.011	10min	0.402	15min	Flows to Rathbone Dr then Baileys Branch Drain (north)
RS & R Rd	0.018	10min	0.43	15min	Flows south then overland to Baileys Branch Drain (south)
RNE,	0.005	10min	0.19	15min	Flows to future road network to north, the existing pipe network to Living Stream
NE	0.001	5min	0.053	15min	Flows to future road network to north, the existing pipe network to Living Stream
SE & E Rd	0.002	5min	0.056	15min	Flows south then overland to Baileys Branch Drain (south)
E	0.019	10min	0.14	15min	Flows to Allen Rd, then existing pipe network to Living Stream
Roads					
EXISTING ROAD	0.043	15min	0.148	15min	Swale volume and discharge points to remain. Eg MRWA pipe to Baileys Branch Drain
Other					
BB	0.004	5min	0.089		Direct flow into Baileys Branch Drain from reserve
Totals					
Total to Allen Rd	0.019	10min	0.14	15min	*Peak from eastern lot to Allen Rd.*
Total to Baileys North	0.032	15min	1.256	15min	*Peak from all areas flowing north*
Total to Baileys South	0.017	15min	1.078	15min	*Peak from majority of south flowing lots plus Bailey Branch Drain reserve*
Total to Armadale Road	0.043	15min	0.148	15min	*Pipe flow into MRWA Armadale Rd network*
Combined totals	0.111		2.622		

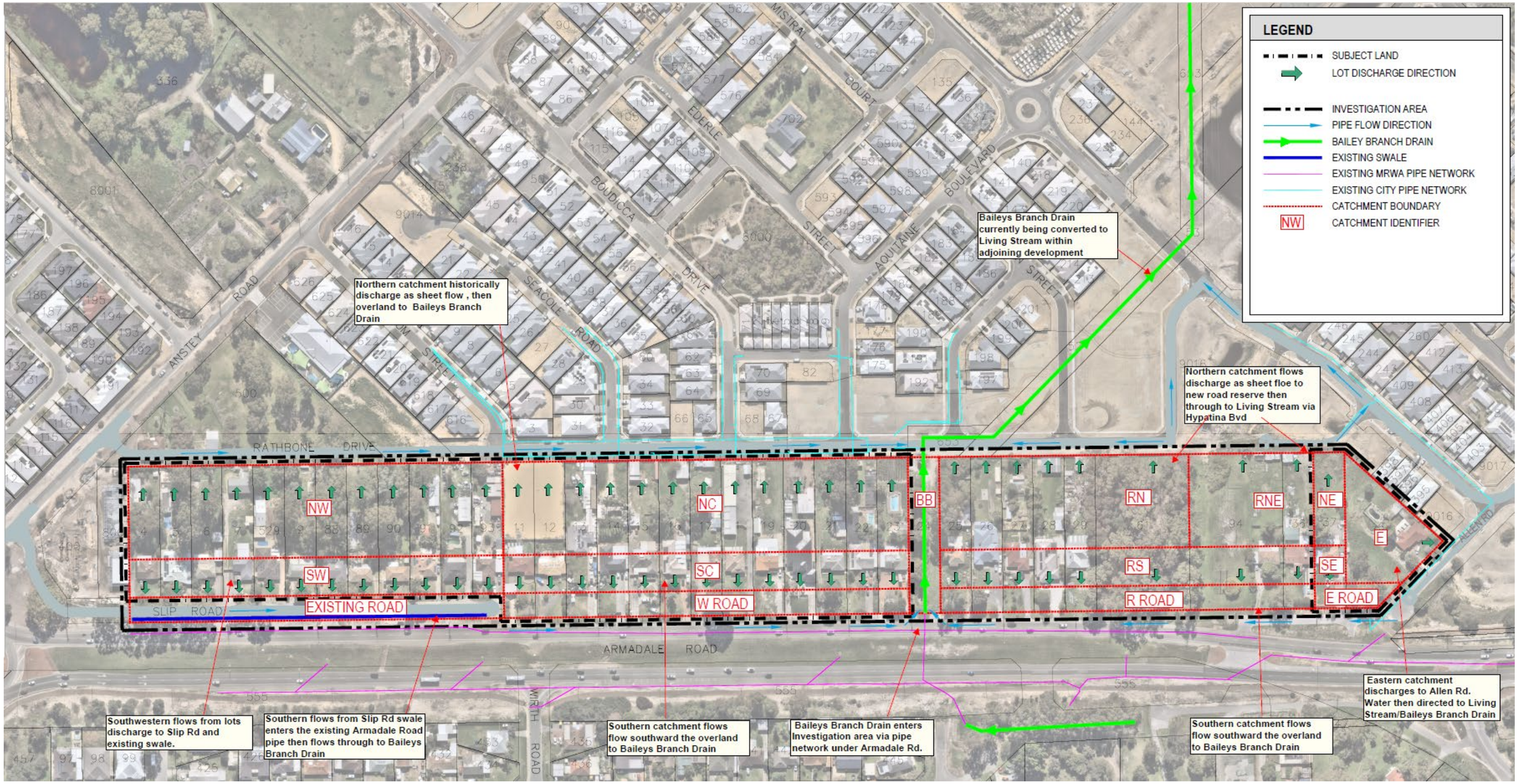


Figure 7 Pre development surface water characteristics

6 GROUNDWATER (PRE DEVELOPMENT)

The following is a summary of the current groundwater characteristics of the site. This information is based on groundwater investigations undertaken as part of the Anstey Road East, Forrestdale LWMS. These are approved levels and have been gathered from 18months of monitoring (including 2 winters) and referencing to surrounding longterm DWER bores.

As the site adjoins the subject land and there is no wetland characteristics noted, this information is deemed suitable for the current level of planning. Conservative values have been used, noting that the groundwater is generally rising as it heads into the subject land. Extrapolated groundwater contours have been superimposed on the subject land and can be seen in Figure 9. Groundwater investigations are be undertaken to refine levels as part of the subdivision process and reported in the relevant UWMP.

6.1 GROUNDWATER LEVELS

The Water Corporation's Baileys Branch drain acts as a draw down point for groundwater. Using contours developed from the maximum groundwater recorded, the groundwater level as the drain leaves the subject land, is approximately 23.6mAHD. To the west, the groundwater rises to approximately 23.8mAHD. Moving to the east of the drain, the groundwater flattens out to approximately 22.4mAHD.

The groundwater maximum levels were generally recorded in September 2016 and minimum levels were recorded in April 2016. The levels change between approximately 1.1m and 2.3m seasonally. The contours can be seen in Figure 9.

These levels are similar to the broader scale groundwater modelling undertaken as part of the Forrestdale main drain arterial strategy which has a general grade from west to east of 24mAHD to 22.3mAHD. These broadscale contours, by definition, do not highlight the localised impact of the Baileys Branch drain within the subject land. These can be seen in Figure 10.

With these AAMGL's, the separation to groundwater is generally

6.2 GROUNDWATER QUALITY

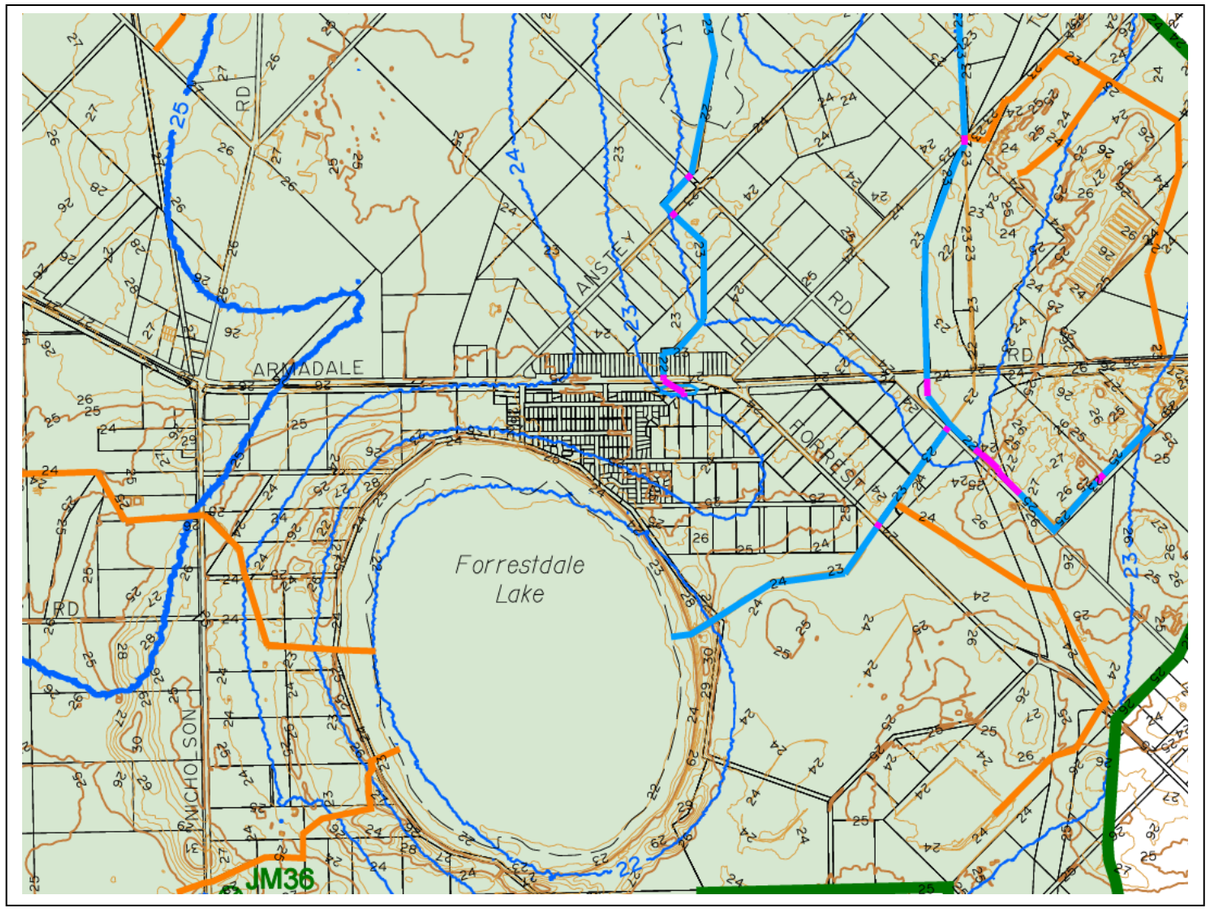
Groundwater quality sampling has not been undertaken to date within the subject land. Quality recorded as part of the adjoining northerly LWMS was reviewed to determine likely quality, primarily in the 2 closes bores; AK1 and AK7. The results can be seen in Table 3.

The results are typical of former rural residential areas on the eastern portions of the Swan Coastal Plain. This includes slightly acidic groundwater with high nutrients.

Table 3 Water quality of nearby bores.

Parameter	ANZECC	AK1	AK7
EC (mS/cm)	0.12 – 0.30	1.79	4.90
pH	6.5 – 8.0	6.66	6.33
TN (mg/L)	1.2	23	9.5
TP (mg/L)	0.065	0.66	1.04
TKN (mg/L)	-	12.1	9.5
Ammonia (mg/L)	0.08	0.33	0.28
Nitrite as N (mg/L)	-	0.05	0.01
Nitrate as N		11.02	0.02

Figure 8 Groundwater levels as per Forrestdale main drain arterial drainage strategy



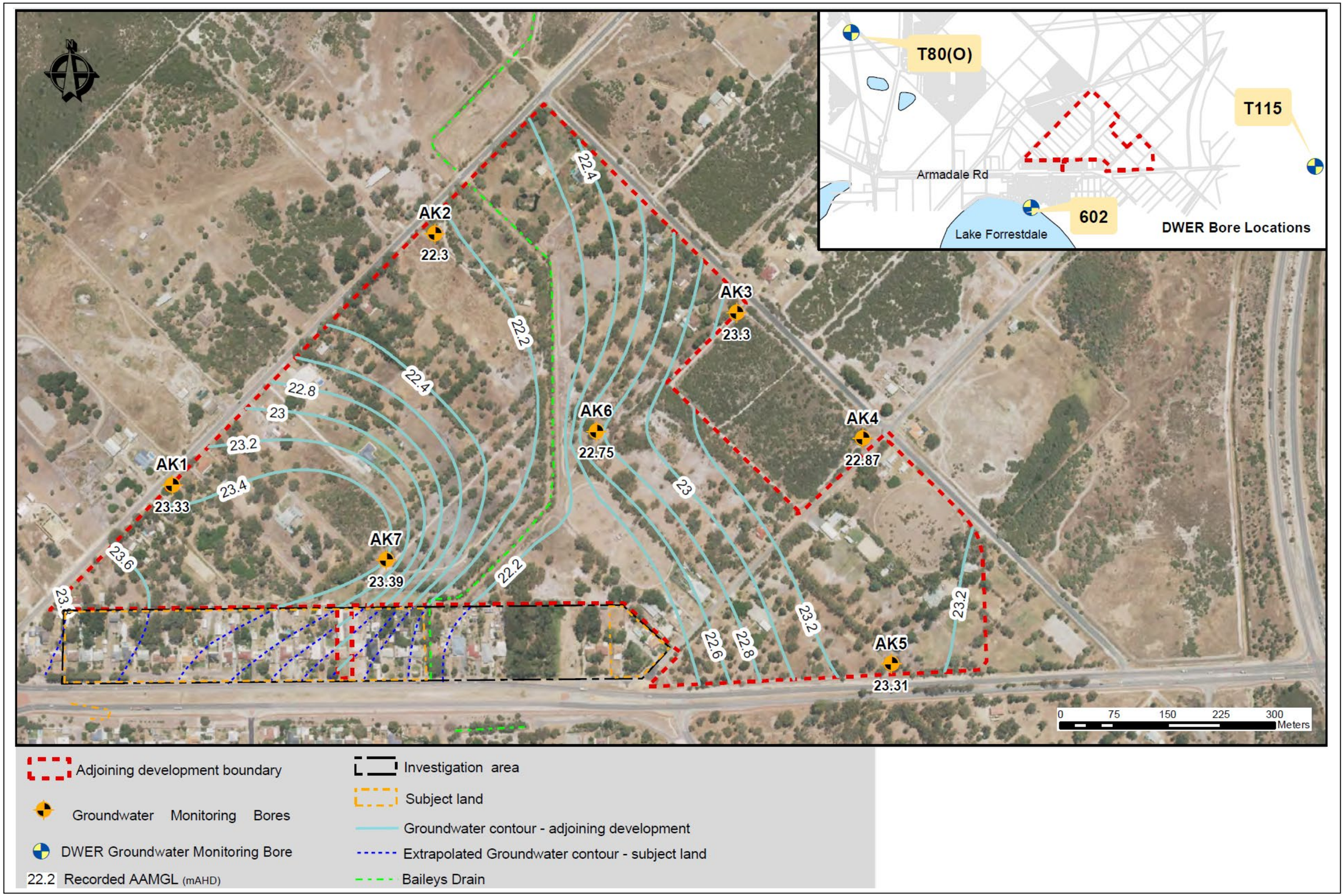


Figure 9 Pre-groundwater AAMGL contours – *extrapolated from adjoining LWMS*

7 DRAINAGE MANAGEMENT STRATEGY OVERVIEW

The aim of Drainage Management for the subject land is to generally manage the water flows so that water treatment is achieved and that the major storms are controlled prior to release.

All flows up to the 1EY are to be treated to reduce nutrients, sediments and other contaminant prior to discharge offsite. Above the 1EY, the main function is to control the flow of drainage water throughout the subject land and its release from the subdivision. This water will predominately be captured and infiltrated while protecting lots from internally generated flooding and regional floods from the Water Corporation's Baileys Branch Drain.

The entire investigation area's stormwater is assumed to flow through to the Baileys Branch Drain in the post development situation. This is in keeping with the assumptions of the FMDADS. It is noted that the modelling for the FMDADS assumed significant storage was to be made available through the conversion of the Baileys Branch Drain into a Living Stream. This conversion begins immediately downstream of the subject land/investigation area.

This Living Stream provides additional stormwater storage for the subject land. It is however noted that the City of Armadale's stormwater guidelines require significant on lot storage. Furthermore, the northern post development catchments feed into the Rathbone Dr, which has not specifically included post development runoff from the subject land/investigation area. As such, flows to the north have been detained to pre development rates. The south western area, which has historically discharged to Armadale Rd will also utilise a post equals pre flow rate for both the lots and the existing Slip Rd. The same philosophy has been applied to the Lots discharging south. This allows for flows that may enter Armadale Rd while the Slip Rd is being built to be kept to the same rate.

The new Slip Rd is also assumed to detain its flow to pre development flow rates, in keeping with Water Corporation's recommendations that flows to the south of the Mahala Estate will need to be the same as the pre development discharge. The final option for required storage and the type of storage within the new Slip Rd is to be determined at the time of detailed design for the Slip Rd and take into account the functionality of the additional drainage being provided downstream, the likelihood that the short time of concentration for this Slip Rd means that its peak flows are likely to precede the peak flows traversing through the Baileys Branch drain system and how much additional detention may actually be available at the time of construction.

The following sections show in more detail how water is treated, detained and conveyed through the investigation area and the management within the three different AEP scenarios,

7.2 – 1EY / Small event

7.3 – 20% AEP /Minor event

7.4 – 1% AEP/ Major event

7.1 MODELLING

The drainage modelling has been undertaken in DRAINS, using the Horton/ILSAX method.

The proposed development is designed to achieve a water sensitive design outcome for the 1EY, 20%AEP and 1% AEP. The system has been designed so that it achieves these outcomes while also controlling groundwater rise via subsoils.

The post development modelling for the development has been split into internal sub catchments related to each portion of connected lots within the actual subject land. The rest of the investigation area has also been modelled to provide preliminary guidance. This is to provide flexibility to future design due to the multiple ownerships present. The final discharge point for the entire investigation area is assumed to be the Baileys Branch drain. This is in keeping with the drainage design of the adjoining northern and eastern development. It also aligns with the current drainage pipe network within Armadale Road and Alen Rd and the pre development overland flow path for the majority of the subject land. The catchments can be seen in Figure 10.

The existing lots are assumed to be approximately split with 70% of the lot to flow north and 30% south for the southern portions. The exception is the Catchment E which fronts Allen Rd, where the flow will be to Allen Rd.

The northern lot runoff (Catchments NW, NC and RN) is assumed to be currently catered for within the Rathbone Rd network designed as part of the adjoining current development, based on the flows being detained to pre development rates. For the designed portion, it is noted that allowance has been made for a future pipe along the boundary with the subject land/investigation area. Rathbone Rd does not extend to the far eastern portion of the investigation area. Instead flows of the northern eastern lot catchments (NE and RNE) will travel northward through future roads, into Hypatia Rd, then enter the Living Stream approximately 100m to the north within Mahala Estate. This flow path can be seen in Figure 10.
All southern lot catchments (SW, SC, RS and SE) are assumed to flow to the existing or future Slip Rd. The existing Slip Rd has also been modelled with the assumption that the current swale along the slip road will remain in a form similar to what is currently present. The modelling assumes a 0.5m deep swale with 1:4 sides, to take flows from both the existing Slip Rd and any post detention flows from the SW lot Catchment. This portion of the Slip Rd is assumed to still discharge into the drainage pipe network within Armadale Road that flows through to the Baileys Brach drain (DN300mm pipe). The future proposed Slip Rd (Catchments W Rd, R Rd and E Rd) is to be composed of a pit and pipe network, with suitable initial infiltration in soakwells for treatment. This is to discharge to the Bailey Branch Drain either directly or potentially via the existing Armadale Road outlet infrastructure. The exact connection is to be determine in consultation with the City, WC and MRWA as part of detailed design. The connection is to also consider the WC requirements in relation to infrastructures and flows for the Baileys Branch Drain. The option for storage assumes roadside soakwells, however alternative detention options may be installed as part of detailed design, in agreement with the City.

As noted above Catchment E will flow into Allen Rd. From here the flow is to the future Living Stream within the Mahala Estate, via Hypatia Bvd. The flow path can be seen in Figure 10. There is the potential that a portion of Catchment SE may flow via Allen Rd northward once the pipe capacity is exceeded. In this scenario, this water will most likely then enter the Living Stream to the north. For the current assessment however, Catchment SE is assumed to all flow via the slip land directly to the Baileys Branch Drain.

The Drainage Reserve containing the Bailey Branch Drain has been modelled as it currently appears (Catchment BB).

The future investigation areas have all been assumed to be developed in a similar manner to the subject land lots. This is a conservative option, noting that a portion of the investigation area may potentially be POS, which would generally have a lower run off rate.

The other key modelling assumptions and characteristics are as follows:

- Horton/ ILSAX drainage modelling method used.
- ARR 2016 methodology and rainfall figures used.
- Catchments were designed to be logical areas of stormwater capture and discharge. Currently the indicative strata layouts show that the northern portion will front onto Rathbone Rd, while the south portions will front the Slip Rd the split is approximately one third flowing south and the rest heading north.
- All lots were assumed to be 80% directly connected impervious, with a further 10% indirectly connected impervious. The remaining 10% was assumed to be pervious gardens and landscaping.
- The existing and future slip roads were assumes to be 65% impervious (including 5% indirectly connected).
- Impervious areas had an assumed retardance coefficient of 0.013 for connected areas and 0.01 for disconnected impervious areas.
- Pervious surfaces were assumed to have a retardance coefficient of 0.1.
- Lots are assumed to detain stormwater within their boundary to the City of Armadale's requirement for the 1%AEP 1 hour event on sandy soils, with lot connections plus an additional 45% storage volume to reduce flows in the 20% AEP to pre development rates. The on-lot infiltration system was assumed to be in 0.9m deep x 1500mm diameter soakwells. An overall initial infiltration rate of 1.5m/day was assumed based on the 1.7m/day of the nearest test location with. A clogging factor was then applied to reduce the effective infiltration to 0.8m/day. This may be refined at detailed design depending on actual permeabilities of the fill and insitu soils. Storage per catchment is outlined in Table 4.
- The soakwells were assumed to discharge via a pipe at the top of the soakwell to the road drainage network. Sub catchments smaller than 5000m^2 were assumed to have a 100mm diameter outlet pipe, while those over were assumed to have a 150mm outlet pipe.
- Once soakwell capacity was reached, it was assumed there was a safe overland flow path to the road network.

- The final storms modelled were the 5min,10min,15min, 20min,25min, 30min, 1 hr, 2hr, 3hr, 4.5hr, 6 hr, 9hr, 12hr, 18 hr and 24 hour. Longer events were not modelled as the peak events off any localised or combined areas were generally less than 9 hours. These events were modelled for the 20% AEP and 1%AEP.
- The new southern slip road was assumed to use 0.9m deep x 1500mm diameter soakwells for detention in Scenario A. An effective infiltration to 0.8m/day from the base was assumed.
- The northern pipe to Baileys Branch Drain is assumed to be within the Rathbone Dr system.
- The southern pipes for the new slip roads are assumed to be new 300mm concrete pipes.
- The existing slip road is assumed to continue to flow into the Armadale Rd drainage network via a 300mm pipe, with flows in excess of the pipe capacity to flow along the new Slip Rd.

7.2 1EY STORM EVENT AND WATER QUALITY

The 1EY detention and treatment will predominately utilise on site soakage within the lots. The design parameters for treatment and attenuation of minor storms up to the 1EY event will be to provide treatment area within the systems.. The modelled storage can be seen in Table 6.

There is no modelled overflow from the lots in the 1EY.

For the existing southern slip road, the existing grassed swale will provide treatment for road runoff prior to infiltration.

7.3 DRAINAGE MANAGEMENT PLAN – 20%AEP

On Lot Storage is has been modelled as shallow (0.9m) soakwells. Due to the sandy in situ soils and use of free draining fill sand and the use of subsoils, soakwells are deemed suitable. The soakwells effectively detain the entire on lot 20% AEP event, with minor overflows in some 20% events (see Table 5). A summary of the modelled soakwells per sub catchment area can be seen in Table 4.

The new Slip Rd network is also to use soakwells or other storage devices to detain the 20% AEP to pre development rates. The required storage is outlined in Table 4.

Table 5 outlines the post development flow for the 20% AEP. Table 6 provides a summary of the difference between the pre development and post development flows for the subject land for the 20% AEP. Due to the entire lot stormwater being infiltrated, and the roadside water being detained, the post development flow is slightly below the pre development flow rate.
Any flows off the subject land will predominately be via groundwater flows, once the peak stormwater event has passed.

Peak flows generally occur in the 12hr event for lots and in the s 10min from the southern portion due to the Slip Rd discharge.

Table 4 Storage required for each sub catchment

Post sub catchment	Area (m2)	Storage			
		City lot requirement (1%AEP/1hr)		For Pre dev requirement	
		*Soakwells**	*Volume (m^3)*	Soakwells*	Volume (m^3)
Lots					
NW	14476	*225*	*357.6*	326	518.5
SW	5928	*92*	*146.2*	133	212.0
NC	15682	*243*	*386.2*	352	560.0
SC	6419	*100*	*158.9*	145	230.5
RN	9654	*150*	*238.4*	218	345.7
RS	5925	*95*	*151.0*	138	218.9
RNE	4828	*75*	*119.2*	109	172.8
NE	1207	*19*	*30.2*	28	43.8
SE	493	*8*	*12.7*	12	18.4
E	3137	*49*	*77.9*	71	112.9
Total Lots	**67749**	***1056***	***1678.4***	**1531.2**	**2433.7**
Roads					
EXISTING ROAD**	3859	*NA*	*NA*	NA **	54.6
W ROAD	4181	*NA*	*NA*	91	145.4
R ROAD	3861	*NA*	*NA*	84	134.2
E ROAD	773	*NA*	*NA*	17	26.9
Total Roads	12674			193	361.1
Other					
BB	2024	*NA*	*NA*	NA	NA
Total all	**82447**	***1056.0***	***1678.4***	**1724.0**	**2794.8**

*Note: * = Nearest whole soakwell*
*** = Storage within existing roadside swale*

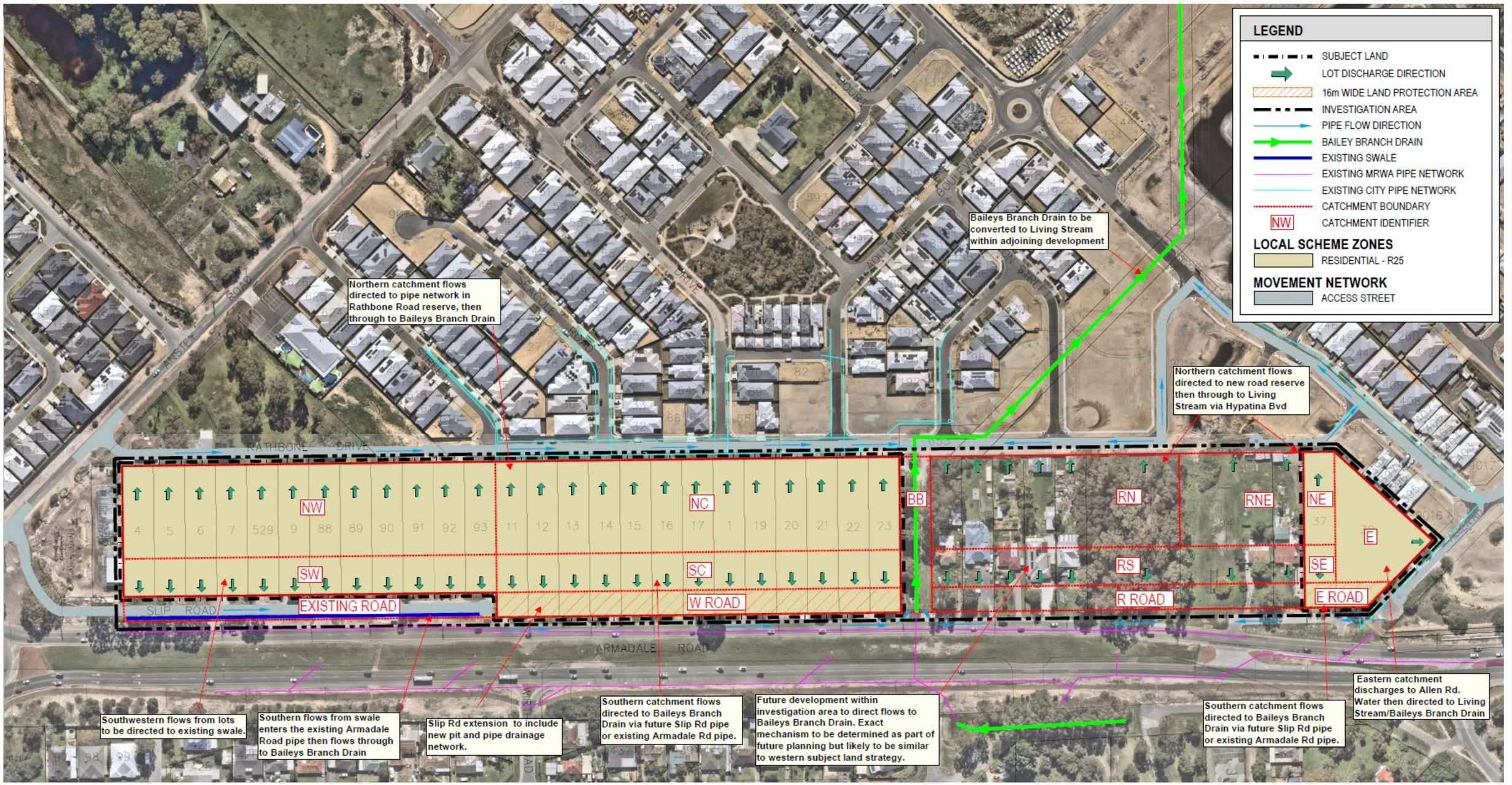


Figure 10 Post Development Drainage Catchments and Characteristics

7.4 DRAINAGE MANAGEMENT PLAN – 1%AEP

The Subject area has been designed to safely manage the 1%AEP flood event so that impacts on the subject land and downstream infrastructure, the environment and people's safety are minimised.

All floor levels are to be a minimum of 500mm above the relevant adjoining 1% AEP flood level of the Baileys Branch Drain. This provides a minimal floor level of 23.73mAHD (flood level is 23.23mAHD on southern boundary). As all portions of the subject land are already generally above this height, there is a very low risk of flooding.

All finished floor levels are to also 0.3m above the adjoining flood level of the relevant road flood flow (generally taken as the top of kerb).

Within each future strata lot/ developed lot, a safe flow path is to be designed from the detention systems through to the relevant road system. The difference between the in-lot surface flow and finished floor level should be 0.3m.

The flood peak leaving the investigation area has been modelled as occurring at in the 30min – 2hr hour storms.

In the 1% AEP event, the lot detention systems will fill to overflowing with potentially some water stored within the internal driveway networks. Water will then flow along the roads to the northern or southern road systems then through to Baileys Branch Drain for the majority of the development. The exception is the NE and RNE catchments which will flow via the adjoining road network northward to the Living Stream. The other potential exception may be a portion of the SE, which may flow northward on Allen Road once the pipe capacity is exceeded. In this instance, the water will flow to Allen St then through to the Living Stream to the north. These flow paths can be seen in Figure 11.

Should the Baileys Branch Drain through the subject land have its sides flattened to a level suitable to allow this to be open to the public or for general landscaping/ecological outcomes, then there will be considerably more available storage within drain. While not required for this development due to the considerable on lot storage, this will provide further protection from flooding, including in the event that the proposed 1500mm downstream pipe is partially blocked. If this area is to be modified it will need to conform to the Water Corporations DS66 design standard for guidance on the minimum design requirements for landscaped drains.

It is noted however that the runoff rate is significantly below the pre development rate in the 1% AEP, due to the large amounts of on lot storage to meet the requirement for the 20% AEP pre development flow rate to be met. This means that the flows are generally in keeping with the requirements of the FMDADS, while noting that there may be an option to increase flows subject to later detailed design. Table 6 provides a comparison of the pre development and post development flows for the subject land in the 1% AEP.

REGIONAL FLOODING

It is understood that the downstream works will not significantly change the flood levels of the Baileys Branch Drain through the subject land. The regional flood levels outlined in the Forrestdale main drain arterial drainage strategy highlight that the subject land is above the modelled flood level. Any widening of the drain to create a living stream or make it suitable for inclusion into POS accessible by the public will increase the available storage. In doing so, it will not increase flood heights.

Table 5 Post Development discharge rate summary

Sub catchment	20% AEP		1% AEP		End destination/Comments
	Flow rate (m^3/s)	Critical event	Flow rate (m^3/s)	Critical event	
Lots					
NW	0.009	12hr	0.113	2hr	Flows to Rathbone Dr then Baileys Branch Drain (north)
SW	0.01	12hr	0.056	1.5hr	Flows to existing Slip Rd swale then MRWA pipe to Baileys Branch Drain
NC	0.01	12hr	0.093	2hr	Flows to Rathbone Dr then Baileys Branch Drain (north)
SC	0.01	12hr	0.069	1.5hr	Flows to future Slip Rd swale then new pit and pipe network to Baileys Branch Drain (south)
RN	0.006	12hr	0.027	2hr	Flows to Rathbone Dr then Baileys Branch Drain (north)
RS	0.002	12hr	0.053	1.5hr	Flows to future Slip Rd swale then new pit and pipe network to Baileys Branch Drain (south)
RNE	0.002	12hr	0.017	2hr	Flows to future road network to north, the existing pipe network to Living Stream
NE	0.001	12hr	0.015	1.5hr	Flows to future road network to north, the existing pipe network to Living Stream
SE	0.001	12hr	0.009	1.5hr	Flows to future Slip Rd swale then new pit and pipe network to Baileys Branch Drain (south)
E	0.002	12hr	0.083	30min	Flows to Allen Rd, then existing pipe network to Living Stream
Roads ***(flows for new roads is prior to detention)***					
EXISTING ROAD	0.04	15min	0.08	1.5hr	Swale volume and discharge points to remain. Eg MRWA pipe to Baileys Branch Drain
W ROAD	0.09	5min	0.191	5min	New pit and pipe network to Baileys Branch Drain (south)
R ROAD	0.083	5min	0.377	5min	New pit and pipe network to Baileys Branch Drain (south)
E ROAD	0.017	5min	0.035	5min	New pit and pipe network to Baileys Branch Drain (south)
Other					
BB	0.004	5min	0.089	15min	Direct flow into Baileys Branch Drain from reserve
Totals					
Total to Allen Rd/ Hypatina Bvd	0.003	6hr	0.1	1hr	*Combined flow peak, assuming both peak at same time*
Total to Baileys North	0.013	6hr	0.247	2hr	*Peak from all north flowing lots*
Total to Baileys South	0.002	10min	0.255	5min	*Peak includes storage within new Slip Rd*
Total to Armadale Road	0.04	15min	0.08	1.5hr	*Assumes existing Slip Rd swale remains,*
Combined totals	0.058		0.682		

Table 6 Pre vs Post development flow summary

Major catchment Discharge Point	Pre development Flow rate (m^3/s)		Post development Flow rate (m^3/s)	
	20% AEP	1% AEP	20% AEP	1% AEP
Total to Allen Rd/ Hypatina Bvd	0.019	0.14	0.003	0.1
Total to Baileys North	0.032	1.256	0.013	0.247
Total to Baileys South	0.017	1.078	0.002	0.255
Total to Armadale Road	0.043	0.148	0.04	0.08
Combined totals	0.111	2.622	0.058	0.682

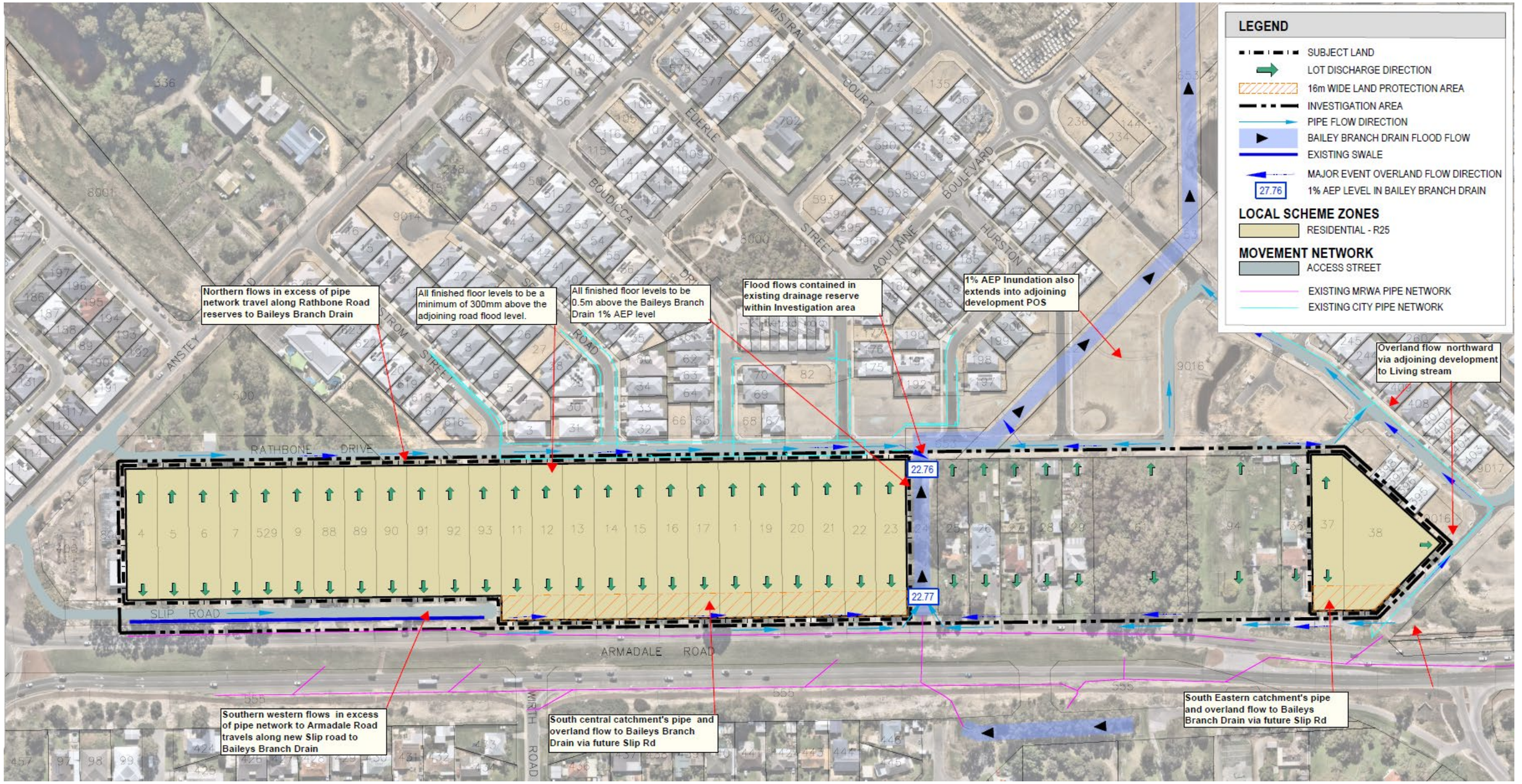


Figure 11 1%AEP Drainage Plan

8 GROUNDWATER MANAGEMENT STRATEGY

The focus of groundwater management for the subject land is to maintain groundwater as close as possible to existing levels, while maintaining adequate separation from infrastructure. Furthermore, groundwater will be managed to improve water quality before it leaves the subject land.

8.1 INFRASTRUCTURE SEPARATION

A vertical separation between significant infrastructure and the onsite groundwater is to be implemented. It is assumed that the separation will generally be 1.5m, however this may be modified as part of detailed design, provided there is suitable separation to protect infrastructure and allow for onsite infiltration of stormwater. Groundwater/subsoil modelling will be performed at UWMP stage in accordance with the IPWEA (2016) Draft Specification on Separation Distances for Groundwater Controlled Urban Development.

IPWEA (2016) requires the provision of a minimum 0.3m of coarse sand in the rear of lots above the 50% AEP phreatic surface for residential lots of size 400-800m^2, and a 0.15m clearance for lots <400 m^2. These criteria will be used as the basis for establishing fill requirements for the site, in consultation with the City.

All infiltration systems are to have their base a minimum of 0.5m above the CGL. To achieve this, shallow soakwells are assumed to be used for the majority of the subject land, with the exact type and base depth to be determined as part of detailed design.

Fill

The separation will be achieved partially through use of porous, clean fill across the site. Porous clean fill will be used to achieve groundwater separation under the roads and lots. Any fill of imported sands will require compaction to relevant standards. The fill will be required to have a permeability of at least 5m/day at 95% compaction, to allow water to easily infiltrate down to the original soil profile and groundwater layer (noting that the stormwater system has been modelled at 0.8m/day to conservatively deal with clogging or short term saturated soil conditions and assuming it is in the in-situ soil rather than clean draining imported sand).

This LWMS recognised that the City has had previous experiences with poor infiltration of imported fill, where the permeability rates used for the assessments have not been met. On-site confirmation via testing of permeability rates will therefore be undertaken, for each development. Further specific details of this testing will be appropriately defined at UWMP stage.

Subsoil system

Further management of the groundwater is obtained via a subsoil system to create a controlled groundwater level (CGL). The CGL is to be set at approximately the annual average maximum groundwater level (AAMGL), as determined by groundwater monitoring on each development parcel. The groundwater level is to be determined prior to detailed design as part of the subdivision process. The subsoils are not to be laid lower than the AAMGL unless the section is minor in nature (eg <100m and 0.2m lower) and can be proven to have no detrimental effects such as mobilization of contaminants (including ASS) or impact on natural systems. Any lowering will require the specific agreement of the City and DWER.

The road subsoil system is to be designed based on a free flowing outlet, either into the existing/future road drainage network or the Bailey Branch Drain. Overall the subsoil system will grade towards the Baileys Drain.

The subsoil network may include systems within each strata development, subject to detailed design.

Baileys Branch Drain

The Baileys Branch Drain currently controls groundwater rise in the local area. This will continue as the inverts are to remain the same and the downstream levels are not changing significantly.

8.2 QUALITY MANAGEMENT

Water off the public and private road surfaces will be directed to localised infiltration treatment structures. This will minimize nutrients and other contaminants from entering the groundwater.

Fertiliser use for landscaping areas is recommended to be minimised and utilise slow release products, as necessary. This will reduce the total load of nutrients applied to the development area and minimse the risk for nutrient movement into the groundwater.

9 WATER SERVICING AND SUSTAINABLE USAGE STRATEGY

9.1 POTABLE WATER

The following information has been sourced from the Forrestdale Structure Plan Servicing Report (2023).

The Water Corporation owns and maintains the potable water reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and the Design and Construction Requirements for Water Reticulation Systems up to DN250 (DS63).

All water main extensions required for the development Site will be laid within the existing and proposed road reserves, on the correct alignment and in accordance with the Utility Providers Code of Practice. These mains will provide both potable water supply and hydrants for fire suppression to each lot.

Internal plumbing for strat developments will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant. Flow and pressure checks will likely be required as part of any assessment of fire water supply for commercial or multi-storey residential developments.

Based on the Water Corporation EsiNet data there is an existing 100CI water reticulation main running along the west side of the Site along Armadale Road. This reticulation extends down towards and runs along Allen Road. the A DN250P reticulation main also crosses the 100CI main and runs into the Mahala Estate landholdings through the Water Corporation's BBD corridor located in Lot 24 in approximately the middle of the proposed Site.

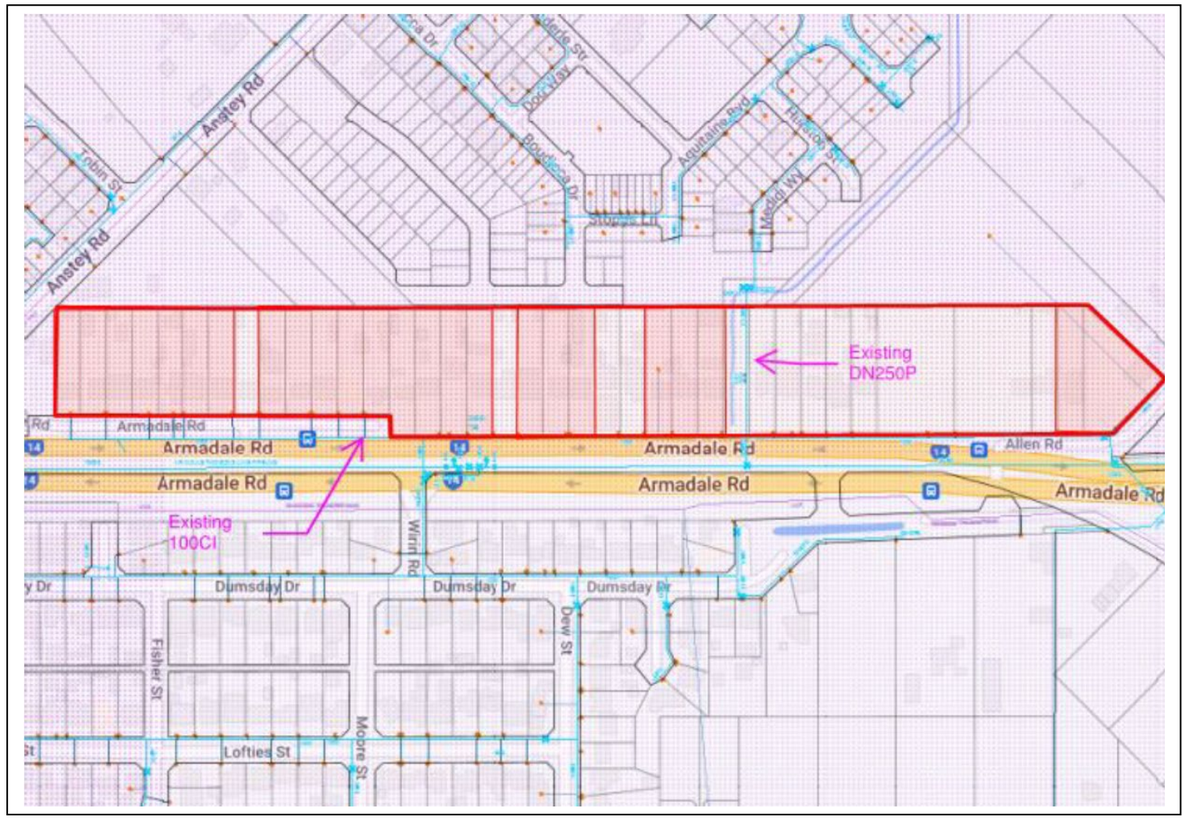


Figure 12 Current Potable water reticulation

Based on preliminary review of available information the existing 100CI main provides potable water supply to the existing residential lots and is anticipated would similarly provide a source to supply the new lot within the development. This would require decommissioning of some existing and the installation of new water connections. There is an existing 100P water supply in a constructed section of Rathbone Drive within the Mahala Estate that may also provide a point of supply for the development.

Information obtained from the Water Corporation indicates that the development of this Site may be supplied without the need to construction distribution mains, by way of extension from existing water mains in the area. Based on anecdotal information there may be a requirement to upgrade some of the 100CI reticulation as part of the development. This information is subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.

9.2 WASTEWATER MANAGEMENT

The following information has been sourced from the Forrestdale Structure Plan Servicing Report (2023).

The Water Corporation owns and maintains the sewerage reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and Design and Construction Requirements for Gravity Sewer DN150 to SN600 (DS50).

Any internal plumbing for strata developments will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant.

Based on available Water Corporation planning information and EsiNet data this Site is within the catchment of the Water Corporation's Balannup L wastewater pump station (WWPSL). Sewer flows generated from the development are therefore planned to be conveyed to this infrastructure. The WWPSL is located within the adjacent Mahala Estate landholdings to the north. There is an existing DN300 gravity sewer network that runs along Anstey Road through the Mahala Estate (including a section of constructed Rathbone Drive) that conveys flows into the WWPS.

Based on a preliminary review of available information there is a single DN150 sewer stub located off the DN300 reticulation at the Anstey/Armadale Road intersection however without a considerable amount of fill the level is unlikely to be suitable to effectively grade sewer into. There is a single DN150 sewer stub located off the end of the DN300 reticulation in Rathbone Drive that may providing a connection point however this will only be for a limited number of lots adjacent to the stub location and is also restricted by existing landholdings. There is no other provision on the section of DN300 reticulation along Rathbone Drive for external flows to be connected into this existing system without modification of live assets including plastic lined Type 6 access chambers. There is a DN225 inlet stub at the WWPSL Site that may also provide a suitable connection point however this will require extension of and installation of a considerable length of reticulation Allen Road and along the frontage of the development to provide service to the Site.

Based on a developable area of approx. 4.4 hectares with 212 lots yielded, the expected design flows (GSDF) generated from the Development Site are in the order of 2.25L/s. It is assumed this can be managed via DN150 sewer reticulation with connectivity into existing networks discussed above. This information is subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.

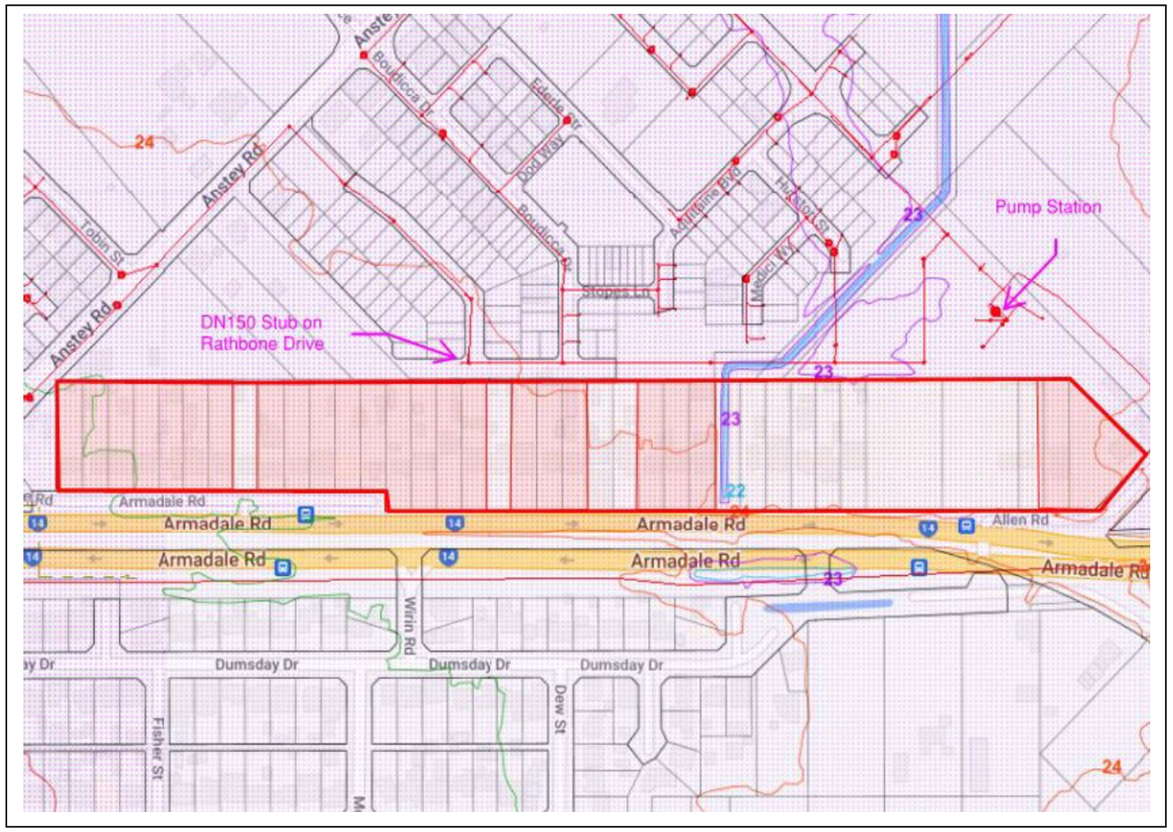


Figure 13 Current Sewer.

9.3 LANDSCAPING

Landscaping will use suitable native species and other waterwise species throughout. The objective of the landscaping is to implement strategies that minimise the quantity of irrigation required including mulching, low use of slow release fertilisers, retention of native trees where possible and new plantings of native species. There is no Public Open Space (POS) within the actual subject land. Should the current Bailey Branch Drain reserve be landscaped enhance its visual appeal or ecological functioning, these works are to be undertaken in line with the Water Corporation's Design Guidelines (specifically DS66). It is noted however that the narrow space currently available may preclude a suitable outcome being achievable. As such this area may be retained solely as a drainage corridor, with its associated low level of ecological benefit.

It is not envisaged that there will be significant areas requiring longterm irrigation. As such a separate groundwater bore is not considered practical. Any irrigation would therefore be via mains water or irrigation from the adjoining Living Stream landscaping source to the north. If required, tinkered water may be used during implementation.

9.4 FIREFIGHTING WATER SUPPLY

Fire hydrants will be provided throughout, as per the relevant regulations. On lot firefighting supplies will be provided for the relevant strata developments, which will be determined as part of each development application.

10 WATER DEPENDENT ECOSYSTEMS MANAGEMENT STRATEGY

There are no direct linkages between the subject land and any water dependent ecosystems (WDE). The following provides a summary of how water will be managed to protect WDE further downstream as well as the creation of on site WDE's.

10.1 CREATING NEW WDE

The creation of new potential WDEs in the form of localised vegetated infiltration systems within each development area will provide benefits to the overall ecosystem functioning in the natural environment. They would serve as small ephemeral wetlands and provide some habitat for generalist species.

To maximise the potential of the systems for habitat values and migration, future landscaping along Baileys Branch Drain should utilise suitable native vegetation and riparian species. This will link in with Living Stream works taking place to the north. This work is to be undertaken by the Water Corporation.

10.2 TREATMENT FOR PROTECTION OF DOWNSTREAM ENVIRONMENTS

The water quality treatment and detention structures will manage flows off the site so that the downstream systems receive clean water at similar rates to the current runoff. Landscaping is to utilise nutrient wise practices to minimise any potential runoff of nutrients.

11 MONITORING & MAINTENANCE

11.1 PREDEVELOPMENT

Pre-development monitoring for the subject land is to focus on groundwater. Levels and quality should be investigated prior to subdivision detailed design. The level information will be used to inform detailed design of the subsoil network and fill levels. Monitoring bores should be installed and monitored to collect the winter peak groundwater levels.

The groundwater quality information, in conjunction with testing of the soil profile for contaminants, is to be used to determine what actions if any should be taken to treat groundwater prior to discharge to the Baileys Branch Drain or other external networks. It may also be used to determine the most appropriate locations that stormwater should be infiltrated to avoid the mobilisation of potential contaminants.

Outside of the Baileys Branch Drain, no surface water monitoring has been undertaken due to the lack of high quality wetlands or waterways on site or adjoining.

Surface water quality has been undertaken for Baileys Branch Drain as part of the Anstey Rd East, Forrestdale LWMS, with one of the monitoring points being at the southern boundary of the current subject land. The results are outlined in Section 5 above. The results are typical levels for Main Drian networks that travers historical farmland and urban areas on the sandy waterlogged Swan Coastal Plain soils. As this short section of drain will be unable to rectify any upstream issues, it has been determined that there is no value in undertaking further dedicated surface water monitoring.

11.2 CONSTRUCTION PHASE

Installation of drainage control structures is to be undertaken ahead of the construction phase of the subdivision development. This will include the use of water sensitive urban design techniques such as sediment curtains, hydromulching and temporary detention basins to maintain the quality of the water leaving the development area during construction. The swales and sub surface storage collection pits will be monitored for any damage, including sediment build up and litter accumulation during, and at the completion of construction to ensure the pit's effectiveness is not diminished post-development.

Details are to be provided in a sediment and erosion control plan, which is to be undertaken prior to on-ground works for each stage.

11.3 POST-DEVELOPMENT

Routine monitoring will focus on the functionality of the WSUD elements compared to their specified design requirements. The monitoring will be both for any relevant works within a strata development or any new public road networks or relevant reserve areas created.

This will include:

- ensuring the drainage inlet and outlet structures are free of debris;
- vegetative cover of the systems is maintained;
- sediment build up is not impeding the functionality;
- erosion is not present;
- soils are not compacted;
- litter is removed; and
- excessive hydrocarbons are not present in the system.
- Storage systems maintain adequate volumes and infiltration rates in line with design

Monitoring of the established WSUD elements operations can provide important insights on the likely performanceof them in pollution reduction and stormwater management functionality. Inspection of the WSUD elements will be undertaken by the developer until an agreed upon time between developers and the Local Government (a minimum of 12 months afterthe completion of works). Inspections should occur every three months. Table 6 summaries the particular items to monitorand the purpose of monitoring, the trigger signs that require immediate action and the maintenance action required.

It is recommended that vegetated WSUD elements are monitored by personnel with floristic knowledge and/or qualifications, as they will be capable of identifying evasive species within the vegetated WSUD systems. Furthermore, personnel in charge of monitoring should have a good understanding of principles and the functional design of the WSUD elements and the treatment system. The maintenance activities prompted through monitoring activities will generally require coordination between landscape and civil services.

Maintenance inspections should be scheduled to be conducted after a significant storm event. Inspections should focus on ponding time for the different systems, unequal surface flow distribution, sedimentation and scouring, vegetation removal, as well as deposition of coarse litter.

Table 7 Monitoring and Maintenance Schedule

Function	Item to Monitor	Details Monitored	Trigger for Immediate Action	Maintenance Action Required	Monitoring Frequency during maintenance period	Responsible Authority (Timeline)
CONSTRUCTION PHASE & POST-DEVELOPMENT						
Drainage Management Systems (includes traditional and WSUD systems)	Structural Design	Systems are constructed to engineer detailed design specification	Systems constructed differs to design specifications.	Remedial work to rectify systems to meet design specifications.	During and after construction	Developer until handover to strata body/Local Authority
	Structural Effectiveness (inlets, traps and outlets)	Inspection for debris, litter and sediments surrounding structural components	Debris, litter or sediments causing blockages or impairing functions.	Remove any debris or blockages. Inspect systems for any erosion related issues.	Monthly	Developer until handover to strata body/Local Authority
	Erosion	Inspection for erosion.	Presence of severe erosion or erosion impairing functions.	Investigate, identify and rectify the cause of the erosion. Replace filter media as required.	Monthly	Developer until handover to strata body/Local Authority
	Sediment Build Up	Inspection for sediment accumulation within pits, on the surface of bioretention systems and within basins.	Accumulation of large volumes of sediments and/or silts in pits or on the surface (according to Shire standards).	Investigate, identify and stabilise cause of sediment source. Remove accumulated sediments and replace filter media or plants removed.	Event based (mobilisation of sediments) and a minimum of every 3 months	Developer until handover to strata body/Local Authority
	Compaction	Inspection of filter media for compaction, could include being driven on.	Water remains ponding longer than designed in bioretention system after a storm event.	Investigate cause of compaction. If localised, remove top 500mm of filter media, break up the filter and then return to system without any compaction. If extensive seek expert advice.	Monthly	Developer until handover to strata body/Local Authority
	Weeds	Inspection for the presence of weeds.	Weeds are noxious or highly invasive or if weeds cover more than 25% of area.	Manual removal or targeting herbicide application, with waterway approved products.	Monthly	Developer until handover to strata body/Local Authority
	Plant Condition	Inspection of vegetation health and cover, and presence of dead plants.	Plants dying or a pattern of plant deaths.	Investigate cause of plant deaths and rectify. Infill planting may be required.	Monthly	Developer until handover to strata body/Local Authority
	Organic Litter	Inspection for the presence of organic litter (e.g.. leaves) on surface.	Litter coverage is thick or extensive, or detracting from the visual appearance of the system.	Investigate source of litter and undertake appropriate response, e.g. alter landscaping maintenance practices, community education). Remove litter.	Monthly	Developer until handover to strata body/Local Authority
	Rubbish/Litter	Inspection for the presence of litter.	Litter is blocking structures or detracting from the visual appearance of the system.	Identify source of litter and undertake appropriate responses. Remove litter.	Every 3 months	Developer until handover to strata body/Local Authority
	Oil/Hydrocarbons	Inspection for the occurrence of oil on surface.	Oil coverage persists for more than 3 weeks, and is thick.	Notify the EPA of the spill and clean up requirements.	Every 3 months	Developer until handover to strata body/Local Authority
	Road sediment and litter	Determine level of sediment and litter build up on roads.	Visible litter and sediment that is in quantities that could have a detrimental impact on downstream WSUD systems	Sweeping of roads to remove sediment and litter	Monthly for 2 years from completion of each stage	Developer until handover to strata body/Local Authority

12 IMPLEMENTATION PLAN

The developer is committed to undertaking the water management strategies outlined in this report. The following details the actions and works to undertaken by the developer and relevant authorities as part of the development of the subject land.

COMMITMENTS BY DEVELOPERS

- Geotechnical investigations for each lot
- Groundwater investigations to determine the peak groundwater levels for each lot.
- Production of engineering drawings at the development of each stage of development.
- Water sensitive urban design techniques such as sediment curtains, hydro-mulching and temporary detention basins will be used to maintain the quality of the water leaving the development area during construction.
- Construction and ongoing maintenance during agreed maintenance periods of the stormwater drainage systems and infrastructure.
- Appropriate earthworks employed across the site.
- Planting of suitable landscaping species to minimize the requirement of non-stormwater irrigation.
- Production of any UWMP's as required
- Updated modelling of all stormwater management systems as part of detailed design
- Produce and implement Construction and Sediment Control reports.
- Implement all servicing and drainage infrastructure in accordance with the LWMS and future detailed design.
- Apply appropriate fill and groundwater control structures on site as required.
- Undertake post-development monitoring as required.

REQUIREMENTS OF THE CITY OF ARMADALE

- Review and approval of any UWMP's
- Responsibility for the maintenance of the stormwater system after handover
- Approval of drainage design and other water management works.
- Approval of building licenses including on lot stormwater detention systems.

REQUIREMENTS OF THE DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION

- Review and approval of LWMS.
- Provision of advice to assist with approvals of the UWMP's, especially in relation to regional flows through the Baileys Branch drain if required.

REQUIREMENTS OF THE WATER CORPORATION

- Review and approval of water servicing.
- Review and approval of any modifications to the Bailey Branch Drain and drainage discharges.
- Manage the potable water service to the development.
- Manage the wastewater servicing for the development.
- Management of the Bailey Branch Drain for drainage and flood requirements.

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Appendix A SERVICING REPORT



SERVICING REPORT

Anstey Keane Urban Development Precinct
Armadale Road Structure Plan

JDS201900.00 Rev C

September 2025

Prepared for:

Rowe Group

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Appendix

Appendix 1 – Preliminary Local Structure Plan & Lot Concept Plans

DOCUMENT REVIEW				
Revision	**Date Issued**	**Issue Type**	**Written By**	**Approved By**
Rev A	16th June 2023	Information	BG	GB
Rev B	24th Nov 2023	Information	BT	GB
Rev C	19th Sep 2025	Information	RR	BT

1 Executive Summary

JDSi Consulting Engineers has been engaged by Rowe Group (herein referred to as the Developer) to assess the engineering servicing and constraints associated with the proposed development of the "Anstey Keane Urban Development Precinct – Armadale Road Structure Plan" (herein referred to as the Site) identified in the preliminary structure plan document in Appendix A. This report provides advice on the civil engineering elements relating to the proposed development of the Site. It is specifically focussed on existing external services and development constraints from adjacent developments as well as service authority requirements to allow servicing of the proposed development. This report does not address the internal building services or built form development requirements.

This report provides a desktop study only. Several recommendations for further action in order to progress the development through to detailed design, with regards to the civil infrastructure requirements, are summarised below:

- Complete a detailed feature survey and geotechnical investigation of the site.
- Engage a Hydrology Consultant to progress an Urban Water Management Plan for the Site, in consultation with the civil design.
- Complete a detailed Traffic Impact Assessment and commence consultation with Local Authority and MRWA to confirm potential road upgrades.
- Confirm final Water Corporation planning with regards to water and sewer servicing for the development.
- Confirm Western Power network capacity through formal submission of a Feasibility Request or Design Information Package.
- Commence negotiations with communications providers to confirm options for communications supply to the Site.

The above summary of recommendations is not exhaustive as there will be numerous actions required to achieve an approved design that meets industry and regulatory requirements for quality, price, sustainability and safety.

This report incorporates the modifications to the Structure Plan requested by the Western Australian Planning Commission (WAPC) in August 2025, as outlined in their Schedule of Modifications. This includes additional information regarding earthworks levels, retaining / banking requirements for the lots, as well as further details regarding connection to the existing sewer network.

2 Key Objectives

The key objectives of this report are to:

- Review and analyse existing documentation associated with the Site.
- Highlight existing infrastructure assets within the development area.
- Advise on anticipated infrastructure requirements for the planned development.
- Demonstrate the development can be serviced in the short to medium term.
- Advise on the implementation of key infrastructure requirements.
- Provide commentary on any potential key infrastructure upgrades required to accommodate the proposed development.

3 Introduction

The development Site is located approximately 30km south of the Perth CBD in the municipality of the City of Armadale (herein referred to as the Local Authority). The Site is approximately 5.2ha and is made up of individually owned land parcels bound between the Anstey Grove development site and Anstey Road to the west, the Mahala Estate development site and Rathbone Drive to the north, existing rural landholdings and Allen Road to the east, and Armadale Road to the south. A current aerial image of the Site is depicted in Figure 1 below.

The Site includes a number of existing residential lots adjacent to Armadale Road. It is proposed the Site will be developed for residential purposes. Based on preliminary information provided by the Developer, the development will consist of strata type residential lots that will be brought to the market in a staged approach.

This report is based on the civil engineering aspects of residential land use and engineering infrastructure requirements to service the proposed development. The engineering review has considered earthworks, roads, stormwater drainage, wastewater, potable water and utility services with a particular emphasis on the existing service capacity and the potential infrastructure upgrades required to support the proposed development.

The report has been based on a desktop study of existing service information, aerial imagery, and preliminary advice from the various service authorities. Consideration has been given to industry standards and policies and JDSi's in-house experience related to other developments in the area. The information provided may be subject to change as development progresses in the area.



Figure 1: Site Location

4 Study Area

The Site predominantly contains existing large residential lots with established residential structures, sheds, pools, scattered trees and low-lying vegetation.

The broader study investigation area also contains an existing Western Power 132kVa powerline and easement traversing through existing Lot 94 located towards the east and an existing Water Corporation's Branch Drain (Bailey's Branch Drain) which runs through existing Lot 24, more central through the development. The 132kVa Power line is subject to a 26m easement and the main drain a 15m easement/reserve both vested in the respective service authorities.

4.1 Topography

Based on desktop information and available feature survey data the Site area is generally of flat surface elevation ranging from approximately RL 24.0m AHD in the east to 25.0m AHD in the west. Refer to Figure 2 below for the indicative topography of the surrounding land.

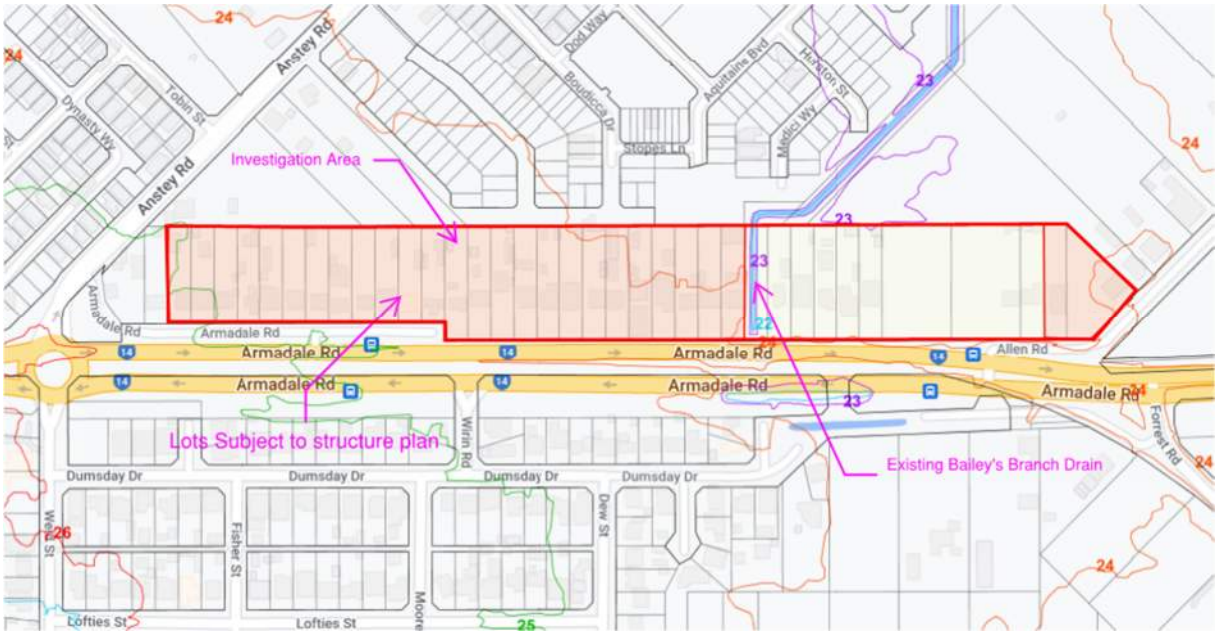


Figure 2: Site Topography

4.2 Groundwater

Based on the LWMS prepared by Oversby Consulting for the Site, the maximum groundwater across the site varies from 23.8mAHD in the west, through to 23.6mAHD at the existing Water Corporation Bailey's Branch Drain and then down to 22.2mAHD to the east of the drain. Seasonal changes in groundwater are in the range of 1.1m to 2.3m.

The Site is characterised by high groundwater levels. Based on available hydrological information the groundwater control for the region is the base flow in the existing Water Corporation Bailey's Branch Drain at 21.6m AHD. Management of the high groundwater will include a combination of subsoil drainage and fill in order to achieve adequate separation between finished lot levels and groundwater.

Based on natural surface levels and the topography of the Site there is likely to be around 1.0m clearance to the estimated AAMGL. It is expected dewatering of deep services will be required during construction development. This will be influenced by depth of import fill across the Site and seasonal fluctuations in groundwater level (winter being the most critical period) as well as management of surface water runoff.

Dewatering will have a temporary drawdown effect on the local groundwater, and at certain locations will present a risk of exposing Acid Sulphate Soils (ASS). This will need to be considered and managed concurrently with any ASS requirements for the Site. All dewatering must be carried out in accordance with Department of Water and Environmental Regulation (DWER).

There are no water dependent ecosystems identified within the Site.

It is likely preparation of an Urban Water Management Plan will be a condition of subdivision. This may also require pre-development monitoring of groundwater and surface water prior to development.

It is recommended that a hydrological consultant to be engaged to provide advice on groundwater levels for the Site and management thereof to assist in the detailed design of the drainage and earthworks and address any development conditions.

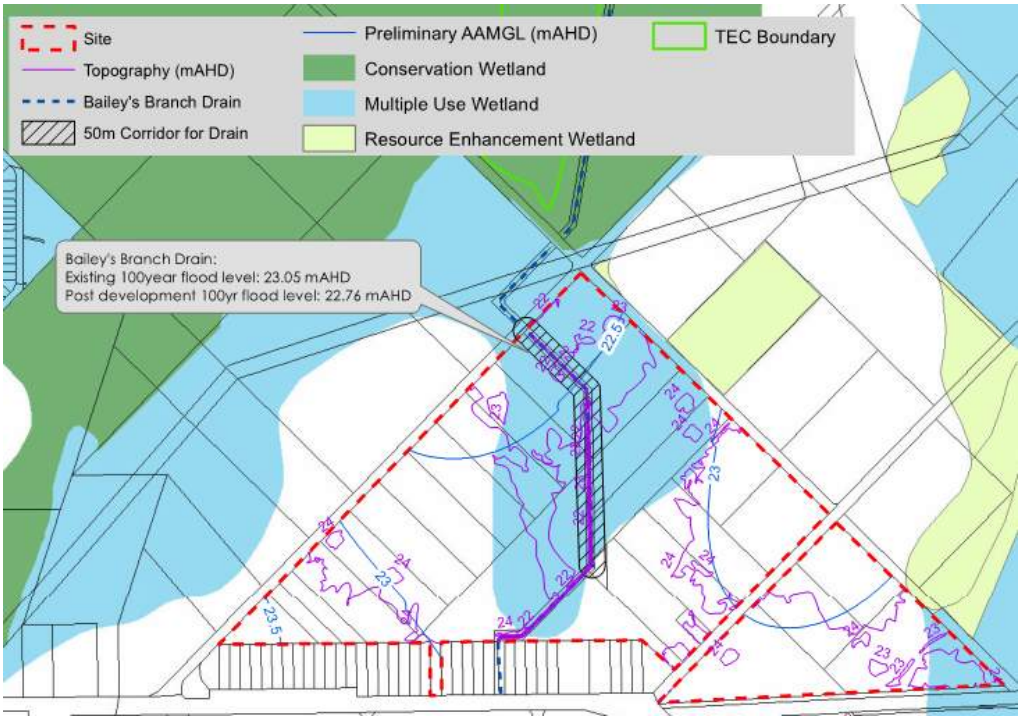


Figure 3: Groundwater and Wetlands

4.3 Geological Conditions

Mapping by the Geological Survey of Western Australia (1986), Armadale Geology Sheets and other available information indicates that the surface geology for the Site consists of varying soils including predominantly Bassendean Sand with some Guildford Formation (low plasticity clay and silty sand with traces of lateritic gravel) to the eastern corner of the study area. Refer Figure 4 below.

It is recommended that a Site-specific investigation be carried out to further inform the civil (earthworks and drainage) and structural (retaining wall) design for the proposed development. This report should include, as a minimum, testing to confirm:

- Existing Soil Characteristics (PSD, Atterberg Limits, MMDD, soil profile)
- Existing Site classification and recommendations to achieve Class A Site
- Permeability Testing & Recommendations for Drainage Design
- Pavement Design Parameters (CBP, Swell %)
- Bearing Capacities
- Acid Sulphate Soil (ASS) Investigations
- Site preparation and compaction recommendations
- Subsurface conditions (karst features such as cavities or loose zones; uncontrolled fill or structures)

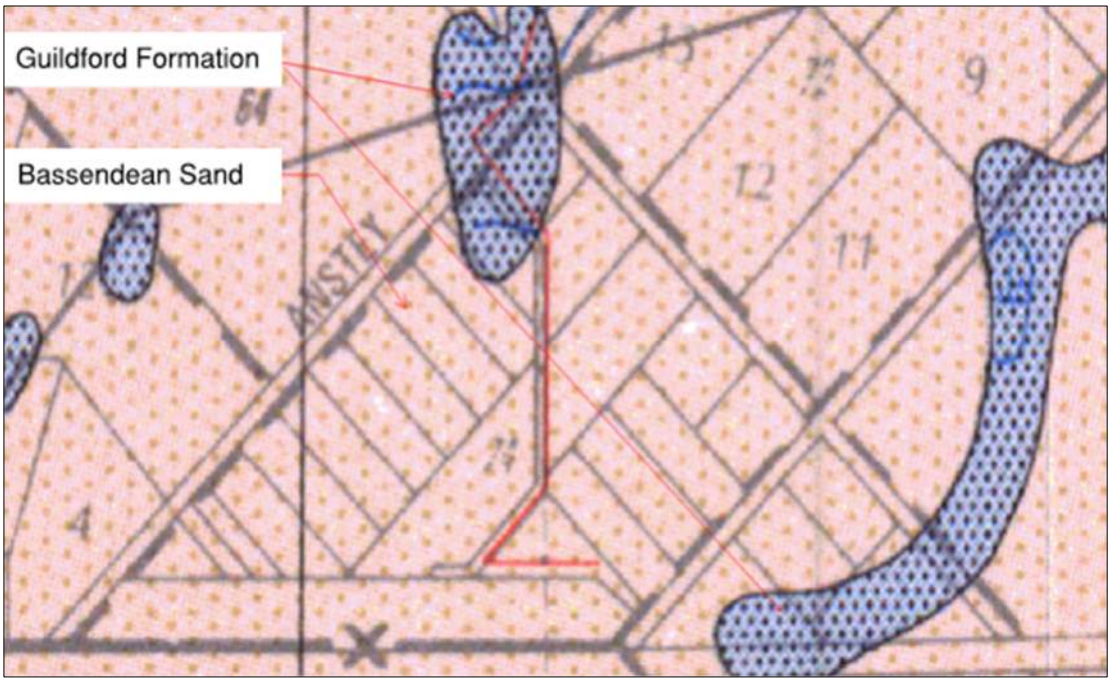


Figure 4: Geological Mapping

4.4 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are soils containing naturally occurring, fine-grained metal sulfides typically pyrite (FeS2), formed under saturated, anoxic/reducing conditions. They generally occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 m AHD). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals. Although soils described represent typical conditions

where ASS occur, in Western Australia these materials have been identified in other soil types such as leached sands and silts.

The iron sulfides in ASS react with oxygen when the soil is exposed to air through excavations or via lowering of the water table. Iron compounds and sulfuric acid are then created along with other substances, including heavy metals. All excavation works and dewatering in ASS must be carefully managed to avoid any potential damage to surrounding land and water ways.

The geology and soil types of the development Site are consistent with a low risk of ASS occurrence. Mapping compiled by DWER supports this and identifies the Site as being in a medium low risk of ASS within 3m of the surface. Refer Figure 5 below. It is recommended investigations into the occurrence of ASS should be included in future geotechnical and/or environmental studies to ensure any risks of encountering ASS are mitigated.

There may be a subdivisional requirement for preparation of a Dewatering and ASS Management Plan. If so, this may require more detailed ASS investigations and analysis during development of the detailed engineering design which will assist in determining the risk of encountering and management of ASS. Detailed specific management plans for treatment will need to be put in place if this investigation identifies the presence of ASS.

Irrespective of specific subdivision conditions it will still be the Developers responsibility to ensure ASS is considered and managed appropriately. DWER has standard guidelines that provide for self-assessment and management of ASS that should be considered to ensure no adverse impact on natural and built development environment.

Given there is likely to be some fill import proposed for the Site it is expected ASS management (if required) would be restricted to deep service excavations i.e. sewer and drainage services. These works may require treatment of both soils and water associated with dewatering activities.

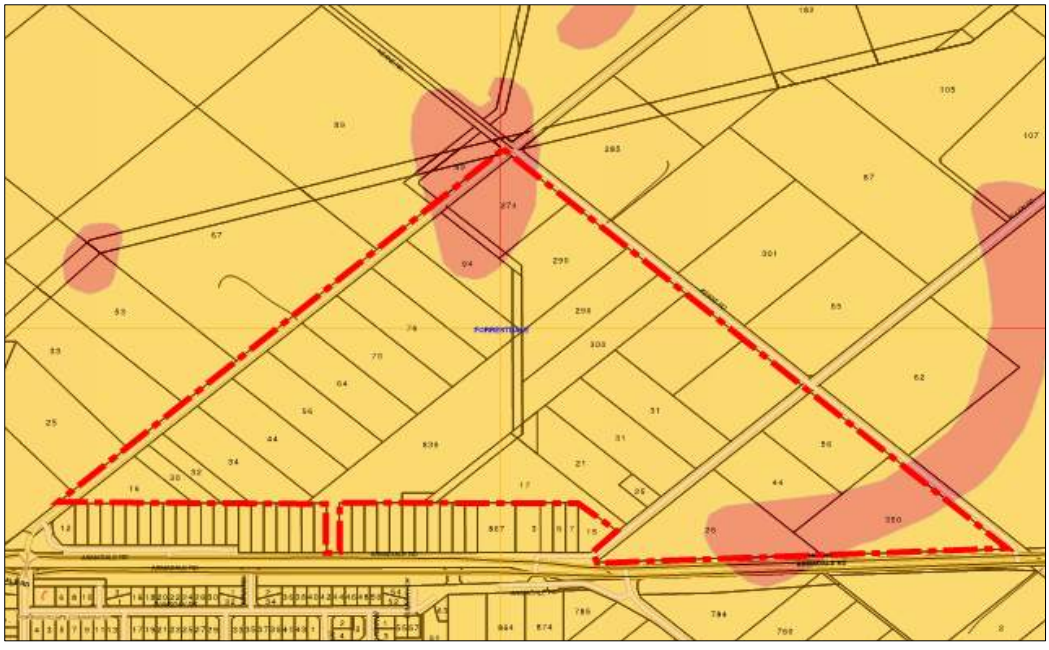


Figure 5: Acid Sulphate Soils Mapping

5 Earthworks and Demolition

5.1 Demolition & Clearing

The Site consists of multiple fixed structures including residential building, sheds, fencing, pools, and scattered trees. Prior to development commencing demolition works will need to be undertaken to remove these structures. This shall include any redundant non-fixed infrastructure, scrap material or rubbish located on the Site. These will need to be removed and disposed of to an approved tipping location. Any demolition works will require permits approved by the Local Authority. It is recommended these works are performed by a licensed demolition contractor.

Give the age and anecdotal evidence from adjacent development it is recommended the services of a qualified environmental consultant are engaged to inspect and audit the Sites for asbestos containing materials (ACM) as these will need to be disposed of in accordance with relevant environmental guidelines and at licensed facilities.

The Local Authority have a strong view on tree retention, and it may be a condition of subdivision approval to undertake predevelopment flora studies to assess the type and quality of existing vegetation and trees and suitability for retention as part of the development. It is recommended that a suitably qualified arborist be engaged to assess and provide commentary on the required tree protection methodologies / zones.

All vegetation marked for clearing should be removed from the Site. Any areas of vegetation identified for retention shall be clearly marked, and physical controls implemented to restrict access by construction machinery during development.

5.2 Bulk Earthworks

All earthworks will need to be undertaken in accordance with recommendations from a detailed Geotechnical Investigation and AS3798 ‘Guidelines on earthworks for commercial and residential developments. It is anticipated that the earthworks can be undertaken on the Site utilising standard civil construction equipment. Noting the proximity of existing residential properties and structures, careful consideration will need to be given to the types and levels of vibratory compaction to be utilised. It is recommended that dilapidation studies and reporting of existing adjacent properties be undertaken prior to development commencing.

It should be noted that the volume of material imported fill can have a significant impact on development costs, depending on the market conditions at the time. This will be influenced by the quality of the material required, availability and distance to source. Amongst the design constraints for the Site the earthworks design shall also consider this and incorporate the most efficient use of insitu materials (where suitable) in bulk earthworks operations to reduce the cost of import fill.

A detailed Geotechnical Investigation will need to be undertaken to determine the suitability of the site for development, along with earthworks and construction recommendations. Given the Site is surrounded by recent subdivisional developments it is not expected that there will be any fundamental geotechnical constraints on the Site.

Based on a review of available information the following constraints exist for the Site, and these will need to be considered further as part of the detailed design process. Due to the absence of survey data, a detailed earthworks design model has not been developed at this stage. Instead, the assumptions below are based on a desktop study using the current available information. The indicative earthworks finished lot levels (FL) are shown in the figure below.

- Proposed lots to be above the level of the existing road network to the North (Rathbone Street) to facilitate overland flow. This road varies from approximately 24.50mAHD in the west, through to 23.50mAHD in the east.

- Appropriate tie-in levels to Allen Rd and Armadale Rd, noting exact levels are currently not available however it's assumed the existing landholdings are generally above the road levels already.
- Proposed lots to be 500mm above the relevant adjoining flood level, resulting in an FFL of approximately 23.73mAHD.
- Suitable separation to groundwater of at least 1.5m, resulting in lot levels ranging from 25.3mAHD in the west through to 23.7mAHD in the east.
- The requirement to contain stormwater drainage on Site and applicable levels for this to be achieved. This is subject to further advice provided by the hydrologist and will be verified during preliminary design.
- The use of retaining walls or battering to tie into existing adjacent property levels.
- Sewer serviceability, noting this is covered in Section 8 of this report, however this does not appear to result in the need to increase lot levels.

Based on the above, and the understanding that the existing site levels range from 24.0mAHD in the east to 25.0mAHD in the west it is not expected that significant earthworks will be required to lift the Site as part of the subdivisional works. It is likely that general cut to fill will need to occur, with the potential requirement for up to 0.5m of fill needed in some areas, depending on final layouts and servicing arrangements.

Staging of development will need to be considered, and it is currently unclear how the development front will progress. If the lots are developed individually rather than as part of a single stage, each owner will need to make temporary arrangements for retaining or battering to tie into the adjoining lots during development. These temporary works will require approval from the affected neighbouring lot owners if their land is impacted. Therefore, constructing multiple adjacent lots in a single package, would be a more efficient and practical approach due to the reduced requirement for temporary works and a simplified approval process.



Figure 6: Site Location

6 Roadworks

The surrounding road network is under the control of the Local Authority and as such all works on and abutting the public roads will be subject to their approval.

The Development Site is bounded by a local access road, Armadale Rd (minor) which is an unkerbed sealed access way off Armadale Road, that provides access to existing residential lots on the southern boundary of the development Site. This access road runs parallel to and includes a single intersection with the main Armadale Road (major) to the south. Armadale Road (major) is a primary distributer under the care and control of Main Roads WA. It is a sealed and kerbed dual carriageway in good condition. The Site is also bound by a partly constructed Rathbone Drive to the north (part of the Mahala Estate), and Allen Road to the east. Allen Road is a local access road and is a single carriage way with kerb along the southeast side only and does not connect through to Armadale Road (major). Rathbone Drive is a sealed and kerbed local access road.

As the development Site is proposed as strata type development, access to the northern lots will be via common property driveways from the existing Rathbone Drive road reserve. .

Access to all existing lots fronting Armadale Road will be provided through a common access place (CAP) road and will require the upgrade and extension of the existing CAP road which currently only services the south-western portion of the existing lots. In areas where no CAP road currently exists, a 16-metre future road widening has been nominated to accommodate a new access road extension. This widening will be taken from the affected lots as shown in the Appendix A.

This CAP road will be consistent with standard residential development including kerbed and asphalted pavement and a road cross-section to align with the existing landform and for the intended traffic volumes. In all cases the road cross section will be designed to cater for utility services on standard verge alignments and appropriate stormwater management strategies in accordance with Local Authority standards and guidelines, Local Government Guidelines for Subdivisional Development (IPWEA) and Main Roads WA requirements.

Typically WAPC conditions require that where any part of a development fronts existing roads those roads will require upgrading to provide suitable access into the Site and in accordance with local structure plan requirements. This is typically the responsibility of the Developer and may be a collective arrangement if multiple Developers are involved. Depending on the roads this may be subject to reimbursement through the Developer Contribution Scheme.

It is therefore anticipated that the Armadale Rd CAP road will require upgrading to a new sealed and kerbed pavement with drainage infrastructure. Allen Road may also require upgrading if the lots at the eastern end are to be developed. Rathbone Drive has only been recently constructed so upgrade is unlikely.

7 Stormwater Drainage

Local Water Management Strategy (LWMS) and Urban Water Management Plans (UWMP) and are now a standard and key part of any development process incorporating principles of integrating water and land use planning, considering all water sources in water planning, integrating water use and natural water processes and a total catchment integration of natural resource use and management (Ref. Stormwater Management Manual for Western Australia, DOW, April 2004 the State Water Strategy 2003 and the State Water Plan 2007).

Stormwater drainage management is a major component of an overall urban water management strategy for which achievement of the principals of the plan may be facilitated through the application of Water Sensitive Urban Design (WSUD) techniques during planning, design, and construction of urban development projects. Objectives of WSUD include but are not limited to the following:

- Detention of stormwater rather than rapid conveyance to maintain predevelopment flows for quantity management.
- Use of vegetation for filtering purposes and nutrient stripping for quality management.
- Use of stormwater to conserve potable water; and
- Water efficient landscaping.

The stormwater drainage from the development will need to be designed and constructed in accordance with Local Authority design guidelines and DWER water sensitive urban design guidelines. As the Local Authority will ultimately own and maintain all stormwater infrastructure the design and construction work will need to be undertaken in accordance with their guidelines and standards, as well as the Local Government Guidelines for Subdivisional Development (IPWEA), noting Local Authority typically require:

Given the historical land use of the Site and potential contaminated land / groundwater, disposal of stormwater via on-Site infiltration may not be suitable as it may cause any contaminants to mobilise and enter the groundwater / ocean. It is recommended that a suitably qualified environmentalist be engaged to confirm any contamination and provide recommendations on dealing with stormwater runoff from the Site.

As per the Local Authority requirements, the stormwater drainage system shall manage runoff for minor storms, up to the 20% AEP event, in traditional pit and pipe system, with major 1% AEP events managed through the road network. The system shall be designed to retain, treat and infiltrate 1 year (15mm) event through bio media and/or other filtration media. The design philosophy for the development Site will need to demonstrate post development flows and volumes do not exceed predevelopment flows.

JDSi understand that Oversby Consulting have completed an LWMS over the Site which sets out the proposed drainage strategy. Further refinement of this will occur through detailed design and the subsequent preparation of a UWMP.

7.1 Subsoil Drainage

The high ground water in the area is generally managed/controlled via a subsoil drainage network, which will have free outfall into the main drains. The subsoil will be located at the AAMGL to maintain the predevelopment level and manage surface runoff.

Further studies by hydrological consultants will be required to determine the required separation between the finished levels and the maximum groundwater levels (AAMGL). This will allow infiltration by soak wells for larger lots. For the smaller cottage lots, lot connection pits may be required.

The Local Authority notes the following desirable separations from the phreatic crest between subsoil drainage lines to establish development levels:

- 500mm to lots at the furthest point from subsoil drains (back of lot).
- 500mm to passive open spaces at the furthest point from subsoil drains.
- 750mm to active (turfed) open spaces at the furthest point from subsoil drains.
- 900mm to ovals at the furthest point from subsoil drains.

7.2 Bailey's Branch Drain

Bailey's Branch Drain is a Water Corporation drainage asset that traverses the Armadale road to the middle of the Site (existing lot 24) discharging under Anstey Road near the intersection of Anstey Road and Keane Road. It is a steep sided open trapezoidal drain.

The drain provides a drainage outlet for upstream catchments and stormwater generated within the development area. As part of the broader development in the area on behalf of the Water Corporation the main drain will be widened and realigned between Rathbone Drive and Anstey Road within the Mahala Estate landholdings. As such it is not expected there will be any requirement to modify the BBD within this development.

8 Sewer Reticulation

The Water Corporation owns and maintains the sewerage reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and Design and Construction Requirements for Gravity Sewer DN150 to SN600 (DS50). This report does not provide advice on internal plumbing works, although it is noted internal plumbing will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant.

To provide a sewer reticulation to the development, suitably qualified consultants will be required to design the proposed sewer reticulation network and submit to the Water Corporation for approval. Applicable headworks charges will need to be paid by the Developer, and these will be determined by the Water Corporation at the time of application.

Based on available Water Corporation planning information and EsiNet data this Site is within the catchment of the Water Corporation's Balannup L wastewater pump station (WWPSL). Sewer flows generated from the development are therefore planned to be conveyed to this infrastructure. The WWPS is located within the adjacent Mahala Estate landholdings to the north-east of the Site.

Based on a developable area of approx. 5.2 hectares with an R25 residential zoning, the expected design flows (GSDF) generated from the Development Site are in the order of 1.66L/s. This can be typically managed via a DN150 sewer reticulation network.

To the west of the Site there is an existing DN300 gravity sewer network on Anstey Road, near the intersection of Armadale Rd, however the levels of this sewer would prohibit servicing of this development without significant amount of imported fill. There is a dual sewer system in Rathbone Drive along the northern boundary of the majority of the Site, which consists of a deeper (5m+) DN300 sewer and a shallower DN150 sewer. Sewer lot connections will need to be constructed to each strata lot from the existing DN150 parallel sewer located in Rathbone Drive. An internal, private plumbing system can then be constructed to service each strata lot. Internal works within each individual strata lot will be need to be completed by a licenced plumber in accordance with AS3500.

Based on a preliminary assessment the existing sewer system is at a depth that will provide a suitable level of service for the Site with little change to the current ground level. Due to the fragmented landholding a connection point will be required to each lot. Access will need to be resolved for the western side of the Site, as Rathbone Drive does not extend this far, however the proposed sewer could be constructed through the private landholdings and protected by an easement. As the eastern portion of the site is in close proximity of the WWPS there is no concerns with sewer serviceability from the DN225 currently located in Allen Rd.

Final connection locations and details are subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.



Figure 7: Preliminary Sewer Reticulation Assessment

9 Water Reticulation

The Water Corporation owns and maintains the potable water reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and the Design and Construction Requirements for Water Reticulation Systems up to DN250 (DS63).

All water main extensions required for the development Site will be laid within the existing and proposed road reserves, on the correct alignment and in accordance with the Utility Providers Code of Practice. These mains will provide both potable water supply and hydrants for fire suppression to each lot. This report does not provide advice on internal plumbing works, although it is noted internal plumbing will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant. Flow and pressure checks will likely be required as part of any assessment of fire water supply for commercial or multi-storey residential developments.

To provide a potable water supply to the development a suitably qualified consultant will be required to design the proposed water reticulation network and submit to the Water Corporation for approval. Applicable headworks charges will need to be paid by the Developer, and these will be determined by the Water Corporation at the time of application.

Based on the Water Corporation EsiNet data there is an existing 100CI water reticulation main running along Armadale Road to the west of the Site. This pipe extends through to Allen Road. A DN250P reticulation main also crosses the 100CI main and runs into the Mahala Estate landholdings through the Water Corporation's BBD corridor located in Lot 24 in approximately the middle of the proposed Site.

Based on a preliminary review of available information the existing 100CI main provides potable water supply to the existing residential lots and is anticipated would similarly provide a source to supply the new lots within the development. This would require decommissioning of some existing and the installation of new water connections. There is an existing 100P water supply in a constructed section of Rathbone Drive within the Mahala Estate that may also provide a point of supply for the development.

Information obtained from the Water Corporation indicates that the development of this Site may be supplied without the need to construct distribution mains, by way of extension from existing water mains in the area. Based on anecdotal information there may be a requirement to upgrade some of the 100CI reticulation as part of the development. This information is subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.

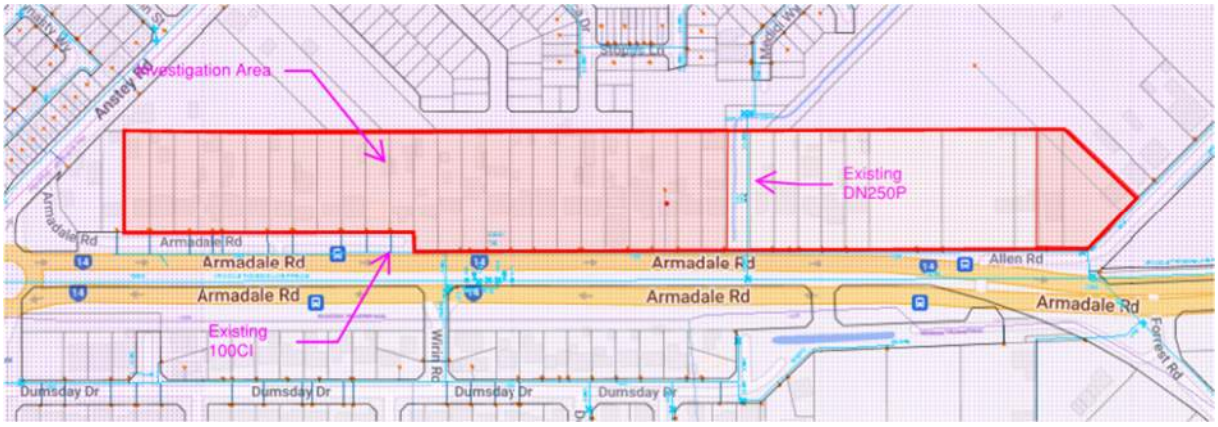


Figure 8: Existing Water Reticulation

10 Power Supply

Western Power owns and operates all electrical supply network assets within the development area and therefore all new electrical supply equipment and cables will need to be installed in accordance with Western Power, WAER (West Australian Electrical Requirements), AS3000 specifications and Standards.

22kV High Voltage (HV) and low Voltage (LV) overhead electricity distribution assets have been identified in the area of the proposed development. These assets are supplied from the Western Power Southern River Zone Substation via the Terrier Place (SNR 507.0 L101 Terrier Place) Feeder. There is also an existing 132kV HV overhead transmission line traversing the proposed development through existing Lot 24 which is protected by a 26m wide easement can pose an immediate hazard. Easement width TBC by WP.

The safe working distance from transmission lines is 6m. Any area surrounding live electrical asset within this distance is unsafe for ordinary persons, equipment and material. Safe working distances do not allow for sag or swing of powerlines. When working within the vicinity, allowances must be made for sag and swing of overhead powerlines; inadvertent movement of excavation machinery and cranes; and personnel and materials.

Based on available dial before you dig and Western Power data, there is existing overhead HV and LV aerials along Armadale Road. The LV network appears to provide overhead supply to existing residential lots within the development estate. Based on available information there is also existing underground low voltage network along a constructed section of Rathbone Drive in the adjacent Mahala Estate. JDSi anticipate this existing infrastructure with some modification and extension may serve as connection points for the development.

It should be noted that the existing overhead assets along Armadale Road and Allen Road adjacent to the development may require undergrounding as part of the development works. These requirements are typically identified as part of the development subdivisional approval conditions.

The estimated total power demand for the proposed development is approximately 380kVA based on 4.7kVA per residential lot. It is highly likely that the development will require a minimum of one transformer and one switchgear.

Based on the Western Power Network Capacity Mapping Tool, the available capacity within the area is estimated to have less than 5000kVA. There may be a requirement for the power to be augmented to service the proposed development.

This advice is required to be confirmed with Western Power through the mechanisms of a feasibility study and design information package (DIP) and is dependent on the number of services required for the development and existing network capacity.

Western Power cannot reserve network capacity therefore we recommend the Developer lodge a formal application with the Utility as soon as practicable. All future development's electricity load requirements will be required to be approved by Western Power.

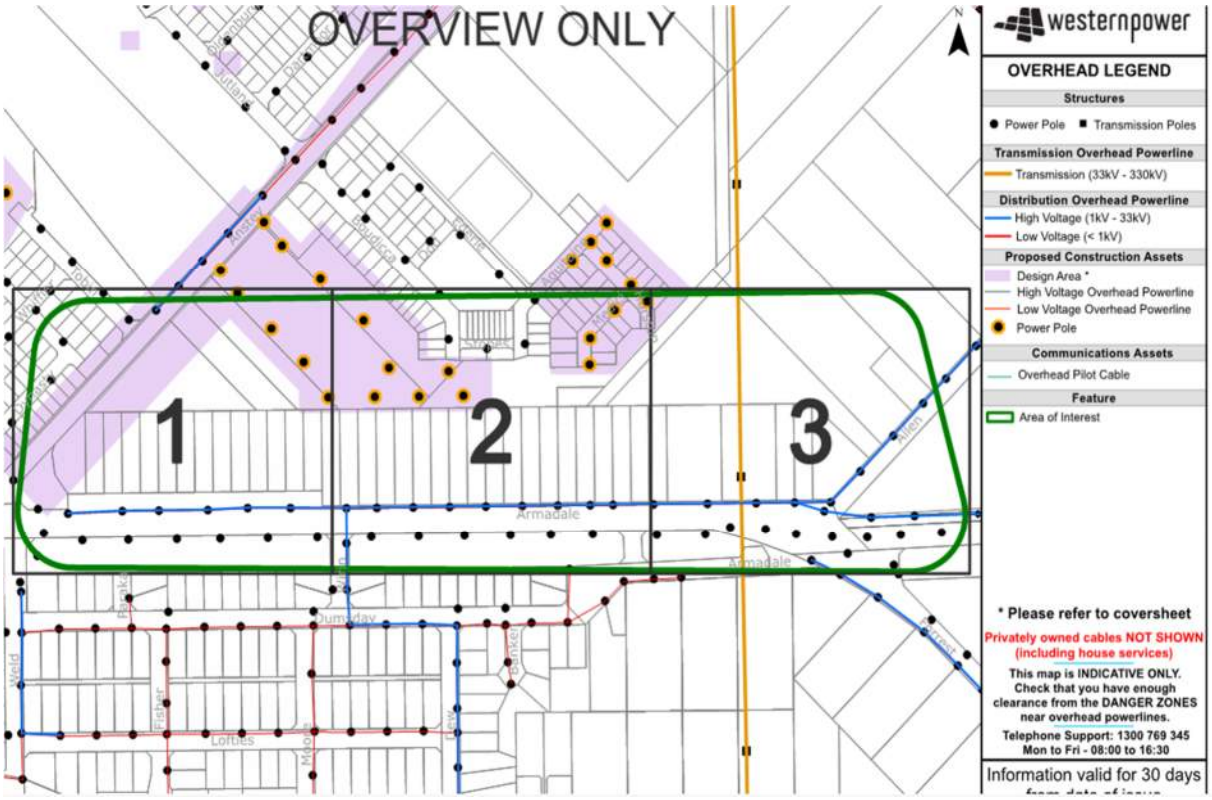


Figure 9: Existing High Voltage Overhead infrastructure

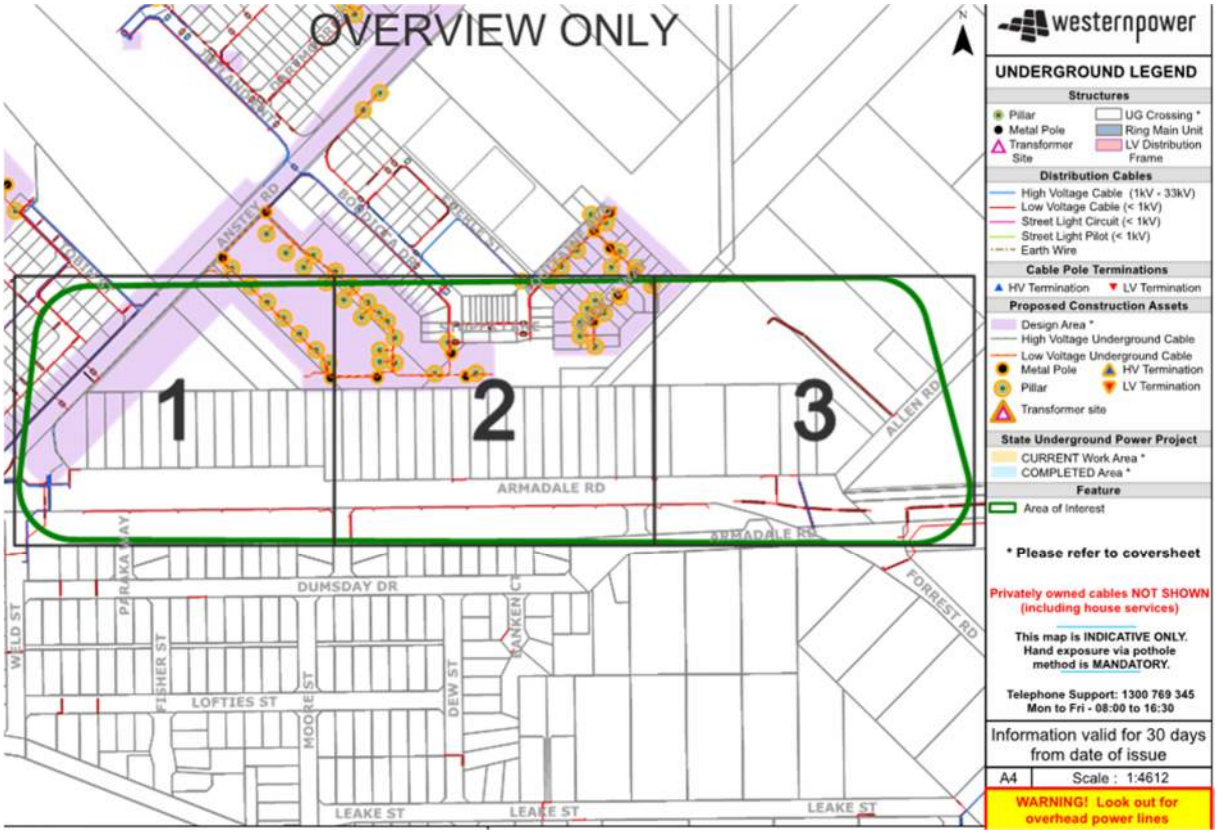


Figure 10: Existing Low Voltage Overhead Infrastructure

11 Gas

Before You Dig Australia (BYDA) information indicates that there is an existing 80PVC medium pressure gas main located along Anstey Rd and Armadale Rd, and this extends through to Allen Rd. This infrastructure is owned and maintained by ATCO.

The next closest asset is a 110PE gas main located within the existing Lot 24 which connects to the gas main running along Armadale Rd and provides a feed into the Mahala Estate to the North. There is an existing 200ST 1900kPa High Pressure gas asset that runs along the western side of Anstey Rd and southern side of Armadale Rd. This is identified as a “Critical Asset” and high risk in nature. Construction works within 15m of this infrastructure will require prior approval from Atco Gas and will require an approved gas spotter to be present for the duration of works.

Reticulated gas is not considered an essential service and is generally not required as a condition of development. It is usual practice to install the gas reticulation network for the subdivision within a common services trench, and the Developer typically incurs no cost for this. If there is an extension required to connect to the nearest high-pressure gas main the developer will be required to pay for the trenching to the gas main as a headworks cost.

Based on the above there does not appear to be any major constraints with regards to providing gas infrastructure to the Site.



Figure 11: Portion of existing Gas Infrastructure

12 Telecommunications

Before You Dig Australia (BYDA) information indicates there is an existing communication pit and pipe network provided by Telstra, NBN and Vocus adjacent to the Site along Armadale Rd, Anstey Rd and Allen Rd. This network provides service to the existing residential lots in the development Site.

There is an existing Optus cable along the southern side of Armadale Rd. In addition to this, there is existing Opticomm infrastructure within the section of constructed Rathbone Drive in the adjacent Mahala Estate to the North of the Site.

JDSi anticipate the existing infrastructure on Rathbone Drive and Armadale Rd would serve as a connection point for the Development however this would need to be confirmed with the communications provider at the time of making an application for connection and is dependent on the number of services required for the Development.

General communication services for the Site will consist of the installation of a standard pit and pipe network in accordance with communication guidelines and standards for Single and Multiple Dwelling Units (SDU's & MDU's). The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There may be some local land requirements for equipment Sites, similar to current provisions which will be accommodated at detailed subdivision stage.

The cost for installing the pit and pipe system will generally be funded by the Developer, whilst the Communications Provider will fund the installation of cable & fibre infrastructure, including backhaul into the Fibre Distribution Hubs (FDHs), Network Termination Device's (NTDs) or other Communication Facilities located in the Development.

Due to the location of the existing communications infrastructure and existing fixed line networks, and depending on the chosen provider, it is not expected that significant service back haul would be required for this Site.

Based on the above there does not appear to be any major constraints with regards to providing communications infrastructure to the development.

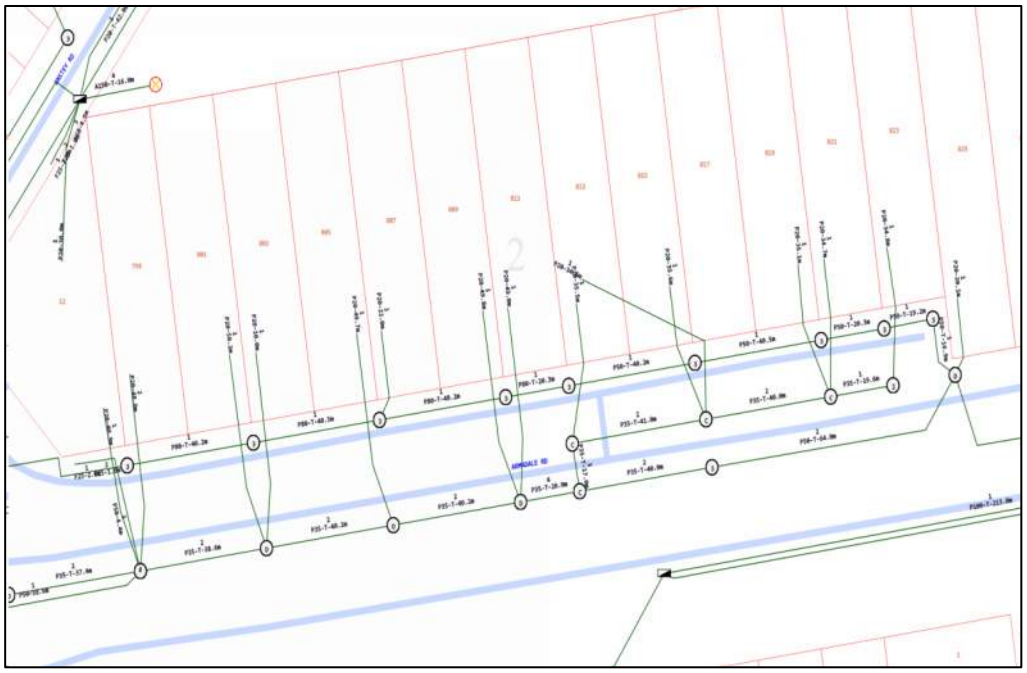


Figure 12: Portion of existing Communications Assets

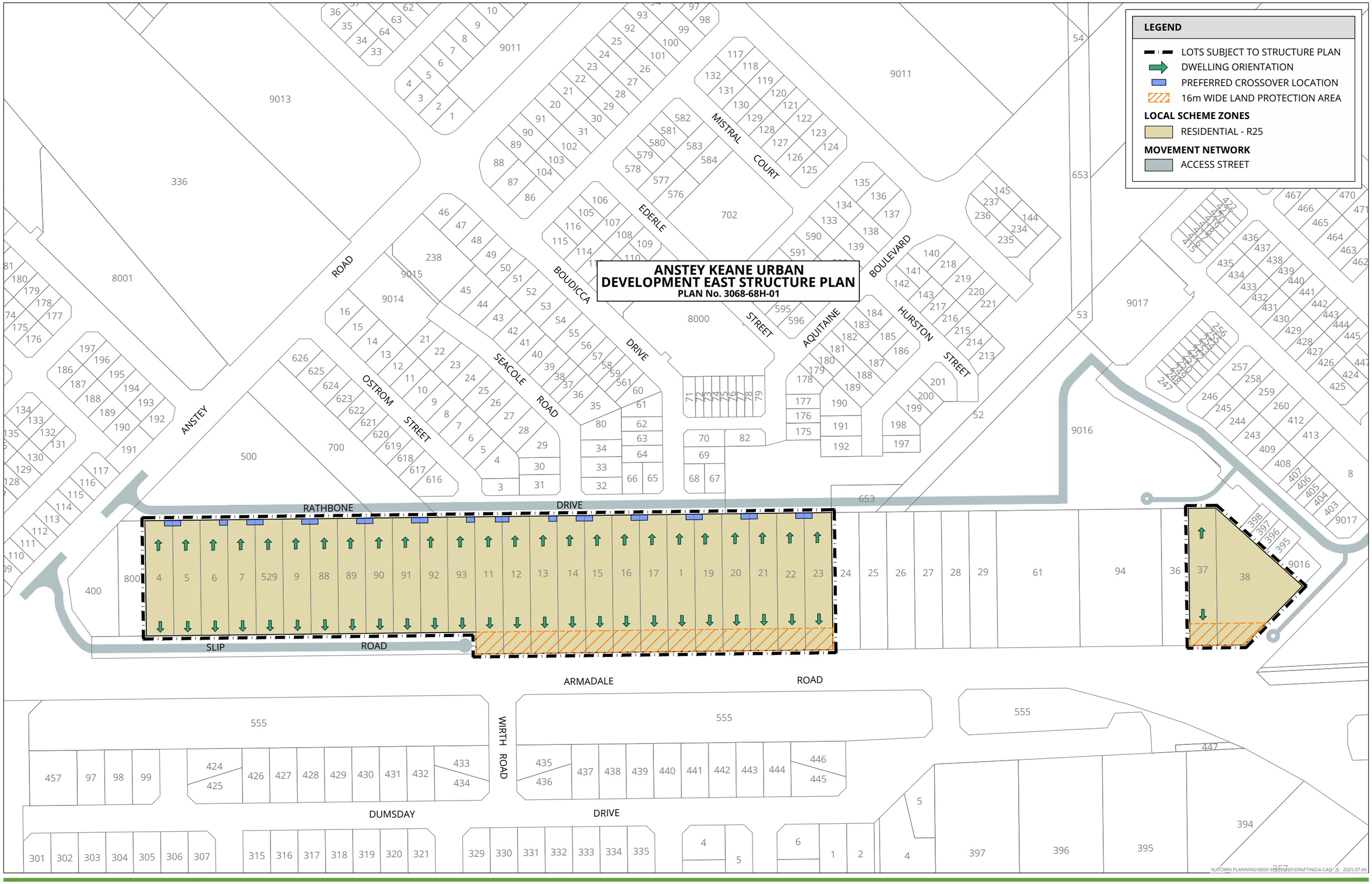
13 Disclaimer

JDSi have undertaken this assessment based on a desktop study and subsequently assumptions have been made which, if incorrect, have potential to change the assessment and/or recommendations. Major cost implications exist through factors which cannot be assured at this time including upgrading and provision of utility services, WAPC conditions of development, Local Authority Scheme Requirements, ground conditions, timing of adjacent developments, etc.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office.

APPENDIX A
PRELIMINARY LOCAL STRUCTURE PLAN & LOT CONCEPT PLANS



LOCAL STRUCTURE PLAN

VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N

0 55 m
SCALE @ A3: 1:2500

9269-LSP-01-C

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PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: MNG

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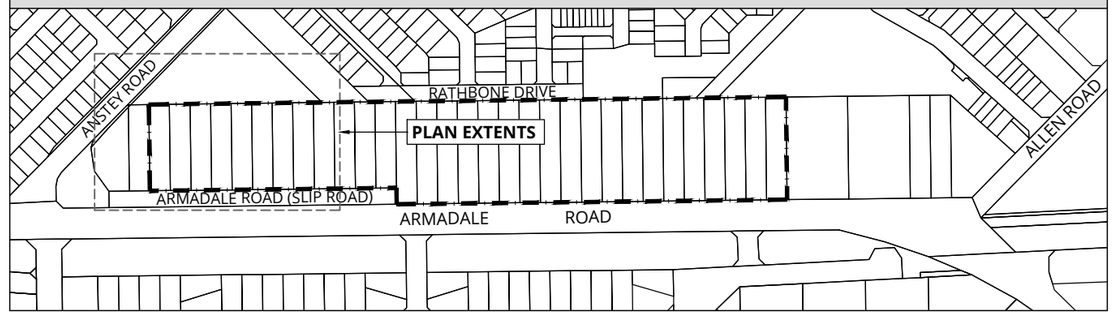
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LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



ANSTEY ROAD

FUTURE LOCAL CENTRE

RATHBONE DRIVE

117

116

115

400 LOCAL CENTRE

800

1 427m²	CP 111m²	1 394m²	CP 103m²	1 424m²	CP 110m²	1 370m²	CP 97m²	1 370m²	CP 97m²	1 436m²	CP 113m²	1 436m²	CP 113m²	1 478m²	CP 124m²	1 478m²	CP 124m²						
2 538m² 4		2 497m² 5		2 534m² 6		2 468m² 7		2 467m² 529		2 549m² 9		2 550m² 88		2 601m² 89		2 601m² 90							
BALANCE LOT 4 625m²		BALANCE LOT 5 706m²		BALANCE LOT 6 633m²		BALANCE LOT 7 766m²		BALANCE LOT 529 766m²		BALANCE LOT 9 602m²		BALANCE LOT 88 602m²		BALANCE LOT 89 498m²		BALANCE LOT 90 498m²							

SLIP ROAD (ARMADALE ROAD)

LEFT IN /LEFT OUT

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CONCEPT PLAN - R25 DENSITY (PAGE 1 OF 3)

VARIOUS LOTS - ARMADALE ROAD

FORRESTDALE

N

0 20 m

SCALE @ A3: 1:600

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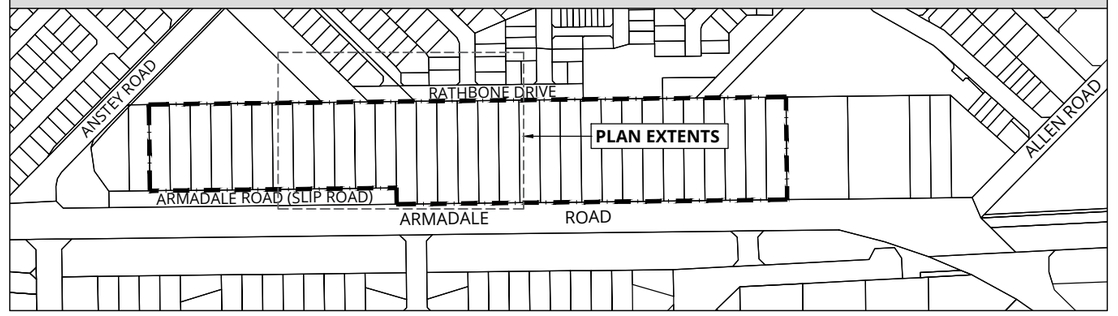
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



618 617 616

RATHBONE DRIVE

RATHBONE DRIVE

1 440m² | **2** 474m² | **1** 375m² | **2** 472m² | **1** 440m² | **2** 554m² | **1** 510m² | **4** 342m² | **2** 510m² | **3** 342m² | **1** 318m² | **2** 322m² | **1** 399m² | **2** 403m² | **1** 399m² | **2** 403m² | **1** 318m² | **2** 322m² | **1** 398m² | **2** 402m² | **1** 399m² | **2** 403m²

CP 115m² | CP 98m² | CP 114m² | CP 308m² | CP 164m² | CP 204m² | CP 204m² | CP 164m² | CP 204m² | CP 204m² | CP 204m²

91 | 92 | 93 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 1

BALANCE LOT 91 672m² | **BALANCE LOT 92** 755m² | **BALANCE LOT 93** 591m² | **BALANCE LOT 11** 1016m² | **BALANCE LOT 12** 1016m² | **BALANCE LOT 13** 1218m² | **BALANCE LOT 14** 1016m² | **BALANCE LOT 15** 1016m² | **BALANCE LOT 16** 1217m² | **BALANCE LOT 17** 1016m² | **BALANCE LOT 1** 1016m²

ARMADALE ROAD (SLIP ROAD)

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CONCEPT PLAN - R25 DENSITY (PAGE 2 OF 3)

VARIOUS LOTS - ARMADALE ROAD
FORRESTDALE

N

0 20 m
SCALE @ A3: 1:600

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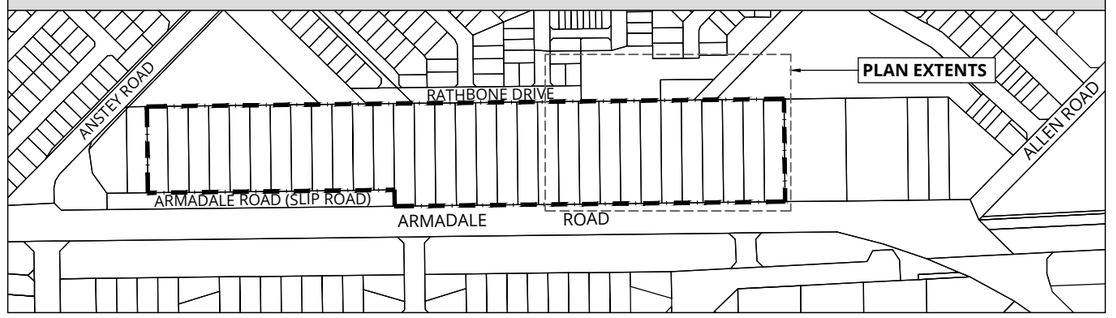
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



69 68 67

RATHBONE DRIVE RATHBONE DRIVE

CP 204m² 1 399m² 2 403m²
CP 204m² 1 399m² 2 403m²
CP 172m² 1 334m² 2 338m²
CP 204m² 1 399m² 2 403m²
CP 204m² 1 399m² 2 403m²
CP 202m² 1 399m² 2 403m²
CP 204m² 1 399m² 2 403m²
CP 202m² 1 399m² 2 403m²
CP 164m² 1 318m² 2 322m²
CP 204m² 1 399m² 2 403m²
CP 204m² 1 399m² 2 403m²
CP 204m² 1 399m² 2 403m²

DRAINAGE 24

19 **BALANCE LOT 19** 1016m²
20 **BALANCE LOT 20** 1177m²
21 **BALANCE LOT 21** 1017m²
22 **BALANCE LOT 22** 1017m²
23 **BALANCE LOT 23** 1017m²
25 **BALANCE LOT 25** 1017m²
26 **BALANCE LOT 26** 1218m²
27 **BALANCE LOT 27** 1017m²
28 **BALANCE LOT 28** 1017m²
29 **BALANCE LOT 29** 1017m²

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CONCEPT PLAN - R25 DENSITY (PAGE 3 OF 3)

VARIOUS LOTS - ARMADALE ROAD
FORRESTDALE

N

0 20 m
SCALE @ A3: 1:600

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Appendix B FORESTDALE MAIN DRAIN ARTERIAL STRATEGY

Government of **Western Australia**
Department of **Water**

Forrestdale main drain arterial drainage strategy

Looking after all our water needs

Department of Water

November 2009

Department of Water
168 St Georges Terrace
Perth Western Australia 6000
Telephone +61 8 6364 7600
Facsimile +61 8 6364 7601
http://www.water.wa.gov.au

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November 2009

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Acknowledgements

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The Water Corporation was the project manager for the development of this plan prior to the establishment of the Department of Water.

For more information about this report contact the team leader of urban drainage planning, Drainage and Waterways Branch, Department of Water.

ISBN 978-1-921549-36-6 (online)

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Summary

This final *Arterial drainage strategy* has been prepared by the Water Corporation for the Department of Water. It provides the details of the *Arterial drainage strategy* for the Forrestdale main drain catchment discussed in the *Southern River integrated land and water management plan* (Department of Water 2009).

The *Arterial drainage strategy* presents the Department of Water's guidance for the Water Corporation, City of Armadale, City of Gosnells, Western Australian Planning Commission, land developers and other state agencies about water management issues to help development proceed within the Forrestdale main drain catchment area.

The *Arterial drainage strategy* and the *Southern River integrated land and water management plan* (Department of Water 2009) also assist in integrating land and water planning as required by *Statement of planning policy no. 2.9: water resources* (Western Australian Planning Commission 2004) and outlined in *Better urban water management* (Department of Planning and Infrastructure, Department of Water, Western Australian Local Government Authority and Department of Environment, Water, Heritage and the Arts 2008).

All water management strategies, local structure plans, local planning scheme amendments and subdivision plans prepared for areas of proposed new development should demonstrate compliance with the strategies, objectives and design criteria detailed in this document.

A summary plan and checklist for developers has been developed and included with this document.

A regional scale controlled groundwater level is established and advice for developers and stakeholders for the management of groundwater quantity and quality within the Forrestdale main drain catchment area is given.

Figure 3 shows the strategy, which was developed based on the sustainability approach considering environmental, economic and social issues in the study area.

1 Introduction

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Figure 1) (Western Australian Planning Commission 2001) provides a guide to the future development and management of key environmental issues for the locality of Southern River in the City of Gosnells and Forrestdale, Brookdale and Wungong in the City of Armadale.

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) describes potential development areas, road networks, major community facilities, conservation and parks and recreation reserves, and a neighbourhood structure. It also provides proposals for the implementation of the plan including zoning mechanisms, staging, and financial and management arrangements.

However, the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) did not fully address drainage and environmental issues and in February 2001, the Water and Rivers Commission commissioned JDA consultant hydrologists to undertake the development of *the Southern River/Forrestdale/Brookdale/Wungong district structure plan urban water management strategy* (JDA 2002).

In reviewing the *Urban water management strategy* (JDA 2002) the Environmental Protection Authority advised that it favoured a staged approach to development based on precautionary principles that would allow for monitoring of the impacts of development on water quality and hydrology and subsequent retrofitting of constructed drainage infrastructure if required. Consequently the Environmental Protection Authority sought assurances regarding the implementation of the *Urban water management strategy* (JDA 2002) and requested that a memorandum of understanding (MOU) be prepared and signed by all agencies involved in the implementation of the *Urban water management strategy* (JDA 2002). The MOU was signed in October 2003.

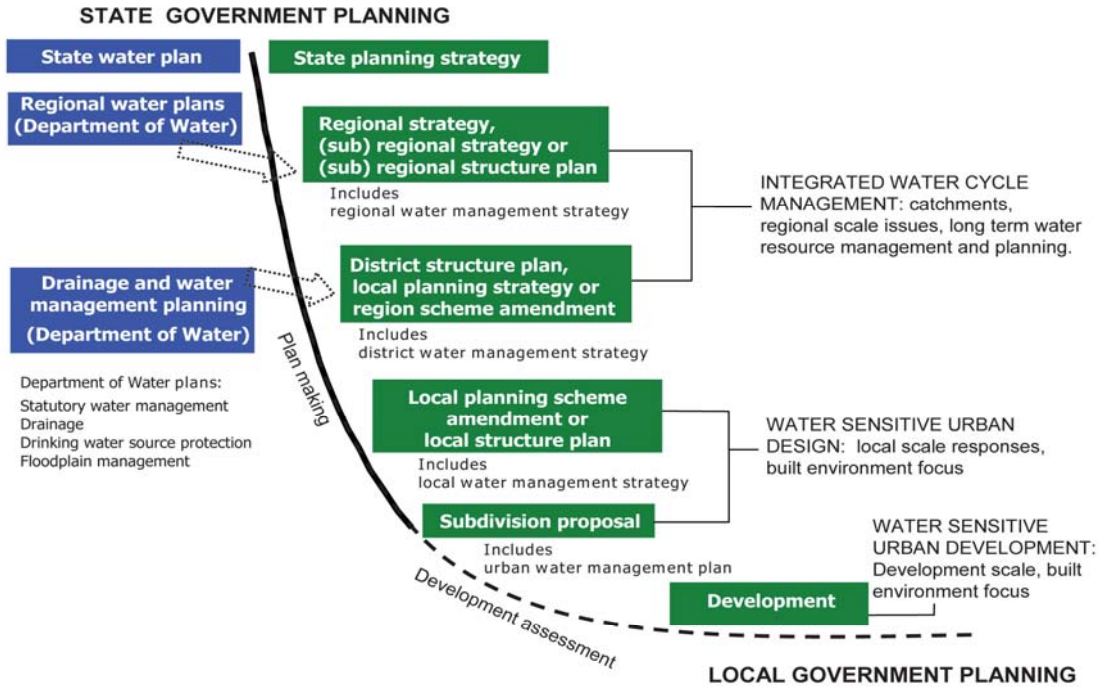
Under the MOU, the Water Corporation has undertaken the coordination and project management of the development of the *Southern River integrated land and water management plan* (Department of Water 2009) in consultation with all parties. In order to provide the surface water management section of this plan, a technical working group was established by the MOU steering committee to develop the recommendations of the *Urban water management strategy* (JDA 2002) into an *Arterial drainage strategy* for the Forrestdale main drain catchment.

The scope of the *Southern River integrated land and water management plan* (Department of Water 2009) covers all aspects of total water cycle management, including:

- protection of significant environmental assets within the structure plan area, including meeting water requirements and managing potential impacts from development

- water demands, supply options, opportunities for conservation and demand management measures and wastewater management
- surface runoff, including peak event (flood) management and the application of water sensitive urban design principles for frequent events
- groundwater, including the impact of urbanisation, variation in climate, installation of drainage to reduce groundwater levels, potential impacts on the environment and the potential to use groundwater as a resource
- water quality management, which includes source control of pollution inputs by catchment management, acid sulfate soil management, control of contaminated discharges from industrial areas and management of nutrient exports from surface runoff and groundwater through structural measures.

The *Southern River integrated land and water management plan* (Department of Water 2009) and this *Arterial drainage strategy* for the Forrestdale main drain catchment form the drainage and water management plan within the state government planning framework, as defined in *Better urban water management* (Department of Planning and Infrastructure, Department of Water, Western Australian Local Government Authority and Department of Environment, Water, Heritage and the Arts 2008) and outlined in Figure 2 below.



Note: The above diagram depicts the optimal process. In situations where there is existing zoning and a lack of guiding information, a flexible approach to implementation may be required. This is at the discretion of the Western Australian Planning Commission on advice of the Department of Water.

Figure 2 Planning framework integrating drainage planning with land planning processes

This document presents the proposed *Arterial drainage strategy* for the Forrestdale main drain catchment in accordance with the responsibilities for drainage planning assigned to the Department of Water by the state government.

1.1 Planning background

In addition to *Better urban water management* (Department of Planning and Infrastructure, Department of Water, Western Australian Local Government Authority and Department of Environment, Water, Heritage and the Arts 2008), the *Arterial drainage strategy* uses the following documents to define its key principles and objectives:

- *Liveable neighbourhoods – Edition 4 (*Western Australian Planning Commission 2007)
- *State planning policy no. 2.9: water resources* (Western Australian Planning Commission 2004)
- *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001).

1.2 Previous studies

A number of key investigations have been undertaken in the Forrestdale locality. It is the aim of this *Arterial drainage strategy* to incorporate information from all of these studies and present design criteria and management strategies.

The *Southern River/Forrestdale/Brookdale/ Wungong district structure plan urban water management strategy* was completed in 2002 by JDA consultant hydrologists. It presented stormwater management strategies for the study area and some of the proposed strategies have been incorporated into this study.

Regional-scale groundwater modelling was completed by Rockwater Pty Ltd in 2005 for the Water Corporation to assess any impacts from variations in climate or planned development in the study area.

An evaluation of the impact of water releases from stormwater arterial drainage on Forrestdale wetlands has been completed by GHD (2007) for the Water Corporation.

The study area has been assessed for acid sulfate soil risk, the results of which are presented in *Planning bulletin no. 64: acid sulfate soils* (Western Australian Planning Commission 2003).

Preliminary investigation into the ecological water requirements of selected wetlands on the Forrestdale main drain alignment (ENV 2007) has been undertaken.

Environmental water requirements of groundwater dependent ecosystems have not yet been published for this area.

1.3 Summary plan and checklist

Figure 3 provides an overview of the Forrestdale main drain catchment *Arterial drainage strategy* addressing stormwater quantity management. A checklist to assist developers in the preparation of local water management strategies has also been developed.

The checklist provides a summary of items to be addressed by developers in the preparation of local water management strategies for assessment by the City of Armadale or the City of Gosnells when an application for a local structure plan is lodged.

The checklist should be completed and signed by a suitably qualified professional and submitted to the local government with the local water management strategy for assessment when an application for a local structure plan is lodged.

Local water management strategy checklist for developers

The checklist provides a summary of items to be addressed by developers in the preparation of local water management strategies for assessment by the City of Armadale or the City of Gosnells when an application for a local structure plan is lodged.

The checklist should be completed and signed by a suitably qualified professional and submitted to council together with the local water management strategy.

Applicant:……

Name of structure plan:……

Version of structure plan: ……

Contact: ……

Address: ……

Telephone number:……Email: ……

Authorised Signature: ……

Date:……

	Item	Submission		Assessment	
		Document ref. 1	Comments2	Compliance	Comment
1.0 Introduction					
1.1	Drainage and water management principles and design objectives for this structure plan				
1.2	Planning background (subject land)				
1.3	Previous studies (related to drainage and water)				
2.0 Proposed development					
2.1	Key elements of structure plan				
2.2	Previous land use and potential sources of contamination				
2.3	Finished lot levels – (determined by greater of 100 year flood protection criteria or minimum separation of building foundations to MGL or a groundwater level approved by the Department of Water)				
2.4	Assessment of risk undertaken				
3.0	Existing site characteristics				
3.1	Topography and landform identified				
3.2	Environmental geology of the site identified (including soil types, ASS and PASS)				
3.3	Soil hydraulic conductivity and infiltration capacity of the site identified				
3.4	Groundwater levels, flows and quality of the site mapped (include identification and monitoring of any local or regional groundwater bores)				
3.5	Surface water flows and quality of the site identified (include flow monitoring of existing drainage)				
3.6	Environmental assets and water-dependent ecosystems mapped				
3.7	Indigenous sites identified				
3.8 Existing	infrastructure and constraints to design identified (include management strategies for any identified constraints)				
3.9	Site water balance pre-development and post-development identified				
3.10	Water sustainability initiatives				
4.0 Storm	water management				
4.1	Pre- and post-development hydrology (1-year, 5-year and 100-year ARI events)				
4.2	1-year ARI event managed for ecological protection in accordance with the *Integrated land and water management plan*				
4.3	5-year ARI event managed for serviceability in accordance with the *Integrated land and water management plan*				
4.4	100-year ARI event managed for flood protection in accordance with the *Integrated land and water*				

[1] Identify the section in the local structure plan in which this item has been addressed. It is possible that some items are not applicable and if this is the case, please put an explanation in the comments section.

[2] Please make comments as to the applicability of this criterion.

	management plan (include flow paths and emergency access routes and fully identify flood plain and protection measures)				
4.5	Finished lot levels at minimum of 0.5m above 100-year ARI flood levels.				
4.6	POS credits identified				
4.7	Water quality management BMPs to achieve design targets: Vegetated bioretention systems sized at 2% of the constructed impervious area they receive runoff from OR to achieve: at least 80% reduction of total suspended solids at least 60% reduction of total phosphorus at least 45% reduction of total nitrogen at least 70% reduction of gross pollutants				
5.0 Grou ndwater management					
5.1	Groundwater level management strategy				
5.2	Bioretention system, subsurface drainage and drainage inverts				
5.3	Subsurface drainage design				
5.4	Groundwater management strategies to achieve: at least 60% reduction of total phosphorus at least 45% reduction of total nitrogen				
5.5	Discharge to water-dependent ecosystems				
5.6	Specifications for imported fill (where proposed)				
5.7	Finished lot levels at a minimum of 0.8 m above the phreatic line				
6.0 Monitoring					
6.1	Monitoring programs commenced 2 years prior to proposed development				
6.2	Monitoring/sampling to follow Australian Standards				
6.3	Monitoring/sampling locations				
6.4	Water quality parameters to be monitored (refer to *Integrated land and water management plan)*				
6.5	Monitoring program to include a contingency action plan to manage risk				
7.0 Implementation					
7.1 Commitments					
7.2 Maintenance schedules					
7.3	Roles and responsibilities (for pre-development, during construction and all periods post-development)				
7.4 Funding					
7.5 Review					

2 Pre-development environment

Documents referred to for background information include:

- *Forrestdale main drain arterial drainage scheme technical report* (Water Corporation 2007)
- *Southern River/Forrestdale/Brookdale/Wungong district structure plan urban water management strategy* (JDA 2002)
- *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001)
- *Planning bulletin no. 64: acid sulfate soils (*Western Australian Planning Commission 2003)
- *Swan coastal geomorphic wetland mapping*
- *Aboriginal Heritage Act 1972* and *Register of aboriginal sites* (Department of Indigenous Affairs)

2.1 Study area

The Forrestdale main drain catchment is located 20 km south of Perth, and has an area of approximately 54 km^2. Approximately 19 km^2, or one third of the total catchment area forms the Forrestdale Lake subcatchment. The Forrestdale main drain discharges into the Southern River, approximately 6 km upstream of its confluence with the Canning River. The catchment lies within the boundaries of the City of Gosnells and the City of Armadale (Figure 4).

The existing land use of the catchment (Figure 5) is predominantly rural/agricultural with large areas of regional open space. The majority of rural land is used for the agistment of horses and grazing of cattle. There are relatively few residential areas, with Forrestdale townsite and the kennel zone alongside Ranford Road being the most significant of these.

Substantial areas of rural land and regional open space are wetland areas with much of the catchment being subject to periodic inundation from annual groundwater fluctuations. Existing rural residential properties in the catchment have been constructed on pads to prevent flooding.

There are two kennel zones currently situated within the Forrestdale main drain catchment: one at the corner of Ranford Road and Wright Road, which is approximately 0.3 km^2 in size; and a second, considerably larger area to the east of Ranford Road of approximately 0.9 km^2, which is bisected by the Forrestdale main drain.

Forrestdale townsite covers approximately 0.6 km^2 and is mainly situated to the south of Armadale Road on the northern edge of Forrestdale Lake. The town remains partially unsewered and therefore has the potential to adversely affect the water quality of Baileys branch drain and the Forrestdale main drain.

2.2 Geotechnical information

The catchment is located on the Swan Coastal Plain and is predominantly flat with levels varying from 28 m Australian height datum (AHD) in the west sloping gently to the north and east, to around 18 m AHD at the Southern River, which forms the eastern boundary of the catchment (Figure 6).

2.3 Soils

The superficial geology of the area includes degraded, low dunes of Bassendean sand with low-lying interdunal areas.

The base of the superficial formation generally slopes downwards to the west, steeply from around 0 m AHD near Southern River gradually down to about -20 m AHD beneath the centre of the Jandakot mound. The superficial formations generally consist of sandy sediments (a thin layer of Bassendean sand overlying Gnangara sand) with small isolated pockets of clayey sediments (Guildford clay) (Rockwater 2005).

The Ascot formation, consisting of fossiliferous limestone and calcareous sand with some clay, generally lies at the base of the superficial formations. There is commonly a 'coffee rock' (variably-cemented ferruginous sand) layer up to 17 m thick below the water table (Rockwater 2005).

Where intersected, the top of the underlying Leederville formation (cretaceous sediments) generally consists of siltstone or shale. The superficial formations are underlain by the Kardinya shale member of the Osborne formation in the west and north.

Average hydraulic conductivities of the superficial formations have been estimated as ranging from 1.1-8.9 m/d in the area underlain by Gnangara sand (and Ascot formation), and 0.5-5.3 m/d in areas of Guildford clay (Rockwater 2005).

Acid sulfate soils

The Western Australian Planning Commission's *Planning bulletin no. 64: acid sulfate soils* (2003), which is based upon a review of existing geomorphological, geological and hydrological information, indicates that the majority of the Forrestdale main drain catchment has a moderate to low risk of containing actual acid sulfate soils and potential acid sulfate soils (Figure 7). However, some portions of the catchment have a high risk, including some areas where modifications to the Forrestdale main drain and Baileys branch drain are proposed.

Investigations will be needed to identify areas of acid sulfate soils and these areas will require an acid sulfate soil management plan to be prepared in accordance with the strict amelioration standards set out in *Planning bulletin no. 64: acid sulfate soils* (Western Australian Planning Commission 2003).

2.4 Environmental assets and water-dependent ecosystems

The location of Bush Forever sites and *Environmental protection policy (Swan Coastal Plain) 1992* wetlands are identified in Figure 8. These have been considered in developing the proposals for modifications to the Forrestdale main drain and Baileys branch drain. However, these sites do not necessarily represent all occurrences of rare or endangered species within the catchment. A more detailed environmental assessment by a qualified consultant should be undertaken prior to the commencement of vegetation clearance.

Forrestdale Lake is listed under the Ramsar convention as a wetland of international significance, as well as being a conservation category wetland and an *Environmental protection policy (Swan Coastal Plain) 1992* lake. The entire lake is contained within Bush Forever site no. 345.

Balannup Lake is a conservation category wetland and an *Environmental protection policy (Swan Coastal Plain) 1992* lake, and is contained within Bush Forever site no. 413.

The Forrestdale main drain catchment also contains many other substantial Bush Forever sites and numerous wetlands classified as conservation category wetlands or resource enhancement wetlands including:

- Baileys wetland – conservation category wetland within Bush Forever site no. 342
- Harrisdale swamp – conservation category wetland within Bush Forever site no. 253
- Southern River floodplain wetland – conservation category wetland within Bush Forever site no. 464
- Kennels wetland – conservation category wetland within Bush Forever site no. 465
- Lander Road swamp – conservation category wetland
- Confluence wetland – conservation category wetland within Bush Forever site no. 342
- Nicholson Road wetland – conservation category wetland within Bush Forever site no. 262
- Gerty Way wetland – resource enhancement wetlands adjacent to Bush Forever site no. 340
- Forrestdale Business Park wetland – conservation category wetland
- East Forrestdale palusplain – conservation category wetland within Bush Forever site no. 345.

The Department of Environment and Conservation has recorded the presence of several priority and declared rare flora species within the catchment boundary.

In addition, there are three claypan threatened ecological communities and one Muchea limestone threatened ecological community within the catchment boundary.

The locations of these sites are identified in Figure 8 and have been considered in developing the proposals for modifications to the main drainage system.

2.5 Social considerations

The *Aboriginal Heritage Act 1972* was introduced in Western Australia in 1972 to protect aboriginal heritage. The Act recognises Aboriginal peoples' strong relationships to the land, which may go back many thousands of years.

The Act provides automatic protection for all places and objects in Western Australia that are important to Aboriginal people because of connections to their culture. These places and objects are referred to as aboriginal sites.

The Department of Indigenous Affairs maintains a *Register of aboriginal sites* as a record of places and objects of significance to which the Act applies. The presence of an aboriginal site places restrictions on what can be done to the land. Anyone who wants to use land for research, development or any other cause should investigate whether there is an aboriginal heritage site on the land.

The Minister for Indigenous Affairs is responsible for the administration of the Act. Under the Act it is an offence for anyone to excavate, damage, destroy, conceal or in any way alter an aboriginal site without the Minister's permission. The Department of Indigenous Affairs assists the Minister in the administration of the Act. The *Register of aboriginal sites* identifies several sites of indigenous significance in the Forrestdale main drain catchment. These sites are mostly concentrated around the Southern River and its flood plain, but also include Forrestdale Lake and other smaller sites around the catchment.

The locations of these sites are identified in Figure 8 and have been considered in developing the proposals for modifications to the main drainage system. None of the proposals for Water Corporation drains that are described in this report are expected to impact on these sites. However, an assessment should be undertaken by a qualified consultant to determine whether a more thorough aboriginal heritage investigation of the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) area needs to be undertaken for any specific location to identify unregistered sites.

The design of modifications to the main drainage system has considered the potential for public amenity usage of areas within and adjacent to proposed drainage facilities. Flood storage areas have been designed to be kept dry, except during extreme storm events, and will be landscaped to provide the community with public open spaces with multiple potential uses.

2.6 Surface water

The modelled existing drainage system is shown in Figure 9. Approximately one third of the total catchment area forms the Forrestdale Lake subcatchment. Forrestdale Lake is linked to the Forrestdale main drain via a high level overflow on the eastern side of the lake. The top water level of Forrestdale Lake has to reach a level of 23.75 m AHD before overflowing into the main drainage system downstream.

Forrestdale main drain

Forrestdale main drain connects Forrestdale Lake to the Southern River. It was constructed as a rural drain in the 1970s to manage the regional groundwater level and prevent the Westfield wastewater treatment site from being flooded.

The Forrestdale main drain has levee banks along much of its length and it passes through or adjacent to a number of Bush Forever sites and conservation category wetlands.

Baileys branch drain

Baileys branch drain connects the existing Forrestdale townsite to the Forrestdale main drain upstream of Ranford Road. It was constructed in conjunction with the Forrestdale main drain for the purpose of managing regional groundwater and preventing flooding within the townsite. The drain is also contained in levees for much of its length and passes adjacent to Bush Forever site no 342. The Dumsday Drive compensation basin is located within the townsite at the head of this drain.

Keane Road branch drain

The Keane Road branch drain is connected to the Forrestdale main drain south of Armadale Road with the purpose of alleviating flooding of the Westfield wastewater treatment site.

Local authority drains

The James drain, which drains the area west of Forrestdale Lake, passes through major wetlands upstream and downstream of Nicholson Road before discharging into Forrestdale Lake.

The Forrestdale Lake south drain is largely undefined and although it is quite substantial at the Nicholson Road crossing, it quickly reduces in size and is replaced by indistinct overland flow to Forrestdale Lake.

Balannup Lake is linked to the Balannup Lake drain via a high level overflow from the north of the lake. The drain overflows to the Lander Road swamp and flows through a very large floodplain upstream of Southern River Road before it joins the Forrestdale main drain just upstream of Holmes Street.

Balannup drain drains the catchment upstream of Nicholson Road and discharges into Baileys branch drain approximately 300 m upstream of its confluence with the Forrestdale main drain via a 600 mm connection pipe. Harrisdale Swamp discharges into Balannup drain which then flows through Bush Forever site no. 342, where its depth becomes very shallow.

The Precinct 4 north and south drains are small and indistinct drains, which disappear before reaching the Southern River or Forrestdale main drain near the Tonkin Highway.

Murphy's drain is a small drain east of the Tonkin Highway with overflows regularly occurring into adjacent rural land before flowing to the Forrestdale main drain upstream of Allen Road.

System capacity

Long section drawings of the main drainage routes within the catchment are presented in Figures 10a to 10j.

Modelling indicates that the main drainage system comprising the Forrestdale main drain, Baileys branch drain and Keane Road branch drain can generally contain the three-year average recurrence interval storm event with approximately 300 mm freeboard to the top of the bank.

The 10-year average recurrence interval storm event can generally be conveyed within the Water Corporation main drainage system, although no freeboard is available. Elsewhere in the catchment, on local authority drains there is significant flooding during the 10-year average recurrence interval storm event.

During the 100-year average recurrence interval storm event the levee banks of the main drainage system are overtopped, contributing to the inundation of extensive areas of rural land, Bush Forever sites, and wetlands.

There is little difference between the 10 and 100-year average recurrence interval storm event discharges from the Forrestdale main drain to the Southern River, due to the large storage volumes that are retained within the catchment during a major storm event in naturally occurring floodplains and wetlands.

High tailwater conditions in the Southern River (levels equivalent to the 25-year flood event has been used for the purposes of this study), when combined with a major storm event, have a large effect on the Forrestdale main drain. Floodwater extends into very large natural floodplains on the Forrestdale main drain downstream of Holmes Street and on the Balannup Lake drain upstream of Southern River Road and at its confluence with the Forrestdale main drain.

Environmental aspects

The inundation of wetland areas is caused by a combination of direct runoff from the local catchment area into low-lying land and overland flooding of runoff from a wider catchment area via nearby drains, and also due to elevated groundwater levels.

The Balannup drain and Baileys branch drain contribute to the periodic inundation of Baileys Wetland within Bush Forever site no. 342, in events of greater than three-year average recurrence interval. This inundation occurs mainly due to the throttling influence of the Baileys branch drain connection to the Forrestdale main drain, with water backing up the shallow drains upstream and overflowing into the wetland.

The Forrestdale main drain and Baileys branch drain contribute to the periodic inundation of several other wetlands in events of greater than 10-year average recurrence interval.

Some of the local authority drains in the catchment contribute to wetland inundation in events more frequent than the one-year average recurrence interval.

The contribution of surface runoff to the inundation of wetlands is, however, relatively minor compared with the depth and extent of inundation due to high groundwater levels experienced each year, particularly during wet periods such as shown in Figure 11.

Conclusions

The existing drainage system has insufficient capacity to convey the 10-year average recurrence interval event under existing development conditions. The 10-year event is expected to result in significant flooding in the catchment, with overtopping of local authority drains and insufficient freeboard in the Water Corporation main drainage system.

The results of groundwater modelling predict that during wet years (e.g. 1915–1931) the area inundated by shallow groundwater is substantially greater than the area predicted to be inundated by surface runoff resulting from the 10-year or 100-year rainfall event.

Surface water quality

The Forrestdale main drain is within the catchment for the Southern River, which the Swan River Trust has identified as a priority catchment in its *Healthy rivers action plan* (Swan River Trust 2008). The Environmental Protection Authority has previously advised that a condition for development in the district structure plan area is the demonstration that development can be managed to meet the environmental objectives and targets for the Southern River catchment, documented in the Swan River Trust's Healthy Rivers Program.

The Swan River Trust's Healthy Rivers Program is a key instrument for the implementation of the *Swan and Canning Rivers Management Act 2006* which protects waterways such as the Southern River, as well as the Swan and Canning rivers, for their significance as important ecosystems and valuable recreational waterways. The Swan River Trust has developed short and long-term end-of-catchment water quality targets for nutrient concentrations in tributaries of the Swan-Canning river system.

The long-term targets for nutrient concentrations in the Southern River are 1.0 mg/L total nitrogen and 0.1 mg/L total phosphorus. Typical existing concentrations measured in the Forrestdale main drain are 3.2 mg/L total nitrogen and 0.5 mg/L total phosphorous.

The Swan River Trust has accepted that, although the Healthy Rivers Program targets represent long-term management targets, the agreed condition for development is that there is to be no deterioration in water quality in the Forrestdale main drain or the Southern River.

2.7 Groundwater

Groundwater flows

The Forrestdale main drain catchment is situated in an area of very shallow groundwater immediately to the east of the Jandakot mound. There are extensive areas in the catchment where the groundwater rises to the surface for extended periods.

As well as the obvious implications this has for fill requirements with proposed development, drainage designs will also need to consider likely changes in groundwater and their impact on both capacity and functionality of the main drainage system. Drainage in the catchment is inextricably linked to the groundwater. The Forrestdale main drain and Baileys branch drain were originally constructed to control regional winter groundwater levels with direct and indirect (overland) connections existing between lakes/wetlands in the catchment and the drainage system.

Groundwater modelling

Rockwater Pty Ltd carried out regional groundwater modelling of the Forrestdale main drain catchment in 2005. The modelling study investigated changes to groundwater levels that would result from urban development under three climate scenarios:

- dry rainfall period (post-1975) – 788 mm
- very wet period (1915–1931 rainfall) – approximately 1200 mm
- very dry period (1994–1995) – 690 mm

The report discusses the seasonal variability of groundwater levels in the catchment stating that the average annual groundwater fluctuation in the catchment are generally in the range 1.2 to 2 m, increasing to 2 to 2.5 m near drains and in areas of Guildford clay.

Modelled pre-development maximum groundwater level contours (788 mm annual rainfall scenario) are presented in Figure 11 (Rockwater 2005).

The results of the regional groundwater model have been incorporated into the InfoWorks surface water model by the application of winter peak starting water levels in wetlands and key sections of the drainage system. These starting water levels provide an assessment of the drainage system’s ability to manage significant rainfall events at times of peak groundwater as well as an indication of the base flow within the drain at these times.

The predicted winter peak starting water levels in a selection of key wetlands are presented in Table 1 below for the various pre-development scenarios that were studied.

The environmental impact of groundwater interaction with wetlands and drains is discussed in Section 4.

Table 1 Groundwater model calculated wetland water levels (m AHD)

Location	788 mm rainfall (788 mm)		High (1920s) rainfall (approx. 1200 mm)		Low rainfall (690 mm)	
	Summer minimum	Winter peak	Summer minimum	Winter peak	Summer minimum	Winter peak
Forrestdale Lake (Bush Forever site no. 345)	21.5	22.5	21.6	23.2	21.4	22.2
Balannup Lake (Bush Forever site no. 413)	19.9	21.7	20.1	22.5	19.8	21.3
Harrisdale swamp (Bush Forever site no. 253)	24.3	25.2	26.4	26.9	23.7	24.4
Baileys wetland (Bush Forever site no. 342)	20.0	21.5	20.0	22.9	19.9	21.3
Kennels wetland (Bush Forever site no. 465)	19.9	20.8	19.9	21.7	19.9	20.7
Confluence wetland (Bush Forever site no. 342)	20.1	21.1	20.3	22.3	20.1	20.9
Gerty Way wetland (Adj Bush Forever site no. 340)	19.7	19.9	19.7	21.3	23.3	20.9
Lander swamp	19.0	21.3	19.4	23.5	18.9	20.9
East Forrestdale palusplain (Bush Forever site no. 345)	21.3	22.4	21.4	23.1	21.1	22.1
Gibbs Rd swamp (Bush Forever site no. 344)	23.8	25.2	24.7	27.3	23.5	24.4

3 Proposed development

3.1 Key elements of the structure plan

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) as shown on Figure 1 designates 16 km^2 of the Forrestdale main drain catchment for medium density residential development (mainly allowable housing density of 15 per hectare (R15) with approximately 25 per cent allowable housing density of 25 per hectare (R25)), 3 km^2 for light industrial use, and 2 km^2 for mixed business/ commercial, community facilities, and village and neighbourhood centres.

The remainder of the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) area is to form public open space or remain rural with conservation areas and environmental management areas protected. The kennels zone to the east of Ranford Road will remain unchanged. Some areas have been identified in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) for possible future development, but it is believed unlikely that they will be required for urbanisation within the next 30 years.

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) describes proposed land use change from the existing mainly rural land use to mainly urban land use (Figure 1). This change in land use will result in increased runoff during large (major) rainfall events that will require upgrades to the drainage system.

The drainage upgrade strategy, previously recommended by the *Urban water management strategy* (JDA 2002) and endorsed by the Environmental Protection Authority, proposed widening the Forrestdale main drain and Baileys branch drain for their entire lengths, to create a meandering 'living stream' style drain within a broad multiple use corridor. Whilst this approach may be both aesthetically desirable and hydraulically achievable, there are a number of constraints within the catchment that limit its potential for adoption:

- Several sections of drain pass through or adjacent to Bush Forever sites. Modifications to Bush Forever sites require referral to the Environmental Protection Authority.
- Sections of the Forrestdale main drain (most notably through the kennels zone downstream of Ranford Road) are closely bounded by developed private properties.

In developing this drainage strategy, the locations of these constraints have been identified as well as several other alternative areas where there are more feasible opportunities for increased widening or storage.

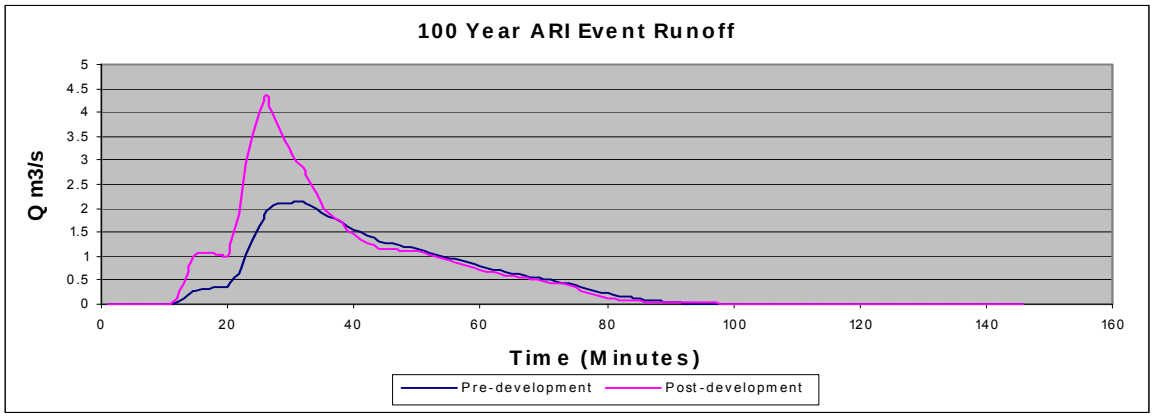
4 Protection of environmental assets

The following strategies have been developed to protect and enhance the value of environmental assets in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) area.

Minimise changes to hydrology to prevent impacts on watercourses and wetlands

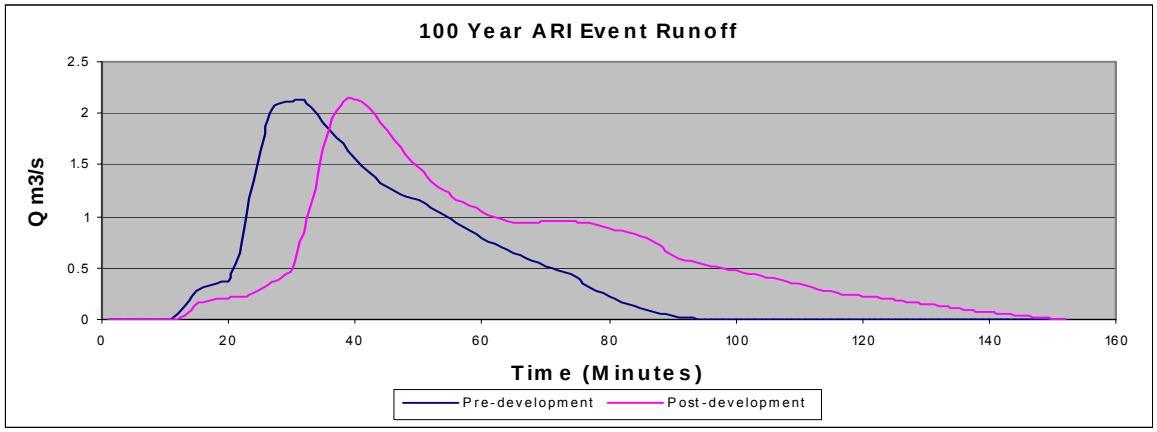
Changes in land use from rural to urban may lead to local increases in peak flows and volumes of runoff due to increases in impervious area (Figure 12). Large increases in peak flows and volumes have the potential to adversely impact on receiving environments by causing erosion and increasing the period of inundation of vegetation.

Figure 12 Typical pre- and post-development runoff hydrograph comparison.



Surface water management should ensure that urban development does not increase the peak flows discharging to receiving environments, although there may be increases in total runoff volumes (Figure 13). Development should also ensure that watercourses and wetlands do not dry out due to over-abstraction of water resources or lowering of groundwater levels.

Figure 13 Typical pre- and post-development runoff hydrograph comparison, with compensated post-development flows.



Manage and restore watercourses and wetlands

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* area includes several significant wetlands and Bush Forever sites that are considered high-value environmental assets that should be protected. Some parts of the existing drainage system are located in or adjacent to these areas and flow over these wetlands during storm events.

To evaluate the environmental impact of any upgrade to the drainage system, it is necessary to determine any changes to the hydrologic regime of these wetlands. The hydrologic regime of a wetland can be characterised by the frequency, depth (or extent) and duration of any inundation.

A separate study of the interaction of surface water runoff and the wetlands of the Forrestdale main drain catchment has been carried out and is presented in *Evaluating the impact of water releases from stormwater arterial drainage on Forrestdale wetlands* (GHD 2007). The study concluded that the discharge of additional flood flows to Forrestdale wetlands during infrequent (> 10 year average recurrence interval event) storm events will have no significant impact on the hydrology of these wetlands.

This conclusion is based on the following:

- An examination of the available data for Gibbs Road Swamp and Forrestdale Lake supports the conclusion of previous studies (Environmental Resources Management Group 2000) that wetland water levels are largely determined by regional groundwater levels.
- Temporary increases in wetland water level due to surface flows during storm events (< 0.3 m) are insignificant compared to the seasonal fluctuations in water level due to groundwater (1.0-2.0 m), the annual variability in maximum water levels (standard deviation 0.25 m) and long-term decline in water level due to drying climate (0.2-0.5 m).
- Areas temporarily inundated by surface water inflows will usually be inundated by seasonal groundwater rises later in the same year. Only if a major storm event occurs when the wetland is at its annual maximum water level will the additional inflows lead to an increase in the maximum water level that year. The probability of a 100-year average recurrence interval storm event coinciding with the annual maximum wetland water levels is considerably less than one in 100 years.

Regional and local groundwater levels are maintained by the requirement for existing drain inverts to be maintained and not lowered, and for new drain inverts to be located at or above a groundwater level endorsed by the Department of Water. This requirement also includes subsurface drainage, which in all developments will be located at or above a groundwater level endorsed by the Department of Water.

The duration of water level changes due to surface water inflows during infrequent storm events can be managed by hydraulic control structures that can discharge surface water from the wetland to the drainage system after the storm event has passed, as discussed in Section 5.2.

The performance of these structures can be specified in consultation with environmental managers and can include sufficient flexibility to allow future changes, including modification to allow the diversion of surface flows from the drainage system to the wetlands to maintain the hydrologic regime during dry periods.

There are other potentially more significant impacts on wetland water levels than the proposed infrequent discharges from the Forrestdale main drain, including decreasing groundwater levels due to long-term climate change and additional groundwater abstraction. Careful management of drainage discharges to wetlands offers the opportunity to manage the hydrology of the wetlands during dry periods or in times of decreasing groundwater levels by diverting surface flows from the drainage system, protecting those wetland systems.

The short-term impacts of construction of the preferred option will be managed by ensuring that appropriate investigation and mitigation procedures are followed at all times prior to and during construction.

Additional management strategies and design criteria for the protection of environmental assets are presented in the *Southern River integrated land and water management plan (*Department of Water 2009*)*.

5 Stormwater management strategy

The key objectives for surface water management are:

- protection of wetlands and waterways from the impacts of urban runoff
- protection of infrastructure and assets from flooding and inundation

5.1 Floodplain management

Mitigate flooding to manage risks to human life and property

Planning measures recommended are:

- New dwellings in proposed and existing residential areas should have their floor levels elevated 500 mm above the 100-year average recurrence interval flood level.
- New industrial or commercial premises should have their floor levels elevated 500 mm above the 100-year average recurrence interval flood level.
- To provide egress for emergency services major arterial roads with immunity to the 100-year average recurrence interval flood level should be identified. Other residential streets should be designed to be serviceable up to the five-year average recurrence interval flood event.
- The design of the new urban areas should incorporate current best practice in water sensitive urban design to mitigate the impacts of urbanisation in the catchments on regional water quantity and quality.
- Waterways within the structure plan area should be constructed to manage the flooding from the 100-year average recurrence interval flood event within their channels and floodplains without allowing flooding from the upstream catchment to enter adjacent residential areas.
- New drainage corridors should be designed with consideration of the current practice in water sensitive urban design by incorporating water quality management controls and riparian vegetation.

5.2 Surface water quantity management

As a result of the identified constraints on widening certain sections of the main drainage system (Section 3.1), it will not be possible to directly convey the entire post-development 100-year average recurrence interval event peak flow. It is therefore necessary to attenuate the peak discharge by providing the equivalent storage to that which currently exists naturally within the catchment. Some storage is provided within the drain, which is hydraulically controlled by existing culverts that restrict downstream flow. However, it is necessary to also provide some additional storage within the system, especially to allow for the potential loss of floodplains identified in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001).

Two options were approved by the technical working group for investigation:

Option A (adopted)

- widening of Forrestdale main drain and Baileys branch drain in all areas except within environmentally sensitive areas i.e. Bush Forever sites, conservation category wetlands etc
- continued use of wetland areas for storage of floodwaters and allowance for additional floodwater volumes to pass through wetland areas during infrequent storm events.

This option uses existing overland flood routes into wetland areas. In some cases this may involve lowering sections of the levee bank through wetland areas to provide more defined flood routes.

Option B

- widening of Forrestdale main drain and Baileys branch drain along some of their length and construction of flood storage areas outside wetlands
- prevention of any additional flooding of wetland areas.

This option with limited wetland inundation provides the additional storage required by increasing storage on the main drainage system in the form of constructed flood storage areas requiring additional land for drainage purposes. Such provision has not been allowed for in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001).

Adopted strategy

The adopted strategy was endorsed on the basis that the changes to the periodic inundation of the wetlands from drainage overflows during major storm events is insignificant when compared to the impact due to the variability in the annual groundwater regime under existing land development conditions.

The environmental impacts from the adopted strategy were supported ‘in principle’ by the Department of Environment and Conservation. Changes to the hydrologic regimes of the wetlands due to surface flows during storm events (<0.3 m) are insignificant compared to the seasonal fluctuations in water level due to groundwater (1.0–2.0 m), the annual variability in maximum water levels (0.25 m) and long-term decline in water level due to drying climate (0.2–0.5 m).

The adopted strategy also offers the opportunity to manage the hydrology of the wetlands during dry periods by diverting surface flows from the drainage system. In addition, by using existing wetlands to store surface water during infrequent storm events, it minimises the construction of additional flood storage areas, reducing the land required for drainage purposes. Figure 3 shows details of the adopted *Arterial drainage strategy*.

Figures 14a to 14j show the long section of the main drains and some of the precinct drains under the preferred option.

The key assumption in developing the adopted strategy is that existing overland flood paths into wetland areas continue to be used during infrequent events, allowing

increased use of the available storage within these areas. This strategy makes no change to the drains that pass through or adjacent to wetland areas other than to allow more extensive inundation at these points in the system by forming defined (and therefore controllable) flow paths out of the low flow channel. The adopted strategy allows the partial removal or lowering of levee banks and the incorporation of flow control devices.

The use of existing wetlands for storage of drainage flows from infrequent major rainfall events will not significantly affect the hydrologic regime of these wetlands. As described in Section 4, water level changes due to seasonal and annual fluctuations in groundwater are far greater than the water level changes that will result from the diversion of surface flows from infrequent major rainfall events.

Engineered hydraulic control structures will be installed, only where necessary, to regulate flows to and from the drainage system, controlling the depth and duration of inundation of wetlands due to diversion of surface flows. In the case of prolonged dry periods, these structures would allow the diversion of flows from the drainage system to maintain the hydrologic regime of significant wetlands if requested by environmental regulators.

The Forrestdale main drain and Baileys branch drain both require widening as shown on Figure 3. This has been achieved in areas where increasing the size of the drainage reserve has little impact on proposed development and provides opportunities for improving the aesthetics of the immediate surroundings.

Widening of the main drain should be located within linear public open space as shown in the typical cross-sections of Figures 14a-14j. The design includes a main drainage waterway within the linear public open space, incorporating a one-year low flow channel, sized to convey all flows up to and including the critical 10-year average recurrence interval event. More extreme events are then allowed to flow out of this waterway channel and use a broad shallow gradient floodplain area. Because it is infrequently inundated, the flood plain area may be landscaped in keeping with its primary purpose of flood storage and conveyance. This will improve the aesthetic nature of the drain reserve, and provide a valuable area of open space area for public amenity usage.

Minimise changes in hydrology to prevent impacts on receiving environments

Urbanisation results in increased impervious area. Increased rates and volumes of stormwater runoff should be managed to protect infrastructure and assets from flooding and inundation, whilst both water quantity and quality should be managed to protect wetlands and waterways from risk of increased inundation and contaminant loads. Surface water management should ensure that urban development does not increase the peak flows discharging to receiving environments.

Surface water quantity management is not restricted to preventing runoff from increasing due to development, but should also manage the maintenance or even restoration of desirable environmental flows and/or hydrological cycles where potential impacts on significant ecosystems such as wetlands are identified.

Design objectives

- For the critical one-year average recurrence interval event, the post-development discharge volume and peak flow rates shall be maintained relative to pre-development conditions in all parts of the catchment. Where there are identified impacts on significant ecosystems, desirable environmental flows and/or hydrological cycles shall be maintained or restored as outlined in this report and approved by the Department of Water.
- The catchment runoff shall be managed for all average recurrence interval events up to and including the 100-year average recurrence interval event within the development area to pre-development peak flow rates. Pre-development critical 10 and 100-year average recurrence interval event peak flow rates are specified in Table 2 of this report.
- Water sensitive urban design and best management practices promoting on-site retention of events up to the one-year average recurrence interval shall form the basis of the surface water quantity management strategy for minor events.

Increase in the post development peak flow rates from 5- to100-year average recurrence interval events may be considered, where it can be demonstrated (at district or local water management strategy stage) that the pre-development hydrologic, hydraulic, geomorphic and ecological characteristics of the downstream catchment and receiving environment can be protected and maintained.

Manage surface water flows from major events to protect infrastructure and assets

Hydrologic and hydraulic modelling of the study area using InfoWorks CS has determined indicative subcatchment scale peak discharge flows and volumes, detention volumes required to manage surface water flows from major events, and hydraulic grade lines within the main waterways.

Detention volumes required to meet specified 10 and 100-year average recurrence interval peak flow criteria are also presented in Table 2 of this report.

Figure 3 and Table 2 below present the proposed surface water management strategy for the Forrestdale main drain catchment. Indicative 100-year flood levels, subcatchment delineation (Figure 3), and discharge flows, discharge volumes and detention volumes (Table 2) are provided as a guide to developers. These should be refined and located during local structure planning via the local water management strategy, and finalised during subdivision scale planning via the urban water management plan.

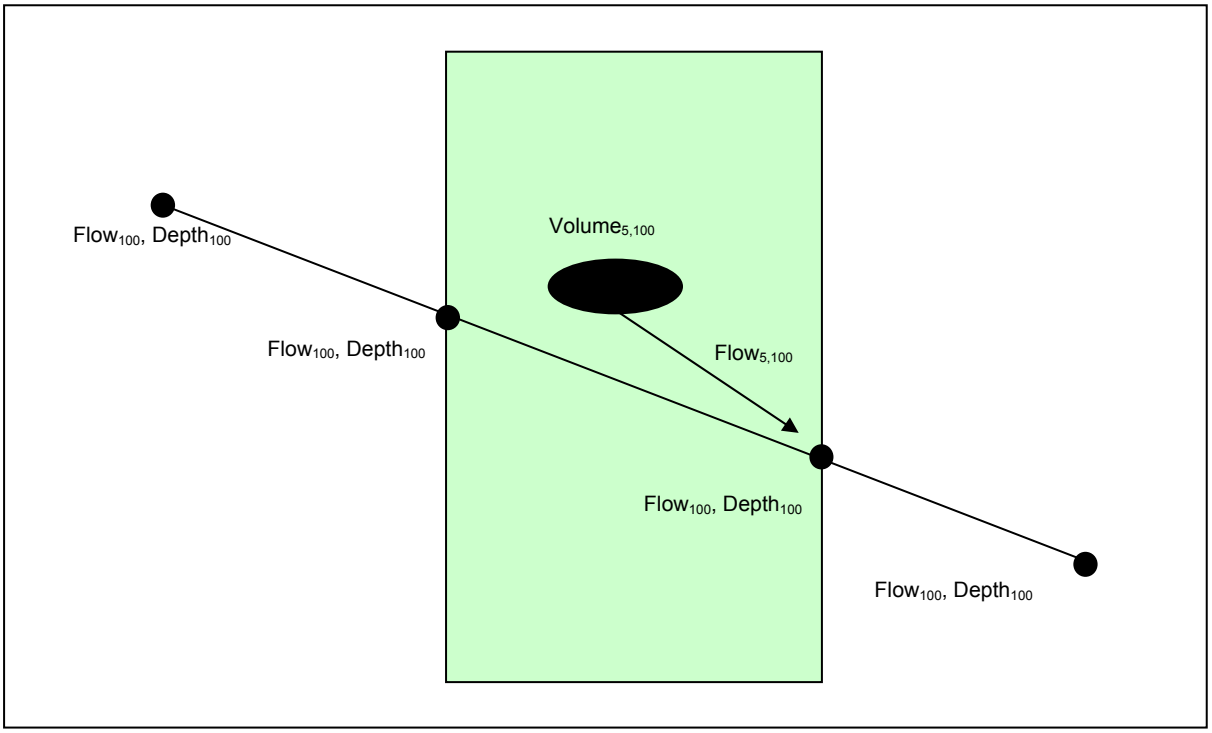
For each subcatchment, the critical 10 and 100-year average recurrence interval event pre-development discharge flow rates are presented in Table 2 along with an indicative post-development storage volume required to maintain that flow rate. It is important to note that the *Arterial drainage strategy* model assumes that the one-year one-hour average recurrence interval event (from allotments and also from the road network) is retained at source, so this volume is not included in the indicative flood detention volumes provided in Table 2. Flows from the road network in a one-year

average recurrence interval event should be retained (or detained for the duration of the one-year event) within the road reserve network in a manner that mitigates pollutant export.

Discharge flow rates quoted in Table 2 are not within main waterways, and do not include flows generated by upstream subcatchments. Discharge criteria are set for whole subcatchments at the point at which they connect to main waterways as indicated by Figure 15 below.

For each modelled node (Figure 15) along the main waterways, the critical 100-year average recurrence interval event hydraulic grade line with associated peak flow rates are presented on longitudinal sections (Figures 10a-10j and 14a – 14j).

Figure 15 Schematic presentation of information provided for subcatchments and main waterways



Where a proposed development forms a part of one or more of the subcatchments presented in Figure 3, the storage volume to be provided by that development should be calculated based on the subcatchment surface area as a percentage of the total subcatchment surface area.

Table 2 Subcatchment drainage planning criteria – ultimate development

Subcatchment identification	Catchment	Peak discharge flow (m^3/s)		Detention volume (m^3)	
Subdivisional storage basins	area (ha)	10-year	100-year	10-year	100-year
CATL5B 11.3		0.0	0.3	1400	1730
CATL6 30.72		0.1	0.4	10470	12910

Subcatchment identification	Catchment	Peak discharge flow (m^3/s)		Detention volume (m^3)	
Subdivisional storage basins	area (ha)	10-year	100-year	10-year	100-year
CATL5C 28.33		0.2	0.1	3590	4190
CATF11C 13.64		0.2	0.2	1420	1920
CATF11B 24.81		0.1	0.2	4340	4830
CATF11D 18.76		0.0	0.3	2480	2890
P4A 18.65		0.1	0.2	2350	2750
P4B 38.53		0.1	0.7	4940	5180
P4C 30.64		0.1	0.2	4680	6390
P4D 34.18		0.0	0.2	3810	4440
P4E 34.01		0.1	0.4	7410	8640
P4F 35.1		0.1	0.4	7420	8690
CATT3A 31.9		0.1	0.3	17700	20720
CATT3B 28.24		0.3	1.1	8970	9760
CATT4 21.54		0.1	0.1	3230	4300
BA8B 9.26		0.1	0.1	1100	1330
cat_lot152 9.29		0.0	0.4	1770	2150
BA8A 21.32		0.1	0.1	4010	5620
SC10 4.69		0.0	0.4	1760	2140
BA14B 68.42		0.1	0.2	17960	23600
BA13A 23.86		0.1	0.2	8730	10700
BA17 38.46		0.1	0.1	5550	7630
BA14C 21.3		0.1	0.3	2400	2990
BA11A 42.7		0.1	0.1	11070	15730
BA14a 41.39		0.1	0.3	6950	8220
BA11B 10.63		0.1	0.1	1570	2070
CATK1 9.13		0.1	0.1	1500	1900
CATB1 58.45		0.9	1.2	2910	4770
CATB2B 30.13		0.1	0.2	5750	7380
CATB2A 26.06		0.1	0.4	2910	3540
CATB3 50.55		0.1	0.4	5520	7630
CATF7C 29		0.1	0.2	3640	4330
CATF2a 24.9		0.1	0.2	5050	6450
CATF5 46.1		0.1	0.2	10340	13200
CATF3b 30.7		0.1	0.3	5580	7670
CATF8a 33.41		0.2	0.4	10510	11580
CATF7A 31.5		0.1	0.5	12440	14740
BA2 84.2		0.1	0.3	24570	32010
BA5B 36.7		0.0	0.2	7900	8960

A summary of peak flows and levels at critical locations along Forrestdale main drain and associated drains (Figure 3) are presented in Table 3 below.

Table 3 Flows and levels at critical locations – ultimate development (see Figure 3)

Location	Peak flows (m^3/s)		Peak levels (m AHD)	
Number (Figure 3) and description	10-Year ARI	100-Year ARI	10-Year ARI	100-Year ARI
1. Forrestdale main drain at Armadale Rd	1.6	2.3	22.3	23.0
2. Forrestdale main drain at Anstey Rd	2.4	3.4	22.2	22.7
3. Forrestdale main drain at Ranford Rd	3.8	4.7	21.9	22.3
4. Forrestdale main drain at Holmes St	6.4	7.8	20.9	21.2
5. Baileys branch drain at Keane Rd	0.7	0.8	22.3	22.7
6. Baileys branch drain at discharge to Forrestdale main drain	1.3 1.8		22.0	22.3
7. Keane Rd branch drain at discharge to Forrestdale main drain	0.8 1.1		22.4	23.0
8. Murphys drain at discharge to Forrestdale main drain	1.9 2.8		22.3	22.9
9. Balannup drain at Nicholson Rd	0.9	1.0	24.4	24.5
10. Balannup drain at discharge to Baileys branch drain	0.9 0.9		22.2	22.6
11. Balannup Lake drain at Southern River Rd	0.4	0.5	21.1	21.4
12. Balannup Lake drain at Matison Rd	0.9	0.9	21.1	21.4
13. Precinct 4 north drain at Passmore St	0.4	0.6	19.9	20.5
14. Precinct 4 south drain at Passmore St	0.4	0.7	21.7	22.0
15. James drain at Armadale Rd	0.9	1.1	25.4	25.6
16. James drain at discharge to Forrestdale Lake	0.2 0.3		22.9	23.1

Average recurrence interval (ARI)

The following specific main drainage upgrades are proposed by this *Arterial drainage strategy:*

Forrestdale townsite

- Baileys drain requires widening within a linear public open space of approximately 50 m width for a length north of Armadale Road (see Figure 3 section 2).
- The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) shows the corridor required for drainage purposes and this is approximately the area required under the *Arterial drainage strategy.*
- Immediately downstream of Anstey Road there is a short length of drain to Keane Road that runs through land that remains rural but that should be widened.
- To maintain the existing hydrologic regime of the Baileys wetland (Bush Forever site no. 342) it will be necessary to reinstall the 600 mm connection from the Balannup drain into Baileys branch drain which was removed as part of the existing development of the North Forrestdale area.

Adjacent to Tonkin Highway (Armadale Road to Allen Road)

- Forrestdale main drain requires widening within a linear public open space of approximately 50 m width along the length adjacent to Tonkin Highway (see Figure 3, section 1).
- The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) shows an area required for drainage at the southern end of the required drainage corridor, immediately north of Armadale Road. The area of land required for drainage is similar but now in a different location, although on the same landholding. The widened drain should be located in linear public open space (see linear public open space inserts on Figure 3). Its location adjacent to the Tonkin Highway provides a buffer between that road and the urban area, as well as providing a potential wildlife corridor between areas of remnant bushland.

Tonkin Highway (at Allen Road) to Anstey Road

- Forrestdale main drain requires widening within a linear public open space of approximately 50 m width for a length from the Tonkin Highway (at Allen Road) to Anstey Road (see Figure 3, section 1).
- Along this length of drain the land to the west of the drain will remain zoned rural and the land to the east of the drain is shown on the district structure plan as potential light industrial.
- The current district structure plan shows some land required for drainage within this light industrial area and this area is approximately equivalent to the land required for widening the drain under the *Arterial drainage strategy*.

Anstey Road to Ranford Road

- Forrestdale main drain requires widening within a linear public open space of approximately 70–100 m width for a length from the Anstey Road to Ranford Road (see Figure 14, section 3). This is regional drainage infrastructure and land acquisition will be required.
- Along this length of drain the land is already zoned light industrial and the district structure plan shows a wide drainage corridor. However, the corridor is bounded to the north-west by conservation category wetlands and to the south-west by a Bush Forever site, which may place significant environmental constraints on any drainage works.
- In order to fully utilise the proposed storage upstream of Ranford Road and provide protection to the existing properties within the kennels zone, it will be necessary to block one 900 mm diameter barrel of the Ranford Road culvert.

Kennels to Phoebe Road

- Forrestdale main drain requires widening within a linear public open space to create online flood storage area between the kennels zone and Phoebe Road (see Figure 3, section 4).
- The current district structure plan shows the corridor required for drainage purposes and this is approximately the area required under the *Arterial drainage strategy.*

Phoebe Road to Holmes Street

- Forrestdale main drain requires widening within a linear public open space to create online flood storage areas between Phoebe Road and Holmes Street (see Figure 3, section S4).
- The current district structure plan shows the corridor required for drainage purposes and this is approximately the area required under the *Arterial drainage strategy.*

Precinct 4

- The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) currently indicates a drainage corridor running along the eastern boundary of Precinct 4, adjacent to the Tonkin Highway. This *Arterial drainage strategy* recommends the retention of existing drainage routes, as shown on Figure A3c.

In all locations where a widened drain within linear public open space is proposed, a low flow channel to convey baseflow and minor events (< one-year average recurrence interval) will be incorporated into the base of the main drainage channel. With appropriate planting and treatment, the low flow channel may be modified to improve water quality by providing opportunities for biofiltration as well as provide habitat, provided that the hydraulic capacity is not reduced.

5.3 Surface water quality management

The environmental values of downstream waterways within, and surrounding, the study area should be upheld.

Maintaining pre-development discharge rates and volumes from developed catchments is expected to prevent the majority of contaminants from reaching the waterways by ensuring that the majority of flows from high frequency events are detained or infiltrated on site.

Provided that the initial flow of more significant events is subject to the same detention and treatment received by high frequency events, surface runoff that occurs during more significant events represents a lower risk to downstream water quality. This is because nutrients and other contaminants that represent a threat to downstream water quality are typically transported within the ‘first flush’ of an event.

To meet the objective of no deterioration in water quality, the MOU group has developed a water quality management strategy as part of the *Southern River integrated land and water management plan* (Department of Water 2009).

To meet the objective of no deterioration in water quality, water quality will be monitored in the arterial drainage system, particularly the Forrestdale main drain. Should water quality monitoring in the Forrestdale main drain indicate deterioration, the Department of Water will seek to determine the cause and take corrective action.

In addressing any observed deterioration in water quality in the Forrestdale main drain, the Department of Water may recommend that treatment measures be included in the arterial drainage system. Where any treatment systems are installed, they should not reduce the hydraulic capacity of the arterial drainage system and should be compatible with the land uses of any multiple use corridors. It is critical that the design and construction of any treatment systems be undertaken in close collaboration with the drainage asset managers of the service providers (local authority or the Water Corporation).

5.4 Key design criteria

Surface water quantity

- The one-year one-hour average recurrence interval event shall be detained at source for the duration of the event through the use of retention (soakage) or storage devices. Refer to Chapter 9 of the *Stormwater management manual for Western Australia* (Department of Water 2004-2007) for devices suited to the soil types for this catchment. The *Stormwater management manual for Western Australia* (Department of Water 2004-2007) contains guidance for the appropriate design of retention and detention systems.
- The post-development critical one-year average recurrence interval peak flow and volume and the 100-year average recurrence interval peak flow shall be consistent with pre-development flows at:
    - the discharge points of all subdivisions into waterways
    - the discharge points from the structure plan area
    - the discharge points of each subcatchment.
- Flows from developed areas should be attenuated, in accordance with Table 2 which protects the regional system, in flood detention/storage areas incorporated into public open space within the subdivision and located outside floodways.
- Post-development flows for all average recurrence interval events should be discharged at flow rates which are consistent with pre-development flow rates for those same events.
- Developments outside the floodway should ensure finished floor levels at a minimum of 0.5 m above the 100-year flood level.
- The existing cross-sectional area of waterways should be maintained. Restoration of waterways is encouraged and in some cases channel realignments and

channel profile modifications may be carried out, provided it is demonstrated that the pre-development cross-sectional area has been preserved.

- Public open space and retention basins should operate as dry basins with a minimum clearance of 0.3 m between the groundwater level endorsed by the Department of Water and the invert of the basin.
- Defined major arterial roads should remain passable in the 100-year average recurrence interval event. The local authority should be contacted to identify roads where this criteria applies.
- Minor roads should remain passable in the five-year average recurrence interval event.
- Emergency evacuation areas should be defined at least 2.0 m above the 100-year average recurrence interval event level.
- Water quality treatment systems and water sensitive urban design structures should be designed in accordance with the *Stormwater management manual for Western Australia* (Department of Water 2004-2007) and *Australian runoff quality* (Institute of Engineers Australia 2006).

Surface water quality

Designs for infrastructure and management measures to achieve ecological protection and water quality outcomes should be based on the methodologies established in the *Stormwater management manual for Western Australia* (Department of Water 2004–07).

Targets are to be achieved through adopting a treatment train approach including:

- non-structural measures to reduce applied nutrient loads
- on-site retention of the one-year one-hour average recurrence interval event
- bioretention structures/systems, (also referred to as rain gardens) to be sized at two per cent of connected constructed impervious areas.

If it is proposed to use a computer stormwater modelling tool to assess a proposed water quality management strategy, the following design targets are recommended:

As compared with a development that does not actively managed water quality, developments should achieve:

- at least 80 per cent reduction of total suspended solids
- at least 60 per cent reduction of total phosphorus
- at least 45 per cent reduction of total nitrogen.
- at least 70 per cent reduction of gross pollutants

Proponents shall develop and present the strategies for water quantity and quality management in the local water management strategy and urban water management plans to support the planning approvals required for the development to proceed.

Engineering drawings submitted to council for approval should be supported by clear and auditable documentation, providing details of proposed staging and implementation of the surface and groundwater quantity and quality management strategy.

It is strongly recommended that consultants meet with the local authority to discuss proposed surface and groundwater management strategies and to gain further guidance on site-specific requirements of the local authority at commencement of any local water management strategy or urban water management plan.

Further details on water quality management strategies appropriate to this catchment are provided in the *Southern River integrated land and water management plan* (Department of Water 2009).

6 Groundwater management strategy

The key objectives for groundwater management are:

- protection of infrastructure and assets from flooding and inundation by high seasonal groundwater levels, perching and/or soil moisture
- protection of groundwater-dependent ecosystems from the impacts of urban runoff
- management and minimisation of changes in groundwater levels and groundwater quality following development/redevelopment

6.1 Groundwater modelling

Manage groundwater levels to protect infrastructure and assets

Groundwater modelling (Rockwater 2005) investigated a range of potential development scenarios. The groundwater model was designed to predict maximum groundwater levels for a range of climate scenarios with the conclusion that filling and/or drainage will be required over substantial areas of the catchment to prevent periodic inundation of the development areas.

The modelling also considered the use of subsoil drains to control groundwater levels within developed areas and the impact of those drains on the lakes and wetlands in the catchment. Subsoil drains are necessary to control peak groundwater levels in substantial areas of the catchment. Without them groundwater levels in the catchment would rise up to 0.2 m higher in winter as a result of urban development, and increase the groundwater flux, thereby impacting on environmentally-sensitive wetlands.

The results of the regional groundwater model have been incorporated into the InfoWorks surface water model by the application of winter peak starting water levels in wetlands and inflows to key sections of the drainage system. These starting water levels and inflows provide an assessment of the drainage systems' ability to manage significant rainfall events at times of peak groundwater, as well as an indication of the base flow within the drain at these times. Subsoil drainage flows predicted by this scenario of the groundwater model have also been incorporated into the InfoWorks surface water model used in this study.

Further information regarding the selection of pre- and post-development model scenarios and the construction and calibration of the groundwater model may be gained by requesting a copy of the *Southern River development area groundwater model* (Rockwater 2005) report from the Water Corporation.

Figure 11 presents the modelled Rockwater (2005) maximum groundwater level (788 mm annual rainfall scenario) and provides a guide to regional groundwater levels in the study area. However, groundwater levels should be determined in consultation with the Department of Water and presented in local water management strategies.

Further investigations will be required to determine local scale predicted maximum groundwater level for individual developments to determine whether subsurface drainage is required for protection of urban infrastructure. This drainage should always be located at or above a groundwater level endorsed by the Department of Water and presented in the local water management strategy.

Additional groundwater management strategies and design criteria are presented in the *Southern River integrated land and water management plan* (Department of Water 2009).

6.2 Groundwater quality management

The environmental values of groundwater within, and surrounding, the study area should be upheld.

Maintain groundwater quality at pre-development levels (median winter concentrations) and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the (sub) catchment in which the development is located.

Water sensitive urban design and best management practices should not only promote infiltration to aid in prevention of possible local flooding from increased runoff due to urbanisation, but they should also treat the water prior to its discharge to waterways, wetlands and to groundwater. This is particularly important given the high variability in phosphorus retention capacity of the soils in the study area and the anticipated increase in nutrient load due to urbanisation.

Where subsoil drainage is installed for groundwater level or soil moisture control, a 'treatment system' (swale/ bioretention etc) at each subsoil drain outlet point will be required. The *Stormwater management manual for Western Australia* (Department of Water 2004-07) contains guidance for the design of subsoil drainage, appropriate to calculated flow rates.

Where appropriate, field investigations should be undertaken to identify acid sulfate soils. Any reduction in groundwater level should not expose acid sulfate soils to the air, as this may cause groundwater contamination. If field investigations identify acid sulfate soils, further advice should be sought from the Department of Environment and Conservation.

Contaminated sites must be managed in accordance with the *Contaminated Sites Act 2003*.

6.3 Key design criteria

- The importation of clean fill and/or the provision of subsurface drainage will be required to ensure that adequate separation of building floor slabs from groundwater is achieved. In such instances, the subsurface drainage will need to be placed at or above a groundwater level endorsed by the Department of Water.

Guidelines on determining the groundwater drainage level are in preparation by the Department

- The bio-retention system and drainage inverts are to be set at or above the a groundwater level endorsed by the Department, although existing drainage inverts can remain.
- Subsurface drainage should be designed with free-draining outlets.
- Fill imported onto the site is to incorporate a band of material that will reduce phosphorus export via soil leaching, whilst also meeting soil permeability and soil compaction criteria specified by the local government authority.
- Where development is associated with any new or existing waterway or open drain that intersects the shallow water table, and that may discharge pollutants from the shallow groundwater to receiving environments, the following interim targets will be adopted until such time as appropriate site-specific targets are developed:

As compared with a development that does not actively manage water quality, the following should be achieved:

- at least 60 per cent reduction of total phosphorous
- at least 45 per cent reduction of total nitrogen.

Where development is associated with an ecosystem that is dependent on a particular hydrologic regime for survival, the water quality discharged to the groundwater should be in accordance with the requirements of the Department of Environment and Conservation.

Engineering drawings submitted to council for approval should be supported by clear and auditable documentation, providing details of proposed staging and implementation of the surface and groundwater quantity and quality management strategy.

It is strongly recommended that consultants meet with the local authority to discuss proposed surface and groundwater management strategies and to gain further guidance on site-specific requirements of the local authority at commencement of any local water management strategy or urban water management plan.

Further details of groundwater quality management strategies and design criteria are presented in the *Southern River integrated land and water management plan* (Department of Water 2009).

7 Commitment to best management practice

Best management practices suitable for use in the Forrestdale main drain catchment and supported by the Department of Water are presented in the *Southern River integrated land and water management plan* (Department of Water 2009).

In order to meet the design criteria of reductions in total phosphorus, total nitrogen, total suspended solids and gross pollutants as compared to developments in which water treatment is not undertaken, it is necessary to use a combination of best management practice strategies.

In addition, best management practice strategies reduce risks of flooding on housing and infrastructure while maximising the potential for stormwater to be treated as a resource.

8 Implementation

8.1 Requirements for following stages

State planning policy 2.9: water resources (Western Australian Planning Commission 2004) requires that planning should contribute to the protection and wise management of water resources through local and regional planning strategies, structure plans, schemes, subdivisions, strata subdivisions and development applications. *Better urban water management* (Department of Planning and Infrastructure, Department of Water, Western Australian Local Government Authority and Department of Environment, Water, Heritage and the Arts 2008), provides guidance on implementation of *State planning policy 2.9.* It identifies the requirements for water management strategies and plans that should be developed to accompany the land use planning and approvals process in the *Southern River integrated land and water management plan* (Department of Water 2009) area at each stage of the planning process

In summary, all local structure planning should incorporate a local water management strategy consistent with the strategies and objectives of the *Southern River integrated land and water management plan* (Department of Water 2009) and this *Arterial drainage strategy*. Subsequent subdivision applications should be accompanied by an urban water management plan where required by the Department of Water and the City of Armadale or the City of Gosnells, and/or should be consistent with an approved local water management strategy and with the strategies and objectives of the *Southern River integrated land and water management plan* (Department of Water 2009) and this *Arterial drainage strategy.*

Guidelines for *Developing a local water management strategy* are currently in preparation by the Department of Water.

Urban water management plans: guidelines for preparing plans and for complying with subdivision conditions (Department of Water 2008) are available of the Department of Water's website.

Developers are encouraged to contact the Department of Water (Swan Avon regional office) and the City of Armadale or the City of Gosnells early in the planning process to discuss specific water management requirements for proposals.

8.2 Review of integrated land and water management plan and *Arterial drainage strategy*

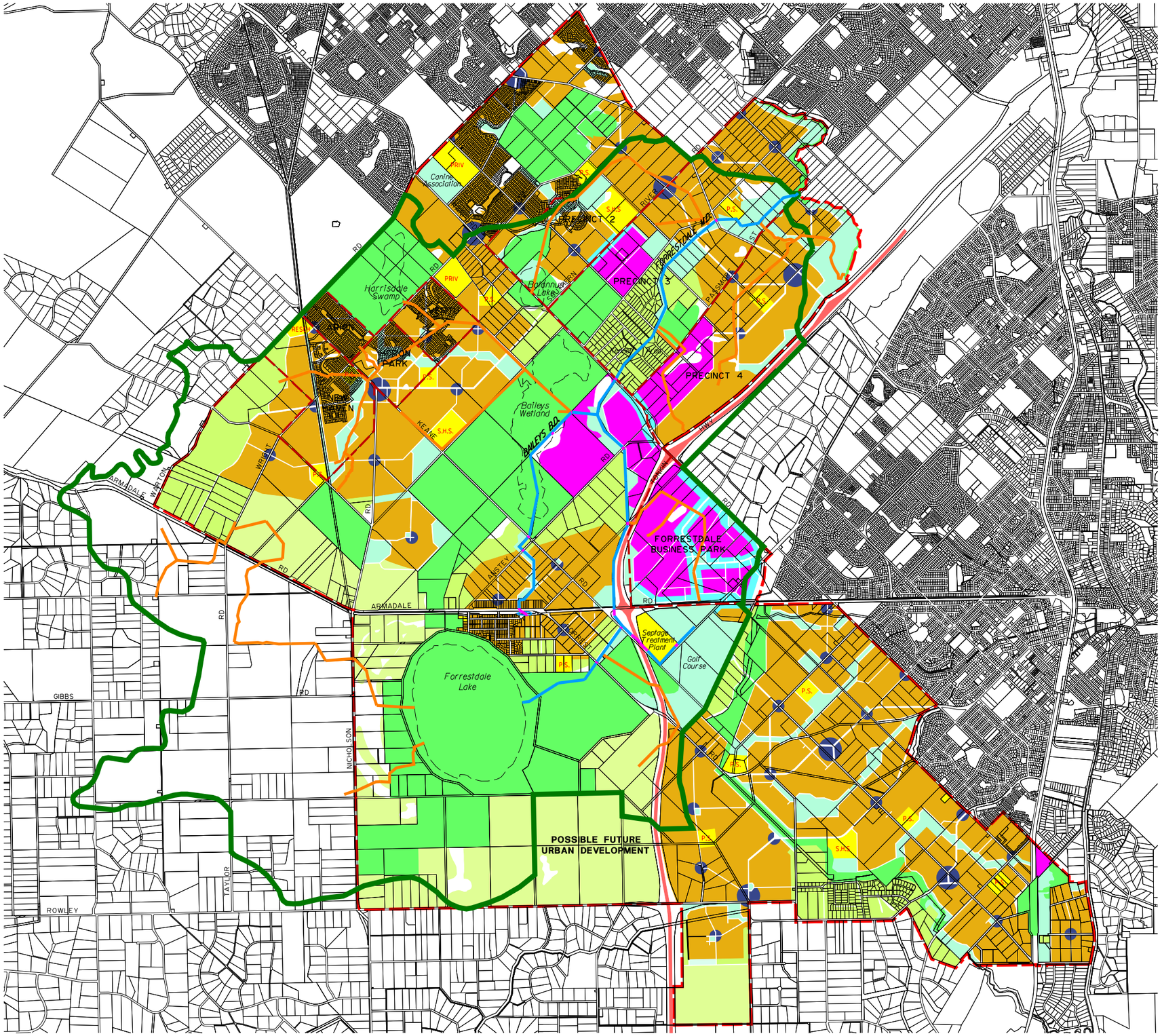
It is intended that the *Southern River integrated land and water management plan* (Department of Water 2009) and this *Arterial drainage strategy* be reviewed within ten years or earlier if deemed necessary until development has occurred consistent with the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001).

The review should be undertaken by the Department of Water, with agreement from the Environmental Protection Authority, Western Australian Planning Commission, the City of Armadale, the City of Gosnells and the Water Corporation. The review should cover, but not be limited to the following:

- assessment of impacts of development
- design objectives
- requirements for local water management strategies and urban water management plans
- cost-recovery mechanisms.

Monitoring requirements and an implementation action plan for the Forrestdale main drain catchment is presented in the *Southern River integrated land and water management plan* (Department of Water 2009).

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N

LEGEND

- District Structure Plan Boundary
- Scheme Boundary
- Precinct Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Water Corporation Compensating Basin

Landuse

- Neighbourhood Centre
- Village Centres
- Urban (Including balance of P.O.S.)
- Mixed Business/Commercial
- Light Industrial
- Open Space (Including drainage corridors)
- Rural
- Rural Living and Semi-Rural Living
- Parks and Recreation Reservation (Existing and proposed)
- Community Facilities
- PRIV Private School
- P.S. Public School
- RESVH Research
- S.H.S. Senior High School

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig 1 ProposedLandUse.dgn

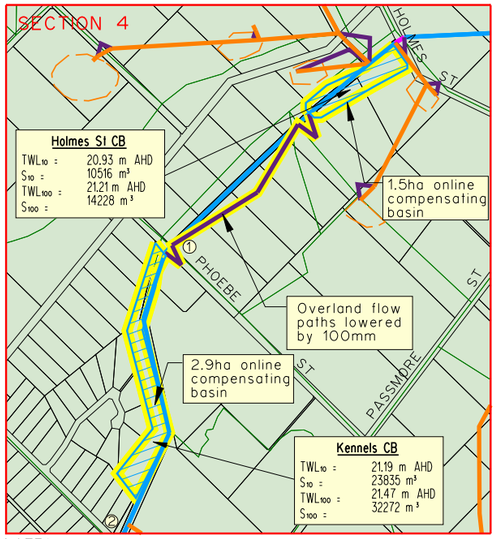
WATER CORPORATION

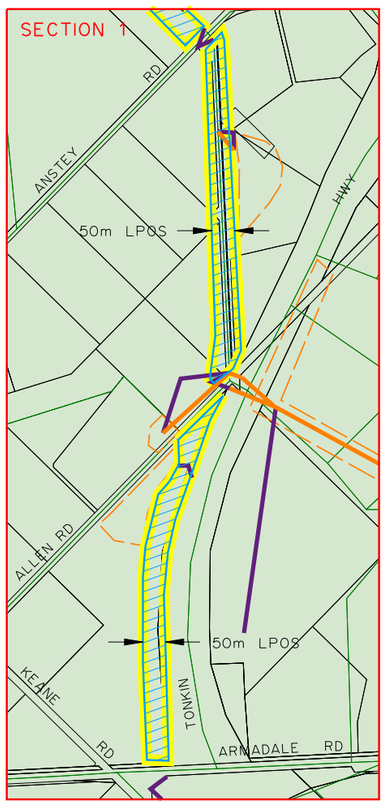
SOUTHERN RIVER-FORRESTDALE-BROOKDALE-WUNGONG DISTRICT STRUCTURE PLAN: PROPOSED LAND USE

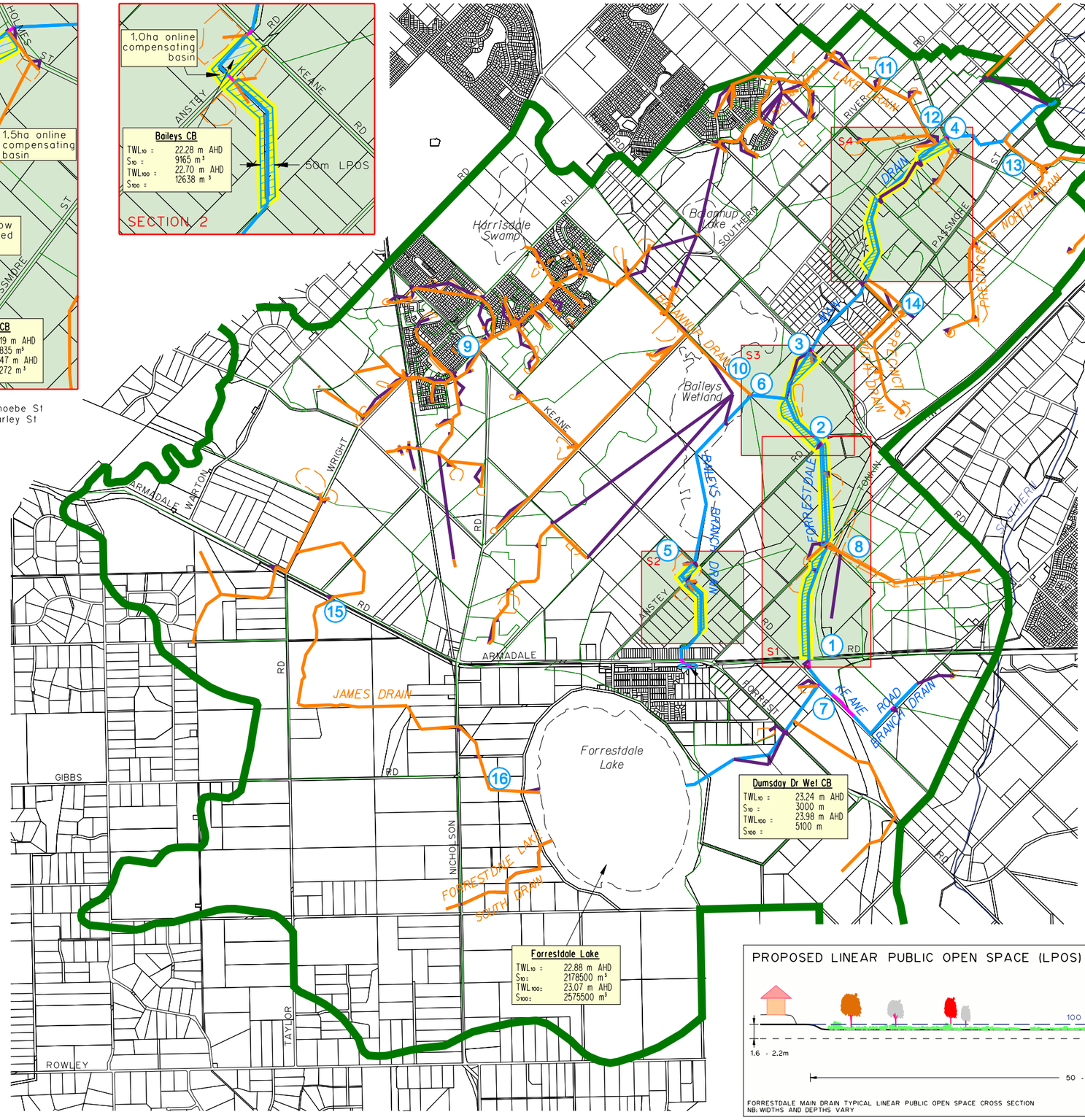
Figure 1

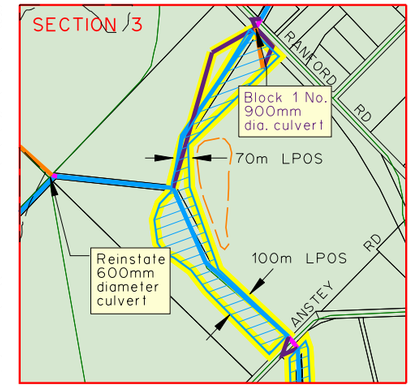
PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

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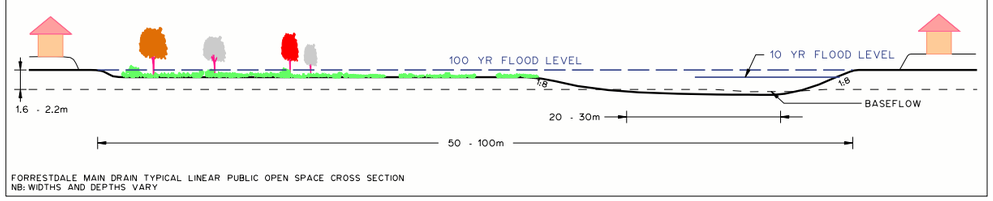
N

LEGEND

- Scheme Boundary
- Sub Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Overland Flow Path
- Proposed Upgrade
- Proposed Linear Public Open Space
- Water Corporation Compensating Basin
- Local Authority Compensating Basin (See Figure A3a-f for details)
- ① Critical Flow and Level Locations (see Table 5.2)

0 500 1000 1500 2000
SCALE OF METRES

PROPOSED LINEAR PUBLIC OPEN SPACE (LPOS)



FORRESTDALE MAIN DRAIN TYPICAL LINEAR PUBLIC OPEN SPACE CROSS SECTION
NB: WIDTHS AND DEPTHS VARY

FORRESTDALE MAIN DRAIN CATCHMENT
ARTERIAL DRAINAGE STRATEGY

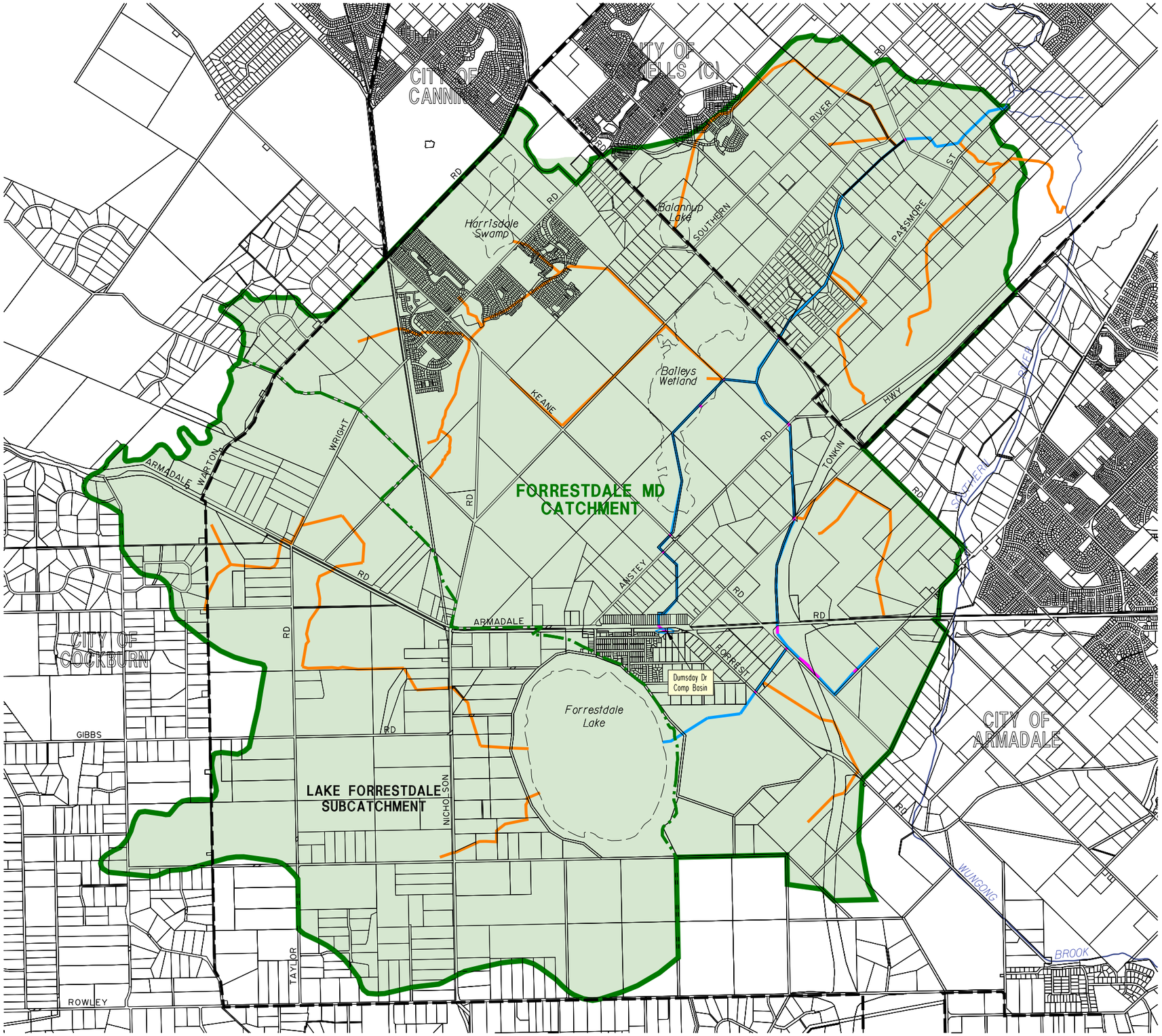
Figure 3

WATER CORPORATION

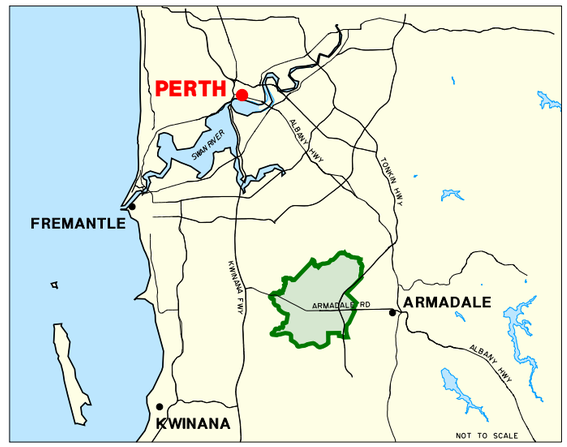
PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

AUTHOR: P Haywood DESIGN FILE: Fig 3 Strategy.dgn

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N



LEGEND

- Scheme Boundary
- Lake Catchment Boundary
- Shire Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Water Corporation Compensating Basin

0 500 1000 1500 2000
SCALE OF METRES

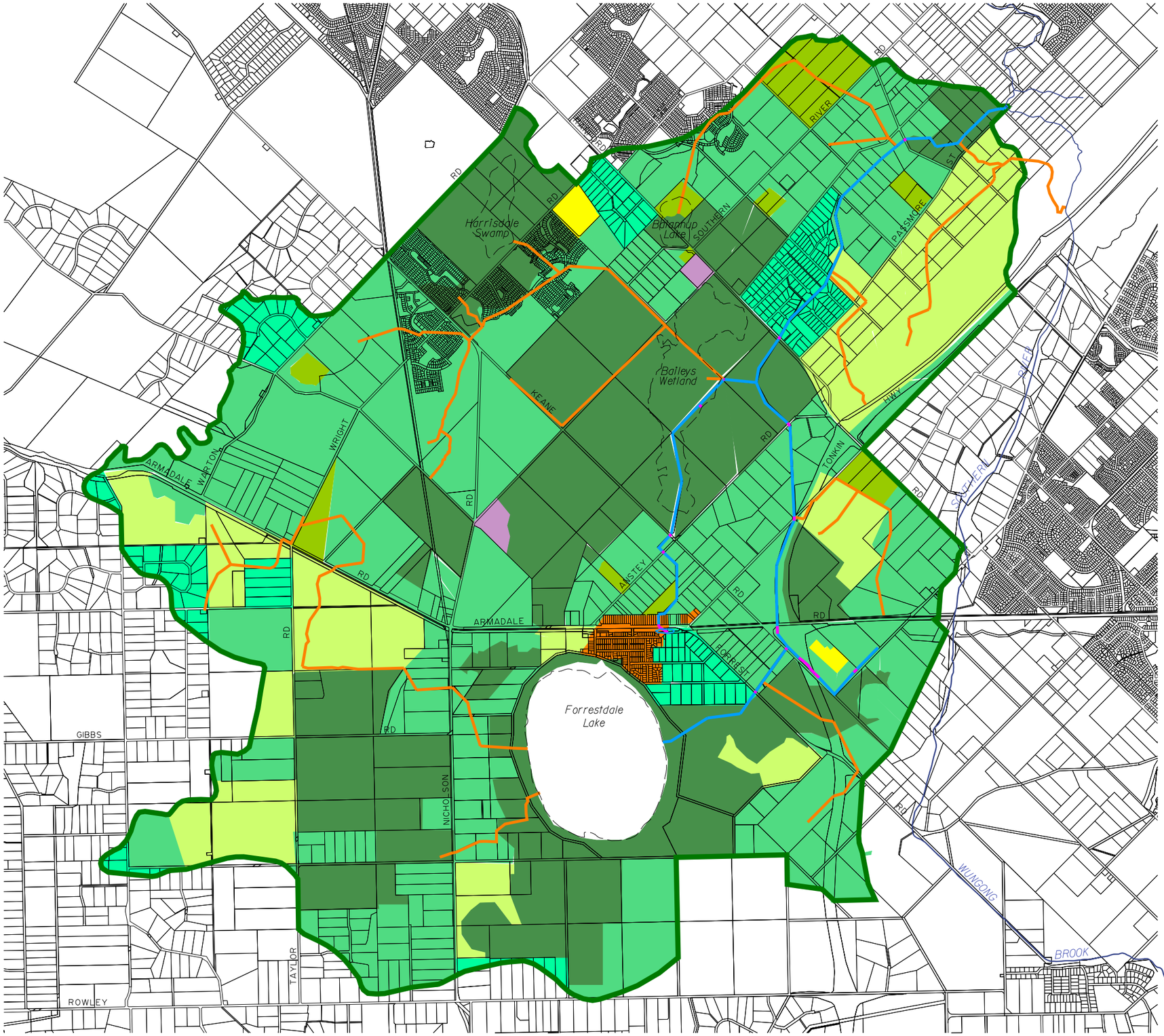
AUTHOR: SLee DESIGN FILE: Fig 4 Locality.dgn

WATER CORPORATION

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

LOCALITY
Figure 4

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LEGEND

- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Water Corporation Compensating Basin

Landuse

- Farming
- Light Industrial
- Public Open Space
- Public Purposes
- Regional Open Space
- Residential
- Rural
- Rural Residential

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig 5 ExistingLandUse.dgn

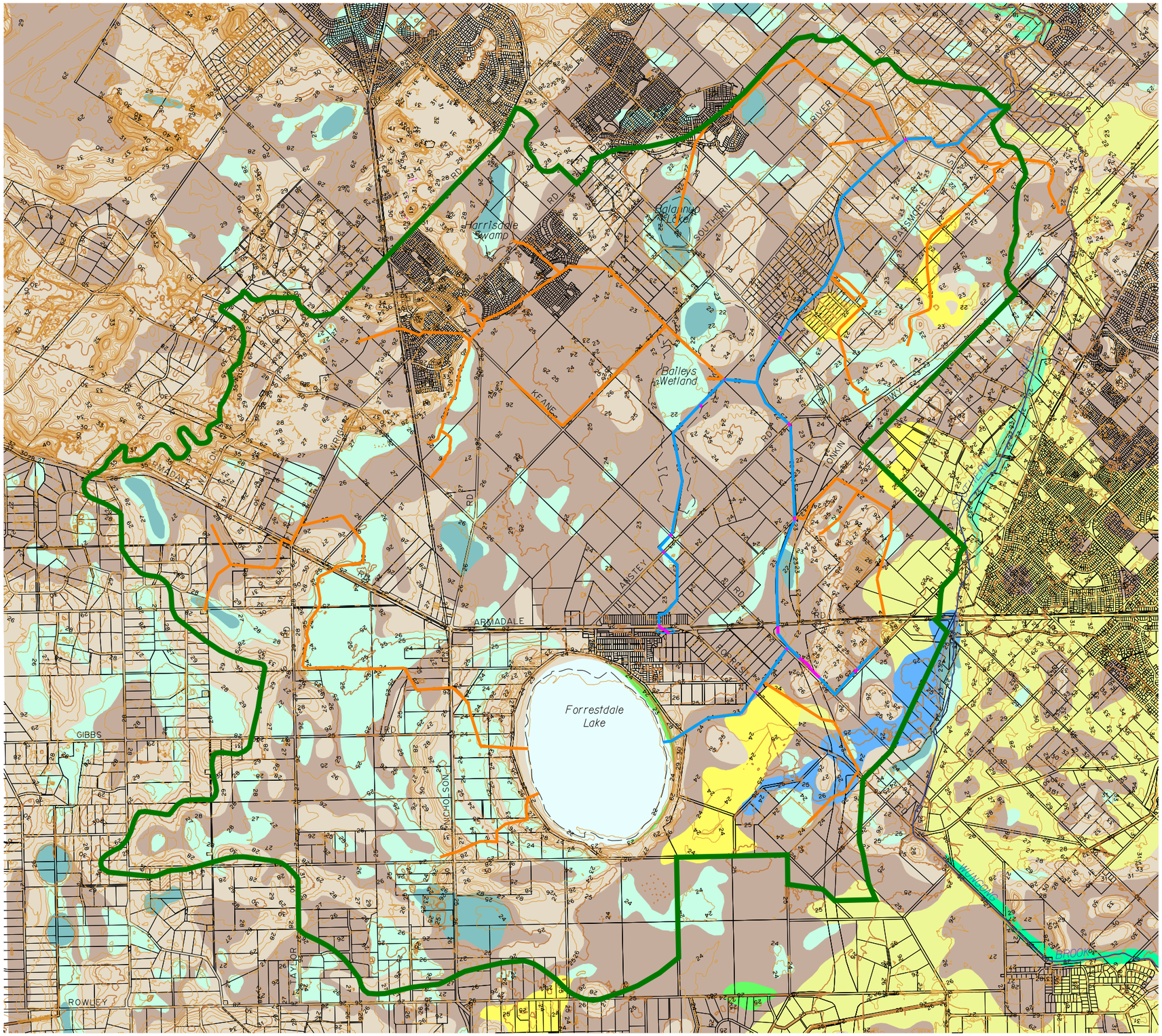
WATER CORPORATION

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

EXISTING LAND USE

Figure 5

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AUTHOR: SLee DESIGN FILE: Fig 6 TopographyGeology.dgn

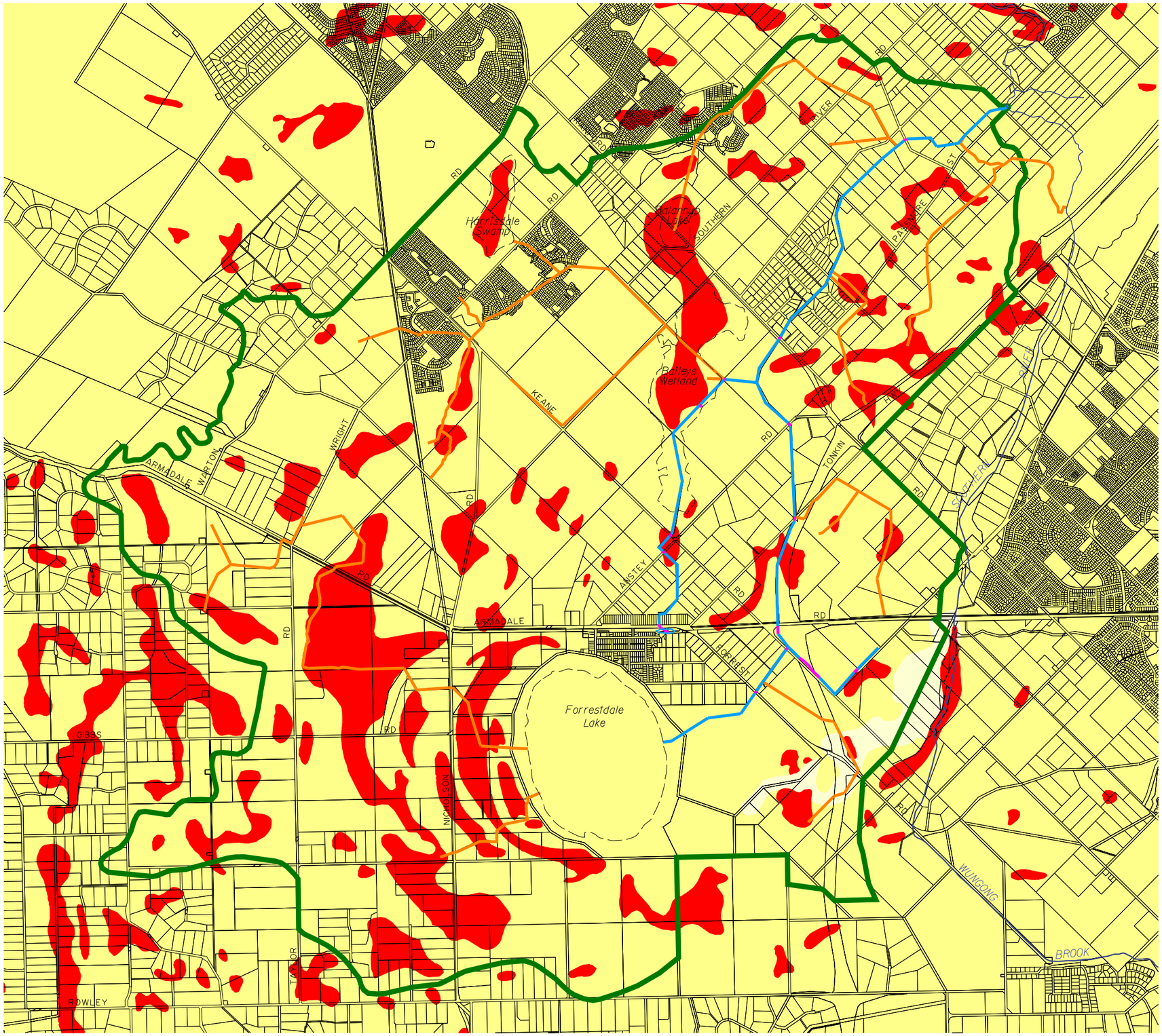
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PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

TOPOGRAPHY AND GEOLOGY

Figure 6

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LEGEND

- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Water Corporation Compensating Basin

Acid Sulfate Soils Risk (ASS)

- Class 1 - High risk of ASS <3 m from soil surface
- Class 2 - Moderate to low risk of ASS occuring <3 m from soil
- Class 3 - Low to no risk of ASS occuring at depths of <3 m

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig 7 AcidSulphateSoils.dgn

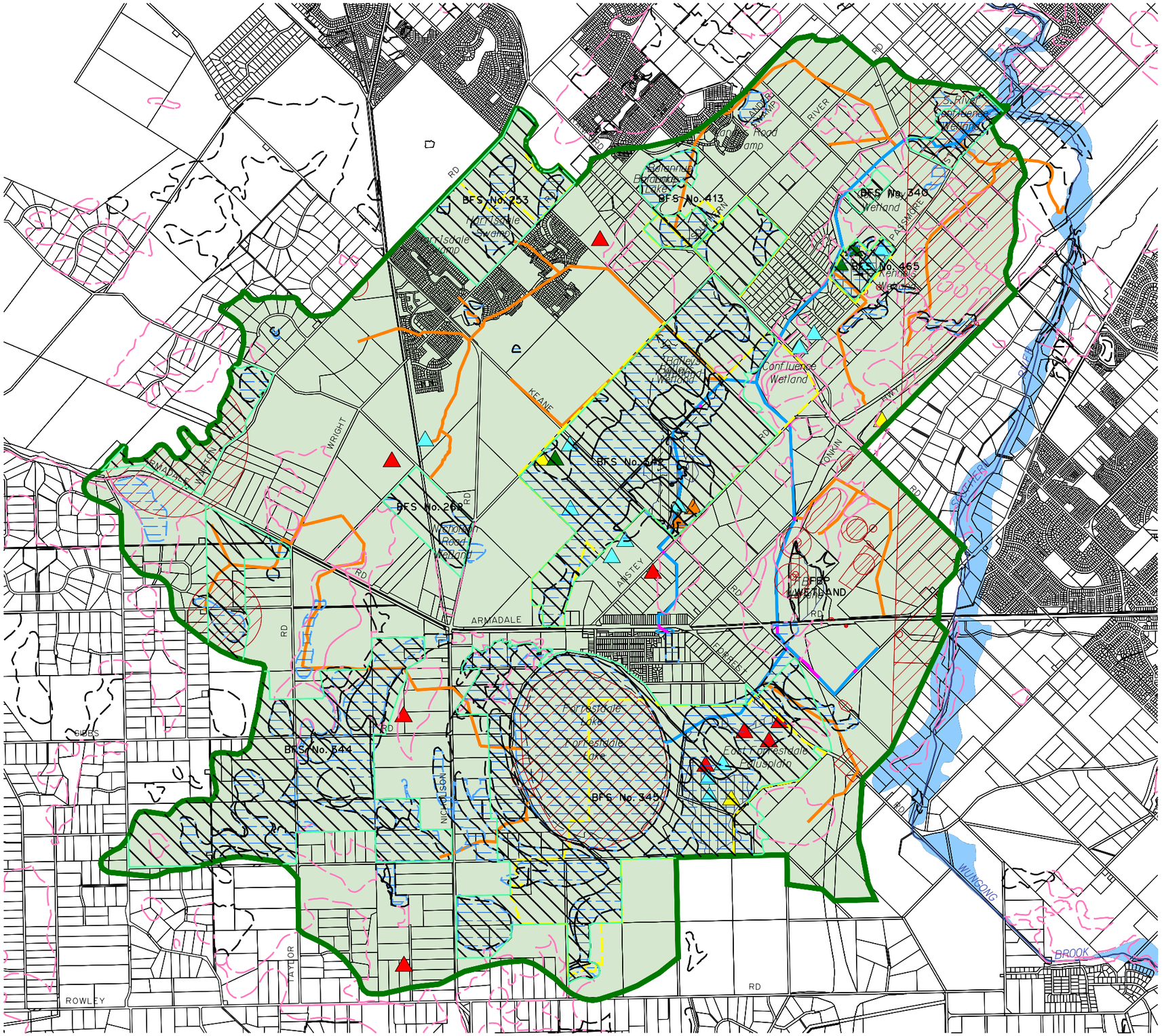
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ACID SULPHATE SOILS

Figure 7

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N

LEGEND

- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Bush Forever Site
- E.P.P Wetlands
- Indigenous Site
- Extent of Vegetation Mapping
- Conservation Category Wetland
- Resource Enhancement Wetland
- 100 year Southern River Flood Extent
- Water Corporation Compensating Basin
- Threatened Ecological Communities
- {R} Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: P Haywood DESIGN FILE: Fig 8 EnvironmentSocial.dgn

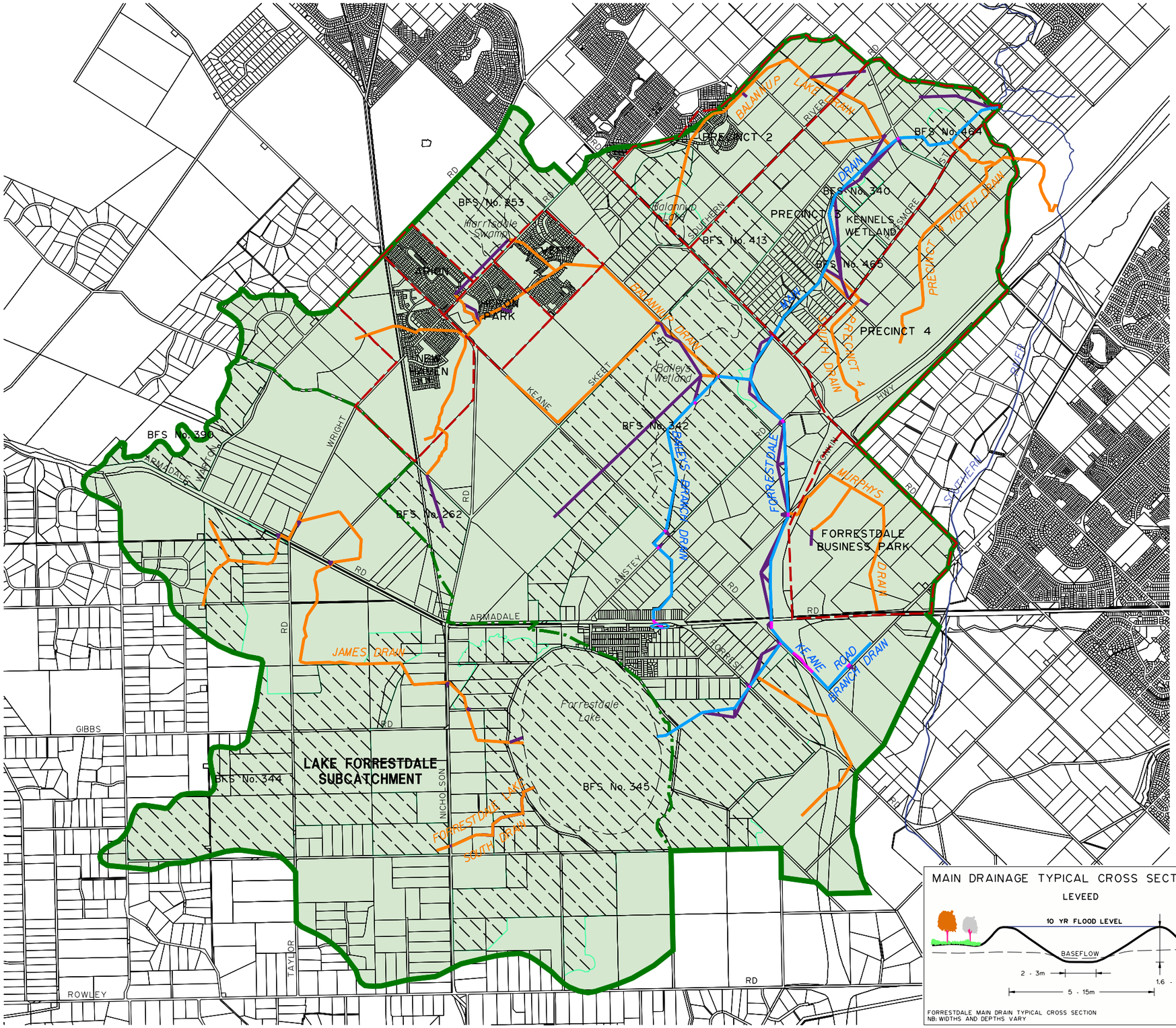
WATER CORPORATION

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Figure 8

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.



AUTHOR: SLee DESIGN FILE: Fig 9 ExistingSystem.dgn

WATER CORPORATION

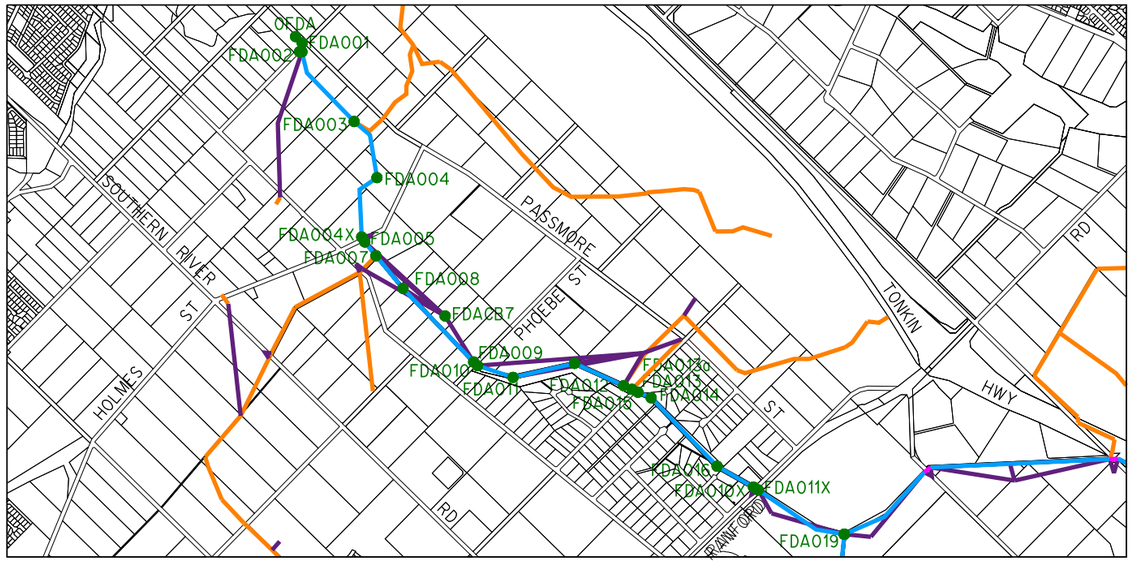
PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

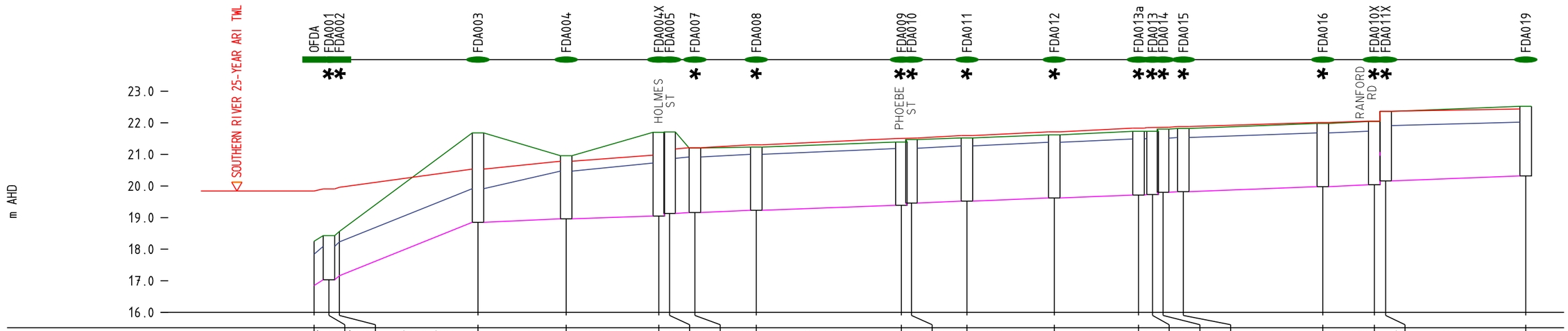
EXISTING SYSTEM DETAILS

Figure 9

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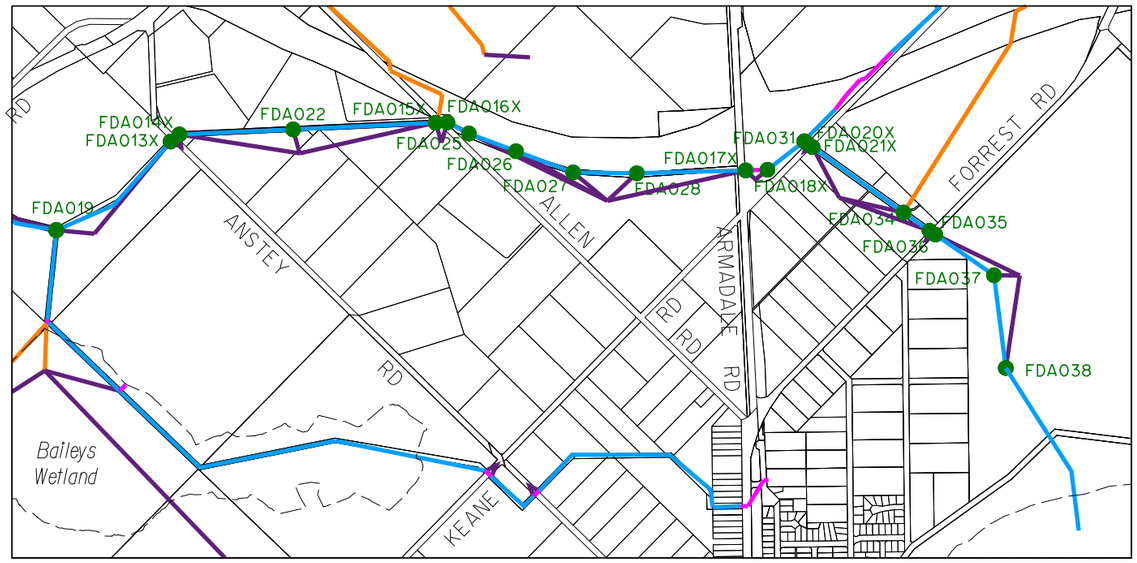
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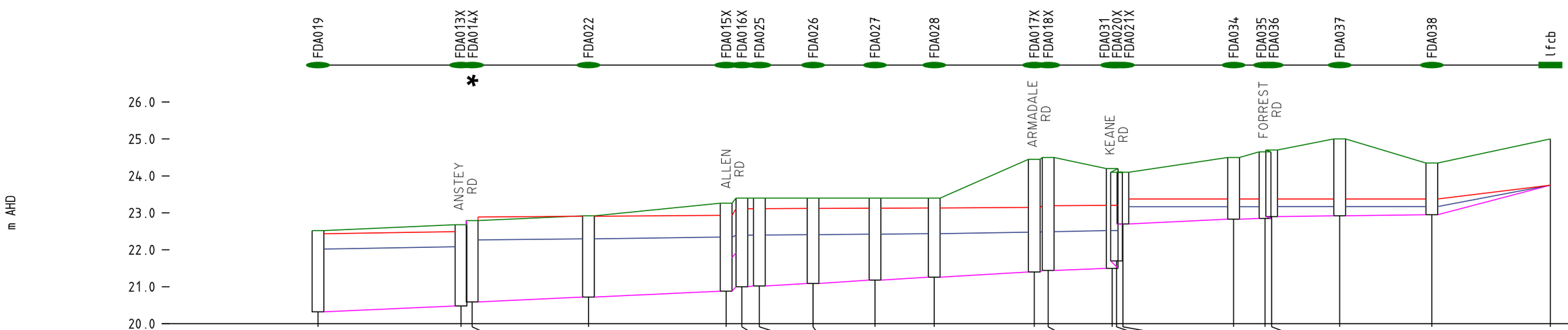




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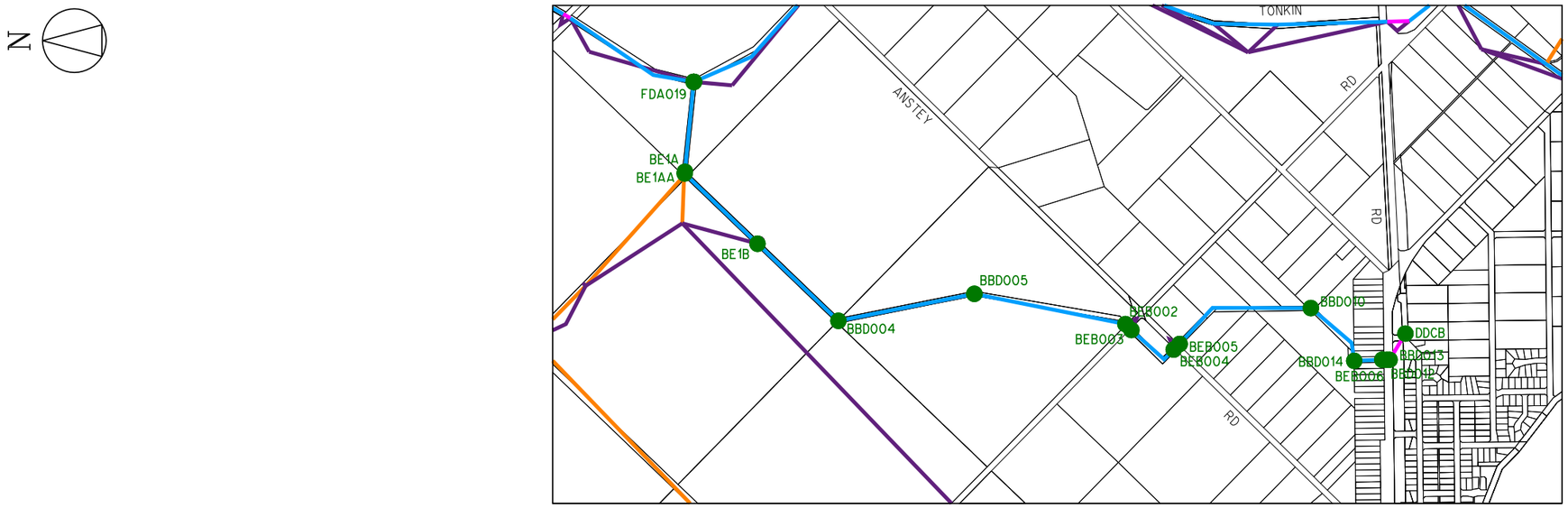
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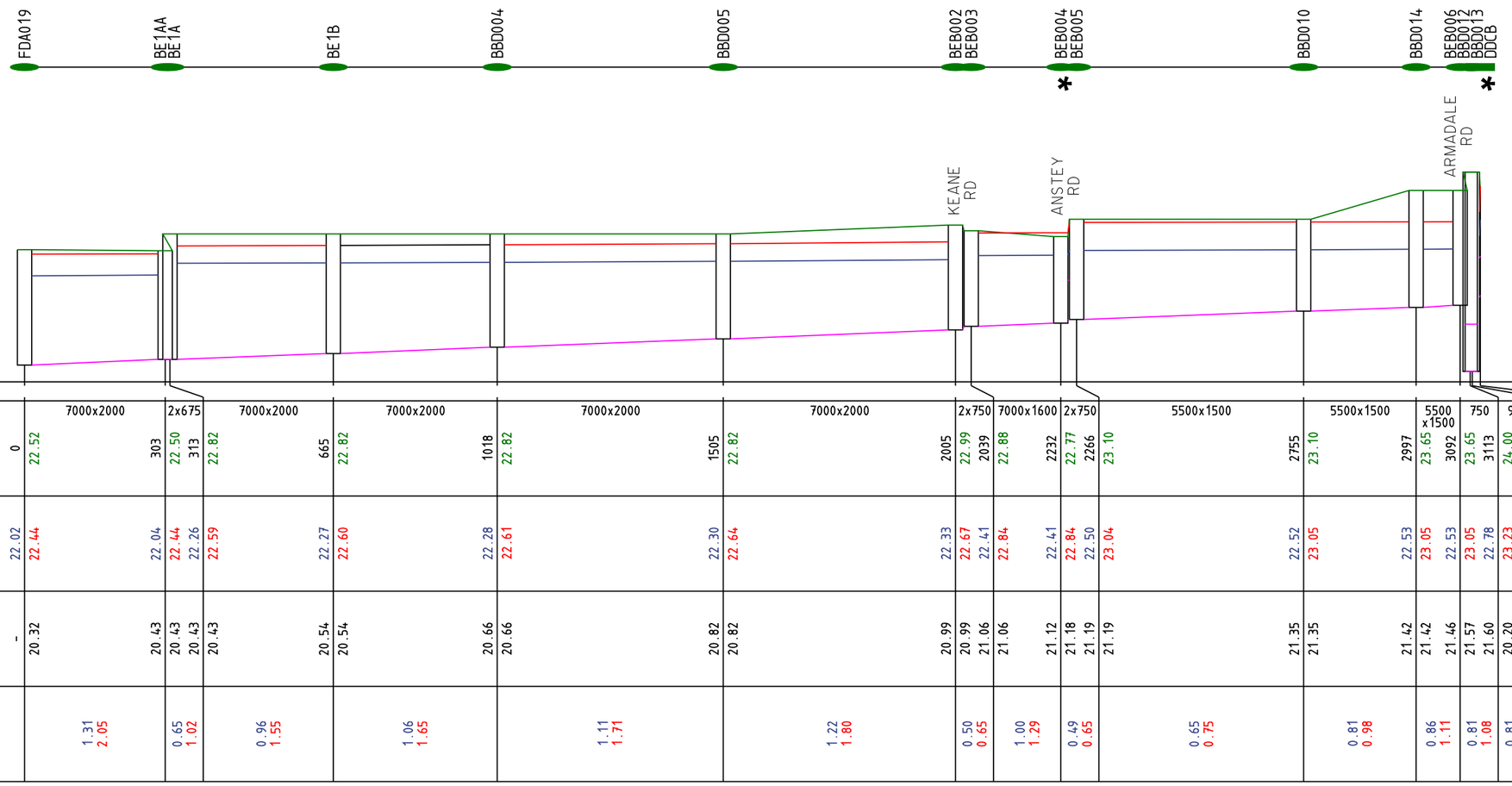




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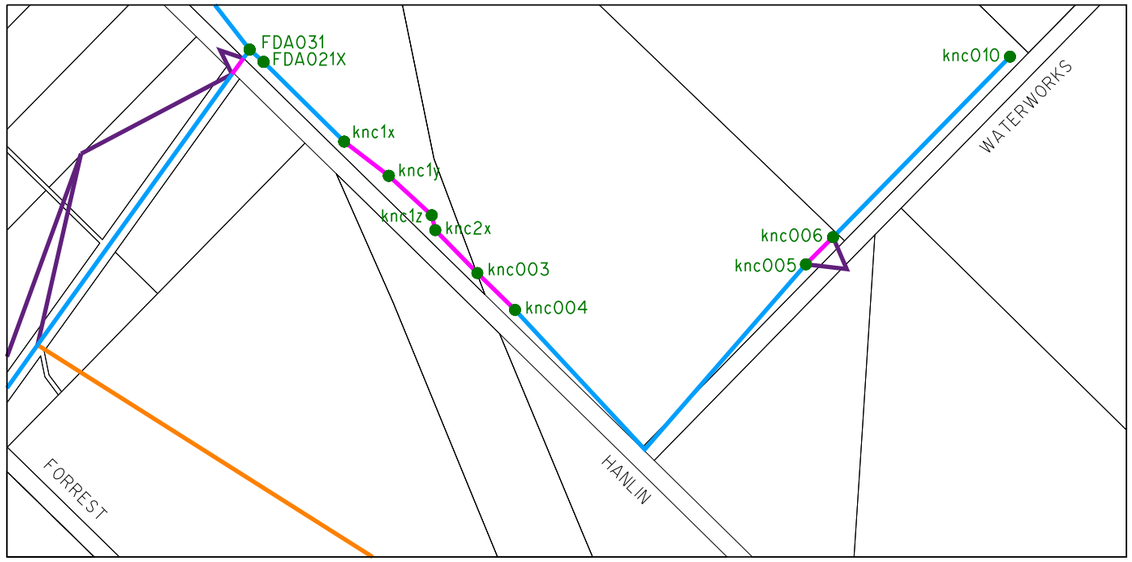


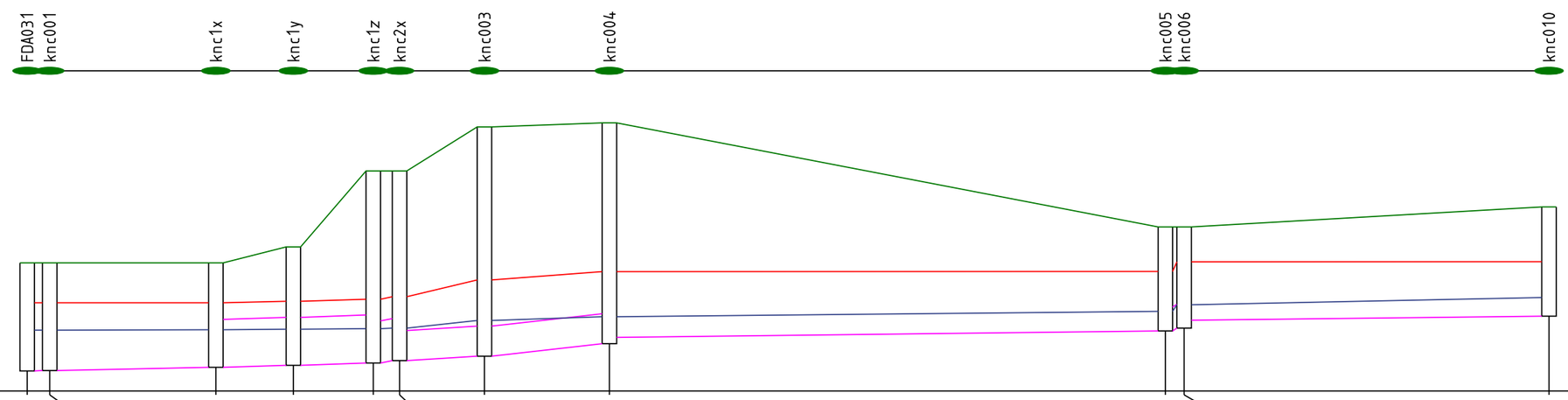


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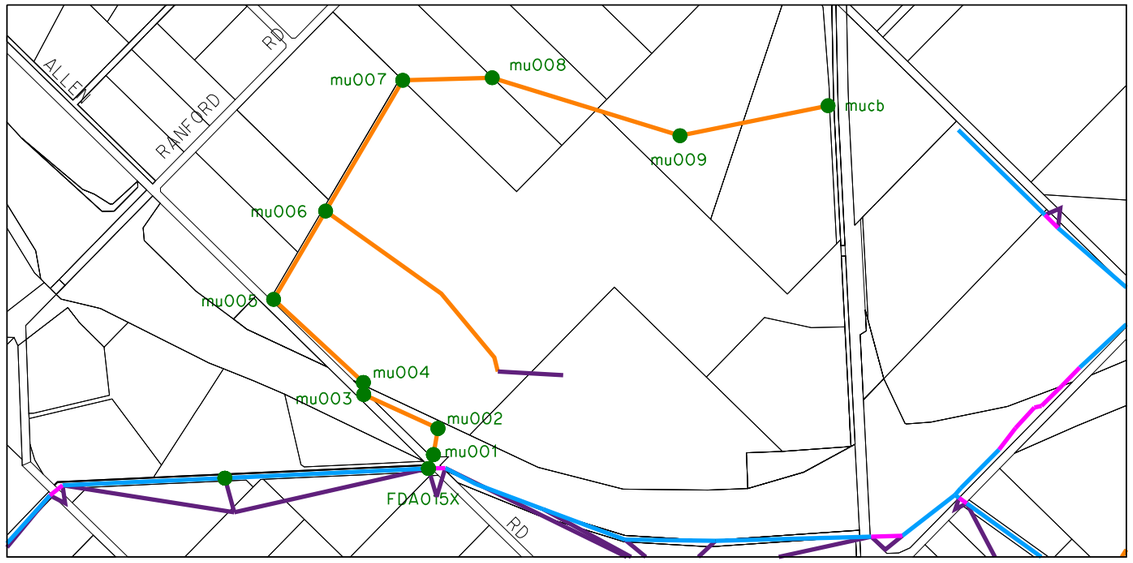




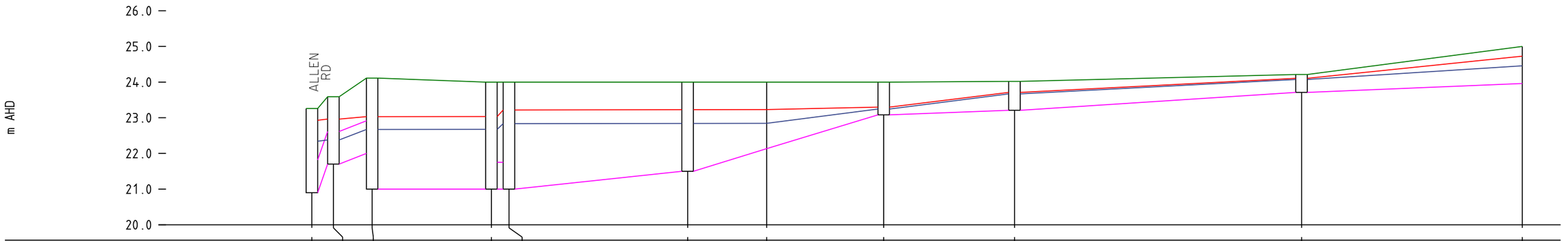
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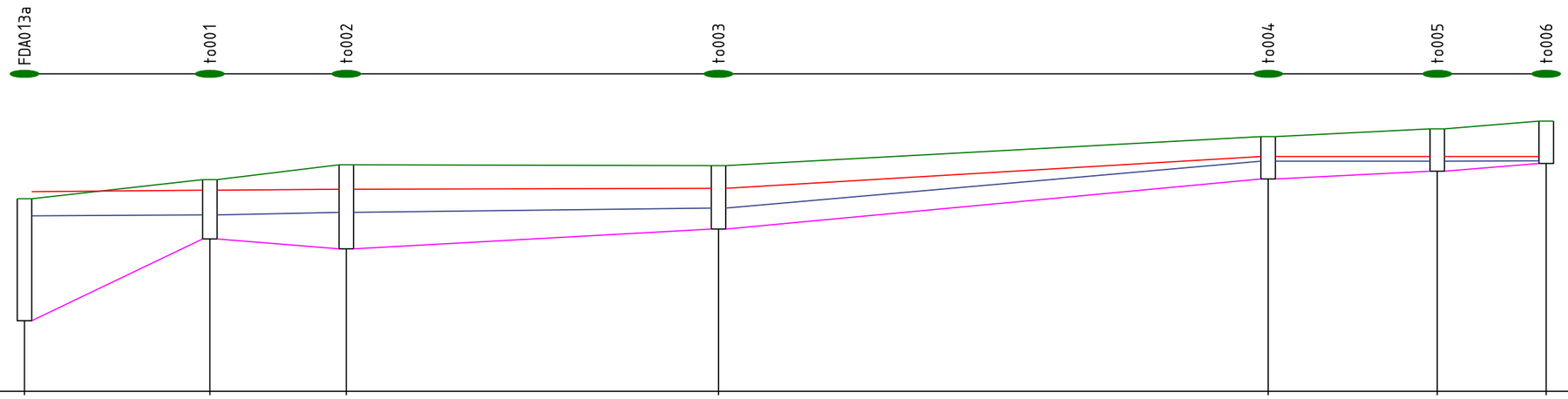


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Size (mm)		18000x600		18000x600		18000x600		18000x600		18000x600		18000x600		
Chainage (m)	0	183		319		688		1233		1401		1509		
Ground level (m AHD)	21.73	22.00		22.21		22.20		22.61		22.72		22.83		
10 year ARI HGL level (m AHD)	21.49	21.50		21.54		21.60		22.26		22.26		22.27		
100 year ARI HGL level (m AHD)	21.83	21.85		21.86		21.88		22.33		22.33		22.33		
Invert level (m AHD)	-	20.00	21.16	21.16	21.02	21.02	21.30	21.30	22.01	22.01	22.12	22.12	22.23	-
Max 10 year ARI flow (m3/s)		0.53		0.60		0.32		0.32		-0.03		-0.01		
Max 100 year ARI flow (m3/s)		0.88		1.02		0.53		0.59		-0.07		-0.01		

AUTHOR: P Haywood DESIGN FILE: Fig 10f LS Precinct4Sth pre.dgn

WATER CORPORATION

Precinct 4 South Drain

LONGITUDINAL SECTION

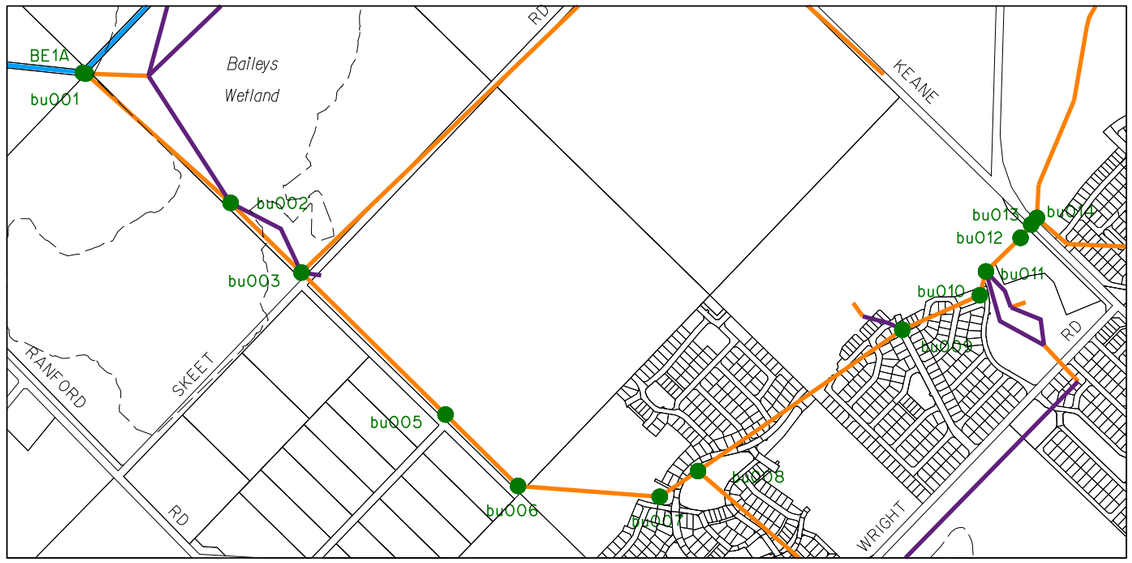
HGLs And Flows Existing System

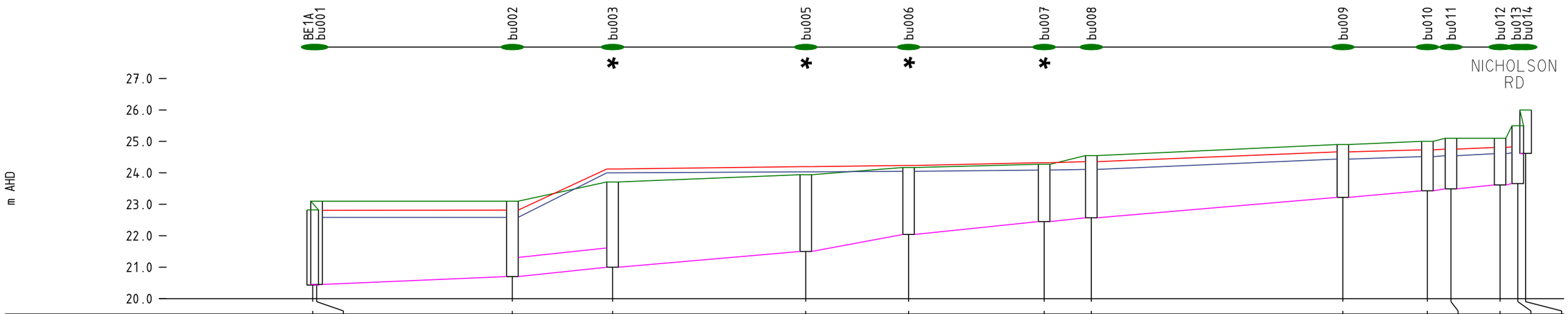
Figure 10f

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

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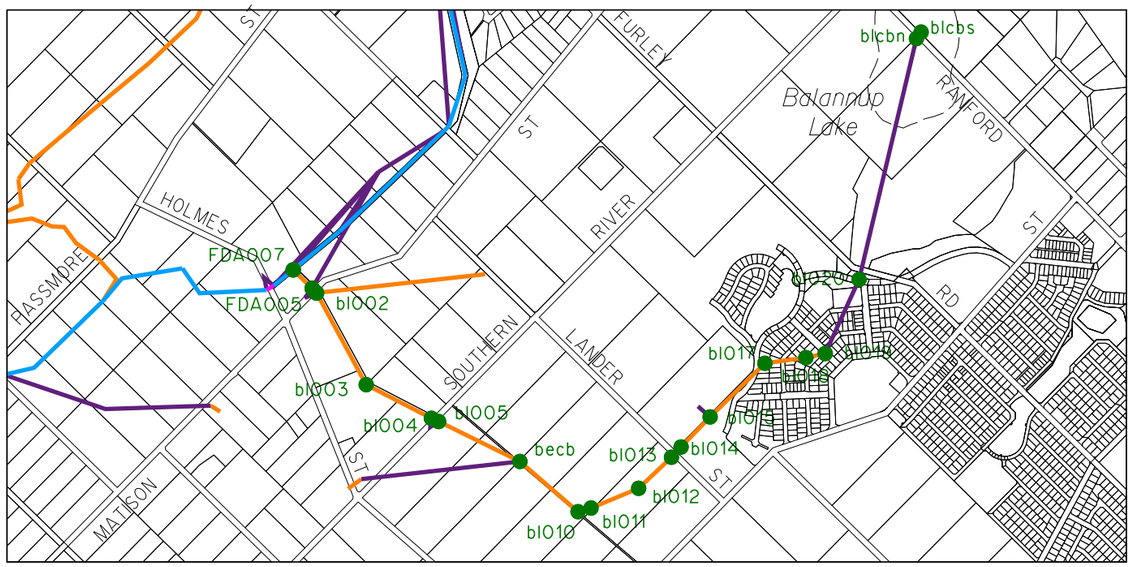


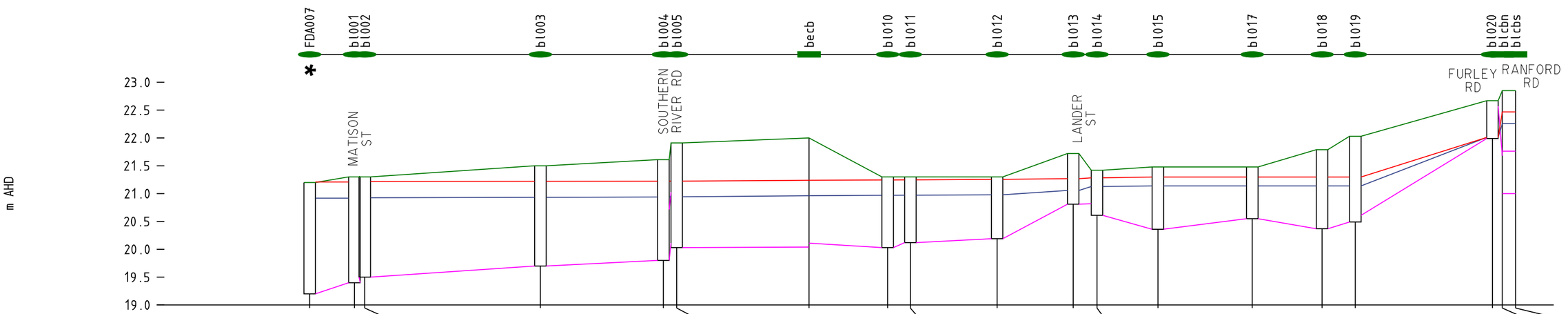


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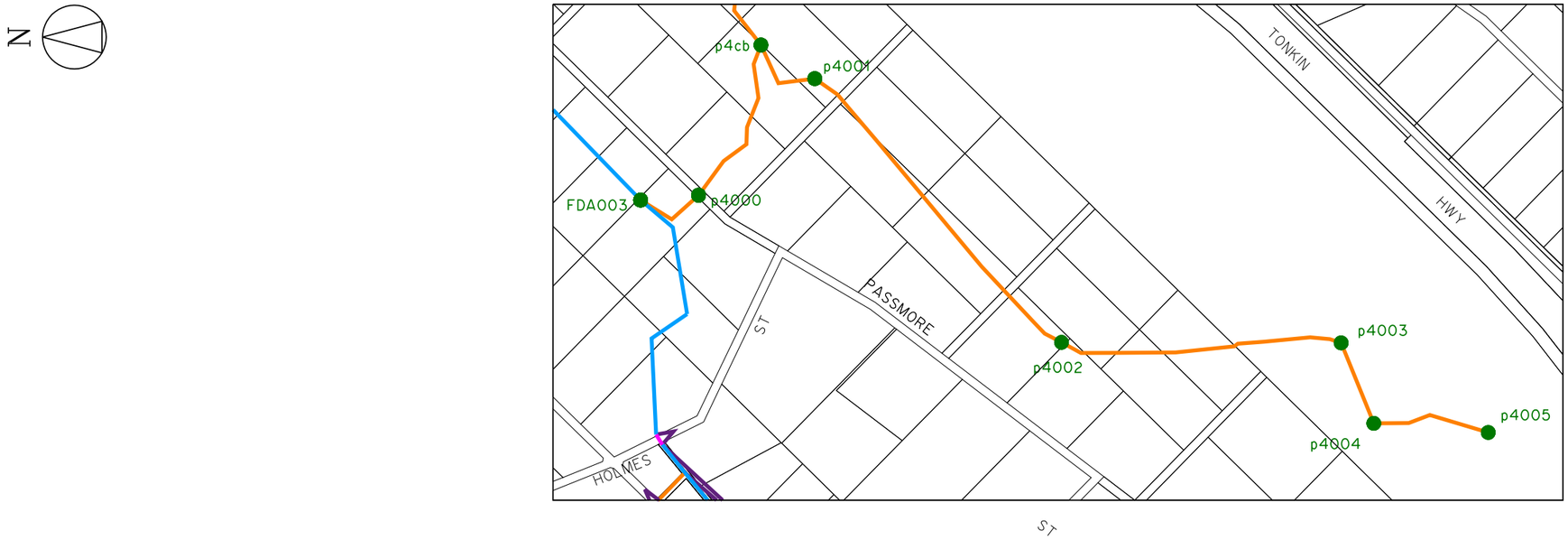
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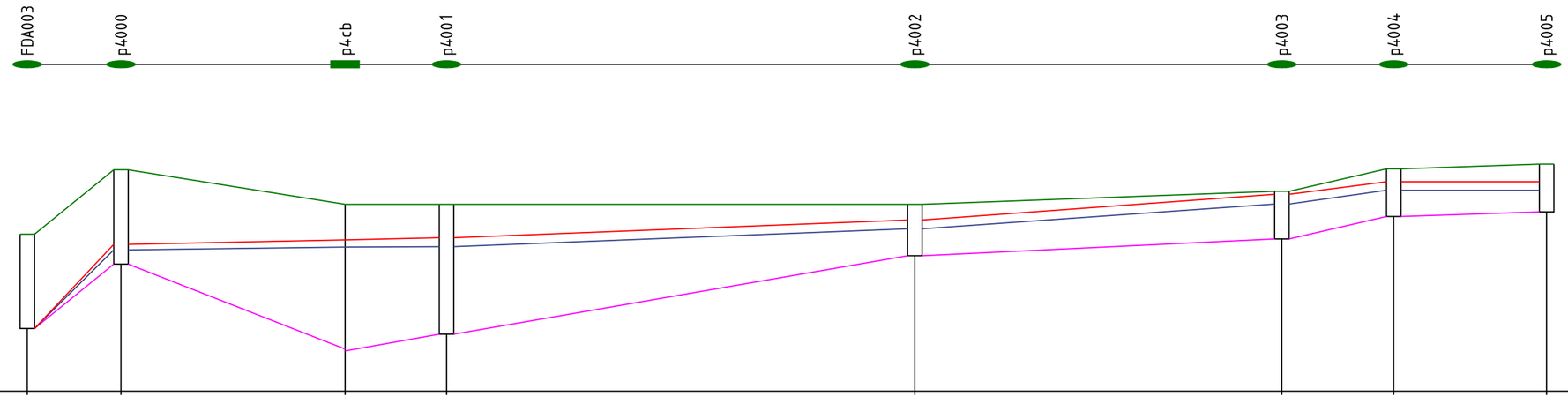




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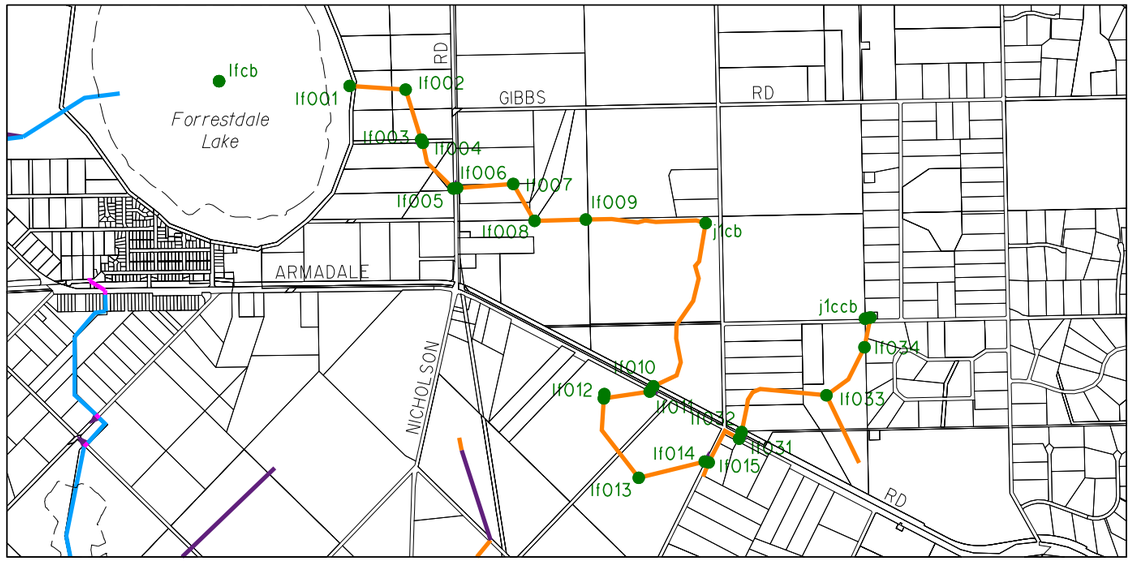


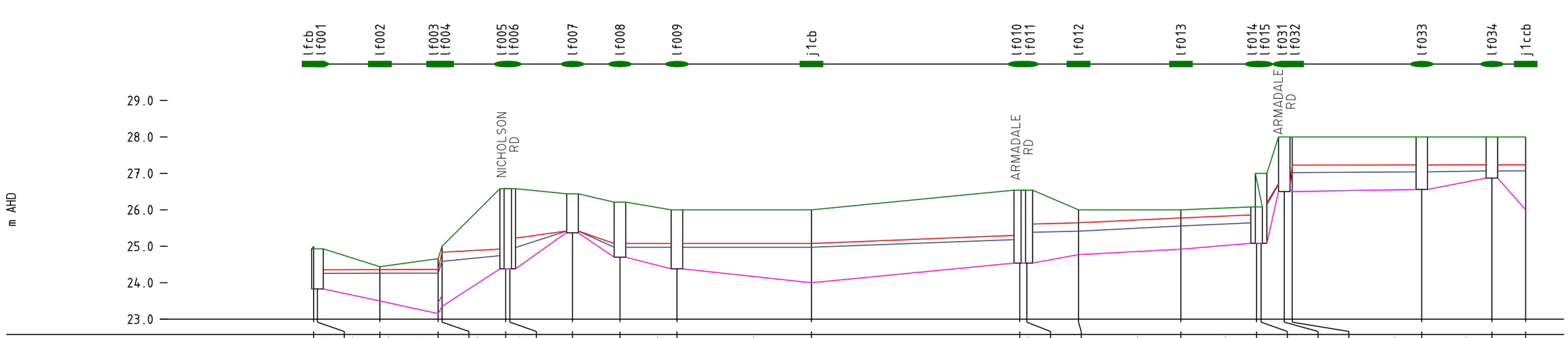


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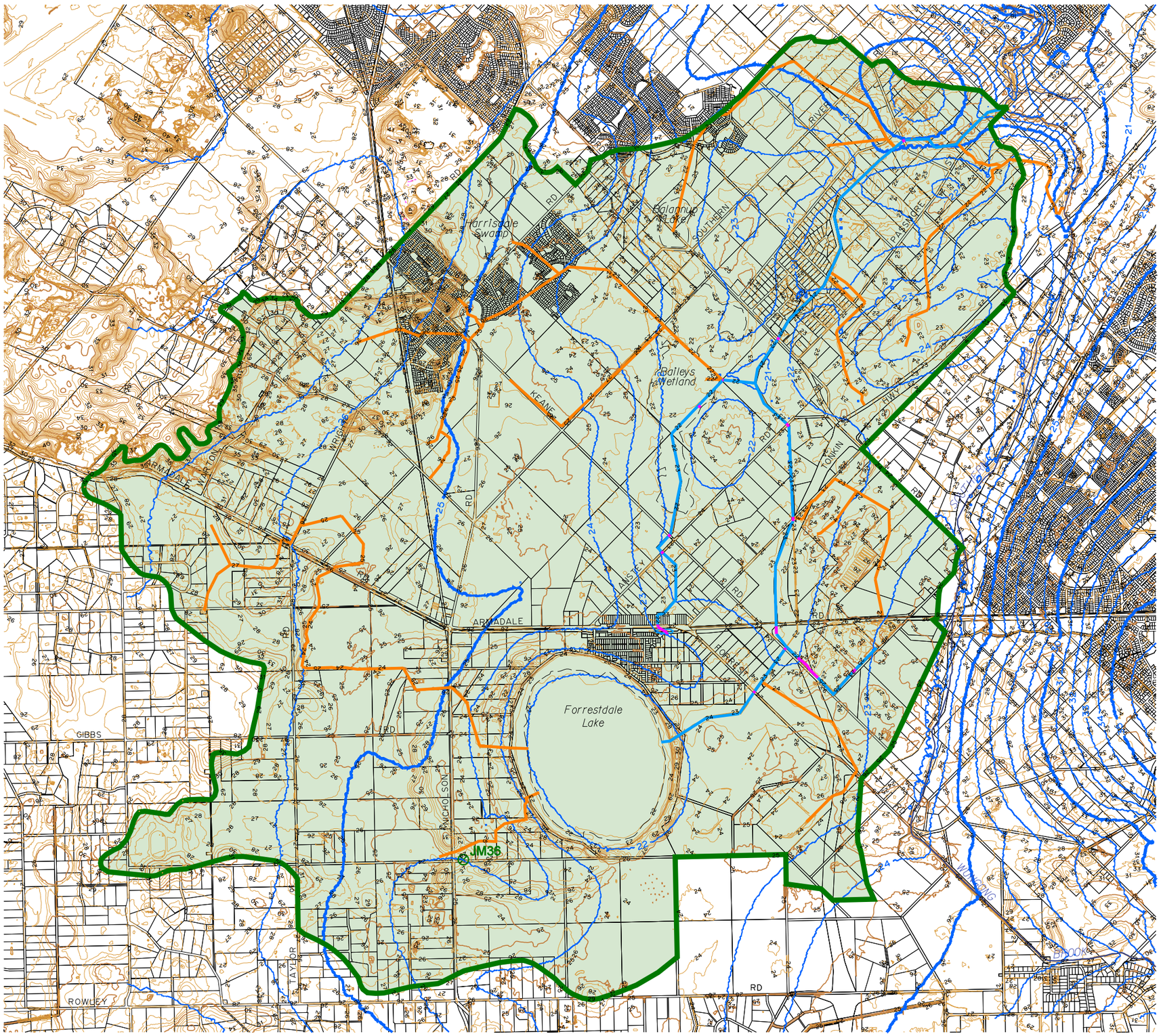
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LEGEND

- Scheme Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Pre Development Modelled Maximum Groundwater Level - 788mm Annual Rainfall Scenario (Rockwater, 2005)
- Water Corporation Compensating Basin
- Surface Contour (m)
- Groundwater Monitoring Bore

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig 11 PreDevMaxGW 788mmAnnualRain.dgn

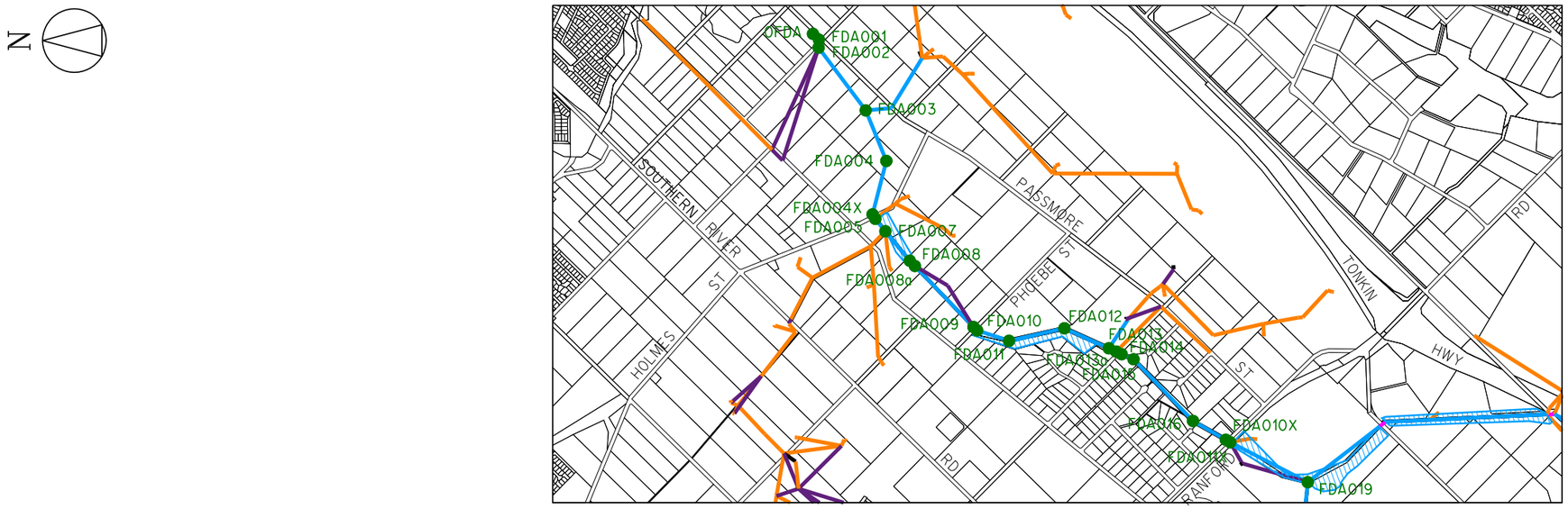
WATER CORPORATION

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PRE DEVELOPMENT CONTROLLED GROUNDWATER LEVEL - 788mm ANNUAL RAINFALL SCENARIO (ROCKWATER, 2005)

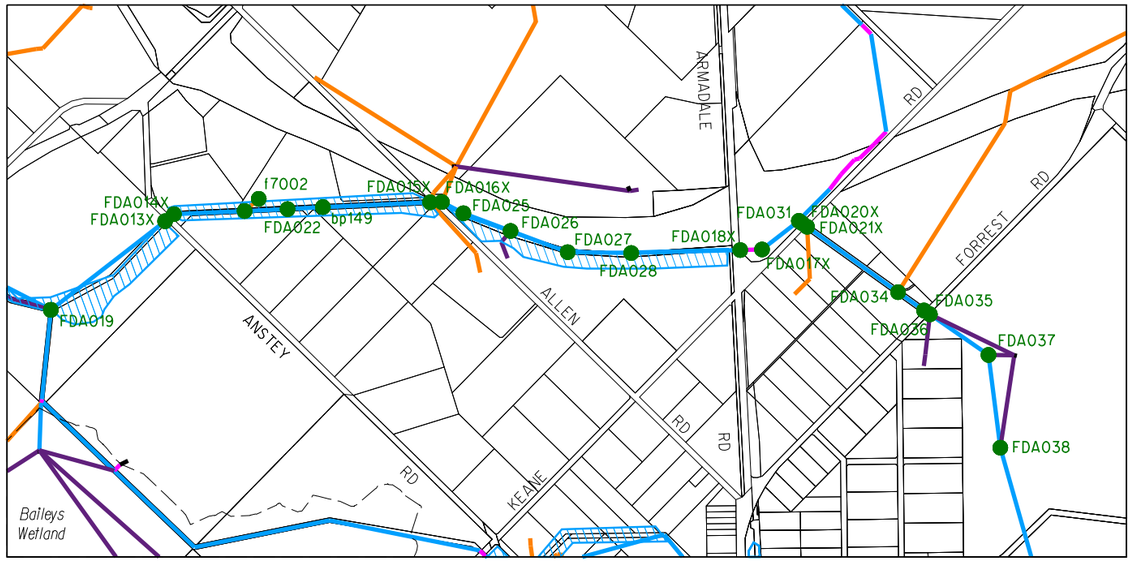
Figure 11

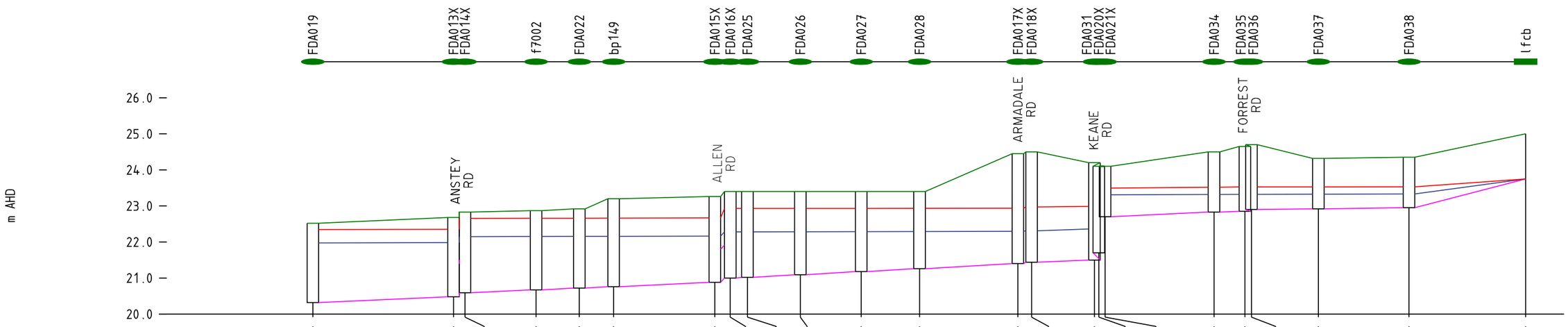
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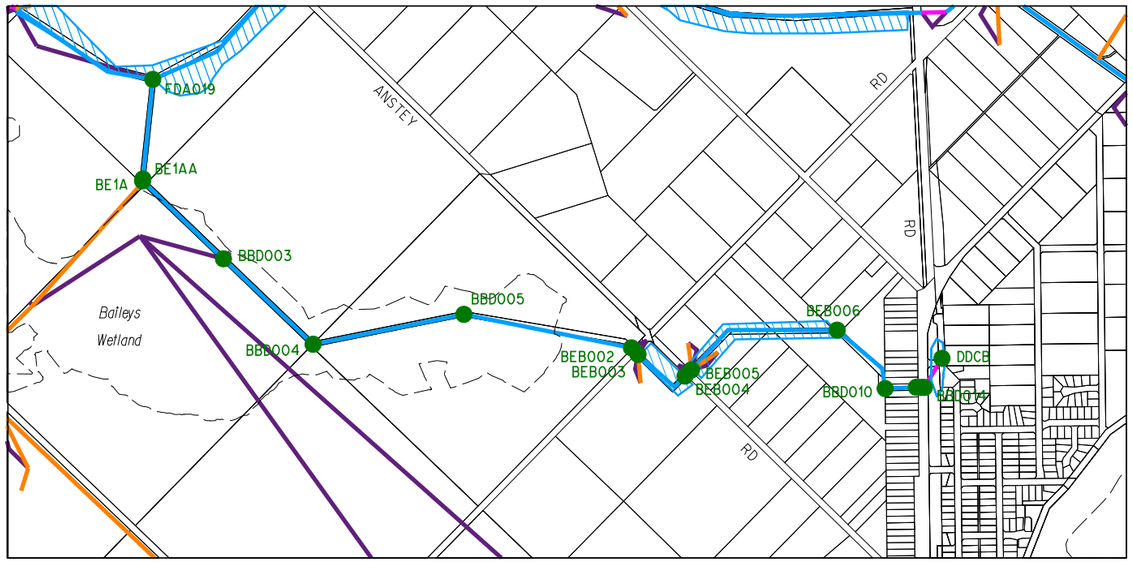
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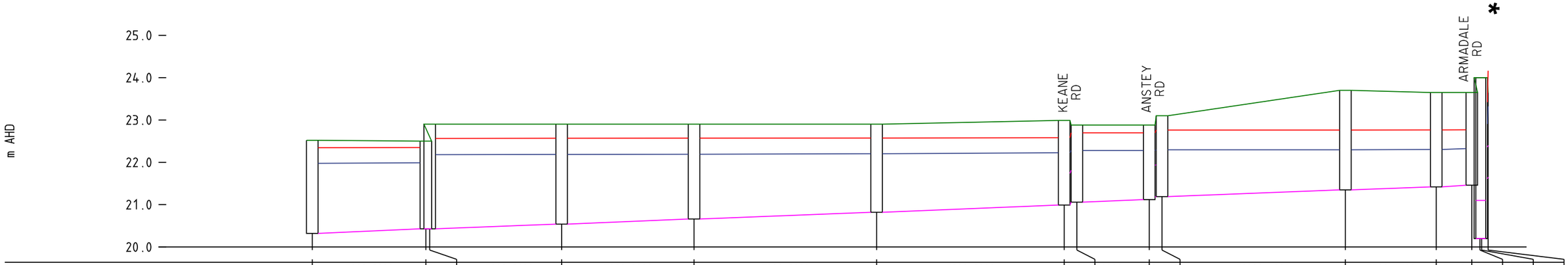




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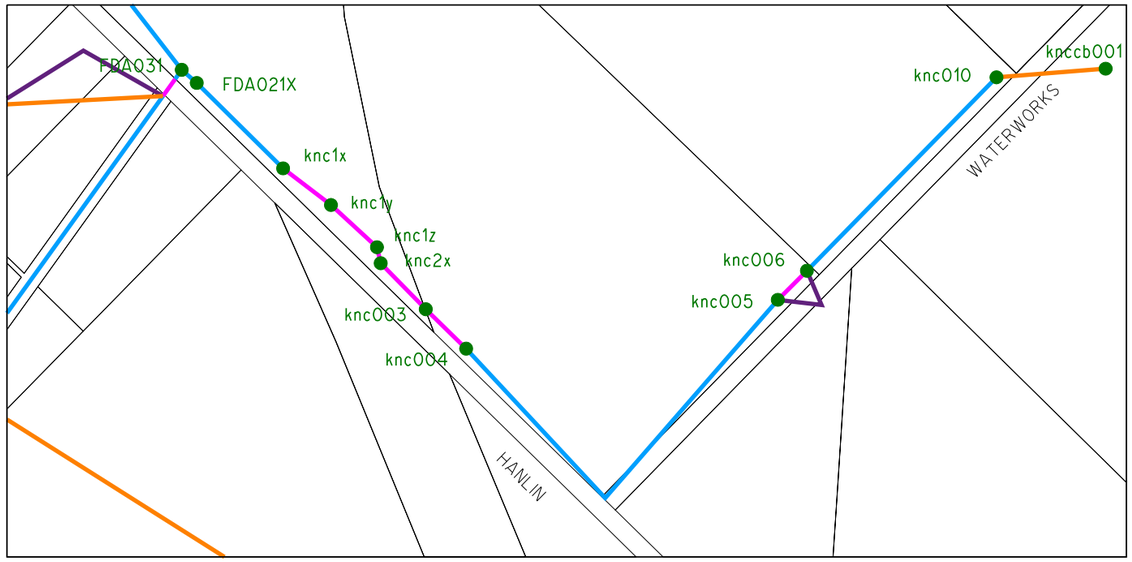




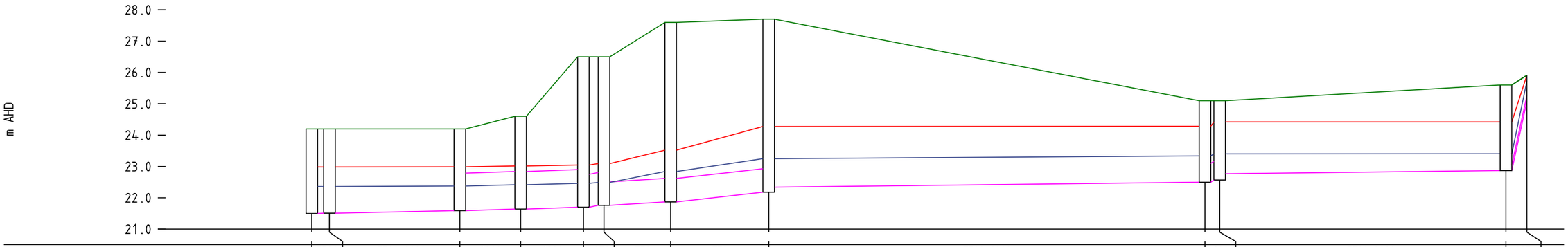
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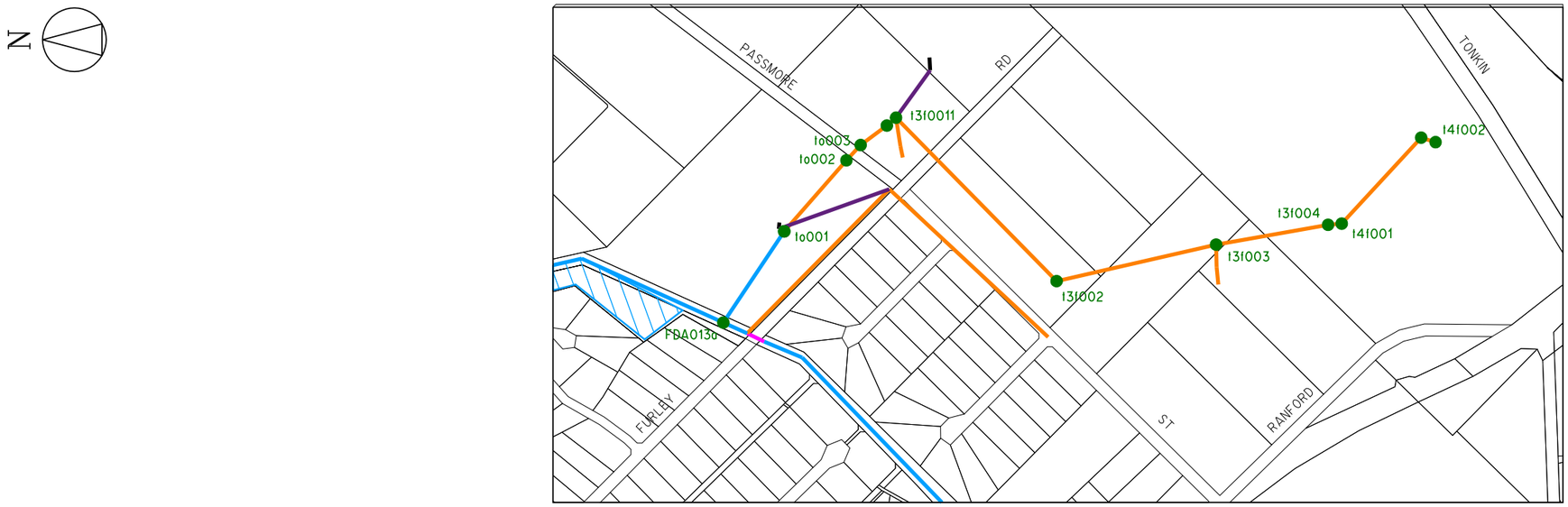


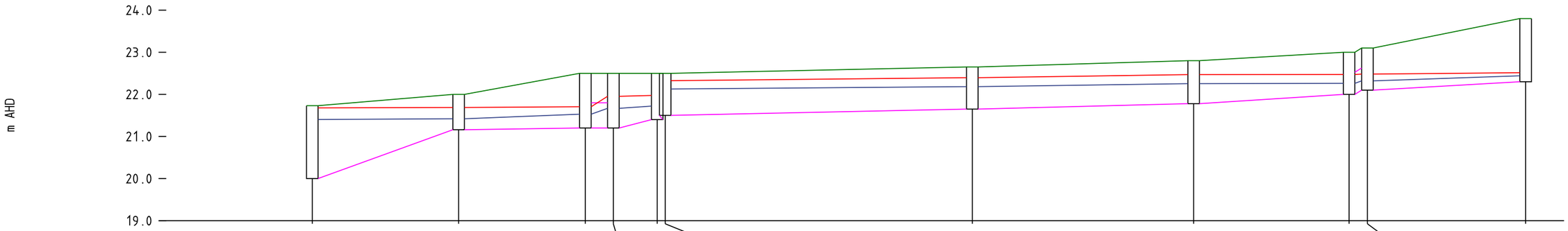




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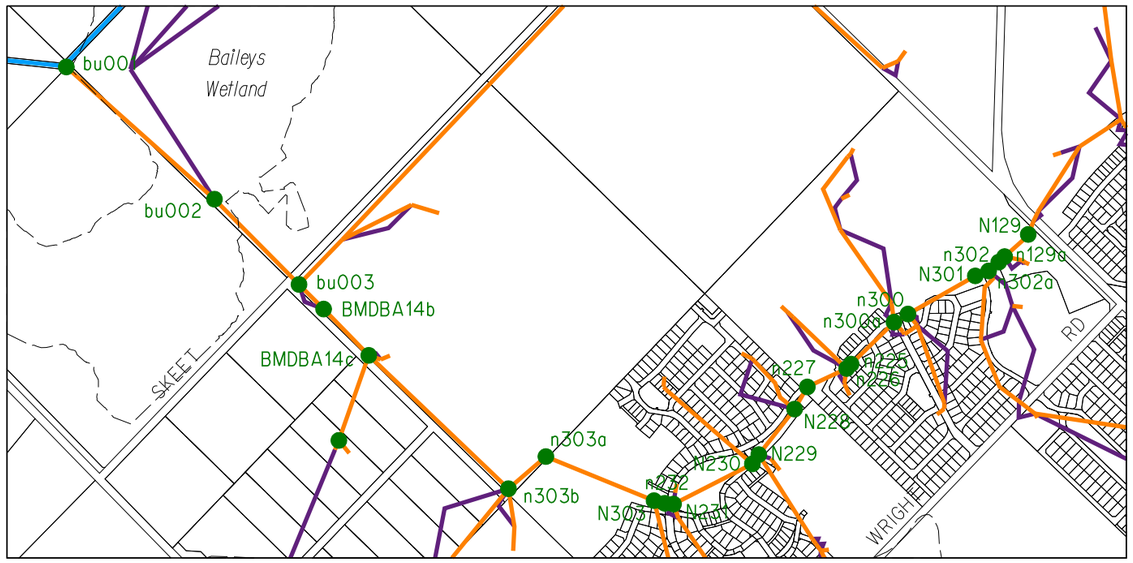


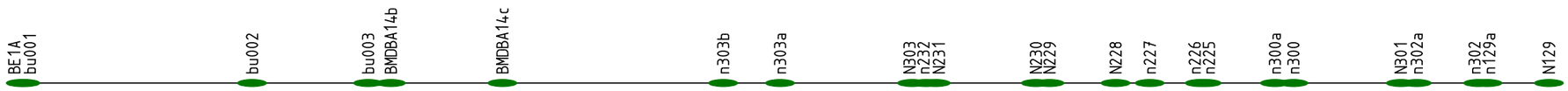


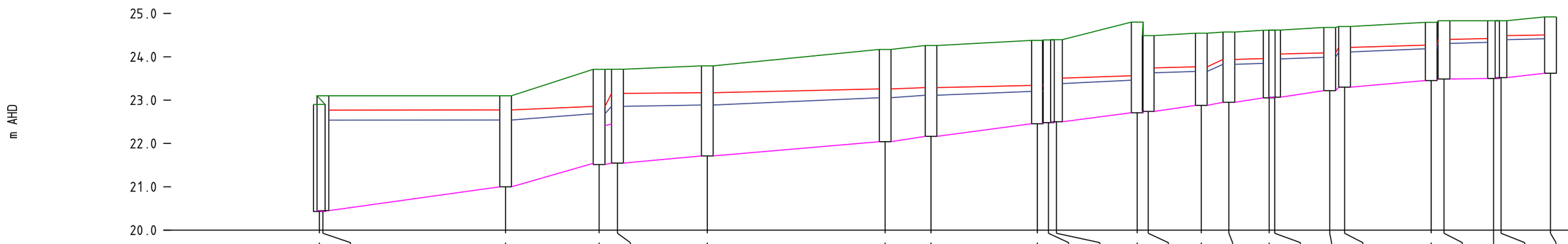
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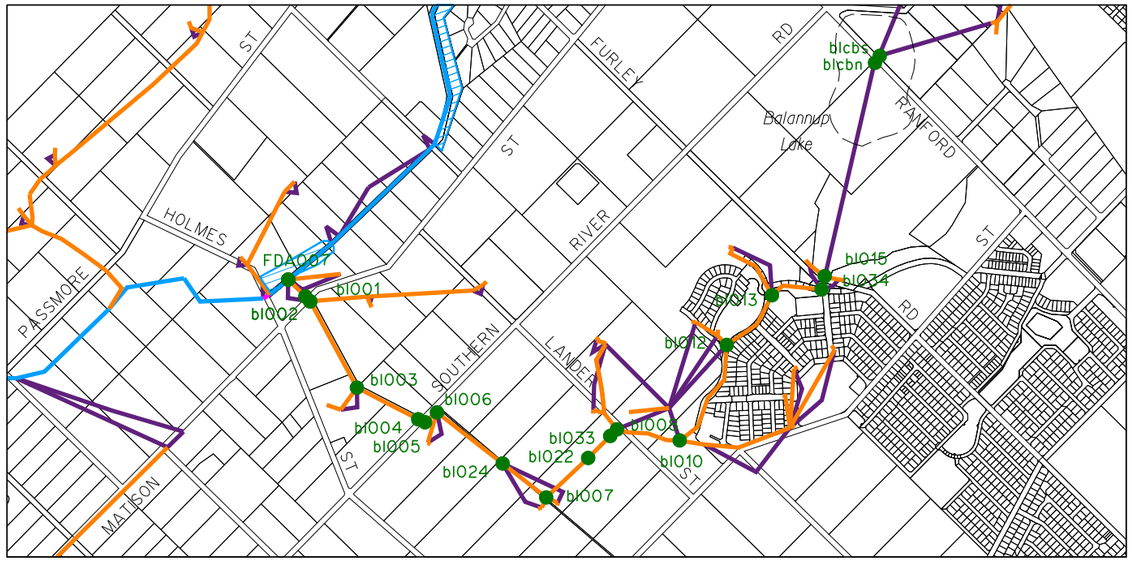


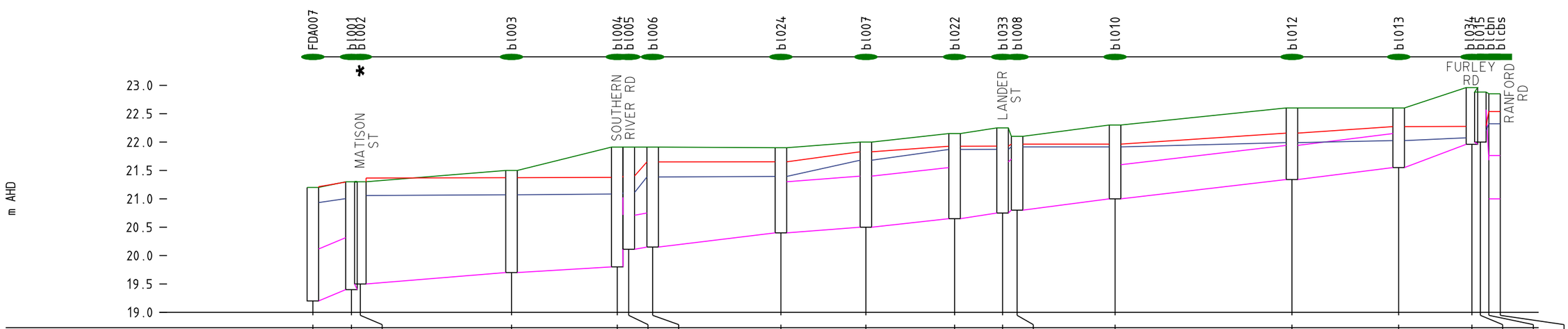


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Chainage (m)	0	21.20	91	21.30	112	21.30	469	21.50	719	21.91	746	21.91	802	21.91	1105	21.90	1306	22.00	1515	22.15	1629	22.25	1663	22.10	1894	22.30	2312	22.60	2564	22.60	2737	22.96	2757	22.88	2777	22.85	2804	22.85
Ground level (m AHD)																																					
10 year ARI HGL level (m AHD)	20.93	21.21	21.00	21.30	21.06	21.36	21.07	21.37	21.08	21.38	21.11	21.40	21.39	21.65	21.39	21.65	21.68	21.83	21.87	21.93	21.87	21.93	21.91	21.96	21.91	21.96	21.99	22.16	22.03	22.27	22.07	22.28	22.20	22.29	22.32	22.54	22.32	22.54
100 year ARI HGL level (m AHD)																																					
Invert level (m AHD)	-	19.20	19.40	19.40	19.50	19.50	19.70	19.70	19.80	19.80	20.11	20.11	20.15	20.15	20.40	20.40	20.50	20.50	20.65	20.65	20.75	20.75	20.80	20.80	21.00	21.00	21.34	21.34	21.55	21.55	21.96	21.96	22.00	22.57	21.68	21.00	21.00	-
Max 10 year ARI flow (m3/s)		0.61	0.61	0.61	0.71	0.88	0.88	0.83	0.83	0.43	0.43	0.43	0.43	0.71	0.71	0.70	0.70	0.67	0.67	0.67	0.67	0.67	0.67	0.40	0.40	0.09	0.09	0.08	0.08	0.08	0.08	0.07	0.07	-	-	-0.10	-0.15	
Max 100 year ARI flow (m3/s)		0.71	0.71	0.71	0.93	0.93	0.93	0.91	0.91	0.48	0.48	0.48	0.48	0.76	0.76	0.71	0.71	0.68	0.68	0.68	0.68	0.68	0.68	0.58	0.58	0.15	0.15	0.14	0.14	0.17	0.17	0.07	0.07	-	-	-0.15	-0.15	

✱ INDICATES FLOODING DURING 100 YR ARI STORM EVENT

AUTHOR: P Haywood DESIGN FILE: Fig 14g LS Precinct2-3 post.dgn

WATER CORPORATION

Precinct 2-3 Drain

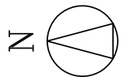
LONGITUDINAL SECTION

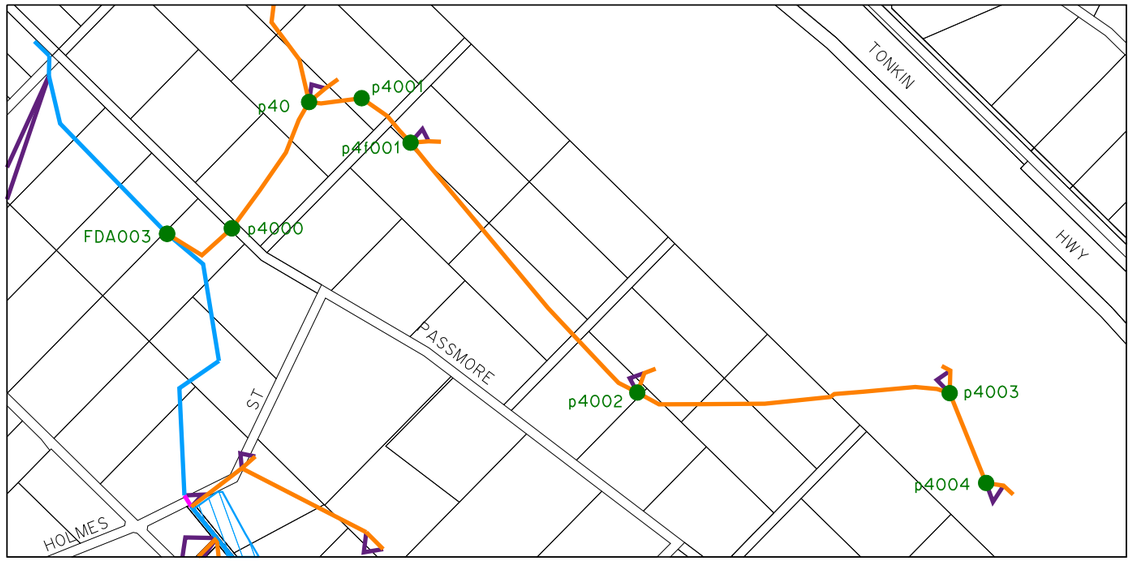
HGLs And Flows For Option A Adopted Strategy

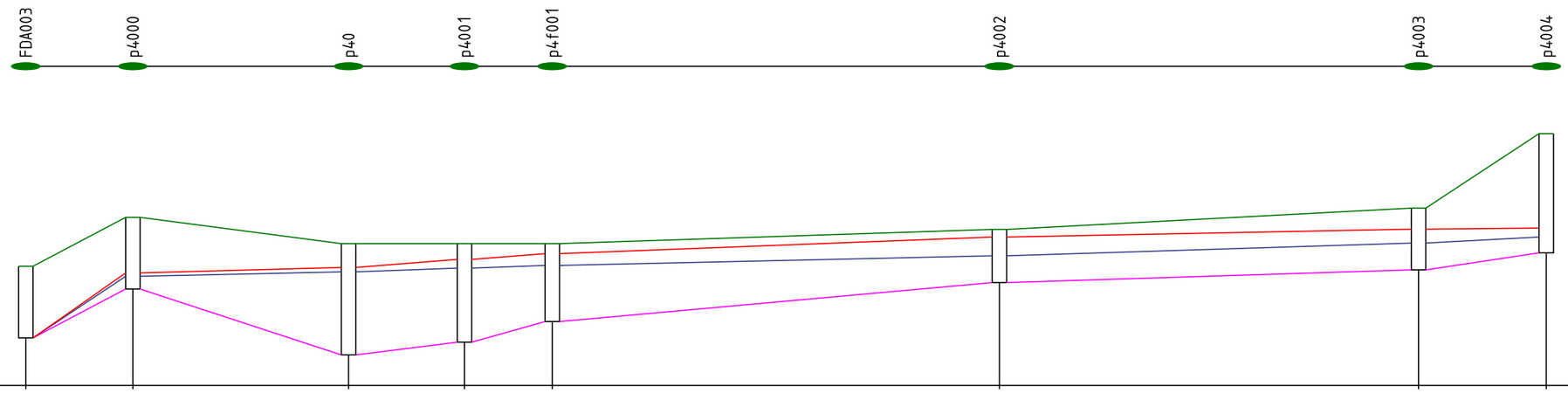
Figure 14g

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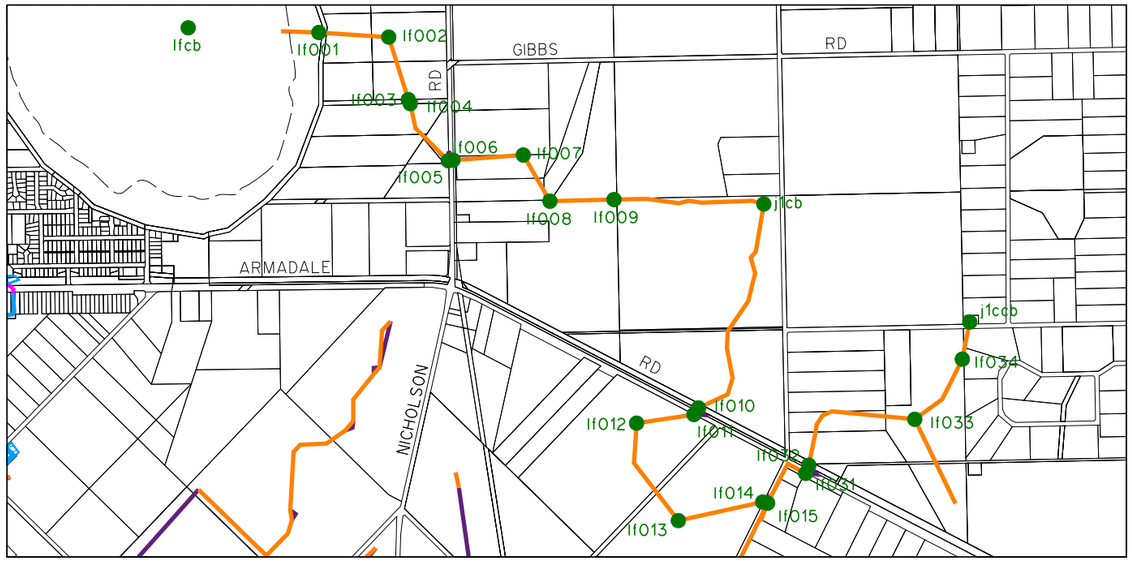


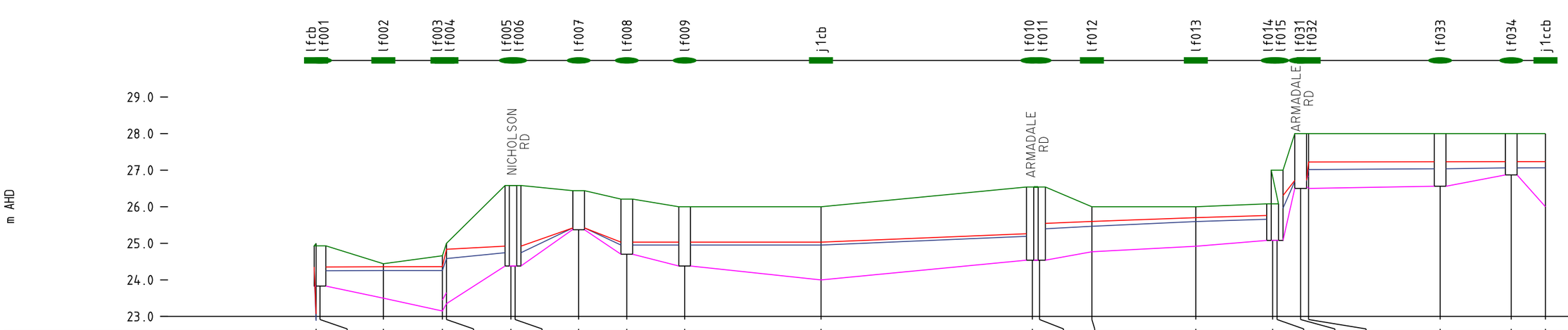


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Chainage (m)	0	25.00	24.93	24.44	24.66	25.00	26.58	26.58	26.44	26.21	26.00	26.00	26.00	26.54	26.54	26.00	26.00	26.08	27.00	28.00	28.00	28.00	28.00	28.00								
Ground level (m AHD)		20	340	639	659	985	1006	1328	1571	1864	2554	3623	3659	3924	4450	4838	4861	4980	5020	5686	6045	6218										
10 year ARI HGL level (m AHD)	22.88	23.07	24.35	24.36	24.26	24.36	24.84	24.92	24.92	25.42	24.95	25.00	24.95	25.00	25.19	25.26	25.55	25.60	25.59	25.70	25.66	25.76	26.31	26.72	27.23	27.04	27.23	27.06	27.23			
100 year ARI HGL level (m AHD)		24.25	24.25		24.58		24.74	24.74	24.38	25.42	25.37	24.95	25.00	24.95	25.00	25.40	25.47		26.69	27.02		25.96	26.50	26.53				27.06	27.23				
Invert level (m AHD)	-	23.83	23.83	23.50	23.15	23.15	23.35	23.35	24.38	24.38	25.38	25.37	24.70	24.70	24.38	24.38	24.00	24.00	24.54	24.54	24.54	24.77	24.77	24.92	24.92	25.08	25.08	25.08	25.08	26.53	26.53	26.50	26.56	26.56	26.87	26.87	26.00	-
Max 10 year ARI flow (m3/s)		0.17	0.17	0.31	0.11	0.93	-0.01	-0.01	-	-	-	0.00	0.85	0.85	0.70	0.46	0.46	0.15	0.07	0.23	0.06	0.06										
Max 100 year ARI flow (m3/s)		0.25	0.25	0.79	0.14	1.78	-0.02	-0.03	-	-	-	0.00	1.13	1.14	0.93	0.63	0.63	0.19	0.09	0.39	0.12	0.13										

AUTHOR: P Haywood DESIGN FILE: Fig 14i LS James post.dgn

WATER CORPORATION

James Drain

LONGITUDINAL SECTION

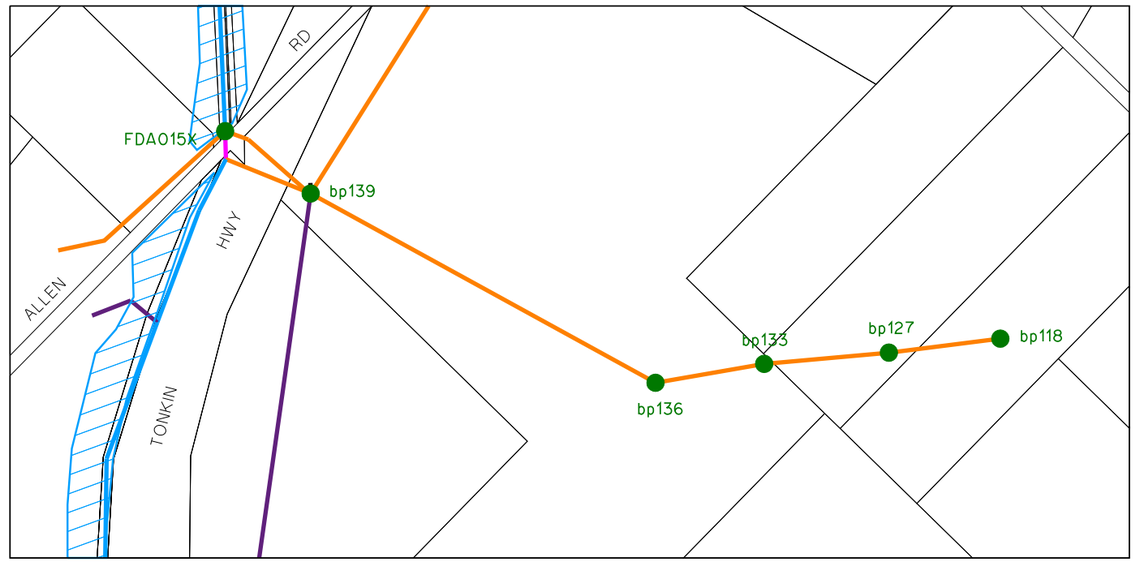
HGLs And Flows For Option A Adopted Strategy

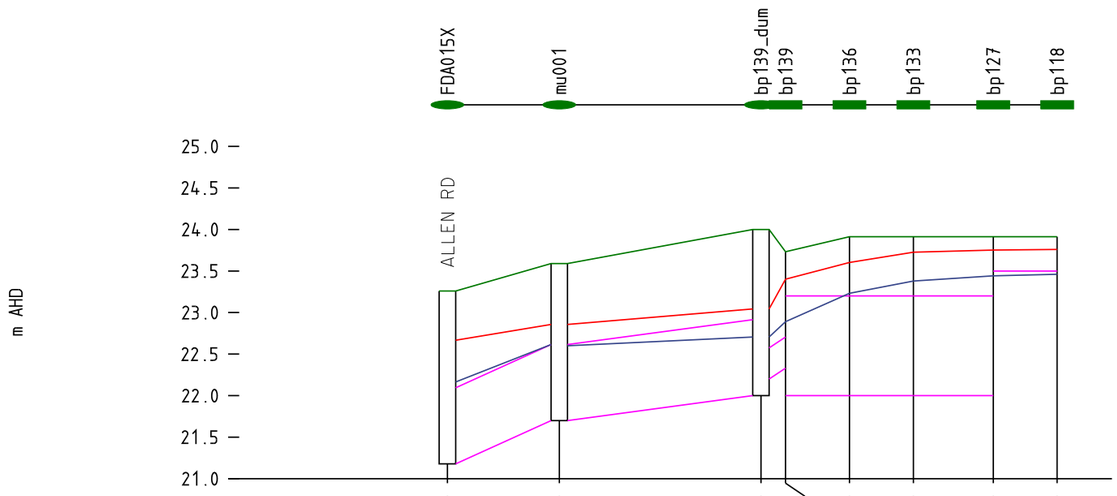
Figure 14i

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Appendices

Appendix A – Stormwater modelling in InfoWorks CS

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A.1 Hydraulic modelling in InfoWorks CS

InfoWorks CS is a hydraulic modelling package used to simulate stormwater drainage systems. The software package is capable of hydrological modelling of the complete urban water cycle, including stormwater drainage master planning or studies, assessments of flooding in urban drainage systems and hydraulic response of the stormwater network infrastructure to the changes in the land use. The hydraulic software component can resolve open channel and closed conduit flows and model the effect of backwater and reverse flow. The model is used predominantly for calculations of event-based simulations; therefore the initial conditions are usually set to the worst-case scenario.

Time-varying surface runoff generated by the runoff routing model discharges into the hydraulic network. The hydraulic network consists of interconnected nodes (manholes, outfalls and storage basins) and links (weirs, pipes, culverts and open channels).

Mannings roughness coefficients applied to the conduits are summarised in Table A1.

Table A1 Culverts roughness coefficients (Mannings n)

Drain type	Manning's coefficient of roughness
Reinforced concrete pipe	0.012
Concrete box culvert	0.013
Over road flood route	0.015
Maintained open drain	0.030
Over land flood route	0.035

Nodes and manholes in the hydraulic network are modelled by standard units offered in InfoWorks CS. Most commonly, the flood level for nodes was set to a ground level. The exceptions were the basins connected to the main drain by an overland flow path; in this case flood level was elevated by 0.3 m to allow utilisation of the flow path. The default values used for nodes are summarised in Table A2.

Table A2 Default fields for nodes and manholes

Node field	Unit	Value
Shaft area bottom	m^2	1.2
Shaft area top	m^2	1.2
Floodable area	m^3	1.0

Regional flood storage areas were designed according to the principles outlined in Chapter 6. First, the InfoWorks CS model is run for pre-development land use to determine maximum discharge from the catchment for a critical 100-year average recurrence interval rainfall event. The discharge of the catchment is to be maintained in the post-development scenario.

The catchment drains into a detention basin. A sealed dummy node is connected to the invert of the detention basin by a nominal 100 mm pipe to prevent the detention basin from filling by water in the initialisation of the model. The outflow pipe is connected at the invert level of the storage. The diameter of the outflow pipe will

depend on storage size, pre-development discharge and storage elevation relative to the main drain, but rarely exceeds 450-600 mm.

The detention storage design is tested by running a critical 100-year average recurrence interval rainfall event for a post-development scenario. The discharge from the detention basin should not exceed the pre-development level and the storage volume should also be fully utilised. If the storage volume is inadequate, the basin is resized to achieve required volume utilisation, discharge out of the basin and the shape of the hydrograph.

Groundwater levels in drains and basins were modelled by the application of water levels and inflows directly into the drain or basin via dummy outfall nodes with reversed flap valves to prevent drain flows from discharging out of the model. Inflows were used to represent subsurface drainage flows estimated from the *Southern River development area groundwater model* (Rockwater 2005) and were applied at several locations throughout the model. Appropriate levels to represent groundwater inflows were identified with reference to the peak winter groundwater levels determined by *Southern River development area groundwater model* (Rockwater 2005).

The modelled maximum groundwater level (788 mm annual rainfall scenario) at the proposed location of the basin has been used to determine the invert of the detention basin. The invert of detention basins should be at least 300 mm above maximum groundwater level.

A.2 Modelling assumptions

The following assumptions used for modelling of Forrestdale main drain catchment:

- maximum groundwater levels (788 mm annual rainfall scenario) applied as starting water levels in basins and as baseflows in drains
- 100-year average recurrence interval rainfall event applied to whole catchment with universal start time
- 25-year river level applied as constant tailwater in the Southern River floodplain
- no infiltration modelled within flood storage areas or other components of the drainage system
- conservative parameterisation.

In isolation, these are all reasonable design assumptions to make, but it is essential that the build-up of conservatism is not forgotten. Any one of these assumptions when considered in isolation could have significant implications for the cost of the final solution, and when combined that effect could be multiplied.

A.3 Surface runoff parameters

InfoWorks CS uses the stormwater management model routing model to generate rainfall runoff from the catchment. The flow is routed using a single non-linear reservoir; its routing coefficients depend on surface roughness, surface area, ground slope, and catchment width. The runoff model consists of three components: initial losses, runoff model and runoff rate (routing). Each sub-catchment in the study area

(Figures A1 and A2) is subdivided into surface types (Table A3). These are pervious without depression storage (runoff routing value of 0.025, fixed runoff coefficient of 10 per cent), pervious with depression storage (runoff routing value of 0.025, fixed runoff coefficient of 20 per cent) and impervious with depression storage (runoff routing value of 0.015, fixed runoff coefficient 100 per cent). In rural areas an initial loss (depression storage) of 15 mm is set for natural pervious surface to account for initial wetting of the catchment.

Table A3 InfoWorks model runoff area properties

Runoff surface ID	Surface type	Surface roughness (Mannings n)	Initial loss (mm)	Fixed runoff coefficient
1	Pervious	0.025	0	0.1
2	Impervious	0.015	1.5	1
3	Pervious (shallow water table)	0.05 15		0.4-0.5 (varies with average recurrence interval event)

Permanently wet areas within the swamps and the wetlands were modelled as 100 per cent impervious (fixed runoff coefficient 100 per cent) without any initial losses.

The land use of the existing catchments was determined from the existing cadastre; the distinct structure plan provided the land use breakdown for the ultimate development. Each land use was assigned a runoff coefficient according to the *Urban main drainage manual* (Water Corporation 1998); the coefficients are summarised in Table A4. The equivalent runoff coefficients, which can be used to convert the stormwater management model routing model coefficients to rational method parameters, are also presented.

Table A4 InfoWorks model land use surface breakdown

Land use category	Runoff area 1 (%)	Runoff area 2 (%)	Runoff area 3 (%)	Equivalent runoff coefficient
Conservation category wetland	0%	0%	100%	0.40
Community facilities	28%	72%	0%	0.75
Environmental protection policy lake	0%	0%	100%	0.40
Light industrial	22%	78%	0%	0.80
Mixed business/commercial	22%	78%	0%	0.80
Open space (including drainage corridors)	0%	0%	100%	0.40
Parks and recreation reservation	0%	0%	100%	0.40
Primary regional road	20%	80%	0%	0.82
Roads	20%	80%	0%	0.82
Rural	0%	0%	100%	0.40
Rural living and semi-rural living	0%	0%	100%	0.40
Urban (including balance of public open space)	89%	11%	0%	0.20
Village/ neighbourhood centres	28%	72%	0%	0.75

The percentage of surface types for individual catchments was calculated from the existing land use and district structure plan; the results are summarised in Table A5 (pre-development scenario) and Table A6 (post development scenario).

The design rainfall events for the one-hour, three-hour, six-hour, 12-hour, 24-hour, 48-hour and 72-hour durations were run for two-year, 10-year and 100-year average recurrence interval occurrences were generated from long-term continuous rainfall records. These were then used to design the stormwater drainage infrastructure.

Table A5 Existing catchment land use breakdown and loss model

Land use	Catchment area (ha)	Equivalent (rational method) runoff coefficient
Farming 103		0.40
Light industrial	10	0.80
Open space (including drainage corridors)	178	0.40
Community facilities	22	0.75
Conservation category wetlands, Environmental protection policy lakes, parks and recreation reservation (including proposed), and other rural areas	1886	0.40
Urban (including balance of public open space)	38 0.20	
Rural 2025		0.40
Rural living and semi-rural living	172	0.40
Total catchment	**4434**	**0.40**

Table A6 Proposed catchment land use breakdown and loss model

Land use	Catchment area (ha)	Equivalent (rational method) runoff coefficient
Light industrial	275	0.80
Open space (including drainage corridors)	301	0.40
Community facilities	90	0.75
Conservation category wetlands, Environmental protection policy lakes, parks and recreation reservation (including proposed). 1423		0.40
Urban (including balance of public open space) 1092		0.20
Rural 423		0.40
Rural living and semi-rural living	424	0.40
Village/neighbourhood centres	30	0.75
Mixed business/ commercial	58	0.80
Roads 317		0.82
Total catchment	4434	0.42

Notes:

- The high runoff coefficient for unfilled areas takes into account the high groundwater table of the catchment.
- The small increase in total catchment runoff does not reflect the increased flow into drains via subsoil drainage. This has been separately accounted for in the model and represents an increase in regional groundwater levels.

Table A7 InfoWorks model catchment properties for pre-development scenario

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
B10A 103.9		0.6	575	0 12.47		91.43	0.12
B10B 53.2		0.7	412	0 6.38		46.80	0.12
B11A 204.2		0.1	806	0	0	204.22	-
B11B 32.1		0.1	320	0	0	32.11	-
B12 114.0		0.1	602	0	0	114.00	-
B13 35.4		0.5	336	0	4.25	31.20	0.12
B1A 131.2		0.1	646	0	26.23	104.92	0.20
B1B 85.6		0.1	522	0	17.13	68.51	0.20
B1C 15.4		0.1	221	0	3.07	12.28	0.20
B3A 29.5		0.3	307	0	5.31	24.21	0.18
B3B 67.5		0.5	463	0	12.14	55.32	0.18
B3C 22.4		0.5	267	0	4.04	18.40	0.18
B4 74.8		0.1	488	0	0	74.83	-
B5 187.0		0.1	772	0	0	187.03	-
B6 74.4		0.1	487	0	0	74.45	-
B7 67.7		0.1	464	0	0	67.75	-
B8 100.4		0.1	565	0	0	100.38	-
BA1D 7.9		0.1	158	0	0	7.85	-
BA6A 16.2		0.1	227	0	0	16.15	-
bu033 35.2		0.1	335	0	4.22	30.97	0.12
CATB1 58.4		0.5	431	43.84 14.61		0	0.25
CATB2 56.2		0.5	423	0	0	56.18	-
CATB3 53.7		0.2	414	0	0	53.71	-
CATB4 55.8		0.0	421	0	0	55.78	-
CATF1 671.1		0.2	1462	0	127.52	543.63	0.19
CATF10 38.5		0.2	350	32.73 5.78		0	0.15
CATF11A 11.5		0.2	191	0	0	11.51	-
CATF11B 24.6		0.2	280	0	0	24.64	-
CATF11C 14.4		0.2	214	0	0	14.44	-
CATF11D 18.8		0.2	244	0	0	18.76	-
CATF11E 2.1		0.2	82	0	0	2.09	-
CATF12A 47.3		0.0	388	0	0	47.25	-
CATF12B 10.1		0.0	180	0	0	10.14	-
CATF2 136.4		0.3	659	0	0	136.39	-
CATF3 93.9		0.1	547	0	0	93.93	-
CATF4 19.5		0.6	249	17.54	1.95	0	0.10
CATF5 54.5		0.0	417	0	0	54.54	-
CATF7 125.1		0.0	631	0	0	125.06	-
CATF8 64.0		0.3	452	0	0	64.03	-
CATF9 66.2		0.0	459	59.57 6.62		0.00	0.10
CATG1 149.0		0.0	689	0	0	148.97	-
CATJ1a 160.5		0.1	715	0	0	160.47	-
CATJ1b 214.2		0.1	826	0	0	214.23	-
CATJ1c 70.6		0.1	474	0	0	70.57	-
CATJ2 488.5		0.1	1247	0	0	488.50	-
CATK1 47.1		0.0	387	0	0	47.05	-

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
CATK2 48.1		0.6	391	0	0	48.09	-
CATL1 87.7		0.3	528	0	0	87.71	-
CATL2 91.7		0.3	540	0	0	91.69	-
CATL3 65.7		0.2	458	0	0	65.74	-
CATL4 56.1		0.0	423	0	0	56.14	-
CATL5A 8.2		0.2	161	0	0	8.19	-
CATL5B 10.8		0.2	186	0	0	10.82	-
CATL5C 27.4		0.2	295	0	0	27.37	-
CATL6 30.4		0.1	311	0	0	30.36	-
CATM1 97.7		0.1	558	0	0	97.66	-
CATT1A 45.0		0.1	379	0	0	45.02	-
CATT1B 52.8		0.1	410	0	0	52.84	-
CATU4 49.1		0.7	396	0	0	49.13	-
FDACB1 13.5		0.0	208	0	0	13.53	-
MU02 40.4		0.1	359	0	0	40.42	-
MU02B 50.5		0.1	401	0	0	50.49	-
P4A 154.7		0.1	702	0	0	154.67	-
P4B 41.6		0.1	364	0	0	41.62	-
to007 24.1		0.0	277	20.26	3.86	0	0.16
tocb 33.9		0.2	328	0	0	33.87	-

Table A.8 InfoWorks model catchment properties for post-development scenario

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
B12 111.4		0.1	595.5	0	0	111.42	0.00
BA1 101.3		0.1	568	1.01	4.05	96.27	0.04
BA10 63.5		0.1	449.7	43.84	11.44	8.26	0.18
BA11A 42.7		0.1	368.7	26.05	7.69	8.97	0.18
BA11B 10.6		0.1	183.8	7.21	3.39	0	0.32
BA13A 23.9		0.1	275.6	11.45	12.40	0	0.52
BA14a 41.4		0.1	363	30.63	9.52	1.24	0.23
BA14B 68.4		0.1	466.7	49.94	16.42	2.05	0.24
BA14C 21.3		0.1	260.4	14.06	4.90	2.34	0.23
BA17 38.5		0.1	349.9	26.15	12.31	0	0.32
BA2 84.1		0.1	517.4	21.02	5.89	57.19	0.07
BA3 68.4		0.1	466.6	46.51	19.83	2.74	0.29
BA5A 23.9		0.1	276.1	0	0	23.94	-
BA5B 37.0		0.1	343	26.61	9.24	0	0.25
BA5C 51.0		0.1	402.8	0	0	50.98	-
BA5d 39.3		0.1	353.6	0	0	39.27	-
BA6A 17.0		0.1	232.8	0	0	17.03	-
BA6B 27.8		0.1	297.4	0.56	3.61	23.61	0.13
BA8A 21.3		0.1	260.5	14.71	5.76	0.85	0.27
BA8B 9.3		0.1	171.6	6.11	1.94	1.20	0.21
BA9 55.2		0.1	419.1	5.52	6.07	43.59	0.11
bp119 6.5		0.1	144.1	1.96	4.57	0	0.70

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
bush 5.5		0	132.1	4.00	1.48	0	0.27
cat_lot152 9.3		0.1	171.9	4.46	1.30	1.49	0.14
cat_lot153 8.1		0.1	160.9	0.31	0.09	0.11	0.01
cat_lot154 7.8		0.1	157.7	0.29	0.09	0.10	0.01
cat_lot155 10.6		0.1	183.6	9.00	1.59	0	0.15
CATB1 58.4		0.5	431.3	26.30	15.78	16.37	0.27
CATB2A 26.1		0.5	288	18.50	5.99	1.56	0.23
CATB2B 30.1		0.5	309.7	20.49	6.93	2.71	0.23
CATB3 50.6		0.2	401.1	13.65	3.03	33.87	0.06
CATB4 55.8		0	421.4	0	0	55.78	-
CATB5 208.2		0.1	814.1	0	2.08	206.13	0.01
CATB6 49.3		0.7	396.1	0.49	1.97	46.81	0.04
CATB7 32.4		0.1	321	0.65	2.59	29.13	0.08
CATF1 670.7		0.2	1461.1	0	127.43	543.24	0.19
CATF10 38.6		0.2	350.3	3.47	12.72	22.36	0.33
CATF11A 11.5		0.2	191.4	0	0	11.51	-
CATF11B 24.8		0.2	281	15.13	4.96	4.71	0.20
CATF11C 13.6		0.2	208.4	5.87	2.87	4.91	0.21
CATF11D 18.8		0.2	244.3	12.57	2.44	3.75	0.13
CATF11E 2.1		0.2	81.5	0.02	0.04	2.03	0.02
CATF12A 47.1		0	387.3	11.31	6.13	29.69	0.13
CATF12B 10.1		0	179.6	7.81	2.33	0	0.23
CATF2a 24.9		0.3	281.5	10.21	6.47	8.22	0.26
CATF2b 111.6		0.3	596	0.00	1.12	110.49	0.01
CATF3a 64.6		0.1	453.6	2.59	9.70	52.36	0.15
CATF3b 30.7		0.1	312.7	14.44	6.76	9.53	0.22
CATF4A 16.1		0.6	226.2	13.98	1.93	0.16	0.12
CATF4B 10.9		0.6	186	2.17	8.69	0	0.80
CATF5 46.1		0.1	383.3	29.07	11.08	6.00	0.24
CATF7A 31.5		0.1	316.5	5.67	20.77	5.04	0.66
CATF7B 56.1		0	422.7	0.56	1.12	54.44	0.02
CATF7C 29.0		0.1	303.6	24.61	4.05	0.29	0.14
CATF8 64.0		0.3	451.5	0	0	64.03	-
CATF9 66.1		0.1	458.8	1.32	4.63	60.17	0.07
CATG1 148.7		0	688.1	28.26	13.39	107.09	0.09
CATJ1 160.8		0.1	715.4	0	0	160.77	-
CATJ2 489.2		0.1	1247.9	0	0	489.20	-
CATJ3 216.6		0.1	830.3	0	0	216.57	-
CATJ4 70.6		0.1	474	0	0	70.60	-
CATK1 9.1		0	170.4	5.20	3.29	0.64	0.36
CATK2A 42.6		0.6	368	0	0.43	42.13	0.01
CATK2B 34.9		0.6	333.4	0	0.35	34.57	0.01
CATL1 32.0		0.3	318.9	0.64	2.88	28.44	0.09
CATL2 62.6		0.3	446.3	4.38	4.38	53.81	0.07
CATL3 12.7		0.2	200.9	0.63	1.65	10.40	0.13
CATL5A 8.2		0.2	161.4	6.30	1.88	0	0.23

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
CATL5B 11.3		0.2	189.7 8.70		2.60	0	0.23
CATL5C 28.3		0.2	300.3 21.53		6.80	0	0.24
CATL6 30.7		0.1	312.7	8.29 18.43		3.99	0.60
CATT1A 18.0		0.1	239.6	0.54 1.62		15.87	0.09
CATT1B 15.7		0.1	223.6	1.41 5.18		9.11	0.33
CATT2 24.1		0.1	277.1	0.24 1.21		22.68	0.05
CATT3A 31.9		0.1	318.9	6.39 19.49		6.07	0.61
CATT3B 28.2		0.1	299.8 8.47		19.77	0	0.70
CATT4 21.5		0.1	261.9	14.43 3.23		3.88	0.15
creek 29.4		0.1	305.7	22.01 7.34		0.00	0.25
FBPw 35.5		0.1	336.1	0	0	35.49	-
FDACB1 13.5		0	207.5	0	0	13.53	-
LAC 11.8		0.2	193.9	9.33 2.13		0.35	0.18
LB 16.5		0.2	229.4	13.23 2.98		0.33	0.18
LD 9.9		0.2	177.6	7.03 2.87		0	0.29
LE1 3.9		0.2	111	3.17	0.70	0	0.18
LE2 5.9		0.2	136.6	3.46 1.41		1.00	0.24
LF1 7.3		0.2	152.3	5.68 1.09		0.51	0.15
LF2 5.3		0.2	129.5	1.32 1.11		2.85	0.21
LF3 4.7		0.2	122.6	4.16 0.57		0	0.12
LF4 6.4		0.2	67.3	2.89 1.09		2.44	0.17
LF5 2.9		0.2	96.5	1.46 1.46		0.00	0.50
LG 3.9		0.2	111.9	1.14 1.46		1.34	0.37
LH 14.6		0.2	215.4	8.45 6.12		0	0.42
LH2 2.8		0.2	94.2	0.72 2.06		0	0.74
LI 5.1		0.2	126.9	2.02 2.94		0.10	0.58
LJ 6.0		0.2	138	4.13 1.85		0	0.31
LK 2.8		0.2	94.7	2.51 0.31		0	0.11
LL 14.4		0.2	213.9	10.49 3.88		0	0.27
LM 9.4		0.2	173.4	8.12 1.32		0	0.14
LN 13.2		0.2	205.3	11.39 1.85		0	0.14
LO 19.6		0.2	221.5	14.51 5.10		0	0.26
N115 7.1		0.1	150	2.12	4.95	0	0.70
N116 5.3		0.1	129.8	1.59 3.71		0	0.70
N117 9.8		0.1	176.8	2.95 6.87		0	0.70
N120 10.6		0.1	183.9	3.19 7.44		0	0.70
N121 5.0		0.1	126.7	1.51 3.53		0	0.70
N122 3.2		0.1	100.2	0.95 2.21		0	0.70
N123 10.6		0.1	184.1	3.19 7.45		0	0.70
N124 9.0		0.1	169.4	2.70 6.31		0	0.70
N125 9.1		0.1	170.6	2.74 6.40		0	0.70
N126 6.3		0.1	141.1	1.88 4.38		0	0.70
N128 4.6		0.1	121	1.38	3.22	0	0.70
N129fbp 6.3		0.1	141.6 1.89		4.41	0	0.70
N130 4.2		0.1	115.6	1.26 2.94		0	0.70
N131 5.8		0.1	135.6	1.73 4.04		0	0.70
N132 5.7		0.1	134.8	1.71 4.00		0	0.70

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
N134 7.1		0.1	150.4	2.13	4.98	0	0.70
N135 6.5		0.1	144.3	1.96	4.58	0	0.70
N137 5.6		0.1	133.1	1.67	3.89	0	0.70
N138 7.9		0.1	158.4	2.36	5.52	0	0.70
N140 10.2		0.1	179.8	3.05	7.11	0	0.70
N141 8.6		0.1	165.6	2.58	6.03	0	0.70
N142 5.2		0.1	129.1	1.57	3.67	0	0.70
N143 8.4		0.1	163.5	2.52	5.88	0	0.70
N144 7.5		0.1	154.7	2.26	5.26	0	0.70
NH1A-1 6.1		0.1	139.4	3.36	2.75	0	0.45
NH1A-2 5.7		0.1	135.2	3.39	0.92	1.44	0.16
P4 14.2		0.1	212.5	8.08	2.84	3.26	0.20
P4A 18.7		0.1	243.7	12.50	4.29	1.87	0.23
P4B 38.5		0.1	350.2	25.05	8.48	5.01	0.22
P4C 30.6		0.1	312.3	19.92	3.06	7.66	0.10
P4D 34.2		0.1	329.8	24.61	6.84	2.73	0.20
P4E 34.0		0.1	329	24.15	9.86	0	0.29
P4F 35.1		0.1	334.3	23.17	9.83	2.11	0.28
SC10 5.5		0.1	132	4.54	0.93	0	0.17
SC10a 1.3		0.1	65.3	1.11	0.23	0	0.17
SC12 9.8		0.1	176.8	6.87	2.95	0	0.30
SC12a 1.9		0.1	77	1.55	0.32	0	0.17
SC13 10.2		0.1	180.1	7.03	3.16	0	0.31
SC14 17.1		0.1	233.6	14.23	2.92	0	0.17
SC14a 3.0		0.1	98.1	2.51	0.51	0	0.17
SC15 11.0		0.1	186.8	6.90	4.05	0	0.37
SC15A 4.2		0.1	115.6	2.56	1.64	0	0.39
SC16 2.2		0.1	84.4	1.86	0.38	0	0.17
SC17 0.8		0.1	49.5	0.64	0.13	0	0.17
SC2 1.3		0.1	64.7	1.09	0.22	0	0.17
SC5 4.8		0.1	124.1	3.48	1.36	0	0.28
SC5a 1.6		0.1	70.7	1.30	0.27	0	0.17
SC6 16.8		0.1	231.1	13.93	2.85	0	0.17
SC7 10.6		0.1	184	7.66	2.98	0	0.28
SC7a 2.4		0.1	87.5	2.00	0.41	0	0.17
SC7b 6.6		0.1	144.4	4.72	1.83	0	0.28
SC8 2.8		0.1	94.9	2.04	0.79	0	0.28
SC8a 5.6		0.1	133.1	4.62	0.95	0	0.17
SC9 6.0		0.1	138	4.66	1.32	0	0.22
SCA9A 5.1		0.1	127.9	0	0	5.14	-
VER11AA 1.7		0.1	73.5	1.36	0.34	0	0.20
VER11AB 1.1		0.1	59	0.88	0.22	0.00	0.20
VER11AC 3.2		0.1	100.4	1.24	0.32	1.62	0.10
VER12A 7.1		0.1	149.8	4.23	1.06	1.76	0.15
VER14A 5.5		0.1	132.1	4.39	1.10	0	0.20
VER15A 1.7		0.1	74.2	0	0	1.73	-

Subcatchment identification	Total area (ha)	Vector slope (%)	Catchment width (m)	Runoff area 1 (ha)	Runoff area 2 (ha)	Runoff area 3 (ha)	FI
VER16A 2.4		0.1	86.5	1.27	0.31	0.78	0.13
VER1A 3.4		0.1	104.5	2.37	0.58	0.48	0.17
VER2A 1.7		0.1	73.8	1.04	0.65	0.02	0.38
VER2AA 1.8		0.1	75.7	1.44	0.36	0	0.20
VER2AB 2.6		0.1	91.8	1.85	0.45	0.34	0.17
VER2B 10.8		0.1	185.8	9.22	1.63	0	0.15
VER2C 8.6		0.1	165.3	5.32	2.92	0.34	0.34
VER2D 3.0		0.1	98.5	1.58	0.70	0.76	0.23
VER2E 7.5		0.1	154.7	5.41	1.95	0.15	0.26
VER2F 6.9		0.1	148.1	5.58	1.31	0	0.19
VER2G 7.9		0.1	158.4	6.70	1.18	0	0.15
VER2H 3.7		0.1	109.1	3.33	0.41	0	0.11
VER2J 4.9		0.1	124.6	3.90	0.83	0.15	0.17
VER2K 4.7		0.1	121.9	3.97	0.70	0	0.15
VER3A 3.0		0.1	98.2	1.49	0.36	1.18	0.12
VER4A 2.9		0.1	96.4	1.43	0.35	1.14	0.12
VER5A 1.0		0.1	57.5	0.58	0.15	0.31	0.14
VER6A 4.9		0.1	124.4	0	0	4.86	-
VER7A 3.2		0.1	101.5	2.59	0.65	0.00	0.20
VER8A 0.9		0.1	53.3	0.72	0.18	0.00	0.20
VER9A 3.8		0.1	109.7	2.27	0.57	0.95	0.15

A.4 Model calibration

The lack of flow measurements on Forrestdale main drain did not allow calibration of model flows. This factor led to the adoption of conservative model parameterisation and the use of design storm events only.

A.5 Local arterial drainage – conceptual design

Local arterial drainage conceptual designs are presented in Figures A3a to A3f

The local arterial drainage designs presented in this *Arterial drainage strategy* for individual precincts are conceptual designs only. Whilst they may be developed directly into detailed designs, it is the preference of the Department of Water that they be used to provide an initial set of drainage characteristics for a development from which drainage designs following water sensitive urban design principles are developed.

Conceptual designs include:

- proposed arterial drainage alignments, designed to provide optimum performance for the subcatchment
- detention basins, designed to compensate the 100-year average recurrence interval event to not exceed its pre-development peak flow.

The conceptual design of a dry basin is presented in Figure A4. Imported fill will be required in some locations to ensure that residential lots are constructed with a finished floor level at a minimum of 500 mm above the 100-year flood level both in the drain and within the basin.

The Department of Water does not generally support the construction of wet basins, ornamental lakes, irrigation lakes or open water bodies. Further information on this may be found in *Interim position statement: constructed lakes* (Department of Water 2007).

A.6 City of Gosnells – Precinct 2 (Bletchley Park)

A conceptual design for the drainage in this catchment has been prepared by consultants (GHD) working on behalf of developers. The drainage, as described in the *Bletchley Park local water management strategy* (GHD 2005) has been incorporated into the InfoWorks model. Figure A3a shows the layout of the proposed drainage network and the locations of planned compensating basins.

Total catchment area	= 166 ha
Estimated pre-development 100-year peak discharge	= 1.2 m^3/s
Estimated 100-year tailwater condition	= 21.3 m AHD

It is important to note that the catchment includes two school sites, which the local water management strategy designs intend not to contribute to the local arterial drains. Therefore the total contributing area has been reduced by 9 ha. It is essential therefore that the building conditions for these two sites stipulate on-site detention of all flows up to and including the critical 100-year average recurrence interval event.

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) did not fully address the drainage corridors required for this precinct. The *Bletchley Park local water management strategy* (GHD 2005) proposes to maintain the existing path of Balannup Lake drain.

The local water management strategy was designed with a higher indicated 100-year tailwater condition and as a result will require additional throttling to meet the peak discharge criteria. InfoWorks modelling suggests that twin 600 mm culverts immediately upstream of Southern River Road will be sufficient. These replace twin 915 mm culverts indicated in the local water management strategy.

A.7 City of Gosnells– Precinct 3

Figure A2 provides details of compensating basins proposed within Precinct 3 as well as showing proposed arterial drainage routes that in general follow the routes of existing agricultural drains.

Precinct 3 to Balannup Lake drain

100-year flood storage parameters		Holmes St North	Lander St	Stirling St North
100-year peak discharge	m^3/s 0.3		0.4	0.1

100-year peak downstream tailwater	m	21.4 21.9		21.8
Contributing area	ha	11.3	30.7	28.3
100-year surface area	ha	0.2	1.3	0.5

The existing route of the Balannup Lake drain is not included in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001); it is proposed to maintain its existing course serving both Precincts 2 and 3.

Precinct 3 to Forrestdale main drain

100-year flood storage parameters		Matison Rd	Holmes St south	Stirling St south
100-year peak discharge	m^3/s 0.2		0.2	0.3
100-year peak downstream tailwater	m	21.3 21.2		21.2
Contributing area	ha	13.6	24.8	18.8
100-year surface area	ha	0.2	0.6	0.4

Precinct 3 to Southern River

Conceptual designs for the small section of Precinct 3 known as Subprecinct 3A are in the early stages of development by consultants (ENV Australia Ltd) on behalf of developers.

Total catchment area = 18 ha

Estimated pre-development 100-year peak discharge

(to Southern River floodplain and Forrestdale main drain) = 0.1 m^3/s

At present, drainage of the subprecinct ponds occurs in two locations: along the north side of Matison Street, and at the corner of Holmes Street and Southern River Road. During major storm events these roads can be overflowed and drainage then flows overland into the Precinct 2 floodplain north of Southern River Road, and the Southern River floodplain conservation category wetland and Forrestdale main drain in the south.

With the development of Subprecinct 3A, the drainage design should be such that overflows to the conservation category wetland and Forrestdale main drain are maintained at pre-development levels.

For the purposes of this study, the existing natural storage to the south has been retained, as shown in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001). Overflows into the conservation category wetland post-development remain the same as pre-development. It is assumed that additional flows are diverted downstream to the Leslie Street local authority outlet via the Matison Street drain.

With the development of Precinct 2, overflows into the Precinct 2 floodplain can no longer occur, and for the purposes of this study it has been assumed that this area will also be diverted to the Leslie Street local authority outlet.

A.8 City of Gosnells – Precinct 4

The proposed arterial drainage routes and compensating basin details for Precinct 4 are shown in Figure A3c. This catchment is divided into two subprecincts, each discharging directly into the Forrestdale main drain, although Precinct 4 North also makes use of an existing drainage path directly into the Southern River.

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission, 2002) indicates a drainage corridor running along the entire eastern boundary of the Precinct 4 north drain catchment adjacent to the Tonkin Highway before turning west into the Forrestdale main drain at the northern end. During the development of the *Arterial drainage strategy* it was found that excessive fill would be required to drain this precinct to the proposed corridor. It is therefore proposed that the existing drainage routes are retained and in general the routes of existing agricultural drains have been followed.

Precinct 4 north drain

100-year flood storage parameters		Dallen St west	Holmes St	Stirling St	Furley Rd	Gerty St	Dallen St east
100-year peak discharge	m^3/s	0.2 0.7 0.		2 0.2		0.4	0.4
100-year peak downstream tailwater	m	21.7 21.9	22.1		22.2	22.2	21.9
Contributing area	ha	18.7	38.5 30.6		34.2	34.0	35.1
100-year surface area	ha	0.3 0.5 0.8			0.4	1.0	1.0

Precinct 4 south drain

100-year flood storage parameters		Passmore St	Ranford Rd	Tonkin Hwy
100-year peak discharge	m^3/s	0.3 1.1 0.1		
100-year peak downstream tailwater	m	22.4 22.5 22.5		
Contributing area	ha	31.9 28.2 21.5		
100-year surface area	ha	2.4	1.1	0.5

A.9 City of Armadale – North Forrestdale

North Forrestdale encompasses all of the land connected to the Balannup drain, which passes through Bush Forever site no. 342 and connects to Baileys branch drain via a single 600 mm diameter culvert. Baileys branch drain then continues through twin 675 mm diameter culverts and joins the Forrestdale main drain some 300 m upstream of Ranford Road.

The drainage corridors indicated in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) have already been modified in the *North Forrestdale urban water management strategy* (Parsons Brinkerhoff 2005) and in general are proposed to follow the existing Balannup drain and agricultural drainage routes.

Figure A3d shows the proposed arterial drainage routes through North Forrestdale and provides details of proposed flood storage areas. Where conceptual drainage

designs have been developed by others, they have been incorporated into the InfoWorks model. The general layout of these designs is indicated in Figure A3d.

Nicholson Road West

100 year flood storage parameters		Nicholson Rd west	Wright Rd west	Mason Rd
100-year peak discharge	m^3/s 0.1		0.4	0.1
100-year peak downstream tailwater	m	25.9 26.9		25.9
Contributing area	ha	9.3	9.2	21.3
100-year surface area	ha	0.2	0.2	0.7

Balannup Lake

100 year flood storage parameters		Reilly Rd south	Reilly Rd north	Lakeside	Southern River Rd
100-year peak discharge	m^3/s	0.2 0.2 0.1			0.3
100-year peak downstream tailwater	m	23.4 23.5 23.5			23.4
Contributing area	ha	68.4 23.9 38.5			21.3
100-year surface area	ha	3.0	1.2	0.8	0.3

The *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) proposes development of areas that are currently inundated in significant storm events forming a part of the Balannup Lake floodplain. This not only reduces the floodable area of the lake but also reduces its natural catchment. Some stormwater runoff is directed to Balannup Lake to maintain pre-development top water levels. The remainder is diverted to the Balannup drain upstream of Bush Forever site no. 342 and provision for this is made within the downstream flood storage areas.

In developing drainage proposals for this catchment, this complex hydrological change has been considered and short-term flood levels for various significant events within the lake remain unchanged. The longer-term seasonal and inter-annual effects of the reduced lake catchment as a result of development are unknown.

Nicholson Road east

100-year flood storage parameters		Skeet Rd	Skeet Rd north	Keane Rd
100-year peak discharge	m^3/s 0.1		0.3	0.1
100-year peak downstream tailwater	m	23.4 23		23.5
Contributing area	ha	42.7	41.4	10.6
100-year surface area	ha	2.0	0.9	0.2

Much of this catchment is currently undrained with a gradual slope towards the wetland within Bush Forever site no. 342. This wetland is then linked to the Balannup drain and Baileys branch drain close to their confluence. Similar to the Balannup Lake subcatchment, the contribution that this area makes to the inundation of the wetland in major events has been maintained by ensuring that any additional flows are diverted around the wetland. In addition, the existing drain serving this area,

running adjacent to Bush Forever site no. 342 and joining Balannup drain at Skeet Road, will be retained.

Newhaven

Consultants (Parsons Brinkerhoff) on behalf of the developers have prepared a conceptual design of stormwater drainage system for Newhaven and this has been incorporated into the model.

Total catchment area	= 142 ha
Estimated pre-development 100-year peak discharge	= 0.8 m^3/s
Estimated 100-year tailwater condition	= 25.5 m AHD

Generally the design of this area ensures that post development flows are similar to pre-development flows.

Lot 49 – Heron Park

Consultants (Parsons Brinkerhoff) on behalf of the developers have prepared a conceptual design of stormwater drainage system for Heron Park.

Total catchment area	= 49 ha
Estimated pre-development 100-year peak discharge	= 0.3 m^3/s
Estimated 100-year tailwater condition	= 24.7m AHD

There is currently some uncertainty regarding the existing hydrological regime of the conservation category wetland within this development. Control levels for the wetlands will need to be set ensuring that any change between the pre- and post-development 100-year average recurrence interval levels are acceptable to the relevant environmental regulators.

Generally the design of this area ensures that post-development flows are similar to pre-development flows.

Lot 50 – Vertu

Consultants (Parsons Brinkerhoff) on behalf of the developers have prepared a conceptual design of stormwater drainage system for Vertu.

Total catchment area	= 60 ha
Estimated pre-development 100-year peak discharge	= 0.3 m^3/s
Estimated 100-year tailwater condition	= 24.3 m AHD

Generally the design of this area ensures that post development flows are similar to pre-development flows.

Lot 388 – Arion

Consultants (JDA Consultant Hydrologists) on behalf of the developers have prepared a conceptual design of stormwater drainage system for Arion.

Total catchment area	= 35 ha

Estimated pre-development 100-year peak discharge = 0.1 m^3/s

Estimated 100-year tailwater condition = 26.1 m AHD

Generally the design of this area ensures that post-development flows are similar to pre-development flows.

Lot 153 and 154 – Burtonia Gardens

Consultants (JDA Consultant Hydrologists) on behalf of the developers have prepared a conceptual design of stormwater drainage system for Burtonia Gardens.

Total catchment area = 27 ha

(includes 11 ha upstream undeveloped catchment)

Estimated pre-development 100-year peak discharge = 0.06 m^3/s

Estimated 100-year tailwater condition = 26.5 m AHD

Generally the design of this area ensures that post development flows are similar to pre-development flows.

A.10 City of Armadale – Keane Road branch drain and Forrestdale townsite and business park

Apart from the Forrestdale main drain and Baileys branch drain, drainage corridors have not been identified in the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) for these precincts. Figure A3e shows the proposed drainage routes for each of these precincts and provides details of proposed flood storage areas.

Keane Rd branch drain

100-year flood storage parameters		Armadale Rd
100-year peak discharge	m^3/s 0.1	
100 year peak downstream tailwater	m	24.3
Contributing area	ha	9.1
100-year surface area	ha	0.2

Only a very small part of this precinct is proposed for development and the existing drainage will be maintained with the addition of a single compensating basin.

Forrestdale townsite to Baileys branch drain

100-year flood storage parameters		Dumsday Dr	Anstey Rd	Keane Rd Sth	Keane Rd Nth
100-year peak discharge	m^3/s	1.2 0.2 0.4			0.4
100-year peak downstream tailwater	m	23.1 23		23	22.9
Contributing area	ha	58.4 30.1 26.1			50.6
100-year surface area	ha	0.4	0.9	0.4	1.1

The existing Dumsday Drive compensating basin was relocated by the City of Armadale as part of converting Armadale Road into a dual carriageway through the

existing Forrestdale townsite. The volume of the basin was reduced as a result of these works, but modelling has determined that the shortfall in storage can be accommodated in the proposed upgrade of the Baileys branch drain upstream of Anstey Road.

Forrestdale townsite to main drain

100-year flood storage parameters		Allen Rd north	Forrest Rd	Allen Rd south	Tonkin Hwy
100-year peak discharge	m^3/s 0.2		0.2	0.2	0.3
100-year peak downstream tailwater	m	23.1 24.1		23.4	24
Contributing area	ha	29.0 24.9		46.1	30.7
100-year surface area	ha	0.5	0.8	1.7	1.1

Forrestdale business park

A conceptual design of the catchment has been prepared by consultants (Parsons Brinkerhoff) and incorporated into the InfoWorks model.

Total catchment area = 176 ha

Estimated pre-development 100-year peak discharge = 1.0 ^{m3}/s

Estimated 100-year tailwater condition = 23.1 m AHD

An additional 375 mm diameter connection has been made from this precinct to the Forrestdale main drain with an upstream invert level of 21.5 m AHD which is approximately 0.5 m below the modelled regional maximum groundwater level (788 mm annual rainfall scenario).

An opportunity exists to reduce the fill and/or storage volume requirements for this catchment by the use of the existing conservation category wetland to store some flooding from significant events. Following the development of this catchment, the natural catchment of the wetland will be reduced and therefore periodic surface flows into the wetland will be lower.

In order to mitigate this reduction in surface water flows, it may be possible to divert some of the major event flows out of the constructed flood storage areas and into the wetland. Control levels for flow into the wetland would need to be set to ensure that any change between the pre- and post-development 100-year average recurrence interval levels are acceptable to the relevant environmental regulators.

Industrial area (Allen Road to Ranford Road)

100-year flood storage parameters		Anstey Rd
100-year peak discharge	m^3/s 0.5	
100-year peak downstream tailwater	m	23
Contributing area	ha	31.5
100-year surface area	ha	1.8

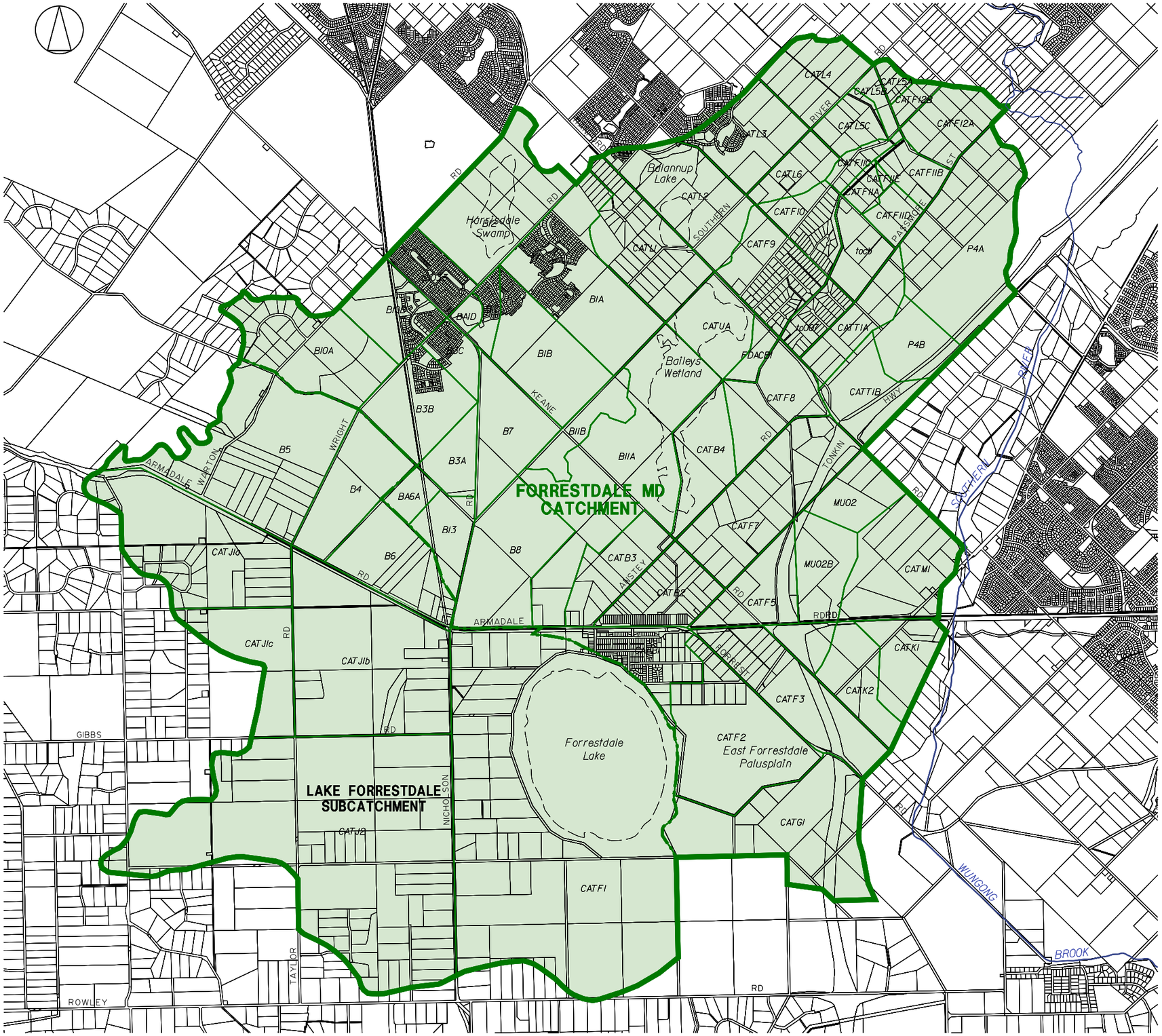
The existing land use between Anstey Road and Ranford Road has been retained at present, as there is some doubt about the rezoning of this land to industrial being investigated. It is believed that the land within Bush Forever site no. 342 between Anstey Road and the Forrestdale main drain will remain rural.

A.11 City of Armadale – upper Forrestdale Lake

100-year flood storage parameters		Wright Rd west	Wright Rd east
100-year peak discharge	m^3/s 0.3		0.2
100-year peak downstream tailwater	m	26.2	26.2
Contributing area	ha	84.2	36.7
100-year surface area	ha	4.0	1.0

A large part of the Forrestdale Lake catchment is contained within Bush Forever site no. 344 and 345 and most of it lies outside of the *Southern River/Forrestdale/Brookdale/Wungong district structure plan* (Western Australian Planning Commission 2001) area. The only area where there is some development planned is the upper catchment, to the north of Armadale Road at Mason Road. The *Southern River/Forrestdale/Brookdale/Wungong district structure plan urban water management strategy* (JDA 2002) recommended that the section of this catchment to the north of Armadale Road be diverted into the Balannup drain via North Forrestdale. However, it has since been determined that this loss of catchment area has the potential to have a significant negative impact on Lake Forrestdale. Current proposals therefore maintain the existing catchment boundaries with discharge to Lake Forrestdale.

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.





LEGEND

- Scheme Boundary
- Lake Catchment Boundary
- InfoWorks SubCatchment
- CATF2 InfoWorks SubCatchment Number

0 500 1000 1500 2000
SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig_A1_ModelledSubcatchments_pre.dgn

WATER CORPORATION

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

MODELLED SUBCATCHMENTS PRE-DEVELOPMENT

Figure A1

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

INSERT 1

INSERT 2

FORRESTDALE MD CATCHMENT

LAKE FORRESTDALE SUBCATCHMENT

Hartfield Park

Balonnup Lake

Harrisdale Swamp

Bailey's Wetland

Forrestdale Lake

CATF2b East Forrestdale Palusplain

LEGEND

- Scheme Boundary
- Lake Catchment Boundary
- InfoWorks SubCatchment
- CATF2 InfoWorks SubCatchment Number

N

0 500 1000 1500 2000

SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig_A2_ModelledSubcatchments_post.dgn

WATER CORPORATION

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

MODELLED SUBCATCHMENTS POST-DEVELOPMENT

Figure A2

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

Lander Swamp (Wel)

TWL_{10}	=	21.61 m AHD
S_{10}	=	55000 m^3
TWL_{100}	=	21.96 m AHD
S_{100}	=	91500 m^3

Balfour St CB (Dry)

CGL	=	20.48 mAHD
LWL	=	21.65 mAHD
TWL_{10}	=	22.14 mAHD
S_{10}	=	1460 m^3
TWL_{100}	=	22.30 mAHD
S_{100}	=	2010 m^3
Existing GL	=	22.03 mAHD
Area	=	0.35 ha
Fill GL	=	22.30 mAHD

Bletchley Park CB2 (Dry)

CGL	=	19.69 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	22.18 mAHD
S_{10}	=	2080 m^3
TWL_{100}	=	22.23 mAHD
S_{100}	=	2230 m^3
Existing GL	=	21.30 mAHD
Area	=	0.34 ha
Fill GL	=	22.53 mAHD

Bletchley Park CB1 (Dry)

CGL	=	19.62 mAHD
LWL	=	21.70 mAHD
TWL_{10}	=	22.33 mAHD
S_{10}	=	910 m^3
TWL_{100}	=	22.36 mAHD
S_{100}	=	970 m^3
Existing GL	=	21.30 mAHD
Area	=	0.18 ha
Fill GL	=	22.66 mAHD

Southern River Rd CB (Dry)

CGL	=	19.67 mAHD
LWL	=	21.00 mAHD
TWL_{10}	=	21.91 mAHD
S_{10}	=	1960 m^3
TWL_{100}	=	22.00 mAHD
S_{100}	=	2480 m^3
Existing GL	=	21.91 mAHD
Area	=	0.70 ha
Fill GL	=	22.30 mAHD

Developer to throttle existing 2x915mm diameter culverts to 2x600mm diameter culverts

Fridayhill Dr CB (Dry)

CGL	=	21.78 mAHD
LWL	=	22.01 mAHD
TWL_{10}	=	22.38 mAHD
S_{10}	=	90 m^3
TWL_{100}	=	22.40 mAHD
S_{100}	=	100 m^3
Existing GL	=	22.40 mAHD
Area	=	0.05 ha
Fill GL	=	22.61 mAHD

Lander St East CB (Dry)

CGL	=	21.23 mAHD
LWL	=	22.10 mAHD
TWL_{10}	=	22.73 mAHD
S_{10}	=	970 m^3
TWL_{100}	=	22.74 mAHD
S_{100}	=	990 m^3
Existing GL	=	21.48 mAHD
Area	=	0.18 ha
Fill GL	=	23.04 mAHD

Furley Rd North CB (Dry)

CGL	=	21.05 mAHD
LWL	=	22.40 mAHD
TWL_{10}	=	23.02 mAHD
S_{10}	=	1470 m^3
TWL_{100}	=	23.08 mAHD
S_{100}	=	1640 m^3
Existing GL	=	22.67 mAHD
Area	=	0.28 ha
Fill GL	=	23.38 mAHD

Lander St West CB (Dry)

CGL	=	21.19 mAHD
LWL	=	22.60 mAHD
TWL_{10}	=	23.26 mAHD
S_{10}	=	3010 m^3
TWL_{100}	=	23.26 mAHD
S_{100}	=	3050 m^3
Existing GL	=	22.05 mAHD
Area	=	0.50 ha
Fill GL	=	23.56 mAHD

Furley Rd South CB (Dry)

CGL	=	21.61 mAHD
LWL	=	22.40 mAHD
TWL_{10}	=	23.05 mAHD
S_{10}	=	2230 m^3
TWL_{100}	=	23.10 mAHD
S_{100}	=	2410 m^3
Existing GL	=	22.67 mAHD
Area	=	0.39 ha
Fill GL	=	23.40 mAHD

Furley Rd East CB (Dry)

CGL	=	22.43 mAHD
LWL	=	22.62 mAHD
TWL_{10}	=	23.19 mAHD
S_{10}	=	1130 m^3
TWL_{100}	=	23.28 mAHD
S_{100}	=	1360 m^3
Existing GL	=	22.80 mAHD
Area	=	0.24 ha
Fill GL	=	23.63 mAHD

Forresters Way CB (Dry)

CGL	=	21.68 mAHD
LWL	=	22.21 mAHD
TWL_{10}	=	22.61 mAHD
S_{10}	=	520 m^3
TWL_{100}	=	22.65 mAHD
S_{100}	=	580 m^3
Existing GL	=	22.40 mAHD
Area	=	0.16 ha
Fill GL	=	22.95 mAHD

Balannup Lake (Wel)

TWL_{10}	=	22.32 m AHD
S_{10}	=	97000 m
TWL_{100}	=	22.54 m AHD
S_{100}	=	144000 m

BLETCHLEY PARK

BALANNUP LAKE DRAIN

FORRESTDALE MAIN DRAIN

Balannup Lake

RD

RIVER

LEGEND

- Sub Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Overland Flow Path
- Conceptual Design Prepared By Others
- Water Corporation Compensating Basin
- Local Authority Compensating Basin

N

0 200 400 600

SCALE OF METRES

NOTE
School sites are on soakage and do not contribute to the local drainage system

AUTHOR: P Haywood DESIGN FILE: Fig-A3a_ArterialDrainagePrecinct2.dgn

WATER CORPORATION

LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN (PRECINCT 2)

Figure A3a

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

Stirling St Nth CB (Dry)

CGL	=	20.24 mAHD
LWL	=	21.00 mAHD
TWL_{10}	=	22.07 mAHD
S_{10}	=	3590 m^3
TWL_{100}	=	22.20 mAHD
S_{100}	=	4190 m^3
Existing GL	=	21.21 mAHD
Area	=	0.45 ha
Fill GL	=	22.50 mAHD

Holmes St Nth CB (Dry)

CGL	=	20.47 mAHD
LWL	=	21.56 mAHD
TWL_{10}	=	22.59 mAHD
S_{10}	=	1400 m^3
TWL_{100}	=	22.76 mAHD
S_{100}	=	1730 m^3
Existing GL	=	23.06 mAHD
Area	=	0.20 ha
Fill GL	=	23.06 mAHD

Bradley St CB West (Wet)

CGL	=	21.20 mAHD
LWL	=	20.00 mAHD
TWL_{10}	=	20.72 mAHD
S_{10}	=	3387 m^3
TWL_{100}	=	21.02 mAHD
S_{100}	=	5136 m^3
Existing GL	=	21.20 mAHD
Area	=	0.73 ha
Fill GL	=	21.32 mAHD

Bradley St CB East (Wet)

CGL	=	20.40 mAHD
LWL	=	19.40 mAHD
TWL_{10}	=	20.30 mAHD
S_{10}	=	2615 m^3
TWL_{100}	=	20.32 mAHD
S_{100}	=	2687 m^3
Existing GL	=	20.40 mAHD
Area	=	0.38 ha
Fill GL	=	20.62 mAHD

Holmes St Sth CB (Dry)

CGL	=	20.60 mAHD
LWL	=	21.00 mAHD
TWL_{10}	=	22.16 mAHD
S_{10}	=	4340 m^3
TWL_{100}	=	22.25 mAHD
S_{100}	=	4830 m^3
Existing GL	=	22.67 mAHD
Area	=	0.56 ha
Fill GL	=	22.55 mAHD

Lander St CB (Dry)

CGL	=	21.73 mAHD
LWL	=	22.03 mAHD
TWL_{10}	=	23.18 mAHD
S_{10}	=	10470 m^3
TWL_{100}	=	23.37 mAHD
S_{100}	=	12910 m^3
Existing GL	=	22.60 mAHD
Area	=	1.26 ha
Fill GL	=	23.67 mAHD

Matison St CB (Dry)

CGL	=	19.96 mAHD
LWL	=	21.00 mAHD
TWL_{10}	=	22.00 mAHD
S_{10}	=	1420 m^3
TWL_{100}	=	22.24 mAHD
S_{100}	=	1920 m^3
Existing GL	=	21.26 mAHD
Area	=	0.22 ha
Fill GL	=	22.54 mAHD

Stirling St Sth CB (Dry)

CGL	=	21.17 mAHD
LWL	=	21.47 mAHD
TWL_{10}	=	22.60 mAHD
S_{10}	=	2480 m^3
TWL_{100}	=	22.72 mAHD
S_{100}	=	2890 m^3
Existing GL	=	21.94 mAHD
Area	=	0.35 ha
Fill GL	=	23.02 mAHD

LEGEND

- Sub Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Overland Flow Path
- Water Corporation Compensating Basin
- Local Authority Compensating Basin

N

0 200 400 600 800

SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig_A3b_ArterialDrainagePrecinct3.dgn

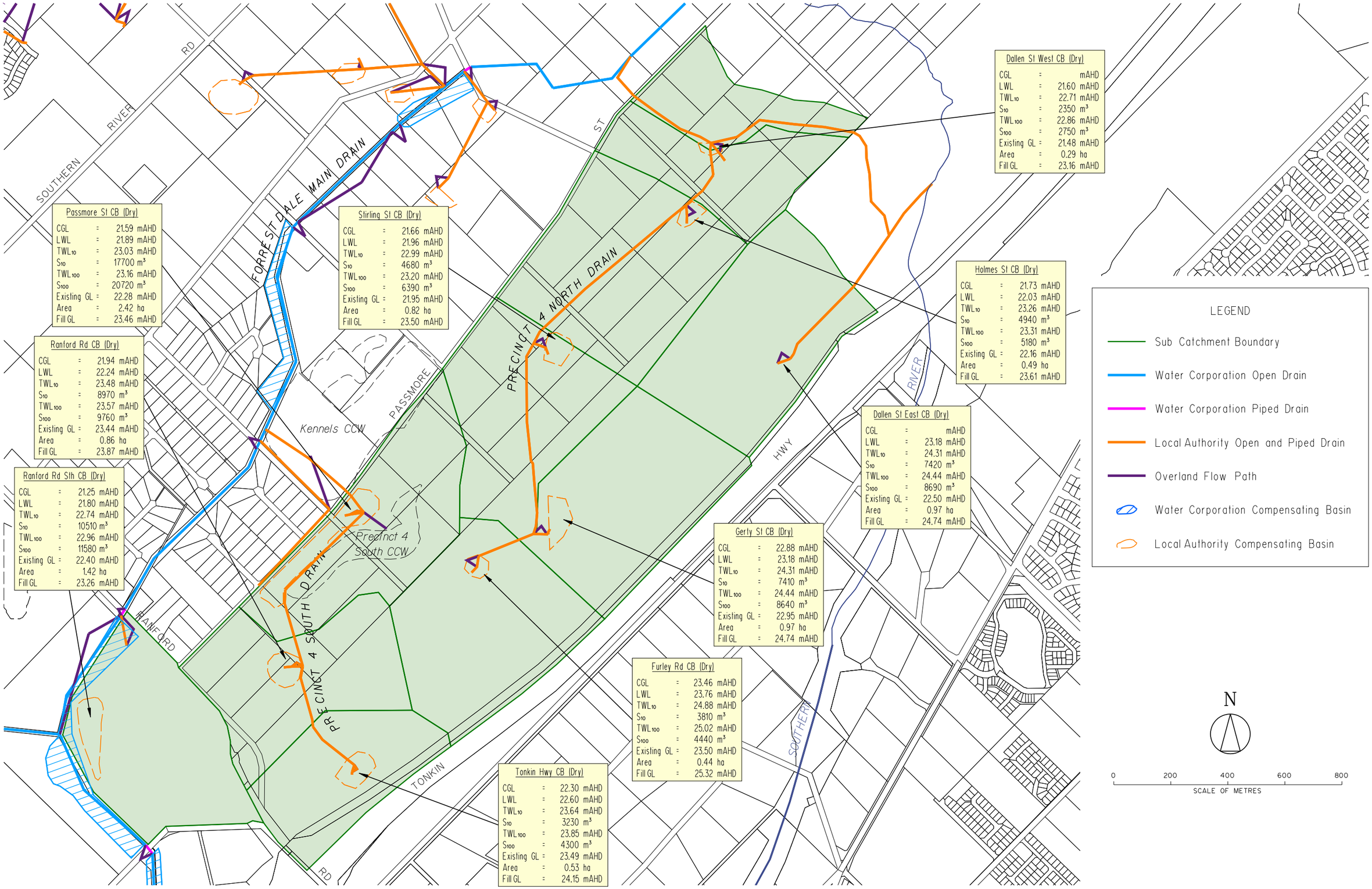
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PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN (PRECINCT 3)

Figure A3b

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.



AUTHOR: SLee DESIGN FILE: Fig_A3c_ArterialDrainagePrecinct4.dgn

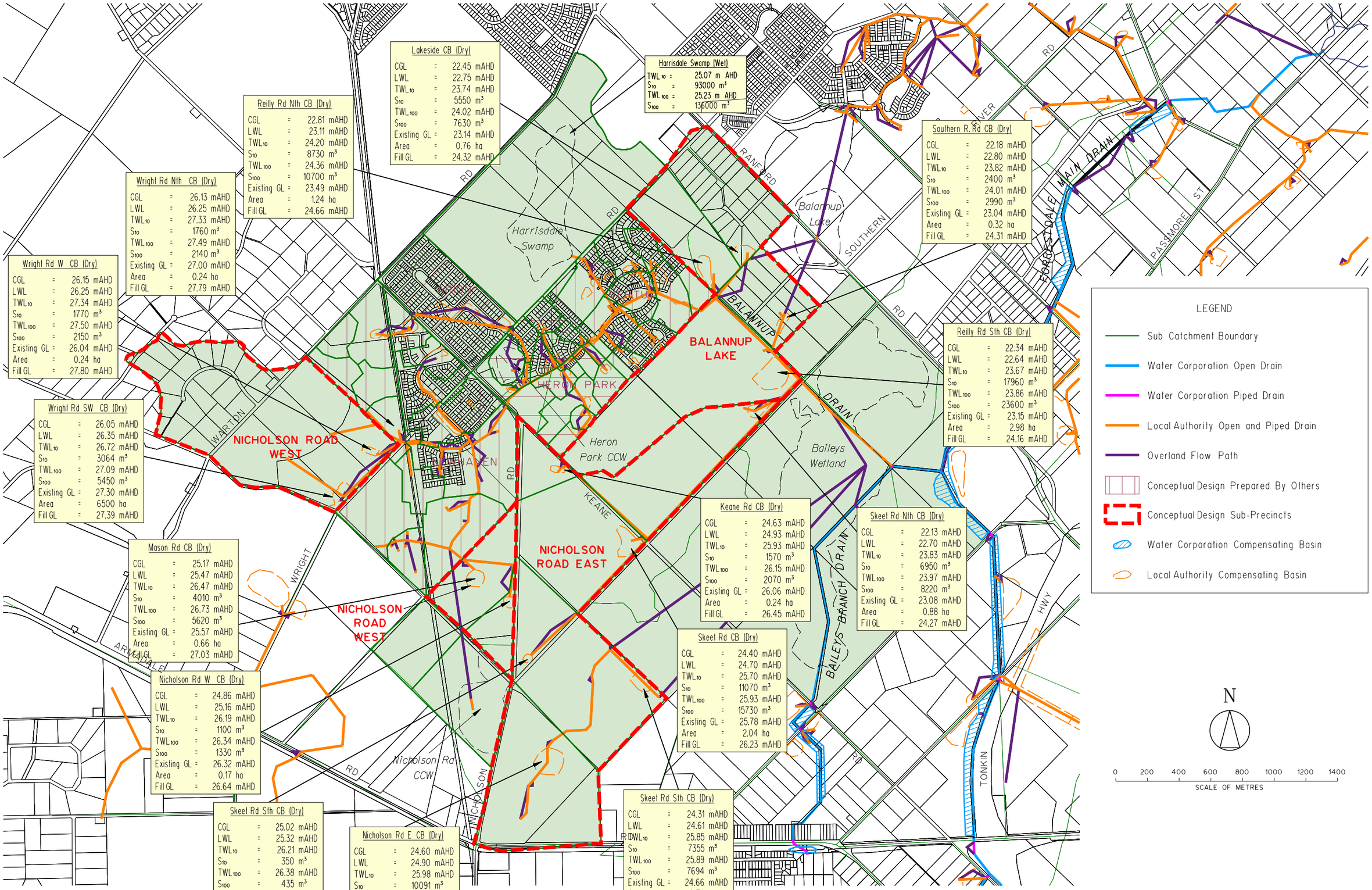
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LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN (PRECINCT 4)

Figure A3c

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

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AUTHOR: P Haywood DESIGN FILE: Fig_A3d_ArterialDrainageNthForrestdale.dgn

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LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN (NORTH FORRESTDALE)

Figure A3d

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.

Allen Rd Sth CB (Dry)

CGL	=	21.96 mAHD
LWL	=	22.26 mAHD
TWL_{10}	=	23.29 mAHD
S_{10}	=	10340 m^3
TWL_{100}	=	23.47 mAHD
S_{100}	=	13200 m^3
Existing GL	=	23.31 mAHD
Area	=	1.67 ha
Fill GL	=	23.77 mAHD

Allen Rd Nth CB (Dry)

CGL	=	21.90 mAHD
LWL	=	22.20 mAHD
TWL_{10}	=	23.32 mAHD
S_{10}	=	3640 m^3
TWL_{100}	=	23.46 mAHD
S_{100}	=	4330 m^3
Existing GL	=	23.39 mAHD
Area	=	0.49 ha
Fill GL	=	23.76 mAHD

Keane Rd Nth CB (Dry)

CGL	=	22.21 mAHD
LWL	=	22.20 mAHD
TWL_{10}	=	23.19 mAHD
S_{10}	=	5520 m^3
TWL_{100}	=	23.36 mAHD
S_{100}	=	7630 m^3
Existing GL	=	22.55 mAHD
Area	=	1.12 ha
Fill GL	=	23.66 mAHD

Keane Rd Sth CB (Dry)

CGL	=	21.92 mAHD
LWL	=	22.20 mAHD
TWL_{10}	=	23.23 mAHD
S_{10}	=	2910 m^3
TWL_{100}	=	23.40 mAHD
S_{100}	=	3540 m^3
Existing GL	=	22.57 mAHD
Area	=	0.38 ha
Fill GL	=	23.70 mAHD

Anstey Rd CB (Dry)

CGL	=	21.23 mAHD
LWL	=	21.60 mAHD
TWL_{10}	=	22.65 mAHD
S_{10}	=	12440 m^3
TWL_{100}	=	22.78 mAHD
S_{100}	=	14740 m^3
Existing GL	=	22.30 mAHD
Area	=	1.81 ha
Fill GL	=	23.08 mAHD

Forrestdale Business Park CB (Wet) a

CGL	=	22.06 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	23.46 mAHD
S_{10}	=	10780 m^3
TWL_{100}	=	23.76 mAHD
S_{100}	=	12420 m^3
Existing GL	=	24.00 mAHD
Area	=	0.55 ha
Fill GL	=	24.06 mAHD

Forrestdale Business Park CB (Wet) b

CGL	=	22.06 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	23.44 mAHD
S_{10}	=	12630 m^3
TWL_{100}	=	23.75 mAHD
S_{100}	=	14640 m^3
Existing GL	=	23.50 mAHD
Area	=	0.65 ha
Fill GL	=	24.05 mAHD

Forrestdale Business Park CB (Wet) c

CGL	=	22.06 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	23.38 mAHD
S_{10}	=	10150 m^3
TWL_{100}	=	23.73 mAHD
S_{100}	=	12020 m^3
Existing GL	=	25.00 mAHD
Area	=	0.54 ha
Fill GL	=	24.03 mAHD

Forrestdale Business Park CB (Wet) d

CGL	=	22.06 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	23.23 mAHD
S_{10}	=	11170 m^3
TWL_{100}	=	23.60 mAHD
S_{100}	=	13560 m^3
Existing GL	=	27.00 mAHD
Area	=	0.65 ha
Fill GL	=	23.90 mAHD

Forrestdale Business Park CB (Wet) e

CGL	=	22.06 mAHD
LWL	=	21.50 mAHD
TWL_{10}	=	22.89 mAHD
S_{10}	=	78290 m^3
TWL_{100}	=	23.40 mAHD
S_{100}	=	107050 m^3
Existing GL	=	26.00 mAHD
Area	=	5.62 ha
Fill GL	=	23.70 mAHD

Anstey Rd CB (Dry)

CGL	=	21.94 mAHD
LWL	=	22.20 mAHD
TWL_{10}	=	23.25 mAHD
S_{10}	=	5750 m^3
TWL_{100}	=	23.44 mAHD
S_{100}	=	7380 m^3
Existing GL	=	22.58 mAHD
Area	=	0.89 ha
Fill GL	=	23.74 mAHD

Dumsday Dr CB (Wet)

CGL	=	22.95 mAHD
LWL	=	21.15 mAHD
TWL_{10}	=	23.32 mAHD
S_{10}	=	2910 m^3
TWL_{100}	=	24.16 mAHD
S_{100}	=	4770 m^3
Existing GL	=	23.65 mAHD
Area	=	0.21 ha
Fill GL	=	24.46 mAHD

Forrest Rd CB (Dry)

CGL	=	22.62 mAHD
LWL	=	23.80 mAHD
TWL_{10}	=	24.87 mAHD
S_{10}	=	5050 m^3
TWL_{100}	=	25.05 mAHD
S_{100}	=	6450 m^3
Existing GL	=	24.19 mAHD
Area	=	0.77 ha
Fill GL	=	25.35 mAHD

Tonkin Hwy CB (Dry)

CGL	=	22.14 mAHD
LWL	=	22.60 mAHD
TWL_{10}	=	23.53 mAHD
S_{10}	=	5580 m^3
TWL_{100}	=	23.72 mAHD
S_{100}	=	7670 m^3
Existing GL	=	23.67 mAHD
Area	=	1.12 ha
Fill GL	=	24.02 mAHD

Armadale Rd CB (Dry)

CGL	=	mAHD
LWL	=	24.70 mAHD
TWL_{10}	=	25.70 mAHD
S_{10}	=	1500 m^3
TWL_{100}	=	25.89 mAHD
S_{100}	=	1900 m^3
Existing GL	=	24.72 mAHD
Area	=	0.23 ha
Fill GL	=	26.19 mAHD

LEGEND

- Sub Catchment Boundary
- Water Corporation Open Drain
- Water Corporation Piped Drain
- Local Authority Open and Piped Drain
- Overland Flow Path
- Conceptual Design Prepared By Others
- Conceptual Design Sub-Precincts
- Water Corporation Compensating Basin
- Local Authority Compensating Basin

N

0 200 400 600 800 1000

SCALE OF METRES

AUTHOR: SLee DESIGN FILE: Fig-A3e_ArterialDrainageKeaneForrestdale.dgn

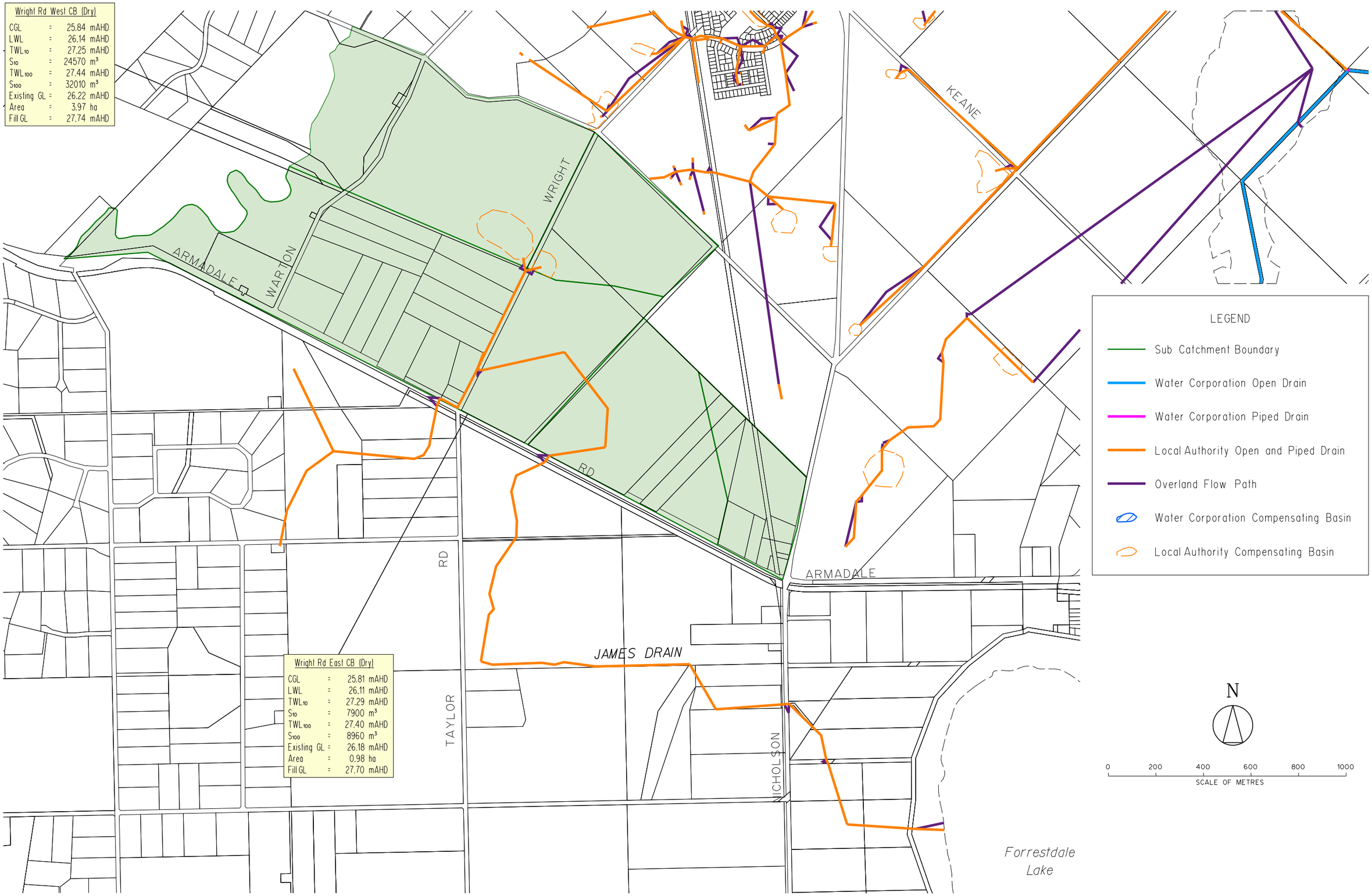
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LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN KEANE RD BD, FORRESTDALE TOWNSITE & BUSINESS PARK

Figure A3e

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

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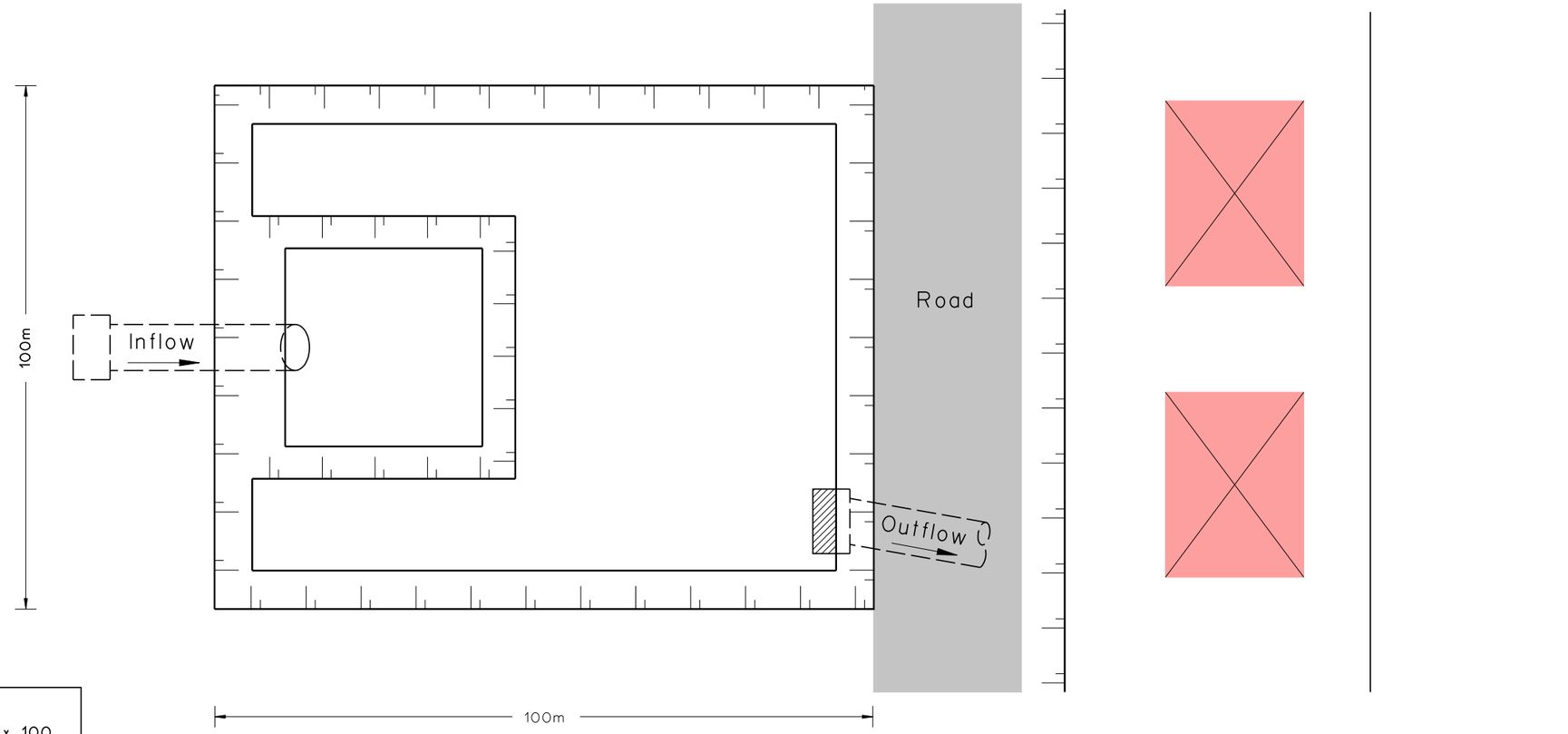
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LOCAL ARTERIAL DRAINAGE CONCEPTUAL DESIGN (UPPER FORRESTDALE LAKE)

Figure A3f

PROJECT N°: DP215 DATE: 26/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

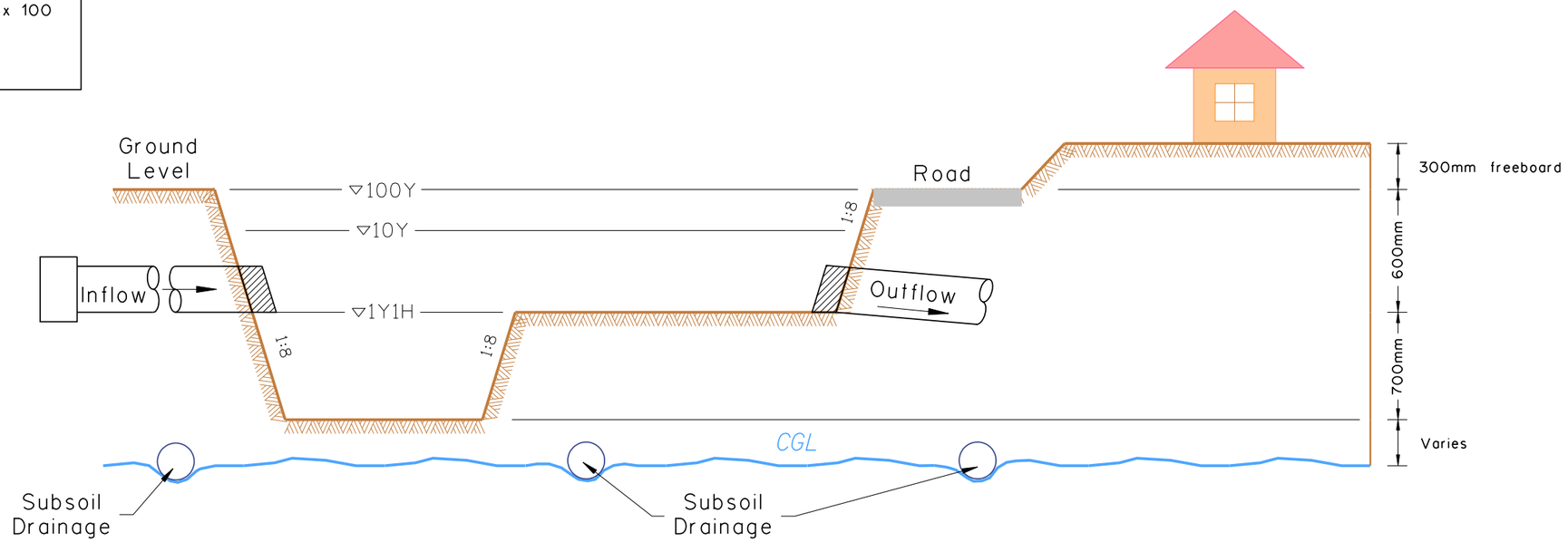
THE INFORMATION CONTAINED HEREIN IS SUBJECT TO ONGOING REVIEW AND AMENDMENTS AND SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED REPORT.



Land Requirement:

$$\frac{\text{CB Area}}{\text{POS Area}} = \frac{100 \times 100}{50{,}000} \times 100 = 20\%$$

$$\frac{\text{CB Area}}{\text{S/C Area}} = \frac{100 \times 100}{500{,}000} \times 100 = 2\%$$



CONCEPTUAL DESIGN OF LOCAL DRY DETENTION BASINS

Figure A.4

AUTHOR: vlchong DESIGN FILE: Fig_A4_ConceptualDryDetentionBasins.dgn

PROJECT N°: DP215 DATE: 21/08/2009 COORDINATE SYSTEM: MGA94 - Zone 50

List of shortened forms

AHD	Australian height datum
ARI	Average recurrence interval
ASS	Acid Sulfate Soil
BMP	Best management practice
HGL	Hydraulic grade line
MGL	Maximum groundwater level
PASS	Potential acid sulfate soils
POS	Public open space
TWL	Top water level

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ATTACHMENT 6

Bushfire Management Plan



Bushfire Management Plan

Local Structure Plan

Armadale Road, Forrestdale

City of Armadale

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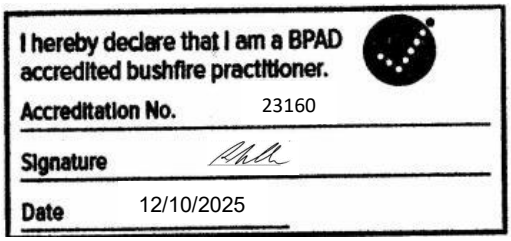
Prepared For:
Rowe Group
12 October 2025
Version 2.0

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Document Information

Prepared for:	Rowe Group
Project Name:	Anstey Keane Urban Development Precinct – Armadale Road Structure Plan
Project Address:	Armadale Road, corner Anstey Road, Forrestdale WA 6112
Prepared by:	Rohan Carboon (Level 3 - BPAD 23160)
	Bushfire Safety Consulting Pty Ltd





Document Control

Bushfire Management Plan – LSP Armadale Road, Forrestdale			
REPORT VERSION	**PURPOSE**	**AUTHOR/REVIEWER AND ACCREDITATION DETAILS**	**DATE SUBMITTED**
V1	Draft for review	Rohan Carboon (Level 3 BPAD 23160) Dr Karen Brown (Level 2 BPAD 48364)	27/06/2023
V2	Update new LSP layout to new format and new guidelines	Rohan Carboon (Level 3 BPAD 23160)	12/10/2025

Front cover photo: Proposed LSP over the site

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EXECUTIVE SUMMARY

This Bushfire Management Plan (BMP) has been prepared to support a proposed Local Structure Plan (LSP) over a site that contains 23 existing lots on the northern side of Armadale Road in Forrestdale. The lots are located close to the Anstey Road intersection and make up five different sub-areas (herein referred to collectively as 'the site'). The LSP proposes to create urban residential lots, as well as associated infrastructure. Total dwelling yield will be confirmed at a later stage following more detailed subdivision designs and layouts. Land immediately to the north of the lots has been cleared, dwellings are under construction on the urban residential lots. There is a rural residential lot with horses to the north-west currently vegetated in some woodland trees over pasture grasses, however this lot is likely to be developed in the future. South of the site and Armadale Road is largely developed into residential lots and another area with an approved MRS zoning of urban currently undergoing a Structure Plan process. A landscape scale bushfire cannot impact the site.

The LSP provides a guide for residential development within the site and creates a framework for the future urban subdivision of the site into anticipated residential lots. There is no existing bushfire threat within the site and following development less vegetation is expected to exist. Other isolated areas of classified vegetation surrounding the site have an impact, but do not restrict the site being developed within compliant constraints.

All areas within 150 metres of the site boundary have been assessed for vegetation classification and BAL contours. Temporary classified vegetation adjoining the site to the north-west does impact the site and a temporary internal perimeter Asset Protection Zone (APZ) will be established along this boundary until the adjacent classified vegetation has been cleared for future development. No buildings can be built in the temporary Perimeter APZ until clearing of adjacent classification occurs and lot portions can achieve BAL-29 or lower. All other lots within 100 metres of classified vegetation can achieve BAL-29 or lower and will be established and maintained to APZ standards. There is good vehicular access surrounding the site and future internal public roads will comply with SPP3.7 and the Guidelines. A reticulated water supply will be provided and fire hydrants will be installed by the developer/s to meet the specifications of Water Corporation (Design Standard 63) and DFES requirements.

The proposal complies with the State Planning Policy No. 3.7: Bushfire (SPP 3.7) and the Planning for Bushfire Guidelines (2024).

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1 PROPOSAL DETAILS

This Bushfire Management Plan (BMP) has been prepared to support a Local Structure Plan (LSP) over a number of lots located on the northern side of Armadale Road, near the Anstey Road intersection in Forrestdale (see Figure 1). The existing lots are approximately 2000m^2 each in size and together are herein referred to as "the site", with locations shown in Figure 2. It is located within the City of Armadale, approximately 22 km south-south-east of the Perth Central Business District (CBD) and 8 kilometres west of Armadale City Centre.

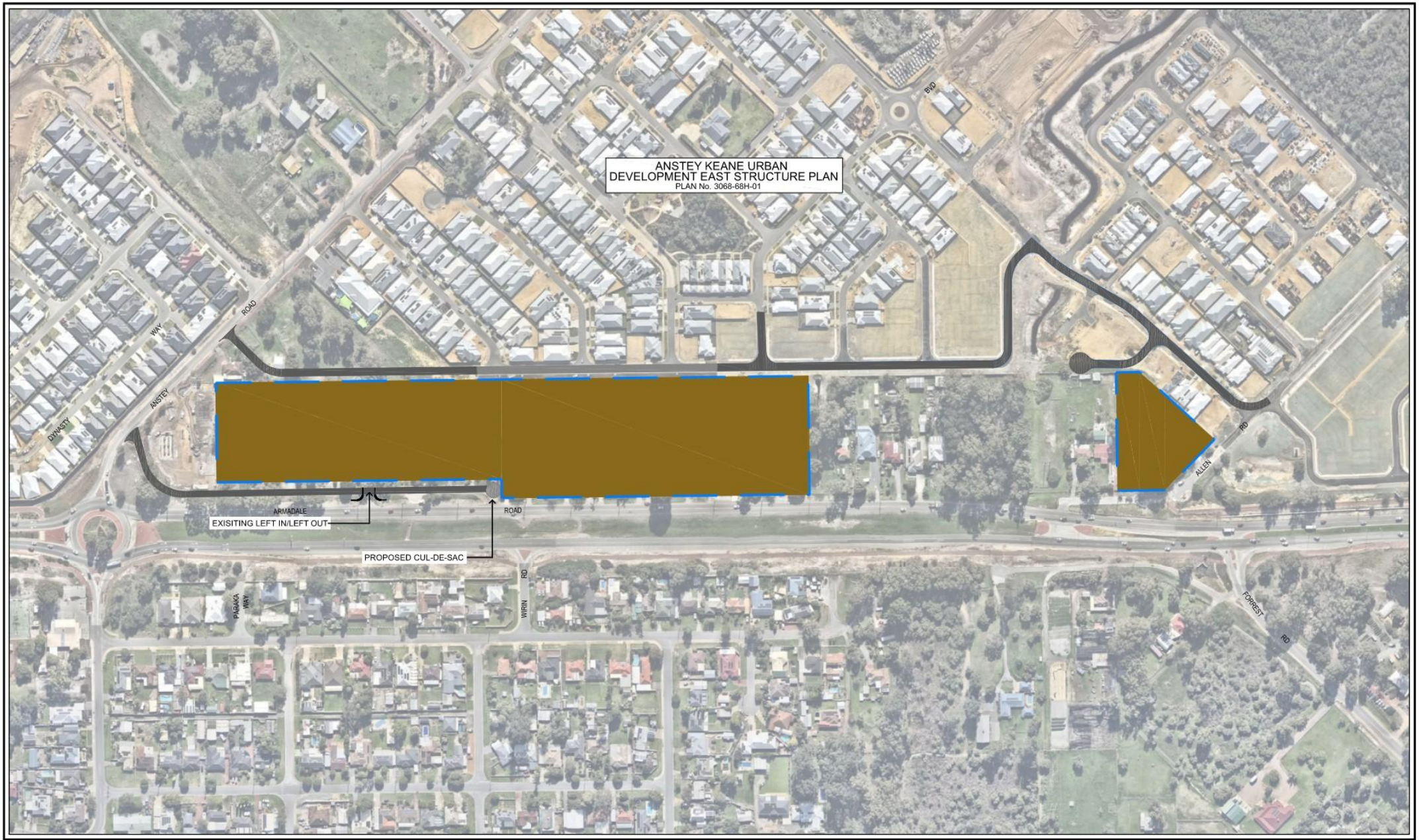
The site is currently zoned 'Urban Development Zone' under the City of Armadale Town Planning Scheme 4 and currently contains rural residential dwellings and associated structures and gardens. The LSP proposes to create urban residential lots, as well as associated infrastructure. Total dwelling yield will be confirmed at a later stage following more detailed subdivision designs and layouts. The site is proposed to be developed in two stages, with stage two subject to a future Metropolitan Region Scheme (MRS) reservation and subsequent extension of the existing Armadale Road slip road.

Land to the north of the proposed LSP site is similarly zoned 'Urban Development Zone', with all but one lot to the north-west currently cleared and under development of urban residential lots. Lots to the east and west of the site is similarly zoned 'Urban Development Zone', with newly developed urban residential lots to the west and existing rural residential lots to the east. Land to the south of the site and Armadale Road is zoned 'Residential R12.5/25 and contains existing urban residential development with average lot size of 800m^2. A drainage line with vegetation maintained in a low threat condition runs adjacent to the site to the north east.

All proposed lots will have direct driveway entrance onto an existing or newly created public road. Existing egress from the site is supplied by an existing slip road which runs parallel to Armadale Road, providing access to Armadale Road heading east and Anstey Road. This slip road contains a 107 metre long no through section with compliant turnaround. The site will also connect to new public roads being created to the north and east of the site, providing egress to two different routes to at least two suitable destinations. The fully developed site does not require any permanent Emergency Access Ways (EAW), however during the development of subdivision stages, temporary EAW's may be required to ensure two access ways are provided at all times.

This Bushfire Management Plan (BMP) has been prepared to support the subdivision application. It addresses future subdivision conditions by providing responses to the performance criteria in the Planning for Bushfire Guidelines (2024).

If there is a bushfire within or near the site, implementing this BMP will reduce the threat to residents, property and emergency response personnel.



Location details:	Armadale Road, Cnr Anstey Rd Forrestdale
Assessment date:	July, 2025
Prepared by:	Bushfire Safety Consulting
Accreditation level:	Level 3 BPAD Practitioner
Accreditation number:	BPAD 23160
Accreditation expiry date:	31st January, 2026
Date aerial photo:	July, 2025

FIGURE 1
LOCAL STRUCTURE PLAN

0 20 40 60 80 100 120m
SCALE 1:3000 @ A3
DATE: JULY 2025
NORTH

LEGEND

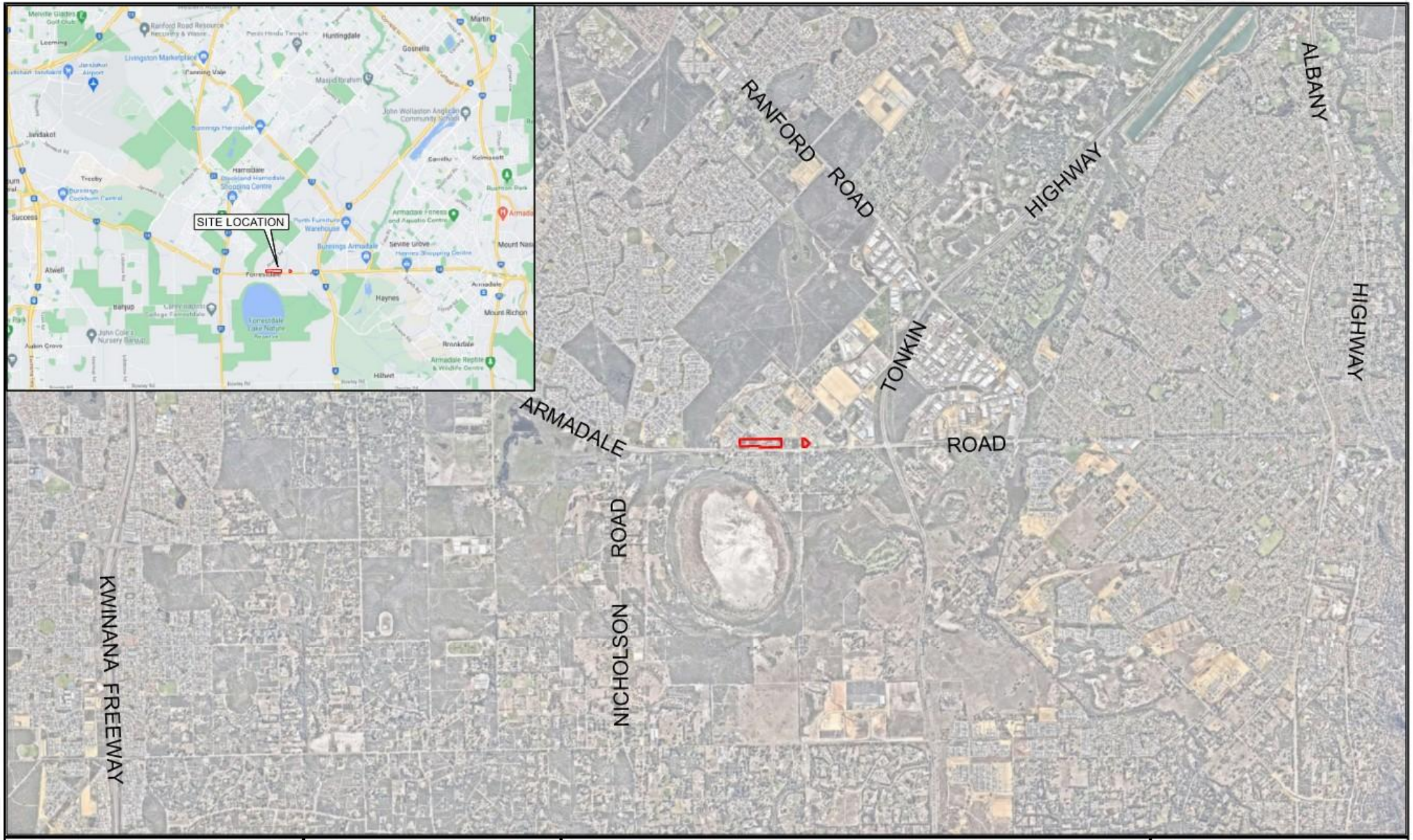
- SUBJECT LAND
- EXISTING PUBLIC ROAD
- FUTURE PUBLIC ROAD
- COMPLIANT TURNAROUND FOR FIREFIGHTING APPLIANCES

LOCAL SCHEME ZONES

- R25

SOURCE OF PHOTOGRAPHY: NEARMAP

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Accreditation number:	BPAD 23160
Accreditation expiry date:	31st January, 2026
Date aerial photo:	July, 2025

FIGURE 2
SITE LOCATION PLAN

0 200 400 600m
SCALE 1:60 000 @ A4
DATE: JULY 2025
NORTH

LEGEND
SUBJECT LAND

Base mapping supplied by Nearmap & Google Maps

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1.1 Policy and Guidelines

1.1.1 Application of SPP 3.7

The State Planning Policy No. 3.7: Bushfire (SPP 3.7) The policy intent is to implement effective, risk-based land use planning and development to manage and/or mitigate risk to people, property and infrastructure to an acceptable level.

The policy contains objectives and policy outcomes and measures as well as reference to the Bushfire Protection Criteria as outlined in the Planning for Bushfire Guidelines (WAPC 2024) (the Guidelines). The policy applies to this Development Application because the site is located in a designated bushfire prone area on the WA Map of Bushfire Prone Areas (Figure 3).

SPP3.7 and the Planning for Bushfire Guidelines provides the foundation for land use planning to address bushfire risk management in Western Australia. The following policy measures will need to comply with SPP 3.7:

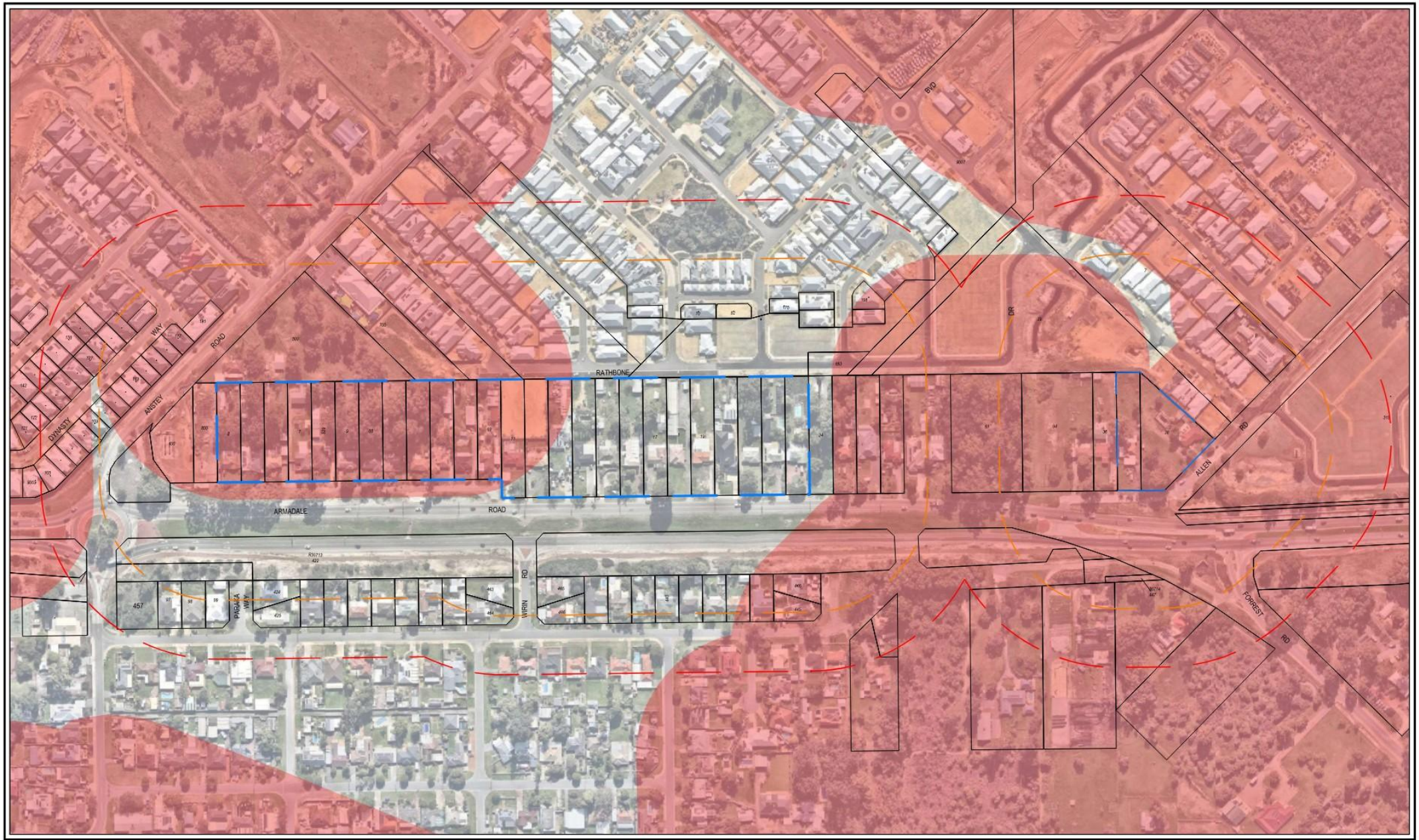
Table 1. Policy measures

Policy Measure 7.1	The measures ensure bushfire is considered at the earliest possible stage in the planning process and all subsequent stages. A Bushfire Management Plan should be developed in accordance with the Guidelines and include the following - an assessment of environmental, biodiversity and conservation values, - a Bushfire Hazard Level assessment and BAL Contour Map, - an identification of issues and an assessment against the bushfire protection criteria.
Policy Measure 7.2	Policy measure 7.2 applies as the proposal triggers a Broader Landscape Assessment. The site is located in a Broader Landscape Type A resulting in the broader landscape risk to people, property and infrastructure is acceptable.
Policy Measure 7.5	The Structure Plan site is able to fully comply with the acceptable solutions of the Guidelines negating the need for a specific outcomes-based approach in accordance with this policy.

The site does not contain proposed minor or unavoidable development, or high-risk land use under *SPP 3.7.*

1.1.2 Planning for Bushfire Guidelines (2024)

The Planning for Bushfire Guidelines (2024) provides the criteria and acceptable solutions that are assessed and accommodated within this BMP. The Planning for Bushfire Guidelines (2024) is intended to inform and guide decision makers, referral authorities and proponents to achieve acceptable bushfire protection outcomes, including expectations at the different stages of planning. Section 5 of the Guidelines outlines all the considerations and Bushfire Protection Criteria for Structure Plans and Residential applications that are applicable for this application.



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Assessment date:	July, 2025
Prepared by:	Bushfire Safety Consulting
Accreditation level:	Level 3 BPAD Practitioner
Accreditation number:	BPAD 23160
Accreditation expiry date:	31st January, 2026
Date aerial photo:	July, 2025

FIGURE 3
BUSHFIRE PRONE AREAS

0 20 40 60 80 100 120m

SCALE 1:3000 @ A3
DATE: JULY 2025

NORTH

LEGEND

- SUBJECT LAND
- ASSESSMENT AREA (150m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE
- ASSESSMENT AREA (100m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE
- BUSHFIRE PRONE AREAS

SOURCE OF PHOTOGRAPHY: NEARMAP

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2 ENVIRONMENTAL CONSIDERATIONS

2.1 Native Vegetation – Modification and Clearing

The development site consists primarily of residential dwellings and lots on established residential properties and does not contain intact native vegetation. There are no environmental restrictions to limit a future development on the site (Table 2).

Table 2. Environmental Considerations

Environmental Consideration	Site	Comments
Bush Forever (COP-071)	✗	Site is not a declared Bush Forever area.
Conservation Covenant (DPIRD-023)	✗	There are no conservation covenants on the site.
Conservation Wetland or Buffer (DBCA-019; DBCA-017)	✗	There are no conservation wetlands or buffers on the site.
Environmentally Sensitive Area (DWER-070)	✗	The site is not a declared Environmentally Sensitive Area under the Environmental Protection Act 1986.
Local Government	✗	There are no identified environmental planning considerations under the City of Armadale Town Planning Scheme no. 4.
RAMSAR Wetland (DBCA-010)	✗	There are no declared RAMSAR wetlands at the site.
Regionally Significant Natural Areas (DWER-070)	✗	There are no regionally significant natural areas within the site.
Removal of Restricted Vegetation	✗	The addition proposal does not require the removal of restricted vegetation.
Threatened Ecological Communities (DBCA-038)	✗	There are no threatened ecological communities at the site.
Threatened and Priority Fauna (DBCA-037)	✗	There are no threatened fauna species recorded at the site.
Threatened and Priority Flora (DBCA-036)	✗	There are no recorded species of threatened flora at the site.
Aboriginal Heritage (DBCA-001)	✗	No aboriginal heritage sites have previously been recorded within the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Enquiry System.

2.2 Re-vegetation/Landscape Plans

There are no revegetation or landscape plans in the proposed Structure Plan area.

3 BUSHFIRE ASSESSMENT RESULTS

Bushfires are common in the City of Armadale and local brigades respond to numerous bushfires in the district annually in remnant bushland areas. Although not exposed to a large landscape scale fire, this BMP plays a critical role in ensuring that the development of the land appropriately mitigates the risk from bushfire from all surrounding vegetation.

A detailed Bushfire Attack Level Contour map assessment was undertaken, within a 150 m radius of the site, a post development vegetation classification map has been developed, a detailed assessment of effective slopes and a detailed BAL Contour map is found in the following figures.

3.1. BROADER LANDSCAPRE ASSESSMENT

Broader Landscape Assessment (BLA) is a methodology to understand the likely size and intensity of a bushfire and to determine the broader landscape type surrounding the planning proposal. The BLA area assessed includes a 2 kilometre zone around this proposed Local Structure plan in the development of Anstey Keane Urban Development East Structure Plan on Armadale Road, Forrestdale.

3.1.1 Methodology

The methodology followed in outlined in Appendix A in the Guidelines (2024) and include an assessment of:

- The broad vegetation categories (Figure 4.1)
- The aspect from four quadrants aligned to the intercardinal directions (Figure 4.2)
- The broad vegetation patterns (Figure 4.3)
- District vehicular access routes (Figure 4.4)

The analysis of these four variables were assessed against the points based system in the Guidelines with the outcomes represented in Table 3 to determine the broader landscape type



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FIGURE 4
BROADER LANDSCAPE ASSESSMENT

0 200 400 600 800m

SCALE 1:20,000 @ A3
DATE: SEPTEMBER 2025

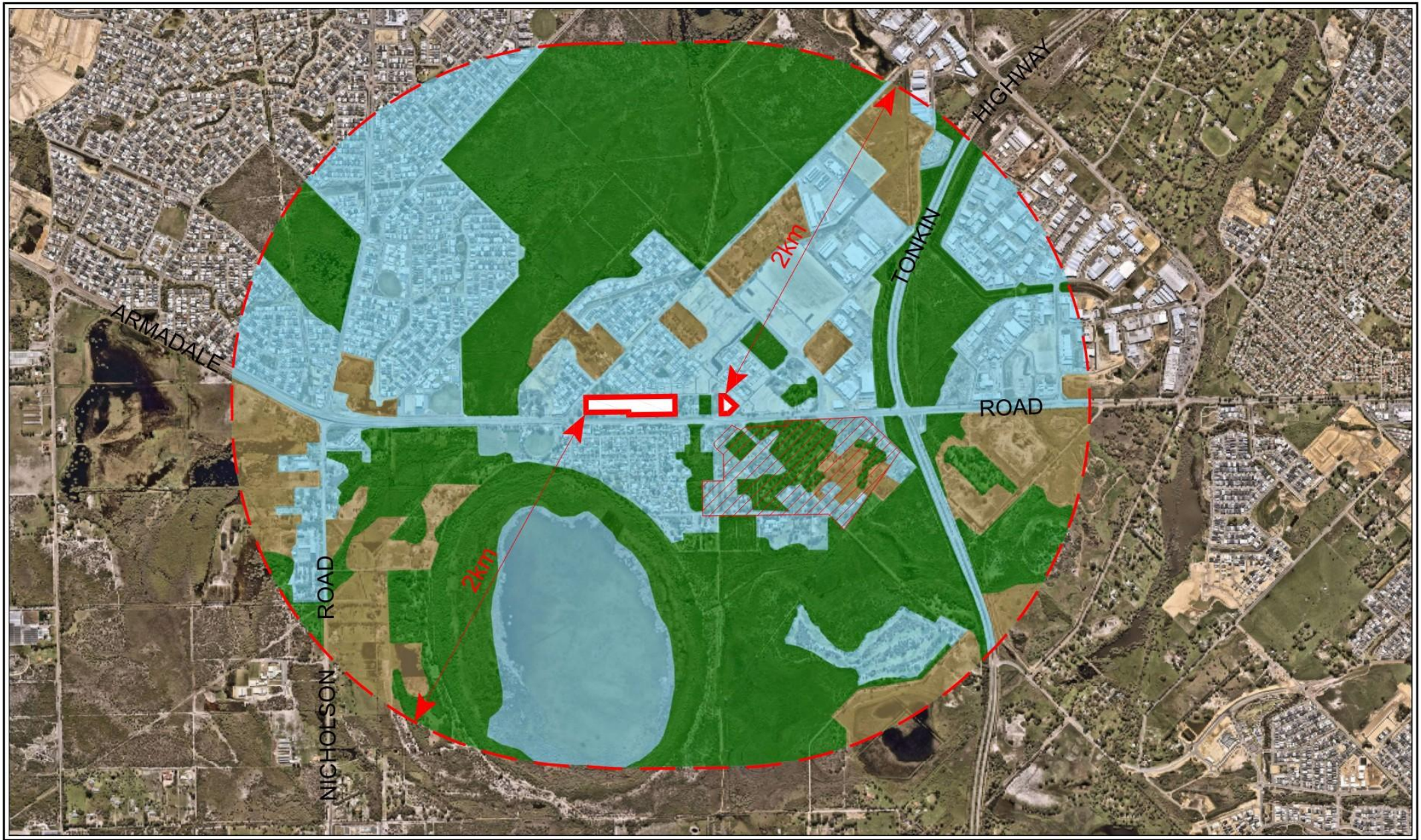
NORTH

LEGEND

SUBJECT LAND

SOURCE OF PHOTOGRAPHY: NEARMAP

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FIGURE 4.1
BROADER LANDSCAPE
ASSESSMENT - VEGETATION MAP

0 200 400 600 800m

SCALE 1:20,000 @ A3
DATE: SEPTEMBER 2025

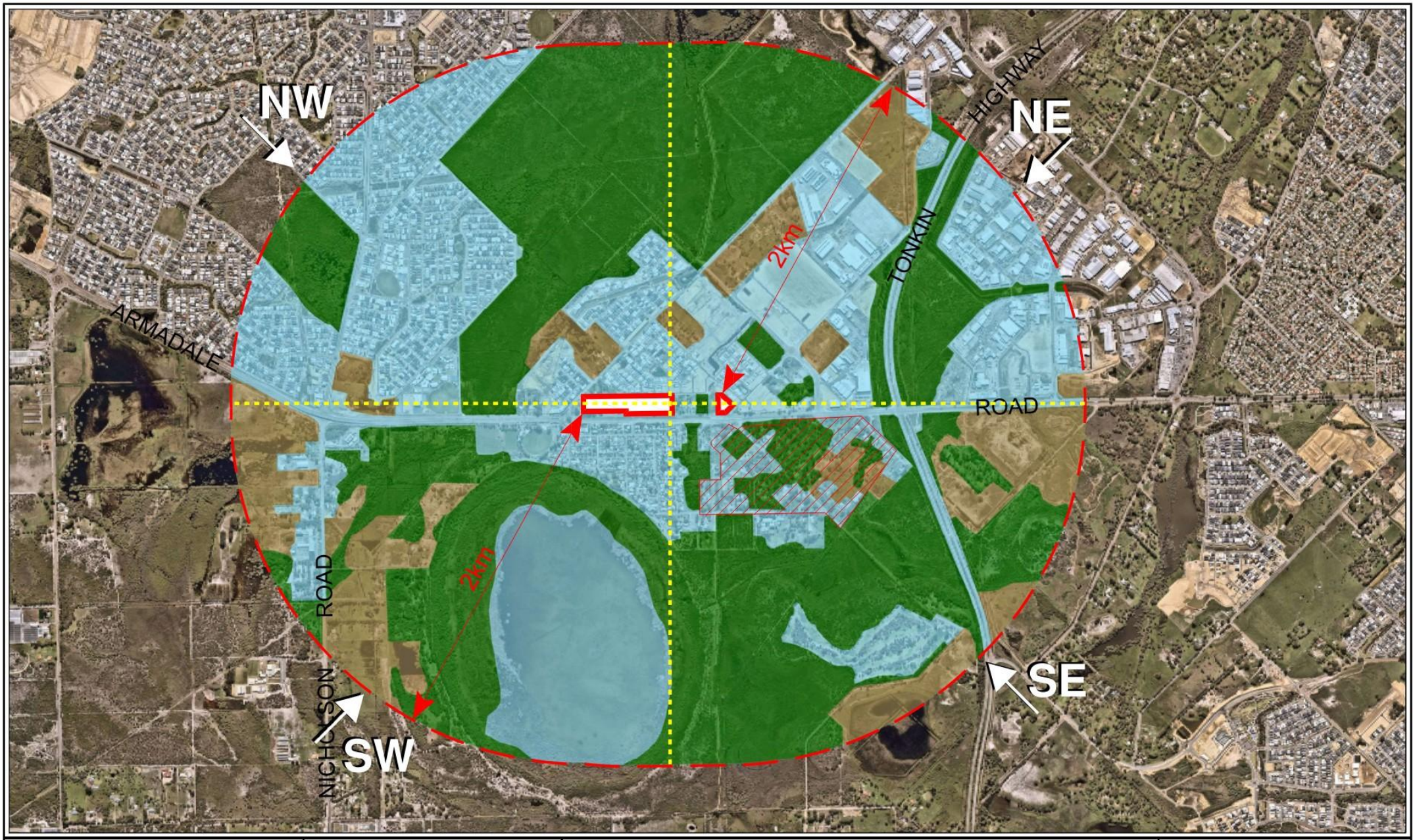
NORTH

LEGEND

- SUBJECT LAND
- 2km ASSESSMENT BUFFER
- LOW THREAT VEGETATION
- UNMANAGED GRASSLAND
- ALL OTHER CLASSIFIED VEGETATION
- APPROVED URBAN UNDER MRS AND CURRENT STRUCTURE PLAN PROCESS

SOURCE OF PHOTOGRAPHY: NEARMAP

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FIGURE 4.2
VEGETATION ASPECT MAP

0 200 400 600 800m

SCALE 1:20,000 @ A3
DATE: SEPTEMBER 2025

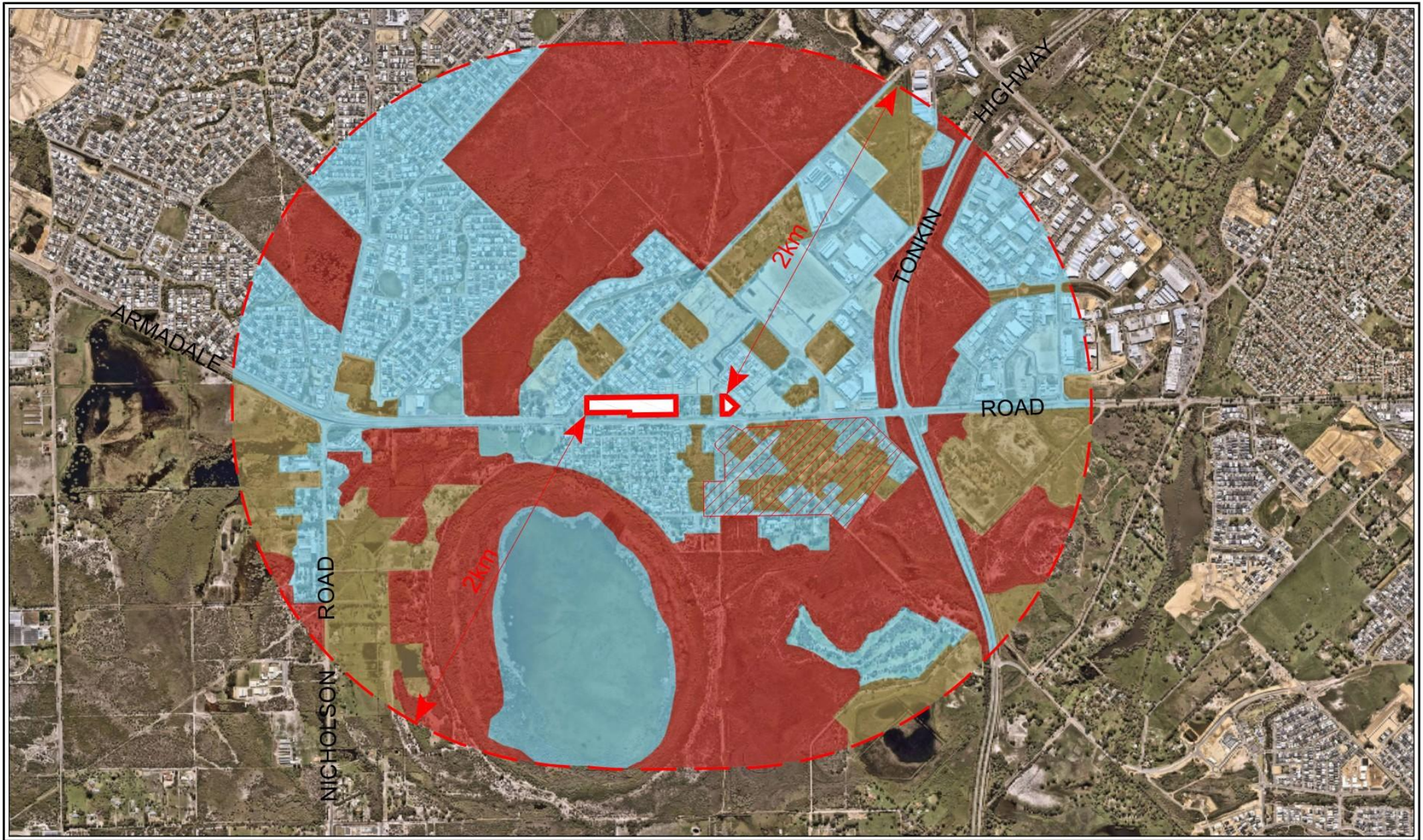
NORTH

LEGEND

- SUBJECT LAND
- 2km ASSESSMENT BUFFER
- LOW THREAT VEGETATION
- UNMANAGED GRASSLAND
- ALL OTHER CLASSIFIED VEGETATION
- APPROVED URBAN UNDER MRS AND CURRENT STRUCTURE PLAN PROCESS

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FIGURE 4.3
PREDOMINANT VEGETATION PATTERN

0 200 400 600 800m

SCALE 1:20,000 @ A3
DATE: SEPTEMBER 2025

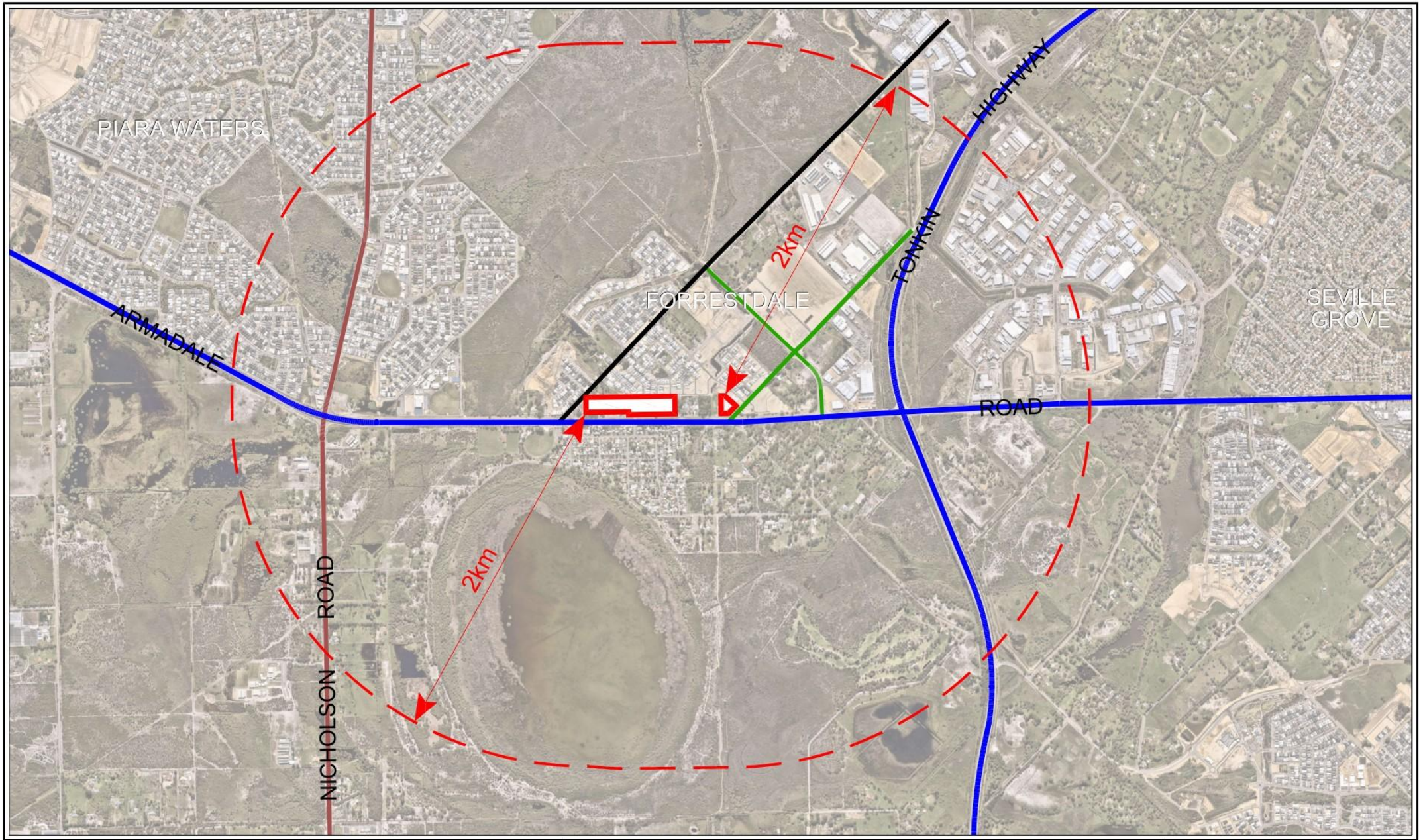
NORTH

LEGEND

- SUBJECT LAND
- 2km ASSESSMENT BUFFER
- CLEARED VEGETATION
- MOSAIC PATTERN
- LARGE TRACTS OF CLASSIFIED VEGETATION
- APPROVED URBAN UNDER MRS AND CURRENT STRUCTURE PLAN PROCESS

SOURCE OF PHOTOGRAPHY: NEARMAP

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FIGURE 4.4
ACCESS ROUTES

0 200 400 600 800m

SCALE 1:20,000 @ A3
DATE: SEPTEMBER 2025

NORTH

LEGEND

- SUBJECT LAND
- 2km ASSESSMENT BUFFER
- PRIMARY DISTRIBUTOR
- DISTRIBUTOR A
- DISTRIBUTOR B
- ACCESS ROAD

SOURCE OF PHOTOGRAPHY: NEARMAP

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3.1.2 Broader Landscape Type Outcome

Using the methodology outlined in Step 3 in the Guidelines, the following points-based analysis was undertaken for the site. The criterion is assessed against the site with responses outlined that correspond to the points-based system. The points column is tallied up to provide a total points number which determines what Broad Landscape type is achieved. The analysis and outcome is found in Table 3 below.

Table 3. Broader Landscape Type Assessment

CRITERIA	RESPONSE	POINTS
Proximity of the planning proposal to a suitable destination:	The planning area is 7kms from the edge of Armadale and 8km to Canningvale. Both of these areas have large zones not declared bushfire prone. They are suitable destinations.	**2**
The road pattern from the planning proposal to a suitable destination is:	The road to Armadale and Canningvale is direct. The road pattern is simple and direct with limited intersections via Armadale Road, Tonkin Hwy and Kwinana Fwy.	**1**
The predominant vegetation pattern is:	A mosaic pattern of vegetation. The zone 100-300 metres around the site are predominantly non vegetated or unmanaged grassland. Some areas of continuous classified vegetation does occur but it is set further back from the site to the north and south. More than 50% of the full assessment area is either non vegetated or mosaic pattern vegetation.	**2**
Exposure of the planning proposal to an identified external bushfire hazard (excluding Class G Grassland) is from:	The interface of the development site is largely against non vegetated areas and two small vegetated strips of remnant vegetation. There are two very small areas of woodland, forest vegetation, the external hazard is from the South or Armadale Road and a small area of woodland to the North West.	**2**
		TOTAL POINTS
0-11 points (BLT A) **12-20 points (BLT B)**		**7**
BROADER LANDSCAPE TYPE DETERMINED		**TYPE A**

3.2 BAL CONTOUR MAP INPUTS

A detailed Bushfire Attack Level Contour map assessment was undertaken, within a 150 m radius of the site, a post development vegetation classification map has been developed, a detailed assessment of effective slopes and a BAL Contour map is found in the following figures.

The methodology used to assess the site is outlined in the *Planning for Bushfire (2024).* The site and surrounding areas can be seen in **Figure 5** and a BAL Contour Map (**Figure 6**) is provided in accordance with Appendix A3 of the guidelines. Assessing bushfire hazards at the site-specific level accounts for the predominant class of vegetation on the site and surrounding area for a minimum of 150 m.

3.2.1 Assessment Inputs

The methodology used to assess the site is outlined in the *Planning for Bushfire (2024).* The broad zoning layout is known, and a strategic level bushfire hazard assessment is not required. A post development vegetation classification plan is provided, and a BAL Contour plan is provided in accordance with Appendix 3 of the guidelines.

Assessing bushfire threat at the site-specific level requires evaluating the predominant class of vegetation on the site and surrounding area for a minimum of 150 m, as shown in the Vegetation Classification Map (Figure 4).

3.2.2 Vegetation Classification

The vegetation surrounding the site consists predominantly of low threat managed vegetation and non-vegetated areas. Areas of Class B Woodland occur on the NW interface in some horse paddocks and east of Forrest Road.

Class A Forest occurs on one lot between the two sites and also south of Armadale Road in a future bushland reserve. The vegetation consists predominately of Eucalypts with canopy cover exceeding 30%, and understorey consisting largely of small to large shrubs.

The vegetation plots on and surrounding the site and within 150 metres of the site boundary are found in Figure 5 with plot descriptions below.

Photo ID: 1 **Plot Number:** 1 **Vegetation classification or exclusion clause:** Class B Woodland **Description/justification of classification:** Eucalypts varying in heights to 15m; 10 – 30% foliage cover and grass understorey in horse paddocks.	

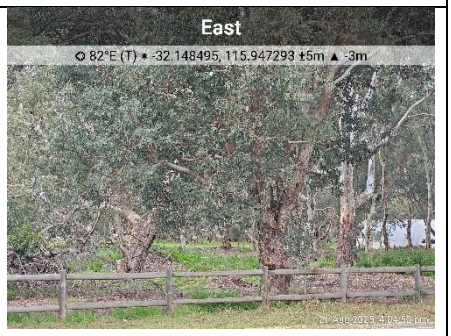
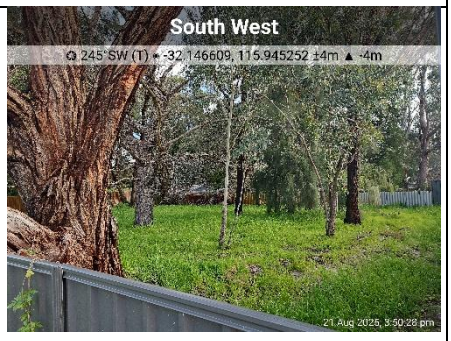
Photo ID: 2 **Plot Number:** 1 **Vegetation classification or exclusion clause:** Class B Woodland **Description/justification of classification:** Eucalypts varying in heights to 15m; 10 – 30% foliage cover and grass understorey in horse paddocks.	
Photo ID: 3 **Plot Number:** 1 **Vegetation classification or exclusion clause:** Class B Woodland **Description/justification of classification:** Eucalypts varying in heights to 15m; 10 – 30% foliage cover with leaf matter and grass understorey.	
Photo ID: 4 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class a Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage, ladder fuels and leaf matter on the ground.	
Photo ID: 5 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover, ladder fuels and leaf matter on the ground.	
Photo ID: 6 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover ladder fuel layer of shrubs.	

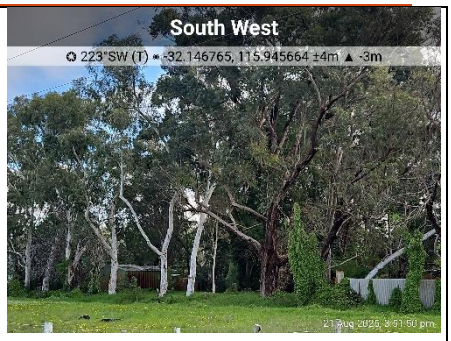
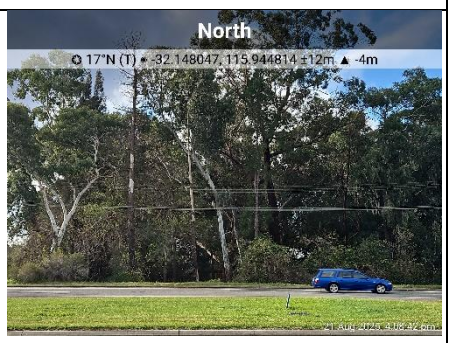
Photo ID: 7 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage, ladder fuels and leaf matter on the ground.	
Photo ID: 8 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage, leaf matter on the ground.	
Photo ID: 9 **Plot Number:** 2 **Vegetation classification or exclusion clause:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover and a distinct middle storey fuel layer of shrubs, leaf matter on the ground.	
Photo ID: 10 **Plot Number:** 2 **Description/justification of classification:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover and a distinct middle storey fuel layer of shrubs, leaf matter on the ground.	
Photo ID: 11 **Plot Number:** 2 **Description/justification of classification:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover and a distinct middle storey fuel layer of mixed species of shrubs.	

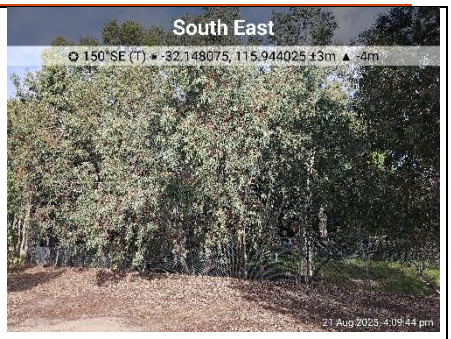
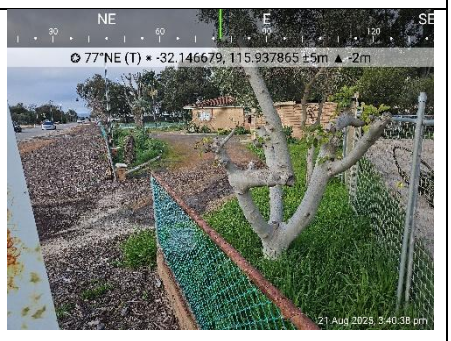
Photo ID: 12 **Plot Number:** 2 **Description/justification of classification:** Class A Forest **Description/justification of classification:** Eucalypts with heights to 20m, 30 – 70% foliage cover and a distinct middle storey fuel layer of mixed species of shrubs, leaf matter on the ground.	
Photo ID: 13 **Plot Number:** 3 **Description/justification of classification:** Class D Scrub **Description/justification of classification:** Mixed species of shrubs 2-6m tall.	
Photo ID: 14 **Plot Number:** 3 **Description/justification of classification:** Class D Scrub **Description/justification of classification:** Mixed species of shrubs averaging 3-4 metres in height;	
Photo ID: 15 **Plot Number:** 4 **Description/justification of classification:** Class G Grassland **Description/justification of classification:** Grass fuels in paddock.	
Photo ID: 16 **Plot Number:** 4 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; managed road verge, front yard and gardens.	

Photo ID: 17 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; mowed grass in central road reserve.	
Photo ID: 18 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained back yard.	
Photo ID: 19 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained grass.	
Photo ID: 20 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; managed gardens.	
Photo ID: 21 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained grass area on the edge of Armadale Road.	

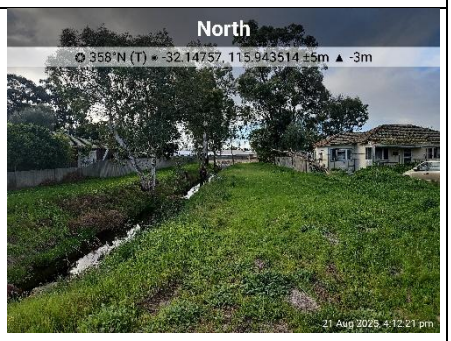
Photo ID: 22 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained grass area around sheds and home.	
Photo ID: 23 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained grassed area in the centre of Armadale Road.	
Photo ID: 24 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; vegetation maintained along Anstey Road.	
Photo ID: 25 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained gardens and lawn area.	
Photo ID: 26 **Plot Number:** 5 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (f) **Description/justification of classification:** Low threat vegetation; maintained grass fuels in drainage reserve.	

Photo ID: 27 **Plot Number:** 6 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (e) **Description/justification of classification:** Non vegetated area; housing lots and roads.	
Photo ID: 28 **Plot Number:** 6 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (e) **Description/justification of classification:** Non vegetated area; Rathbone Road.	
Photo ID: 29 **Plot Number:** 6 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (e) **Description/justification of classification:** Non vegetated area; lots ready for sale.	
Photo ID: 30 **Plot Number:** 6 **Description/justification of classification** Exclusion Clause 2.2.3.2 (e) **Description/justification of classification:** Non-vegetated areas, development under construction.	
Photo ID: 31 **Plot Number:** 7 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (c) **Description/justification of classification:** Area of vegetation less than 0.25ha and not within 20m of the proposed site and other classified vegetation.	

Photo ID: 32 **Plot Number:** 8 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (d) **Description/justification of classification:** Small strips of vegetation less than 20m wide and not within 20m of the proposed site and other classified vegetation.	
Photo ID: 33 **Plot Number:** 8 **Description/justification of classification:** Exclusion Clause 2.2.3.2 (d) **Description/justification of classification:** Small strip of vegetation less than 10m wide and not within 20m of the proposed site and other classified vegetation.	

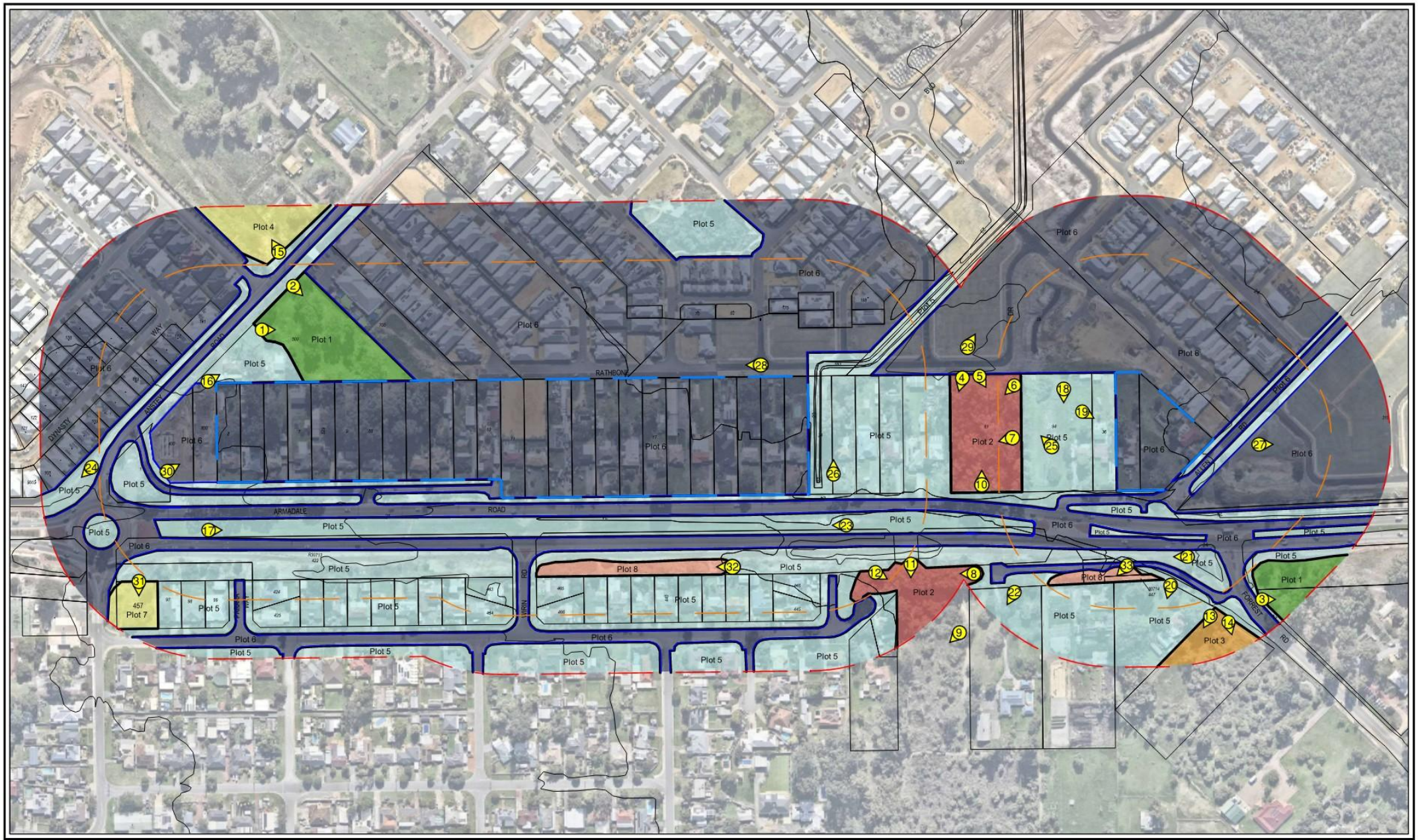
3.2.3 Effective Slope

The landscape on and surrounding the site is the slope that will affect the behaviour of an approaching bushfire. The effective slope under the classified vegetation surrounding the site is flat in all directions.

The topography and effective slopes are outlined in Table 3.

Table 4. Summary of vegetation type and effective slope

Vegetation Area/ Plot	Applied Vegetation Classification	Effective Slope under the Classified Vegetation (degrees)
1	Class B Woodland	Flat
2	Class A Forest	Flat
3	Class D Scrub	Flat
4	Class G Grassland	Flat
5	Exclusion Clause 2.2.3.2 (f)	N/A
6	Exclusion Clause 2.2.3.2 (e)	N/A
7	Exclusion Clause 2.2.3.2 (c)	N/A
8	Exclusion Clause 2.2.3.2 (d)	N/A



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FIGURE 5 - VEGETATION CLASSIFICATION MAP (BAL CONTOUR MAP)

0 20 40 60 80 100 120m

SCALE 1:3000 @ A3
DATE: SEPTEMBER 2025

NORTH

LEGEND

- SUBJECT LAND
- ASSESSMENT AREA (150m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE
- ASSESSMENT AREA (100m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE

SOURCE OF PHOTOGRAPHY: NEARMAP

- PLOT 1 CLASS B WOODLAND
- PLOT 2 CLASS A FOREST
- PLOT 3 CLASS D SCRUB
- PLOT 4 CLASS G GRASSLAND
- PLOT 5 EXCLUSION CLAUSE 2.2.3.2(f)
- PLOT 6 EXCLUSION CLAUSE 2.2.3.2(e)
- PLOT 7 EXCLUSION CLAUSE 2.2.3.2(c)
- PLOT 8 EXCLUSION CLAUSE 2.2.3.2(d)

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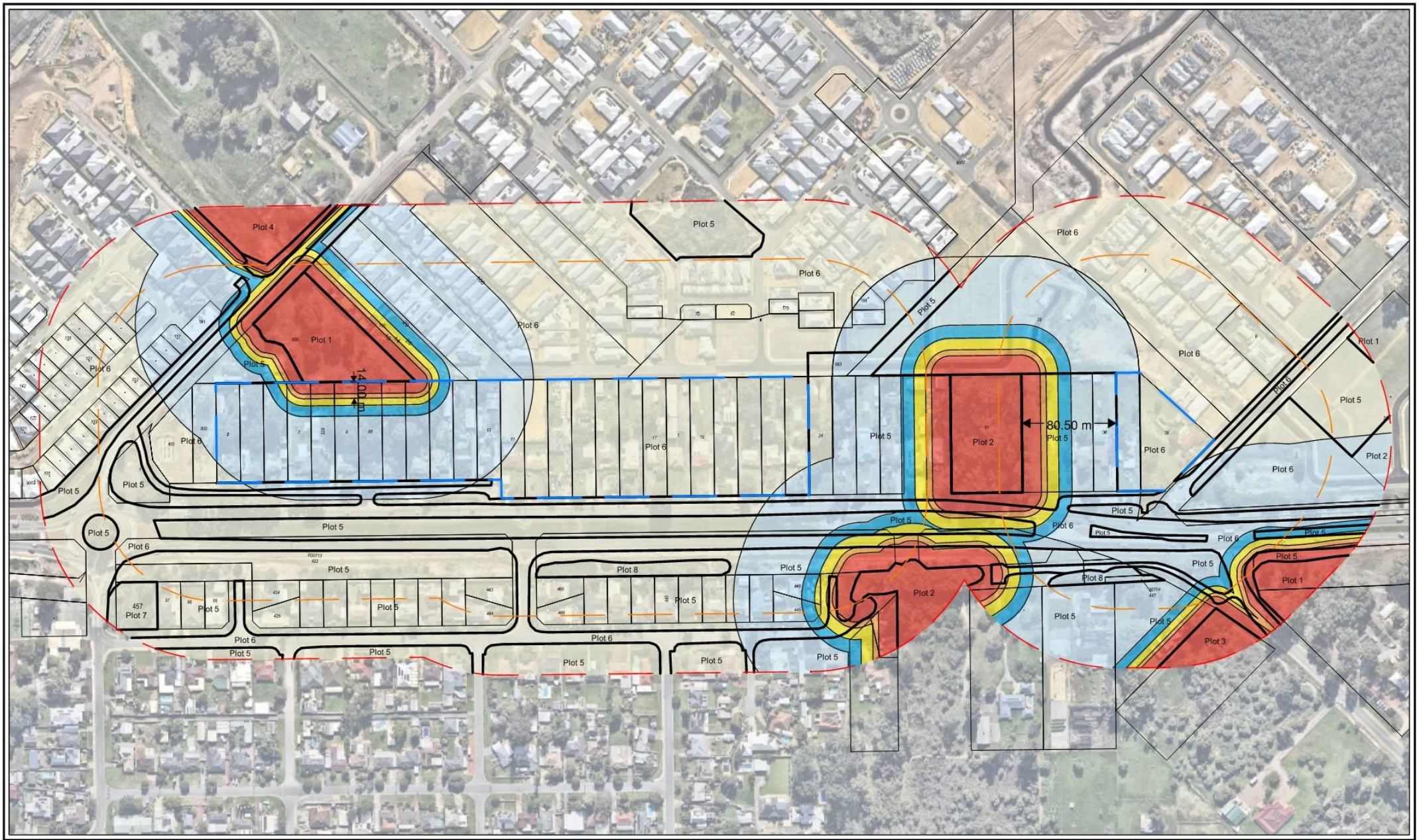
3.2.4 Assessment Outputs

A BAL contour assessment was undertaken according to Appendix 3 of the Guidelines and the results are found in Table 4 and Figure 5.

A method 1 BAL Assessment was undertaken to determine the BAL contours impacting the site and the outputs are provided in Table 3.

Table 5. Summary of assessment outputs

Site Area	Plot No	Applied Vegetation Classification	Effective slope	Minimum Separation Distance	Highest BAL Contour On Lots
Western Portion	1	Class B Woodland	Flat/upslope	0 m	BAL – FZ
				With 14m internal perimeter APZ on northern boundary	BAL – 29
Eastern Portion	2	Class A Forest	Flat/upslope	80.5m	BAL-12.5



Location details:	Armadale Road, Cnr Anstey Rd Forrestdale
Assessment date:	July, 2025
Prepared by:	Bushfire Safety Consulting
Accreditation level:	Level 3 BPAD Practitioner
Accreditation number:	BPAD 23160
Accreditation expiry date:	31st January, 2026
Date aerial photo:	July, 2025

FIGURE 6
BAL CONTOUR MAP

0 20 40 60 80 100 120m

SCALE 1:3000 @ A3
DATE: SEPTEMBER 2025

NORTH

LEGEND

- SUBJECT LAND
- ASSESSMENT AREA (150m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE
- ASSESSMENT AREA (100m) FROM THE EXTERNAL BOUNDARY OF THE SUBJECT SITE

SOURCE OF PHOTOGRAPHY: NEARMAP

INDICATIVE BUSHFIRE ATTACK LEVELS

- BAL LOW
- BAL 12.5
- BAL 19
- BAL 29
- BAL 40
- BAL FLAME ZONE

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4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The small area of classified vegetation in the area surrounding the site to the north-west is expected to be largely cleared for development in the future.

Predicted radiant heat flux levels and ember attack could impact the site as evident in the BAL Contour Plan (**Figure 6**).

This bushfire threat to the proposed development will be managed through compliance with SPP 3.7 and the *Planning for Bushfire Guidelines (2024)*.

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA 5: Structure plans and subdivision applications.

This report adopts an acceptable solution system of control for each bushfire protection criteria. This methodology is consistent with the *Planning for Bushfire Guidelines (2024).* The management issues are:

- Siting and Design
- Vehicular Access.
- Water Supply

Acceptable solutions are proposed for all bushfire protection criteria.

Land use planning bushfire risk mitigation strategies are comprehensively detailed in the following sections by providing responses to the bushfire protection criteria that fulfil the outcomes of the bushfire hazard management issues outlined in the *Planning for Bushfire Guidelines (2024).* The compliance details are outlined in Table 6 below.

5.1 Compliance Table

Acceptable solutions are proposed for all of the Bushfire Protection Criteria and each illustrates a means of satisfactorily meeting the corresponding performance criteria. Land use planning bushfire risk mitigation strategies are comprehensively detailed in the following sections by providing responses to the performance criteria that fulfil the intent of the bushfire hazard management issues outlined in the *Planning for Bushfire Guidelines (2024).* The compliance checklist assessed against Bushfire Protection Criteria 5: Structure Plans and Subdivisions applications is shown in Table 6 and the final outcomes are outlined in Figure 7 showing the spatial representation of the bushfire mitigation measures.

Table 6: Compliance Table		
Bushfire Protection Criteria	**Method of compliance** **Acceptable Solutions**	**Proposed bushfire management strategies**
Element 1: Location 01 Avoid broader landscapes that present an unacceptable risk to life, property and infrastructure.	**A1.1 Development Location** The subject site is located in Bushfire Prone Area: Area 2 **Broader Landscape Type A** The Site is located in an area that is Broader Landscape Type A (see Table 3).	The Subject site is located in an area that is a Broader Landscape Type A. This location satisfied the policy outcome for Element 1: Location and no additional consideration is required.
Element 2: Siting and Design **Outcomes:**	**A2.1 – Siting and Design** Ensure that each proposed and existing lot(s) contains a sufficient development site(s) that can achieve a radiant heat impact not exceeding 29kW/m² (BAL-29).	**Full compliance –** Every proposed lot can achieve a sufficient internal setback (if required) to achieve radiant heat impact not exceeding 29kW/m² (BAL-29) on a future dwelling

O2 Ensure siting and design solutions: Manage or mitigate the bushfire risk to people, property and infrastructure; and Avoid, or where unavoidable minimise the clearing of native vegetation.	**A2.2 Asset Protection Zone (APZ)** Where a habitable building cannot be wholly within an area with a radiant heat impact not exceeding 29kW/m^2 (BAL-29) in its pre-development state, an APZ is to be provided and meet the following requirements: **Width**: the APZ is to be measured from the development site, and of sufficient size to ensure the radiant heat impact of a bushfire does not exceed 29kW/m^2 (BAL-29) in all circumstances **Location**: the APZ is to be contained solely within the boundaries of the lot, except in instances where: - The vegetation on the adjoining lot(s) is, and will continue to be low threat as per clause 2.2.3.2 of AS 3959 of the requirements of Appendix B2, Table 9 – APZ technical requirements, or an alternative standard in a local planning scheme, on an ongoing basis in perpetuity; or - The adjoining land is and will remain in perpetuity, non-vegetated **Management**: the APZ is managed in accordance with the requirements of Appendix B.2, Table 9 – APZ technical requirements, or an alternative standard in a gazetted local planning scheme.	**Full compliance is achieved on all criteria including the following:** **Width** – the perimeter APZ is measured from the walls or supporting posts of each habitable building in all directions towards classified vegetation. **Location** – All APZ's are fully contained within Armadale Road, Cnr Anstey Rd, Forrestdale. APZ technical requirements are found in Table 9 in the guidelines and are found in Appendix 1 in this report **Management** – the owner of the future Development will establish the APZ to the technical standards after subdivision approval. A temporary perimeter APZ is sited on the north-west boundary of the site until classified vegetation adjacent to the site has been cleared for development. Development is restricted in this zone until the adjacent vegetation is permanently cleared and the requirement for the temporary Perimeter APZ is removed. This will ensure all buildings will be built in BAL-29 or lower. Lots within 100 metres of classified vegetation will be managed in accordance with APZ standards (see Appendix 1).
	A2.3 Clearing of native vegetation The development avoids, or where unavoidable, minimises the clearing of native vegetation.	**Full compliance is achieved.** The Structure plan avoids the clearing of native vegetation. A the site is already developed and no native vegetation occurs on site except isolated trees.
Element 3: Vehicular Access **Outcomes:** **O3 Ensure the design and capacity of vehicular access and egress provide:** - **for efficient evacuation to a suitable destination(s) and / or**	**A3.1 Public Roads** Public roads are to meet the requirements in Appendix B.3, Table 10	**Full compliance is achieved.** The public roads to be created, as well as surrounding existing roads, comply with minimum public road standards as outlined in Appendix B.3, Table 10 found in Appendix 2.

- **as a contingency measure for vulnerable land uses, an onsite shelter, where demonstrated appropriate, as a last resort option.**	**A3.2 Access routes** Area 2: Public Road access should be provided in two different directions to two different suitable destinations, with an all-weather surface.	**Full compliance is achieved** Public roads surround the site, access will be provided in two different directions to two different suitable destinations, with an all-weather surface.
	A3.3a No-through roads Area 2: If the public road access to the subject site is via a no-through road which cannot be avoided due to demonstrated site constraints, the public road access is to be a maximum of 200 metres from the proposed lot(s) boundary to an intersection where two-way access is provided. The no-through road may exceed 200 metres if it is demonstrated that an alternative access, including an emergency access way, cannot be provided due to site constraints and the following requirements are met: • The no-through road travels towards a suitable destination; and • The balance of the no-through road that is greater than 200 metres from the subject site is wholly within BAL-LOW, or is within a residential built-out area, or is within Area 1 **(Figure 29).**	**Full compliance is achieved** The Armadale Road access road to the south-west of the site has a 107 metre no through road section which contains a compliant turnaround for firefighting appliances. Any unavoidable no through roads within the site will comply with SPP3.7 and the Guidelines.
	A3.3b - No through road requirements A no-through road is to meet all the following requirements: - requirements of a public road (Appendix B.3, Table 10, Column 2); and - turn around area/head (Figure 30).	**Full compliance is achieved**

	A3.4 Emergency Access Way Where it is demonstrated that A3.2 and A 3.3 cannot be achieved due to site constraints or where an alternative design option does not exist, an emergency access way can be considered as an acceptable solution. An emergency access way is to meet the following requirements: • The requirements of Appendix B.3, Table 10, Column 3; • Provides a through connection to a public road; • Is no more than 500 metres in length; • Connects to a public road network (note: an emergency access way onto the State Road Network requires access approval from Main Roads WA); • The proponent obtaining consent from the local government, that it will accept care, control and management for the access way; and • Is signposted and, if gated, gates must open for the whole carriageway width and remain unlocked.	**Full compliance is achieved** No Emergency access ways are proposed, however temporary EAWs may be utilised to ensure two way access during the development and complies with the minimum standards outlined in Appendix 2.
	A3.5a Perimeter roads A perimeter road is a public road and is to be provided for greenfield or infill development where 10 or more lots are proposed (including as part of a staged subdivision) with the aim of: • Separating areas of permanent classified vegetation under AS 3959 which adjoin the subject site, from the proposed lot(s); and • Removing the need for battle-axe lots that back onto areas of classified vegetation. • A perimeter road is to meet the requirements contained in Appendix B.3, Table 10, Column 1. A perimeter road may not be required where: • The adjoining classified vegetation is Class G Grassland; • Lots are zoned for rural living or equivalent; • It is demonstrated that it cannot be provided due to site constraints; or • All lots have frontage to an existing public road.	**Full compliance is achieved.** Perimeter roads not required as all lots will have a road frontage to existing public roads. Existing public roads surround the perimeter of the site.

	A3.5 Fire services access route Where proposed lots adjoin classified vegetation under AS3959 (Excluding Class G Grassland), and a perimeter road is not required in accordance with A3.5a, a fire service access route is to be provide firefighter access, where access is not available to the classified vegetation. A fire service access route is to meet the following requirements: - Requirements of Appendix B.3, Table 10, Column 4 - Be through routes with no dead ends - Must be signposted - No further than 500 metres form a public road - The proponent obtaining consent from the local government that it will accept care, control and management; and If gated, gates open the whole carriageway width and can be locked by the local government and/or the emergency services if keys are provided for each gate.	**Full compliance is achieved.** No formal fire service access route is proposed or required.
	A3.6 Battle-axe access legs Where it is demonstrated that a battle-axe access let cannot be avoided due to site or design constraints, it can be considered as an acceptable solution. There are no battle-axe technical requirements where the point of the battle-axe access leg joins the effective area of the battle-axe lot, is less than 50 metres from a public road in a reticulated water area. In circumstances where the above acceptable solution is not met, or the battle-axe lot is in a non-reticulated water area, the battle-axe leg is to meet the following requirements: • Requirements in Appendix B.3, Table 10, Column 5; • Passing bays every 200 metres with a minimum length of 20 metres and a minimum additional carriageway width of two metres (i.e. the combined carriageway width of the passing bay and constructed private driveway to be a minimum six metres); and • Turn-around area/head (Figure 30).	**Full compliance is achieved** Not applicable, if battle-axe access legs are proposed at subdivision stage, compliance is required.

Element 4: Water Supply **Outcomes:** **O3 Ensure that sufficient water is available to enable people, property and infrastructure to be defended from bushfire.**	**A4.1 Water supply for structure plans** Evidence that a reticulated or sufficient and sustainable non-reticulated water supply for bushfire firefighting can be provided at the subdivision and/or development application stage, in accordance with the specifications of the relevant water supply authority or the requirements in Appendix B.4: Water Supply dedicated for bushfire firefighting. Where the provision of a strategic water tank(s) is required, a suitable area should be identified as a Crown reserve on the structure plan, to the satisfaction of the WAPC on advice from the local government.	**Full compliance is achieved.** A reticulated water supply will be provided at the subdivision.
	A4.2 Water supply for subdivision applications Where a reticulated water supply is existing or proposed, a hydrant connection(s) should be provided in accordance with the specifications of the relevant water supply authority. Where these specifications cannot be met, then the following applies: • The provision of a water tank(s) in accordance with the requirements of Appendix B.4, Table 11 – Water supply dedicated for the bushfire firefighting; and Where the provision of a strategic water tank(s) is applicable, then the following requirements apply: • Land to be ceded free of cost to the Crown for the placement of the tank(s); • The proposed reserve where the tank is to be located is identified on the plan of subdivision • Tank capacity, construction and fittings, provided in accordance with the requirements of Appendix B.4; and • A strategic water tank is to be located no more than a 10-minute drive from the furthest development site (at legal road speeds).	**Full compliance is achieved.** Water supply provided with roadside fire hydrants consistent with standards.
	A4.3 Water supply for existing habitable building(s) Where subdivision includes an existing habitable building(s) that is to be retained, a hydrant connection(s) should be provided in accordance with the specifications of the relevant water supply authority. Where these specifications cannot be met, a water tank(s) should be provided in accordance with the requirements of Appendix B.4, Table 5 – Water supply dedicated for bushfire firefighting.	**Not applicable**

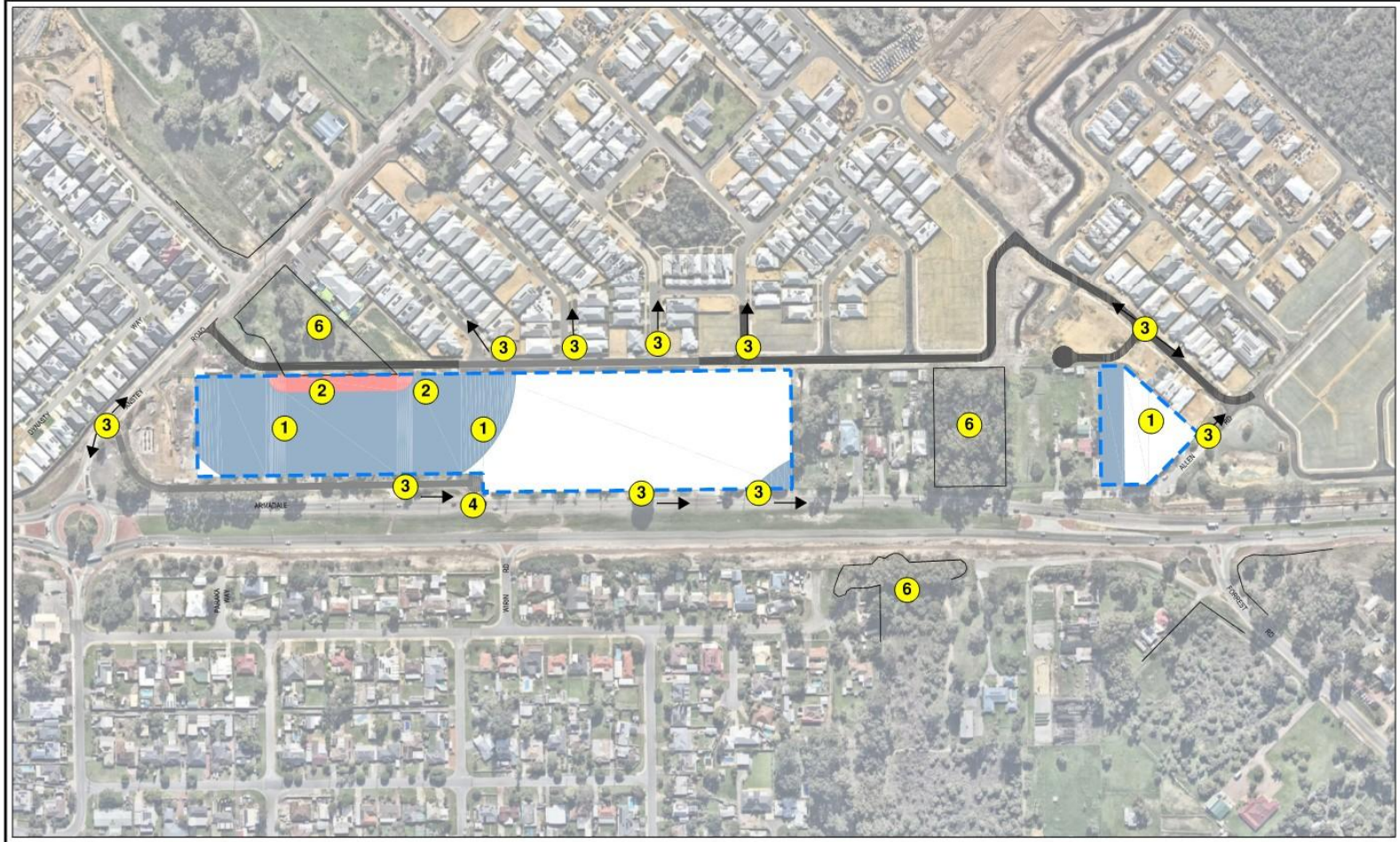
5.2 Additional Bushfire Mitigation Measures

A temporary perimeter APZ will be established and maintained in the site adjacent to woodland vegetation until the classified vegetation adjacent to the site is cleared for future development. This will ensure that all future dwellings will be exposed to BAL-29 or lower. In addition, all lots within the site and within 100 metres of classified vegetation will be established and maintained to APZ standards (see Appendix 1). Temporary Emergency Access Ways may be utilised during staged construction to ensure two access routes are maintained at all times.

The future subdivision application will layout the residential lots and roads. All lots will be maintained in a low threat condition prior to the issuing of titles.

A summary of management strategies is outlined in Figure 7.

There are no specific Vulnerable or High-Risk Land Uses proposed at the site. Any specific applications will trigger the necessary requirements under State Planning Policy 3.7.



REQUIREMENTS

1. All lots within 100 metres of classified vegetation will be established and maintained to APZ standards outlined in the BMP.

2. A temporary perimeter APZ along the north-western boundary will be established and maintained until classified vegetation adjacent to the site is permanently cleared for future development. All future dwellings can achieve BAL-29 or lower.

3. Armadale Road provides access to the east and west via the slip road and access through Anstey Road. Newly created public roads to the north provide egress to the north, east and west.

4. Armadale Road sliproad contains a 107 metre long no through road section which meets standards and has a compliant turnaround area for firefighting appliances.

5. The site is reticulated and hydrants will be provided to standards.

6. Temporary classified vegetation adjacent to the site poses the greatest threat from bushfire. Long term bushfire hazard once the surrounding area has been developed is significantly lower.

LEGEND:

- SUBJECT LAND
- PERIMETER ASSET PROTECTION ZONE
- LIMIT OF BUSHFIRE PRONE AREA
- FUTURE PUBLIC ROAD
- EXISTING PUBLIC ROAD
- COMPLIANT TURNAROUND FOR FIREFIGHTING APPLIANCES

FIGURE 7 - SPATIAL REPRESENTATION OF BUSHFIRE MITIGATION STRATEGIES

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0 20 40 60 80 100 120 140 160 180m

SCALE 1:4000 @ A3
DATE: SEPTEMBER 2025

NORTH

Location details:	Armadale Road, Cnr Anstey Rd Forrestdale
Assessment date:	July, 2025
Prepared by:	Bushfire Safety Consulting
Accreditation level:	Level 3 BPAD Practitioner
Accreditation number:	BPAD 23160
Accreditation expiry date:	31st January, 2026
Date aerial photo:	July, 2025

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE MEASURES

Table 7 outlines the initial and ongoing responsibilities, actions and associated works that need to be undertaken by the developer, future landowners and the City of Armadale. A Bushfire Planning Practitioner will certify the BAL ratings are correct and necessary implementation actions have been completed at subdivision stages.

Table 7. Responsibility for bushfire measures

DEVELOPER / PROPONENT / LANDOWNER **LSP, SUBDIVISION STAGE AND ONGOING MANAGEMENT**	
1	**At subdivision stage, update the BMP and ensure compliance with SPP 3.7 and the guidelines.**
2	**At subdivision stage, ensure vegetation within the site is removed and managed in a low threat condition within 100 metres of the subdivision boundaries where possible and confirm BAL ratings for individual lots prior to the creation of titles and to support building license applications.**
3	**Install public roads (if proposed) to standards outlined in Appendix 2.**
4	**Ensure the site complies with the City of Armadale's Fire Control Order as published..**
5	**A notification, pursuant to Section 70A of the Transfer of Land Act 1893 is to be placed on the certificate(s) of title of the lots within the Bushfire Prone Area. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows: 'The lot(s) is/are subject to a Bushfire Management Plan. (Local Government)'.**
6	**Update the Bushfire Management Plan as requested by the City of Armadale if it has reason to believe site conditions have substantially changed, or new methodologies or practice are adopted as identified in future revisions of the "Guidelines".**
CITY OF ARMADALE – ONGOING MANAGEMENT	
14	**Maintain public roads to appropriate standards and ensure compliance with the City of Armadale's Fire Control Notice.**

7 CONCLUSION

This Plan provides acceptable solutions and responses to the performance criteria that fulfil the intent of the bushfire hazard management issues outlined in the *Guidelines for Planning in Bushfire Prone Areas* (WAPC 2024). However, community bushfire safety is a shared responsibility between governments, fire agencies, communities and individuals.

The local structure plan is located in the Bushfire Prone Area (i.e. within 100 m of classified vegetation) and risk is reduced via compliance with *AS 3959:2018* standards. BAL-29 will not be exceeded on future dwellings, and existing and recommended APZ incorporates lots in the bushfire prone area and road reserves where they occur between bushfire hazard and the site.

A minimum of two access options and dedicated fire hydrant spacings for fire-fighting are provided.

The proposed development will fall within the acceptable level of risk.

BAL ratings will be certified at the creation of titles for lot purchasers to submit for the building license application process.

REFERENCES

Standards Australia. 2018. Construction of buildings in bushfire-prone areas (Amendments 1-3), AS 3959-2018, Standards Australia International Ltd, Sydney.

Western Australian Planning Commission (WAPC). 2024. State Planning Policy No. 3.7: Bushfire (SPP3.7). 2024. Western Australian Planning Commission and Department of Planning WA, Government of Western Australia.

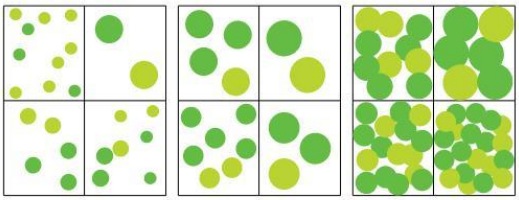
Western Australian Planning Commission (WAPC). 2024. Planning for Bushfire Guidelines (2024). Western Australian Planning Commission and Department of Planning WA, Government of Western Australia.

APPENDICES

Appendix 1: Asset Protection Zone Standards
Appendix 2: Vehicular Access Technical Requirements
Appendix 3: City of Armadale's Fire Break and Hazard Reduction Notice

Appendix 1: Asset Protection Zone Standards

Table 9: Asset Protection Zone (APZ) technical requirements

OBJECT	REQUIREMENT
Fences within the APZ	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).
Fine fuel load (combustible, dead vegetation matter less than 6 mm in thickness)	• Should be managed and removed on a regular basis to be maintained as low threat vegetation • Should be maintained at less than two tonnes per hectare (on average) • Mulches should be non-combustible such as stone, gravel, shells, rock or crushed mineral earth or wood mulch more than five millimetres in thickness.
Trees* (more than 6 m 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 less than 15 per cent of the total APZ area • Tree canopies at maturity should be at least 5 m apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided the total canopy cover within the APZ does not exceed 15 per cent and is not connected to the tree canopy outside the APZ. Tree canopy cover – ranging from 15 to 70 per cent at maturity  15% 30% 70%
Shrub* and scrub* (0.5 m to 6 m in height). Shrub and scrub more than 6 m in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings • Should not be planted in clumps more than five square metres in area • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground cover* (less than 0.5 m in height. Ground cover more than 0.5 m in height is to be treated as shrub)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above • Can be located within two metres of a structure but three metres from windows or doors if more than 100 mm in height.
Grass	• Grass should be maintained at a height of 100 mm 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 cover, grass and non- combustible mulches as prescribed above.
Liquid petroleum gas cylinders	• Should be located on the side of a building farthest 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.

Notes:
** Plant flammability, landscaping design and maintenance should be considered – refer to following explanatory notes*

Fine fuel load is the combustible, dead or dry vegetation matter on the ground, near ground, or elevated. Fine fuel includes grass, leaves, bark and twigs less than six millimetres in diameter that ignite readily and are burnt rapidly when dry.

Fine fuel should be maintained at less than 2t/ha. 100gm/m² equates to 1t/ha. To estimate a fuel load (in t/ha), collect the dry fine fuel from a representative one square meter and weigh (in grams using kitchen scales) and multiply the weight by 0.01.

Appendix 2: Vehicle Access Technical Requirements

Table 10: Vehicular access technical requirements

	1		2		3		4		5	
TECHNICAL REQUIREMENTS	**PERIMETER ROADS**		**PUBLIC ROADS**		**EMERGENCY ACCESS WAY[3]**		**FIRE SERVICE ACCESS ROUTE[3]**		**BATTLE-AXE & PRIVATE DRIVEWAYS[1]**	
MAP OF BUSH FIRE PRONE AREAS DESIGNATION	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**
Minimum horizontal clearance (metres)	12	8	See note 5		10	6	10	6	6	
Minimum vertical clearance (metres)	4.5									
Minimum weight capacity (tonnes)	15									
Maximum grade unsealed road[2]	See note 5		See note 5		1:10 (10% or 6°)					
Maximum grade sealed road[2,4]					1:7 (14.3% or 8°)					
Maximum average grade sealed road					1:10 (10% or 6°)					
Minimum inner radius of road curves (metres)					8.5					

Notes:

[1] Driveways and battle-axe legs to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision where not required to comply with the widths in this Appendix or the Guidelines.

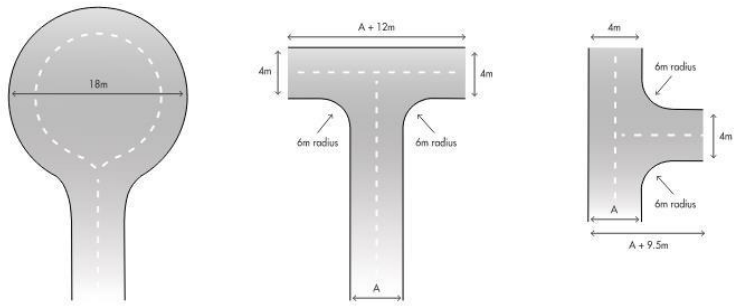
[2] Dips must have no more than a 1 in 8 (12.5% - 7.1 degrees) entry and exit angle.

[3] To have crossfalls between 3 per cent and 6 per cent.

[4] For sealed roads only the maximum grade of no more than 1 in 5 (20 per cent) (11.3 degrees) for no more than 50 metres is permissible, except for short constrictions to 3.5 metres for no more than 30 metres in length where an obstruction cannot be reasonably avoided or removed.

[5] As outlined in the Institute of **Public Works Engineering Australasia (IPWEA) subdivision guidelines**, **Liveable Neighbourhoods**, **Austroads Standards** Main Roads standard, supplement, policy or guideline and/or any applicable or relevant local government standard or policy.

Figure 30: Design requirements for a turn-around area



Appendix 3: City of Armadale Fire Break and Hazard Reduction Notice

CITY OF Armadale

Fire-break and Hazard Reduction Notice 2024/2025



Notice to all owners and occupiers of land situated within the City Of Armadale

BUSH FIRES ACT 1954

Notice is hereby given that pursuant to Section 33(1) of the *Bush Fires Act 1954*, all owners and/or occupiers of land within the City of Armadale are required to carry out fire prevention works in accordance with the requisitions of this Notice, to prevent the outbreak, spread or extension of a bush fire, on or before the 30th day of November 2024, or within fourteen days of becoming the owner or occupier of land should this be after the 30th day of November 2024, and maintain the required fire prevention works up to and including the 31st day of March 2025.

1. Definitions

Authorised Officer means an employee of the City of Armadale appointed as a Bush Fire Control Officer.

Bushfire Management Plan (BMP) means a plan that has been developed in accordance with *State Planning Policy 3.7*, and approved by the City of Armadale to reduce and mitigate fire hazards within a particular subdivision, lot or other area of land anywhere in the district.

Driveway means a point of access to a Habitable Building accessible for both conventional two wheel drive vehicles and firefighting appliances that is totally clear of inflammable matter and other objects or things.

Fire-break means an area of land constructed to a Trafficable surface and maintained totally clear of all inflammable matter leaving bare mineral earth, and includes the pruning and removal of any living or dead trees, scrub or any other material encroaching into the Vertical Axis of the fire-break area. Such fire-breaks may be constructed by one or more of the following methods: ploughing, cultivating, scarifying, raking, burning, chemical spraying or other method as approved by an Authorised Officer. Reticulated and maintained green lawn may be accepted in lieu of a Fire-break.

Fire Management Plan has the same meaning as Bushfire Management Plan.

Flammable Matter means any tree, bush, plant, grass, mineral, vegetable, substance, object, thing or material (except for living trees, shrubs, plants and lawns under cultivation) or any other thing deemed by an Authorised Officer to be capable of combustion that may, or is likely to, catch fire and burn.

Fuel Depot / Fuel Storage Area means an area of land, building or structure where fuel (i.e. petrol, diesel, kerosene, or any other hydrocarbon liquid) is kept, excepting where the quantities of fuel being stored are considered "minor storage quantities" under Table 2.1 of *Australian Standard AS1940* The storage and handling of flammable and combustible liquids.

Habitable Building means a dwelling, workplace, place of gathering or assembly and includes a building used for storage or display of goods or produce for sale by wholesale in accordance with classes 1 — 9 of the *Building Code of Australia*.

Haystack means any collection of hay including fodder rolls placed or stacked that exceeds 100m^3 in size (e.g. five (5) metres x five (5) metres x four (4) metres), whether in a shed, other structure or in the open air.

Trafficable means to be able to travel from one point to another in a four-wheel drive fire appliance on a clear surface, unhindered without any obstruction that may endanger such fire appliances. A Fire-break is not to terminate, or lead to a dead end without provision for egress to a safe place or a cleared turn around area of 17.5 metre radius.

Vertical Axis means a continuous vertical uninterrupted line at a right angle to the horizontal line of the Fire-break.

2. All Land greater than 5,000m^2

a. A three (3) metre wide Fire-break with a four (4) metre high Vertical Axis shall be constructed and maintained as close as practicable inside the property boundary but no more than ten (10) metres from the boundary around the entire perimeter of the property; and

b. A three (3) metre wide Fire-break with a four (4) metre high Vertical Axis shall be constructed and maintained immediately surrounding all outbuildings, sheds, haystacks and groups of buildings situated on the land; and

c. A three (3) metre wide driveway with a four (4) metre high Vertical Axis shall be installed and maintained; and

d. Gutters, roofs and walls of all Habitable Buildings are to be maintained free of Flammable Matter.

3. All Land 5,000m^2 or less

a. All Flammable Matter on the entire property (noting that this does not include living trees, shrubs, plants and reticulated lawns under cultivation) shall be reduced and maintained to a height of less than five (5) centimetres; and,

b. A three (3) metre wide driveway with a four (4) metre Vertical Axis shall be installed and maintained; and

Fire-break and Hazard Reduction Notice 2024/2025

c. Gutters, roofs and walls of all Habitable Buildings are to be maintained free of Flammable Matter.

4. Fuel Depot / Fuel Storage Areas

a. All inflammable matter within the Fuel Depot / Fuel Storage Area shall be cleared leaving bare mineral earth; and

b. A three (3) metre wide Fire-break with a four (4) metre Vertical Axis shall be installed and maintained immediately surrounding the Fuel Depot / Fuel Storage Area.

5. Hazard Reduction

The requirements of this Notice are considered to be the minimum requirement for fire prevention work, not only to protect individual properties but the district in general.

A separate Special Works Notice may be issued to individual landowners pursuant to Section 33 of the *Bush Fires Act 1954* to carry out further hazard reduction works with respect to anything upon the land, where in the opinion of an Authorised Officer, it is likely to be conducive to the outbreak and/or the extension of a bushfire.

6. Application to Vary Fire-break and Hazard Reduction Notice Requirements

If you consider, for any reason, that it is impractical to meet the requirements of this Notice, you may apply in writing to the City of Armadale, or its duly Authorised Officers, **no later than the 1st day of October 2024**, requesting authorisation to employ other methods of fire prevention. If permission is not granted by the City you must comply with the requirements of this Notice.

In some instances naturally occurring features such as rocky outcrops, natural watercourses or landscaping such as reticulated gardens, lawns or driveways may be an acceptable substitute for a Fire-break.

If approved the requirements of all approved variations to the Fire-break and Hazard Reduction Notice shall be established on or before the 30th day of November 2024 (or within 14 days of you becoming the owner or occupier should this occur after that date) and be maintained up to and including the 31st day of March 2025.

Note: No Fire-break exemptions will be given. Please apply for a Variation if an alternative location for Fire-break installation is required.

7. Bushfire Management Plans

Where an approved Bushfire Management Plan (BMP), exists for an individual or group of properties as part of a development or subdivision approval, the owners and/or occupiers of those properties shall comply with the requirements and responsibilities of that BMP in its entirety. Some BMPs may also require compliance with this Notice.

BMPs can be viewed on the City's website via **www.armadale.wa.gov.au/bushfire-management-plans**. If you have trouble accessing your BMP please contact the City's Customer Service Team on 9394 5000.

8. Asset Protection Zone (APZ) Assessments

Where an approved Asset Protection Zone (APZ) has been developed in accordance with *Australian Standard 3959* as part of a development application, compliance with the requisitions of the APZ assessment is required in addition to the requirements contained within this Notice.

9. Penalties

Failure or neglect to comply with the requisitions of this Notice is an offence and can result in a penalty of up to $5000.

Furthermore, Authorised Officers, servants, workmen, contractors, vehicles, machinery and appliances (as the officers deem fit) may enter upon the land and carry out the requisitions of this Notice that are not complied with by the time specified in the Notice, and the amount of any costs and expenses incurred may be recovered from you as the owner and/or occupier of the land.

By order of the City of Armadale

Chief Executive Officer
Joanne Abbiss

Additional Important Information

Camping or Cooking Fires (Section 25(1a) *Bush Fires Act 1954*)

In accordance with the provisions of Section 25(1a) of the *Bush Fires Act 1954* the lighting of camping or cooking fires is prohibited on all land within the City of Armadale during the Prohibited Burning Time. This prohibition does not apply to a gas appliance that does not consume solid fuel comprising of a fire, the flame of which is encapsulated by the appliance.

Burning of Garden Refuse (Section 24G(2) *Bush Fires Act 1954*)

For the purposes of this Notice, *"Restricted Burning Time"* means the 1st day of October 2024 through until the 31st day of May 2025 (inclusive and as varied pursuant to Section 18 of the *Bush Fires Act 1954*) and the *"Prohibited Burning Time"* means the 1st day of December 2024 through until the 31st day of March 2025 (inclusive and as varied pursuant to Section 17 of the *Bush Fires Act 1954*).

a. In accordance with the provisions of Section 24G of the *Bush Fires Act 1954* the burning of garden refuse in an incinerator or on the ground that would otherwise be permitted under Section 24F is absolutely prohibited –

   i. on land 1,200m² in size or less, during the Restricted Burning Time; and

   ii. on land larger than 1,200m² in size, during the Prohibited Burning Time.

The effect of this Notice is that the burning of garden refuse in an incinerator or on the ground on land that is 1,200m² or less in size is prohibited at all times, unless specifically authorised by a bush fire control officer, and the burning of garden refuse in an incinerator or on the ground is prohibited on all land within the district during the Prohibited Burning Time.

b. In addition to the restrictions under Clause (a), garden refuse in an incinerator or on the ground must be burnt in accordance with the following conditions –

   i. There is no inflammable matter (other than that being burnt) within five (5) metres of the fire at any time while the fire is burning; and

   ii. The fire is lit between 6.00pm and 11.00pm and is completely extinguished before midnight on the same day; and

   iii. At least one person is present at the site of the fire at all times until it is completely extinguished; and

   iv. When the fire is no longer required, the person who lit the fire must ensure that the fire is completely extinguished by the application of water or earth; and

   v. Only one pile (up to one (1) cubic metre in size) of garden refuse may be burnt at any one time; and

   vi. No burning on a Sunday or a day that is a Public Holiday; and

   vii. The person intending to light the fire must telephone the Department of Fire and Emergency Services' Communications Centre (COMCEN) on 08 9395 9209 and register the burn immediately prior to lighting the fire.

c. Any time when there is in force a fire danger forecast issued for the district by the Bureau of Meteorology of Catastrophic, Extreme or High, a Total Fire Ban (TFB) or any other prohibition is in effect under the *Bush Fires Act 1954*, burning of garden refuse in an incinerator or on the ground is prohibited on all land within the district.

The *City of Armadale Environment, Animals and Nuisance Local Laws 2002* further restricts and/or prohibits burning of rubbish or refuse on land in the district.

No Burning on Sundays or Public Holidays

In accordance with Clause 49(2)(a) of the *City Of Armadale Environment, Animals and Nuisance Local Laws 2002* an owner and/or occupier of land shall not set fire to, or cause or allow to be set on fire, any bush, rubbish or refuse whatsoever on a Sunday or a day that is a Public Holiday, except when specifically authorised to do so for the purpose of fuel reduction by a Bush Fire Control Officer (BFCO) duly appointed under Section 38 of the *Bush Fires Act 1954*.

Clearing of Remnant Native Vegetation – Rural Living & Special Rural Zone

In accordance with the *City of Armadale Town Planning Scheme No.4*, a separate Development Approval to clear native vegetation on properties zoned Rural Living or Special Rural may need to be obtained. Generally, clearing to satisfy necessary bush fire protection measures as determined by the local government or other relevant authority is exempt from planning approval. Please refer to the following sections of *Town Planning Scheme No.4* for further information:

- Clause 4.7.5 deals with clearing where a property contains a development envelope;
- Clause 4B.7 deals with clearing in the Rural Living and General Rural zones; and,
- Clause 4C.9 deals with clearing in the Strategic Regional Centre, District Centre, Local Centre and Mixed Business/Residential zones.

See link - **https://www.armadale.wa.gov.au/sites/default/files/assets/documents/docs/Planning_and_Land_Use/Town_Planning_Scheme_No.4.pdf**

Specific situations where development approval is required for the clearing of remnant native vegetation is outlined within the following info sheet:

https://www.armadale.wa.gov.au/sites/default/files/assets/documents/docs/Planning_and_Land_Use/Info_Clearing_Vegetation_Fire_Hazard_Reduction.pdf

Important Number

ALL EMERGENCIES CALL 000 | FIRE AMBULANCE POLICE

DFES TOTAL FIRE BAN HOTLINE 1800 709 355

Western Australian Bureau of Meteorology 1300 183 341

City of Armadale Rangers 9394 5000 | After Hours 1300 886 885

To obtain a fire permit 9394 5000

Information correct at time of printing 12 July 2024

7 Orchard Avenue Armadale
9394 5000 | info@armadale.wa.gov.au
armadale.wa.gov.au

CITY OF Armadale

Fire-break and Hazard Reduction Notice 2024/2025

ATTACHMENT 7

Acoustic Assessment

HERRING STORER ACOUSTICS

VARIOUS LOTS ARMADALE ROAD FORRESTDALE

STRUCTURE PLAN

ROAD TRAFFIC (SPP 5.4) NOISE MANAGEMENT PLAN

JULY 2023

OUR REFERENCE: 31346-4-22228

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

SPP 5.4 NOISE MANAGEMENT PLAN
FORRESTDALE STRUCTURE PLAN

Job No: 22228

Document Reference: 31346-4-22228
FOR

ROWE GROUP

DOCUMENT INFORMATION			
Author:	Paul Daly	**Checked By:**	Tim Reynolds
Date of Issue:	27 July 2023		

REVISION HISTORY

Revision	Description	Date	Author	Checked
1	Staging for wall		PLD	
2	Updated for DPLH Comments – Including removal of wall	13/03/2026	PLD	
3	Updated Opportunities and Constraints Plan	29/04/2026	PLD	

DOCUMENT DISTRIBUTION

Copy No.	Version No.	Destination	Hard Copy	Electronic Copy
1	4	Rowe Group Attn: Sam Bowers Email: Sam.Bowers@rowegroup.com.au		✓

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APPENDICIES

A	Subdivision Concept Plan
B	Noise Contour Plots
C	Quiet House Design Noise Contour Plot
D	“Quiet House” Design – General Information
E	MRWA Traffic Data
F	Noise Monitoring Data

EXECUTIVE SUMMARY

Herring Storer Acoustics were commissioned by Rowe Group on behalf of the owners to carry out an acoustical assessment of noise received within the proposed Local Structure Plan (LSP) for various Lots on Armadale Road, which is bounded by Anstey, Allen and Armadale Roads.

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).

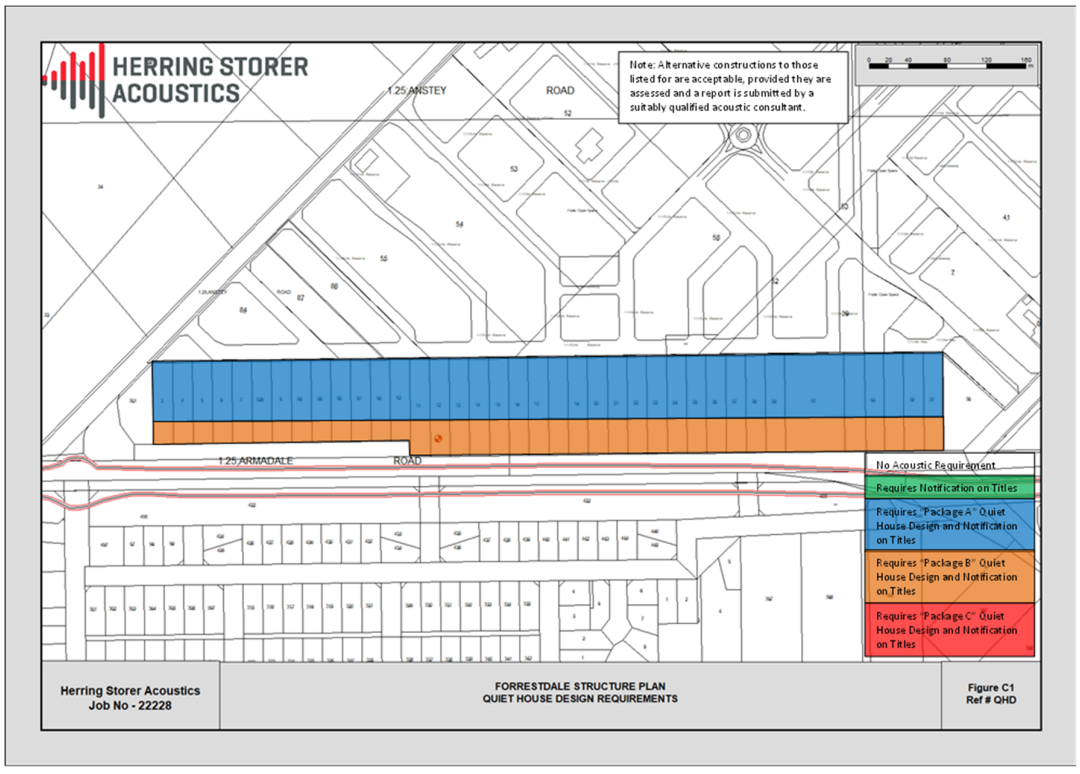
INTERNAL

$L_{Aeq(Day)}$ 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, the following have been provided:

- Quiet House Design Packages and Notification on Titles for façade Lots 55 dB(A) or greater.



Any future lots exceeding the 55 dB(A) day target criteria would require Notification on Titles.

The acoustic advice provided is based on the Local Structure Plan. This advice may be refined at Subdivision Stage when more details as to Lot alignment and subdivision heights become available.

1. INTRODUCTION

Herring Storer Acoustics were commissioned by Rowe Group on behalf of the owners to carry out an acoustical assessment of noise received within the proposed Local Structure Plan (LSP) for various Lots on Armadale Road, which is bounded by Anstey, Allen and Armadale Roads.

As part of the study, the following was carried out:

- Measurement at the proposed development of the current noise levels for road traffic on Armadale Road.
- Determine by noise modelling the noise that would be received at proposed residences within this development from vehicles travelling on Armadale Road in 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 future notification on titles.

For information, the Subdivision Plan is attached in Appendix A.

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 as part of the study with the results used to calibrate the noise model.

In summary, the monitoring was undertaken over seven-day period commencing 17th August 2022. Monitoring was conducted at boundary of the development, facing Armadale Road (Lot 12). The monitor was placed 20m from the nearest running edge of the respective road of interest.

The results of this monitoring are summarised in Table 3.1.

TABLE 3.1: SUMMARY OF MEASURED ROAD TRAFFIC NOISE LEVELS (dB(A))

Date	Monitor		
	$L_{A10(18hour)}$	$L_{Aeq,day}$ (6am to 10pm)	$L_{Aeq,night}$ (10pm to 6am)
AVERAGE	**68.4**	**65.5**	**56.8**

Note: Based on the results of the noise monitoring the difference between the L_{Aeq} (Day) and L_{Aeq} (Night) is greater than 5 dB(A) (ie; 8.7 dB(A)). Hence, achieving compliance with the day period criteria would also result in compliance with the night period criteria and the day period has been used for the assessment.

For information, the results of the monitoring are shown graphically in Appendix E with Figure 3.1 showing the location map, and Figure 3.2 showing the monitor in situ and the Armadale Road surface.



FIGURE 3.1 - NOISE MONITOR LOCATION PLAN



FIGURE 3.2 - NOISE MONITOR IN SITU AND 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 4.1 - NOISE MODELLING INPUT DATA

Parameter	Current (2021/22)	Future (2041)
Traffic flows VPD Armadale Road East Bound	13,600	30,400
Traffic flows VPD Armadale Road West Bound	13,000	26,800
Heavy Vehicles (%)	10%	10%
Traffic Speed km/hr	80	80
Road Surface	14mm Chipseal	14mm Chipseal
Façade Correction	+2.5	+2.5

The future road traffic volumes were based on information provided by the MRWA ROM department (shown in Appendix E) and the traffic maps.

Other input data for the model included:

- Traffic data from MRWA (https://mrapps.mainroads.wa.gov.au/TrafficMap/)
- Traffic as provided by the MRWA ROM Department, as attached in Appendix E.
- 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 vehicle's 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 Lots of the development (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 proposed Armadale Road, the following scenarios were modelled:

1. Current Traffic Volumes (Calibration)
2. Future traffic volumes No Noise Control.
3. Future traffic volumes with future development (houses on Lots)

We note that for Armadale Road, the difference between the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ would be greater than 5 dB(A), hence the day period is the critical period for compliance and achieving compliance with the day period criteria will also result in compliance with the night period criteria.

Therefore, noise modelling was only undertaken for the day period and the results are shown as Figures in Appendix B and 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)

For lots where noise level would be above the 55 dB(A) limit, notifications on titles are required.

To comply with the Policy, the following have been provided:

- Quiet House Design Packages and Notification on Titles for façade Lots 55 dB(A) or greater (Identified in Appendix C).

As there are existing residential dwellings on the Lots, the built form provides a barrier to rear Lots. If these were to be demolished, the future dwelling built in its place would provide the same form of attenuation. Therefore, Future buildings located on the boundary Lots of the development have been assumed to be present for future road traffic volumes being either existing, or newly constructed.
Any future lots exceeding the 55 dB(A) day target criteria would require Notification on Titles.

Information on the deemed to satisfy constructions for the various “Quiet House Design” packages are contained in Appendix D.

Notes:

1 The summary of the Quiet House Design Packages constructions attached in Appendix 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.

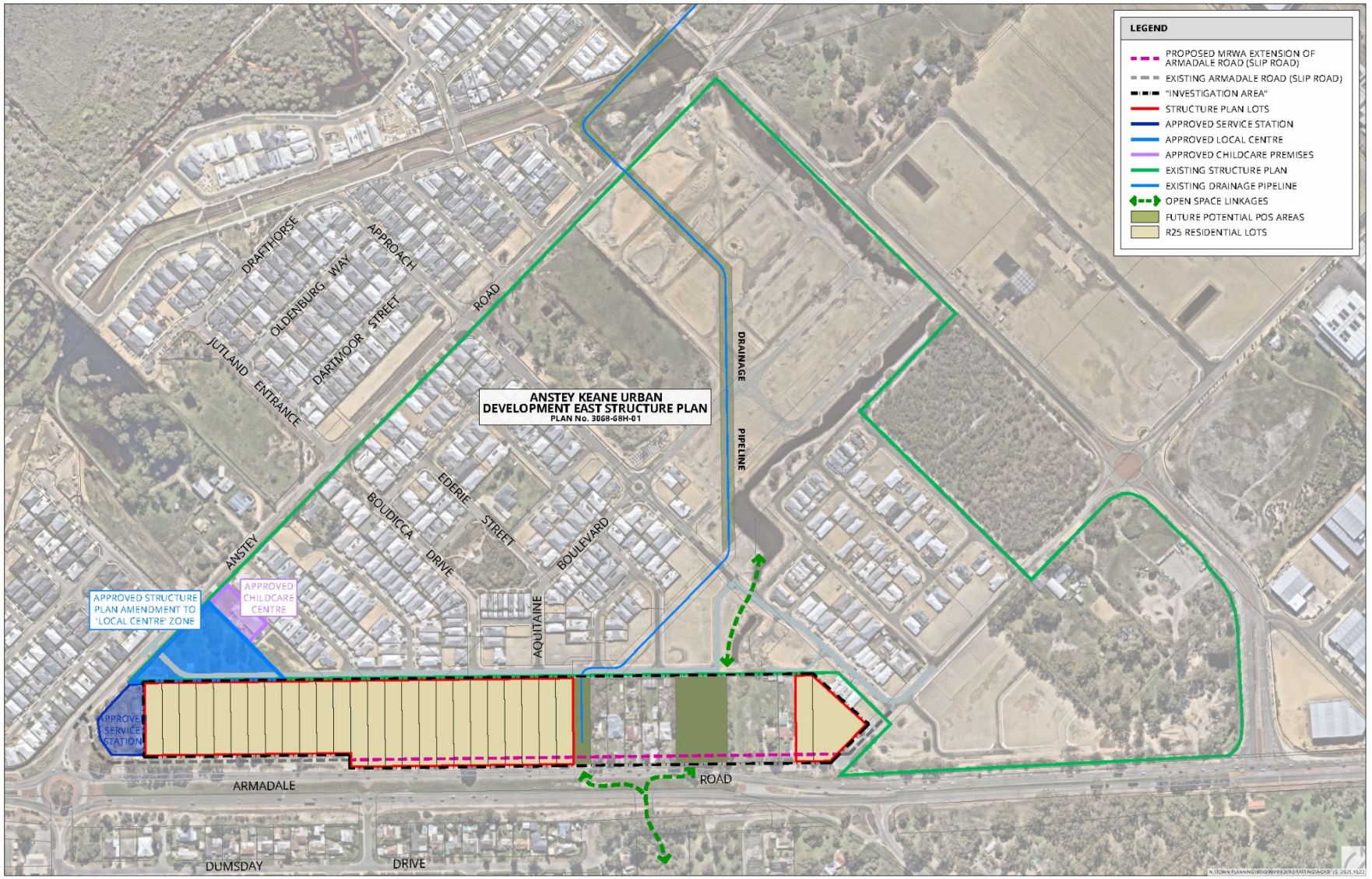
2 Quiet House Design requirements are likely to lessen for residential premises set back from the roadway, as the façade residences will barrier those behind.

3 Additionally, these residences also require Notifications on Titles.

4 The acoustic advice provided is based on the Local Structure Plan. This advice may be refined at Subdivision Stage when more details as to Lot alignment and subdivision heights become available.

APPENDIX A

LOCAL STRUCTURE PLAN



OPPORTUNITIES AND CONSTRAINTS
VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N
0 75 m
SCALE @ A3: 1:4000
9269-FIG-08-C

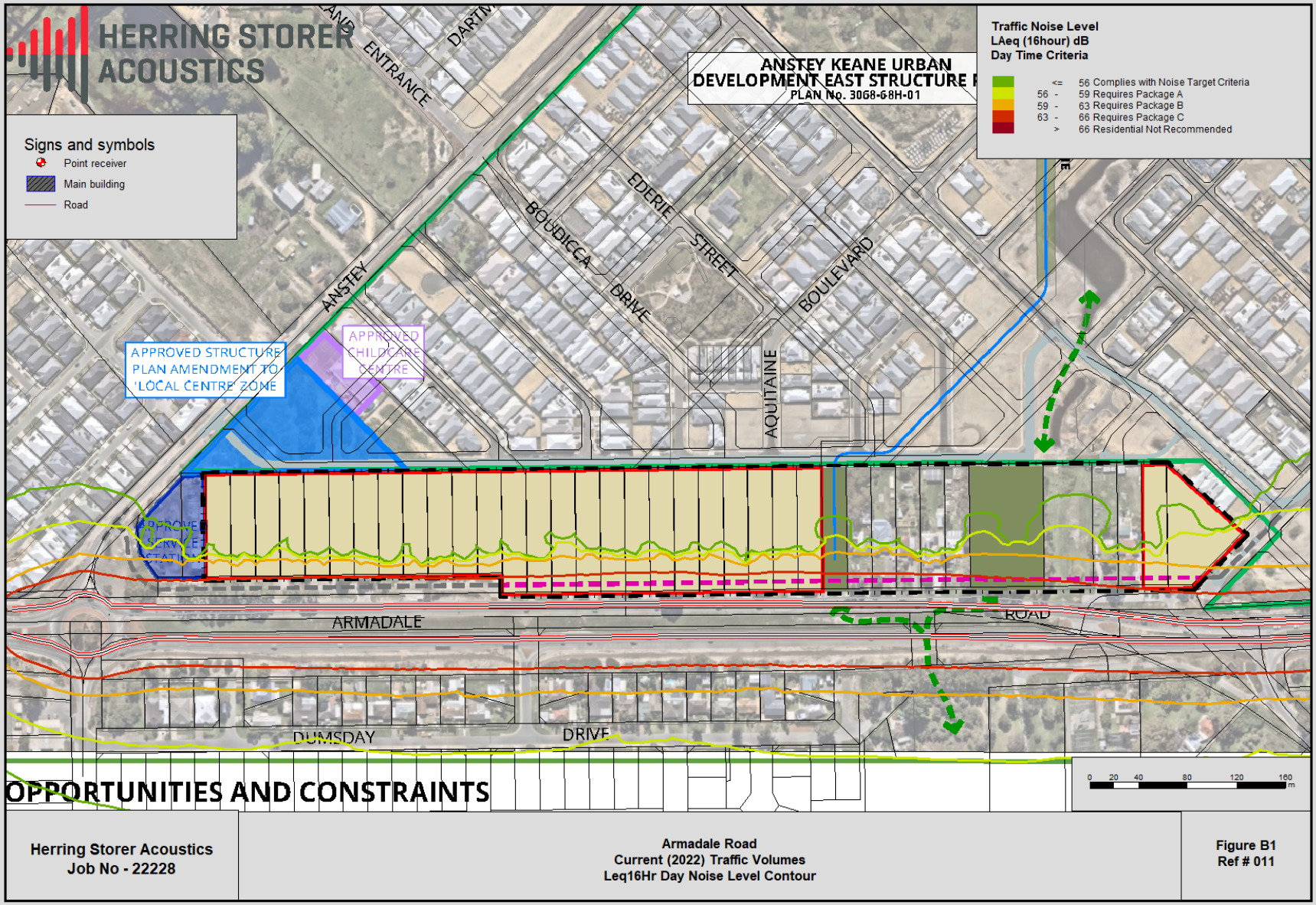
DRAWN: JS
DATE CREATED: 2025.10.22
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

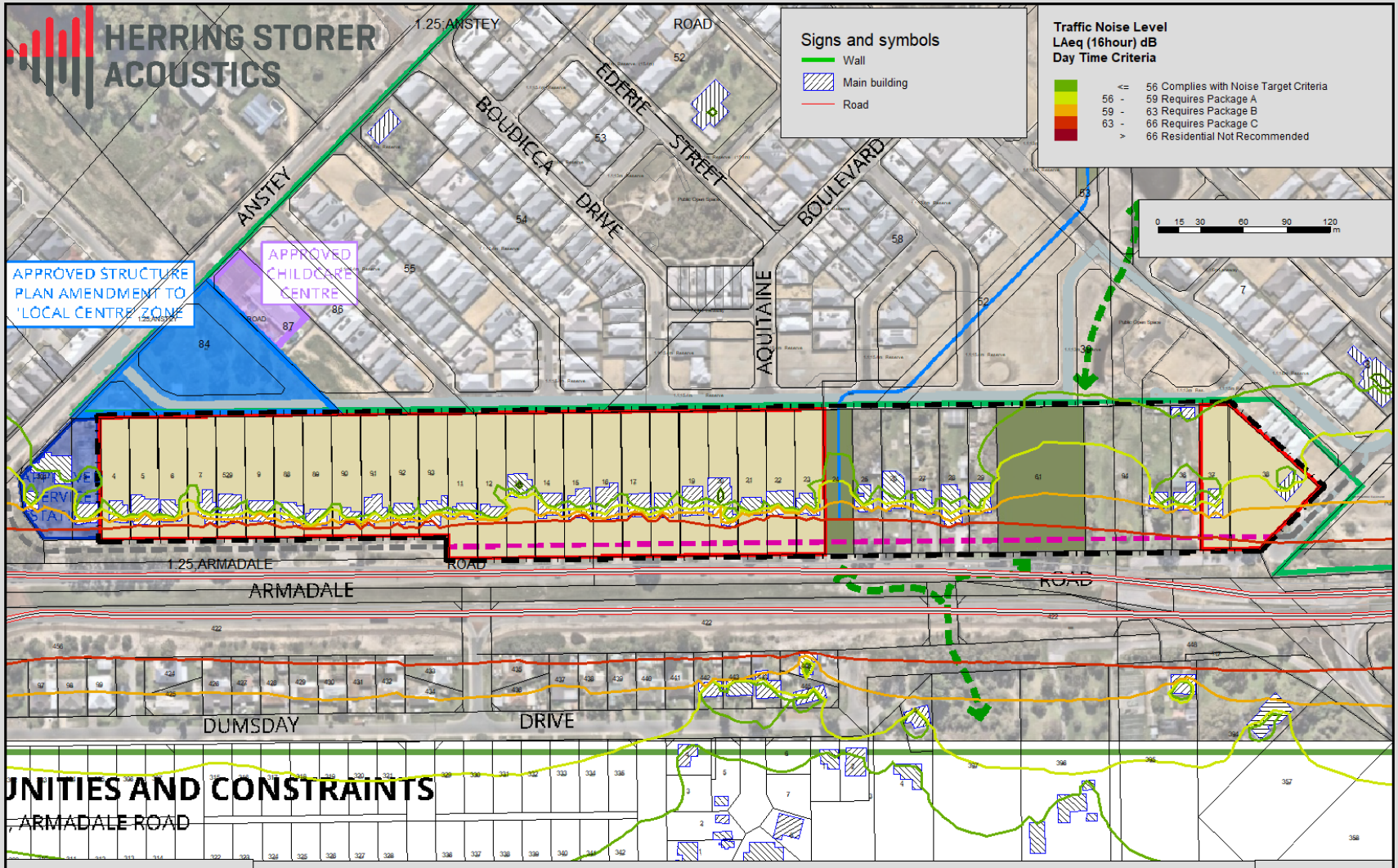
This document may not be reproduced without the written consent of Rowe Group. All areas and dimensions are subject to survey.

ROWE GROUP DESIGN

APPENDIX B

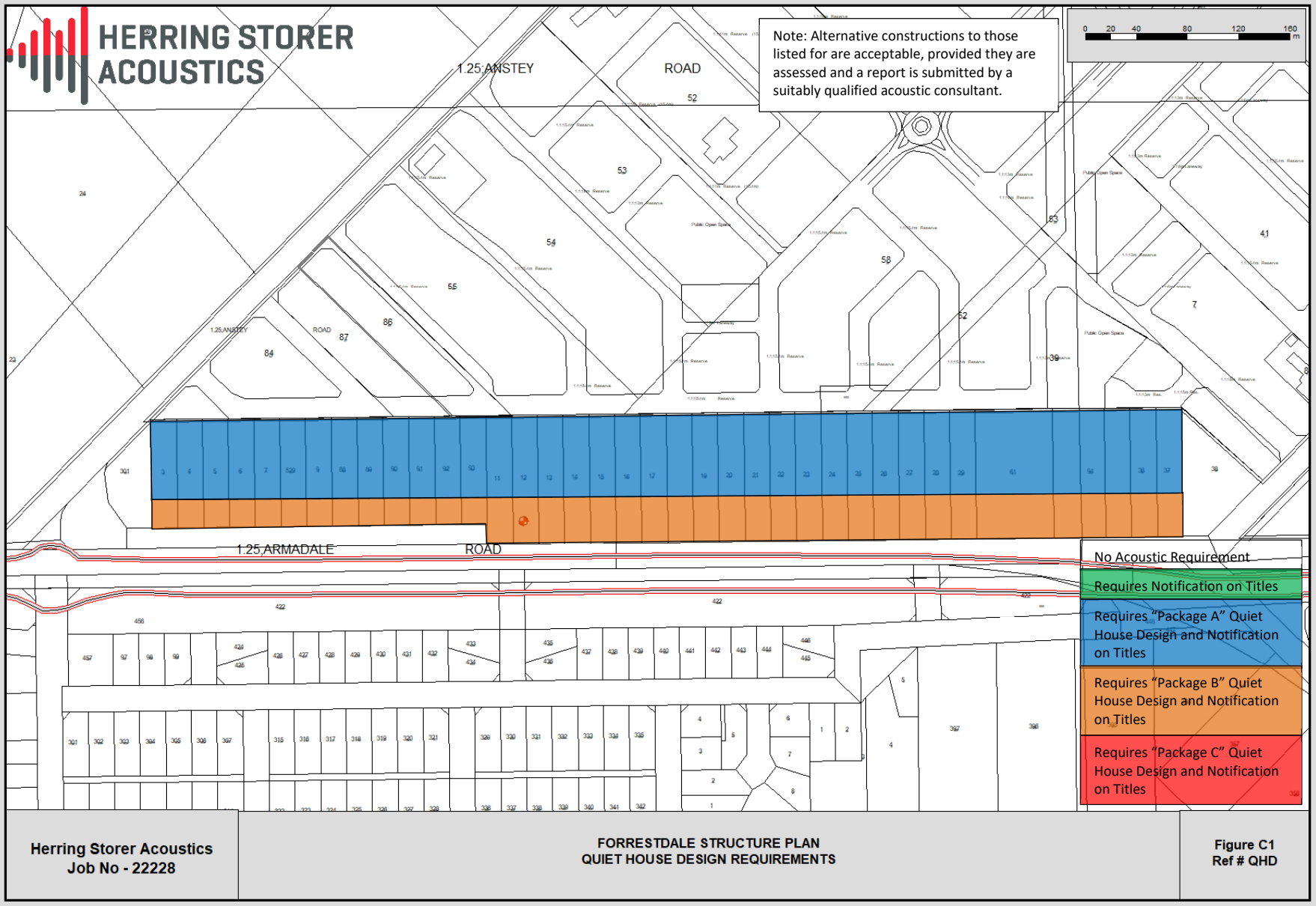
NOISE CONTOUR PLOTS


HERRING STORER ACOUSTICS
ENTRANCE
ANSTEY KEANE URBAN DEVELOPMENT EAST STRUCTURE
PLAN No. 3068-68H-01
Traffic Noise Level
LAeq (16hour) dB
Day Time Criteria
<= 56 Complies with Noise Target Criteria
56 - 59 Requires Package A
59 - 63 Requires Package B
63 - 66 Requires Package C
> 66 Residential Not Recommended
Signs and symbols
Point receiver
Main building
Road
ANSTEY
BOUDICCA
DRIVE
EDERIE
STREET
BOULEVARD
AQUITAINE
APPROVED STRUCTURE PLAN AMENDMENT TO 'LOCAL CENTRE' ZONE
APPROVED CHILDCARE CENTRE
ARMADALE
ROAD
DUMSDAY
DRIVE
0 20 40 80 120 160 m
OPPORTUNITIES AND CONSTRAINTS
Herring Storer Acoustics
Job No - 22228
Armadale Road
Current (2022) Traffic Volumes
Leq16Hr Day Noise Level Contour
Figure B1
Ref # 011


HERRING STORER ACOUSTICS
Signs and symbols
Wall
Main building
Road
Traffic Noise Level
LAeq (16hour) dB
Day Time Criteria
<= 56 Complies with Noise Target Criteria
56 - 59 Requires Package A
59 - 63 Requires Package B
63 - 66 Requires Package C
> 66 Residential Not Recommended
0 15 30 60 90 120 m
1.25 ANSTEY ROAD
EDERIE STREET
BOUDICCA DRIVE
AQUITAINE BOULEVARD
ANSTEY
APPROVED STRUCTURE PLAN AMENDMENT TO 'LOCAL CENTRE' ZONE
APPROVED CHILDCARE CENTRE
1.25 ARMADALE ROAD
ARMADALE
DUMSDAY DRIVE
UNITIES AND CONSTRAINTS
ARMADALE ROAD
Herring Storer Acoustics
Job No - 22228
Armadale Road
Future Traffic Volumes (Current or Future Housing)
LAeq (16hour) Day Noise Level Contour
Figure B2
Ref # 012

APPENDIX C

"QUIET HOUSE" DESIGN REQUIREMENTS


HERRING STORER ACOUSTICS
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
0 20 40 80 120 160 m
1.25;ANSTEY
ROAD
1.25;ARMADALE
ROAD
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
Herring Storer Acoustics
Job No - 22228
FORRESTDALE STRUCTURE PLAN
QUIET HOUSE DESIGN REQUIREMENTS
Figure C1
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*)

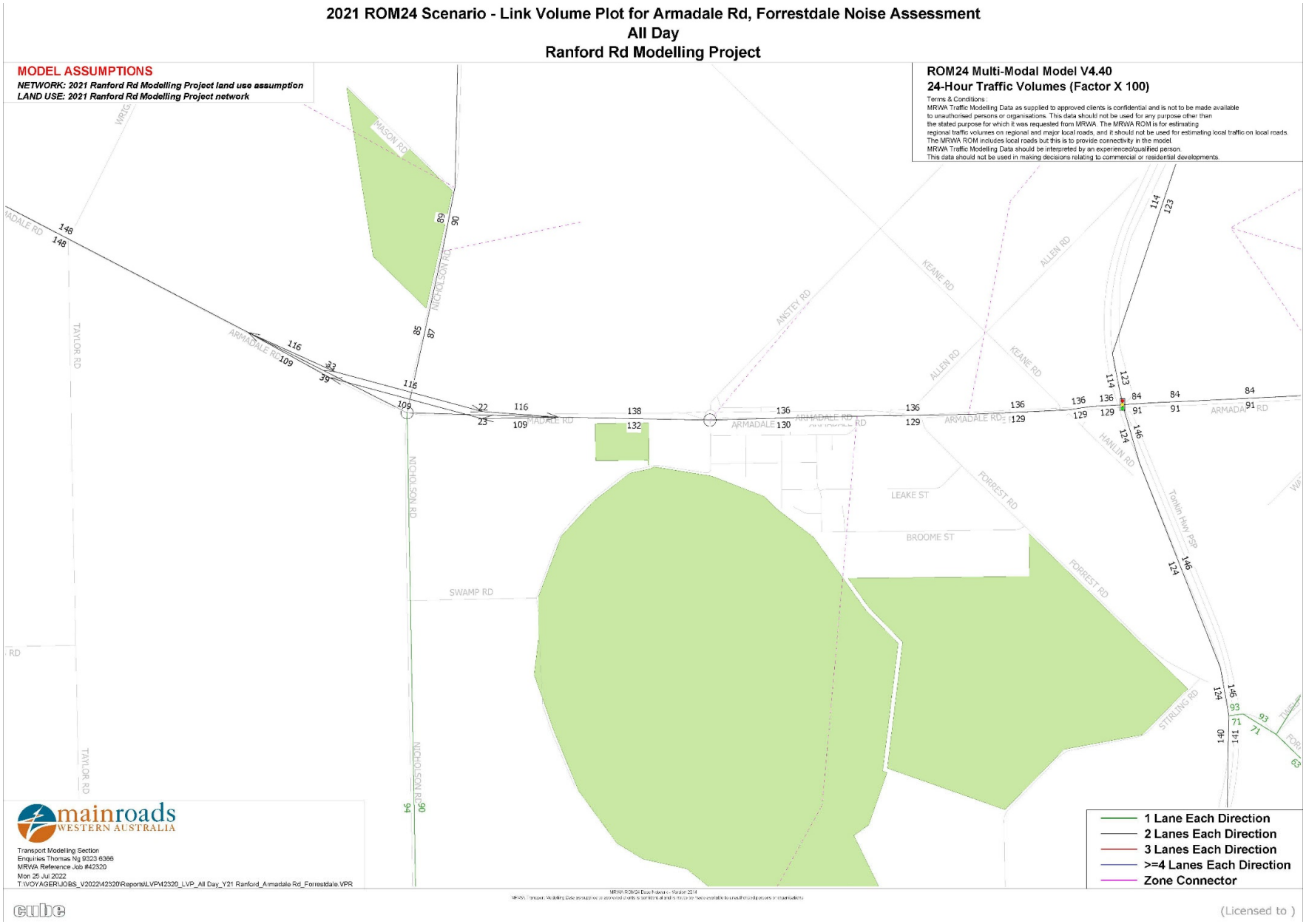
Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
B **Quiet House B**	**Facing**	**Bedroom and indoor 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%			

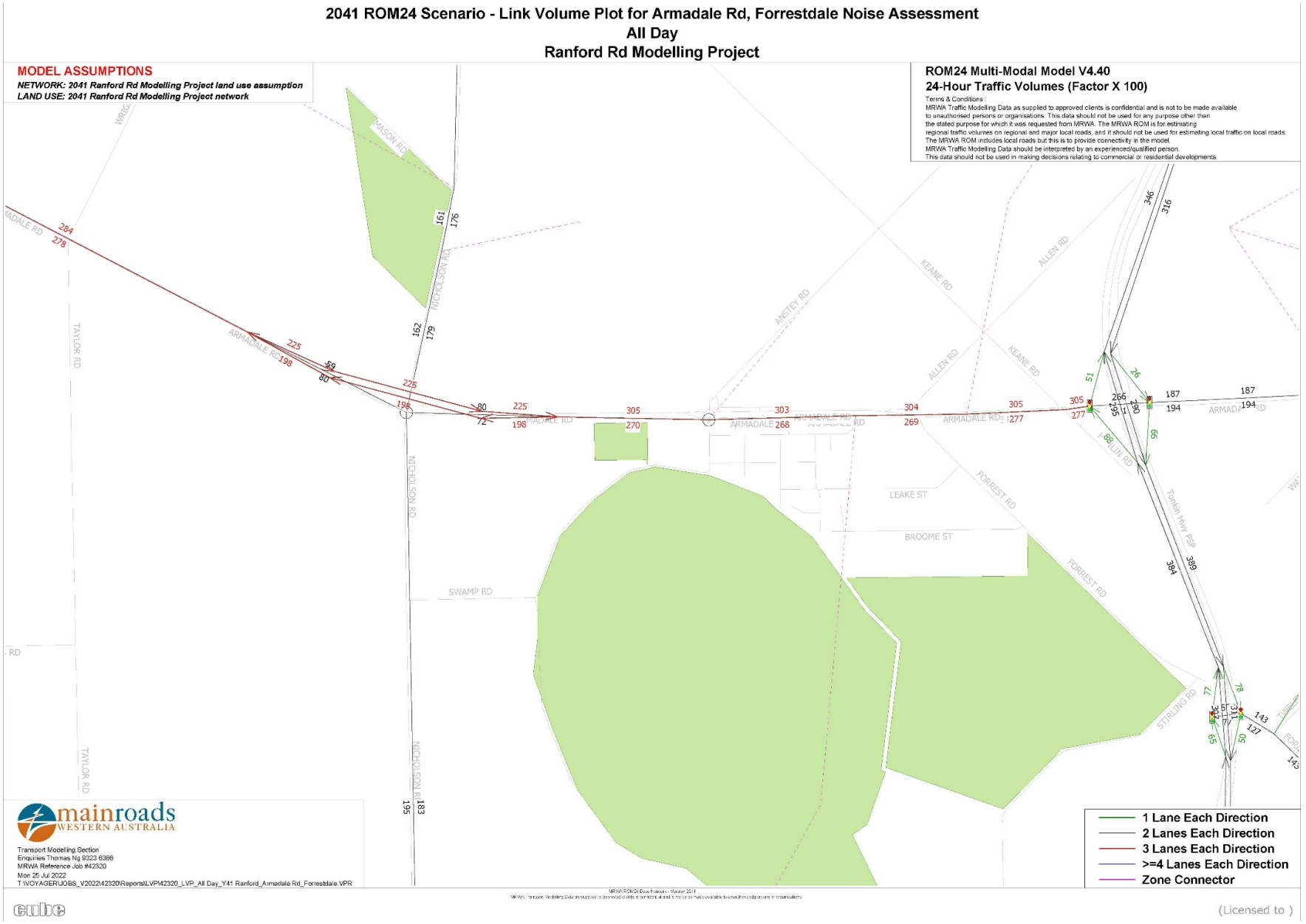
Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

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 **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	**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 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

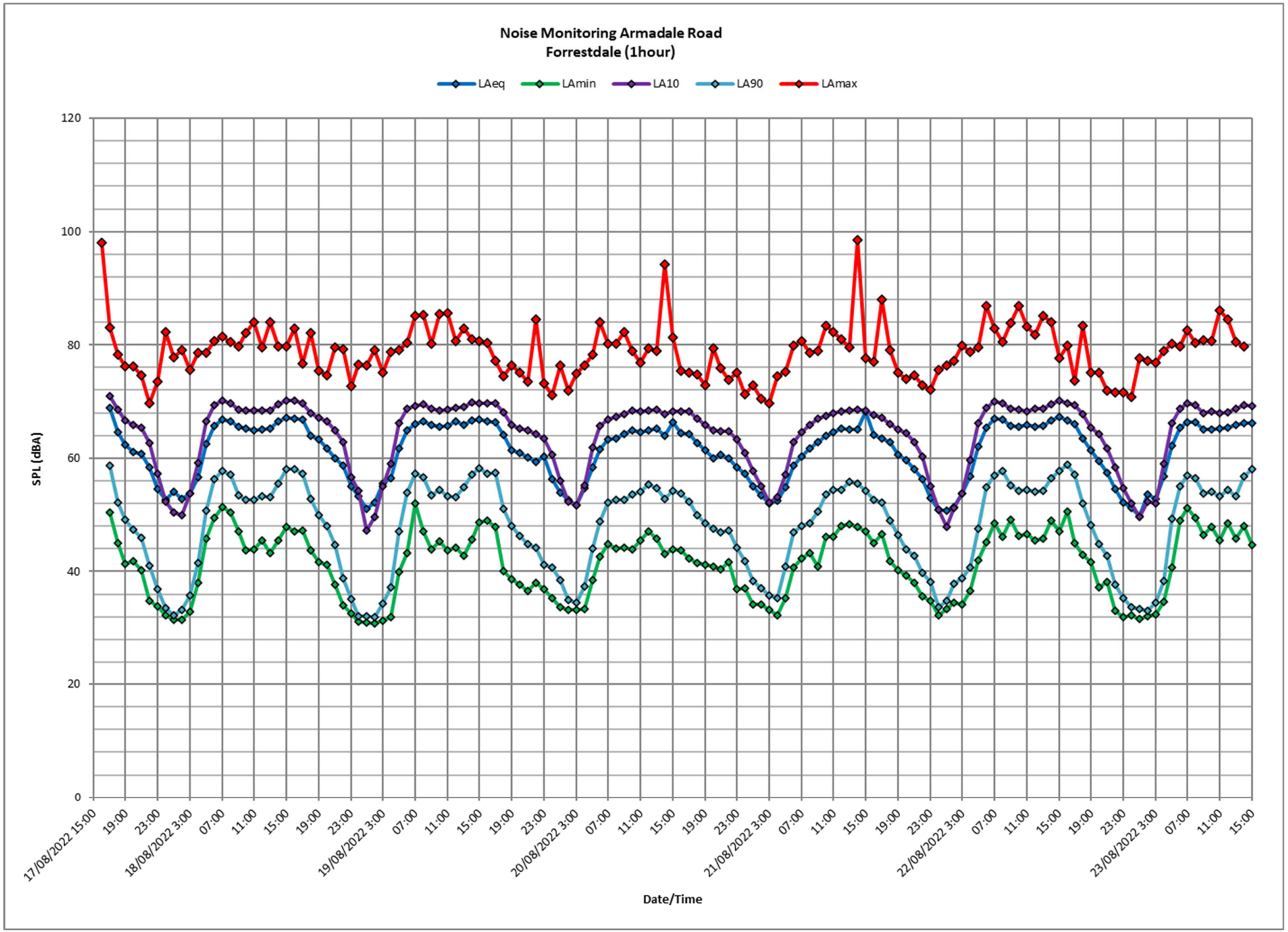
TRAFFIC DATA


2021 ROM24 Scenario - Link Volume Plot for Armadale Rd, Forrestdale Noise Assessment
All Day
Ranford Rd Modelling Project
MODEL ASSUMPTIONS
NETWORK: 2021 Ranford Rd Modelling Project land use assumption
LAND USE: 2021 Ranford Rd Modelling Project network
ROM24 Multi-Modal Model V4.40
24-Hour Traffic Volumes (Factor X 100)
Terms & Conditions :
MRWA Traffic Modelling Data as supplied to approved clients is confidential and is not to be made available to unauthorised persons or organisations. This data should not be used for any purpose other than the stated purpose for which it was requested from MRWA. The MRWA ROM is for estimating regional traffic volumes on regional and major local roads, and it should not be used for estimating local traffic on local roads. The MRWA ROM includes local roads but this is to provide connectivity in the model. MRWA Traffic Modelling Data should be interpreted by an experienced/qualified person. This data should not be used in making decisions relating to commercial or residential developments.
ARMADALE RD
MASON RD
NICHOLSON RD
TAYLOR RD
ANSTEY RD
KEANE RD
ALLEN RD
HAMLIN RD
LEAKE ST
BROOME ST
FORREST RD
SWAMP RD
STIRLING RD
Tonkin HWY PSP
mainroads WESTERN AUSTRALIA
Transport Modelling Section
Enquiries Thomas Ng 9323 6388
MRWA Reference Job #42320
Mon 25 Jul 2022
T:\VOYAGER\JOBS_V2022\42320\Reports\LVP\42320_LVP_All Day_Y21 Ranford_Armadale Rd_Forrestdale.VPR
1 Lane Each Direction
2 Lanes Each Direction
3 Lanes Each Direction
>=4 Lanes Each Direction
Zone Connector
cube
(Licensed to)


2041 ROM24 Scenario - Link Volume Plot for Armadale Rd, Forrestdale Noise Assessment
All Day
Ranford Rd Modelling Project
MODEL ASSUMPTIONS
NETWORK: 2041 Ranford Rd Modelling Project land use assumption
LAND USE: 2041 Ranford Rd Modelling Project network
ROM24 Multi-Modal Model V4.40
24-Hour Traffic Volumes (Factor X 100)
Terms & Conditions :
MRWA Traffic Modelling Data as supplied to approved clients is confidential and is not to be made available to unauthorised persons or organisations. This data should not be used for any purpose other than the stated purpose for which it was requested from MRWA. The MRWA ROM is for estimating regional traffic volumes on regional and major local roads, and it should not be used for estimating local traffic on local roads. The MRWA ROM includes local roads but this is to provide connectivity in the model.
MRWA Traffic Modelling Data should be interpreted by an experienced/qualified person.
This data should not be used in making decisions relating to commercial or residential developments.
ARMADALE RD
NICHOLSON RD
TAYLOR RD
MASON RD
ANSTEY RD
KEANE RD
ALLEN RD
LEAKE ST
BROOME ST
FORREST RD
SWAMP RD
STIRLING RD
Tonkin Hwy PSP
mainroads
WESTERN AUSTRALIA
Transport Modelling Section
Enquiries Thomas Ng 9323 6366
MRWA Reference Job #2320
Mon 25 Jul 2022
T:\VOYAGER\JOBS_V2022\42320\Reports\LVP\42320_LVP_All Day_Y41 Ranford_Armadale Rd_Forrestdale.VPR
1 Lane Each Direction
2 Lanes Each Direction
3 Lanes Each Direction
>=4 Lanes Each Direction
Zone Connector
cube
(Licensed to)

APPENDIX F

MONITORING DATA


Noise Monitoring Armadale Road
Forrestdale (1hour)
LAeq
LAmin
LA10
LA90
LAmax
SPL (dBA)
120
100
80
60
40
20
0
17/08/2022 15:00
19:00
23:00
18/08/2022 3:00
07:00
11:00
15:00
19:00
23:00
19/08/2022 3:00
07:00
11:00
15:00
19:00
23:00
20/08/2022 3:00
07:00
11:00
15:00
19:00
23:00
21/08/2022 3:00
07:00
11:00
15:00
19:00
23:00
22/08/2022 3:00
07:00
11:00
15:00
19:00
23:00
23/08/2022 3:00
07:00
11:00
15:00
Date/Time

ATTACHMENT 8

Preliminary Tree Assessment



PRELIMINARY TREE ASSESSMENT

VARIOUS LOTS - ARMADALE ROAD & ALLEN ROAD, FORRESTDALE

PREPARED FOR:
ROWE GROUP
SAM BOWERS
TOWN PLANNER

PREPARED BY:
LUKE LUMBUS
ARBORICULTURAL CONSULTANT
E: LUKE@ARBORIBUS.COM.AU – M: 0406 396 778
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DATE ISSUED: 2 DECEMBER 2022

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1 PURPOSE OF THIS REPORT

- To undertake an Arboricultural inspection of trees within various properties on Armadale Road & Allen Road in Forrestdale (refer highlighted areas in figure 1); provide comment regarding tree status and; identify preliminary considerations to be further established as part of any proposed development in proximity to trees identified for retention.



Figure 1. Location of areas specified for tree assessment (Outlined Red) along Armadale Road & Allen Road in Forrestdale. Aerial image source Rowe Group - Date supplied - 30 August 2022

ARBORIBUS
CONSULTING

2 BACKGROUND

2.1 BRIEF

- At the request of Sam Bowers (Town Planner Rowe Group), Arboribus Consulting has been engaged to assess the trees within various properties on Armadale Road & Allen Road in Forrestdale and provide the following information:
    - Install aluminium tree tags and individually number each tree >200 mm diameter
    - Identify genus, species and common name
    - Comment on current health, structure & age of the subject trees
    - Obtain height, canopy spread and trunk diameter measurement(s)
    - Provide Tree Protection Zone and Structural Root Zone measurements
    - Detail observations and comments for each tree
    - Provide preliminary recommendations and canopy pruning considerations
    - Provide a suitability rating for each tree (for incorporation into an urban development)
    - Provide Arboricultural comment regarding potential impacts and modifications necessary to achieve a more 'tree sensitive' design
    - Provide background information regarding the Australian Standard AS 4970 '*Protection of Trees on Development Sites*' 2009 and
    - Conclusions and Recommendations.

2.2 ARBORICULTURAL INSPECTION

- Arboribus Consulting undertook a ground level assessment of the 264 trees on 21, 22, 23, 24 & 25 November 2022.

2.3 LIMITATIONS OF THIS REPORT

- The Arboricultural assessment was undertaken at ground level and did not incorporate any aerial inspection or; below ground or; specialist investigation, for the subject trees.
- Modification to proposed designs and the development of appropriate work methodologies will be required in order to address issues raised within this report to ensure root and canopy impact can be minimised for the project.
- The information contained within this report is preliminary in nature and is not intended to be used as a 'Tree Protection Plan (TPP)' for the proposed Armadale Road Development. Further inputs by an AQF 5 Arborist will be required to review designs and develop a site-specific TPP in accordance with AS 4970-2009 for implementation by the contractors nominated for the works.

3 SUMMARY OF FINDINGS

3.1 TOTAL NUMBER OF TREES INSPECTED

- A total of x 264 trees were assessed as part of the proposed Armadale Road development - refer *Appendix A Tree Location and ID Number Map & Appendix B Table of Results* for detail.
- All identified Trees have aluminium number tags installed at approximately 1.5 meters from ground level on main stems – refer figure 2 for example of tags utilised for the project.



Figure 2. Showing metal tree tag and numbering of the identified trees installed approx. 1.5 meters from ground level

3.2 TREE SPECIES INSPECTED

- Of the 264 trees assessed, the following genera were documented:
    - Various *Eucalyptus* species x60
    - *Syagrus romanzoffiana* x41
    - *Callistemon* species x 35
    - *Archontophoenix Cunninghamiana* x13
    - *Phoenix canariensis x* 9
    - Other x 106
- Summary of species origin were documeneted to be:
    - Introduced species x 137 (52%)
    - Australian Native species x 109 (41% total)
    - Indemic West Australian species x 18 (7% total)
- All assessed trees are considered well suited to the Forrestdale locale.

3.3 AGE STATUS

- Synopsis of general age status for the assessed trees was broken down into the following:
    - Juvenile = x 0
    - Semi Mature = x 7
    - Early Mature = x 29
    - Mature = x 228
    - Post Mature = x 0

3.4 USEFUL LIFE EXPECTANCY (ULE)

- Synopsis of Useful Life Expectancy (ULE) for the assessed trees was broken down into the following:
    - Dead (no chance of recovery) = x 6
    - <5 Years = x 2
    - 5 - 15 Years = x 24
    - 15 – 40 Years = x 138
    - 40 + Years = x 94

3.5 SUMMARY OF CANOPY HEALTH

- Synopsis of canopy health for the assessed trees was broken down into the following:
    - Good = x 233
    - Reasonable = x 19
    - Questionable = x 6
    - Poor = x 0
    - Dead (no chance of recovery) = x 6

  Refer Appendix B Definitions Canopy Health for detail.
- The majority of trees assessed were considered to be in Good or Reasonable health status. Various (minor) health issues identified are considered manageable within the scope of general horticultural management for the site.
- 6x Trees displayed Questionable health status. If identified for retention into the development, these trees will require specific Arboricultural input and/or targeted remedial treatments to improve general health status during construction - refer *Appendix B Table of Results* for detail.
- 6x Trees (Tag numbers 04, 35, 55, 166, 188 & 192) were confirmed dead at the time of inspection and are considered unsuitable for incorporation into the development.

3.6 SUMMARY OF CANOPY STRUCTURE

- Synopsis of individual canopy structure for the assessed trees was broken down into the following:
    - Good = x 122
    - Reasonable = x 78

- Questionable = x 57
- Poor = x 7

Refer Appendix B Definitions Canopy Structure for detail.

- The Majority of trees assessed displayed Good or Reasonable canopy structure. A number of minor structural problems were identified; however, are considered manageable as part of general tree pruning maintenance responsibilities for the site – refer *3.10 Canopy Management Considerations and Appendix B* for further detail.
- 64x Trees displayed Questionable or Poor Canopy Structure. A number of these trees are considered problematic for retention into the development however; If they are to be considered for integration, the identified trees will require further specific Arboricultural input/ongoing monitoring and/or targeted remedial treatments implemented, to address identified issues and improve site safety – refer Appendix B for detail.

3.7 PEST AND DISEASES

- No obvious visual presence of any significant pest infestations or fungal sporophores were observed at the time of assessment.

3.8 SUITABILITY FOR INCORPORATION INTO AN URBAN DEVELOPMENT

- *'Suitability For Incorporation Into An Urban Development'* provides a retention value based on:
  - the trees current health and/or structural status
  - if they are well positioned within the landscape
  - the species known tolerances for disturbance and
  - species characteristics that are considered suitable for retention and incorporation into an urban development area.
- Synopsis of suitability for incorporation into an urban development was broken down into the following:
  - Optimal = x 111
  - Acceptable = x 84
  - Questionable = x 31
  - Unsuitable = x 38

Refer Appendix B Definitions Suitability for Incorporation into an Urban Development for detail.

- The Majority of trees assessed were categorized as Optimal &/or Acceptable (74%) - these trees are considered well placed or display favourable health and/or structural characteristics
- 31x trees were categorized as Questionable (12%) - these trees may be considered for retention; however, will require specific Arboricultural health and/or structural management measures developed by a AQF 5 Arborist and implemented as part of their retention into the development.

- 38x trees were categorized as Unsuitable (14%) - these trees are considered unsuitable for incorporation into an urban development and/or display problematic health or structural form or; are not considered compatible with proposed construction or development.

3.9 SUMMARY OF PRELIMINARY RECOMMENDATIONS

- Due to health and/or structural issues identified at the time of inspection, Tree Numbers 04, 10, 15, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 35, 45, 48, 52, 55, 76, 124, 127, 137, 147, 151, 153, 157, 158, 166, 168, 169, 170, 186, 187, 188, 191, 192, 193, 194, 200, 617, 662, 211, 212, 213, 214, 225, 235 & 253 are considered problematic for long term retention or integration and should be considered for removal as part of the development.
- 19 x Trees (Trees Numbers 02, 03, 49, 84, 85, 88, 90, 91, 161, 195, 616, 205, 228, 230, 232, 233, 236, 256, 257) have been identified as 'Requiring Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified'. Further input and consideration of the identified issues are required with an AQF level 5 Arborist before making a definitive conclusion on their incorporation into the proposed development.
- The remainder of the 195 x trees assessed have been considered appropriate for retention and that a site-specific Arboricultural design review and Tree Protection Plan (TPP) be developed by an AQF 5 Arborist in accordance with AS 4970-2009 and implemented for the trees identified for retention into the proposed Armadale Road development works.

3.10 CANOPY MANAGEMENT CONSIDERATIONS

- Canopy pruning considerations have been made for the trees identified for retention – refer Appendix B for detail.
- Works include the removal of major dead wood (Greater than 30 mm in diameter), removal of dead fronds and loose leaf bases for Palm Trees and; the removal of any dead trees. Trees identified as not requiring canopy pruning works have been recommended to be Monitored and Reinspected in 12 months.
- Aerial inspections are to be undertaken throughout the canopies by nominated tree pruning contractor to identify and address structural issues not able to be seen from the ground level inspection and further recommendations made as and where required by the nominated AQF level 5 Arborist.
- All canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 '*Pruning of Amenity Trees*' 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance of the nominated AQF level 5 Arborist.

3.11 SALVAGING OF TREES & TIMBER

- Where the design is not compatible with successful tree retention and existing trees are required to be removed as part of the project, the following should be considered:
    - Potential Transplant/relocation elsewhere for amenable species
    - Milling of timber into slabs for furniture or features for integration into the design
    - Crafting or turning wood into features/items/furniture/art interpretive sculpture etc by woodturners, craftsmen or artists
    - Dependent on species, consideration could be given to using the brush and logs as bank or ground stabilisation for regeneration works or habitat creation in bush or POS areas
    - Consideration could be given to harvesting of the seed (if the trees have viable fruit) and germinate from existing source as ceremonial replanting once the works have completed. Any tree stock proposed for this type of approach are to be grown in accordance with the processes identified in the Australian Standards AS 2303 *'Tree Stock for Landscape Use'* 2015 and planted in accordance with best industry practice.

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4 TREES OF NOTE



A: Rear of No 813 Stand of mature Eucalyptus camaldulensis (River Red Gum)
B: Rear of No 817 Stand of mature Eucalyptus camaldulensis (River Red Gum)
C: Front of No 837 mature Corymbia maculata (Spotted Gum)
D: Rear of No 801 – various mature native trees in reasonable condition
E: Rear of No 825 –Olea europaea (Olive) good specimen
F: Rear of No 15 Allen Rd – Brachychiton rupestris (QLD Bottle Tree) good specimen

Aerial image source https://web.metromap.com.au/map Image Date – 4 October 2022
Images by Arboribus Consulting (2022)

5 PRELIMINARY ARBORICULTURAL INPUTS FOR THE DESIGN

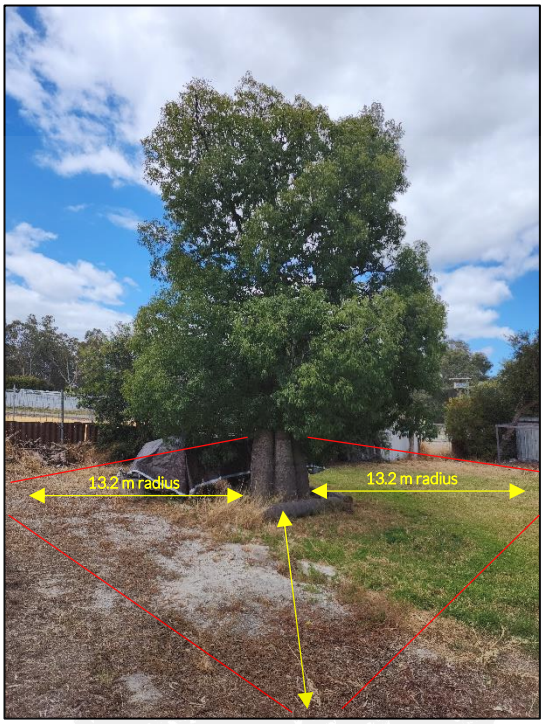


Figure 3. *Tree 229 Brachychiton rupestris (QLD Bottle Tree) image showing approximate nominal 13.2-meter Tree Protection Zone (TPZ) radius*

5.1 TREE PROTECTION ZONE (TPZ) BACKGROUND AND OVERVIEW

- Tree Protection Zone (TPZ) is defined in AS4970 *'Protection of Trees on Development Sites 2009' as*:

  "A specified area above and below ground and at a given distance from the trunk set aside for the protection of a trees roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development."
- To calculate the TPZ, the formula 12 times (x) the Trunk Diameter (DBH - Diameter at Breast Height measured at 1.4 meters from ground level) is utilised (for the majority of tree species and types).
- The TPZ is measured in meters as a radius from the centre of the main stem – refer figure 3 for detail.
- *Special Note: the TPZ is not the canopy diameter; canopy width; and/or drip line measurement. Canopy measurements are not to be used as the AS4970 nominal Tree Protection Zones.*
- Refer *Appendix B Table of Results* for TPZ projections for each of the trees identified for retention.

5.2 ARBORICULTURAL DESIGN REVIEW BACKGROUND INFORMATION

- Tree protection measures in keeping with AS 4970 *'Protection of Trees on development sites'* 2009' must be incorporated into the proposed design in order to achieve tree sensitive outcomes for the project.

- Review of all proposed designs for the development should recognise the specified TPZ delineations and that all efforts are made by the design team to avoid/minimise any proposed works or structures within these specific TPZ areas.
- Where minor encroachments into a Tree Protection Zone (TPZ) are planned, input from an AQF level 5 Arborist will be required to review proposed works or structures; provide tree sensitive measures or alternatives and; assist in the development of appropriate methodologies to ensure tree root and canopy impact can be minimised.
- Where significant incursions are proposed within TPZs (i.e., greater than 10%), an AQF level 5 Arborist is to demonstrate how the encroachment or works can occur without adversely impacting the health and/or inground stability of the tree or; identify where modifications to the design or alternative methodologies are required.

5.3 ARBORICULTURAL COMMENT ON THE PROPOSED DESIGN

5.3.1 POTENTIAL CONSTRUCTION WORKS WITHIN TREE PROTECTION ZONES

- Any construction or works being proposed within Tree Protection Zones (TPZs) of the assessed trees will necessitate modification to the proposed design(s) and; the development of appropriate work methodologies in order to alleviate unnecessary/avoidable impacts to the trees identified for retention. Works planned to be undertaken within or immediately adjacent specified TPZs for the proposed Armadale Road development may include (but may not be limited to):
    - Establishment of site and works boundaries
    - Dismantling of trees identified for removal
    - Establishment of the specified Tree Protection Zones (TPZs)
    - Demolition and removal of existing /structures/buildings/fencing/ etc
    - Decommissioning of existing services and below ground infrastructure
    - Demolition of existing roads, road infrastructure and crossovers/kerbing
    - Cut to fill works
    - Forward works & site preparation to set levels, batters and soil contours, removal of organic layer etc...
    - Installation of all proposed below ground services (and their associated infrastructure and components)
    - Construction of buildings, dwellings, structures, retaining walls paths or ramps etc
    - Installation of new roads, paths and carpark areas (i.e. preparation for levels, boxing out, installation of subbase and compaction, bitumen and kerbing etc..)
    - Hard and Soft landscaping (i.e.. levels and contouring, retaining walls, structures, planting of vegetation, mulching, soiling, installation of irrigation etc).

5.3.2 MODIFICATIONS TO BE IMPLIMENTED FOR THE DESIGN

- Modification of existing soil levels is to be avoided within TPZ areas. Moderate raising of soil levels may be considered (refer below dot point) within/adjacent the TPZ areas as an alternative to cutting, lowering, and/or boxing out existing levels. Any proposed grade cuts required for levels, footings and road boxouts etc.. can injure arterial/surface roots and will need to be addressed to limit root loss and associated impact to the trees identified for retention.
- Where fill is being proposed within TPZs, washed and screened single grade gravel or aggregate with no fines is recommended to be used (*Note: any required areas of fill to be installed greater than 150 mm within TPZs will be subject to prior approval from the nominated AQF level 5 Arborist and the potential installation of remediation measures (or materials) to assist with aeration and infiltration within TPZs).*
- Roads, crossovers, kerbs, paths, ramps etc.. being proposed within TPZs should be designed to 'float' (i.e., installed on top of existing ground levels) to limit box outs and root impacts and allow root mass to be retained beneath roadways and paths.
- Alignments and locations of any below ground services and associated infrastructure that travel within/through TPZs are to be installed via non-destructive methods (i.e., subterranean boring, micro tunnelling or industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. *Note: Mechanical excavation is not permitted within TPZs.*
- Any footings for proposed structures (i.e. retaining walls, fencing etc) are to be designed to 'float' (i.e., installed on top of existing ground levels) or lintels designed and installed to protect and bridge over the roots to allow for their retention. Where this may be impractical/cost prohibitive, rootzone investigations are to be undertaken via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) to locate and accommodate roots greater than 30 mm in diameter. This may require any concrete footings to be poured at locations where no large roots are encountered.
- Any hardscape structures being proposed within TPZs should also be designed to 'float' (i.e., installed on top of existing ground levels) to limit excavations and associated root impacts (i.e. applicable to buildings, dwellings, structures, retaining walls paths, finishes etc..). Where this unattainable or not achievable, non-destructive methods (industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) are to be utilised to verify where root mass exists, and structures placed/positioned accordingly to retain roots and achieve a tree sensitive outcome. Roots measuring over 30 mm in diameter are to be retained and protected. Location of footings and/or structures are to be adjusted to avoid roots greater than 30 mm in diameter. Roots less than 30 mm in diameter are to be pruned appropriately by the nominated contractor under the direction of the nominated AQF level 5 Arborist.

5.3.3 PROPOSED METHODOLOGIES FOR WORKS IN TPZS

- Prior to any works on site, erection of dedicated TPZ fencing (and TPZ signage), is to identify the nominal TPZ delineations and are to be established by the nominated contractor(s) and; signed off by the nominated AQF level 5 Project Arborist prior to site works *Note:- Any alteration or modification of the fencing is to be approved prior by an AQF level 5 Arborist and documented as part of ongoing tree preservation reporting for the site.*
- That any works proposed within the nominal TPZ delineations will require prior approval from the nominated AQF level 5 Arborist. (in collaboration with the Project team) and the works be supervised by the nominated AQF level 5 Arborist.
- Dismantling of trees identified for removal is to be undertaken such that no damage occurs to the canopies and/or root systems of the trees identified for retention. Stumps are to be ground out only *Note: Mechanical excavation/grubbing out of stumps is not permitted within TPZs.*
- Any Demolition works (including but not limited to: existing dwellings /structures /fencing /sheds /roads etc) are to be undertaken under the supervision of the nominated AQF level 5 Arborist such that roots are protected and retained within TPZs. Positioning of machinery is to recognise the TPZ delineations to limit impacts to root systems and collision impacts to trunks and canopies and will necessitate ground protection measures being installed. Types of machinery, working room and swing radius etc.. will need to be considered to ensure damage is avoided for the retained trees. *Note:- Any canopy pruning required for demolition or civils works is to be approved prior by the nominated AQF level 5 Arborist (in collaboration with the Project team) and documented as part of ongoing tree preservation reporting for the proposed Armadale Road development.*
- Alignments and locations of any below ground services and associated infrastructure that travel within/through TPZs are to be installed via non-destructive methods (i.e., subterranean boring, micro tunnelling or industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. *Note: Mechanical excavation is not permitted within TPZs.*
- Take off and/or tie in points and proposed infrastructure designed within TPZs are to be installed via non-destructive installation methods (industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. Roots less than 30 mm in diameter are to be pruned appropriately). *Note: Mechanical excavation is not permitted within TPZs.*
- Any Mechanical tracking in TPZs will require prior approval from the nominated AQF level 5 Arborist and need to facilitate prior installation of ground protection measures. Access and egress and; screwing of tracks within TPZs is to be minimised.
- Where excavations are proposed in close proximity to or may impact TPZs, installation of Box shoring, shutter boards, piling or utilisation of jet grouting (grout injection) may be necessary to limit soil slippage and undermining of root systems.

- Any proposed footings within TPZs are to be undertaken via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and accommodate roots greater than 30 mm in diameter. Roots less than 30 mm in diameter may be pruned subject to approval of the nominated AQF level 5 Arborist). *Note: Mechanical excavation is not permitted within TPZs.*
- Canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 *'Pruning of Amenity Trees'* 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance of the nominated AQF level 5 Arborist.
- Alignments and locations of any irrigation infrastructure proposed within TPZs are to be adjusted to avoid/accommodate roots greater than 30 mm in diameter and installed via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist). *Note: Mechanical excavation is not permitted within TPZs.*
- Any tree stock proposed for planting, are to be grown in keeping with the processes identified in the Australian Standards AS 2303 *'Tree Stock for Landscape Use' 2015* and planted in accordance with industry best practice. Consideration will need to be given to the proposed planting areas and suitable tree species selection able to thrive appropriately (both above and below ground) in each given circumstance proposed.
- Planting of any vegetation within TPZs is to be undertaken that planting holes are strategically placed to avoid any tree roots greater than 30 mm in diameter.

5.3.4 OTHER TPZ ISSUES TO BE CONSIDERED FOR THE PROJECT

- Other site issues that may impact or encroach the specified TPZs, are to be recognised and addressed as part of site works. It is recommended that the matters below avoid the specified protection delineations of the trees. Where this isn't achievable, ground protection measures are to be installed prior. Matters include (but may not be limited to):
    - Dedicated access and egress points for the site
    - Location of site offices and amenities
    - Parking/storage of vehicles and machinery
    - Lay down areas and storage of construction materials
    - Or any other activity that may compromise tree health or structure not identified above.
- Consideration will need to be given to the timing of the proposed works and the impacts that may arise during seasonal weather extremes i.e. avoiding the heat of Summer and scheduling works and planting in the cooler months of Autumn and early Winter (if possible) to limit unnecessary stress to the vegetation.
- To help maintain current health displays and offset impacts sustained during the development works, supplementary irrigation & monthly applications of Liquid wetting agent & Organic soil drench, will need to be accommodated during the construction and works phase. These applications are to be applied evenly within the TPZs of all trees identified for retention.

- Ongoing Arboricultural assessment and inputs will be required for the project to gauge tree response and address health and or structural issue that may arise prior to, during and post completion of the proposed Armadale Road development.

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6 CONCLUSIONS

- Further discussion and inputs with a suitably qualified and experienced AQF 5 Arborist will help to assist with the identification of worthwhile trees for incorporation into the proposed Armadale Road development.

- Tree protection measures in keeping with AS 4970 '*Protection of Trees on development sites*' 2009' must be incorporated into the proposed design and into any proposed works methodologies in order to achieve tree sensitive outcomes for the project.

  The retention of existing ground levels; limiting excavations within the specified TPZs and; implementing appropriate remedial measures will be important in the future success for the trees identified for incorporation. Where encroachments into a TPZ are necessary, further input from an AQF level 5 Arborist will be required to review proposed encroachments and assist in the development of appropriate methodologies to allow works to occur in a sensitive manner.

  Consideration needs to be given to the sensitivity of some of our native tree species and their lack of tolerance to close proximity rootzone disturbance (and subsequent root loss) that is common with urban developments and typical construction methods.

- As part of the Tree Protection responsibilities for the project only suitable qualified and experienced AQF 5 Arborists should be engaged to:
  - Identify worthwhile specimens to be incorporated into the proposed development
  - Undertake ongoing reviews and provide Arboricultural inputs into the design; methodologies and/or proposed encroachments into TPZs of the trees
  - Develop a site-specific Tree Protection Plan in keeping with AS 4970 '*Protection of Trees on Development Sites*' 2009
  - Provide approval of any works within TPZs
  - Supervise approved works within TPZs
  - Approve and oversee canopy pruning works
  - Monitor tree health and structure during works
  - Provide ongoing reporting and assessments as and where required
  - Provide sign off reporting that documents the tree status post completion of the works.

- The nature of Arboricultural works required for the site can be expected to evolve and change over time. It is important to acknowledge that trees are dynamic, living organisms which are influenced by their above and below ground environs. Regular Arboricultural inspections are recommended to; monitor, document and respond to potential future tree changes that may require further arboricultural intervention not covered within this report.

7 RECOMMENDATIONS

1. That Further discussion and inputs be sought from a suitably qualified and experienced AQF 5 Arborist to identify worthwhile trees for incorporation into the development.

2. That consideration be given to the dismantling of Tree Numbers 04, 10, 15, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 35, 45, 48, 52, 55, 76, 124, 127, 137, 147, 151, 153, 157, 158, 166, 168, 169, 170, 186, 187, 188, 191, 192, 193, 194, 200, 617, 662, 211, 212, 213, 214, 225, 235 & 253 prior to the commencement of the development.

3. That if identified for retention, Trees Numbers 02, 03, 49, 84, 85, 88, 90, 91, 161, 195, 616, 205, 228, 230, 232, 233, 236, 256, 257 will require further Arboricultural inputs into the specific issues identified within this report before making a definitive conclusion on their incorporation into the proposed Armadale Road Development.

4. Where trees have been identified for retention and incorporation into the development, all project specific drawings are updated to include Tree specific numbering & accurate Tree Protection Zones (TPZ) & Structural Root Zones (SRZ) delineations for the trees - refer *Appendix B Table of Results'* for TPZ & SRZ projections for each of the trees identified for assessment.

5. That where trees have been identified for retention and incorporation into the development, that appropriate refinements, design modifications and the development of tree sensitive works methodologies identified in Point *5. Preliminary Arboricultural Inputs for the Design* are incorporated into drawings and specifications and implemented for the project. Where appropriate modification is not achievable within TPZ areas, removal of the tree(s) may be required – subject to review and approval by an AQF level 5 Arborist.

6. That a site-specific Tree Protection Plan (TPP) be developed by an AQF 5 Arborist for trees identified for retention in keeping with the processes identified in Australian Standards AS 4970 *'Protection of Trees on Development Sites'* 2009 to be implemented by the nominated contactor for the duration of the works.

7. That Tree Protection Zones (TPZs) are established at the commencement of construction and are maintained for the duration of the works for all trees identified for retention (refer Appendix C for detail).

8. That the trees are monitored and any proposed works within the TPZs are supervised & documented by an AQF 5 Arborist in keeping with the Australian Standards AS 4970 *'Protection of Trees on Development Sites'* 2009 & AS 4373 *'Pruning of Amenity Trees'* 2007.

9. That any canopy pruning works for trees identified for retention are undertaken in keeping with Australian Standard AS 4373 *'Pruning of Amenity Trees'* 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance/direction of an AQF 5 Arborist.

10. That sign off reporting be undertaken by an AQF 5 Arborist that documents the condition of the trees post completion of the project and that provides a maintenance schedule for the client to implement post completion of the construction works.

11. That the subject trees be visually assessed by an AQF level 5 Arborist in 12 months (December 2023) or after significant weather events, to report on status and identify and respond appropriately to new or developing tree related issues.

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8 REFERENCES AND READING

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APPENDIX A – TREE LOCATION & ID NUMBER MAP

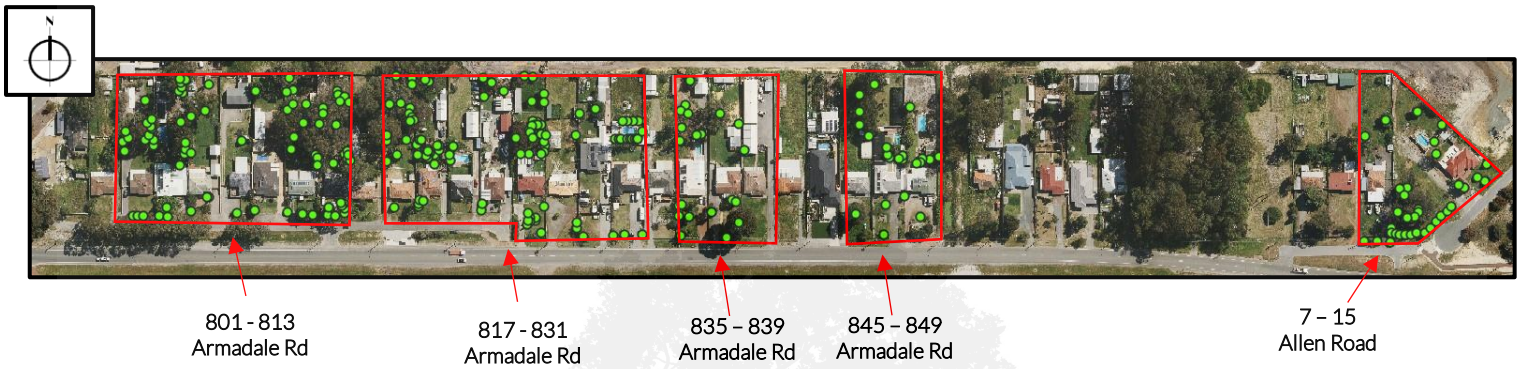


Figure 4. Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only Aerial image source https://web.metromap.com.au/map Image Date – 4 October 2022

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Figure 5. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only*
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022

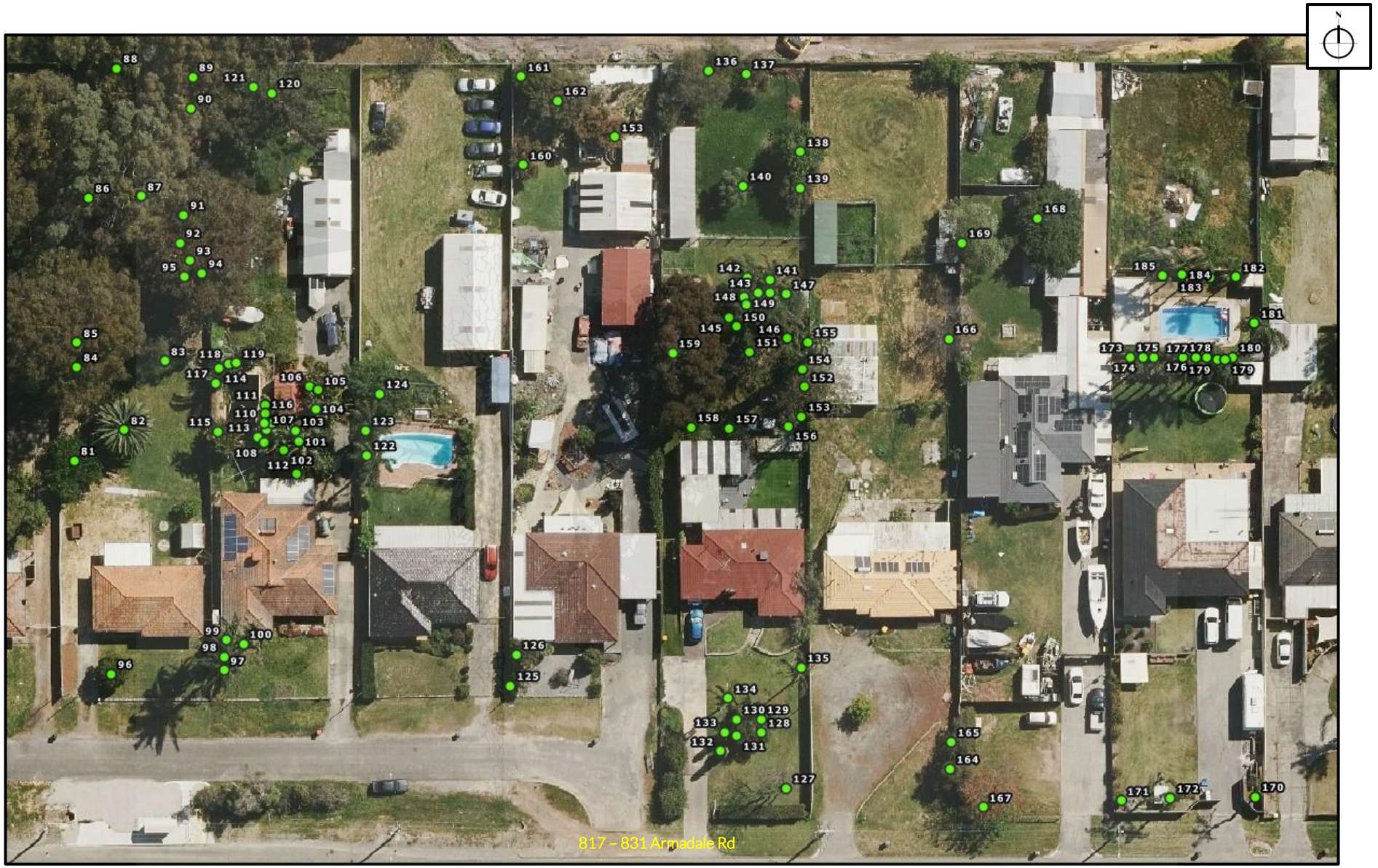


Figure 6. Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022



Figure 7. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only*
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022



Figure 8. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022*

APPENDIX B – TABLE OF RESULTS & DEFINITIONS

DEFINITIONS - GENERAL

Tree ID Number	Provides an individual Tag identification number.
Nomenclature & Tree Identification	Identifies the genus, species and common name for the tree.
Estimated Age	Identifies the estimated age at the time of assessment. (Juvenile, Semi Mature, Early Mature, Mature, Senescing).
Estimated Tree Height	Estimate of the Trees Height in meters.
Estimated Canopy Spread	Estimate of the Trees canopy spread in meters.
Useful Life Expectancy (ULE)	Estimate of the trees Useful Life Expectancy (ULE) (less than 5 Years, 5 – 15 years, 15 – 40 years, or over 40 years).
Canopy Health	Identifies the visual health display at the time of assessment. (Exceptional, Good, Reasonable, Questionable, Poor, Dead) – refer Canopy Health Definitions below for further detail.
Canopy Structure	Identifies the canopies visual structural form at the time of assessment. (Good, Reasonable, Questionable, Poor, Dead) – refer Canopy Structure Definitions below for further detail.
Trunk Diameter @ Widest Point	Measurement of trunk diameter in millimetres. Typically measured at 1.4 meters above ground level or at the widest point of bifurcated or multi stemmed trunks.
Tree Protection Zone (TPZ) Radius (M)	Calculated as: x12 Trunk Diameter measured as a radius from centre of the trunk. Identified in AS 4970 'Protection of Trees on Development Sites' 2009 ' as 'the area of root and canopy area requiring protection during construction so the tree remains viable. Any works proposed within this area requires approval from an AQF 5 Arborist prior to commencement. .***Special Note:- the TPZ is not the canopy diameter; canopy width; and/or drip line measurement. Canopy measurements are not to be used as the AS4970 nominal Tree Protection Zones***
Trunk Diameter @ Ground Level	Measurement of trunk diameter in millimetres measured at ground level. Measurement essential for accurate calculation of Structural Root Zone (SRZ) radius
Structural Root Zone (SRZ) Radius (M)	Calculated as: Diameter at ground level x 50) $^{0.42}$ x 0.64 measured as a radius from centre of the trunk. Identified in AS 4970 'Protection of Trees on Development Sites' 2009 '*as the area required for tree stability'. Special* ***Note:- the SRZ is not to be mistaken for; or utilised as a Tree Protection Zone (TPZ) refer TPZ definition above for detail.***
Comments	General information for the assessed tree.
Suitability For Incorporation Into An Urban Development	Identifies a retention value based on health and structural status, are well positioned, have known tolerances or species characteristics considered suitable for retention into an urban development area (Optimal, Acceptable, Questionable, Unsuitable) – refer Definitions below for further detail.
Preliminary Recommendation	Identifies preliminary recommendations for the individual (remove, retain, or additional Arboricultural input/assessments required).
Canopy Management Considerations	Provides Canopy pruning recommendations for the individual tree. *Special Note: All canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 'Pruning of Amenity Trees' 2007 by suitably qualified and experienced Arborists under the guidance of Arboribus Consulting.*

DEFINITIONS – CANOPY HEALTH

Exceptional
The tree is demonstrating exceptional growth and exhibits a full dense canopy of foliage for a specimen of the species. Leaf colouration, distribution and size are all exceptional for the species. No visual signs of any pests and/or disease impacting tree health. Seasonal growth and/or callous development is active and evident.
Good
Tree displays typical foliage size, colouration, and density for a specimen of the species. Seasonal growth and/or callous development all appear typical. Seasonal deadwood may be apparent however likely as a result of natural attrition and not an indication of reduction in the trees wellbeing. May have minor seasonal pest (or disease) issues; however, unlikely to impact general health and wellbeing.
Reasonable
Tree displays typical foliage size and colouration; however, may display a reduction in ideal growth. The tree may exhibit modest visual health issues or minor areas of concern. Canopy density may be affected or have a slightly higher percentage of deadwood than what would be considered 'typical'. Seasonal growth and/or callous development may be slightly impeded. Presence of a pest or disease may be evident. However, issues noted considered easily addressed within the scope of proactive tree management.
Questionable
Canopy starting to indicate decline. Apical/terminal sections of the canopy may be actively declining or dead. Pests or diseases may be prevalent and impacting health that require intervention. Subject tree will require a tree specific management plan to be developed to address health issues noted and/or require targeted remedial intervention(s) and/or analysis or further investigation and/or monitored on a more detailed basis.
Poor
Canopy Indicates decline. Canopy may display less than 25% live photosynthetic mass. Majority of tertiary and secondary limbs are dead or compromised. Current health condition such that significant remedial intervention is unlikely to assist in appropriate/worthwhile recovery.
Dead
Tree has no active conductive tissue - indicating no chance of recovery.

DEFINITIONS – CANOPY STRUCTURE

Good
Primary and secondary framework and Primary and secondary branch attachments (unions) display typical form for a specimen of the species. Tree exhibits no significant visual issues within the canopy; however, may display minimal/minor structural imperfections (that may be addressed within the scope of proactive tree management).
Reasonable
Tree displays reasonable canopy structural form and generally free of significant issues; however, the tree may exhibit modest visual issues, structural defects or areas of concern that may require to be addressed with remedial work or require to be monitored. This may include, minor competition/suppression issues, minor leans, codominant stems and branches, minor bark inclusions, noticeable wounding & damage, previously lopped canopies; storm damaged and/or vandalisms where epicormic regeneration has developed satisfactory branch attachment etc… However, issues can be addressed or monitored within the scope of proactive tree management.
Questionable
Primary and secondary canopy structural form displays defects, flaws or areas of concern that may lead to future issues. This could include issues that may affect structural integrity including Storm damage & previous deleterious pruning, significant asymmetry & competition issues, problematic leans, codominant stems with bark inclusions and swelling present, substantial wounding & damage, major decay, poor branch taper etc that will require to be addressed with remedial intervention; be further investigated and/or; specifically monitored in an ongoing basis.
Poor
Tree displays substantial/major structural flaws within its primary and/or secondary (or beyond) canopy structural form i.e.: extensive decay and/or hollows, broken or compromised unions, substantial splits breaks and/or fractures etc.. where remedial, Arboricultural or Engineering intervention is unlikely to improve form or substantially reduce site risk.

DEFINITIONS – SUITABILITY FOR INCORPORATION INTO AN URBAN DEVELOPMENT

- *Suitability For Incorporation Into An Urban Development'* provides a retention value based on:
    - the trees current health and/or structural status
    - if they are well positioned within the landscape
    - the species known tolerances for disturbance and
    - species characteristics that are considered suitable for retention and incorporation into an urban development area.

Optimal
These trees are considered well placed or display favourable health and/or structural characteristics and worthwhile incorporating.
Acceptable
These trees may be well placed and/or display reasonable health and/or structural form however may require a level of Horticultural/Arboricultural intervention to address minor issues.
Questionable
Tree may display defects, flaws or areas of concern that may lead to future issues. These trees may be considered for retention; however, will require specific Arboricultural health and/or structural management measures developed by a AQF 5 Arborist implemented as part of their retention into the development and; monitored in an ongoing basis.
Unsuitable
Tree displays substantial/major structural flaws where remedial, Arboricultural or Engineering intervention is unlikely to improve form or substantially reduce site risk. considered unsuitable for incorporation into an urban development and/or not considered compatible with proposed construction or development.

ARBORIBUS
CONSULTING

TABLE OF RESULTS

ARBORIBUS
CONSULTING

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
01	*Eucalyptus conferruminata (Bald Island marlock)*	Mature	5	7	5 - 15 years	Reasonable	Reasonable	0.250	3.00	0.300	2.00	Damage to surface roots (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 1 meter and 2 meters, Minor canopy suppression noted, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
02	*Eucalyptus conferruminata (Bald Island marlock)*	Early Mature	5	5	5 - 15 years	Questionable	Questionable	0.180	2.16	0.200	1.68	Canopy indicates decline, CoA Verge Tree	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
03	*Eucalyptus conferruminata (Bald Island marlock)*	Early Mature	3	4	5 - 15 years	Reasonable	Questionable	0.200	2.40	0.250	1.85	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between 1 meter and 2 meters, CoA Verge Tree	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
04	*Olea europaea (Olive)*	Mature	7	4	Dead	Dead	Questionable	0.300	N/A	0.400	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
05	*Brachychiton populneus (Kurrajong)*	Mature	12	8	40 + years	Good	Good	0.380	4.56	0.480	2.43	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
06	*Eucalyptus globulus (Tasmanian Blue Gum)*	Mature	15	15	40 + years	Good	Reasonable	0.880	10.56	1.110	3.46	Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+, Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
07	*Callistemon viminalis (Bottlebrush)*	Mature	6	6	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Main stem bifurcates between ground level and 500mm, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
08	*Eucalyptus rudis (Flooded Gum)*	Mature	8	10	40 + years	Good	Reasonable	0.700	8.40	0.700	2.85	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
09	*Corymbia calophylla (Marri)*	Early Mature	12	8	40 + years	Good	Good	0.290	3.48	0.350	2.13	Canopy displays leggy structural form, Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
10	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	9	10	15 - 40 years	Good	Questionable	0.300	3.60	0.380	2.20	Canopy displays leggy structural form, Included bark unions noted (minor), Major canopy suppression noted	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
11	*Callistemon viminalis (Bottlebrush)*	Mature	7	6	15 - 40 years	Good	Reasonable	0.500	6.00	0.500	2.47	Main stem bifurcates at ground level, Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
12	*Callistemon viminalis (Bottlebrush)*	Mature	7	6	15 - 40 Years	Good	Good	0.210	2.52	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
13	*Brachychiton populneus (Kurrajong)*	Mature	10	11	40 + years	Good	Good	0.420	5.04	0.550	2.57	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
14	*Washingtonia robusta (Mexican Fan Palm)*	Semi-Mature	4	4	40 + years	Good	Reasonable	0.300	3.00	0.400	N/A	Minor canopy suppression noted, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
15	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	10	11	40 + years	Good	Questionable	0.530	6.36	0.650	2.76	Canopy displays leggy structural form, Main stem bifurcates between 500mm and 1 meter, Major canopy suppression noted, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
16	*Callistemon viminalis (Bottlebrush)*	Mature	10	8	15 - 40 years	Good	Good	0.330	3.96	0.400	2.25	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
17	*Melaleuca rhaphiophylla (Fresh Water Paperbark)*	Mature	4	12	40 + years	Good	Good	1.500	15.00	1.500	3.92	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
18	*Cupressus macrocarpa (Monterey Cypress)*	Mature	8	3	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
19	*Pinus pinaster (Maritime Pine)*	Mature	18	12	40 + years	Good	Good	0.570	6.84	0.650	2.76	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
20	*Fraxinus griffithii (Evergreen Ash)*	Mature	11	14	15 - 40 years	Good	Reasonable	1.000	12.00	1.000	3.31	Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
21	*Schefflera actinophylla (Umbrella Tree)*	Mature	6	10	15 - 40 years	Good	Questionable	0.800	9.60	0.800	3.01	Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
22	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	1.100	13.20	1.500	3.92	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (major), Main stem bifurcates between 3 meters and 4 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
23	*Tamarix aphylla (Tamarisk)*	Mature	13	13	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Canopy displays leggy structural form, Included bark unions noted (minor), Main stem bifurcates between ground level and 500mm, Minor canopy suppression noted, species considered not suitable for incorporation into development due to suckering	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
24	*Eucalyptus grandis (Rose Gum)*	Mature	30	18	15 - 40 years	Good	Questionable	1.100	13.20	1.100	3.44	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 1 meter and 2 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
25	*Brachychiton populneus (Kurrajong)*	Semi-Mature	5	3	15 - 40 years	Good	Questionable	0.200	2.40	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
26	*Eucalyptus grandis (Rose Gum)*	Mature	25	13	15 - 40 years	Good	Questionable	0.400	4.80	0.500	2.47	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
27	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	15 - 40 years	Good	Questionable	0.680	8.16	0.950	3.24	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Included bark unions noted (major), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
28	*Eucalyptus grandis (Rose Gum)*	Mature	30	13	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
29	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	0.500	6.00	0.650	2.76	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
30	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
31	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	9	14	15 - 40 years	Good	Questionable	0.900	10.80	0.900	3.17	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Friction stems noted within canopy (150 mm to 300 mm dia.), Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.), noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
32	*Syzygium smithii (Lilly Pilly)*	Mature	7	7	15 - 40 years	Good	Reasonable	0.310	3.72	0.350	2.13	Canopy displays leggy structural form, Main stem bifurcates between ground level and 500mm, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
33	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	15 - 40 years	Good	Questionable	1.150	13.80	1.600	4.03	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Damage to surface roots (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Hollows (habitat) noted throughout canopy, Main stem bifurcates above 4 meters+	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
35	*Eucalyptus grandis (Rose Gum)*	Mature	6	4	Dead	Dead	Questionable	1.000	N/A	1.000	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
34	*Eucalyptus robusta (Swamp Mahogany)*	Mature	12	12	15 - 40 years	Good	Reasonable	0.450	5.40	0.550	2.57	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
36	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	4	15 - 40 years	Good	Good	0.200	2.40	0.200	1.68	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
37	*Xanthorrhoea preissii (Grass Tree)*	Mature	2	2	40 + years	Good	Good	0.300	2.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
38	*Xanthorrhoea preissii (Grass Tree)*	Mature	2	2	40 + years	Good	Good	0.300	2.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
39	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	5 - 15 years	Good	Questionable	0.200	2.40	0.220	1.75	Included bark unions noted (minor), Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
40	*Hibiscus tiliaceus 'rubra' (Cottonwood)*	Early Mature	3	5	15 - 40 years	Good	Reasonable	0.350	4.20	0.350	2.13	Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
41	*Bauhinia x blakeana (Hong Kong Orchid Tree)*	Mature	5	6	15 - 40 years	Good	Reasonable	0.350	4.20	0.400	2.25	Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
42	*Ficus microcarpa var. hillii (Hills Weeping Fig)*	Early Mature	10	12	40 + years	Good	Reasonable	0.500	6.00	0.500	2.47	Canopy displays leggy structural form, Main stem bifurcates between ground level and 500mm, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
43	*Ficus benjamina (Weeping Fig)*	Mature	10	10	40 + years	Good	Reasonable	0.330	3.96	0.400	2.25	Included bark unions noted (minor), Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
44	*Callistemon viminalis (Bottlebrush)*	Mature	4	8	15 - 40 years	Good	Reasonable	0.700	8.40	0.700	2.85	Main stem bifurcates at ground level, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
45	*Citharexylum spinosum (Fiddlewood)*	Mature	3	5	15 - 40 years	Good	Poor	0.600	7.20	0.650	2.76	Canopy previously lopped (Major - not in keeping with AS4373), Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
46	*Melaleuca armillaris (Bracelet Honey Myrtle)*	Mature	5	8	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
47	*Ficus benjamina (Weeping Fig)*	Early Mature	10	12	40 + years	Good	Good	0.500	6.00	0.550	2.57	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
48	*Eucalyptus cladocalyx (Sugar Gum)*	Mature	11	10	5 - 15 years	Questionable	Questionable	0.450	5.40	0.500	2.47	Canopy starting to indicate decline, Damage noted to main stem (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Significant terminal deadwood noted within canopy, Tree on lean (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
49	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	40 + years	Good	Reasonable	0.710	8.52	0.900	3.17	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
50	*Eucalyptus robusta (Swamp Mahogany)*	Mature	13	16	15 - 40 years	Good	Reasonable	0.680	8.16	0.910	3.18	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
51	*Eucalyptus rudis (Flooded Gum)*	Early Mature	8	8	40 + years	Good	Good	0.230	2.76	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
52	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	5	12	15 - 40 years	Good	Questionable	1.000	12.00	1.000	3.31	Tree displays multi stemmed form, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
53	*Eucalyptus rudis (Flooded Gum)*	Mature	16	20	40 + years	Good	Good	1.000	12.00	1.200	3.57	Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (150 mm to 300 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
54	*Tipuana tipu (Pride of Bolivia)*	Early Mature	5	5	15 - 40 years	Good	Reasonable	0.200	2.40	0.250	1.85	Minor deadwood noted within canopy, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
55	*Corymbia calophylla (Marri)*	Mature	4	4	Dead	Dead	Poor	0.300	N/A	0.300	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
56	*Syagrus romanzoffiana (Queen Palm)*	Semi-Mature	4	3	40 + years	Good	Good	0.200	2.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
57	*Syagrus romanzoffiana (Queen Palm)*	Semi-Mature	12	5	40 + years	Good	Good	0.200	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
58	*Washingtonia robusta (Mexican Fan Palm)*	Mature	16	4	15 - 40 years	Good	Good	0.410	3.00	0.770	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
59	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.310	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
60	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.960	11.52	1.100	3.44	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
61	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	20	15 - 40 years	Good	Reasonable	1.100	13.20	1.300	3.69	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 3 meters and 4 meters, Minor canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
62	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.940	11.28	1.100	3.44	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
63	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.950	11.40	1.100	3.44	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Main stem bifurcates between 3 meters and 4 meters, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
64	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	1.000	12.00	1.200	3.57	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
65	*Eucalyptus camaldulensis (River Red Gum)*	Mature	23	16	15 - 40 years	Good	Reasonable	0.760	9.12	0.900	3.17	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (minor), Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
66	*Agonis flexuosa (WA Peppermint)*	Mature	11	13	15 - 40 years	Reasonable	Reasonable	0.800	9.60	0.900	3.17	Canopy displays leggy structural form, Minor canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
67	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.260	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
68	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.440	4.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
69	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.550	4.00	0.600	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
70	*Syagrus romanzoffiana (Queen Palm)*	Mature	8	5	40 + years	Good	Good	0.300	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
71	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.360	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
72	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	40 + years	Good	Good	0.200	4.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
73	*Strelitzia nicolai (Giant Bird Of Paradise)*	Mature	6	11	15 - 40 years	Good	Reasonable	3.000	6.00	3.000	N/A	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
74	*Eucalyptus camaldulensis (River Red Gum)*	Mature	12	16	40 + years	Good	Reasonable	0.640	7.68	0.700	2.85	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
75	*Callistemon viminalis (Bottlebrush)*	Mature	10	5	15 - 40 years	Reasonable	Good	0.200	2.40	0.200	1.68	Canopy displays leggy structural form, Canopy noted to be slightly sparse, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
76	*Schinus terebinthifolius (Brazilian Pepper)*	Early Mature	4	8	40 + years	Good	Reasonable	0.350	4.20	0.400	2.25	Friction stems noted within canopy (< 50mm dia.), Minor canopy suppression noted, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
77	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.300	4.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
78	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.250	3.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
79	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.320	5.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
80	*Livistona chinensis (Chinese Fan Palm)*	Early Mature	3	4	15 - 40 years	Good	Good	0.400	3.00	0.450	N/A	Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
81	*Morus alba 'Pendula' (Weeping Mulberry)*	Early Mature	4	6	15 - 40 years	Good	Reasonable	0.250	3.00	0.300	2.00	Main stem bifurcates between 1 meter and 2 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
82	*Phoenix canariensis (Canary Island Date Palm)*	Mature	8	10	40 + years	Good	Good	0.930	6.00	1.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
83	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	12	6	40 + years	Good	Good	0.230	2.76	0.350	2.13	Canopy displays leggy structural form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
84	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	40 + years	Good	Reasonable	1.250	15.00	1.400	3.81	Damage to surface roots (minor), Included bark unions noted (minor), Main stem bifurcates between 3 meters and 4 meters, Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
85	*Eucalyptus camaldulensis (River Red Gum)*	Mature	23	13	15 - 40 years	Reasonable	Questionable	0.800	9.60	0.950	3.24	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
86	*Eucalyptus camaldulensis (River Red Gum)*	Mature	30	15	40 + years	Good	Good	1.000	12.00	1.300	3.69	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
87	*Eucalyptus camaldulensis (River Red Gum)*	Mature	30	20	40 + years	Good	Reasonable	0.950	11.40	1.200	3.57	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (minor), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
88	*Eucalyptus rudis (Flooded Gum)*	Mature	25	15	40 + years	Good	Reasonable	1.000	12.00	1.000	3.31	Canopy displays leggy structural form, Minor canopy suppression noted, Tree displays multi stemmed form, surface roots noted	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
89	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	15	40 + years	Good	Reasonable	0.710	8.52	0.800	3.01	Canopy displays leggy structural form, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 3 meters and 4 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
90	*Eucalyptus camaldulensis (River Red Gum)*	Mature	17	7	15 - 40 years	Good	Reasonable	0.550	6.60	0.550	2.57	Canopy displays leggy structural form, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates at ground level, Prior branch failures noted within canopy (150 mm to 300 mm dia.), Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
91	*Callistemon viminalis (Bottlebrush)*	Mature	6	8	5 - 15 years	Questionable	Reasonable	0.300	3.60	0.300	2.00	Canopy noted to be slightly sparse, Canopy starting to indicate decline, Main stem bifurcates at ground level	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
92	*Eucalyptus rudis (Flooded Gum)*	Mature	10	12	40 + years	Good	Reasonable	0.440	5.28	0.500	2.47	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
93	*Eucalyptus camaldulensis (River Red Gum)*	Mature	20	20	40 + years	Good	Reasonable	1.200	14.40	1.300	3.69	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
94	*Eucalyptus camaldulensis (River Red Gum)*	Mature	13	10	15 - 40 years	Good	Reasonable	0.380	4.56	0.450	2.37	Friction stems noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
95	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	13	5	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
97	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	9	40 + years	Good	Good	0.300	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
98	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	9	40 + years	Good	Good	0.330	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
96	*Unknown Shrub*	Mature	3	4	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
99	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	10	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
100	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	40 + years	Reasonable	Good	0.250	4.00	0.300	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
101	*Dypsis decaryi (Triangle Palm)*	Mature	5	6	40 + years	Good	Good	0.450	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
102	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	5	40 + years	Good	Good	0.250	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
103	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.450	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
104	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
105	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	4	40 + years	Good	Good	0.300	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

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Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
106	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	4	4	40 + years	Good	Good	0.250	3.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
107	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	5	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
108	*Howea forsteriana (Kentia Palm)*	Mature	4	5	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
109	*Howea forsteriana (Kentia Palm)*	Mature	4	5	40 + years	Good	Good	0.100	4.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
110	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	5	5	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
111	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	7	6	40 + years	Good	Good	0.300	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
112	*Dracaena marginata (Madagascar Dragon Tree)*	Mature	3	4	40 + years	Good	Reasonable	0.600	7.20	0.600	2.67	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
113	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
114	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
115	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
116	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
117	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
118	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
119	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
120	*Eucalyptus robusta (Swamp Mahogany)*	Mature	15	14	40 + years	Good	Reasonable	0.650	7.80	0.750	2.93	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
121	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	5	8	40 + years	Good	Good	0.300	3.60	0.400	2.25	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
122	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	7	40 + years	Good	Good	0.330	4.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
123	*Syagrus romanzoffiana (Queen Palm)*	Mature	8	6	40 + years	Good	Good	0.330	4.00	0.408	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
124	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	5	8	40 + years	Good	Questionable	0.450	5.40	0.450	2.37	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between ground level and 500mm, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
125	*Beaucarnea recurvata (Ponytail Palm)*	Mature	3	1	15 - 40 years	Good	Questionable	0.330	2.00	0.900	N/A	Canopy previously lopped (not in keeping with AS4373)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
126	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	5 - 15 years	Good	Questionable	0.200	2.40	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
127	*Robinia pseudoacacia (Black Locust)*	Mature	10	10	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Included bark unions noted (major), Main stem bifurcates at ground level, Tree displays multi stemmed form, species considered not suitable for incorporation into development due to suckering	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
128	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
129	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
130	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
131	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
132	*Cupressus sempervirens 'Swane's Golden' (Golden Pencil Pine)*	Mature	5	2	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
133	*Cupressus sempervirens 'Swane's Golden' (Golden Pencil Pine)*	Mature	5	2	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
134	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.300	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
135	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.300	3.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

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136	*Agonis flexuosa (WA Peppermint)*	Mature	5	9	15 - 40 years	Good	Reasonable	0.700	8.40	0.700	2.85	Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
137	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	5 - 15 years	Good	Questionable	0.200	2.40	0.200	1.68	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
138	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	6	7	40 + years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
139	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Reasonable	0.200	2.40	0.300	2.00	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
140	*Olea europaea (Olive)*	Semi-Mature	5	4	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
141	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	8	40 + years	Good	Good	0.250	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
142	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
143	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
144	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
145	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
146	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
147	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	3	5	15 - 40 years	Questionable	Questionable	0.350	4.20	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
149	*Syzygium smithii (Lilly Pilly)*	Mature	10	8	15 - 40 years	Good	Reasonable	0.300	3.60	0.350	2.13	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
148	*Syzygium smithii (Lilly Pilly)*	Mature	12	10	15 - 40 years	Good	Reasonable	0.400	4.80	0.450	2.37	Canopy displays leggy structural form, Main stem bifurcates between 1 meter and 2 meters	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
150	*Syzygium smithii (Lilly Pilly)*	Mature	13	10	15 - 40 years	Good	Good	0.280	3.36	0.350	2.13	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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151	*Melia azedarach (Cape Lilac)*	Mature	14	11	5 - 15 years	Good	Questionable	0.450	5.40	0.500	2.47	Damage noted to main stem (minor), Decay of woody tissue noted in main stem (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
152	*Melia azedarach (Cape Lilac)*	Mature	14	12	15 - 40 years	Good	Reasonable	0.500	6.00	0.600	2.67	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
153	*Salix babylonica (Weeping Willow)*	Mature	12	3	5 - 15 years	Good	Questionable	1.000	12.00	1.000	3.31	Canopy displays leggy structural form, Stand of 2 *Salix*	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
154	*Beaucarnea recurvata (Ponytail Palm)*	Mature	4	2	40 + years	Good	Good	0.300	3.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
155	*Washingtonia robusta (Mexican Fan Palm)*	Mature	14	4	40 + years	Good	Good	0.400	4.00	0.550	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
156	*Butia capitata (Jelly Palm)*	Early Mature	4	3	40 + years	Good	Good	1.000	3.00	1.000	N/A	Tree is considered to be a reasonable specimen of the species, Stand of 2 Palms	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
157	*Callistemon viminalis (Bottlebrush)*	Mature	3	3	5 - 15 years	Good	Poor	0.500	6.00	0.500	2.47	Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
158	*Callistemon viminalis (Bottlebrush)*	Mature	2	2	5 - 15 years	Good	Poor	0.400	4.80	0.400	2.25	Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
159	*Corymbia citriodora (Lemon-scented Gum)*	Mature	15	15	40 + years	Good	Good	0.630	7.56	0.700	2.85	Deadwood noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
160	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
161	*Melaleuca bracteata (Black Tea Tree)*	Mature	5	6	15 - 40 years	Good	Questionable	0.350	4.20	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between ground level and 500mm	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
162	*Agonis flexuosa (WA Peppermint)*	Mature	5	8	40 + years	Good	Reasonable	0.400	4.80	0.400	2.25	Canopy displays leggy structural form, Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates at ground level, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
163	*Callistemon viminalis (Bottlebrush)*	Mature	5	7	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
164	*Callistemon species (Bottlebrush)*	Mature	5	5	15 - 40 years	Good	Good	0.250	3.00	0.250	1.85	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
165	*Callistemon viminalis (Bottlebrush)*	Mature	6	5	15 - 40 years	Good	Reasonable	0.330	3.96	0.330	2.08	Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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166	*Prunus species (Prunus)*	Mature	6	12	Dead	Dead	Questionable	0.600	N/A	0.600	N/A	Dead Tree – no chance of recovery, Included bark unions noted (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
167	*Erythrina x sykesii (Coral Tree)*	Mature	8	10	15 - 40 years	Good	Reasonable	0.600	7.20	0.600	2.67	Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
168	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	6	12	15 - 40 years	Good	Questionable	0.900	10.80	0.900	3.17	Canopy previously lopped (Major - not in keeping with AS4373), Tree displays multi stemmed form, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
169	*Pyrus calleryana 'Bradford' (Bradford Pear)*	Mature	10	12	15 - 40 years	Good	Questionable	0.800	9.60	0.800	3.01	Friction stems noted within canopy (50 mm to 150 mm dia.), Prior branch failures noted within canopy (50 mm to 150 mm dia.), Tree displays multi stemmed form, Tree displays questionable form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
170	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	4	5 - 15 years	Good	Questionable	0.370	3.00	0.450	N/A	Palm displays unusual structural form (not straight/upright)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
172	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.350	3.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
171	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.350	3.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
173	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
174	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
175	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
176	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
177	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
178	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
179	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
179	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

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180	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	4	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species,Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
181	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	8	15 - 40 years	Good	Good	0.430	4.00	0.430	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
182	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	5	15 - 40 years	Good	Good	0.300	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
183	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.330	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
184	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.330	3.00	0.450	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
185	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	5	15 - 40 years	Good	Good	0.330	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
186	*Dypsis decaryi (Triangle Palm)*	Mature	5	3	<5 years	Good	Poor	0.450	3.00	0.380	N/A	Canopy previously lopped (Major - not in keeping with AS4373), meristem has been cut/dammaged	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
187	*Lagunaria patersonii (Norfolk Island Hibiscus)*	Mature	12	8	15 - 40 years	Good	Reasonable	0.400	4.80	0.450	2.37	Canopy displays leggy structural form, Main stem bifurcates between 2 meters and 3 meters, species considered problematic for retention and incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
188	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	2	Dead	Dead	Poor	0.250	N/A	0.400	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
189	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	8	15 - 40 years	Good	Good	0.350	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
190	*Beaucarnea recurvata (Ponytail Palm)*	Mature	3	3	15 - 40 years	Good	Good	0.300	3.00	1.000	N/A	Major canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
191	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	7	10	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Damage noted to basal area(minor), Friction stems noted within canopy (150 mm to 300 mm dia.), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
192	*Prunus species (Prunus)*	Mature	5	6	Dead	Dead	Questionable	0.500	N/A	0.500	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
193	*Prunus species (Prunus)*	Mature	5	6	<5 years	Reasonable	Questionable	0.500	6.00	0.500	2.47	Canopy starting to indicate decline, Included bark unions noted (major), Main stem bifurcates at ground level	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
194	*Macadamia integrifolia (Macadamia)*	Mature	5	8	15 - 40 years	Reasonable	Questionable	0.500	6.00	0.500	2.47	Included bark unions noted (major), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
195	*Eucalyptus camaldulensis (River Red Gum)*	Mature	15	16	15 - 40 years	Good	Questionable	0.650	7.80	0.750	2.93	Canopy displays leggy structural form, Included bark unions noted (minor), Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
616	*Eucalyptus camaldulensis (River Red Gum)*	Mature	20	20	15 - 40 years	Good	Questionable	0.750	9.00	0.800	3.01	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (150 mm to 300 mm dia.), Included bark unions noted (major), Main stem bifurcates above 4 meters+	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
615	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.350	4.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
614	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.350	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
613	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.300	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
196	*Melaleuca nesophila (Showy Honey Myrtle)*	Mature	4	10	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
197	*Corymbia maculata (Spotted Gum)*	Mature	30	20	40 + years	Good	Reasonable	1.100	13.20	1.300	3.69	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
198	*Corymbia ficifolia (Red Flowering Gum)*	Mature	9	10	15 - 40 years	Reasonable	Reasonable	0.650	7.80	0.700	2.85	Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 1 meter and 2 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
199	*Melaleuca bracteata (Black Tea Tree)*	Mature	8	8	15 - 40 years	Good	Good	0.400	4.80	0.450	2.37	Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 3 meters and 4 meters, Prior branch failures noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
200	*Callistemon viminalis (Bottlebrush)*	Mature	5	5	5 - 15 years	Good	Questionable	0.400	4.80	0.400	2.25	Canopy previously lopped (not in keeping with AS4373), Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
617	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	5	5 - 15 years	Good	Questionable	0.600	7.20	0.600	2.67	Prior branch failures noted within canopy (150 mm to 300 mm dia.), canopy consists of regrowth from previously cut stump	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
662	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	10	7	15 - 40 years	Good	Questionable	0.300	3.60	0.350	2.13	Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
201	*Eucalyptus grandis (Rose Gum)*	Mature	18	15	40 + years	Good	Good	0.570	6.84	0.650	2.76	Canopy displays leggy structural form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
202	*Lophostemon confertus (QLD Box)*	Mature	12	12	40 + years	Good	Good	0.550	6.60	0.600	2.67	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
203	*Eucalyptus grandis (Rose Gum)*	Mature	25	15	40 + years	Good	Reasonable	0.680	8.16	0.750	2.93	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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204	*Eucalyptus rudis (Flooded Gum)*	Mature	17	13	40 + years	Good	Reasonable	0.720	8.64	0.800	3.01	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
205	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	40 + years	Good	Reasonable	1.000	12.00	1.500	3.92	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
206	*Sapium sebiferum (Chinese Tallow)*	Mature	6	8	15 - 40 years	Good	Good	0.360	4.32	0.500	2.47	Main stem bifurcates between 1 meter and 2 meters, Minor deadwood noted within canopy, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
207	*Sapium sebiferum (Chinese Tallow)*	Mature	6	11	15 - 40 years	Good	Good	0.420	5.04	0.520	2.51	Damage to surface roots (minor), Deadwood noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
208	*Cupressus macrocarpa (Monterey Cypress)*	Mature	5	5	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
209	*Olea europaea (Olive)*	Mature	11	10	40 + years	Good	Good	0.400	4.80	0.550	2.57	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
210	*Syzygium smithii (Lilly Pilly)*	Early Mature	9	5	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
211	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	10	6	5 - 15 years	Reasonable	Questionable	0.230	2.76	0.300	2.00	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
212	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	2	5 - 15 years	Good	Questionable	0.150	2.00	0.200	1.68	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
213	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	5	4	5 - 15 years	Reasonable	Questionable	0.210	2.52	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
214	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	3	5 - 15 years	Good	Questionable	0.200	2.40	0.250	1.85	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
215	*Eucalyptus grandis (Rose Gum)*	Early Mature	12	10	40 + years	Good	Good	0.300	3.60	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, tree situated adjacent dead stump	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
217	*Phoenix canariensis (Canary Island Date Palm)*	Mature	11	8	40 + years	Good	Good	0.700	5.00	0.850	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
216	*Carya illinoinensis (Pecan)*	Semi-Mature	5	6	40 + years	Good	Good	0.280	3.36	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
218	*Arbutus unedo (Irish Strawberry Tree)*	Mature	7	8	15 - 40 years	Reasonable	Reasonable	0.500	6.00	0.600	2.67	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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219	*Cassia fistula (Golden Shower Tree)*	Early Mature	6	5	15 - 40 years	Good	Reasonable	0.220	2.64	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
220	*Laurus nobilis (Bay Tree)*	Mature	6	5	15 - 40 years	Good	Reasonable	0.450	5.40	0.450	2.37	Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
221	*Dracaena marginata (Madagascar Dragon Tree)*	Early Mature	3	3	15 - 40 years	Good	Reasonable	0.350	4.20	0.350	2.13	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
222	*Dracaena marginata (Madagascar Dragon Tree)*	Early Mature	3	3	15 - 40 years	Good	Good	0.500	6.00	0.350	2.13	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
223	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Good	0.330	3.96	0.350	2.13	Tree is considered to be a good specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
224	*Magnolia grandiflora (Bull Bay Magnolia)*	Semi-Mature	5	4	15 - 40 Years	Reasonable	Reasonable	0.250	3.00	0.250	1.85	Canopy noted to be chlorotic (Yellowing off), Canopy starting to indicate decline, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
225	*Hedera species (Ivy Tree)*	Mature	4	5	15 - 40 years	Good	Poor	3.000	N/A	3.000	N/A	Dead tree stump covered in Ivy	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
226	*Phoenix canariensis (Canary Island Date Palm)*	Mature	9	8	40 + years	Good	Good	0.800	5.00	0.900	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
227	*Phoenix canariensis (Canary Island Date Palm)*	Mature	9	8	40 + years	Good	Good	0.800	5.00	0.900	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
228	*Jacaranda mimosifolia (Jacaranda)*	Mature	11	10	15 - 40 years	Good	Questionable	0.800	9.60	1.000	3.31	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Decay of woody tissue noted in 1st order limbs (significant), Main stem bifurcates between 1 meter and 2 meters. Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
229	*Brachychiton rupestris (QLD Bottle Tree)*	Mature	7	6	40 + years	Good	Good	1.100	13.20	1.100	3.44	Tree is considered to be a good specimen of the species, fluting of main stem noted - not considered problematic at this stage	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
230	*Callistemon viminalis (Bottlebrush)*	Mature	6	4	5 - 15 years	Good	Questionable	0.300	3.60	0.500	2.47	Tree displays multi stemmed form, Tree on lean (minor)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
231	*Butia capitata (Jelly Palm)*	Early Mature	3	3	15 - 40 years	Reasonable	Good	0.600	3.00	0.600	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
232	*Citharexylum spinosum (Fiddlewood)*	Mature	8	11	15 - 40 years	Good	Questionable	1.000	12.00	1.000	3.31	Friction stems noted within canopy (50 mm to 150 mm dia.), Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
233	*Eucalyptus camaldulensis (River Red Gum)*	Mature	21	20	15 - 40 years	Good	Questionable	0.900	10.80	1.000	3.31	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+, Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
234	*Eucalyptus robusta (Swamp Mahogany)*	Mature	14	12	15 - 40 years	Good	Reasonable	0.590	7.08	0.700	2.85	Canopy displays leggy structural form, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.

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235	*Eucalyptus robusta (Swamp Mahogany)*	Mature	10	8	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
236	*Eucalyptus robusta (Swamp Mahogany)*	Mature	14	12	15 - 40 years	Good	Questionable	0.700	8.40	0.800	3.01	Canopy displays leggy structural form, Damage noted to main stem (minor), Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters, Significant branch failures noted (300 mm + dia.)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
237	*Eucalyptus robusta (Swamp Mahogany)*	Mature	10	8	15 - 40 years	Good	Reasonable	0.350	4.20	0.400	2.25	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
238	*Eucalyptus robusta (Swamp Mahogany)*	Mature	15	13	15 - 40 years	Good	Good	0.500	6.00	0.700	2.85	Canopy displays leggy structural form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
239	*Eucalyptus robusta (Swamp Mahogany)*	Mature	11	11	15 - 40 years	Good	Reasonable	0.350	4.20	0.450	2.37	Deadwood noted within canopy (< 50mm dia.), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
240	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	20	40 + years	Good	Good	0.880	10.56	0.950	3.24	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
241	*Phoenix canariensis (Canary Island Date Palm)*	Early Mature	5	8	40 + years	Good	Good	0.800	5.00	0.800	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
242	*Agonis flexuosa 'Nana' (Dwarf WA Peppermint)*	Mature	3	3	5 - 15 years	Good	Reasonable	0.250	3.00	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
243	*Agonis flexuosa 'Nana' (Dwarf WA Peppermint)*	Mature	3	6	15 - 40 years	Good	Reasonable	0.300	3.60	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
244	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Good	Reasonable	0.150	2.00	0.200	1.68	Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
245	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Main stem bifurcates at ground level	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
246	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	15 - 40 years	Good	Reasonable	0.250	3.00	0.250	1.85	Main stem bifurcates at ground level, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
247	*Callistemon viminalis (Bottlebrush)*	Early Mature	3	3	15 - 40 years	Good	Good	0.100	2.00	0.150	1.50	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
248	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	15 - 40 years	Good	Reasonable	0.180	2.16	0.220	1.75	Main stem bifurcates between 500mm and 1 meter, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
249	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
250	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Good	0.200	2.40	0.250	1.85	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
251	*Callistemon viminalis (Bottlebrush)*	Mature	6	4	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
252	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
253	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Good	Questionable	0.250	3.00	0.250	1.85	Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
254	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
255	*Melaleuca rhaphiophylla (Fresh Water Paperbark)*	Mature	4	5	5 - 15 years	Reasonable	Reasonable	0.700	8.40	0.700	2.85	Tree displays multi stemmed form, CoA Verge Tree situated under power infrastructure	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
256	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	4	5 - 15 years	Questionable	Questionable	0.600	7.20	0.600	2.67	Canopy indicates decline, Canopy noted to be sparse, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 1 meter and 2 meters, , CoA Verge Tree situated under power infrastructure	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
257	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	3	5 - 15 years	Questionable	Questionable	0.410	4.92	0.500	2.47	Canopy indicates decline, Canopy noted to be sparse, Canopy previously lopped (Major - not in keeping with AS4373), CoA Verge Tree situated under power infrastructure	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

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APPENDIX C - TREE PROTECTION ZONE (TPZ) OVERVIEW

INTRODUCTION

- Tree protection measures in keeping with AS 4970 'Protection of Trees on development sites' 2009' must be incorporated into the proposed design and implemented under the supervision of a AQF Level 5 Project Arborist in order to achieve tree sensitive outcomes for the project.
- Reporting is to be in keeping with the stages identified within *AS 4970 'Protection of Trees on Development Sites'* 2009 and industry best practice.

TPZ BACKGROUND INFORMATION

- To determine a Tree Protection Zone (TPZ), the trunk Diameter measured at Breast Height (1.4 meters from ground level) is multiplied by x 12. This is to be measured as a radius from the centre of the main stem at ground level. As identified in AS 4970 *The TPZ is to not be less than 2 meters and no greater than 15 meter radius.*
- The calculated TPZ includes both the above ground and below ground parts of the tree.
- Any construction works proposed to occur within the TPZ will require Arboricultural assessment and approval from a AQF 5 Project Arborist prior to commencement.
- Modification of the design and/or construction methodologies may be necessary to allow the proposed design to proceed.
- Ongoing Arboricultural review of methodologies and works within the TPZs will be required by the Project Arborist for the duration of the development or construction works.

ESTABLISH TREE PROTECTION ZONES (TPZ) WITHIN THE SITE

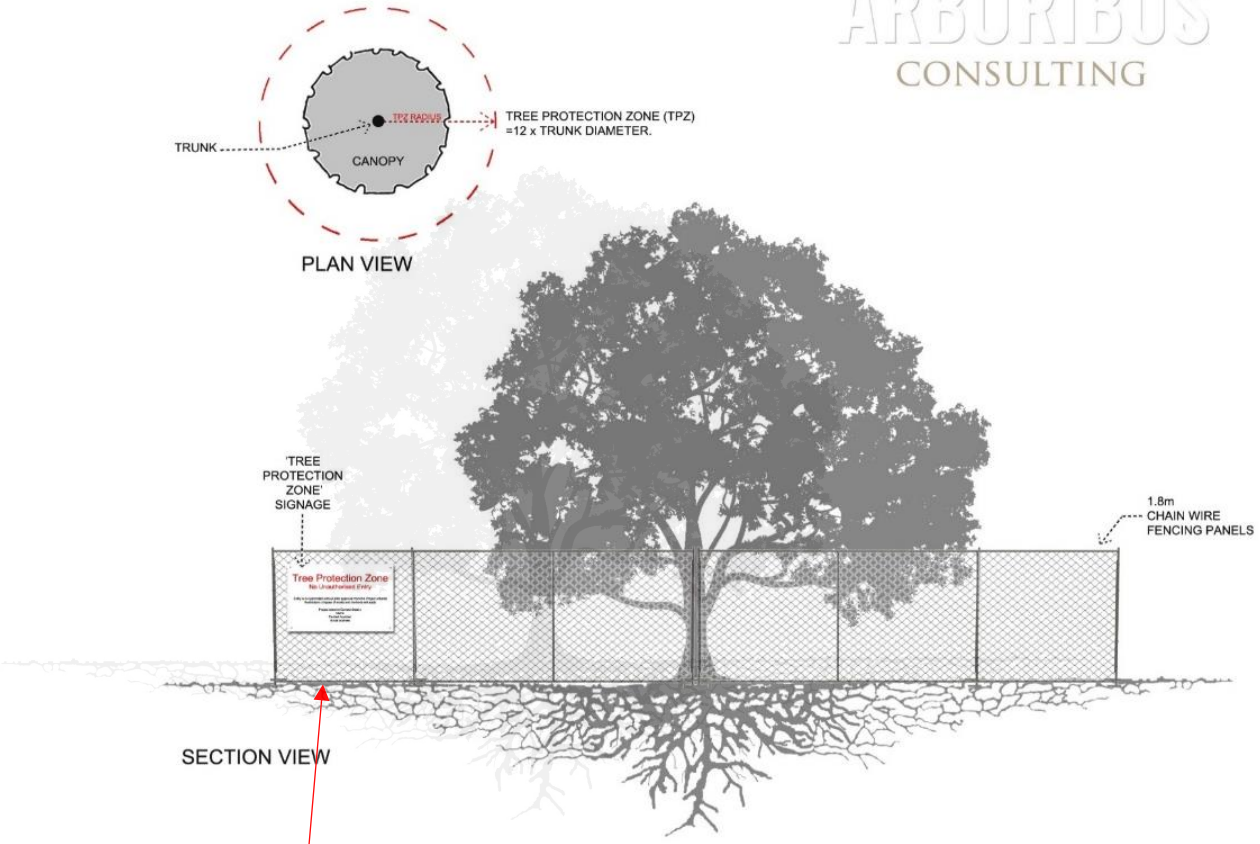
- TPZs are to be identified at their perimeter via 1.8-meter chain wire fencing panels (refer below figure for detail).
- This dedicated Fencing is to have signage installed (refer below figure for detail) that identifies the TPZ as a protected area and that no access is permitted without prior approval from the Project Arborist.
- TPZ Fencing is to remain for the duration of the construction phase. Maintenance and general upkeep of the fencing is the responsibility of the nominated Contractor.
- Any alteration or modification of the fencing is to be approved prior by the Project Arborist and documented as part of ongoing tree preservation reporting for the site.

PROHIBITED ACTIVITIES WITHIN TPZS

- Unauthorised access
- Mechanical Excavation, trenching or unapproved works of any kind

- Unauthorised modification of existing grade (i.e., raising or lowering of soil levels)
- Storage of construction materials, fuels, or phytotoxic chemicals etc…
- Parking, fuelling, tracking, or storage of vehicles or machinery of any kind
- Unauthorised placement of site facilities or waste disposal bins
- Stockpiling of soil, spoil or any construction debris
- Disposal of liquid waste including paint and concrete wash out
- Cleaning or washing of tools and equipment
- Unauthorised pruning of branches or roots.

TPZ EXAMPLE



TREE PROTECTION ZONE FENCING

TO BE IMPLEMENTED FOR TREES IDENTIFIED FOR RETENTION AND MAINTAINED FOR THE DURATION OF WORKS.



APPENDIX D – GENERAL SITE IMAGES

801 – 813 ARMADALE RD








817 – 831 ARMADALE RD








835 – 839 ARMADALE RD



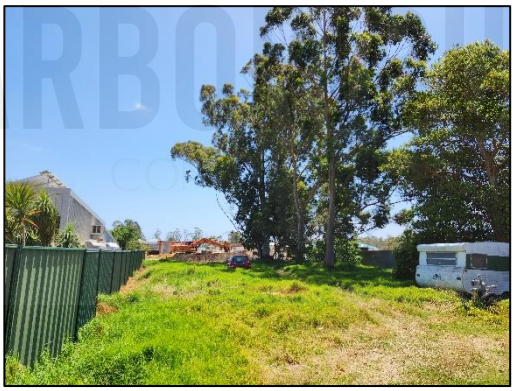





845 – 849 ARMADALE RD








7 – 15 ALLEN ROAD








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If you have any queries or if I can be of further assistance, do not hesitate to contact me on 0406 396 778.

Regards,



Luke Lumbus

COMPANY AND CONSULTANTS DETAILS

Consultant Details:	Luke Lumbus – Consulting Arboriculturist & Director
Qualifications:	AQF 8 - Graduate Certificate in Arboriculture (Melbourne University) AQF 5 - Diploma in Arboriculture – (Challenger TAFE, Western Australia) International Society of Arboriculture (ISA) Certified Arborist - AU 0014A Quantified Tree Risk Assessment (QTRA) User Number 1935
Company Trading Name:	Arboribus Pty Ltd
Established:	October 2021
Australian Business Number:	82 653 281 782
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Insurance:	Public Liability Insurance $20 Million (QBE Australia) Professional Indemnity $5 Million (Dual Australia)

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DISCLAIMER

- The Consultant is trained, qualified and competent in their field of expertise and will employ their knowledge, training, and skill to provide informed comments and recommendations. However, the Client acknowledges there may be latent conditions and factors the Consultant cannot reasonably determine from a visual inspection. Unless otherwise agreed with the Client and documented in the Report, the Consultant's inspection will be conducted visually and so will not determine any latent conditions hidden within the tree or below the ground level.

- The Client hereby acknowledges that the information contained in this report is intended to provide preliminary guidance and recommendations for how to manage and protect the tree(s) that are the subject of this report, however, given the nature of the subject matter, trees as living organisms are subjected to many varied and dynamic factors.
- This report does not attempt to predict or anticipate potential future failure(s) of the subject tree(s) and/or its above and/or below ground parts – failure of trees and their parts can be influenced by numerous factors including (but not be limited to): -
    - Age
    - Health and Structural status of both above and/or below ground component(s)
    - Recent, historic or prolonged impacts to root(s)
    - Sudden or unapproved alterations to the trees growing environ(s)
    - Storm events, high winds, persistent heat and/or other severe climatic events
    - Standard and quality of previous works undertaken.

  This report and the advice within it cannot and shall not be construed as a guarantee the subject trees will not at some point deteriorate further and/or not survive.

- Where recommendations or advice have been provided, and the Client (or approved third party) does not adhere to such recommendations this shall be deemed to be an act or omission of the Client and the Client shall indemnify the Consultant for any damage, injury or loss that may occur as a result. It is the client's responsibility to organise any required re-inspections at the intervals specified.

- The Client warrants that it has disclosed all complete and accurate information in relation to the trees that are the subject of this report and the like and the Client hereby indemnifies and holds the Consultant harmless from any costs, losses or damage resulting in any way from matters not disclosed by the Client.

- The Client must acknowledge that it is their responsibility, prior to any work being conducted in connection with the Report, to obtain all necessary approvals in relation to carrying out the work that may be recommended by this report, including without limitation: approval from any local council, local or state government agency, or other authorised body, landlord, neighbour or any other persons or body corporate with legislative, regulatory or other interest over the trees or land that is the subject of this report.

- Arboribus shall not be required to attend court or provide evidence regarding this report unless predetermined provisions are agreed to between Arboribus and the Client, including additional payment of fees for such services.

- This report is confidential and for the exclusive use by the client for whom it was prepared. This report shall not be modified, reissued, printed, or distributed partially and/ or in its entirety without the formal permission provided by Arboribus Pty Ltd. Any unauthorised modification of this report invalidates the entire report. © Arboribus Consulting 2022. All Rights Reserved.

ATTACHMENT 9

Environmental Assessment Report

Tuesday, 14 March 2023

Our Ref: A22.051_LRP_ER_0_FINAL

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Rowe Group-Town Planning and Urban Design
3/369 Newcastle St
Northbridge WA 6003

ATTENTION: Sam Bowers

SUBJECT: STRUCTURE PLAN – VARIOUS LOTS, ARMADALE ROAD, FORRESTDALE

Western Environmental Approvals Pty Ltd (WEPL) presents the following letter report in response to additional requirements from the City of Armadale (CoA). Initially a desktop assessment of the potential for threatened flora, fauna and communities to be located in the Structure Plan area (Figure 1) was conducted and provided to the CoA. As advised by the City of Armadale, an Arborist Report (Tree Survey) was undertaken by Arboribus in December 2022 (Appendix A) to accompany the Structure Plan. Arboribus were requested to photograph all vegetated areas to enable an assessment of whether the assessefd properties supported in-tact native vegetation. Using the Arboribus report, further assessment was undertaken for the potential presence of any Threatened or Priority Flora or Ecological Communities and Black Cockatoo habitat within the Structure Plan Area. The results of this assessment are provided in this letter.

Scope of Work

In order to identify the potential presence of threatened flora, fauna or communities and Black Cockatoo habitat values, the following work was undertaken:

- Desktop assessment and summary of publicly available information and purchased searches of Department of Biodiversity, Conservation and Attractions (DBCA) databases for threatened and priority fauna, flora and vegetation. This included an assessment, using the arborist report, of potential Black Cockatoo foraging, nesting or roosting habitat considering both native and introduced tree species present on site. No site assessment was undertaken by WEPL as part of this report.
- GIS assimilation of necessary maps to identify Threatened Ecological Communities (TEC) and Declared Rare Flora (DRF) locations.
- Analysis of Arboribus report to identify potential flora, vegetation and Black Cockatoo values.
- Discussion of results and identification of any areas of interest from the desktop assessment and commentary on State and Commonwealth environmental legislation or management requirements.

Methodology

Database searches were undertaken to compile a list of potential threatened and conservation listed flora, fauna, and ecological communities within or surrounding the Structure Plan Area (Table 1).

Table 1. Database searches of the Structure Plan Area.

Database Name	Date Received and Reference Number	Search Type	Search Area
Threatened and Priority Ecological Communities database search (Department of Biodiversity Conservation and Attractions)	14/09/2022 21-0922EC	TECs and PECs	10 km buffer around the Structure Plan area
Threatened and Priority Flora (TPFL) database search (Department of Biodiversity Conservation and Attractions)	15/09/2022 58-0922FL	Threatened and Priority Flora	10 km buffer around the Structure Plan area
Western Australian Herbarium (WAHerb) flora database search (Department of Biodiversity Conservation and Attractions)	15/09/2022 58-0922FL	Threatened and Priority Flora	10 km buffer around the Structure Plan area
DBCA Threatened and Priority Fauna database search (Department of Biodiversity Conservation and Attractions)	15/09/2022 FAUNA#7330	Threatened and Priority Fauna	20 km buffer around the Structure Plan area
Protected Matters Search Tool Department of Agriculture Water and the Environment, 2022a)	16/09/2022	Commonwealth listed Threatened flora and fauna and TECs	10 km buffer around the Structure Plan area

Results

Threatened Flora, Fauna and Ecological Communities

The database searches found that no threatened flora or fauna species or ecological communities were identified within the Structure Plan Area which is demonstrated in Figures 1-3. This is confirmed by the City of Armadale (CoA) local biodiversity strategy which does not consider the area a local natural area, reflecting the absence of intact vegetation.

The Structure Plan Area is within the buffer of one type of threatened community Banksia Woodland of the Swan Coastal Plain (OCC ID: 121154, 121190 and 121155; Figure 3). These are associated with mapped patches of Banksia Woodland TEC and are identified in the CoA local biodiversity strategy as patches of local natural areas. These areas are not within and do not overlap with the Structure Plan Area.

The result from the arborist report and site images (Arboribus, 2022) give additional evidence that there is no intact native vegetation, with mainly planted and non-native upper stratum species being present and the mid and ground stratum being cleared gardens and parkland.

Black Cockatoo Habitat Assessment

The DBCA database search identified two locations where White-tailed Black Cockatoos (either Carnaby's or Baudin's) have been sighted near the Structure Plan Area (Figure 2), 360 m east and 200 m south from the centre of the Structure Plan Area.

Utilising tree data from the site visit by Arboribus (2022; Appendix A), the likely conservation values for the three Black Cockatoo species could be inferred.

Breeding Habitat

None of the trees listed by Arboribus (2022) were immediately identified as likely comprising breeding habitat (possessing suitable hollows). It typically takes between 100- 200 years for eucalyptus trees to form a suitable hollow where trees with a DBH of > 500 mm typically considered large enough to potentially support hollow development (DAWE, 2022; Johnstone *et. Al*. 2013; MRWA, 2022). There were two tree species present within the area assessed that are known to have the potential to support breeding hollows (as per DAWE, 2022), these were *Corymbia calophylla* and *Eucalyptus rudis.*

Both *C. calophylla* trees (ID 09 & 55; Appendix A) had DBH < 500 mm and are therefore considered too small to support hollow development. One *C. calophylla* (ID 55) was dead and was recommended to be removed. Five *E. rudis* (Table 2) with DBH >500 mm were present within the Structure Plan area. *E. rudis* is a known tree species that Carnaby's Black Cockatoos (BC) utilise for breeding (DAWE, 2022). *E. rudis* is not recognised as a known tree species that Baudin's BC or Forest Red-tailed BC utilise for breeding purposes, however it is known that they breed in eucalyptus trees that can form hollows, indicating that *E. rudis* can potentially be a nesting tree for Baudin's BC and Forest Red-tailed BC as well (DAWE, 2022).

The DAWE, 2022 guidelines acknowledge that many non endemic species of eucalypt may have the potential to form a suitable hollow. Although generally not specifically studied, it is considered that the timeframe of between 100-200 years for eucalyptus trees to form a suitable hollow observed in WA endemic species is likely reasonable to apply to these species. Due to the age of plantings in the area it is considered unlikely that the planted non endemic trees present would be of a sufficient age class to be forming suitable hollows and only one tree supporting hollows were observed during the Arboribus assessment.

One non endemic tree (Tree 33), a *Eucalyptus grandis*, was identified as possessing hollows by Arboribus (2022). Assessment of the size of hollows or potential suitability for Black Cockatoo usage was not within the scope of the arborist assessment. As seen in Plate 1, any branches that have been removed and that could potentially possess a hollow does not appear to have suitable width or depth for the hollow to be utilised by Black Cockatoos. The average diameter hollows that Carnaby's and Forest Red-tailed Black Cockatoos utilise are 26 and 34 cm wide respectively and > 1 m deep (DAWE, 2022; Saunders *et al.,* 2014a; Saunders *et al.,* 2014b; Johnstone *et al.,* 2013). The preferred hollow dimensions for Baudin's Black Cockatoo have not been studied specifically, but considered likely to be similar to that of Carnaby's Black Cockatoo (DAWE, 2022).



Plate 1: Eucalyptus grandis recorded with hollow, tree 33 in arborist report (image provided by Arboribus)

Trees for which a low residual potential for Black Cockatoo breeding habitat to be present are summarised below in Table 2.

Table 2: Potential Breeding Trees for Black Cockatoo Species

Note: References are Groom (2011); DAWE, (2022); MRWA, (2022); Johnstone, et al. (2013); * indicates non-native species.

Tree ID	Species	DBH (mm)
8	*Eucalyptus rudis*	700
33	**Eucalyptus grandis*	1600
53	*Eucalyptus rudis*	1200
88	*Eucalyptus rudis*	1000
92	*Eucalyptus rudis*	500
204	*Eucalyptus rudis*	800

Roosting Habitat

Most of the eucalyptus species present could potentially be utilised for roosting for all three Black Cockatoo species. All three Black Cockatoo species roost in both native and non-native eucalyptus trees with consideration that:

- the tree has to be tall,
- be close to foraging habitat,
- close to permanent water source (MRWA,2022; DAWE,2022).

It has been found that Baudin's BC roost in trees that are between 14-25 m tall (Johnstone and Kirkby, 2008) and Carnaby's BC in >25 m tall trees with DBH >1 m (Le Roux, 2017). Forest Red-tailed BC roost in tall trees on protective perches within the canopy (Johnstone and Kirkby, 2008). The Structure Plan area is located < 1 km north of Forrestfield Lake for a permanent water source as well as > 1 km south of a Bush Forever (site number 342) area for foraging habitat. In total, 36 trees within the Structure Plan area are potential roosting trees and are listed in Table 3. The species are ranked Low, Medium, High as the potential for being a roosting site for the different Black Cockatoo species. Both tree dimensions and tree species (i.e., known roosting tree species) were considered to determine the level of potential roosting site.

Table 3: Potential Roosting Trees for Black Cockatoo Species

Note: References are Groom (2011); DAWE, (2022); MRWA, (2022); Le Roux, (2017); Johnstone and Kirkby, (2008); Johnstone, et al. (2017); * indicates non-native species.

Tree ID	Species	DBH (mm)	Height (m)	Carnaby's BC	Baudin's BC	Forest Red-tailed BC	Arborist comment
6	**Eucalyptus globulus*	1110	15	Low	Low	Medium	Suitable for retention
9	*Corymbia calophylla*	350	12	Low	Low	Medium	Suitable for retention
19	**Pinus pinaster*	650	18	Low	Medium	Medium	Suitable for retention
22	**Eucalyptus grandis*	1500	30	Medium	Low	Medium	Unsuitable for retention
24	**Eucalyptus grandis*	1100	30	Medium	Low	Medium	Unsuitable for retention
26	**Eucalyptus grandis*	500	25	Low	Low	Medium	Unsuitable for retention
27	**Eucalyptus grandis*	950	30	Medium	Low	Medium	Unsuitable for retention
28	**Eucalyptus grandis*	700	30	Low	Low	Medium	Unsuitable for retention

Tree ID	Species	DBH (mm)	Height (m)	Carnaby's BC	Baudin's BC	Forest Red-tailed BC	Arborist comment
29	**Eucalyptus grandis*	650	30	Low	Low	Medium	Unsuitable for retention
30	**Eucalyptus grandis*	700	30	Low	Low	Medium	Unsuitable for retention
33	**Eucalyptus grandis*	1600	30	Medium	Low	Medium	Unsuitable for retention
49	**Eucalyptus grandis*	900	30	Low	Low	Medium	Further assessment required
53	*Eucalyptus rudis*	1200	16	Low	Medium	Medium	Suitable for retention
60	**Eucalyptus camaldulensis*	1100	35	Medium	Medium	Medium	Suitable for retention
61	**Eucalyptus camaldulensis*	1300	35	Medium	Medium	Medium	Suitable for retention
62	**Eucalyptus camaldulensis*	1100	35	Medium	Medium	Medium	Suitable for retention
63	**Eucalyptus camaldulensis*	1100	35	Medium	Medium	Medium	Suitable for retention
64	**Eucalyptus camaldulensis*	1200	35	Medium	Medium	Medium	Suitable for retention
65	**Eucalyptus camaldulensis*	900	23	Low	Medium	Medium	Suitable for retention
84	**Eucalyptus camaldulensis*	1400	25	Medium	Medium	Medium	Further assessment required
85	**Eucalyptus camaldulensis*	950	23	Low	Medium	Medium	Further assessment required
86	**Eucalyptus camaldulensis*	1300	30	Medium	Medium	Medium	Suitable for retention
87	**Eucalyptus camaldulensis*	1200	30	Medium	Medium	Medium	Suitable for retention
88	*Eucalyptus rudis*	1000	25	Medium	Medium	Medium	Further assessment required
89	**Eucalyptus camaldulensis*	800	25	Low	Medium	Medium	Suitable for retention
90	**Eucalyptus camaldulensis*	550	17	Low	Medium	Medium	Further assessment required
93	**Eucalyptus camaldulensis*	1300	20	Low	Medium	Medium	Suitable for retention

Tree ID	Species	DBH (mm)	Height (m)	Carnaby's BC	Baudin's BC	Forest Red-tailed BC	Arborist comment
195	**Eucalyptus camaldulensis*	750	15	Low	Medium	Medium	Further assessment required
197	**Corymbia maculata*	1300	30	Low	Low	Medium	Suitable for retention
201	**Eucalyptus grandis*	650	18	Low	Medium	Medium	Suitable for retention
203	**Eucalyptus grandis*	750	25	Low	Medium	Medium	Suitable for retention
204	*Eucalyptus rudis*	800	17	Low	Medium	Medium	Further assessment required
205	*Eucalyptus grandis*	1500	30	Medium	Medium	Medium	Further assessment required
233	**Eucalyptus camaldulensis*	1000	21	Low	Medium	Medium	Suitable for retention
240	**Eucalyptus camaldulensis*	950	25	Medium	Medium	Medium	Suitable for retention
616	**Eucalyptus camaldulensis*	800	20	Low	Medium	Medium	Further assessment required

Foraging Habitat

Overall foraging habitat value was assessed as being low for all Black Cockatoo species. The extent of species comprising suitable foraging habitat within the Structure Plan Area does not form a significant portion of habitat available in the local area. Significant areas of habitat are present outside of the Structure Plan Area in the surrounding area within local natural areas and remnant bushland. The foraging potential of likely foraging species and the number of trees present is summarised below in Table 4. There were two trees present of *C. calophylla* (one is dead), which is a primary food source for Baudin's and Forest Red-tailed BC (DAWE, 2022). The primary food source for Carnaby's BC are proteaceous species such as Banksia which were not recorded (DAWE, 2022). There are 36 trees of the eastern-state species *Callistemon viminalis* (Bottlebrush) which were considered as a medium priority foraging species for Carnaby's BC (Groom, 2011). Other introduced species that were present and are common foraging species for Carnaby's BC and Baudin's BC include *Pinus pinaster* and Macadamia. For Forest Red-tailed BC foraging species Cape lilac and marginal value foraging *Eucalyptus camaldulensis* are also present.

Table 4: Potential Foraging Tree Species Present within the Structure Plan area.

Note: References are Groom (2011), DAWE, (2022), MRWA, (2022); Valentine & Stock (2008); * indicates non-native species.

Species	Carnaby's BC	Forest Red-tailedBC	Baudin's BC	Number of Trees Present
Agonis flexuosa	Low			3 trees present

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Species	Carnaby's BC	Forest Red-tailedBC	Baudin's BC	Number of Trees Present
Callistemon viminalis	Medium			35 trees present, 5 of these trees recommended to be removed
Carya illinoinensis **(Pecan)**	Low		Low	1 tree present
Corymbia calophylla	High	High	High	2 trees present, 1 of them was dead and recommended to be removed
Corymbia ficifolia	Medium			1 tree present
Corymbia maculata		Low		1 tree present
Eucalyptus grandis		Low		14 trees present, 9 of these trees recommended to be removed
Eucalyptus robusta	Medium			9 trees present, 1 of these trees recommended to be removed
Eucalyptus camaldulensis		Low		26 trees present, 2 of these trees recommended to be removed
Ficus benjamina	Low			2 trees present
Ficus microcarpa var hillii	Low			1 tree present
Hibiscus tiliaceus rubra	Low			1 tree present
Jacaranda mimosifolia	Low			1 tree present
Macadamia integrifolia	Medium		Medium	1 tree present, recommended to be removed
Melia azedarach **(Cape lilac)**	Low	Medium		2 trees present, 1 of these trees recommended to be removed
Olea europaea **(Olive)**		Low		1 dead tree present, recommended to be removed
Pinus pinaster	Medium		Medium	1 tree present
Xanthorrhoea preissii	Medium			2 shurbs present

Conclusion

From the database search and arborist report, it can be concluded that the Structure Plan area does not have intact native vegetation and that significant Black Cockatoo habitat values are likely not present.

Due to the absence of intact vegetation and the mapped absence of threatened flora and fauna species and TECs, a Spring survey is not required for the site. This is apparent from the site visit by Arboribus (2022), which showed that there is no intact native vegetation and most of the upper stratum is planted, and non-native species and the mid and ground stratum is parkland cleared.

No trees were immediately identified as likely comprising breeding habitat (possessing suitable hollows). Five endemic Flooded Gums with suitable DBH are present (arborist report did not comment on hollow presence)

and one non-native eucalypt with hollows present. Significant foraging habitat values are not considered to be likely present. Potential roosting habitat is present as tall trees.

This report should be read in conjunction with the Schedule - Statement of Limitations. Should you have any queries regarding the above, please contact the undersigned on (08) 6162 8980.

Yours sincerely,
Western Environmental Approvals Pty Ltd



DALE NEWSOME
Director

Schedule

- Statement of Limitation

Attachments

- Figure 1
- Figure 2
- Figure 3
- Appendix A

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Statement of Limitations

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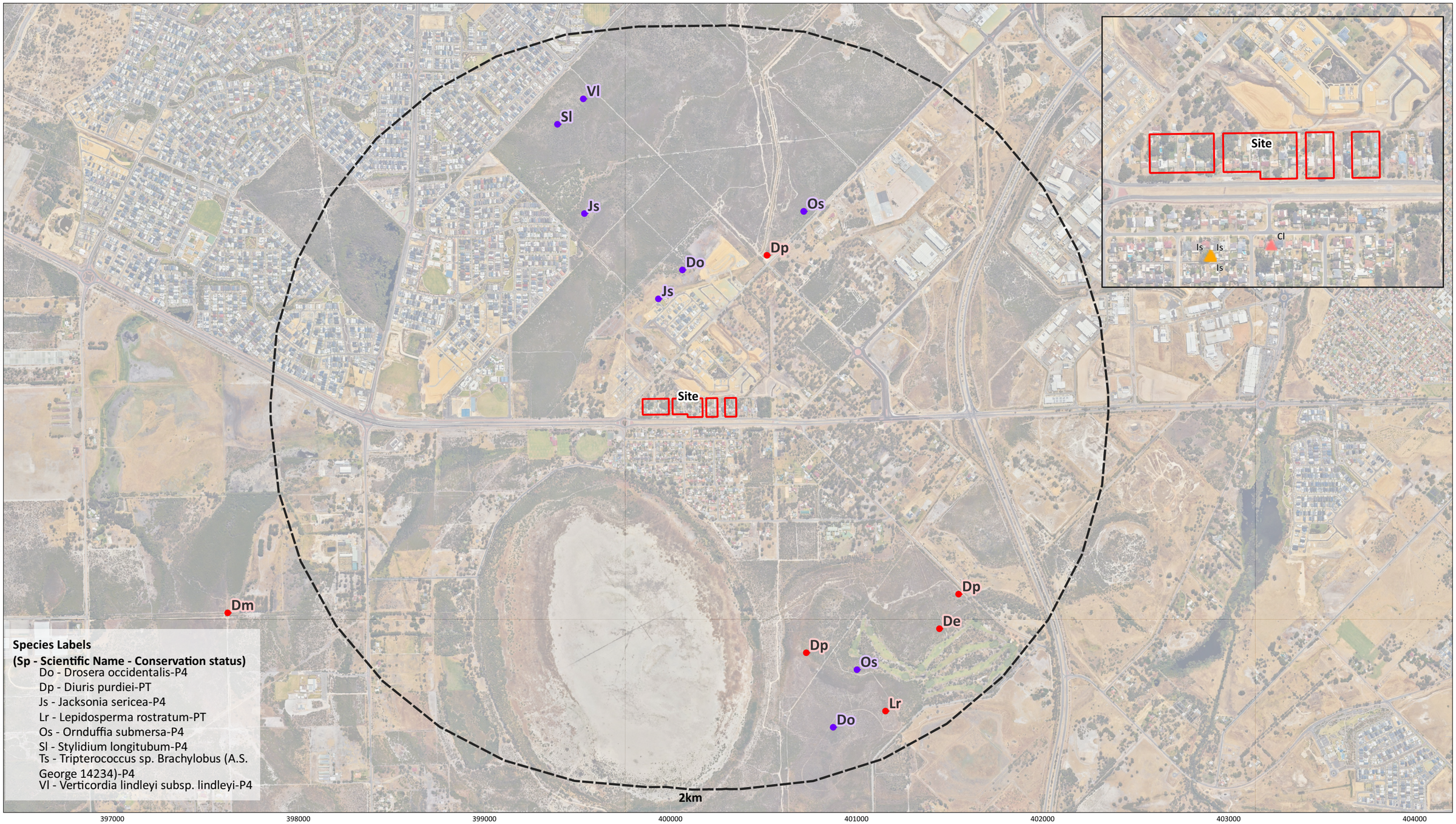


Figure 1: Database Search Results Flora

N

0 300 600 900 1,200 m

SCALE: 1:20,000	SHEET SIZE: A3 COLOUR
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A22.051 / VERSION: 0
DATA SOURCE: LANDGATE AERIAL IMAGERY 2022	DRAWN BY / REVIEWED BY: AC / LT / DATE: 23/9/2022

PROJECT/REPORT NAME
Structure Plan
Various Lots Armadale Rd, Forrestdale

CLIENT
Sam Bowers

Legend

- Site Boundary

DBCA Flora Database

- Priority 4
- Treatened

No	Description	Drawn	Approved	Date
A	Original issue	AC	LT	23/9/2022

NOTES:
Cadastral boundary from LANDGATE 2022

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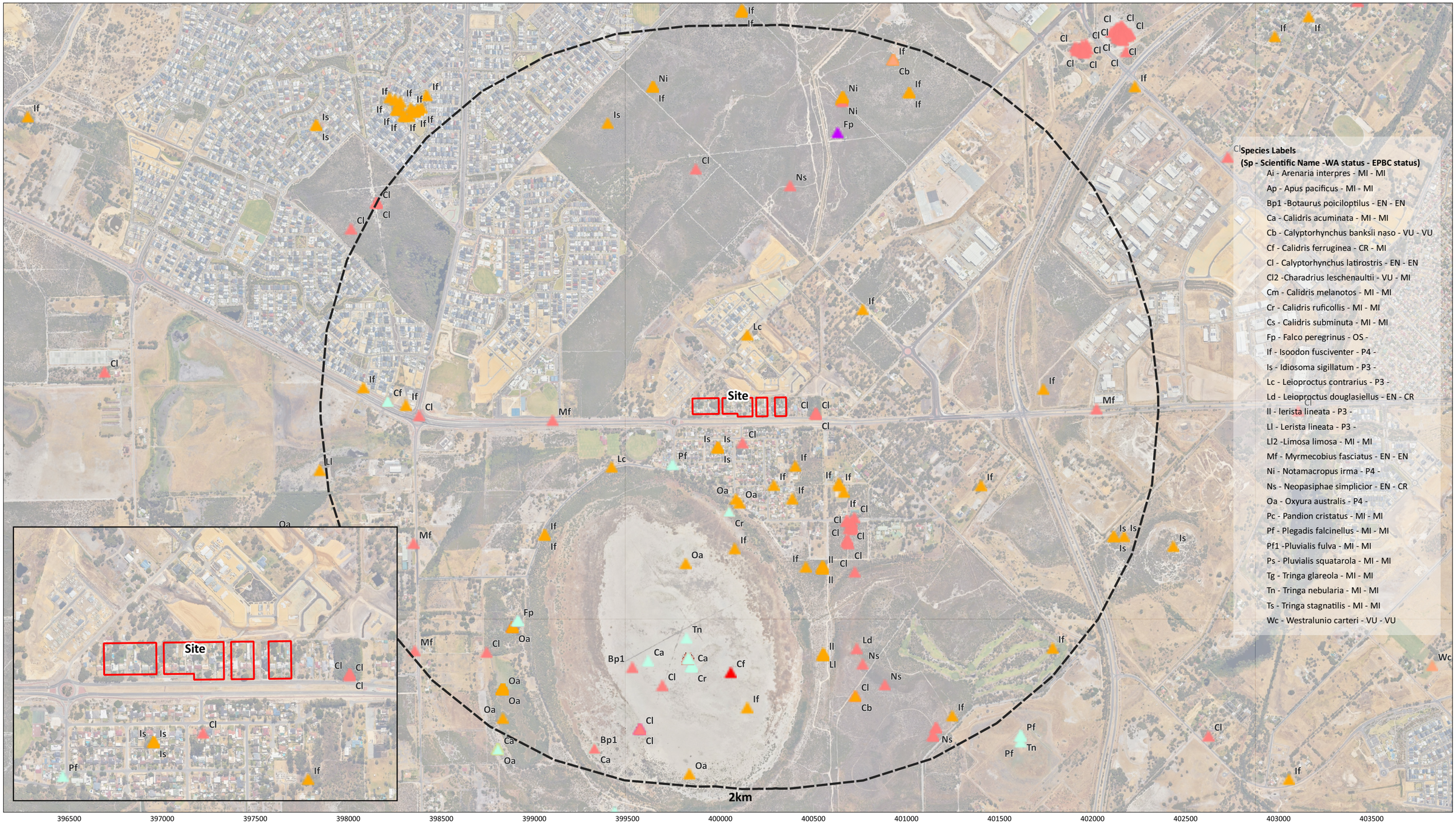


Figure 2: Database Search Results Fauna

N

0 300 600 900 1,200 m

PROJECT/REPORT NAME	Structure Plan Various Lots Armadale Rd, Forrestdale
SCALE	1:20,000
SHEET SIZE	A3 COLOUR
CLIENT	Sam Bowers
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.051
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	AC / LT
DATE	23/9/2022

Legend

Site Boundary

DBCA Fauna Database

- Threatened - Critically endangered
- Threatened - Endangered
- Threatened - Vulnerable
- Specially Protected - migratory
- Specially Protected - other specially protected
- Priority

No	Description	Drawn	Approved	Date
A	Original issue	AC	LT	23/9/2022

NOTES:

Cadastral boundary from LANDGATE 2022

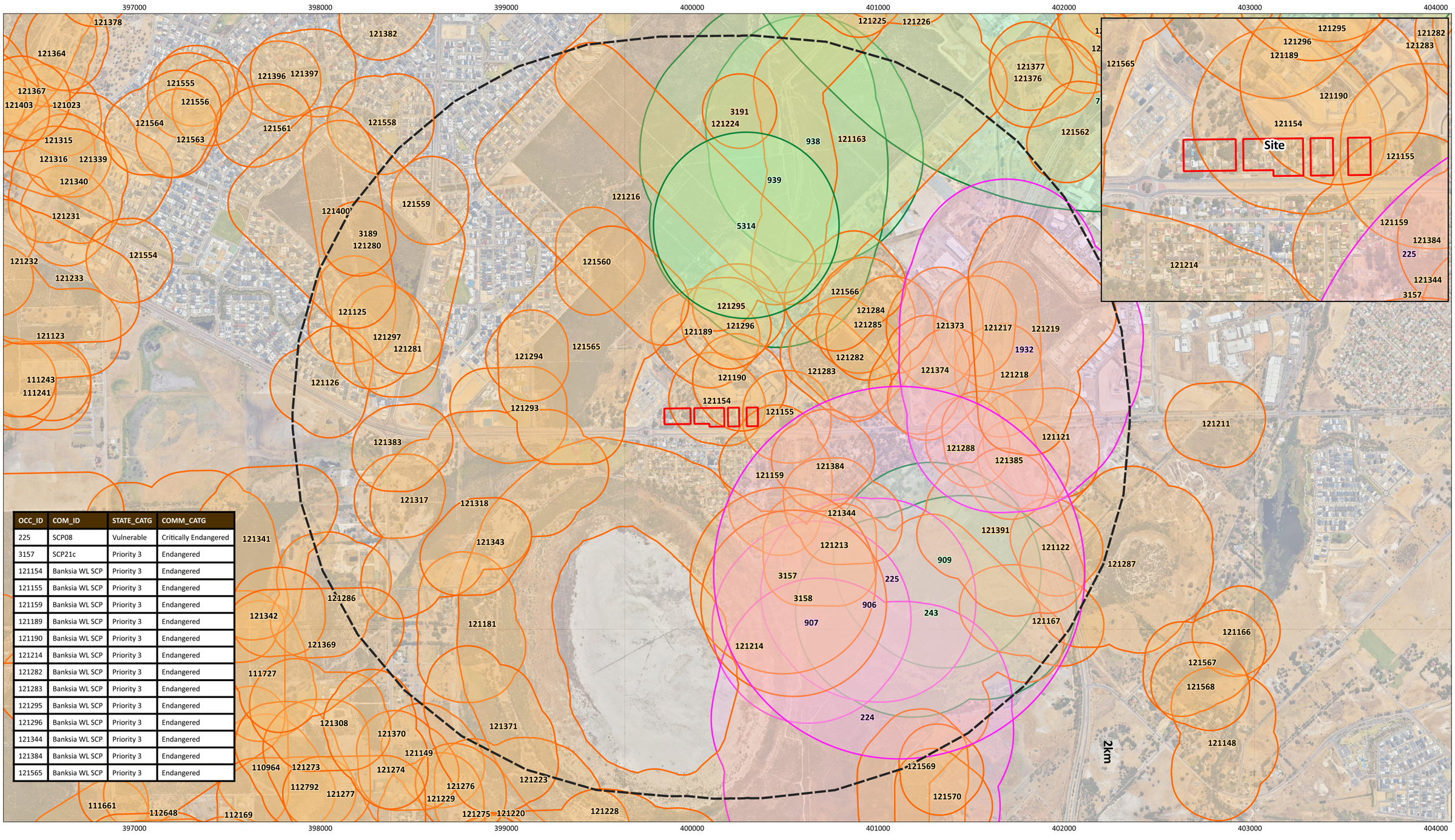
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OCC_ID	COM_ID	STATE_CATG	COMM_CATG
225	SCP08	Vulnerable	Critically Endangered
3157	SCP21c	Priority 3	Endangered
121154	Banksia WL SCP	Priority 3	Endangered
121155	Banksia WL SCP	Priority 3	Endangered
121159	Banksia WL SCP	Priority 3	Endangered
121189	Banksia WL SCP	Priority 3	Endangered
121190	Banksia WL SCP	Priority 3	Endangered
121214	Banksia WL SCP	Priority 3	Endangered
121282	Banksia WL SCP	Priority 3	Endangered
121283	Banksia WL SCP	Priority 3	Endangered
121295	Banksia WL SCP	Priority 3	Endangered
121296	Banksia WL SCP	Priority 3	Endangered
121344	Banksia WL SCP	Priority 3	Endangered
121384	Banksia WL SCP	Priority 3	Endangered
121565	Banksia WL SCP	Priority 3	Endangered

Figure 3: Threatened Ecological Communities

N

0 300 600 900 1,200 m

PROJECT/REPORT NAME	Structure Plan Various Lots Armadale Rd, Forrestdale
SCALE	1:20,000
SHEET SIZE	A3 COLOUR
CLIENT	Sam Bowers
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A22.051
VERSION	0
DATA SOURCE	LANDGATE AERIAL IMAGERY 2022
DRAWN BY / REVIEWED BY	AC / LT
DATE	23/9/2022

Legend

Site Boundary

Threatened Ecological Communities (DBCA-038)

Endangered

Vulnerable

Priority 3

No	Description	Drawn	Approved	Date
A	Original issue	AC	LT	23/9/2022

NOTES:

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APPENDIX A Arboribus (2022) report



PRELIMINARY TREE ASSESSMENT

VARIOUS LOTS - ARMADALE ROAD & ALLEN ROAD, FORRESTDALE

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DATE ISSUED: 2 DECEMBER 2022

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1 PURPOSE OF THIS REPORT

- To undertake an Arboricultural inspection of trees within various properties on Armadale Road & Allen Road in Forrestdale (refer highlighted areas in figure 1); provide comment regarding tree status and; identify preliminary considerations to be further established as part of any proposed development in proximity to trees identified for retention.



Figure 1. Location of areas specified for tree assessment (Outlined Red) along Armadale Road & Allen Road in Forrestdale. Aerial image source Rowe Group - Date supplied - 30 August 2022

ARBORIBUS
CONSULTING

2 BACKGROUND

2.1 BRIEF

- At the request of Sam Bowers (Town Planner Rowe Group), Arboribus Consulting has been engaged to assess the trees within various properties on Armadale Road & Allen Road in Forrestdale and provide the following information:
    - Install aluminium tree tags and individually number each tree >200 mm diameter
    - Identify genus, species and common name
    - Comment on current health, structure & age of the subject trees
    - Obtain height, canopy spread and trunk diameter measurement(s)
    - Provide Tree Protection Zone and Structural Root Zone measurements
    - Detail observations and comments for each tree
    - Provide preliminary recommendations and canopy pruning considerations
    - Provide a suitability rating for each tree (for incorporation into an urban development)
    - Provide Arboricultural comment regarding potential impacts and modifications necessary to achieve a more 'tree sensitive' design
    - Provide background information regarding the Australian Standard AS 4970 '*Protection of Trees on Development Sites*' 2009 and
    - Conclusions and Recommendations.

2.2 ARBORICULTURAL INSPECTION

- Arboribus Consulting undertook a ground level assessment of the 264 trees on 21, 22, 23, 24 & 25 November 2022.

2.3 LIMITATIONS OF THIS REPORT

- The Arboricultural assessment was undertaken at ground level and did not incorporate any aerial inspection or; below ground or; specialist investigation, for the subject trees.
- Modification to proposed designs and the development of appropriate work methodologies will be required in order to address issues raised within this report to ensure root and canopy impact can be minimised for the project.
- The information contained within this report is preliminary in nature and is not intended to be used as a 'Tree Protection Plan (TPP)' for the proposed Armadale Road Development. Further inputs by an AQF 5 Arborist will be required to review designs and develop a site-specific TPP in accordance with AS 4970-2009 for implementation by the contractors nominated for the works.

3 SUMMARY OF FINDINGS

3.1 TOTAL NUMBER OF TREES INSPECTED

- A total of x 264 trees were assessed as part of the proposed Armadale Road development - refer *Appendix A Tree Location and ID Number Map & Appendix B Table of Results* for detail.
- All identified Trees have aluminium number tags installed at approximately 1.5 meters from ground level on main stems – refer figure 2 for example of tags utilised for the project.



Figure 2. Showing metal tree tag and numbering of the identified trees installed approx. 1.5 meters from ground level

3.2 TREE SPECIES INSPECTED

- Of the 264 trees assessed, the following genera were documented:
    - Various *Eucalyptus* species x60
    - *Syagrus romanzoffiana* x41
    - *Callistemon* species x 35
    - *Archontophoenix Cunninghamiana* x13
    - *Phoenix canariensis x* 9
    - Other x 106
- Summary of species origin were documeneted to be:
    - Introduced species x 137 (52%)
    - Australian Native species x 109 (41% total)
    - Indemic West Australian species x 18 (7% total)
- All assessed trees are considered well suited to the Forrestdale locale.

3.3 AGE STATUS

- Synopsis of general age status for the assessed trees was broken down into the following:
    - Juvenile = x 0
    - Semi Mature = x 7
    - Early Mature = x 29
    - Mature = x 228
    - Post Mature = x 0

3.4 USEFUL LIFE EXPECTANCY (ULE)

- Synopsis of Useful Life Expectancy (ULE) for the assessed trees was broken down into the following:
    - Dead (no chance of recovery) = x 6
    - <5 Years = x 2
    - 5 - 15 Years = x 24
    - 15 – 40 Years = x 138
    - 40 + Years = x 94

3.5 SUMMARY OF CANOPY HEALTH

- Synopsis of canopy health for the assessed trees was broken down into the following:
    - Good = x 233
    - Reasonable = x 19
    - Questionable = x 6
    - Poor = x 0
    - Dead (no chance of recovery) = x 6

  Refer Appendix B Definitions Canopy Health for detail.
- The majority of trees assessed were considered to be in Good or Reasonable health status. Various (minor) health issues identified are considered manageable within the scope of general horticultural management for the site.
- 6x Trees displayed Questionable health status. If identified for retention into the development, these trees will require specific Arboricultural input and/or targeted remedial treatments to improve general health status during construction - refer *Appendix B Table of Results* for detail.
- 6x Trees (Tag numbers 04, 35, 55, 166, 188 & 192) were confirmed dead at the time of inspection and are considered unsuitable for incorporation into the development.

3.6 SUMMARY OF CANOPY STRUCTURE

- Synopsis of individual canopy structure for the assessed trees was broken down into the following:
    - Good = x 122
    - Reasonable = x 78

- Questionable = x 57
- Poor = x 7

Refer Appendix B Definitions Canopy Structure for detail.

- The Majority of trees assessed displayed Good or Reasonable canopy structure. A number of minor structural problems were identified; however, are considered manageable as part of general tree pruning maintenance responsibilities for the site – refer *3.10 Canopy Management Considerations and Appendix B* for further detail.
- 64x Trees displayed Questionable or Poor Canopy Structure. A number of these trees are considered problematic for retention into the development however; If they are to be considered for integration, the identified trees will require further specific Arboricultural input/ongoing monitoring and/or targeted remedial treatments implemented, to address identified issues and improve site safety – refer Appendix B for detail.

3.7 PEST AND DISEASES

- No obvious visual presence of any significant pest infestations or fungal sporophores were observed at the time of assessment.

3.8 SUITABILITY FOR INCORPORATION INTO AN URBAN DEVELOPMENT

- *'Suitability For Incorporation Into An Urban Development'* provides a retention value based on:
  - the trees current health and/or structural status
  - if they are well positioned within the landscape
  - the species known tolerances for disturbance and
  - species characteristics that are considered suitable for retention and incorporation into an urban development area.
- Synopsis of suitability for incorporation into an urban development was broken down into the following:
  - Optimal = x 111
  - Acceptable = x 84
  - Questionable = x 31
  - Unsuitable = x 38

Refer Appendix B Definitions Suitability for Incorporation into an Urban Development for detail.

- The Majority of trees assessed were categorized as Optimal &/or Acceptable (74%) - these trees are considered well placed or display favourable health and/or structural characteristics
- 31x trees were categorized as Questionable (12%) - these trees may be considered for retention; however, will require specific Arboricultural health and/or structural management measures developed by a AQF 5 Arborist and implemented as part of their retention into the development.

- 38x trees were categorized as Unsuitable (14%) - these trees are considered unsuitable for incorporation into an urban development and/or display problematic health or structural form or; are not considered compatible with proposed construction or development.

3.9 SUMMARY OF PRELIMINARY RECOMMENDATIONS

- Due to health and/or structural issues identified at the time of inspection, Tree Numbers 04, 10, 15, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 35, 45, 48, 52, 55, 76, 124, 127, 137, 147, 151, 153, 157, 158, 166, 168, 169, 170, 186, 187, 188, 191, 192, 193, 194, 200, 617, 662, 211, 212, 213, 214, 225, 235 & 253 are considered problematic for long term retention or integration and should be considered for removal as part of the development.
- 19 x Trees (Trees Numbers 02, 03, 49, 84, 85, 88, 90, 91, 161, 195, 616, 205, 228, 230, 232, 233, 236, 256, 257) have been identified as 'Requiring Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified'. Further input and consideration of the identified issues are required with an AQF level 5 Arborist before making a definitive conclusion on their incorporation into the proposed development.
- The remainder of the 195 x trees assessed have been considered appropriate for retention and that a site-specific Arboricultural design review and Tree Protection Plan (TPP) be developed by an AQF 5 Arborist in accordance with AS 4970-2009 and implemented for the trees identified for retention into the proposed Armadale Road development works.

3.10 CANOPY MANAGEMENT CONSIDERATIONS

- Canopy pruning considerations have been made for the trees identified for retention – refer Appendix B for detail.
- Works include the removal of major dead wood (Greater than 30 mm in diameter), removal of dead fronds and loose leaf bases for Palm Trees and; the removal of any dead trees. Trees identified as not requiring canopy pruning works have been recommended to be Monitored and Reinspected in 12 months.
- Aerial inspections are to be undertaken throughout the canopies by nominated tree pruning contractor to identify and address structural issues not able to be seen from the ground level inspection and further recommendations made as and where required by the nominated AQF level 5 Arborist.
- All canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 '*Pruning of Amenity Trees*' 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance of the nominated AQF level 5 Arborist.

3.11 SALVAGING OF TREES & TIMBER

- Where the design is not compatible with successful tree retention and existing trees are required to be removed as part of the project, the following should be considered:
    - Potential Transplant/relocation elsewhere for amenable species
    - Milling of timber into slabs for furniture or features for integration into the design
    - Crafting or turning wood into features/items/furniture/art interpretive sculpture etc by woodturners, craftsmen or artists
    - Dependent on species, consideration could be given to using the brush and logs as bank or ground stabilisation for regeneration works or habitat creation in bush or POS areas
    - Consideration could be given to harvesting of the seed (if the trees have viable fruit) and germinate from existing source as ceremonial replanting once the works have completed. Any tree stock proposed for this type of approach are to be grown in accordance with the processes identified in the Australian Standards AS 2303 *'Tree Stock for Landscape Use'* 2015 and planted in accordance with best industry practice.

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4 TREES OF NOTE



A: Rear of No 813 Stand of mature Eucalyptus camaldulensis (River Red Gum)
B: Rear of No 817 Stand of mature Eucalyptus camaldulensis (River Red Gum)
C: Front of No 837 mature Corymbia maculata (Spotted Gum)
D: Rear of No 801 – various mature native trees in reasonable condition
E: Rear of No 825 –Olea europaea (Olive) good specimen
F: Rear of No 15 Allen Rd – Brachychiton rupestris (QLD Bottle Tree) good specimen

Aerial image source https://web.metromap.com.au/map Image Date – 4 October 2022
Images by Arboribus Consulting (2022)

5 PRELIMINARY ARBORICULTURAL INPUTS FOR THE DESIGN

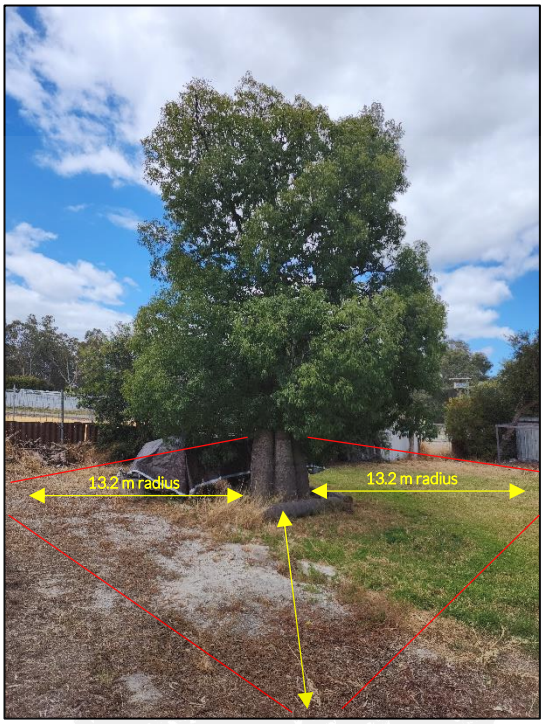


Figure 3. *Tree 229 Brachychiton rupestris (QLD Bottle Tree) image showing approximate nominal 13.2-meter Tree Protection Zone (TPZ) radius*

5.1 TREE PROTECTION ZONE (TPZ) BACKGROUND AND OVERVIEW

- Tree Protection Zone (TPZ) is defined in AS4970 *'Protection of Trees on Development Sites 2009' as*:

  "A specified area above and below ground and at a given distance from the trunk set aside for the protection of a trees roots and crown to provide for the viability and stability of a tree to be retained where it is potentially subject to damage by development."
- To calculate the TPZ, the formula 12 times (x) the Trunk Diameter (DBH - Diameter at Breast Height measured at 1.4 meters from ground level) is utilised (for the majority of tree species and types).
- The TPZ is measured in meters as a radius from the centre of the main stem – refer figure 3 for detail.
- *Special Note: the TPZ is not the canopy diameter; canopy width; and/or drip line measurement. Canopy measurements are not to be used as the AS4970 nominal Tree Protection Zones.*
- Refer *Appendix B Table of Results* for TPZ projections for each of the trees identified for retention.

5.2 ARBORICULTURAL DESIGN REVIEW BACKGROUND INFORMATION

- Tree protection measures in keeping with AS 4970 *'Protection of Trees on development sites'* 2009' must be incorporated into the proposed design in order to achieve tree sensitive outcomes for the project.

- Review of all proposed designs for the development should recognise the specified TPZ delineations and that all efforts are made by the design team to avoid/minimise any proposed works or structures within these specific TPZ areas.
- Where minor encroachments into a Tree Protection Zone (TPZ) are planned, input from an AQF level 5 Arborist will be required to review proposed works or structures; provide tree sensitive measures or alternatives and; assist in the development of appropriate methodologies to ensure tree root and canopy impact can be minimised.
- Where significant incursions are proposed within TPZs (i.e., greater than 10%), an AQF level 5 Arborist is to demonstrate how the encroachment or works can occur without adversely impacting the health and/or inground stability of the tree or; identify where modifications to the design or alternative methodologies are required.

5.3 ARBORICULTURAL COMMENT ON THE PROPOSED DESIGN

5.3.1 POTENTIAL CONSTRUCTION WORKS WITHIN TREE PROTECTION ZONES

- Any construction or works being proposed within Tree Protection Zones (TPZs) of the assessed trees will necessitate modification to the proposed design(s) and; the development of appropriate work methodologies in order to alleviate unnecessary/avoidable impacts to the trees identified for retention. Works planned to be undertaken within or immediately adjacent specified TPZs for the proposed Armadale Road development may include (but may not be limited to):
    - Establishment of site and works boundaries
    - Dismantling of trees identified for removal
    - Establishment of the specified Tree Protection Zones (TPZs)
    - Demolition and removal of existing /structures/buildings/fencing/ etc
    - Decommissioning of existing services and below ground infrastructure
    - Demolition of existing roads, road infrastructure and crossovers/kerbing
    - Cut to fill works
    - Forward works & site preparation to set levels, batters and soil contours, removal of organic layer etc...
    - Installation of all proposed below ground services (and their associated infrastructure and components)
    - Construction of buildings, dwellings, structures, retaining walls paths or ramps etc
    - Installation of new roads, paths and carpark areas (i.e. preparation for levels, boxing out, installation of subbase and compaction, bitumen and kerbing etc..)
    - Hard and Soft landscaping (i.e.. levels and contouring, retaining walls, structures, planting of vegetation, mulching, soiling, installation of irrigation etc).

5.3.2 MODIFICATIONS TO BE IMPLIMENTED FOR THE DESIGN

- Modification of existing soil levels is to be avoided within TPZ areas. Moderate raising of soil levels may be considered (refer below dot point) within/adjacent the TPZ areas as an alternative to cutting, lowering, and/or boxing out existing levels. Any proposed grade cuts required for levels, footings and road boxouts etc.. can injure arterial/surface roots and will need to be addressed to limit root loss and associated impact to the trees identified for retention.
- Where fill is being proposed within TPZs, washed and screened single grade gravel or aggregate with no fines is recommended to be used (*Note: any required areas of fill to be installed greater than 150 mm within TPZs will be subject to prior approval from the nominated AQF level 5 Arborist and the potential installation of remediation measures (or materials) to assist with aeration and infiltration within TPZs).*
- Roads, crossovers, kerbs, paths, ramps etc.. being proposed within TPZs should be designed to 'float' (i.e., installed on top of existing ground levels) to limit box outs and root impacts and allow root mass to be retained beneath roadways and paths.
- Alignments and locations of any below ground services and associated infrastructure that travel within/through TPZs are to be installed via non-destructive methods (i.e., subterranean boring, micro tunnelling or industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. *Note: Mechanical excavation is not permitted within TPZs.*
- Any footings for proposed structures (i.e. retaining walls, fencing etc) are to be designed to 'float' (i.e., installed on top of existing ground levels) or lintels designed and installed to protect and bridge over the roots to allow for their retention. Where this may be impractical/cost prohibitive, rootzone investigations are to be undertaken via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) to locate and accommodate roots greater than 30 mm in diameter. This may require any concrete footings to be poured at locations where no large roots are encountered.
- Any hardscape structures being proposed within TPZs should also be designed to 'float' (i.e., installed on top of existing ground levels) to limit excavations and associated root impacts (i.e. applicable to buildings, dwellings, structures, retaining walls paths, finishes etc..). Where this unattainable or not achievable, non-destructive methods (industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) are to be utilised to verify where root mass exists, and structures placed/positioned accordingly to retain roots and achieve a tree sensitive outcome. Roots measuring over 30 mm in diameter are to be retained and protected. Location of footings and/or structures are to be adjusted to avoid roots greater than 30 mm in diameter. Roots less than 30 mm in diameter are to be pruned appropriately by the nominated contractor under the direction of the nominated AQF level 5 Arborist.

5.3.3 PROPOSED METHODOLOGIES FOR WORKS IN TPZS

- Prior to any works on site, erection of dedicated TPZ fencing (and TPZ signage), is to identify the nominal TPZ delineations and are to be established by the nominated contractor(s) and; signed off by the nominated AQF level 5 Project Arborist prior to site works *Note:- Any alteration or modification of the fencing is to be approved prior by an AQF level 5 Arborist and documented as part of ongoing tree preservation reporting for the site.*
- That any works proposed within the nominal TPZ delineations will require prior approval from the nominated AQF level 5 Arborist. (in collaboration with the Project team) and the works be supervised by the nominated AQF level 5 Arborist.
- Dismantling of trees identified for removal is to be undertaken such that no damage occurs to the canopies and/or root systems of the trees identified for retention. Stumps are to be ground out only *Note: Mechanical excavation/grubbing out of stumps is not permitted within TPZs.*
- Any Demolition works (including but not limited to: existing dwellings /structures /fencing /sheds /roads etc) are to be undertaken under the supervision of the nominated AQF level 5 Arborist such that roots are protected and retained within TPZs. Positioning of machinery is to recognise the TPZ delineations to limit impacts to root systems and collision impacts to trunks and canopies and will necessitate ground protection measures being installed. Types of machinery, working room and swing radius etc.. will need to be considered to ensure damage is avoided for the retained trees. *Note:- Any canopy pruning required for demolition or civils works is to be approved prior by the nominated AQF level 5 Arborist (in collaboration with the Project team) and documented as part of ongoing tree preservation reporting for the proposed Armadale Road development.*
- Alignments and locations of any below ground services and associated infrastructure that travel within/through TPZs are to be installed via non-destructive methods (i.e., subterranean boring, micro tunnelling or industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. *Note: Mechanical excavation is not permitted within TPZs.*
- Take off and/or tie in points and proposed infrastructure designed within TPZs are to be installed via non-destructive installation methods (industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and shall be adjusted to avoid/accommodate roots greater than 30 mm in diameter. Roots less than 30 mm in diameter are to be pruned appropriately). *Note: Mechanical excavation is not permitted within TPZs.*
- Any Mechanical tracking in TPZs will require prior approval from the nominated AQF level 5 Arborist and need to facilitate prior installation of ground protection measures. Access and egress and; screwing of tracks within TPZs is to be minimised.
- Where excavations are proposed in close proximity to or may impact TPZs, installation of Box shoring, shutter boards, piling or utilisation of jet grouting (grout injection) may be necessary to limit soil slippage and undermining of root systems.

- Any proposed footings within TPZs are to be undertaken via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist) and accommodate roots greater than 30 mm in diameter. Roots less than 30 mm in diameter may be pruned subject to approval of the nominated AQF level 5 Arborist). *Note: Mechanical excavation is not permitted within TPZs.*
- Canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 *'Pruning of Amenity Trees'* 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance of the nominated AQF level 5 Arborist.
- Alignments and locations of any irrigation infrastructure proposed within TPZs are to be adjusted to avoid/accommodate roots greater than 30 mm in diameter and installed via non-destructive methods (i.e., industrial soil vacuum under the supervision of the nominated AQF level 5 Arborist). *Note: Mechanical excavation is not permitted within TPZs.*
- Any tree stock proposed for planting, are to be grown in keeping with the processes identified in the Australian Standards AS 2303 *'Tree Stock for Landscape Use' 2015* and planted in accordance with industry best practice. Consideration will need to be given to the proposed planting areas and suitable tree species selection able to thrive appropriately (both above and below ground) in each given circumstance proposed.
- Planting of any vegetation within TPZs is to be undertaken that planting holes are strategically placed to avoid any tree roots greater than 30 mm in diameter.

5.3.4 OTHER TPZ ISSUES TO BE CONSIDERED FOR THE PROJECT

- Other site issues that may impact or encroach the specified TPZs, are to be recognised and addressed as part of site works. It is recommended that the matters below avoid the specified protection delineations of the trees. Where this isn't achievable, ground protection measures are to be installed prior. Matters include (but may not be limited to):
    - Dedicated access and egress points for the site
    - Location of site offices and amenities
    - Parking/storage of vehicles and machinery
    - Lay down areas and storage of construction materials
    - Or any other activity that may compromise tree health or structure not identified above.
- Consideration will need to be given to the timing of the proposed works and the impacts that may arise during seasonal weather extremes i.e. avoiding the heat of Summer and scheduling works and planting in the cooler months of Autumn and early Winter (if possible) to limit unnecessary stress to the vegetation.
- To help maintain current health displays and offset impacts sustained during the development works, supplementary irrigation & monthly applications of Liquid wetting agent & Organic soil drench, will need to be accommodated during the construction and works phase. These applications are to be applied evenly within the TPZs of all trees identified for retention.

- Ongoing Arboricultural assessment and inputs will be required for the project to gauge tree response and address health and or structural issue that may arise prior to, during and post completion of the proposed Armadale Road development.

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6 CONCLUSIONS

- Further discussion and inputs with a suitably qualified and experienced AQF 5 Arborist will help to assist with the identification of worthwhile trees for incorporation into the proposed Armadale Road development.

- Tree protection measures in keeping with AS 4970 '*Protection of Trees on development sites*' 2009' must be incorporated into the proposed design and into any proposed works methodologies in order to achieve tree sensitive outcomes for the project.

  The retention of existing ground levels; limiting excavations within the specified TPZs and; implementing appropriate remedial measures will be important in the future success for the trees identified for incorporation. Where encroachments into a TPZ are necessary, further input from an AQF level 5 Arborist will be required to review proposed encroachments and assist in the development of appropriate methodologies to allow works to occur in a sensitive manner.

  Consideration needs to be given to the sensitivity of some of our native tree species and their lack of tolerance to close proximity rootzone disturbance (and subsequent root loss) that is common with urban developments and typical construction methods.

- As part of the Tree Protection responsibilities for the project only suitable qualified and experienced AQF 5 Arborists should be engaged to:
  - Identify worthwhile specimens to be incorporated into the proposed development
  - Undertake ongoing reviews and provide Arboricultural inputs into the design; methodologies and/or proposed encroachments into TPZs of the trees
  - Develop a site-specific Tree Protection Plan in keeping with AS 4970 '*Protection of Trees on Development Sites*' 2009
  - Provide approval of any works within TPZs
  - Supervise approved works within TPZs
  - Approve and oversee canopy pruning works
  - Monitor tree health and structure during works
  - Provide ongoing reporting and assessments as and where required
  - Provide sign off reporting that documents the tree status post completion of the works.

- The nature of Arboricultural works required for the site can be expected to evolve and change over time. It is important to acknowledge that trees are dynamic, living organisms which are influenced by their above and below ground environs. Regular Arboricultural inspections are recommended to; monitor, document and respond to potential future tree changes that may require further arboricultural intervention not covered within this report.

7 RECOMMENDATIONS

1. That Further discussion and inputs be sought from a suitably qualified and experienced AQF 5 Arborist to identify worthwhile trees for incorporation into the development.

2. That consideration be given to the dismantling of Tree Numbers 04, 10, 15, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 35, 45, 48, 52, 55, 76, 124, 127, 137, 147, 151, 153, 157, 158, 166, 168, 169, 170, 186, 187, 188, 191, 192, 193, 194, 200, 617, 662, 211, 212, 213, 214, 225, 235 & 253 prior to the commencement of the development.

3. That if identified for retention, Trees Numbers 02, 03, 49, 84, 85, 88, 90, 91, 161, 195, 616, 205, 228, 230, 232, 233, 236, 256, 257 will require further Arboricultural inputs into the specific issues identified within this report before making a definitive conclusion on their incorporation into the proposed Armadale Road Development.

4. Where trees have been identified for retention and incorporation into the development, all project specific drawings are updated to include Tree specific numbering & accurate Tree Protection Zones (TPZ) & Structural Root Zones (SRZ) delineations for the trees - refer *Appendix B Table of Results'* for TPZ & SRZ projections for each of the trees identified for assessment.

5. That where trees have been identified for retention and incorporation into the development, that appropriate refinements, design modifications and the development of tree sensitive works methodologies identified in Point *5. Preliminary Arboricultural Inputs for the Design* are incorporated into drawings and specifications and implemented for the project. Where appropriate modification is not achievable within TPZ areas, removal of the tree(s) may be required – subject to review and approval by an AQF level 5 Arborist.

6. That a site-specific Tree Protection Plan (TPP) be developed by an AQF 5 Arborist for trees identified for retention in keeping with the processes identified in Australian Standards AS 4970 *'Protection of Trees on Development Sites'* 2009 to be implemented by the nominated contactor for the duration of the works.

7. That Tree Protection Zones (TPZs) are established at the commencement of construction and are maintained for the duration of the works for all trees identified for retention (refer Appendix C for detail).

8. That the trees are monitored and any proposed works within the TPZs are supervised & documented by an AQF 5 Arborist in keeping with the Australian Standards AS 4970 *'Protection of Trees on Development Sites'* 2009 & AS 4373 *'Pruning of Amenity Trees'* 2007.

9. That any canopy pruning works for trees identified for retention are undertaken in keeping with Australian Standard AS 4373 *'Pruning of Amenity Trees'* 2007 by suitably qualified and experienced AQF 3 Arborists under the guidance/direction of an AQF 5 Arborist.

10. That sign off reporting be undertaken by an AQF 5 Arborist that documents the condition of the trees post completion of the project and that provides a maintenance schedule for the client to implement post completion of the construction works.

11. That the subject trees be visually assessed by an AQF level 5 Arborist in 12 months (December 2023) or after significant weather events, to report on status and identify and respond appropriately to new or developing tree related issues.

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8 REFERENCES AND READING

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APPENDIX A – TREE LOCATION & ID NUMBER MAP

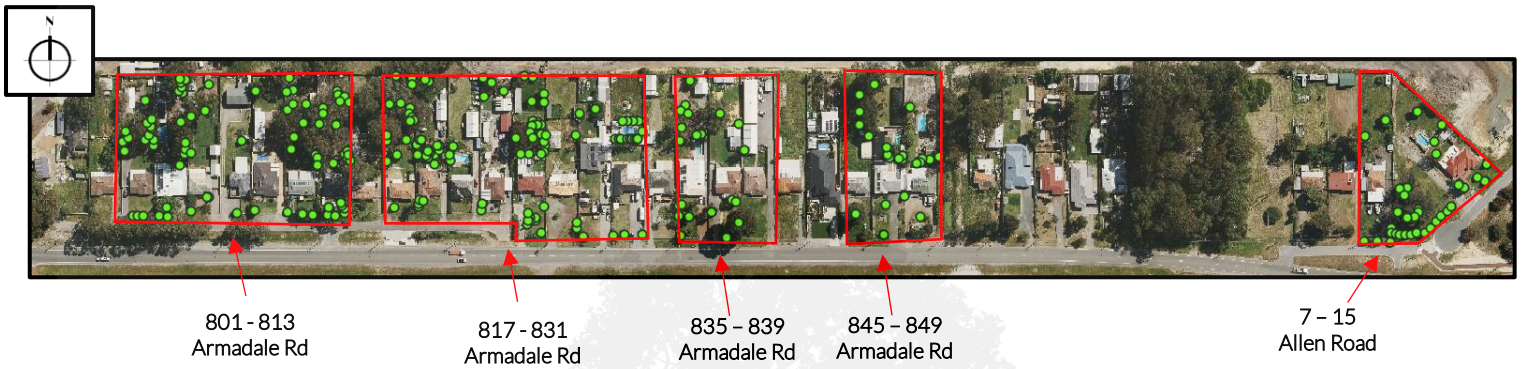


Figure 4. Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only Aerial image source https://web.metromap.com.au/map Image Date – 4 October 2022

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Figure 5. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only*
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022

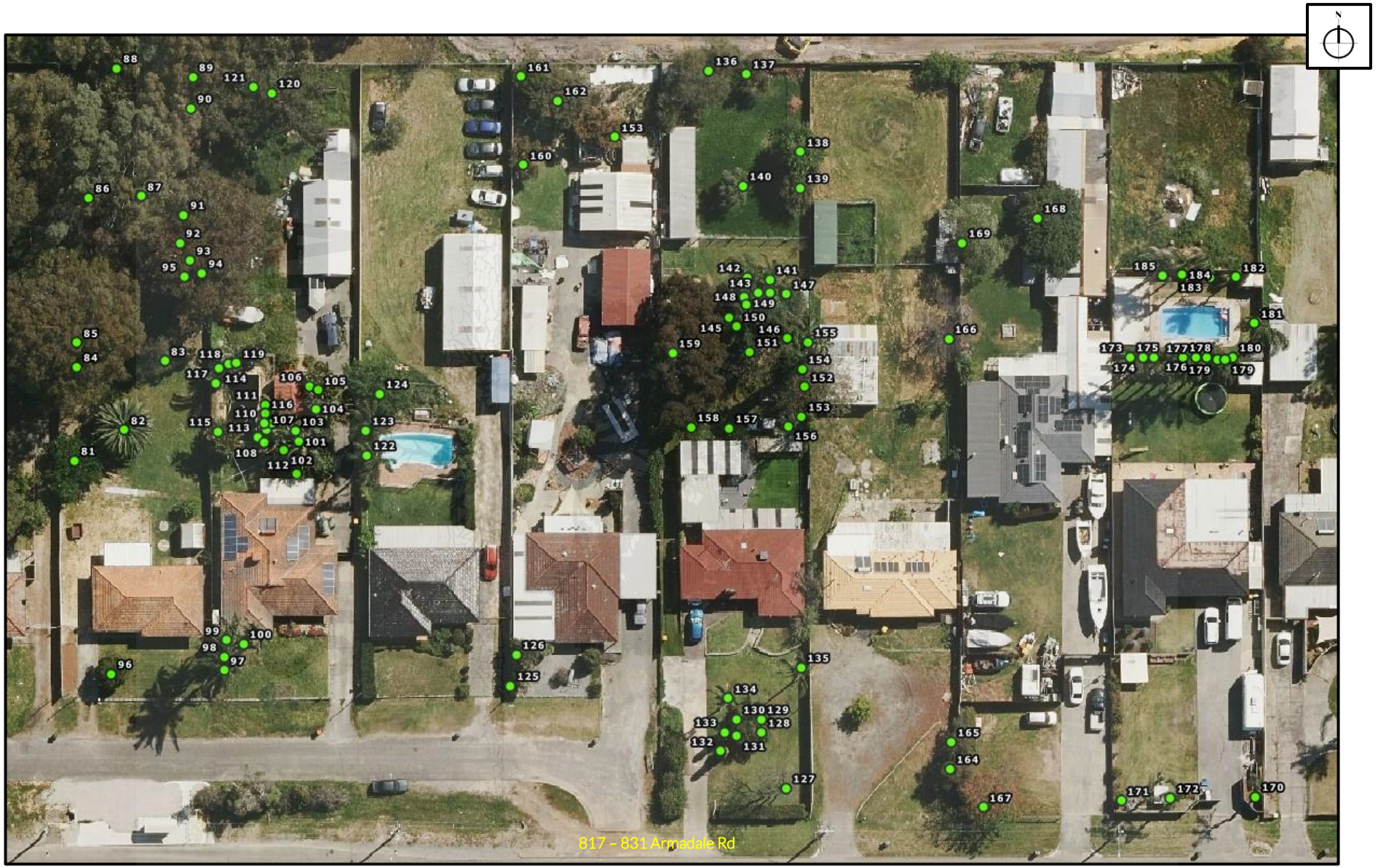


Figure 6. Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022



Figure 7. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only*
Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022



Figure 8. *Tree Location & ID Numbering Map Please note: The location of the trees are indicative and for reference purposes only Aerial image source https://web.metromap.com.au /map Image Date – 4 October 2022*

APPENDIX B – TABLE OF RESULTS & DEFINITIONS

DEFINITIONS - GENERAL

Tree ID Number	Provides an individual Tag identification number.
Nomenclature & Tree Identification	Identifies the genus, species and common name for the tree.
Estimated Age	Identifies the estimated age at the time of assessment. (Juvenile, Semi Mature, Early Mature, Mature, Senescing).
Estimated Tree Height	Estimate of the Trees Height in meters.
Estimated Canopy Spread	Estimate of the Trees canopy spread in meters.
Useful Life Expectancy (ULE)	Estimate of the trees Useful Life Expectancy (ULE) (less than 5 Years, 5 – 15 years, 15 – 40 years, or over 40 years).
Canopy Health	Identifies the visual health display at the time of assessment. (Exceptional, Good, Reasonable, Questionable, Poor, Dead) – refer Canopy Health Definitions below for further detail.
Canopy Structure	Identifies the canopies visual structural form at the time of assessment. (Good, Reasonable, Questionable, Poor, Dead) – refer Canopy Structure Definitions below for further detail.
Trunk Diameter @ Widest Point	Measurement of trunk diameter in millimetres. Typically measured at 1.4 meters above ground level or at the widest point of bifurcated or multi stemmed trunks.
Tree Protection Zone (TPZ) Radius (M)	Calculated as: x12 Trunk Diameter measured as a radius from centre of the trunk. Identified in AS 4970 'Protection of Trees on Development Sites' 2009 ' as 'the area of root and canopy area requiring protection during construction so the tree remains viable. Any works proposed within this area requires approval from an AQF 5 Arborist prior to commencement. .***Special Note:- the TPZ is not the canopy diameter; canopy width; and/or drip line measurement. Canopy measurements are not to be used as the AS4970 nominal Tree Protection Zones***
Trunk Diameter @ Ground Level	Measurement of trunk diameter in millimetres measured at ground level. Measurement essential for accurate calculation of Structural Root Zone (SRZ) radius
Structural Root Zone (SRZ) Radius (M)	Calculated as: Diameter at ground level x 50) $^{0.42}$ x 0.64 measured as a radius from centre of the trunk. Identified in AS 4970 'Protection of Trees on Development Sites' 2009 '*as the area required for tree stability'. Special* ***Note:- the SRZ is not to be mistaken for; or utilised as a Tree Protection Zone (TPZ) refer TPZ definition above for detail.***
Comments	General information for the assessed tree.
Suitability For Incorporation Into An Urban Development	Identifies a retention value based on health and structural status, are well positioned, have known tolerances or species characteristics considered suitable for retention into an urban development area (Optimal, Acceptable, Questionable, Unsuitable) – refer Definitions below for further detail.
Preliminary Recommendation	Identifies preliminary recommendations for the individual (remove, retain, or additional Arboricultural input/assessments required).
Canopy Management Considerations	Provides Canopy pruning recommendations for the individual tree. *Special Note: All canopy pruning works are to be undertaken in keeping with Australian Standard AS 4373 'Pruning of Amenity Trees' 2007 by suitably qualified and experienced Arborists under the guidance of Arboribus Consulting.*

DEFINITIONS – CANOPY HEALTH

Exceptional
The tree is demonstrating exceptional growth and exhibits a full dense canopy of foliage for a specimen of the species. Leaf colouration, distribution and size are all exceptional for the species. No visual signs of any pests and/or disease impacting tree health. Seasonal growth and/or callous development is active and evident.
Good
Tree displays typical foliage size, colouration, and density for a specimen of the species. Seasonal growth and/or callous development all appear typical. Seasonal deadwood may be apparent however likely as a result of natural attrition and not an indication of reduction in the trees wellbeing. May have minor seasonal pest (or disease) issues; however, unlikely to impact general health and wellbeing.
Reasonable
Tree displays typical foliage size and colouration; however, may display a reduction in ideal growth. The tree may exhibit modest visual health issues or minor areas of concern. Canopy density may be affected or have a slightly higher percentage of deadwood than what would be considered 'typical'. Seasonal growth and/or callous development may be slightly impeded. Presence of a pest or disease may be evident. However, issues noted considered easily addressed within the scope of proactive tree management.
Questionable
Canopy starting to indicate decline. Apical/terminal sections of the canopy may be actively declining or dead. Pests or diseases may be prevalent and impacting health that require intervention. Subject tree will require a tree specific management plan to be developed to address health issues noted and/or require targeted remedial intervention(s) and/or analysis or further investigation and/or monitored on a more detailed basis.
Poor
Canopy Indicates decline. Canopy may display less than 25% live photosynthetic mass. Majority of tertiary and secondary limbs are dead or compromised. Current health condition such that significant remedial intervention is unlikely to assist in appropriate/worthwhile recovery.
Dead
Tree has no active conductive tissue - indicating no chance of recovery.

DEFINITIONS – CANOPY STRUCTURE

Good
Primary and secondary framework and Primary and secondary branch attachments (unions) display typical form for a specimen of the species. Tree exhibits no significant visual issues within the canopy; however, may display minimal/minor structural imperfections (that may be addressed within the scope of proactive tree management).
Reasonable
Tree displays reasonable canopy structural form and generally free of significant issues; however, the tree may exhibit modest visual issues, structural defects or areas of concern that may require to be addressed with remedial work or require to be monitored. This may include, minor competition/suppression issues, minor leans, codominant stems and branches, minor bark inclusions, noticeable wounding & damage, previously lopped canopies; storm damaged and/or vandalisms where epicormic regeneration has developed satisfactory branch attachment etc… However, issues can be addressed or monitored within the scope of proactive tree management.
Questionable
Primary and secondary canopy structural form displays defects, flaws or areas of concern that may lead to future issues. This could include issues that may affect structural integrity including Storm damage & previous deleterious pruning, significant asymmetry & competition issues, problematic leans, codominant stems with bark inclusions and swelling present, substantial wounding & damage, major decay, poor branch taper etc that will require to be addressed with remedial intervention; be further investigated and/or; specifically monitored in an ongoing basis.
Poor
Tree displays substantial/major structural flaws within its primary and/or secondary (or beyond) canopy structural form i.e.: extensive decay and/or hollows, broken or compromised unions, substantial splits breaks and/or fractures etc.. where remedial, Arboricultural or Engineering intervention is unlikely to improve form or substantially reduce site risk.

DEFINITIONS – SUITABILITY FOR INCORPORATION INTO AN URBAN DEVELOPMENT

- *Suitability For Incorporation Into An Urban Development'* provides a retention value based on:
    - the trees current health and/or structural status
    - if they are well positioned within the landscape
    - the species known tolerances for disturbance and
    - species characteristics that are considered suitable for retention and incorporation into an urban development area.

Optimal
These trees are considered well placed or display favourable health and/or structural characteristics and worthwhile incorporating.
Acceptable
These trees may be well placed and/or display reasonable health and/or structural form however may require a level of Horticultural/Arboricultural intervention to address minor issues.
Questionable
Tree may display defects, flaws or areas of concern that may lead to future issues. These trees may be considered for retention; however, will require specific Arboricultural health and/or structural management measures developed by a AQF 5 Arborist implemented as part of their retention into the development and; monitored in an ongoing basis.
Unsuitable
Tree displays substantial/major structural flaws where remedial, Arboricultural or Engineering intervention is unlikely to improve form or substantially reduce site risk. considered unsuitable for incorporation into an urban development and/or not considered compatible with proposed construction or development.

ARBORIBUS
CONSULTING

TABLE OF RESULTS

ARBORIBUS
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Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
01	*Eucalyptus conferruminata (Bald Island marlock)*	Mature	5	7	5 - 15 years	Reasonable	Reasonable	0.250	3.00	0.300	2.00	Damage to surface roots (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 1 meter and 2 meters, Minor canopy suppression noted, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
02	*Eucalyptus conferruminata (Bald Island marlock)*	Early Mature	5	5	5 - 15 years	Questionable	Questionable	0.180	2.16	0.200	1.68	Canopy indicates decline, CoA Verge Tree	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
03	*Eucalyptus conferruminata (Bald Island marlock)*	Early Mature	3	4	5 - 15 years	Reasonable	Questionable	0.200	2.40	0.250	1.85	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between 1 meter and 2 meters, CoA Verge Tree	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
04	*Olea europaea (Olive)*	Mature	7	4	Dead	Dead	Questionable	0.300	N/A	0.400	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
05	*Brachychiton populneus (Kurrajong)*	Mature	12	8	40 + years	Good	Good	0.380	4.56	0.480	2.43	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
06	*Eucalyptus globulus (Tasmanian Blue Gum)*	Mature	15	15	40 + years	Good	Reasonable	0.880	10.56	1.110	3.46	Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+, Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
07	*Callistemon viminalis (Bottlebrush)*	Mature	6	6	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Main stem bifurcates between ground level and 500mm, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
08	*Eucalyptus rudis (Flooded Gum)*	Mature	8	10	40 + years	Good	Reasonable	0.700	8.40	0.700	2.85	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
09	*Corymbia calophylla (Marri)*	Early Mature	12	8	40 + years	Good	Good	0.290	3.48	0.350	2.13	Canopy displays leggy structural form, Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
10	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	9	10	15 - 40 years	Good	Questionable	0.300	3.60	0.380	2.20	Canopy displays leggy structural form, Included bark unions noted (minor), Major canopy suppression noted	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
11	*Callistemon viminalis (Bottlebrush)*	Mature	7	6	15 - 40 years	Good	Reasonable	0.500	6.00	0.500	2.47	Main stem bifurcates at ground level, Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
12	*Callistemon viminalis (Bottlebrush)*	Mature	7	6	15 - 40 Years	Good	Good	0.210	2.52	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
13	*Brachychiton populneus (Kurrajong)*	Mature	10	11	40 + years	Good	Good	0.420	5.04	0.550	2.57	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
14	*Washingtonia robusta (Mexican Fan Palm)*	Semi-Mature	4	4	40 + years	Good	Reasonable	0.300	3.00	0.400	N/A	Minor canopy suppression noted, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
15	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	10	11	40 + years	Good	Questionable	0.530	6.36	0.650	2.76	Canopy displays leggy structural form, Main stem bifurcates between 500mm and 1 meter, Major canopy suppression noted, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
16	*Callistemon viminalis (Bottlebrush)*	Mature	10	8	15 - 40 years	Good	Good	0.330	3.96	0.400	2.25	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
17	*Melaleuca rhaphiophylla (Fresh Water Paperbark)*	Mature	4	12	40 + years	Good	Good	1.500	15.00	1.500	3.92	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
18	*Cupressus macrocarpa (Monterey Cypress)*	Mature	8	3	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
19	*Pinus pinaster (Maritime Pine)*	Mature	18	12	40 + years	Good	Good	0.570	6.84	0.650	2.76	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
20	*Fraxinus griffithii (Evergreen Ash)*	Mature	11	14	15 - 40 years	Good	Reasonable	1.000	12.00	1.000	3.31	Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
21	*Schefflera actinophylla (Umbrella Tree)*	Mature	6	10	15 - 40 years	Good	Questionable	0.800	9.60	0.800	3.01	Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
22	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	1.100	13.20	1.500	3.92	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (major), Main stem bifurcates between 3 meters and 4 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
23	*Tamarix aphylla (Tamarisk)*	Mature	13	13	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Canopy displays leggy structural form, Included bark unions noted (minor), Main stem bifurcates between ground level and 500mm, Minor canopy suppression noted, species considered not suitable for incorporation into development due to suckering	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
24	*Eucalyptus grandis (Rose Gum)*	Mature	30	18	15 - 40 years	Good	Questionable	1.100	13.20	1.100	3.44	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 1 meter and 2 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
25	*Brachychiton populneus (Kurrajong)*	Semi-Mature	5	3	15 - 40 years	Good	Questionable	0.200	2.40	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
26	*Eucalyptus grandis (Rose Gum)*	Mature	25	13	15 - 40 years	Good	Questionable	0.400	4.80	0.500	2.47	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
27	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	15 - 40 years	Good	Questionable	0.680	8.16	0.950	3.24	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Included bark unions noted (major), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
28	*Eucalyptus grandis (Rose Gum)*	Mature	30	13	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
29	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	0.500	6.00	0.650	2.76	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
30	*Eucalyptus grandis (Rose Gum)*	Mature	30	15	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
31	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	9	14	15 - 40 years	Good	Questionable	0.900	10.80	0.900	3.17	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373), Friction stems noted within canopy (150 mm to 300 mm dia.), Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Prior branch failures noted within canopy (150 mm to 300 mm dia.), noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
32	*Syzygium smithii (Lilly Pilly)*	Mature	7	7	15 - 40 years	Good	Reasonable	0.310	3.72	0.350	2.13	Canopy displays leggy structural form, Main stem bifurcates between ground level and 500mm, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
33	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	15 - 40 years	Good	Questionable	1.150	13.80	1.600	4.03	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Damage to surface roots (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Hollows (habitat) noted throughout canopy, Main stem bifurcates above 4 meters+	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
35	*Eucalyptus grandis (Rose Gum)*	Mature	6	4	Dead	Dead	Questionable	1.000	N/A	1.000	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
34	*Eucalyptus robusta (Swamp Mahogany)*	Mature	12	12	15 - 40 years	Good	Reasonable	0.450	5.40	0.550	2.57	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
36	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	4	15 - 40 years	Good	Good	0.200	2.40	0.200	1.68	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
37	*Xanthorrhoea preissii (Grass Tree)*	Mature	2	2	40 + years	Good	Good	0.300	2.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
38	*Xanthorrhoea preissii (Grass Tree)*	Mature	2	2	40 + years	Good	Good	0.300	2.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
39	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	5 - 15 years	Good	Questionable	0.200	2.40	0.220	1.75	Included bark unions noted (minor), Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
40	*Hibiscus tiliaceus 'rubra' (Cottonwood)*	Early Mature	3	5	15 - 40 years	Good	Reasonable	0.350	4.20	0.350	2.13	Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
41	*Bauhinia x blakeana (Hong Kong Orchid Tree)*	Mature	5	6	15 - 40 years	Good	Reasonable	0.350	4.20	0.400	2.25	Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
42	*Ficus microcarpa var. hillii (Hills Weeping Fig)*	Early Mature	10	12	40 + years	Good	Reasonable	0.500	6.00	0.500	2.47	Canopy displays leggy structural form, Main stem bifurcates between ground level and 500mm, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
43	*Ficus benjamina (Weeping Fig)*	Mature	10	10	40 + years	Good	Reasonable	0.330	3.96	0.400	2.25	Included bark unions noted (minor), Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
44	*Callistemon viminalis (Bottlebrush)*	Mature	4	8	15 - 40 years	Good	Reasonable	0.700	8.40	0.700	2.85	Main stem bifurcates at ground level, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
45	*Citharexylum spinosum (Fiddlewood)*	Mature	3	5	15 - 40 years	Good	Poor	0.600	7.20	0.650	2.76	Canopy previously lopped (Major - not in keeping with AS4373), Main stem bifurcates at ground level, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
46	*Melaleuca armillaris (Bracelet Honey Myrtle)*	Mature	5	8	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
47	*Ficus benjamina (Weeping Fig)*	Early Mature	10	12	40 + years	Good	Good	0.500	6.00	0.550	2.57	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
48	*Eucalyptus cladocalyx (Sugar Gum)*	Mature	11	10	5 - 15 years	Questionable	Questionable	0.450	5.40	0.500	2.47	Canopy starting to indicate decline, Damage noted to main stem (minor), Deadwood noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Significant terminal deadwood noted within canopy, Tree on lean (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
49	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	40 + years	Good	Reasonable	0.710	8.52	0.900	3.17	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
50	*Eucalyptus robusta (Swamp Mahogany)*	Mature	13	16	15 - 40 years	Good	Reasonable	0.680	8.16	0.910	3.18	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
51	*Eucalyptus rudis (Flooded Gum)*	Early Mature	8	8	40 + years	Good	Good	0.230	2.76	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
52	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	5	12	15 - 40 years	Good	Questionable	1.000	12.00	1.000	3.31	Tree displays multi stemmed form, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
53	*Eucalyptus rudis (Flooded Gum)*	Mature	16	20	40 + years	Good	Good	1.000	12.00	1.200	3.57	Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (150 mm to 300 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
54	*Tipuana tipu (Pride of Bolivia)*	Early Mature	5	5	15 - 40 years	Good	Reasonable	0.200	2.40	0.250	1.85	Minor deadwood noted within canopy, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
55	*Corymbia calophylla (Marri)*	Mature	4	4	Dead	Dead	Poor	0.300	N/A	0.300	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
56	*Syagrus romanzoffiana (Queen Palm)*	Semi-Mature	4	3	40 + years	Good	Good	0.200	2.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
57	*Syagrus romanzoffiana (Queen Palm)*	Semi-Mature	12	5	40 + years	Good	Good	0.200	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
58	*Washingtonia robusta (Mexican Fan Palm)*	Mature	16	4	15 - 40 years	Good	Good	0.410	3.00	0.770	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
59	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.310	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
60	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.960	11.52	1.100	3.44	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
61	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	20	15 - 40 years	Good	Reasonable	1.100	13.20	1.300	3.69	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 3 meters and 4 meters, Minor canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
62	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.940	11.28	1.100	3.44	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
63	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	0.950	11.40	1.100	3.44	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Main stem bifurcates between 3 meters and 4 meters, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
64	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	15 - 40 years	Good	Reasonable	1.000	12.00	1.200	3.57	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
65	*Eucalyptus camaldulensis (River Red Gum)*	Mature	23	16	15 - 40 years	Good	Reasonable	0.760	9.12	0.900	3.17	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (minor), Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
66	*Agonis flexuosa (WA Peppermint)*	Mature	11	13	15 - 40 years	Reasonable	Reasonable	0.800	9.60	0.900	3.17	Canopy displays leggy structural form, Minor canopy suppression noted, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
67	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.260	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
68	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.440	4.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
69	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.550	4.00	0.600	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
70	*Syagrus romanzoffiana (Queen Palm)*	Mature	8	5	40 + years	Good	Good	0.300	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
71	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.360	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
72	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	40 + years	Good	Good	0.200	4.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
73	*Strelitzia nicolai (Giant Bird Of Paradise)*	Mature	6	11	15 - 40 years	Good	Reasonable	3.000	6.00	3.000	N/A	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
74	*Eucalyptus camaldulensis (River Red Gum)*	Mature	12	16	40 + years	Good	Reasonable	0.640	7.68	0.700	2.85	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
75	*Callistemon viminalis (Bottlebrush)*	Mature	10	5	15 - 40 years	Reasonable	Good	0.200	2.40	0.200	1.68	Canopy displays leggy structural form, Canopy noted to be slightly sparse, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
76	*Schinus terebinthifolius (Brazilian Pepper)*	Early Mature	4	8	40 + years	Good	Reasonable	0.350	4.20	0.400	2.25	Friction stems noted within canopy (< 50mm dia.), Minor canopy suppression noted, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
77	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.300	4.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
78	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.250	3.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
79	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	7	15 - 40 years	Good	Good	0.320	5.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
80	*Livistona chinensis (Chinese Fan Palm)*	Early Mature	3	4	15 - 40 years	Good	Good	0.400	3.00	0.450	N/A	Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
81	*Morus alba 'Pendula' (Weeping Mulberry)*	Early Mature	4	6	15 - 40 years	Good	Reasonable	0.250	3.00	0.300	2.00	Main stem bifurcates between 1 meter and 2 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
82	*Phoenix canariensis (Canary Island Date Palm)*	Mature	8	10	40 + years	Good	Good	0.930	6.00	1.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
83	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	12	6	40 + years	Good	Good	0.230	2.76	0.350	2.13	Canopy displays leggy structural form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
84	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	18	40 + years	Good	Reasonable	1.250	15.00	1.400	3.81	Damage to surface roots (minor), Included bark unions noted (minor), Main stem bifurcates between 3 meters and 4 meters, Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
85	*Eucalyptus camaldulensis (River Red Gum)*	Mature	23	13	15 - 40 years	Reasonable	Questionable	0.800	9.60	0.950	3.24	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
86	*Eucalyptus camaldulensis (River Red Gum)*	Mature	30	15	40 + years	Good	Good	1.000	12.00	1.300	3.69	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
87	*Eucalyptus camaldulensis (River Red Gum)*	Mature	30	20	40 + years	Good	Reasonable	0.950	11.40	1.200	3.57	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Included bark unions noted (minor), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
88	*Eucalyptus rudis (Flooded Gum)*	Mature	25	15	40 + years	Good	Reasonable	1.000	12.00	1.000	3.31	Canopy displays leggy structural form, Minor canopy suppression noted, Tree displays multi stemmed form, surface roots noted	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
89	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	15	40 + years	Good	Reasonable	0.710	8.52	0.800	3.01	Canopy displays leggy structural form, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 3 meters and 4 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
90	*Eucalyptus camaldulensis (River Red Gum)*	Mature	17	7	15 - 40 years	Good	Reasonable	0.550	6.60	0.550	2.57	Canopy displays leggy structural form, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates at ground level, Prior branch failures noted within canopy (150 mm to 300 mm dia.), Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
91	*Callistemon viminalis (Bottlebrush)*	Mature	6	8	5 - 15 years	Questionable	Reasonable	0.300	3.60	0.300	2.00	Canopy noted to be slightly sparse, Canopy starting to indicate decline, Main stem bifurcates at ground level	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
92	*Eucalyptus rudis (Flooded Gum)*	Mature	10	12	40 + years	Good	Reasonable	0.440	5.28	0.500	2.47	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
93	*Eucalyptus camaldulensis (River Red Gum)*	Mature	20	20	40 + years	Good	Reasonable	1.200	14.40	1.300	3.69	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates between 2 meters and 3 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
94	*Eucalyptus camaldulensis (River Red Gum)*	Mature	13	10	15 - 40 years	Good	Reasonable	0.380	4.56	0.450	2.37	Friction stems noted within canopy (50 mm to 150 mm dia.), Major canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
95	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	13	5	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
97	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	9	40 + years	Good	Good	0.300	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
98	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	9	40 + years	Good	Good	0.330	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
96	*Unknown Shrub*	Mature	3	4	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
99	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	10	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
100	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	40 + years	Reasonable	Good	0.250	4.00	0.300	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
101	*Dypsis decaryi (Triangle Palm)*	Mature	5	6	40 + years	Good	Good	0.450	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
102	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	5	40 + years	Good	Good	0.250	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
103	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.450	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
104	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
105	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	4	40 + years	Good	Good	0.300	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

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Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
106	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	4	4	40 + years	Good	Good	0.250	3.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
107	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	5	4	40 + years	Good	Good	0.200	3.00	0.250	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
108	*Howea forsteriana (Kentia Palm)*	Mature	4	5	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
109	*Howea forsteriana (Kentia Palm)*	Mature	4	5	40 + years	Good	Good	0.100	4.00	0.200	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
110	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	5	5	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
111	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	7	6	40 + years	Good	Good	0.300	4.00	0.350	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
112	*Dracaena marginata (Madagascar Dragon Tree)*	Mature	3	4	40 + years	Good	Reasonable	0.600	7.20	0.600	2.67	Tree displays multi stemmed form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
113	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
114	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
115	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
116	*Phoenix roebelenii (Dwarf Date Palm)*	Mature	3	3	40 + years	Good	Good	0.200	2.00	0.150	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
117	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
118	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
119	*Dypsis decaryi (Triangle Palm)*	Mature	5	5	40 + years	Good	Good	0.400	3.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
120	*Eucalyptus robusta (Swamp Mahogany)*	Mature	15	14	40 + years	Good	Reasonable	0.650	7.80	0.750	2.93	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months

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121	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	5	8	40 + years	Good	Good	0.300	3.60	0.400	2.25	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
122	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	7	40 + years	Good	Good	0.330	4.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
123	*Syagrus romanzoffiana (Queen Palm)*	Mature	8	6	40 + years	Good	Good	0.330	4.00	0.408	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
124	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	5	8	40 + years	Good	Questionable	0.450	5.40	0.450	2.37	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between ground level and 500mm, Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
125	*Beaucarnea recurvata (Ponytail Palm)*	Mature	3	1	15 - 40 years	Good	Questionable	0.330	2.00	0.900	N/A	Canopy previously lopped (not in keeping with AS4373)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
126	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	5 - 15 years	Good	Questionable	0.200	2.40	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
127	*Robinia pseudoacacia (Black Locust)*	Mature	10	10	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Included bark unions noted (major), Main stem bifurcates at ground level, Tree displays multi stemmed form, species considered not suitable for incorporation into development due to suckering	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
128	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
129	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
130	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
131	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Reasonable	Reasonable	0.200	2.40	0.200	1.68	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
132	*Cupressus sempervirens 'Swane's Golden' (Golden Pencil Pine)*	Mature	5	2	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
133	*Cupressus sempervirens 'Swane's Golden' (Golden Pencil Pine)*	Mature	5	2	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
134	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.300	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
135	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.300	3.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
136	*Agonis flexuosa (WA Peppermint)*	Mature	5	9	15 - 40 years	Good	Reasonable	0.700	8.40	0.700	2.85	Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
137	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	5 - 15 years	Good	Questionable	0.200	2.40	0.200	1.68	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
138	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	6	7	40 + years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
139	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Reasonable	0.200	2.40	0.300	2.00	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
140	*Olea europaea (Olive)*	Semi-Mature	5	4	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
141	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	8	40 + years	Good	Good	0.250	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
142	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.200	4.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
143	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
144	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
145	*Syagrus romanzoffiana (Queen Palm)*	Mature	12	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
146	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	8	40 + years	Good	Good	0.200	5.00	0.300	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
147	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	3	5	15 - 40 years	Questionable	Questionable	0.350	4.20	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
149	*Syzygium smithii (Lilly Pilly)*	Mature	10	8	15 - 40 years	Good	Reasonable	0.300	3.60	0.350	2.13	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
148	*Syzygium smithii (Lilly Pilly)*	Mature	12	10	15 - 40 years	Good	Reasonable	0.400	4.80	0.450	2.37	Canopy displays leggy structural form, Main stem bifurcates between 1 meter and 2 meters	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
150	*Syzygium smithii (Lilly Pilly)*	Mature	13	10	15 - 40 years	Good	Good	0.280	3.36	0.350	2.13	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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151	*Melia azedarach (Cape Lilac)*	Mature	14	11	5 - 15 years	Good	Questionable	0.450	5.40	0.500	2.47	Damage noted to main stem (minor), Decay of woody tissue noted in main stem (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
152	*Melia azedarach (Cape Lilac)*	Mature	14	12	15 - 40 years	Good	Reasonable	0.500	6.00	0.600	2.67	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
153	*Salix babylonica (Weeping Willow)*	Mature	12	3	5 - 15 years	Good	Questionable	1.000	12.00	1.000	3.31	Canopy displays leggy structural form, Stand of 2 *Salix*	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
154	*Beaucarnea recurvata (Ponytail Palm)*	Mature	4	2	40 + years	Good	Good	0.300	3.00	0.500	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
155	*Washingtonia robusta (Mexican Fan Palm)*	Mature	14	4	40 + years	Good	Good	0.400	4.00	0.550	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
156	*Butia capitata (Jelly Palm)*	Early Mature	4	3	40 + years	Good	Good	1.000	3.00	1.000	N/A	Tree is considered to be a reasonable specimen of the species, Stand of 2 Palms	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
157	*Callistemon viminalis (Bottlebrush)*	Mature	3	3	5 - 15 years	Good	Poor	0.500	6.00	0.500	2.47	Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
158	*Callistemon viminalis (Bottlebrush)*	Mature	2	2	5 - 15 years	Good	Poor	0.400	4.80	0.400	2.25	Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
159	*Corymbia citriodora (Lemon-scented Gum)*	Mature	15	15	40 + years	Good	Good	0.630	7.56	0.700	2.85	Deadwood noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
160	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Main stem bifurcates at ground level, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
161	*Melaleuca bracteata (Black Tea Tree)*	Mature	5	6	15 - 40 years	Good	Questionable	0.350	4.20	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Main stem bifurcates between ground level and 500mm	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
162	*Agonis flexuosa (WA Peppermint)*	Mature	5	8	40 + years	Good	Reasonable	0.400	4.80	0.400	2.25	Canopy displays leggy structural form, Friction stems noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates at ground level, Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
163	*Callistemon viminalis (Bottlebrush)*	Mature	5	7	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
164	*Callistemon species (Bottlebrush)*	Mature	5	5	15 - 40 years	Good	Good	0.250	3.00	0.250	1.85	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
165	*Callistemon viminalis (Bottlebrush)*	Mature	6	5	15 - 40 years	Good	Reasonable	0.330	3.96	0.330	2.08	Main stem bifurcates between 500mm and 1 meter, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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166	*Prunus species (Prunus)*	Mature	6	12	Dead	Dead	Questionable	0.600	N/A	0.600	N/A	Dead Tree – no chance of recovery, Included bark unions noted (minor)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
167	*Erythrina x sykesii (Coral Tree)*	Mature	8	10	15 - 40 years	Good	Reasonable	0.600	7.20	0.600	2.67	Tree is considered to be a reasonable specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
168	*Schinus terebinthifolius (Brazilian Pepper)*	Mature	6	12	15 - 40 years	Good	Questionable	0.900	10.80	0.900	3.17	Canopy previously lopped (Major - not in keeping with AS4373), Tree displays multi stemmed form, noxious weed species - not suitable for incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
169	*Pyrus calleryana 'Bradford' (Bradford Pear)*	Mature	10	12	15 - 40 years	Good	Questionable	0.800	9.60	0.800	3.01	Friction stems noted within canopy (50 mm to 150 mm dia.), Prior branch failures noted within canopy (50 mm to 150 mm dia.), Tree displays multi stemmed form, Tree displays questionable form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
170	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	4	5 - 15 years	Good	Questionable	0.370	3.00	0.450	N/A	Palm displays unusual structural form (not straight/upright)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
172	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.350	3.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
171	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	5	15 - 40 years	Good	Good	0.350	3.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
173	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
174	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
175	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
176	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
177	*Syagrus romanzoffiana (Queen Palm)*	Mature	13	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
178	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
179	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
179	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy

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180	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	4	15 - 40 years	Good	Good	0.350	3.00	0.500	N/A	Tree is considered to be a good specimen of the species,Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
181	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	8	15 - 40 years	Good	Good	0.430	4.00	0.430	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
182	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	5	15 - 40 years	Good	Good	0.300	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
183	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.330	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
184	*Syagrus romanzoffiana (Queen Palm)*	Mature	11	5	15 - 40 years	Good	Good	0.330	3.00	0.450	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
185	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	5	15 - 40 years	Good	Good	0.330	3.00	0.400	N/A	Tree is considered to be a good specimen of the species, Previously spiked	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
186	*Dypsis decaryi (Triangle Palm)*	Mature	5	3	<5 years	Good	Poor	0.450	3.00	0.380	N/A	Canopy previously lopped (Major - not in keeping with AS4373), meristem has been cut/dammaged	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
187	*Lagunaria patersonii (Norfolk Island Hibiscus)*	Mature	12	8	15 - 40 years	Good	Reasonable	0.400	4.80	0.450	2.37	Canopy displays leggy structural form, Main stem bifurcates between 2 meters and 3 meters, species considered problematic for retention and incorporation into development	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
188	*Archontophoenix cunninghamiana (Bungalow Palm)*	Mature	6	2	Dead	Dead	Poor	0.250	N/A	0.400	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
189	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	8	15 - 40 years	Good	Good	0.350	5.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
190	*Beaucarnea recurvata (Ponytail Palm)*	Mature	3	3	15 - 40 years	Good	Good	0.300	3.00	1.000	N/A	Major canopy suppression noted, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
191	*Morus alba 'Pendula' (Weeping Mulberry)*	Mature	7	10	15 - 40 years	Good	Questionable	0.600	7.20	0.600	2.67	Damage noted to basal area(minor), Friction stems noted within canopy (150 mm to 300 mm dia.), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
192	*Prunus species (Prunus)*	Mature	5	6	Dead	Dead	Questionable	0.500	N/A	0.500	N/A	Dead Tree – no chance of recovery	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
193	*Prunus species (Prunus)*	Mature	5	6	<5 years	Reasonable	Questionable	0.500	6.00	0.500	2.47	Canopy starting to indicate decline, Included bark unions noted (major), Main stem bifurcates at ground level	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
194	*Macadamia integrifolia (Macadamia)*	Mature	5	8	15 - 40 years	Reasonable	Questionable	0.500	6.00	0.500	2.47	Included bark unions noted (major), Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
195	*Eucalyptus camaldulensis (River Red Gum)*	Mature	15	16	15 - 40 years	Good	Questionable	0.650	7.80	0.750	2.93	Canopy displays leggy structural form, Included bark unions noted (minor), Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
616	*Eucalyptus camaldulensis (River Red Gum)*	Mature	20	20	15 - 40 years	Good	Questionable	0.750	9.00	0.800	3.01	Canopy displays leggy structural form, Deadwood noted within canopy (50 mm to 150 mm dia.), Friction stems noted within canopy (150 mm to 300 mm dia.), Included bark unions noted (major), Main stem bifurcates above 4 meters+	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
615	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.350	4.00	0.450	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
614	*Syagrus romanzoffiana (Queen Palm)*	Mature	10	6	40 + years	Good	Good	0.350	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
613	*Syagrus romanzoffiana (Queen Palm)*	Mature	9	6	40 + years	Good	Good	0.300	4.00	0.400	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove dead fronds and loose leaf bases to tidy
196	*Melaleuca nesophila (Showy Honey Myrtle)*	Mature	4	10	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
197	*Corymbia maculata (Spotted Gum)*	Mature	30	20	40 + years	Good	Reasonable	1.100	13.20	1.300	3.69	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
198	*Corymbia ficifolia (Red Flowering Gum)*	Mature	9	10	15 - 40 years	Reasonable	Reasonable	0.650	7.80	0.700	2.85	Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 1 meter and 2 meters, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
199	*Melaleuca bracteata (Black Tea Tree)*	Mature	8	8	15 - 40 years	Good	Good	0.400	4.80	0.450	2.37	Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 3 meters and 4 meters, Prior branch failures noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
200	*Callistemon viminalis (Bottlebrush)*	Mature	5	5	5 - 15 years	Good	Questionable	0.400	4.80	0.400	2.25	Canopy previously lopped (not in keeping with AS4373), Prior branch failures noted within canopy (150 mm to 300 mm dia.)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
617	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	5	5 - 15 years	Good	Questionable	0.600	7.20	0.600	2.67	Prior branch failures noted within canopy (150 mm to 300 mm dia.), canopy consists of regrowth from previously cut stump	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
662	*Eucalyptus camaldulensis (River Red Gum)*	Early Mature	10	7	15 - 40 years	Good	Questionable	0.300	3.60	0.350	2.13	Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
201	*Eucalyptus grandis (Rose Gum)*	Mature	18	15	40 + years	Good	Good	0.570	6.84	0.650	2.76	Canopy displays leggy structural form, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
202	*Lophostemon confertus (QLD Box)*	Mature	12	12	40 + years	Good	Good	0.550	6.60	0.600	2.67	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
203	*Eucalyptus grandis (Rose Gum)*	Mature	25	15	40 + years	Good	Reasonable	0.680	8.16	0.750	2.93	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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204	*Eucalyptus rudis (Flooded Gum)*	Mature	17	13	40 + years	Good	Reasonable	0.720	8.64	0.800	3.01	Deadwood noted within canopy (50 mm to 150 mm dia.), Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
205	*Eucalyptus grandis (Rose Gum)*	Mature	30	20	40 + years	Good	Reasonable	1.000	12.00	1.500	3.92	Canopy displays leggy structural form, Deadwood noted within canopy (150 mm to 300 mm dia.), Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
206	*Sapium sebiferum (Chinese Tallow)*	Mature	6	8	15 - 40 years	Good	Good	0.360	4.32	0.500	2.47	Main stem bifurcates between 1 meter and 2 meters, Minor deadwood noted within canopy, Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
207	*Sapium sebiferum (Chinese Tallow)*	Mature	6	11	15 - 40 years	Good	Good	0.420	5.04	0.520	2.51	Damage to surface roots (minor), Deadwood noted within canopy (< 50mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
208	*Cupressus macrocarpa (Monterey Cypress)*	Mature	5	5	15 - 40 years	Good	Reasonable	0.300	3.60	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
209	*Olea europaea (Olive)*	Mature	11	10	40 + years	Good	Good	0.400	4.80	0.550	2.57	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
210	*Syzygium smithii (Lilly Pilly)*	Early Mature	9	5	15 - 40 years	Good	Good	0.250	3.00	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
211	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	10	6	5 - 15 years	Reasonable	Questionable	0.230	2.76	0.300	2.00	Canopy displays leggy structural form, Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
212	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	2	5 - 15 years	Good	Questionable	0.150	2.00	0.200	1.68	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
213	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	5	4	5 - 15 years	Reasonable	Questionable	0.210	2.52	0.300	2.00	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
214	*Fraxinus griffithii (Evergreen Ash)*	Early Mature	3	3	5 - 15 years	Good	Questionable	0.200	2.40	0.250	1.85	Canopy previously lopped (not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
215	*Eucalyptus grandis (Rose Gum)*	Early Mature	12	10	40 + years	Good	Good	0.300	3.60	0.350	2.13	Canopy previously lopped (not in keeping with AS4373), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, tree situated adjacent dead stump	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
217	*Phoenix canariensis (Canary Island Date Palm)*	Mature	11	8	40 + years	Good	Good	0.700	5.00	0.850	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
216	*Carya illinoinensis (Pecan)*	Semi-Mature	5	6	40 + years	Good	Good	0.280	3.36	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
218	*Arbutus unedo (Irish Strawberry Tree)*	Mature	7	8	15 - 40 years	Reasonable	Reasonable	0.500	6.00	0.600	2.67	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months

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219	*Cassia fistula (Golden Shower Tree)*	Early Mature	6	5	15 - 40 years	Good	Reasonable	0.220	2.64	0.300	2.00	Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species, Tree on lean (minor)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
220	*Laurus nobilis (Bay Tree)*	Mature	6	5	15 - 40 years	Good	Reasonable	0.450	5.40	0.450	2.37	Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
221	*Dracaena marginata (Madagascar Dragon Tree)*	Early Mature	3	3	15 - 40 years	Good	Reasonable	0.350	4.20	0.350	2.13	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
222	*Dracaena marginata (Madagascar Dragon Tree)*	Early Mature	3	3	15 - 40 years	Good	Good	0.500	6.00	0.350	2.13	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
223	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Good	0.330	3.96	0.350	2.13	Tree is considered to be a good specimen of the species, CoA Verge Tree	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
224	*Magnolia grandiflora (Bull Bay Magnolia)*	Semi-Mature	5	4	15 - 40 Years	Reasonable	Reasonable	0.250	3.00	0.250	1.85	Canopy noted to be chlorotic (Yellowing off), Canopy starting to indicate decline, Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
225	*Hedera species (Ivy Tree)*	Mature	4	5	15 - 40 years	Good	Poor	3.000	N/A	3.000	N/A	Dead tree stump covered in Ivy	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
226	*Phoenix canariensis (Canary Island Date Palm)*	Mature	9	8	40 + years	Good	Good	0.800	5.00	0.900	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
227	*Phoenix canariensis (Canary Island Date Palm)*	Mature	9	8	40 + years	Good	Good	0.800	5.00	0.900	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
228	*Jacaranda mimosifolia (Jacaranda)*	Mature	11	10	15 - 40 years	Good	Questionable	0.800	9.60	1.000	3.31	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Decay of woody tissue noted in 1st order limbs (significant), Main stem bifurcates between 1 meter and 2 meters. Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
229	*Brachychiton rupestris (QLD Bottle Tree)*	Mature	7	6	40 + years	Good	Good	1.100	13.20	1.100	3.44	Tree is considered to be a good specimen of the species, fluting of main stem noted - not considered problematic at this stage	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
230	*Callistemon viminalis (Bottlebrush)*	Mature	6	4	5 - 15 years	Good	Questionable	0.300	3.60	0.500	2.47	Tree displays multi stemmed form, Tree on lean (minor)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
231	*Butia capitata (Jelly Palm)*	Early Mature	3	3	15 - 40 years	Reasonable	Good	0.600	3.00	0.600	N/A	Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
232	*Citharexylum spinosum (Fiddlewood)*	Mature	8	11	15 - 40 years	Good	Questionable	1.000	12.00	1.000	3.31	Friction stems noted within canopy (50 mm to 150 mm dia.), Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
233	*Eucalyptus camaldulensis (River Red Gum)*	Mature	21	20	15 - 40 years	Good	Questionable	0.900	10.80	1.000	3.31	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373), Deadwood noted within canopy (50 mm to 150 mm dia.), Main stem bifurcates above 4 meters+, Tree displays multi stemmed form	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
234	*Eucalyptus robusta (Swamp Mahogany)*	Mature	14	12	15 - 40 years	Good	Reasonable	0.590	7.08	0.700	2.85	Canopy displays leggy structural form, Minor canopy suppression noted, Prior branch failures noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.

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235	*Eucalyptus robusta (Swamp Mahogany)*	Mature	10	8	15 - 40 years	Good	Questionable	0.550	6.60	0.700	2.85	Canopy displays leggy structural form, Canopy previously lopped (Major - not in keeping with AS4373)	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
236	*Eucalyptus robusta (Swamp Mahogany)*	Mature	14	12	15 - 40 years	Good	Questionable	0.700	8.40	0.800	3.01	Canopy displays leggy structural form, Damage noted to main stem (minor), Included bark unions noted (major), Main stem bifurcates between 2 meters and 3 meters, Significant branch failures noted (300 mm + dia.)	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
237	*Eucalyptus robusta (Swamp Mahogany)*	Mature	10	8	15 - 40 years	Good	Reasonable	0.350	4.20	0.400	2.25	Canopy displays leggy structural form, Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
238	*Eucalyptus robusta (Swamp Mahogany)*	Mature	15	13	15 - 40 years	Good	Good	0.500	6.00	0.700	2.85	Canopy displays leggy structural form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
239	*Eucalyptus robusta (Swamp Mahogany)*	Mature	11	11	15 - 40 years	Good	Reasonable	0.350	4.20	0.450	2.37	Deadwood noted within canopy (< 50mm dia.), Minor canopy suppression noted, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Remove major deadwood >30mm dia.
240	*Eucalyptus camaldulensis (River Red Gum)*	Mature	25	20	40 + years	Good	Good	0.880	10.56	0.950	3.24	Deadwood noted within canopy (50 mm to 150 mm dia.), Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove major deadwood >30mm dia.
241	*Phoenix canariensis (Canary Island Date Palm)*	Early Mature	5	8	40 + years	Good	Good	0.800	5.00	0.800	N/A	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Remove dead fronds and loose leaf bases to tidy
242	*Agonis flexuosa 'Nana' (Dwarf WA Peppermint)*	Mature	3	3	5 - 15 years	Good	Reasonable	0.250	3.00	0.300	2.00	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
243	*Agonis flexuosa 'Nana' (Dwarf WA Peppermint)*	Mature	3	6	15 - 40 years	Good	Reasonable	0.300	3.60	0.400	2.25	Tree displays multi stemmed form, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Acceptable (Reasonably located &/or Reasonable Specimen)	Monitor and Reinspect in 12 months
244	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Good	Reasonable	0.150	2.00	0.200	1.68	Minor canopy suppression noted	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
245	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Main stem bifurcates at ground level	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
246	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	15 - 40 years	Good	Reasonable	0.250	3.00	0.250	1.85	Main stem bifurcates at ground level, Prior branch failures noted within canopy (50 mm to 150 mm dia.)	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
247	*Callistemon viminalis (Bottlebrush)*	Early Mature	3	3	15 - 40 years	Good	Good	0.100	2.00	0.150	1.50	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
248	*Callistemon viminalis (Bottlebrush)*	Mature	4	4	15 - 40 years	Good	Reasonable	0.180	2.16	0.220	1.75	Main stem bifurcates between 500mm and 1 meter, Tree is considered to be a reasonable specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
249	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months

Tree Tag ID No.	Nomenclature & Tree Identification	Est Age	Est Tree Height	Est Canopy Spread	Useful Life Expectancy (ULE)	Canopy Health	Canopy Structure	Trunk Diameter @ Widest Point	Tree Protection Zone (TPZ) Radius (M)	Trunk Diameter Above Buttress	Structural Root Zone (SRZ) Radius (M)	Comments	Preliminary Recommendation	Suitability For Incorporation Into An Urban Development	Canopy Management Considerations
250	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Good	0.200	2.40	0.250	1.85	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
251	*Callistemon viminalis (Bottlebrush)*	Mature	6	4	15 - 40 years	Good	Good	0.200	2.40	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
252	*Callistemon viminalis (Bottlebrush)*	Mature	4	6	15 - 40 years	Good	Reasonable	0.400	4.80	0.400	2.25	Tree displays multi stemmed form	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
253	*Callistemon viminalis (Bottlebrush)*	Mature	4	3	15 - 40 years	Good	Questionable	0.250	3.00	0.250	1.85	Tree displays multi stemmed form	Consider removal – Tree Displays Health or Structural issues that may be problematic for long term retention or integration	Unsuitable for incorporation (Not compatible with design &/or problematic health or structural form)	
254	*Callistemon viminalis (Bottlebrush)*	Mature	4	5	15 - 40 years	Good	Good	0.300	3.60	0.300	2.00	Tree is considered to be a good specimen of the species	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
255	*Melaleuca rhaphiophylla (Fresh Water Paperbark)*	Mature	4	5	5 - 15 years	Reasonable	Reasonable	0.700	8.40	0.700	2.85	Tree displays multi stemmed form, CoA Verge Tree situated under power infrastructure	Consider Retaining - Develop and implement Tree Protection Plan (TPP) in accordance with AS4970-2009	Optimal (Well Placed &/or Good Specimen)	Monitor and Reinspect in 12 months
256	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	4	5 - 15 years	Questionable	Questionable	0.600	7.20	0.600	2.67	Canopy indicates decline, Canopy noted to be sparse, Deadwood noted within canopy (< 50mm dia.), Main stem bifurcates between 1 meter and 2 meters, , CoA Verge Tree situated under power infrastructure	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	
257	*Eucalyptus camaldulensis (River Red Gum)*	Mature	4	3	5 - 15 years	Questionable	Questionable	0.410	4.92	0.500	2.47	Canopy indicates decline, Canopy noted to be sparse, Canopy previously lopped (Major - not in keeping with AS4373), CoA Verge Tree situated under power infrastructure	Further Arboricultural input and/or assessment required in regard to health, structural or other issues identified	Questionable (Modifications and inputs required for incorporation &/or may display Questionable health or structural issues)	

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APPENDIX C - TREE PROTECTION ZONE (TPZ) OVERVIEW

INTRODUCTION

- Tree protection measures in keeping with AS 4970 'Protection of Trees on development sites' 2009' must be incorporated into the proposed design and implemented under the supervision of a AQF Level 5 Project Arborist in order to achieve tree sensitive outcomes for the project.
- Reporting is to be in keeping with the stages identified within *AS 4970 'Protection of Trees on Development Sites'* 2009 and industry best practice.

TPZ BACKGROUND INFORMATION

- To determine a Tree Protection Zone (TPZ), the trunk Diameter measured at Breast Height (1.4 meters from ground level) is multiplied by x 12. This is to be measured as a radius from the centre of the main stem at ground level. As identified in AS 4970 *The TPZ is to not be less than 2 meters and no greater than 15 meter radius.*
- The calculated TPZ includes both the above ground and below ground parts of the tree.
- Any construction works proposed to occur within the TPZ will require Arboricultural assessment and approval from a AQF 5 Project Arborist prior to commencement.
- Modification of the design and/or construction methodologies may be necessary to allow the proposed design to proceed.
- Ongoing Arboricultural review of methodologies and works within the TPZs will be required by the Project Arborist for the duration of the development or construction works.

ESTABLISH TREE PROTECTION ZONES (TPZ) WITHIN THE SITE

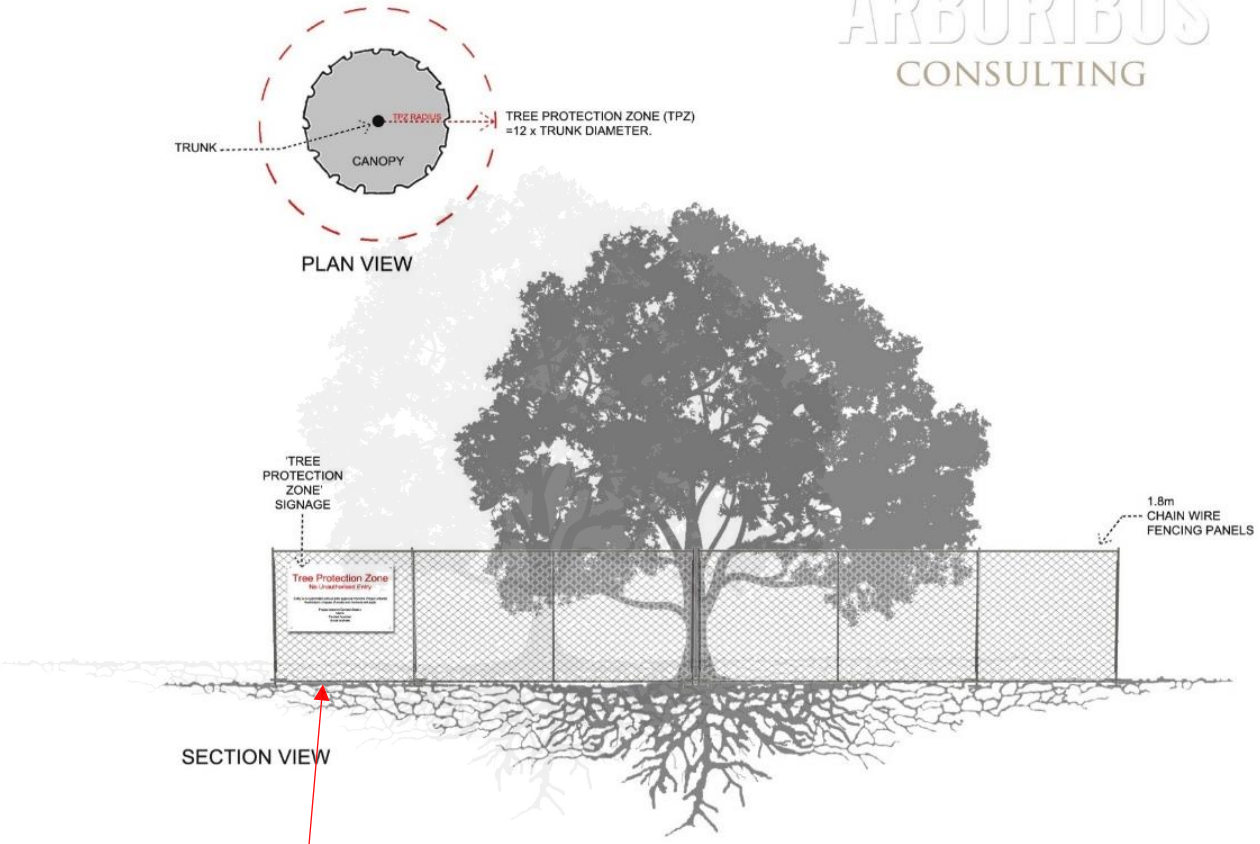
- TPZs are to be identified at their perimeter via 1.8-meter chain wire fencing panels (refer below figure for detail).
- This dedicated Fencing is to have signage installed (refer below figure for detail) that identifies the TPZ as a protected area and that no access is permitted without prior approval from the Project Arborist.
- TPZ Fencing is to remain for the duration of the construction phase. Maintenance and general upkeep of the fencing is the responsibility of the nominated Contractor.
- Any alteration or modification of the fencing is to be approved prior by the Project Arborist and documented as part of ongoing tree preservation reporting for the site.

PROHIBITED ACTIVITIES WITHIN TPZS

- Unauthorised access
- Mechanical Excavation, trenching or unapproved works of any kind

- Unauthorised modification of existing grade (i.e., raising or lowering of soil levels)
- Storage of construction materials, fuels, or phytotoxic chemicals etc…
- Parking, fuelling, tracking, or storage of vehicles or machinery of any kind
- Unauthorised placement of site facilities or waste disposal bins
- Stockpiling of soil, spoil or any construction debris
- Disposal of liquid waste including paint and concrete wash out
- Cleaning or washing of tools and equipment
- Unauthorised pruning of branches or roots.

TPZ EXAMPLE



TREE PROTECTION ZONE FENCING

TO BE IMPLEMENTED FOR TREES IDENTIFIED FOR RETENTION AND MAINTAINED FOR THE DURATION OF WORKS.



APPENDIX D – GENERAL SITE IMAGES

801 – 813 ARMADALE RD








817 – 831 ARMADALE RD








835 – 839 ARMADALE RD



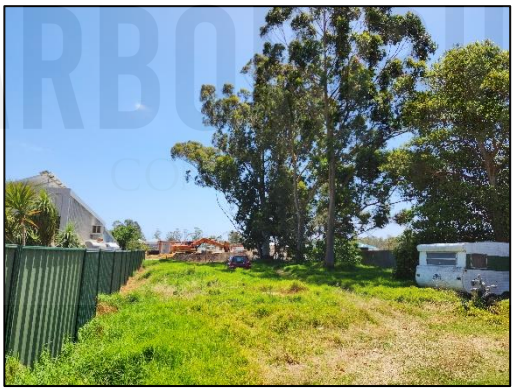





845 – 849 ARMADALE RD








7 – 15 ALLEN ROAD








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If you have any queries or if I can be of further assistance, do not hesitate to contact me on 0406 396 778.

Regards,



Luke Lumbus

COMPANY AND CONSULTANTS DETAILS

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Established:	October 2021
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Australian Company Number:	653 281 782
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Website:	www.arboribus.com.au
Insurance:	Public Liability Insurance $20 Million (QBE Australia) Professional Indemnity $5 Million (Dual Australia)

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DISCLAIMER

- The Consultant is trained, qualified and competent in their field of expertise and will employ their knowledge, training, and skill to provide informed comments and recommendations. However, the Client acknowledges there may be latent conditions and factors the Consultant cannot reasonably determine from a visual inspection. Unless otherwise agreed with the Client and documented in the Report, the Consultant's inspection will be conducted visually and so will not determine any latent conditions hidden within the tree or below the ground level.

- The Client hereby acknowledges that the information contained in this report is intended to provide preliminary guidance and recommendations for how to manage and protect the tree(s) that are the subject of this report, however, given the nature of the subject matter, trees as living organisms are subjected to many varied and dynamic factors.
- This report does not attempt to predict or anticipate potential future failure(s) of the subject tree(s) and/or its above and/or below ground parts – failure of trees and their parts can be influenced by numerous factors including (but not be limited to): -
    - Age
    - Health and Structural status of both above and/or below ground component(s)
    - Recent, historic or prolonged impacts to root(s)
    - Sudden or unapproved alterations to the trees growing environ(s)
    - Storm events, high winds, persistent heat and/or other severe climatic events
    - Standard and quality of previous works undertaken.

  This report and the advice within it cannot and shall not be construed as a guarantee the subject trees will not at some point deteriorate further and/or not survive.

- Where recommendations or advice have been provided, and the Client (or approved third party) does not adhere to such recommendations this shall be deemed to be an act or omission of the Client and the Client shall indemnify the Consultant for any damage, injury or loss that may occur as a result. It is the client's responsibility to organise any required re-inspections at the intervals specified.

- The Client warrants that it has disclosed all complete and accurate information in relation to the trees that are the subject of this report and the like and the Client hereby indemnifies and holds the Consultant harmless from any costs, losses or damage resulting in any way from matters not disclosed by the Client.

- The Client must acknowledge that it is their responsibility, prior to any work being conducted in connection with the Report, to obtain all necessary approvals in relation to carrying out the work that may be recommended by this report, including without limitation: approval from any local council, local or state government agency, or other authorised body, landlord, neighbour or any other persons or body corporate with legislative, regulatory or other interest over the trees or land that is the subject of this report.

- Arboribus shall not be required to attend court or provide evidence regarding this report unless predetermined provisions are agreed to between Arboribus and the Client, including additional payment of fees for such services.

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ATTACHMENT 10

Transport Impact Assessment

Engineering a better future for over 20 years!

Anstey Keane Urban Development Precinct - Armadale Road Structure Plan

Transport Impact Assessment

PREPARED FOR:
Landowners c/- Rowe Group

October 2025

Document history and status

Author	Revision	Approved by	Date approved	Revision type
R White	r01	B Bordbar	2/08/2023	
R White	r01a	B Bordbar	6/10/2025	Revised

File name: t20260-rw-r01a.docx

Author: Robin White

Project manager: Behnam Bordbar

Client: Landowners c/- Rowe Group

Project: Various Lots, Armadale Road, Forrestdale

Document revision: r01a

Project number: t20.260

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The Client alone shall have a license to use the documents referred to above for the purpose of completing the Project, but the Client shall not use, or make copies of, such documents in connection with any work not included in the Project, unless written approval is obtained from the Consultant or otherwise agreed through a separate contract.

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1 Introduction

This Transport Impact Assessment has been prepared by Transcore with regard to the proposed *Anstey Keane Urban Development Precinct – Armadale Road Structure Plan* for various lots along Armadale Road, Forrestdale, in the City of Armadale.

The subject site consists of various lots located on the northern side of Armadale Road between Anstey Road and Allen Road in Forrestdale, as shown in **Figure 1**, which shows the zones and reservations of the Metropolitan Region Scheme. It also shows the location of the nearby Forrestdale Business Park West Structure Plan area within the Armadale Redevelopment Scheme Area west of Tonkin Highway.

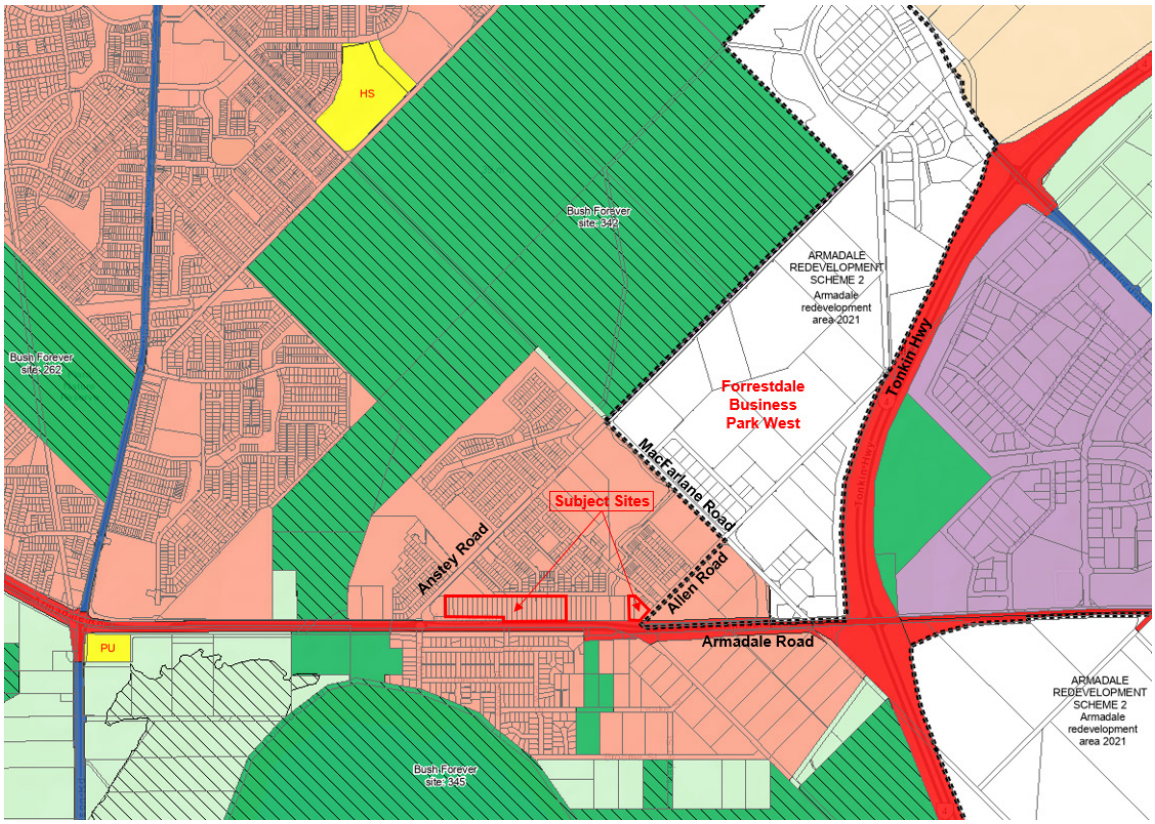


Figure 1: Site location

The proposed Structure Plan has been revised in 2025 to address the Schedule of Modifications issued by the Western Australian Planning Commission. This revised Transport Impact Assessment reflects the revised Structure Plan and addresses specific requirements of the Schedule of Modifications.

2 Proposed Structure Plan

The proposed Structure Plan for the subject sites is shown in **Appendix A**.

The proposed Structure Plan is also shown in **Figure 2** in context with the adjacent Anstey Keane Urban Development East Structure Plan, which covers the area to the north and east of the subject sites.

Figure 2 also shows an approved service station site, proposed local centre site and approved childcare centre site on the southeast side of Anstey Road near the western end of the proposed Structure Plan area.

The subject sites currently consist of 27 lots with access mostly from Armadale Road (the two eastern lots have access via Allen Road). The proposed Structure Plan has R25 density coding across the subject sites, so a dwelling yield of approximately 118 dwellings is anticipated from this Structure Plan area.

The WAPC Schedule of Modifications also requires the TIA to take into consideration future traffic generation from remaining lots fronting Armadale Road that do not form part of the Structure Plan area. For the purpose of this analysis it is assumed that those lots would potentially accommodate a further 51 dwellings at R25 density, so a total dwelling yield of 169 dwellings is assumed for this traffic analysis.

The adjacent *Anstey Keane Urban Development East Structure Plan* includes provision for a new access street (Rathbone Drive) along the northern boundary of most of the subject sites (except the lots currently accessed via Allen Road). This new access street would become the main access route for future development on the subject sites. This would provide access to Anstey Road in the west and to MacFarlane Road (via Allen Road and future Hypatia Boulevard) in the east, as shown in **Figure 2**.

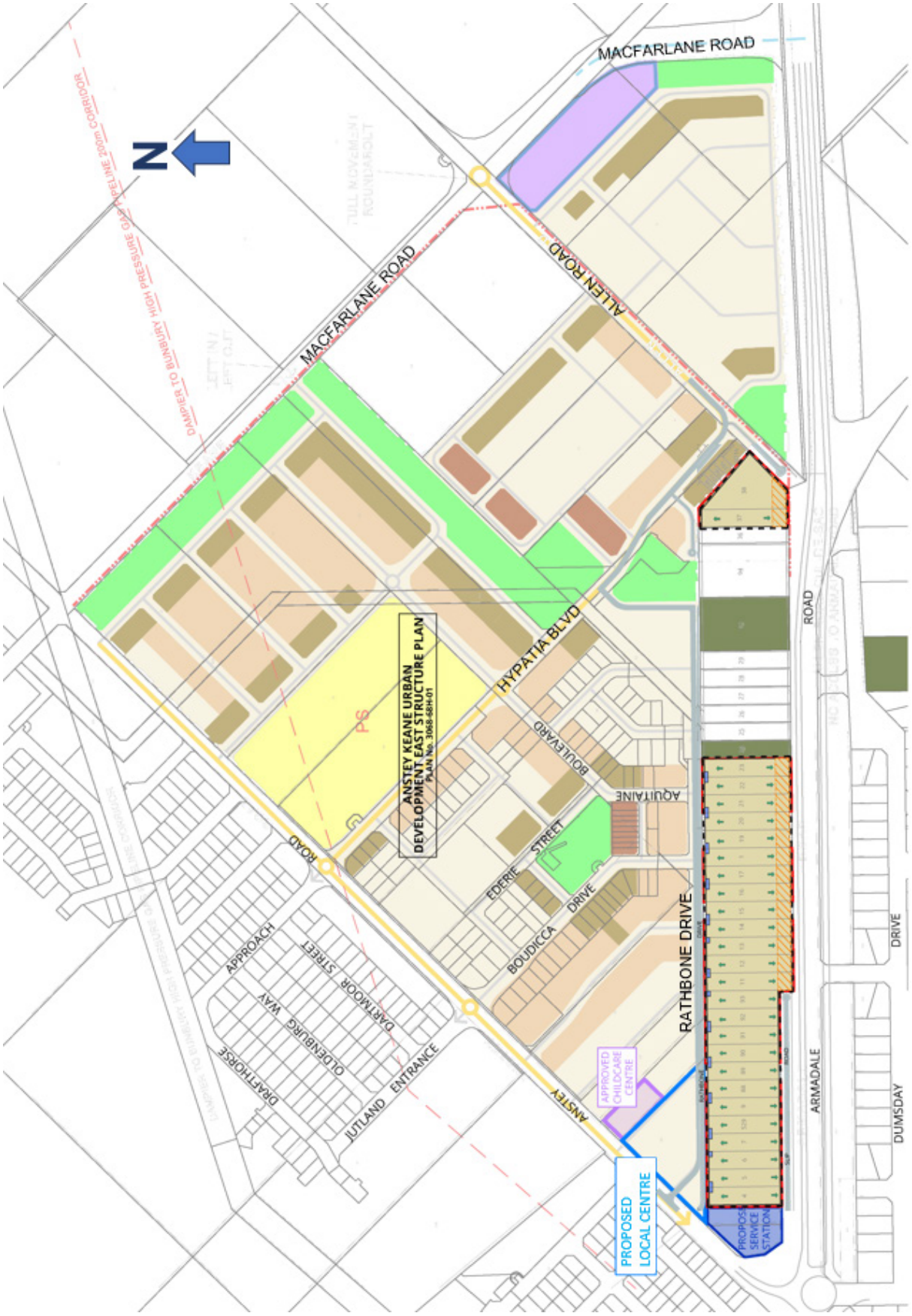


Figure 2: Proposed Structure Plan and Adjacent Structure Plan

3 Existing Situation

3.1 Existing Land Use

Existing land uses within the subject site are predominantly single dwellings on large lots (typically 1,702 or 2,024m^2 lot area) along the northern side of Armadale Road, as shown in **Figure 3**.



Figure 3: Existing land use

Residential subdivision development is progressing to the north and west of the subject sites, as can be seen in **Figure 3**.

South of Armadale Road is the existing Forrestdale townsite with the Forrestdale Hall and several playing fields and ovals located southwest of the Armadale Rd / Anstey Rd / Weld St intersection.

3.2 Existing Road Network

Armadale Road is a Primary Distributor road under the care and control of Main Roads WA and is covered by a Primary Regional Roads reservation in the Metropolitan Region Scheme (MRS), as shown in **Figure 1**. It is currently constructed as a dual carriageway road (2 lanes each way) in this area. Median width is approximately 7-8m west of Anstey Road, 20m between Anstey and Allen Roads and 6m east of Allen Road. An 80km/h speed limit applies on Armadale Road in this area. There is also an existing **Armadale Road service road** on the northern side of Armadale Road, which extends approximately 300m east from Anstey Road. It has a left in / left out connection to Armadale Road approximately 200m east of Anstey Road. It is unkerbed and has a sealed width of approximately 5.6m. It currently provides driveway access to 13 dwellings fronting this section of Armadale Road. It should be noted that this service road is within the road reserve of Armadale Road and is therefore controlled by Main Roads WA, although it is not within the Primary Regional Roads Reservation for Armadale Road in the MRS.

Anstey Road is currently classified as a District Distributor B in the Main Roads WA functional road hierarchy, providing local access within this area. It is constructed as a single carriageway, two-lane rural road. Anstey Road currently links through from Armadale Road to Ranford Road. Anstey Road has a posted speed limit of 60km/h from Armadale Road to MacFarlane Road and 70km/h from MacFarlane Road to Ranford Road.

Allen Road is a local road, classified as an Access Road in the Main Roads WA functional road hierarchy. It is constructed as a single carriageway, two-lane road southwest of MacFarlane Road. This section terminates at a cul-de-sac on the eastern side of the proposed Structure Plan area. It previously connected through to Armadale Road but has been severed by the City of Armadale to avoid use of this section of road by industrial traffic from Forrestdale Business Park West. The southernmost section of Allen Road, parallel to Armadale Road, still connects to Armadale Road as a full-movement T-intersection and provides driveway access to three dwellings fronting this section of Armadale Road.

MacFarlane Road (formerly Keane Road) is also currently a local road (an Access Road). About 300m of MacFarlane Road southeast from Anstey Road is still constructed as a single carriageway, two-lane rural road, but the remaining section northwest of Allen Road has been upgraded to two 5m carriageways with a 2m median.

The southern section of MacFarlane Road is the new, realigned section of Keane Road between Armadale Road and Allen Road. It is currently classified as an Access Road but is constructed as a dual carriageway road with additional widening to accommodate the turn paths of oversize vehicles transporting heavy equipment to and from Forrestdale Business Park West.

The Armadale Rd / Anstey Rd / Weld St intersection is constructed as a 4-arm roundabout accommodating two through lanes in each direction on Armadale Road.

The intersection of the Armadale Road service road on Anstey Road is a priority-controlled (give way) T-intersection.

The Allen Rd / MacFarlane Rd intersection is constructed as a 4-arm roundabout with additional widening to accommodate oversize vehicles on the southern section of MacFarlane Road and the northern section of Allen Road.

The Armadale Rd / MacFarlane Rd intersection is constructed as a signalised T-intersection.

3.3 Existing Traffic Volumes

Existing weekday traffic volumes at the Armadale Rd / Anstey Rd / Weld Street roundabout were counted by a video survey undertaken for this project on Wednesday, 24 May 2023. The results of that traffic count are presented in **Appendix B**.

The proportion of the surveyed weekday traffic flows that occurs during morning and afternoon peak hours on each of those roads is summarised in **Table 1**. The percentage of heavy vehicles is shown for the daily total on each road.

Table 1: Existing Peak Period Traffic Flows

Road	AM Peak Hour	PM Peak Hour	24-hour Day
	0730-0830	1500-1600	
Armadale Rd west	3,016vph	2,946vph	33,203vpd
	9.1% of vpd	8.9% of vpd	6.9% HV
Armadale Rd east	2,668vph	2,637vph	29,643vpd
	9.0% of vpd	8.9% of vpd	6.5% HV
Anstey Rd north	403vph	429vph	4,422vpd
	9.1% of vpd	9.7% of vpd	10.6% HV
Weld St south	87vph	104vph	1,304vpd
	6.7% of vpd	8.0% of vpd	2.5% HV

3.4 Public Transport

Bus Route No. 519 runs on Armadale Rd and Nicholson Rd from Murdoch Train Station to Armadale Train Station, as shown in **Figure 4**.

This route provides an hourly service Monday to Friday with more frequent service (2 per hour) in the AM and PM peak periods. There is currently no service on weekends or public holidays.

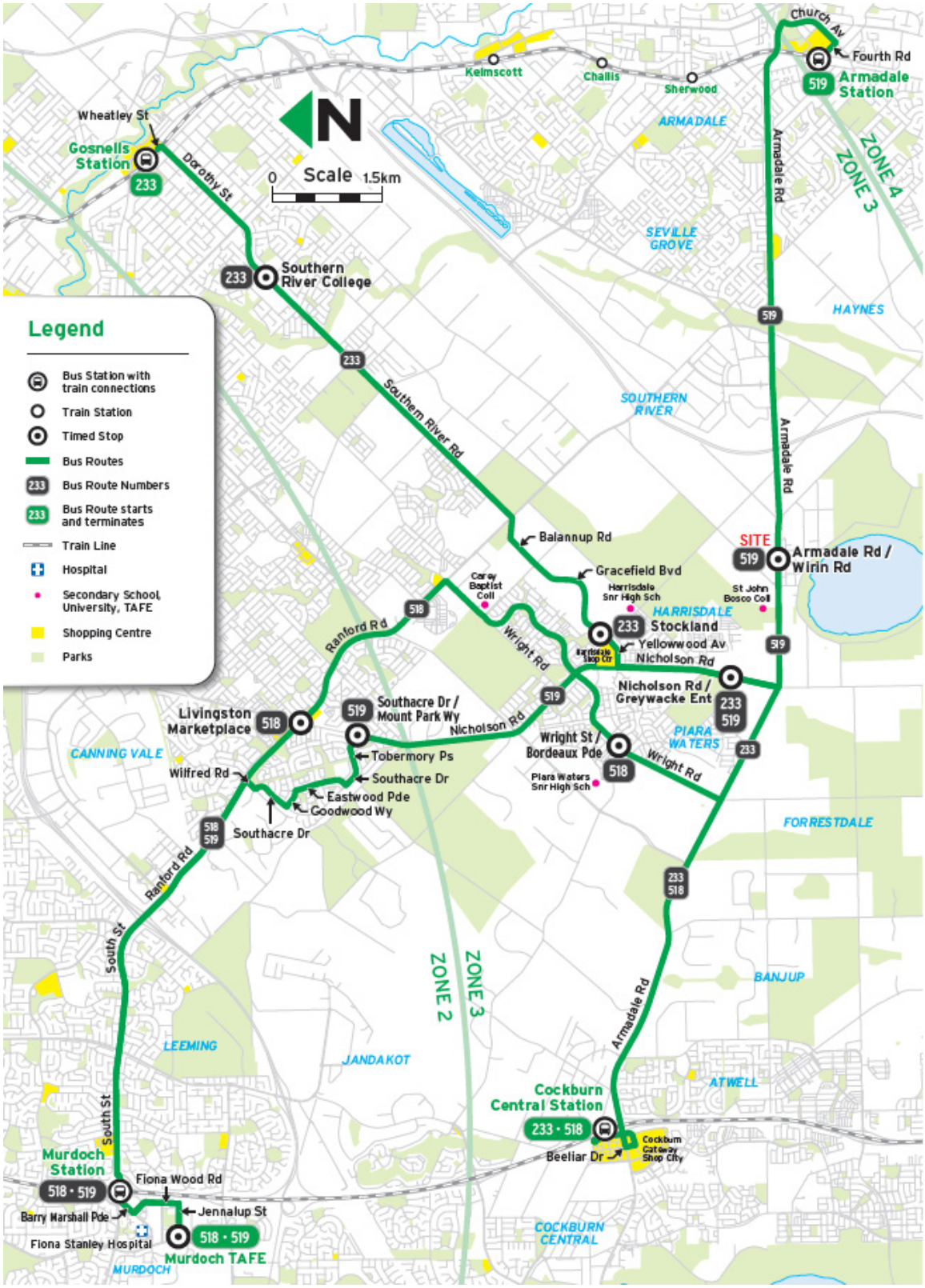


Figure 4: Existing bus routes

3.5 Pedestrian and Cyclist Facilities

There is a 3m wide shared path provided on one side of Armadale Road. West of Anstey Road it is located on the northern side of Armadale Road and east of Anstey Road it is located on the southern side of Armadale Road. There is also a 1.5m wide footpath on the southern side of Armadale Road west of Weld Street to provide access to the playing fields south of Armadale Road. Recent subdivision development north of the proposed Structure Plan area includes footpaths on one side of each access street.

Armadale Road also includes on-road cycle lanes on all sections west of Forrest Road but not yet east of Forrest Road.

High-level future planning for cycling facilities is now set out in Western Australia's Long Term Cycle Network (LTCN), which identifies an aspirational blueprint to ensure State and local governments continue to work together towards the delivery of a continuous cycling network providing additional transport options, recreational opportunities and support for tourism and commercial activity. The LTCN identifies the function of a route - primary, secondary or local - rather than the form it should take. Function considers the type of activities that take place along a route, and the level of demand (existing and potential). A route's built form is based on the characteristics of the environment, including space availability, topography, traffic conditions (speed, volumes), primary users, and so on.

The Long-Term Cycle Network map illustrated in **Figure 5** shows existing and planned primary routes (red) including Armadale Road, secondary routes (blue) including Anstey Road, and local routes (green) including MacFarlane Road in this area.

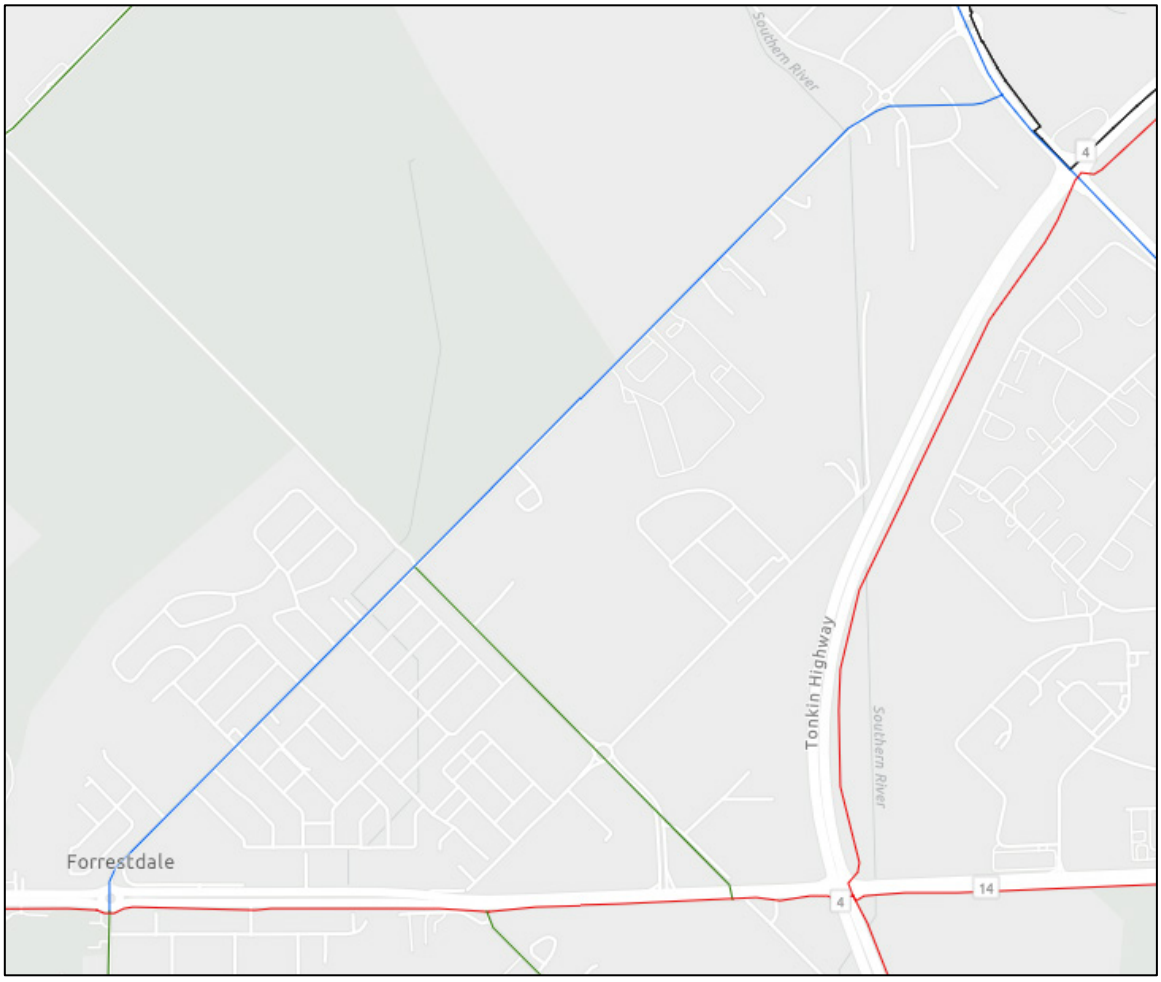


Figure 5. Long Term Cycle Network (source: Department of Transport)

3.6 Changes to Surrounding Road Network

The *Anstey Keane Urban Development East Structure Plan*, which covers the area to the north and east of the subject sites, provides for Anstey Road to be closed off on the southwest side of MacFarlane Road. This is to prevent industrial traffic travelling through this future residential area. That structure plan provides a circuitous through route between Anstey Road and Allen Road (see **Figure 2**) to allow residential traffic access from this area to both MacFarlane Road and to Anstey Road while discouraging industrial through traffic.

Main Roads WA currently still has plans for future extension of the existing Armadale Road service road through from Anstey Road, parallel to Armadale Road, to connect to Allen Road, as shown in the extract from MRWA Plan 8221-8-2 shown in **Figure 6**. That plan dates back to 1982 with minor amendments in 1984 and 1997. (The 4-way intersection shown at Armadale Rd / Allen Rd / Forrest Rd in that plan should not be considered current planning, as it would create a through route for industrial traffic through this residential precinct along Allen Road. The Armadale Rd / Forrest Rd T-

intersection will continue to provide access for future urban development in Forrestdale south of Armadale Road.)

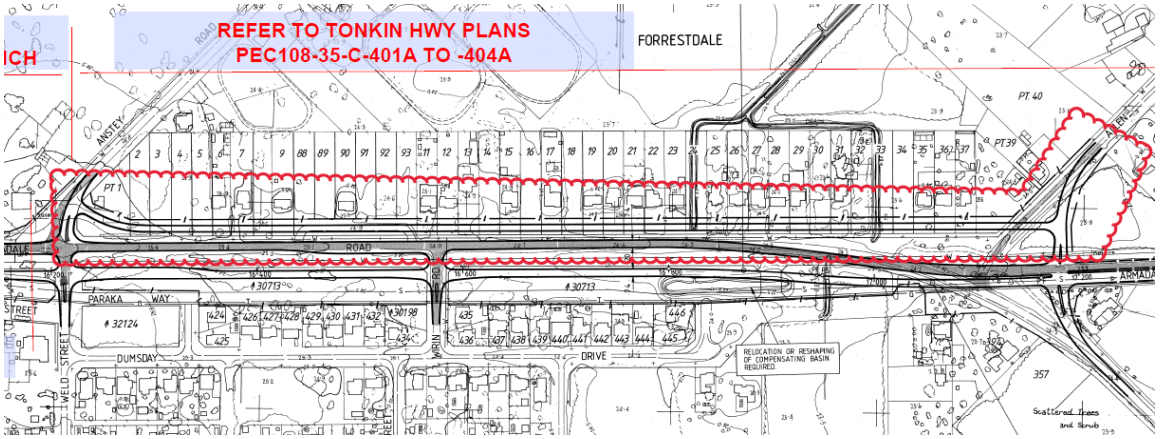


Figure 6: MRWA concept plan for extension of Armadale Rd service road

The MRWA concept plan for extension of the Armadale Rd service road is also reflected by 2010 Department of Planning & Infrastructure Plan No 1.7105-1, which shows 16m road widening of the the existing Armadale Road reserve. This plan is not signed as approved but does provide an indication of the land area required if that proposal should go ahead. It should be noted that this plan has not been formalised through declaration of a Planning Control Area or an MRS Amendment to widen the Primary Regional Roads Reservation for Armadale Road. Main Roads WA has advised that this proposal is not in Main Roads 4-year forward estimated construction program and is therefore considered long term planning. The WAPC Schedule of Modifications for this Structure Plan requires the Structure Plan to identify 16m land protection area for future road widening requirement to Armadale Road within the subject sites.

This section of Armadale Road (including the Armadale Rd service road east of Anstey Road and the short section of Allen Road parallel to Armadale Road) is declared as Control of Access on Main Roads WA Drawing No 1460-132. Main Roads WA advised that this "demonstrates the prevention of any new access being granted onto Armadale Road along this section, interim or permanent." The WAPC Schedule of Modifications for this Structure Plan refers to existing left in / left out access to/from Armadale Road being temporary and may be removed in future.

Tonkin Hwy is ultimately planned to freeway standard, which would involve construction of grade-separated interchanges to replace existing signalised intersections such as Tonkin Hwy / Armadale Rd.

Upgrading of Anstey Road to urban standard within the Anstey Keane Urban Development Precinct is included in the Developer Contributions Plan for this precinct. A preliminary concept plan has been prepared by JDSi civil engineers and a revised draft concept plan prepared in 2025 during the DCP review shows the future Anstey Road / Rathbone Drive intersection, future service station access on Anstey Road, and Anstey Road / Armadale Road service road intersection north of the Armadale Rd / Anstey Rd / Weld St roundabout. An extract from that draft plan is shown in **Figure 7**. Note that this is shown purely as an indicative concept plan and

has not been officially endorsed and is currently still subject to review. It is anticipated the future Anstey Road / Rathbone Drive intersection design would be further refined for the future Local Centre development application at that location.

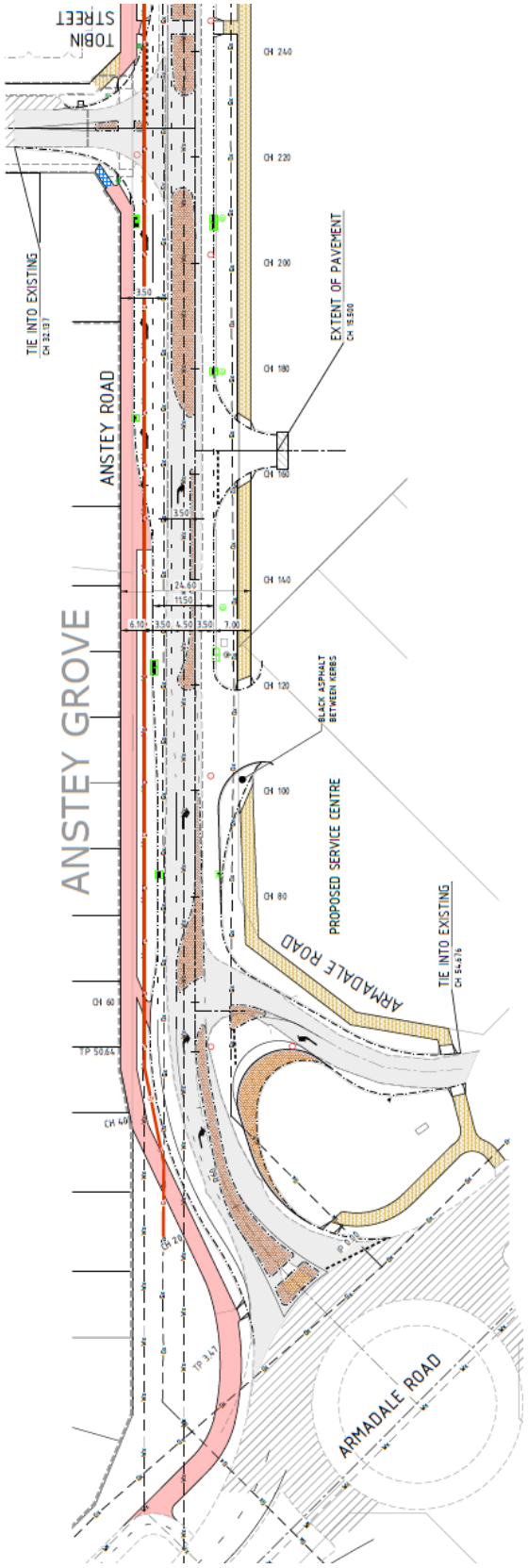


Figure 7: Anstey Road concept plan

3.7 Public Transport Network Planning

The Department of Transport plan, *Public Transport for Perth in 2031*, envisages a future bus rapid transit route from Armadale to Cockburn Central providing a cross-suburban link between the Mandurah and Armadale railway lines. However this is part of the ultimate network for a city of 3.5 million people and is indicated as beyond 2031.

4 Proposed Transport Network

4.1 Road Hierarchy

The proposed hierarchy of roads around the Structure Plan area is illustrated in **Figure 8** using the road hierarchy defined in the Western Australian Planning Commission *Liveable Neighbourhoods* (LN) policy.

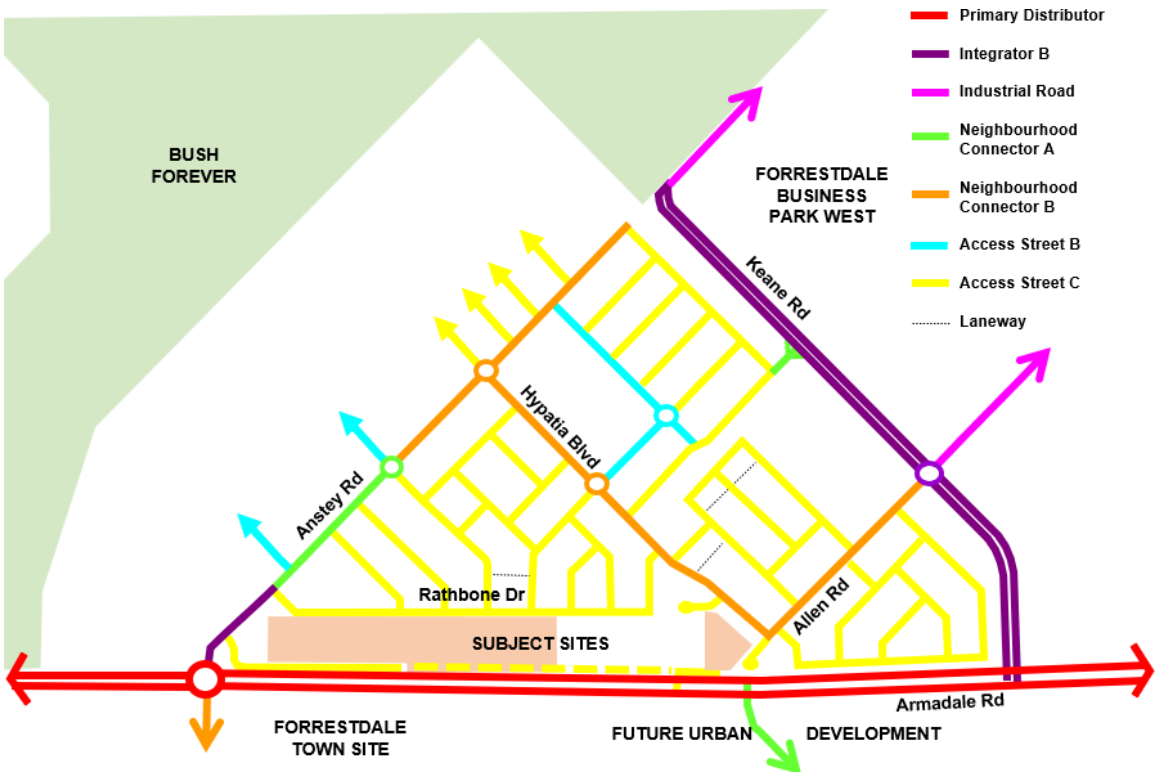


Figure 8: Road Hierarchy

Some key characteristics of the relevant road classifications for neighbourhood connectors and access streets have been summarised in **Table 2** below. These are generally based on Liveable Neighbourhoods guidelines although the proposed widths do vary slightly from the standard Liveable Neighbourhoods cross-section diagrams. This table is based on the equivalent table in the TIA report for the *Anstey Keane Urban Development East Structure Plan* (Anstey East, Anstey Road, Forrestdale - Proposed Local Structure Plan Transport Impact Assessment, July 2020) and the road hierarchy on the surrounding road network shown in **Figure 8** is also based on that report with appropriate modifications for the proposed Structure Plan for the subject sites addressed in this report. Refer to that previous TIA report for further details of the surrounding road network.

Table 2: Road Hierarchy

Road Classification	Indicative upper volume	Indicative road reserve width	Indicative road pavement width
Integrator B	15,000 vpd	29.2m	2 x 5m (incl. cycle lanes), 6m median & embayed parking
Neighbourhood Connector A	7,000 vpd	24.4m	2 x 5m (incl. cycle lanes), 2m median & embayed parking
Neighbourhood Connector B	3,000 vpd	19.4m to 20m (18m min)	7m (plus embayed parking)
Access Street A	3,000 vpd	24m typical	2 x 3.5m, 6m median & embayed parking
Access Street B	3,000 vpd	18m typical	6m (plus embayed parking)
Access Street C	3,000 vpd	15.4m to 16m	7.2m
Access Street D	1,000 vpd	14.2m to 15m	6m
Laneway	300 vpd	6m typical	6m

Anstey Road

Anstey Road is shown in **Figure 8** as an Integrator B for the southern section from Armadale Road to Rathbone Drive, then Neighbourhood Connector A north of Rathbone Drive and then Neighbourhood Connector B further north again. The Neighbourhod Connector A and B sections of Anstey Road shown on **Figure 8** are not impacted by the Structure Plan for the subject sites.

The southernmost section of Anstey Road from Armadale Road to Rathbone Drive was indicated as a Neighbourhood Connector A in the *Anstey Keane Urban Development East Structure Plan*. The only significant difference between the standard cross-sections of an Integrator B and a Neighbourhood Connector A is the median width. A standard Neighbourhood Connector A is shown with a 2m median but an Integrator B is shown with a 6m median so that cars turning right out from a side street can pause in the median and undertake that right turn movement in two stages. This becomes important at higher traffic volumes to minimise delays for those right turning cars but is less important at lower traffic volumes.

The planning for this southernmost section of Anstey Road has continued to evolve in response to development proposals in this area. Current planning for this southernmost section of Anstey Road has a 3.6m median, two 3.5m traffic lanes and two 1.5m cycle lanes within a 24.6m road reserve, which has imposed 2.25m road widening on both sides of the existing 20.1m road reserve of Anstey Road. It is not feasible to widen the road reserve any further due to impacts on approved subdivision / development on both sides of Anstey Road.

The 3.6m median width accommodates a right turn pocket for vehicles turning right from Anstey Road but vehicles turning right onto Anstey Road need to complete that right turn as a single movement, not in two stages. This will be checked in the intersection analysis section of this report (section 6.5) to confirm satisfactory intersection operation for those right turn movements.

Access Streets
The basic access street width required by the City of Armadale in this area is the 15.4m Access Street C of *Liveable Neighbourhoods*. This standard is able to accommodate traffic volumes up to 3,000 vpd.

Two roads within the *Anstey Keane Urban Development East Structure Plan* adjacent to the primary school site are proposed to have 18m widths and will include embayed parking for the primary school.

Laneways
In Liveable Neighbourhoods the standard road reserve width for laneways is 6.0 metres. These would typically be designed with flush kerbing (i.e. at the same level as the laneway pavement) and central drainage, and can accommodate two-way vehicle movement and rubbish collection. Visitor car parking is typically constructed in the road reserve adjacent to proposed lots serviced by laneways at a typical rate of one bay per every two dwellings.

However, for any laneways that provide the only public road frontage for lots abutting public open space in the proposed concept plan, a 9.0m wide road reserve is proposed for these laneways to accommodate services as well. This width is able to accommodate a 6m carriageway and parking on one side, where required.

4.2 Public Transport

The existing bus service along Armadale Road adjacent to the site is noted in section 3.4 and long term potential upgrade of bus services along Armadale Road is noted in section 3.7.

Previous advice from the Public Transport Authority (PTA) indicates any potential bus service through Forrestdale Business Park West would be in the longer term and would be related to the level of development of the surrounding areas. A likely alignment for a potential bus service would be along Ranford Road, to provide a strategic connection to Armadale. Anstey Road and Macfarlane Road are also possibilities due to connections to adjacent areas, although a Ranford Road service would likely be of a higher priority.

The potential future link road east of Anstey Road to Allen Road to connect to MacFarlane Road (shown in orange on **Figure 8** as a Neighbourhood Connector B road) would provide a suitable route for a future bus service through the adjacent *Anstey Keane Urban Development East Structure Plan* area if and when the PTA decides to provide a bus service through this area.

4.3 Pedestrian and Cyclist Facilities

The proposed pedestrian and cyclist network around the Structure Plan area is illustrated in **Figure 9**.

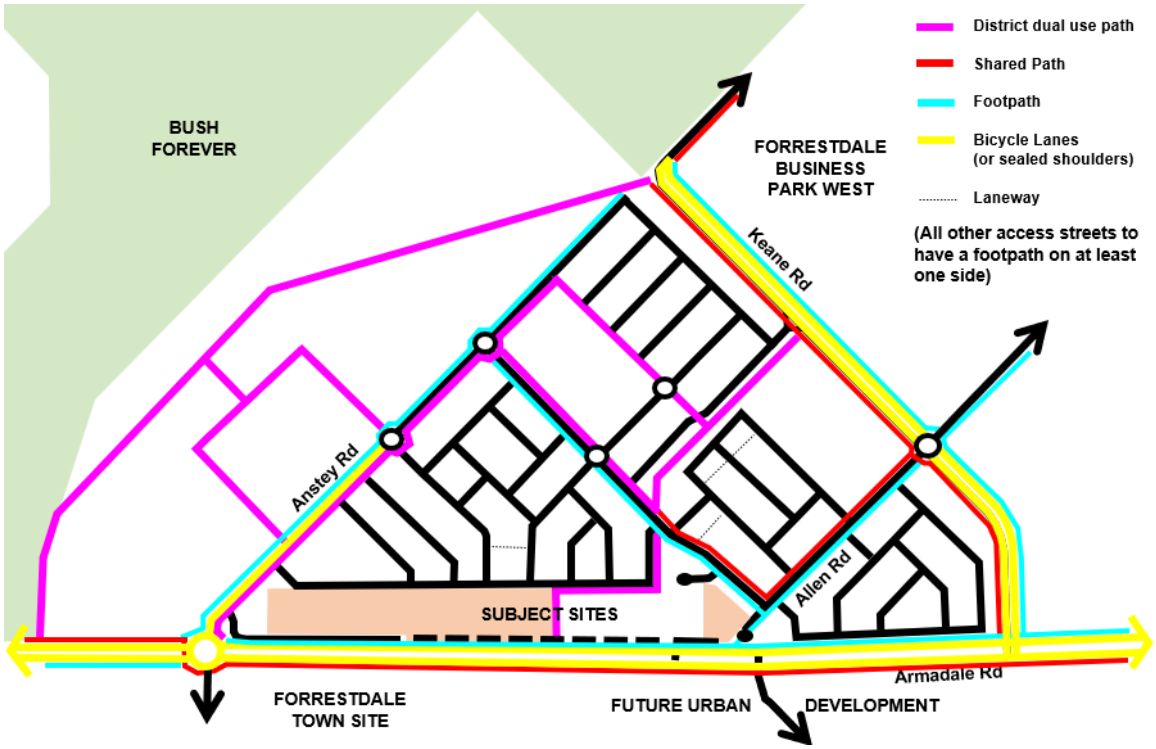


Figure 9: Pedestrian and cyclist facilities

In accordance with Liveable Neighbourhoods guidelines, paths will be provided on at least one side of all roads. There would be paths on both sides on all Neighbourhood Connector roads, including a shared path at least 2m wide on one side of Anstey Road, Allen Road and the proposed neighbourhood connector road link between them within the adjacent Anstey Keane Urban Development East Structure Plan area.

A network of district dual use paths has been identified as part of the development contribution plan for this precinct and those paths are also shown on **Figure 9**.

On-street cycle lanes are normally included only on Neighbourhood Connector A roads and above, as indicated in the details of the road hierarchy listed in **Table 2**. This principle is reflected in **Figure 9**.

5 Integration with Surrounding Area

The Western Australian Planning Commission's *South Metropolitan Peel Sub-regional Planning Framework* (March 2018) identifies the subject sites and current rural zoned land around the existing Forrestdale townsite including land south of Armadale Road as Urban Expansion areas. This would involve future rezoning and structure planning for current rural zoned areas as well.

During preparation of the *Forrestdale Business Park West Structure Plan* the City of Armadale raised concerns about the potential for industrial traffic from FBP West to use Allen Rd and Anstey Rd as a short cut to and from Armadale Rd. Discussions between the MRA and City of Armadale initially agreed that Anstey Road and Allen Road would both be closed off with cul-de-sac heads at the southwest side of MacFarlane Road to prevent industrial traffic travelling through this rural/residential area. However, the details of the Allen Road closure were subsequently revised and Allen Road was severed just north of Armadale Road in 2016, instead of south of MacFarlane Road.

The future road network in the adjacent *Anstey Keane Urban Development East Structure Plan* area, north of the subject sites, is illustrated in the road hierarchy plan at **Figure 8**.

Future subdivision and development within the subject sites north of Armadale Road will be accessed from Rathbone Drive along the southern boundary of the adjacent *Anstey Keane Urban Development East Structure Plan* area and will be planned to integrate well with development in that adjacent area.

6 Analysis of the Transport Network

6.1 Assessment Period

The traffic analysis in this report is not based on a particular assessment year but is based on full development of the wider Anstey Keane Urban Precinct north of Armadale Road.

Future traffic volumes on Armadale Road used in this report make reference to previous traffic projections from Main Roads WA for 2031 that were utilised for previous reports in this area. Main Roads WA has also previously advised that traffic flows on Armadale Road may be significantly higher in the long term and those longer term traffic volumes on Armadale Road are also utilised. This is consistent with traffic projections used in the *Anstey East, Anstey Road, Forrestdale - Proposed Local Structure Plan Transport Impact Assessment* (July 2020) and the *Lots 91, 101 and 200 Anstey Road, Forrestdale - Proposed Local Structure Plan Transport Impact Assessment* (December 2019).

The WAPC *Transport Impact Assessment Guidelines* generally asks for analysis at year of completion of development and ten years after completion of development. The timing of full development of the subject sites and surrounding areas is currently unknown, so analysis has been undertaken for the abovementioned full development and long term future scenarios instead.

The 2023 weekday traffic survey at the Armadale Rd / Anstey Rd / Weld Street roundabout (see section 3.3) recorded existing peak hours as 0730-0830 (AM peak) and 1500-1600 (PM peak). Accordingly, those peak periods are utilised for the traffic analysis in this report.

6.2 Traffic generation

The future weekday traffic flows used as base traffic for this analysis have been sourced from the *Anstey East, Anstey Road, Forrestdale - Proposed Local Structure Plan Transport Impact Assessment* (July 2020) and the *Proposed LSP Amendment, Lot 500 (16) Anstey Road, Forrestdale Transport Impact Assessment* (December 2022). The 2022 report built upon the 2020 report analysis to include proposed commercial developments along Anstey Road north and south of the future Rathbone Drive intersection.

The daily traffic generation rate used in the subject site for this report is 10 vehicle trips per day (vpd) per dwelling, as generally required by the City of Armadale for structure planning in the North Forrestdale area.

The anticipated dwelling yield of approximately 118 dwellings from this Structure Plan area will therefore generate approximately 1,180vpd. The potential additional dwelling yield of 51 dwellings on the Armadale Road lots not included in this Structure

Plan would potentially generate an additional 510vpd. This transport impact assessment takes into account the potential total 1,690vpd traffic generation from this area.

Approximately 25% of this traffic generation is anticipated to remain within the Anstey Keane Urban Precinct including trips to/from the school and commercial developments. The distribution of the remainder of trips to/from external destinations has been assigned on the surrounding road network based on the trip distribution utilised in the 2020 Anstey East LSP TIA report, as summarised in **Table 3**.

Table 3: External Trip Distribution

Approach Road	Percentage of Trips
Armadale Road (west)	42%
Armadale Road (east)	24%
Anstey Road (northeast)	12%
Allen Road (northeast)	18%
Weld Street (south)	2%
Forrest Road (south)	2%
Total	**100%**

Traffic generation for the future Local Centre at the future Anstey Rd / Rathbone Dr intersection was assessed in the December 2022 TIA report but has been re-evaluated based on the latest trip rates available from the NSW *Guide to Transport Impact Assessment* (2024), which is currently the best available source for traffic generation rates in Australia. Trip rates for small suburban shopping centres of 1000-6000m^2 GLFA have been utilised. The appropriate weekday trip rate is calculated as 0.695A + 1327vpd, where A is gross leasable floor area. For a potential future floor area of 2400m^2 this results in a daily traffic generation of approximately 2995vpd.

The December 2022 TIA report noted this local centre would primarily serve the local catchment within the Anstey Keane Urban Development Precinct and anticipated 80% of traffic would be attracted from this local area. The other 20% was assumed to be 10% from south of Armadale Road via Weld Street, 5% from the west on Armadale Road and 5% from the east on Armadale Road. It should be noted that the trips from residential areas to/from this local centre would not be additional traffic generation from those residential areas. The local centre would simply provide a more attractive, closer alternative for some of the trips that would otherwise be undertaken to more distant shopping centres in surrounding areas.

6.3 Traffic Flow Forecasts

The future total daily traffic flows on the road network around the subject site have been modelled for the future scenario of full development of this area as discussed above.

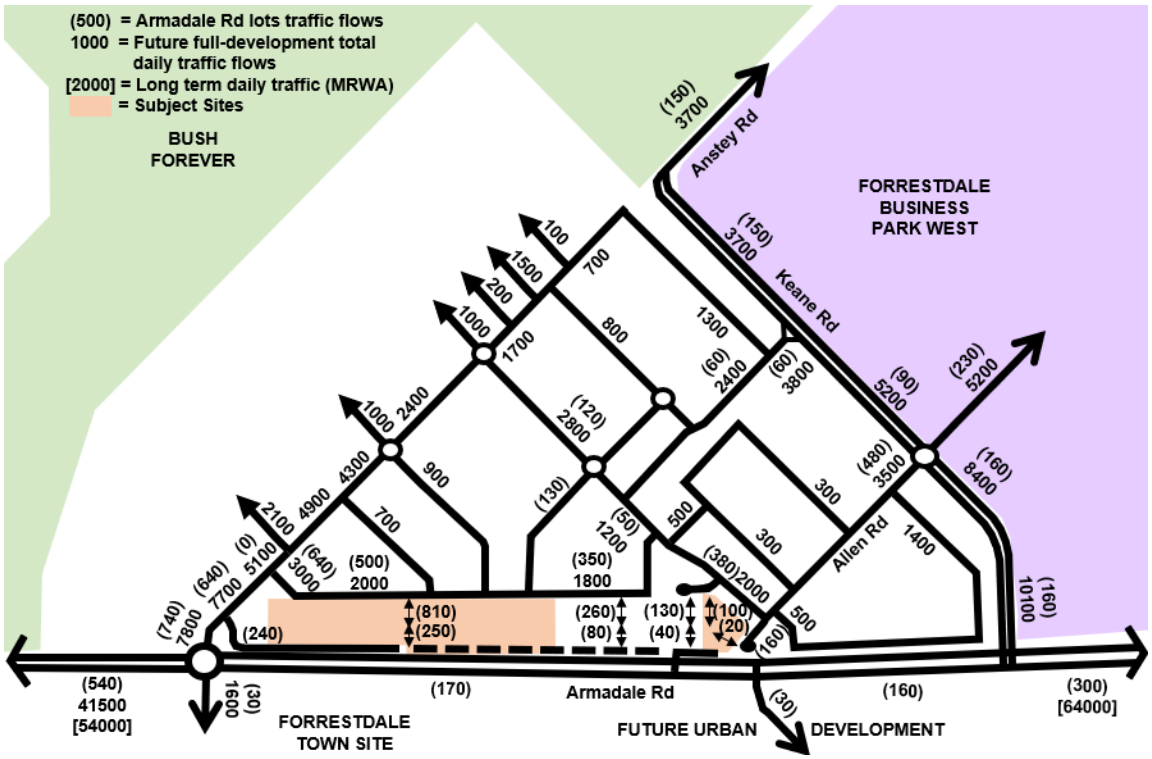


Figure 10: Future Daily Traffic Volumes

Figure 10 shows the total future traffic flows on the major roads around the subject sites with full development of the Anstey-Keane Urban Precinct and surrounding area. The component of these future traffic flows that would be generated by future urban development of the Armadale Road lots is shown in brackets. Note that this also includes potential future subdivision of the Armadale Road lots that are not included in this Structure Plan area.

Peak hour traffic flows from the modelled urban areas have been estimated using residential trip rates recommended in the WAPC *Transport Impact Assessment Guidelines* (2016), which are 0.2vph/dwelling in / 0.6vph/dwelling out during the AM peak) and 0.5vph/dwelling in / 0.3vph/dwelling out during the PM peak.

Peak hour traffic flows on Armadale Road have been calculated based on existing peak hour traffic flows percentage of daily traffic flows and existing peak hour directional splits determined from the 2023 weekday traffic survey at the Armadale Rd / Anstey Rd / Weld Street roundabout documented in **Appendix B**.

The resultant peak hour traffic flows at the Armadale Rd / Anstey Rd / Weld Street roundabout are shown in **Figure 11** for the future, full-development scenario (i.e.

Armadale Rd 41,500vpd) and in **Figure 12** for the long term future scenario (i.e. Armadale Rd 54,000vpd).

Future, full-development, peak hour traffic flows at the Anstey Rd / Rathbone Dr intersection are shown in **Figure 13**. There is no external through traffic on these roads so these traffic flows would not change in the long term scenario.

Future, full-development, peak hour traffic flows at the Anstey Rd / Armadale Road service road intersection are shown in **Figure 14**. This is based on the future full-development scenario with that service road connection extended eastwards to Allen Road and no direct connection anymore between Armadale Road and this service road.

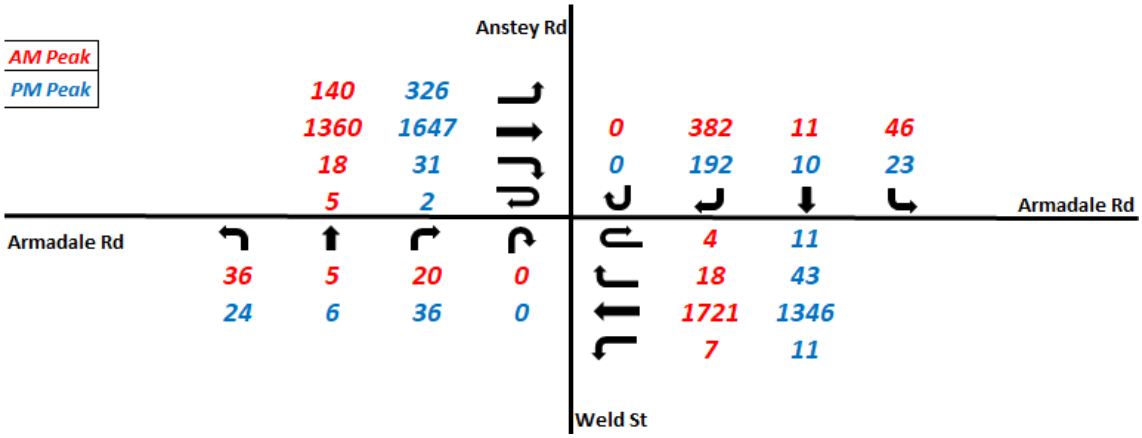


Figure 11: Future Full Development Peak Hour Traffic at Armadale Rd / Anstey Rd Roundabout

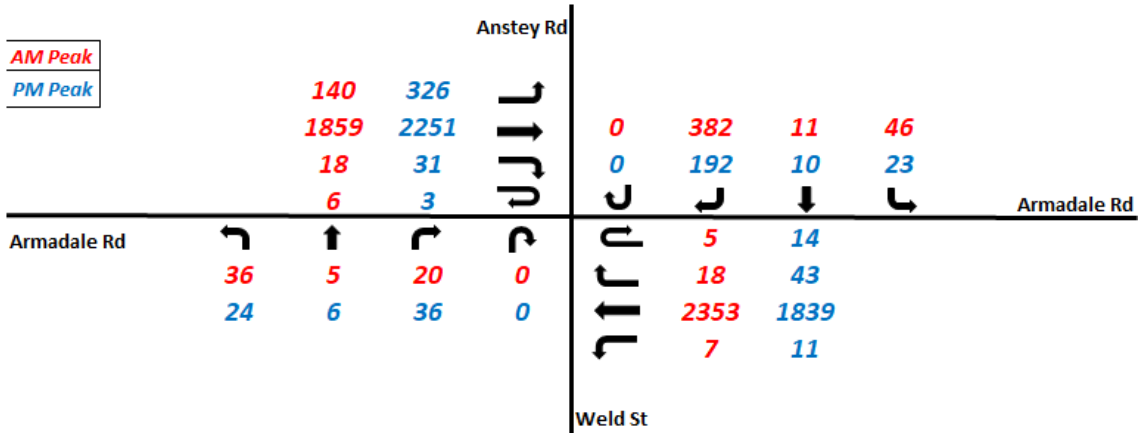


Figure 12: Long Term Future Peak Hour Traffic at Armadale Rd / Anstey Rd Roundabout

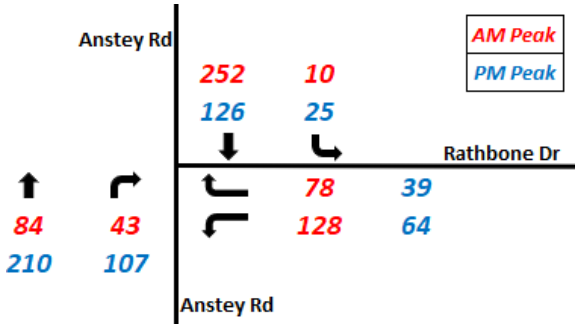


Figure 13: Future Full Development Peak Hour Traffic at Anstey Rd / Rathbone Dr Intersection

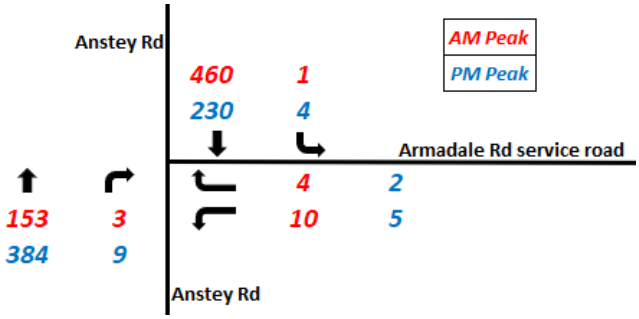


Figure 14: Future Full Development Peak Hour Traffic at Anstey Rd / Armadale Road service road intersection

6.4 Roads and Intersections

The anticipated future road network around the subject sites has been detailed in section 4 of this transport impact assessment, including discussion of the proposed road hierarchy in section 4.1.

The internal roads within the subject sites will consist of minor access streets and laneways and will be determined at subdivision stage for each site.

Planning for commercial development on the two lots northeast of the Armadale Rd / Anstey Rd / Weld Street roundabout makes provision for a right turn lane within the planned 3.6m median on this section of Anstey Road.

A similar right turn lane would be appropriate on Anstey Road at the Anstey Rd / Rathbone Dr intersection to accommodate traffic flows into Rathbone Drive for the planned local centre northeast of this intersection, as well as future residential development accessed via Rathbone Drive. (See **Figure 7** and associated discussion in section 3.6)

6.5 Intersection Analysis

Intersection capacity analysis has been undertaken for the Armadale Rd / Anstey Rd / Weld St roundabout, the Anstey Rd / Rathbone Dr intersection and the Anstey Rd / Armadale Rd service road intersection for the future, full development AM and PM peak hour traffic flows shown in **Figure 11**, **Figure 12, Figure 13** and **Figure 14**, as well as the existing traffic flows surveyed at the Armadale Rd / Anstey Rd / Weld St roundabout shown in **Appendix B**.

Capacity analysis of these intersections has been undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs include Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

SIDRA Network analysis has been undertaken for the long term future scenario for upgrading of the Armadale Rd / Anstey Rd / Weld St roundabout, the Anstey Rd / Rathbone Dr intersection and the Armadale Rd / Armadale Rd service road LILO intersection.

The results of the SIDRA analysis are summarised in **Appendix C**.

Armadale Road / Anstey Road / Weld Street roundabout

The SIDRA analysis at Tables C1a and C1b in Appendix C indicate that the existing Armadale Rd / Anstey Rd / Weld St roundabout (layout shown in Figure C1) currently operates satisfactorily in the 2023 AM and PM peak periods of existing traffic flows. The analysis indicates the existing roundabout currently operates at around 54% to 57% of capacity and overall level of service A in both these weekday peak periods. All movements operate at level of service A or B.

The SIDRA analysis at Tables C2a and C2b in Appendix C indicate that the Armadale Rd / Anstey Rd / Weld St roundabout (layout shown in Figure C2) will operate satisfactorily in the future AM and PM peak periods with the forecast traffic flows for full development of this area. The roundabout is anticipated to operate at around 79% (AM peak) and 68% (PM peak) of capacity and overall level of service A during both these weekday peak periods. All movements are anticipated to operate at level of service A or B.

In the longer term Main Roads WA has previously indicated that traffic volumes on this section of Armadale Road could be as high as 54,000vpd, which would require Armadale Road to be upgraded to three lanes each way through this intersection. Figure C4 shows the SIDRA layout for this upgraded roundabout as part of SIDRA Network analysis including the connections to the Armadale Road service road. The SIDRA Network analysis at Tables C4a and C4b indicate that this upgraded Armadale Rd / Anstey Rd / Weld St roundabout will operate satisfactorily in the long term AM and PM peak periods with the forecast traffic flows for full development of this area. The upgraded roundabout is anticipated to operate at around 67% (AM peak) and 61% (PM peak) of capacity and overall level of service A during both weekday peak periods. All movements are anticipated to operate at level of service A or B.

These results indicate that the existing two-lane roundabout is able to accommodate the traffic generated on Anstey Road by full development of this area. In the longer term when regional traffic growth increases traffic volumes on Armadale Road to the point where Main Roads WA decides to upgrade Armadale Road to three lanes each way, that upgrade would include upgrading the roundabout to three lanes as well. That upgraded roundabout would then operate satisfactorily under the forecast long-term traffic flows. Therefore it is considered that it is future regional traffic growth that will generate the requirement for Armadale Road and this roundabout to be upgraded to three lanes, not development in and around the Structure Plan area, so the roundabout upgrade (or signalised intersection, if that is what MRWA decides upon) should be part of a future MRWA Armadale Road upgrade project.

Anstey Road / Armadale Road service road intersection

The SIDRA Network analysis at Tables C5a and C5b in Appendix C relate to the future intersection represented as part of the SIDRA Network layout shown in Figure C4. The SIDRA results at Tables C5a and C5b indicate this intersection would operate satisfactorily in the future AM and PM peak periods with the forecast traffic flows for full development of this area shown in Figure 14. The intersection is anticipated to operate at around 26% (AM peak) and 21% (PM peak) of capacity with all movements operating at level of service A or B in both these weekday peak periods in this long term future scenario.

Armadale Road / Armadale Road service road LILO intersection

The SIDRA Network analysis at Tables C6a and C6b in Appendix C relate to the left in / left out (LILO) intersection represented as part of the SIDRA Network layout shown in Figure C4. This has been undertaken as a 'worst case' scenario for hypothetical traffic volumes as this LILO access has not been factored into the traffic volumes at the other two intersections modelled in this SIDRA Network analysis. (The LILO intersection would actually result in slightly lower traffic volumes at the other two intersections.) The hypothetical left turn volumes modelled are based on 25 dwellings having access from this service road, half of the traffic generated being left turns to/from Armadale Road and all of those left turns occurring at this LILO intersection.

The SIDRA Network results at Tables C6a and C6b indicate this intersection would operate satisfactorily. The intersection is anticipated to operate at around 45% (AM

peak) and 44% (PM peak) of capacity with all movements operating at level of service A in both these weekday peak periods in this long term future scenario.

Anstey Road / Rathbone Drive intersection

The SIDRA analysis at Tables C3a and C3b in Appendix C relate to the future intersection represented by the SIDRA intersection layout shown in Figure C3. The SIDRA results at Tables C3a and C3b indicate this intersection would operate satisfactorily in the future AM and PM peak periods with the forecast traffic flows for full development of this area shown in **Figure 13**. Note that those traffic volumes assume the service road is ultimately extended eastward to connect to Allen Road with no direct connection between Armadale Road and the service road.

This intersection is anticipated to operate at around 22% (AM peak) and 12% (PM peak) of capacity with all movements operating at level of service A in both these weekday peak periods.

The WAPC Schedule of Modifications asked for intersection warrants at the Anstey Rd / Rathbone Dr intersection to be assessed. This refers to channelised intersection treatments including provision of right turn lane and/or left turn lane on Anstey Rd at this intersection. The relevant warrants are set out in *Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management*. The relevant future, full-development traffic volumes from **Figure 13** have been inserted on the relevant graph from that Guide in **Figure 15** below.

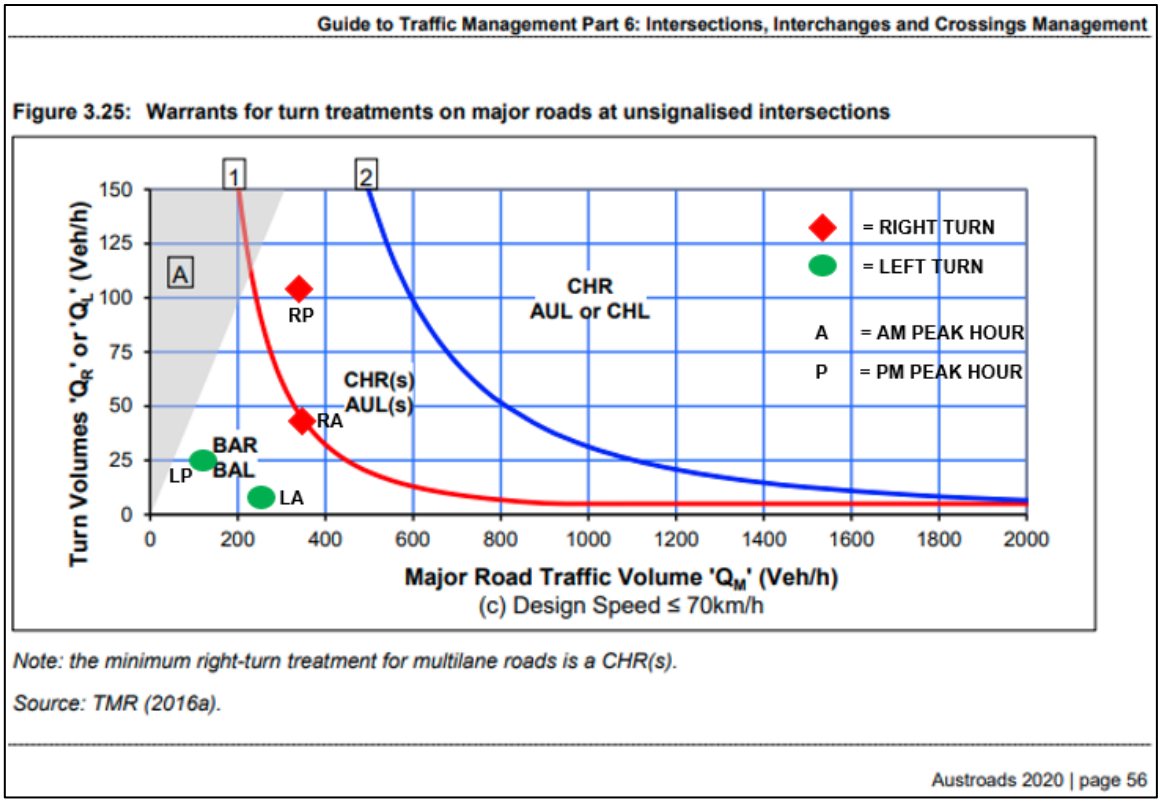


Figure 15: Warrants for turn treatments at Anstey Rd / Rathbone Dr intersection

The red diamond symbols used for the right turn traffic flows fall above the red line on **Figure 15** indicating that a short channelised right turn (CHR(s)) treatment will be appropriate for the right turn from Anstey Road into Rathbone Drive, as proposed.

The green circle symbols used for the left turn traffic flows fall well below the red line on **Figure 15** confirming that a short auxiliary left turn lane (AUL(s)) treatment will not be required for the left turn from Anstey Road into Rathbone Drive, as proposed.

6.6 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that *"Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access. Wider lots with paired driveways and protected reversing areas in the parking lane may be used on streets with up to 7000 vehicles per day."*

The proposed Structure Plan for the subject sites will not change the status of any roads in the surrounding area in relation to this guidance.

The future road network within the subject sites will all carry significantly less than that threshold of 5000vpd, so there will not be any restriction on direct driveway access for any lots within the subject sites.

The existing dwellings within the subject sites currently have driveway access from the existing Armadale Road service road or directly from Armadale Road or Allen Road. It is anticipated that development would be staged on many of these existing properties with the first stage of development being on the northern portions of these properties with access via planned Rathbone Drive on the northern side of those properties. Existing driveway access arrangements for the existing dwellings are anticipated to remain until the full area of those properties are redeveloped or the Armadale Road service road is extended eastwards providing alternative frontage access for the subject sites.

6.7 Pedestrian / Cycle Networks

The proposed network of footpaths and shared paths (dual use paths) for pedestrians and cyclists around the subject sites is described in section 4.3 of this report. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists to and from the subject sites and connection to future urban development in the surrounding area.

The WAPC *Transport Impact Assessment Guidelines* (2016) provides guidance on the levels of traffic volumes that are likely to affect the ability for pedestrians to cross various types of road. Based on that guidance an undivided two-lane road should be acceptable for pedestrians crossing traffic volumes of up to approximately 11,000 vpd and this threshold can be increased to around 28,000 vpd by adding a central median

or pedestrian refuge islands. On a four-lane road, because of its greater carriageway width, this threshold is lower; even with a median island the threshold is only around 16,000 vpd.

The only road abutting the Structure Plan area that will carry traffic volumes above these levels is Armadale Road. The traffic signals at the Armadale Road / MacFarlane Road (Keane Road) intersection include crossing facilities to assist pedestrians and cyclists to cross Armadale Road and MacFarlane Road at that location.

6.8 Walk / Cycle to School

The subject sites will be within the local catchment area for the future Primary School within the adjacent *Anstey Keane Urban Development East Structure Plan* area, north of the subject sites.

The diagram at **Figure 16** illustrates the variety of routes avaible for students walking or cycling from the subject sites to that future Primary School site and distance from the school site to Rathbone Drive. Those potential routes utilise the existing or planned path network on the local road network within the adjacent structure plan.



Figure 16: Existing and future pedestrian routes to Primary School

Those pedestrian routes do not have to cross any roads carrying high traffic volumes (see **Figure 10**). Most would need to cross Rathbone Drive but potential crossing

locations would be spread out along the length of Rathbone Drive as the subject sites extend along much of this road length and the existing footpath is constructed on the northern verge of Rathbone Drive. Pedestrian and cyclist movements of students will naturally become concentrated at key locations on the roads adjacent to the school site. Detailed design for students crossing roads such as Hypatia Boulevard adjacent to the school site will be addressed as part of the future development application for that Primary School.

It is understood that the subject sites lie within the catchment area for Harrisdale Senior High School, which is located about 1.9km north of the subject sites (corner of Keane Road and Skeet Road in Harrisdale, on the other side of an extensive Bush Forever area. That should be considered beyond reasonable walking / cycling range for most future students from the subject sites.

There is also John Bosco Catholic College located on the northern side of Armadale Road to the west, which is approximately 900m walk / cycle distance from the western end of the subject sites. The existing 3m wide shared path on the northern side of Armadale Road west of Anstey Road provides a suitable pedestrian and cyclist access route to that school.

6.9 Access to Public Transport

The existing bus route on Armadale Road provides public transport services in the vicinity of the subject site and is anticipated to be upgraded further in future.

The WAPC *Transport Impact Assessment Guidelines* (2016) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route.

The subject sites only extend about 100m north of Armadale Road, so that guidance is satisfied.

7 Conclusions

This transport impact assessment relates to the proposed *Anstey Keane Urban Development Precinct – Armadale Road Structure Plan* for various lots along Armadale Road between Anstey Road and Allen Road in Forrestdale, in the City of Armadale.

The subject sites currently consist of 27 lots with access mostly from Armadale Road (the two eastern lots have access via Allen Road). The proposed Structure Plan has R25 density coding across the subject sites, so a dwelling yield of approximately 118 dwellings is anticipated from this Structure Plan area.

This TIA also takes into consideration future traffic generation from remaining lots fronting Armadale Road that do do form part of the Structure Plan area. For the purpose of this analysis it is assumed that those lots would potentially accommodate a further 51 dwellings at R25 density, so a total dwelling yield of 169 dwellings is assumed for this traffic analysis.

The adjacent *Anstey Keane Urban Development East Structure Plan* includes provision for a new access street (Rathbone Drive) along the northern boundary of most of the subject sites (except the properties already accessed via Allen Road). This new access street would become the main access route for future development on the subject sites. This would provide access to Anstey Road in the west and to MacFarlane Road (via Allen Road and future Hypatia Boulevard) in the east.

Future residential subdivision of the potential 169 dwellings (i.e. the Structure Plan area plus Armadale Road lots not within the Structure Plan area) would potentially generate traffic flows of up to 1,690vpd.

Future traffic flows on the road network around the Structure Plan area have been modelled with full development of this area. The future Local Centre north of the western end of this LSP area is also taken into account in this analysis.

The southernmost section of Anstey Road from Armadale Road to Rathbone Drive was indicated as a Neighbourhood Connector A in the *Anstey Keane Urban Development East Structure Plan*.

The combined effects of traffic generation associated with planned commercial development along southern sections of Anstey Road and residential subdivision of the subject sites will increase future traffic flows above the 7,000vpd threshold from Neighbourhood Connector A to Integrator B classification.

The only significant difference between the standard cross-sections of an Integrator B and a Neighbourhood Connector A is the median width. A standard Neighbourhood Connector A is shown with a 2m median but an Integrator B is shown with a 6m median so that cars turning right out from a side street can pause in the median and undertake that right turn movement in two stages. This becomes important at higher traffic volumes to minimise delays for those right turning cars but is less important at lower traffic volumes.

Current planning for this southernmost section of Anstey Road has a 3.6m median, two 3.5m traffic lanes and two 1.5m cycle lanes within a 24.6m road reserve, which has imposed 2.25m road widening on both sides of the existing 20.1m road reserve of Anstey Road. It is not feasible to widen the road reserve any further due to impacts on approved subdivision / development on both sides of Anstey Road.

The 3.6m median width accommodates a right turn pocket for vehicles turning right from Anstey Road but vehicles turning right onto Anstey Road need to complete that right turn as a single movement, not in two stages. Intersection capacity analysis confirms that this intersection arrangement will operate satisfactorily at the Anstey Road / Rathbone Drive intersection for the future traffic flows resulting from full development of the subject sites and surrounding area.

The Armadale Road service road intersection on Anstey Road is also planned to have a similar treatment when Anstey Road is upgraded and is also shown to operate satisfactorily in future.

Intersection capacity analysis indicates that the existing two-lane roundabout at the Armadale Rd / Anstey Rd / Weld St intersection is able to accommodate the traffic generated on Anstey Road by full development of the Structure Plan area and the neighbouring Anstey Keane urban development area between MacFarlane Road and Armadale Road.

In the longer term when regional traffic growth increases traffic volumes on Armadale Road to the point where Main Roads WA decides to upgrade Armadale Road to three lanes each way, that upgrade would include upgrading the roundabout to three lanes as well. That upgraded roundabout would then operate satisfactorily under the forecast long-term traffic flows. Therefore it is considered that it is future regional traffic growth that will generate the requirement for Armadale Road and this roundabout to be upgraded, not development in and around the Structure Plan area, so the roundabout upgrade (or signalised intersection, if that is what Main Roads WA decides upon) should be part of a future Armadale Road upgrade project by Main Roads WA.

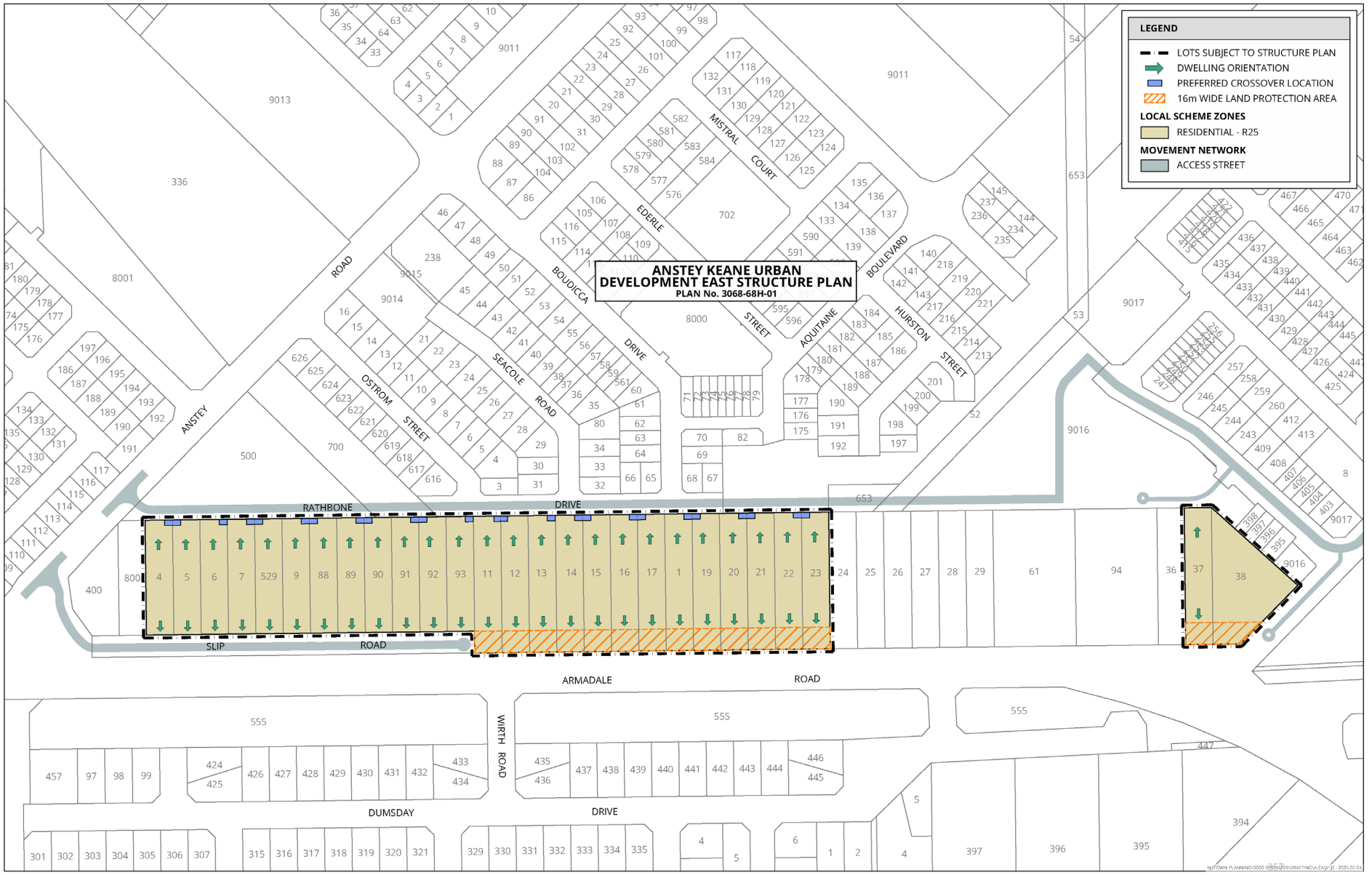
The existing dwellings within the subject sites currently have driveway access from the existing Armadale Road service road or directly from Armadale Road or Allen Road. It is anticipated that development would be staged on many of these existing properties with the first stage of development being on the northern portions of these properties with access via planned Rathbone Drive on the northern side of those properties. Existing driveway access arrangements for the existing dwellings are anticipated to remain until the full area of those properties are redeveloped. However, a 16m land protection area is identified in the proposed Structure Plan across the frontage of lots east of the existing Armadale Road serve road to accommodate future widenting of the Armadale Road road reserve, which will ultimately allow for extension of that existing service road to accommodate frontage access for those properties and remove the requirement for direct driveway access onto Armadale Road in future.

Appendix A

PROPOSED LOCAL STRUCTURE PLAN

transcore

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LOCAL STRUCTURE PLAN

VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N

0 55 m
SCALE @ A3: 1:2500

9269-LSP-01-C

DRAWN: JS
DATE CREATED: 2025.07.04
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: MNG

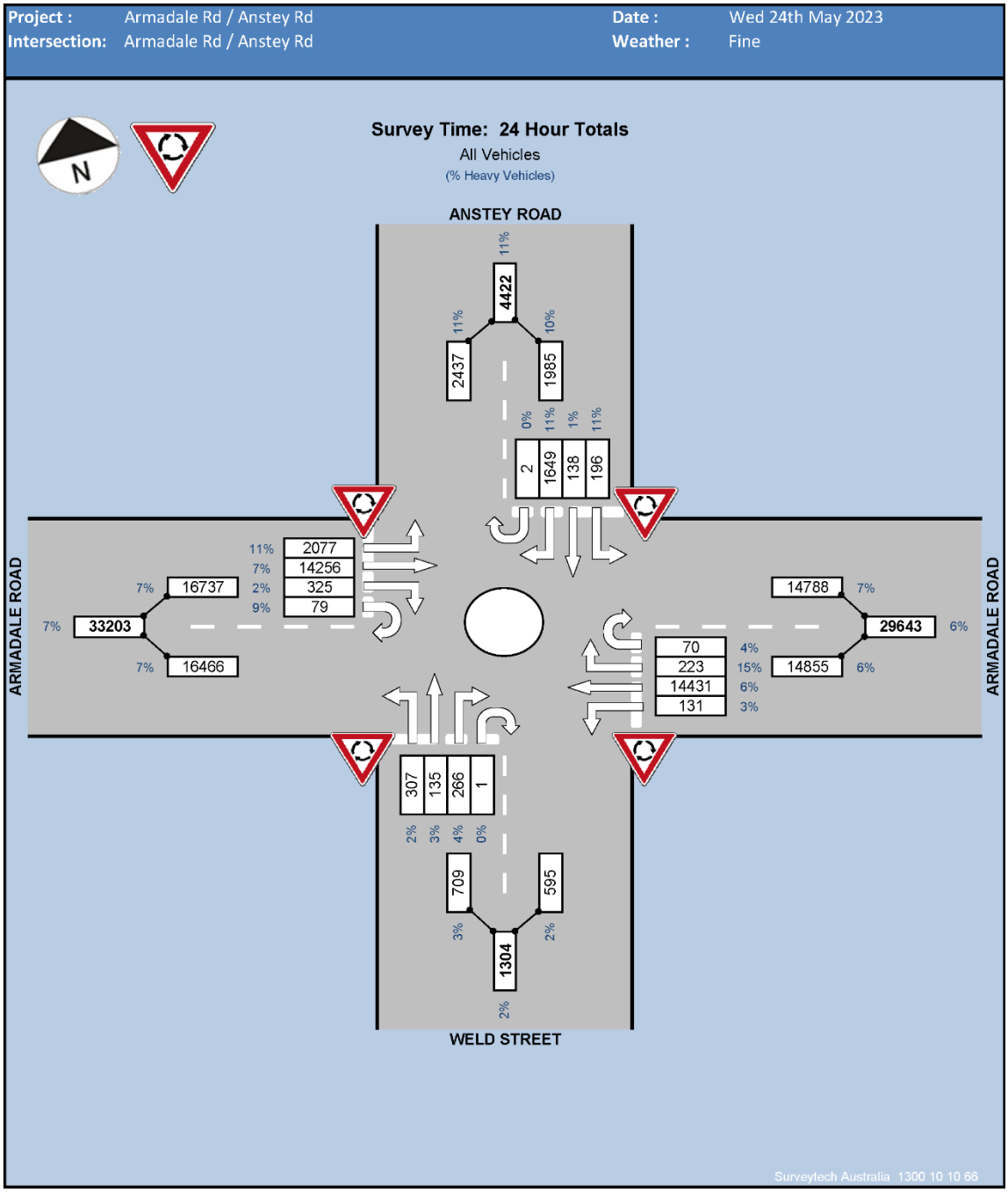
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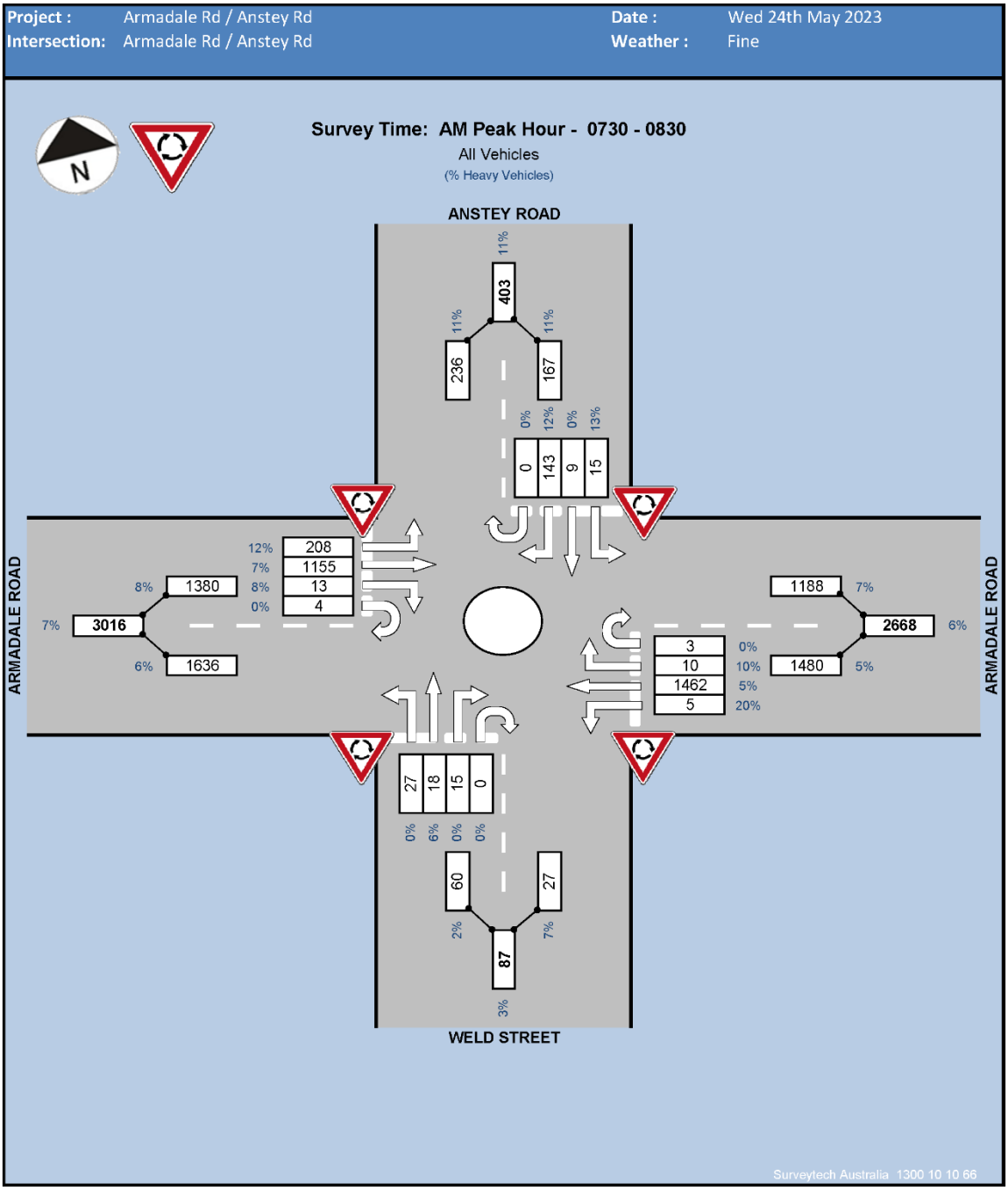
ROWE GROUP DESIGN

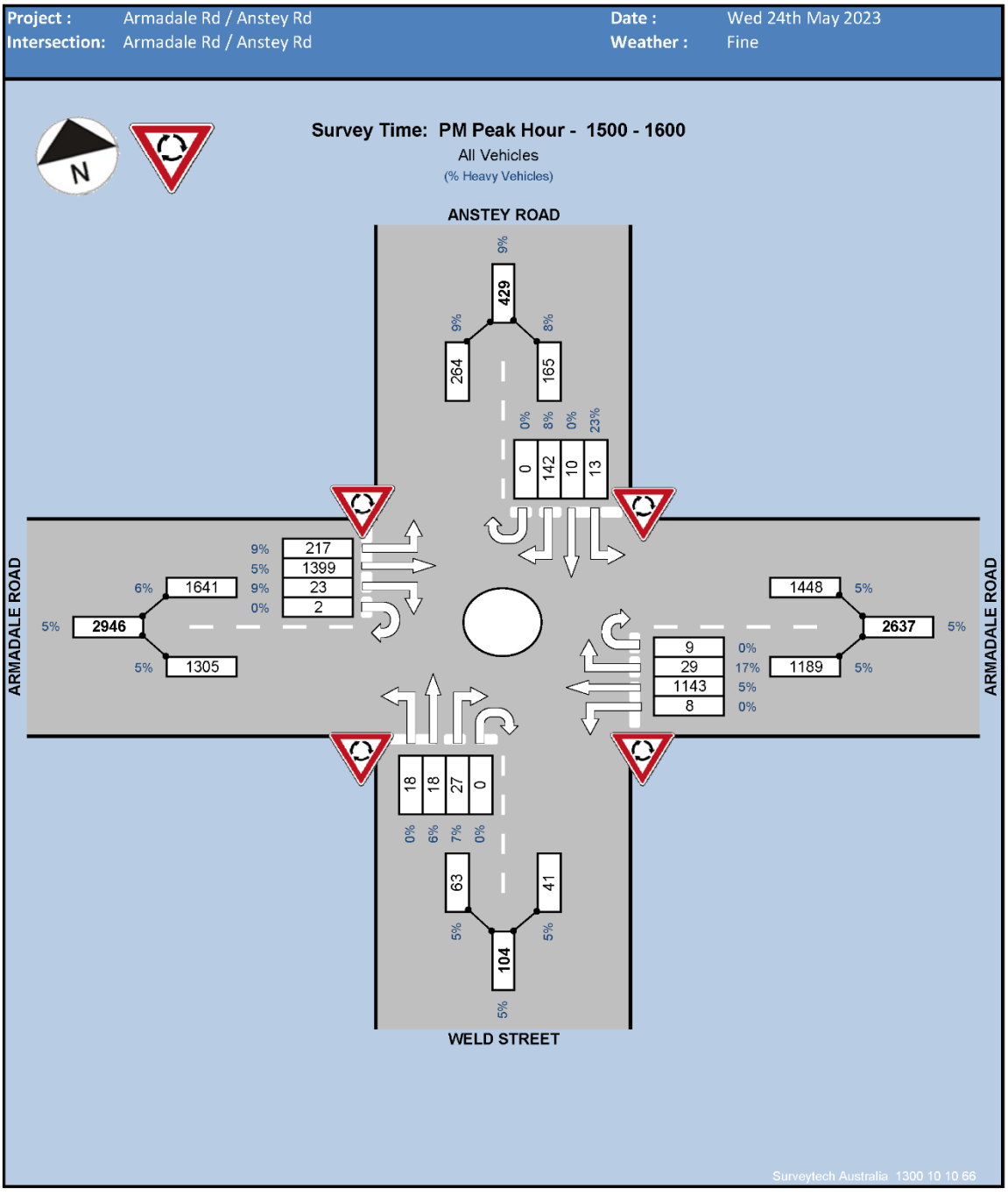
Appendix B

2023 TRAFFIC SURVEY

Engineering a better future for over 20 years!


Project : Armadale Rd / Anstey Rd
Intersection: Armadale Rd / Anstey Rd
Date : Wed 24th May 2023
Weather : Fine
Survey Time: 24 Hour Totals
All Vehicles
(% Heavy Vehicles)
ANSTEY ROAD
WELD STREET
ARMADALE ROAD
ARMADALE ROAD
N
11%
4422
11%
2437
10%
1985
0%
2
11%
1649
1%
138
11%
196
11%
2077
7%
14256
2%
325
9%
79
7%
16737
7%
33203
7%
16466
14788
7%
29643
6%
14855
6%
70
4%
223
15%
14431
6%
131
3%
307
2%
135
3%
266
4%
1
0%
709
3%
595
2%
1304
2%
Surveytech Australia 1300 10 10 66


Project : Armadale Rd / Anstey Rd
Intersection: Armadale Rd / Anstey Rd
Date : Wed 24th May 2023
Weather : Fine
Survey Time: AM Peak Hour - 0730 - 0830
All Vehicles
(% Heavy Vehicles)
ANSTEY ROAD
WELD STREET
ARMADALE ROAD
ARMADALE ROAD
403
236
167
0
143
9
15
208
1155
13
4
1380
3016
1636
1188
2668
1480
3
10
1462
5
27
18
15
0
60
27
87
Surveytech Australia 1300 10 10 66


Project : Armadale Rd / Anstey Rd
Intersection: Armadale Rd / Anstey Rd
Date : Wed 24th May 2023
Weather : Fine
N
Survey Time: PM Peak Hour - 1500 - 1600
All Vehicles
(% Heavy Vehicles)
ANSTEY ROAD
WELD STREET
ARMADALE ROAD
ARMADALE ROAD
9%
429
9%
264
8%
165
0%
0
8%
142
0%
10
23%
13
9%
217
5%
1399
9%
23
0%
2
6%
1641
5%
2946
5%
1305
1448
5%
2637
5%
1189
5%
9
0%
29
17%
1143
5%
8
0%
18
0%
18
6%
27
7%
0
0%
63
5%
104
5%
41
5%
Surveytech Australia 1300 10 10 66

Appendix C

SIDRA INTERSECTION ANALYSIS

Engineering a better future for over 20 years!

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

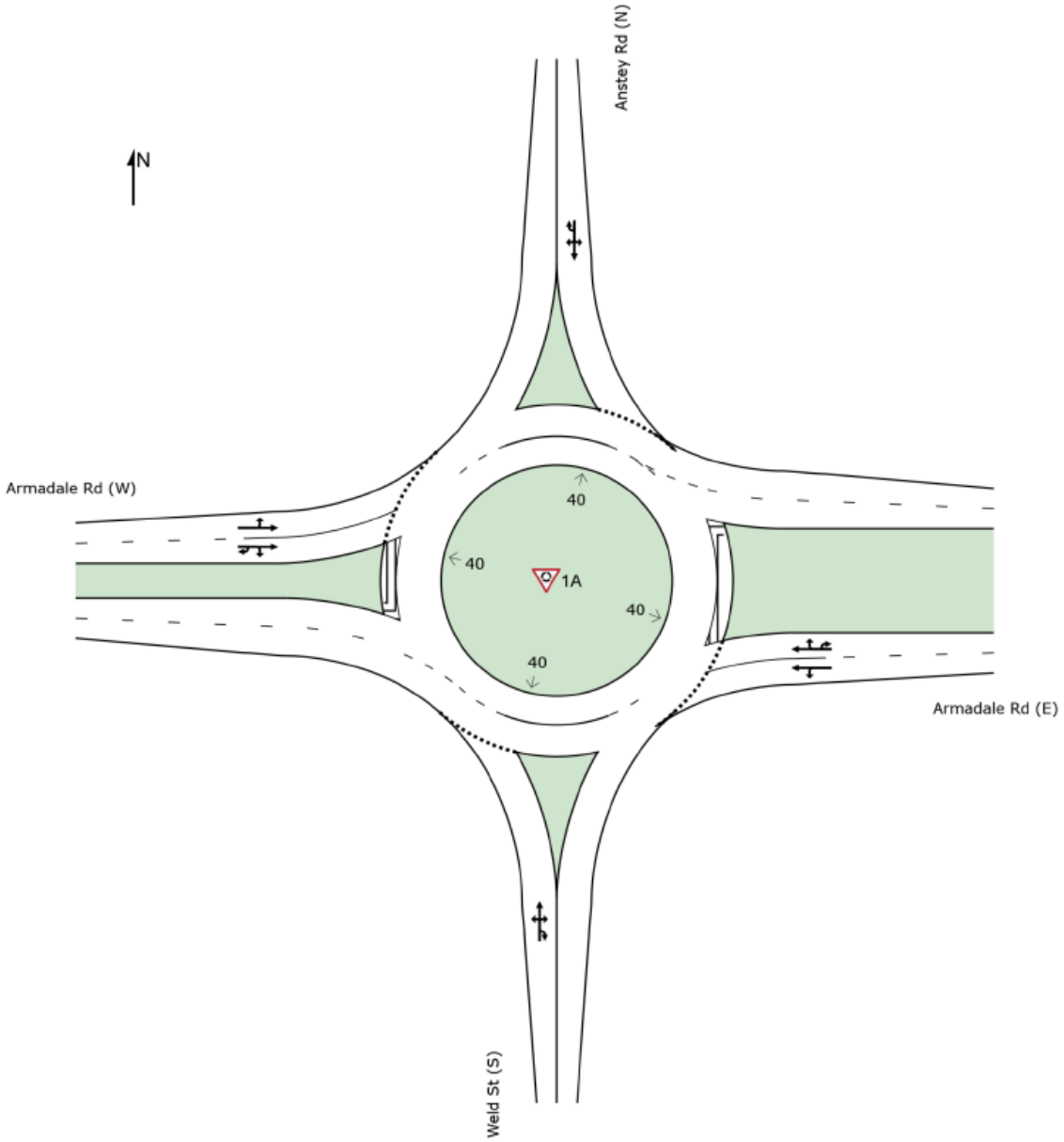


Figure C1. Existing Armadale Rd / Anstey Rd / Weld St roundabout layout analysed in SIDRA

Table C1a. SIDRA results – Existing Armadale Rd / Anstey Rd / Weld St roundabout – 2023 AM peak (0730-0830)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	28	0.0	28	0.0	0.095	5.3	LOS A	0.4	3.0	0.70	0.73	0.70	52.9
5	T1	All MCs	19	5.6	19	5.6	0.095	4.7	LOS A	0.4	3.0	0.70	0.73	0.70	48.9
6	R2	All MCs	16	0.0	16	0.0	0.095	10.8	LOS B	0.4	3.0	0.70	0.73	0.70	52.2
6u	U	All MCs	1	0.0	1	0.0	0.095	12.9	LOS B	0.4	3.0	0.70	0.73	0.70	52.2
Approach			64	1.6	64	1.6	0.095	6.6	LOS A	0.4	3.0	0.70	0.73	0.70	51.4
East: Armadale Rd (E)															
7	L2	All MCs	5	20.0	5	20.0	0.544	6.6	LOS A	4.5	35.6	0.49	0.49	0.49	53.7
8	T1	All MCs	1539	5.1	1539	5.1	0.544	6.4	LOS A	4.5	35.6	0.51	0.50	0.51	63.8
9	R2	All MCs	11	10.0	11	10.0	0.544	13.7	LOS B	4.3	34.2	0.53	0.51	0.53	54.6
9u	U	All MCs	3	0.0	3	0.0	0.544	10.7	LOS B	4.3	34.2	0.53	0.51	0.53	63.4
Approach			1558	5.1	1558	5.1	0.544	6.5	LOS A	4.5	35.6	0.51	0.50	0.51	63.7
North: Anstey Rd (N)															
10	L2	All MCs	16	13.3	16	13.3	0.232	6.2	LOS A	0.8	7.2	0.60	0.80	0.60	51.6
11	T1	All MCs	9	0.0	9	0.0	0.232	5.4	LOS A	0.8	7.2	0.60	0.80	0.60	47.1
12	R2	All MCs	151	11.9	151	11.9	0.232	12.7	LOS B	0.8	7.2	0.60	0.80	0.60	50.8
12u	U	All MCs	1	0.0	1	0.0	0.232	12.2	LOS B	0.8	7.2	0.60	0.80	0.60	53.8
Approach			177	11.3	177	11.3	0.232	11.8	LOS B	0.8	7.2	0.60	0.80	0.60	50.7
West: Armadale Rd (W)															
1	L2	All MCs	219	11.5	219	11.5	0.457	5.6	LOS A	3.5	29.0	0.23	0.43	0.23	56.9
2	T1	All MCs	1216	7.0	1216	7.0	0.457	5.7	LOS A	3.5	29.0	0.24	0.43	0.24	65.3
3	R2	All MCs	14	7.7	14	7.7	0.457	12.7	LOS B	3.5	28.2	0.25	0.42	0.25	54.5
3u	U	All MCs	4	0.0	4	0.0	0.457	9.8	LOS A	3.5	28.2	0.25	0.42	0.25	65.4
Approach			1453	7.7	1453	7.7	0.457	5.8	LOS A	3.5	29.0	0.24	0.43	0.24	63.7
All Vehicles			3252	6.5	3252	6.5	0.544	6.4	LOS A	4.5	35.6	0.40	0.49	0.40	62.5

Table C1b. SIDRA results – Existing Armadale Rd / Anstey Rd / Weld St roundabout – 2023 PM peak (1500-1600)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	19	0.0	19	0.0	0.088	4.4	LOS A	0.3	2.6	0.62	0.68	0.62	52.6
5	T1	All MCs	19	5.6	19	5.6	0.088	3.8	LOS A	0.3	2.6	0.62	0.68	0.62	48.7
6	R2	All MCs	28	7.4	28	7.4	0.088	10.2	LOS B	0.3	2.6	0.62	0.68	0.62	50.2
6u	U	All MCs	1	0.0	1	0.0	0.088	12.1	LOS B	0.3	2.6	0.62	0.68	0.62	52.0
Approach			67	4.7	67	4.7	0.088	6.8	LOS A	0.3	2.6	0.62	0.68	0.62	50.4
East: Armadale Rd (E)															
7	L2	All MCs	8	0.0	8	0.0	0.441	5.9	LOS A	3.3	25.9	0.45	0.48	0.45	54.3
8	T1	All MCs	1203	4.9	1203	4.9	0.441	6.3	LOS A	3.3	25.9	0.46	0.49	0.46	64.0
9	R2	All MCs	31	17.2	31	17.2	0.441	14.0	LOS B	3.1	25.0	0.48	0.51	0.48	52.7
9u	U	All MCs	9	0.0	9	0.0	0.441	10.5	LOS B	3.1	25.0	0.48	0.51	0.48	63.3
Approach			1252	5.1	1252	5.1	0.441	6.5	LOS A	3.3	25.9	0.46	0.49	0.46	63.6
North: Anstey Rd (N)															
10	L2	All MCs	14	23.1	14	23.1	0.259	8.4	LOS A	1.1	8.7	0.69	0.85	0.69	49.1
11	T1	All MCs	11	0.0	11	0.0	0.259	6.3	LOS A	1.1	8.7	0.69	0.85	0.69	46.6
12	R2	All MCs	149	7.7	149	7.7	0.259	13.3	LOS B	1.1	8.7	0.69	0.85	0.69	51.3
12u	U	All MCs	1	0.0	1	0.0	0.259	13.1	LOS B	1.1	8.7	0.69	0.85	0.69	53.2
Approach			175	8.4	175	8.4	0.259	12.5	LOS B	1.1	8.7	0.69	0.85	0.69	50.8
West: Armadale Rd (W)															
1	L2	All MCs	228	8.8	228	8.8	0.557	5.8	LOS A	4.6	36.7	0.34	0.45	0.34	57.1
2	T1	All MCs	1473	5.1	1473	5.1	0.557	6.0	LOS A	4.6	36.7	0.36	0.45	0.36	65.0
3	R2	All MCs	24	8.7	24	8.7	0.557	13.1	LOS B	4.5	36.0	0.37	0.45	0.37	53.8
3u	U	All MCs	2	0.0	2	0.0	0.557	10.1	LOS B	4.5	36.0	0.37	0.45	0.37	64.5
Approach			1727	5.7	1727	5.7	0.557	6.0	LOS A	4.6	36.7	0.35	0.45	0.35	63.6
All Vehicles			3221	5.6	3221	5.6	0.557	6.6	LOS A	4.6	36.7	0.42	0.49	0.42	62.4

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

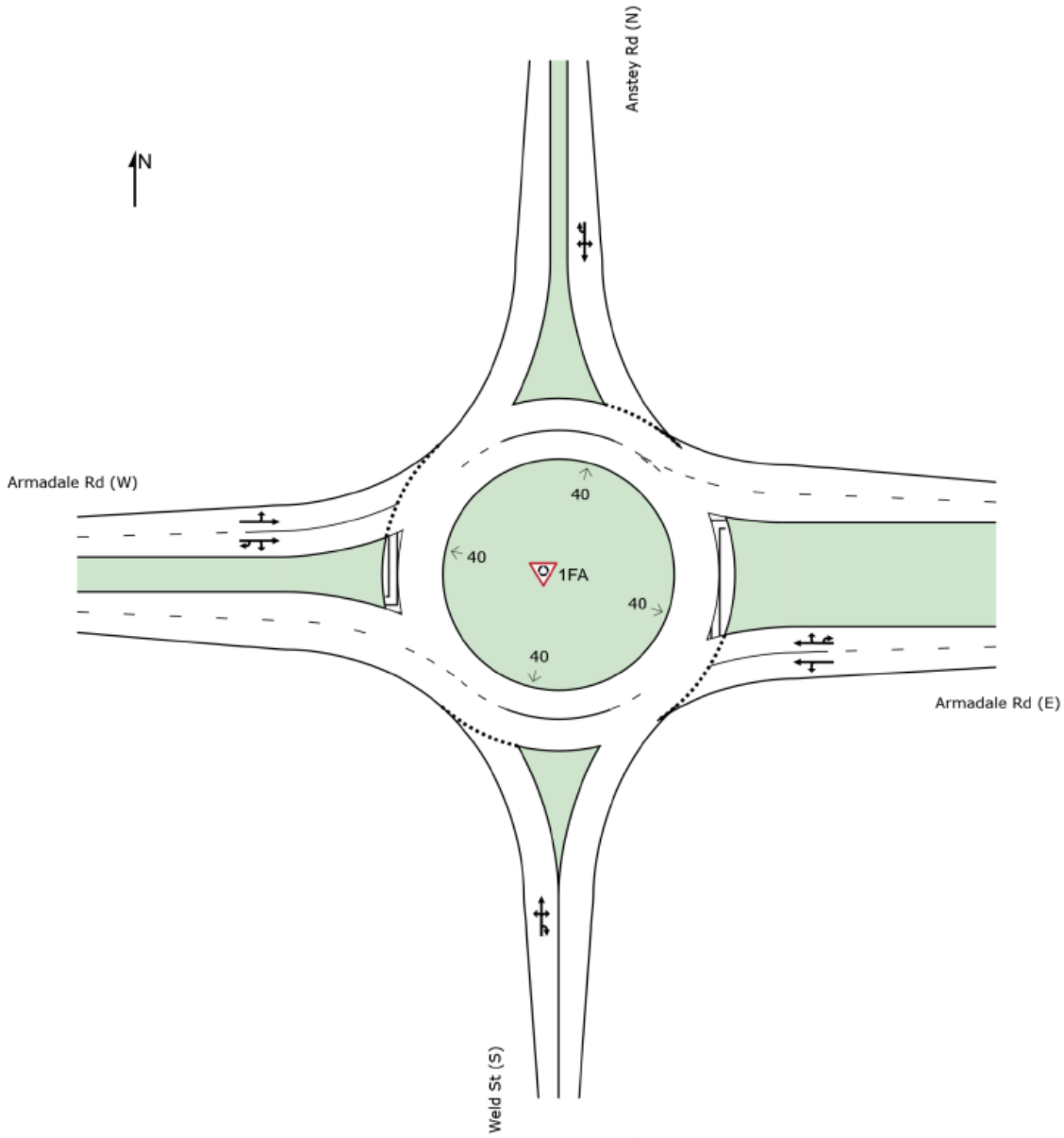


Figure C2. Future Armadale Rd / Anstey Rd / Weld St roundabout layout analysed in SIDRA (Armadale Rd 4 lanes)

Table C2a. SIDRA results – Armadale Rd / Anstey Rd / Weld St roundabout – Future AM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	38	0.0	38	0.0	0.175	9.3	LOS A	0.9	7.0	0.89	0.89	0.89	49.9
5	T1	All MCs	5	3.0	5	3.0	0.175	8.7	LOS A	0.9	7.0	0.89	0.89	0.89	46.4
6	R2	All MCs	21	0.0	21	0.0	0.175	14.9	LOS B	0.9	7.0	0.89	0.89	0.89	49.3
6u	U	All MCs	1	0.0	1	0.0	0.175	17.0	LOS B	0.9	7.0	0.89	0.89	0.89	49.3
Approach			65	0.2	65	0.2	0.175	11.2	LOS B	0.9	7.0	0.89	0.89	0.89	49.4
East: Armadale Rd (E)															
7	L2	All MCs	7	20.0	7	20.0	0.791	11.5	LOS B	12.2	95.8	0.92	0.83	1.17	49.7
8	T1	All MCs	1812	5.1	1812	5.1	0.791	11.8	LOS B	12.2	95.8	0.93	0.85	1.22	57.8
9	R2	All MCs	19	3.3	19	3.3	0.791	19.8	LOS B	11.5	90.4	0.95	0.87	1.28	51.3
9u	U	All MCs	4	0.0	4	0.0	0.791	16.9	LOS B	11.5	90.4	0.95	0.87	1.28	56.8
Approach			1842	5.1	1842	5.1	0.791	11.9	LOS B	12.2	95.8	0.93	0.85	1.22	57.7
North: Anstey Rd (N)															
10	L2	All MCs	48	3.3	48	3.3	0.594	8.8	LOS A	3.4	26.0	0.75	0.99	1.03	51.9
11	T1	All MCs	12	3.3	12	3.3	0.594	8.5	LOS A	3.4	26.0	0.75	0.99	1.03	45.7
12	R2	All MCs	402	3.3	402	3.3	0.594	15.2	LOS B	3.4	26.0	0.75	0.99	1.03	51.1
12u	U	All MCs	1	0.0	1	0.0	0.594	15.1	LOS B	3.4	26.0	0.75	0.99	1.03	51.9
Approach			463	3.3	463	3.3	0.594	14.3	LOS B	3.4	26.0	0.75	0.99	1.03	51.1
West: Armadale Rd (W)															
1	L2	All MCs	147	3.3	147	3.3	0.501	5.5	LOS A	4.1	32.9	0.24	0.42	0.24	59.2
2	T1	All MCs	1432	7.0	1432	7.0	0.501	5.7	LOS A	4.1	32.9	0.25	0.42	0.25	65.2
3	R2	All MCs	19	7.7	19	7.7	0.501	12.8	LOS B	4.1	32.8	0.26	0.42	0.26	54.4
3u	U	All MCs	5	0.0	5	0.0	0.501	9.8	LOS A	4.1	32.8	0.26	0.42	0.26	65.2
Approach			1603	6.7	1603	6.7	0.501	5.8	LOS A	4.1	32.9	0.25	0.42	0.25	64.4
All Vehicles			3974	5.4	3974	5.4	0.791	9.7	LOS A	12.2	95.8	0.64	0.69	0.80	59.1

Table C2b. SIDRA results – Armadale Rd / Anstey Rd / Weld St roundabout – Future PM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	25	0.0	25	0.0	0.111	5.3	LOS A	0.5	3.7	0.71	0.80	0.71	51.8
5	T1	All MCs	6	3.0	6	3.0	0.111	4.6	LOS A	0.5	3.7	0.71	0.80	0.71	48.1
6	R2	All MCs	38	7.4	38	7.4	0.111	11.1	LOS B	0.5	3.7	0.71	0.80	0.71	49.4
6u	U	All MCs	1	0.0	1	0.0	0.111	12.9	LOS B	0.5	3.7	0.71	0.80	0.71	51.1
Approach			71	4.2	71	4.2	0.111	8.5	LOS A	0.5	3.7	0.71	0.80	0.71	50.1
East: Armadale Rd (E)															
7	L2	All MCs	12	0.0	12	0.0	0.548	6.3	LOS A	4.7	36.9	0.58	0.53	0.58	53.6
8	T1	All MCs	1417	4.9	1417	4.9	0.548	6.7	LOS A	4.7	36.9	0.59	0.54	0.59	63.0
9	R2	All MCs	45	3.3	45	3.3	0.548	13.9	LOS B	4.4	34.8	0.61	0.57	0.61	55.7
9u	U	All MCs	12	0.0	12	0.0	0.548	11.0	LOS B	4.4	34.8	0.61	0.57	0.61	62.3
Approach			1485	4.8	1485	4.8	0.548	7.0	LOS A	4.7	36.9	0.60	0.54	0.60	62.7
North: Anstey Rd (N)															
10	L2	All MCs	24	11.0	24	11.0	0.421	11.2	LOS B	2.2	17.2	0.81	0.96	0.97	49.7
11	T1	All MCs	11	3.0	11	3.0	0.421	9.2	LOS A	2.2	17.2	0.81	0.96	0.97	45.2
12	R2	All MCs	202	3.3	202	3.3	0.421	16.0	LOS B	2.2	17.2	0.81	0.96	0.97	50.5
12u	U	All MCs	1	0.0	1	0.0	0.421	15.9	LOS B	2.2	17.2	0.81	0.96	0.97	51.3
Approach			238	4.1	238	4.1	0.421	15.2	LOS B	2.2	17.2	0.81	0.96	0.97	50.2
West: Armadale Rd (W)															
1	L2	All MCs	343	3.3	343	3.3	0.681	5.9	LOS A	7.0	54.6	0.43	0.48	0.43	58.2
2	T1	All MCs	1734	5.1	1734	5.1	0.681	6.2	LOS A	7.0	54.8	0.46	0.47	0.46	64.3
3	R2	All MCs	33	8.7	33	8.7	0.681	13.4	LOS B	6.9	54.8	0.49	0.47	0.49	53.2
3u	U	All MCs	2	0.0	2	0.0	0.681	10.4	LOS B	6.9	54.8	0.49	0.47	0.49	63.6
Approach			2112	4.9	2112	4.9	0.681	6.3	LOS A	7.0	54.8	0.45	0.47	0.45	63.0
All Vehicles			3905	4.8	3905	4.8	0.681	7.1	LOS A	7.0	54.8	0.53	0.54	0.54	61.6

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

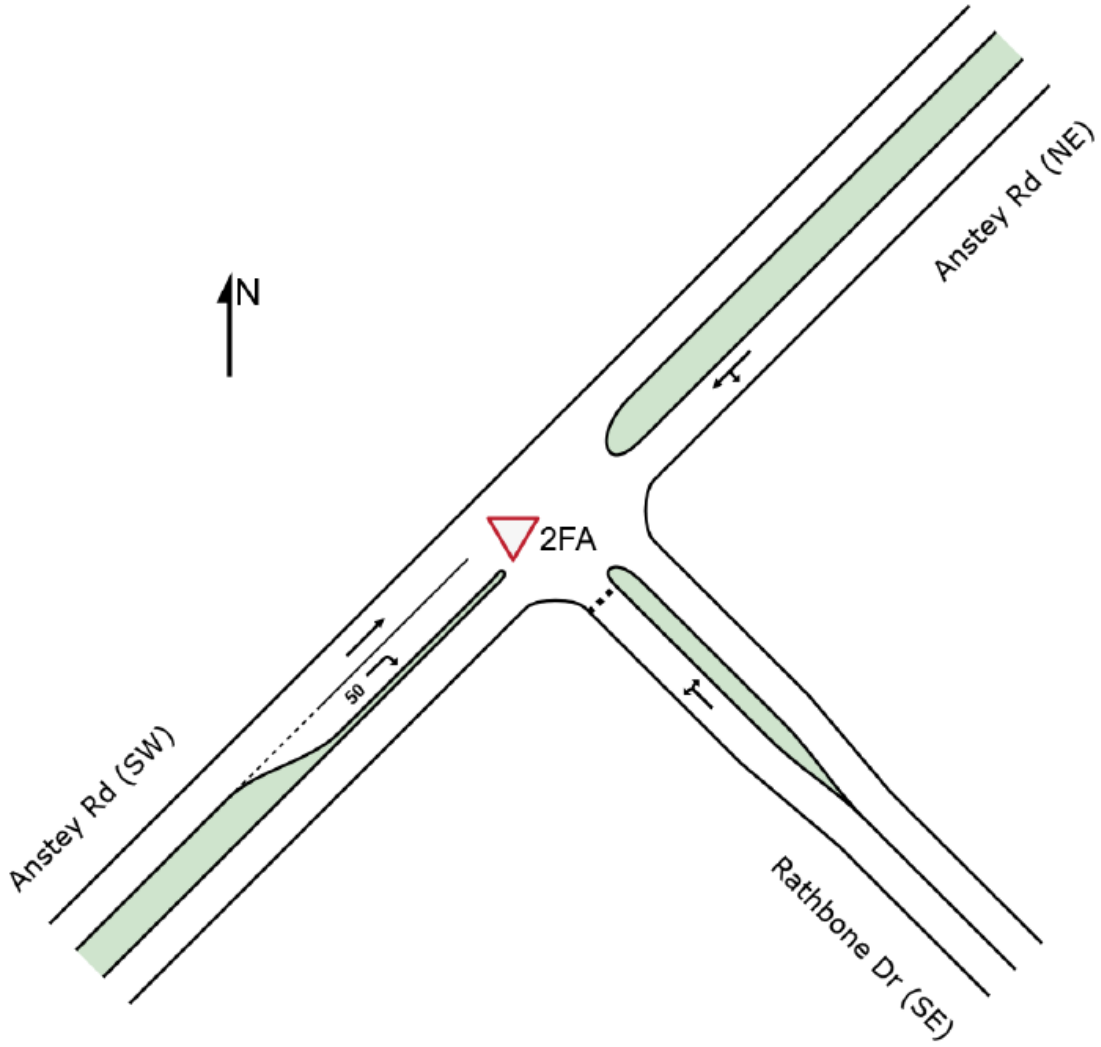


Figure C3. Future Anstey Rd / Rathbone Dr intersection layout analysed in SIDRA

Table C3a. SIDRA results – Anstey Rd / Rathbone Dr intersection – Future AM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
SouthEast: Rathbone Dr (SE)															
4	L2	All MCs	135	3.0	135	3.0	0.221	5.7	LOS A	1.0	7.2	0.45	0.62	0.45	47.2
6	R2	All MCs	82	3.0	82	3.0	0.221	7.9	LOS A	1.0	7.2	0.45	0.62	0.45	47.2
Approach			217	3.0	217	3.0	0.221	6.5	LOS A	1.0	7.2	0.45	0.62	0.45	47.2
NorthEast: Anstey Rd (NE)															
7	L2	All MCs	11	3.0	11	3.0	0.145	4.6	LOS A	0.0	0.0	0.00	0.02	0.00	48.4
8	T1	All MCs	265	3.3	265	3.3	0.145	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	49.8
Approach			276	3.3	276	3.3	0.145	0.2	NA	0.0	0.0	0.00	0.02	0.00	49.8
SouthWest: Anstey Rd (SW)															
2	T1	All MCs	88	3.3	88	3.3	0.046	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
3	R2	All MCs	45	3.0	45	3.0	0.033	5.5	LOS A	0.1	1.1	0.37	0.55	0.37	47.4
Approach			134	3.2	134	3.2	0.046	1.9	NA	0.1	1.1	0.12	0.19	0.12	49.1
All Vehicles			626	3.2	626	3.2	0.221	2.8	NA	1.0	7.2	0.18	0.27	0.18	48.7

Table C3b. SIDRA results – Anstey Rd / Rathbone Dr intersection – Future PM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
SouthEast: Rathbone Dr (SE)															
4	L2	All MCs	67	3.0	67	3.0	0.110	5.0	LOS A	0.4	3.3	0.35	0.55	0.35	47.4
6	R2	All MCs	41	3.0	41	3.0	0.110	8.2	LOS A	0.4	3.3	0.35	0.55	0.35	47.4
Approach			108	3.0	108	3.0	0.110	6.3	LOS A	0.4	3.3	0.35	0.55	0.35	47.4
NorthEast: Anstey Rd (NE)															
7	L2	All MCs	26	3.0	26	3.0	0.084	4.6	LOS A	0.0	0.0	0.00	0.09	0.00	48.1
8	T1	All MCs	133	3.3	133	3.3	0.084	0.0	LOS A	0.0	0.0	0.00	0.09	0.00	49.5
Approach			159	3.3	159	3.3	0.084	0.8	NA	0.0	0.0	0.00	0.09	0.00	49.2
SouthWest: Anstey Rd (SW)															
2	T1	All MCs	221	3.3	221	3.3	0.116	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
3	R2	All MCs	113	3.0	113	3.0	0.074	5.1	LOS A	0.3	2.6	0.28	0.53	0.28	47.6
Approach			334	3.2	334	3.2	0.116	1.8	NA	0.3	2.6	0.09	0.18	0.09	49.1
All Vehicles			601	3.2	601	3.2	0.116	2.3	NA	0.4	3.3	0.11	0.22	0.11	48.8

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

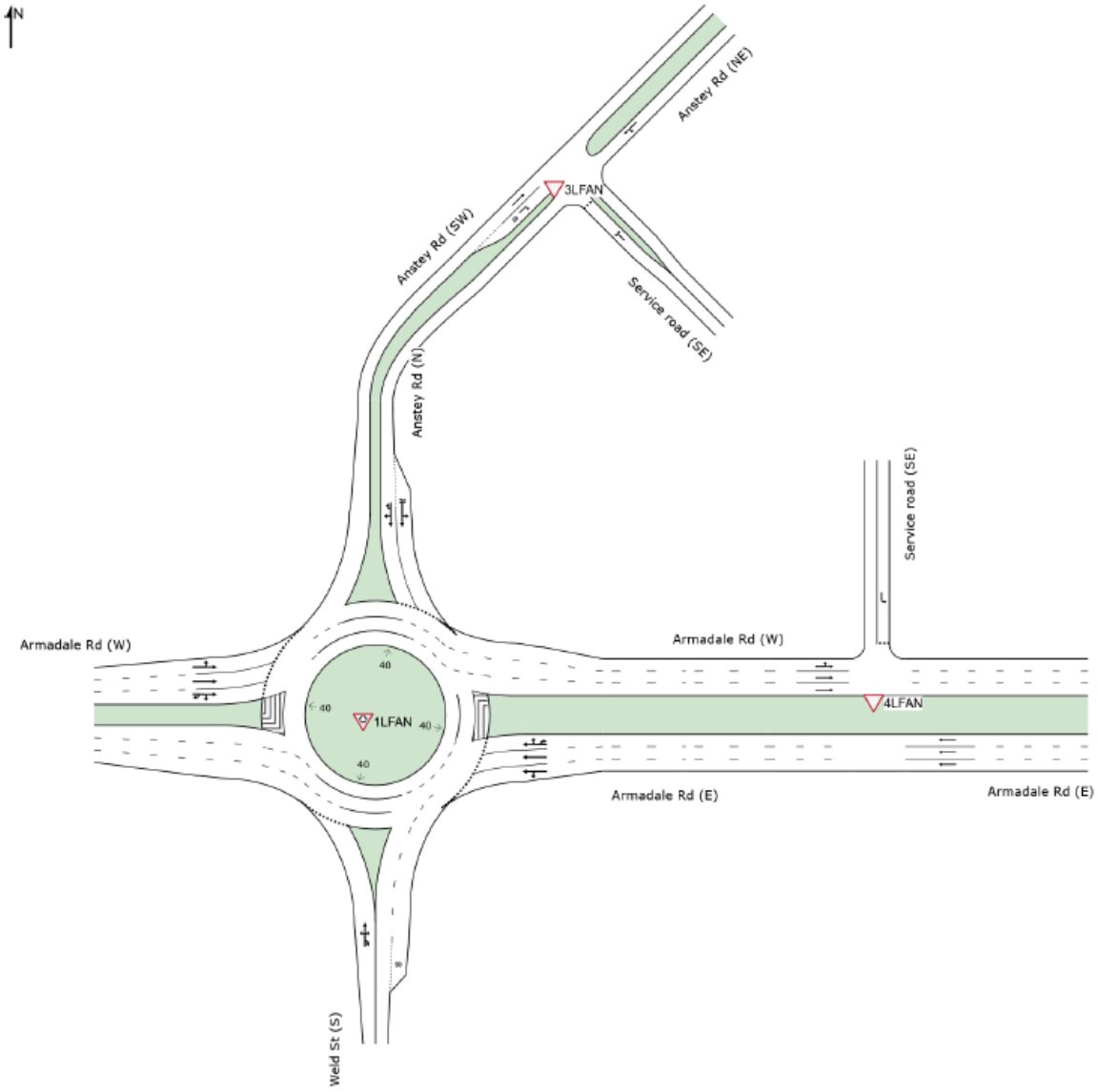


Figure C4. Long term Armadale Rd / Anstey Rd / Weld St roundabout layout and service road intersections analysed in SIDRA Network (Armadale Rd 6 lanes)

Table C4a. SIDRA results – Armadale Rd / Anstey Rd / Weld St roundabout – Long term AM peak with full development

Vehicle Movement Performance															
Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	38	0.0	38	0.0	0.209	11.3	LOS B	1.0	7.1	0.88	0.93	0.88	47.8
5	T1	All MCs	5	3.0	5	3.0	0.209	10.8	LOS B	1.0	7.1	0.88	0.93	0.88	19.0
6	R2	All MCs	21	0.0	21	0.0	0.209	16.8	LOS B	1.0	7.1	0.88	0.93	0.88	19.0
6u	U	All MCs	1	0.0	1	0.0	0.209	18.9	LOS B	1.0	7.1	0.88	0.93	0.88	23.4
Approach			65	0.2	65	0.2	0.209	13.2	LOS B	1.0	7.1	0.88	0.93	0.88	40.6
East: Armadale Rd (E)															
7	L2	All MCs	7	20.0	7	20.0	0.674	8.3	LOS A	6.6	51.6	0.71	0.66	0.79	40.8
8	T1	All MCs	2477	5.1	2477	5.1	0.674	8.6	LOS A	6.6	51.6	0.73	0.70	0.83	55.6
9	R2	All MCs	19	3.3	19	3.3	0.674	15.6	LOS B	6.3	49.2	0.75	0.72	0.86	39.2
9u	U	All MCs	5	0.0	5	0.0	0.674	12.7	LOS B	6.3	49.2	0.75	0.72	0.86	39.2
Approach			2508	5.1	2508	5.1	0.674	8.7	LOS A	6.6	51.6	0.73	0.70	0.83	55.5
North: Anstey Rd (N)															
10	L2	All MCs	48	3.3	48	3.3	0.109	6.8	LOS A	0.4	2.8	0.67	0.79	0.67	25.9
11	T1	All MCs	12	3.3	12	3.3	0.109	6.9	LOS A	0.4	2.8	0.67	0.79	0.67	32.5
12	R2	All MCs	402	3.3	402	3.3	0.510	13.4	LOS B	2.6	19.5	0.76	0.99	0.99	47.4
12u	U	All MCs	1	0.0	1	0.0	0.510	14.2	LOS B	2.6	19.5	0.76	0.99	0.99	24.1
Approach			463	3.3	463	3.3	0.510	12.5	LOS B	2.6	19.5	0.75	0.96	0.95	46.7
West: Armadale Rd (W)															
1	L2	All MCs	147	3.3	147	3.3	0.455	5.5	LOS A	3.5	27.8	0.22	0.42	0.22	62.7
2	T1	All MCs	1957	7.0	1957	7.0	0.455	5.7	LOS A	3.5	27.8	0.24	0.42	0.24	62.3
3	R2	All MCs	19	7.7	19	7.7	0.455	12.8	LOS B	3.4	27.6	0.25	0.42	0.25	58.5
3u	U	All MCs	6	0.0	6	0.0	0.455	9.8	LOS A	3.4	27.6	0.25	0.42	0.25	65.3
Approach			2129	6.7	2129	6.7	0.455	5.8	LOS A	3.5	27.8	0.24	0.42	0.24	62.3
All Vehicles			5166	5.5	5166	5.5	0.674	7.9	LOS A	6.6	51.6	0.53	0.61	0.60	56.7

Table C4b. SIDRA results – Armadale Rd / Anstey Rd / Weld St roundabout – Long term PM peak with full development

Vehicle Movement Performance															
Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
South: Weld St (S)															
4	L2	All MCs	25	0.0	25	0.0	0.141	6.4	LOS A	0.5	4.1	0.74	0.86	0.74	51.9
5	T1	All MCs	6	3.0	6	3.0	0.141	5.8	LOS A	0.5	4.1	0.74	0.86	0.74	24.5
6	R2	All MCs	38	7.4	38	7.4	0.141	12.2	LOS B	0.5	4.1	0.74	0.86	0.74	24.5
6u	U	All MCs	1	0.0	1	0.0	0.141	14.0	LOS B	0.5	4.1	0.74	0.86	0.74	28.2
Approach			71	4.2	71	4.2	0.141	9.6	LOS A	0.5	4.1	0.74	0.86	0.74	40.0
East: Armadale Rd (E)															
7	L2	All MCs	12	0.0	12	0.0	0.479	6.3	LOS A	3.2	25.2	0.45	0.50	0.45	45.1
8	T1	All MCs	1936	4.9	1936	4.9	0.479	6.6	LOS A	3.2	25.2	0.47	0.52	0.47	58.8
9	R2	All MCs	45	3.3	45	3.3	0.479	13.3	LOS B	3.0	23.7	0.48	0.54	0.48	44.0
9u	U	All MCs	15	0.0	15	0.0	0.479	10.5	LOS B	3.0	23.7	0.48	0.54	0.48	44.0
Approach			2007	4.8	2007	4.8	0.479	6.7	LOS A	3.2	25.2	0.47	0.52	0.47	58.6
North: Anstey Rd (N)															
10	L2	All MCs	24	11.0	24	11.0	0.091	9.8	LOS A	0.3	2.7	0.77	0.85	0.77	22.2
11	T1	All MCs	11	3.0	11	3.0	0.091	7.8	LOS A	0.3	2.7	0.77	0.85	0.77	28.7
12	R2	All MCs	202	3.3	202	3.3	0.347	14.5	LOS B	1.7	13.1	0.82	0.96	0.92	46.3
12u	U	All MCs	1	0.0	1	0.0	0.347	15.3	LOS B	1.7	13.1	0.82	0.96	0.92	22.9
Approach			238	4.1	238	4.1	0.347	13.7	LOS B	1.7	13.1	0.81	0.95	0.90	45.2
West: Armadale Rd (W)															
1	L2	All MCs	343	3.3	343	3.3	0.607	5.9	LOS A	5.4	41.9	0.38	0.47	0.38	60.9
2	T1	All MCs	2369	5.1	2369	5.1	0.607	6.1	LOS A	5.4	42.2	0.41	0.46	0.41	60.1
3	R2	All MCs	33	8.7	33	8.7	0.607	13.3	LOS B	5.3	42.2	0.43	0.46	0.43	56.7
3u	U	All MCs	3	0.0	3	0.0	0.607	10.3	LOS B	5.3	42.2	0.43	0.46	0.43	64.0
Approach			2748	5.0	2748	5.0	0.607	6.2	LOS A	5.4	42.2	0.41	0.46	0.41	60.1
All Vehicles			5064	4.8	5064	4.8	0.607	6.8	LOS A	5.4	42.2	0.46	0.51	0.46	58.4

Table C5a. SIDRA results – Anstey Rd / Armadale Rd service road intersection – Long term AM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
SouthEast: Service road (SE)															
4	L2	All MCs	11	3.0	11	3.0	0.019	6.5	LOS A	0.1	0.5	0.51	0.64	0.51	33.8
6	R2	All MCs	4	3.0	4	3.0	0.019	10.0	LOS B	0.1	0.5	0.51	0.64	0.51	36.0
Approach			15	3.0	15	3.0	0.019	7.5	LOS A	0.1	0.5	0.51	0.64	0.51	34.6
NorthEast: Anstey Rd (NE)															
7	L2	All MCs	1	3.0	1	3.0	0.255	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	45.2
8	T1	All MCs	484	3.3	484	3.3	0.255	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
Approach			485	3.3	485	3.3	0.255	0.0	NA	0.0	0.0	0.00	0.00	0.00	49.8
SouthWest: Anstey Rd (SW)															
2	T1	All MCs	161	3.3	161	3.3	0.085	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
3	R2	All MCs	3	3.0	3	3.0	0.003	5.9	LOS A	0.0	0.1	0.49	0.55	0.49	37.1
Approach			164	3.3	164	3.3	0.085	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.5
All Vehicles			664	3.3	664	3.3	0.255	0.2	NA	0.1	0.5	0.01	0.02	0.01	48.8

Table C5b. SIDRA results – Anstey Rd / Armadale Rd service road intersection – Long term PM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
SouthEast: Service road (SE)															
4	L2	All MCs	5	3.0	5	3.0	0.015	5.4	LOS A	0.1	0.4	0.48	0.58	0.48	33.6
6	R2	All MCs	5	3.0	5	3.0	0.015	9.9	LOS A	0.1	0.4	0.48	0.58	0.48	35.8
Approach			11	3.0	11	3.0	0.015	7.6	LOS A	0.1	0.4	0.48	0.58	0.48	34.9
NorthEast: Anstey Rd (NE)															
7	L2	All MCs	4	3.0	4	3.0	0.130	4.6	LOS A	0.0	0.0	0.00	0.01	0.00	45.1
8	T1	All MCs	242	3.3	242	3.3	0.130	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	49.5
Approach			246	3.3	246	3.3	0.130	0.1	NA	0.0	0.0	0.00	0.01	0.00	49.3
SouthWest: Anstey Rd (SW)															
2	T1	All MCs	404	3.3	404	3.3	0.213	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	49.9
3	R2	All MCs	9	3.0	9	3.0	0.007	4.8	LOS A	0.0	0.2	0.34	0.51	0.34	37.9
Approach			414	3.3	414	3.3	0.213	0.1	NA	0.0	0.2	0.01	0.01	0.01	49.4
All Vehicles			671	3.3	671	3.3	0.213	0.2	NA	0.1	0.4	0.01	0.02	0.01	48.8

Table C6a. SIDRA results – Armadale Rd / Armadale Rd service road intersection – Long term AM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
East: Armadale Rd (E)															
2	T1	All MCs	2508	5.1	2508	5.1	0.452	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	49.7
Approach			2508	5.1	2508	5.1	0.452	0.2	NA	0.0	0.0	0.00	0.00	0.00	49.7
North: Service road (SE)															
4	L2	All MCs	7	3.0	7	3.0	0.013	6.5	LOS A	0.0	0.3	0.57	0.67	0.57	44.8
Approach			7	3.0	7	3.0	0.013	6.5	LOS A	0.0	0.3	0.57	0.67	0.57	44.8
West: Armadale Rd (W)															
7	L2	All MCs	3	3.0	3	3.0	0.376	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	15.0
8	T1	All MCs	2028	7.0	2028	7.0	0.376	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
Approach			2032	7.0	2032	7.0	0.376	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.8
All Vehicles			4547	5.9	4547	5.9	0.452	0.2	NA	0.0	0.3	0.00	0.00	0.00	49.8

Table C6b. SIDRA results – Armadale Rd / Armadale Rd service road intersection – Long term PM peak with full development

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Qued	Eff. Stop Rate	Number of Cycles to Depart	Aver. Speed km/h
East: Armadale Rd (E)															
2	T1	All MCs	2007	4.9	2007	4.9	0.362	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
Approach			2007	4.9	2007	4.9	0.362	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.8
North: Service road (SE)															
4	L2	All MCs	4	3.0	4	3.0	0.010	8.3	LOS A	0.0	0.2	0.66	0.73	0.66	43.0
Approach			4	3.0	4	3.0	0.010	8.3	LOS A	0.0	0.2	0.66	0.73	0.66	43.0
West: Armadale Rd (W)															
7	L2	All MCs	6	3.0	6	3.0	0.443	4.7	LOS A	0.0	0.0	0.00	0.00	0.00	15.0
8	T1	All MCs	2440	5.1	2440	5.1	0.443	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.7
Approach			2446	5.1	2446	5.1	0.443	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.7
All Vehicles			4458	5.0	4458	5.0	0.443	0.1	NA	0.0	0.2	0.00	0.00	0.00	49.7

ATTACHMENT 11

Main Roads WA Plans

UNDER REVIEW BY MRWA
REFER TO ROAD PLANNING BRANCH

REFER TO TONKIN HWY PLANS
PEC108-35-C-401A TO -404A

399 200E | 399 400E | 399 600E | 399 800E | 400 000E | 400 200E | 400 400E | 400 600E | 400 800E

6 442 800 N | 6 442 600 N | 6 442 400 N

MATCH JOINS LINE DRG N° 8221 - 7-1

PI 12
6 442 539·4363 N
400 269·5305 E

PI 13
6 442 528·0642 N
400 453·2165 E

ARMADALE ROAD

ANSTEY ROAD

WELD STREET

WIRIN ROAD

ALLEN ROAD

FORREST ROAD

LAWLEY STREET

PARAKA WAY

DUMSDAY DRIVE

LOFTIES STREET

FISHER ST

MOORE STREET

DEW STREET

LEAKE STREET

FORRESTDALE

FORRESTDALE LAKE

RECREATION OVAL

Scrub

Scattered Trees and Scrub

PT 1 | PT 39 | PT 40 | PT 61

2 | 3 | 4 | 5 | 6 | 7 | 9 | 88 | 89 | 90 | 91 | 92 | 93 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 57 | 72 | 357

31023 MWS RESERVE | 27950 | 30713 | 32124 | 27131 | 30198

1.7087

RELOCATION OR RESHAPING OF COMPENSATING BASIN REQUIRED.

REFER TO LOCAL AUTHORITY AND M.R.P.A. FOR ARMADALE ROAD.

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

V.P.I.
STA 15800
LVC 100
ELE 24·68
K 125

V.P.I.
STA 16200
LVC 100
ELE 26·28
K -125

V.P.I.
STA 16950
LVC 100
ELE 23·28
K 133

+0·4% | -0·4% | +0·35%

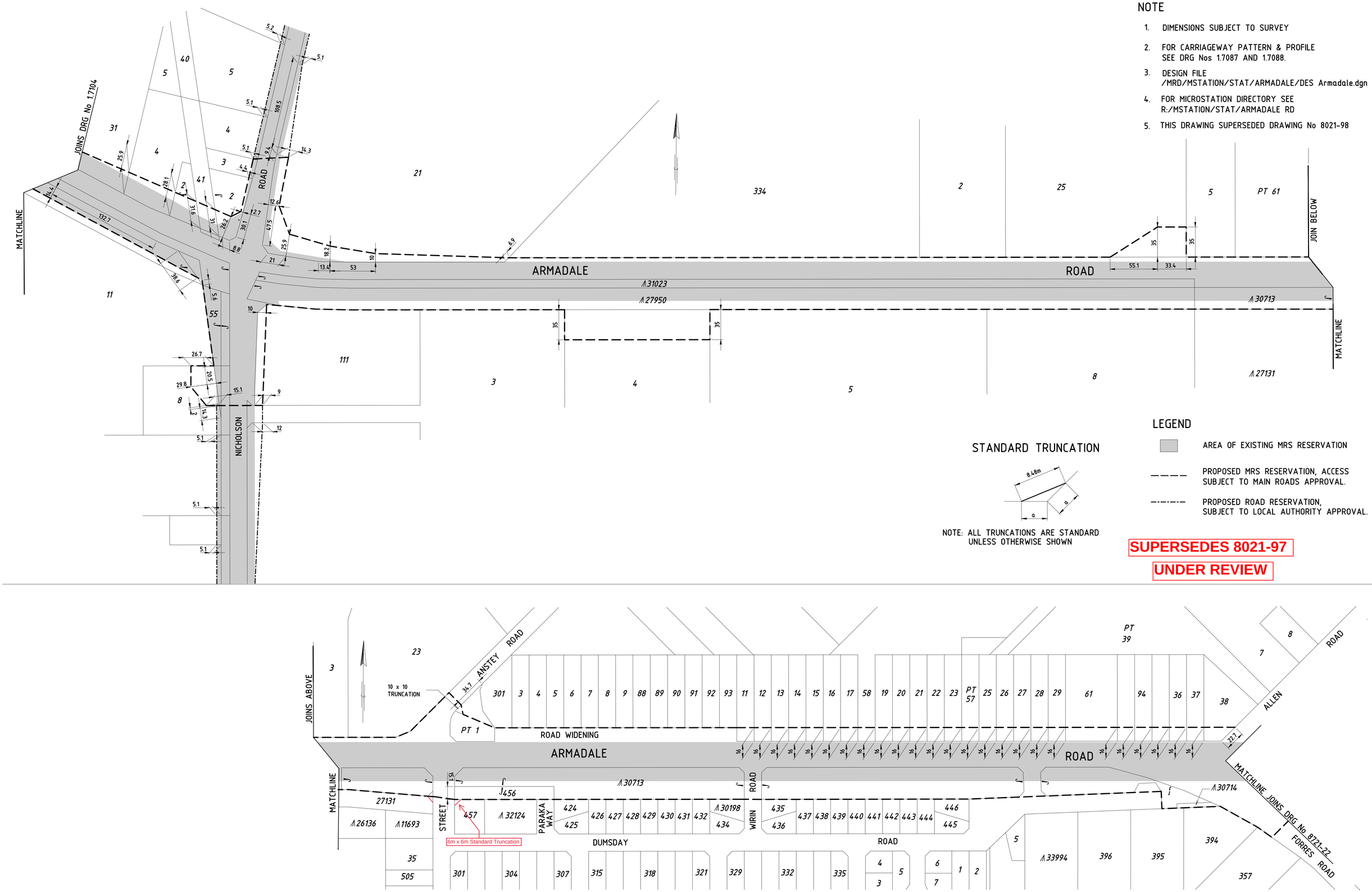
℄ ANSTEY ROAD WELD STREET | ℄ WIRIN ROAD | ℄ ALLEN ROAD FORREST ROAD

REFER TO LOCAL AUTHORITY AND M.R.P.A. FOR ARMADALE ROAD.

| | | |

NOTE

1. DIMENSIONS SUBJECT TO SURVEY
2. FOR CARRIAGEWAY PATTERN & PROFILE SEE DRG Nos 1.7087 AND 1.7088.
3. DESIGN FILE /MRD/MSTATION/STAT/ARMADALE/DES Armadale.dgn
4. FOR MICROSTATION DIRECTORY SEE R:/MSTATION/STAT/ARMADALE RD
5. THIS DRAWING SUPERSEDED DRAWING No 8021-98



LEGEND

AREA OF EXISTING MRS RESERVATION

PROPOSED MRS RESERVATION, ACCESS SUBJECT TO MAIN ROADS APPROVAL.

PROPOSED ROAD RESERVATION, SUBJECT TO LOCAL AUTHORITY APPROVAL.

STANDARD TRUNCATION

NOTE: ALL TRUNCATIONS ARE STANDARD UNLESS OTHERWISE SHOWN

SUPERSEDES 8021-97

UNDER REVIEW

SCALE 1:2000

AECOM FILE: T:\60099877 - Armadale Rd Stud\5 CADD\5.3 Working\Final drawings\Roads\Mstation\17105.dgn

Department for Planning and Infrastructure

No.	DESCRIPTION	CHECKED/DATE	AUTH'D/DATE	SCANNED DATE	FILENAME
1	ISSUED FOR APPROVAL	06/08/2010	A. R.		

IN THE ABSENCE OF THE APPROVED SIGNATURE THIS DRAWING SHALL BE TREATED AS PRELIMINARY

SIGNATURES	DATE	SIGNATURES	DATE
DESIGNED : K. GRENDA	12/2009	EXAMINED :	
DRAWN : K. GRENDA	12/2009	APPROVED :	
CHECKED : L. VILJOEN	02/2010	FILE REF :	

GDA

SHEET SIZE A1

NORTH

AS ABOVE

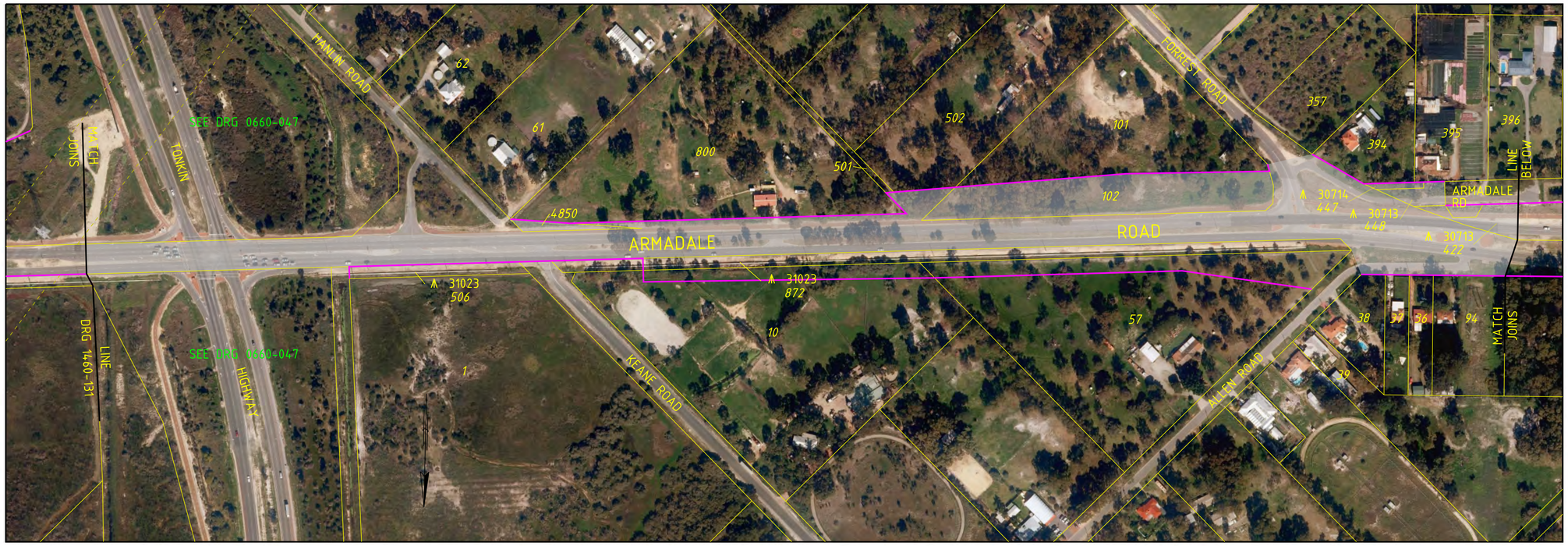
ARMADALE ROAD - ROUTE H23

LAND PROTECTION PLAN

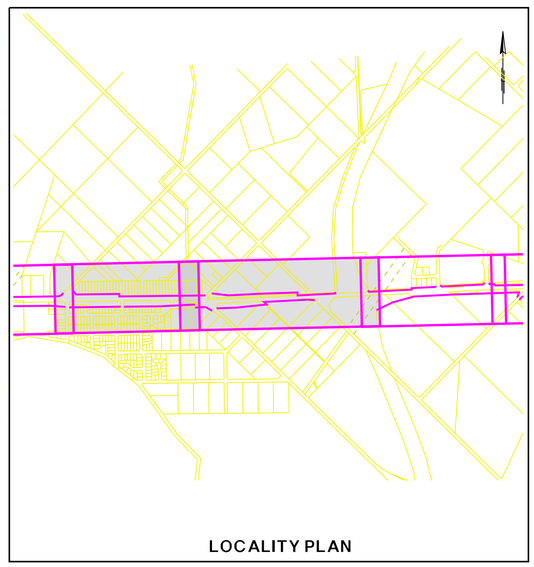
NICHOLSON ROAD TO ALLEN ROAD
9.53 SLK TO 7.19 SLK
CITY OF ARMADALE

URBAN TRANSPORT SYSTEMS DIRECTORATE

PLAN No. 1.7105 1







LOCALITY PLAN

AMENDMENTS

No	DESCRIPTION	DATE	AUTHORISED	PROCLAMATION DATE	MICRO DATE

NOTES

1. FOR ACCESS DETAILS REFER TO DRAWING
2. S.L.K. IS A MAIN ROADS STRAIGHT LINE KILOMETRE AND IS APPROXIMATE ONLY.
3. CADASTRAL MODEL : 0973A
4. SECTION OF ROAD OR LAND RESERVED FOR A FUTURE ROAD SECTION TO BE SUBJECT TO CONTROL OF ACCESS

INITIAL PROCLAMATION

METROPOLITAN REGION

Telephone 9311 8333 Fax 9311 8383

APPROVED FOR IMPLEMENTATION

FILE NUMBER	DATE	APPROVAL NUMBER

AUTHORISED

APPROVED

Government of Western Australia

mainroads WESTERN AUSTRALIA

FINANCE AND SERVICES
PROPERTY MANAGEMENT

Telephone 9323 4580 Fax 9323 4600

DRAWN/DESIGNED W.M. ROLLINGS DATE OCT 2014

AUDITED IN ACCORDANCE WITH STANDARD 67-08-48 IN THE ROAD AND TRAFFIC ENGINEERING MANUAL

SCALE 1:2000 (0 20 40 60 80 100 120 140 160 180 200)

SCAN DATE

A1

ARMADALE ROAD H23

CONTROL OF ACCESS
FOR GAZETTAL PURPOSES ONLY
6.0 - 7.99 SLK

LOCAL AUTHORITY (101) CITY OF ARMADALE

DRAWING TYPE	DRAWING NUMBER	AMEND.
6800	1460-132	

FILE NUMBER

ATTACHMENT 12

Engineering Servicing Report



SERVICING REPORT

Anstey Keane Urban Development Precinct
Armadale Road Structure Plan

JDS201900.00 Rev D

March 2026

Prepared for:

Rowe Group

JDSi CONSULTING ENGINEERS

P: 08 9227 0595
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Perth WA 6000

PO Box 7483
Cloisters Square PO
WA 8650

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Appendix

Appendix A – Preliminary Local Structure Plan & Lot Concept Plans
Appendix B – Water Corporation Planning Advice

DOCUMENT REVIEW				
Revision	**Date Issued**	**Issue Type**	**Written By**	**Approved By**
Rev A	16th June 2023	Information	BG	GB
Rev B	24th Nov 2023	Information	BT	GB
Rev C	19th Sep 2025	Information	RR	BT
Rev D	5th March 2026	Information	BT	BT

1 Executive Summary

JDSi Consulting Engineers has been engaged by Rowe Group (herein referred to as the Developer) to assess the engineering servicing and constraints associated with the proposed development of the "Anstey Keane Urban Development Precinct – Armadale Road Structure Plan" (herein referred to as the Site) identified in the preliminary structure plan document in Appendix A. This report provides advice on the civil engineering elements relating to the proposed development of the Site. It is specifically focussed on existing external services and development constraints from adjacent developments as well as service authority requirements to allow servicing of the proposed development. This report does not address the internal building services or built form development requirements.

This report provides a desktop study only. Several recommendations for further action in order to progress the development through to detailed design, with regards to the civil infrastructure requirements, are summarised below:

- Complete a detailed feature survey and geotechnical investigation of the site.
- Engage a Hydrology Consultant to progress an Urban Water Management Plan for the Site, in consultation with the civil design.
- Complete a detailed Traffic Impact Assessment and commence consultation with Local Authority and MRWA to confirm potential road upgrades.
- Confirm final Water Corporation planning with regards to water and sewer servicing for the development.
- Confirm Western Power network capacity through formal submission of a Feasibility Request or Design Information Package.
- Commence negotiations with communications providers to confirm options for communications supply to the Site.

The above summary of recommendations is not exhaustive as there will be numerous actions required to achieve an approved design that meets industry and regulatory requirements for quality, price, sustainability and safety.

This report incorporates the modifications to the Structure Plan requested by the Western Australian Planning Commission (WAPC) in August 2025, as outlined in their Schedule of Modifications. This includes additional information regarding earthworks levels, retaining / banking requirements for the lots, as well as further details regarding connection to the existing sewer network.

2 Key Objectives

The key objectives of this report are to:

- Review and analyse existing documentation associated with the Site.
- Highlight existing infrastructure assets within the development area.
- Advise on anticipated infrastructure requirements for the planned development.
- Demonstrate the development can be serviced in the short to medium term.
- Advise on the implementation of key infrastructure requirements.
- Provide commentary on any potential key infrastructure upgrades required to accommodate the proposed development.

3 Introduction

The development Site is located approximately 30km south of the Perth CBD in the municipality of the City of Armadale (herein referred to as the Local Authority). The Site is approximately 5.2ha and is made up of individually owned land parcels bound between the Anstey Grove development site and Anstey Road to the west, the Mahala Estate development site and Rathbone Drive to the north, existing rural landholdings and Allen Road to the east, and Armadale Road to the south. A current aerial image of the Site is depicted in Figure 1 below.

The Site includes a number of existing residential lots adjacent to Armadale Road. It is proposed the Site will be developed for residential purposes. Based on preliminary information provided by the Developer, the development will consist of strata type residential lots that will be brought to the market in a staged approach.

This report is based on the civil engineering aspects of residential land use and engineering infrastructure requirements to service the proposed development. The engineering review has considered earthworks, roads, stormwater drainage, wastewater, potable water and utility services with a particular emphasis on the existing service capacity and the potential infrastructure upgrades required to support the proposed development.

The report has been based on a desktop study of existing service information, aerial imagery, and preliminary advice from the various service authorities. Consideration has been given to industry standards and policies and JDSi's in-house experience related to other developments in the area. The information provided may be subject to change as development progresses in the area.



Figure 1: Site Location

4 Study Area

The Site predominantly contains existing large residential lots with established residential structures, sheds, pools, scattered trees and low-lying vegetation.

The broader study investigation area also contains an existing Western Power 132kVa powerline and easement traversing through existing Lot 94 located towards the east and an existing Water Corporation's Branch Drain (Bailey's Branch Drain) which runs through existing Lot 24, more central through the development. The 132kVa Power line is subject to a 26m easement and the main drain a 15m easement/reserve both vested in the respective service authorities.

4.1 Topography

Based on desktop information and available feature survey data the Site area is generally of flat surface elevation ranging from approximately RL 24.0m AHD in the east to 25.0m AHD in the west. Refer to Figure 2 below for the indicative topography of the surrounding land.

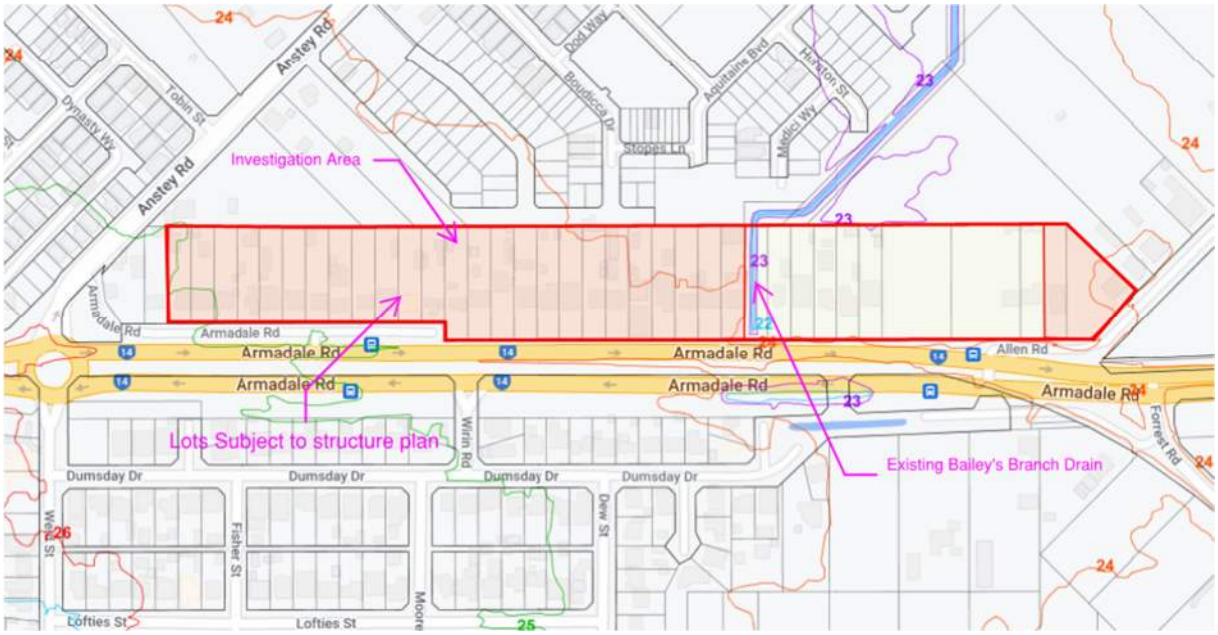


Figure 2: Site Topography

4.2 Groundwater

Based on the LWMS prepared by Oversby Consulting for the Site, the maximum groundwater across the site varies from 23.8mAHD in the west, through to 23.6mAHD at the existing Water Corporation Bailey's Branch Drain and then down to 22.2mAHD to the east of the drain. Seasonal changes in groundwater are in the range of 1.1m to 2.3m.

The Site is characterised by high groundwater levels. Based on available hydrological information the groundwater control for the region is the base flow in the existing Water Corporation Bailey's Branch Drain at 21.6m AHD. Management of the high groundwater will include a combination of subsoil drainage and fill in order to achieve adequate separation between finished lot levels and groundwater.

Based on natural surface levels and the topography of the Site there is likely to be around 1.0m clearance to the estimated AAMGL. It is expected dewatering of deep services will be required during construction development. This will be influenced by depth of import fill across the Site and seasonal fluctuations in groundwater level (winter being the most critical period) as well as management of surface water runoff.

Dewatering will have a temporary drawdown effect on the local groundwater, and at certain locations will present a risk of exposing Acid Sulphate Soils (ASS). This will need to be considered and managed concurrently with any ASS requirements for the Site. All dewatering must be carried out in accordance with Department of Water and Environmental Regulation (DWER).

There are no water dependent ecosystems identified within the Site.

It is likely preparation of an Urban Water Management Plan will be a condition of subdivision. This may also require pre-development monitoring of groundwater and surface water prior to development.

It is recommended that a hydrological consultant to be engaged to provide advice on groundwater levels for the Site and management thereof to assist in the detailed design of the drainage and earthworks and address any development conditions.

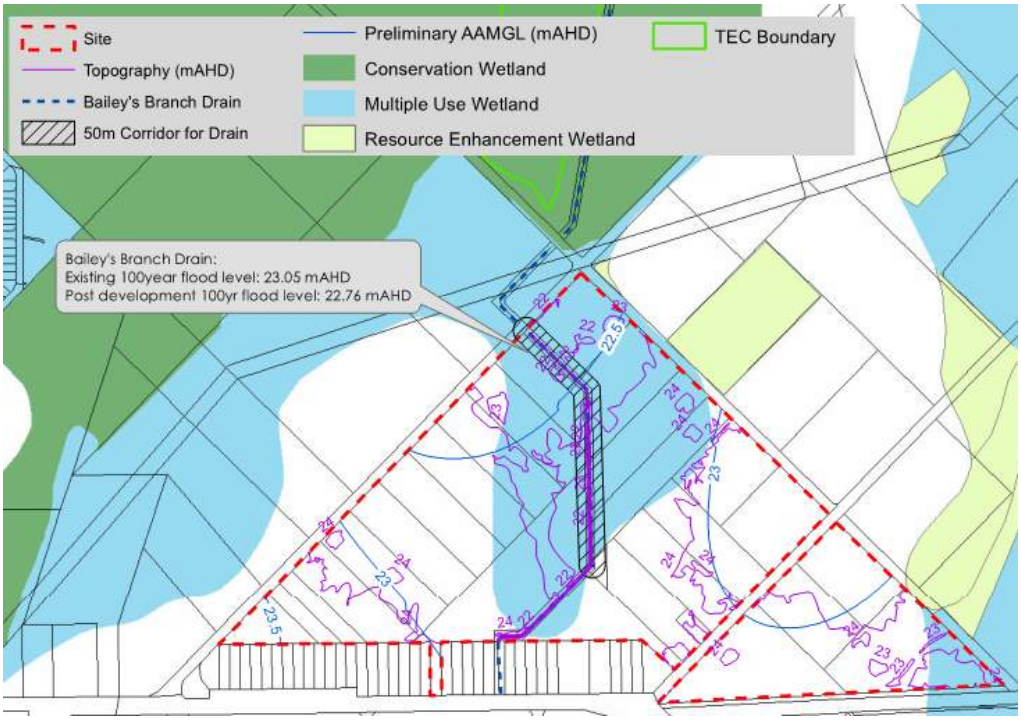


Figure 3: Groundwater and Wetlands

4.3 Geological Conditions

Mapping by the Geological Survey of Western Australia (1986), Armadale Geology Sheets and other available information indicates that the surface geology for the Site consists of varying soils including predominantly Bassendean Sand with some Guildford Formation (low plasticity clay and silty sand with traces of lateritic gravel) to the eastern corner of the study area. Refer Figure 4 below.

It is recommended that a Site-specific investigation be carried out to further inform the civil (earthworks and drainage) and structural (retaining wall) design for the proposed development. This report should include, as a minimum, testing to confirm:

- Existing Soil Characteristics (PSD, Atterberg Limits, MMDD, soil profile)
- Existing Site classification and recommendations to achieve Class A Site
- Permeability Testing & Recommendations for Drainage Design
- Pavement Design Parameters (CBR, Swell %)
- Bearing Capacities
- Acid Sulphate Soil (ASS) Investigations
- Site preparation and compaction recommendations
- Subsurface conditions (karst features such as cavities or loose zones; uncontrolled fill or structures)

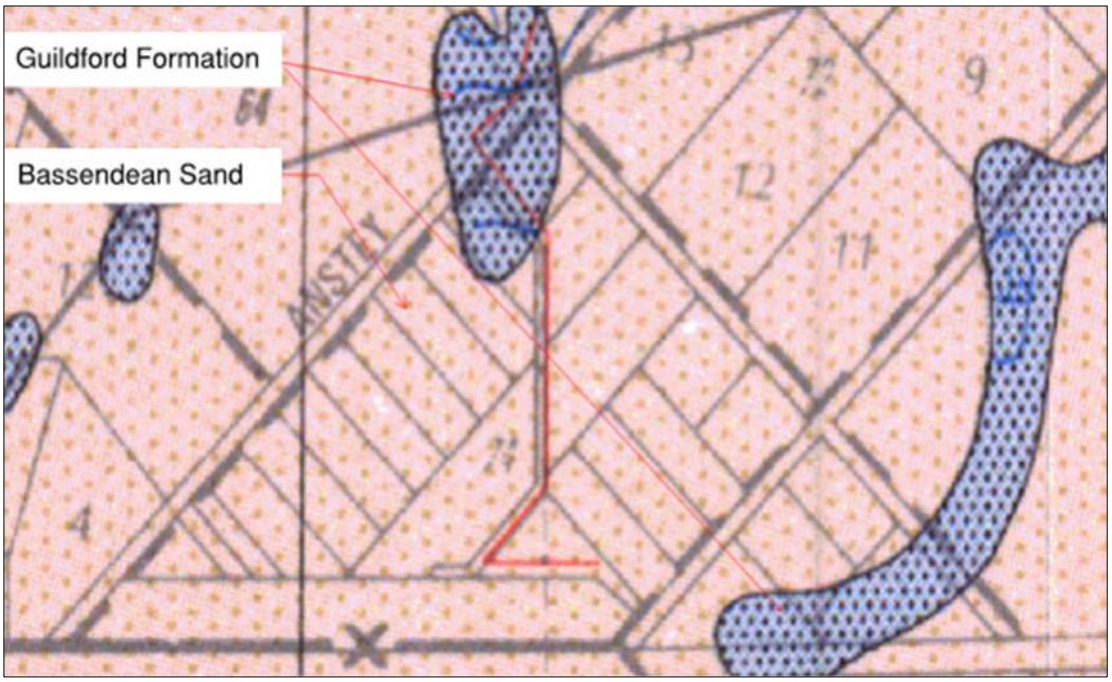


Figure 4: Geological Mapping

4.4 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are soils containing naturally occurring, fine-grained metal sulfides typically pyrite (FeS2), formed under saturated, anoxic/reducing conditions. They generally occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 m AHD). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals. Although soils described represent typical conditions

where ASS occur, in Western Australia these materials have been identified in other soil types such as leached sands and silts.

The iron sulfides in ASS react with oxygen when the soil is exposed to air through excavations or via lowering of the water table. Iron compounds and sulfuric acid are then created along with other substances, including heavy metals. All excavation works and dewatering in ASS must be carefully managed to avoid any potential damage to surrounding land and water ways.

The geology and soil types of the development Site are consistent with a low risk of ASS occurrence. Mapping compiled by DWER supports this and identifies the Site as being in a medium low risk of ASS within 3m of the surface. Refer Figure 5 below. It is recommended investigations into the occurrence of ASS should be included in future geotechnical and/or environmental studies to ensure any risks of encountering ASS are mitigated.

There may be a subdivisional requirement for preparation of a Dewatering and ASS Management Plan. If so, this may require more detailed ASS investigations and analysis during development of the detailed engineering design which will assist in determining the risk of encountering and management of ASS. Detailed specific management plans for treatment will need to be put in place if this investigation identifies the presence of ASS.

Irrespective of specific subdivision conditions it will still be the Developers responsibility to ensure ASS is considered and managed appropriately. DWER has standard guidelines that provide for self-assessment and management of ASS that should be considered to ensure no adverse impact on natural and built development environment.

Given there is likely to be some fill import proposed for the Site it is expected ASS management (if required) would be restricted to deep service excavations i.e. sewer and drainage services. These works may require treatment of both soils and water associated with dewatering activities.

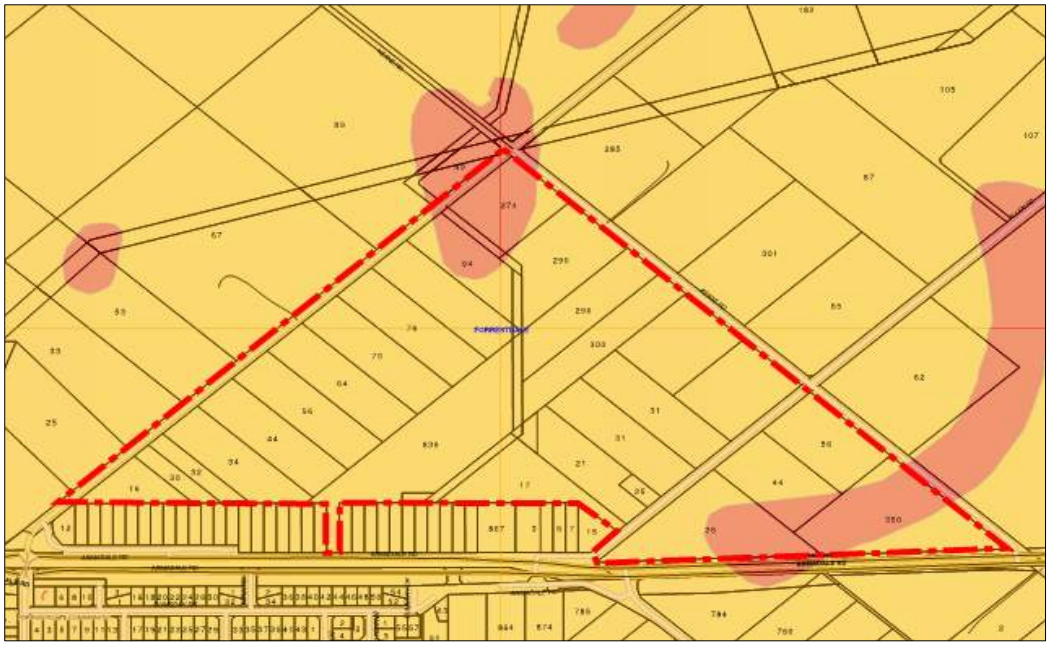


Figure 5: Acid Sulphate Soils Mapping

5 Earthworks and Demolition

5.1 Demolition & Clearing

The Site consists of multiple fixed structures including residential building, sheds, fencing, pools, and scattered trees. Prior to development commencing demolition works will need to be undertaken to remove these structures. This shall include any redundant non-fixed infrastructure, scrap material or rubbish located on the Site. These will need to be removed and disposed of to an approved tipping location. Any demolition works will require permits approved by the Local Authority. It is recommended these works are performed by a licensed demolition contractor.

Give the age and anecdotal evidence from adjacent development it is recommended the services of a qualified environmental consultant are engaged to inspect and audit the Sites for asbestos containing materials (ACM) as these will need to be disposed of in accordance with relevant environmental guidelines and at licensed facilities.

The Local Authority have a strong view on tree retention, and it may be a condition of subdivision approval to undertake predevelopment flora studies to assess the type and quality of existing vegetation and trees and suitability for retention as part of the development. It is recommended that a suitably qualified arborist be engaged to assess and provide commentary on the required tree protection methodologies / zones.

All vegetation marked for clearing should be removed from the Site. Any areas of vegetation identified for retention shall be clearly marked, and physical controls implemented to restrict access by construction machinery during development.

5.2 Bulk Earthworks

All earthworks will need to be undertaken in accordance with recommendations from a detailed Geotechnical Investigation and AS3798 ‘Guidelines on earthworks for commercial and residential developments. It is anticipated that the earthworks can be undertaken on the Site utilising standard civil construction equipment. Noting the proximity of existing residential properties and structures, careful consideration will need to be given to the types and levels of vibratory compaction to be utilised. It is recommended that dilapidation studies and reporting of existing adjacent properties be undertaken prior to development commencing.

It should be noted that the volume of material imported fill can have a significant impact on development costs, depending on the market conditions at the time. This will be influenced by the quality of the material required, availability and distance to source. Amongst the design constraints for the Site the earthworks design shall also consider this and incorporate the most efficient use of insitu materials (where suitable) in bulk earthworks operations to reduce the cost of import fill.

A detailed Geotechnical Investigation will need to be undertaken to determine the suitability of the site for development, along with earthworks and construction recommendations. Given the Site is surrounded by recent subdivisional developments it is not expected that there will be any fundamental geotechnical constraints on the Site.

Based on a review of available information the following constraints exist for the Site, and these will need to be considered further as part of the detailed design process. Due to the absence of survey data, a detailed earthworks design model has not been developed at this stage. Instead, the assumptions below are based on a desktop study using the current available information. The indicative earthworks finished lot levels (FL) are shown in the figure below.

- Proposed lots to be above the level of the existing road network to the North (Rathbone Street) to facilitate overland flow. This road varies from approximately 24.50mAHD in the west, through to 23.50mAHD in the east.

- Appropriate tie-in levels to Allen Rd and Armadale Rd, noting exact levels are currently not available however it's assumed the existing landholdings are generally above the road levels already.
- Proposed lots to be 500mm above the relevant adjoining flood level, resulting in an FFL of approximately 23.73mAHD.
- Suitable separation to groundwater of at least 1.5m, resulting in lot levels ranging from 25.3mAHD in the west through to 23.7mAHD in the east.
- The requirement to contain stormwater drainage on Site and applicable levels for this to be achieved. This is subject to further advice provided by the hydrologist and will be verified during preliminary design.
- The use of retaining walls or battering to tie into existing adjacent property levels.
- Sewer serviceability, noting this is covered in Section 8 of this report, however this does not appear to result in the need to increase lot levels.

Based on the above, and the understanding that the existing site levels range from 24.0mAHD in the east to 25.0mAHD in the west it is not expected that significant earthworks will be required to lift the Site as part of the subdivisional works. It is likely that general cut to fill will need to occur, with the potential requirement for up to 0.5m of fill needed in some areas, depending on final layouts and servicing arrangements.

Staging of development will need to be considered, and it is currently unclear how the development front will progress. If the lots are developed individually rather than as part of a single stage, each owner will need to make temporary arrangements for retaining or battering to tie into the adjoining lots during development. These temporary works will require approval from the affected neighbouring lot owners if their land is impacted. Therefore, constructing multiple adjacent lots in a single package, would be a more efficient and practical approach due to the reduced requirement for temporary works and a simplified approval process.



Figure 6: Site Location

6 Roadworks

The surrounding road network is under the control of the Local Authority and as such all works on and abutting the public roads will be subject to their approval.

The Development Site is bounded by a local access road, Armadale Rd (minor) which is an unkerbed sealed access way off Armadale Road, that provides access to existing residential lots on the southern boundary of the development Site. This access road runs parallel to and includes a single intersection with the main Armadale Road (major) to the south. Armadale Road (major) is a primary distributer under the care and control of Main Roads WA. It is a sealed and kerbed dual carriageway in good condition. The Site is also bound by a partly constructed Rathbone Drive to the north (part of the Mahala Estate), and Allen Road to the east. Allen Road is a local access road and is a single carriage way with kerb along the southeast side only and does not connect through to Armadale Road (major). Rathbone Drive is a sealed and kerbed local access road.

As the development Site is proposed as strata type development, access to the northern lots will be via common property driveways from the existing Rathbone Drive road reserve. .

Access to all existing lots fronting Armadale Road will be provided through a common access place (CAP) road and will require the upgrade and extension of the existing CAP road which currently only services the south-western portion of the existing lots. In areas where no CAP road currently exists, a 16-metre future road widening has been nominated to accommodate a new access road extension. This widening will be taken from the affected lots as shown in the Appendix A.

This CAP road will be consistent with standard residential development including kerbed and asphalted pavement and a road cross-section to align with the existing landform and for the intended traffic volumes. In all cases the road cross section will be designed to cater for utility services on standard verge alignments and appropriate stormwater management strategies in accordance with Local Authority standards and guidelines, Local Government Guidelines for Subdivisional Development (IPWEA) and Main Roads WA requirements.

Typically WAPC conditions require that where any part of a development fronts existing roads those roads will require upgrading to provide suitable access into the Site and in accordance with local structure plan requirements. This is typically the responsibility of the Developer and may be a collective arrangement if multiple Developers are involved. Depending on the roads this may be subject to reimbursement through the Developer Contribution Scheme.

It is therefore anticipated that the Armadale Rd CAP road will require upgrading to a new sealed and kerbed pavement with drainage infrastructure. Allen Road may also require upgrading if the lots at the eastern end are to be developed. Rathbone Drive has only been recently constructed so upgrade is unlikely.

7 Stormwater Drainage

Local Water Management Strategy (LWMS) and Urban Water Management Plans (UWMP) and are now a standard and key part of any development process incorporating principles of integrating water and land use planning, considering all water sources in water planning, integrating water use and natural water processes and a total catchment integration of natural resource use and management (Ref. Stormwater Management Manual for Western Australia, DOW, April 2004 the State Water Strategy 2003 and the State Water Plan 2007).

Stormwater drainage management is a major component of an overall urban water management strategy for which achievement of the principals of the plan may be facilitated through the application of Water Sensitive Urban Design (WSUD) techniques during planning, design, and construction of urban development projects. Objectives of WSUD include but are not limited to the following:

- Detention of stormwater rather than rapid conveyance to maintain predevelopment flows for quantity management.
- Use of vegetation for filtering purposes and nutrient stripping for quality management.
- Use of stormwater to conserve potable water; and
- Water efficient landscaping.

The stormwater drainage from the development will need to be designed and constructed in accordance with Local Authority design guidelines and DWER water sensitive urban design guidelines. As the Local Authority will ultimately own and maintain all stormwater infrastructure the design and construction work will need to be undertaken in accordance with their guidelines and standards, as well as the Local Government Guidelines for Subdivisional Development (IPWEA), noting Local Authority typically require:

Given the historical land use of the Site and potential contaminated land / groundwater, disposal of stormwater via on-Site infiltration may not be suitable as it may cause any contaminants to mobilise and enter the groundwater / ocean. It is recommended that a suitably qualified environmentalist be engaged to confirm any contamination and provide recommendations on dealing with stormwater runoff from the Site.

As per the Local Authority requirements, the stormwater drainage system shall manage runoff for minor storms, up to the 20% AEP event, in traditional pit and pipe system, with major 1% AEP events managed through the road network. The system shall be designed to retain, treat and infiltrate 1 year (15mm) event through bio media and/or other filtration media. The design philosophy for the development Site will need to demonstrate post development flows and volumes do not exceed predevelopment flows.

JDSi understand that Oversby Consulting have completed an LWMS over the Site which sets out the proposed drainage strategy. Further refinement of this will occur through detailed design and the subsequent preparation of a UWMP.

7.1 Subsoil Drainage

The high ground water in the area is generally managed/controlled via a subsoil drainage network, which will have free outfall into the main drains. The subsoil will be located at the AAMGL to maintain the predevelopment level and manage surface runoff.

Further studies by hydrological consultants will be required to determine the required separation between the finished levels and the maximum groundwater levels (AAMGL). This will allow infiltration by soak wells for larger lots. For the smaller cottage lots, lot connection pits may be required.

The Local Authority notes the following desirable separations from the phreatic crest between subsoil drainage lines to establish development levels:

- 500mm to lots at the furthest point from subsoil drains (back of lot).
- 500mm to passive open spaces at the furthest point from subsoil drains.
- 750mm to active (turfed) open spaces at the furthest point from subsoil drains.
- 900mm to ovals at the furthest point from subsoil drains.

7.2 Bailey's Branch Drain

Bailey's Branch Drain is a Water Corporation drainage asset that traverses the Armadale road to the middle of the Site (existing lot 24) discharging under Anstey Road near the intersection of Anstey Road and Keane Road. It is a steep sided open trapezoidal drain.

The drain provides a drainage outlet for upstream catchments and stormwater generated within the development area. As part of the broader development in the area on behalf of the Water Corporation the main drain will be widened and realigned between Rathbone Drive and Anstey Road within the Mahala Estate landholdings. As such it is not expected there will be any requirement to modify the BBD within this development.

8 Sewer Reticulation

The Water Corporation owns and maintains the sewerage reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and Design and Construction Requirements for Gravity Sewer DN150 to SN600 (DS50). This report does not provide advice on internal plumbing works, although it is noted internal plumbing will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant.

To provide a sewer reticulation to the development, suitably qualified consultants will be required to design the proposed sewer reticulation network and submit to the Water Corporation for approval. Applicable headworks charges will need to be paid by the Developer, and these will be determined by the Water Corporation at the time of application.

Based on available Water Corporation planning information (Figure 7) and EsiNet data this Site is within the catchment of the Water Corporation's Balannup L wastewater pump station (WWPSL). Sewer flows generated from the development are therefore planned to be conveyed to this infrastructure. The WWPS is located within the adjacent Mahala Estate landholdings to the north-east of the Site.

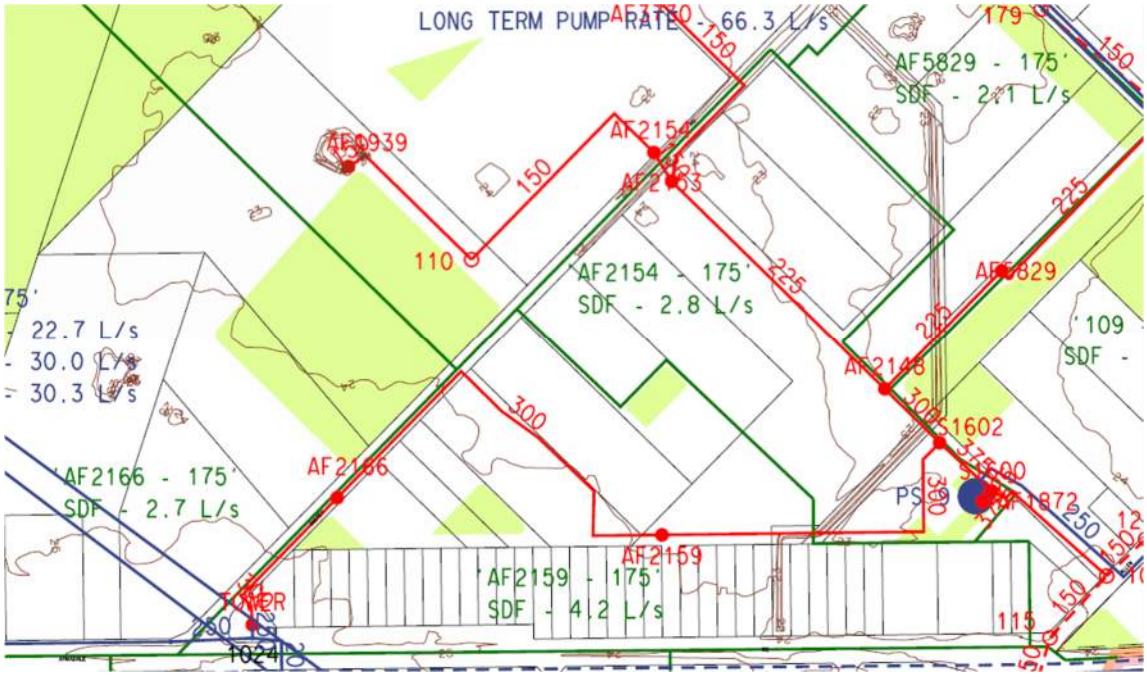


Figure 7: Extract from current Water Corporation Wastewater Planning

Based on a developable area of approx. 5.2 hectares with an R25 residential zoning, the expected design flows (GSDF) generated from the Development Site are in the order of 1.66L/s. This can be typically managed via a DN150 sewer reticulation network.

To the west of the Site there is an existing DN300 gravity sewer network on Anstey Road, near the intersection of Armadale Rd, however the levels of this sewer would prohibit servicing of this development without significant amount of imported fill.

There is a parallel sewer system in Rathbone Drive along the northern boundary of the majority of the Site, which consists of a deeper (5m+) DN300 sewer and a shallower DN150 sewer. Sewer lot connections will need to be constructed to each strata lot from the existing DN150 sewer located in Rathbone Drive. An internal, private plumbing system can then be constructed to service each strata lot. Internal works within each individual strata lot will be need to be completed by a licenced plumber in accordance with AS3500.

Based on a preliminary assessment the existing DN150 sewer system on Rathbone Drive, this is at a depth that will provide a suitable level of service for the majority of the Site, with little change to the current ground level. Due to the fragmented landholding a connection point will be required to each lot.

Access will need to be resolved for the western side of the Site, as Rathbone Drive does not extend this far, however the proposed sewer could be constructed through the private landholdings and protected by an easement.

As the eastern portion of the site is in close proximity of the WWPS there is no concerns with sewer serviceability from the DN225 currently located in Allen Rd, noting that a DN150 extension along Allen Rd will be required to service the eastern land holdings.

Final connection locations and details are subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.

Included in Appendix B is a copy of the latest planning advice received from the Water Corporation, noting this aligns with the above desktop analysis by JDSi.



Figure 8: Preliminary Sewer Reticulation Assessment

9 Water Reticulation

The Water Corporation owns and maintains the potable water reticulation system in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard Water Corporation requirements and guidelines including the Developers Manual, and the Design and Construction Requirements for Water Reticulation Systems up to DN250 (DS63).

All water main extensions required for the development Site will be laid within the existing and proposed road reserves, on the correct alignment and in accordance with the Utility Providers Code of Practice. These mains will provide both potable water supply and hydrants for fire suppression to each lot. This report does not provide advice on internal plumbing works, although it is noted internal plumbing will need to meet the requirements of AS3500 'Plumbing and drainage' as documented by the Building Services consultant. Flow and pressure checks will likely be required as part of any assessment of fire water supply for commercial or multi-storey residential developments.

To provide a potable water supply to the development a suitably qualified consultant will be required to design the proposed water reticulation network and submit to the Water Corporation for approval. Applicable headworks charges will need to be paid by the Developer, and these will be determined by the Water Corporation at the time of application.

Based on the Water Corporation EsiNet data there is an existing 100CI water reticulation main running along Armadale Road to the west of the Site. This pipe extends through to Allen Road. A DN250P reticulation main also crosses the 100CI main and runs into the Mahala Estate landholdings through the Water Corporation's BBD corridor located in Lot 24 in approximately the middle of the proposed Site.

Based on a preliminary review of available information the existing 100CI main provides potable water supply to the existing residential lots and is anticipated would similarly provide a source to supply the new lots within the development. This would require decommissioning of some existing and the installation of new water connections. There is an existing 100P water supply in a constructed section of Rathbone Drive within the Mahala Estate that may also provide a point of supply for the development.

Information obtained from the Water Corporation indicates that the development of this Site may be supplied without the need to construct distribution mains, by way of extension from existing water mains in the area. Based on anecdotal information there may be a requirement to upgrade some of the 100CI reticulation as part of the development. This information is subject to confirmation from the WC planning branch during the subdivision approval process and detailed design.

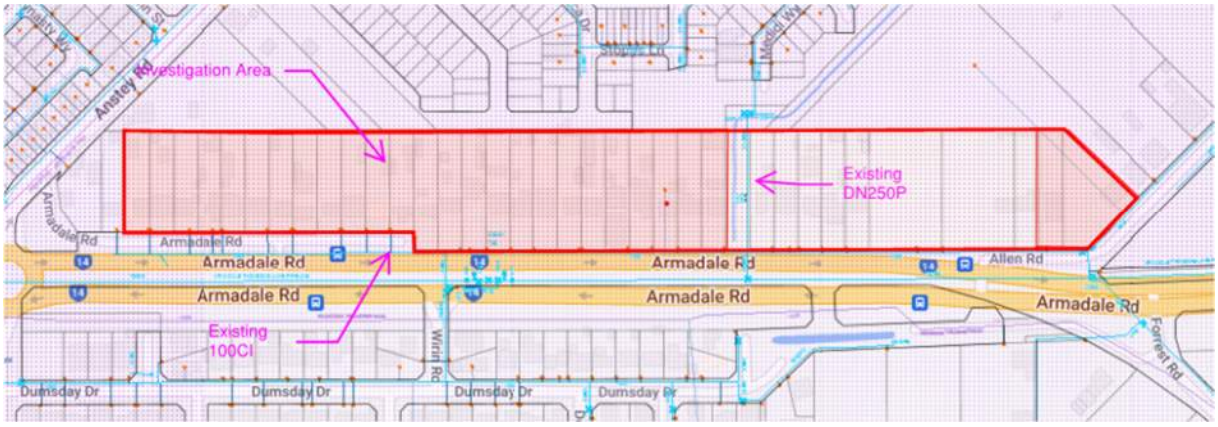


Figure 9: Existing Water Reticulation

10 Power Supply

Western Power owns and operates all electrical supply network assets within the development area and therefore all new electrical supply equipment and cables will need to be installed in accordance with Western Power, WAER (West Australian Electrical Requirements), AS3000 specifications and Standards.

22kV High Voltage (HV) and low Voltage (LV) overhead electricity distribution assets have been identified in the area of the proposed development. These assets are supplied from the Western Power Southern River Zone Substation via the Terrier Place (SNR 507.0 L101 Terrier Place) Feeder. There is also an existing 132kV HV overhead transmission line traversing the proposed development through existing Lot 24 which is protected by a 26m wide easement can pose an immediate hazard. Easement width TBC by WP.

The safe working distance from transmission lines is 6m. Any area surrounding live electrical asset within this distance is unsafe for ordinary persons, equipment and material. Safe working distances do not allow for sag or swing of powerlines. When working within the vicinity, allowances must be made for sag and swing of overhead powerlines; inadvertent movement of excavation machinery and cranes; and personnel and materials.

Based on available dial before you dig and Western Power data, there is existing overhead HV and LV aerials along Armadale Road. The LV network appears to provide overhead supply to existing residential lots within the development estate. Based on available information there is also existing underground low voltage network along a constructed section of Rathbone Drive in the adjacent Mahala Estate. JDSi anticipate this existing infrastructure with some modification and extension may serve as connection points for the development.

It should be noted that the existing overhead assets along Armadale Road and Allen Road adjacent to the development may require undergrounding as part of the development works. These requirements are typically identified as part of the development subdivisional approval conditions.

The estimated total power demand for the proposed development is approximately 380kVA based on 4.7kVA per residential lot. It is highly likely that the development will require a minimum of one transformer and one switchgear.

Based on the Western Power Network Capacity Mapping Tool, the available capacity within the area is estimated to have less than 5000kVA. There may be a requirement for the power to be augmented to service the proposed development.

This advice is required to be confirmed with Western Power through the mechanisms of a feasibility study and design information package (DIP) and is dependent on the number of services required for the development and existing network capacity.

Western Power cannot reserve network capacity therefore we recommend the Developer lodge a formal application with the Utility as soon as practicable. All future development's electricity load requirements will be required to be approved by Western Power.

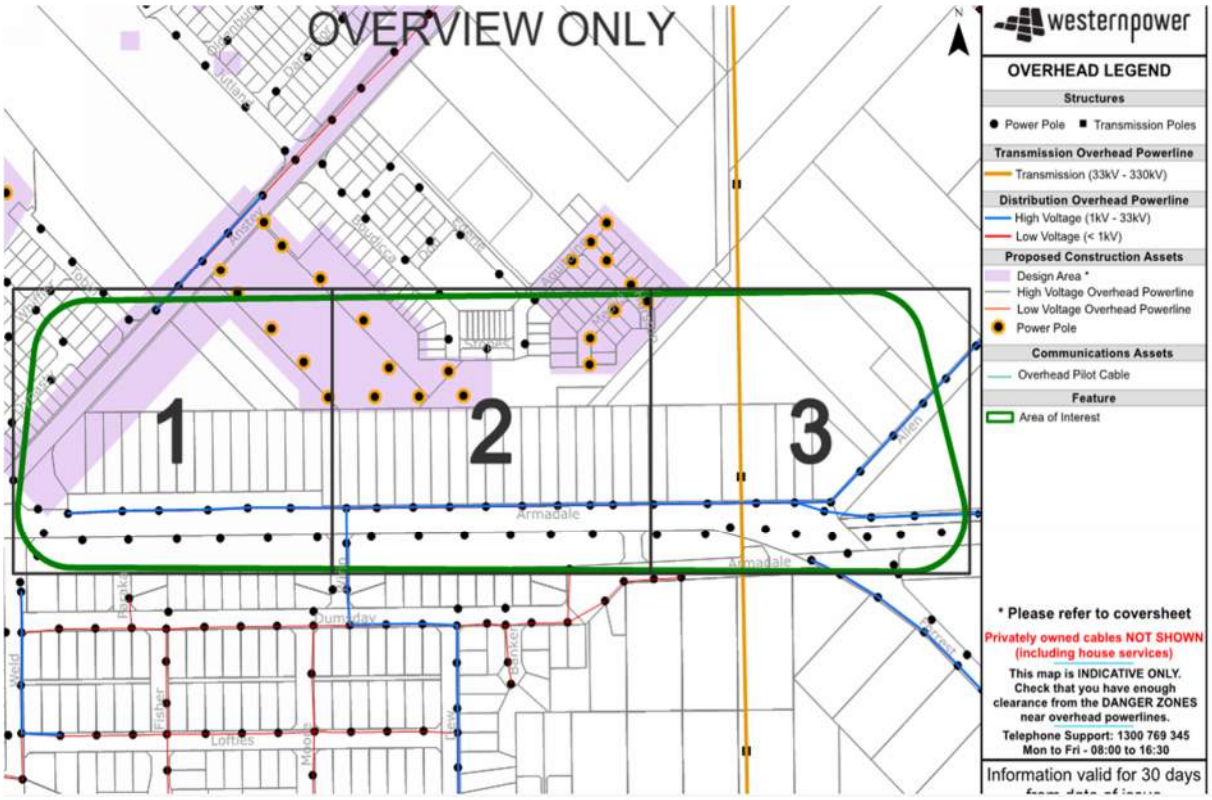


Figure 10: Existing High Voltage Overhead infrastructure

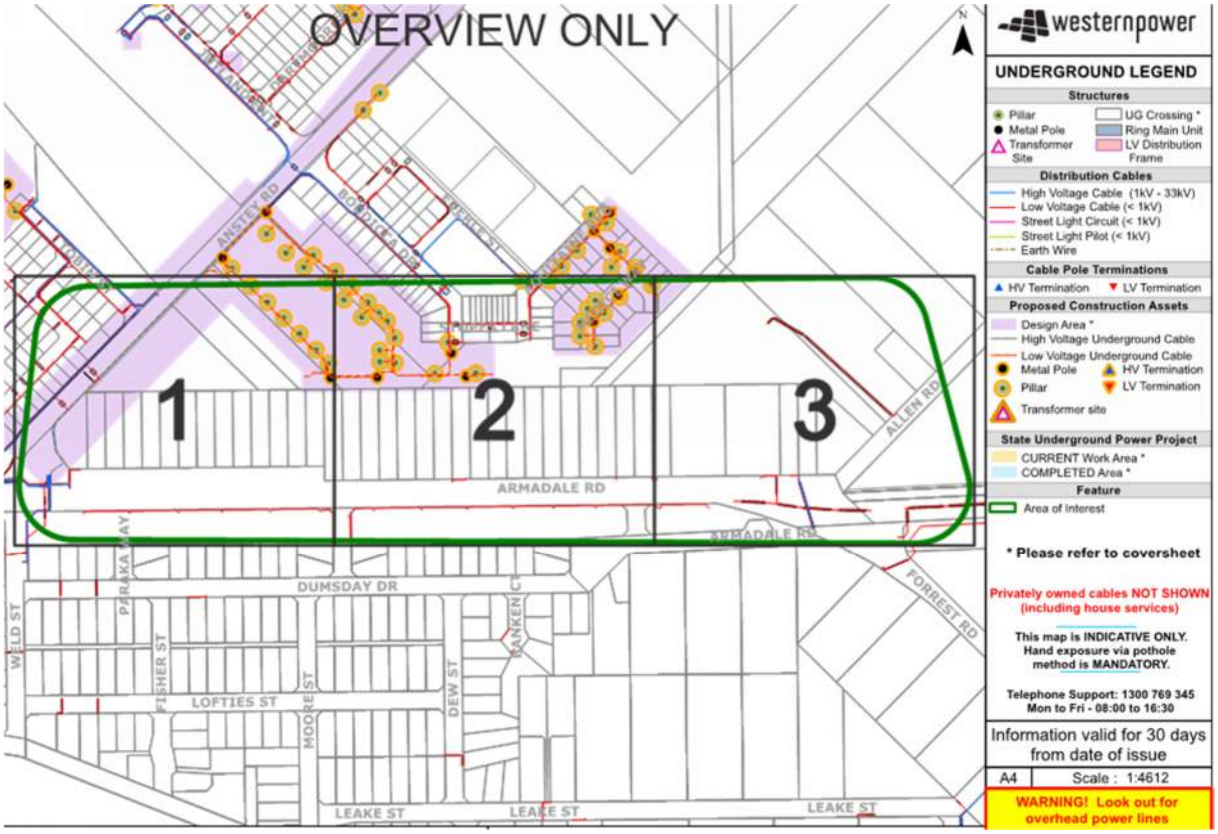


Figure 11: Existing Low Voltage Overhead Infrastructure

11 Gas

Before You Dig Australia (BYDA) information indicates that there is an existing 80PVC medium pressure gas main located along Anstey Rd and Armadale Rd, and this extends through to Allen Rd. This infrastructure is owned and maintained by ATCO.

The next closest asset is a 110PE gas main located within the existing Lot 24 which connects to the gas main running along Armadale Rd and provides a feed into the Mahala Estate to the North. There is an existing 200ST 1900kPa High Pressure gas asset that runs along the western side of Anstey Rd and southern side of Armadale Rd. This is identified as a “Critical Asset” and high risk in nature. Construction works within 15m of this infrastructure will require prior approval from Atco Gas and will require an approved gas spotter to be present for the duration of works.

Reticulated gas is not considered an essential service and is generally not required as a condition of development. It is usual practice to install the gas reticulation network for the subdivision within a common services trench, and the Developer typically incurs no cost for this. If there is an extension required to connect to the nearest high-pressure gas main the developer will be required to pay for the trenching to the gas main as a headworks cost.

Based on the above there does not appear to be any major constraints with regards to providing gas infrastructure to the Site.



Figure 12: Portion of existing Gas Infrastructure

12 Telecommunications

Before You Dig Australia (BYDA) information indicates there is an existing communication pit and pipe network provided by Telstra, NBN and Vocus adjacent to the Site along Armadale Rd, Anstey Rd and Allen Rd. This network provides service to the existing residential lots in the development Site.

There is an existing Optus cable along the southern side of Armadale Rd. In addition to this, there is existing Opticomm infrastructure within the section of constructed Rathbone Drive in the adjacent Mahala Estate to the North of the Site.

JDSi anticipate the existing infrastructure on Rathbone Drive and Armadale Rd would serve as a connection point for the Development however this would need to be confirmed with the communications provider at the time of making an application for connection and is dependent on the number of services required for the Development.

General communication services for the Site will consist of the installation of a standard pit and pipe network in accordance with communication guidelines and standards for Single and Multiple Dwelling Units (SDU's & MDU's). The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There may be some local land requirements for equipment Sites, similar to current provisions which will be accommodated at detailed subdivision stage.

The cost for installing the pit and pipe system will generally be funded by the Developer, whilst the Communications Provider will fund the installation of cable & fibre infrastructure, including backhaul into the Fibre Distribution Hubs (FDHs), Network Termination Device's (NTDs) or other Communication Facilities located in the Development.

Due to the location of the existing communications infrastructure and existing fixed line networks, and depending on the chosen provider, it is not expected that significant service back haul would be required for this Site.

Based on the above there does not appear to be any major constraints with regards to providing communications infrastructure to the development.

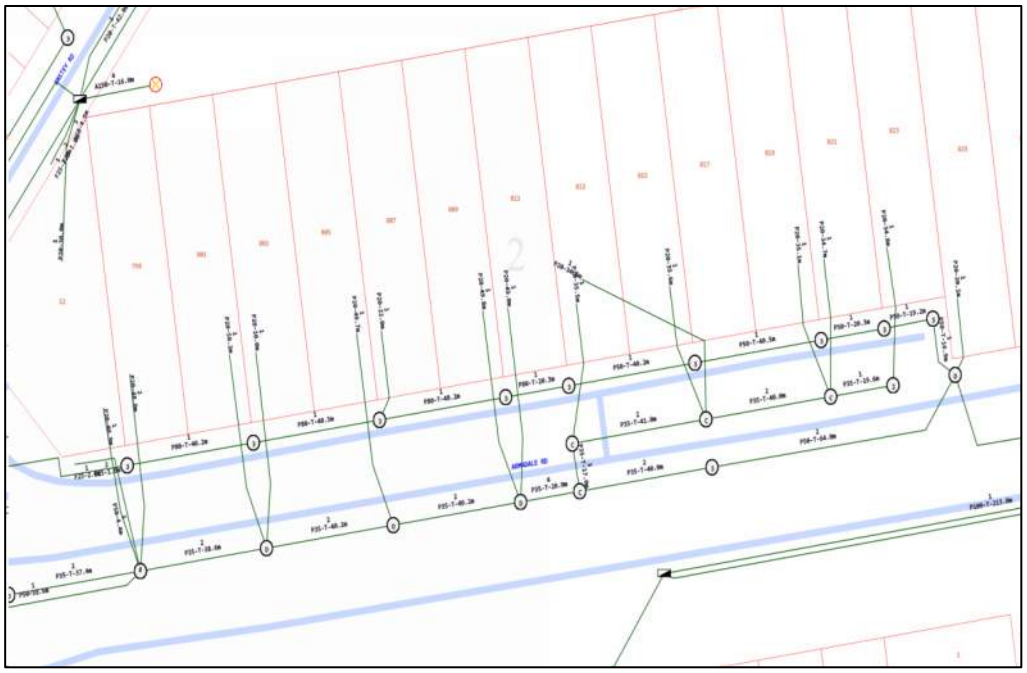


Figure 13: Portion of existing Communications Assets

13 Disclaimer

JDSi have undertaken this assessment based on a desktop study and subsequently assumptions have been made which, if incorrect, have potential to change the assessment and/or recommendations. Major cost implications exist through factors which cannot be assured at this time including upgrading and provision of utility services, WAPC conditions of development, Local Authority Scheme Requirements, ground conditions, timing of adjacent developments, etc.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office.

APPENDIX A
PRELIMINARY LOCAL STRUCTURE PLAN & LOT CONCEPT PLANS

ANSTEY KEANE URBAN DEVELOPMENT EAST STRUCTURE PLAN

PLAN No. 3068-68H-01

LEGEND

- LOTS SUBJECT TO STRUCTURE PLAN
- DWELLING ORIENTATION
- PREFERRED CROSSOVER LOCATION
- 16m WIDE LAND PROTECTION AREA

LOCAL SCHEME ZONES

- RESIDENTIAL - R25

MOVEMENT NETWORK

- ACCESS STREET

ANSTEY ROAD
OSTROM STREET
SEACOLE ROAD
BOUDICCA DRIVE
EDERLE STREET
MISTRAL COURT
AQUITAINE BOULEVARD
HURSTON STREET
HYPATIA LOULEVARD
ALLEN ROAD
RATHBONE DRIVE
SLIP ROAD
ARMADALE ROAD
WIRTH ROAD
DUMSDAY DRIVE

LOCAL STRUCTURE PLAN

VARIOUS LOTS, ARMADALE ROAD
FORRESTDALE

N

0 50 m
SCALE @ A3: 1:2500

9269-LSP-01-F

DRAWN: JS
DATE CREATED: 2026.04.07
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE

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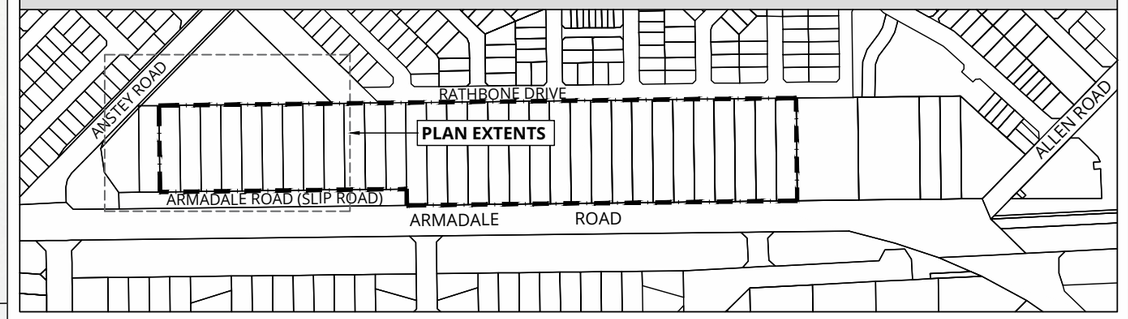
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LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- **7** PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



ANSTEY ROAD

FUTURE LOCAL CENTRE

RATHBONE DRIVE

117

116

115

99

1 499m² | **1** 499m² | **1** 424m² | **1** 370m² | **1** 370m² | **1** 436m² | **1** 436m² | **1** 478m² | **1** 478m²

CP 110m² | CP 97m² | CP 97m² | CP 113m² | CP 113m² | CP 124m² | CP 124m²

2 404m² (4) | **2** 404m² (5) | CP 243m² | CP 242m²

2 534m² (6) | **2** 468m² (7) | **2** 467m² (529) | **2** 549m² (9) | **2** 550m² (88) | **2** 601m² (89) | **2** 601m² (90)

BALANCE LOT 4 554m² | **BALANCE LOT 5** 554m² | **BALANCE LOT 6** 633m² | **BALANCE LOT 7** 766m² | **BALANCE LOT 529** 766m² | **BALANCE LOT 9** 602m² | **BALANCE LOT 88** 602m² | **BALANCE LOT 89** 498m² | **BALANCE LOT 90** 498m²

SLIP ROAD (ARMADALE ROAD)

LEFT IN /LEFT OUT

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CONCEPT PLAN - R25 DENSITY (PAGE 1 OF 3)

VARIOUS LOTS - ARMADALE ROAD

FORRESTDALE

N

0 20 m

SCALE @ A3: 1:600

9269-CON-14-D

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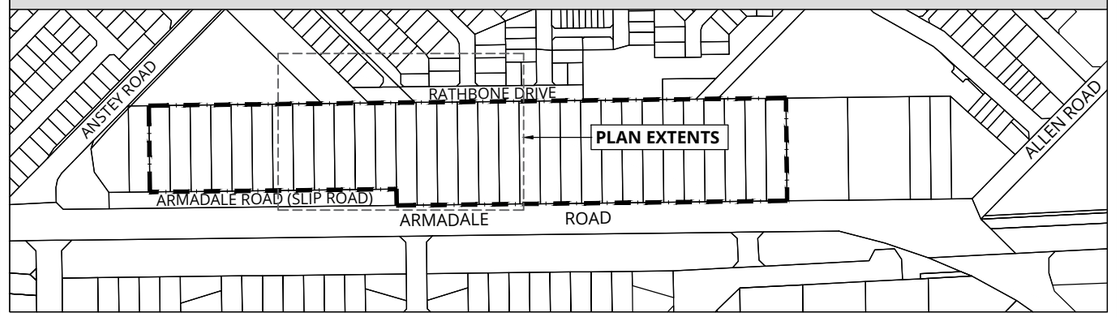
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- 7 PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



618
617
616
RATHBONE DRIVE
RATHBONE DRIVE

ARMADALE ROAD (SLIP ROAD)

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CONCEPT PLAN - R25 DENSITY (PAGE 2 OF 3)

VARIOUS LOTS - ARMADALE ROAD
FORRESTDALE

N

0 20 m
SCALE @ A3: 1:600

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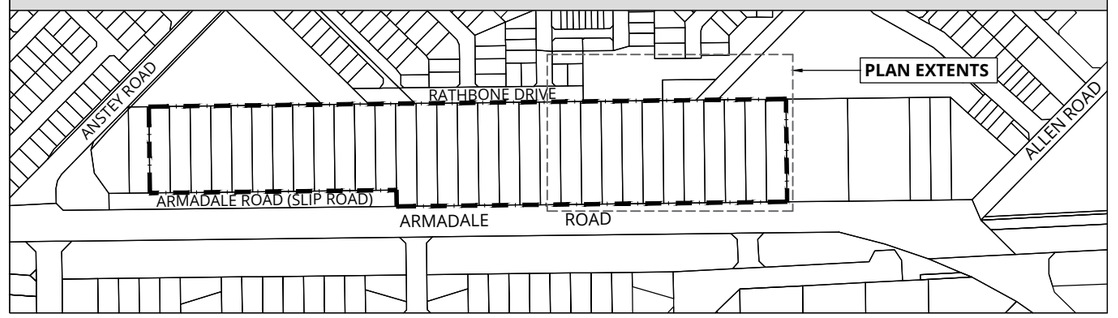
LEGEND

- SUBJECT SITE
- EXISTING BOUNDARIES
- 7 EXISTING LOT NUMBERS
- PROPOSED BOUNDARIES
- 7 PROPOSED LOT NUMBERS
- EXISTING DWELLING TO BE RETAINED
- PRIMARY DWELLING ORIENTATION

INDICATIVE FUTURE DEVELOPMENT

- INDICATIVE FUTURE BOUNDARIES
- FUTURE PRIMARY DWELLING ORIENTATION

LOCATION PLAN SCALE @ A3= 1:6000



RATHBONE DRIVE

RATHBONE DRIVE

69 68 67

CP 204m² 1 399m² 2 403m² — BALANCE LOT 1 6m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 19 1016m²

CP 172m² 1 334m² 2 338m² — BALANCE LOT 20 1177m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 21 1017m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 22 1017m²

CP 202m² 1 399m² 2 403m² — BALANCE LOT 23 1017m²

DRAINAGE 24

CP 204m² 1 399m² 2 403m² — BALANCE LOT 25 1017m²

CP 164m² 1 318m² 2 322m² — BALANCE LOT 26 1218m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 27 1017m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 28 1017m²

CP 204m² 1 399m² 2 403m² — BALANCE LOT 29 1017m²

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CONCEPT PLAN - R25 DENSITY (PAGE 3 OF 3)

VARIOUS LOTS - ARMADALE ROAD

FORRESTDALE

N

0 20 m

SCALE @ A3: 1:600

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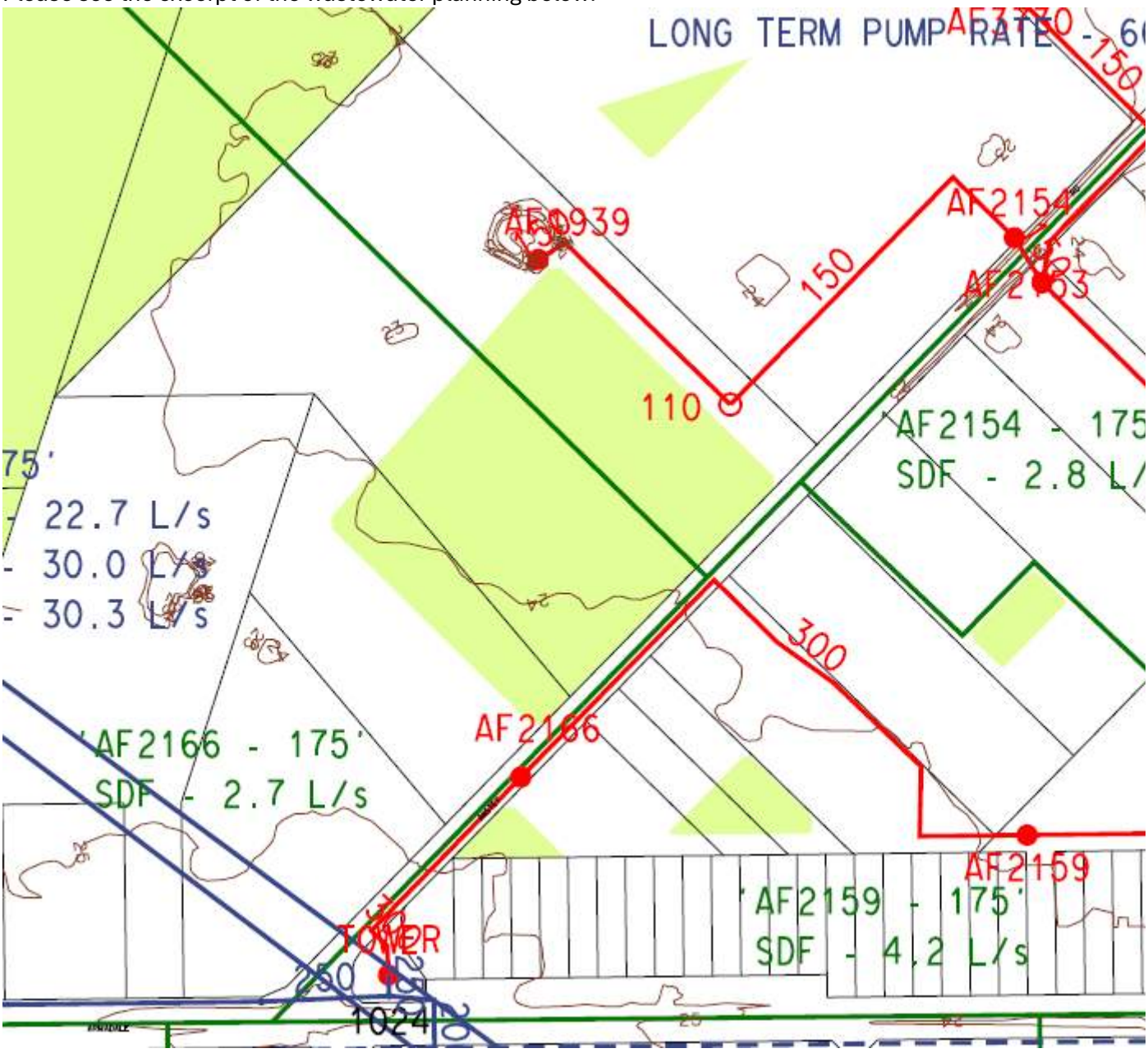
APPENDIX B
WATER CORPORATION PLANNING ADVICE

Blair Trew

From: Luke Gabriel <Luke.Gabriel@watercorporation.com.au>
Sent: Monday, 9 February 2026 3:52 PM
To: Sam Bowers
Cc: Brendan Oversby; Blair Trew; David Maiorana
Subject: RE: 'Anstey Keane Urban Development Precinct' Structure Plan – Water Corporation Confirmation (LWMS and Sewer Connection) (JobRef: 9269)

Hi Sam,

Please see the excerpt of the wastewater planning below:



This precinct area is planned to be serviced via gravity and is planned to go into the access chamber AF2159, there is an existing DN150 retic sewer (Not shown) that runs parallel to the DN300 which these lots can connect to without fill required. Planning has not shown any fill on the plan, and I have also done a quick analysis and found that these lots should be able to connect into the existing sewer on Rathbone Drive. The WC suggest that this should checked again once final lot levels have been finalised.

Note however that the lot at the very eastern end of the structure plan is planned to gravitate to the east through a proposed DN150 sewer.

Hope this helps.

Kind regards,

Luke.

Luke Gabriel
Snr Plnr – Land Use Planning
Development Services

E Luke.Gabriel@watercorporation.com.au
T (08) 9420 3966

watercorporation.com.au

From: Sam Bowers <Sam.Bowers@rowegroup.com.au>
Sent: Monday, 9 February 2026 12:25 PM
To: Luke Gabriel <Luke.Gabriel@watercorporation.com.au>
Cc: Brendan Oversby <brendan@oversbyconsulting.com.au>; Blair Trew <blair.trew@jdsi.com.au>; David Maiorana <David.Maiorana@rowegroup.com.au>
Subject: RE: 'Anstey Keane Urban Development Precinct' Structure Plan – Water Corporation Confirmation (LWMS and Sewer Connection) (JobRef: 9269)

Hi Luke,

Thanks for the discussion and confirming receipt.

Could you also please confirm that the sewer query will be reviewed as part of this process?

Given the urgency, it would be appreciated if you could request that the relevant departments prioritise their review and provide a response as soon as possible.

Regards,

Sam Bowers
Senior Town Planner

ROWE GROUP
35 YEARS 1991 – 2026

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Northbridge WA 6003