GOVERNMENT OF WESTERN AUSTRALIA

Western Australian Planning Commission

Our Ref: 833-2-24-69 (RLS/0977/1)
Your Ref: -
Enquiries: Anthony Muscara (6551 9441)

Chief Executive Officer
City of Kalamunda
PO Box 42
KALAMUNDA WA 6926

Dear Sir/Madam

Proposed MRS Amendment
Wattle Grove South Precinct
Request for Preliminary Comment

Please find enclosed a thumb drive containing a report in support of a proposed amendment for the abovementioned area in the Metropolitan Region Scheme. It would be appreciated if you could provide any preliminary comments your organisation may have on the proposal by Friday 6 August 2021.

Once your comments have been reviewed, a report may be presented to the Western Australian Planning Commission recommending the initiation of an amendment to the Metropolitan Region Scheme. Should an amendment be initiated, we will again contact you seeking your formal comment on the amendment proposal.

If you have any queries regarding the proposed amendment, please email Anthony Muscara at anthony.muscara@dplh.wa.gov.au.

Yours faithfully

Ms Sam Fagan
Secretary
Western Australian Planning Commission

6 July 2021

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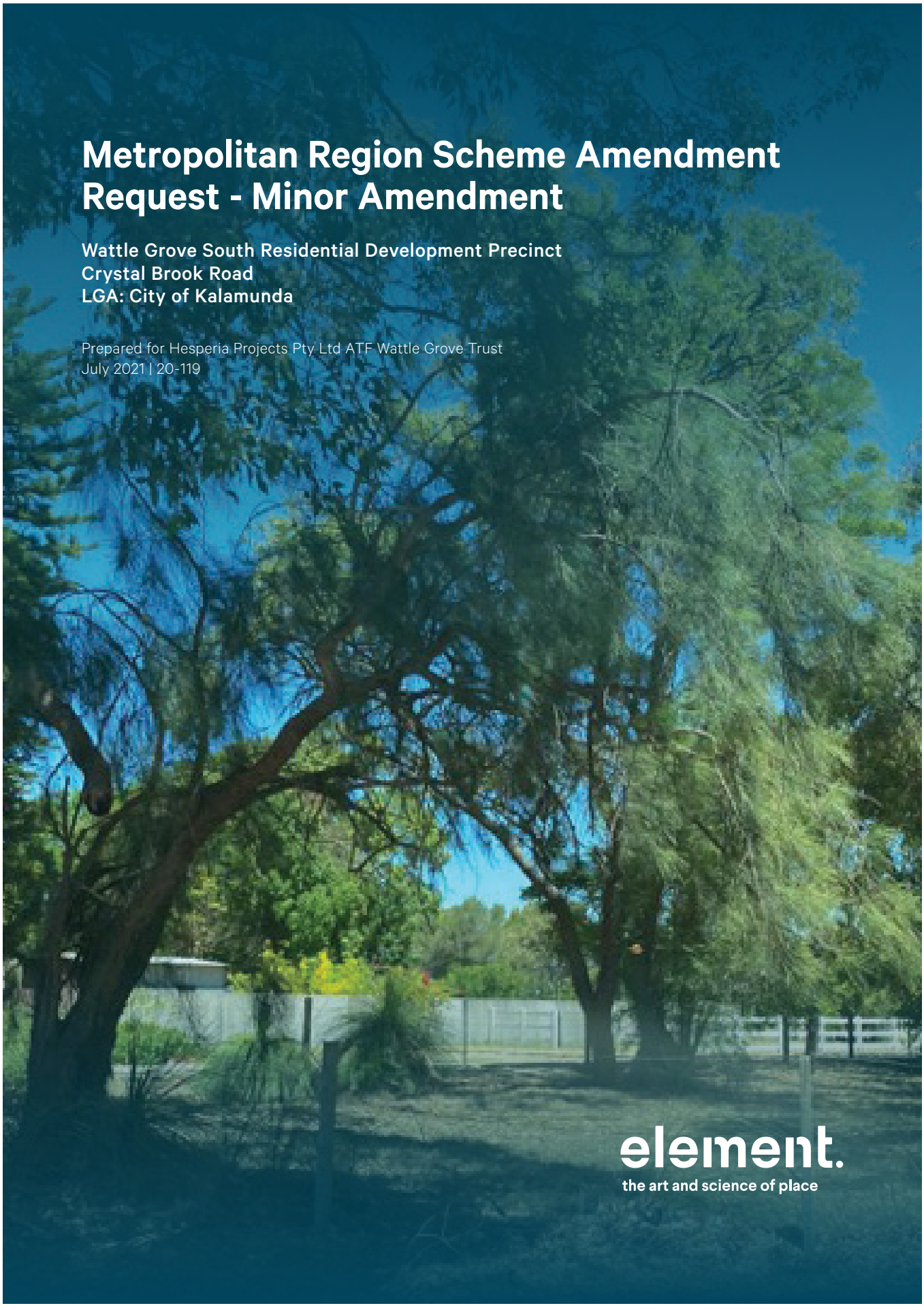
ABN 35 482 341 493



Metropolitan Region Scheme Amendment Request - Minor Amendment

Wattle Grove South Residential Development Precinct
Crystal Brook Road
LGA: City of Kalamunda

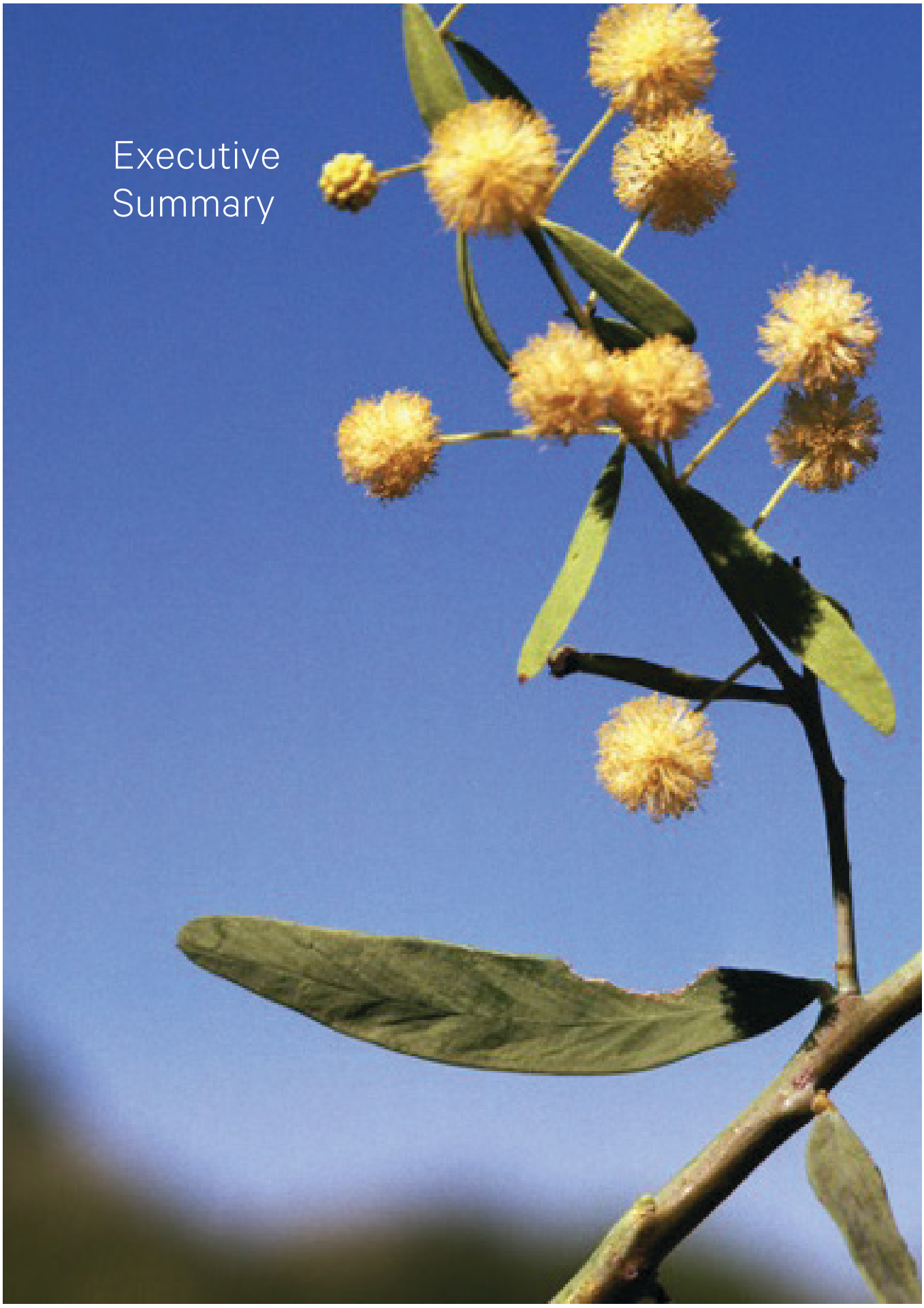
Prepared for Hesperia Projects Pty Ltd ATF Wattle Grove Trust
July 2021 | 20-119

element.
the art and science of place

We acknowledge the custodians of this land, the Whadjuk Nyoongar and their Elders past, present and emerging. We wish to acknowledge and respect their continuing culture and the contribution they make to the life of this city and this region.

Document ID: /Volumes/Graphics/2020/20-119 - Wattle Grove, Advice/00 Draft Report/Scheme Amendment/20-119 Metropolitan Region Scheme Amendment Request Folder

Issue	Date	Status	Prepared by	Approved by
1	15.06.21	Draft	Matt Raymond	Tony Paduano
2	02.07.21	Final	Matt Raymond	Tony Paduano


Executive
Summary

Hesperia Projects Pty Ltd ATF Wattle Grove Trust (Hesperia) proposes to rezone approximately 106ha of 'Rural' zoned land under the Metropolitan Region Scheme (MRS) which is generally located to the south of Crystal Brook Road in Wattle Grove to 'Urban'. Bounded by Welshpool Road East, Crystal Brook Road to the north, and Tonkin Highway to the west, the subject site is located within the City of Kalamunda, approximately 15 kilometres south-east of the Perth CBD and 14km south of Midland Strategic Metropolitan Centre. The proposed rezoning is consistent with the State strategic planning framework, as well as the Local Planning Strategy, which identify the area for urban expansion.

The proposal represents the first stage in the planning process which will ultimately deliver a unique residential master planned development for Wattle Grove South. Key elements of the project include:

- the retention and integration of existing good quality vegetation. The localised areas containing vegetation with the greatest environmental significance will be retained for conservation. The project will also maximise tree retention throughout the site and introduce substantial new tree planting to achieve significant tree canopy areas and local amenity as the site develops;
- the integration of innovative sustainable urban drainage and use for passive irrigation of the public realm setting the benchmark for future development in the area;
- the creation of landscape linkages, recreational nodes and circuits of pedestrian routes within the site and promote connections to the surrounding landscape; and
- the incorporation of best practice sustainability principles through EnviroDevelopment certification.

The area represents a consolidated area of the wider 'Urban Expansion' footprint identified by the Western Australian Planning Commission's (WAPC) *North-East Sub-Regional Planning Framework*. The WAPC's Frameworks identifies the following key considerations for the 'Crystal Brook Urban Investigation Area':

- geotechnical analysis/land suitability to provide connections to reticulated wastewater services;
- bushfire risk; and
- protection of significant environmental attributes.

The proposed boundaries of the urban area which forms this MRS amendment proposal is a direct response to these key considerations and in particular, feedback provided by the local community during the consideration of a draft conceptual masterplan for the broader Wattle Grove area, and the subsequent decision in late 2020 by the City of Kalamunda Council to reduce the urban development area to the south of Crystal Brook Road. In particular, this decision primarily responded to the higher quality environmental features associated with the Crystal Brook located to the north of Crystal Brook Road, which have subsequently been excluded from this proposal.

The proposed MRS amendment is consistent with the WAPC's Framework as it promotes an appropriate consolidated 'Urban' area as envisaged by the *North-East Sub-Regional Planning Framework*. The proposal advocates for a consolidated urban form, focusing residential development in an area with existing infrastructure, whilst protecting environmental features to create sustainable communities that will become attractive places to live and work. Development of the site for urban purposes represents the most efficient use of the land given:

- the subject sites strategic location in close proximity to the existing urban front;
- the capacity of existing and planned infrastructure and services;
- the future Forrestfield Train Station and nearby major arterial routes (e.g. Tonkin Highway and Roe Highway);
- it is in close proximity to employment hubs including the Maddington Kenwick Strategic Employment Area (MKSEA); and
- it is largely cleared with very few areas of good or better quality remnant vegetation.

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The MRS amendment for the 'Urban' zoning is deemed consistent with the aspirations documented in the City's Local Planning Strategy, and more broadly the WAPC's North-East Sub-Regional Planning Framework. The City of Kalamunda's Local Planning Strategy also identifies the subject site as an 'Investigation Area' where it envisages a range of densities:

> *Growth by 25,000 people accommodated as in scenarios 1 and 2 plus Residential Bushland development R5 (R2.5) of Special Rural land to the east of Hawtin Road/Lewis Road (R5) and Wattle Grove south of Welshpool Road to a range of densities (R2.5, R5, R20 and R30 in centre) and including a Neighbourhood Centre in Wattle Grove. At current development rates the final part of this scenario (Special Rural land to Urban) would be required by 2025.*

The subject site is currently zoned 'Special Rural' and 'Rural Composite' under the City of Kalamunda Local Planning Scheme No.3 (LPS3). It is proposed to concurrently rezone the subject site to the 'Residential Development' zone under LPS3, whilst coordinating the detailed design, including the protection and enhancement of identified environmental assets and land use allocations through the requisite structure plan.

The supporting information provided in this amendment report demonstrates that the subject site is capable of being rezoned for 'Urban' purposes without the need to go through the intervening stage of urban deferment:

- the land is capable of being provided with essential services;
- the proposed urban development area represents a logical progression of development. This will be formalised by a subsequent local structure plan; and
- the constraints relating to environmental issues (including retention of vegetation, drainage management and noise emissions) can be satisfactorily addressed.

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List of Appendices

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List of Figures

Abbreviations

Abbreviations used in this report are summarised below for ease of reference:

AHD Australian Height Datum (AHD)

CCW Conservation Category

DBCA Department of Biodiversity, Conservation and Attractions

DPLH Department of Planning Lands and Heritage

DRF Declared Rare Flora

DRF Declared, Rare and Priority Flora

DSP District Structure Plan

DWER Department of Water and Environment Regulation

DWMS District Water Management Strategy

LPS3 City of Kalamunda Local Planning Scheme No.3

LSP Local Structure Plan

LWMS Local Water Management Strategy

MKSEA Maddington Kenwick Strategic Employment Area

MRS Metropolitan Region Scheme

POS Public Open Space

REW Resource Enhancement wetlands

WAPC Western Australian Planning Commission

element.

Consultant Team

This rezoning application has been prepared on behalf of the landowners in association with Hesperia with input from the following consultants:

Consultant	Discipline
Hesperia and Activate Projects	Development project managers
element	Planning and urban design
EPCAD	Landscape design
Cardno	Traffic modelling and assessment
TABEC	Civil engineering and servicing
Hyd2o	Water management
Strategen JBS&G	Environmental investigations
Strategen JBS&G	Bushfire management
Horizon Heritage Management	Cultural heritage
MNG	Surveying

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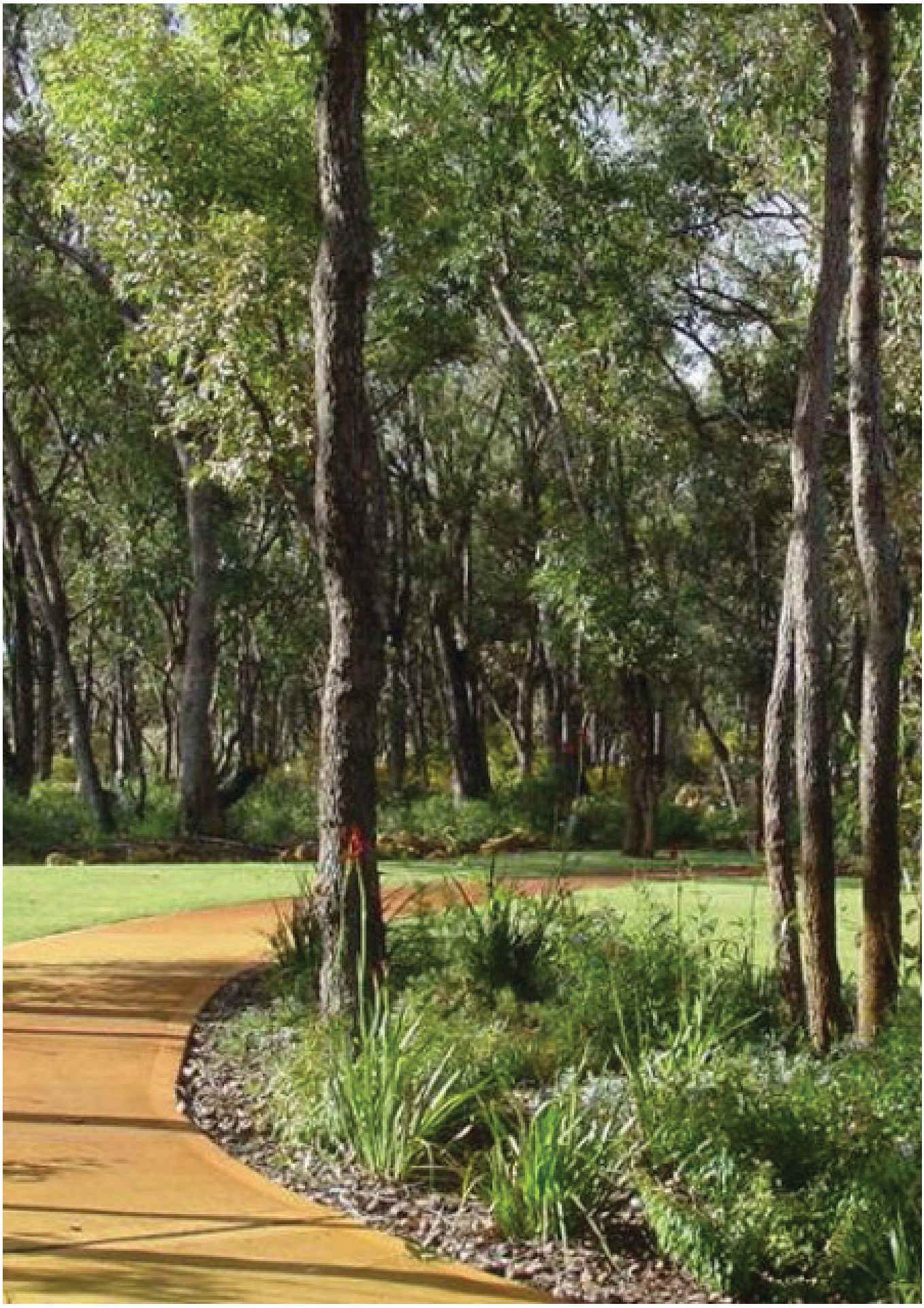

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1. Introduction

1.1 Purpose

The purpose of the amendment is to rezone multiple lots located south of Crystal Brook Road, Wattle Grove from 'Rural' to 'Urban' under the Metropolitan Region Scheme (MRS). The proposed amendment shall implement the majority of the urban zone earmarked under the Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework. The Framework currently identifies the majority of the broader Wattle Grove area as an Urban Expansion area.

The total land area subject of this MRS amendment is approximately 106ha. The amendment will facilitate further planning to enable the development of the subject site for residential purposes through a subsequent local structure plan and amendment to the City of Kalamunda Local Planning Scheme No.3 (LPS3) from 'Rural Composite' and 'Rural Residential' to 'Urban Development' zone. Preliminary discussions with the City of Kalamunda officers indicate the City would contemplate a concurrent rezoning of LPS3 to 'Residential Development' zone in accordance with section 126[3] of the *Planning and Development Act*.

Refer to Figure 1 – Amendment Proposal

1.2 Scope and Content of the Amendment

The amendment proposes to:

- Rezone the subject site from 'Rural' to 'Urban' zone: 106ha
- The total area subject of this amendment is approximately: 106ha.

Refer to Section 2.2 for complete list of lot details.

1.3 Substantiality

The *Planning and Development Act 2005* allows amendments to the MRS to be processed as either "minor" or "major" amendments depending on whether they are considered to constitute a substantial alteration to the MRS or not. This amendment is considered to meet the WAPC's 'minor' amendment criteria for the following reasons:

- The size and scale of the proposed amendment is not considered regionally significant as it does not reflect a regional change to the planning strategy or philosophy for the metropolitan region.
- The proposal aligns with the WAPC's *North-East Sub-Regional Planning Framework* which identifies the rezoning area as an Urban Expansion area.
- All service infrastructure can be readily provided to service the development via extensions to the existing network within the adjacent neighbourhood.

1.4 Pre-Lodgement Consultation

The project team have commenced pre-lodgement consultation with the various government and servicing agencies as part of its preparation of this proposal. This dialogue will continue through the pre-referral and referral processes of the MRS amendment proposal.

Figure 1 – Amendment Proposal

Figure 1. Amendment Proposal

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KEY

Excluded from Rural zone and included in Urban zone

Figure 1. Amendment Proposal

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2. Background

2.1 Location

The subject site is located within the south-eastern portion of the suburb Wattle Grove in the City of Kalamunda, approximately 15 kilometres south-east of the Perth CBD and 14km south of Midland Strategic Metropolitan Centre (refer Figure 2 – Location Plan). The subject site has direct access to Brentwood Road, Victoria Road, Crystal Brook Road, and Welshpool Road East. It is bounded by Crystal Brook Road and existing rural residential lots (north), Tonkin Highway (west), Boundary Road (north-west) and the City's border with the City of Gosnells (east).

Refer to Figure 2 – Location Plan

The subject site is situated within close proximity to established and future residential, commercial, public open space (POS) areas and services including:

- Residential development within the suburb of Forrestfield, located approximately 2km north of the subject site;
- Beckenham Train Station located approximately 4.5km south west of the subject site;
- Westfield Carousel located approximately 5km south west of the subject site;
- Hartfield Park Recreation Centre located approximately 700m north;
- Earmarked City of Gosnells District Open Space, located immediately adjacent to the south east boundary of the subject site;
- Lesmurdie National Park located 1.2km to the north east; and
- The site is located approximately 6km south of the future Forrestfield Train Station.

Refer to Figure 3 – Context Plan

Development of the site for urban purposes represents the most efficient use of the land given the subject land's strategic location in close proximity to the urban front, the capacity of existing infrastructure and services, the future Forrestfield Train Station and nearby major arterial routes (e.g. Tonkin Highway and Roe Highway). The subject land abuts the City of Gosnells Maddington Kenwick Strategic Employment Area (MKSEA) a developing general industrial/ business area.

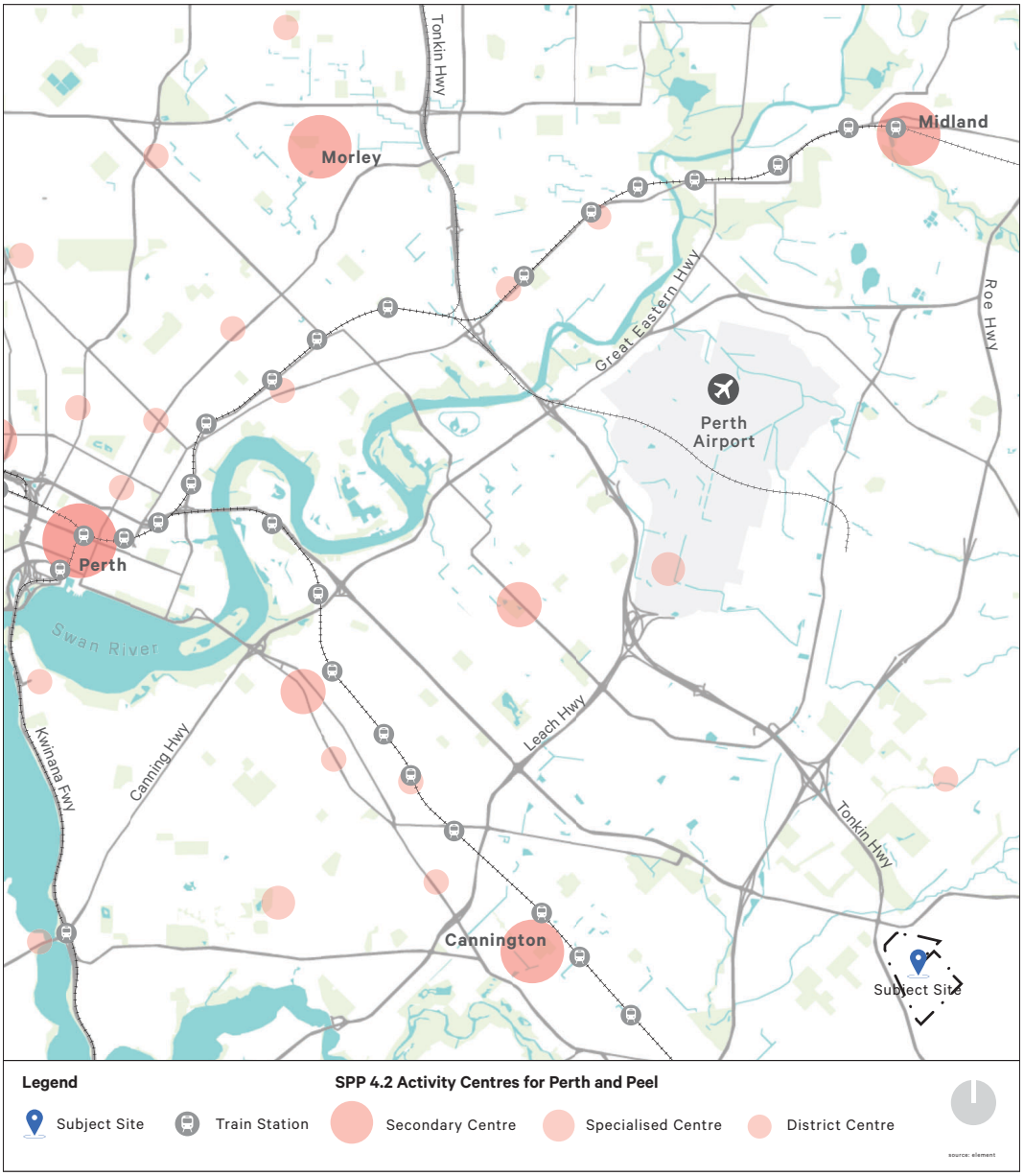

Figure 2. Location Plan

element.

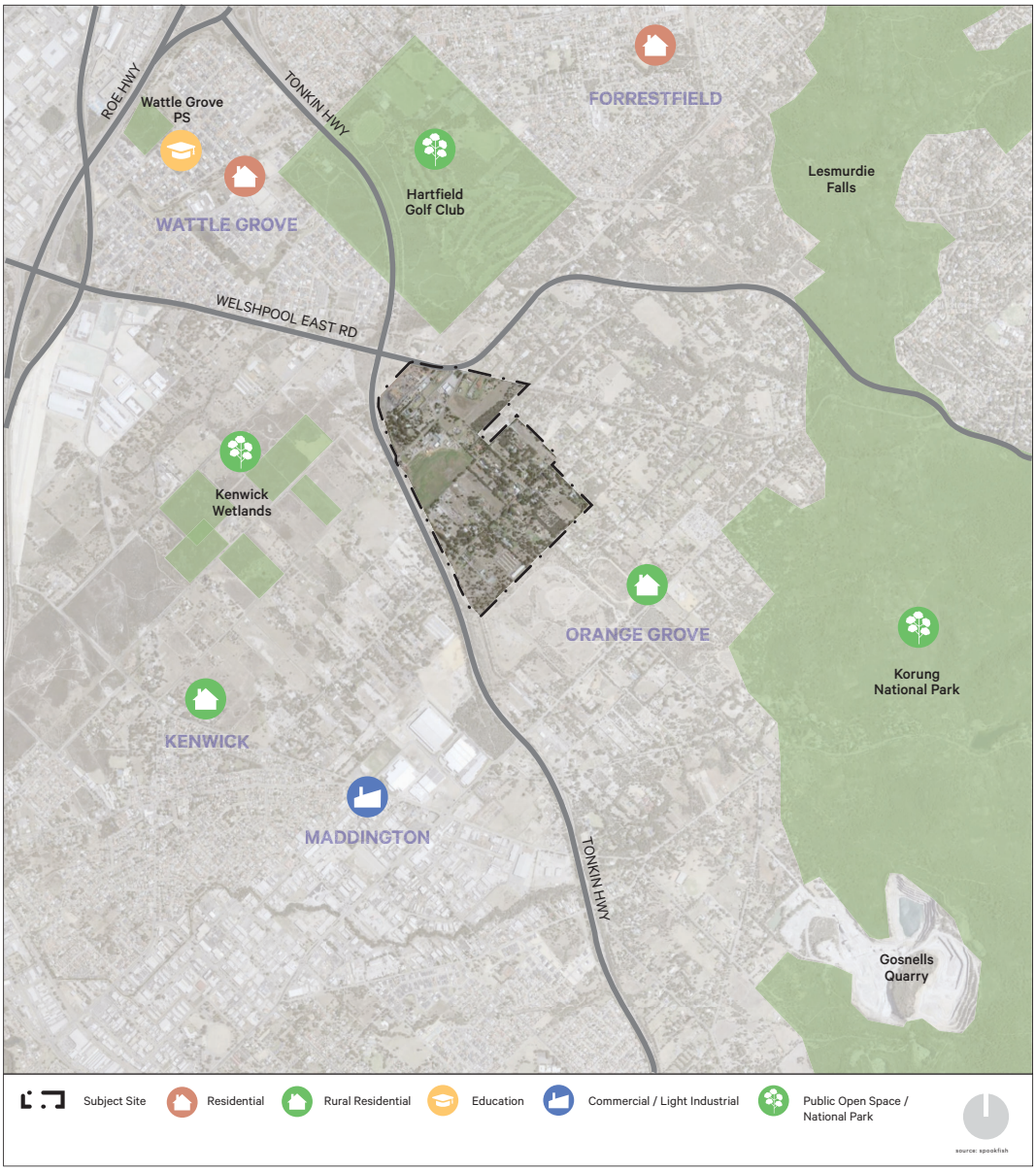

Figure 3. Context Plan

2.2 Title Details

The majority of the subject site is made of multiple privately held landholdings, with the Water Corporation owning a small portion adjacent to the Tonkin Highway road reserve.

Table 1: Certificate of Title Details

LOT	ADDRESS	PLAN	AREA (ha)	CERTIFICATE OF TITLE	AREA (ha)
1	16 Crystal Brook Road	D 89357	1.0001	2049/543	1.0001
1	71 Victoria Road	D 17111	0.8094	1899/178	0.8094
2	10 Crystal Brook Road	D 89357	1.0001	2049/544	1.0001
2	731 Welshpool Road East	D17824	1.4891	2095/458	1.4891
2	75 Victoria Road	D 20390	1.6189	1184/893	1.6189
3	101 Victoria Road	D 22344	2.0003	533/143A	2.0003
3	4 Crystal Brook Road	D 89357	1.0005	2049/545	1.0005
3	48 Victoria Road	D 24545	2.0286	1279/390	2.0286
4	15 Brentwood Road	D 89357	1.7082	2049/546	1.7082
4	95 Victoria Road	D 22344	2.0682	1260/435	2.0682
6	66 Victoria Road	D 36699	2.0291	2086/347	2.0291
7	112 Victoria Road	D 38638	2.0306	303/193A	2.0306
8	30 Brentwood Road	D 78133	1.0028	1880/97	1.0028
9	38 Brentwood Road	D 78133	1.0000	1880/98	1.0000
12	135 Victoria Road	D 20055	1.0270	1468/687	1.0270
12	60 Brentwood Road	D69292	2.7161	1719/145	2.7161
13	50 Brentwood Road	D69293	1.4712	1719/146	1.4712
17	100 Victoria Road	DP 31257	1.0290	2525/515	1.0290
21	102 Victoria Road	DP 31257	1.0000	2525/516	1.0000
41	83 Victoria Road	DP 73806	2.0359	2883/197	2.0359
51	87 Victoria Road	DP 410912	1.0000	2942/341	1.0000
52	89 Victoria Road	DP 410912	1.0337	2942/342	1.0337
53	63 Brentwood Road	D61568	2.0320	1602/152	2.0320
54	96 Victoria Road	D 75466	2.0306	1854/759	2.0306
55	90 Victoria Road	D 75466	2.0290	1854/760	2.0290
56	70 Victoria Road	D 82046	0.9757	2137/85	0.9757
81	54 Victoria Road	D 85279	1.0000	1996/451	1.0000
82	60 Victoria Road	D 85279	1.0004	1996/452	1.0004
83	56 Victoria Road	D 85279	1.0284	1996/455	1.0284
84	58 Victoria Road	D 85279	1.0287	2000/598	1.0287
89	78 Victoria Road	D 96434	4.1136	2137/84	4.1136
100	125 Victoria Road	D 72046	2.0315	1787/877	2.0315
100	20 Brentwood Road	D78132	1.0001	1890/322	1.0001
101	121 Victoria Road	D 72046	2.0308	1787/878	2.0308
101	14 Brentwood Road	D 78132	1.1687	1890/323	1.1687
106	126 Victoria Road	D 58020	1.8714	1555/885	1.8714
107	122 Victoria Road	D 85261	1.0873	2010/934	1.0873
108	120 Victoria Road	D 85261	0.9458	2010/935	0.9458

LOT	ADDRESS	PLAN	AREA (ha)	CERTIFICATE OF TITLE	AREA (ha)
146	721 Welshpool Road East	P3380	3.2908	1877/347	3.2908
210	30 Crystal Brook Road	P 3380	4.9493	1083/183	4.9493
213	41 Brentwood Road	P3380	4.0625	1104/948	4.0625
214	53 Brentwood Road	P3380	4.0619	1234/524	4.0619
249	131 Victoria Road	P 3380	3.9004	1219/312	3.9004
251	111 Victoria Road	P 3380	4.0646	1978/845	4.0646
254	79 Victoria Road	P 3380	1.6467	1184/894	1.6467
255	61 Victoria Road	P 3380	2.0804	1711/245	2.0804
262	86 Victoria Road	P 3380	1.0001	2112/497	1.0001
264	108 Victoria Road	P 3380	2.0305	1877/577	2.0305
266	128 Victoria Road	P 3380	1.0383	1608/726	1.0383
303	69 Brentwood Road	D100106	3.0731	2199/265	3.0731
340	65 Victoria Road	D 68789	1.9996	1711/244	1.9996
501	31 Brentwood Road	P 27676	1.0133	2515/874	1.0133
502	25 Brentwood Road	P 27676	1.0295	2515/875	1.0295
502	53 Victoria Road	D 89202	0.8976	2067/367	0.8976
503	23 Brentwood Road	P 27676	1.0422	2515/876	1.0422
503	57 Victoria Road	D 89202	1.0033	2067/368	1.0033
504	21 Brentwood Road	P 27676	1.0998	2515/877	1.0998
880	739 Welshpool Road East	P41806	1.1483	2576/720	1.1483
881	737 Welshpool Road East	P41806	1.1196	2576/721	1.1196

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) and its associated easement sits adjacent to the Tonkin Highway road reserve. Easements apply to Lots 12, 146, 53, 303, 107, 106, 266, and 249. The DBNGP corridor and associated easements will not be impacted through this MRS amendment proposal.

Refer to Figure 4 – Existing lots located within proposed MRS amendment proposal

2.3 Site Characteristics and Land Uses

Most of the lots within the subject site are rural residential lifestyle properties or are vacant land and also contains composite business and limited horticulture activities (including a turf-farm). Historical aerial imagery over the site was taken in 1953, where a number of lots had already been subdivided and cleared for rural land uses including pasture and horse and equestrian activities. There is some evidence of extraction activities in and adjacent to the south of the site between 1953 and 1974. Remnant vegetation remained present across many lots in the north and centre of the site prior to 1974, with some regrowth or planting also having occurred. The majority of the clearing within the site had been completed by 1995, and rural-residential development began around 2010 in the north and north west of the site.

Refer to Figure 5 – Aerial Photo

Historically the subject site included a former poultry farm, however, this land use ceased over a decade ago. A turf farm is located within the north-western portion of the site, and an interim interface may be required to be implemented until such time that this use ceases and/or it is developed for urban uses.

The subject site does not contain any waterways. It does contain a mapped resource enhancement wetland adjacent to Tonkin Highway in the southern corner of the turf farm, *(Resource Enhancement Wetland UFI 15257)* although from a review of the historical aerial photos confirms the wetland site has been cleared and filled and no longer exists. A second resource enhancement wetland is located at the northern end of the site adjacent to the Tonkin Highway and Welshpool Road intersection.

Figure 4. Existing lots located within proposed MRS amendment proposal

element.

Figure 5. Aerial Photo

2.3.1 Topography, Geology and Soils

Regional topographic contour mapping indicates that the site is relatively flat to undulating, with elevation ranging from 22 m Australian Height Datum (AHD) in the north of the site to 36 mAHD in the south.

The subject site is located between the Yule Brook Main Drain (approximately 200 m to the north) and Bickley Brook Main Drain (approximately 1.8 km to the south), which are both external to the site. Surface water is expected to drain from approximately southeast to northwest throughout the majority of the site, via existing flowpaths and culverts, toward the Yule Brook Main Drain and the Brixton Street Wetlands on the opposite side of Tonkin Highway.

The site is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia. The Swan Coastal Plain is described as a low-lying coastal plain which is often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

The site lies predominantly within the Pinjarra system, with the southern portion within the Forrestfield system. The site comprises three geomorphological units.

Refer to Appendix B – Environmental Assessment Report for further information.

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3. Planning Framework

The following section discusses the relevant strategic planning framework in the context of the MRS amendment proposal:

- Perth and Peel@3.5 Million and North East Sub-Regional Planning Framework;
- State Planning Policy No. 3 – Urban Growth and Settlement;
- City of Kalamunda Local Planning Strategy;
- City of Kalamunda Local Housing Strategy (Draft); and
- City of Kalamunda Local Planning Scheme No.3.

3.1 Perth and Peel@3.5 Million and North East Sub-Regional Planning Framework

The Perth and Peel @ 3.5 Million document provides strategic guidance to government agencies and local governments on land use, land supply, land development, environmental protection, infrastructure investment and the delivery of physical and community/social infrastructure for the Perth and Peel regions. The document seeks to meet the targets identified under Directions 2031 and the State Planning Strategy 2050. The suite of documents also includes four subregional planning frameworks for the Central, North-West, North-East and South Metropolitan Peel sub-regions. The four sub-regional planning frameworks detail where future homes and employment should be located, and where important environmental assets should be avoided and protected.

Refer to Figure 6 – Extract of North East Sub-Regional Planning Framework

The subject site is situated within the North East Sub-Regional Planning Framework and is identified for Urban land uses (Urban Expansion) consistent with the proposed MRS zoning. It is noted that a very small portion of the subject site, located close to the north-western boundary, is designated as 'Rural'. This appears to be an irregularity in the mapping, where it would be logical to round off the urban expansion precinct up to Boundary Road.

The Framework advocates for a consolidated urban form that focuses residential development in areas with existing infrastructure (or within identified service areas) which minimises environmental impacts to create sustainable communities that are attractive places to live and work.

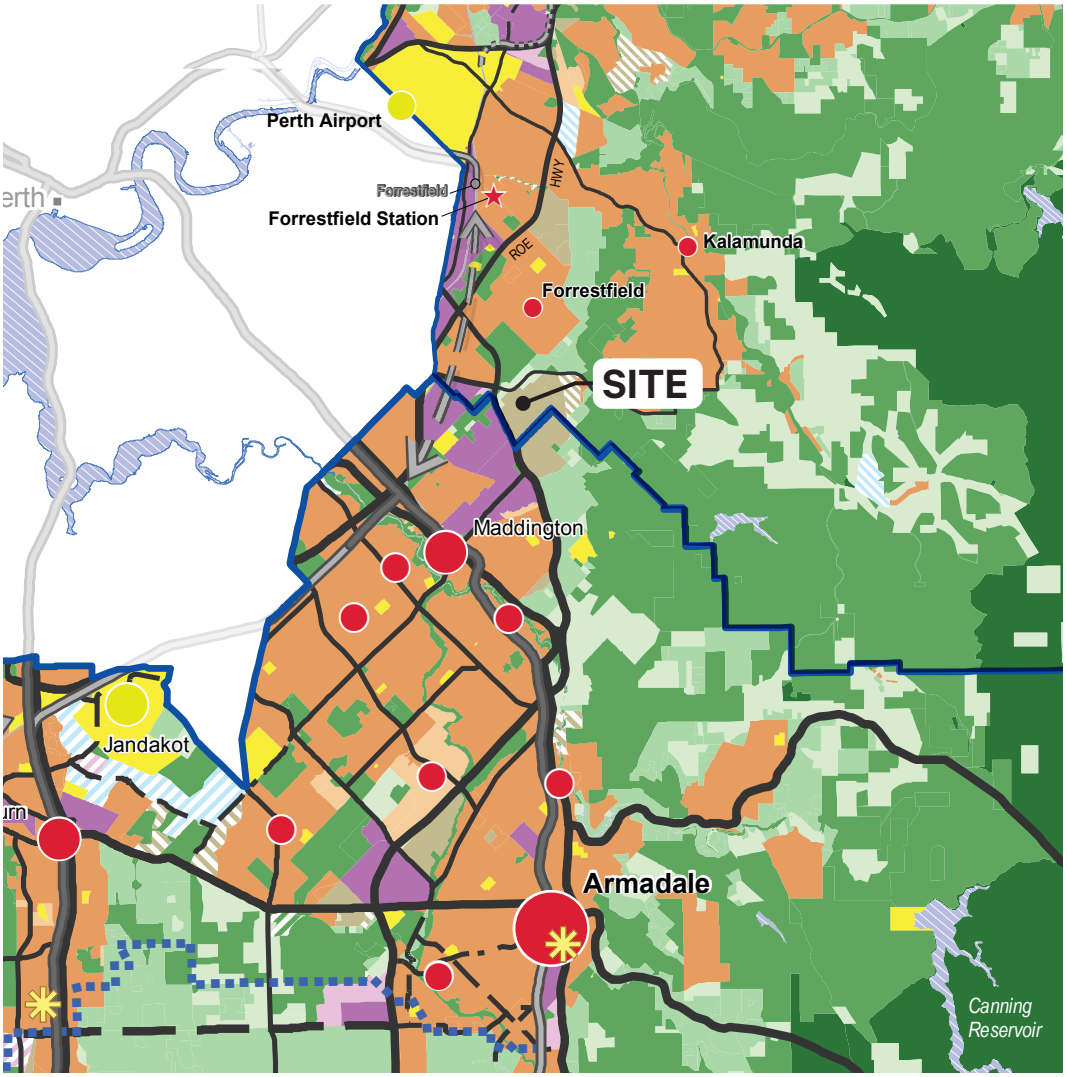
The Framework contains strategic priorities which seeks to provide development of under-utilised urban land that can be serviced with the required infrastructure and that is located in proximity to activity centres, transit corridors and/or areas of high amenity. In this regard the proposed amendment will allow for residential development in occur close proximity to existing road, strategic employment areas and urban infrastructure in accordance with the general intent of Perth and Peel@3.5 Million and the associated North-East Sub-regional Planning Framework. The Framework identifies the following key considerations for the Crystal Brook Urban Investigation Area:

- Geotechnical analysis/land suitability to provide connections to reticulated wastewater services;
- Bushfire risk; and
- Protection of significant environmental attributes.

These matters are considered and addressed as part of this MRS amendment request.

The Frameworks set out staging of urban development. The subject land is identified as 'Medium-Long (2022+)'. The Frameworks state as follows:

> *"the timeframes depicted on the urban staging plan set out the anticipated timing for commencement of development, aligned with planned service provision and should not be construed as preventing further detailed planning from occurring in the interim."*



Legend

- Sub-region boundary
- Swan Valley Planning Act boundary

Framework land uses

- Railway
- Urban
- Urban deferred
- Urban expansion
- Urban investigation (Refer to Table 2 for key considerations)
- City centre
- Industrial
- Industrial expansion
- Industrial investigation (Refer to Table 6 for key considerations)
- Rural residential
- Rural
- State forest
- Open space
- Open space investigation
- Public purposes
- Waterway
- Planning investigation (Refer to Table 3 for key considerations)

Regional roads (MRS)

- Existing
- Proposed

Rail

- Passenger rail/station - existing
- Passenger rail/station - proposed Stage 1 METRONET
- Passenger rail - further investigation
- Freight rail - proposed

NOTE: Transit corridors are shown on Plan 5

- Public purposes - proposed
- Proposed open space - sport

Activity centres

- Strategic metropolitan
- Secondary
- District
- Other (Classification to be determined by more detailed planning)
- Specialised

NOTE: This is a conceptual representation of broad planning intentions within the sub-region. Further planning processes and decision-making under relevant legislation will need to be undertaken, including with reference to amendment of statutory instruments and detailed planning.

Figure 6. Extract of North East Sub-Regional Planning Framework

element.

3.2 State Planning Policy No. 3 – Urban Growth and Settlement

State Planning Policy (SPP) 3.0 sets out the principles and considerations that guide the development of new urban growth and settlements. It focuses on consolidation in areas with good access to employment, services and transportation, minimised environmental impact and efficient use of suitable land and infrastructure.

The proposed amendment is consistent with SPP 3.0 as it will realise residential consolidation and intensification within an area of land that has immediate access to transport, services and employment. All essential services can be readily and efficiently connected from the immediate surrounding areas.

3.3 City of Kalamunda Local Planning Strategy

The City of Kalamunda's Local Planning Strategy provides a vision and strategic planning direction for the municipality over the next 20 years. Scenario 3 is the recommended scenario for the Local Planning Strategy. The subject site is identified in the Strategy as an 'Investigation Area':

> *Growth by 25,000 people accommodated as in scenarios 1 and 2 plus Residential Bushland development R5 (R2.5) of Special Rural land to the east of Hawtin Road/Lewis Road (R5) and Wattle Grove south of Welshpool Road to a range of densities (R2.5, R5, R20 and R30 in centre) and including a Neighbourhood Centre in Wattle Grove. At current development rates the final part of this scenario (Special Rural land to Urban) would be required by 2025.*

The proposed MRS amendment for the 'Urban' zoning is consistent with the aspirations documented in the City's Local Planning Strategy.

Refer to Figure 7: City of Kalamunda Local Planning Strategy

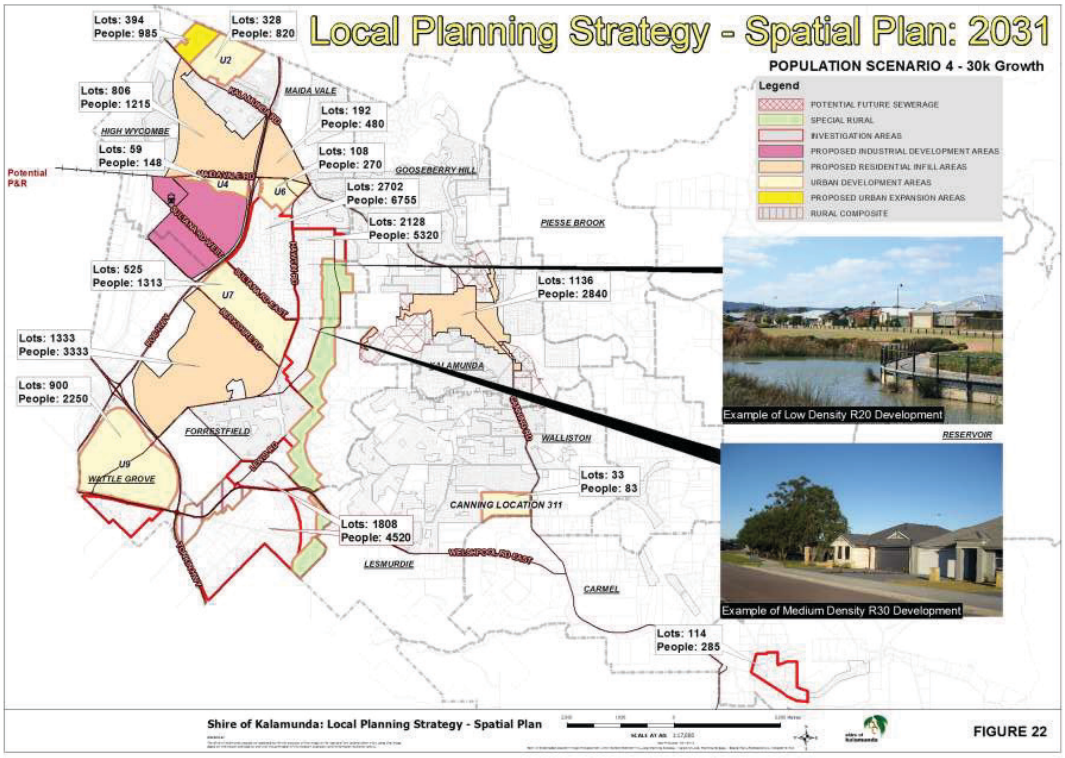


Figure 7. City of Kalamunda Local Planning Strategy

3.4 City of Kalamunda Local Housing Strategy (Draft)

The draft Local Housing Strategy adopted by the City of Kalamunda outlines the future housing needs of current and future residents. The Local Housing Strategy has reviewed State Government policies and strategies, to ensure density and dwelling targets are met by the City. The objectives of the strategy are to ensure new development and infill development is implemented in a manner which complements the amenity of the local region, while providing diverse housing for the community. The document identifies the subject site as an Investigation Area. According to the City, the final version of the document will note Council's determination on the recent Concept Plan's strategic intent, principles and content for the project area.

According to the draft Strategy, Forrestfield, Wattle Grove, Maida Vale and High Wycombe are anticipated to experience the largest increase in the number of new dwellings, as a result of new developments and urban renewal.

Refer to Figure 8: City of Kalamunda Draft Local Housing Strategy – Investigation Areas

The draft Strategy provides estimated projected dwelling yields for the broader Wattle Grove South area, which includes areas both north and south of Crystal Brook Road *(refer to Section 8.2 of Draft Strategy, where the City's desktop projections are based on 280ha).* The draft Strategy contemplates four population growth scenarios, ranging between a residential dwelling yield of 560 - 4,200 dwellings based on housing density scenarios. As the proposed MRS amendment seeks to rezone only a portion of the land located to the south of Crystal Brook Road (estimated to be a total area of 106ha) this smaller footprint will yield a lessor number of dwellings (to be determined during the detailed design stage).

3.5 City of Kalamunda Local Planning Scheme No.3

The subject site is currently zoned 'Special Rural' and 'Rural composite' under the City of Kalamunda Local Planning Scheme No.3 (LPS3).

Refer to Figure 9: City of Kalamunda Local Planning Scheme No.3

It is proposed to concurrently rezone the subject site to the 'Urban Development' zone under LPS3. This shall enable the efficient implementation of the urban zone including a mechanism to ensure the identification, conservation and management of environmentally significant features, whilst coordinating the detailed design and land use allocations through the proposed structure plan. The objectives of the 'Urban Development' zone are:

- To provide orderly and proper planning through the preparation and adoption of a Structure Plan setting the overall design principles for the area.
- To permit the development of land for residential purposes and for commercial and other uses normally associated with residential development.

element.

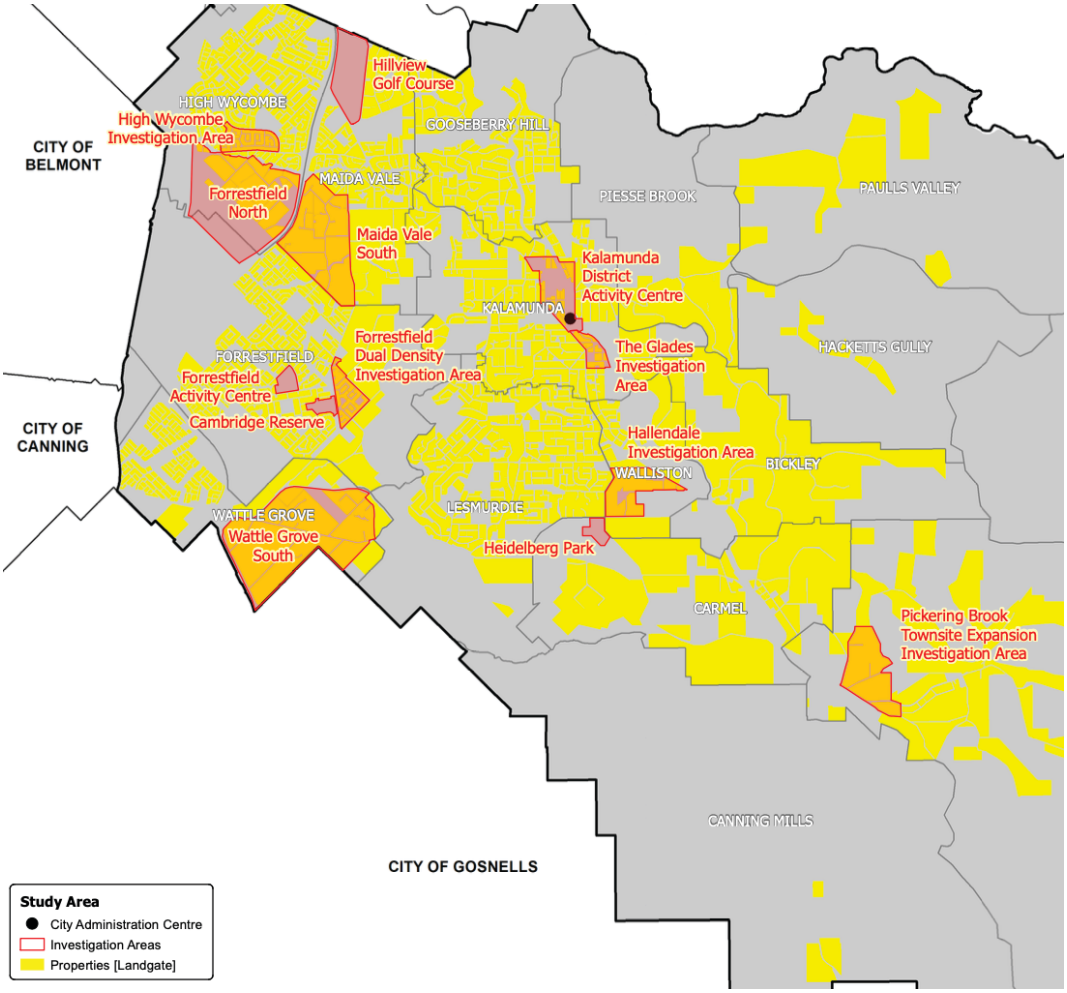


Figure 8. City of Kalamunda Draft Local Housing Strategy – Investigation Areas

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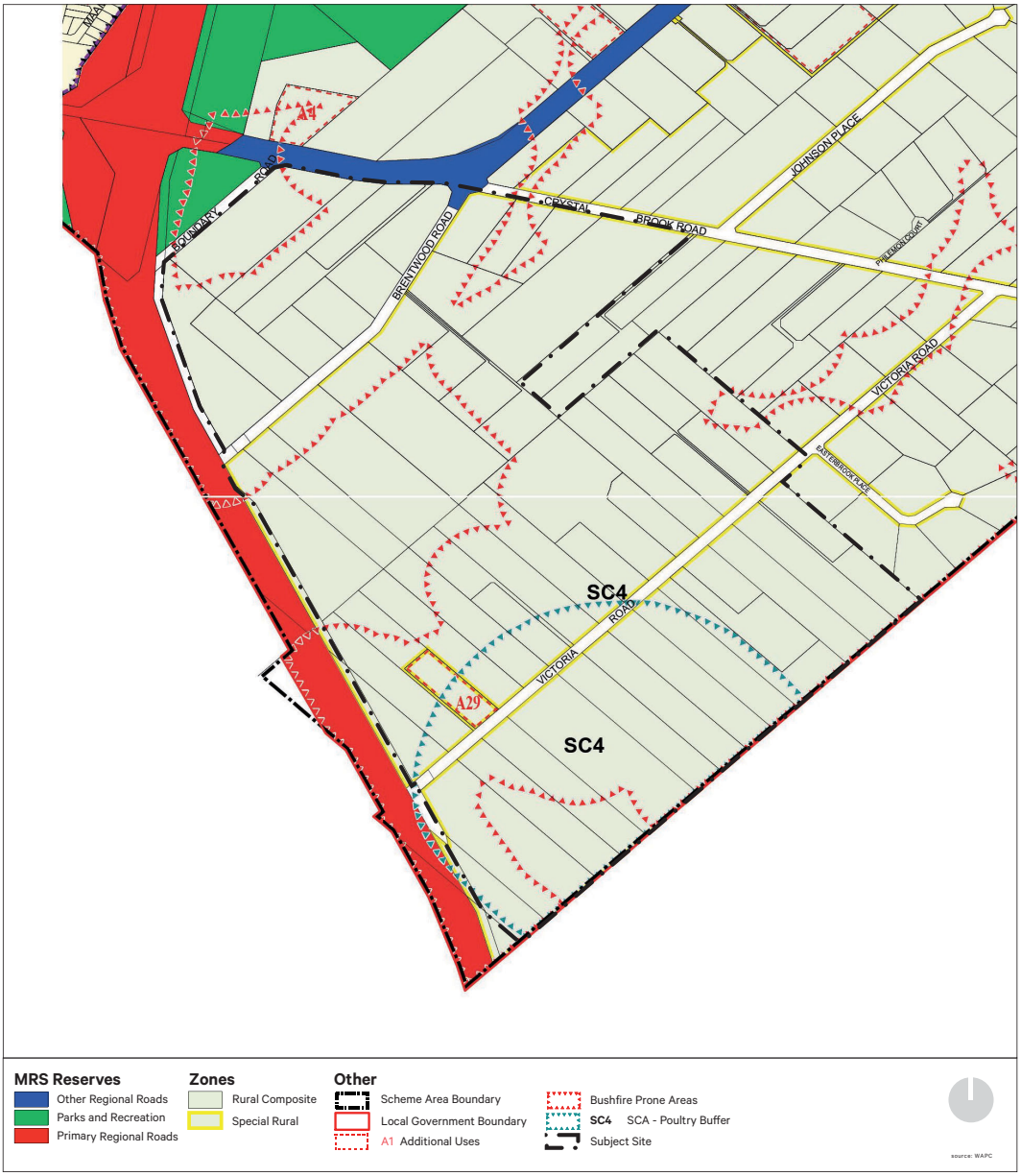

Figure 9. City of Kalamunda Local Planning Scheme No.3

element.

4. Environmental Considerations

The following section identifies the environmental site considerations and relevant environmental policy framework which apply to the MRS amendment area and its future planning. In addition, respective environmental project commitments are identified throughout this section (refer to blue coloured boxes), with the full list provided in section 10 (Structure Plan and Implementation) of this report, covering:

- Vegetation Management;
- Wetland Management;
- Stormwater Management;
- Bushfire Management;
- Noise Management; and
- Environmental Management.

4.1 Aircraft Noise - State Planning Policy 5.1 Land Use Planning In The Vicinity of Perth Airport

State Planning Policy 5.1 (SPP 5.1) is predicated on the Australian Noise Exposure Forecast (ANEF), which was prepared by Perth Airport Pty Ltd in consultation with Airservices Australia. The ANEF chart shows contours representing a forecast of future noise exposure around an airport that has been endorsed by Airservices Australia on the basis of approved operational arrangements and air traffic forecasts.

The rezoning area lies entirely outside the 2020 Ultimate ANEF contours (refer to Figure 10). Residential development can occur unrestricted within the subject site.

Refer to Figure 10 – Perth Airport 2020, Ultimate ANEF Contours (Source: Perth Airport, 02/06/2020)

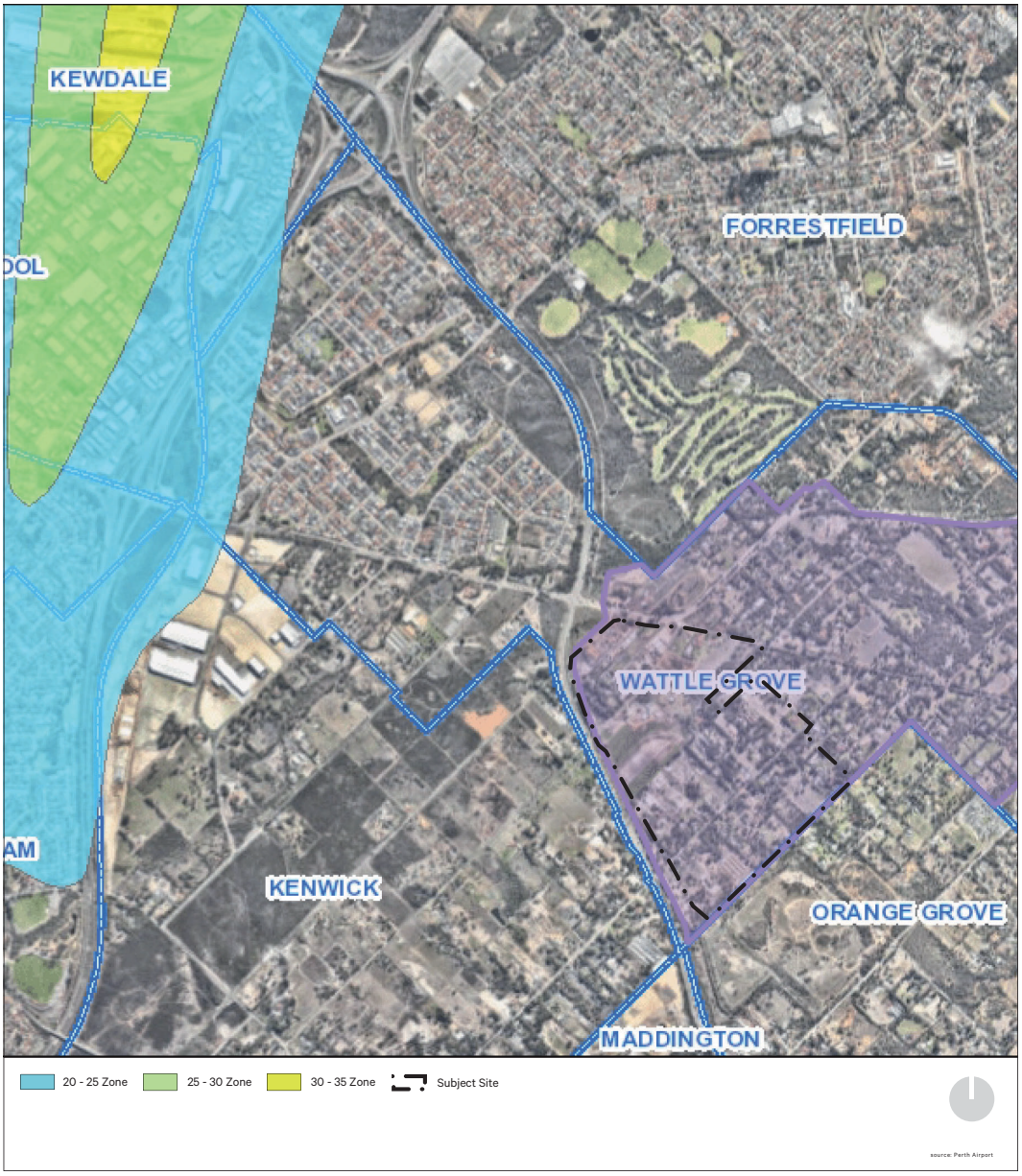

Figure 10. Perth Airport 2020, Ultimate ANEF Contours (Source: Perth Airport, 02/06/2020)

4.2 Neighbouring Land Use Considerations - Noise, Odour and Dust Emissions

Draft Statement of Planning Policy 4.1 provides guidance for considering proposals to rezone land for sensitive uses in the vicinity of, various industry types. The objectives of SPP 4.1 are to:

- protect existing and proposed industry, and infrastructure facilities from encroachment by incompatible land uses that would adversely affect efficient operations;
- avoid land use conflict between existing and proposed industry/ infrastructure facilities and sensitive land uses; and
- promote compatible land uses in areas impacted by existing and proposed industry and infrastructure facilities.

The proposed urban development area is located to the east of the proposed Maddington Kenwick Strategic Employment Area (MKSEA), and is separated by the existing Tonkin Highway road reserve and adjoining Dampier to Bunbury Natural Gas Pipeline easement corridor, providing a separation distance in excess of 120m.

MKSEA is to be developed for General Industry, with an emphasis on warehouse and logistics operations given its strategic location relative to key transport routes, and not as a heavy industrial area. Future land uses within the industrial area will therefore not result in industries associated with emissions considerations.

The EPA's Environmental Protection Guidance Statement No.3 Separation Distances Between Industrial and Sensitive Land Uses provides advice on which land uses require separation, and recommends suggested separation distances in the absence of site-specific modelling. The guidance outlines the EPA's suggestions on the application of separation distances for schemes and scheme amendments during the environmental impact assessment process.

Potential noise and odour emission sources located within and outside of the subject site have been identified as:

- an existing poultry farm;
- interim interface (if required) with the turf farm;
- Tonkin Highway; and
- existing dog kennels.

Refer to Figure 11 - Neighbouring Land Use Considerations (Source: Strategen JBS&G)

These land uses need to be understood in the context of the future urban development footprint. As a general principle, land use conflict should be considered at each stage of the planning framework, increasing in detail at each level, from the MRS amendment down to the structure plan, detailed subdivision design and building stages. These matters are discussed below.

4.2.1 Poultry Farms

Historically the subject site was affected by the operations of two poultry farms, however, one of these former poultry farms is no longer operational and the second will cease operation to enable the redevelopment of the farm to an alternative strategic employment related land use:

Table 2: Poultry Farm Locations

Address	Comments	Implications to Urban Zone
Former Poultry Farm No. 1 Lot 251 (111) Victoria Road, Wattle Grove (City of Kalamunda), within the subject site.	Special Control Area (SCA) applied under the City of Kalamunda LPS No. 3 within a buffer of 300m. This facility has ceased operations.	None
Poultry Farm No.2 127 Victoria Road, Kenwick (City of Gosnells)	500m applied under the City of Gosnells TPS.5. This facility will cease operations prior to residential development occurring.	None

Refer to Figure 11 - Neighbouring Land Use Considerations (Source: Strategen JBS&G)

Based on the above review of poultry farm operations (existing and historic), the proposed MRS amendment for 'Urban' is not compromised.

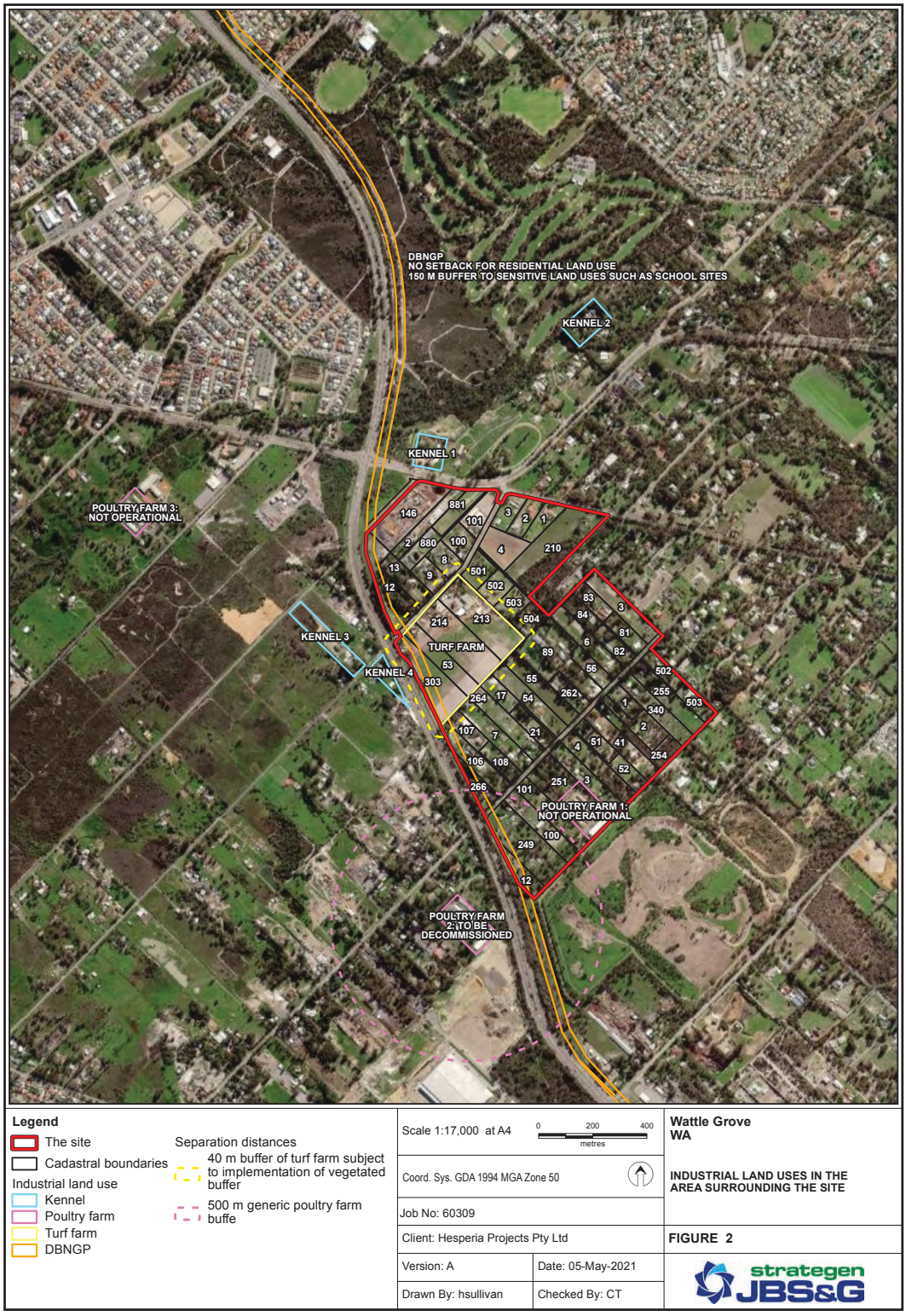

Figure 11. Neighbouring Land Use Considerations (Source: Strategen JBS&G)

4.2.2 Turf Farm

A turf farm is located within the subject site, situated across Lots 303, 53, 214 and 213 to the south of Brentwood Road. Ultimately it is the intent for this operation to cease operations to enable the landowner to redevelop the land for residential purposes, however, an interim interface may be required.

Refer to Figure 11 - Neighbouring Land Use Considerations (Source: Strategen JBS&G)

The EPA applies a guiding generic separation distance of 500m due to potential dust, odour and noise impacts. These generic separation distances are subject to site-specific investigations. The Department of Health further defines how site-specific operations and associated buffers are defined. The Department has largely adopted the best practice standards described by the Queensland Department of National Resources in their Planning guidelines: separating agricultural and residential land uses – August 1997 and supported by CSIRO (2002), which applies a baseline of 300m separation distance for the control of spray drift. This can be reduced down to 40m where a vegetative buffer has been designed, implemented and managed. This level of detail will be addressed at the future structure planning stage and through the staged implementation of the residential estate.

Should the turf farm operations continue in the medium term, a number of interim measures will be required to be implemented to ensure the Department of Health, the Department of Water and Environmental Regulation and the City of Kalamunda are satisfied with the future release of residential lots. This includes:

- Implementation of a suitable design interface and spatial buffer between the turf farm and residential lots; and
- Coordinated staged release of residential lots, providing a suitable spatial buffer from the turf farm.

4.2.3 Road Noise

The subject site abouts Tonkin Highway road reserve. Provisions of the WAPC's *State Planning Policy 5.4 - Road and Rail Noise (SPP 5.4)* will need to be adhered to. The purpose of SPP 5.4 is to minimise the adverse impact of road and rail noise on noise-sensitive land-use and/ or development within the specified trigger distance of strategic freight and major traffic routes and other significant freight and traffic routes. Under the SPP 5.4 the appropriate criteria for assessment is:

- **EXTERNAL**
  LAeq(Day) of 60 dB(A);
  LAeq(Night) of 55 dB(A).
- **INTERNAL**
  LAeq(Day) of 40 dB(A) in living and work areas; and
  LAeq(Night) of 35 dB(A) in bedrooms.

Additional to the above, noise received at an outdoor area should also be reduced as far as practicable, with an aim of achieving an LAeq of 50 dB(A) during the night period. For residential developments, the possible noise amelioration options that are normally considered are:

- Noise walls.
- Quiet House design applied to those affected houses, normally the closest to the source of the emissions.

A Transportation Noise Assessment will be prepared to support the local structure plan in accordance with the requirements of SPP 5.4 to assess noise levels in the vicinity of major roads. Any perceived potential impacts of noise emissions from the Highway can be directly addressed through a number of design and management tools when planning the future stages of the Wattle Grove South precinct, including but not limited to:

- Road traffic noise walls will be required to minimise road traffic noise from Tonkin Highway.
- Design, orientation and configuration of lots.
- Quiet House Packages will be incorporated as part of road traffic noise mitigation. These packages generally consist of upgraded glazing.
- Notifications placed on lot titles where the noise level exceeds the assigned noise levels advising of the potential noise. Note that the extent of affected lots is to be determined when modelling includes road traffic noise walls and future buildings.

The above noise mitigation and notification measures will be reviewed as further detailed planning for the residential precinct is progressed, and detailed modelling being undertaken based on the final structure plan design and anticipated built form. On the basis of the above, the proposed rezoning to 'Urban' under the MRS can proceed unfettered.

4.2.4 Kennels

There are currently four dog kennels located outside of the subject site, as identified in Table 3.

Table 3: Kennel Locations and Closest Existing Sensitive Receptor (Dwellings)

Address	Comments
Kennel No. 1 Swan Animal Haven 714 Welshpool Road East, Wattle Grove (City of Kalamunda)	Located 60m to an existing dwelling.
Kennel No. 2 Paws Claws and Beaks Retreat 810 Welshpool Road East, Wattle Grove (City of Kalamunda)	Located 120m to an existing dwelling.
Kennel No.3 Allbreeds K9 Bootcamp and Pet Retreat Brentwood Road, Kenwick (City of Gosnells)	Located 60m to an existing dwelling.
Kennel No.4 Blue cross Animal Services 207 Brentwood Road, Kenwick (City of Gosnells)	Located 70m to an existing dwelling.

Refer to Figure 11 - Neighbouring Land Use Considerations (Source: Strategen JBS&G)

Dog kennel operations are managed/monitored by the City of Kalamunda and the City of Gosnells. The approvals issued by the City require the operators to meet their respective conditions of operation, including noise emissions received by existing dwellings. These conditions of operation are applied to the four kennels identified in Table 3.

The proposed urban development footprint of the Wattle Grove South precinct is located further away from the kennels and the existing sensitive receptors. Since each of these kennels is required to achieve noise emission compliance at existing residences (generally located within 60m of the kennels) the development itself does not encroach within the existing effective buffer.

A noise impact assessment for the proposed rezoning area will be undertaken as part of a broader noise analysis to account for future sensitive noise receptors (dwellings). This will include a contextual assessment of existing background noise where the periphery of the subject site is currently affected by road noise (the Noise Regulations take into consideration background noise from road traffic to some extent by way of a transport factor). This will factor in noise abatement initiatives including a noise wall along Tonkin Highway.

Project Commitment:

A site-specific noise assessment shall be undertaken in relation to traffic noise associated with Tonkin Highway and/or existing dog kennels.

The noise assessment is to identify the range of noise mitigation measures that will be applied, such as noise barriers (noise walls) to the Tonkin Highway and potentially acoustic glazing, which can ensure that the future proposed urban land use will have an acceptable level of amenity.

Should proposed residences be adversely affected by noise stemming from the southbound carriageway to Tonkin Highway, notifications on title may be required.

4.3 Natural Gas Pipeline

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) runs inside the western boundary of the subject site, intersecting eight lots. The development of land within the DBNGP corridor is subject to restrictions originating under the Petroleum Pipelines Act 1969, Energy Coordination Act 1994 and the Dampier to Bunbury Pipeline Act 1997. Planning Bulletin 87: High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region (WAPC 2007) and subsequent draft DC Policy 4.3 – Planning for High-Pressure Gas Pipelines (WAPC 2016) seek to protect people from unacceptable levels of risk by protecting high pressure gas pipelines from unregulated encroachment. The draft DC 4.3 policy replaces PB 87. The Australian Gas Infrastructure Group (management authority of the DBNGP) has been consulted regarding the proposed residential development which will interface with the existing pipeline easement in the context of required building setbacks. The Australian Gas Infrastructure Group has confirmed a '0'm setback applies to residential lots adjacent to the easement, whilst a 150m separation distance may apply to sensitive land uses in the absence of a Quantitative Risk Assessment that identifies that a reduced setback is possible. This existing infrastructure and associated separation distances can therefore be accommodated as part of the 'Urban' zone, and integrated as part of the subsequent structure planning and subdivision stages.

4.4 Biodiversity and Natural Assets

The existing environmental values of the site have been widely documented over the last 3 years by various consultants. The following reports have been undertaken:

- 360 Environmental (2018) Environmental Assessment Report;
- AECOM (2020) Wattle Grove Ecological Surveys;
- URBAQUA (2020) Wattle Grove South Water Monitoring Report
- Strategen-JBS&G (2021) Environmental Assessment Report (including significant tree and black cockatoo habitat assessment); and
- Hyd2o (2021) District Water Management Plan.

Based on the environmental values identified within the site, Strategen JBS&G conclude that any environmental factors relating to the site can be appropriately avoided or minimised through detailed design undertaken as part of the future planning process. Strategen JBS&G also conclude that on this basis there are no significant environmental issues located within or identified external to the rezoning area which would prevent it from being rezoned from 'Rural' to 'Urban' under the MRS.

Refer to Appendix B: Environmental Assessment Report for further information.

A summary of the key matters addressed in the Environmental Assessment Report is provided below in the following section.

4.4.1 Flora and Vegetation

Vegetation in the subject site is highly fragmented, consisting of limited areas of remnant native vegetation separated by significantly altered areas containing a combination of cleared and parkland cleared areas.

Refer to Figure 12: Vegetation Condition Mapping

Some remnant native trees are scattered throughout the site, however, the majority of trees are non-native or exotic trees, such as planted eastern states species, including Corymbia citriodora (lemon scented gum) or foreign taxa such as Melia azedarach (cape lilac).

Vegetation within the subject site ranges from Completely Degraded to Excellent, with the Excellent and Very Good vegetation reflecting remnant vegetation occurring in limited localised areas within portions of some private lots. The areas of higher quality vegetation that have conservation value will be retained in Conservation Public Open Space, within public ownership for preservation and management by the City of Kalamunda.

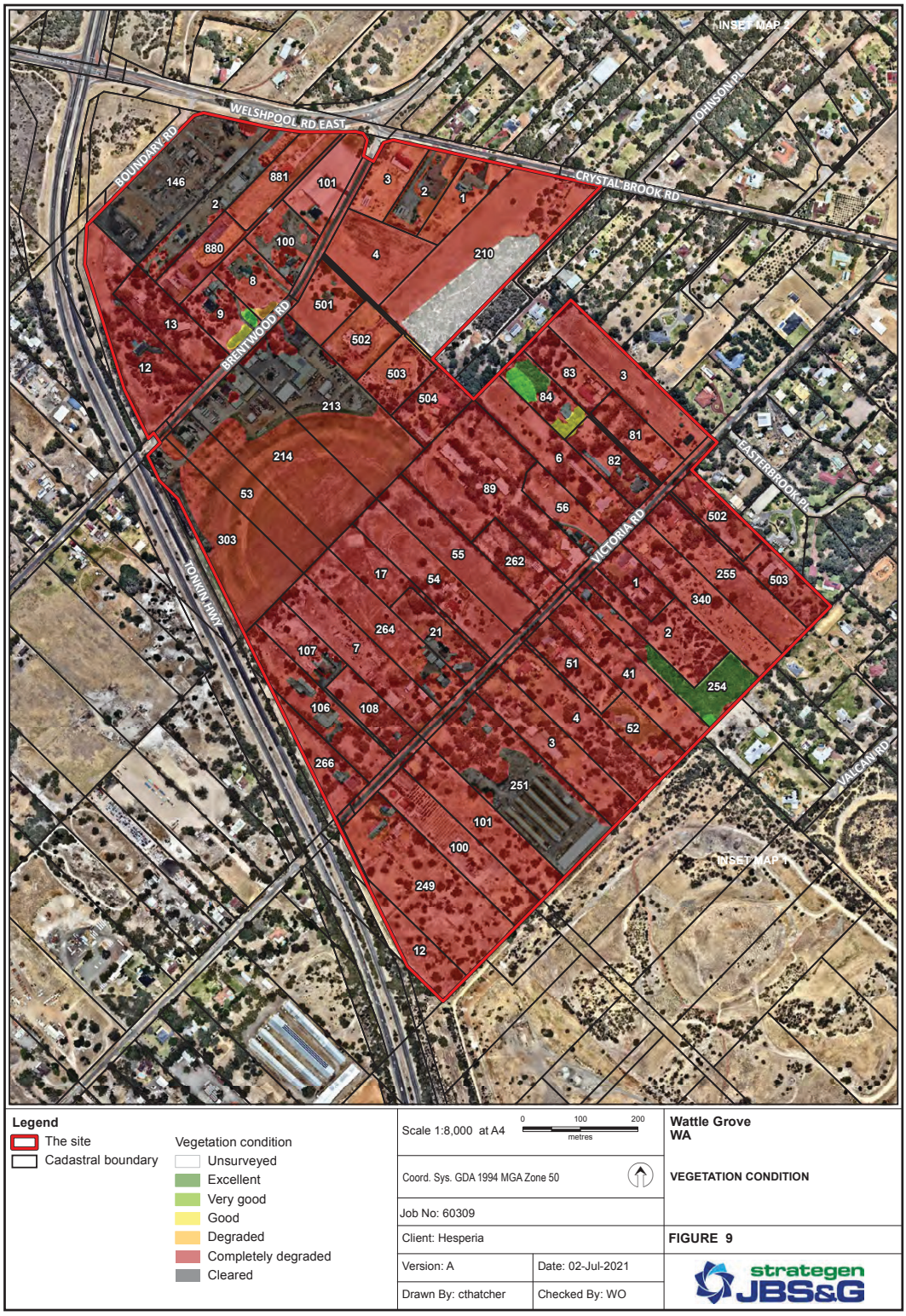

Figure 12. Vegetation Condition Mapping

4.4.2 Fauna and Habitat

Due to the subject site being mostly cleared of native vegetation and used for rural purposes, it is not likely that it would offer large areas of valuable intact habitat. The surrounding environment is also representative of clearing and rural land uses containing modified vegetation to the north, west and south of the site. Large areas of intact vegetation area located to the east of the subject site and are considered to provide better fauna habitat than the site itself (360 Environmental 2018).

Foraging habitat identified within the Survey Area is considered to generally have 'low' to 'low to moderate' foraging habitat value for Carnaby's Cockatoo and low foraging habitat value for Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo, based on the type and density of suitable foraging species. Limited areas identified as having 'moderate' foraging habitat value coincide with the areas of remnant vegetation that will be retained. The subject site represents <0.1% of the existing native vegetation within the local area (15 km radius) and Carnaby's Black Cockatoo breeding sites are known from within a 15 km radius.

The Rainbow Bee-eater (Merops ornatus) and Southern Brown Bandicoot (Isoodon obesulus fusciventer) have historically been recorded within the areas of higher quality remnant vegetation that will be retained in Conservation Public Open Space areas within public ownership for preservation and management by the City of Kalamunda.

4.4.3 Ecological communities and conservation significant flora

Banksia Woodlands on the Swan Coastal Plain (including limited areas of FCT20a and SCP20b) were the only conservation significant ecological communities identified within the survey area. These listed ecological communities were highly fragmented and restricted to small patches of remnant vegetation amongst housing and semi-rural properties. Notwithstanding, these areas coincide with the areas of higher quality remnant vegetation and will be retained in Conservation Public Open Space areas within public ownership for preservation and management by the City of Kalamunda.

The survey area also identified two conservation significant flora taxa, being Conospermum undulatum (T) and Isopogon autumnalis (P3) (previously named Isopogon drummondii), concentrated in two localised areas within the site. These two areas also coincide with the areas of higher quality remnant vegetation and will be retained in Conservation Public Open Space areas within public ownership for preservation and management by the City of Kalamunda.

Project Commitment:

Portions of Lot 210 Crystal Brook Road and Lots 2 and 254 Victoria Road containing native vegetation with significant environmental values as identified in the Environmental Assessment Report (Strategen 2021) are to be designated as Public Open Space – 'Nature POS' for the benefit of Conservation and ceded to the City of Kalamunda in order to protect and preserve native vegetation or other special flora or fauna qualities.

The acquisition and funding of the 'Nature POS' areas shall be undertaken in accordance with WAPC Development Control Policy 2.3 'Public Open Space in Residential Areas' (2002); WAPC Position Statement 'Cash-in-Lieu of Public Open Space'; and the City of Kalamunda Local Planning Policy 32 'Local Open Space'.

4.5 Conservation Areas - Bush Forever (State Planning Policy 2.8 - Bushland Policy for the Perth Metropolitan Region)

State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region (SPP 2.8) aims to provide a policy and implementation framework that will ensure bushland protection and management issues are addressed and integrated with broader land use planning and decision-making. In general, the policy does not prevent development where it consistent with policy measures and other planning and environmental considerations. In accordance with SPP 2.8, proposals must recognise regionally significant bushland and outline methods by which it will avoid, minimise and offset any likely adverse impacts it will have on regionally significant bushland. The policy predominantly deals with two distinct subjects, Bush Forever areas and local bushland areas.

No Bush Forever sites occur within the subject site. The closest Bush Forever sites are located approximately 100 m to the northwest (Site 387, the Greater Brixton Street Wetlands) and 50 m to the northeast (Site 320, Hartfield Road Bushland), and will not be impacted by the proposed MRS rezoning. There are no DBCA managed lands within the subject site, with the nearest conservation reserve being the Brixton Street Wetlands, Kenwick, 100 m west of the subject site boundary on the opposite side of Tonkin Highway.

4.6 Regional Ecological Linkages

Ecological corridors have been identified in the Perth metropolitan region to limit the effects of fragmentation across areas of remnant bushland. Across the Project Area there is one Regional Ecological Linkage at the north-westernmost extent of the Project Area (Link ID: 40), which connects the Brixton Street Wetlands and the Hartfield Road Bushland (WALGA 2008). The very small portion of the subject site (portions of Lot 146 Welshpool Road East and Lot 12 Brentwood Road) falls within an Regional Ecological Linkage, however has been either developed, cleared or significantly altered.

Refer to Figure 13 - Regional Ecological Linkages (Source: Strategen JBS&G)

4.7 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for the Environment under section 15b of the *Environmental Protection Act 1986*. Eight ESAs are mapped within the subject site according to the dataset available through DWER (2020).

Many of the ESAs mapped within the subject site are associated with the locations of declared rare flora, however based on surveys undertaken by AECOM (2020) many of these areas have been historically cleared and the Threatened flora associated with the ESA boundary are no longer present. Accordingly, the corresponding ESAs are no longer considered to be applicable.

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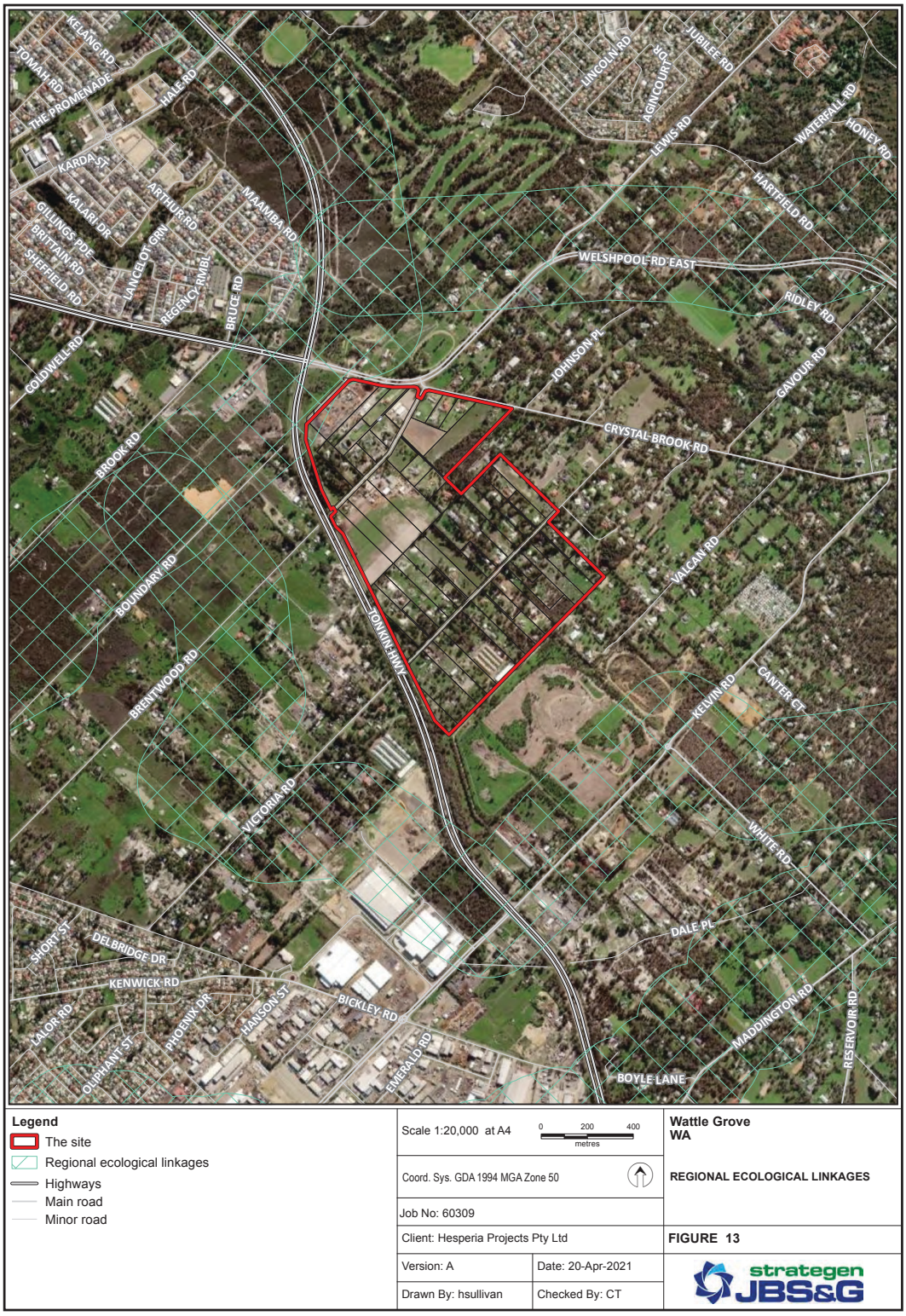

Figure 13. Regional Ecological Linkages (Source: Strategen JBS&G)

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4.8 Geomorphic Wetlands

Regional geomorphic wetland mapping (WALGA 2019) indicates that two Resource Enhancement Wetlands (REW) partially intersect the site (refer to Table 4: Geomorphic Wetlands within the Site, below).

Table 4: Geomorphic Wetlands within the Site

Geomorphic Wetland Unique Identifier (UFI)	Wetland Category	Wetland Type
UFI 8037	Resource Enhancement	Sumpland
UFI 15257	Resource Enhancement	Palusplain

Figure 14 - Geomorphic Wetlands (Source: Strategen JBS&G)

One of the REWs (UFI 15257) is identified as a seasonally waterlogged Plausplain, located in the northern corner of the site. The second REW (UFI 8037) is identified as a seasonally inundated sumpland located on the western boundary of the site which has been cleared and filled and no longer exists.

REW 15257, and the intersecting water table and vegetation have been significantly modified during the construction of Tonkin Highway and the DBNGP, and the adjoining rural-residential land use. It is noted that this REW is largely located within the DBNGP corridor, which precludes residential development and may be integrated into public open space. This represents an opportunity for the wetland function to be restored during the development of the site. Notwithstanding, should any subdivision or development the REW be proposed, an assessment would be required to determine any environmental values of the wetland and requirements for retention to the satisfaction of the Department of Biodiversity, Conservation and Attractions (DBCA).

Two Conservation Category Wetlands (CCW) are located within Lot 501 immediately north of the site on the opposite side of Boundary Road. Land use planning typically requires a buffer of 50m between the boundary of a CCW and any potential development. This boundary is reflected in DWER (2019) mapping that classifies the surrounding area as an Environmentally Sensitive Area (ESA). The ESA intersects four lots in the northern portion of the site (lots 146, 12, 13 and 2). Notwithstanding, it is noted that Lot 501 is to be incorporated into the new Tonkin Highway/Welshpool Road East interchange and further consideration to the interface in this location will be required following detailed design by MRWA through the local structure planning process for the site.

To the west of the site, on the opposite side of Tonkin Highway, there are a series of CCW, Resource Enhancement Wetlands (REW) and Multiple Use Wetlands (MUW) associated with the Brixton Street Wetlands which is listed as a nationally important wetland. The wetland is seasonally inundated, with most of the water supply entering through direct precipitation. The wetlands support several threatened flora species and ecological communities. The wetland is currently subject to pressures from introduced weeds and fauna (rabbits and foxes), water abstraction, inappropriate fire regime, pollution (particularly from surrounding non-residential land uses, including the turf farm), altered drainage and recreational activities. The proposed urban development will reduce any existing adverse impacts on the Brixton Street Wetlands by improving water quality (and potentially quantity if required by the DBCA) and reducing the nutrient levels exported from the site. This is addressed in further detail in Section 4.9 Urban Water Management, below.

Project Commitment:

Prior to subdivision or development of Lot 112 and 146 Brentwood Road, Wattle Grove an assessment of the portion of Resource Enhancement Wetland UFI 15257 that intersects with the site is to be undertaken to determine any environmental value of the wetland to the satisfaction of the Department of Biodiversity, Conservation and Attractions (DBCA).

If it is determined by the DBCA that the wetland or portions of the wetland within the site is worthy of retention, a Wetland Management Plan shall be prepared and is to address as a minimum, actions to prevent and manage impacts of urban development on the wetland and associated wetland buffer, including any vegetation that has been identified for retention.

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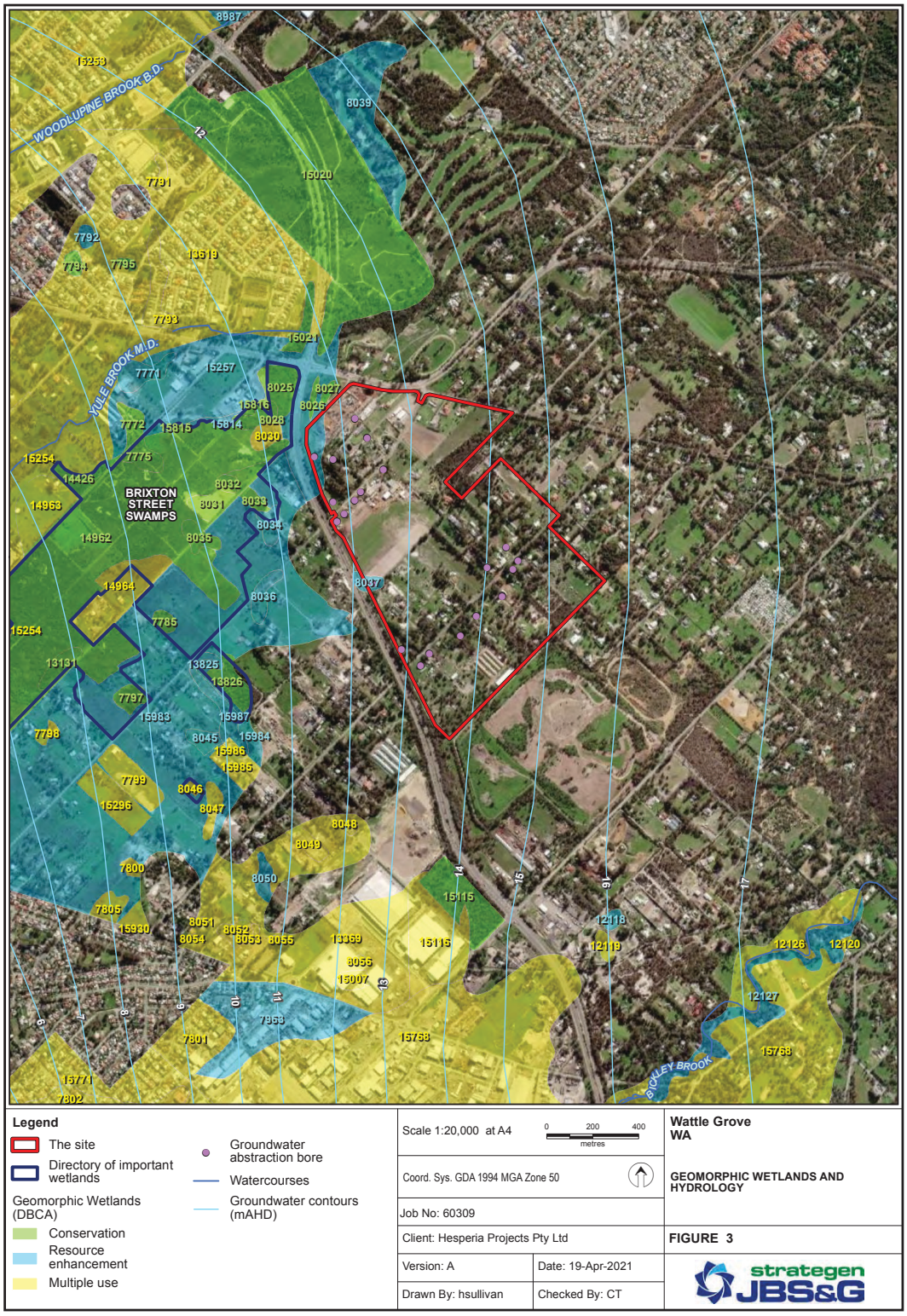

Figure 14. Geomorphic Wetlands (Source: Strategen JBS&G)

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4.9 Urban Water Management

A District Water Management Strategy (DWMS) has been prepared by Hyd2o Hydrology consultants to support the MRS amendment proposal. The DWMS has been prepared in accordance with the principles and objectives of Better Urban Water Management (Western Australian Planning Commission, 2008) and following discussions with key agencies ultimately involved with its implementation including the City of Kalamunda, DBCA and DWER.

Refer to Appendix C – District Water Management Strategy, hyd2o Hydrology

Topography across the site varies between 21m AHD in the west to a high of 35m AHD at its eastern boundary, with a fall from east to west across the site. This site has good clearance to regional groundwater and existing culverts under Tonkin Highway connect runoff from the site to downstream stormwater systems. All of this drainage is well above the regional groundwater table and does not export groundwater from within the site toward the wetlands.

As noted under section 4.8, environmental considerations and values of the Greater Brixton Street Wetland area are recognised as a key consideration which will ultimately guide the hydrological design of the site. Bourke (2017) provided the following description of the wetlands:

> *"The Greater Brixton Street Wetlands are located in an area identified as one of the most important conservation areas on the Swan Coastal Plain (Bourke, 2017). The biota associated with low lying areas (i.e. damplands, palusplains and basins) are adapted to, or require seasonal flooding and shallow water tables for their long-term persistence. Given the declines in rainfall experienced across the Perth region and the broader south-west of Western Australia over the last 30 years it is likely that changes to the hydrological cycle within the Greater Brixton Street Wetland area have already occurred or will occur in the future "*

Recent works undertaken by Emerge as part of the Maddington Kenwick Strategic Employment Area environmental studies have further contributed to the understanding of these wetlands. To assist this process further, an additional supplementary monitoring program for the site and its relationship to the wetlands is being undertaken by Hyd2o on behalf of Hesperia.

Based on the sites existing environment, the following key constraints and opportunities are identified to guide the development of the water management strategy:

- There is generally good clearance to regional groundwater across the site.
- Underlying soils may limit opportunities for stormwater management via infiltration in some areas of the site.
- Given the sites proximity to the Greater Brixton St wetland area, there is an opportunity to significantly reduce nutrient input to the landscape via land use change given existing historical uses in the area including poultry and turf farms.
- Re-development of the site provides opportunities to improve the existing interface of drainage flows into the Greater Brixton St wetland Area. Development also provides an opportunity for site monitoring to interface with any government initiatives toward improved wetland function and understanding.
- There is an opportunity to counteract effects of declining rainfall on the wetlands via a strategic approach to stormwater management in consultation with key agencies.

The DWMS identifies that the proposed change in land use provides an opportunity to significantly reduce groundwater abstraction and nutrient application and export in proximity to the wetlands. The DWMS will be reviewed by DWER prior to the WAPCs consideration of a final recommendation on the MRS amendment. Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of a Local Water Management Strategy and Urban Water Management Plans for individual stages of development within the site.

Project Commitment:

A Local Water Management Strategy (LWMS) and Urban Water Management Plan(s) (UWMPs) are to be prepared and implemented in accordance with the District Water Management Strategy (hyd2o, April 2021) and WAPC's 'Better Urban Water Management' (2008. The LWMS is to demonstrate the following:

- A reduction of predevelopment nutrient rates; and
- Maintenance of predevelopment flows to the satisfaction of the DWER.

4.10 Integrating Biodiversity Measures – City of Kalamunda Draft Local Biodiversity Strategy

The City of Kalamunda draft Local Biodiversity Strategy has been advertised and is pending finalisation. The document seeks to achieve the following objectives:

- To increase the protection status of priority natural areas in the City, including on local government managed or owned lands, and on private land;
- To appropriately manage local natural areas to reduce threats, considering the identified local biodiversity conservation priorities;
- To increase the viability and resilience of natural areas by establishing buffers and ecological linkages; considering the impacts of climate change;
- To integrate biodiversity considerations across all areas of City's business and operations;
- To achieve long term community engagement in biodiversity management.

Whilst the majority of the subject site is not identified in the draft strategy as having a high Natural Area Prioritisation rating, there are two discrete pockets of land which are identified as having a 20-23.5 and 24-27.5 rating (the higher the number of characteristics known within an area, the higher its relative conservation priority – potentially up to the range of 38-42.5). While this rating reflects a medium biodiversity value rating it still highlights vegetation with local biodiversity value. These areas will be retained in Conservation Public Open Space areas within public ownership for preservation and management by the City of Kalamunda as part of the structure planning and subdivision design stages of the project. As outlined in Section 10 of this report, Local Structure Plan provisions will provide a statutory mechanism to ensure that these areas are identified and vested in the City for conservation management.

The MRS rezoning and subsequent stages of planning provide a mechanism whereby the areas of higher quality vegetation can be brought into public ownership for conservation and management. These areas are identified within the Design Considerations plan incorporated in this amendment report (refer to Section 6.0). A network of future public open space areas and conservation lots will play a role to protect the values of the existing vegetation and provide green linkages through the subject site.

Project Commitment:

Prior to subdivision or development of Lot 210 Crystal Brook Road and Lots 2 and 254 Victoria Road, Wattle Grove a Vegetation and Fauna Management Plan(s) is required to be prepared and implemented for the applicable conservation areas. The Vegetation and Fauna Management Plan(s) is to address:

- Fencing and any other measures required to limit public access;
- Initial rehabilitation and weed control;
- Educational signage; and
- Requirements for ongoing environmental management and maintenance (including bushfire control)

Preparation of a Tree Retention Plan, which details location, species, size and structural health of significant trees (>300 DBH) within the site proposed to be retained during subdivision works.

Preparation of a Tree Canopy Strategy that demonstrates that a minimum 20% tree canopy cover can be achieved and how this will be implemented within the rezoning area.

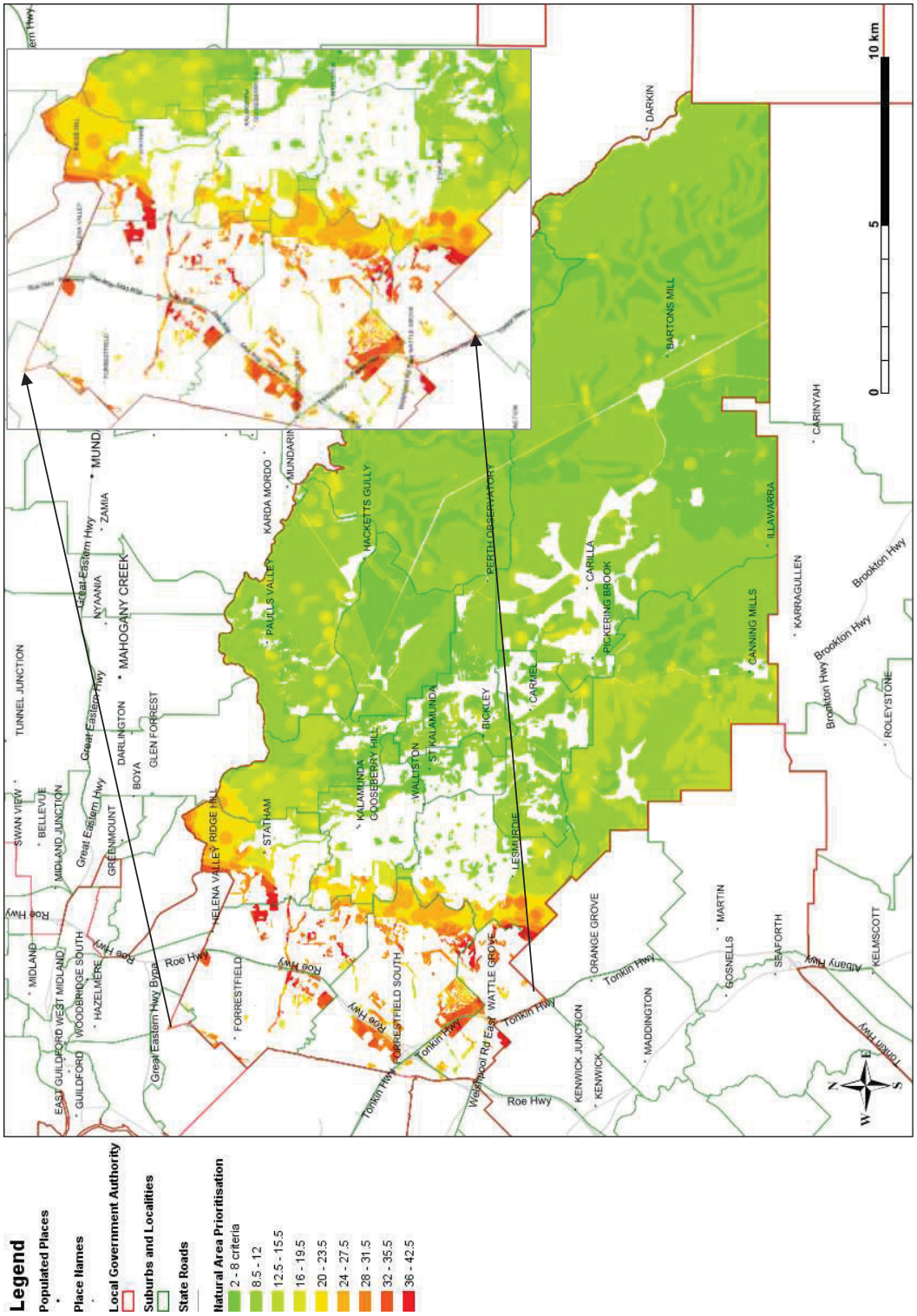

Figure 15. Natural Area Prioritisation (Source: Draft Local 2020 Kalamunda Local Biodiversity Strategy)

4.11 Bushfire (State Planning Policy No. 3.7 – Planning in Bushfire Prone Areas)

Planning in Bushfire Prone Areas (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 subject site is identified within a 'bushfire prone area' on the state wide Map of Bush Fire Prone Areas as prepared by the Office of Bushfire Risk Management.

A Bushfire Management Plan (BMP) has been prepared (Strategen-JBS&G) to support the MRS amendment, which includes an assessment of vegetation within and surrounding the site to determine applicable bushfire hazards, in accordance with Australian Standard 3959:2018 Construction of buildings in bushfire prone areas (AS 3959), and an assessment of the bushfire protection criteria outlined in the Guidelines.

At this strategic planning stage, provisions have not yet been made for future landscaping or designation of public open space (POS) and drainage areas within the project area. Other than the three discrete localised conservation areas that have been identified within the project area, the balance of the area has been predominantly parkland cleared with little to no understorey. It is expected that many of the existing large trees will be retained, generally within areas of POS, drainage/ road corridors and larger lots, and such that the bushfire risk can be appropriately managed in an urban setting.

The extent and type of vegetation within any future POS and drainage areas will be determined at future planning stages, including through the development of landscape concepts and plans, which will identify any areas containing vegetation classified under AS 3959—20018 Construction of Buildings in Bushfire-Prone Areas (AS 3959; SA 2009) as well as any areas that may be excluded from development.

In the event of any vegetation classified under AS3959 being retained within the development (such as for conservation, within POS or drainage basins), appropriate setbacks will be implemented between vegetation and proposed lots/ dwellings to ensure that a rating of BAL-29 is not exceeded. This information will be reflected in a subsequent Bushfire Management Plan prepared to support local structure planning for the locality.

The BMP provided as part of this MRS amendment request has determined that the rezoning to Urban can satisfy the requirements of SPP 3.7 and the Guidelines.

Refer to Appendix D – Bushfire Management Plan

Future development will include a minimum of two connections to the existing Crystal Brook Road/ Welshpool Road East, at different locations, providing a minimum of two access/ egress points. These points will enable future occupants of the project area the option of travelling east-west along Crystal Brook Road/ Welshpool Road east, and subsequently north-south along Tonkin Highway. Additional access/ egress points will be provided to the south-east of the project area, where this is supported by relevant land owners and agencies through consultation with these parties.

Staging design will be critical in ensuring that compliance with two access routes (acceptable solution A3.1) is delivered for all stages at all times. This may require public road construction in advance of stages and/or provision of temporary compliant cul-de-sacs/emergency access ways.

Project Commitment:

A Bushfire Management Plan (BMP) is to be prepared to inform the local structure plan and implemented through the subdivision and development processes, including building setbacks and construction standards required to achieve a Bushfire Attack Level (BAL) 29 or lower in accordance with Australian Standards (AS3959-2009): 'Construction of buildings in bushfire prone areas'.

Notifications will be required on the titles of those lots identified in the BMP as having a BAL rating of 12.5 or above.

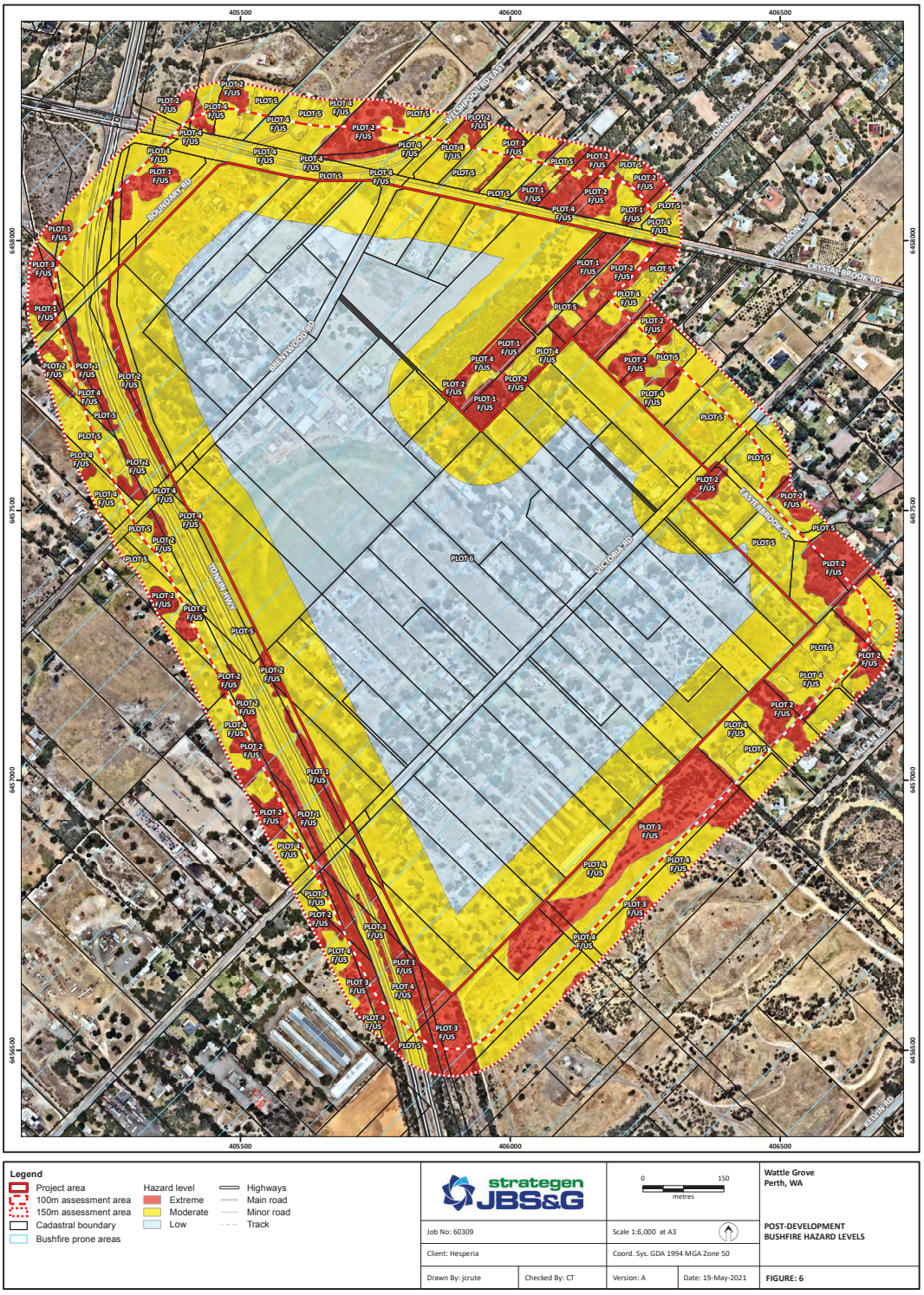

Figure 16. Post-Development Site Conditions - Bushfire Attack Level Contours (Source: Strategen JBS&G)

4.12 Site Contamination

According to the Contaminated Sites Database (DWER 2018) the subject site does not contain any registered contaminated sites. The nearest known contaminated site for restricted use is located 380 m to the west of the site, with a total of five contaminated sites in a 1 km radius, including two that have been remediated for restricted use. These sites will not impact the rezoning area *(refer to Appendix B – Environmental Assessment Report)*.

Project Commitment:

Prior to subdivision or development, whichever occurs first, of Lots 53, 213, 214 and 303 Brentwood Road ('turf farm') and Lot 251 Victoria Road ('former poultry farm'), Wattle Grove, a site investigation and remediation report (if required) shall be prepared and implemented with respect to potential contamination.

element.

5. Heritage Considerations

5.1 Heritage

The Aboriginal Heritage Act 1972 (AH Act) provides for the protection and preservation of Aboriginal heritage and culture throughout Western Australia, including places and objects that are of significance to Aboriginal people. Aboriginal sites and materials are protected whether or not they have been previously recorded or reported. The process of rezoning or reservation of land in a region scheme is not in itself directly affected by the AH Act. Proposed changes to land-use at MRS amendment stage are broad by nature and do not physically interfere with the land. Consideration of any protection that may be required is addressed more specifically at later stages of the planning process, typically when preparing a local structure plan.

According to the Department of Planning, Lands & Heritage Aboriginal Affairs Aboriginal Heritage Inquiry System the subject site is partly affected by two registered Aboriginal Heritage sites located along the southern boundary near the Tonkin Highway reserve. These sites are identified as:

- ID 4343 Brentwood Road Swamp. Type: Artefacts/Scatter
- ID 4342 Brentwood Road Quarry.Type: Artefacts/Scatter

Refer to Figure 17: Mapped boundary of registered Aboriginal Heritage Sites (Source: Strategen-JBSG)

DPLH 4342 Brentwood Road Quarry is listed on the Register of Aboriginal Sites as an artefact scatter and quarry with a reliable location. The site was relocated and recorded to a site identification level by Archae-aus Pty Ltd in 2019 while undertaking an archaeological heritage survey for proposed Tonkin Highway Upgrades and Grade Separation for Main Roads WA. Archae-aus identified a dense scatter of quartz and fossiliferous chert flaked artefacts in a deflated sand dune on the west side of Tonkin Highway, on the opposite side to the rezoning area (Horizon Heritage Management, 2021). As such, this site will not be impacted by development within the proposed Urban area.

A site assessment was undertaken by Horizon Heritage Management (2021) to verify the location of Brentwood Road Swamp (Site ID 4343). A reliable location for the site will be determined following DPLH being advised of the results of the site assessment. A reliable site location will be made available in due course. As the site is a registered Aboriginal heritage site, it is afforded protection under the AH Act.

There are no registered State Heritage Sites or Other Heritage Sites (City of Kalamunda Municipal Heritage Places) located within the subject site. However it is noted that there is one heritage listed site (Other Heritage Sites), known as 'White's home and store, located on the corner of Crystal Brook Road and Victoria Road.

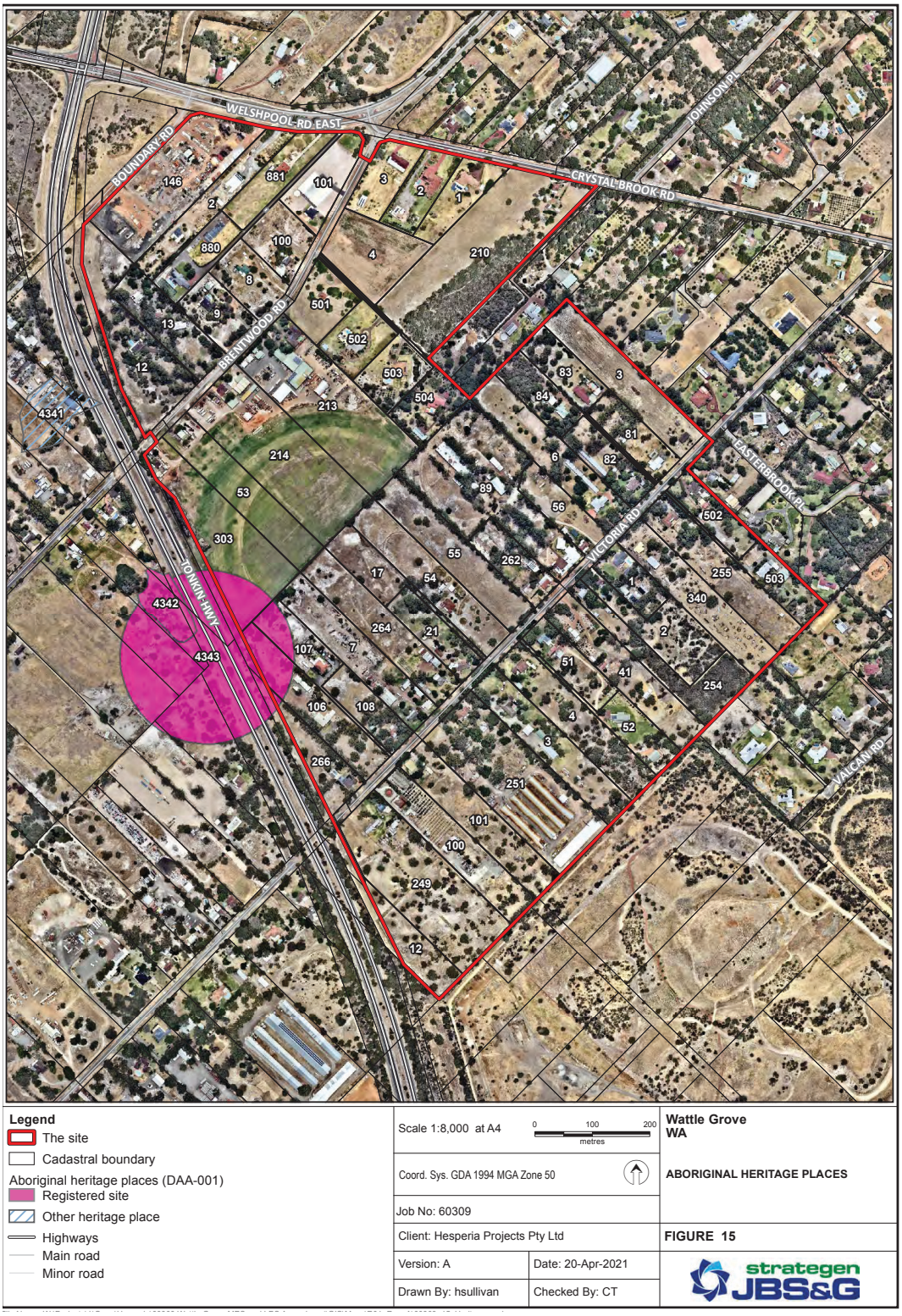

Figure 17. Mapped boundary of registered Aboriginal Heritage Sites (Source: Strategen-JBSG)

element.

6. Design Considerations

The future structure planning design for the 'Urban' zone will be progressed over the coming months. Broadly the project design ethos is to:

- *Retain a 'rural suburban' feel to streetscapes and open space which captures the essence of the wider setting.*
- *Retain existing areas of good quality vegetation wherever practical enhancing visual connectivity between identified tree groups of significance.*
- *Provide visual connections to conservation areas and features of interest that assist in orientation and legibility.*
- *Integrate innovative sustainable urban drainage and use for passive irrigation of the public realm setting the benchmark for future development in the area.*
- *Create landscape linkages, recreational nodes and circuits of pedestrian routes within the site and promote connections to the surrounding landscape.*
- *Encourage community ownership and sense of pride through the creation of diverse urban landscapes that reflect the site's unique characteristics.*

6.1 Key Design Principles

Maximise Tree Canopy

Many Local Government Areas across the Perth metropolitan area have set a target to achieve a minimum 20% canopy cover across their municipality to address heat sinks, improve overall community health and enhance landscape character. In response to this, the City of Kalamunda has recently released its draft Urban Forest Strategy.

The draft document identifies Wattle Grove as currently having 15-20% tree canopy. A key objective is to maximise tree retention within new public open space areas, streetscapes and larger lots and introduce substantial street tree planting to achieve significant tree canopy areas and local amenity as the site develops. Substantial tree planting shall be undertaken as part of the future redevelopment of the existing and proposed 'Urban' zone to achieve significant tree canopy areas as the site develops and which will result in an increase to the current area of tree canopy.

How this will be achieved:

The area has a wealth of trees and they distinguish the locality and the character. To fully reflect the existing landscape values of this location, a strategy is adopted comprising:

- Tree identification;
- Tree value assessment;
- Tree retention; and
- Supplemental tree planting.

- By assessing at planning scale through to the detailed design of streets, identification of tree stock will consistently be undertaken and assessed as to the practicalities of effective retention. The landscape strategy that is being applied to the urbanisation of this area is pragmatic but has the ability to ensure that the ultimate character of the neighbourhoods reflect the prevailing qualities of this place.
- By identifying all tree assets to inform decision making, tree retention within the public realm will form a major component of the new landscape. The conservation category trees and vegetation will be protected, retained and managed within the open spaces.
- Supplemental street tree planting is proposed that uses waterwise species of exotic species and native species reflecting the broad range of trees that make up much of the landscape. Street tree planting will not comprise mono-cultures but groups of mixed species. This not only continues the existing character of mixes found in the locality but also provides a level of diversity that is an insurance against a specific species failure. Opportunities to provide improved black cockatoo foraging habitat will also be a focal point of any tree planting program.

Unique Public Open Space and Domain

The visual landscape qualities will provide places for the community to enjoy. The public's amenity will be provided for by ensuring that easy physical access is provided through the landscape.

How this will be achieved:

- Paths, streets and trails will link nodes of recreation while creating circuit routes for walking and cycling. Streets will create shady linear links to open space and incidental spaces developed to be valued punctuations that reinforce the aesthetic, deliver urban canopy and house small recreational elements such as fitness and small play elements.
- A strong connection to the hills will be achieved through exploiting current views, retention and reproduction of the rural living aesthetic in the developed landscape. Views out of the locality to the hills will be achievable down key streets and also from open space. These views will be important in creating the landscape values enjoyed by the community.
- Streets will contain visual clues to the 'journey' of stormwater through adaptations of water control systems into landscape design. Swales and control devices designed to support and passively irrigate tree groups as well as enabling best practice in water sensitive urban design.

Connected Community

How this will be achieved:

- Recreational walking trails. Paths and linking trails will be located for maximum retention of existing vegetation and landscape features. The pedestrian asset will form easily legible routes that will be associated with roads within verges, linked to public open space and be developed to create a series of alternative circuit routes of differing lengths.
- Walks have the potential to be educational through exploration and this aspect of living in the area also reflected in the design of open space. New planting of trees selected to provide a distinctive element aligned with routes will further emphasise and make legible a hierarchy of paths.
- Shared use pedestrian/bicycles paths may have a specific species of tree associated with them to further delineate their type and purpose. These are likely to be in groups at strategic locations that announce the paths through the form and colour of selected species.

7. Movement Network Considerations

A Transport Impact Assessment (TIA) has been prepared by Cardno which outlines the transport aspects considered for the MRS amendment area (refer to Appendix E) The assessment has been prepared in accordance with the WAPC Transport Assessment Guidelines for Developments: Volume 2 – Planning Schemes, Structure Plans and Activity Centre Plans (2016). The following conclusions were made in regards to the proposed MRS amendment:

1. An analysis of expected daily traffic volumes on the external road network indicates that:
    - Welshpool Road East, between Tonkin Highway and Crystal Brook Road, will increase to over 30,000 vehicles per day. This can be accommodated within the existing road layout, but will require intersection upgrades (refer below).
    - Crystal Brook Road will require upgrading to accommodate between 6,000 and 10,000 vehicles per day. The extent and form of upgrades will be subject to the location of access points to the Site and the internal subdivisional road layouts, and will be further assessed at Structure Plan stage.
    - Kelvin Road is expected to have moderate increases in traffic volumes but remain within the Distributor B threshold.
2. Analysis of the key intersections on the external road network has been undertaken with the following conclusion:
    - The future interchange at Tonkin Highway / Welshpool Road East and Tonkin Highway / Kelvin Road is expected to be able to cater for the proposed development traffic. Note that the analysis is based on a concept design and MRWA has yet to confirm the final design for these interchanges;
    - Welshpool Road East and Crystal Brook Road intersection would need upgrades to cater for the proposed development; and
    - Crystal Brook Road and Kelvin Road can cater for the proposed development and no upgrade requirement is identified at this stage.
3. To support the sites development, modifications to bus routes in the area should be investigated in collaboration with the Public Transport Authority. In particular, there is an opportunity to provide for Route 283, or a new route, to operate through the site.
4. Well-connected pedestrian and cycling networks should be provided within the site, as well as convenient connections to the Tonkin Highway PSP. Welshpool Road East and Crystal Brook Road upgraded sections should include high-quality pedestrian and cycling facilities.

8. Servicing Considerations

An Engineering Infrastructure report has been prepared by TABEC Civil Engineering consultants to demonstrate that the subject site can be suitably serviced for residential purposes. Based on the preliminary engineering servicing review and resolution of a wastewater funding arrangement with the Water Corporation, there would appear to be no engineering or servicing constraints to the development of the site. A summary of TABEC's report is provided below.

Refer to Appendix F – Servicing Report

8.1 Gas Infrastructure

There is no reticulated gas supply within the site or generally within the immediately adjacent area. However, an ATCO Gas high-pressure gas main is located in Welshpool Road East to the west of the site, terminating near the Lancelot Garden cul-de-sac, Wattle Grove. Welshpool Road East also contains a medium-pressure gas main that extends through the existing Wattle Grove residential development north of Welshpool Road East and west of Tonkin Highway. In discussions with ATCO, a connection to and extension of the existing high-pressure main in Welshpool Road East will allow a reticulated gas network to be provided to the site.

There is an easement for the Dampier to Bunbury gas pipeline (DBNGP) immediately east of Tonkin Highway, adjacent to the site. The DBNGP corridor houses a major high-pressure gas pipeline that supplies natural gas to essential heavy and light industry, power generation and homes within Western Australia. The Department of Planning, Lands and Heritage (DPLH) manages the DBNGP corridor under the Dampier to Bunbury Pipeline Act 1997 (DBPA), on behalf of the DBNGP Land Access Minister.

Site planning and design should promote compatible uses, particularly public open space in the gas pipeline corridor/ easements. Roads and service crossings in the gas pipeline corridor/easements should be as close as practicable to perpendicular to the corridor/easements and may be approved subject to appropriate conditions recommended by the pipeline owners.

Several quantitative risk assessments of the DBNGP in the Perth metropolitan region have been undertaken and identify setback distances from the edge of the corridor/easements for sensitive developments as well as residential, commercial, and industrial development. The Australian Gas Infrastructure Group has advised that the DBNGP in this location is built to a residential (T1) standard.

For proposals within the setback distances, a pipeline risk management plan will be required to demonstrate that the risk from the pipeline is within acceptable risk levels. The risk management plan may require a risk assessment, which is the responsibility of the applicant and must be undertaken in consultation with the pipeline owner.

8.2 Wastewater

Though the Wattle Grove subject area is not currently serviced by a wastewater scheme, the site is within the Water Corporation license area and covered by the Wattle Grove Sewer District (SD) conceptual wastewater planning.

Though within the Wattle Grove SD, the site is located on the planned boundary between the Corporation's Wattle Grove and Forrestfield sewer districts. Crystal Brook Road is the topographical boundary between the sewer districts. In September 2020 Water Corporation wastewater planners conducted a review of planning and an assessment of the relative costs and merits of servicing this land either through the Wattle Grove SD downhill to the south west, as per the Water Corporation long-term planning (identified as Option 2), or pumping northwards through the Forrestfield SD on a temporary basis (identified as Option 1), as depicted in Figure 17.

Option 1, the proposed option of a temporary/interim WWPS pumping northwards into the Forrestfield SD is not supported because of a lack of conveyance capacity in the Forrestfield sewer network and because additional out-of-catchment pumped flows into the Forrestfield SD would immediately trigger a requirement to extend the DN1500 Maida Vale main sewer and install a section of the DN1050 and DN750 Forrestfield branch sewers.

As such, the Water Corporation's assessment concluded that the preferred longer-term Option 2 option, in terms of capital and operating cost and technical feasibility, is to service the entire future 'Urban Expansion' area plus the MKSEA industrial area westwards into the Wattle Grove SD.

The major works required to service the Wattle Grove SD are currently identified as:

- 1.4km of DN750 gravity sewer along Bickley Brook Rd;
- 830m of DN600 gravity sewer along Bickley Brook Rd;
- 1.5km of DN600 gravity sewer along Brentwood Rd; and
- 750m of DN450 sewer along Brentwood Rd up to Tonkin Highway.

Notwithstanding, through the further detailed planning for the locality, there is an opportunity to review and optimise the sewer infrastructure required for this locality.

The ultimate discharge from the area being a gravity connection to the existing 900mm Branch Sewer located in Bickley Road, near Dulwich Street in Maddington. It is understood that the Water Corporation wastewater planners have undertaken some fairly detailed and extensive options analyses in response to previous queries from the City of Kalamunda and prospective developers.

The MRS rezoning proposal, in consultation with Water Corporation, will enable the further detailed design required to implement a sewer solution for this locality.

Providing the site with an internal reticulated sewer system will be achieved through the orderly development of the site. Wastewater infrastructure will be designed and constructed in accordance with Water Corporation standards and requirements.

8.3 Water Supply

The site is within the Water Corporation license area. With respect to water planning, the site is situated at the eastern edge of the Trunk Mains PRV scheme. As the site is currently zoned 'Rural', the Corporation's water planning is based on this zoning, which arose from the WAPC's Foothills Structure Plan. The Water Corporation has advised the water planning will be revised as the land is rezoned to 'Urban'.

Water supply to the site is currently via the DN1400 Canning/Foothills Trunk Main that runs south to north along the base of the foothills. Supply occurs through various Pressure Reducing Valves (PRVs) located along the trunk main. The nearest PRVs to the site are the Boyle Lane PRV to the south, and the Hale Rd PRV to the north. The sketch below, provided by the Water Corporation, shows the arrangement described above and the HGL route.

The existing water distribution main from the Boyle Lane PRV is a DN460 – _DN510 cast iron main running north-west along Bickley Rd. The existing reticulation mains that extend off this distribution main to serve the areas to the east, including the site, are as follows:

- Victoria Rd: DN100 Cast Iron.
- Brentwood Rd: DN150 PVC and Cast Iron.
- Welshpool East Rd – Crystal Brook Rd: DN150 Steel and Ductile Iron. Noting there is a zone valve at the corner of Crystal Brook Rd and Victoria Rd which is the break between the PRV zone and the upper High Level (HL) zone.
- Brook Rd-Grove Rd-Logistics Rd: DN200 Ductile Iron and DN180 PE.

The site and services in the Urban Expansion area will be included in the Water Corporation's water planning and hydraulic modelling undertaken to determine the impact on existing customers and the changes required to the size and timing of future distribution mains.

In the interim, the Water Corporation has advised that water supply to a future urban development of the site will be supplied from the Trunk Main PRV scheme. An extension of the existing mains adjacent to and throughout the site will not have sufficient capacity or pressure to serve the proposed development, and as such, the initial supply is likely to be via new water reticulation mains, typically DN250 PVC and DN200 PVC as required. The Water Corporation will undertake planning and will follow in with distribution mains in the future as needed.

An internal water reticulation network will also be constructed within the site to provide a service to all lots in accordance with the Water Corporation's requirements.

element.

8.4 Power Supply

The site has a 66kV high voltage (HV) overhead power line extending along the south-eastern side of Brentwood Road. The site also has 22kV HV overhead power lines running along the north-western side of Brentwood Road and Victoria Road and a low voltage (LV) overhead power line on the south-eastern side of Boundary Road. The existing cables will be able to provide power to the proposed development of the site.

Western Power will require the 22kV HV overhead power lines that are adjacent to the proposed residential development to be undergrounded as part of the subdivision works. A review of the Western Power Network Capacity Mapping Tool indicates that there is capacity in the existing network to service the development of the site. The mapping tool indicates that the capacity for the majority of the site is in excess of 30MVA, whilst the north-western corner has a capacity of between 20MVA to 25MVA. Power will be reticulated underground throughout the development. Low voltage (LV) feeders will extend from transformers feeding the pillar units servicing each new lot.

Street lighting will also be required as part of the development in accordance with Western Power and City of Kalamunda guidelines.

8.5 Telecommunications

The site is within the NBN network footprint and NBN fixed line services are available within the site.

The existing road reserves within the study area contain NBN services within a Telstra pit and pipe network. It is expected that NBN will require a new pit and pipe network to be provided as part of the development.

9. Coordination of Local and Region Scheme Amendments

If the WAPC resolves to approve the proposed amendment to the MRS, the City of Kalamunda will have 90 days from the day on which the amendment takes effect to initiate an amendment to its Local Planning Scheme to rezone the subject site to ensure it is consistent with the objectives of the applicable zone or reserve under the MRS. Under section 126(3) of the *Planning and Development Act 2005* the City of Kalamunda has the option of recommending to the WAPC to concurrently rezone land that is being zoned Urban under the MRS to a "Development" zone (or similar) in its LPS.

It is therefore requested that a concurrent local planning scheme amendment be progressed to provide for a zone that is consistent with the intent of the MRS amendment to provide for future residential development. A 'Residential Development' zone is an appropriate zone under the LPS which provides for structure planning to occur prior to subdivision and development. The objectives of the 'Residential Development' zone are to –

- provide for the coordinated development of future residential areas through the application of a comprehensive plan to guide subdivision and development to be known as a "Structure Plan";
- provide for predominantly residential development, but including also a range of compatible services, consistent with the needs of an integrated neighbourhood, and planned so as to minimise adverse impacts on amenity;
- avoid the development of land for any purposes or at a time when it is likely to compromise development elsewhere in the district or prejudice the future development of land in the Residential Development zone for more appropriate purposes;
- take account of the need to protect the amenity and on-going use of adjacent property owners as well as to provide for the needs of future residents.

This will provide the appropriate zone for more comprehensive planning to be undertaken through the structure planning process to coordinate future subdivision and development (refer to section 10 of this report for further information).

element.

10. Structure Plan and Implementation Provisions

The subsequent structure plan being prepared for the subject site will address the detailed planning for the land, including:

- density of residential lots,
- road layout,
- location and size of public open spaces,
- landscape strategy,
- conservation lot management plan,
- noise mitigation measures, and
- heritage and place planning design considerations.

The table below specifies the environmental requirements that will need to be addressed during the Local Structure Plan and subdivision/development stages of the Wattle Grove South project. This schedule of provisions shall be incorporated into the statutory section (Part 1) of the Local Structure Plan. The subdivision and development of land in the precinct is to be in accordance with a structure plan prepared and approved pursuant to Part 4 of the deemed provisions including the following requirements:

Item	Project Commitments	How Will It Be Implemented	Stage and Agency Review
1.	***Vegetation Management***	*Portions of Lot 210 Crystal Brook Road and Lots 2 and 254 Victoria Road containing native vegetation with significant environmental values as identified in the Environmental Assessment Report (Strategen 2021) and identified in Plan 1 of the Local Structure Plan, are to be designated as Public Open Space – 'Nature POS' for the benefit of Conservation and ceded to the City of Kalamunda in order to protect and preserve native vegetation or other special flora or fauna qualities.* *The acquisition and funding of the 'Nature POS' areas shall be undertaken in accordance with WAPC Development Control Policy 2.3 'Public Open Space in Residential Areas' (2002), WAPC Position Statement 'Cash-in-Lieu of Public Open Space' and the City of Kalamunda Local Planning Policy 32 'Local Open Space'.*	*Subdivision – Condition of Approval (City of Kalamunda and WAPC)*
		Prior to subdivision or development of Lot 210 Crystal Brook Road and Lots 2 and 254 Victoria Road, Wattle Grove a Vegetation and Fauna Management Plan(s) is required to be prepared and implemented for the applicable conservation areas. The Vegetation and Fauna Management Plan(s) is to address: • *Fencing and any other measures required to limit public access;* • *Initial rehabilitation and weed control;* • *Educational signage; and* • *Requirements for ongoing environmental management and maintenance (including bushfire control)*	*Local Structure Plan and Subdivision* *(City of Kalamunda and DBCA)*

Item	Project Commitments	How Will It Be Implemented	Stage and Agency Review
1.	***Vegetation Management***	*Preparation of a Tree Retention Plan, which details location, species, size and structural health of significant trees (>300 DBH) within the site proposed to be retained during subdivision works.* *Preparation of a Tree Canopy Strategy that demonstrates that a minimum 20% tree canopy cover can be achieved and how this will be implemented within the rezoning area.*	*Local Structure Plan and Subdivision* *(City of Kalamunda)*
2.	***Wetland Management***	*Prior to subdivision or development of Lot 112 and 146 Brentwood Road, Wattle Grove an assessment of the portion of Resource Enhancement Wetland UFI 15257 that intersects with the site is to be undertaken to determine any environmental value of the wetland to the satisfaction of the Department of Biodiversity, Conservation and Attractions (DBCA).* *If it is determined by the DBCA that the wetland or portions of the wetland within the site is worthy of retention, a Wetland Management Plan shall be prepared and is to address as a minimum, actions to prevent and manage impacts of urban development on the wetland and associated wetland buffer, including any vegetation that has been identified for retention.*	*Local Structure Plan (DBCA, City of Kalamunda)*
3.	***Stormwater Management***	*A Local Water Management Strategy (LWMS) and Urban Water Management Plan(s) (UWMPs) are to be prepared and implemented in accordance with the District Water Management Strategy (hyd2o, April 2021) and WAPC's 'Better Urban Water Management' (2008. The LWMS is to demonstrate the following:* • *A reduction of predevelopment nutrient rates; and* • *Maintenance of predevelopment flows* *to the satisfaction of the DWER.*	*Local Structure Plan and Subdivisions (DWER, City of Kalamunda)*
4.	***Bushfire Management***	*A Bushfire Management Plan (BMP) is to be prepared to inform the local structure plan and implemented through the subdivision and development processes, including building setbacks and construction standards required to achieve a Bushfire Attack Level (BAL) 29 or lower in accordance with Australian Standards (AS3959-2009): 'Construction of buildings in bushfire prone areas'.* *Notifications will be required on the titles of those lots identified in the BMP as having a BAL rating of 12.5 or above.*	*Local Structure Plan, Subdivision and Local Development Plans (DFES and City of Kalamunda)*
5.	***Noise Management***	*A site-specific noise assessment shall be undertaken in relation to traffic noise associated with Tonkin Highway and/or existing dog kennels.* *The noise assessment is to identify the range of noise mitigation measures that will be applied, such as noise barriers (noise walls) to the Tonkin Highway and potentially acoustic glazing, which can ensure that the future proposed urban land use will have an acceptable level of amenity.* *Should proposed residences be adversely affected by noise stemming from the southbound carriageway to Tonkin Highway, notifications on title may be required.*	*Local Structure Plan and Subdivision (City of Kalamunda, DWER)*
6.	***Environmental Management***	*Prior to subdivision or development, whichever occurs first, of Lots 53, 213, 214 and 303 Brentwood Road ('turf farm') and Lot 251 Victoria Road ('former poultry farm'), Wattle Grove, a site investigation and remediation report (if required) shall be prepared and implemented with respect to potential contamination.*	*Subdivision (City of Kalamunda and DWER)*

element.

Item	Project Commitments	How Will It Be Implemented	Stage and Agency Review
7.	***Acid Sulfate Soil Management***	*Prior to subdivision or development works an Acid Sulfate Soil self-assessment is to be undertaken and (if required) the preparation and implementation of an Acid Sulfate Soil Management Plan.*	*Subdivision (City of Kalamunda)*

The final version of these provisions will be included in the 'Part 1 – Implementation' section of the structure plan report, when lodged with the City of Kalamunda. The project team will collaborate with the relevant government agencies to refine these provisions to ensure all relevant matters are addressed.

element.

11. Conclusion

This report has been prepared by **element**, on behalf of Hesperia in support of an amendment request to rezone the subject site from 'Rural' to 'Urban' under the MRS. The amendment is considered to meet the 'minor' amendment criteria for the following reasons:

- the size and scale of the proposed amendment is not considered regionally significant as it does not reflect a regional change to the planning strategy or philosophy for the metropolitan region;
- the proposal aligns with the WAPC's North-East Sub-Regional Planning Framework which identifies the majority of the broader Wattle Grove area as an Urban Expansion area;
- the proposal also aligns with the City of Kalamunda's strategic planning for the region, where the Local Planning Strategy identifies the Wattle Grove/Crystal Brook area as an Investigation Area, whilst the draft Local Housing Strategy estimates projected increased residential dwelling yields for the Wattle Grove South area; and
- all service infrastructure can be readily provided to service the development via extensions to the existing network within the adjacent neighbourhood.

The above MRS amendment modifications are considered consistent with the principles of orderly and proper planning. It is therefore requested that the WAPC resolve to support the amendment to the MRS and proceed to initiate the amendment as a minor amendment in accordance with Division 4, Part 4 of the *Planning and Development Act 2005*.

element.

Appendix A – MRS Amendment Mapping

KEY

Subject land

Region Scheme Zones and Reservations

- Parks and Recreation
- Primary Regional Road
- Other Regional Road
- Bush Forever
- Urban
- Industrial
- Rural

KEY

- Excluded from Rural zone and included in Urban zone

Proposed MRS Amendment

Wattle Grove South

Date: 8 March 2021 Scale: NTS@ A3 File: 20-119 PL1A MRS Amendment Staff: MR/LC Checked: MR

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Appendix B – Environmental Assessment Report


strategen
JBS&G
Hesperia Projects Pty Ltd
Wattle Grove South MRS Amendment
Environmental Assessment Report
2 July 2021
60309/135,818 (Rev 0)
JBS&G Australia Pty Ltd T/A Strategen-JBS&G
www.jbsg.com.au

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Executive Summary

Hesperia Projects Pty Ltd (the Proponent) are proposing to rezone approximately 106 ha of "Rural" zoned land bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west (collectively, the site) to enable development of the site for residential purposes. The site is located approximately 30 km east of the Perth CBD within the City of Kalamunda.

The site is currently zoned "Rural" under the Metropolitan Region Scheme (MRS) and "Special Rural" and "Rural composite" under the City of Kalamunda Local Planning Scheme (LPS) No. 3. It is proposed to rezone the site under the MRS to "Urban".

This Environmental Assessment Report (EAR) has been prepared to inform and support the initiation of the proposed MRS amendment by assessing the potential environmental impacts that could arise from the land use change and subsequent development of the site. Based on the environmental values identified within the site, the key environmental factors associated with the proposed amendment to the MRS are:

- Social surroundings
- Inland Waters
- Terrestrial Environmental Quality
- Flora and Vegetation
- Terrestrial Fauna

As outlined in this report, it is considered that any potential impacts to the above factors can be appropriately avoided, minimised, or offset through detailed development design as part of the future planning process, and if required, through a referral under the EPBC Act. It is considered there are no significant environmental issues located within the rezoning area which would prevent it from being rezoned from 'Rural' to 'Urban' under the MRS.

1. Introduction

1.1 Overview

Hesperia Projects Pty Ltd (the Proponent) are proposing to rezone approximately 106 ha of 'Rural' zoned land bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west (collectively, the site; Figure 1) to enable development of the site for residential purposes. The proposed amendment shall implement the majority of the urban zone earmarked under the Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework. The Framework identifies the majority of the broader Wattle Grove area as an Urban Expansion area. The site is located approximately 30 km east of Perth CBD within the City of Kalamunda.

The site is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'Special Rural' and 'Rural composite' under the City of Kalamunda Local Planning Scheme (LPS) No 3.

1.2 Purpose and scope of this document

This Environmental Assessment Report (EAR) has been prepared to support the rezoning application for the site and includes identification of:

- Applicable legislation, policy and guidance;
- The environmental, bushfire and heritage characteristics of the site;
- Potential impacts to the above characteristics associated with the proposed rezoning;
- Relevant approval requirements; and
- The likely spatial and management responses of future development to ensure that any identified potential impacts can be mitigated or managed as to not result in a 'significant' impact.

1.3 Consultation

1.3.1 Environmental Protection Authority (EPA)

In accordance with Section 48 of the *Planning and Development Act 2005* all proposed Schemes and amendments are to be referred to EPA for assessment against their Environmental Principles, Factors and Objectives. Section 4 includes an assessment of the proposed rezoning based on the known environmental features occurring across the site.

2. Legislation, policies and guidelines

Key statutory and policy documents are listed below, and where specifically relevant to the proposed rezoning, are described in detail in the following sections.

2.1 Federal legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of Agriculture Water and the Environment (DAWE). The EPBC Act aims to protect and manage nine Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties
- National Heritage Places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth Marine Areas
- Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Consideration of MNES of relevance to the site is provided in subsequent sections of this report. Referral under the EPBC Act may be required for any impacts to MNES that are significant and cannot be avoided.

2.2 State legislation

This environmental assessment has been conducted with reference to the following State legislation which provides for the environmental and heritage values, and bushfire risk addressed within this report:

- *Biodiversity Conservation Act 2016* (BC Act)
- *Environmental Protection Act 1986* (EP Act)
- *Biosecurity and Agriculture Management Act 2007* (BAM Act)
- *Rights in Water and Irrigation Act 1914* (RIWI Act)
- *Metropolitan Water Supply, Sewerage and Drainage Act 1909*
- *Aboriginal Heritage Act 1972 (WA)* (AH Act)
- *Contaminated sites Act 2003* (CS Act)
- Contaminated Sites Regulations 2006 (CS regulations)
- *Planning and Development Act 2005.*

2.2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is administered by the Environmental Protection Authority (EPA). The Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.

Part IV of the EP Act makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals, and land use planning schemes. The EPA uses environmental principles, factors, and associated objectives as the basis for assessing whether a proposal or land use planning scheme's impact on the environment is acceptable.

2.2.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* has now replaced the *Wildlife Conservation Act 1950* (WC Act). On 3 December 2016, several parts of the new Act were enacted by the State Governor. The remaining parts of the Act and the associated Regulations came into effect on 1 January 2019.

In addition to providing for the protection of flora and fauna, the *Biodiversity Conservation Act 2016* includes provisions for threatened ecological communities, threatening processes, critical habitats and environmental pests.

2.2.3 State Planning Policies

The Western Australian Planning Commission (WAPC) prepares and adopts state planning policies under statutory procedures set out in part 3 of the *Planning and Development Act 2005.* State planning policies relevant to the project are listed below:

- State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Areas* (SPP 2.8)
- State Planning Policy 2.9: *Water Resources* (SPP 2.9)
- State Planning Policy 3.7: *Planning in Bushfire Prone Areas* (SPP 3.7)
- State Planning Policy 4.1: *State Industrial Buffer Policy* (SPP 4.1)
- State Planning Policy 5.4: *Road and Rail Transport Noise and Freight Considerations in Land Use Planning – Section 5.3 Noise Criteria* (SPP 5.4)

2.3 Environmental Protection Authority (EPA) guidance

The assessment has considered the recommendations of EPA regulatory guidance as listed below:

- *Environmental Factor Guideline - Social Surroundings*
- *Environmental Factor Guideline - Inland Waters*
- *Environmental Factor Guideline - Terrestrial Environmental Quality*
- *Environmental Factor Guideline - Flora and Vegetation*
- *Environmental Factor Guideline - Terrestrial Fauna*
- *Technical Guidance - Terrestrial fauna surveys*
- *Technical Guidance - Sampling methods for terrestrial vertebrate fauna*
- *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*
- *EPA Guidance Statement No. 33 Environmental Guidance for Planning and Development (EPA 2008)*

- *Environmental Protection Bulletin No. 20 Protection of naturally vegetated areas through planning and development.*
- *EPA Guidance Statement No. 3: Separation Distances between Industrial and Sensitive Land Uses*.

Section 4 of this report provides a detailed assessment against the above EPA Guidelines.

2.4 Local government policies, strategies, and guidance

The City of Kalamunda has developed numerous polices, strategies and guidelines relevant to planning and the environment, as listed below. Reference to these documents has been made throughout the report where applicable to a specific environmental factor.

- Development in Bushfire Prone Areas (City of Kalamunda)
- Environmental Land Use Planning Strategy (City of Kalamunda 2019)
- Draft 2020 Kalamunda Local Biodiversity Strategy (Oct 2020)
- City of Kalamunda Local Environment Strategy (2018)
- Draft Urban Forest Strategy (Nov 2020)

3. Overview of existing environment

3.1 Land use

3.1.1 Previous land use

First available aerial imagery over the site was taken in 1953, where several lots had already been divided and cleared for rural land uses including pasture, market gardens and agriculture. There is some evidence of extraction activities in the south of the site between 1953 and 1974. Remnant vegetation remained present across many lots in the north and centre of the site prior to 1974, with some regrowth or planting also having occurred. Some rural residential dwellings were constructed by 1974 and the area is understood to have been developed for horse rearing/breeding and equestrian activities. Most of the clearing within the site had been completed by 1995, and residential development began around 2010 in the north and north west of the site.

3.1.2 Current land use

The site is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'Special Rural' and 'Rural composite' under the City of Kalamunda Local Planning Scheme (LPS) No. 3.

The site currently comprises numerous landholdings and contains a mixture of land uses including residential and rural living, composite business along Welshpool Road and horticulture. A turf farm is located within the site and extends across lots 303, 53, 214 and 213, south of Brentwood Road. There is a former poultry farm located at Lot 251 within the south-east portion of the site, that ceased operations over a decade ago. The Dampier to Bunbury natural gas pipeline (DBNGP) also runs along the western edge of the site adjacent to Tonkin Highway.

Within and in proximity to the site, there are a number of land uses that warrant consideration during the staged release of residential land for the project. These include a turf farm, poultry farm, kennels and the DBNGP, shown on Figure 2. A detailed description and assessment of impacts from these land uses against policy is provided in section 4.1.3.2.

3.2 Topography, geology and soils

Regional topographic contour mapping (DPIRD 2019) indicates that the site is relatively flat to undulating, with elevation ranging from 22 m Australian Height Datum (AHD) in the north of the site to 36 m AHD in the south (Figure 3).

The site is located between Yule Brook Main Drain (approximately 200 m to the north) and Bickley Brook Main Drain (approximately 1.8 km to the south). Surface water is expected to drain from approximately southeast to northwest throughout the majority of the site, toward the Yule Brook Main Drain and the Brixton Street Wetlands on the opposite side of Tonkin Highway (DWER 2019).

The bedrock geology of the site is characterised by the Coolyena Group (K-CY-xk-s) described as chalk, greensand, glauconitic sandstone, siltstone, marl that is characteristically glauconitic (DMIRS 2018).

The site is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain is described as a low-lying coastal plain which is often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast: the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchwood & McArthur 1980; Gibson et al. 1994). Each major system is further subdivided into

detailed geomorphologic units (Churchwood & McArthur 1980; Semeniuk 1990; Gibson et al. 1994). The site lies predominantly within the Pinjarra system, with the southern portion within the Forrestfield system (DPIRD 2020). The site comprises three geomorphological units (DPIRD 2020) that are summarised in Table 3.1 and shown on Figure 3.

Table 3.1: Soil Landscape Units within the Site

Soil Landscape Unit	Unit Description
213Pj_Gf6 (Pinjarra, Phase Gf6)	Seasonally inundated swamps with very poorly drained uniform non-cracking clays.
213Pj_Gf7 (Pinjarra, Phase Gf7)	Minor rises with deep rapidly drained brownish, siliceous, or bleached sands underlain by mottled yellow clay. Low woodland of B. prionotes and some tall E. calophylla with E. rudis along streamlines.
213Fo_Ff1 (Forrestfield (D Range), F1 Phase)	Foot and low slopes < 10% with deep rapidly drained siliceous yellow brown sands, and pale or bleached sands with yellow-brown subsoil. Shrubland of unidentified species.

3.3 Hydrology

3.3.1 Surface water

The site is located within the catchment of Yule Brook, with two major watercourses in proximity which are the Yule Brook Main Drain situated 200 m north and the Bickley Brook Main Drain approximately 1.8 km south (Water Corporation 2017). There are no mapped watercourses that traverse the site (DoW 2012) however a, constructed minor drain line exists along the northern boundary of lot 210 extending from Crystal Brook Road to a constructed dam (360 Environmental 2018). The site is not within a mapped 100 Year ARI Floodplain Area (DoW 2015).

Drainage within the site consists predominantly of open swales and crossovers/culverts, with limited piped drainage (hyd2o 2021). Drainage occurs well above the groundwater table and does not export groundwater from within the site toward the wetlands (hyd2o 2021). The site has no formal external drainage entering the site; an open swale runs along the northern boundary of Crystal Brook Road which acts as a cut-off for flow coming from the north (hyd2o 2021).

The Greater Brixton Street Wetlands are located to the west of the site on the opposite side of Tonkin Highway. The wetlands are discussed in greater detail in section 3.3.3.

3.3.2 Groundwater

3.3.2.1 Desktop

The site is located within the Perth groundwater catchment area and Shire of Kalamunda and Per South Confined subareas. The site is situated upon the Perth – Superficial Swan (Level 1), Perth – Leederville (Level 2) and Perth – Yarragadee North (Level 3) aquifers (DWER 2019).

Regional historical maximum groundwater contour mapping by DWER indicates that the water table is situated at approximately 11.5 m in the north western corner of the site to 16 m AHD in the eastern boundary, which equates to approximately 10 m to 20 m below ground level (based on regional topographic contours) (DWER 2019). Groundwater flows across the site from approximately east to west (DWER 2019), toward the Greater Brixton Street Wetlands.

There are currently 14 groundwater extraction licenses active within the site. These licenses, their allocations and their date of expiry are presented below in Table 3.2. Groundwater bore locations are displayed in Figure 4. The proposed change in landuse provides an opportunity to significantly reduce groundwater abstraction in proximity to the wetlands.

Table 3.2: Groundwater licenses within the site

WRI Number	Allocation (KL)	Date of expiry
155757	6525	25/03/2024
151840	8000	12/08/2030
203064	176000	04/07/2029
153306	14000	19/02/2027
174016	4300	12/10/2021
153414	6800	17/08/2030
179091	4000	24/07/2024
152784	2400	23/07/2030
167697	6500	10/12/2029
178291	8650	27/03/2024
174364	14200	20/10/2021
153399	4500	22/12/2021
164455	4780	23/07/2025
154071	3530	05/11/2023

3.3.2.2 Site assessment

Hyd2o (2021) reviewed the DWER Water Information Reporting tool to evaluate the accuracy of desktop groundwater information. This found that there are no DWER bores with long term records in close proximity of the site, meaning any derived groundwater data will have limited accuracy. Hyd2o installed three bores within the site in November 2020 to be used in combination with bores previously installed by Douglas Partners and Urbaqua, to refine groundwater mapping.

The assessment by Hyd2o (2021) reported average annual maximum groundwater levels across the site to range from 15.9 mAHD in the north western corner near Tonkin Highway to approximately 17.3 mAHD on the south western corner of the site. Regional groundwater depth was found to range from 5 m to 20 m below the natural ground surface (Hyd2o 2021). The result of the site assessment was a refinement of desktop-derived groundwater data, indicating that groundwater flow across the site is in a broadly westerly, direction (Hyd2o 2021).

3.3.2.3 Nutrients

Hyd2o (2021) undertook pre-development nutrient assessment using the Urban Nutrient Decision Outcomes (UNDO) model. The UNDO model is a conceptual decision support tool developed by DWER that evaluates nutrient reduction decisions for urban developments on the Swan Coastal plain in south-west Western Australia (hyd2o 2021). The assessment considered current and adjacent land uses that have the potential to export nutrients to the site, including the turf farm, septic tanks and livestock (hyd2o 2021). The nutrient application rate for bowling greens was used as a surrogate for turf farms, as a specific rate is not provided by the model for this land use (hyd2o 2021). Based on typical nutrient application rate estimates for each land use, the model indicates pre-development nutrient inputs to the environment are 12,304 kg/year and 1,139 kg/year of TN and TP, respectively (hyd2o 2021). The resultant nutrient export is 293.2 kg/year and 15.2 kg/year of TN and TP, respectively (hyd2o 2021). The calculation considers soil types, groundwater gradients, and depth to groundwater. In this regard, the proposed change in land use provides an opportunity to significantly reduce nutrient application and export in proximity to the Greater Brixton Street wetlands and Yule Brook.

3.3.3 Geomorphic wetlands

The nature of the protection and management that wetlands within the Swan Coastal Plain are afforded is guided by the management category to which they have been assigned. These management categories and their objectives are outlined in Table 3.3.

Table 3.3: Wetland management categories and management objectives

Category	Objective
Conservation (C category) Wetlands	To preserve wetland (natural) attributes and functions
Resource Enhancement (R category) wetlands	To restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use (M category) wetlands	To use, develop and manage wetlands in the context of water, town and environmental planning

Regional geomorphic wetland mapping (WALGA 2019) indicates that two Resource Enhancement Wetlands (REW) partially intersect the site. These are described in Table 3.4 and shown on Figure 4.

Table 3.4: Geomorphic Wetlands within the Site

Geomorphic Wetland Unique Identifier (UFI)	Wetland Category	Wetland Type
UFI 8037	Resource Enhancement	Sumpland
UFI 15257	Resource Enhancement	Palusplain

One of the REWs (UFI 15257) is a seasonally waterlogged Plausplain, located in the northern corner of the site. The second REW with UFI 8037 is a seasonally inundated sumpland located on the western boundary of the site.

To the west of the site, on the opposite side of Tonkin Highway, there are a series of CCW, REW and Multiple Use Wetlands (MUW) associated with the Brixton Street Wetlands which is listed as a nationally important wetland. The wetland is seasonally inundated, with most of the water supply entering through direct precipitation. The wetlands support several threatened flora species and ecological communities. The wetland is currently subject to pressures from introduced weeds and fauna (rabbits and foxes), water abstraction, inappropriate fire regime, pollution (particularly from surrounding non-residential land uses, including the turf farm), altered drainage and recreational activities.

Two CCWs are located within lot 501 immediately north of the site on the opposite side of Boundary Road. Land use planning typically requires a buffer of 50m between the boundary of a CCW and any potential development. This boundary is reflected in DWER (2019) mapping that classifies the surrounding area as an Environmentally Sensitive Area (ESA). The ESA intersects four lots in the northern portion of the site (lots 146, 12, 13 and 2). Notwithstanding, it is noted that Lot 501 is to be incorporated into the new Tonkin Highway/Welshpool Road East interchange and further consideration to the interface in this location will be required following detailed design by MRWA through the local structure planning process for the site.

REWs have typically been partly modified but will support ecological attributes and values. The EPA advise that reasonable measures should be taken to minimise the potential impacts on REWs and their appropriate buffers (WRC 2001; EPA 2008). The draft guideline for determining buffer requirements to consider an appropriate buffer distance relevant for REWs depends on the management target. However, typically it is recommended as being between 10 m and 50 m (WAPC 2005). The two REWs partially within the site, and the corresponding water table and vegetation have been significantly modified during the construction of Tonkin Highway and the DBNGP, and adjoining rural-residential and turf farm land uses (including filling). Notwithstanding, it is noted that the REWs are largely located within the DBNGP corridor, which precludes residential development

and is proposed to be integrated into public open space. This represents an opportunity for a wetland function to be restored during the development of the site.

3.3.4 Public drinking water source area

The *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (MWSSD Act) and the *Country Areas Water Supply Act 1947* (CAWS Act) identify and categorise public drinking water source areas as catchment areas, water reserves, or underground water pollution control areas.

A review of the Perth Groundwater Map (DWER 2019) indicates there are no Public Drinking Water Source Areas (PDWSA) located within or adjacent to the site. The nearest is the Victoria Reservoir Catchment Area drinking water source, which is a Priority 1 PDWSA located 5.8 km to the south east.

3.4 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring, iron-sulfide rich soils, sediments or organic substrates, formed under waterlogged conditions. If exposed to air, these sulfides can oxidise and release sulfuric acid and heavy metals. This process can occur due to drainage, dewatering or excavation.

The site is identified in the ASS Risk Map as being within a moderate to low-risk area. This indicates the site has a moderate to low risk of ASS occurring within 3 m of the natural soil surface, but a high to moderate of ASS beyond 3 m (DWER 2017; Figure 5).

3.5 Contamination

The *Contaminated Sites Act 2003* (CS Act) defines contamination as having a substance present in land or water above background concentrations that presents a risk of harm to human health or the environment. The act also provides for the identification, recording, management and remediation of contaminated sites. Contamination commonly occurs through accidental leakage and spillage, or poor site management practices.

According to the Contaminated Sites Database (DWER 2018) the site does not contain any registered contaminated sites (Figure 5). The nearest known contaminated site for restricted use is located 380 m to the west of the site, with a total of five contaminated sites in a 1 km radius (Table 3.5), including two which have been remediated for restricted use.

Table 3.5: Contaminated Areas within 1 km of the Site

Lot	Nature and Extent of Contamination	Status	Distance from and relationship to the Site (m)
Lot 13 on Plan 13089	Following remediation, asbestos-containing material may be encountered on the surface or in soil beneath the site.	Remediated for restricted use	970m. No impact to the site expected.
Portion of lot 57 on Plan 4647	Hydrocarbons (e.g from petrol) present in groundwater beneath site.	Remediated for restricted use.	800m. Located hydraulically downgradient of the site, no impact to the site expected.

Lot	Nature and Extent of Contamination	Status	Distance from and relationship to the Site (m)
Lot 7 on Diagram 43545	Surface and subsurface soils are impacted with hydrocarbons. Groundwater beneath the Source and Affected Sites are impacted with hydrocarbons.	Contaminated – remediation required	800m. Located hydraulically downgradient of the site, no impact to the site expected.
Welshpool Road, immediately east of Caldwell Road for approx. 140m	Surface and subsurface soils are impacted with hydrocarbons. Groundwater beneath the Source and Affected Sites impacted with hydrocarbons.	Contaminated – remediation required.	800m. Located hydraulically downgradient of the site, no impact to the site expected.
Lot 804 on Plan 59983	Fragments of asbestos containing material (ACM) are present within the soils at the site	Contaminated – restricted use	380m. No impact to the site expected.

3.6 Vegetation and flora

3.6.1 Desktop assessment

3.6.1.1 Bioregion

The site occurs within the Perth subregion of the Swan Coastal Plain region under the Interim Biogeographic Regionalisation of Australia (IBRA).

3.6.1.2 Pre-European vegetation

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that a retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANECC 2000). The Western Australian Environmental Protection Agency has previously adopted the ANZECC 30% retention target; however, under Position Statement No. 2, they also adopted a 10% level of the pre-clearing extent of vegetation that was regarded as being a level representing 'endangered' (EPA 2000). The Position Statement has subsequently been replaced with the EPA's Envronmental Factor Guideline (EPA 2016) which describes a more qualitative approach to biodiversity conservation and no longer mentions percentage targets.

Remnant vegetation within the site is mapped as belonging to two sub-associations of the Pinjarra vegetation system, based on state-wide vegetation mapping by Beard (Beard et al. 2013). These are shown on Figure 6 and are described as:

- Pinjarra 968.3: Medium woodland of Jarrah, Marri and Wandoo
- Pinjarra 3.2: Medium forest of Jarrah and Marri.

Most of the Pinjarra vegetation association has been historically cleared, including within the subject site, with approximately 9% remaining on the Swan Coastal Plain.

Table 3.6: State, local and regional representation of vegetation communities

Region	Vegetation association	Pre-European Extent (ha)	Current Extent (ha)	% Remaining
Western Australia	Pinjarra 3.2	15,738.25	1,844.72	11.72
	Pinjarra 968.3	137,184.58	9,172.10	6.69
Swan Coastal Plain IBRA Region	Pinjarra 3.2	13,738.98	1,586.73	11.55
	Pinjarra 968.3	135,999.02	8,996.33	6.61
Perth IBRA subregion	Pinjarra 3.2	13,738.98	1,586.73	11.55
	Pinjarra 968.3	135,999.02	8,996.33	6.61

Region	Vegetation association	Pre-European Extent (ha)	Current Extent (ha)	% Remaining
City of Kalamunda	Pinjarra 3.2	265.40	36.09	13.60
	Pinjarra 968.3	487.50	74.76	15.33

Vegetation complex mapping of the Swan Coastal Plain was completed by Heddle et al. (1980) and considers soils, landforms, and floristics. As shown on Figure 6, the site straddles the Forrestfield, Guildford, and Southern River Complexes on the Ridge Hill Shelf, fluviatile deposits (deposited by watercourses) and aeolian deposits (wind-driven deposits). The Forrestfield Complex is dominated by open forest or woodland of Marri (*Corymbia calophylla*), Wandoo (*Eucalyptus wandoo*) and Jarrah (*Eucalyptus marginata*) on heavier, gravelly soils by Jarrah, Marri, and Sheoak (*Allocasuarina* spp.) on sandier soils. The Guildford Complex is dominated by open forest to woodland of Marri, Wandoo, and Jarrah, with areas of just Wandoo. The Southern River Complex is an open woodland of Marri, Jarrah, and Banksia. Woodlands of flooded hum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca raphiophylla*) occur in wet areas in all three complexes (Heddle, Loneragan & Havel 1980).

3.6.1.3 Database searches

Flora

In 2018 360 Environmental conducted database searches using a 10 km buffer in NatureMap and the EPBC Protected Matters Search Tool (PMST) to identify flora species of conservation significance potentially occurring in the site. These database searches were re-run by Strategen-JBS&G to ensure the identification of flora species of conservation significance are current.

A total of 92 flora taxa of conservation significance were identified by database searches as potentially occurring within the site (Table 3.7). Results indicate 24 species were listed as Threatened, under both the BC Act and the EPBC Act; the remaining 68 flora taxa are priority listed flora species under the BC Act.

The potential for these plants to occur within the site was assessed based on general habitat requirements and distribution. 24 Threatened and 68 Priority flora species were considered to have the potential to occur within the site (Table 3.7). Of these, two conservation significant flora taxa were identified by AECOM (2020) to have been historically recorded within the site:

- *Conospermum undulatum* (T)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*

Database search results are presented in Appendix A.

Table 3.7: Threatened and Priority flora potentially occurring within the site

Species FAMILY Common name (if applicable)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Calectasia cyanea (Blue Tinsel Lily)	Critically Endangered	Threatened	Possible
Grevillea thelemanniana (Spider Net Grevillea)	Critically Endangered	Threatened	Possible
Ptilotus pyramidatus	Critically Endangered	Threatened	Unknown
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Threatened	Likely
Andersonia gracilis	Endangered	Threatened	Possible
Austrostipa bronwenae	Endangered	Threatened	Likely
Banksia mimica (Summer Honeypot)	Endangered	Threatened	Possible
Caladenia huegelii (Grand Spider Orchid)	Endangered	Threatened	Unknown
Drakaea elastica (Glossy-leaved Hammer Orchid)	Endangered	Threatened	Likely

Species FAMILY Common name (if applicable)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Calytrix breviseta subsp. breviseta	Endangered	Threatened	Likely
Darwinia apiculata (Scarp Darwinia)	Endangered	Threatened	Possible
Diuris purdiei (Purdie's Donkey Orchid)	Endangered	Threatened	Unknown
Eremophila glabra subsp. chlorella	Endangered	Threatened	Likely
Macarthuria keigheryi	Endangered	Threatened	Possible
Lepidosperma rostratum	Endangered	Threatened	Likely
Thelymitra stellata (Star Orchid)	Endangered	Threatened	Likely
Acacia anomala (Grass Wattle)	Vulnerable	Threatened	Possible
Acacia aphylla (Leafless Rock Wattle)	Vulnerable	Threatened	Possible
Anthocercis gracilis (Slender Tailflower)	Vulnerable	Threatened	Possible
Conospermum undulatum	Vulnerable	Threatened	Confirmed
Eleocharis keigheryi	Vulnerable	Threatened	Possible
Tetraria australiensis	Vulnerable	Threatened	Unlikely
Goodenia arthrotricha	Endangered	Threatened	Possible
Grevillea curviloba subsp. incurva	Endangered	Threatened	Possible
Calandrinia sp. Piawaning (A.C. Beauglehole 12257)	-	P1	Likely
Schoenus sp. Beaufort (G.J. Keighery 6291)	-	P1	Possible
Thelymitra magnifica (Crystal Brook Star Orchid)	-	P1	Likely
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	-	P1	Possible
Boronia humifusa	-	P1	Possible
Haloragis scoparia	-	P1	Possible
Hydrocotyle striata	-	P1	Possible
Ptilotus sericostachyus subsp. *roseus*	-	P1	Unlikely
Senecio gilbertii	-	P1	Possible
Lepyrodia curvescens	-	P2	Possible
Melaleuca viminalis	-	P2	Possible
Schoenus loliaceus	-	P2	Possible
Comesperma griffinii	-	P2	Likely
Paracaleana sp. Laterite (G. Brockman GBB 3571)	-	P2	Likely
Andersonia sp. *Blepharifolia* (F. & J. Hort 1919)	-	P2	Possible
Stenanthemum sublineare	-	P2	Possible
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	-	P2	Possible
Pithocarpa corymbulosa (Corymbose Pithocarpa)	-	P3	Possible
Platysace ramosissima	-	P3	Possible
Schoenus benthamii	-	P3	Possible
Schoenus capillifolius	-	P3	Possible
Schoenus pennisetis	-	P3	Possible
Schoenus sp. Waroona (G.J. Keighery 12235)	-	P3	Possible

Species FAMILY Common name (if applicable)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Stylidium aceratum	-	P3	Possible
Stylidium periscelianthum (Pantaloon Triggerplant)	-	P3	Possible
Styphelia filifolia	-	P3	Unknown
Thysanotus anceps	-	P3	Possible
Isopogon autumnalis (Previously *Isopogon drummondii)*	-	P3	Confirmed
Isotropis cuneifolia subsp. *glabra*	-	P3	Possible
Allocasuarina grevilleoides	-	P3	Possible
Jacksonia gracillima	-	P3	Possible
Lasiopetalum glutinosum subsp. *glutinosum*	-	P3	Unlikely
Meionectes tenuifolia	-	P3	Possible
Myriophyllum echinatum	-	P3	Possible
Babingtonia urbana (Coastal Plain Babingtonia)	-	P3	Unlikely
Banksia pteridifolia subsp. *vernalis*	-	P3	Unlikely
Byblis gigantea (Rainbow Plant)	-	P3	Unlikely
Chamaescilla gibsonii	-	P3	Possible
Comesperma rhadinocarpum (Slender-fruited Comesperma)	-	P3	Unknown
Angianthus micropodioides	-	P3	Possible
Banksia kippistiana var. *paenepeccata*	-	P3	Possible
Asteridea gracilis	-	P3	Possible
Beaufortia purpurea (Purple Beaufortia)	-	P3	Possible
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	-	P3	Likely
Carex tereticaulis	-	P3	Possible
Halgania corymbose	-	P3	Possible
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	-	P3	Likely
Haemodorum loratum	-	P3	Likely
Halgania corymbosa	-	P3	Possible
Acacia horridula	-	P3	Likely
Stackhousia sp. Red-blotched corolla (A. Markey 911)	-	P3	Possible
Schoenus natans (Floating Bog-rush)	-	P4	Possible
Lasiopetalum bracteatum	-	P4	Likely
Cyanicula ixioides subsp. *ixioides*	-	P4	Unknown
Senecio leucoglossus	-	P4	Possible
Stylidium longitubum (Jumping Jacks)	-	P4	Possible
Stylidium striatum (Fan-leaved Triggerplant)	-	P4	Possible
Verticordia lindleyi subsp. *lindleyi*	-	P4	Likely
Ornduffia submersa	-	P4	Unknown
Lasiopetalum bracteatum (Helena Velvet Bush)	-	P4	Likely
Acacia oncinophylla subsp. *patulifolia*	-	P4	Likely
Boronia tenuis	-	P4	Unlikely

Species FAMILY Common name (if applicable)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
(Blue Boronia)			
Drosera occidentalis (Western Sundew)	-	P4	Unknown
Hibbertia montana	-	P4	Possible
Calothamnus accedens	-	P4	Possible
Calothamnus graniticus subsp. *leptophyllus*	-	P4	Possible
Dodonaea hackettiana (Hackett's Hopbush)	-	P4	Possible
Pimelea rara (Summer Pimelea)	-	P4	Possible

Ecological communities

AECOM's (2020) database searches identified 14 conservation significant ecological communities that occurred near the site, including six TECs listed under the EPBC Act). These are presented in Table 3.8.

Table 3.8: Conservation Significant Ecological Communities identified by database searches

Community	Conservation Status		Presence in the site (AECOM 2020)
	State	Federal	
Banksia Woodlands of the Swan Coastal Plain Incorporating the State listed TECs and PECs: • Banksia attenuata woodlands over species rich dense shrublands (FCT20a) • Banksia attenuata and/or Eucalypt marginata woodlands of the eastern side of the Swan Coastal Plain (SCP20b) • Low lying Banksia attenuata woodlands or shrublands (SCP21c) • Banksia dominated woodlands of the Swan Coastal Plain	 EN EN P3 P3	E	Present Present (ID in portions of Lots 84 and 254 Victoria Rd) Present (ID in portions of Lots 254 Victoria Rd and Lot 9 Brentwood Ave) Absent Present (ID in portions of Lots 84 and 254 Victoria Rd)
SCP20c Shrublands and Woodlands of the Eastern Swan Coastal Plain (FCT20c)	CR	E	Absent
Clay Pans of the Swan Coastal Plain Incorporating the State listed TECs: • Herb rich saline shrublands in clay pans (SCP07) • Herb rich shrublands in clay pans (SCP08) • Shrublands on dry clay flats. (SCP10a)	 VU VU EN	CE	Absent Absent Absent Absent
SCP 3a Corymbia calophylla – Kingia australis Woodlands on Heavy Soils of the Swan Coastal Plain (FCT3a)	CR	E	Absent
SCP3b Corymbia calophylla – Eucalyptus marginata Woodlands on Sandy Clay Soils of the southern Swan Coastal Plain (FCT3b)	VU	-	Absent
SCP3c Corymbia calophylla – Xanthorrhoea preissii Woodlands and Shrublands, Swan Coastal Plain (FCT3c)	CR	E	Absent
Central Northern Darling Scarp Granite Shrubland Community	P4	-	Absent
SCP02 Southern Wet Shrublands, Swan Coastal Plain (FCT02)	EN	-	Absent
Muchea Limestone – Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	EN	E	Absent

3.6.2 Site survey

Two flora and vegetation surveys have been undertaken within the site (Figure 7):

- AECOM (2020) Wattle Grove Ecological Surveys
- Strategen (2020) Black Cockatoo Habitat Assessment

Approximately 53% of the site has been subject to a flora and vegetation survey by AECOM (2020) and a further 19% was covered by the Black Cockatoo Habitat Assessment. The flora and fauna characteristics of the site are reasonably well known, with some gaps within Lots 210 and 2 where native vegetation may be present (DPIRD 2020). The results of the surveys are summarised below.

3.6.2.1 Vegetation Types

A total of five vegetation types were mapped within the site (AECOM 2020). Three vegetation types represent remnant native vegetation while the remaining two are highly modified or planted (Figure 8). Areas previously subject to clearing or development have been identified as 'Cleared'. Areas not subject to a site assessment have been extrapolated based on adjacent environmental values and review of aerial imagery, where possible. The area each vegetation type occupies within the site is provided in Table 3.9.

Table 3.9: Vegetation types mapped within the surveyed portion of the site - adapted from AECOM (2020)

Vegetation type	Area (ha)	Percentage total (%)
Remnant native vegetation		
BaEpPf	2.16	2.03
BmXpEc	0.42	0.39
EmMpLp	0.05	0.05
Total remnant native vegetation	**2.63**	**2.48**
Highly modified vegetation		
Planted	2.32	2.17
Trees	20.84	19.63
Total highly modified vegetation	**23.16**	**21.82**
Other		
Cleared land	**78.55**	**73.99**
Unknown	**1.82**	**1.71**
Grand total	**106.16**	**100**

3.6.2.2 Vegetation Condition

Vegetation in the site was highly fragmented, consisting of several patches of remnant native vegetation separated by significantly altered areas containing a combination of cleared and parkland cleared areas (Figure 9). Many trees within these areas area planted species endemic to the eastern states such as *Corymbia citriodora* (lemon scented gum) or foreign taxa such as **Melia azedarach* (cape lilac). Vegetation within the site ranged from Completely Degraded to Excellent, with the Excellent and Very Good vegetation limited to specific lots, being a very small area on Lot 9 Brentwood Road and portions of Lots 84 and 254 Victoria Road (AECOM 2020). A breakdown of the vegetation condition within the site, is provided in Table 3.10.

Table 3.10: Vegetation condition

Vegetation condition	Area (ha)	Percentage total (%)
Excellent	1.15	1.08
Very Good	0.29	0.27
Good	0.24	0.23
Degraded	0.13	0.13
Completely degraded	87.77	82.67
Cleared	14.76	13.9
Unknown	1.82	1.72
Total	**106.16**	**100**

3.6.2.3 Weeds

Two Declared Pest plants were identified by AECOM as occurring within the survey area, **Asparagus asparagoides* (bridal creeper) and **Rubus ulmifolius* (blackberry). AECOM (2020) did not include a location for these weed species, so it cannot be determined whether they fall within the subject site.

3.6.2.4 Conservation significant flora

AECOM undertook an ecological spring survey, incorporating flora and vegetation in October 2019 (AECOM 2020). The survey recorded data from twelve quadrats and eight relevés, covering a broader area of the Wattle Grove locality than the site. The result of this survey has been augmented by the further survey work by Strategen JSB&G.

AECOM's survey recorded 165 native vascular flora taxa from the broader survey area and 21 introduced flora taxa, many of which are not expected to occur within the site. This included two conservation significant flora taxa, concentrated in two localised areas, within the site (Figure 10):

- *Conospermum undulatum* (T)
- *Isopogon autumnalis* (P3), previously named *Isopogon drummondii*.

The AECOM field survey was undertaken at an appropriate time to identify conservation significant orchid species if present, however, the survey only gained access to approximately 50% of lots and recognised that there is potential for conservation significant flora taxa to have been missed if present. Strategen JSB&G (2021) conducted a further site survey incorporating a number of the previously surveyed and significant additional lots within the site (and which are generally representative of the site) and which were predominantly parkland cleared containing introduced and some limited native trees. There are some small, localised areas of vegetation that have not yet been subject to survey that could possibly retain some conservation significant flora. Aerial photography and knowledge of the site suggests these areas are limited in number and scale and are concentrated within Lot 210.

Conospermum undulatum (waxy-leaved smokebush) is an erect shrub which grows to 1.5 m height and is characterised by its fibrous, longitudinally fissured stems and wide leaves with wavy margins. It is listed as Vulnerable under the EPBC Act and is ranked as Vulnerable (VU) under World Conservation Union (IUCN 1994) Red List criterion B1+2c, with its main threats being listed as further land clearing, poor habitat quality, road and firebreak maintenance, inappropriate fire regimes, weeds, recreational activities and rabbit grazing (DEC 2009). *Conospermum undulatum* is recorded from 25 historical populations, comprising 83 subpopulations. However, only 20 populations currently contain extant plants (DEC 2009). It occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat. Habitat critical to the survival of *C. undulatum* includes the area of occupancy of important populations and areas of similar habitat surrounding important populations (DEC 2009). Important populations of *C. undulatum* are listed in the species' recovery plan.

Isopogon autumnalis is an erect shrub growing to 1 m height with cream-yellow flowers and mostly terete leaves (Rye and MacFarlane 2019). It is listed as a Priority 3 taxon by Department of Biodiversity, Conservation and Attractions (DBCA). It is known from a large range extending from the southern Lesueur Sandplains through the Swan Coastal Plain and Dandaragan Plateau to the Northern Jarrah Forrest. It prefers white, grey or yellow sand, often over laterite. It was previously known as *Isopogon drummondii* but was renamed in 2019 due to lack of a type specimen and descriptions being based on cultivated specimens (Rye and MacFarlane 2019). Variants of the taxon with larger leaves were transferred to *Isopogon sphaerocephalus*.

Two additional conservation significant flora species, *Banksia mimica* and *Lasiopetalum glutinosum* subsp. *glutinosum,* were identified in the 2018 desktop assessment through DBCA records (360 Environmental 2018). *B. mimica* was previously recorded south east of the Crystal Brook Road and Brentwood Road junction. All properties in this vicinity have since been cleared for residential development, and no native vegetation remains. *B. mimica* was not recorded during the field survey (AECOM 2020).

Naturemap records of *L. glutinosum* within the site are associated with Paganoni Swamp, approximately 60 km south west of the site. The occurrence of *L. glutinosum* within the site is therefore considered a result of mapping inaccuracies. AECOM determined that the species is unlikely to occur within the site, given it is associated with lateritic outcrops on the Darling Scarp. AECOM (2020) did not identify L. glutinosum during the survey.

3.6.2.5 Threatened and Priority Ecological Communities

Two vegetation types within the site were confirmed by AECOM (2020) to represent state and/or Commonwealth Threatened and Priority Ecological Communities (Table 3.11). These are illustrated on Figure 10. Vegetation types BmXpEc and BaEpPf were determined to represent the Banksia Woodlands of the Swan Coastal Plain, which is listed as a Threatened Ecological Community (TEC) under the EPBC Act (Endangered) and under the BC Act as Priority 3. The northern patch of BaEpPf and BmXpEc were found to tentatively represent FCT20b: *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the Eastern Swan Coastal Plain (TEC). The southern patch of BaEpPf was found to represent SCP20a: *Banksia attenuata* woodlands over species rich dense shrublands.

Table 3.11: Vegetation communities (adapted from AECOM 2020)

Vegetation Community	Location in site	Approx. mapped area (ha)	Statistical Analysis	Confirmed TEC/PEC	Conservation Status	
					State	Federal
BmXpEc: *Banksia menziesii, Allocasuarina fraseriana* and *Eucalyptus todtiana* low open woodland over *Xanthorrhoea preissii, Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* low open shrubland over **Ehrharta calycina*, *Dasypogon bromeliifolius* and *Anigozanthos manglesii* subsp. *manglesii* mixed grass and forbland.	Portions of Lot 9 Brentwood Rd and Lot 84 Victoria Rd	0.42	FCT20b *B. attenuata* and/or *E. marginata* woodlands of the Eastern side of the SCP (SCP20b)	No. Revision of the criteria to be defined as PEC, bringing them in alignment with criteria for the TEC, means this patch no longer represents the PEC.	TEC (EN)	EN – Banksia woodlands of the Swan Coastal Plain Ecological Community

Vegetation Community	Location in site	Approx. mapped area (ha)	Statistical Analysis	Confirmed TEC/PEC	Conservation Status	
					State	Federal
BaEpPf **Banksia Woodland** *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* low open woodland over *Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* and *Allocasuarina humilis* low shrubland over *Phlebocarya filifolia*, *Mesomelaena pseudostygia* and *Lepidosperma leptostachyum* low sedgeland. *drummondii.*	Portions of Lots 84 and 254 Victoria Rd	1.14	Northern Patch: FCT20b *B. attenuata* and/or *E. marginata* woodlands of the Eastern SCP (SCP20b)	Yes (tentative).	TEC (EN)	
			Southern Patch: FCT 20a *B. attenuata* woodlands over species rich dense shrublands (SCP20a).	Yes.	TEC (EN)	

3.7 Fauna and habitat

3.7.1 Desktop assessment

Conservation significant fauna searches were conducted using a 10 km buffer in NatureMap and the EPBC Protected Matters Search Tool (PMST) to identify fauna species potentially occurring in the site.

The database search indicated 38 fauna taxa of conservation significance have the potential to occur within the site (Table 3.12). A total of 14 species are listed as Threatened under both the BC Act and EPBC Act. As the site is predominantly cleared of native vegetation and used for rural purposes, the site is not considered to offer large areas of intact habitat. The surrounding environment is also representative of clearing and rural land uses containing limited vegetation to the north, west and south of the site. Large areas of intact vegetation area located to the east of the site that may provide higher quality fauna habitat (360 Environmental 2018). An assessment of the likelihood for each species to occur was undertaken, based on the habitat types within the site. The likelihood for each species to occur within the site is presented in Table 3.12.

Table 3.12: Fauna desktop assessment

Common name (*Scientific name*)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Australasian Bittern (*Botaurus poiciloptilus*)	Endangered	Threatened	Unlikely

Common name (*Scientific name*)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Brush-tailed Bettong (*Bettongia penicillata ogilbyi*)	Critically Endangered	Threatened	Unlikely
Eastern Curlew (*Numenius madagascariensis*)	Critically Endangered	Threatened	Unlikely
Curlew Sandpiper (*Calidris ferruginea*)	Critically Endangered	Threatened	Unlikely
Australian Painted Snipe (*Rostratula australis*)	Endangered	Threatened	Possible
Western Ringtail Possum (*Pseudocheirus occidentalis*)	Vulnerable	Threatened	Unlikely
Quokka (*Setonix brachyurus*)	Vulnerable	Threatened	Unlikely
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	Vulnerable	Threatened	Possible
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Vulnerable	Threatened	Likely
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered	Threatened	Likely
Chuditch (*Dasyurus geoffroii*)	Vulnerable	Threatened	Unlikely
Short-tongued Bee (*Leioproctus douglasiellus*)	Critically Endangered	Threatened	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	Critically Endangered	Threatened	Unlikely
South Western Phascogale (*Phascogale tapoatafa wambenger*)	-	Conservation Dependent Fauna	Unknown
Great Egret (*Ardea modesta*)	Marine	International Agreement	Possible
Rainbow Bee-eater (*Merops ornatus*)	Marine	International Agreement	Confirmed: sighted in remnant vegetation within Lot 254 Victoria Road by AECOM (2020)
Wood Sandpiper (*Tringa glareola*)	Marine/Migratory	International Agreement	Possible
Common Sandpiper (*Tringa hypoleucos*)	Marine/Migratory	International Agreement	Possible
Common Greenshank (*Tringa nebularia*)	Marine/Migratory	International Agreement	Possible
Marsh Sandpiper (*Tringa stagnatilis*)	Marine/Migratory	International Agreement	Possible
Peregrine Falcon (*Falco peregrinus*)	-	Other Specially Protected Fauna	Unlikely
Western Swamp Tortoise (*Pseudemydura umbrina*)	-	Threatened	Unknown
Scorpionfly (*Austromerope poultoni*)	-	Priority 2	Unknown
A short-tongued bee (*Leioproctus bilobatus*)	-	Priority 2	Unknown
Southern Death Adder (*Acanthophis antarcticus*)	-	Priority 3	Unlikely
Black Striped Snake (*Neelaps colonotos*)	-	Priority 3	Possible
Water-rat (*Hydromys chrysogaster*)	-	Priority 4	Possible
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	-	Priority 4	Confirmed: sighted in remnant vegetation within Lots 84 and 254 Victoria Road by AECOM (2020)
Western Brush Wallaby (*Macropus irma*)	-	Priority 4	Possible

Common name (*Scientific name*)	Conservation status		Potential to occur (based on desktop assessment)
	EPBC Act	BC Act	
Blue billed Duck (*Oxyura australis*)	-	Priority 4	Unlikely

3.7.2 Site survey

AECOM (2020) undertook an ecological survey that incorporated fauna habitat in October 2019. The survey covered a broader area than the site and recorded a total of five fauna habitat types. The survey was limited to properties for which access was provided. Given the survey area was broader than the subject site, the discussion of AECOM's findings is limited to the current subject site.

Five fauna habitat types were recorded in the site within properties for which access was provided. Excluding the substantial cleared and hardstand areas, the predominant fauna habitat identified during the site surveys is scattered (introduced and native) trees, with localised areas of planted and maintained gardens. A complete breakdown of the fauna habitat types recorded within the surveyed portion of the site is provided in Table 3.13, and presented on Figure 11. Portions of Lots 84 and 256 Victoria Road and small portion of Lot 9 Brentwood Road were identified as containing Banksia woodland fauna habitat. Lot 256 Victoria Road also contains a very small portion of Eucalyptus woodland habitat, while Lot 8 Brentwood Road contains a very small portion of Shrubland habitat. Additional areas not subject to a site survey have been interpreted based on review of aerial imagery and known environmental values, where possible.

Table 3.13: Fauna habitat types within surveyed, vegetated portion of the site – adapted from AECOM (2021)

Fauna Habitat Type	Area (ha)	Percentage of total (%)
Banksia Woodland	1.78	1.68
Eucalyptus Woodland	0.05	0.04
Planted and Maintained Gardens	2.13	2.01
Scattered Trees	20.84	19.63
Shrubland	0.99	0.93
Cleared	78.55	73.99
Unknown	1.82	1.72
Total	**106.16**	**100**

AECOM (2020) recorded habitat of varying quality that may be suitable for Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos, as well as for Quenda, within the site boundary. AECOM (2020) recorded Quenda sightings at three locations (Lots 254 and 84) and Rainbow Bee-eater at one location (Lot 254) within the areas of remnant vegetation (Figure 11).

3.7.3 Black cockatoo habitat assessment

3.7.3.1 Methods

Two black cockatoo habitat assessments have been undertaken within the site:

- AECOM (2020) Wattle Grove Ecological Surveys
- Strategen-JBS&G significant tree and black cockatoo habitat assessment (undertaken 2021 to inform this EAR)

The AECOM (2020) Black Cockatoo habitat assessment covered the same survey area as demonstrated by Figure 3.6, broader than the current site boundary. The survey recorded data from twelve quadrats and eight relevés across the survey area and was limited to properties for which access was provided.

Strategen-JBS&G undertook a significant tree and black cockatoo habitat assessment in February 2021 incorporating additional areas of the site to result in a combined survey area representing 72% of the site. The survey also provided further context to support habitat mapping over the balance of

the site. This assessment was undertaken by two ecologists from Strategen JBS&G with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012).

Foraging habitat assessment

The Survey Area was traversed on foot to record any flora species with the potential to provide a food source for black cockatoos. This data was collected across the site to inform habitat quality assessment method, detailed below.

Habitat Scoring Method

The Department of Agriculture, Water and the Environment (DAWE) have recognised that the scoring tool to determine the value of Black Cockatoo habitat, contained in the 2017 *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus banksii naso* (DEE 2017), is flawed and as such have recommended against the use of this tool.

Bamford Consulting Ecologists (BCE 2018) have developed a Black Cockatoo foraging habitat scoring system (Attachment A), which has been previously accepted by the DAWE for projects subject to EPBC Act assessment. The BCE (2018) scoring system comprises of the following components to determine an overall score out of 10:

- Step 1: A score out of 6 for the vegetation composition, condition and structure. This represents the condition of the site in relation to the ecological requirements of the Threatened species and includes considerations of vegetation condition and structure and the density of foraging species present.
- Step 2: A score out 3 for the context of the site, where consideration is given to the extent of native vegetation remaining within 15km of the Project Area and the percentage of that extent that the Project Area represents, and if breeding is known/likely or unlikely to occur within 15km. This represents the relative importance to the site with regard to its position in the landscape including connectivity needs of the Threatened species. This includes considerations of the proximity of the site in relation to breeding and roosting habitat, and the importance of the role the site may plater in relation to the overall species population.

Site context scoring is applied as outlined below in Table 3.14.

Table 3.14: Site context scoring

Site context score / 3	Percentage of the existing native vegetation within the 'local' area that the study site represents	
	Local (within 15km) breeding known/likely	Local (within 15km) breeding unlikely
3	>5%	>10%
2	1-5%	5-10%
1	0.1-1%	1-5%
0	<0.1%	<0.1%

- Step 3: A species density score out of 1, where consideration is given to any sightings or foraging evidence recorded within the Project Area. If foraging evidence or sightings have been made within the Project Area, a score of 1 is assigned.
- Step 4: Determining the total score out of 10, which may require moderation where a score of 2 of lower has been ascribed at Step 1.

Where a raw foraging score of 2 or less out of 6 has been assigned, a site context score and species density score of 0 has been applied, so as not to overstate foraging value (Bamford Consulting Ecologists 2018).

This method was devised to achieve a score out of 10 to describe habitat quality when using the DAWE Offset Calculator. However, Step 1 alone has been used to inform Black Cockatoo habitat mapping of the Survey Area, as this step provides sufficient information to distinguish the habitat quality of each VT. Total scores were also calculated, should they be required for future reference.

Habitat quality presented within this document uses data collected during both the AECOM (2020) and Strategen-JBS&G (2021) surveys, analysed using the above methods.

Significant tree assessment

Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC 2012). Tree species which may be potential breeding or roosting trees are outlined in Table 3.15 and displayed on Figure 12. Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e trees which provide a roost or rest area for the birds). The locations of such trees within the Survey Area were recorded using a GPS. In addition to the location and DBH, the species, health and estimated DBH of each tree was also recorded, along with the presence of any hollows.

Table 3.15: Black cockatoo potential breeding and roosting tree species

Scientific name	Common name	Breeding	Roosting
Corymbia calophylla	Marri	Yes	Yes
Corymbia maculata	Spotted Gum	-	Yes
Eucalyptus accedens	Powderbark	Yes	-
Eucalyptus camaldulensis	River Red Gum	-	Yes
Eucalyptus citriodora	Lemon Scented Gum	-	Yes
Eucalyptus diversicolor	Karri	Yes	-
Eucalyptus globulus	Tasmania Blue Gum	-	Yes
Eucalyptus gomphocephala	Tuart	Yes	Yes
Eucalyptus grandis	Flooded Gum, Rose Gum	-	Yes
Eucalyptus longicornis	Red Morrell	Yes	-
Eucalyptus loxophleba	York Gum	Yes	-
Eucalyptus marginata	Jarrah	Yes	Yes
Eucalyptus megacarpa	Bullich	Yes	Yes
Eucalyptus occidentalis	Swamp Yate	Yes	-
Eucalyptus patens	Blackbutt	Yes	Yes
Eucalyptus robusta	Swamp Mahogany	-	Yes
Eucalyptus rudis	Flooded Gum	Yes	Yes
Eucalyptus salmonophloia	Salmon Gum	Yes	-
Eucalyptus salubris	Gimlet	Yes	-
Eucalyptus wandoo	Wandoo	Yes	Yes
Pinus pinaster	Pinaster, Maritime Pine	--	Yes
Pinus radiata	Monterey, Radiata Pine		Yes

Source: Groom 2011, DSEWPaC 2012

3.7.3.2 Results

Foraging habitat

Foraging habitat identified within the Survey Area is shown in Figure 12. Foraging habitat quality is detailed in Table 3.17 to Table 3.19. These results represent the outcomes of analysis using data collected during both the AECOM (2020) and Strategen-JBS&G (2021) surveys.

Vegetation within the Survey Area is considered to generally have 'low' to 'low to moderate' foraging habitat value for Carnaby's Cockatoo and low foraging habitat value for Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo, based on density of suitable foraging species.

The site represents <0.1% of the existing native vegetation within the local area (15 km radius) and Carnaby's Black Cockatoo breeding sites are known from within a 15 km radius, therefore was assigned a context score of 1.

Active foraging was observed during the field survey, and therefore a score of 1 was assigned for species density.

Table 3.16: Carnaby's Cockatoo foraging habitat quality within Survey Area

Vegetation composition score	Primary foraging species	Secondary foraging species	Site Context score	Species density	Total score
4 – Moderate	*Banksia attenuata* *Banksia menziesii* *Eucalyptus marginata* *Corymbia calophylla*	*Eucalyptus gomphocephala* Allocasuarina spp.	1	1	6
3 – Low to moderate	*Eucalyptus marginata* *Corymbia calophylla*	*Eucalyptus gomphocephala* Allocasuarina spp.	1	1	5
2 – Low foraging value	*Eucalyptus marginata (scattered)*	*Eucalyptus gomphocephala* Allocasuarina spp.	n/a	n/a	2
1 – Low to negligible	*Eucalyptus marginata (scattered)*	Allocasuarina spp.	n/a	n/a	1

Table 3.17: Forest Red-tailed Black Cockatoo foraging habitat quality within Survey Area

Vegetation composition score	Primary foraging species	Secondary foraging species	Site Context score	Species density	Total score
3 – Low to moderate	*Eucalyptus marginata* *Corymbia calophylla*	*Eucalyptus gomphocephala* Allocasuarina spp.	1	1	5
2 – Low foraging value	*Eucalyptus marginata (scattered)*	*Eucalyptus gomphocephala* Allocasuarina spp.	n/a	n/a	2
1 – Low to negligible	*Eucalyptus marginata (scattered)*	Allocasuarina spp.	n/a	n/a	1

Table 3.18: Baudin's Black Cockatoo foraging habitat quality within Survey Area

Vegetation composition score	Primary foraging species	Secondary foraging species	Site Context score	Species density	Total score
3 – Low to moderate	*Corymbia calophylla*	*Banksia attenuata* *Banksia menziesii* *Eucalyptus marginata* *Eucalyptus gomphocephala* Allocasuarina spp.	1	1	5
2 – Low foraging value	*Nil*	*Eucalyptus gomphocephala*	n/a	n/a	2

Vegetation composition score	Primary foraging species	Secondary foraging species	Site Context score	Species density	Total score
		Eucalyptus marginata (scattered) Allocasuarina spp.			
1 – Low to negligible	*Nil*	*Eucalyptus marginata (scattered)* Allocasuarina spp.	n/a	n/a	1

Table 3.19: Black cockatoo habitat within surveyed portion of the site (AECOM 2020; Strategen-JBS&G 2021)

Black cockatoo habitat	Area (ha)
Carnaby's Cockatoo	
Moderate foraging value	2.16
Low to moderate foraging value	9.01
Low foraging value	9.27
Low to negligible foraging value	1.74
Forest Red-tailed Black Cockatoo	
Low to Moderate foraging value	2.23
Low foraging value	17.58
Low to negligible foraging value	2.37
Baudin's Black Cockatoo	
Low to moderate foraging value	2.23
Low foraging value	17.58
Low to negligible foraging value	2.37

Breeding Habitat

Within the site, 84 trees were recorded with a suitable DBH to support potential hollow development (≥ 500 mm; Figure 12). Of these, two trees (Jarrah) contained hollows potentially suitable for black cockatoo breeding. Further inspection with a drone and/ or pole camera is required to confirm internal dimensions and suitability to support breeding.

Roosting Habitat

No roosts were identified during the assessment; however, the Project Area contains potential roosting habitat in the form of tall Jarrah, Marri, Tuart, and introduced Eucalyptus species throughout the site and is located less than 6km from a confirmed roost site (DBCA 2019).

3.8 Conservation areas

State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region (SPP 2.8) aims to provide a policy and implementation framework that ensures bushland protection and management issues throughout the Perth Metropolitan Region are adequately addressed and integrated with broader land use planning and decision-making (WAPC 2010). In accordance with SPP 2.8, proposals must recognise regionally significant bushland and outline methods by which it will avoid, minimise, and offset any likely adverse impacts it will have on regionally significant bushland.

The policy predominantly deals with two distinct subjects, Bush Forever areas and local bushland areas.

Bush Forever

No Bush Forever sites occur within the site. The closest point of the nearest Bush Forever sites are approximately 105 m to the west on the opposite side of Tonkin Highway (Site 387, the Greater Brixton Street Wetlands) and approximately 90 m to the northwest on the opposite side of Welshpool Road East (Site 320, Hartfield Road Bushland). Each of these Bush Forever areas are associated with several CCWs including UFIs 13131, 14962, 7775, 7772, 8031, 8032 and 15815.

Conservation Areas

There are no DBCA managed lands within the site, with the nearest conservation reserve being the Brixton Street Wetlands, Kenwick, approximately 105 m west of the site boundary.

The Brixton Street Wetlands are understood to be the most biologically diverse Bush Forever site on the Swan Coastal Plain and are included in the Register of the National Estate.

3.9 Regional Ecological Linkages

Ecological corridors have been identified in the Perth metropolitan region to limit the effects of fragmentation across areas of remnant bushland. Across the Project Area there is one Regional Ecological Linkage at the north-westernmost extent of the Project Area (Link ID: 40), which connects the Brixton Street Wetlands and the Hartfield Road Bushland (WALGA 2008). The small portion of the Regional Ecological Linkage which falls within the site (over portions of Lot 146 Welshpool Road East and Lot 12 Brentwood Road) has been mostly cleared (Figure 13).

3.10 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for the Environment under section 15b of the *Environmental Protection Act 1986*. ESAs are only relevant in the limited context of exemptions in the clearing regulations, which do not apply to ESAs.

Eight ESAs are mapped within the site according to the dataset available through DWER (2020). The location of each ESA is shown on Figure 14, and each is described in Table 3.20 (GoA 2021).

Many of the ESAs mapped within the site are associated with the locations of declared rare flora, however based on surveys undertaken by AECOM (2020) (see Section 3.6.1.3) many of these areas have been historically cleared and the Threatened flora associated with the ESA boundary are no longer present. Accordingly, the corresponding ESAs are no longer considered to be applicable.

Table 3.20: Environmentally Sensitive Areas within the site

ESA feature number	ESA purpose	Comment
115043	Within 50m of Conservation Category Wetland	Associated with the small area of mapped CCW on Lot 501 external to the site that is within the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Area within the site has been significantly altered. Further consideration of the interface is required following detailed design by MRWA.
125161	Within 50m of Conservation Category Wetland & associated with Threatened or Rare Flora	Associated with the small area of mapped CCW on Lot 501 external to the site is within the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Area within the site has been significantly altered. Also associated with TEC located within the Brixton Street wetlands located on the opposite side of Tonkin Highway, greater than 100m west of the site.
122572	Within 50m of Conservation Category Wetland	Associated with the small area of mapped CCW on Lot 501 external to the site is within the proposed Tonkin Highway/Welshpool Road East intersection upgrade. Area within the site has been significantly altered. Further consideration of the interface is required following detailed design by MRWA.
116753	Associated with Threatened Ecological Community	Associated with TEC located within the Brixton Street wetlands located on the opposite side of Tonkin Highway, greater than 100m west of the site. Area within the site has been significantly altered.

ESA feature number	ESA purpose	Comment
118323	Threatened or Rare Flora	Associated with the historic record of a *Conospermum undulatum* in this location. The area has been significantly altered and no evidence of the flora was observed during the AECOM 2020 survey of this location.
118326	Threatened or Rare Flora	Associated with the historic record of a *Lasiopetalum glutinosum* in this location. The area has been significantly altered and no evidence of the flora was observed during the AECOM 2020 survey of this location.
118327	Threatened or Rare Flora	Associated with the historic record of a *Lasiopetalum glutinosum* in this location. The area has been cleared and no evidence of the flora was observed during the AECOM 2020 survey of this location.
118324	Threatened or Rare Flora	Associated with the historic record of a *Conospermum undulatum* in this location. Remnant vegetation in the immediate area has been identified as locally significant vegetation and is proposed to be retained.

3.11 Bushfire risk

The site has been mapped as being within a bushfire prone area, according to mapping by the Department of Fire and Emergency Services (DFES 2019).

As a result of the bushfire prone status of the site, a Bushfire Management Plan (BMP) is required to accompany the MRS amendment application to address the following requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7), namely Policy Measure 6.3:

- A bushfire hazard level (BHL) assessment or where lot layout is known, a Bushfire Attack Level (BAL) contour assessment to determine the indicative acceptable BAL ratings across the site
- Identification of any bushfire hazard issues arising from the above assessment
- Assessment against the bushfire protection criteria requirements contained within the Guidelines demonstrating compliance can be achieved in subsequent planning stages.

A Bushfire Management Plan (BMP) (Strategen-JBS&G 2021) has been prepared to support the MRS amendment, which includes an assessment of vegetation within and surrounding the site to determine applicable bushfire hazards, in accordance with Australian Standard 3959:2018 Construction of buildings in bushfire-prone areas (AS 3959) and an assessment of the bushfire protection criteria outlined in the Guidelines. The BMP has determined that the future MRS amendment can satisfy the requirements of SPP 3.7 and the Guidelines. The anticipated environmental impacts of the MRS amendment have specifically considered any bushfire management requirements. No further environmental impacts (such as clearing of vegetation) beyond those outlined in this report will be required to implement urban development across the site, consistent with the MRS amendment.

3.12 Heritage

3.12.1 Indigenous heritage

The *Aboriginal Heritage Act 1972* (AH Act) aims to protect Aboriginal heritage by registering Aboriginal sites (places and/or objects) that are of cultural importance to Aboriginal people. Any

proposal to use or alter an area of land, for purposes such as research or development, must first determine if Aboriginal sites occur within the proposed area. If an Aboriginal site is found to occur, permission must be sought from the Minister for Aboriginal Affairs before that land can be used or altered in any way.

A search of the Department of Planning, Lands and Heritage – Aboriginal Heritage Places mapping tool (DPLH 2021) found that the site intersects one registered heritage site: Brentwood Road Swamp (Site ID 4343). Another heritage site, Brentwood Road Quarry (Site ID 4342), is located externally to the site on the opposite side of Tonkin Highway. The general location of these two heritage places, as depicted in the DPLH mapping, are shown on Figure 15.

DPLH 4343 Brentwood Road Swamp was recorded in 1973 and is listed on the Register of Aboriginal Sites as an artefact scatter with an unreliable location. A site assessment was undertaken by Horizon Heritage Management (2021) to verify the location of the registered heritage site. A reliable location for the site will be determined following DPLH consideration of the results of the site assessment. The site is a registered Aboriginal heritage site and as such is afforded protection under the AH Act.

3.12.2 European heritage

European cultural heritage places are recorded in a variety of different heritage listings. Some of these listings give statutory protection to heritage places, through requirements for heritage-related approvals or referrals. A search of the State Heritage Office InHerit search tool did not identify any European cultural heritage places within or adjacent to the site (SHO 2021).

4. Assessment of Potential Impacts

The potential impacts of urban development within the site have been assessed, based on the applicable policy considerations, receiving environment, potential impacts, management measures to be implemented, and the predicted outcomes. Based on the findings of the desktop assessment, the following Key Environmental Factors are considered relevant to the proposal:

- Social surroundings
- Inland waters
- Terrestrial environmental quality
- Flora and vegetation
- Terrestrial fauna

4.1 Key Environmental Factor - Social Surroundings

4.1.1 Environmental objective

To protect social surroundings from significant harm.

4.1.2 Policy considerations

The EPA (2016) outline a number of key considerations for social surroundings within the *Environmental Factor Guideline: Social Surroundings* which are discussed below, where relevant, with relation to future development of the site.

Regarding noise, future development will be subject to the requirements of *State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4).

4.1.3 Receiving environment and potential impacts

4.1.3.1 Aboriginal Heritage

The site intersects one Registered Aboriginal Heritage site: Brentwood road swamp (Site ID 4343). The site is classified as 'artefacts/scatter', and all obligations under the *Aboriginal Heritage Act 1972* (AH Act) will apply to any future development.

DPLH 4343 Brentwood Road Swamp is listed on the Register of Aboriginal Sites as an artefact scatter with an unreliable location. A site assessment was undertaken by Horizon Heritage Management (2021) to verify the location. A reliable location will be advised following a report of the results to DPLH. As the site is confirmed to be registered, and as such is protected under the AH Act, the revised location of the site may have implications for future development. The proponent will respond and factor in any subsequent advice received from DPLH as part of the MRS referral process. The subsequent structure plan and subdivision design will be informed by the location of the site, and whether it falls within the MRS amendment site boundary.

4.1.3.2 Assessment of industrial land uses against policy requirements

The boarding kennels, poultry farm, turf farm, and DBNGP areas identified in section 3.1.2 as potentially causing noise, odour and/or dust impacts have been assessed against applicable policies and guidance, including required separation distances from sensitive land use.

Separation distances

The *EPA Guidance Statement No. 3 – Separation Distances Between Industrial and Sensitive Land Uses* provides advice on generic separation distances between specific industry and sensitive land uses to avoid or minimise the potential for land use conflict. Whilst this is a useful as starting point, the Guidance Statement recognises that site-specific technical analysis is the most appropriate

guidance in these types of scenarios. The broad guidance parameters of the EPA's Guidance Statement No.3 as they apply to the identified land uses are summarised in Table 4.1. This table also includes reference to the Department of Health's supplementary position statement regarding the separation of agricultural and residential land uses. The Department has largely adopted the best practice standards described by the Queensland Department of National Resources in their Planning guidelines: separating agricultural and residential land uses – August 1997 and is supported by CSIRO (2002).

The purpose of applying separation distances is to reduce impacts such as noise, dust, and odour on nearby sensitive land uses. The definition of sensitive land uses, according to the EPA (2005), includes residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child-care facilities, institutions, and shopping centres.

Table 4.1: Industrial land uses within and in the vicinity of the site

Land use	Location	Reference on Figure 2	Distance from nearest point within the site	Current separation distance to nearest sensitive land use	Potential impacts	Comment
Kennels	714 Welshpool Road East, Wattle Grove (City of Kalamunda)	Kennel 1	70m	60m to existing dwelling	Noise, Odour	EPA guidance (without site specific noise modelling) 500m in rural zones, up to 1km in urban areas (EPA 2005) Existing kennels have been approved by the City of Kalamunda and Gosnells, subject to operational compliance in the context of existing sensitive receptors (dwellings).
	810 Welshpool Road East, Wattle Grove (City of Kalamunda)	Kennel 2	700m	120m to existing dwelling		
	200 Brentwood Road, Kenwick (City of Gosnells)	Kennel 3	170m	60m to existing dwelling		
	207 Brentwood Road, Kenwick (City of Gosnells)	Kennel 4	70m	70m to existing dwelling		
Poultry farm	111 Victoria Road, Wattle Grove (City of Kalamunda)	Poultry Farm 1	Within the site (Lot 251)	70m to existing dwelling	Noise, Dust, Odour	Special Control Area (SCA) applied under the City of Kalamunda LPS No. 3 within a buffer of 300m (DPLH 2020). This facility has ceased operations.

Land use	Location	Reference on Figure 2	Distance from nearest point within the site	Current separation distance to nearest sensitive land use	Potential impacts	Comment
	127 Victoria Road, Kenwick (City of Gosnells)	Poultry Farm 2	245m	50m to existing dwelling		No specific separation distances specified in CoG (2019) TPS. 300 – 1000 m buffer (EPA 2005) 500 m buffer (GoWA 2004). This facility will cease operations prior to residential development occurring.
	56 Brook Road, Wattle Grove (City of Kalamunda)	Poultry Farm 3	800m	180m to existing dwelling		Special Control Area (SCA) applied under the City of Kalamunda LPS No. 3 within a buffer of 300m (DPLH 2020). Buffer does not impinge upon subject site.
Turf farm	41, 53, 63 & 69 Brentwood Road, Wattle Grove (City of Kalamunda)	Turf Farm	Within the site (lots 303, 53, 214 and 213)	130m to existing dwelling	Noise, Dust, Odour	500m (EPA 2005) (without site specific assessment). Department of Health refer to a 300m separation distance for control of spray drift, which can be reduced down to 40m where a vegetative buffer has been designed and implemented.
Dampier to Bunbury Natural Gas Pipeline	Immediately east of Tonkin Highway.	DBNGP	Within the site (numerous lots)	3m	Risk	Residential use permitted up to the DBNGP easement corridor, 150m buffer to school sites (Australian Gas Infrastructure Group 2020)

Specific commentary in relation to each existing land uses identified under Table 4.1 are discussed in the following section.

Kennels

Dog kennel operations are managed/monitored by the City of Kalamunda and the City of Gosnells. The approvals issued by the City require the operators to meet their respective conditions of operation, including noise emissions received by existing dwellings. Furthermore, the *Environmental*

Protection (Noise) Regulations 1997 require that the kennels achieve compliance with noise emissions to existing sensitive receptors (existing dwellings). The proposed urban development footprint of the Wattle Grove South precinct is located further away from the kennels and the existing sensitive receptors. Since each of these kennels is required to achieve noise emission compliance at existing residences (generally located within 60m of the kennels) the development itself does not encroach within the existing effective noise buffer.

It is noted that these requirements have also applied to the residential development of Wattle Grove north of Welshpool Road East, currently located within the generic buffer distances of the existing kennels.

A noise impact assessment for the proposed rezoning area will be undertaken as part of a broader noise analysis to account for future sensitive noise receptors (dwellings). This will include a contextual assessment of existing background noise where the periphery of the subject site is currently affected by road noise (the Noise Regulations take into consideration background noise from road traffic by way of a transport factor). This will factor in noise abatement initiatives including a noise wall along Tonkin Highway and any requirements to address noise through quiet house design, and will be implemented through the local structure plan, subdivision and built development processes.

Poultry Farms

A former poultry farm exists within the south-east portion of the site, within Lot 251, and a further two poultry farms (1 disused) are located external to the site 245m and 800m away, respectively. The EPAs *Guidance Statement 3* (EPA 2005) states a generic separation distance of 300m – 1000m should be applied between poultry farms and sensitive land uses. The *Environmental Code of Practice for Poultry Farms in Western Australia* (GoWA 2004) states a minimum buffer distance of 500m from existing or future residential zones. A 300 m buffer has been applied to poultry farms under the City of Kalamunda LSP, while the City of Gosnells Town Planning Scheme No. 6 has applied a 500 m buffer.

Poultry Farm 1, located within the site, has a 300m 'Special Control Area' buffer applied under the City of Kalamunda LPS No. 3. Notwithstanding, it is understood that poultry farming activities on the site ceased over a decade ago. From information provided by the proponent, it is understood that the poultry farm required significant upgrades in order to comply with new standards at the time and was no longer economical to operate. It is recognised that following the rezoning process the poultry farm will no longer be permitted to operate and will not enjoy any non-conforming land use rights. The proponent has also entered into an agreement with the landowner to purchase Lot 251.

Poultry Farm 2 has a generic 500m buffer applied under the City of Gosnells TPS No. 6. Poultry Farm No.2 will cease operations in the coming year.

Poultry Farm 3 will not have any impacts on the proposed MRS amendment, given that the farm has a separation distance of 300m applied under the City of Kalamunda LPS No. 3 and is located 800m from the site in much closer proximity to the existing Wattle Grove residential estate north of Welshpool Road East. In any event, it is noted that this poultry farm is no longer operational, having ceased operation a number of years ago.

Turf Farm

One turf farm is located within the site, within lots 303, 53, 214 and 213 to the south of Brentwood Road. It is intended that this operation will cease to enable the landowner to redevelop the land for residential purposes post the rezoning process. The EPA applies a guiding generic separation distance of 500m (EPA 2015) due to potential dust, odour, and noise impacts. These separation distances are subject to site-specific investigations. The Department of Health further defines how site-specific operations and associated buffers are defined. The Department's baseline refers to a

300m separation distance for the control of spray drift. This can be reduced to 40m where a vegetative buffer has been designed, implemented, and managed. This level of detail will be addressed at the local structure plan stage prior to the staged implementation of the residential estate. Depending on the timing of the turf farm operations and the future staged release of residential lots and if required, a suitable design interface and buffer will be implemented to the satisfaction of the Department of Health, DWER and the City of Kalamunda.

Natural Gas Pipeline

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) runs inside the western boundary of the site, intersecting portions of eight lots (Figure 2). The development of land within the DBNGP corridor is subject to restrictions originating under the Petroleum Pipelines Act 1969, Energy Coordination Act 1994 and the Dampier to Bunbury Pipeline Act 1997. *Planning Bulletin 87: High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region* (WAPC 2007) and subsequent draft DC Policy 4.3 – Planning for High-Pressure Gas Pipelines (WAPC 2016) seek to protect people from unacceptable levels of risk by protecting high pressure gas pipelines from unregulated encroachment. The draft DC 4.3 policy replaces PB 87. Consistent with the requirements of draft DC Policy 4.3 the Australian Gas Infrastructure Group (management authority of the DBNGP) has been consulted by the project planners (element) regarding the proposed residential development which will interface with the existing pipeline easement in the context of required building setbacks. The Australian Gas Infrastructure Group has confirmed that the DNGP in this location is built to a residential (T1) standard. This means that residential development is permitted up to the boundary of the easement, that is, a 0 m setback applies to residential lots adjacent to the easement (as was provided for in Table 1 of PB 87). It is understood that a greater separation distance of 150 m will apply to more sensitive land uses such as school sites.

4.1.4 Management measures

Noting the above, the following potential management and mitigation measures have been identified to ensure impacts to social surroundings are appropriately managed as development of the site progresses.

Table 4.2: Potential management and mitigation measures for social surroundings

Parameter	Potential management and mitigation measures
Noise and odour	• Confirmation by the proponent to the WAPC and the City of Kalamunda that Poultry Farm 1 and Poultry Farm 2 have ceased operations. • Implementation of a site-specific vegetated buffer and associated separation distance between the Turf Farm and future sensitive receptors (dwellings), should it be necessary (dependent on the timing to decommission the operations/staged release of urban development). • Maintenance of existing buffers from Kennels 1, 2, and 3 to existing sensitive receptors (dwellings). Site specific noise modelling to be undertaken as lot layouts and noise mitigation solutions are confirmed.
Risk (DBNGP)	• Existing DBNGP corridor to be set aside as public open space to be managed by the City of Kalamunda.
Aboriginal Heritage	• Required management will be informed by the revised, reliable location of Site ID 4343, Brentwood Road Swamp. • If any portion of the revised location of Brentwood Road Swamp is within the site boundary, opportunities to retain the area within public open space will be explored. Alternatively, approval may need to be sought under Section 18 of the AH Act.

4.1.5 Predicted outcomes

Residual impacts to social surroundings from noise, odour and dust are anticipated to be effectively mitigated through an appropriate design response in accordance with SPP 5.4 and the establishment and maintenance of separation distances between industrial and sensitive land uses as per EPA

(2005), the Department of Health (2021), City of Kalamunda (DPLH 2020), City of Gosnells (CoG 2019) and future site-specific investigations.

Based on the above, the proposal is therefore anticipated to meet the EPA objective for social surroundings.

4.2 Key Environmental Factor - Inland Waters

4.2.1 Environmental objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

4.2.2 Policy considerations

The EPA outlines a number of key considerations for inland waters within the *Environmental Factor Guideline: Inland Waters* (EPA 2018) which are discussed below, where relevant, with relation to future development of the site.

The key principles and objectives for sustainable water management is provided in the following:

- Liveable Neighbourhoods Edition 4 (WAPC 2009)
- Water Resources Statement of Planning Policy 2.9 (WAPC 2004)
- Stormwater Management Manual for WA (Department of Water 2007)
- Decision Making Process for Stormwater in Western Australia (Decision Process, DWER 2017)
- Better Urban Water Management (WAPC 2008)
- Interim: Developing a Local Water Management Strategy (DoW 2008)

4.2.3 Receiving environment

Regional groundwater currently flows east to west, with the depth to groundwater ranging between 12 m AHD to 17 m across the site. This indicates that superficial groundwater is at a moderate depth, between 10 m and 20 m at maximum levels. Based on the topographic contours, surface water flows from south to north toward the Yule Brook Main Drain.

Two Palusplain Conservation Category Wetlands are located directly north of the site (within Lot 501/D61608). Portions of two mapped Resource Enhancement Wetlands are also located within the site, including one Palusplain and one Sumpland (Figure 4). The buffer areas associated with the Conservation Category Wetlands extend into Lots 146, 12, and 13.

4.2.4 Potential impacts

Urban development associated with a change to the MRS may result in an alteration to surface and groundwater quality and flow dynamics. In terms of groundwater, this alteration may include an increased rate of recharge (Lerner 2002; Garcia-Fresca 2005). A change in land use to urban residential development would result in the decommissioning of the turf farm and removal of all septic tanks from within the site boundary, as smaller residential lots will be connected to the main sewerage network. This would in turn result in a decrease in nutrient exports downstream.

The extent of impacts on groundwater flow will be dependent on the amount and location of sub-surface infrastructure (McGrane 2016). Subsoil drainage is considered unlikely to be required, however, should any be required in localised areas, all flows would be treated prior to any off site discharge (hyd2o, 2021). As such, there are not anticipated to be any adverse impacts resulting from this proposal. Potential changes to water quality within the site will be modelled as part of subsequent stages of the planning process.

With regard to surface water, detailed development design will be undertaken with the objective of maintaining surface water flow across the site. Given the absence of surface water bodies within the site, there are no significant adverse impacts to surface water resulting from the proposed MRS amendment.

Hyd2o (2021) undertook a hydrological assessment of the site to assess the existing nutrient input and export from the site under current land uses, and provide the results of nutrient modelling to detail nutrient input and exports under the proposed land use. Current nutrient inputs are 12,304 kg/year of TN and 1,139 kg/year of TP per annum based on typical nutrient application rate estimates (hyd2o 2021). From this, hyd2o (2021) concluded that the resultant nutrient export was 293.2 kg/year of TN and 15.2 kg/year of TP (with soil type, groundwater gradient, and depth to groundwater considered in the calculation). Nutrient modelling results indicate the proposed land use change will have a positive effect on nutrient input and exports. Nutrient inputs will decrease to 3,715 kg/year for TN and 581 kg/year for TP post-development with the resultant rate of export decreasing to 94.2 kg/r and 8.1 kg/year, respectively (hyd2o 2021). This constitutes a nutrient export reduction of 68% and 47% for TN and TP, respectively (hyd2o 2021).

4.2.5 Management measures

The following potential mitigation and management measures have been identified which may be implemented to ensure impacts to inland waters are appropriately managed as development of the site progresses.

Table 4.3: Potential mitigation and management measures for inland waters

Parameter	Proposed mitigation and management measures
Hydrology	Additional hydrological investigations will be undertaken to enable the preparation of a Local Water Management Strategy and Urban Water Management Plan, which will be required as part of the future planning process. Surface water flows to the wetland will be informed by the requirements of the wetland and will be determined at subsequent stages of development through consultation with agencies.
Stormwater management	Post-development annual stormwater discharge volumes and peak flows will be required to be maintained relative to pre-development conditions. Water quality will be maintained or improved through the treatment of runoff in biofiltration systems prior to infiltration, with specific detail provided in the LWMS as part of the future planning process.
Geomorphic wetlands	Opportunities for retention of Geomorphic Wetlands within the site will be investigated at subsequent stages of the planning and development process. Dependant on the outcomes of site-specific investigations, appropriate buffers to development may be applied to CCWs and REWs, or applications to reclassify the category of some wetlands may be lodged with the DBCA, if this is considered appropriate.
Nutrient management	The land use change is expected to result in a net reduction in nutrient input and export from the site relative to existing land use.

A District Water Management Strategy (hyd2o 2021) has also been prepared to support the proposal with the protection of the Greater Brixton Street Wetland Area identified as a key consideration.

4.2.6 Predicted outcome

Considering the above, it is not expected that development associated with an amendment to the MRS will result in significant direct, indirect, or cumulative impacts to inland waters. Potential impacts to hydrology will be further addressed at the Local Structure Plan and Subdivision stages of development through the preparation of a LWMS and UWMP, respectively, and mitigated through the implementation of best urban water management (WAPC 2008).

4.3 Key Environmental Factor - Terrestrial Environmental Quality

4.3.1 Environmental objective

To maintain the quality of land and soils so that environmental values are protected.

4.3.2 Policy considerations

The EPA outlines a number of key considerations for terrestrial environmental quality within the environmental *Factor Guideline: Terrestrial Environmental Quality* (EPA 2018), which are discussed below, where relevant, in relation to urban development of the site.

4.3.3 Receiving environment

4.3.3.1 Acid Sulfate Soils

A desktop assessment indicates the entirety of the site is mapped as having a moderate to low risk of ASS occurring within 3m of the natural soil surface. Preliminary geotechnical investigations undertaken by Douglas Partners in 2020 confirm this mapped outcome. Further ASS investigations will be undertaken should excavation below 3m of the natural soil surface be required within the site to clarify if there are any areas affected by ASS.

4.3.3.2 Contamination

A review of the Contaminated Sites Database (DWER 2018) showed no areas within 1km of the site that are listed as 'Contaminated – remediation required' or 'Remediated for restricted use' under the *Contaminated Sites Act 2003*. As such, and given the historic rural-residential use of the site, it is considered that contamination issues are unlikely to be a constraint to the proposed urban development. Further site assessments will be undertaken to identify any potential pathways for contamination, and to confirm whether there are any risks to the environment or human health.

4.3.4 Potential impacts

The potential impacts of urban development will be clarified based on the results of ASS and contamination investigations that will be undertaken as part of subsequent stages of the planning and development process. Given the site is mapped as having a moderate to low risk of ASS occurring within 3m of the natural soil surface, management measures may need to be implemented to prevent the acidification of the soils and groundwater.

4.3.5 Management measures

The requirement for management measures with respect to ASS and contaminated areas will be informed by site-specific investigations. The management of any potential ASS within the site will adhere to the guidelines specified in DER (2015*) Treatment and management of soils and water in acid sulfate soil landscapes.*

4.3.6 Predicted outcome

The quality of land and soils is anticipated to be appropriately managed throughout the development process and is not expected to be a constraint to development. Further confirmation of the presence and required management of ASS or contamination within the site will be informed by site-specific investigations.

4.4 Key Environmental Factor – Flora and Vegetation

4.4.1 Environmental objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

4.4.2 Policy considerations

The EPA outlines the key considerations for flora and vegetation within the Environmental Factor Guideline: Flora and Vegetation (EPA 2016b) which are discussed below, where relevant, with relation to future development of the site.

The key principles and objectives for sustainable flora and vegetation management are provided in the following:

- *Technical Guidance – Flora and vegetation surveys for Environmental Impact Assessment* (EPA 2016)
- *Environmental Protection of Native Vegetation in Western Australia Position Statement No. 2* (EPA 2000), subsequently replaced by *Factor Guideline – Flora and Vegetation* (EPA 2016)
- *Draft Perth and Peel Green Growth Plan for 3.5 million* (DBCA 2015) and *Review of the Strategic Assessment of the Perth and Peel Regions - 2015 draft documents and mapping* (Green Growth Plan Mapping) (Department of the Premier and Cabinet, 2019)
- *A guide to the assessment of applications to clear native vegetation* (DWER 2014)
- *Australia's Strategy for Nature 2019-2030* (Commonwealth of Australia, 2019)
- State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Area* (WAPC 2010)
- WA Environmental Offsets Policy (EPA 2011)
- Bush Forever: keeping the bush in the city (WAPC 2000)
- Relevant Conservation Advice and Recovery Plans.

4.4.3 Receiving environment

The site contains limited remnant vegetation from the Pinjarra 3.2 (mainly Jarrah and Marri) and Pinjarra 968.3 (Jarrah, Marri and Wandoo) vegetation sub-associations, of which 6.6-15.3% remains on the Swan Coastal Plain. Vegetation at the site has been mostly cleared, and now consists primarily of lawns, planted trees and garden beds, with some small areas of native vegetation in Degraded to Excellent condition and scattered native trees.

AECOM (2020) found two vegetation communities, representing two State listed TECs, a PEC and one Federally listed TEC within the site. 95 individuals of the Threatened flora taxa *Conospermum undulatum* and 160 individuals of the Priority 3 flora taxa *Isopogon drummondii* were identified within discrete localised areas on the properties which AECOM (2020) was able to access.

Remnant vegetation within the site occurs on Freehold land and Road Reserve.

4.4.4 Potential impacts

The potential impacts to flora and vegetation associated with an amendment to the MRS are predominately limited to vegetation removal arising from any future subdivision approvals. Removal of vegetation would decrease connectivity between nearby vegetation areas, in particular the Brixton Street Wetlands and the Hartfield Road Bushland.

Two conservation significant flora taxa and two conservation significant floristic communities are present within the site. The remnant vegetation associated with these has a low value for conservation due to the small size and lack of understory connectivity to other nearby bushland areas. These areas are currently freehold lots with no consistent strategy for bushland management.

DBCA has records of 226 individuals of *Conospermum undulatum* at Wattle Grove Population 11, which lies within the survey area examined by AECOM (2020), in addition to the 95 individuals AECOM recorded during field surveys. Approximately 12,000 individuals were recorded as extant at the time populations were last surveyed (DEC 2009). Clearing of all remnant vegetation within the Project Area would reduce the known numbers of *C. undulatum* by approximately 2.6%.

Between 6.6% and 15.3% of the pre-European extent of the vegetation sub-associations present in the site remains. Further vegetation removal would minimally impact these percentages, as there is little native vegetation remaining within the site (Figure 8).

Removal of further vegetation from the Project Area would not cause fragmentation of native vegetation areas, which are already highly fragmented within the Project Area. Minimal groundwater and land degradation impacts would be incurred given the low levels of remnant native vegetation remaining within the Project Area.

4.4.5 Management measures

Based on the results of the flora and vegetation assessments that have been undertaken to date (see Section 3.6.2) the lots containing flora and vegetation values of most significance are Lots 210, 254 and 84 (Figure 10). Both areas, which contain Banksia Woodlands of the Swan Coastal Plain TEC, *Isopogon drummondii*, and the vast majority of *Conospermum undulatum* individuals, area proposed to be retained as POS for the benefit of conservation. Additionally, the retention of significant trees will be explored throughout the remainder of the site as part of the detailed development design process, which will be undertaken in subsequent stages of the planning process. All native vegetation retention will contribute directly toward maintaining the ecological connectivity between the site and surrounding conservation areas.

All retained conservation areas will be actively managed by the developer and/or local government, to minimise the degradation of retained areas. Detailed development design will also consider the use of native flora in streetscaping.

4.4.6 Predicted outcome

It is anticipated that all impacts associated with the proposed MRS amendment can be sufficiently avoided, minimised, or offset through subsequent detailed development design and, assessment under the EPBC Act and EP Act if required. As such, the key environmental factor - flora and vegetation is not anticipated to be a constraint to development.

4.5 Key Environmental Factor - Terrestrial Fauna

4.5.1 Environmental objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.5.2 Policy considerations

Terrestrial fauna surveys that have informed planning for the site have been conducted in accordance with the *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and the Environmental Factor Guideline: Terrestrial Fauna (EPA 2016).

The EPA outlines a number of key considerations for terrestrial fauna within the *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2018), which are discussed below, where relevant, with relation to the proposed rezoning of the site.

4.5.3 Receiving environment

Based on searches of the EPBC Protected Matters Search Tool and the DBCA's Naturemap databases, the desktop assessment identified a total of 14 conservation significant species (including Priority species) that may potentially occur within the vicinity of the site. Of these, three species were considered likely to occur: Carnaby's Cockatoo (T - EN), Forest Red-tailed Black Cockatoo (T - V) and Quenda (P4) are considered likely to use the site based on their habitat requirements. During the field survey, AECOM (2020) confirmed the presence of the Quenda and Rainbow Bee-eater (Migratory) within the site. In addition, Strategen-JBS&G (2021) recorded active foraging by all Black Cockatoo species during the habitat assessment.

There is a total of 22.18ha of foraging habitat of varying quality for Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos within the site. The majority of this provides 'low' (9.01 ha) to 'low to moderate' (9.27 ha) quality foraging habitat for Carnaby's Cockatoo. For Baudin's and Forest Red-tailed Black Cockatoos, the majority (17.58 ha) of the habitat is of 'low' foraging quality. A total of 89 potential breeding trees with a DBH greater than 500mm were recorded within the site, of which two contain potentially suitable hollows.

There is a total of 14,876ha of potential Black Cockatoo foraging habitat in the regional area (within a 12 km radius) (Figure 16). 53% of this is contained within DBCA managed reserves, including within:

- Korung National park (4,101.46 ha),
- Beelu National Park (1,016.77 ha),
- Greenmount State Forest (883.55 ha),
- Kalamunda National Park (375.60 ha), and
- Greenmount National Park (70.44 ha).

4.5.4 Potential impacts

Development of the site will result in direct and indirect impacts to terrestrial fauna as a result of:

- Potential clearing of foraging and potential breeding habitat for the three species of Black Cockatoo, ranging in quality from 'low to negligible to 'moderate' for Carnaby's Cockatoo and 'negligible to low' to 'low to moderate' for Baudin's and Forest Red-tailed Black Cockatoos
- Clearing of potentially suitable habitat for Quenda.

No other conservation significant species are considered likely to be significantly impacted through the development of the site.

4.5.5 Management measures

Opportunities for the retention of significant trees and Black Cockatoo foraging habitat will be explored as part of the detailed development design which will be undertaken in subsequent stages of the planning process. All retention within the site will contribute toward maintaining the ecological connectivity between the site and surrounding conservation areas.

Vegetation patches identified as containing *Conospermum undulatum* and conservation significant floristic communities could be retained as public open space as part of the structure planning and detailed subdivision stages. This would retain the identified quenda habitat as well as the areas that contain better quality Black Cockatoo habitat. The retention of vegetation within these areas would equate to approximately 0.25 ha of 'moderate' and 1.67 ha of 'low to moderate' Carnaby's Cockatoo habitat, and 1.92 ha of 'low' quality habitat for Baudin's and Forest Red-tailed Black Cockatoos. Eight potential breeding trees with a DBH greater than 500mm would also be conserved in this way. All retained conservation areas will be actively managed by the developer and/or local government, to minimise the degradation of retained areas.

4.5.6 Predicted outcome

It is anticipated that all impacts associated with the proposed MRS amendment can be sufficiently avoided, minimised, or offset through the subsequent detailed development design, and assessment under the EPBC Act, if required. As such, the key environmental factor – terrestrial fauna is not anticipated to be a constraint to development.

5. Other environmental issues

5.1 Bushfire Management

As a result of the site being within a mapped bushfire prone area, a Bushfire Management Plan (BMP) is required to accompany the scheme amendment application to address the following requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7), namely Policy measure 6.3 which states:

- A bushfire hazard level (BHL) assessment or, where lot layout is known, a Bushfire Attack Level (BAL) contour assessment to determine the indicative acceptable BAL ratings across the site
- Identification of any bushfire hazard issues arising from the above assessment
- Assessment against the bushfire protection criteria requirements contained within the Guidelines demonstrating compliance ca be achieved in subsequent planning stages.

A Bushfire Management Plan has been prepared for the site, which should be read in conjunction with this EAR.

The BMP has determined that the future MRS amendment can satisfy the requirements of SPP 3.7 and the Guidelines. The anticipated environmental impacts of the MRS amendment have specifically considered any bushfire management requirements. No further environmental impacts (such as clearing of vegetation) beyond those outlined in this report will be required in order to implement urban development across the site, consistent with the MRS amendment.

5.2 Assessment under the EPBC Act

The site contains a number of matters considered to be of National Environmental Significance under the EPBC Act and as such, future urban development may require referral to the DAWE under for potential impacts. MNES that could potentially be impacted by urban development may include:

- Banksia woodlands of the Swan Coastal Plain ecological community
- *Conospermum undulatum*
- Baudin's Cockatoo (*Calyptorhynchus baudinii*)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)

Those areas with greatest environmental significance are proposed to be retained within POS for the benefit of conservation, and as such any anticipated impacts are considered to be minor in nature.

It should be noted that any assessment under the EPBC Act will be done later in the development process and will be based on further detailed planning for the site including the incorporation of remnant trees, and the intersection with MNES.

6. Conclusion

This EAR has been prepared on behalf of Hesperia, the proponent for the MRS amendment request to rezone the site from 'Rural' to 'Urban' to allow for the future development of the site for residential and related purposes.

The EAR has been prepared to inform and support the initiation of the proposed MRS amendment by assessing the potential environmental impacts that could arise from the land use change and subsequent development of the site. Based on the environmental values identified within the site, the key environmental factors associated with the proposed amendment to the MRS are:

- Social surroundings
- Inland Waters
- Terrestrial Environmental Quality
- Flora and Vegetation
- Terrestrial Fauna

It is considered that impacts to the above factors can be appropriately avoided, minimised, or offset through detailed development design as part of the future planning process, or through assessment by the EPA and/or DAWE under the EP Act or EPBC Act respectively, if required. It is considered there are no significant environmental issues located within the rezoning area which would prevent it from being rezoned from 'Rural' to 'Urban' under the MRS.

7. Limitations

Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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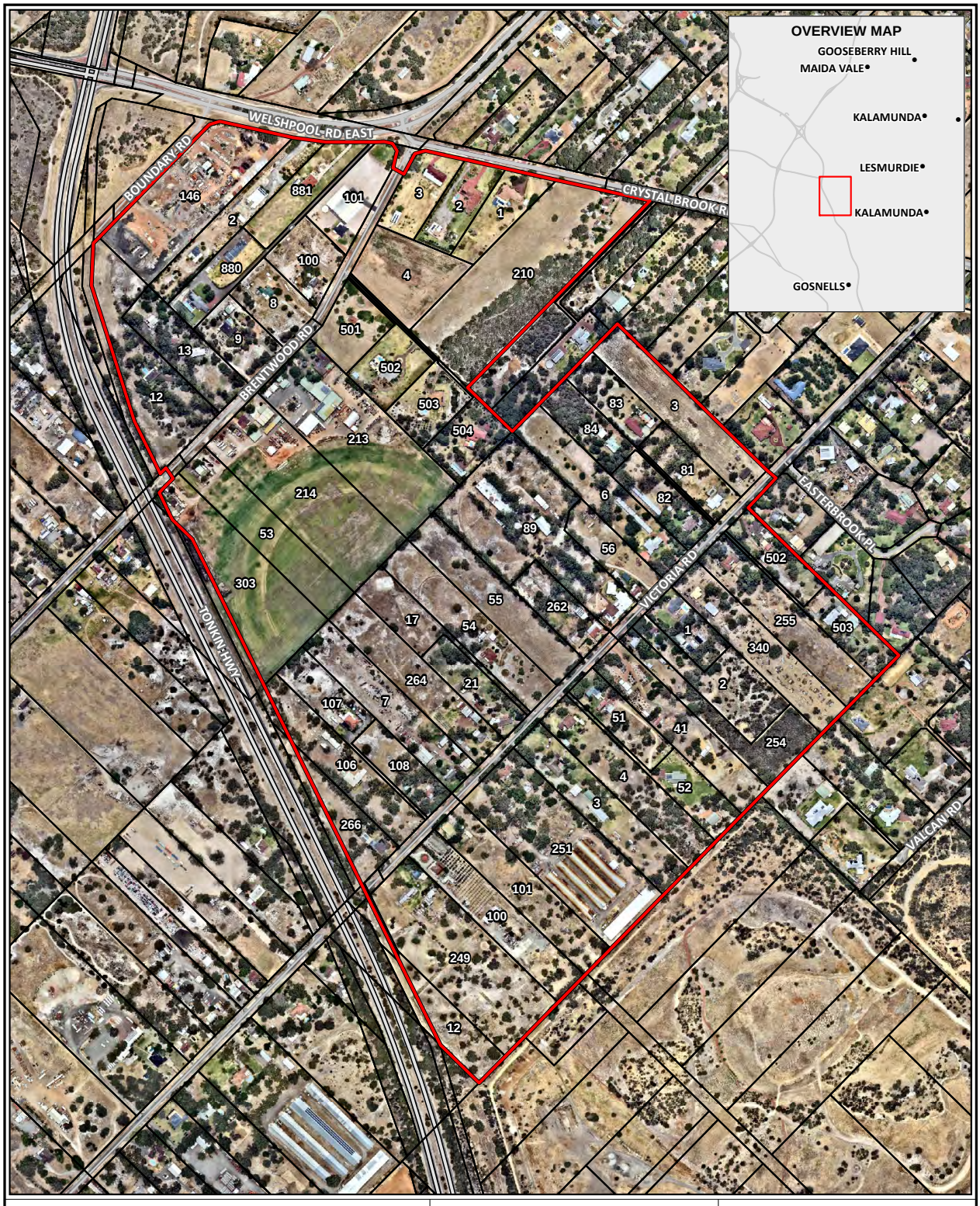
8. Figures



Legend

- The site
- Cadastral boundary
- Highways
- Main road
- Minor road

Scale 1:8,000 at A4 (0 100 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**THE SITE**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 1**
Version: A	Date: 19-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_01_TheSite.mxd
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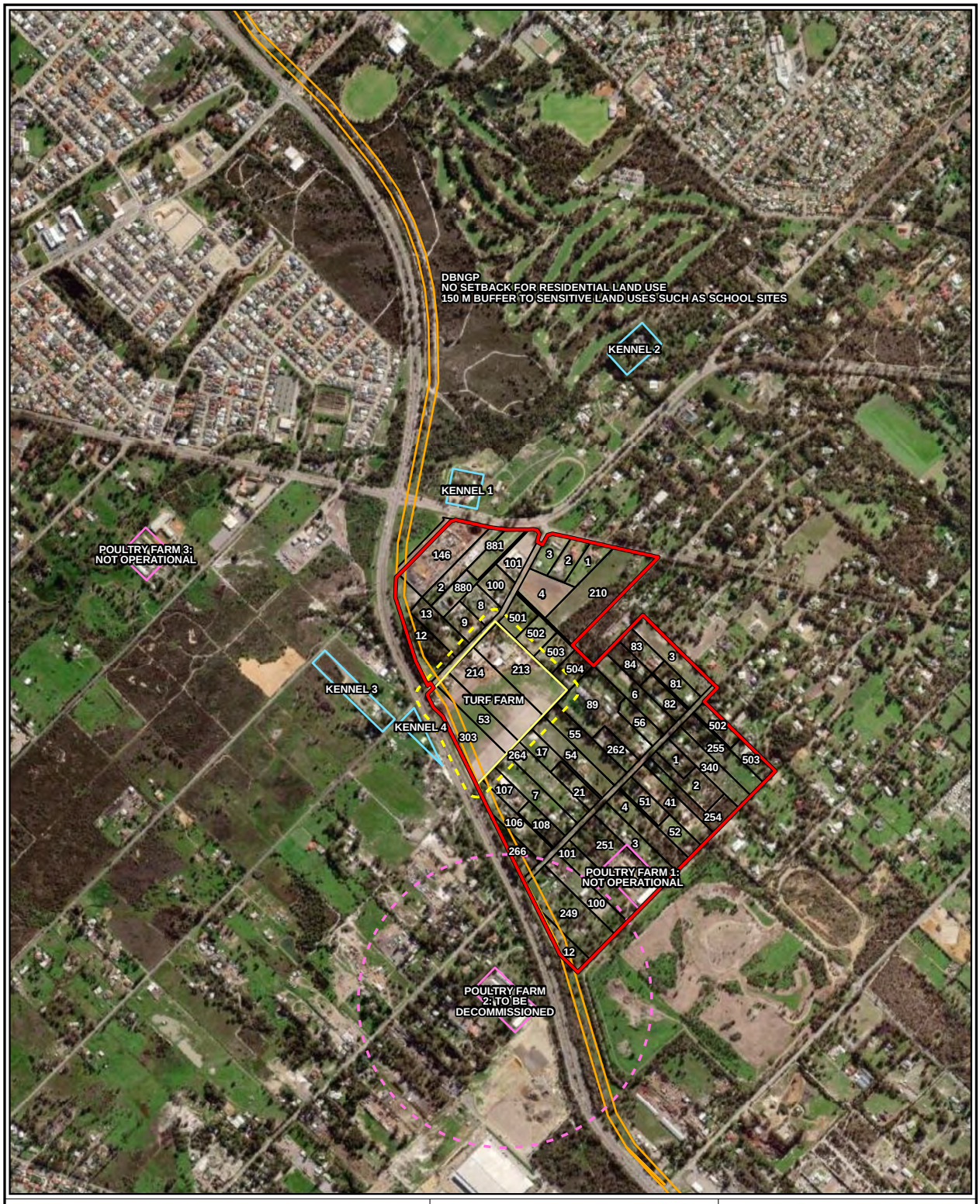


Legend

- The site
- Cadastral boundaries

Industrial land use
- Kennel
- Poultry farm
- Turf farm
- DBNGP

Separation distances
- 40 m buffer of turf farm subject to implementation of vegetated buffer
- 500 m generic poultry farm buffe

Scale 1:17,000 at A4 — 0 200 400 metres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 60309

Client: Hesperia Projects Pty Ltd

Version: A | Date: 05-May-2021

Drawn By: hsullivan | Checked By: CT

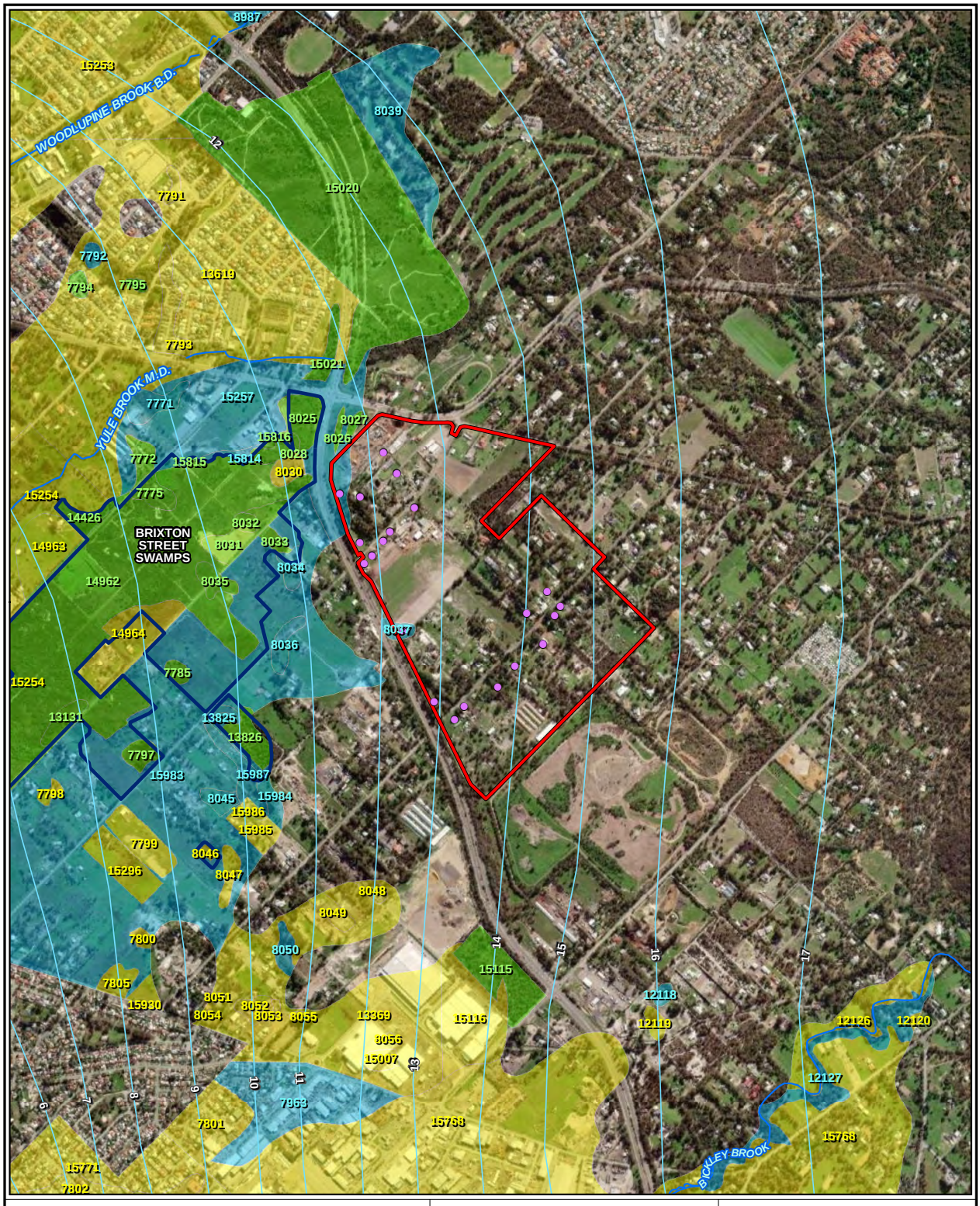
Wattle Grove
WA

INDUSTRIAL LAND USES IN THE AREA SURROUNDING THE SITE

FIGURE 2

strategen JBS&G

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_02_LandUses.mxd
Image Reference: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- The site
- Directory of important wetlands
- Geomorphic Wetlands (DBCA)
  - Conservation
  - Resource enhancement
  - Multiple use
- Groundwater abstraction bore
- Watercourses
- Groundwater contours (mAHD)

Scale 1:20,000 at A4 (0 200 400 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**GEOMORPHIC WETLANDS AND HYDROLOGY**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 3**
Version: A	Date: 19-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_03_Water_Wetlands.mxd
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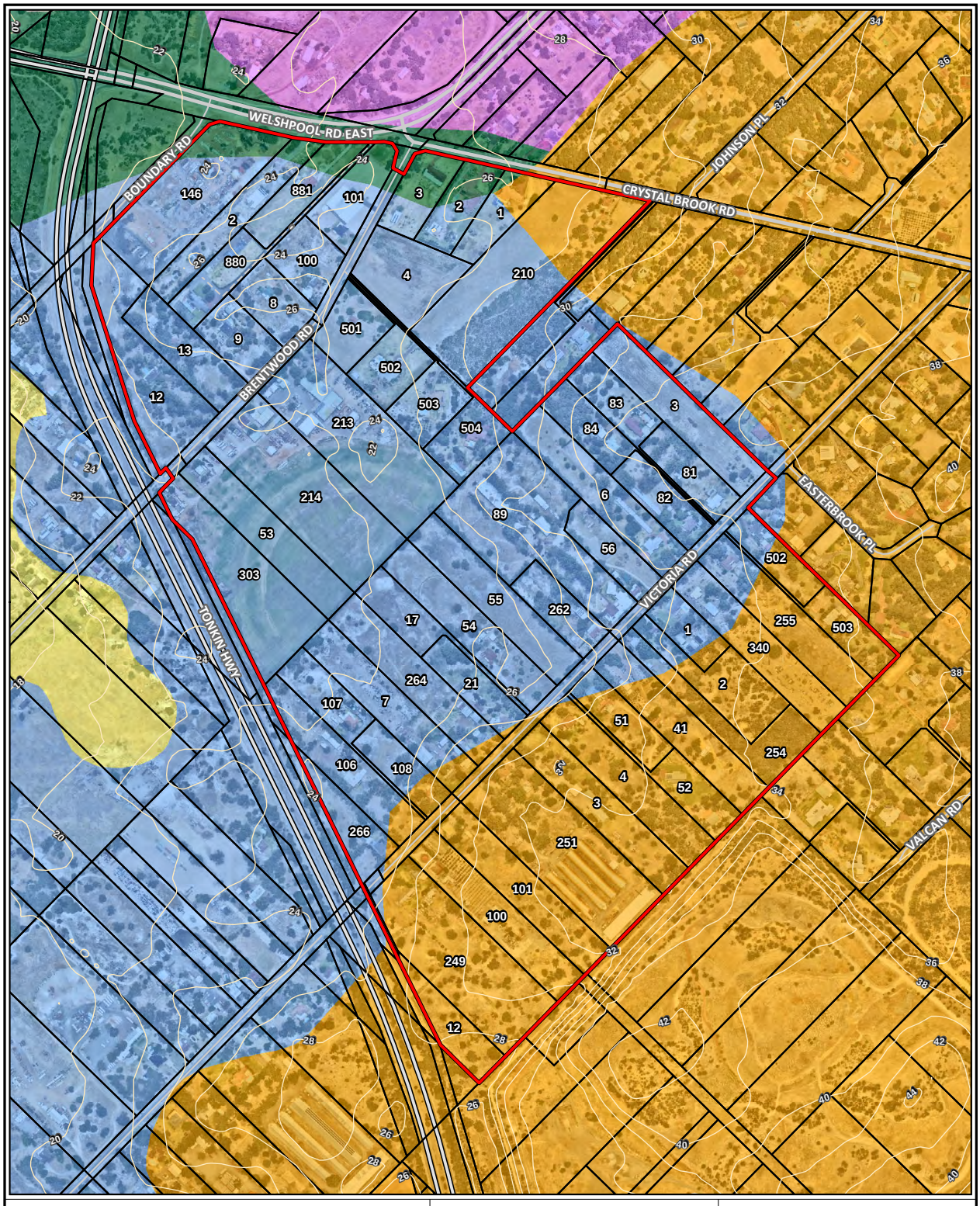

Legend

- The site
- Cadastral boundary
- Topographic contours (mAHD)
- Highways
- Main road
- Minor road
- Track

Soil landscape units

- Forrestfield (D Range) F1 Phase
- Pinjarra, Phase Gf3
- Pinjarra, Phase Gf4
- Pinjarra, Phase Gf5
- Pinjarra, Phase Gf6
- Pinjarra, Phase Gf7

Scale 1:8,000 at A4 (0 100 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**TOPOGRAPHY, GEOLOGY AND SOILS**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 4**
Version: A	Date: 19-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

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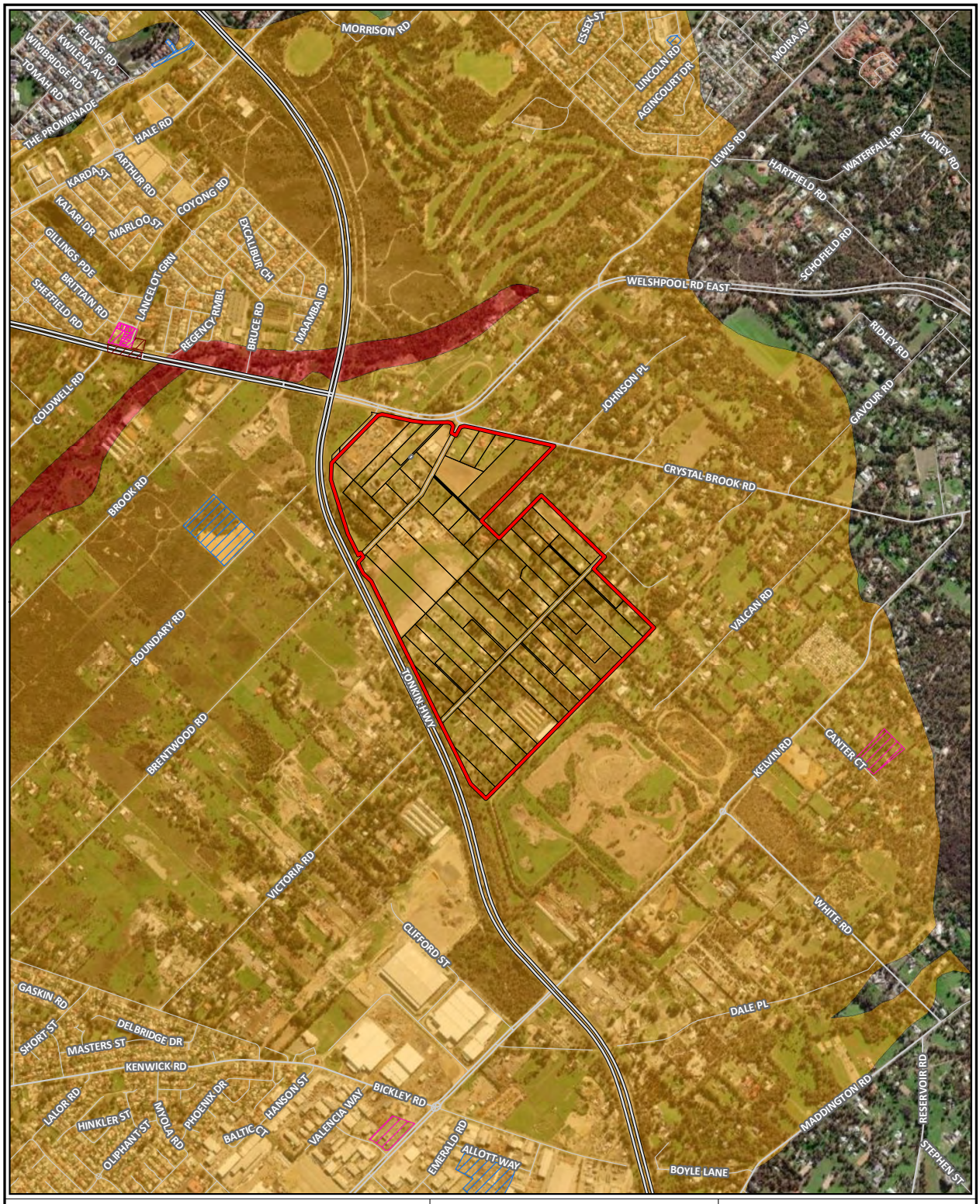

Legend

- The site

Contaminated sites
- Contaminated - remediation required
- Contaminated - restricted use
- Remediated for restricted use

Acid sulfate soil risk mapping
- High to moderate risk
- Moderate to low risk

- Highways
- Main road
- Minor road

Scale 1:20,000 at A4 (0, 200, 400 metres)

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 60309

Client: Hesperia Projects Pty Ltd

Version: A | Date: 19-Apr-2021

Drawn By: hsullivan | Checked By: CT

Wattle Grove WA

ACID SULFATE SOILS AND CONTAMINATED SITES

FIGURE 5

strategen JBS&G

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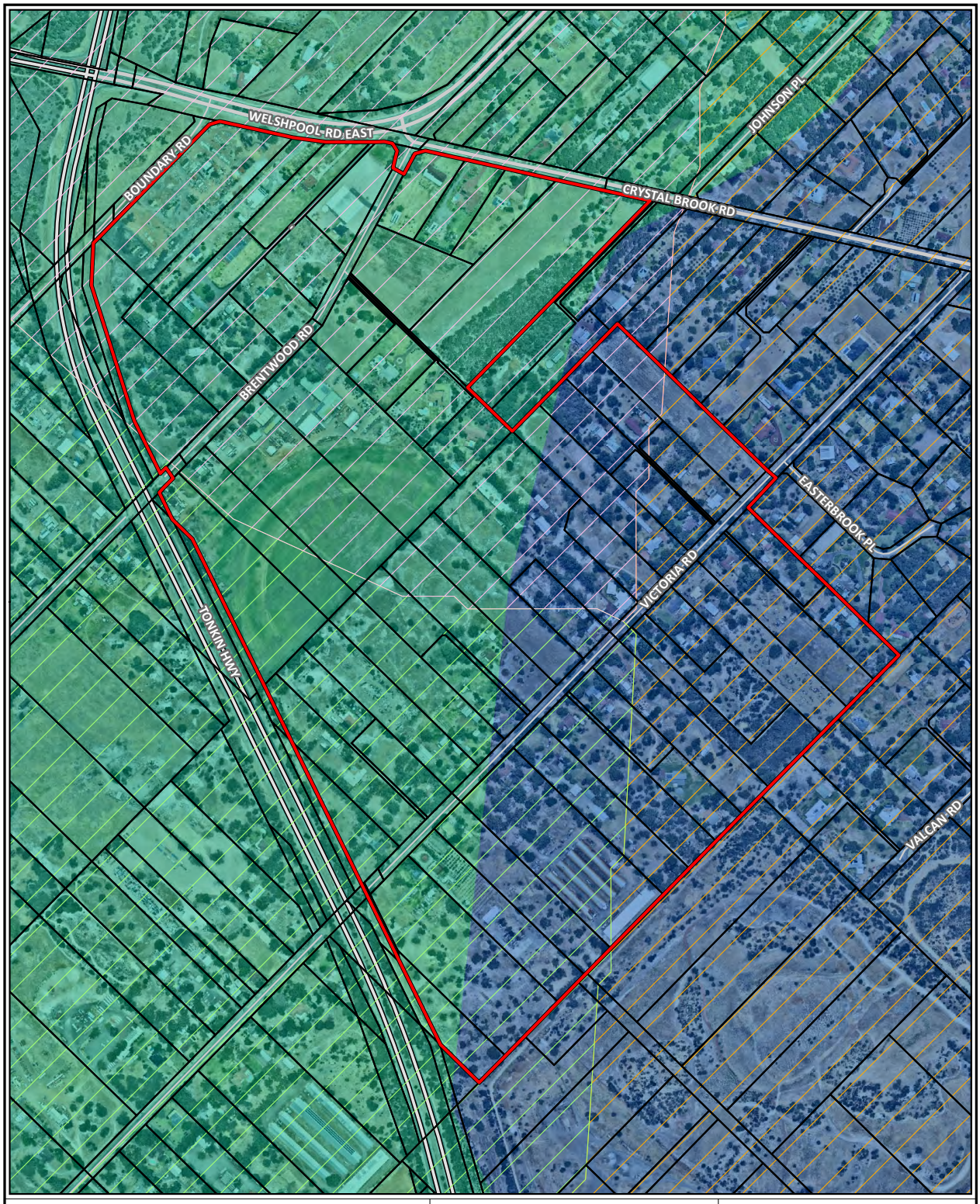

Legend

- The site
- Cadastral boundary

Vegetation complex
- Forrestfield Complex
- Guildford Complex
- Southern River Complex

Vegetation association
- Pinjarra 3
- Pinjarra 968
- Highways
- Main road
- Minor road

Scale 1:8,000 at A4 (0 100 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**PRE-EUROPEAN VEGETATION ASSOCIATIONS AND COMPLEXES**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 6**
Version: A	Date: 19-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

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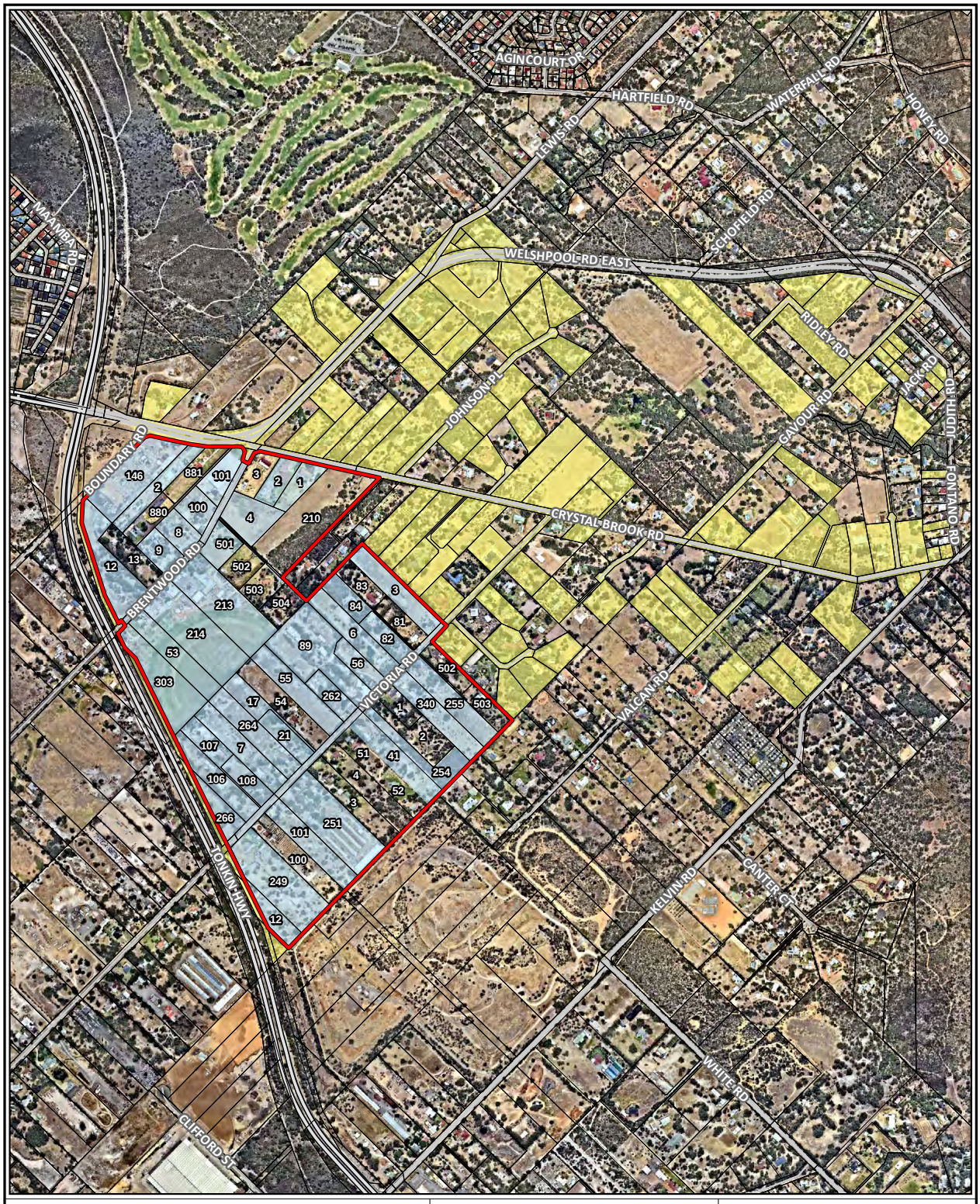

Legend

- The site
- Areas previously subject to survey - within the site
- Areas previously subject to survey - outside of the site
- Cadastral boundary
- Highways
- Main road
- Minor road

Scale 1:15,000 at A4 (0 200 400 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**PREVIOUS SURVEY AREAS**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 7**
Version: A	Date: 19-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

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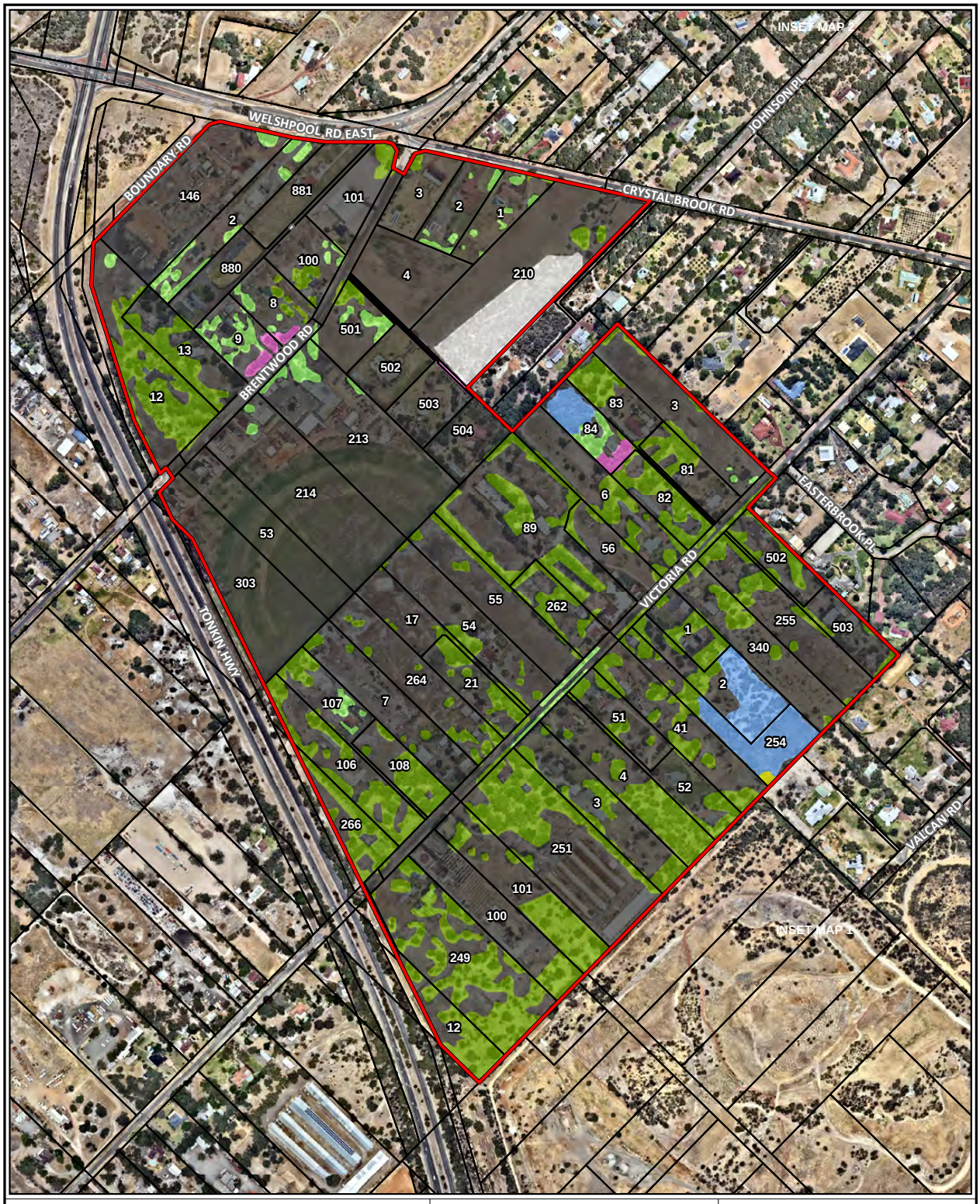

Legend

- The site
- Cadastral boundary

Vegetation type

- Unsurveyed
- BaEpPf
- BmXpEc
- EmMpLp
- Planted
- Cleared
- Trees

Scale 1:8,000 at A4 (0 100 200 metres)	**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50	**VEGETATION TYPES**
Job No: 60309	
Client: Hesperia	**FIGURE 8**
Version: A / Date: 02-Jul-2021	strategen JBS&G
Drawn By: cthatcher / Checked By: WO	

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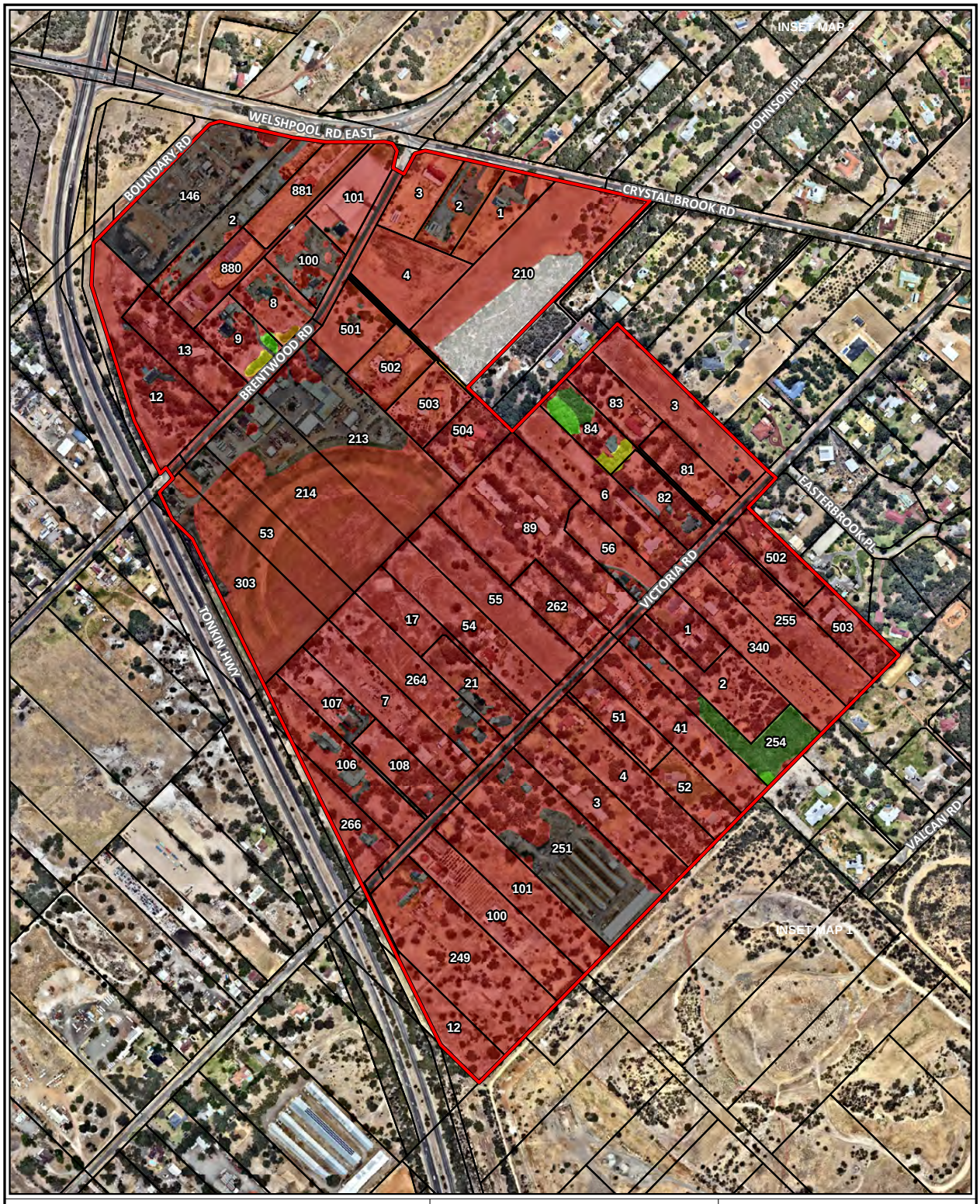

Legend

- The site
- Cadastral boundary

Vegetation condition

- Unsurveyed
- Excellent
- Very good
- Good
- Degraded
- Completely degraded
- Cleared

Scale 1:8,000 at A4 (0 100 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**VEGETATION CONDITION**
Job No: 60309		
Client: Hesperia		**FIGURE 9**
Version: A	Date: 02-Jul-2021	strategen JBS&G
Drawn By: cthatcher	Checked By: WO	

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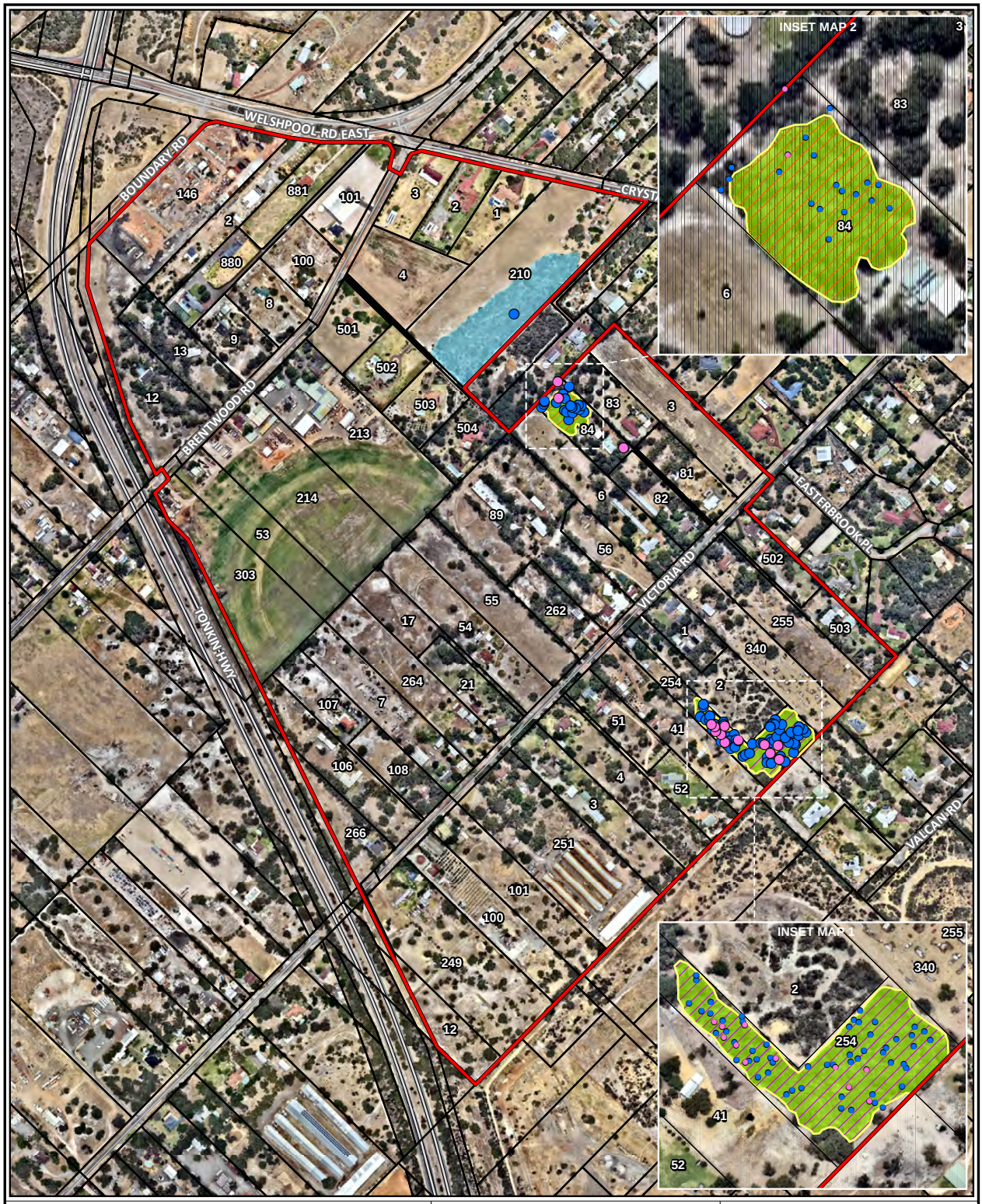


Legend

- The site
- Cadastral boundary

State Threatened and Priority Ecological Communities

- SCP 20a: *Banksia attenuata* woodlands over species rich dense shrublands State TEC (EN)
- FCT 20b: *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the Eastern Swan Coastal Plain (tentative) State TEC (EN)
- Banksia Woodlands of the Swan Coastal Plain State PEC (P3)
- Banksia Woodlands of the Swan Coastal Plain EPBC TEC (EN)
- Potential Ecological Community - subject to detailed survey

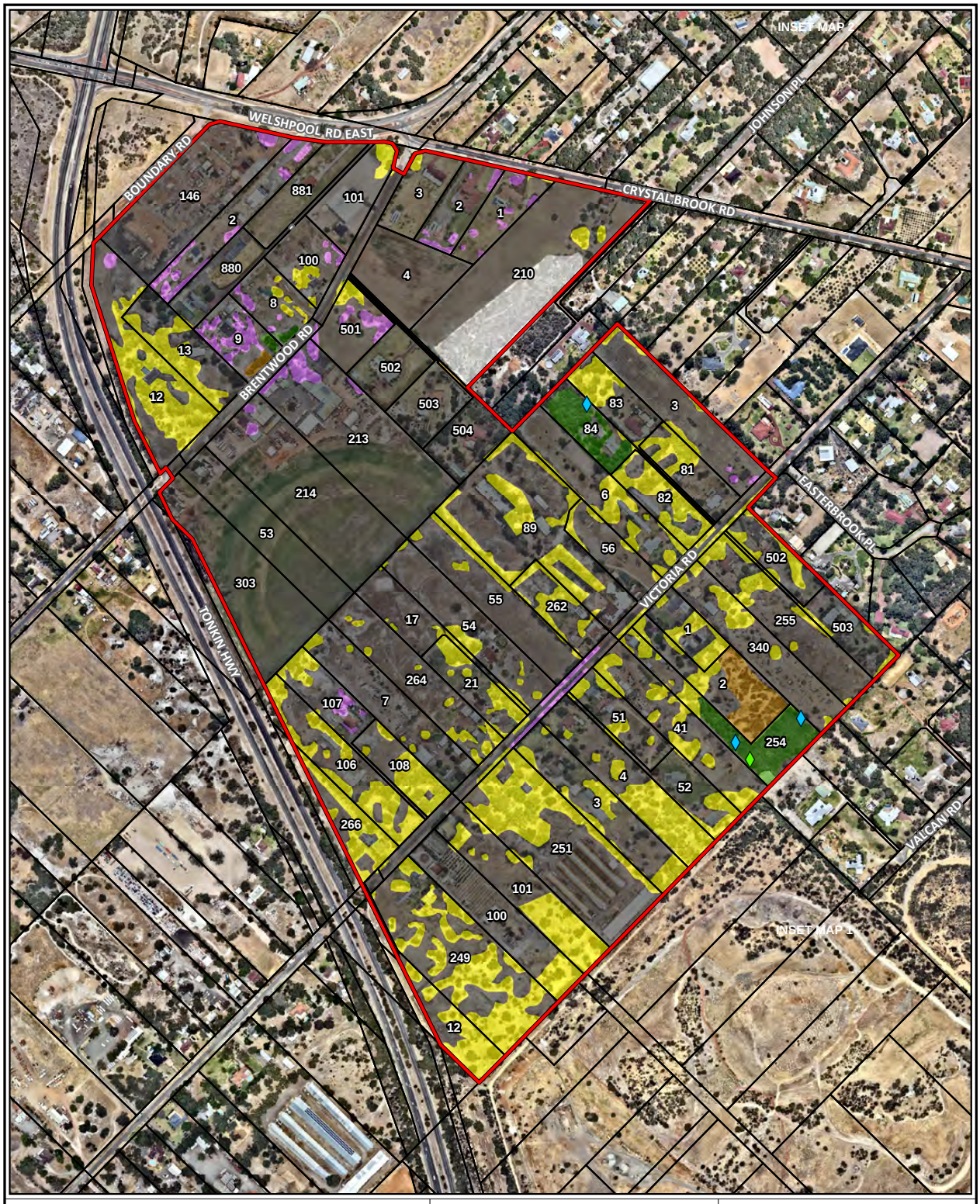
Threatened and Priority Flora species within the site

- *Conospermum undulatum* (T)
- *Isopogon drummondii* (P3)

- Highways
- Main road
- Minor road

Scale 1:8,000 at A4 (0, 100, 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES AND FLORA SPECIES**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 10**
Version: A	Date: 20-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_10_TEC_Flora.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021.



Legend

- The site
- Cadastral boundary

Conservation significant fauna observations

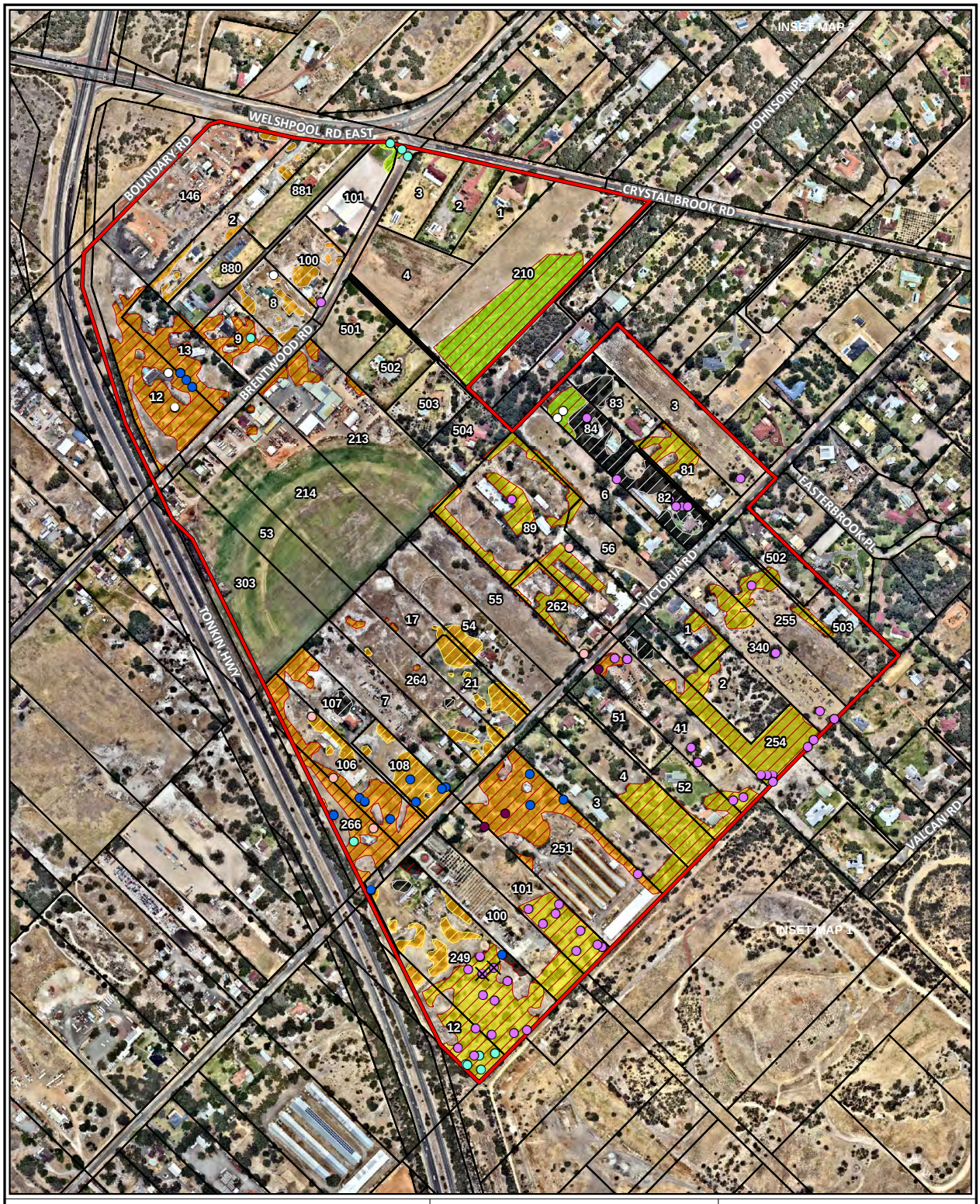
- Rainbow Bee-eater
- Quenda (P4)

Fauna habitat type

- Unsurveyed
- Banksia woodland
- Eucalyptus
- Planted and maintained gardens
- Scattered trees
- Shrubland
- Cleared

Scale 1:8,000 at A4 (0, 100, 200 metres)	**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50	**FAUNA HABITAT AND OBSERVATIONS**
Job No: 60309	
Client: Hesperia	**FIGURE 11**
Version: A / Date: 02-Jul-2021	strategen JBS&G
Drawn By: cthatcher / Checked By: WO	

File Name: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_11_FaunaHabitat.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021.



Legend

The Site
Cadastral boundary

Carnaby's Cockatoo foraging quality
- Moderate
- Low to Moderate
- Low
- Negligible to low

Baudin's and Forest Red-tailed Black Cockatoo foraging quality
- Low to Moderate
- Low
- Negligible to low

Black Cockatoo habitat trees
- *Corymbia calophylla*
- *Eucalyptus gomphocephala*
- *Eucalyptus marginata*
- *Eucalyptus patens*
- *Eucalyptus rudis*
- *Eucalyptus todtiana*
- Potentially suitable hollow

Scale 1:8,000 at A4 (0, 100, 200 metres)	**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50	**BLACK COCKATOO HABITAT**
Job No: 60309	
Client: Hesperia	**FIGURE 12**
Version: A / Date: 10-May-2021	strategen JBS&G
Drawn By: hsullivan / Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_12_BCHabitat.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021.

Legend

- The site
- Regional ecological linkages
- Highways
- Main road
- Minor road

Scale 1:20,000 at A4 (0 200 400 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**REGIONAL ECOLOGICAL LINKAGES**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 13**
Version: A	Date: 20-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

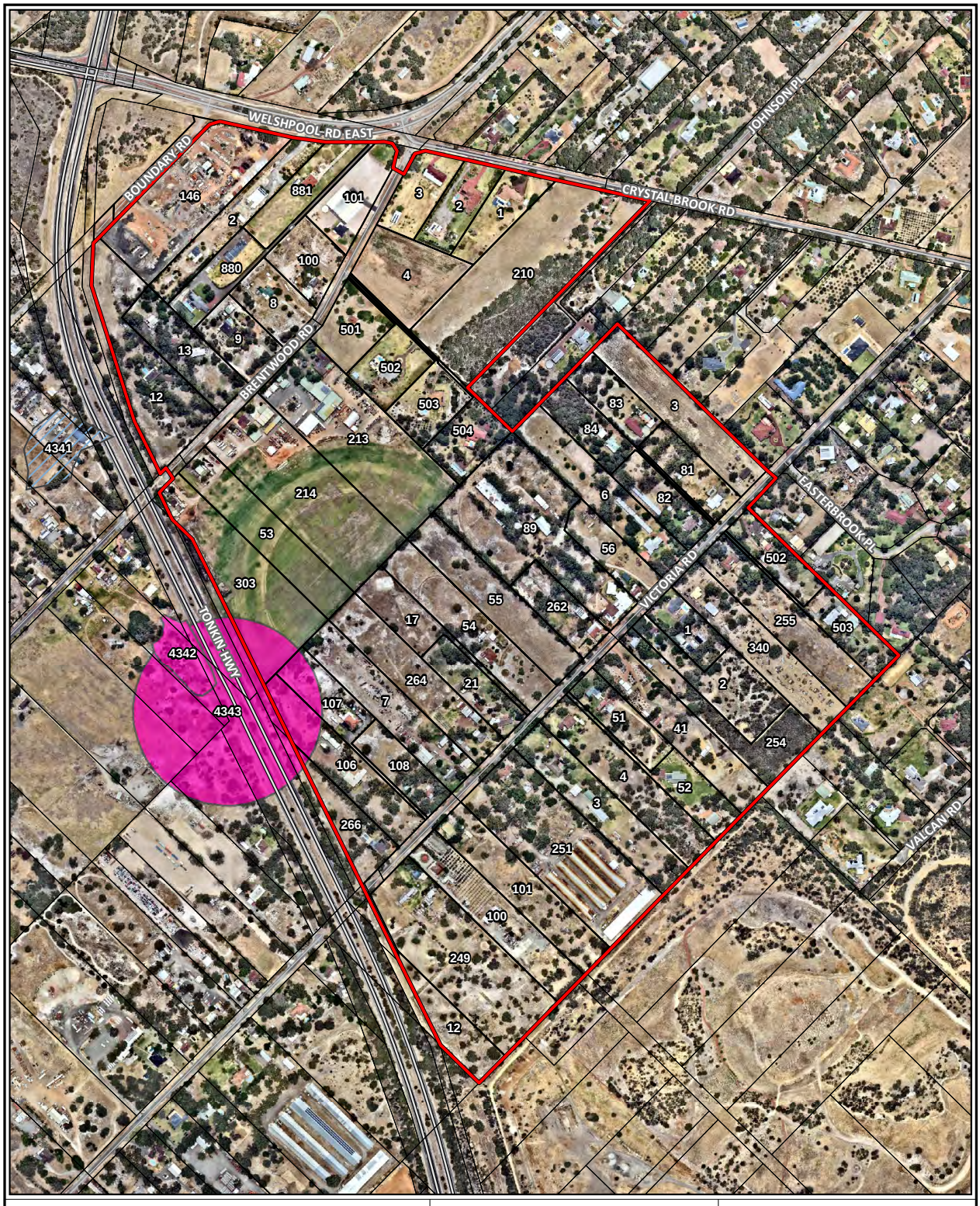
File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_13_Linkages.mxd
Image Reference: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- The site
- Environmentally sensitive areas (DWER)
- Cadastral boundary
- Highways
- Main road
- Minor road

Scale 1:8,000 at A4	0 100 200 metres	**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**ENVIRONMENTALLY SENSITIVE AREAS**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 14**
Version: A	Date: 20-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_14_ESAs.mxd
Image Reference:



Legend

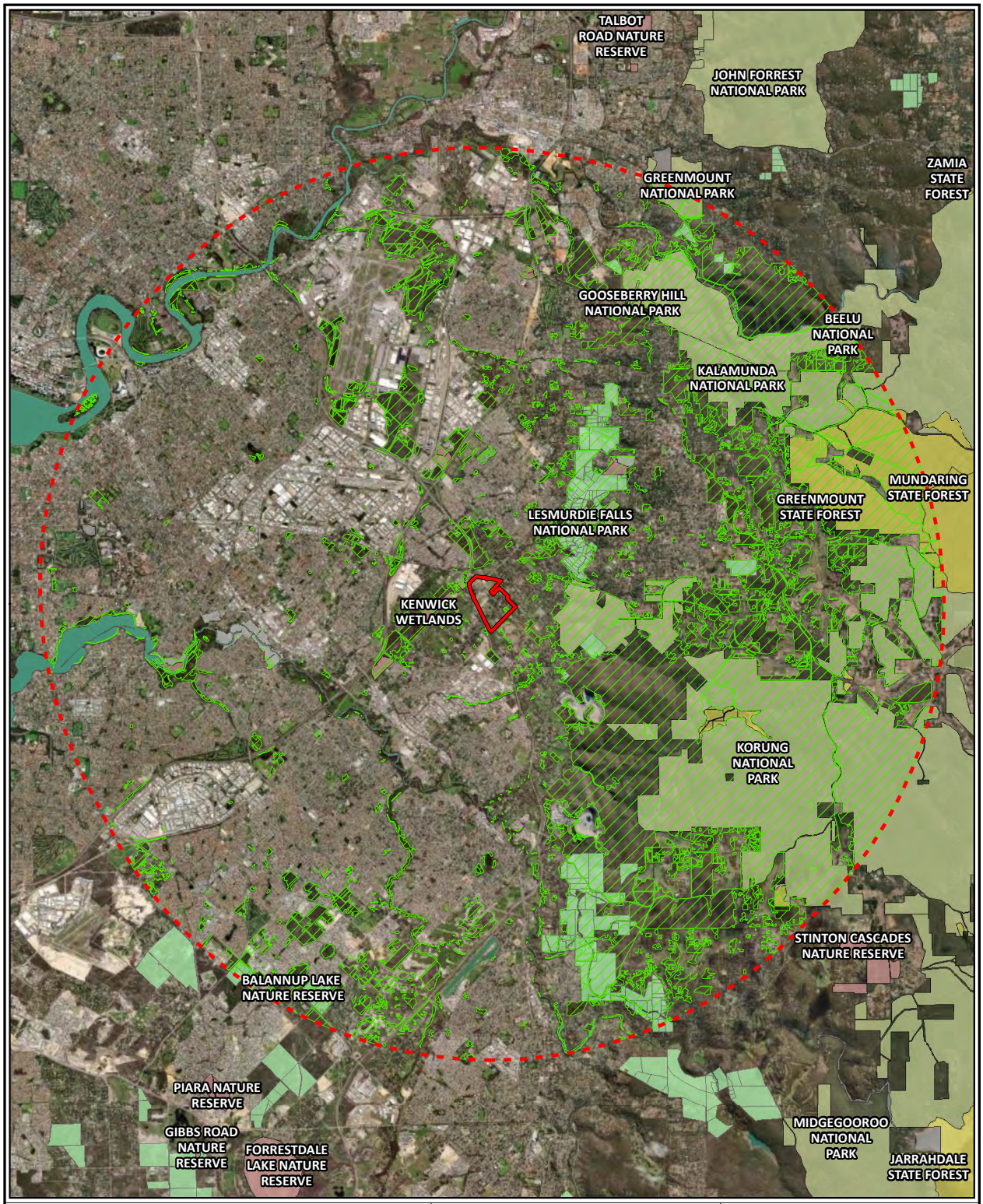
- The site
- Cadastral boundary

Aboriginal heritage places (DAA-001)

- Registered site
- Other heritage place
- Highways
- Main road
- Minor road

Scale 1:8,000 at A4 (0 100 200 metres)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**ABORIGINAL HERITAGE PLACES**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 15**
Version: A	Date: 20-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_15_Heritage.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021.



Legend

- The site
- 12km radius of the site
- Indicative Black Cockatoo foraging habitat within 12km

DBCA managed land
- National Park
- Crown Freehold - Dept Managed
- SCRM ACT - River Reserve
- Section 5(1)(g) Reserve
- Section 5(1)(h) Reserve
- Nature Reserve
- State Forest
- Other Reserves

Scale 1:140,000 at A4 (0 1 2 Kilometers)		**Wattle Grove WA**
Coord. Sys. GDA 1994 MGA Zone 50		**REGIONAL BLACK COCKATOO FORAGING HABITAT**
Job No: 60309		
Client: Hesperia Projects Pty Ltd		**FIGURE 16**
Version: A	Date: 20-Apr-2021	strategen JBS&G
Drawn By: hsullivan	Checked By: CT	

File Name: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R01_Rev_A\60309_16_RglBCHabitat.mxd
Image Reference: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Appendix A Database search results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 26/02/2021

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 00' 05" E,32° 00' 44" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	19708	*Abutilon grandifolium*	Y		
2.	3207	*Acacia alata (Winged Wattle)*			
3.	15429	*Acacia alata var. alata*			
4.	3219	*Acacia anomala (Grass Wattle)*		T	
5.	3220	*Acacia aphylla (Leafless Rock Wattle)*		T	
6.	15466	*Acacia applanata*			
7.	3233	*Acacia barbinervis*			
8.	15469	*Acacia barbinervis subsp. barbinervis*			
9.	17858	*Acacia dealbata*	Y		
10.	3294	*Acacia dentifera*			
11.	3307	*Acacia divergens*			
12.	11926	*Acacia drewiana subsp. drewiana*			
13.	11192	*Acacia drummondii subsp. elegans*			
14.	3323	*Acacia ericifolia*			
15.	3331	*Acacia extensa (Wiry Wattle)*			
16.	3373	*Acacia horridula*		P3	
17.	3374	*Acacia huegelii*			
18.	3382	*Acacia incrassata*			
19.	3383	*Acacia incurva*			
20.	3409	*Acacia lasiocarpa (Panjang)*			
21.	14932	*Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)*		P1	
22.	11611	*Acacia lasiocarpa var. lasiocarpa*			
23.	15721	*Acacia lasiocarpa var. sedifolia*			
24.	3410	*Acacia lateriticola*			
25.	17861	*Acacia longifolia*	Y		
26.	17464	*Acacia longifolia subsp. longifolia*	Y		
27.	3454	*Acacia nervosa (Rib Wattle)*			
28.	3464	*Acacia obovata*			
29.	3469	*Acacia oncinophylla*			Y
30.	14131	*Acacia oncinophylla subsp. patulifolia*		P4	
31.		*Acacia parramattensis*			
32.	17860	*Acacia podalyriifolia*	Y		
33.	3502	*Acacia pulchella (Prickly Moses)*			
34.	15481	*Acacia pulchella var. glaberrima*			
35.	15483	*Acacia pulchella var. pulchella*			
36.	3504	*Acacia pycnantha (Golden Wattle)*	Y		
37.	3527	*Acacia saligna (Orange Wattle, Kudjong)*			
38.	30033	*Acacia saligna subsp. lindleyi*			
39.	30034	*Acacia saligna subsp. pruinescens*			
40.	30032	*Acacia saligna subsp. saligna*			
41.	3541	*Acacia sessilis*			
42.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
43.	3574	*Acacia teretifolia*			
44.	3591	*Acacia urophylla*			
45.	3602	*Acacia willdenowiana (Grass Wattle)*			
46.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
47.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
48.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
49.	24262	*Acanthiza inornata (Western Thornbill)*			
50.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
51.	1205	*Acanthocarpus canaliculatus*			
52.	25242	*Acanthophis antarcticus (Southern Death Adder)*		P3	
53.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.

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Page 1

NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
54.	7811	*Acanthospermum hispidum (Starburr)*	Y		
55.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
56.	24281	*Accipiter cirrocephalus subsp. cirrocephalus (Collared Sparrowhawk)*			
57.	25536	*Accipiter fasciatus (Brown Goshawk)*			
58.	24283	*Accipiter fasciatus subsp. didimus (Brown Goshawk)*			
59.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
60.		*Acercella falcipes*			
61.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
62.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
63.	24831	*Acrocephalus australis subsp. gouldi (Australian Reed Warbler)*			
64.	6205	*Actinotus leucocephalus (Flannel Flower)*			
65.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
66.	14970	*Adenanthos barbiger*			
67.	1775	*Adenanthos cygnorum (Common Woollybush)*			
68.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
69.	1791	*Adenanthos obovatus (Basket Flower)*			
70.	25	*Adiantum aethiopicum (Common Maidenhair)*			
71.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
72.	18396	*Aeonium haworthii*	Y		
73.		*Afurcagobius suppositus*			
74.	1505	*Agave americana (Century Plant)*	Y		
75.	5316	*Agonis flexuosa (Peppermint, Wonil)*			
76.	179	*Agrostis gigantea (Redtop Bent)*	Y		
77.	23474	*Agrostocrinum hirsutum*			
78.	1261	*Agrostocrinum scabrum (Blue Grass Lily)*			
79.	23501	*Agrostocrinum scabrum subsp. scabrum*			
80.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
81.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
82.		*Akamptogonus novarae*			
83.	1056	*Alexgeorgea nitens*			
84.	1374	*Allium ampeloprasum*	Y		
85.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
86.	1729	*Allocasuarina grevilleoides*		P3	
87.	1731	*Allocasuarina huegeliana (Rock Sheoak, Kwowl)*			
88.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
89.	1734	*Allocasuarina microstachya*			
90.	1739	*Allocasuarina thuyoides (Horned Sheoak)*			
91.		*Allothereua maculata*			
92.	20755	*Alstroemeria psittacina*	Y		
93.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
94.	2652	*Alternanthera nodiflora (Common Joyweed)*			
95.	48626	*Althenia australis*			
96.	46334	*Amanita kalamundae (Kalamunda Lepidella)*		P3	
97.	48332	*Amanita preissii (Cinnamon-ring Lepidella)*		P3	
98.	45014	*Amanita quenda*		P1	
99.	38756	*Amanita umbrinella*			
100.	43542	*Amanita wadjukiorum*		P3	
101.	38757	*Amanita xanthocephala*			
102.	2655	*Amaranthus albus (Tumbleweed)*	Y		
103.	7820	*Ambrosia artemisiifolia (Annual Ragweed, Bitterweed, Hay-feverweed, Hog-weed)*	Y		
104.	7821	*Ambrosia psilostachya (Perennial Ragweed)*	Y		
105.	13380	*Amphibromus nervosus*			
106.	194	*Amphipogon amphipogonoides*			
107.	197	*Amphipogon debilis*			
108.	199	*Amphipogon strictus (Greybeard Grass)*			
109.	200	*Amphipogon turbinatus*			
110.	13267	*Amyema linophylla subsp. linophylla*			
111.	2380	*Amyema miquelii (Stalked Mistletoe)*			
112.	2383	*Amyema preissii (Wireleaf Mistletoe)*			
113.		*Aname mainae*			
114.		*Aname tepperi*			
115.	1058	*Anarthria gracilis*			
116.	1059	*Anarthria humilis*			
117.	1060	*Anarthria laevis*			
118.	24310	*Anas castanea (Chestnut Teal)*			
119.	24312	*Anas gracilis (Grey Teal)*			
120.	24313	*Anas platyrhynchos (Mallard)*			
121.		*Anas platyrhynchos subsp. domesticus*			
122.	24315	*Anas rhynchotis (Australasian Shoveler)*			
123.	24316	*Anas superciliosa (Pacific Black Duck)*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
124.		*Ancylidae sp.*			
125.	6300	*Andersonia aristata (Rice Flower)*			
126.	6309	*Andersonia gracilis*		T	
127.	6312	*Andersonia involucrata*			
128.	6314	*Andersonia lehmanniana*			
129.	11471	*Andersonia lehmanniana subsp. lehmanniana*			
130.	41732	*Andersonia sp. Blepharifolia (F. & J. Hort 1919)*		P2	
131.	7831	*Angianthus micropodioides*		P3	
132.	7833	*Angianthus preissianus*			
133.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
134.	11470	*Anigozanthos bicolor subsp. bicolor*			
135.	1409	*Anigozanthos humilis (Catspaw)*			
136.	11434	*Anigozanthos humilis subsp. humilis*			
137.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
138.	11261	*Anigozanthos manglesii subsp. manglesii*			
139.	29487	*Anigozanthos manglesii var. x angustifolius*			
140.	1416	*Anigozanthos viridis (Green Kangaroo Paw, Kurulbardang)*			
141.	11566	*Anigozanthos viridis subsp. viridis*			
142.		*Anisops hyperion*			
143.	17455	*Anredera cordifolia*	Y		
144.		*Anser anser*			
145.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
146.	24088	*Antechinus flavipes subsp. leucogaster (Yellow-footed Antechinus, Mardo)*			
147.	6946	*Anthocercis gracilis (Slender Tailflower)*		T	
148.	24561	*Anthochaera carunculata (Red Wattlebird)*			
149.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
150.	12724	*Anthotium junciforme*			
151.	202	*Anthoxanthum odoratum (Sweet Vernal Grass)*	Y		
152.	25670	*Anthus australis (Australian Pipit)*			
153.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
154.	3686	*Aotus cordifolia*			
155.	3688	*Aotus gracillima*			
156.	3692	*Aotus procumbens*			
157.	1116	*Aphelia brizula*			
158.	1117	*Aphelia cyperoides*			
159.	1118	*Aphelia drummondii*			
160.	43548	*Aphelia sp. Albany (B.G. Briggs 596)*			
161.	12040	*Apium prostratum subsp. prostratum var. prostratum (Sea Celery)*			
162.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
163.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
164.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
165.	24285	*Aquila audax (Wedge-tailed Eagle)*			
166.		*Arachnura higginsi*			
167.		*Araneus cyphoxis*			
168.		*Araneus eburneiventris*			
169.		*Araneus eburnus*			
170.		*Araneus senicaudatus*			
171.		*Araneus talipedatus*			
172.	17355	*Araujia sericifera*	Y		
173.	32314	*Archidium rehmannii*			
174.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
175.	38969	*Arcyria minuta*			
176.	25557	*Ardea garzetta (Little Egret)*			
177.	25558	*Ardea ibis (Cattle Egret)*			
178.	25559	*Ardea intermedia (Intermediate Egret)*			
179.	41324	*Ardea modesta (great egret, white egret)*			
180.	24340	*Ardea novaehollandiae (White-faced Heron)*			
181.	24341	*Ardea pacifica (White-necked Heron)*			
182.	25560	*Ardea sacra (Eastern Reef Egret, Eastern Reef Heron)*			
183.		*Argiope trifasciata*			
184.	12063	*Aristida holathera var. holathera*			
185.	1264	*Arnocrinum preissii*			
186.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
187.	24352	*Artamus cinereus subsp. melanops (Black-faced Woodswallow)*			
188.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
189.	24356	*Artamus personatus (Masked Woodswallow)*			
190.		*Artema atlanta*			
191.	28288	*Artemisia arborescens (Silver Wormwood)*	Y		
192.		*Artoria linnaei*			
193.		*Artoriopsis eccentrica*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
194.		*Artoriopsis expolita*			
195.		*Artoriopsis joergi*			
196.	226	*Arundo donax (Giant Reed)*	Y		
197.		*Asadipus kunderang*			
198.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
199.	1201	*Asparagus officinalis (Asparagus)*	Y		
200.	1364	*Asphodelus fistulosus (Onion Weed)*	Y		
201.		*Astartea aff. fascicularis sthcst*			
202.	20350	*Astartea affinis (West-coast Astartea)*			
203.	20249	*Astartea leptophylla (River-bank Astartea)*			
204.	20283	*Astartea scoparia (Common Astartea)*			
205.		*Asterella drummondii*			
206.	7849	*Asteridea gracilis*		P3	
207.	4400	*Asterolasia pallida*			
208.	6323	*Astroloma ciliatum (Candle Cranberry)*			
209.	6327	*Astroloma foliosum (Candle Cranberry)*			
210.	6328	*Astroloma glaucescens*			
211.	6330	*Astroloma macrocalyx (Swan Berry)*			
212.	6334	*Astroloma pallidum (Kick Bush)*			
213.	6337	*Astroloma stomarrhena (Red Swamp Cranberry)*			
214.	6339	*Astroloma xerophyllum*			
215.	2462	*Atriplex hypoleuca*			
216.	2471	*Atriplex prostrata (Hastate Orache)*	Y		
217.		*Austracantha minax*			
218.	48574	*Australotomurus morbidus (cemetery springtail, Guildford springtail)*		P3	
219.		*Austrammo harveyi*			
220.		*Austroboletus occidentalis*			
221.	42106	*Austroparmelina conlabrosa*			
222.	38480	*Austrostipa bronwenae*		T	
223.	17233	*Austrostipa campylachne*			
224.	17234	*Austrostipa compressa*			
225.	17237	*Austrostipa elegantissima*			
226.	17241	*Austrostipa hemipogon*			
227.	17245	*Austrostipa mollis*			
228.		*Austrostipa sp.*			
229.	37421	*Austrostipa sp. Marchagee (B.R. Maslin 1407)*			
230.	17257	*Austrostipa variabilis*			
231.	231	*Avellinia michelii*	Y		
232.	233	*Avena barbata (Bearded Oat)*	Y		
233.		*Avena sp. Yule5*			Y
234.	20013	*Axonopus fissifolius*	Y		
235.	24318	*Aythya australis (Hardhead)*			
236.	42902	*Azolla rubra*			
237.	18279	*Babiana angustifolia*	Y		
238.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
239.	45403	*Babingtonia pelloeae (Pelloe's Babingtonia)*			
240.	45402	*Babingtonia urbana (Coastal Plain Babingtonia)*		P3	
241.		*Backobourkia heroine*			
242.	38976	*Badhamia foliicola*			
243.	38978	*Badhamia panicea*			
244.		*Badumna insignis*			
245.	1382	*Baeometra uniflora*	Y		
246.		*Ballarra longipalpus*			
247.	32682	*Banksia armata var. armata*			
248.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
249.	32678	*Banksia bipinnatifida subsp. bipinnatifida*			
250.	32576	*Banksia dallanneyi (Couch Honeypot)*			
251.	32580	*Banksia dallanneyi subsp. dallanneyi var. dallanneyi*			
252.	32577	*Banksia dallanneyi subsp. dallanneyi var. mellicula*			
253.	1819	*Banksia grandis (Bull Banksia, Pulgarla)*			
254.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
255.	1823	*Banksia incana*			
256.	33399	*Banksia incana var. incana*			
257.	32214	*Banksia kippistiana*			
258.	32216	*Banksia kippistiana var. paenepeccata*		P3	
259.	1830	*Banksia littoralis (Swamp Banksia, Pungura)*			
260.	1834	*Banksia menziesii (Firewood Banksia)*			
261.	32211	*Banksia mimica (Summer Honeypot)*		T	
262.	32202	*Banksia nivea (Honeypot Dryandra, Pudjarn)*			
263.	32138	*Banksia pteridifolia subsp. vernalis*		P3	

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264.	32080	*Banksia sessilis var. sessilis*			
265.	12111	*Banksia sphaerocarpa var. sphaerocarpa (Fox Banksia)*			
266.	32045	*Banksia squarrosa subsp. squarrosa*			
267.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
268.	32031	*Banksia vestita (Summer Dryandra)*			
269.	1855	*Banksia victoriae (Woolly Orange Banksia)*			
270.	32315	*Barbula calycina*			
271.		*Barnardius zonarius*			
272.	32321	*Bartramia breutelii*			
273.	32323	*Bartramia pseudostricta*			
274.	740	*Baumea arthrophylla*			
275.	743	*Baumea juncea (Bare Twigrush)*			
276.	744	*Baumea laxa*			
277.	745	*Baumea preissii*			
278.	747	*Baumea rubiginosa*			
279.	5387	*Beaufortia macrostemon (Darling Range Beaufortia)*			
280.	5390	*Beaufortia purpurea (Purple Beaufortia)*		P3	
281.	5393	*Beaufortia squarrosa (Sand Beaufortia, Sand Bottlebrush, Puno)*			
282.	7046	*Bellardia trixago (Bellardia)*	Y		
283.	48868	*Bellardia viscosa*	Y		
284.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
285.	3157	*Billardiera floribunda (White-flowered Billardiera)*			
286.	25788	*Billardiera fraseri (Elegant Pronaya)*			
287.	25798	*Billardiera fusiformis (Australian Bluebell)*			
288.	24319	*Biziura lobata (Musk Duck)*			
289.	1417	*Blancoa canescens (Winter Bell)*			
290.	749	*Bolboschoenus caldwellii (Marsh Club-rush)*			
291.	48689	*Bolboschoenus fluviatilis*		P1	
292.		*Boletus sp.*			
293.	4413	*Boronia crenulata (Aniseed Boronia)*			
294.	11503	*Boronia crenulata subsp. crenulata var. crenulata*			
295.	16636	*Boronia crenulata subsp. viminea*			
296.	4414	*Boronia cymosa (Granite Boronia)*			
297.	4417	*Boronia dichotoma*			
298.	16618	*Boronia humifusa*		P1	
299.	4432	*Boronia ovata*			
300.	17665	*Boronia purdieana subsp. purdieana*			
301.	4438	*Boronia ramosa*			
302.	11381	*Boronia ramosa subsp. anethifolia*			
303.	11564	*Boronia ramosa subsp. ramosa*			
304.	4444	*Boronia tenuis (Blue Boronia)*		P4	
305.	1272	*Borya scirpoidea*			
306.	1273	*Borya sphaerocephala (Pincushions)*			
307.	24251	*Bos taurus (European Cattle)*	Y		
308.	48782	*Bossiaea angustifolia*			
309.	14396	*Bossiaea aquifolium subsp. aquifolium*			
310.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
311.	3714	*Bossiaea ornata (Broad Leaved Brown Pea)*			
312.		*Bostockia porosa*			
313.	6341	*Brachyloma preissii (Globe Heath)*			
314.	8661	*Brachypodium distachyon (False Brome)*	Y		
315.	7878	*Brachyscome iberidifolia*			
316.	42380	*Brachyurophis fasciolatus subsp. fasciolatus (Narrow-banded Shovel-nosed Snake)*			
317.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
318.	2993	*Brassica fruticulosa (Twiggy Turnip)*	Y		
319.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
320.	2995	*Brassica x napus*	Y		
321.	244	*Briza maxima (Blowfly Grass)*	Y		
322.	245	*Briza minor (Shivery Grass)*	Y		
323.	246	*Bromus alopecuros*	Y		
324.	248	*Bromus catharticus (Prairie Grass)*	Y		
325.	249	*Bromus diandrus (Great Brome)*	Y		
326.	250	*Bromus hordeaceus (Soft Brome)*	Y		
327.	32330	*Bryum argenteum*			
328.	32331	*Bryum lanatum*			
329.	1366	*Bulbine semibarbata (Leek Lily)*			
330.	1383	*Burchardia bairdiae*			
331.	12770	*Burchardia congesta*			
332.	1385	*Burchardia multiflora (Dwarf Burchardia)*			
333.	24359	*Burhinus grallarius (Bush Stone-curlew)*			

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334.	3178	*Byblis gigantea (Rainbow Plant)*		P3	
335.		*Byssomerulius corium*			
336.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
337.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
338.	25715	*Cacatua roseicapilla (Galah)*			
339.	25716	*Cacatua sanguinea (Little Corella)*			
340.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
341.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
342.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
343.		*Caenidae sp.*			
344.	1276	*Caesia micrantha (Pale Grass Lily)*			
345.	1277	*Caesia occidentalis*			
346.	15330	*Caladenia arenicola*			
347.	13853	*Caladenia arrecta*			
348.	44900	*Caladenia denticulata subsp. rubella*			
349.	1586	*Caladenia discoidea (Dancing Orchid)*			
350.	1590	*Caladenia ferruginea (Rusty Spider Orchid)*			
351.	1592	*Caladenia flava (Cowslip Orchid)*			
352.	15348	*Caladenia flava subsp. flava*			
353.	15502	*Caladenia footeana*			
354.	17980	*Caladenia hiemalis*			
355.	15354	*Caladenia hirta subsp. hirta*			
356.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
357.	13859	*Caladenia longicauda subsp. clivicola*			
358.	15363	*Caladenia longicauda subsp. eminens*			
359.	15365	*Caladenia longicauda subsp. longicauda*			
360.	1604	*Caladenia macrostylis (Leaping Spider Orchid)*			
361.	1605	*Caladenia marginata (White Fairy Orchid)*			
362.	17760	*Caladenia nobilis*			
363.	15503	*Caladenia paludosa*			
364.	15377	*Caladenia reptans subsp. reptans*			
365.	15379	*Caladenia serotina*			
366.	2846	*Calandrinia calyptrata (Pink Purslane)*			
367.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
368.	2854	*Calandrinia granulifera (Pygmy Purslane)*			
369.	2856	*Calandrinia liniflora (Parakeelya)*			
370.	16365	*Calandrinia sp. Kenwick (G.J. Keighery 10905)*			
371.	20096	*Calandrinia sp. Piawaning (A.C. Beauglehole 12257)*		P1	
372.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
373.	1214	*Calectasia grandiflora (Blue Tinsel Lily)*			
374.	19309	*Calectasia narragara*			
375.	4717	*Callitriche stagnalis (Common Starwort)*	Y		
376.	36520	*Callitris acuminata (Dwarf Cypress)*			
377.	36600	*Callitris pyramidalis (Swamp Cypress)*			
378.	5396	*Calothamnus accedens*		P4	
379.	11333	*Calothamnus graniticus subsp. leptophyllus*		P4	
380.	5411	*Calothamnus hirsutus*			
381.	5415	*Calothamnus lateralis*			
382.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
383.	35816	*Calothamnus quadrifidus subsp. quadrifidus*			
384.	5428	*Calothamnus rupestris (Mouse Ears)*			
385.	5429	*Calothamnus sanguineus (Silky-leaved Blood flower, Pindak)*			
386.	5431	*Calothamnus torulosus*			
387.	16492	*Calycopeplus paucifolius*			
388.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
389.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
390.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
391.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
392.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
393.	5437	*Calytrix acutifolia*			
394.	5439	*Calytrix angulata (Yellow Starflower)*			
395.	5441	*Calytrix aurea*			
396.	13653	*Calytrix breviseta subsp. breviseta*		T	
397.	5458	*Calytrix flavescens (Summer Starflower)*			
398.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
399.	5461	*Calytrix glutinosa*			
400.	5476	*Calytrix sapphirina*			
401.	13655	*Calytrix simplex subsp. suboppositifolia*			

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402.		*Calytrix sp.*			
403.	5485	*Calytrix variabilis*			
404.	19713	*Campsis radicans*	Y		
405.	32334	*Campylopus australis*			
406.	32461	*Campylopus bicolor var. bicolor*			
407.	32338	*Campylopus introflexus*	Y		
408.		*Carassius auratus*			
409.	17318	*Cardiospermum grandiflorum*	Y		
410.	754	*Carex divisa (Divided Sedge)*	Y		
411.	755	*Carex fascicularis (Tassel Sedge)*			
412.	759	*Carex tereticaulis*		P3	
413.	1162	*Cartonema philydroides*			
414.	11351	*Cassytha aurea var. hirta*			
415.	2951	*Cassytha flava (Dodder Laurel)*			
416.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
417.	11501	*Cassytha glabella forma casuarinae*			
418.	11211	*Cassytha glabella forma dispar*			
419.	2956	*Cassytha pomiformis (Dodder Laurel)*			
420.	2957	*Cassytha racemosa (Dodder Laurel)*			
421.	11242	*Cassytha racemosa forma pilosa*			
422.	11799	*Cassytha racemosa forma racemosa*			
423.		*Cassytha sp. scps*			Y
424.	18321	*Casuarina glauca*	Y		
425.	1742	*Casuarina obesa (Swamp Sheoak, Kuli)*			
426.	760	*Caustis dioica*			
427.		*Ceinidae sp.*			
428.		*Celaenia excavata*			
429.	41564	*Cenchrus clandestinus (Kikuyu Grass)*	Y		
430.	41566	*Cenchrus longisetus (Feathertop)*	Y		
431.	41567	*Cenchrus macrourus (African Feather Grass)*	Y		
432.	41563	*Cenchrus purpureus (Elephant Grass)*	Y		
433.	41568	*Cenchrus setaceus (Fountain Grass)*	Y		
434.	7916	*Centaurea melitensis (Maltese Cockspur, Malta Thistle)*	Y		
435.	7917	*Centaurea solstitialis (St Barnaby's Thistle, Yellow Star Thistle)*	Y		
436.	6539	*Centaurium erythraea (Common Centaury)*	Y		
437.	6542	*Centaurium tenuiflorum*	Y		
438.	6214	*Centella asiatica*			
439.	7918	*Centipeda cunninghamii (Common Sneezewood, Gukwonderuk, Old Man Weed)*			
440.	35322	*Centranthus ruber subsp. ruber*	Y		
441.		*Centratherum punctatum*			
442.	1120	*Centrolepis alepyroides*			
443.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
444.	1123	*Centrolepis caespitosa*			
445.	1125	*Centrolepis drummondiana*			
446.	1129	*Centrolepis glabra (Smooth Centrolepis)*			
447.	1131	*Centrolepis inconspicua*			
448.	1132	*Centrolepis mutica*			
449.	1134	*Centrolepis polygyna (Wiry Centrolepis)*			
450.	43642	*Centrolepis sp. Kalannie (B.J. Lepschi et al. BJL 3517)*			
451.		*Cephaloziella exiliflora*			
452.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
453.	32462	*Ceratodon purpureus subsp. convolutus*			
454.		*Ceratopogonidae sp.*			
455.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
456.		*Cercophonius granulosus*			
457.		*Cercophonius sulcatus*			
458.		*Ceryerda cursitans*			
459.	17685	*Chaetanthus aristatus*			
460.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
461.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
462.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
463.	1280	*Chamaescilla corymbosa (Blue Squill)*			
464.	11299	*Chamaescilla corymbosa var. corymbosa*			
465.	19338	*Chamaescilla gibsonii*		P3	
466.	8788	*Chamaescilla versicolor*			
467.	5498	*Chamelaucium uncinatum (Geraldton Wax)*			
468.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
469.	1513	*Chasmanthe floribunda (African Cornflag)*	Y		
470.	31	*Cheilanthes austrotenuifolia*			
471.	34	*Cheilanthes distans (Bristly Cloak Fern)*			

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472.	12818	*Cheilanthes sieberi subsp. sieberi*			
473.	3169	*Cheiranthera preissiana*			
474.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
475.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
476.	47909	*Cheramoeca leucosterna (White-backed Swallow)*			
477.	33939	*Cherax cainii (Marron)*			
478.		*Cherax destructor*			
479.		*Cherax preissii*			
480.		*Cherax quinquecarinatus*			
481.		*Chironominae sp.*			
482.	267	*Chloris gayana (Rhodes Grass)*	Y		
483.	7925	*Chondrilla juncea (Skeleton Weed)*	Y		
484.	17706	*Chordifex sinuosus*			
485.	763	*Chorizandra enodis (Black Bristlerush)*			
486.	764	*Chorizandra multiarticulata*			
487.	8971	*Chorizema cordatum*			
488.	3753	*Chorizema dicksonii (Yellow-eyed Flame Pea)*			
489.	24980	*Christinus marmoratus (Marbled Gecko)*			
490.		*Chroicocephalus novaehollandiae*			
491.	11900	*Chrysanthemoides monilifera subsp. monilifera*	Y		
492.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
493.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
494.	24432	*Chrysococcyx lucidus subsp. plagosus (Shining Bronze Cuckoo)*			
495.	7933	*Chthonocephalus pseudevax (Woolly Groundheads)*			
496.	6543	*Cicendia filiformis (Slender Cicendia)*	Y		
497.	24288	*Circus approximans (Swamp Harrier)*			
498.	24289	*Circus assimilis (Spotted Harrier)*			
499.	48838	*Citrullus amarus*	Y		
500.	27668	*Cladia schizopora*			
501.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
502.	2929	*Clematis pubescens (Common Clematis)*			
503.		*Coenagrionidae sp.*			
504.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
505.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
506.	1044	*Colocasia esculenta (Taro)*			
507.	32999	*Colocasia esculenta var. esculenta*	Y		
508.		*Coltricia cinnamomea*			
509.	38771	*Coltriciella dependens*			
510.	24399	*Columba livia (Domestic Pigeon)*	Y		
511.		*Colus pusillus*			
512.	38990	*Comatricha nigra*			
513.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
514.	4551	*Comesperma ciliatum*			
515.	14663	*Comesperma griffinii*		P2	
516.	4559	*Comesperma polygaloides (Small Milkwort)*			
517.	4560	*Comesperma rhadinocarpum (Slender-fruited Comesperma)*		P3	
518.		*Comesperma sp. Brix1R (possibly virigatum)*			Y
519.	4564	*Comesperma virgatum (Milkwort)*			
520.	48634	*Commersonia corniculata*			
521.	15607	*Conospermum acerosum subsp. acerosum*			
522.	15513	*Conospermum boreale subsp. boreale*			
523.	15041	*Conospermum canaliculatum*			
524.	15516	*Conospermum canaliculatum subsp. canaliculatum*			
525.	16853	*Conospermum capitatum subsp. glabratum*			
526.	1875	*Conospermum huegelii (Slender Smokebush)*			
527.	1882	*Conospermum stoechadis (Common Smokebush)*			
528.	15520	*Conospermum stoechadis subsp. sclerophyllum*			
529.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
530.	1885	*Conospermum triplinervium (Tree Smokebush)*			
531.	13999	*Conospermum undulatum*		T	
532.	6347	*Conostephium minus (Pink-tipped Pearl flower)*			
533.	6348	*Conostephium pendulum (Pearl Flower)*			
534.	6349	*Conostephium preissii*			
535.	11826	*Conostylis aculeata subsp. aculeata*			
536.	11513	*Conostylis aculeata subsp. cygnorum*			
537.	12109	*Conostylis aculeata subsp. preissii*			
538.	1420	*Conostylis androstemma (Trumpets)*			
539.	1423	*Conostylis aurea (Golden Conostylis)*			
540.	11438	*Conostylis candicans subsp. candicans*			
541.	1429	*Conostylis caricina*			

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542.	12035	*Conostylis caricina subsp. caricina*			
543.	1434	*Conostylis festucacea*			
544.	11695	*Conostylis festucacea subsp. festucacea*			
545.	1436	*Conostylis juncea*			
546.	1437	*Conostylis latens*			
547.	1453	*Conostylis serrulata*			
548.	1454	*Conostylis setigera (Bristly Cottonhead)*			
549.	11597	*Conostylis setigera subsp. setigera*			
550.	1455	*Conostylis setosa (White Cottonhead)*			
551.		*Conostylis sp.*			
552.	5502	*Conothamnus trinervis*			
553.	6614	*Convolvulus remotus*			
554.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
555.	7941	*Conyza parva*	Y		
556.		*Conyza sp. Brix1R*			Y
557.		*Conyza sp. Brix4*			Y
558.	20074	*Conyza sumatrensis*	Y		
559.		*Coprinus comatus*			
560.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
561.	24362	*Coracina novaehollandiae subsp. novaehollandiae (Black-faced Cuckoo-shrike)*			
562.		*Corixidae sp.*			
563.		*Cormocephalus aurantiipes*			
564.		*Cormocephalus novaehollandiae*			
565.		*Cormocephalus rubriceps*			
566.		*Cormocephalus strigosus*			
567.		*Cormocephalus turneri*			
568.	2891	*Corrigiola litoralis (Strapwort)*	Y		
569.	48259	*Cortaderia selloana subsp. selloana*	Y		
570.	38774	*Cortinarius archeri*			
571.	38874	*Cortinarius globuliformis*			
572.		*Cortinarius sublargus*			
573.	24416	*Corvus bennetti (Little Crow)*			
574.	25592	*Corvus coronoides (Australian Raven)*			
575.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
576.	17104	*Corymbia calophylla (Marri)*			
577.	18320	*Cotoneaster pannosus*	Y		
578.	7943	*Cotula australis (Common Cotula)*			
579.	7944	*Cotula bipinnata (Ferny Cotula)*	Y		
580.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
581.	7946	*Cotula cotuloides (Smooth Cotula)*			
582.	7947	*Cotula turbinata (Funnel Weed)*	Y		
583.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
584.	25595	*Cracticus tibicen (Australian Magpie)*			
585.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
586.	24423	*Cracticus tibicen subsp. tibicen (Black-backed Magpie)*			
587.	25596	*Cracticus torquatus (Grey Butcherbird)*			
588.	24424	*Cracticus torquatus subsp. torquatus (Grey Butcherbird)*			
589.	13354	*Craspedia variabilis*			
590.	17701	*Crassula closiana*			
591.	3137	*Crassula colorata (Dense Stonecrop)*			
592.	11709	*Crassula colorata var. acuminata*			
593.	11563	*Crassula colorata var. colorata*			
594.	3138	*Crassula decumbens (Rufous Stonecrop)*			
595.	11349	*Crassula decumbens var. decumbens*			
596.	3139	*Crassula exserta*			
597.	3142	*Crassula natans*	Y		
598.	15706	*Crassula natans var. minus*	Y		
599.	18397	*Crassula tetragona subsp. robusta*	Y		
600.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
601.	38780	*Crepidotus eucalyptorum*			
602.	7953	*Crepis foetida (Foetid Hawksbeard)*	Y		
603.	29054	*Crepis foetida subsp. foetida (Stinking Hawksbeard)*	Y		
604.	25398	*Crinia georgiana (Quacking Frog)*			
605.	25399	*Crinia glauerti (Clicking Frog)*			
606.	25400	*Crinia insignifera (Squelching Froglet)*			
607.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
608.	35838	*Cristonia biloba subsp. biloba*			
609.	13527	*Croninia kingiana*			
610.	17368	*Crotalaria agatiflora subsp. agatiflora*	Y		
611.	13470	*Cryptandra arbutiflora var. arbutiflora*			

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612.	9076	*Cryptandra myriantha*			
613.	4804	*Cryptandra nutans*			
614.	4809	*Cryptandra pungens*			
615.	4810	*Cryptandra scoparia*			
616.	30893	*Cryptoblepharus buchananii*			
617.	25020	*Cryptoblepharus plagiocephalus*			
618.		*Cryptoerithus quobba*			
619.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
620.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
621.	25027	*Ctenotus australis*			
622.	25035	*Ctenotus delli (Dell's skink, Darling Range southwest Ctenotus)*		P4	
623.	25039	*Ctenotus fallens*			
624.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain subpop P3), skink)*			
625.	25047	*Ctenotus impar*			
626.	25049	*Ctenotus labillardieri*			
627.	41641	*Ctenotus ora (Coastal Plains Skink)*		P3	
628.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
629.	11021	*Cuscuta planiflora*	Y		
630.	1487	*Cyanella hyacinthoides*	Y		
631.	15114	*Cyanicula gemmata*			
632.	13826	*Cyanicula ixioides subsp. ixioides*		P4	
633.	15404	*Cyanicula sericea*			
634.	51	*Cyathea cooperi*	Y		
635.	768	*Cyathochaeta avenacea*			
636.	769	*Cyathochaeta clandestina*			
637.	17618	*Cyathochaeta equitans*			
638.		*Cyclosa trilobata*			
639.	40661	*Cycnogeton lineare*			
640.	24322	*Cygnus atratus (Black Swan)*			
641.	283	*Cynodon dactylon (Couch)*	Y		
642.	285	*Cynosurus echinatus (Rough Dogstail)*	Y		
643.	776	*Cyperus brevifolius (Kyllinga Weed)*	Y		
644.	783	*Cyperus congestus (Dense Flat-sedge)*	Y		
645.	792	*Cyperus eragrostis (Umbrella Sedge)*	Y		
646.	18318	*Cyperus involucratus*	Y		
647.	18198	*Cyperus papyrus*	Y		Y
648.	806	*Cyperus polystachyos (Bunchy Sedge)*			
649.	815	*Cyperus tenellus (Tiny Flatsedge)*	Y		
650.	816	*Cyperus tenuiflorus (Scaly Sedge)*	Y		
651.	14537	*Cyperus vorsteri*	Y		Y
652.	10916	*Cyrtostylis huegelii*			
653.	17692	*Cytogonidium leptocarpoides*			
654.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
655.	7420	*Dampiera alata (Winged-stem Dampiera)*			
656.	7428	*Dampiera coronata (Wedge-leaved Dampiera)*			
657.	7454	*Dampiera linearis (Common Dampiera)*			
658.	7462	*Dampiera pedunculata*			
659.	7484	*Dampiera trigona (Angled-stem Dampiera)*			
660.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
661.	24606	*Daphoenositta chrysoptera subsp. pileata (Varied Sittella, Black-capped Sitella)*			
662.	5505	*Darwinia apiculata (Scarp Darwinia)*		T	
663.	5508	*Darwinia citriodora (Lemon-scented Darwinia)*			
664.	5531	*Darwinia thymoides*			
665.	18193	*Darwinia thymoides subsp. thymoides*			
666.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
667.	1220	*Dasypogon obliquifolius*			
668.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
669.	6218	*Daucus glochidiatus (Australian Carrot)*			
670.	3793	*Daviesia angulata*			
671.	3799	*Daviesia cordata (Bookleaf)*			
672.	3805	*Daviesia decurrens (Prickly Bitter-pea)*			
673.	19747	*Daviesia decurrens subsp. decurrens*			
674.	3807	*Daviesia divaricata (Marno)*			
675.	18560	*Daviesia divaricata subsp. divaricata*			
676.	11879	*Daviesia hakeoides subsp. hakeoides*			
677.	3815	*Daviesia horrida (Prickly Bitter-pea)*			
678.	3819	*Daviesia longifolia*			
679.	3824	*Daviesia nudiflora*			
680.	16585	*Daviesia nudiflora subsp. nudiflora*			

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681.	3831	*Daviesia pedunculata*			
682.	3832	*Daviesia physodes*			
683.	3833	*Daviesia podophylla*			
684.	3834	*Daviesia polyphylla*			
685.	3835	*Daviesia preissii*			
686.	3839	*Daviesia rhombifolia*			
687.	3845	*Daviesia triflora*			
688.		*Delena cancerides*			
689.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
690.	24999	*Delma grayii*			
691.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
692.	25325	*Dendrelaphis punctulata (Green Tree Snake)*			
693.	24325	*Dendrocygna eytoni (Plumed Whistling Duck)*			
694.	17336	*Dennstaedtia davallioides*	Y		Y
695.		*Dermocybe clelandii*			
696.	38784	*Descomyces albus*			
697.	17663	*Desmocladus asper*			
698.	17691	*Desmocladus fasciculatus*			
699.	16595	*Desmocladus flexuosus*			
700.	46362	*Desmocladus lateriflorus*			
701.	39008	*Diachea leucopodia*			
702.	1259	*Dianella revoluta (Blueberry Lily)*			
703.	11636	*Dianella revoluta var. divaricata*			
704.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
705.	306	*Dichelachne crinita (Longhair Plumegrass)*			
706.	6616	*Dichondra repens (Kidney Weed)*			
707.	1287	*Dichopogon capillipes*			
708.	1289	*Dichopogon preissii*			
709.	39026	*Didymium verrucosporum*			
710.	32345	*Didymodon australasiae*			
711.	17838	*Dielsia stenostachya*			
712.	311	*Digitaria ciliaris (Summer Grass)*	Y		
713.	316	*Digitaria longiflora*			
714.	320	*Digitaria sanguinalis (Crab Grass)*	Y		
715.		*Dingosa murata*			
716.		*Dingosa serrata*			
717.		*Dinocambala ingens*			
718.	1509	*Dioscorea hastifolia (Warrine, Wararn)*			
719.	48378	*Diplachne fusca subsp. fusca*			
720.	24929	*Diplodactylus granariensis subsp. granariensis*			
721.	44654	*Diplodactylus lateroides (Speckled Stone Gecko)*			
722.	24939	*Diplodactylus polyophthalmus*			
723.	24940	*Diplodactylus pulcher*			
724.	18589	*Diplopeltis huegelii subsp. lehmannii*			
725.	3867	*Dipogon lignosus (Dolichos Pea)*	Y		
726.	19649	*Disa bracteata*	Y		
727.	32347	*Ditrichum difficile*			
728.	7961	*Dittrichia graveolens (Stinkwort)*	Y		
729.	12943	*Diuris brumalis*			
730.	11049	*Diuris corymbosa*			
731.	42231	*Diuris decrementa*			
732.	1634	*Diuris laxiflora (Bee Orchid)*			
733.		*Diuris longifolia var. parviflora*			Y
734.	12939	*Diuris magnifica*			
735.	46859	*Diuris ostrina*			
736.	15436	*Diuris porrifolia*			
737.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
738.	1638	*Diuris setacea (Bristly Donkey Orchid)*			
739.	4757	*Dodonaea ceratocarpa*			
740.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
741.	4775	*Dodonaea pinifolia*			
742.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
743.	1640	*Drakaea glyptodon (King-in-his-carriage)*			
744.	15406	*Drakaea gracilis*			
745.	11156	*Drakaea livida*			
746.	24470	*Dromaius novaehollandiae (Emu)*			
747.	3091	*Drosera bulbigena (Midget Sundew)*			
748.	3092	*Drosera bulbosa (Red-leaved Sundew)*			
749.	13219	*Drosera bulbosa subsp. bulbosa*			
750.	13204	*Drosera callistos*			

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751.	48724	*Drosera collina*			
752.	48751	*Drosera drummondii*			
753.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
754.	3097	*Drosera gigantea (Giant Sundew)*			
755.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
756.	13195	*Drosera helodes*			
757.	3101	*Drosera heterophylla (Swamp Rainbow)*			
758.	48768	*Drosera hirsuta*			
759.	13197	*Drosera hyperostigma*			
760.	3105	*Drosera leucoblasta (Wheel Sundew)*			
761.	3106	*Drosera macrantha (Bridal Rainbow)*			
762.	3108	*Drosera marchantii*			
763.	3109	*Drosera menziesii (Pink Rainbow)*			
764.	3110	*Drosera microphylla (Golden Rainbow)*			
765.	15710	*Drosera miniata (Orange Sundew)*			
766.	48709	*Drosera minutiflora*			
767.	3113	*Drosera neesii (Jewel Rainbow)*			
768.	3114	*Drosera nitidula (Shining Sundew)*			
769.	3115	*Drosera occidentalis (Western Sundew)*		P4	
770.	3118	*Drosera pallida (Pale Rainbow)*			
771.	3123	*Drosera platystigma (Black-eyed Sundew)*			
772.	29178	*Drosera porrecta*			
773.	3124	*Drosera pulchella (Pretty Sundew)*			
774.	3125	*Drosera pycnoblasta (Pearly Sundew)*			
775.	3128	*Drosera ramellosa (Branched Sundew)*			
776.	8911	*Drosera rosulata*			
777.		*Drosera sp.*			
778.	49090	*Drosera sp. Branched styles (S.C. Coffey 193)*			
779.	3131	*Drosera stolonifera (Leafy Sundew)*			
780.	13205	*Drosera tubaestylis*			
781.	3135	*Drosera zonaria (Painted Sundew)*			
782.	33500	*Dysphania ambrosioides (Mexican Tea)*	Y		
783.	33480	*Dysphania pumilio (Clammy Goosefoot)*			
784.		*Dytiscidae sp.*			
785.	7374	*Ecballium elaterium (Squirting Cucumber)*	Y		
786.	32351	*Eccremidium pulchellum*			
787.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
788.	11105	*Echinochloa crus-galli*	Y		
789.	329	*Echinochloa crus-pavonis (South American Barnyard Grass)*	Y		
790.	16093	*Echinochloa esculenta*	Y		
791.	337	*Echinochloa pyramidalis (Antelope Grass)*	Y		
792.	6681	*Echium plantagineum (Paterson's Curse)*	Y		
793.	8450	*Eclipta prostrata*	Y		
794.	25096	*Egernia kingii (King's Skink)*			
795.	25100	*Egernia napoleonis*			
796.		*Egretta garzetta*			
797.		*Egretta novaehollandiae*			
798.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
799.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
800.		*Ehrharta sp.*			
801.		*Elanus axillaris*			
802.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
803.	25250	*Elapognathus coronatus (Crowned Snake)*			
804.	5187	*Elatine gratioloides (Waterwort)*			
805.	822	*Eleocharis acuta (Common Spikerush)*			
806.	17605	*Eleocharis keigheryi*		T	
807.	352	*Eleusine coracan (Indian Millet)*	Y		
808.	353	*Eleusine indica (Crowsfoot Grass)*	Y		
809.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
810.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
811.	1644	*Elythranthera emarginata (Pink Enamel Orchid)*			
812.	39030	*Enerthenema papillatum*			
813.	32353	*Entosthodon apophysatus*			
814.	32354	*Entosthodon productus*			
815.		*Eolophus roseicapillus*			
816.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
817.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
818.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
819.	6132	*Epilobium ciliatum*	Y		
820.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			

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821.	14289	*Epilobium tetragonum subsp. tetragonum*	Y		
822.	374	*Eragrostis cilianensis (Stinkgrass)*	Y		
823.	376	*Eragrostis curvula (African Lovegrass)*	Y		
824.	379	*Eragrostis elongata (Clustered Lovegrass)*			
825.	13950	*Eremaea asterocarpa subsp. asterocarpa*			
826.	5540	*Eremaea fimbriata*			
827.	5541	*Eremaea pauciflora*			
828.	14103	*Eremaea pauciflora var. calyptra*			
829.	14104	*Eremaea pauciflora var. pauciflora*			
830.	17150	*Eremophila glabra subsp. chlorella*		T	
831.	1646	*Eriochilus dilatatus (White Bunny Orchid)*			
832.	15411	*Eriochilus dilatatus subsp. magnus*			
833.	15412	*Eriochilus dilatatus subsp. multiflorus*			
834.	15413	*Eriochilus dilatatus subsp. undulatus*			
835.	15414	*Eriochilus helonomos*			
836.	15415	*Eriochilus scaber subsp. scaber*			
837.		*Eriophora biapicata*			
838.	4332	*Erodium botrys (Long Storksbill)*	Y		
839.	4335	*Erodium cygnorum (Blue Heronsbill)*			
840.	6219	*Eryngium pinnatifidum (Blue Devils)*			
841.	41801	*Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)*		P3	
842.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
843.	41810	*Eryngium sp. Subdecumbens (G.J. Keighery 5390)*		P3	
844.	48633	*Erythrina crista-galli*	Y		Y
845.	18299	*Erythrina x sykesii*	Y		
846.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
847.	17359	*Eucalyptus botryoides*	Y		
848.	5580	*Eucalyptus camaldulensis (River Gum, Yabalinyba)*			
849.	5615	*Eucalyptus decipiens (Limestone Marlock, Moit)*			
850.	48440	*Eucalyptus grandis*	Y		
851.	5688	*Eucalyptus laeliae (Darling Range Ghost Gum)*			
852.	5690	*Eucalyptus lane-poolei (Salmon White Gum)*			
853.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
854.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
855.	13548	*Eucalyptus marginata subsp. thalassica (Blue-leaved Jarrah)*			
856.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
857.	13511	*Eucalyptus rudis subsp. rudis*			
858.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			
859.	5797	*Eucalyptus wandoo (Wandoo, Wondu)*			
860.	12906	*Eucalyptus wandoo subsp. wandoo*			
861.	3872	*Euchilopsis linearis (Swamp Pea)*			
862.		*Eucyrtops latior*			
863.		*Eulimnadia sp.*			
864.	29940	*Euphorbia maculata*	Y		
865.	4638	*Euphorbia peplus (Petty Spurge)*	Y		
866.	34757	*Euphorbia prostrata*	Y		
867.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
868.		*Eupograpta kottae*			
869.		*Eurytion incisunguis*			Y
870.	3880	*Eutaxia virgata*			
871.	25621	*Falco berigora (Brown Falcon)*			
872.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
873.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel, Nankeen Kestrel)*			
874.	25623	*Falco longipennis (Australian Hobby)*			
875.	24474	*Falco longipennis subsp. longipennis (Australian Hobby)*			
876.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
877.	24475	*Falco peregrinus subsp. macropus (Australian Peregrine Falcon)*		S	
878.	24041	*Felis catus (Cat)*	Y		
879.	430	*Festuca arundinacea (Tall Fescue)*	Y		
880.	431	*Festuca pratensis (Meadow Fescue)*	Y		
881.	20216	*Ficinia nodosa (Knotted Club Rush)*			
882.	1747	*Ficus carica (Common Fig)*	Y		
883.	894	*Fimbristylis velata*			
884.	32367	*Fissidens megalotis*			
885.	32368	*Fissidens taylorii*			
886.	32469	*Fissidens taylorii var. taylorii*			
887.		*Fistulina hepatica*			
888.	27748	*Flavoparmelia rutidota*			
889.		*Fomitopsis lilacinogilva*			
890.	18392	*Freesia alba x leichtlinii*	Y		

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891.	25727	*Fulica atra (Eurasian Coot)*			
892.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
893.	39033	*Fuligo septica*			
894.	8365	*Fumaria bastardii*	Y		
895.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
896.	31532	*Fumaria muralis subsp. muralis*	Y		
897.		*Fumaria sp.*			
898.	30916	*Funambulus pennanti (Indian Palm Squirrel)*	Y		
899.	32370	*Funaria hygrometrica*			
900.	900	*Gahnia aristata*			
901.	902	*Gahnia decomposita*			
902.	907	*Gahnia trifida (Coast Saw-sedge)*			
903.	34028	*Galaxias occidentalis (Western Minnow)*			
904.	7976	*Galinsoga parviflora (Potato Weed)*	Y		
905.	7321	*Galium divaricatum*	Y		
906.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
907.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
908.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
909.	24765	*Gallirallus philippensis subsp. mellori (Buff-banded Rail)*			
910.		*Gallus gallus*			
911.	434	*Gastridium phleoides (Nitgrass)*	Y		
912.	3887	*Gastrolobium acutum*			
913.	3895	*Gastrolobium calycinum (York Road Poison)*			
914.	20475	*Gastrolobium capitatum*			
915.	20513	*Gastrolobium dilatatum*			
916.	20473	*Gastrolobium ebracteolatum*			
917.	3899	*Gastrolobium epacridoides*			
918.	20483	*Gastrolobium linearifolium*			
919.	20482	*Gastrolobium nervosum*			
920.	3912	*Gastrolobium oxylobioides (Champion Bay Poison)*			
921.	3923	*Gastrolobium spathulatum (Poison Bush)*			
922.	3924	*Gastrolobium spinosum (Prickly Poison)*			
923.	42314	*Gavicalis virescens (Singing Honeyeater)*			
924.	16311	*Gazania linearis*	Y		
925.		*Geastrum sp.*			
926.	24959	*Gehyra variegata*			
927.	32374	*Gemmabryum cheelii*			
928.	32375	*Gemmabryum chrysoneuron*			
929.	32376	*Gemmabryum dichotomum*			
930.	32379	*Gemmabryum inaequale*			
931.	32380	*Gemmabryum pachythecum*			
932.	32381	*Gemmabryum preissianum*			
933.	32383	*Gemmabryum sullivanii*			
934.	3936	*Genista linifolia (Flaxleaf Broom)*	Y		
935.	25404	*Geocrinia leai (Ticking Frog)*			
936.	24401	*Geopelia cuneata (Diamond Dove)*			
937.	25530	*Gerygone fusca (Western Gerygone)*			
938.	32384	*Gigaspermum repens*			
939.	1518	*Gladiolus angustus (Long Tubed Painted Lady)*	Y		
940.	18298	*Gladiolus carneus*	Y		
941.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
942.	2835	*Glinus lotoides (Hairy Carpet Weed)*			
943.	6143	*Glischrocaryon aureum (Common Popflower)*			
944.	7061	*Glossostigma drummondii (Mudmat)*			
945.	48581	*Glossurocolletes bilobatus (a short-tongued bee (southwest), short-tongued bee)*		P2	
946.	17043	*Glyceria declinata*	Y		
947.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
948.	7991	*Gnephosis drummondii*			
949.	8002	*Gnephosis tenuissima*			
950.		*Gnephosis tenuissima - drummondii complex*			
951.		*Gnephosis tenuissima-drummondii complex*			
952.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
953.	11051	*Gomphocarpus physocarpus*	Y		
954.	3945	*Gompholobium aristatum*			
955.	10909	*Gompholobium confertum*			
956.	3950	*Gompholobium knightianum*			
957.	3951	*Gompholobium marginatum*			
958.	3954	*Gompholobium polymorphum*			
959.	3955	*Gompholobium preissii*			
960.	11083	*Gompholobium scabrum*			

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961.	3956	*Gompholobium shuttleworthii*			
962.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
963.	16746	*Gonocarpus benthamii subsp. benthamii*			
964.	6149	*Gonocarpus cordiger*			
965.	6159	*Gonocarpus nodulosus*			
966.	6160	*Gonocarpus paniculatus*			
967.	6161	*Gonocarpus pithyoides*			
968.	7491	*Goodenia arthrotricha*		T	
969.	29362	*Goodenia coerulea*			
970.	12520	*Goodenia fasciculata*			
971.	7517	*Goodenia incana (Hoary Goodenia)*			
972.	12551	*Goodenia micrantha*			
973.	7538	*Goodenia pulchella*			
974.	19286	*Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)*			
975.	19284	*Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)*			
976.	24443	*Grallina cyanoleuca (Magpie-lark)*			
977.	14282	*Gratiola pubescens*			
978.	1964	*Grevillea bipinnatifida (Fuchsia Grevillea)*			
979.	19628	*Grevillea bipinnatifida subsp. bipinnatifida*			
980.	14409	*Grevillea curviloba subsp. incurva*		T	
981.	13429	*Grevillea diversifolia subsp. diversifolia*			
982.	1997	*Grevillea endlicheriana (Spindly Grevillea)*			
983.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
984.	13450	*Grevillea manglesii subsp. manglesii*			
985.	2066	*Grevillea pilulifera (Woolly-flowered Grevillea)*			
986.	15839	*Grevillea preissii subsp. preissii*			
987.	2080	*Grevillea quercifolia (Oak-leaf Grevillea)*			
988.	2101	*Grevillea synapheae (Catkin Grevillea)*			
989.	14421	*Grevillea synapheae subsp. synapheae*			
990.	2107	*Grevillea thelemanniana (Spider Net Grevillea)*		T	
991.	2122	*Grevillea wilsonii (Native Fuchsia)*			
992.	32386	*Grimmia laevigata*			
993.		*Gripopterygidae sp.*			
994.	5013	*Guichenotia micrantha (Small Flowered Guichenotia)*			
995.	5014	*Guichenotia sarotes*			
996.		*Gymnopilus allantopus*			
997.		*Gymnopilus purpuratus*			
998.		*Gyrinidae sp.*			
999.	24487	*Haematopus longirostris (Pied Oystercatcher)*			
1000.	1464	*Haemodorum brevisepalum*			
1001.	1465	*Haemodorum discolor*			
1002.	1468	*Haemodorum laxum*			
1003.	1469	*Haemodorum loratum*		P3	
1004.	1470	*Haemodorum paniculatum (Mardja)*			
1005.	1472	*Haemodorum simplex*			
1006.	1473	*Haemodorum simulans*			
1007.		*Haemodorum sp.*			
1008.	1474	*Haemodorum sparsiflorum*			
1009.	1475	*Haemodorum spicatum (Mardja)*			
1010.	2128	*Hakea amplexicaulis (Prickly Hakea)*			
1011.	2136	*Hakea candolleana*			
1012.	2137	*Hakea ceratophylla (Horned Leaf Hakea)*			
1013.	2143	*Hakea conchifolia (Shell-leaved Hakea)*			
1014.	2149	*Hakea cristata (Snail Hakea)*			
1015.	2152	*Hakea cyclocarpa (Ramshorn)*			
1016.	2158	*Hakea erinacea (Hedge-hog Hakea)*			
1017.	2166	*Hakea incrassata (Marble Hakea)*			
1018.	2171	*Hakea laurina (Pincushion Hakea, Kodjet)*			
1019.	2175	*Hakea lissocarpha (Honey Bush)*			
1020.	2185	*Hakea myrtoides (Myrtle Hakea)*			
1021.	45333	*Hakea neospathulata*			
1022.	2194	*Hakea petiolaris (Sea Urchin Hakea)*			
1023.	16900	*Hakea petiolaris subsp. petiolaris*			
1024.	2197	*Hakea prostrata (Harsh Hakea)*			
1025.	2203	*Hakea ruscifolia (Candle Hakea)*			
1026.	31793	*Hakea sp. Eastern coastal plain (G.J. Keighery 8014)*			
1027.	2206	*Hakea stenocarpa (Narrow-fruited Hakea)*			
1028.	2212	*Hakea sulcata (Furrowed Hakea)*			
1029.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
1030.	2215	*Hakea undulata (Wavy-leaved Hakea)*			

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1031.	2216	*Hakea varia (Variable-leaved Hakea)*			
1032.	6686	*Halgania corymbosa*		P3	
1033.	24295	*Haliastur sphenurus (Whistling Kite)*			
1034.	6178	*Haloragis scoparia*		P1	
1035.	24296	*Hamirostra isura (Square-tailed Kite)*			
1036.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
1037.		*Hebeloma aminophilum*			
1038.		*Hebridae sp.*			
1039.	25409	*Heleioporus barycragus (Hooting Frog)*			
1040.	25410	*Heleioporus eyrei (Moaning Frog)*			
1041.	25412	*Heleioporus psammophilus (Sand Frog)*			
1042.	8008	*Helianthus annuus (Sunflower, Common Sunflower)*	Y		
1043.	3016	*Heliophila pusilla*	Y		
1044.	439	*Hemarthria uncinata (Matgrass)*			
1045.	16933	*Hemiandra glabra*			
1046.	6836	*Hemiandra incana*			
1047.	6838	*Hemiandra linearis (Speckled Snakebush)*			
1048.	6839	*Hemiandra pungens (Snakebush)*			
1049.	38320	*Hemiandra sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)*			
1050.		*Hemicloea sp.*			Y
1051.		*Hemicorduliidae sp.*			
1052.	25232	*Hemidactylus frenatus (Asian House Gecko)*	Y		
1053.	25115	*Hemiergis initialis subsp. initialis*			
1054.	25119	*Hemiergis quadrilineata*			
1055.	6856	*Hemigenia incana (Silky Hemigenia)*			
1056.	29632	*Hemigenia parviflora*			
1057.	6866	*Hemigenia pritzelii*			
1058.	41020	*Hemiphora bartlingii (Woolly Dragon)*			
1059.	41042	*Hemiphora uncinata*			
1060.		*Henicops dentatus*			
1061.	1293	*Hensmania turbinata*			
1062.	1526	*Hesperantha falcata*	Y		
1063.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
1064.		*Hexagonia vesparia*			
1065.	5108	*Hibbertia acerosa (Needle Leaved Guinea Flower)*			
1066.	5109	*Hibbertia amplexicaulis*			
1067.	5112	*Hibbertia aurea*			
1068.	5114	*Hibbertia commutata*			
1069.	20051	*Hibbertia diamesogenos*			
1070.	19778	*Hibbertia glomerata subsp. darlingensis*			
1071.	5134	*Hibbertia huegelii*			
1072.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
1073.	45534	*Hibbertia hypericoides subsp. hypericoides*			
1074.	5139	*Hibbertia lasiopus (Large Hibbertia)*			
1075.	5146	*Hibbertia montana*		P4	
1076.	5148	*Hibbertia mylnei*			
1077.	5152	*Hibbertia ovata*			
1078.	5155	*Hibbertia pilosa (Hairy Guinea Flower)*			
1079.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
1080.	5169	*Hibbertia serrata (Serrate Leaved Guinea Flower)*			
1081.		*Hibbertia sp.*			
1082.	5171	*Hibbertia spicata*			
1083.	11481	*Hibbertia spicata subsp. spicata*			
1084.	5172	*Hibbertia stellaris (Orange Stars)*			
1085.	48381	*Hibbertia striata*			
1086.	5173	*Hibbertia subvaginata*			
1087.	5176	*Hibbertia vaginata*			
1088.	47965	*Hieraaetus morphnoides (Little Eagle)*			
1089.	25734	*Himantopus himantopus (Black-winged Stilt)*			
1090.	24491	*Hirundo neoxena (Welcome Swallow)*			
1091.		*Hoggicosa storri*			
1092.		*Hogna crispipes*			
1093.		*Holasteron perth*			
1094.		*Holasteron wamuseum*			Y
1095.		*Holconia westralia*			
1096.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
1097.	445	*Holcus setiger (Annual Fog)*	Y		
1098.	6222	*Homalosciadium homalocarpum*			
1099.	448	*Hordeum glaucum (Northern Barley Grass)*	Y		
1100.	449	*Hordeum leporinum (Barley Grass)*	Y		

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1101.	450	*Hordeum marinum*	Y		
1102.	451	*Hordeum vulgare (Barley)*	Y		
1103.	3964	*Hovea chorizemifolia (Holly-leaved Hovea)*			
1104.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
1105.	3968	*Hovea trisperma (Common Hovea)*			
1106.	12907	*Hovea trisperma var. grandiflora*			
1107.	12859	*Hovea trisperma var. trisperma*			
1108.	18296	*Humulus lupulus*	Y		
1109.	12741	*Hyalosperma cotula*			
1110.	12742	*Hyalosperma demissum*			
1111.	16759	*Hyalosperma simplex subsp. simplex*			
1112.	5216	*Hybanthus calycinus (Wild Violet)*			
1113.	5221	*Hybanthus floribundus*			
1114.	12007	*Hybanthus floribundus subsp. floribundus*			
1115.		*Hydnangium carneum*			
1116.	166	*Hydrilla verticillata (Water Thyme)*			
1117.	6223	*Hydrocotyle alata*			
1118.	6226	*Hydrocotyle callicarpa (Small Pennywort)*			
1119.	6229	*Hydrocotyle diantha*			
1120.	6233	*Hydrocotyle lemnoides (Aquatic Pennywort)*		P4	
1121.	11847	*Hydrocotyle pilifera var. pilifera*			
1122.	6238	*Hydrocotyle ranunculoides*	Y		
1123.	11074	*Hydrocotyle striata*		P1	
1124.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
1125.		*Hydrophilidae sp.*			
1126.	48587	*Hydroprogne caspia (Caspian Tern)*		IA	
1127.		*Hydropsychidae sp.*			
1128.		*Hydroptilidae sp.*			
1129.		*Hygrocybe astatogala*			
1130.	452	*Hyparrhenia hirta (Tambookie Grass)*	Y		
1131.	38796	*Hypholoma australe*			
1132.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
1133.	35074	*Hypocalymma angustifolium subsp. Dandaragan plateau (S. Patrick 702A)*			
1134.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
1135.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
1136.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
1137.	9352	*Hypochaeris radicata (Flat Weed, Cats-ear)*	Y		
1138.	1070	*Hypolaena exsulca*			
1139.	17841	*Hypolaena pubescens*			
1140.		*Idiommata blackwalli*			
1141.	48935	*Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)*		P3	
1142.	48517	*Inocybe fibrillosibrunnea*			
1143.	48552	*Inocybe tomentipes*			
1144.	38799	*Inocybe violaceocaulis*			
1145.	11	*Isoetes drummondii (Quillwort)*			
1146.	910	*Isolepis cernua (Nodding Club-rush)*			
1147.	20199	*Isolepis cernua var. cernua*			
1148.	20200	*Isolepis cernua var. setiformis*			
1149.	912	*Isolepis cyperoides*			
1150.	914	*Isolepis hookeriana (Bristle Club Rush)*			
1151.	14540	*Isolepis hystrix*	Y		
1152.	917	*Isolepis marginata (Coarse Club-rush)*			
1153.	919	*Isolepis oldfieldiana*			
1154.	10831	*Isolepis prolifera (Budding Club-rush)*	Y		
1155.	924	*Isolepis stellata (Star Club-rush)*			
1156.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
1157.		*Isopeda leishmanni*			
1158.		*Isopeda magna*			
1159.		*Isopedella cana*			
1160.	2221	*Isopogon asper*			
1161.	2227	*Isopogon divergens (Spreading Coneflower)*			
1162.	29775	*Isopogon drummondii*		P3	
1163.	2229	*Isopogon dubius (Pincushion Coneflower)*			
1164.	2237	*Isopogon sphaerocephalus (Drumstick Isopogon)*			
1165.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
1166.	7398	*Isotoma pusilla (Small Isotome)*			
1167.	7399	*Isotoma scapigera (Long-scaped Isotome)*			
1168.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
1169.	19700	*Isotropis cuneifolia subsp. cuneifolia*			
1170.	16317	*Isotropis cuneifolia subsp. glabra*		P3	

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1171.	1532	*Ixia maculata (Yellow Ixia)*	Y		
1172.	1533	*Ixia paniculata*	Y		
1173.	1534	*Ixia polystachya (Variable Ixia)*	Y		
1174.	8092	*Ixiolaena viscosa (Sticky Ixiolaena)*			
1175.	3997	*Jacksonia alata*			
1176.	3998	*Jacksonia angulata*			
1177.	4010	*Jacksonia floribunda (Holly Pea)*			
1178.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
1179.	20462	*Jacksonia gracillima*		P3	
1180.	4018	*Jacksonia lehmannii*			
1181.	4025	*Jacksonia restioides*			
1182.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
1183.	1298	*Johnsonia pubescens (Pipe Lily)*			
1184.	19632	*Johnsonia pubescens subsp. pubescens*			
1185.	20454	*Juncus acutus subsp. acutus*	Y		
1186.	8328	*Juncus amabilis*			
1187.	1177	*Juncus articulatus (Jointed Rush)*	Y		
1188.	1178	*Juncus bufonius (Toad Rush)*	Y		
1189.	1179	*Juncus caespiticius (Grassy Rush)*			
1190.	1180	*Juncus capitatus (Capitate Rush)*	Y		
1191.	11922	*Juncus kraussii subsp. australiensis*			
1192.	1186	*Juncus microcephalus*	Y		
1193.	1188	*Juncus pallidus (Pale Rush)*			
1194.	1189	*Juncus pauciflorus (Loose Flower Rush)*			
1195.	1195	*Juncus subsecundus (Finger Rush)*			
1196.	1196	*Juncus usitatus (Common Rush)*	Y		
1197.		*Kangarosa properipes*			
1198.		*Karaops ellenae*			
1199.		*Karaops jarrit*			
1200.	33980	*Kawaniphila pachomai (Grey Vernal Katydid (southwest), cricket)*		P1	
1201.	4036	*Kennedia carinata*			
1202.	4037	*Kennedia coccinea (Coral Vine)*			
1203.	4044	*Kennedia prostrata (Scarlet Runner)*			
1204.	4045	*Kennedia stirlingii (Bushy Kennedia)*			
1205.	7067	*Kickxia elatine (Pointed Toadflax)*	Y		
1206.	12008	*Kickxia elatine subsp. crinita*	Y		
1207.	7068	*Kickxia spuria (Roundleaf Toadflax)*	Y		
1208.	1221	*Kingia australis (Kingia, Pulonok)*			
1209.	5832	*Kunzea ericifolia (Spearwood, Pondil)*			
1210.	15498	*Kunzea glabrescens (Spearwood)*			
1211.	5835	*Kunzea micrantha*			
1212.	17461	*Kunzea micrantha subsp. micrantha*			
1213.	17785	*Kunzea micrantha subsp. petiolata*			
1214.	11289	*Labichea lanceolata subsp. lanceolata*			
1215.	3669	*Labichea punctata (Lance-leaved Cassia)*			
1216.	38800	*Labyrinthomyces varius*			
1217.		*Laccaria lateritia*			
1218.	38802	*Laccocephalum tumulosum*			
1219.	1370	*Lachenalia reflexa*	Y		
1220.	20019	*Lachnagrostis filiformis*			
1221.	19955	*Lachnagrostis plebeia*			
1222.		*Lactarius clarkeae*			
1223.	38804	*Lactarius eucalypti*			
1224.	29046	*Lactuca serriola forma serriola*	Y		
1225.	18585	*Lagenophora huegelii*			
1226.	14646	*Lagunaria patersonia*	Y		
1227.	24367	*Lalage tricolor (White-winged Triller)*			
1228.	2249	*Lambertia multiflora (Many-flowered Honeysuckle)*			
1229.	14083	*Lambertia multiflora var. darlingensis*			
1230.		*Lampona brevipes*			
1231.		*Lampona cylindrata*			
1232.	28342	*Landoltia punctata (Thin Duckweed)*			
1233.	6733	*Lantana camara (Common Lantana)*	Y		
1234.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
1235.	5025	*Lasiopetalum bracteatum (Helena Velvet Bush)*		P4	
1236.	5034	*Lasiopetalum glabratum*			
1237.	45081	*Lasiopetalum glutinosum subsp. glutinosum*		P3	
1238.	4047	*Lathyrus tingitanus (Tangier Pea)*	Y		
1239.	4052	*Latrobea tenella*			
1240.		*Latrodectus hasseltii*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1241.	38324	*Lavandula dentata var. candicans*	Y		
1242.	38323	*Lavandula stoechas subsp. stoechas*	Y		
1243.	13284	*Lawrencella rosea*			
1244.	4959	*Lawrencia squamata*			
1245.	11815	*Laxmannia grandiflora subsp. grandiflora*			
1246.	1307	*Laxmannia ramosa (Branching Lily)*			
1247.	11911	*Laxmannia ramosa subsp. ramosa*			
1248.	11464	*Laxmannia sessiliflora subsp. australis*			
1249.	1309	*Laxmannia squarrosa*			
1250.		*Lecanora sp.*			
1251.	7568	*Lechenaultia biloba (Blue Leschenaultia)*			
1252.	7572	*Lechenaultia expansa*			
1253.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
1254.	33983	*Leioproctus douglasiellus (a short-tongued bee)*		T	
1255.	1051	*Lemna disperma (Duckweed)*			
1256.	38805	*Lentinellus pulvinulus*			
1257.	44490	*Leontodon rhagadioloides*	Y		
1258.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
1259.	1075	*Lepidobolus preissianus*			
1260.	18074	*Lepidobolus preissianus subsp. preissianus*			
1261.	925	*Lepidosperma angustatum*			
1262.	42741	*Lepidosperma apricola*			
1263.	41620	*Lepidosperma asperatum*			
1264.	930	*Lepidosperma costale*			
1265.	931	*Lepidosperma drummondii*			
1266.	936	*Lepidosperma leptostachyum*			
1267.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
1268.	14642	*Lepidosperma obtusum*			
1269.	940	*Lepidosperma pubisquameum*			
1270.	941	*Lepidosperma resinosum*			
1271.	942	*Lepidosperma rostratum*		T	
1272.	944	*Lepidosperma scabrum*			
1273.		*Lepidosperma sp.*			
1274.	29141	*Lepidosperma sp. Gosnells (A. Markey 1145)*			
1275.	29150	*Lepidosperma sp. Margaret River (B.J. Lepschi 1841)*			
1276.	16284	*Lepidosperma sp. P1 small head (M.D. Tindale 166A)*			
1277.	945	*Lepidosperma squamatum*			
1278.	947	*Lepidosperma tenue*			
1279.	948	*Lepidosperma tetraquetrum*			
1280.	949	*Lepidosperma tuberculatum*			
1281.	1653	*Leporella fimbriata (Hare Orchid)*			
1282.	1077	*Leptocarpus canus (Hoary Twine-rush)*			
1283.	1078	*Leptocarpus coangustatus*			
1284.	46375	*Leptocarpus decipiens*			
1285.	46380	*Leptocarpus kraussii*			
1286.	46382	*Leptocarpus roycei*			
1287.	1080	*Leptocarpus scariosus*			
1288.	15418	*Leptoceras menziesii*			
1289.		*Leptoceridae sp.*			
1290.	2342	*Leptomeria cunninghamii*			
1291.	2344	*Leptomeria empetriformis*			
1292.	2350	*Leptomeria pauciflora (Sparse-flowered Currant Bush)*			
1293.	5847	*Leptospermum erubescens (Roadside Teatree)*			
1294.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
1295.	5857	*Leptospermum spinescens*			
1296.	19241	*Lepyrodia curvescens*		P2	
1297.	1085	*Lepyrodia glauca*			
1298.	1088	*Lepyrodia macra (Large Scale Rush)*			
1299.	1090	*Lepyrodia muirii*			
1300.	25131	*Lerista distinguenda*			
1301.	25133	*Lerista elegans*			
1302.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
1303.		*Lethocolea pansa*			
1304.	6367	*Leucopogon capitellatus*			
1305.	6374	*Leucopogon conostephioides*			
1306.	6397	*Leucopogon glaucifolius*			
1307.	6416	*Leucopogon nutans (Drooping Leucopogon)*			
1308.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
1309.	6434	*Leucopogon polymorphus*			
1310.	6436	*Leucopogon propinquus*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1311.	6439	*Leucopogon pulchellus (Beard-heath)*			
1312.	28311	*Leucopogon sp. Great Southern (R.S. Cowan A 586)*			
1313.	6444	*Leucopogon sprengelioides*			
1314.	6445	*Leucopogon squarrosus*			
1315.	40803	*Leucopogon squarrosus subsp. squarrosus*			
1316.	6447	*Leucopogon strictus*			
1317.	6451	*Leucopogon tenuis*			
1318.	6454	*Leucopogon verticillatus (Tassel Flower)*			
1319.	7674	*Levenhookia preissii (Preiss's Stylewort)*			
1320.	7676	*Levenhookia pusilla (Midget Stylewort)*			
1321.	7677	*Levenhookia stipitata (Common Stylewort)*			
1322.	25005	*Lialis burtonis*			
1323.		*Libellulidae sp.*			
1324.	31333	*Lichenomphalia umbellifera*			
1325.	25659	*Lichenostomus leucotis (White-eared Honeyeater)*			
1326.	25661	*Lichmera indistincta (Brown Honeyeater)*			
1327.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
1328.	48640	*Limnobium laevigatum*	Y		Y
1329.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
1330.	7075	*Linaria maroccana*	Y		
1331.	59	*Lindsaea linearis (Screw Fern)*			
1332.	4362	*Linum marginale (Wild Flax)*			
1333.	4363	*Linum trigynum (French Flax)*	Y		
1334.	36160	*Liparophyllum capitatum*			
1335.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
1336.	25388	*Litoria moorei (Motorbike Frog)*			
1337.	9289	*Lobelia anceps (Angled Lobelia)*			
1338.	7402	*Lobelia gibbosa (Tall Lobelia)*			
1339.	7403	*Lobelia heterophylla (Wing-seeded Lobelia)*			
1340.	7406	*Lobelia rhombifolia (Tufted Lobelia)*			
1341.	7407	*Lobelia rhytidosperma (Wrinkled-seeded Lobelia)*			
1342.	7408	*Lobelia tenuior (Slender Lobelia)*			
1343.	3048	*Lobularia maritima (Sweet Alyssum)*	Y		
1344.	475	*Lolium multiflorum (Italian Ryegrass)*	Y		
1345.	478	*Lolium rigidum (Wimmera Ryegrass)*	Y		
1346.		*Lolium sp.*			
1347.	11384	*Lolium temulentum forma temulentum*	Y		
1348.	11073	*Lolium x hybridum*	Y		
1349.	1222	*Lomandra brittanii*			
1350.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
1351.	1228	*Lomandra hermaphrodita*			
1352.	1229	*Lomandra integra*			
1353.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
1354.	14542	*Lomandra micrantha subsp. micrantha*			
1355.	1234	*Lomandra nigricans*			
1356.	1236	*Lomandra odora (Tiered Matrush)*			
1357.	1239	*Lomandra preissii*			
1358.	1240	*Lomandra purpurea (Purple Mat Rush)*			
1359.	1243	*Lomandra sericea (Silky Mat Rush)*			
1360.	1244	*Lomandra sonderi*			
1361.	1245	*Lomandra spartea*			
1362.	1246	*Lomandra suaveolens*			
1363.		*Longepi woodman*			
1364.	7365	*Lonicera japonica (Japanese Honeysuckle)*	Y		
1365.		*Lophoictinia isura*			
1366.	4059	*Lotus angustissimus (Narrowleaf Trefoil)*	Y		
1367.	8564	*Lotus subbiflorus*	Y		
1368.	4063	*Lotus uliginosus (Greater Lotus)*	Y		
1369.	1092	*Loxocarya cinerea*			
1370.	44680	*Ludwigia repens*	Y		
1371.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
1372.	4066	*Lupinus cosentinii*	Y		
1373.	4067	*Lupinus luteus (Yellow Lupin)*	Y		
1374.	1198	*Luzula meridionalis (Field Woodrush)*			
1375.		*Lycosa ariadnae*			
1376.		*Lycosa godeffroyi*			
1377.	1097	*Lyginia barbata*			
1378.	18049	*Lyginia imberbis*			
1379.		*Lynceus sp.*			
1380.	1656	*Lyperanthus serratus (Rattle Beak Orchid)*			

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1381.	2396	*Lysiana casuarinae*			
1382.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
1383.	36373	*Lysimachia minima*	Y		
1384.	6456	*Lysinema ciliatum (Curry Flower)*			
1385.	34736	*Lysinema pentapetalum*			
1386.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
1387.	2838	*Macarthuria apetala*			
1388.	2839	*Macarthuria australis*			
1389.	17106	*Macarthuria keigheryi*		T	
1390.	4070	*Macroptilium atropurpureum (Purple Bean)*	Y		
1391.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
1392.	18119	*Macrozamia fraseri*			
1393.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
1394.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
1395.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
1396.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
1397.	25654	*Malurus splendens (Splendid Fairy-wren)*			
1398.	24583	*Manorina flavigula (Yellow-throated Miner)*			
1399.		*Maratus pavonis*			
1400.	19421	*Marianthus bicolor (Painted Marianthus)*			
1401.	17637	*Marianthus candidus (White Marianthus)*			
1402.	17636	*Marianthus coeruleopunctatus (Blue-spotted Marianthus)*			
1403.	17635	*Marianthus drummondianus*			
1404.	17633	*Marianthus erubescens*			
1405.		*Masasteron maini*			
1406.	4079	*Medicago polymorpha (Burr Medic)*	Y		
1407.	4080	*Medicago sativa (Alfalfa)*	Y		
1408.	25758	*Megalurus gramineus (Little Grassbird)*			
1409.	20639	*Megathyrsus maximus var. maximus*	Y		
1410.	34676	*Meionectes brownii (Swamp Raspwort)*			
1411.	33638	*Meionectes tenuifolia*		P3	
1412.	37580	*Melaleuca acutifolia*			
1413.	19721	*Melaleuca armillaris*	Y		
1414.	36296	*Melaleuca armillaris subsp. armillaris*	Y		
1415.	5881	*Melaleuca brevifolia*			
1416.	40780	*Melaleuca citrina*	Y		
1417.	13273	*Melaleuca incana subsp. incana*			
1418.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
1419.	5932	*Melaleuca leucadendra*			
1420.	5943	*Melaleuca nesophila (Mindiyed)*			
1421.	20297	*Melaleuca osullivanii*			
1422.	18394	*Melaleuca parviceps*			
1423.	5952	*Melaleuca preissiana (Moonah)*			
1424.	48990	*Melaleuca quinquenervia*	Y		
1425.	5958	*Melaleuca radula (Graceful Honeymyrtle)*			
1426.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
1427.	5961	*Melaleuca scabra (Rough Honeymyrtle, Wurru Bush)*			
1428.	5964	*Melaleuca seriata*			
1429.	5978	*Melaleuca teretifolia (Banbar)*			
1430.	5980	*Melaleuca thymoides*			
1431.	5983	*Melaleuca trichophylla*			
1432.	37683	*Melaleuca viminalis*		P2	
1433.	5987	*Melaleuca viminea (Mohan)*			
1434.	13280	*Melaleuca viminea subsp. viminea*			
1435.	47997	*Melanodryas cucullata (Hooded Robin)*			
1436.	4516	*Melia azedarach (White Cedar)*			
1437.	14985	*Melinis repens*	Y		
1438.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
1439.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
1440.	25184	*Menetia greyii*			
1441.	15994	*Mentha x piperita var. citrata*	Y		
1442.	24598	*Merops ornatus (Rainbow Bee-eater)*			
1443.	953	*Mesomelaena graciliceps*			
1444.	955	*Mesomelaena pseudostygia*			
1445.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
1446.		*Microcarbo melanoleucos*			
1447.	6897	*Microcorys longifolia*			
1448.	25693	*Microeca fascinans (Jacky Winter)*			
1449.	485	*Microlaena stipoides (Weeping Grass)*			
1450.	1657	*Microtis alba (White Mignonette Orchid)*			

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1451.	34158	*Microtis alboviridis*			
1452.	1658	*Microtis atrata (Swamp Mignonette Orchid)*			
1453.	10954	*Microtis media (Tall Mignonette Orchid)*			
1454.	12761	*Microtis media subsp. densiflora*			
1455.	15419	*Microtis media subsp. media*			
1456.	8105	*Millotia myosotidifolia*			
1457.	8106	*Millotia tenuifolia (Soft Millotia)*			
1458.	14344	*Millotia tenuifolia var. tenuifolia (Soft Millotia)*			
1459.	4090	*Mirbelia dilatata (Holly-leaved Mirbelia)*			
1460.	4091	*Mirbelia floribunda (Purple Mirbelia)*			
1461.	4097	*Mirbelia ramulosa*			
1462.	4100	*Mirbelia spinosa*			
1463.	7085	*Misopates orontium (Lesser Snapdragon)*	Y		
1464.		*Missulena granulosa*			
1465.		*Missulena hoggi*			
1466.		*Missulena occatoria*			
1467.		*Mituliodon tarantulinus*			
1468.		*Mitzoruga insularis*			
1469.	4963	*Modiola caroliniana*	Y		
1470.	7378	*Momordica balsamina (Balsam Apple)*	Y		
1471.	29418	*Monoculus monstrosus*	Y		
1472.	7410	*Monopsis debilis*	Y		
1473.	37440	*Monopsis debilis var. depressa*	Y		
1474.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
1475.	19585	*Monotaxis grandiflora var. grandiflora*			
1476.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
1477.	19178	*Moraea lewisiae*	Y		
1478.	19438	*Moraea ochroleuca*	Y		
1479.	19177	*Moraea setifolia*	Y		
1480.	1536	*Moraea vegeta*	Y		
1481.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
1482.	25191	*Morethia lineoocellata*			
1483.	25192	*Morethia obscura*			
1484.	2412	*Muehlenbeckia adpressa (Climbing Lignum)*			
1485.	2415	*Muehlenbeckia polybotrya*			
1486.	24223	*Mus musculus (House Mouse)*	Y		
1487.		*Myandra bicincta*			
1488.		*Myandra cambridgei*			
1489.	38811	*Mycena clarkeana*			
1490.	25610	*Myiagra inquieta (Restless Flycatcher)*			
1491.	25420	*Myobatrachus gouldii (Turtle Frog)*			
1492.	14187	*Myriocephalus occidentalis*			
1493.	6189	*Myriophyllum crispatum*			
1494.	6193	*Myriophyllum echinatum*		P3	
1495.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
1496.		*Nannoperca vittata*			
1497.	44496	*Narcissus tazetta subsp. italicus*	Y		
1498.	44495	*Narcissus tazetta subsp. tazetta*	Y		
1499.	6464	*Needhamiella pumilio*			
1500.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
1501.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
1502.	25686	*Neochmia temporalis (Red-browed Finch)*	Y		
1503.	33984	*Neopasiphae simplicior (a short-tongued bee)*		T	
1504.	24738	*Neophema elegans (Elegant Parrot)*			
1505.	24739	*Neophema petrophila (Rock Parrot)*			
1506.		*Nephila edulis*			
1507.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
1508.		*Nicodamus mainae*			
1509.	6978	*Nicotiana rotundifolia (Round-leaved Tobacco)*			
1510.	25747	*Ninox connivens (Barking Owl)*			
1511.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
1512.	25252	*Notechis scutatus (Tiger Snake)*			
1513.	1381	*Nothoscordum gracile*	Y		
1514.		*Notiasemus glauerti*			
1515.		*Notonectidae sp.*			
1516.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
1517.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
1518.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
1519.	2923	*Nymphaea odorata (Fragrant Waterlily)*	Y		
1520.	24742	*Nymphicus hollandicus (Cockatiel)*			

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1521.		*Occiperipatoides gilesii*			
1522.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
1523.		*Oecobius navus*			
1524.	6138	*Oenothera drummondii (Beach Evening Primrose)*	Y		
1525.	16390	*Oenothera drummondii subsp. drummondii*	Y		
1526.	6139	*Oenothera glazioviana (Evening Primrose)*	Y		
1527.	20052	*Oenothera jamesii*	Y		
1528.	16347	*Oenothera laciniata*	Y		
1529.	6140	*Oenothera mollissima*	Y		
1530.	6141	*Oenothera speciosa (White Evening Primrose)*	Y		
1531.	6142	*Oenothera stricta (Common Evening Primrose)*	Y		
1532.	14292	*Oenothera stricta subsp. stricta*	Y		
1533.	2365	*Olax benthamiana*			
1534.	2367	*Olax scalariformis*			
1535.	8127	*Olearia axillaris (Coastal Daisybush)*			
1536.	8143	*Olearia paucidentata (Autumn Scrub Daisy)*			
1537.		*Oligochaeta sp.*			
1538.	39054	*Oligonema schweinitzii*			
1539.		*Ommatoiulus moreletii*			
1540.	38816	*Omphalotus nidiformis*			
1541.	18254	*Opercularia apiciflora*			
1542.	7346	*Opercularia echinocephala (Bristly Headed Stink Weed)*			
1543.	7348	*Opercularia hispidula (Hispid Stinkweed)*			
1544.	18255	*Opercularia vaginata (Dog Weed)*			
1545.	17	*Ophioglossum lusitanicum (Adders Tongue)*			
1546.	29276	*Opuntia monacantha (Barbary Fig)*	Y		
1547.	5227	*Opuntia stricta (Common Prickly Pear)*	Y		
1548.	46207	*Opuntia tomentosa*	Y		
1549.	46255	*Orianthera campanulata*			
1550.	36177	*Ornduffia albiflora*			
1551.	36200	*Ornduffia submersa*		P4	
1552.	1373	*Ornithogalum thyrsoides (Chinkerichee)*	Y		
1553.	4113	*Ornithopus compressus (Yellow Serradella)*	Y		
1554.	7122	*Orobanche minor (Lesser Broomrape)*	Y		
1555.		*Orthocladiinae sp.*			
1556.	11749	*Orthrosanthus laxus var. laxus (Morning Iris)*			
1557.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
1558.		*Ostearius melanopygius*			
1559.	168	*Ottelia ovalifolia (Swamp Lily)*			
1560.	14532	*Ottelia ovalifolia subsp. chrysobasis*			
1561.	14531	*Ottelia ovalifolia subsp. ovalifolia*			
1562.	4348	*Oxalis caprina*	Y		
1563.	4349	*Oxalis corniculata (Yellow Wood Sorrel)*	Y		
1564.	18331	*Oxalis debilis var. corymbosa (Pink Shamrock)*	Y		
1565.	30375	*Oxalis exilis*			
1566.	4352	*Oxalis glabra*	Y		
1567.	4354	*Oxalis incarnata*	Y		
1568.	4355	*Oxalis perennans*			
1569.	4356	*Oxalis pes-caprae (Soursob)*	Y		
1570.	4358	*Oxalis purpurea (Largeflower Wood Sorrel)*	Y		
1571.		*Oxyopes gracilipes*			
1572.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
1573.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
1574.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
1575.		*Palaemonidae sp.*			
1576.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
1577.	502	*Panicum capillare (Witchgrass)*	Y		
1578.	23483	*Paracaleana brockmanii*			
1579.	23500	*Paracaleana hortiorum*			
1580.	1667	*Paracaleana nigrita (Flying Duck Orchid)*			
1581.	48680	*Paracaleana sp. Laterite (G. Brockman GBB 3571)*		P2	Y
1582.	20101	*Paragonis grandiflora*			
1583.		*Paralampona marangaroo*			
1584.	27906	*Paraporpidia leptocarpa*			
1585.	17114	*Paraserianthes lophantha subsp. lophantha*			
1586.		*Parastacidae sp.*			
1587.	25253	*Parasuta gouldii*			
1588.	25255	*Parasuta nigriceps*			
1589.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
1590.	24625	*Pardalotus punctatus subsp. punctatus (Spotted Pardalote)*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1591.	25682	*Pardalotus striatus (Striated Pardalote)*			
1592.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
1593.	7089	*Parentucellia latifolia (Common Bartsia)*	Y		
1594.	27922	*Parmotrema chinense*			
1595.	527	*Paspalum dilatatum*	Y		
1596.	528	*Paspalum distichum (Water Couch)*	Y		
1597.	532	*Paspalum urvillei (Vasey Grass)*	Y		
1598.	25687	*Passer domesticus (House Sparrow)*	Y		
1599.	5225	*Passiflora filamentosa*	Y		
1600.	1542	*Patersonia babianoides*			
1601.	1546	*Patersonia juncea (Rush Leaved Patersonia)*			
1602.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
1603.	30476	*Patersonia occidentalis var. latifolia*			
1604.	30472	*Patersonia occidentalis var. occidentalis*			
1605.	1551	*Patersonia pygmaea (Pygmy Patersonia)*			
1606.	14433	*Patersonia rudis subsp. rudis*			
1607.	11550	*Patersonia umbrosa var. xanthina (Yellow Flags)*			
1608.	43765	*Pauridia glabella var. glabella*			
1609.	43760	*Pauridia occidentalis*			
1610.	43761	*Pauridia occidentalis var. occidentalis*			
1611.	43762	*Pauridia occidentalis var. quadriloba*			
1612.	10828	*Pavonia hastata*	Y		
1613.		*Paxillus involutus*			
1614.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
1615.	40424	*Pentameris airoides subsp. airoides*	Y		
1616.	40422	*Pentameris pallida*	Y		
1617.	6245	*Pentapeltis peltigera*			
1618.	6006	*Pericalymma ellipticum (Swamp Teatree)*			
1619.	16477	*Pericalymma ellipticum var. ellipticum*			
1620.	16478	*Pericalymma ellipticum var. floridum*			
1621.	13911	*Persicaria decipiens*			
1622.	11020	*Persicaria hydropiper*			
1623.	16984	*Persicaria lapathifolia*	Y		
1624.	16983	*Persicaria maculosa*	Y		
1625.	2255	*Persoonia angustiflora*			
1626.	2262	*Persoonia elliptica (Spreading Snottygobble)*			
1627.	2267	*Persoonia longifolia (Snottygobble)*			
1628.	2273	*Persoonia saccata (Snottygobble)*			
1629.	27952	*Pertusaria remota*			
1630.	48060	*Petrochelidon ariel (Fairy Martin)*			
1631.	48061	*Petrochelidon nigricans (Tree Martin)*			
1632.	48066	*Petroica boodang (Scarlet Robin)*			
1633.	24659	*Petroica goodenovii (Red-capped Robin)*			
1634.	2284	*Petrophile biloba (Granite Petrophile)*			
1635.	20391	*Petrophile juncifolia*			
1636.	2299	*Petrophile linearis (Pixie Mops)*			
1637.	2301	*Petrophile macrostachya*			
1638.	2306	*Petrophile rigida*			
1639.	2308	*Petrophile seminuda*			
1640.	2312	*Petrophile striata*			
1641.	19825	*Petrorhagia dubia*	Y		
1642.	49073	*Peziza austrogeaster*			
1643.	48853	*Phaeotrametes decipiens*			
1644.	25697	*Phalacrocorax carbo (Great Cormorant)*			
1645.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
1646.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
1647.	25699	*Phalacrocorax varius (Pied Cormorant)*			
1648.	547	*Phalaris angusta*	Y		
1649.	551	*Phalaris minor (Lesser Canary Grass)*	Y		
1650.	552	*Phalaris paradoxa (Paradoxa Grass)*	Y		
1651.		*Phalloceros caudimaculatus*			
1652.	24409	*Phaps chalcoptera (Common Bronzewing)*			
1653.	25587	*Phaps elegans (Brush Bronzewing)*			
1654.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		S	
1655.	20460	*Pheladenia deformis*			
1656.		*Phellinus gilvus*			
1657.		*Phenasteron longiconductor*			
1658.	32409	*Philonotis australiensis*			
1659.	18529	*Philotheca spicata (Pepper and Salt)*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1660.	1172	*Philydrella drummondii*			
1661.	1173	*Philydrella pygmaea (Butterfly Flowers)*			
1662.	14306	*Philydrella pygmaea subsp. pygmaea*			
1663.		*Phlebia subceracea*			
1664.	1478	*Phlebocarya ciliata*			
1665.	1479	*Phlebocarya filifolia*			
1666.		*Pholcus phalangioides*			
1667.		*Phreatoicidae sp.*			
1668.		*Phryganoporus candidus*			
1669.		*Phryganoporus gausapatus subsp. occidentalis*			Y
1670.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
1671.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
1672.	16825	*Phyllangium divergens*			
1673.	4675	*Phyllanthus calycinus (False Boronia)*			
1674.	4685	*Phyllanthus scaber*			
1675.	17794	*Phyllanthus tenellus*	Y		
1676.	4	*Phylloglossum drummondii (Pigmy Clubmoss)*			
1677.	6983	*Physalis peruviana (Cape Gooseberry)*	Y		
1678.	39074	*Physarum pusillum*			
1679.		*Physidae sp.*			
1680.		*Phytophthora cinnamomi*			
1681.	2408	*Pilostyles hamiltonii*			
1682.	78	*Pilularia novae-hollandiae (Austral Pillwort)*			
1683.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
1684.	5232	*Pimelea argentea (Silvery Leaved Pimelea)*			
1685.	5238	*Pimelea ciliata (White Banjine)*			
1686.	11928	*Pimelea ciliata subsp. ciliata*			
1687.	11404	*Pimelea imbricata var. major*			
1688.	11402	*Pimelea imbricata var. piligera*			
1689.	5252	*Pimelea lanata*			
1690.	11182	*Pimelea lehmanniana subsp. nervosa*			
1691.	5259	*Pimelea preissii*			
1692.	5260	*Pimelea rara (Summer Pimelea)*		P4	
1693.	18117	*Pimelea rosea subsp. rosea*			
1694.	5264	*Pimelea spectabilis (Bunjong)*			
1695.	12041	*Pimelea suaveolens subsp. suaveolens*			
1696.	5268	*Pimelea sulphurea (Yellow Banjine)*			
1697.	5269	*Pimelea sylvestris*			
1698.		*Pinkfloydia harveii*			
1699.		*Pisolithus sp.*			
1700.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
1701.	8165	*Pithocarpa pulchella (Beautiful Pithocarpa)*			
1702.	18352	*Pithocarpa pulchella var. melanostigma*			
1703.		*Planorbidae sp.*			
1704.	7303	*Plantago lanceolata (Ribwort Plantain)*	Y		
1705.	7304	*Plantago major (Greater Plantain)*	Y		
1706.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
1707.	24842	*Platalea regia (Royal Spoonbill)*			
1708.	25720	*Platycercus icterotis (Western Rosella)*			
1709.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
1710.	24747	*Platycercus spurius (Red-capped Parrot)*			
1711.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
1712.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
1713.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
1714.	6249	*Platysace compressa (Tapeworm Plant)*			
1715.	6253	*Platysace filiformis*			
1716.	6255	*Platysace juncea*			
1717.	11132	*Platysace ramosissima*		P3	
1718.	6259	*Platysace tenuissima*			
1719.	4524	*Platytheca galioides*			
1720.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
1721.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
1722.	32478	*Pleuridium nervosum var. nervosum*			
1723.	65	*Pleurosorus rutifolius (Blanket Fern)*			
1724.	66	*Pleurosorus subglandulosus*			
1725.	38825	*Pluteus pauperculus*			
1726.	571	*Poa annua (Winter Grass)*	Y		
1727.	573	*Poa drummondiana (Knotted Poa)*			
1728.	578	*Poa porphyroclados*			
1729.	25703	*Podargus strigoides (Tawny Frogmouth)*			

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1730.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
1731.	25704	*Podiceps cristatus (Great Crested Grebe)*			
1732.	8173	*Podolepis capillaris (Wiry Podolepis)*			
1733.	8175	*Podolepis gracilis (Slender Podolepis)*			
1734.	8177	*Podolepis lessonii*			
1735.	8179	*Podolepis nutans (Nodding Podolepis)*			
1736.	8182	*Podotheca angustifolia (Sticky Longheads)*			
1737.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
1738.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
1739.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
1740.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
1741.	8188	*Pogonolepis stricta*			
1742.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
1743.		*Poltys laciniosus*			
1744.	2905	*Polycarpon tetraphyllum (Fourleaf Allseed)*	Y		
1745.	8395	*Polygala myrtifolia (Myrtleleaf Milkwort)*	Y		
1746.	4578	*Polygala virgata*	Y		
1747.		*Polygonarea repanda*			Y
1748.	2416	*Polygonum arenastrum (Sand Wireweed)*	Y		
1749.	2419	*Polygonum aviculare (Wireweed)*	Y		
1750.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
1751.	583	*Polypogon tenellus*			
1752.		*Polypompholyx tenella scps*			
1753.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
1754.	4690	*Poranthera huegelii*			
1755.	4691	*Poranthera microphylla (Small Poranthera)*			
1756.	44729	*Porostereum crassum*			
1757.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
1758.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
1759.	2884	*Portulaca oleracea (Purslane, Wakati)*			
1760.	24769	*Porzana fluminea (Australian Spotted Crake)*			
1761.	24770	*Porzana pusilla subsp. palustris (Baillon's Crake)*			
1762.	24771	*Porzana tabuensis (Spotless Crake)*			
1763.	109	*Potamogeton crispus (Curly Pondweed)*			
1764.	48252	*Prasophyllum cuneatum*			
1765.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
1766.	1671	*Prasophyllum elatum (Tall Leek Orchid)*			
1767.	1672	*Prasophyllum fimbria (Fringed Leek Orchid)*			
1768.	1673	*Prasophyllum gibbosum (Humped Leek Orchid)*			
1769.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
1770.	16688	*Prasophyllum gracile*			
1771.	1676	*Prasophyllum hians (Yawning Leek Orchid)*			
1772.	1677	*Prasophyllum macrostachyum (Laughing Leek Orchid)*			
1773.	1680	*Prasophyllum parvifolium (Autumn Leek Orchid)*			
1774.	10853	*Prasophyllum plumiforme*			
1775.	1681	*Prasophyllum regium (King Leek Orchid)*			
1776.	43303	*Protea repens*	Y		
1777.	41832	*Protoglossum luteum*			
1778.	17211	*Prunus cerasifera*	Y		
1779.	25261	*Pseudechis australis (Mulga Snake)*			
1780.	25345	*Pseudemydura umbrina (Western Swamp Tortoise, Western Swamp Turtle)*		T	
1781.	24234	*Pseudomys delicatulus (Delicate Mouse)*			
1782.	25511	*Pseudonaja affinis (Dugite)*			
1783.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
1784.	25264	*Pseudonaja nuchalis (Gwardar, Northern Brown Snake)*			
1785.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
1786.	4155	*Psoralea pinnata (African Scurfpea)*	Y		
1787.	13255	*Pterochaeta paniculata*			
1788.	24702	*Pterodroma brevirostris (Kerguelen Petrel)*			
1789.	24703	*Pterodroma lessonii (White-headed Petrel)*			
1790.	25710	*Pterodroma macroptera (Great-winged Petrel)*			
1791.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
1792.	1686	*Pterostylis barbata (Bird Orchid)*			
1793.	48484	*Pterostylis crebriflora*			
1794.	1687	*Pterostylis dilatata*			
1795.	44527	*Pterostylis erubescens*			
1796.	11118	*Pterostylis pyramidalis (Snail Orchid)*			
1797.	1693	*Pterostylis recurva (Jug Orchid)*			
1798.	12217	*Pterostylis sanguinea*			
1799.		*Pterostylis sp.*			

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1800.	18655	*Pterostylis sp. crinkled leaf (G.J. Keighery 13426)*			
1801.	1698	*Pterostylis vittata (Banded Greenhood)*			
1802.	2716	*Ptilotus declinatus (Curved Mulla Mulla)*			
1803.	11260	*Ptilotus drummondii var. drummondii (Pussytail)*			
1804.	2720	*Ptilotus esquamatus*			
1805.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
1806.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
1807.	2753	*Ptilotus pyramidatus*		T	Y
1808.	11615	*Ptilotus sericostachyus subsp. roseus*		P1	
1809.	40841	*Ptilotus stirlingii subsp. stirlingii*			
1810.	4172	*Pultenaea ericifolia*			
1811.	4181	*Pultenaea reticulata*			
1812.	28007	*Punctelia subalbicans*			
1813.		*Purpureicephalus spurius*			
1814.	48835	*Pycnoporus coccineus*			
1815.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
1816.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
1817.	8195	*Quinetia urvillei*			
1818.	2933	*Ranunculus muricatus (Sharp Buttercup)*	Y		
1819.	11927	*Ranunculus sessiliflorus var. sessiliflorus*			
1820.	3061	*Raphanus raphanistrum (Wild Radish)*	Y		
1821.	24243	*Rattus fuscipes (Western Bush Rat)*			
1822.	24245	*Rattus rattus (Black Rat)*	Y		
1823.		*Raveniella cirrata*			
1824.		*Raveniella peckorum*			
1825.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
1826.	6012	*Regelia ciliata*			
1827.	6014	*Regelia inops*			
1828.	38832	*Resupinatus cinerascens*			
1829.	38833	*Resupinatus subapplicatus*			
1830.	48096	*Rhipidura albiscapa (Grey Fantail)*			
1831.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
1832.	24454	*Rhipidura leucophrys subsp. leucophrys (Willie Wagtail)*			
1833.	13300	*Rhodanthe citrina*			
1834.	15035	*Rhodanthe corymbosa*			
1835.	13234	*Rhodanthe manglesii*			
1836.	13312	*Rhodanthe pyrethrum*			
1837.		*Riccia multifida*			
1838.	4705	*Ricinus communis (Castor Oil Plant)*	Y		
1839.	6020	*Rinzia crassifolia (Darling Range Rinzia)*			
1840.	17020	*Robinia pseudoacacia*	Y		
1841.	45434	*Roldana petasitis*	Y		
1842.	1554	*Romulea flava*	Y		
1843.	14485	*Romulea flava var. minor*	Y		
1844.	1556	*Romulea rosea (Guildford Grass)*	Y		
1845.	11544	*Romulea rosea var. australis (Guildford Grass)*	Y		
1846.	14924	*Romulea rosea var. communis*	Y		
1847.	3066	*Rorippa nasturtium-aquaticum (Watercress)*	Y		
1848.	11151	*Rostraria pumila*	Y		
1849.	32424	*Rosulabryum albolimbatum*			
1850.	44608	*Rosulabryum billarderii*			
1851.	32426	*Rosulabryum campylothecium*			
1852.	32429	*Rosulabryum torquescens*			
1853.	20506	*Rubus anglocandicans*	Y		
1854.	20496	*Rubus laudatus*	Y		
1855.	3191	*Rubus ulmifolius (Blackberry)*	Y		
1856.	23990	*Rubus ulmifolius var. ulmifolius*	Y		
1857.	2429	*Rumex acetosella (Sorrel)*	Y		
1858.	2432	*Rumex conglomeratus (Clustered Dock)*	Y		
1859.	2433	*Rumex crispus (Curled Dock)*	Y		
1860.	2443	*Rumex vesicarius (Ruby Dock)*	Y		
1861.	38836	*Russula erumpens*			
1862.	38837	*Russula flocktoniae*			
1863.	40431	*Rytidosperma acerosum*			
1864.	40425	*Rytidosperma caespitosum*			
1865.	40430	*Rytidosperma pilosum*			
1866.	40427	*Rytidosperma setaceum*			
1867.	2907	*Sagina procumbens (Spreading Pearlwort)*	Y		
1868.	17591	*Sagittaria platyphylla*	Y		
1869.	48430	*Salicornia quinqueflora*			

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1870.	79	*Salvinia molesta (Salvinia)*	Y		
1871.	6483	*Samolus junceus*			
1872.	6484	*Samolus repens (Creeping Brookweed)*			
1873.	11647	*Samolus repens var. repens*			
1874.	2356	*Santalum acuminatum (Quandong, Warnga)*			
1875.	7368	*Scabiosa atropurpurea (Purple Pincushion)*	Y		
1876.	7602	*Scaevola calliptera*			
1877.	7603	*Scaevola canescens (Grey Scaevola)*			
1878.	7613	*Scaevola glandulifera (Viscid Hand-flower)*			
1879.	7619	*Scaevola lanceolata (Long-leaved Scaevola)*			
1880.	7634	*Scaevola phlebopetala (Velvet Fanflower)*			
1881.	7635	*Scaevola pilosa (Hairy Fan-flower)*			
1882.	7636	*Scaevola platyphylla (Broad-leaved Fanflower)*			
1883.	12585	*Scaevola repens*			
1884.	13182	*Scaevola repens var. repens*			
1885.	48834	*Schinus terebinthifolia*	Y		
1886.		*Schizophyllum commune*			
1887.	32432	*Schizymenium bryoides*			
1888.	6263	*Schoenolaena juncea*			
1889.	48356	*Schoenoplectus tabernaemontani*			
1890.	971	*Schoenus andrewsii*			
1891.	972	*Schoenus armeria*			
1892.	973	*Schoenus asperocarpus (Poison Sedge)*			
1893.	974	*Schoenus benthamii*		P3	
1894.	975	*Schoenus bifidus*			
1895.	978	*Schoenus brevisetis*			
1896.	979	*Schoenus caespititius*			
1897.	980	*Schoenus capillifolius*		P3	
1898.	982	*Schoenus clandestinus*			
1899.	984	*Schoenus curvifolius*			
1900.	985	*Schoenus discifer*			
1901.	986	*Schoenus efoliatus*			
1902.	987	*Schoenus elegans*			
1903.	991	*Schoenus grammatophyllus*			
1904.	994	*Schoenus humilis*			
1905.	996	*Schoenus laevigatus*			
1906.	998	*Schoenus latitans*			
1907.	999	*Schoenus loliaceus*		P2	
1908.	1002	*Schoenus nanus (Tiny Bog Rush)*			
1909.	1003	*Schoenus natans (Floating Bog-rush)*		P4	
1910.	1006	*Schoenus odontocarpus*			
1911.	1007	*Schoenus pedicellatus*			
1912.	1008	*Schoenus pennisetis*		P3	
1913.	1009	*Schoenus pleiostemoneus*			
1914.	17614	*Schoenus plumosus*			
1915.	1011	*Schoenus rigens*			
1916.	1013	*Schoenus sculptus (Gimlet Bog-rush)*			
1917.	16280	*Schoenus sp. Beaufort (G.J. Keighery 6291)*		P1	
1918.	17731	*Schoenus sp. Waroona (G.J. Keighery 12235)*		P3	
1919.	18164	*Schoenus sp. smooth culms (K.R. Newbey 7823)*			
1920.	1016	*Schoenus subbarbatus (Bearded Bog-rush)*			
1921.	1017	*Schoenus subbulbosus*			
1922.	1018	*Schoenus subfascicularis*			
1923.	1019	*Schoenus subflavus (Yellow Bog-rush)*			
1924.	1020	*Schoenus sublateralis*			
1925.	1023	*Schoenus tenellus*			
1926.	1026	*Schoenus unispiculatus*			
1927.	17409	*Schoenus variicellae*			
1928.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
1929.	20093	*Scholtzia sp. Bickley (W.H. Loaring s.n. PERTH 06165184)*		X	Y
1930.		*Scleroderma cepa*			
1931.		*Scolopendra laeta*			
1932.		*Scolopendra morsitans*			
1933.	24199	*Scotorepens balstoni (Inland Broad-nosed Bat)*			
1934.	6	*Selaginella gracillima (Tiny Clubmoss)*			
1935.	32433	*Sematophyllum homomallum*			
1936.	25878	*Senecio condylus*			
1937.	8203	*Senecio diaschides*			
1938.	8205	*Senecio gilbertii*		P1	
1939.	8212	*Senecio leucoglossus*		P4	

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1940.	20663	*Senecio multicaulis subsp. multicaulis*			
1941.	20161	*Senecio pinnatifolius*			
1942.	8220	*Senecio vulgaris (Common Groundsel)*	Y		
1943.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
1944.	609	*Setaria palmifolia (Palm Grass)*	Y		
1945.	19453	*Setaria parviflora*	Y		
1946.	611	*Setaria sphacelata (South African Pigeon Grass)*	Y		
1947.	24145	*Setonix brachyurus (Quokka)*		T	
1948.	4980	*Sida hookeriana*			
1949.	2909	*Silene gallica (French Catchfly)*	Y		
1950.	15972	*Silene gallica var. gallica*	Y		
1951.	2910	*Silene nocturna (Mediterranean Catchfly)*	Y		
1952.	8224	*Siloxerus filifolius*			
1953.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
1954.	14583	*Siloxerus multiflorus*			
1955.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
1956.		*Simuliidae sp.*			
1957.	28060	*Siphula coriacea*			
1958.	30948	*Smicrornis brevirostris (Weebill)*			
1959.		*Sminthopsis murina*			
1960.		*Solaenodolichopus pruvoti*			
1961.	6988	*Solanum americanum (Glossy Nightshade)*	Y		
1962.	7020	*Solanum linnaeanum (Apple of Sodom)*	Y		
1963.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
1964.	45036	*Solidago chilensis*	Y		
1965.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
1966.	616	*Sorghum bicolor (Grain Sorghum)*	Y		
1967.	617	*Sorghum halepense (Johnson Grass)*	Y		
1968.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
1969.	1558	*Sparaxis bulbifera*	Y		
1970.	1560	*Sparaxis pillansii (Harlequin Flower)*	Y		
1971.	2912	*Spergula arvensis (Corn Spurry)*	Y		
1972.	8900	*Spergularia marina*			
1973.	4205	*Sphaerolobium linophyllum*			
1974.	4206	*Sphaerolobium macranthum*			
1975.	4207	*Sphaerolobium medium*			
1976.		*Sphaerotrichopus ramosus*			
1977.	1700	*Spiculaea ciliata (Elbow Orchid)*			
1978.	635	*Sporobolus virginicus (Marine Couch)*			
1979.	6930	*Stachys arvensis (Staggerweed)*	Y		
1980.	4716	*Stachystemon vermicularis*			
1981.	4733	*Stackhousia monogyna*			
1982.	9070	*Stackhousia pubescens (Downy Stackhousia)*			
1983.	43540	*Stackhousia sp. Red-blotched corolla (A. Markey 911)*		P3	
1984.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
1985.		*Steatoda capensis*			
1986.		*Steatoda grossa*			
1987.	16197	*Stenanthemum emarginatum*			
1988.	13475	*Stenanthemum humile*			
1989.	19704	*Stenanthemum sublineare*		P2	
1990.	19403	*Stenopetalum gracile*			
1991.		*Stereum illudens*			
1992.	24525	*Sterna fuscata subsp. nubilosa (Sooty Tern)*			
1993.	24329	*Stictonetta naevosa (Freckled Duck)*			
1994.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
1995.	2316	*Stirlingia latifolia (Blueboy)*			
1996.	2317	*Stirlingia simplex*			
1997.		*Storena formosa*			
1998.		*Storena sinuosa*			
1999.	25597	*Strepera versicolor (Grey Currawong)*			
2000.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
2001.	30951	*Streptopelia chinensis subsp. tigrina (Spotted Turtle-Dove)*	Y		
2002.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
2003.	30950	*Streptopelia senegalensis subsp. senegalensis (Laughing Turtle-Dove)*	Y		
2004.	24943	*Strophurus spinigerus subsp. inornatus*			
2005.	24942	*Strophurus spinigerus subsp. spinigerus*			
2006.	18564	*Stylidium aceratum*		P3	
2007.	7681	*Stylidium affine (Queen Triggerplant)*			
2008.	7684	*Stylidium amoenum (Lovely Triggerplant)*			
2009.	17666	*Stylidium amoenum var. amoenum*			

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Department of Biodiversity, Conservation and Attractions

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
2010.	30278	*Stylidium androsaceum*			
2011.	25831	*Stylidium araeophyllum (Stilt Walker)*			
2012.	30276	*Stylidium bicolor*			
2013.	48457	*Stylidium bindoon*			
2014.	7692	*Stylidium breviscapum (Boomerang Triggerplant)*			
2015.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
2016.	7694	*Stylidium bulbiferum (Circus Triggerplant)*			
2017.	7696	*Stylidium calcaratum (Book Triggerplant)*			
2018.	7698	*Stylidium caricifolium (Milkmaids)*			
2019.	7699	*Stylidium carnosum (Fleshy-leaved Triggerplant)*			
2020.	7702	*Stylidium ciliatum (Golden Triggerplant)*			
2021.	7712	*Stylidium despectum (Dwarf Triggerplant)*			
2022.	7713	*Stylidium dichotomum (Pins-and-needles)*			
2023.	7716	*Stylidium diuroides (Donkey Triggerplant)*			
2024.	11808	*Stylidium diuroides subsp. diuroides*			
2025.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
2026.	7719	*Stylidium ecorne (Foot Triggerplant)*			
2027.	7721	*Stylidium emarginatum (Biddy-four-legs)*			
2028.	19251	*Stylidium eriopodum*			
2029.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
2030.	7736	*Stylidium hispidum (White Butterfly Triggerplant)*			
2031.	7742	*Stylidium inundatum (Hundreds and Thousands)*			
2032.	7745	*Stylidium junceum (Reed Triggerplant)*			
2033.	7749	*Stylidium leptophyllum (Needle-leaved Triggerplant)*			
2034.	7752	*Stylidium lineatum (Sunny Triggerplant)*			
2035.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
2036.	7768	*Stylidium obtusatum (Pinafore Triggerplant)*			
2037.	7771	*Stylidium periscelianthum (Pantaloon Triggerplant)*		P3	
2038.	7772	*Stylidium perpusillum (Tiny Triggerplant)*			
2039.	7773	*Stylidium petiolare (Horn Triggerplant)*			
2040.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
2041.	7781	*Stylidium pubigerum (Yellow Butterfly Triggerplant)*			
2042.	7782	*Stylidium pulchellum (Thumbelina Triggerplant)*			
2043.	7783	*Stylidium pycnostachyum (Downy Triggerplant)*			
2044.	33106	*Stylidium recurvum*			
2045.	7785	*Stylidium repens (Matted Triggerplant)*			
2046.	7787	*Stylidium rhynchocarpum (Black-beaked Triggerplant)*			
2047.		*Stylidium roseo-alatum*			
2048.	7790	*Stylidium roseoalatum (Pink-wing Triggerplant)*			
2049.	25806	*Stylidium scariosum*			
2050.	7798	*Stylidium schoenoides (Cow Kicks)*			
2051.		*Stylidium sp.*			
2052.	7803	*Stylidium striatum (Fan-leaved Triggerplant)*		P4	
2053.	45594	*Stylidium tenue subsp. majusculum (Showy Fountain Triggerplant)*			
2054.	45593	*Stylidium tenue subsp. tenue (Little Fountain Triggerplant)*			
2055.	23511	*Stylidium thesioides (Delicate Triggerplant)*			
2056.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
2057.	40947	*Stylidium xanthellum*			
2058.	1260	*Stypandra glauca (Blind Grass)*			
2059.	48297	*Styphelia filifolia*		P3	
2060.	6476	*Styphelia tenuiflora (Common Pinheath)*			
2061.	2639	*Suaeda australis (Seablite)*			
2062.		*Supunna funerea*			
2063.		*Supunna picta*			
2064.	25902	*Symphyotrichum squamatum (Bushy Starwort)*	Y		
2065.	2321	*Synaphea acutiloba (Granite Synaphea)*			
2066.	12914	*Synaphea decorticans*			
2067.	2323	*Synaphea gracillima*			
2068.	2324	*Synaphea petiolaris (Synaphea)*			
2069.	16864	*Synaphea petiolaris subsp. petiolaris*			
2070.	2325	*Synaphea pinnata (Helena Synaphea)*			
2071.	18590	*Synaphea sp. Fairbridge Farm (D. Papenfus 696)*		T	
2072.	2329	*Synaphea spinulosa*			
2073.	15532	*Synaphea spinulosa subsp. spinulosa*			
2074.		*Synothele durokoppin*			
2075.		*Synsphyronus magnus*			
2076.	32437	*Syntrichia antarctica*			
2077.	32438	*Syntrichia pagorum*			
2078.		*Tabanidae sp.*			
2079.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			

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2080.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
2081.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
2082.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
2083.	20024	*Tagetes erecta (Marigold)*	Y		
2084.		*Tamopsis perthensis*			
2085.		*Tanypodinae sp.*			
2086.	38843	*Tapinella panuoides*			
2087.	45613	*Taraxacum khatoonae*	Y		
2088.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
2089.		*Tasmanicosa leuckartii*			
2090.	20135	*Taxandria linearifolia*			
2091.	32440	*Tayloria octoblepharum*			
2092.	33236	*Tecticornia halocnemoides (Shrubby Samphire)*			
2093.	33237	*Tecticornia halocnemoides subsp. halocnemoides*			
2094.	31718	*Tecticornia lepidosperma*			
2095.		*Tegenaria atrica*			Y
2096.	4251	*Templetonia drummondii*			
2097.		*Tetragnatha demissa*			
2098.	32441	*Tetrapterum cylindricum*			
2099.	1033	*Tetraria australiensis*		T	
2100.	1034	*Tetraria capillaris (Hair Sedge)*			
2101.	1036	*Tetraria octandra*			
2102.	35579	*Tetraria sp. Jarrah Forest (R. Davis 7391)*			
2103.	667	*Tetrarrhena laevis (Forest Ricegrass)*			
2104.	4535	*Tetratheca hirsuta (Black Eyed Susan)*			
2105.	48342	*Tetratheca hirsuta subsp. hirsuta*			
2106.	4537	*Tetratheca nuda*			
2107.	4544	*Tetratheca setigera*			
2108.	48597	*Thalasseus bergii (Crested Tern)*		IA	
2109.	1701	*Thelymitra antennifera (Vanilla Orchid)*			
2110.	10856	*Thelymitra benthamiana (Leopard Orchid)*			
2111.	1702	*Thelymitra campanulata (Shirt Orchid)*			
2112.	1705	*Thelymitra crinita (Blue Lady Orchid)*			
2113.	1707	*Thelymitra flexuosa (Twisted Sun Orchid)*			
2114.	11053	*Thelymitra macrophylla*			
2115.	20729	*Thelymitra magnifica (Crystal Brook Star Orchid)*		P1	
2116.		*Thelymitra sp.*			
2117.	1715	*Thelymitra spiralis (Curlylocks)*			
2118.	10862	*Thelymitra stellata (Star Orchid)*		T	
2119.	1718	*Thelymitra villosa (Custard Orchid)*			
2120.	20731	*Thelymitra vulgaris*			
2121.	673	*Themeda triandra*			
2122.		*Thereuopoda lesueurii*			
2123.	5080	*Thomasia foliosa*			
2124.	5084	*Thomasia grandiflora (Large Flowered Thomasia)*			
2125.	5087	*Thomasia macrocarpa (Large Fruited Thomasia)*			
2126.	5091	*Thomasia paniculata*			
2127.	5105	*Thomasia triphylla*			
2128.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
2129.	1317	*Thysanotus anceps*		P3	
2130.	1318	*Thysanotus arbuscula*			
2131.	1319	*Thysanotus arenarius*			
2132.	1320	*Thysanotus asper (Hairy Fringe Lily)*			
2133.	1328	*Thysanotus dichotomus (Branching Fringe Lily)*			
2134.	1330	*Thysanotus fastigiatus*			
2135.	1338	*Thysanotus manglesianus (Fringed Lily)*			
2136.		*Thysanotus manglesianus/patersonii complex*			
2137.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
2138.	1343	*Thysanotus patersonii*			
2139.	1350	*Thysanotus scaber*			
2140.	13783	*Thysanotus sp. Badgingarra (E.A. Griffin 2511)*		P2	
2141.	46055	*Thysanotus sp. Coastal plain (N.H. Brittan 66/63)*			
2142.	1351	*Thysanotus sparteus*			
2143.	1354	*Thysanotus tenellus*			
2144.	1357	*Thysanotus thyrsoideus*			
2145.	1358	*Thysanotus triandrus*			
2146.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
2147.	25519	*Tiliqua rugosa*			
2148.	25204	*Tiliqua rugosa subsp. aspera*			
2149.	25207	*Tiliqua rugosa subsp. rugosa*			

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2150.	45845	*Tilletia viennotii*			
2151.		*Tipulidae sp.*			
2152.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
2153.	24309	*Todiramphus sanctus subsp. sanctus (Sacred Kingfisher)*			
2154.	8248	*Tolpis barbata (Yellow Hawkweed)*	Y		
2155.	32445	*Tortula muralis*			
2156.		*Tortula recurvata*			
2157.	6266	*Trachymene coerulea (Blue Lace Flower)*			
2158.	19045	*Trachymene grandis*			
2159.	6280	*Trachymene pilosa (Native Parsnip)*			
2160.	17684	*Tremulina tremula*			
2161.	11112	*Tribolium uniolae*	Y		
2162.	1481	*Tribonanthes australis (Southern Tiurndin)*			
2163.	1482	*Tribonanthes brachypetala (Nodding Tiurndin)*			
2164.	1483	*Tribonanthes longipetala (Branching Tiurndin)*			
2165.	8798	*Tribonanthes uniflora (Woolly Tiurndin)*			
2166.	8799	*Tribonanthes variabilis (Hairy-stigma Tiurndin)*			
2167.	1485	*Tribonanthes violacea (Violet Tiurndin)*			
2168.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
2169.	4383	*Tribulus terrestris (Caltrop)*	Y		
2170.	39097	*Trichia decipiens*			
2171.	8251	*Trichocline spathulata (Native Gerbera)*			
2172.		*Trichocyclus balladong*			
2173.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
2174.	24755	*Trichoglossus haematodus subsp. moluccanus (Rainbow Lorikeet)*	Y		
2175.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
2176.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
2177.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
2178.	1362	*Tricoryne humilis*			
2179.	1363	*Tricoryne tenella*			
2180.	43207	*Tricostularia exsul*			
2181.	1038	*Tricostularia neesii*			
2182.	4289	*Trifolium angustifolium (Narrowleaf Clover)*	Y		
2183.	17145	*Trifolium angustifolium var. angustifolium*	Y		
2184.	4291	*Trifolium arvense (Hare's Foot Clover)*	Y		
2185.	17542	*Trifolium arvense var. arvense*	Y		
2186.	4292	*Trifolium campestre (Hop Clover)*	Y		
2187.	17763	*Trifolium campestre var. campestre (Hop Clover)*	Y		
2188.	4295	*Trifolium dubium (Suckling Clover)*	Y		
2189.	4297	*Trifolium glomeratum (Cluster Clover)*	Y		
2190.	4298	*Trifolium hirtum (Rose Clover)*	Y		
2191.	17788	*Trifolium pratense var. sativum*	Y		
2192.	19970	*Trifolium resupinatum var. majus*	Y		
2193.	4309	*Trifolium scabrum (Rough Clover)*	Y		
2194.	15509	*Trifolium tomentosum var. tomentosum*	Y		
2195.	33676	*Triglochin calcitrapa*			
2196.	33677	*Triglochin centrocarpa*			
2197.	146	*Triglochin minutissima*			
2198.	147	*Triglochin mucronata*			
2199.	148	*Triglochin muelleri*			
2200.	18587	*Triglochin nana*			
2201.		*Triglochin sp. scps*			
2202.		*Triglochin sp.Brixton 04 (possibly T. mullerii)*			Y
2203.	150	*Triglochin stowardii*			
2204.	151	*Triglochin striata*			
2205.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
2206.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
2207.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
2208.	1139	*Trithuria bibracteata*			
2209.	1141	*Trithuria submersa*			
2210.	38401	*Tritonia gladiolaris (Lined Tritonia)*	Y		
2211.	4360	*Tropaeolum majus (Garden Nasturtium)*	Y		
2212.	13479	*Trymalium ledifolium var. rosmarinifolium*			
2213.	33418	*Trymalium odoratissimum subsp. odoratissimum*			
2214.		*Tubaria rufofulva*			
2215.	48147	*Turnix varius (Painted Button-quail)*			
2216.	24851	*Turnix velox (Little Button-quail)*			
2217.	98	*Typha domingensis (Bulrush, Djandjid)*			
2218.	99	*Typha orientalis (Bulrush, Cumbungi)*			
2219.	25762	*Tyto alba (Barn Owl)*			

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2220.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
2221.	25764	*Tyto novaehollandiae (Masked Owl)*			
2222.	24983	*Underwoodisaurus milii (Barking Gecko)*			
2223.		*Urocampus carinirostris*			
2224.		*Urodacus novaehollandiae*			
2225.		*Urodacus planimanus*			
2226.		*Urodacus woodwardii*			
2227.	8254	*Urospermum picroides (False Hawkbit)*	Y		
2228.	8255	*Ursinia anthemoides (Ursinia)*	Y		
2229.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
2230.	45895	*Ustilago avenae*			
2231.	45896	*Ustilago bromivora*			
2232.	45902	*Ustilago nuda*			
2233.	45906	*Ustilago tepperi*			
2234.	7138	*Utricularia inaequalis*			
2235.	7145	*Utricularia menziesii (Redcoats)*			
2236.	7148	*Utricularia multifida*			
2237.	7153	*Utricularia tenella*			
2238.	7157	*Utricularia violacea (Violet Bladderwort)*			
2239.	33537	*Vallisneria australis*	Y		
2240.	17868	*Vallisneria nana*			
2241.	25577	*Vanellus miles (Masked Lapwing)*			
2242.	24386	*Vanellus tricolor (Banded Lapwing)*			
2243.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
2244.	25225	*Varanus rosenbergi (Heath Monitor)*			
2245.	25526	*Varanus tristis (Racehorse Monitor)*			
2246.	7665	*Velleia trinervis*			
2247.	8257	*Vellereophyton dealbatum (White Cudweed)*	Y		
2248.		*Venator immansueta*			
2249.		*Venatrix arenaris*			
2250.		*Venatrix pullastra*			
2251.	19511	*Verbena officinalis*	Y		
2252.	15725	*Verbesina encelioides*	Y		
2253.	7108	*Veronica arvensis (Wall Speedwell)*	Y		
2254.	6070	*Verticordia acerosa*			
2255.	15431	*Verticordia acerosa var. acerosa*			
2256.	12388	*Verticordia acerosa var. preissii*			
2257.	6076	*Verticordia densiflora (Compacted Featherflower)*			
2258.	12411	*Verticordia densiflora var. cespitosa*			
2259.	15432	*Verticordia densiflora var. densiflora*			
2260.	6077	*Verticordia drummondii (Drummond's Featherflower)*			
2261.	6088	*Verticordia huegelii (Variegated Featherflower)*			
2262.	15433	*Verticordia huegelii var. huegelii*			
2263.	15434	*Verticordia insignis subsp. insignis*			
2264.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
2265.	6107	*Verticordia pennigera*			
2266.	6110	*Verticordia plumosa (Plumed Featherflower)*			
2267.	12449	*Verticordia plumosa var. brachyphylla*			
2268.	15618	*Verticordia plumosa var. plumosa*			
2269.	24206	*Vespadelus regulus (Southern Forest Bat)*			
2270.	4320	*Vicia hirsuta (Hairy Vetch)*	Y		
2271.	4322	*Vicia sativa (Common Vetch)*	Y		
2272.	11474	*Vicia sativa subsp. nigra*	Y		
2273.	12070	*Vicia sativa subsp. sativa*	Y		
2274.	29491	*Vicia tetrasperma*	Y		Y
2275.	4325	*Viminaria juncea (Swishbush, Koweda)*			
2276.	6575	*Vinca major (Blue Periwinkle)*	Y		
2277.	17042	*Vitis vinifera*	Y		
2278.	24040	*Vulpes vulpes (Red Fox)*	Y		
2279.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
2280.	11018	*Vulpia muralis*	Y		
2281.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
2282.	12052	*Vulpia myuros forma megalura*	Y		
2283.	33101	*Vulpia myuros forma myuros*	Y		
2284.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
2285.	7388	*Wahlenbergia multicaulis*			
2286.	7389	*Wahlenbergia preissii*			
2287.	13103	*Watsonia borbonica*	Y		
2288.	18375	*Watsonia knysnana*	Y		
2289.	1566	*Watsonia marginata*	Y		

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.

Department of Biodiversity, Conservation and Attractions

WESTERN AUSTRALIAN MUSEUM

NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
2290.	1567	*Watsonia meriana (Bulbil Watsonia)*	Y		
2291.	18108	*Watsonia meriana var. bulbillifera*	Y		
2292.	18118	*Watsonia meriana var. meriana*	Y		
2293.	1569	*Watsonia versfeldii*	Y		
2294.	32456	*Weissia rutilans*			
2295.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
2296.		*Westrarchaea spinosa*			
2297.	6658	*Wilsonia backhousei (Narrow-leaf Wilsonia)*			
2298.	1394	*Wurmbea dioica (Early Nancy)*			
2299.		*Wurmbea dioica subsp. aff. alba (gjk 12803)*			
2300.	12072	*Wurmbea dioica subsp. alba*			
2301.	1401	*Wurmbea pygmaea*			
2302.	1403	*Wurmbea tenella (Eight Nancy)*			
2303.	28356	*Xanthoparmelia verrucella*			
2304.	1249	*Xanthorrhoea acanthostachya*			
2305.	1251	*Xanthorrhoea brunonis*			
2306.	14544	*Xanthorrhoea brunonis subsp. brunonis*			
2307.	1252	*Xanthorrhoea drummondii*			
2308.	1253	*Xanthorrhoea gracilis (Graceful Grass Tree, Mimidi)*			
2309.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
2310.	20658	*Xanthorrhoea sp. Lesueur (G.J. Keighery 16404)*			
2311.	6283	*Xanthosia atkinsoniana*			
2312.	6284	*Xanthosia candida*			
2313.	6285	*Xanthosia ciliata*			
2314.	6289	*Xanthosia huegelii*			
2315.	44861	*Xerochrysum macranthum*			
2316.	2331	*Xylomelum occidentale (Woody Pear, Djandin)*			
2317.		*Zachria flavicoma*			
2318.	7113	*Zaluzianskya divaricata (Spreading Night Phlox)*	Y		
2319.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		
2320.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of Agriculture, Water and the Environment

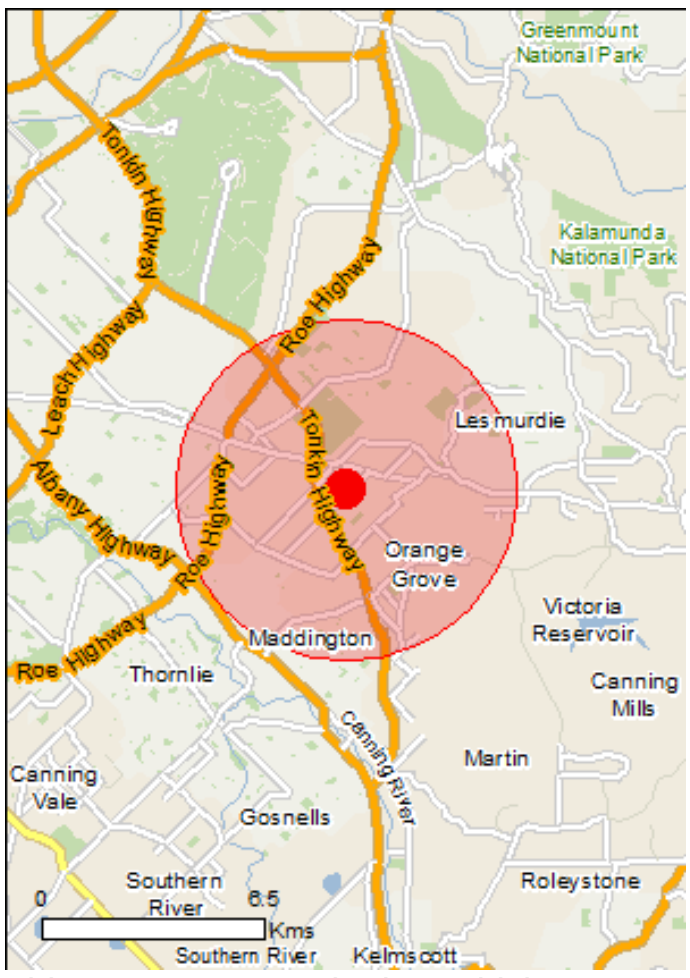
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

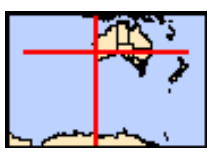
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/02/21 18:43:39



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	44
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	42
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Insects		
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat known to occur within area
Austrostipa bronwenae [87808]	Endangered	Species or species habitat known to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat known to occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eremophila glabra subsp. chlorella [84927]	Endangered	Species or species habitat known to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Goodenia arthrotricha [12448]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Grevillea thelemanniana Spider Net Grevillea [32835]	Critically Endangered	Species or species habitat known to occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat known to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Dundas Road	WA
Kenwick Wetlands	WA
Korung	WA
Lesmurdie Falls	WA
Unnamed WA23076	WA
Unnamed WA29815	WA
Unnamed WA37997	WA

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Brixton Street Swamps	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.01468 116.00525

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Document Distribution

Rev No.	Copies	Recipient	Date
A	1: electronic	Activate Projects on behalf of Hesperia Projects Pty Ltd	09/03/2021
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Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	W. Oversby, H. Sullivan, R. Pratt.	W. Oversby, D. Newsome	D. Newsome		09/03/2021
B	W. Oversby, H. Sullivan	D. Newsome	D. Newsome		10/05/2021


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element.

Appendix C – District Water Management Plan

element.

Appendix D – Bushfire Management Plan

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address: Various Lots, Wattle Grove

Site visit: Yes ☑ No ☐

Date of site visit (if applicable): Day 24 Month February Year 2021

Report author or reviewer: Linden Wears

WA BPAD accreditation level (please circle):

Not accredited ☐ Level 1 BAL assessor ☐ Level 2 practitioner ☐ Level 3 practitioner ☑

If accredited please provide the following.

BPAD accreditation number: 19809 Accreditation expiry: Month June Year 2021

Bushfire management plan version number: 0

Bushfire management plan date: Day 19 Month May Year 2021

Client/business name: Hesperia Projects Pty Ltd

	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?		✔
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the bushfire protection criteria elements)?		✔

Is the proposal any of the following (see SPP 3.7 for definitions)?	Yes	No
Unavoidable development (in BAL-40 or BAL-FZ)		✔
Strategic planning proposal (including rezoning applications)	✔	
High risk land-use		✔
Vulnerable land-use		✔

None of the above ☐

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

Why has it been given one of the above listed classifications (E.g. Considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

BMP to support MRS Amendment

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author or reviewer 

Date 19/05/21


strategen
JBS&G
Hesperia Projects Pty Ltd
Bushfire Management Plan (Rezoning Application)
Wattle Grove
Metropolitan Region Scheme Amendment
19 May 2021
60309/136 164 (Rev 0)
JBS&G Australia Pty Ltd T/A Strategen-JBS&G
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1. Proposal details

1.1 Background

Hesperia Projects Pty Ltd (the Proponent) is proposing to rezone approximately 106 ha of land bound by Welshpool Road East and Crystal Brook Road to the north, and Tonkin Highway to the west (collectively, the site; refer to Figure 1) to enable development of the site for urban purposes (refer to Rezoning Plan, Figure 2). The proposed amendment will implement the majority of the urban zone earmarked under the Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework. The Framework identifies the majority of the broader Wattle Grove area as an Urban Expansion area. The site is located approximately 30 km east of Perth CBD within the City of Kalamunda.

The site is currently zoned 'Special rural' and 'Rural composite' under the City of Kalamunda Local Planning Scheme (LPS) No 3 and predominantly 'Rural' under the Metropolitan Region Scheme (MRS).

1.2 Site description

The site is bound to the north by Welshpool Road East and Crystal Brook Road and to the south-west by Tonkin Highway.

The site comprises numerous land holdings and a mixture of uses, including residential and rural living, agriculture and horticulture. A turf farm extends across lots 303, 53, 214 and 213, south of Brentwood Road.

The project area is highly disturbed as a result of historical clearing and ongoing agricultural/ horticultural use. Vegetation within the site is fragmented with the exception of intact vegetation within portions of Lot 84, Lot 210 and Lot 254. Vegetation comprises Jarrah, Banksia and Marri species as the dominant overstorey species.

The project area is designated as bushfire prone on the *Map of Bush Fire Prone Areas* (DFES 2020; see Plate 1).

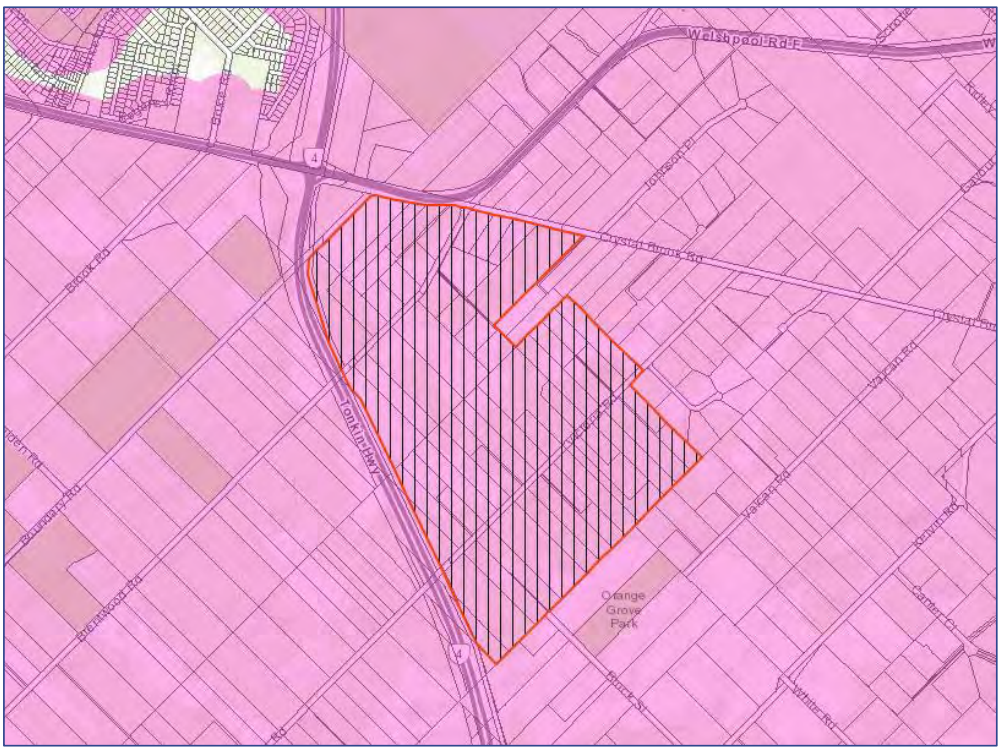


Plate 1: DFES (2020) Map of Bush Fire Prone Areas (as indicated in pink)

1.3 Purpose

This Bushfire Management Plan (BMP) has been prepared to address requirements under *Policy Measure 6.3 of State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015) and *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2017) to support the rezoning proposal.

1.4 Other plans/reports

Strategen-JBS&G has prepared an Environmental Assessment Report (Strategen-JBS&G 2021), to support the rezoning of the project area.

The City of Kalamunda has previously commissioned the Wattle Grove South Ecological Surveys (AECOM 2020) to support the initial planning investigation within the area.

Project area
100m assessment area
150m assessment area
Cadastral boundary

Geomorphic Wetlands (DBCA)
Conservation
Resource enhancement
Multiple use
Banksia Woodlands of the Swan Coastal Plain EPBC TEC (EN)

State Threatened and Priority Ecological Communities
SCP 20a: *Banksia attenuata* woodlands over species rich dense shrublands State TEC (EN)
FCT 20b: *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the Eastern Swan Coastal Plain (tentative) State TEC (EN)
Banksia Woodlands of the Swan Coastal Plain State PEC (P3)

Threatened and Priority Flora species within the Site (AECOM 2020)
Conospermum undulatum (T)
Isopogon drummondii (P3)

strategen JBS&G

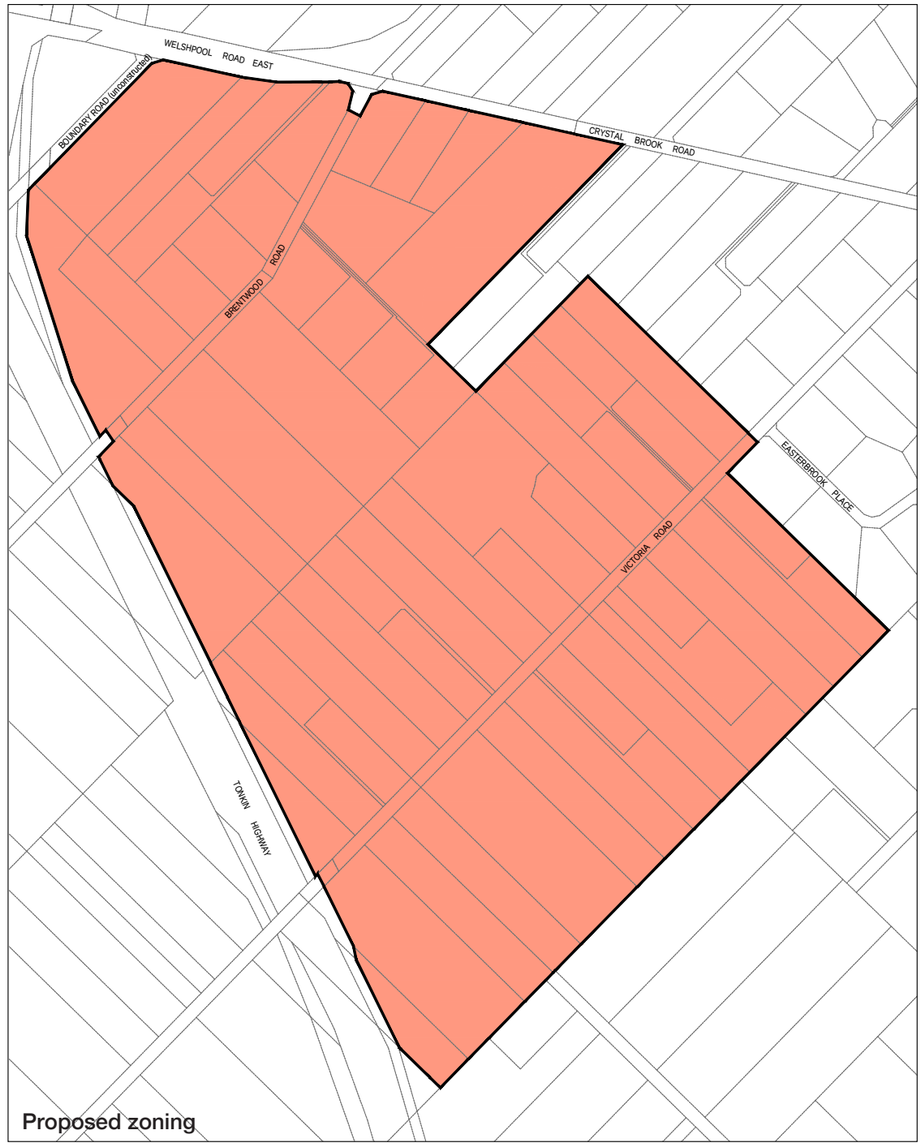
0 150 metres

Wattle Grove
Perth, WA

SITE OVERVIEW

Job No: 60309		Scale 1:6,000 at A3		
Client: Hesperia		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 19-May-2021	**FIGURE: 1**

Document Path: W:\Projects\1)Open\Hesperia\60306 Wattle Grove MRS and LPS Amendment\GIS\Maps\R02_Rev_A\60309_01_A3_SiteOverview.mxd
Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021



KEY

Subject land

Region Scheme Zones and Reservations

- Parks and Recreation
- Primary Regional Road
- Other Regional Road
- Bush Forever
- Urban
- Industrial
- Rural

KEY

- Excluded from Rural zone and included in Urban zone

Proposed MRS Amendment

Wattle Grove South

Date: 8 March 2021 Scale: NTS@ A3 File: 20-119 PL1A MRS Amendment Staff: MR/LC Checked: MR

element.

Level 18, 191 St Georges Terrace, Perth Western Australia 6000.
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2. Environmental considerations

2.1 Native vegetation - modification and clearing

The project area is highly disturbed as a result of historical clearing and ongoing agricultural/ horticultural use. Vegetation within the site is fragmented with the exception of intact vegetation within portions of Lot 84, Lot 210 and Lot 254.

A summary of publicly available environmental data and an Environmental Impact Assessment conducted by Strategen-JBS&G (2021) is presented in Table 1.

Table 1: Summary of environmental values

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
Environmentally Sensitive Area		✓	✓	Eight ESAs are mapped within the site according to the dataset available through DWER (2020). Many of the ESAs mapped within the site are associated with the locations of declared rare flora, however based on surveys undertaken by AECOM (2020; see Section 3.6.1.2), many of these areas have been historically cleared and the Threatened flora associated with the ESA boundaries are no longer present. Three of the mapped ESA boundaries are associated with buffers to conservation category wetlands (CCWs) located externally to the site and generally on the opposite side of Tonkin highway. One ESA is associated with a Threatened Ecological Community.
Swan Bioplan Regionally Significant Natural Area	✓			Not applicable.
Ecological linkages		✓	✓	Across the site there is one Regional Ecological Linkage at the north-westernmost extent of the Project Area (Link ID: 40) which is predominantly external to the site and which connects the Brixton Street Wetlands and the Hartfield Road Bushland (WALGA 2008). The portion of the site which falls within the Regional Ecological Linkage has been mostly cleared.
Wetlands		✓	✓	Regional geomorphic wetland mapping (WALGA 2019) indicates that two Resource Enhancement Wetlands (REW) intersect the site. One of the REWs (UFI 15257) is a seasonally waterlogged plausplain, located in the northern corner of the site. The second REW with UFI 8037 is a seasonally inundated sumpland located on the western boundary of the site which has been filled and cleared. Two CCWs are located within lot 501 immediately north of the site on the opposite side of Boundary Road within an area identified for the future Tonkin Highway/Welshpool Road East intersection upgrade and Brixton Street wetlands are located further west on the opposite side of Tonkin Highway.
Waterways		✓	✓	Two major watercourses are located in close proximity to the site, including The Yule Brook Main Drain situated approximately 200 m north, and the Bickley Brook Main Drain approximately 1.8 km south (Water Corporation 2017). There are no mapped watercourses that traverse the site (DoW 2012), however a constructed minor drain line exists along the northern boundary

Environmental value	Not mapped as occurring within or adjacent to the project area	Mapped as occurring within or adjacent to the project area		Description
		Within	Adjacent	
				of lot 210 extending from Crystal Brook Road to a constructed dam (360 Environmental 2018).
Threatened Ecological Communities		✓	✓	Two State listed threatened ecological communities (TECs) and one Federally TEC were identified within the project area (see Figure 1), by a field survey conducted by AECOM (2020). These are limited in size.
Threatened and priority flora		✓	N/A- adjacent areas have not been surveyed.	AECOM's survey recorded two conservation significant flora taxa: *Conospermum undulatum* (T) *Isopogon autumnalis (*P3), previously named *Isopogon drummondii.* These are limited to discrete locations within portions of 3 lots within the project area. While there may be some small localised areas of vegetation which have not yet been surveyed that could possibly retain some conservation significant flora, aerial photography and general knowledge of the site suggests any areas are limited in both number and potential scale.
Conservation significant fauna habitat		✓	N/A- adjacent areas have not been surveyed.	The site contains potential habitat for a small number of conservation significant fauna, however this habitat is mostly fragmented. The site contains some areas of low to moderate foraging habitat value for Carnaby's Cockatoo and low foraging habitat value for Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo (Strategen-JBS&G 2021). A total of 84 trees were recorded with a suitable DBH to support potential hollow development (≥ 500 mm). Of these, two trees (Jarrah) contained hollows potentially suitable for black cockatoo breeding.
Bush Forever Site			✓	No Bush Forever sites occur within the site. The nearest Bush Forever sites are approximately 80 m to the northwest (Site 387, the Greater Brixton Street Wetlands) and 50 m to the northeast (Site 320, Hartfield Road Bushland) on the opposite site of Tonkin Highway and Welshpool Road East, respectively.
DBCA managed lands and waters (includes legislated lands and waters and lands of interest)	✓			There are no DBCA managed lands within the site, with the nearest conservation reserve being the Brixton Street Wetlands, Kenwick, 100 m west of the site boundary.
Conservation covenants	✓			Hesperia is not aware of any conservation covenants applicable to the site.

Consideration of bushfire risk planning and management will be required at future planning stages in relation to any vegetation that may be retained, such as within wetland buffers, black cockatoo habitat or TECs.

Clearing of vegetation within the site is anticipated to be exempt from requiring a native vegetation clearing permit under Schedule 6 of the *Environment Protection Act 1986* (EP Act), following future subdivision approval.

In the event of "significant impacts" to matters of national environmental significance (MNES) listed under the EPBC Act (for example, black cockatoo habitat and Banksia Woodlands of the Swan Coastal Plain TEC), an EPBC Act referral and subsequent approval will be required.

2.2 Revegetation / Landscape Plans

At this strategic planning stage, provisions have not yet been made for future landscaping or designation of public open space (POS) and drainage areas within the project area. As previously identified, other than the three discrete localised conservation areas that have been identified within the project area, the balance of the area has been predominantly parkland cleared with little to no understorey. It is expected that many of the existing large trees will be retained, generally within areas of POS, drainage/ road corridors and larger lots, and such that the bushfire risk can be appropriately managed in an urban setting.

The extent and type of vegetation within any future POS and drainage areas will be determined at future planning stages, including through the development of landscape concepts and plans, which will identify any areas containing vegetation classified under *AS 3959—20018 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2009) as well as any areas that may be excluded from development.

In the event of any vegetation classified under AS3959 being retained within the development (such as for conservation, within POS or drainage basins), appropriate setbacks will be implemented between vegetation and proposed lots/ dwellings to ensure that a rating of BAL-29 is not exceeded.

This information will be reflected in a subsequent Bushfire Management Plan prepared to support local structure planning for the locality.

3. Bushfire assessment results

3.1 Assessment inputs

3.1.1 Vegetation classification

Strategen-JBS&G assessed the pre-development extent of classified vegetation and exclusions within 150 m of the project area through on-ground verification on 24 February 2021 in accordance with *AS 3959—2018 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2018) and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016).

Georeferenced site photos and a description of the vegetation classifications and exclusions are contained in Appendix B and depicted in Figure 3.

3.1.2 Effective slope

Strategen-JBS&G assessed effective slope under classified vegetation through on-ground verification on 24 February 2021 in accordance with AS 3959. Results were cross-referenced with DPIRD 2m contour data and are depicted in Table 2 and Figure 3.

Regional topographic contour mapping (DPIRD 2019) indicates that the site is relatively flat to gently undulating, with elevation ranging from 22 m Australian Height Datum (AHD) in the north of the site to 36 mAHD in the south, generally sloping down from east to west across the site.

Within the surrounding 150 m assessment area, land to the north and west is predominantly flat in relation to the project area. Land to the south-east and east is generally flat or upslope of the project area.

3.1.3 Pre-development inputs

A summary of the assessed pre-development classified vegetation, exclusions and effective slope within the assessment area and adjacent 150 m are listed in Table 2 and illustrated in Figure 3.

Table 2: Pre-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class A Forest	Flat/upslope (0°)	Trees 10-30 m high at maturity, dominated by Eucalypts, multi-tiered structure comprising tall canopy layer, shrubby middle layer and grass/herb/sedge understorey
2	Class B Woodland	Flat/upslope (0°)	Trees 2-30 m at maturity, dominated by trees with a grassy understorey (lacks shrubby middle layer and deep surface litter)
3	Class D Scrub	Flat/upslope (0°)	Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity
4	Class G Grassland	Flat/upslope (0°)	Grassland greater than 100 mm in height
5	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Low threat cultivated gardens and maintained lawns within surrounding properties and non-vegetated areas including roads, footpaths, driveways and building footprints

3.1.4 Post-development inputs

A summary of the potential post-development classified vegetation, exclusions and effective slope within the assessment area and adjacent 150 m are listed in Table 2 and illustrated in Figure 4.

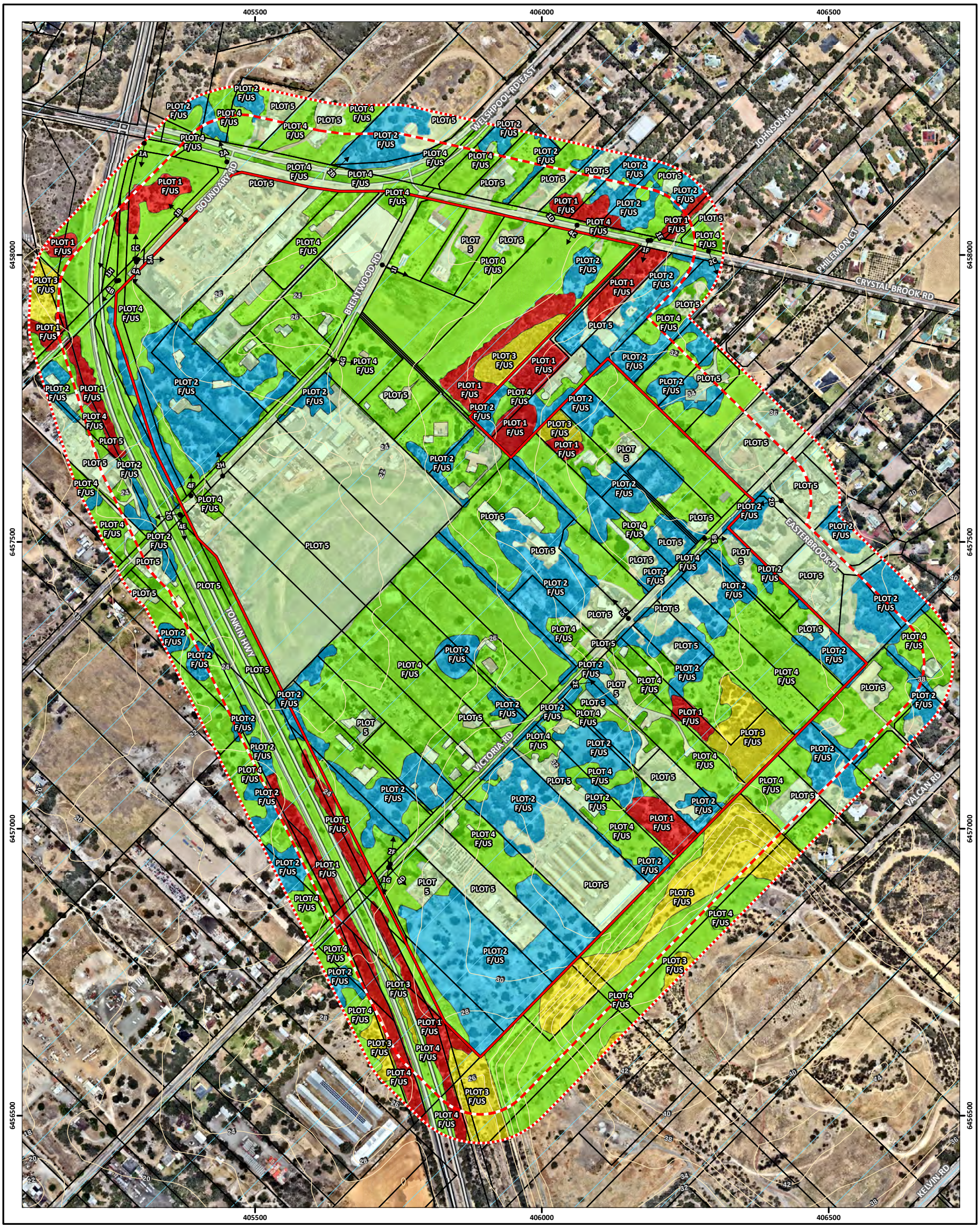
The post-development vegetation classifications for all land external to the project area are expected to remain the same as for the pre-development classifications. If external vegetation is

altered prior to future planning stages, the change in vegetation condition is to be captured through a future BHL assessment or BAL contour map assessment.

In respect of vegetation within the project area, it is recognised that the discrete areas identified as having conservation value will also be retained. A Bushfire Management Plan prepared to support the Local Structure Plan will give further consideration as to the requirement for fire management controls, including building separation distances from vegetation external and internal to the project area, including consideration of the requirements of AS 3959.

Table 3: Post-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class A Forest	Flat/upslope (0°)	Trees 10-30 m high at maturity, dominated by Eucalypts, multi-tiered structure comprising tall canopy layer, shrubby middle layer and grass/herb/sedge understorey
2	Class B Woodland	Flat/upslope (0°)	Trees 2-30 m at maturity, dominated by trees with a grassy understorey (lacks shrubby middle layer and deep surface litter)
3	Class D Scrub	Flat/upslope (0°)	Vegetation with a continuous horizontal and vertical structure, greater than 2 m high at maturity
4	Class G Grassland	Flat/upslope (0°)	Grassland greater than 100 mm in height
5	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Low threat cultivated gardens and maintained lawns within surrounding properties and non-vegetated areas including roads, footpaths, driveways and building footprints



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- Bushfire prone areas

Vegetation classification

- Class A Forest
- Class B Woodland
- Class D Scrub
- Class G Grassland
- Clause 2.2.3.2 (e) & (f)

- Topographic contours (mAHD)
- Photo point directions
- Highways
- Main road
- Minor road
- Track

strategen JBS&G

0 150 metres

Job No: 60309		Scale 1:6,000 at A3	
Client: Hesperia		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: jcrute	Checked By: CT	Version: A	Date: 19-May-2021

Wattle Grove
Perth, WA

PRE-DEVELOPMENT VEGETATION CLASSIFICATION AND EFFECTIVE SLOPE

FIGURE: 3

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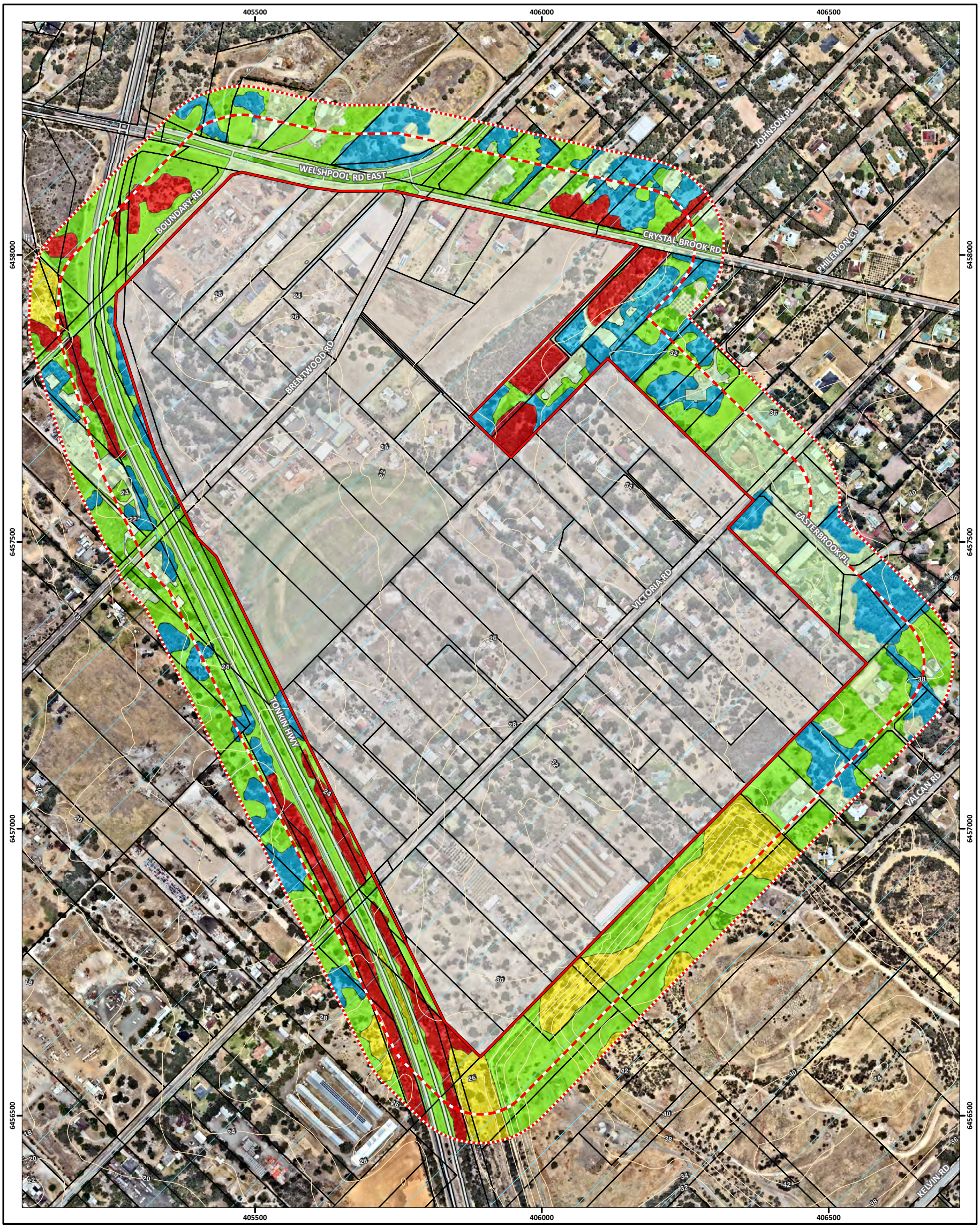

Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- Bushfire prone areas

Feature_VegetationMapping...

- Class A Forest
- Class B Woodland
- Class D Scrub
- Class G Grassland
- Clause 2.2.3.2 (e) & (f)
- Area to be modified to non-vegetated and low threat state

- Topographic contours (mAHD)
- Highways
- Main road
- Minor road
- Track

strategen JBS&G

0 150 metres

Wattle Grove
Perth, WA

Job No: 60309		Scale 1:6,000 at A3	POST-DEVELOPMENT VEGETATION CLASSIFICATION AND EFFECTIVE SLOPE
Client: Hesperia		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: jcrute	Checked By: CT	Version: A	Date: 19-May-2021

FIGURE: 4

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Image Reference: www.nearmap.com© - Imagery Date: 3 January 2021

3.2 Assessment outputs

3.2.1 Bushfire Hazard Level (BHL) assessment

Pre-development classified vegetation extents have been assigned a bushfire hazard level in accordance with the methodology detailed in Appendix Two of the Guidelines, as outlined in Table 4.

Table 4: Bushfire hazard levels and characteristics

Bushfire hazard level	Characteristics*
Extreme	• Class A Forest • Class B Woodland (05) • Class D Scrub • Any classified vegetation with a greater than 10° slope.
Moderate	• Class B Low woodland (07) • Class C Shrubland • Class E Mallee/Mulga • Class G Grassland, including sown pasture and crops • Class G Grassland: Open woodland (06), Low open woodland (08), Open shrubland (09) • Vegetation that has a low hazard level but is within 100 metres of vegetation classified as a moderate or extreme hazard, is to adopt a moderate hazard level.
Low	• Low threat vegetation may include areas of maintained lawns, golf courses, public recreation reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks • Managed grassland in a minimal fuel condition (insufficient fuel is available to significantly increase the severity of the bushfire attack). For example, short-cropped grass to a nominal height of 100 millimetre • Non-vegetated areas including waterways, roads, footpaths, buildings and rock outcrops.
*Vegetation classifications from AS 3959-2018 Table 2.3.	

3.2.1.1 Pre-development

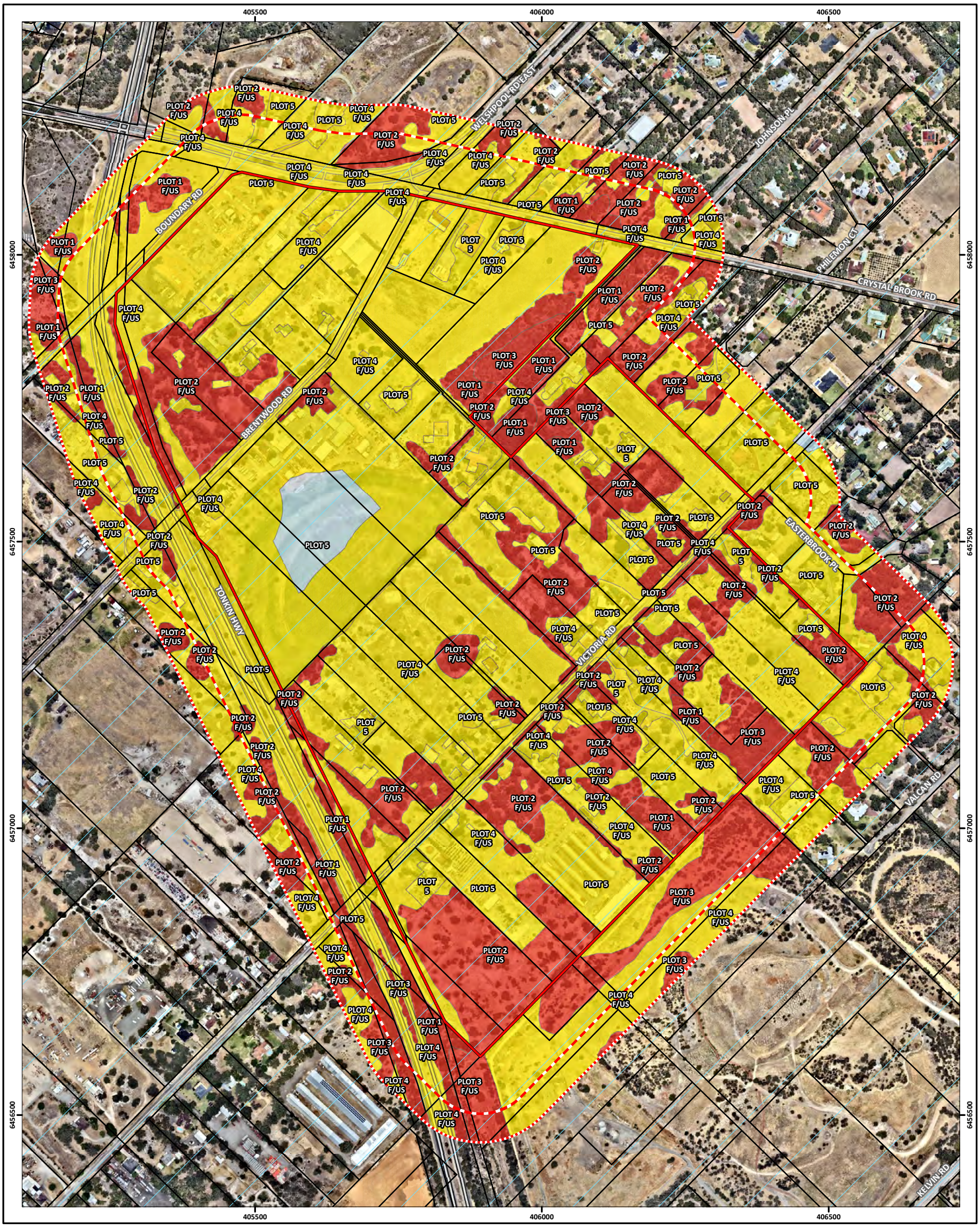
Strategen-JBS&G has mapped the pre-development bushfire hazard levels within the project area and adjacent 150 m wide assessment area. The bushfire hazard levels have been assessed on the basis of the vegetation discussed in Section 3.1 (i.e. the current pre-development extent of classified vegetation within and surrounding the project area).

The pre-development BHL assessment (refer to Figure 5) indicates that based on the existing vegetation, the site contains land with Moderate and Extreme bushfire hazard levels.

3.2.1.2 Post-development

Strategen-JBS&G has mapped the potential post-development bushfire hazard levels to demonstrate that the future bushfire hazard levels will be acceptable for future development to occur within the project area. The bushfire hazard levels have been assigned on the basis of the vegetation discussed in Section 3.1.4 and the future expected vegetation extent within and surrounding the project area.

The post-development BHL assessment (refer to Figure 6) demonstrates that all future habitable development can be located on land with either a Low or Moderate bushfire hazard level. It is noted that three localised areas within the project area that coincide with areas of conservation vegetation and identified as having extreme bushfire hazard levels on the pre-development mapping, will be retained. The urban design response to interface with these areas to manage fire risk will be reflected in a Bushfire Management Plan prepared to support the subsequent Local Structure Plan process.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Bushfire prone areas

Hazard level
- Extreme
- Moderate
- Low

- Highways
- Main road
- Minor road
- Track

strategen JBS&G

0 150 metres

Job No: 60309		Scale 1:6,000 at A3		**PRE-DEVELOPMENT BUSHFIRE HAZARD LEVELS**
Client: Hesperia		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 19-May-2021	**FIGURE: 5**

Wattle Grove
Perth, WA

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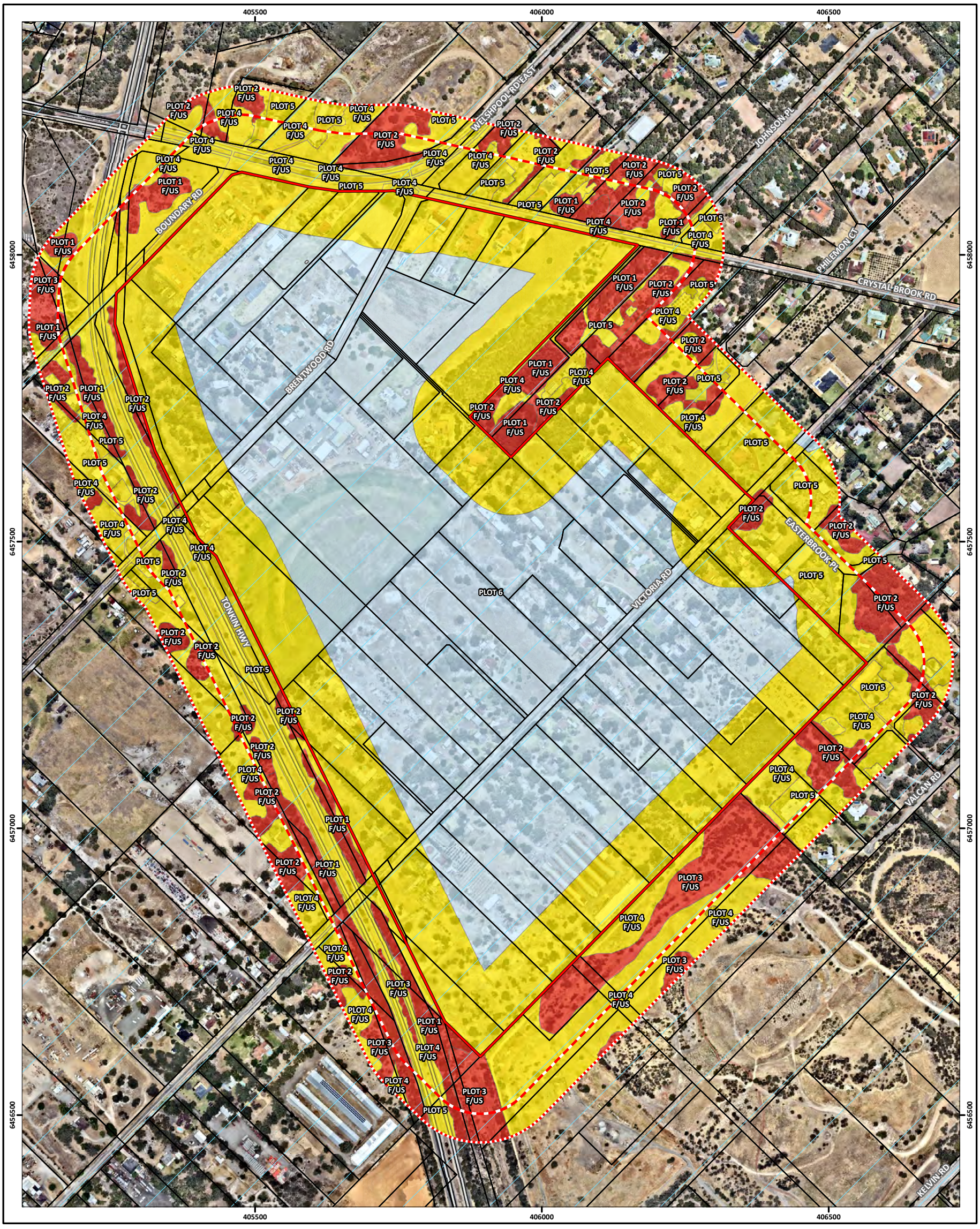

Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- Bushfire prone areas

Hazard level
- Extreme
- Moderate
- Low

- Highways
- Main road
- Minor road
- Track

strategen JBS&G

0 150 metres

Wattle Grove
Perth, WA

Job No: 60309		Scale 1:6,000 at A3		**POST-DEVELOPMENT BUSHFIRE HAZARD LEVELS**
Client: Hesperia		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: jcrute	Checked By: CT	Version: A	Date: 19-May-2021	**FIGURE: 6**

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4. Identification of bushfire hazard issues

4.1 Bushfire context

It is anticipated that there will be minimal bushfire hazards remaining within the project area on completion of development and that any can be appropriately incorporated through the local structure plan to achieve an appropriate interface. The site is expected to be managed to accommodate the proposed urban development, with any areas of POS expected to be excludable and minor in nature. In response to the environmental values identified on site, vegetation retention in localised areas will require a bushfire management response. Future BMPs prepared as part of structure planning and subdivision will detail how the development design will respond to any retention proposed to ensure habitable development is within areas of BAL-29 or less.

In light of the above, Strategen JBS&G considers that the greatest residual bushfire threat to the project area would be from remnant Banksia, Jarrah and Marri woodland vegetation within private land holdings adjacent to the project area, as well as within the Tonkin Highway, Welshpool Road East and Crystal Brook Road road reserves. This vegetation occupies land that is flat/ upslope of the project area and is highly fragmented as a result of clearing/ agricultural land uses, as well as the presence of major roads (Tonkin Highway and Welshpool Road east). As such, there is limited opportunity for this vegetation to support a long fire run in the direction of the project area and thus significant bushfire behaviour is unlikely to be supported. However, the presence of this vegetation results in a moderate bushfire risk to the portions of the project area that interface with these hazards.

At a broader scale, there is the potential for a bushfire to spread from national/ regional parks to the east of the project area, through fragmented vegetation and unmanaged grasses within rural landholdings, in the direction of the project area. The risk of a bushfire spreading from this direction is considered manageable through the application of acceptable solutions, as detailed in Table 5.

4.2 Bushfire hazard issues

Examination of strategic development design in accordance with the Rezoning Plan (Figure 2) and the existing bushfire hazard levels has identified the following bushfire hazard issues to be considered at future planning stages.

4.2.1 On-site areas of pre-development extreme BHL

Strategen-JBS&G understands that, in line with the proposed urban land use of the site, the pre-development classified vegetation extent and associated areas of Extreme BHL within the project area are expected to be modified to a Moderate BHL or lower through development of the site.

4.2.2 Onsite POS and drainage

Landscape concepts and plans will need to be prepared to address fuel treatments throughout any proposed Public Open Space and drainage at the relevant stage of planning (likely subdivision stage) to demonstrate the vegetation classifications or exclusion extents. Habitable building setbacks from any classified vegetation sufficient to achieve BAL—29 will also need to be provided, where required, at interfaces with classified vegetation (such as within POS/ drainage).

4.2.3 Classified vegetation within the project area

As the project area currently contains some areas of bushfire prone vegetation, including Class G Grassland, Class D Scrub, Class B Woodland and Class A Forest, staged construction at the subdivision stage of planning is to consider the BAL impacts from adjacent future stages that have not yet been developed. Low threat buffers may need to be implemented around active stages of development to ensure there is no residual impact from adjacent vegetation to achieve a low threat state on adjacent undeveloped stages.

Additionally, conservation significant vegetation within the project area (including black cockatoo habitat, wetland buffers and/ or TECs) may be retained as part of future development design. Consideration of bushfire risk planning and management will be required at future planning stages in relation to discrete areas of vegetation to be retained that could pose a bushfire risk.

4.2.4 Classified vegetation on adjacent land

There is potential for future residential lots to have direct interfaces with classifiable vegetation on adjacent land as follows:

- residential lots located along the western boundary of the project area could share a direct interface with Class G Grassland, Class B Woodland and Class A Forest within the Tonkin Highway road reserve. Future habitable development would likely require BAL—29 setbacks of 8 m (for grassland), 14 m (for woodland) and 21 m (for forest).
- residential lots situated along the northern boundary of the project area could have an interface with Class G Grassland within the Welshpool Road East and Crystal Brook Road road reserves. Future habitable development would likely require a BAL—29 setback of 8 m (adjacent to grassland) and 14 m (adjacent to woodland).
- residential lots located along the eastern boundary of the project area could have a direct interface with Class G Grassland, Class B Woodland and Class A Forest vegetation within private landholdings. Future habitable development would likely require a BAL—29 setback ranging from 8 m (for grassland), 14 m (for woodland) and 21 m (for forest).

The setbacks outlined above may be reduced through the establishment of 3 m wide perimeter firebreaks in the adjacent land, or through slashing of grassland in accordance with the City of Kalamunda Fire Hazard Reduction Notice (Appendix C) at future planning stages. Additionally, perimeter roads, or low threat POS may be considered to alleviate these BAL impacts. A BAL Contour assessment at the subdivision stage of planning will determine whether any residential lots located near the interface with classifiable vegetation are able to achieve BAL-29 or lower, as required by acceptable solution A1.1 of the Guidelines.

4.2.5 Provision of two access routes

The project area is bordered by Tonkin Highway to the west and south-west and is bordered by private land holdings to the south-east. As such the potential for formalised access/ egress points is currently limited in these directions, but this may change over time.

Notwithstanding, future development will include a minimum of two connections which currently exist to the east through the Crystal Brook Road/ Welshpool Road East intersection, and to the west via Crystal Brook Road/Victoria Road intersection, providing a minimum of two access/ egress points. These points will enable future occupants of the project area the option of travelling east-west within the estate and along Crystal Brook Road/ Welshpool Road East/ Kelvin Road and subsequently north-south along Tonkin Highway. Additional access/ egress points will be provided, where this is supported by relevant land owners and agencies through consultation with these parties.

Staging design will be critical in ensuring that compliance with two access routes (acceptable solution A3.1) is delivered for all stages at all times. This may require public road construction in advance of stages and/or provision of temporary compliant cul-de-sacs/emergency access ways.

4.2.6 Summary

Strategen considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are manageable through standard management responses outlined in the Guidelines and AS 3959 and the strategic level bushfire management strategies outlined in this BMP. These responses will be factored in to proposed development early in the planning process to ensure a

suitable, compliant and effective bushfire management outcome is achieved for protection of future life and property assets and further refined in more detailed Bushfire Management Plans prepared to support subsequent stages of planning.

5. Assessment against the bushfire protection criteria

5.1 Compliance table

An acceptable solutions assessment against the bushfire protection criteria is provided in Table 5.

Table 5: Compliance with the bushfire protection criteria of the Guidelines

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
Element 1: Location	A1.1 Development location	The pre-development BHL assessment (Figure 5) identifies that the project area currently contains land with Moderate and Extreme bushfire hazard levels. On completion of development, however, it is expected that all bushfire prone vegetation will be cleared and/or managed to accommodate the development of urban infrastructure (such as roads and residential lots). Therefore, post-development bushfire hazard levels are expected to be Low or Moderate in locations of proposed habitable development. Any classified vegetation retained or reintroduced within on-site POS and drainage areas as part of local structure plan design will need to consider the appropriate setbacks for habitable development to achieve a maximum of BAL—29. Notwithstanding, the site is considered of sufficient size such that any post-development classification of vegetation throughout on-site POS/drainage could be readily accommodated via compliant subdivision design to ensure all future habitable development can achieve BAL-29 or lower.
Element 2: Siting and design	A2.1 Asset Protection Zone	APZs sufficient to achieve BAL—29 are to be implemented for all lots subject to a BAL above BAL-LOW. The required APZs are to be identified at future planning stages (likely subdivision stage) based on future subdivision/development design and following a BAL contour assessment. Based on the current extent of classifiable vegetation, minimum APZ widths to achieve BAL-29 or lower are likely to be 8 m (for grassland), 14 m (for woodland) and 21 m (for forest). APZs are to be implemented and maintained in accordance with Schedule 1 of the Guidelines (Appendix A) and the City's Firebreak Notice (Appendix C).
Element 3: Vehicular access	A3.1 Two access routes	The project area is bordered by Tonkin Highway to the west and south-west and is bordered by private land holdings to the south-east. As such the potential for formalised access/ egress points is currently limited in these directions but may change over time. Notwithstanding, future development will include a minimum of two connections which currently exist to the east through the Crystal Brook Road/ Welshpool Road East intersection, and to the west via Crystal Brook Road/Victoria Road intersection, providing a minimum of two access/ egress points. These points will enable future occupants of the project area the option of travelling east-west within the estate and along Crystal Brook Road/ Welshpool Road East/Kelvin Road and subsequently north-south along Tonkin Highway. Additional access/ egress points will be provided, where this is supported by relevant landowners and agencies through consultation with these parties. Staging design will be critical in ensuring that compliance with two access routes (acceptable solution A3.1) is delivered for all stages at all times. This may require public road construction in advance of stages and/or provision of temporary compliant cul-de-sacs/emergency access ways.

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
	A3.2 Public road	Provisions for the construction of future public roads to relevant technical requirements under the Guidelines (refer to Appendix D) are to be made at the relevant future stage of planning (likely subdivision stage).
	A3.3 Cul-de-sac (including a dead-end-road)	Cul-de-sacs are to be avoided in bushfire prone areas. If cul-de-sacs are included in future development design, it must be demonstrated why they are unavoidable and they are to comply with relevant technical requirements under the Guidelines (refer to Appendix D), as are any temporary cul-de-sacs required as part of development staging. It is noted that the project area currently contains a number of legacy, non-complaint cul-de-sacs that future design and development will resolve by providing thru access and an interconnected public road network.
	A3.4 Battle-axe	Battle-axes are to be avoided in bushfire prone areas. If battle-axe lots are included in future development design, it must be demonstrated why they are unavoidable and they are to comply with relevant technical requirements under the Guidelines (refer to Appendix D). It is noted that the project area currently contains a number of legacy battle-axes that future design and development will resolve by providing thru access and an interconnected public road network.
	A3.5 Private driveway longer than 50 m	Where future habitable development in an area above BAL-LOW is sited more than 50 m from a public road, the private driveway is to comply with relevant technical requirements under the Guidelines (refer to Appendix D). This is to be addressed at the appropriate stage of planning (likely subdivision stage). Given the proposed urban land use of the site, it is not anticipated that any of the future residential lots would be of a size that would require habitable buildings to be located more than 50 m from a public road.
	A3.6 Emergency access way	It is possible that permanent Emergency Access Ways (EAWs) may form part of proposed development design to further augment bush fire access, although this would be dependent on the outcomes of negotiation with MRWA and private land owners. Any permanent or temporary EAWs required to provide through access to a public road during staging will need to comply with the technical requirements of the Guidelines (refer to Appendix D).
	A3.7 Fire service access routes (perimeter roads)	FSARs may be required to provide firefighter access to the perimeter of the site where public roads are not proposed (refer to Appendix D for technical standards). This will be reviewed during subsequent planning processes. Temporary FSARs may be required during staging of development to provide firefighter access to and around the perimeter of undeveloped portions of the project area.
	A3.8 Firebreak width	Each stage of development is required to comply with the requirements of the City of Kalamunda Fire Hazard Reduction Notice as amended (refer to Appendix C), including: • Land up to 4 000 m^2: all grasses to be maintained at 50 mm or less • Land 4 000 m^2 or greater: 3 m wide, 4 m high firebreaks are to be constructed inside and along all boundaries of land. • 3 m-wide firebreaks are to be installed for balance lots greater than 4 000 m^2 in area during staged development. On completion of the development, residential lots will be less than 4 000 m^2 in area and comprise cultivated gardens and maintained lawns. Therefore, firebreaks would not be required for these lots. POS areas larger than 4 000 m^2 will require 3 m wide firebreaks. Public roads bordering the perimeter of the POS areas would provide sufficient and permanent firebreaks.

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
		In accordance with the City of Kalamunda Fire Hazard Reduction Notice, maintained and living lawns are acceptable in conjunction with or in lieu of mineral earth firebreaks.
Element 4: Water	A4.1 Reticulated areas	Future development will be provided with a reticulated water supply compliant with Water Corporation DS-63 requirements, as detailed in Appendix E. In the unlikely event that a compliant, reticulated water supply cannot be provided, future development will comply with the requirements of A4.2.
	A4.2 Non-reticulated areas	N/A.
	A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively)	N/A.

6. Responsibilities for implementation and management of the bushfire measures

This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. Aside from the preparation of future BMPs to accompany future local scheme rezoning, local structure plans, subdivision and development applications where appropriate, there are no further items to implement, enforce or review at this strategic stage of the planning process.

Future BMPs prepared for subsequent rezoning, local structure plans, subdivision and development applications are to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measures 6.3, 6.4 or 6.5 where applicable) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions or meet the performance requirements of the Guidelines. Future rezoning/local structure plan BMPs will require a similar level of detail to this BMP, updated with specific development details where available, as per the planning proposal. Future subdivision/DA stage BMPs are to include the following detailed information:

- proposed lot layout, including any public open space (POS) and drainage areas
- detailed landscaping design in regard to POS and drainage
- post-development extent of classified vegetation, exclusions and effective slope
- BAL contour map demonstrating that proposed development areas will achieve BAL–29 or lower
- width and alignment of compliant APZs/setbacks
- confirmation of how bushfire management will be addressed during development staging
- proposed approach to fuel management or AS 3959 application in response to on-site POS/drainage
- vehicular access provisions, including demonstration that a minimum of two access routes will be achieved for each stage of development in accordance with Acceptable Solution A3.1
- water supply provisions with regards to reticulated water
- future requirements for any future vulnerable land uses, such as provision of a Bushfire Emergency Evacuation Plan (if relevant)
- future requirements for any future high-risk land uses, such as provision of a Bushfire Risk Management Plan (if relevant)
- provisions for notification on Title for any future lots with a rating of BAL–12.5 or greater as a condition of subdivision
- compliance requirements with the current City annual firebreak notice
- construction of Class 1, 2, 3 or associated 10a buildings in accordance with AS 3959 to the assessed BAL rating
- requirements for BMP compliance reports as conditions of subdivision
- demonstration of compliance with acceptable solutions of the bushfire protection criteria
- proposed implementation and audit program outlining all measures requiring implementation and the appropriate timing and responsibilities for implementation.

On the basis of the information contained in this BMP, Strategen-JBS&G considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are readily manageable through standard management responses outlined in the Guidelines and AS 3959, which will be implemented as required throughout future planning stages. Strategen-JBS&G considers that on implementation of the proposed management measures, the project area will be able to be developed with a manageable level of bushfire risk whilst maintaining full compliance with the Guidelines.

7. References

AECOM Australia Pty Ltd. (2020). *Wattle Grove South Ecological Surveys.* Unpublished report prepared for City of Kalamunda.

Department of Fire and Emergency Services (DFES) 2020, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: https://maps.slip.wa.gov.au/landgate/bushfireprone/, [19/03/2020].

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth.

Department of Water and Environmental Regulation (2020). *Clearing Regulations – Environmentally Sensitive Areas (DWER-046).* Available from: https://services.slip.wa.gov.au/public/rest/services/SLIP_Public_Services/Environment/MapServer/6

Standards Australia (SA) 2018, Australian Standard *AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

Strategen-JBS&G 2021, *Environmental Assessment Report: Wattle Grove MRS Amendment*, report prepared for Hesperia Projects Pty Ltd, Strategen-JBS&G, Perth.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire Prone Areas, Version 1.3 August 2017*, Western Australian Planning Commission, Perth.

8. Limitations

Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

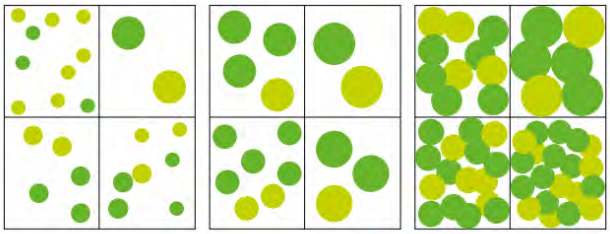
Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Appendix A APZ standards (Schedule 1 of the Guidelines)

Schedule 1: Standards for Asset Protection Zones
• **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used. • **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors. • **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare. • **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.  15% 30% 70% • **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees. • **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs. • **Grass:** should be managed to maintain a height of 100 millimetres or less.

Appendix B Vegetation plot photos and description

Photo ID: 1a (background)

Photo ID: 1b

Photo ID: 1c (background)

Photo ID: 1d

Photo ID: 1e

Photo ID: 1f

Photo ID: 1g (background)

Photo ID: 1h (background)

Photo ID: 1i (background)

Plot number		Plot 1
Vegetation classification	**Pre-development**	Class A Forest
	Post-development	Class A Forest
Description / justification		Trees 10-30 m high at maturity, dominated by Eucalypts, multi-tiered structure comprising tall canopy layer, shrubby middle layer and grass/herb/sedge understorey

Photo ID: 2a (on right)

Photo ID: 2b (on right)

Photo ID: 2c

Photo ID: 2d

Photo ID: 2e

Photo ID: 2f

Photo ID: 2g

Photo ID: 2h

Plot number		Plot 2
Vegetation classification	**Pre-development**	Class B Woodland
	Post-development	Class B Woodland vegetation outside of the project area will remain Class B Woodland post-development. Class B Woodland within the project area will be predominantly cleared or managed to facilitate development thus will be consistent with Clause 2.2.3.2 (e) and (f) of AS3959 following development works. Any vegetation identified for retention through future planning stages will be addressed in subsequent BMPs.
Description / justification		Trees 2-30 m at maturity, dominated by trees with a grassy understorey (lacks shrubby middle layer and deep surface litter)

Photo ID: 4a (foreground)

Photo ID: 4b (foreground)

Photo ID: 4c

Photo ID: 4d

Photo ID: 4e (median strip and road verge)

Photo ID: 4f

Photo ID: 4g

Plot number		Plot 4
Vegetation classification	**Pre-development**	Class G Grassland
	Post-development	Class G Grassland vegetation outside of the project area will remain Class G Grassland post-development. Class G Grassland within the project area will be cleared or managed to facilitate development thus will be consistent with Clause 2.2.3.2 (e) and (f) of AS3959 following development works.
Description / justification		Grassland greater than 100 mm in height

Photo ID: 5a

Photo ID: 5b

Photo ID: 5c

Plot number		Plot 5
Vegetation classification	**Pre-development**	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
	Post-development	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification		Low threat cultivated gardens and maintained lawns within surrounding properties and non-vegetated areas including roads, footpaths, driveways and building footprints

Appendix C City of Kalamunda Fire Hazard Reduction Notice

City of Kalamunda

FIRE HAZARD REDUCTION NOTICE 2020/2021

COMPLIANCE DUE BEFORE: 1 NOV 2020

ASSESSMENTS COMMENCE FROM: 1 NOV 2020

Important: The works outlined below must be completed by 1 November 2020 and maintained in this state up to and including 31 March 2021

NOTICE TO ALL OWNERS AND OCCUPIERS OF LAND WITHIN THE CITY OF KALAMUNDA

Pursuant to Section 33 of the *Bush Fires Act 1954 (WA)*, the City of Kalamunda gives you written notice to act as specified in this notice to land that you own and/or occupy and with respect to any matter which is upon the land that you own and/or occupy situated within the district of the City of Kalamunda.

Failure or neglect to comply with the requisitions of this notice is an offence and can result in a penalty of up to $5000. The City of Kalamunda gives you notice that its 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

ALL LAND WITH A TOTAL AREA OF 4000m² OR MORE

☐ **FIRE-BREAKS**
Install or upgrade a 3-metre-wide by 4-metre-high clearance, bare mineral earth, continuous (no dead ends) trafficable fire-break as close as possible inside the entire perimeter of the land. A reticulated and maintained green lawn may be accepted in lieu of a firebreak.

☐ **DEAD FLAMMABLE MATERIAL**
Maintain all dead flammable material below 8 tonne per hectare (see definition fuel load).

☐ **SLASHING**
Dead grass, shrubs and plants shall be slashed, mowed, or trimmed down to a height no greater than 50mm across the entire property.

☐ **ASSET PROTECTION ZONE (APZ)**
Maintain a fuel reduced zone around all buildings or assets of value which extends 20 metres from the outermost point of the building or asset.

- Ensure gutters, roofs and walls of buildings are free of flammable matter.
- Fuel load within the 20 metres shall be reduced and maintained to no more than 2 tonne per hectare
- Trees over 5 metres in height must be under pruned up to 2 metres.
- Trees or shrubs within 2 metres of the asset must be pruned so that they have an overall height of no greater than 2 metres.

ALL LAND WITH A TOTAL AREA LESS THAN 4000m²

☐ **DEAD FLAMMABLE MATERIAL**
Maintain all dead flammable material below 8 tonne per hectare (see definition fuel load).

☐ **SLASHING**
Dead grass, shrubs and plants shall be slashed, mowed, or trimmed down to a height no greater than 50mm across the entire property.

☐ **CLEAN GUTTER DEBRIS**
Ensure gutters, roofs and walls of buildings are free of flammable matter

VARIATION TO THE FIRE HAZARD REDUCTION NOTICE

If you consider, for any reason, that it is impractical to meet the requirements as per this notice, you may apply in writing for a variation to the requirements of this notice to the City of Kalamunda by no later than 1 October 2020, to request authorisation to employ other methods of fire prevention to land that you own and/or occupy. **An administration fee of $150 applies for applications received after 1 October 2020.**

If permission is not granted to you for a variation of this notice, you must comply with the requirements outlined in the Fire Hazard Reduction Notice.

Variation request application forms are available before 1 October on the City's website at: www.kalamunda.wa.gov.au/our-city/fire/variations

ADDITIONAL WORKS

In addition to the requirements of this notice, regardless of land size, you may be required to carry out further fire prevention works on your land to reduce any hazards considered necessary by the duly Authorised Officer of the City of Kalamunda. If required, these requirements will be outlined in a 'work order' sent to the address of the owner and/or occupier.

EMERGENCY MANAGEMENT PLANS AND CITY APPROVED TREATMENT PLANS

All properties and/or land that are subject to a Bushfire Management Plan, Emergency Management Plan or an approved Bushfire Attack Level assessment (BAL), as a result of subdivision, development application or a City approved treatment plan must comply with the requirements of such plans in their entirety. Compliance with any additional plans does not constitute compliance with this notice.

DEFINITIONS

FIREBREAK
A strip of land cleared of all flammable material with the intention of minimising the spread or extension of a bushfire and provide safe access on your property for emergency vehicles and other firefighting operations.

- No less than 3 metres wide and 4 metres height clearance inside and along all boundaries (including boundaries adjacent to roads, rail and drain reserves and all public open space reserves).
- Must have a corner turning radius of up to 10 metres
- Must be a mineral earth break with a continuous trafficable surface for a 4WD vehicle, clear of any obstructions and must not terminate in a cul-de-sac (dead end)
- Maintained and living lawns are acceptable in conjunction with or in lieu of mineral earth fire breaks, provided that the same width and height requirements for a fire break are applied.
- Must not be more than 4 metres wide (further width extensions may be considered upon written application for approval to the City).

FUEL LOAD:
Any material such as wood, leaves and grass that is likely to be ignited and capable of burning.

- Leaf litter on the ground inclusive of leaves, twigs (up to 6mm diameter) and bark. A fuel load depth of 15mm from the top layer to the mineral earth beneath is indicative of approximately 8 tonne per hectare
- Mulch piles, stored firewood and burn piles contribute to fuel load and must be stored safely or removed from the property.

If you require any further information, please call the City of Kalamunda Community Safety team on (08) 9257 9999 or visit www.kalamunda.wa.gov.au/our-city/fire.

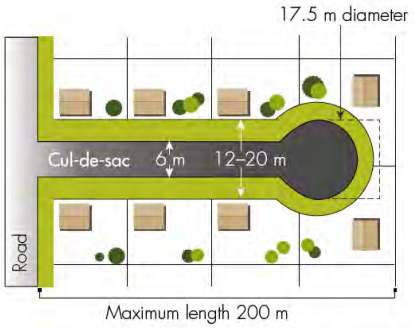
Rhonda Hardy
CHIEF EXECUTIVE OFFICER

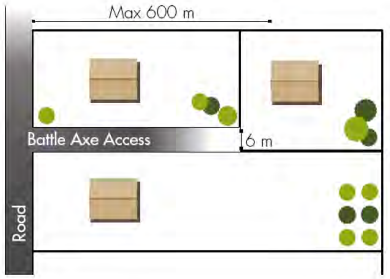
kalamunda.wa.gov.au

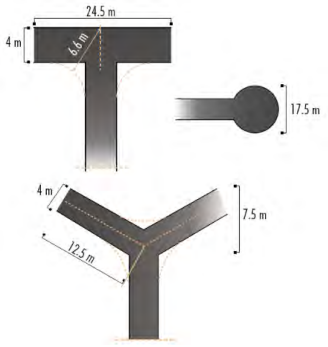
T 9257 9999 **F** 9293 2715 **E** enquiries@kalamunda.wa.gov.au
2 Railway Road KALAMUNDA WA 6076 **PO Box** 42, KALAMUNDA WA 6926
ABN 6074 1095 678

Appendix D Vehicular access technical standards of the Guidelines

Public roads	
Acceptable solution A3.2	A public road is to meet the requirements in Table 1, Column 1.
Explanatory note E3.2	Trafficable surface: Widths quoted for access routes refer to the width of the trafficable surface. A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metre wide paving one metre wide constructed road shoulders. In special circumstances, where eight lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of 90 metres may be provided subject to the approval of both the local government and Department of Fire and Emergency Services. Public road design: All roads should allow for two-way traffic to allow conventional two-wheel drive vehicles and fire appliances to travel safely on them. 

Cul-de-sac (including a dead-end road)	
Acceptable solution A3.3	A cul-de-sac and/ or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/ or will need to be demonstrated by the proponent), the following requirements are to be achieved: • Requirements in Table 1, Column 2 • Maximum length: 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than eight lots are serviced and the emergency access way is no more than 600 metres) • Turn-around area requirements, including a minimum 17.5 metre diameter head.
Explanatory note E3.3	In bushfire prone areas, a cul-de-sac subdivision layout is not favoured because they do not provide access in different directions for residents. In some instances it may be possible to provide an emergency access way between cul-de-sac heads to a maximum distance of 600 metres, so as to achieve two-way access. Such links must be provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency. A cul-de-sac in a bushfire prone area is to connect to a public road that allows for travel in two directions in order to address Acceptable Solution A3.1. 

Battle-axe	
Acceptable solution A3.4	Battle-axe access leg should be avoided in bushfire prone areas. Where no alternative exists, (this will need to be demonstrated by the proponent) all of the following requirements are to be achieved: • Requirements in Table 1, Column 3 • Maximum length: 600 metres • Minimum width: six metres.
Explanatory note E3.4	In bushfire prone areas, lots with battle-axe access legs should be avoided because they often do not provide two-way access and egress for residents and may be easily blocked by falling trees or debris. In some instances, however; it may be appropriate for battle-axe access to be used to overcome specific site constraints. Where used, they should comply with the minimum standards for private driveways. Passing bays should be provided at 200 metre intervals along battle-axe access legs to allow two-way traffic. The passing bays should be a minimum length of 20 metres, with the combined width of the passing bay and the access being a minimum of six metres. Turn-around areas should allow type 3.4 fire appliances to turn around safely (i.e. kerb to kerb 17.5 metres) and should be available at house sites and at 500 metre intervals along the access leg. 

Private driveway longer than 50 metres	
Acceptable solution A3.5	A private driveway is to meet all of the following requirements: • Requirements in Table 1, Column 3 • Required where a house site is more than 50 metres from a public road • Passing bays: every 200 metres with a minimum length of 20 metres and a minimum width of two metres (i.e. the combined width of the passing bay and constructed private driveway to be a minimum six metres) • Turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) and within 50 metres of a house • Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes • All-weather surface (i.e. compacted gravel, limestone or sealed).
Explanatory note E3.5	For a driveway shorter than 50 metres, fire appliances typically operate from the street frontage however where the distance exceeds 50 metres, then fire appliances will need to gain access along the driveway in order to defend the property during a bushfire. Where house sites are more than 50 metres from a public road, access to individual houses and turnaround areas should be available for both conventional two-wheel drive vehicles of residents and type 3.4 fire appliances. Turn-around areas should be located within 50 metres of a house. Passing bays should be available where driveways are longer than 200 metres and turn-around areas in driveways that are longer than 500 metres. Circular and loop driveway designs may also be considered. These criteria should be addressed through subdivision design. Passing bays should be provided at 200 metre intervals along private driveways to allow two-way traffic. The passing bays should be a minimum length of 20 metres, with the combined width of the passing bay and the access being a minimum of six metres. Turn-around areas should allow type 3.4 fire appliances to turn around safely (i.e. kerb to kerb 17.5 metres) and should be available at the house sites and at 500 metre intervals along the driveway. 

Emergency access way	
Acceptable solution A3.6	An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet all of the following requirements: • Requirements in Table 1, Column 4 • No further than 600 metres from a public road • Provided as right of way or public access easement in gross to ensure accessibility to the public and fire services during an emergency • Must be signposted.
Explanatory note E3.6	An emergency access way is not a preferred option however may be used to link up with roads to allow alternative access and egress during emergencies where traffic flow designs do not allow for two-way access. Such access should be provided as a right-of-way or easement in gross to ensure accessibility to the public and fire emergency services during an emergency. The access should comply with minimum standards for a public road and should be signposted. Where gates are used to control traffic flow during non-emergency periods, these must not be locked. Emergency access ways are to be no longer than 600 metres and must be adequately signposted where they adjoin public roads. Where an emergency access way is constructed on private land, a right of way or easement in gross is to be established. 

Fire service access routes (perimeter roads)	
Acceptable solution A3.7	Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for firefighting purposes. Fire service access routes are to meet the following requirements: • Requirements in Table 1, Column 5 • Provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency • Surface: all-weather (i.e. compacted gravel, limestone or sealed) • Dead end roads are not permitted • Turn-around areas designed to accommodate type 3.4 appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) • No further than 600 metres from a public road • Allow for two-way traffic • Must be signposted.
Explanatory note E3.7	Fire service access routes should be established to separate bushfire prone areas from developed areas, and to provide access within and around the edge of subdivisions and related development. Fire service access is used during bushfire suppression operations but can also be used for fire prevention work. Fire service access routes should: • Link up with the road network at regular intervals - the development and road network forms part of the fire service access system • Be adequately signposted • Allow for two-way traffic - that is, two fire appliances must be able to safely pass each other • Have an all-weather surface (i.e. compacted gravel, limestone or sealed) • Have erosion control measures in place. Driveways may be used as part of the designated fire service access system, provided they meet the minimum standard for fire service access routes. It is beneficial to link the fire service access routes with individual driveways to allow quick access to properties and houses during fire emergencies. Where gates are used, these should be wide enough to accommodate type 3.4 fire appliances (minimum width of 3.6m) with the design and construction to be approved by the relevant local government. Gates on fire service access routes may be locked to restrict access provided that a common key system is used and such keys are made available for fire appliances and designated fire officers within the local government area and/or surrounding district. Gates should be installed where fences cross fire service access routes. Management and access arrangements should be in place to ensure that the maintenance of fire service access routes will occur in the long term after an area has been subdivided. A number of options can be used to achieve this, including but not limited to: • Individual property owners being responsible for maintaining fire service access routes where these fall on their property • Providing such access as a right-of-way or easement in gross to ensure accessibility to fire services during an emergency; and/or • A levy system administered by local government to cover the cost of maintaining fire service access routes. Such arrangements should be documented in the relevant planning application (such as a structure plan, subdivision plan or development plan) and should be agreed to by local government.

Technical requirement	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway longer than 50 m	Emergency access way	Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5
* Refer to E3.2 Public roads: Trafficable surface					

Appendix E Water technical standards of the Guidelines

Reticulated areas	
Acceptable solution A4.1	The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.
Explanatory note E4.1	Water supply authorities in Western Australia include the Water Corporation, Aqwest and the Busselton Water Board. The Water Corporation's 'No. 63 Water Reticulation Standard' is deemed to be the baseline criterion for developments and should be applied unless local water supply authorities' conditions apply.

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element.

Appendix E – Transport Impact Assessment

Transport Impact Assessment

Proposed Metropolitan Region Scheme Amendment – Wattle Grove South

CW1163100

Prepared for

Hesperia Pty Ltd

14 June 2021

Cardno

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Tables

Figures

1 Introduction

1.1 Background

Cardno has been commissioned by Hesperia Pty Ltd ("the Client") to prepare a Transport Impact Assessment (TIA) for a proposed Metropolitan Region Scheme (MRS) Amendment in Wattle Grove South (the "Site").

This TIA has been prepared in accordance with the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines Volume 2 – Planning Schemes, Structure Plans and Activity Centre Zones* (2016).

1.2 Site Location

The Site is located in Wattle Grove, bounded by Welshpool Road East, Tonkin Highway and Crystal Brook Road, as shown in **Figure 1-1**. The Site is within the City of Kalamunda.

Figure 1-1 Site Location

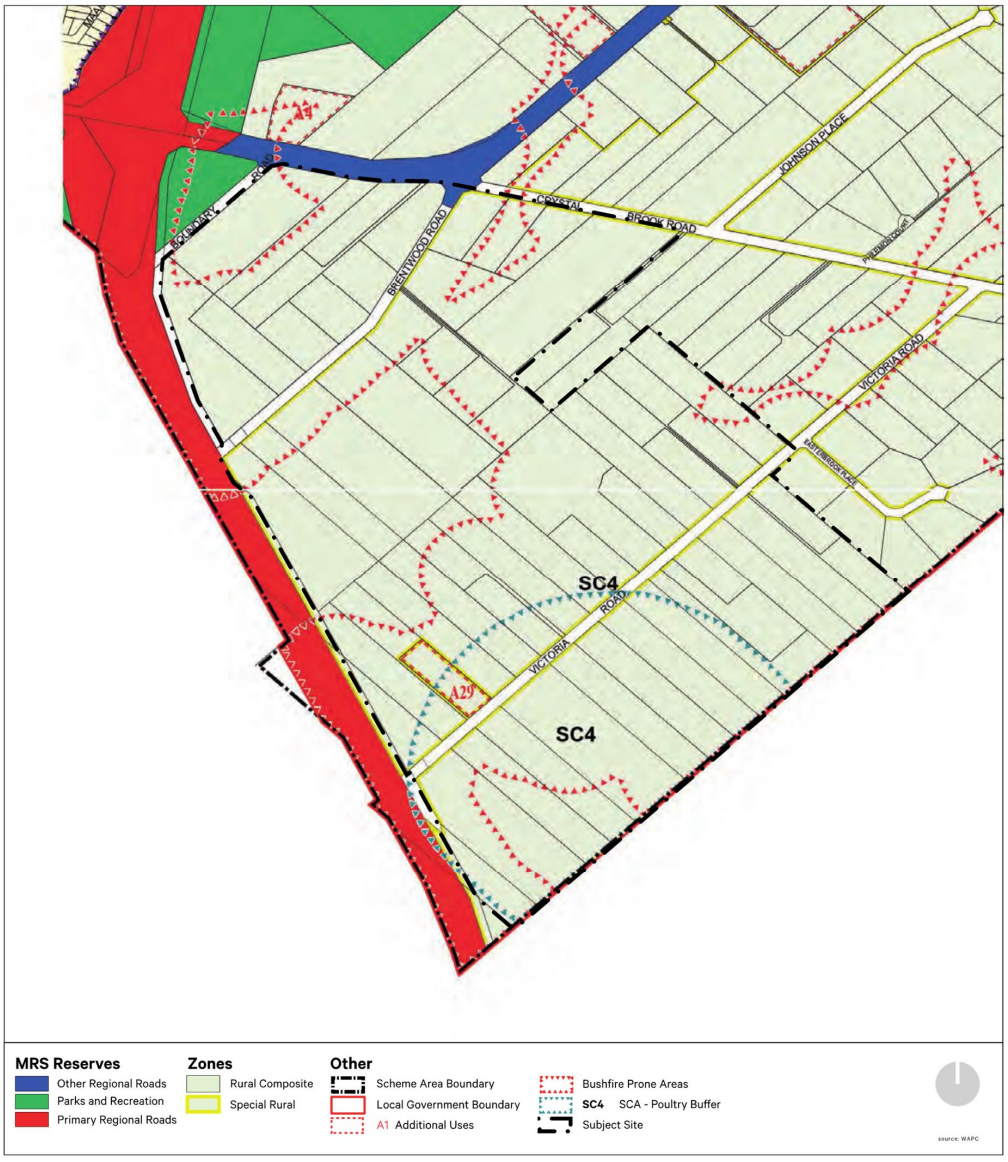
Source: Element

2 Existing Situation

2.1 Existing Land Uses

Pursuant to the *City of Kalamunda Local Planning Scheme No. 3* (LPS3), the Site is currently zoned 'Special Rural' and '*Rural Composite'.* The Site is surrounded by other rural residential and related uses to the east/south. To the west, industrial development is occurring within the 'Maddington-Kenwick Strategic Employment Area' (MKSEA).

Figure 2-1 Existing Local Planning Scheme Zoning



As per the MRS the Site is zoned '*Rural*', as shown below in **Figure 2-2**.

Figure 2-2 MRS Existing Zoning

2.2 Existing Road Network

Road classifications are defined in the Main Roads Functional Hierarchy as follows:

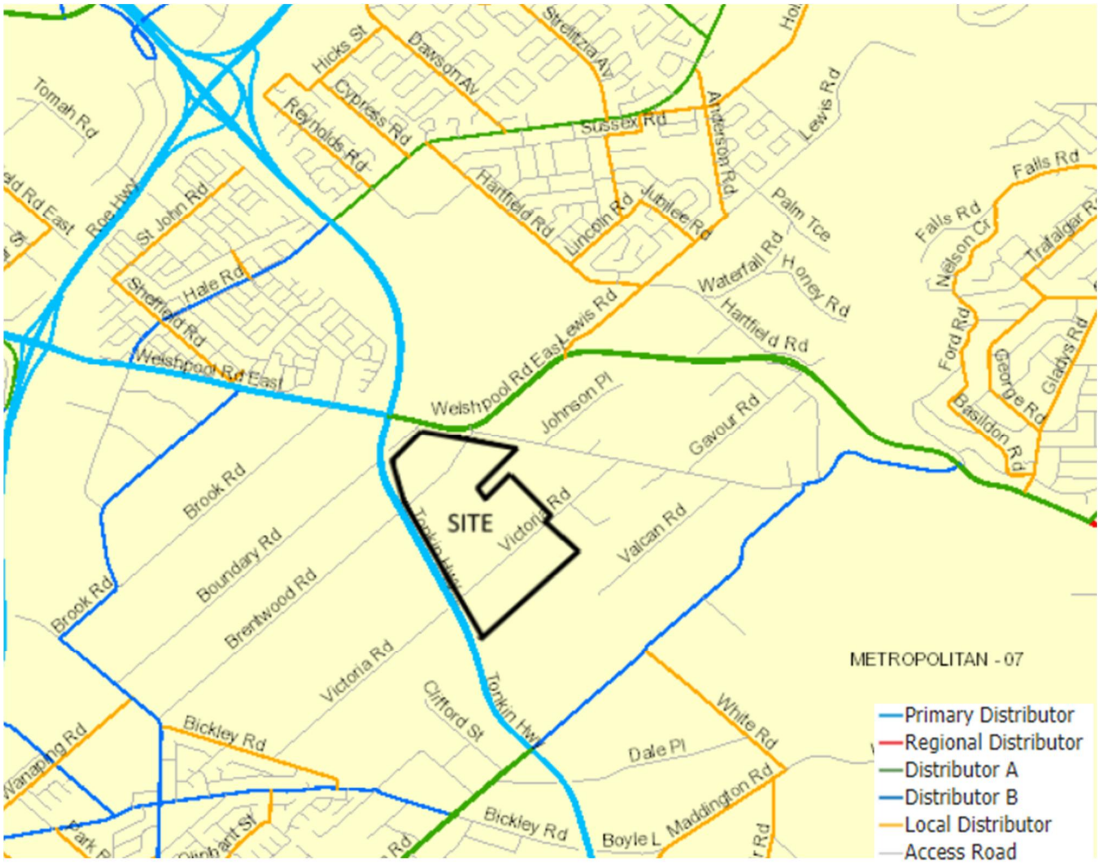
- **Primary Distributors (light blue):** Form the regional and inter-regional grid of MRWA traffic routes and carry large volumes of fast-moving traffic. Some are strategic freight routes, and all are National or State Roads WA.
- **Regional Distributors (red):** Roads that are not Primary Distributors, but which link significant destinations and are designed for efficient movement of people and goods within and beyond regional areas. They are managed by Local Government.
- **District Distributor A (green):** These carry traffic between industrial, commercial and residential areas and connect to Primary Distributors. These are likely to be truck routes and provide only limited access to adjoining properties. They are managed by Local Government.
- **Distributor B (dark blue):** Preform a similar function to District Distributor A but with reduced capacity due to flow restrictions from access to and roadside parking alongside adjoining property. These are often older roads with traffic demand in excess of that originally intended. District Distributor A and B roads run between land-use cells and not through them, forming a grid that would ideally be around 1.5 kilometres apart. They are managed by Local Government.
- **Local Distributors (orange):** Carry traffic within a cell and link District Distributors at the boundary to access roads. The route of the Local Distributor discourages through traffic so that the cell formed by the grid of District Distributors only carries traffic belonging to or serving the area. These roads should accommodate buses but discourage trucks. They are managed by Local Government.
- **Access Roads (grey):** Provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function. These roads are bicycle and pedestrian friendly. They are managed by Local Government.

The Site is bounded by Tonkin Highway to the south, Welshpool Road East to the north and Crystal Brook Road to the east. The surrounding road network is further described in **Table 2-1** and shows the hierarchy as per the Main Roads WA Road Information Mapping System, whilst **Figure 2-3** shows the road hierarchy.

Table 2-1 Road Network Classification

Street Names	Road Hierarchy		Road Network			
	Road Hierarchy	Jurisdiction	No. of Lanes	No. of Footpaths	Width (m)	Posted Speed
Tonkin Highway	Primary Distributor	Main Roads	4	0	28	100
Welshpool Road East	Distributor A	Local Government	4	2	20	80
Crystal Brook Road	Access Road	Local Government	2	1	7	70

Figure 2-3 Road Hierarchy Map



Source: MRWA Road Information Mapping System

The following discusses the intersections / roads that surround the proposed Site:

- **Tonkin Highway/Welshpool Road** East **intersection** is located at the north western boundary of the site. The intersection is a four-way signalised intersection.
- **Welshpool Road East/Crystal Brook Road intersection** is located at the north western boundary of the site. The intersection is a three-way stop-controlled T-intersection.
- **Brentwood Road/Crystal Brook Road intersection** is located at the northern edge of the site. The intersection is a three-way give way-controlled T-intersection comprising single approach and departure lanes.
- **Victoria Road/Crystal Brook Road intersection** is located at the eastern corner of the site. The intersection is a three-way give way-controlled T-intersection comprising single approach and departure lanes for all legs.

2.3 Existing Traffic Volumes

Existing weekday traffic volumes were obtained from Main Roads WA Traffic Map and tube count data provided by the City of Kalamunda for key road sections in the vicinity of the Site.

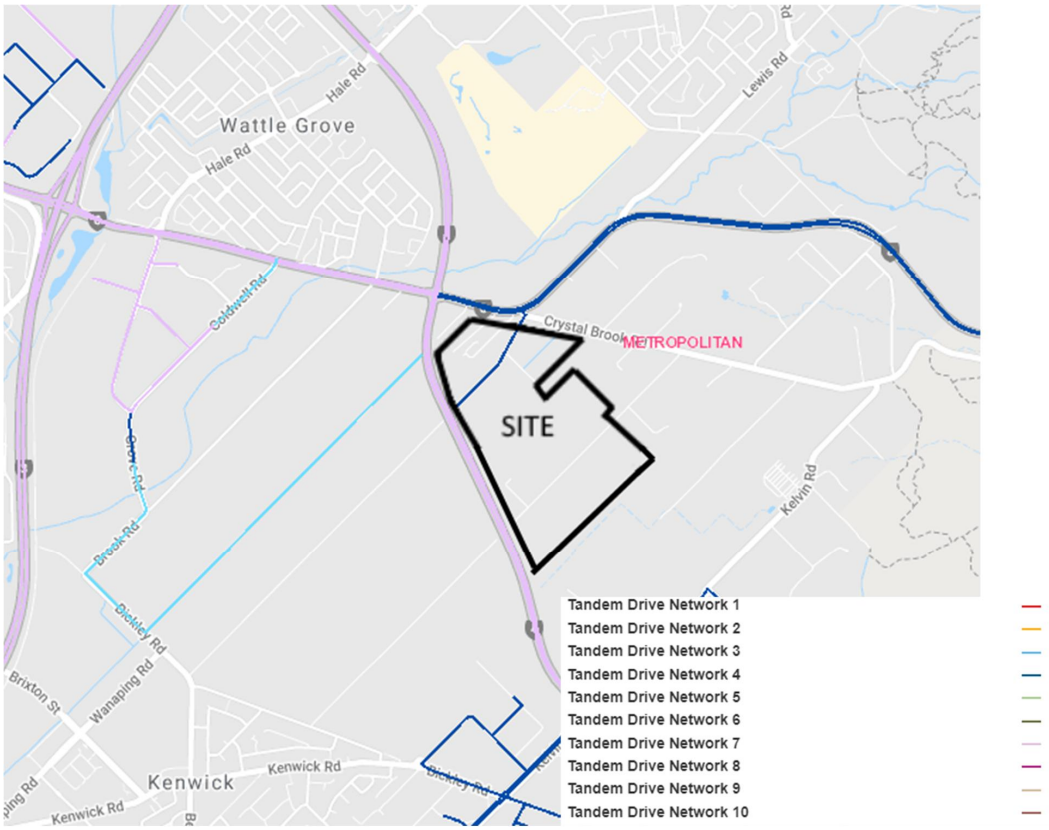
Table 2-2 Existing Weekdays Traffic Volume

Road Name	Year	Daily (vpd)	AM Peak Hour (vph)	PM Peak Hour (vph)	Heavy Vehicle %
Welshpool Road East (East of Tonkin Highway)	2020	18,204	1,597	1,721	12.8
Tonkin Highway (South of Welshpool Road)	2017	48,895	3,838	4,188	10.2
Crystal Brook Road (East of Welshpool Road East)	2020	2,268	201	222	12

2.4 Restricted Access Vehicle (RAV) Network

The existing RAV network is shown below in **Figure 2-4**. Up to RAV 4 sized vehicles can access the Site via Brentwood Road.

Figure 2-4 RAV network map



Source: Main Roads HVS Network Map (2021)

2.5 Existing Public Transport Services

The nearest bus stops to the Site are located to the north of the site on Welshpool Road East and Crystal Brook Road, these stops are serviced by 281, 282 and 283 bus routes, as shown below in **Figure 2-5** and **Figure 2-6.**

Figure 2-5 Nearest Bus Stops

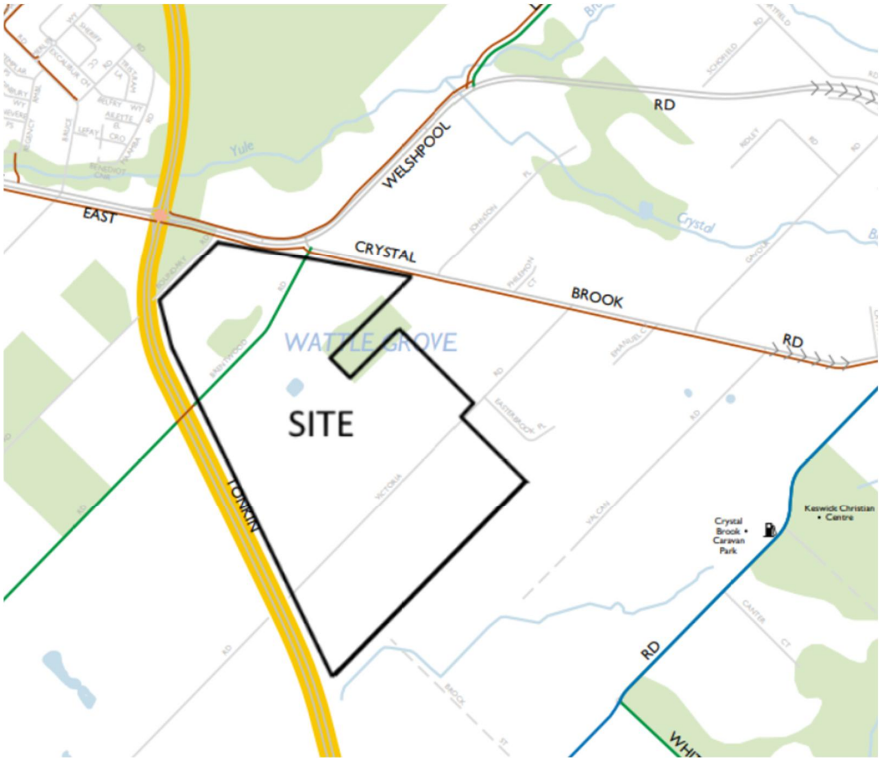
Figure 2-6 Existing Bus Routes

Source: Transperth Network Maps

2.6 Existing Pedestrian/Cycle Networks

Shared paths run along Welshpool Road East and Crystal Brook Road as shown in **Figure 2-7.**"Good Road Riding Environments" are located along Boundary Road. 2.5m sealed shoulders are provided along Tonkin Highway and the Perth Bicycle Network runs along Kelvin Road.

Figure 2-7 Pedestrian and Cycling Network



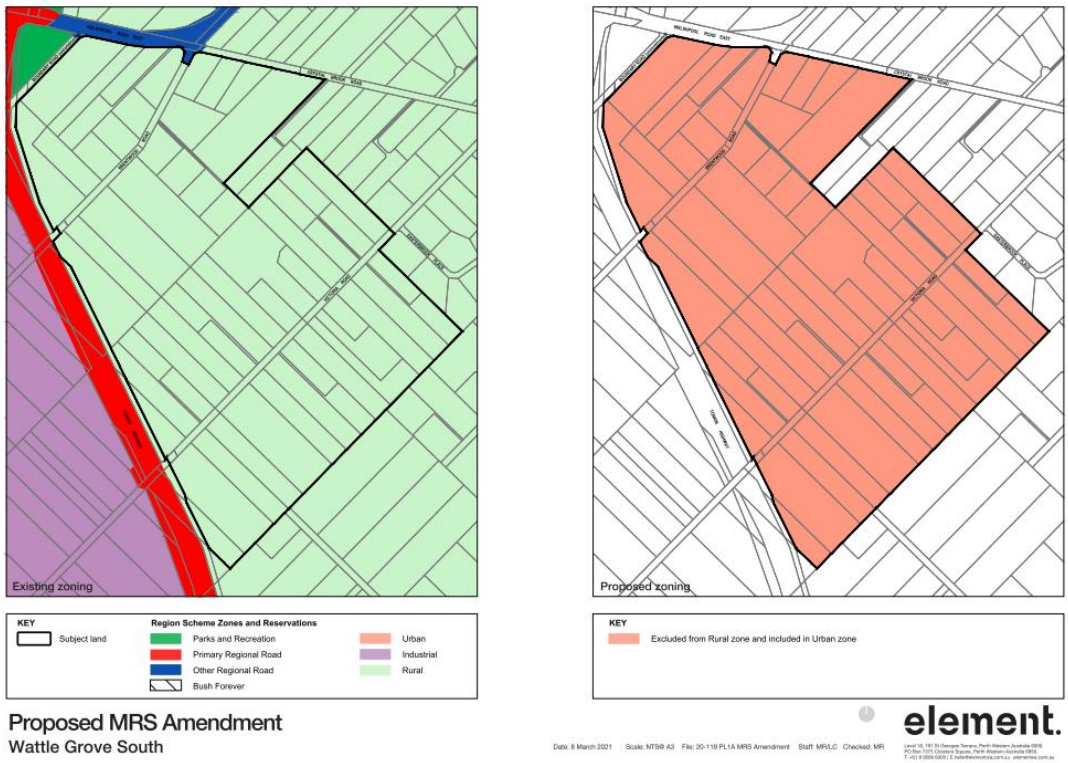
Source: Department of Transport Bike Map

3 Proposed Rezoning Area

The Site is currently zoned for rural purposes as per the City of Kalamunda LPS and the MRS, however an amendment to the Western Australian Planning Commission seeks to change the zoning to a predominantly residential use with complimentary urban uses that would support this outcome.

For the purposes of this level assessment, it is assumed that the predominant land use for the rezoning area will be residential with in the order of 1300 dwellings, representing a higher order magnitude of peak hour trips. Further refinement of land uses and dwelling yield will support further traffic assessment to be undertaken through subsequent planning phases, including Local Structure Planning for the locality, where it is expected that the number of peak our trips will be similar or reduce.

Figure 3-1 Proposed Scheme Amendment Area



Source: Element (2021)

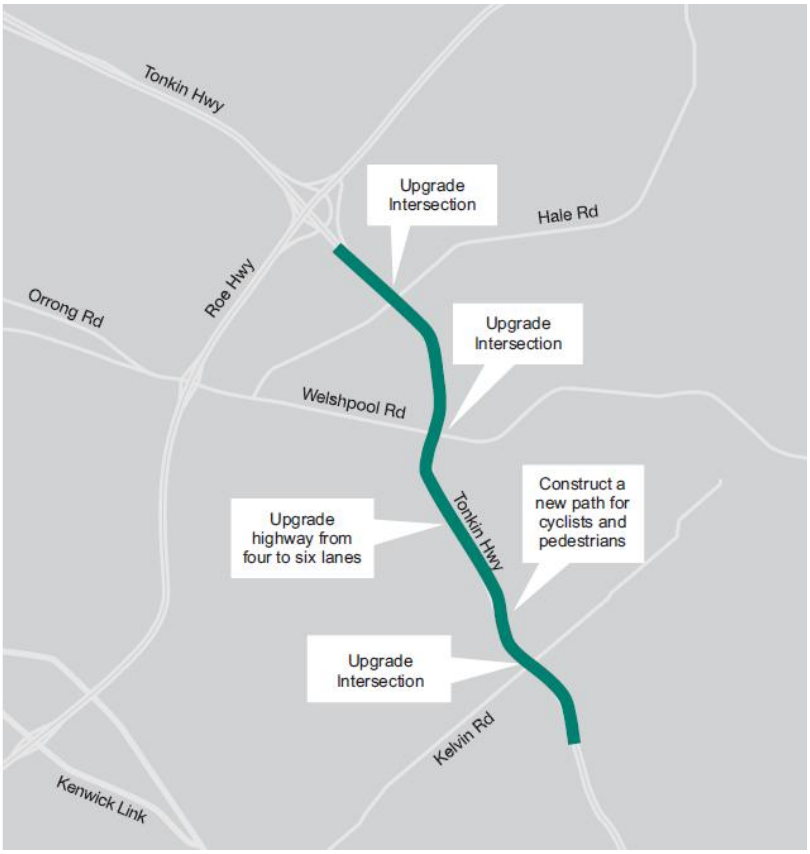
4 Proposed Changes to Transport Network

4.1 External Road Network

4.1.1 Tonkin Highway Upgrade

As part of the Tonkin Highway Corridor Project, Tonkin Highway will be upgraded from four lanes to six lanes and the intersections at Hale Road, Welshpool Road and Kelvin Road will be upgraded as shown in **Figure 4-1.** The proposed changes are funded and is expected to be completed by 2031.

Figure 4-1 Tonkin Highway Corridor Project



Source: Main Roads WA (2021)

4.1.2 Welshpool Road East / Crystal Brook Road Intersection and Brentwood Road.

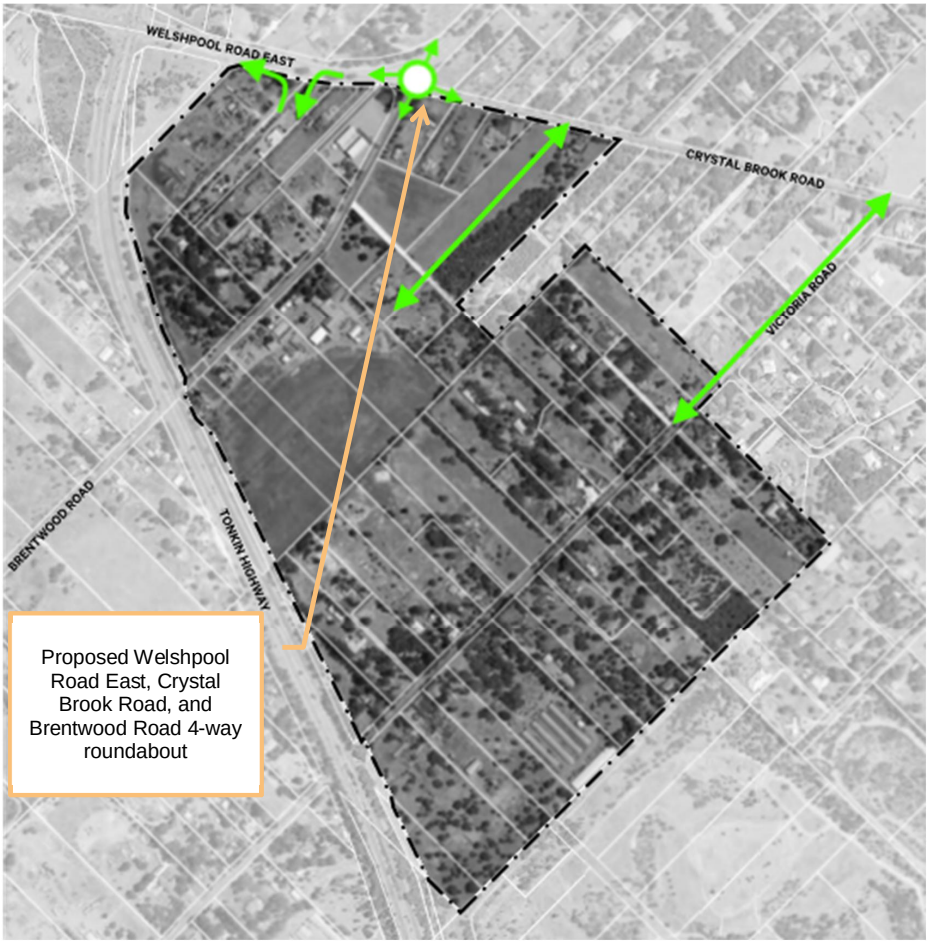
The analysis result presented in **Section 6.5.6 and 6.5.7** of this report indicates that the intersection of Welshpool Road and Crystal Brook Road would need to be upgraded in the future to accommodate traffic generated by the proposed MRS Amendment. Brentwood Road is located close to the intersection and will need to be incorporated in any design for upgrading this intersection. As such, it is proposed that the intersection of Welshpool Road East / Crystal Brook Road and Brentwood Road be converted into a 4-leg roundabout. Refer to **Section 6.5.6 and 6.5.7** for details of the proposed intersection upgrade.

4.2 Internal Road Network

The internal road network and connections the external road network will be further assessed during the structure planning stage.

Indicative access points to the external network are shown in **Figure 4-2** below. Due to the position of the subject land in relation to the strategic road network, particularly Welshpool Road East, the intersection with Crystal Brook Road is the location where the majority of traffic generated by the MRS Amendment enters and exits the regional network. To relieve pressure on this intersection and provide greater network permeability, a Left-In-Left-Out access to Welshpool Road East is proposed between Tonkin Highway and Crystal Brook Road.

Figure 4-2 Indicative Access Arrangements



4.3 Pedestrian/Cycle Network

The Tonkin Highway Corridor Project proposes to construct a new path for cyclists and pedestrians.

Cardno contacted the City of Kalamunda and they are not aware of any other major changes to pedestrian or cycling networks in the vicinity of the Site in the short term.

4.4 Public Transport Network

Cardno contacted the Public Transport Authority and understand there is currently no proposed changes to the network in this area.

5 Integration with Surrounding Area

5.1 Surrounding Attractors and Generators

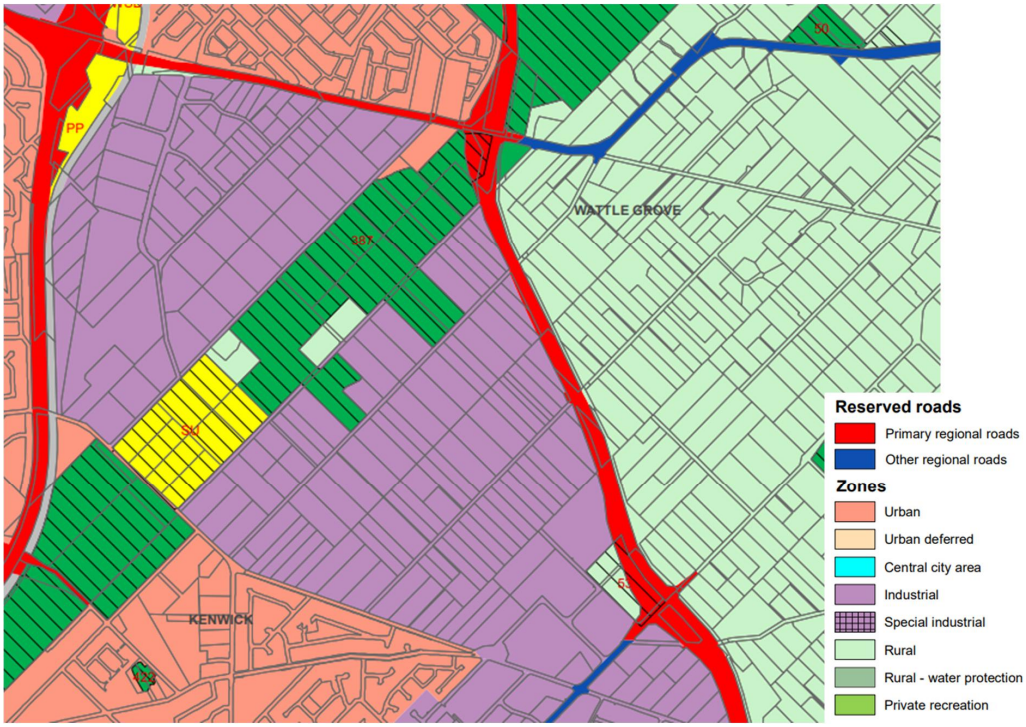
Major trip generators and attractors in the vicinity the Site includes:

- Maddington-Kenwick Strategic Employment Area (MKSEA), a developing industrial area on the west side of Tonkin Highway.
- Existing residential suburbs of Wattle Grove and Forrestfield.
- Existing shopping centres in Forrestfield and Wattle Grove.
- Secondary schools in Kalamunda and Lesmurdie.

5.2 Proposed Changes to Surrounding Land Uses

The most significant land use change nearby the Site is the Maddington-Kenwick Strategic Employment Area (MKSEA) located on the west side of Tonkin Highway as shown below in **Figure 5-1** shaded in purple. Most of the land is still currently rural in nature, however it is being developed gradually into an industrial area.

Figure 5-1 Maddington-Kenwick Strategy Employment Area



Source: Metropolitan Region Scheme

6 Analysis of Transport Network

6.1 Development Traffic Generation

Trip generation has been sourced from WAPC TIA Guidelines and RMS New South Wales *Guide to Traffic Generating Developments Updated traffic surveys.* **Table 6-1** below shows the trip rates for the proposed land use, **Table 6-2** shows the directional distribution. **Table 6-3** shows the resultant trip generation.

For the purposes of this assessment it has been assumed that there is no internal trip containment – i.e. all generated trips access the external road network.

Table 6-1 Trip Generation Rate

Land Use	Source	AM Peak Rate	PM Peak Rate	Daily Rate
Residential Dwellings	RMS	0.95 per dwelling	0.99 per dwelling	10.7 per dwelling

**From RMS Shopping Centre Trip Generation Report (2011)*

Table 6-2 Trip Directional Distribution

Land Use	AM Peak		PM Peak		Daily	
	In	Out	In	Out	In	Out
Residential Dwellings	25%	75%	65%	35%	50%	50%

Table 6-3 Estimated Trip Generation

Land Use	Yield	AM Peak		PM Peak		Daily	
		In	Out	In	Out	In	Out
Residential Dwellings	1300 dwellings	309	926	837	450	6956	6956
	Total	**1235**		**1287**		**13,912**	

6.2 Trip Distribution

For the purpose of the assessment, the residential area is divided into 2 cells to take account the multiple entry points available. Cell 1 is assumed to consist of 90% of the dwellings, while Cell 2 is assumed to have 10% of the dwellings. **Figure 6-1** and **Figure 6-2** shows the trip distribution for the proposed residential cells. The trip distribution is mostly based on ABS journey-to-work data for the area.

The majority of trips are to/from the west on Welshpool Road East, as this is the most convenient link to Tonkin Highway and the wider Perth road network. A left-in, left-out is proposed onto Welshpool Road to improve the level of service expected at the Welshpool Road East/Crystal Brook Road/Brentwood Road intersection. This will be further refined through the traffic assessment to support a local structure plan, including land use typologies for the locality.

Figure 6-1 Residential Cell 1 Distribution

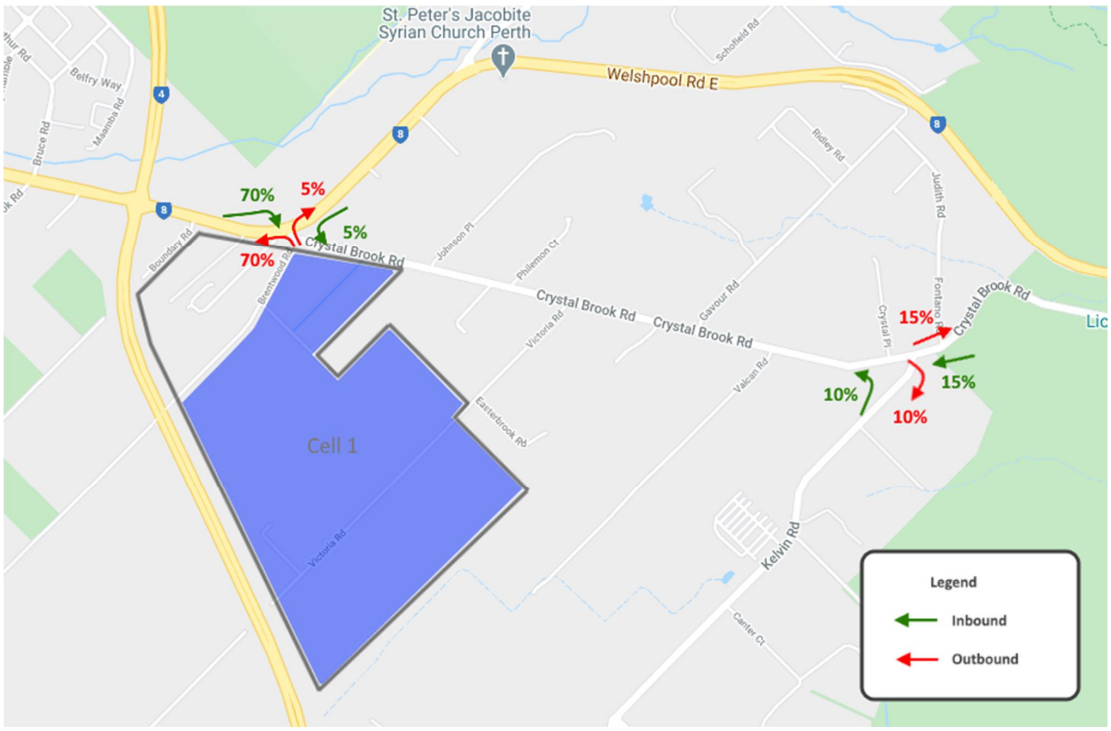
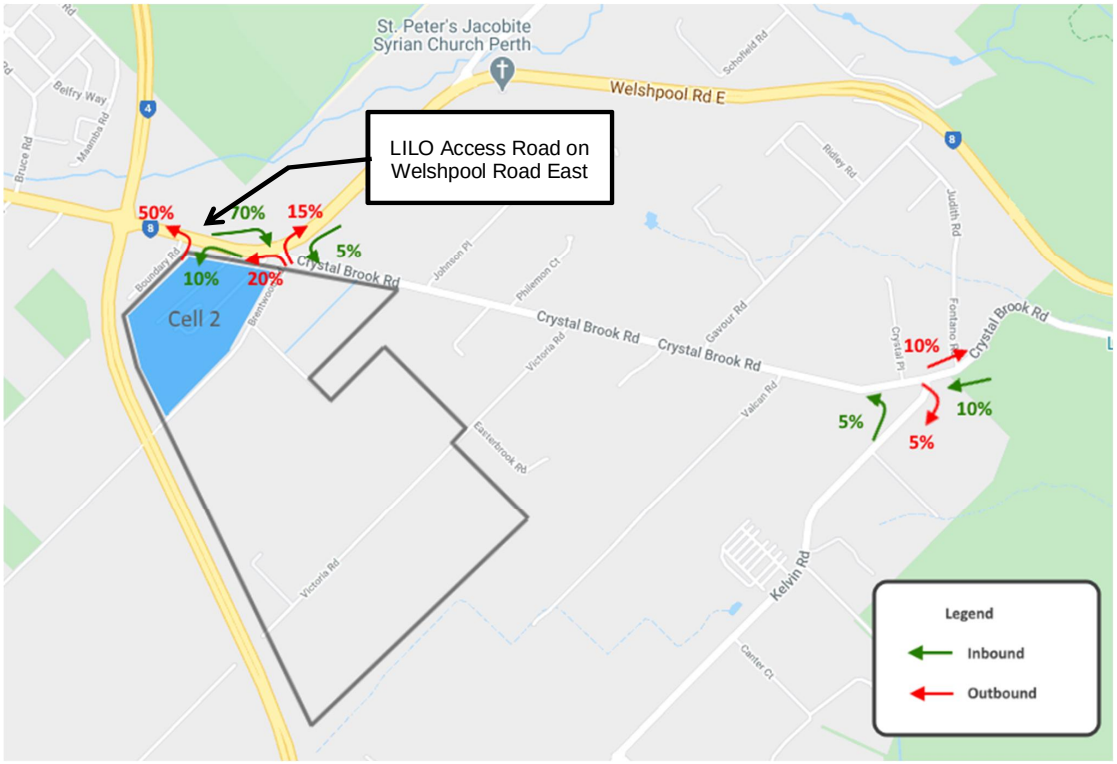


Figure 6-2 Residential Cell 2 Trip Distribution



6.3 Background Traffic

Background traffic data for Welshpool Road East and Crystal Brook Road was obtained from the City of Kalamunda. The data was obtained in 2020, outside of the COVID shutdown period. Data for the Tonkin Highway intersections was obtained from SCATS data via the MRWA Traffic Map.

To determine the traffic growth rate, MRWA ROM data (Job# 41765) was requested. The ROM output provided is using land use scenario for the Tonkin Highway Corridor project. An annual linear growth rate for each intersection leg was calculated by comparing the 2016 and 2036 outputs.

6.4 Daily Traffic Summary

The estimated daily traffic flow at key roads is shown below in **Table 6-4**. The traffic flow forecast is at year 2031 with full development**.**

Table 6-4 Estimated Daily Traffic Volume at 2031 with Full Development

Road	Location	2020 Daily Traffic (vpd)	2031 Development Traffic (vpd)	2031 Total Traffic (vpd)	Recommended Road Hierarchy Classification
Welshpool Road East	North of Crystal Brook Road	16,000	800	17,900	District Distributor A
Welshpool Road East	West of Crystal Brook Road	17,200	9,500	27,800	District Distributor A
Brentwood Road	South of Welshpool Road East	<300	5,400	5,600	Local Distributor
Crystal Brook Road	East of Brentwood Road	2,400	7,400	9,900	District Distributor A
Crystal Brook Road	West of Kelvin Road	1,800	3,300	5,200	District Distributor B
Crystal Brook Road	East of Kelvin Road	4,700	2,000	7,100	District Distributor B
Kelvin Road	South of Crystal Brook Road	5,700	1,300	7,500	District Distributor B
Kelvin Road	East of Tonkin Highway	5,800	1,300	7,700	District Distributor B

Figure 6-3 Daily Traffic Volume 2031

The most significant changes in traffic volume on the external network will occur on Welshpool Road East, west of Crystal Brook Road, and Crystal Brook Road, between Welshpool Road East and Kelvin Road. The latter increases to 10,000 vehicles per day east of Welshpool Road East and 6,000 vehicles per day west of Kelvin Road. To accommodate these volumes, portions of Crystal Brook Road will require upgrading to a form appropriate for District Distributor A/B. The final configuration of Crystal Brook Road will be subject to the location of access points and layout of the internal subdivisional road network, to be determined through the structure planning process

Kelvin Road is projected to have moderate increases in traffic but remains within the District Distributor B threshold.

6.5 Key Intersections Analysis

6.5.1 Analysis Scenario Summary

The SIDRA analysis will be undertaken for the year 2031, the assumed full build-out year, for AM and PM Peaks Hours. At this year, the following is assumed with regards to the road network:

- Tonkin Highway and Welshpool Road is upgraded to a grade separated interchange with Tonkin Highway going over Welshpool Road. The interchange will be a roundabout similar to the ones constructed for NorthLink Project (e.g. at Tonkin Highway and Morley Drive interchange).
- Tonkin Highway and Kelvin Road is upgraded to a roundabout interchange similar to the one at Welshpool Road East.

The above projects have been funded and are expected to be completed before 2031.

6.5.2 SIDRA Results Definition

The subject intersections have been analysed using the SIDRA analysis program. This program calculates the performance of intersections based on input parameters, including geometry and traffic volumes. As an output SIDRA provides values for the Degree of Saturation (DOS), queue lengths, delays, level of service, and 95th Percentile Queue. These parameters are defined as follows:

- Degree of Saturation (DOS) is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The theoretical intersection capacity is exceeded for an un-signalized intersection where DOS > 0.80;
- 95% Queue is the statistical estimate of the queue length up to or below which 95% of all observed queues would be expected;
- Average Delay is the average of all travel time delays for vehicles through the intersection. An unsignalised intersection can be considered to be operating at capacity where the average delay exceeds 55 seconds for any movement; and
- Level of Service (LOS) is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. The different levels of service can generally be described as shown in **Table 6-5.**

Table 6-5 Level of Service (LoS) Performance Criteria

LOS	Description	Signalised Intersection	Unsignalised Intersection
A	Free-flow operations (best condition)	≤10 sec	≤10 sec
B	Reasonable free-flow operations	10-20 sec	10-15 sec
C	At or near free-flow operations	20-35 sec	15-25 sec
D	Decreasing free-flow levels	35-55 sec	25-35 sec
E	Operations at capacity	55-80 sec	35-50 sec
F	A breakdown in vehicular flow (worst condition)	≥80 sec	≥50 sec

A LOS exceeding these values indicates that the road section is exceeding its practical capacity. Above these values, users of the intersection are likely to experience unsatisfactory queueing and delays during the peak hour periods.

6.5.3 Peak Hour Traffic Flow

Peak hour traffic volumes are presented in the figures below.

Figure 6-4 Tonkin Highway / Welshpool Road East 2031 with Development Traffic Volume

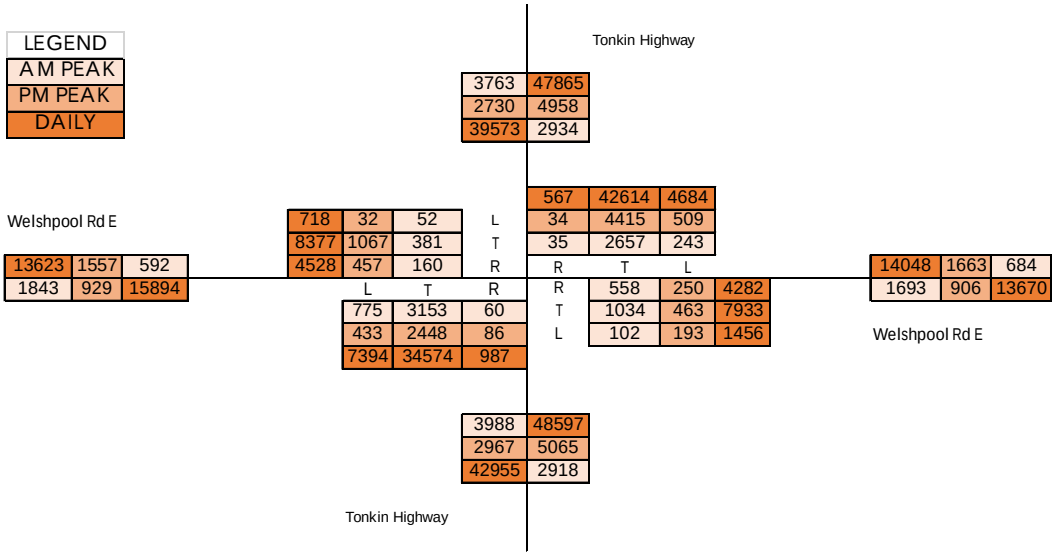


Figure 6-5 Tonkin Highway / Kelvin Road 2031 with Development Traffic Volume

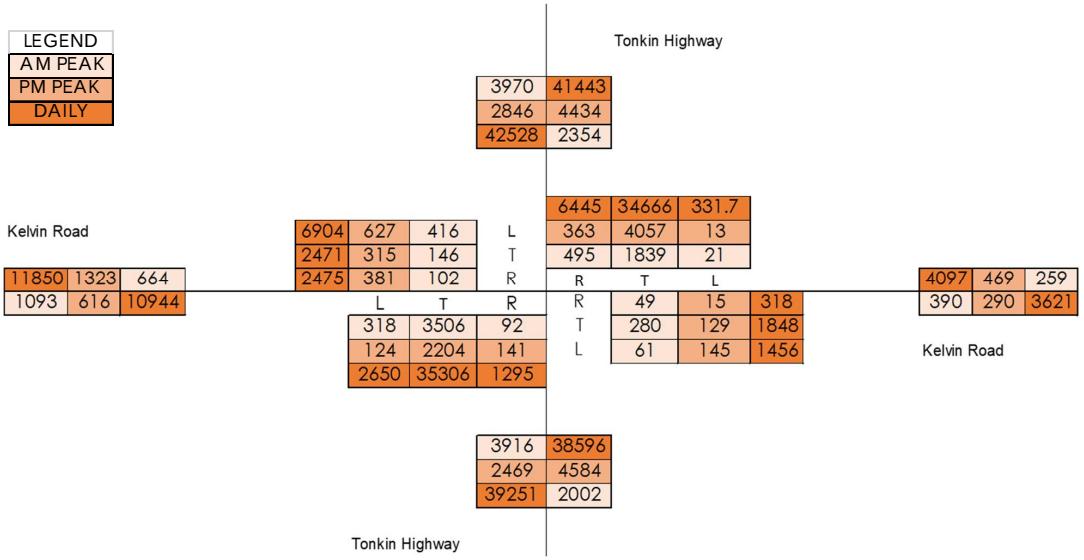


Figure 6-6 Welshpool Road East / Crystal Brook Road/ Brentwood Road 2031 with Development Traffic Volume (4-way roundabout layout)

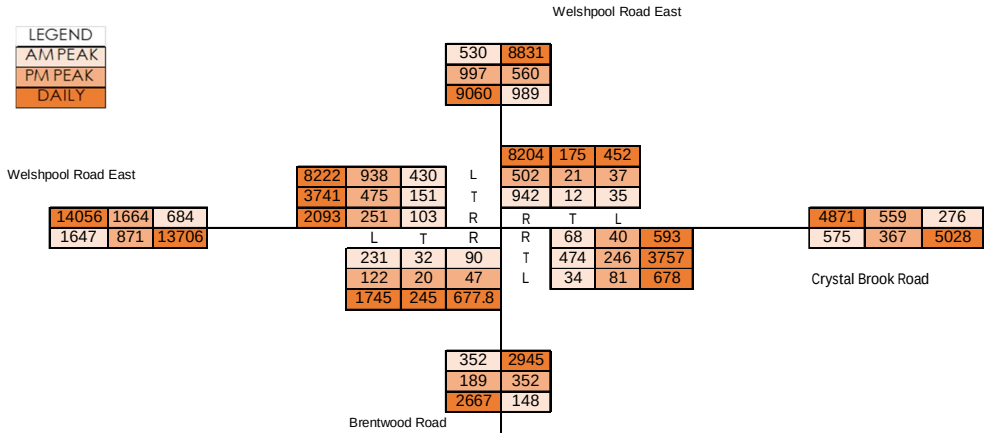
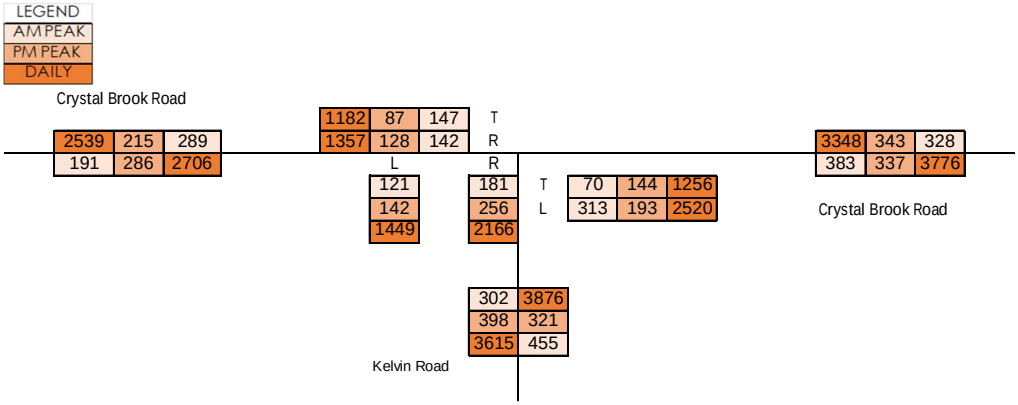


Figure 6-7 Crystal Brook Road / Kelvin Road 2031 with Development Traffic Volume

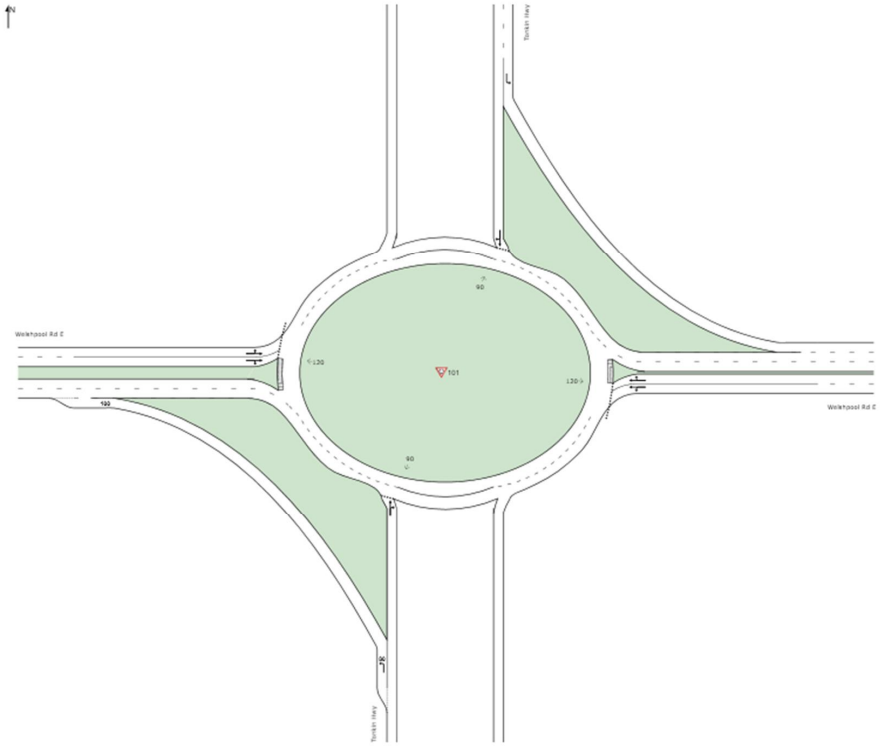


6.5.4 Tonkin Highway / Welshpool Road East

The SIDRA layout of future Tonkin Highway / Welshpool Road East is shown in **Figure 6-8**. Note that Tonkin Highway itself, which is grade separated and goes above the roundabout, is not modelled as it does not interact with the roundabout**.** The layout is largely based on the concept design by MRWA as modelled in the Maddington-Kenwick Strategy Employment Area Precinct 1 Transport Impact Assessment (MKSEA P1 TIA). The final design has not yet been confirmed.

The analysis results for the intersection are presented in **Table 6-6.** The results show that the upgraded future interchange would operate satisfactorily and would be able to cater for the proposed development yield.

Figure 6-8 Tonkin Highway / Welshpool Road East SIDRA Layout



Note that the future Tonkin Highway going over the roundabout is excluded as it will not affect the intersection analysis

Table 6-6 SIDRA Results – Tonkin Highway / Welshpool Road East

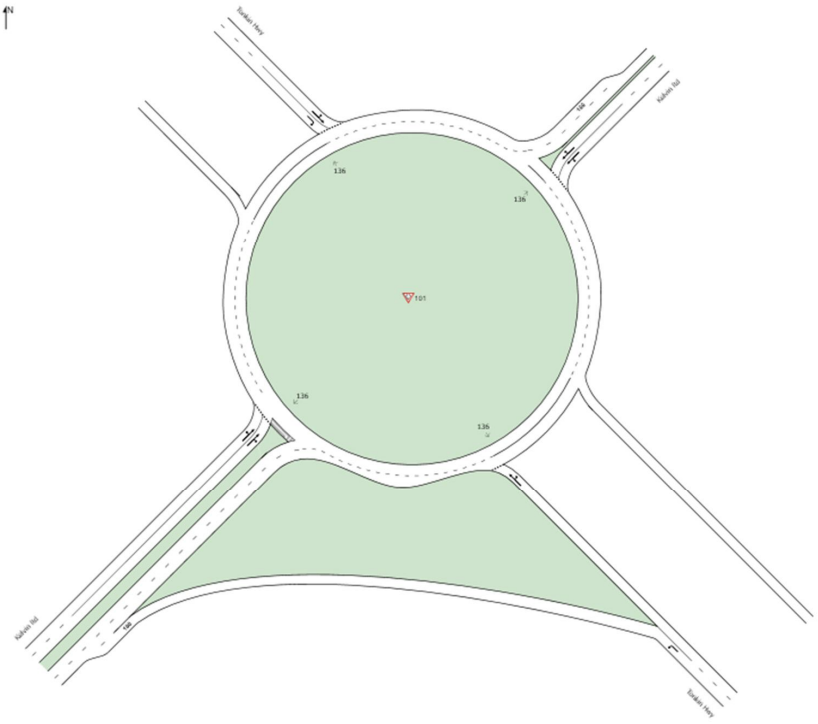
Intersection Approach		Tonkin Highway / Welshpool Road East Year 2031							
		AM Peak				PM Peak			
		DOS	Delay	LOS	95% Queue (m)	DOS	Delay	LOS	95% Queue (m)
Tonkin Highway – S	L	0.476	5.4	A	0	0.266	3.3	A	0
	T	0.085	7.8	A	4.4	0.081	5	A	3.4
	R	0.085	16.1	B	4.4	0.081	13.5	B	3.4
Welshpool Road East – E	L	0.597	4.5	A	51.8	0.419	5.7	A	33.4
	T	0.597	6.5	A	51.8	0.419	6.6	A	33.4
	R	0.597	13.9	B	48.7	0.419	15.6	B	28.2
Tonkin Highway – N	L	0.146	3.2	A	0	0.306	3.2	A	0
	T	0.032	4.7	A	1.3	0.055	7.9	A	3
	R	0.032	13.3	B	1.3	0.055	16.3	B	3
Welshpool Road East – W	L	0.303	6.3	A	23.4	0.612	5.3	A	52.9
	T	0.303	7	A	23.4	0.612	6.1	A	54
	R	0.303	16.4	B	19.5	0.612	15.8	B	54
All vehicles		**0.597**	**7.9**	**A**	**51.8**	**0.612**	**7.6**	**A**	**54**

6.5.5 Tonkin Highway / Kelvin Road

The SIDRA layout of future Tonkin Highway / Kelvin Road is shown in **Figure 6-9**. Note that Tonkin Highway itself, which is grade separated and goes above the roundabout, is not modelled as it does not interact with the roundabout**.** The layout is based on the concept design by MRWA as modelled in the MKSEA P1 TIA. The final design has not yet been confirmed.

The analysis results for intersection are presented in **Table 6-7.** The results show that the upgraded future interchange would operate satisfactorily and would be able to cater for the proposed development yield.

Figure 6-9 Tonkin Highway / Kalvin Road SIDRA Layout



Note that the future Tonkin Highway going over the roundabout is excluded as it will not affect the intersection analysis

Table 6-7 SIDRA Results – Tonkin Highway / Kelvin Road

Intersection Approach		Tonkin Highway / Kelvin Road Year 2031							
		AM Peak				PM Peak			
		DOS	Delay	LOS	95% Queue (m)	DOS	Delay	LOS	95% Queue (m)
Tonkin Highway – S	L	0.209	3.8	A	0	0.082	3.7	A	0
	T	0.108	5.8	A	5	0.138	4.6	A	5.6
	R	0.108	14.8	B	5	0.138	13.5	B	5.6
Kelvin Road – E	L	0.208	5.7	A	9.1	0.17	6.1	A	7.8
	T	0.208	5.6	A	9.1	0.17	6.2	A	7.8
	R	0.208	14.8	B	8.3	0.17	15.3	B	6.3
Tonkin Highway – N	L	0.029	5.7	A	1.1	0.327	10.1	B	22
	T	0.029	5.1	A	1.1	0.327	9.1	A	22
	R	0.455	14.1	B	27.3	0.327	19.2	B	22
Kelvin Road – W	L	0.267	4.2	A	15.5	0.531	5	A	39.1
	T	0.21	4.5	A	11.1	0.458	4.5	A	32.9
	R	0.21	12.9	B	11.1	0.458	12.9	B	32.9
All vehicles		**0.455**	**8.1**	**A**	**27.3**	**0.531**	**9.2**	**A**	**39.1**

6.5.6 Welshpool Road East / Crystal Brook Road (Existing Layout)

The SIDRA layout of Welshpool Road East and Crystal Brook Road is shown in **Figure 6-10** the analysis results for intersection are presented in **Table 6-8.**

The results show that the intersection would not be able to accommodate the proposed development and therefore an upgrade is required.

Figure 6-10 Welshpool Road East / Crystal Brook Road SIDRA Layout

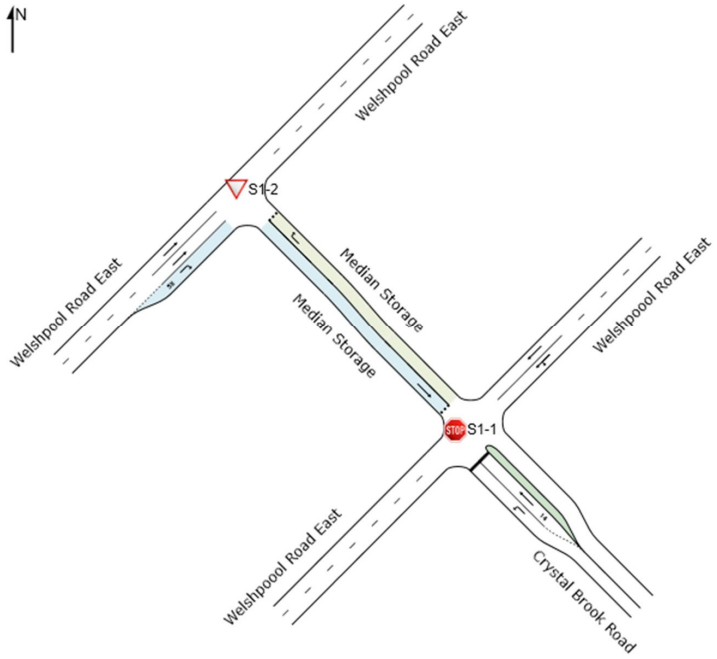


Table 6-8 SIDRA Results –Welshpool Road East / Crystal Brook Road (Existing Layout)

Intersection Approach		Welshpool Road East / Crystal Brook Road (Existing Layout) Year 2031							
		AM Peak				PM Peak			
		DOS	Delay	LOS	95% Queue (m)	DOS	Delay	LOS	95% Queue (m)
Crystal Brook Road – S	L	0.985	40.4	E	236	0.374	6.9	A	15.2
	R	0.916	113.6	F	47.7	0.477	66.9	F	13.2
Welshpool Road East – E	L	0.295	7.1	A	0	0.167	7.1	A	0
	T	0.295	0.1	A	0	0.167	0	A	0
Welshpool Road East – W	T	0.133	0	A	0	0.29	0.1	A	0
	R	0.591	18.9	C	23.8	0.932	26	D	152.5

6.5.7 Welshpool Road East / Crystal Brook Road (Proposed Future Layout)

The proposed upgrade is to modify the intersection of Welshpool Road East, Crystal Brook Road, and Brentwood Road as a 4-leg roundabout. Various layouts were tested before arriving at the SIDRA layout shown in **Figure 6-11**.

Key features of the 4-leg roundabout are:

- Brentwood Road linked directly as the fourth leg of the intersection with 2 approach lanes, 1 being a left turn only auxiliary lane and the other lane being a through and right turn lane.
- 2 westbound approach lanes (1 being an auxiliary lane) on Crystal Brook Road.
- 2 eastbound approach lanes on Welshpool Road East western leg with a third lane being a left turn slip lane towards east/north. The third lane is assumed to be continuous from the roundabout interchange at Tonkin Highway through to this intersection.
- 2 approach lanes on Welshpool Road East north leg, with 1 lane for right turn only and full movement of the other lane.
- Geometric components including the length of deceleration lanes and merges, roundabout island diameters etc to be further confirmed in detailed design stage.

Table 6-9 shows the results for the AM and PM Peak Hour respectively. The results show that the proposed 4- leg roundabout layout would performed adequately.

While this layout operates adequately for the projected traffic volumes, the proposed intersection layout is not final and should be reassessed during the structure planning stages when the land uses and associated traffic patterns would be considered in finer detail.

Figure 6-11 SIDRA Layout – 4-Leg Roundabout Layout

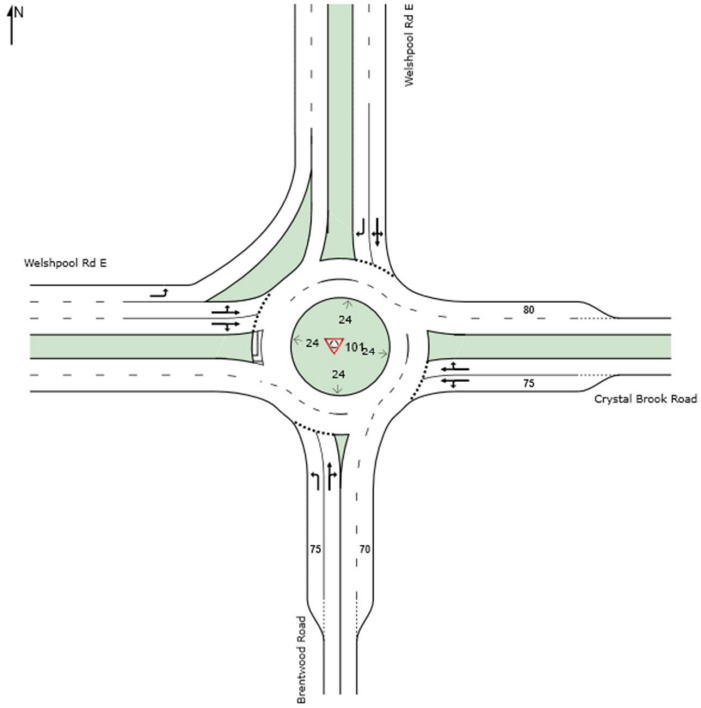


Table 6-9 SIDRA Results –Welshpool Road East / Crystal Brook Road / Brentwood Road (Future Layout)

Intersection Approach		Welshpool Road East / Crystal Brook Road / Brentwood Road (Future Layout) Year 2031							
		AM Peak				PM Peak			
		DOS	Delay	LOS	95% Queue (m)	DOS	Delay	LOS	95% Queue (m)
Brentwood Road – S	L	0.33	8.2	A	13	0.135	6	A	4.5
	T	0.247	9.3	A	8.3	0.097	6.6	A	3
	R	0.247	14.5	B	8.3	0.097	11.8	B	3
Crystal Brook Road – E	L	0.431	9.1	A	18.8	0.234	8	A	8.8
	T	0.431	9.6	A	18.8	0.234	8	A	8.8
	R	0.431	15.3	B	17.6	0.234	13.3	B	8.4
Welshpool Road East – N	L	0.489	8.2	A	25.7	0.366	10.4	B	16.8
	T	0.489	8.5	A	25.7	0.366	10.4	B	16.8
	R	0.489	13.6	B	25.7	0.366	15.5	B	16.8
Welshpool Road East – W	L	0.197	5.8	A	5.3	0.443	5.7	A	13.1
	T	0.185	6.9	A	8.7	0.443	6.9	A	26.6
	R	0.185	12.2	B	8.7	0.443	12	B	26.6
All vehicles		**0.489**	**10.5**	**B**	**25.7**	**0.443**	**8.9**	**A**	**26.6**

6.5.8 Crystal Brook Road / Kelvin Road

The SIDRA layout of Crystal Brook Road / Kelvin Road is shown in **Figure 6-12.** The analysis results for intersection are presented in **Table 6-10.**

The results show that the intersection would operate satisfactorily and would be able to cater for the proposed development yield. No upgrade is proposed for this intersection.

Figure 6-12 Crystal Brook Road / Kelvin Road SIDRA Layout

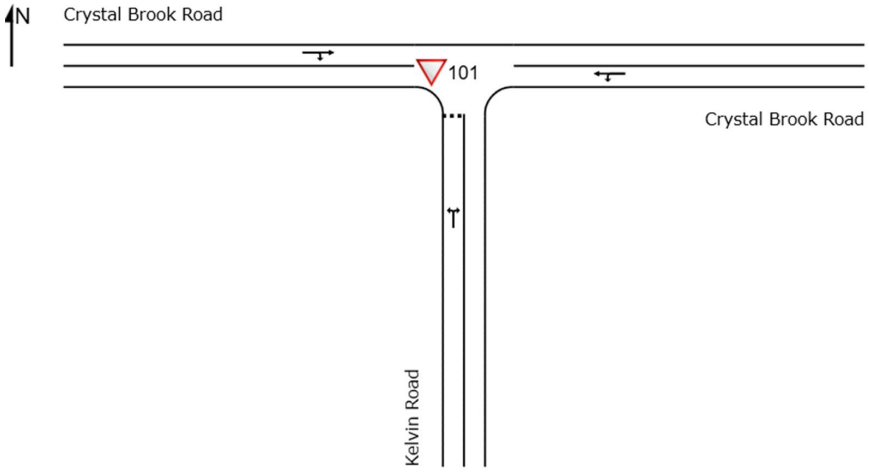


Table 6-10 SIDRA Results –/ Crystal Brook Road / Kelvin Road

Intersection Approach		Crystal Brook Road / Kelvin Road Year 2031							
		AM Peak				PM Peak			
		DOS	Delay	LOS	95% Queue (m)	DOS	Delay	LOS	95% Queue (m)
Kelvin Road – S	T	0.372	6.4	A	14.7	0.473	7.2	A	22.9
	R	0.372	10	B	14.7	0.473	10.1	B	22.9
Crystal Brook Road – E	L	0.232	6.5	A	0	0.197	6.5	A	0
	R	0.232	5.3	A	0	0.197	5.1	A	0
Crystal Brook Road – W	L	0.223	1.5	A	9.4	0.162	1.3	A	6.5
	T	0.223	8.2	A	9.4	0.162	7.7	A	6.5
All Vehicles		**0.372**	**6.5**	**NA**	**14.7**	**0.473**	**7**	**NA**	**22.9**

6.6 Public Transport Access

An existing bus route (283) currently serves Crystal Brook Road, which abuts the northern edge of the Site. In the Structure Plan stage, there is an opportunity to provide additional or alternative bus routes that would cover the southern/central portion of the Site. A suitable internal road network should be developed to facilitate a bus route operating through the site in consultation with the Public Transport Authority.

6.7 Pedestrian and Cycling Network

Well connected pedestrian and cycling networks should be provided within the Site, particularly to any specific destination areas designated as part of future structure planning. External connections should also be provided, particularly to the Tonkin Highway Principal Shared Path (PSP) which is expected to be constructed along the eastern side of Tonkin Highway. Upgraded shared paths should also be provided as part of upgrades to Welshpool Road East and Crystal Brook Road adjacent to the site.

7 Summary

This assessment has been prepared in accordance with the *WAPC Transport Assessment Guidelines for Developments: Volume 2 – Planning Schemes, Structure Plans and Activity Centre Plans* (2016).

The following conclusions have been made in regards to the proposed scheme amendment:

- An MRS Amendment is proposed for a Site in Wattle Grove South bounded by Tonkin Highway, Welshpool Road East, and Crystal Brook Road. The amendment is proposing to rezone the site from 'Rural' to 'Urban' zoning.
- For the purpose of the traffic analysis, it is assumed that the area will be developed predominantly as a residential area with a yield of 1300 dwellings. Future structure planning will refine the land use breakdown and dwelling yield.
- Analysis of expected daily traffic volumes on the external road network indicates that:
  - Welshpool Road East, between Tonkin Highway and Crystal Brook Road, will increase to approximately 28,000 vehicles per day. This can be accommodated within the existing road layout, but will require intersection upgrades (refer below);
  - Crystal Brook Road will require upgrading to accommodate between 5,000 and 10,000 vehicles per day. The extent and form of upgrades will be subject to the location of access points to the Site and the internal subdivisional road layouts, and will be further assessed at Structure Plan stage.
  - Kelvin Road is expected to have moderate increases in traffic volumes but remain within the Distributor B threshold.
- Analysis of the key intersections on the external road network has been undertaken with the following conclusion:
  - The future interchange at Tonkin Highway / Welshpool Road East and Tonkin Highway / Kelvin Road is expected to be able to cater for the proposed traffic generated as part of the new residential area. Note that the analysis is based on a concept interchange design and MRWA is yet to confirm the final design for these interchanges;
  - Welshpool Road East and Crystal Brook Road intersection would need upgrades to cater for the proposed development; and
  - Crystal Brook Road and Kelvin Road intersection can cater for the proposed development and no upgrade requirement is identified at this stage.
- To support the future development, modifications to bus routes in the area should be investigated in collaboration with the Public Transport Authority. In particular, there is an opportunity to integrate the existing bus Route 283 through the new residential development.
- Well-connected pedestrian and cycling networks should be provided within the Site, as well as convenient connections to the existing and planned Tonkin Highway PSP. Welshpool Road East and Crystal Brook Road upgraded sections adjacent to the site should include high-quality pedestrian and cycling facilities.

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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element.

Appendix F – Servicing Report


TABEC
Civil Engineering Consultants
WATTLE GROVE SOUTH
ENGINEERING SERVICING REPORT
HESPERIA PROJECTS PTY LTD
May 2021

CLIENT: HESPERIA PROJECTS PTY LTD

PROJECT: WATTLE GROVE SOUTH

TITLE: ENGINEERING SERVICING REPORT

DOCUMENT REVIEW				
Revision	Date Issued	Written By	Reviewed By	Approved By
A	31.05.2021	BF	CB	BF

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WATTLE GROVE SOUTH

1 INTRODUCTION

TABEC Pty Ltd has prepared the following servicing report for Hesperia Property Pty Ltd to support the Metropolitan Region Scheme rezoning of Wattle Grove, south of Crystal Brook Road, to 'Urban' for future residential and associated development (the site).

The report provides engineering advice on the capability and future infrastructure requirements of the site to support the proposed development and the civil engineering influences on the development plan form. In particular the report considers earthworks, roads, drainage, wastewater, water, gas, power, and communication servicing requirements to support development.

The investigation, servicing recommendations and preparation of the report is primarily based on preliminary advice from the various authorities. The information is current at the time of preparing the report and is therefore subject to change as planning and development progresses in and around the site.

The site is identified by the red boundary/shading on Figure 1 presented below:

Figure 1 – Wattle Grove South Study Area

2 THE STUDY AREA

2.1 Site Description

The site covers an area of approximately 106ha and is located around 15km southeast of the Perth CBD within the Shire of Kalamunda. The site is generally bounded by Welshpool Road East and Crystal Brook Road to the north, lots on the south-eastern side of Victoria Road and the City of Kalamunda/Gosnells local government boundary to the east and Tonkin Highway to the west. The existing Boundary Road reserve is located along the north-western boundary of the site, whilst the existing Brentwood Road and Victoria Road traverse the site.

The Western Australian Planning Commission's (WAPC) North-East Sub-Regional Planning Framework, adopted in March 2018, identifies the Wattle Grove site as Urban Expansion. The City of Kalamunda's Local Planning Strategy 2010 identifies Wattle Grove as an Investigation Area and the site falls within the City's current Wattle Grove South (Crystal Brook) planning project area.

The site is currently zoned 'Rural' under the Metropolitan Regional Scheme (MRS) and the City of Kalamunda Town Planning Scheme. The proposed MRS amendment will rezone the site to 'Urban', refer Figure 2.

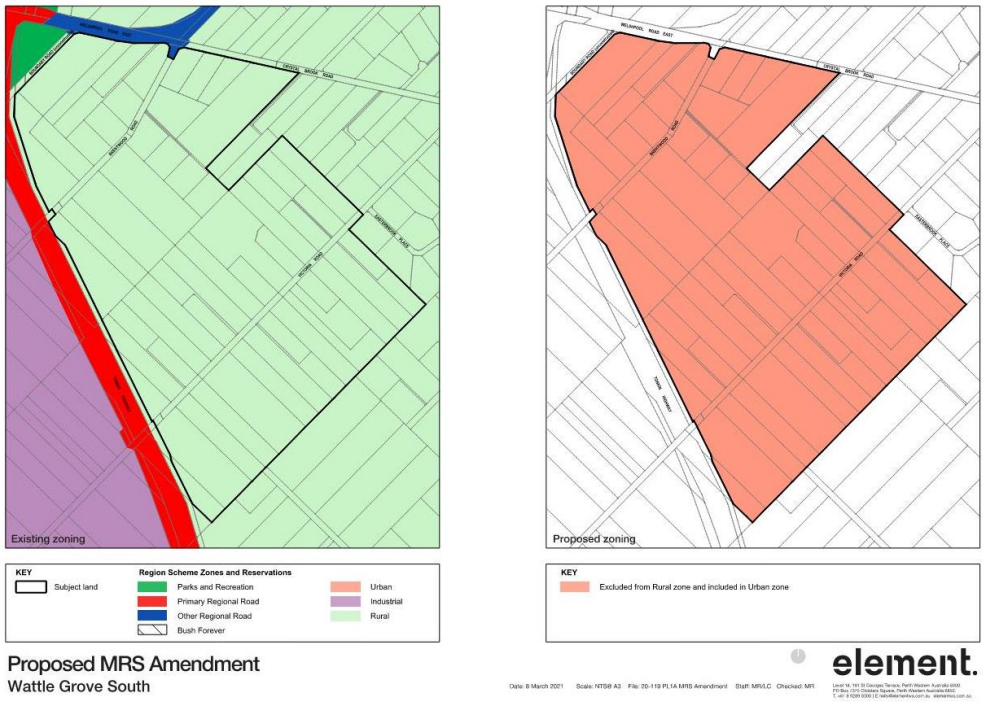

Figure 2 – Wattle Grove South MRS Rezoning Plan (Element, May 2021)

2.2 Landform and Topography

The site is generally cleared with short length grass and shrubs, though the some of the existing semi-rural lots contain trees and the majority have existing houses, multiple sheds, and other small structures. Though most properties are used for residential purposes some are or were utilised for commercial purposes (ie. turf farm, disused poultry farm) and others contain extensive areas of stockpiled materials and old vehicles/machinery etc.

We understand Hesperia have a desire, where possible, to retain and incorporate appropriate trees and vegetation within the proposed development and this will guide the design and earthworks planning for the site.

The site generally slopes from east to west at grades between 0.3% to 1.6%. Existing ground levels fall from ~RL36m AHD along the eastern boundary to ~RL21m AHD in the west.

The site contains no existing waterways, though the turf farm did once have a dam which has since been filled.

The site contains a mapped resource enhancement wetland adjacent to Tonkin Highway in the southern corner of the turf farm, though from a review of the historical aerial photos the wetland site has been filled. A second resource enhancement wetland is located at the northern end of the site adjacent to the Tonkin Highway and Welshpool Road intersection.

A Bush Forever area and the Greater Brixton Street Wetlands are located to the west of the site, on the other side of Tonkin Highway between Brook Road and Boundary Road.

Figure 3 – Wetland Mapping (MNG Access, May 2021)

2.3 Ground Conditions

A preliminary geotechnical investigation was undertaken by Douglas Partners in October/November 2020 over various lots within the site.

The ground conditions encountered within the test pits generally comprise topsoil overlying: Bassendean Sand (generally medium dense to dense, light grey sand) and Yoganup Formation (yellow-brown sand with various fines content). The sand from the Yoganup Formation includes a fines content that increases with depth.

Groundwater was not encountered in the test pits excavated to a depth of up to 2.9 m during the Douglas Partners investigation.

In-situ infiltration testing undertaken by Douglas Partners resulted in permeabilities between 25m/day and 34m/day in the Bassendean Sand and 6m/day and 7m/day in the Yoganup Formation.

Site classification will be determined in accordance with AS 2870-2011 and is based on the expected ground surface movement and the depth to which this movement extends. In its present state, the natural areas with clayey materials within 1.8 m of the surface would be classified as 'Class S' which generally applies to the majority of the site in its current condition.

Douglas Partners recommended that further detailed geotechnical investigation of the development site is undertaken to support the detailed engineering design phase of the development.

2.4 Groundwater

Groundwater flows from east to west across the region, generally following the topography. Department of Water and Environmental Regulation (DWER) minimum groundwater level mapping for the site shows minimum groundwater levels ranging from 15.5mAHD in the east to 11.5mAHD in the west, over 10m below the lowest existing ground levels on the site.

The DWER historical maximum groundwater level mapping does not cover the site.

Groundwater was not observed in the test pits during the geotechnical investigation undertaken by Douglas Partners. However, groundwater was measured by Douglas Partners at depths of between 13.5mAHD and 16.0mAHD on 5 November 2020, within two monitoring wells installed in the southern part of the site.

Hyd2o installed additional groundwater monitoring bores at locations across the site in November 2020. Readings from the existing and newly established groundwater monitoring bores on 23 November 2020 showed groundwater levels ranging from 15.57mAHD to 16.94mAHD. An existing monitoring bore located on Boundary Road adjacent to Tonkin Highway, external to the subject site, had a reading of 18.71mAHD, indicating possible localised perching of groundwater in this location.

Hyd2o hydrology have prepared a DWMS to support the rezoning of the site.

2.5 Acid Sulfate Soils

The Swan Coastal Plain Acid Sulfate Soils (ASS) Risk Map (DWER) designates the site location as having a moderate to low risk of ASS disturbance risk occurring within 3m of natural surface as illustrated in the figure below.

With reference to DWER endorsed guidelines, investigation of ASS as part of a future subdivision of the site is recommended in areas of moderate to low risk for the following:

- Excavation of greater than 100m^3 from below the natural water table; and/or
- Where dewatering (temporary or permanent) is proposed to be undertaken.

If ASS is to be disturbed, a suitably qualified environmental consultant would be engaged to conduct an investigation of the area and if necessary, prepare an ASS Management Plan. The ASS Management Plan will detail the actions to minimise and mitigate potential adverse environmental effects during the works.

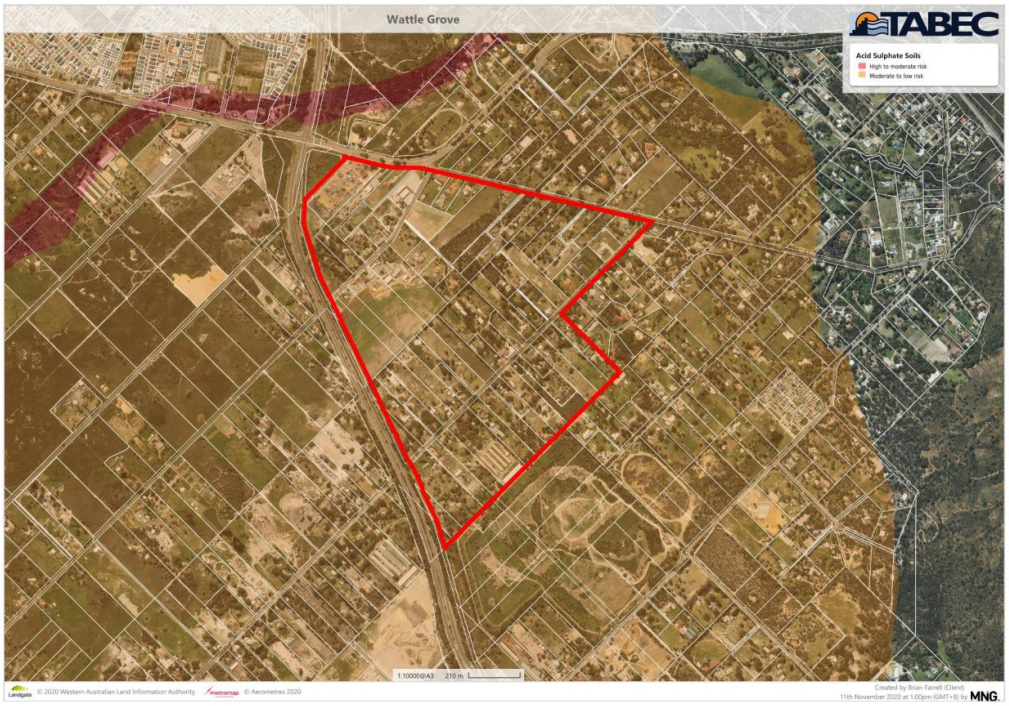

Figure 4 – Acid Sulfate Soil Risk Mapping (DWER)

3 SITEWORKS AND EARTHWORKS

Development of the site will require the demolition of existing buildings and structures prior to undertaking site earthworks, servicing, and roadworks. Following demolition, siteworks and earthworking will take place to provide for a desired development form while addressing any engineering constraints of the site. These constraints could include:

- Existing ground conditions (soil types, any areas of uncontrolled fill or loose sands, etc).
- Conservation areas and tree retention.
- Interface with the Dampier Bunbury Natural Gas Pipeline easement.
- Interface with Welshpool Road East and the future Tonkin Highway flyover.
- Existing Brentwood Road and Victoria Road and the unmade Boundary Road reserve.
- Existing 66kV power transmission line in Brentwood Road.
- Existing services in Brentwood Road and Victoria Road.
- Interface with adjacent properties

The geotechnical investigation indicates that the site's existing ground conditions are suitable for the proposed development. The sand is considered suitable for excavation and re-use as structural fill without impacting the site classification. Additionally, the constraints regarding any loose soils or uncontrolled fill that may exist at the site can be managed during typical earthworks site preparation procedures.

It is anticipated that siteworks to support the proposed residential development will generally comprise the identification and marking of trees to be retained, demolition, removal of grasses and weeds, stripping and blending of topsoil, earthworking of the existing ground surface and the importation of relatively low volumes of sand fill.

Additionally, the geotechnical investigation has indicated that the sandy topsoil is considered suitable for re-use in the earthworks. Following stripping and stockpiling, the topsoil can be screened and the screened topsoil then blended with clean sand. A preliminary blending ratio of approximately 2:1 (clean sand: topsoil/organic sand) was suggested, but will be refined in consultation with the geotechnical engineer following assessment of the material resulting from the screening operations. Any material considered unsuitable for use as fill will be removed from the site or used in non-structural areas.

The earthworks will also incorporate some imported sand filling of the site to improve drainage as well as potentially achieving a better site classification in some locations. The imported material used for filling should be a free drainage clean sand material having a fines content less than 5% and permeability greater than 5m/day to avoid the imported material having a negative impact on site drainage.

Earthworking of the site is also required to ensure the positive drainage of the allotments to the road and drainage areas for disposal. Final levels will also need to accommodate interface levels with the adjacent developments, existing infrastructure and retained vegetation.

The installation of subsoil drainage is not expected to be required given the likely clearance to post-development groundwater water levels. However, direct lot drainage connections are likely to be required in some areas due to the reduced permeability of the existing Yoganup soils.

The earthworks for the site will be based on achieving a targeted site classification in accordance with AS2870. Generally, a site classification of “Class S” is anticipated post development following suitable site preparation as determined by a detailed geotechnical investigation, although a “Class A” site classification is likely to be appropriate in some areas.

Due to the gentle nature of the site grade, stepping between allotments is likely to be able to be achieved with a minimal use of retaining and will promote the retention of existing trees within the site.

4 ROADS

The site is well connected to the regional road network including Tonkin Highway, Welshpool Road East, Crystal Brook Road and Kelvin Road. Roe Highway is also located to the west of the site and is accessible from the site via the Welshpool Road East or Tonkin Highway interchanges.

The site also contains the existing Brentwood Road, Victoria Road and Boundary Road reserves. Brentwood Road and Victoria Road are currently rural styled roads that are unkerbed sealed roads with table drains on both sides. The unmade Boundary Road is currently an unsealed gravel track with no drainage.

Access to the proposed development can be achieved from the existing Welshpool Road East and Crystal Brook Road, along with a logical internal road network connecting the existing Victoria Road, Brentwood Road and Boundary Road. Tonkin Highway is a controlled access road and therefore no direct connection to the highway would be permitted.

It is expected that the existing Brentwood and Victoria roads, within the site would require upgrading to accommodate the new traffic conditions that would result from the change to an urban residential setting. Upgrading is anticipated to include the widening of the existing pavement, kerbing, an asphalt wearing course and in consultation with the City of Kalamunda will seek to preserve the rural character of the area. Options to recycle existing pavement materials will be explored as part of the future design works.

Internally, the road network is likely to include a combination of laneways, access streets and neighbourhood connectors, and will be in accordance with the current Liveable Neighbourhoods, City of Kalamunda standards and IPWEA Subdivision Guidelines. A network of dual use and pedestrian footpaths will also be required to facilitate pedestrian movement throughout the development.

Figure 5 – Victoria Road: from Crystal Brook Road looking Southwest (Google Street View)

Figure 6 – Brentwood Road: from Crystal Brook Road looking Southwest (Google Street View)

Figure 7 – Boundary Road: from Welshpool Road East looking Southwest (Google Street View)

Welshpool Road East is currently kerbed and drained, with an asphalt finish and incorporate concrete pedestrian paths. Therefore, it is not expected that Council will require any upgrading of the road adjacent to the development, except possibly at any proposed intersections.

Crystal Brook Road is currently sealed, kerbed, and drained however, may require an upgrade to the aggregate seal adjacent to the site over time.

It is anticipated that the site could be developed, with development having minimal impact to the current operation of the surrounding road network. Cardno are undertaking a Traffic Impact Assessment to support the proposed MRS rezoning.

5 STORMWATER DRAINAGE

Hyd2o has prepared a District Water Management Strategy (DWMS) to support the rezoning of the area. A Local Water Management Strategy (LWMS) will support the progression of a structure plan approval for the site. UWMP's will be required in order to progress subdivision or further development of the site.

In summary, stormwater runoff from the site generally flows via overland flow across the site from east to west, following the natural topography and existing road reserves. Stormwater will be managed to ensure that post development flow rates are within pre-development levels and that the development of the site is protected from flooding in major storm events. This is generally achieved through the use of detention storage areas spread throughout the development and generally integrated into areas of public open space. These detention storage areas will act to attenuate the runoff to predevelopment levels and will discharge to existing culvert outfalls under Tonkin Highway.

Where required, runoff from individual lots will have a direct connection to the road drainage system to account for any limited permeability of the underlying soils. Where the underlying soils permit, runoff from individual lots will be managed using soak-well systems to retain and infiltrate roof runoff within individual lots.

The first 15mm of rainfall, will be retained and treated within bio-retention systems to ensure water quality objectives are met.

Stormwater Management, with the aims of Water Sensitive Urban Design, will be in accordance with the requirements of Australian Rainfall and Runoff and the City of Kalamunda.

6 WASTEWATER

Though the Wattle Grove subject area is not currently serviced by a wastewater scheme, the site is within the Water Corporation license area and covered by the Wattle Grove Sewer District (SD) conceptual wastewater planning.

The long-term wastewater planning is shown below.

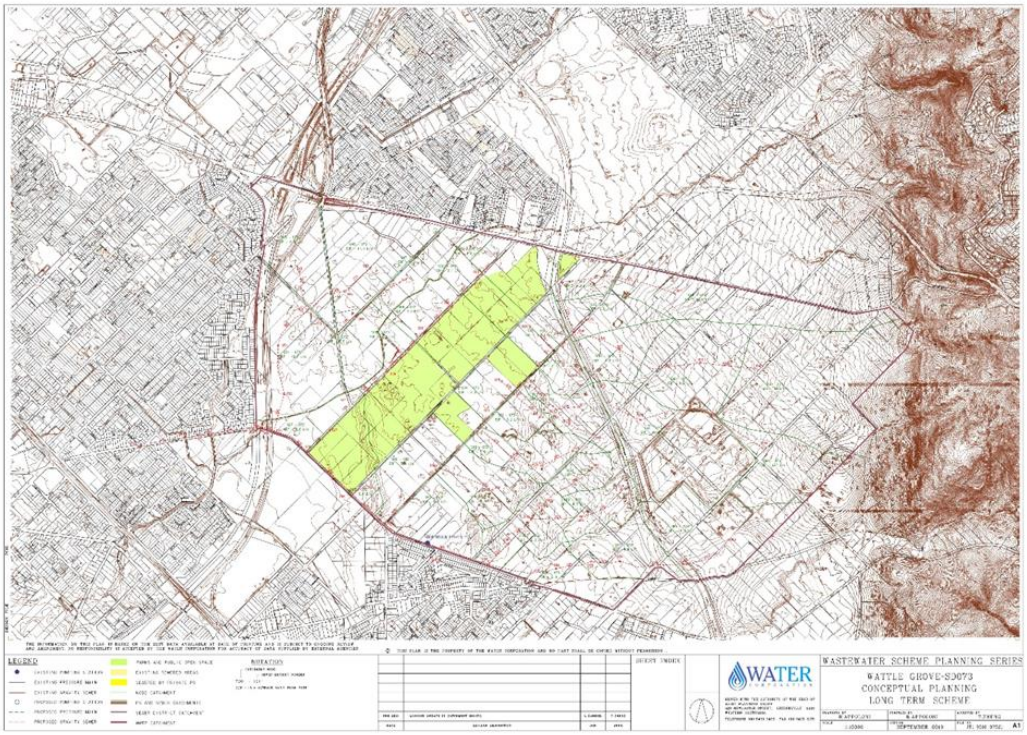

Figure 8 – Wastewater Long Term Planning (Water Corporation)

Though within the Wattle Grove SD, the site is located on the planned boundary between the Water Corporation's Wattle Grove and Forrestfield sewer districts. Crystal Brook Road is identified as the topographical boundary between the sewer districts.

In September 2020 Water Corporation wastewater planners conducted a review of planning and an assessment of the relative costs and merits of servicing this land either through the Wattle Grove SD downhill to the west, as per the Water Corporation's long-term planning (identified as Option 2), or pumping northwards through the Forrestfield SD on a temporary basis (identified as Option 1), as depicted in Figure 9.

Option 1, the proposed option of a temporary/interim WWPS pumping northwards into the Forrestfield SD is not supported because of a lack of conveyance capacity in the Forrestfield sewer network and because additional out-of-catchment pumped flows into the Forrestfield SD would immediately trigger a requirement to extend the DN1500 Maida Vale main sewer and install a section of the DN1050 and DN750 Forrestfield branch sewers.

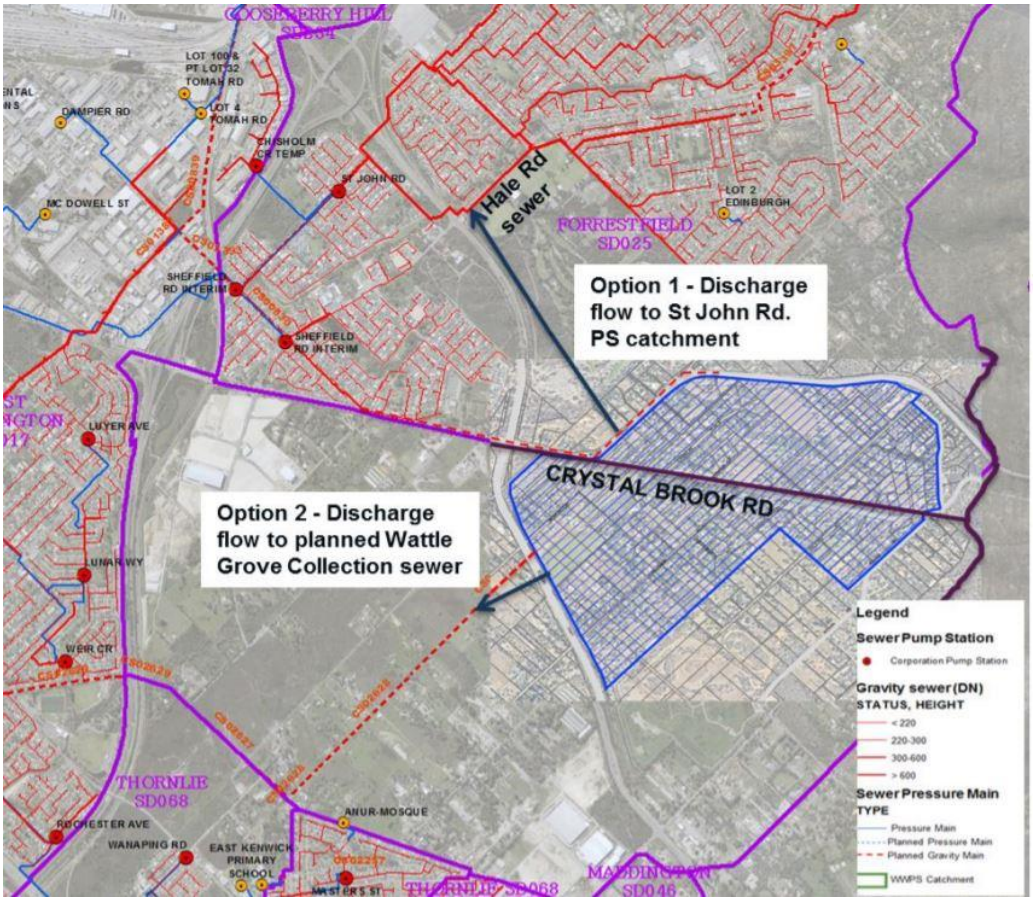

Figure 9 – Wastewater Options (Water Corporation)

As such, the Water Corporation's assessment concluded that the preferred longer-term Option 2 option, in terms of capital and operating cost and technical feasibility, is to service the entire future 'Urban Expansion' area plus the MKSEA industrial area westwards into the Wattle Grove SD.

The major works required to service the Wattle Grove SD includes:

- 1.4km of DN750 gravity sewer along Bickley Brook Rd;
- 830m of DN600 gravity sewer along Bickley Brook Rd;
- 1.5km of DN600 gravity sewer along Brentwood Rd; and
- 750m of DN450 sewer along Brentwood Rd up to Tonkin Highway.

The ultimate discharge from the area being a gravity connection to the existing 900mm Branch Sewer located in Bickley Road, near Dulwich Street in Maddington.

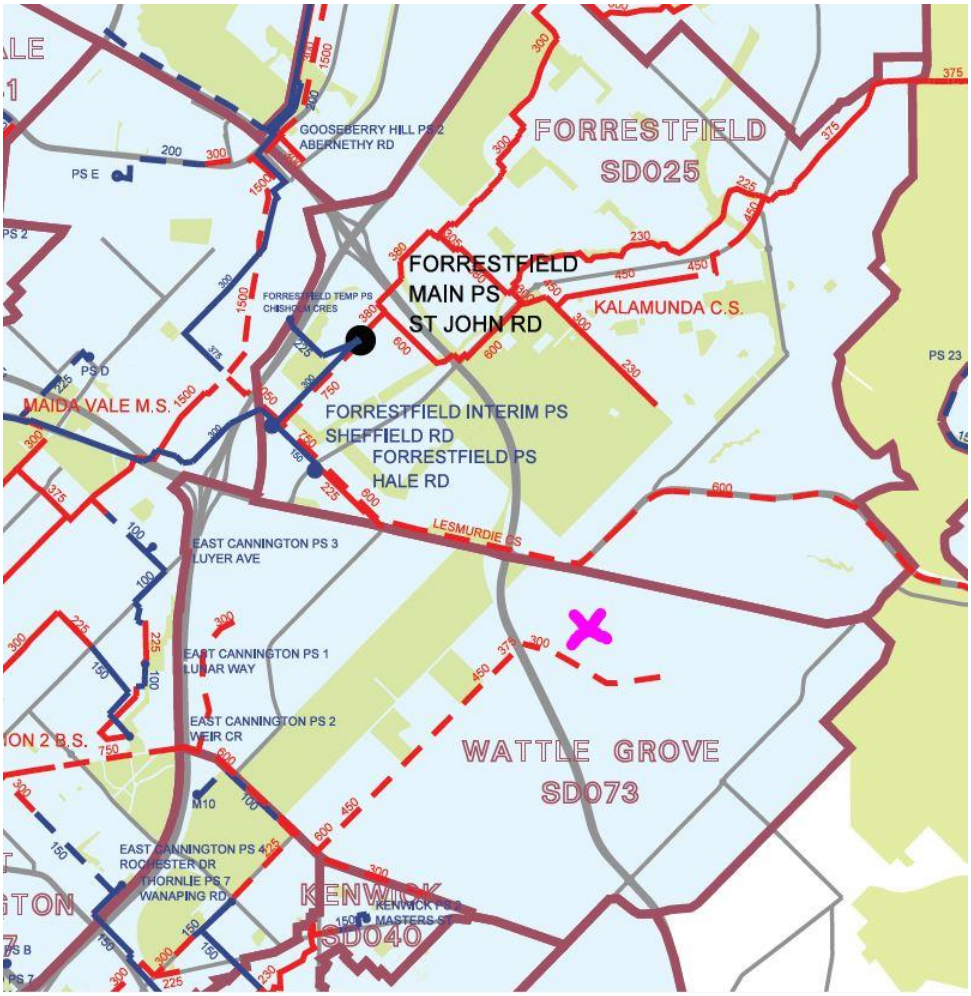

Figure 10 – Wastewater Outfall (Water Corporation)

It is understood that the Water Corporation wastewater planners have undertaken some fairly detailed and extensive options analyses in response to previous queries from the City of Kalamunda and prospective developers.

The MRS rezoning proposal, in consultation with Water Corporation, will stimulate the further detailed design required to implement a sewer solution for this locality.

Providing the site with an internal reticulated sewer system will be achieved through the orderly development of the site. Wastewater infrastructure will be designed and constructed in accordance with Water Corporation standards and requirements.

7 WATER SUPPLY

The site is within the Water Corporation license area.

With respect to water planning, the site is situated at the eastern edge of the Trunk Mains PRV scheme. As the site is currently zoned 'Rural', the Water Corporation's water planning is based on this zoning, which arose from the WAPC's Foothills Structure Plan. The Water Corporation has advised the water planning will be revised as the land is rezoned to 'Urban'.

Water supply to the site is currently via the DN1400 Canning/Foothills Trunk Main that runs south to north along the base of the foothills. Supply occurs through various Pressure Reducing Valves (PRVs) located along the trunk main. The nearest PRVs to the site are the Boyle Lane PRV to the south, and the Hale Rd PRV to the north. The sketch below, provided by the Water Corporation, shows the arrangement described above and the HGL route.

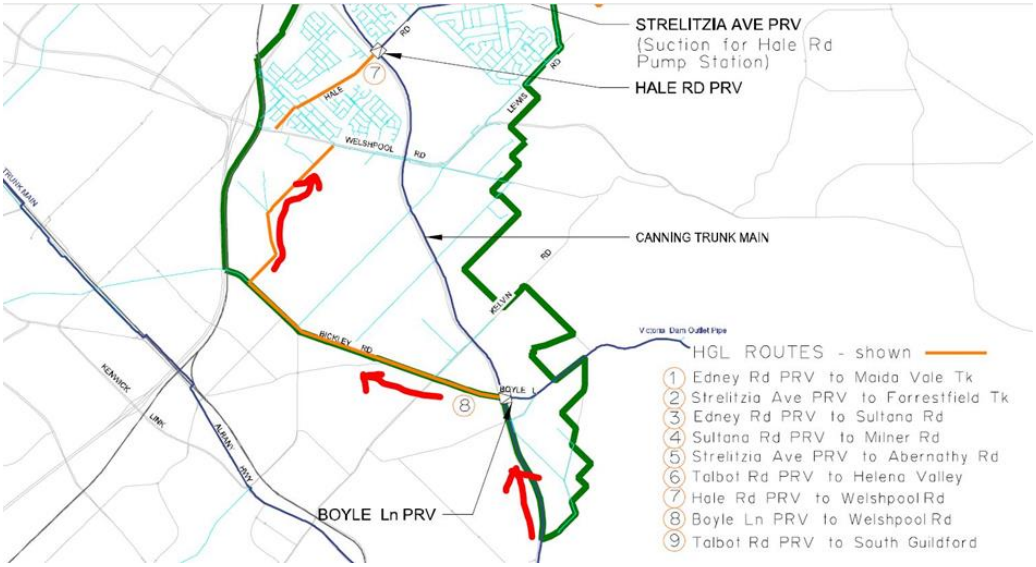

Figure 11 – Existing Water Supply (Water Corporation)

The existing water distribution main from the Boyle Lane PRV is a DN460 – DN510 cast iron main running north-west along Bickley Rd. The existing reticulation mains that extend off this distribution main to serve the areas to the east, including the site, are as follows:

- Victoria Rd: DN100 Cast Iron.
- Brentwood Rd: DN150 PVC and Cast Iron.
- Welshpool East Rd – Crystal Brook Rd: DN150 Steel and Ductile Iron. Noting there is a zone valve at the corner of Crystal Brook Rd and Victoria Rd which is the break between the PRV zone and the upper High Level (HL) zone.
- Brook Rd-Grove Rd-Logistics Rd: DN200 Ductile Iron and DN180 PE.

The site and services in the Urban Expansion area will be included in the Water Corporation's water planning and hydraulic modelling undertaken to determine the impact on existing customers and the changes required to the size and timing of future distribution mains.

In the interim, the Water Corporation has advised that water supply to a future urban development of the site will be supplied from the Trunk Main PRV scheme. An extension of the existing mains adjacent to and throughout the site will not have sufficient capacity or pressure to serve the proposed development, and as such, the initial supply is likely to be via new water reticulation mains, typically DN250 PVC and DN200 PVC as required. The Water Corporation will undertake planning and will follow in with distribution mains in the future as needed.

An internal water reticulation network will also be constructed within the site to provide a service to all lots in accordance with the Water Corporation's requirements.

8 POWER SUPPLY

The site has a 66kV high voltage (HV) overhead power line extending along the south-eastern side of Brentwood Road. The site also has 22kV HV overhead power lines running along the north-western side of Brentwood Road and Victoria Road and a low voltage (LV) overhead power line on the south-eastern side of Boundary Road. The existing cables will be able to provide power to the proposed development of the site.

Figure 12 – Western Power Existing Power Network (Western Power)

Western Power will require the 22kV HV overhead power lines that are adjacent to the proposed residential development to be undergrounded as part of the subdivision works.

A review of the Western Power Network Capacity Mapping Tool indicates that there is capacity in the existing network to service the development of the site. The mapping tool indicates that the capacity for the majority of the site is in excess of 30MVA, whilst the north-western corner has a capacity of between 20MVA to 25MVA.

Figure 13 – Western Power Network Capacity 2020 (Western Power)

Power will be reticulated underground throughout the development. Low voltage (LV) feeders will extend from transformers feeding the pillar units servicing each new lot.

Street lighting will also be required as part of the development in accordance with Western Power and City of Kalamunda guidelines.

9 TELECOMMUNICATIONS

The site is within the NBN network footprint and NBN fixed line services are available within the site.

The existing road reserves within the study area contain NBN services within a Telstra pit and pipe network. It is expected that NBN will require a new pit and pipe network to be provided as part of the development.

10 GAS SUPPLY

10.1 ATCO Gas

There is no reticulated gas supply within the site or generally within the immediately adjacent area. However, an ATCO Gas high-pressure gas main is located in Welshpool Road East to the west of the site, terminating near the Lancelot Garden cul-de-sac, Wattle Grove. Welshpool Road East also contains a medium-pressure gas main that extends through the existing Wattle Grove residential development north of Welshpool Road East and west of Tonkin Highway.

In discussions with ATCO, a connection to and extension of the existing high-pressure main in Welshpool Road East will allow a reticulated gas network to be provided to the site.

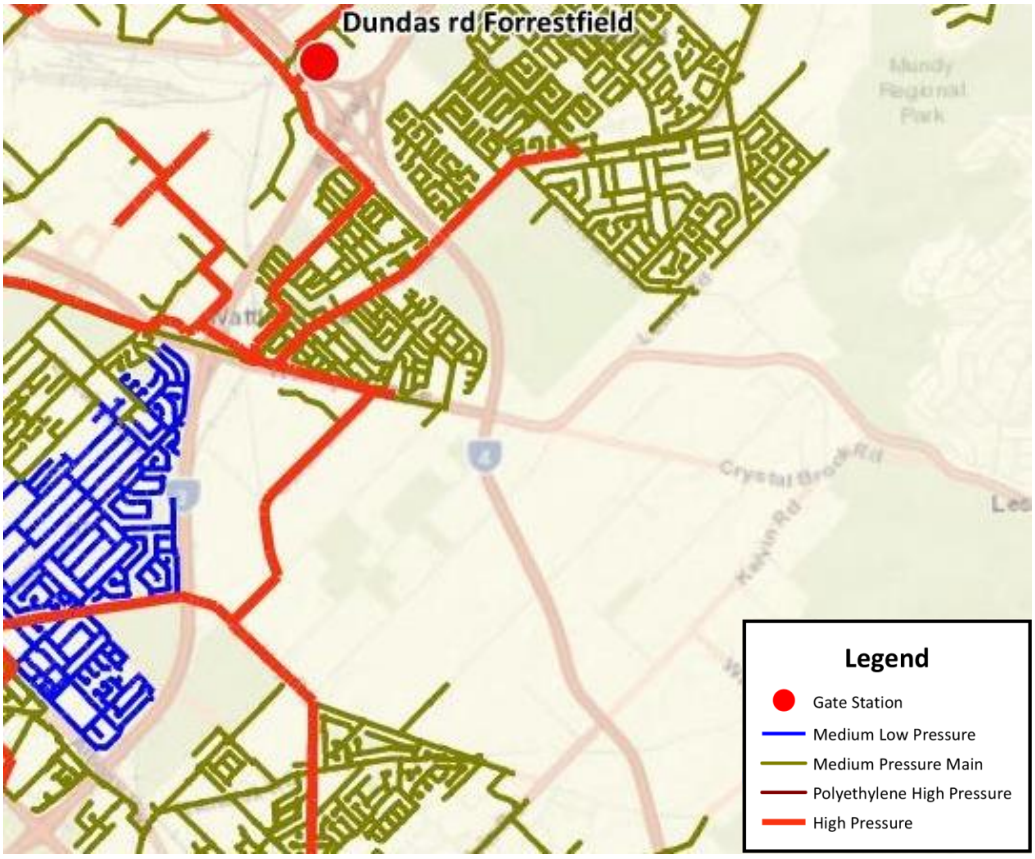

Figure 14 – Existing ATCO Gas Network, Wattle Grove (ATCO, 2019)

10.2 Dampier to Bunbury Gas Pipeline

There is an easement for the Dampier to Bunbury gas pipeline (DBNGP) immediately east of Tonkin Highway, adjacent to the site. The DBNGP corridor houses a major high-pressure gas pipeline that supplies natural gas to essential heavy and light industry, power generation and homes within Western Australia. The Department of Planning, Lands and Heritage (DPLH) manages the DBNGP corridor under the Dampier to Bunbury Pipeline Act 1997 (DBPA), on behalf of the DBNGP Land Access Minister.

Site planning and design should promote compatible uses, particularly public open space in the gas pipeline corridor/easements.

Roads and service crossings in the gas pipeline corridor/easements should be as close as practicable to perpendicular to the corridor/easements and may be approved subject to appropriate conditions recommended by the pipeline owners.

Several quantitative risk assessments of the DBNGP in the Perth metropolitan region have been undertaken and identify setback distances from the edge of the corridor/easements for sensitive developments as well as residential, commercial, and industrial development. The Australian Gas Infrastructure Group has advised that the DBNGP in this location is built to a residential (T1) standard and as such, the nominated setback distance for the section of the DBNGP adjacent to the site are:

Pipeline	Setback Distance		
	Sensitive	Residential	Industrial/ Commercial
DBNGP2 Between Muchea and Kwinana	90m	0m	0m

For proposals within the setback distances, a pipeline risk management plan will be required to demonstrate that the risk from the pipeline is within acceptable risk levels. The risk management plan may require a risk assessment, which is the responsibility of the applicant and must be undertaken in consultation with the pipeline owner.

11 CONCLUSION

Given the location, the site is strategically placed to accommodate urban development. The site is accessible from the existing road network and there are overall servicing strategies in place to allow the development of this landholding.

Based on the preliminary engineering servicing review and continued progression of the wastewater servicing design with the Water Corporation, no engineering or servicing constraints to the development of the site have been identified.

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Wattle Grove South

District Water Management Strategy

June 2021

Client: Hesperia

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Executive Summary

Hyd2o was commissioned by Hesperia to prepare this District Water Management Strategy (DWMS) to support the proposed metropolitan region scheme (MRS) amendment for land within Wattle Grove known as the Wattle Grove South residential estate (herein referred to as the site).

The site has a total area of approximately 106 ha located within the City of Kalamunda.

The proposed MRS amendment from 'Rural' to 'Urban' for the site has been prepared by element Town Planners to facilitate future urban development of the area.

The site is bound to the north by Crystal Brook Rd and Welshpool Rd East, and bounded to the south and west by the Tonkin Highway, with existing rural landholdings to the east. It currently comprises a mix of various rural landholdings and a turf farm. A former poultry farm is located within the site on its eastern boundary.

Topography across the site varies between 21 mAHD in the west to a high of 35 mAHD at its eastern boundary, with a fall from east to west across the site. This site has good clearance to regional groundwater and existing culverts under Tonkin Hwy connect runoff from the site to downstream stormwater systems.

Environmental considerations and values of the Greater Brixton St Wetland area are recognised as a key consideration which will ultimately guide the hydrological design of the site. In this regard, the proposed change in land use provides an opportunity to significantly reduce groundwater abstraction and nutrient application and export in proximity to the wetlands.

This document has been prepared in accordance with the principles and objectives of Better Urban Water Management (Western Australian Planning Commission, 2008).

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of a Local Water Management Strategy and Urban Water Management Plans for individual stages of development within the site.

District Water Management Strategy Summary

Water Supply	
Water Efficiency	• Promotion of 6 star building standards (water efficient fixtures and fittings). • Use of water-wise plantings in POS and landscape rehabilitation areas.
Water Supply	• Construction; Temporary groundwater licencing where/if required • Lots: Water Corporation IWSS and rainwater tanks (optional). • POS: Groundwater Irrigation bore.
Wastewater	• Water Corporation reticulated sewerage.
Stormwater	
Design & Management	• All habitable development levels to have suitable clearance above the 1% AEP flood levels of the local stormwater management system. • Post development stormwater discharge from the site assessed and considered relative to existing conditions and site opportunities and constraints. • Water quality to be improved relative to pre development conditions to improve ecological conditions.
Lot Scale	• Soakwells where possible, with consideration of lot connections if required based on geotechnical considerations and minimising imported fil • Rainwater tanks (optional). • Water-wise landscaping (where appropriate).
Street Scale	• Rain gardens / biofiltration areas. • Swales / piped drainage. • Bottomless manholes / underground storage cells.
Estate Scale	• Water quality treatment areas for first 15mm runoff via biolfitration. • Flood management areas sized to attenuate flows in accordance with agency requirements and capacity of downstream infrastructure. • Potential use of portions of the Bunbury to Dampier Natural Gas pipeline corridor for major event stormwater management. • Post development performance monitoring and annual reporting.
Groundwater	
Fill & Subsoil	• Use of imported fill to be minimised. • Subsoil unlikely to be required due to groundwater depth
Acid Sulphate Soils	• Acid sulphate soils to be investigated as a separate process (if required) and reported at later stages of planning.
Implementation	
Process	• Predevelopment groundwater and surface water monitoring program complete. • Future stages of planning consistent with BUWM including preparation of LWMS's and UWMP's.

1. Introduction

Hyd2o was commissioned by Hesperia to prepare this District Water Management Strategy (DWMS) to support the proposed metropolitan region scheme (MRS) amendment for land within Wattle Grove. The boundary of the site is shown in Figure 1, with a total area of approximately 106 ha located within the City of Kalamunda.

The proposed MRS amendment for the site is shown in Figure 2 and has been prepared by element Town Planners to facilitate future urban development of the area.

The proposed rezoning of the site has considered the opportunities and constraints of the existing environment and uses this information to inform the development of this document. This document provides an integrated total water cycle management approach to the rezoning application, with an assessment of the pre-development environment, development of water use sustainability initiatives, a stormwater management strategy, nutrient and groundwater management strategy and a plan for implementation.

A completed copy of the DWMS Checklist for Developers is included as Appendix A to assist the Department of Water and Environmental Regulation (DWER) in review of this document.

1.1 Planning Context

This site is currently zoned 'Rural' under the Metropolitan Region Scheme. The proposed MRS amendment is shown in Figure 2 and shows the proposed rezoning to 'Urban'.

Better Urban Water Management (Western Australian Planning Commission (WAPC), 2008) provides guidance on the implementation of State Planning Policy 2.9 Water Resources (Government of WA, 2003).

The urban water management planning process for the site is shown in Table 1.

Three water management documents are likely to be required to facilitate the future development of the site, this District Water Management Strategy (DWMS), a Local Water Management Strategy (LWMS) and an Urban Water Management Plan (UWMP) as summarised below in Table 1. Note that several urban water management plans may be required for the site depending on the staging of subdivision.

This DWMS supports the proposed development of the area as urban.

Table 1: Urban Water Management Process

Planning Phase	Planning Document	Urban Water Management Documents
MRS Amendment	MRS Amendment	Wattle Grove South District Water Management Strategy **THIS DOCUMENT**
Local Structure Plan/TPS Amendment	Local Structure Plan	Local Water Management Strategy **FUTURE PREPARATION**
Subdivision	Subdivision Application	Urban Water Management Plan **FUTURE PREPARATION**

1.2 Previous Studies and Relevant Documents

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

- Better Urban Water Management (WAPC, 2008)
- Stormwater Management Manual for WA (Department of Water, 2007)
- Decision Process for Stormwater Management in WA (DWER, 2017)
- Guidelines for District Water Management Strategies (Department of Water, 2013)

2. Existing Environment

2.1 Existing Landuse

The 106 ha site is located in the suburb of Wattle Grove in the City of Kalamunda. The site is bound to the north by Crystal Brook Rd and Welshpool Rd East, and bounded to the south and west by the Tonkin Highway, with existing rural landholdings to the east (Figure 1).

The site currently comprises a mix of various rural landholdings and a turf farm. A former poultry farm is located on its eastern boundary.

Figure 3 shows an aerial photograph with existing land use and topography. Natural surface elevations across the site varies between 21 mAHD in the west to a high of 35 mAHD at its eastern boundary, with a general fall from east to west across the site.

2.2 Environmental Geology

According to the Armadale 1:50 000 Environmental Geology Series Sheet 2033 I and 2133 IV (Jordan, 1986), the site is characterised from west to east (Figure 4) as:

- Bassendean Sand (S8) – white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to surrounded, of eolian origin.
- Thin Bassendean Sand over cohesive materials of the Guildford Formation (S10) – white to pale grey sand at surface, over alluvial deposits of sandy clay to clayey sand of the Guildford Formation.
- Sand (Yoganup Formation) (S12) - yellow, fine grained sand with minor silt and clay, subangular and medium to coarse grained quartz, of colluvial origin.

A preliminary geotechnical investigation was undertaken by Douglas Partners in October 2020. This investigation included excavation of 15 test pits, Perth sand penetrometer (PSP) testing adjacent to each test pit location, and infiltration testing. The typical ground conditions as described by Douglas Partners (2020) were similar to the regional mapping as follows:

- **Topsoil** – grey-brown, sandy topsoil with silt and roots, between 0.1 m to 0.15 m in thickness. Overlying:
- **Bassendean Sand (light grey sand):**

  SAND SP – generally medium dense to dense, light grey sand, with trace silt encountered underlying the topsoil or surficial fill to depths of between 0.8 m and test pit termination depths of 2.5 m at some test locations.
- **Yoganup Formation (yellow-brown sand with various fines content):**

  The sand from the Yoganup Formation is yellow-brown and includes a fines content that increases with depth. When described based on its composition in accordance with AS 1726-2017, the sand is logged as 'Sand trace silt and clay' (up to 5% fines content) near surface, gradually transitioning with depth to 'Sand with clay' (5% to 12% fines content) and then 'Clayey Sand' (greater than 12% fines content):

  SAND SP-SM – generally medium dense to dense, light brown and yellow-brown sand, with low plasticity to non-plastic fines content of between approximately 5% to 12%, underlying topsoil or surficial fill at some test locations and present below the

Bassendean sand at another from 0.8 m depth. Loose sand was encountered at one location to at least 1.0 m depth. Fines content typically increases with depth.

SAND/Clayey SAND SP-SC/SC – yellow-brown sand with clay/clayey sand (approximately 12% and greater content of low plasticity fines) was encountered from depths of between 0.1 m and 1.6 m extending to depths of between 0.6 m and termination depths of up to 2.5 m in some locations.

Clayey SAND SC – yellow-brown low plasticity clayey sand was encountered from depths of between 0.6 m and 1.5 m extending to termination depths of up to 2.5 m in some locations.

The exceptions to the above profile are some localised areas of fill and coffee rock.

Groundwater was not observed in any test pits excavated on 28 October 2020, to a depth up to 2.9 m. Four in situ infiltration tests were conducted at depths between 0.5 m and 1.0 m. Soil permeability values ranged from 6 m/day to 34 m/day, with the higher rates associated with Bassendean Sands, and lower rates with the Yoganup Formation.

Douglas Partners (2020) anticipate these permeabilities will decrease following densification of the soils during earthworks. The Yoganup sand is anticipated to have a generally low permeability following compaction, and is unlikely to form a suitably drained material for on-site stormwater disposal, unless specific additional drainage provisions are adopted.

It was recommended the clayey sand should be considered impermeable for site drainage following earthworks.

2.2.1 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 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 investigations are commonly required as part of the conditions of subdivision or as a requirement for a dewatering license application.

The WAPC's Bulletin 64 (WAPC, 2003) ASS risk mapping for the site indicates the site is located within an area of moderate to low risk of acid sulfate soils occurring within 3.0 m of natural soil surface.

Notwithstanding, following preparation of detailed engineering plans, further investigation will be undertaken to determine if there is the presence (and any likelihood of disturbance) of ASS and if so, an appropriate management plan will be prepared and implemented.

2.3 Water Sensitive Ecosystems

The site contains two mapped resource enhancement wetlands located adjacent to Tonkin Hwy (Figure 5). These wetlands are largely cleared, with one historically filled and currently grassed as part of a turf farm. Immediately adjacent to the north western corner of the site at the Welshpool Rd and Tonkin Hwy intersection are several conservation category wetlands.

The main environmentally significantly feature in proximity to the site are the conservation category Greater Brixton St Wetlands located on the western side of Tonkin Hwy. Bourke (2017) provided the following description of the wetlands:

> *"The Greater Brixton Street Wetlands are located in an area identified as one of the most important conservation areas on the Swan Coastal Plain (Bourke, 2017). The biota associated with low lying areas (i.e. damplands, palusplains and basins) are adapted to, or require seasonal flooding and shallow water tables for their long-term persistence. Given the declines in rainfall experienced across the Perth region and the broader south-west of Western Australia over the last 30 years it is likely that changes to the hydrological cycle within the Greater Brixton Street Wetland area have already occurred or will occur in the future "*

Bourke (2017) reported that while many previous studies and monitoring programs have been undertaken of the area, there was still scope to improve hydrological understanding through additional monitoring. Recent works undertaken by Emerge as part of the Maddington Kenwick Strategic Employment Area environmental studies have contributed to this understanding.

To assist this process further, an additional supplementary monitoring program for the site and its relationship to the wetlands is being undertaken by the developer. This program is further discussed in Section 5.2.1.

In relation to potential nutrient loads toward the wetlands from the site, an assessment of the existing nutrient input and export from the site under current land use is provided in Section 2.7.

Nutrient inputs and exports under the proposed land use are discussed in Section 6.3.

2.4 Surface Water

The site is located within the catchment of Yule Brook (Figure 6).

Yule Brook is a natural watercourse at its headwaters which becomes a network of drains in its lower reaches that are part of the Water Corporation's Yule Brook Main Drain. The Yule Brook has a total catchment area of 55 km^2, most of which is highly modified and includes urban uses such as light to medium industry and high-density residential developments, as well as agricultural uses such as horticulture and poultry farming.

The site represents approximately 2% of its total catchment.

Figure 6 shows the location of Yule Brook, key topographic catchment boundaries and existing stormwater pipes and open drains in the vicinity of the site. The site has three outlets which drain under Tonkin Hwy located at the southern ends of Boundary Rd (2x 900 mm diameter), Brentwood Rd (2 x 350mm diameter) and Victoria Rd (1 x 300 mm diameter). All

of these outlets ultimately direct flow toward the Greater Brixton St Wetland area, albeit via different routes.

Topographically, the majority of the site is located in the catchment of the Brentwood Rd culverts. These culverts flow to open road side drains on the southern side of Tonkin Hwy before entering the wetlands approximately 1.8 km downstream of the site.

The existing road drainage within the site consists mainly of open swales and crossovers/culverts, with limited piped drainage. All of this drainage is well above the regional groundwater table and does not export groundwater from within the site toward the wetlands. Regional groundwater levels within the site are discussed in Section 2.5.

Based on field inspection, the site has no formal external drainage entering into the site, with an open swale running along the northern boundary of Crystal Brook Road which acts as a cutoff for flow from the north.

2.5 Groundwater

The Department of Water and Environmental Regulation's (DWER) online Perth Groundwater Map, shows that groundwater levels across the site range from approximately 11.5 mAHD in the north western corner of the site to 16.0 mAHD in the elevated eastern boundary area (Figure 7).

The contours are based on May 2003 data and are representative of a summer minimum condition. Groundwater flow is mapped as broadly in a westerly direction.

A review of DWER's Water Information Reporting tool however indicates there are no DWER bores with long term record in close proximity to the site so the above levels are considered to have limited accuracy. DWER's maximum groundwater level contours do not cover the site.

Hyd2o installed three bores (WG1-WG3) within the site in November 2020 as shown on Figure 7, with lithological logs contained in Appendix B. These bores together with bores previously installed by Douglas Partners and Urbaqua were used to refine groundwater mapping for the site. All bores were monitored on November 23 2020.

Online data from two regional DWER bores (SC 05-08 and SC 09-08) was used to derive a correction factor to apply to the monitored data and determine average annual maximum groundwater levels (AAMGL) over the site. It should be noted that the usage of relatively short term historical DWER bore data, reflected by hydrographs in Appendix C, is a result of limited data availability in the region. Correction factor calculations are shown in Table 2 while the resulting AAMGL values at the site bores are shown in Table 3.

AAMGL groundwater contours are shown in Figure 7 ranging from 15.9 mAHD in the north western corner near Tonkin Hwy to approximately 17.3 mAHD on the south western corner of the site, with a regional groundwater depth from 5m to 20m below natural surface.

This groundwater mapping refinement based on site specific data showed groundwater flow was in a north-westerly rather than westerly direction at the site indicating groundwater flow from the site would not be toward the Greater Brixton St wetland area.

It is important to note the Douglas Partners (2020) preliminary geotechnical investigation indicated ground conditions within the site generally consist of sand overlying clayey sand materials, although clayey sand also occurs near ground surface in some parts of the site.

Coffee rock was encountered at several test locations. The site may therefore encounter perching of groundwater in some areas above less permeable materials. Anecdotal evidence from landholders suggest groundwater levels in the area of the Bunbury to Dampier Natural Gas Pipeline Corridor (BDNGPC) adjacent to Tonkin Hwy reduced following the excavation of coffee rock in that area during construction.

Consistent with this, a higher groundwater level than the regional groundwater table was recorded at an unidentified bore (Mba, Figure 7) near the Tonkin Hwy/Welshpool Rd intersection, indicating some perching may be currently occurring in that area.

Areas of potential perching will be examined further during more detailed stages of planning and groundwater mapping refined as additional monitoring data are collected.

Table 2: AAMGL for DWER Bores

Bore	Period of Record	Groundwater Level (mAHD) Nov-20	AAMGL 2000-2020 (mAHD)	Correction Factor (m)
SCC 05-08	2010 - 2020	22.44	22.69	+0.25
SCC 09-08	2010 - 2020	10.22	10.64	+0.42
Correction Factors for Site Bores				+0.34

Table 3: AAMGL for Site Bores

Bore	Natural Surface (mAHD)	Water Level 20/11/2020 (mAHD)	AAMGL (mAHD)	Depth to AAMGL Below Natural Surface (m)
Hyd2o Bores				
WG1	31.45	16.38	16.72	14.73
WG2	25.47	16.94	17.28	8.19
WG3	22.32	16.15	16.49	5.83
Douglas Partners Bores				
MBc	32.73	16.68	17.02	15.71
MBb	31.25	16.79	17.13	14.12
Unknown Origin				
Mba	20.03	18.71	19.05	0.98*
Urbaqua Bore				
GW01	22.99	15.57	15.91	7.08

*Perching suspected

2.6 Water Quality

Urbaqua (2020) undertook a monitoring program for the wider Wattle Grove South area on behalf of the City of Kalamunda from July 2019 to September 2020.

This program installed a number of groundwater monitoring bores and identified six locations for surface water monitoring one of which (SW6) represents the main culvert under Tonkin Hwy for the site near the Welshpool Rd intersection (Figure 6 & Appendix D).

No monitoring of groundwater was undertaken and agreed by DWER due to the depth of groundwater beneath the site. DWER typically do not require predevelopment groundwater monitoring where the groundwater depth exceeds 5m.

Urbaqua (2020) monitoring results are provided in Appendix D based on sampling over 12 occasions. Summarising the key results for SW6:

- In situ pH ranged from 7.04 to 9.01, with the mean of 7.83 within the ANZECC (2000) guideline range of 6.5-8.0.
- Electrical Conductivity (EC) ranged from 1130 µs/cm to 1812 µs/cm (mean 1527 µs/cm), well above the ANZECC guideline range for freshwater of 120-300 µs/cm.
- Total Nitrogen (TN) ranged from 1.6 mg/L to 3.9 mg/L (mean 2.5 mg/L), consistently above the ANZECC (2000) guideline value of 1.2 mg/L.
- Total Phosphorus (TP) ranged from 0.08 mg/L to 0.21 mg/L (mean 0.13 mg/L) consistently exceeding the ANZECC (2000) guideline value of 0.065 mg/L.

Although no further predevelopment monitoring is necessary to meet DWER requirements, given the proximity of the site to the Greater Brixton St wetlands, a supplementary monitoring program has been commenced and will extend to June 2022 to further assist in improving the hydrological understanding of the area and facilitate improvements in water management for the wetlands. The program was developed in consultation with DBCA and details of the program are provided in Section 5.2.1.

2.7 Nutrient Input Assessment

The Urban Nutrient Decision Outcomes (UNDO) model is a conceptual decision support tool developed by DWER that evaluates nutrient reduction decisions for urban developments on the Swan Coastal Plain in south-west Western Australia. It is designed for ease-of-use by urban development proponents and for assessment by local and state government authorities.

The tool was developed to assess the nutrient impacts of urban development on the Swan Coastal Plain in a consistent and scientifically rigorous manner, and improve scientific understanding relating to nutrient issues, and efficiencies in the investment to manage nutrients. The tool is web-based, and provides users with the ability to implement a range of structural or non-structural design options to evaluate and reduce nutrients exported from an urban development.

Modelling outputs of the site's existing land use using UNDO are detailed in Appendix E.

Note that although UNDO doesn't include turf farms as a specified use in the model, bowling greens are included and have been used as a turf farm surrogate for this analysis, with the area increased to reflect the increased total annual nutrient application that would occur

at a turf farm. The Department of Water (2010) Survey of Urban Nutrient Inputs on the Swan Coastal Plain report indicates nutrient application rates for turf farms as 432.8 kg/ha/yr for TN and 14.5 kg/hr/hr for TP, which are more than double that of a bowling green.

Note that the existing model also reflects the existing use of septic tanks and livestock within the site, but does not reflect any potential legacy uses such as the disused chicken sheds.

The results indicate nutrient inputs of 12,304 kg/yr of TN and 1,139 kg/yr of TP to the environment annually based on typical nutrient application rate estimates.

The resultant nutrient export was 293.2 kg/yr of TN and 15.2 kg/yr of TP. These export estimate considers soil types, groundwater gradients, and depth to groundwater in its calculation.

Estimates of post development nutrient input and export rates following land use change are addressed in Section 4.4.

2.8 Constraints and Opportunities

Based on the sites existing environment, the following key constraints and opportunities are identified to guide the development of the water management strategy:

- There is generally good clearance to regional groundwater across the site.
- Underlying soils may limit opportunities for stormwater management via infiltration in some areas of the site.
- Given the sites proximity to the Greater Brixton St wetland area, there is an opportunity to reduce nutrient input to the landscape via land use change given existing historical uses in the area including poultry and turf farms.
- Re-development of the site provides opportunities to improve the existing interface of drainage flows into the Greater Brixton St wetland Area. Development also provides an opportunity for site monitoring to interface with any government initiatives toward improved wetland function and understanding.
- There is an opportunity to counteract effects of declining rainfall on the wetlands via a strategic approach to stormwater management in consultation with key agencies.

3. Design Principles & Criteria

Key design principles and criteria for the site are shown in Table 4 and have been established consistent with the key reference documents previously detailed in Section 1.2, and reflect the site constraints and opportunities identified in Section 2. These principles and criteria are used to formulate the water management strategy for the site to remain within the identified constraints and opportunities of the existing environment.

Table 4: Design Principles & Criteria

Strategy Elements	DWMS Method & Approach
Environmental	
Greater Brixton St Wetland Area	• Land use change to establish a net reduction in nutrient input and export from the site relative to existing land use. • Surface water flows to the wetland to retain pre-development rates, however these can be modified to address wetland need in consultation with agencies.
Water Use Sustainability	
Water Efficiency	• Water efficiency implementation to be consistent with Building Codes of Australia requirements. • Aim for less than 100 kL/person/year water use. • Establish "Waterwise" Public Open Spaces. • Maximise infiltration where practicable.
Water Supply	• Minimise overall use of scheme water for non-drinking purposes. • Water Corporation IWSS for lots plus rainwater tanks (non mandated). • Use of groundwater for POS irrigation.
Wastewater	• Water Corporation reticulated sewerage.
Stormwater	
Ecological Protection	• Combination of lot soakwells (15mm infiltration on site) and lot connection pits to be used. • Establishment of biofiltration areas for treatment of first 15 mm road runoff.
Serviceability	• Piped drainage system sized to convey 5 year ARI / 20% AEP event.
Flood Protection	• Establish minimum habitable floor levels at 0.5m above the 1% AEP flood level of the local stormwater management system. • Overland flow paths within road reserves for safe conveyance of flows exceeding pipe drainage system capacity. • 1% average exceedance probability (AEP) events to continue to flow offsite at acceptable rates consistent with downstream ecological and infrastructure constraints.
Groundwater	
Fill Requirement & Subsoil Drainage	• Development levels to establish an acceptable clearance to groundwater systems. Imported fill to be minimised. Use of subsoil drainage unlikely.
Acid Sulphate Soils & Contamination	• Management of any Acid Sulphate Soils to be handled as a separate process to the DWMS consistent with DoE (2004) requirements and reported in future water management planning documents.

4. Water Management Strategy

4.1 Water Supply Management

4.1.1 Fit for Purpose Water Source Planning

The Water Corporation's Integrated Water Supply System (IWSS) will supply potable water to future homes on the site.

The site is located within the Shire of Kalamunda Groundwater Management Subarea. While DWER's Water Register indicates the superficial aquifer in this area still has water available for allocation, DWER have advised the aquifer is nearing full allocation.

Deeper aquifers such as the Leederville and Yarragadee are fully allocated in this area.

Based on review of DWER's Water Register the site currently has 14 existing groundwater licences in the superficial aquifer with a total allocation of approximately 264,000 kL/yr. This includes a licence of 176,000 kL/yr for the existing turf farm. Extracts from DWER's Water Register are included in Appendix F.

This existing licencing would exceed requirements for long term POS irrigation within the site post development.

With respect to construction water requirements depending on ultimate staging considerations, some temporary licencing may be sought from DWER. Discussions with DWER's Swan Avon region have indicated temporary licences are still issued in this groundwater sub area.

4.1.2 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).
- Water efficiency consistent with Building Codes of Australia.
- Establish "Waterwise" Public Open Space
- Maximising on site retention and reuse of stormwater.

Further detail of water conservation measures will be provided at later stages of planning.

4.1.3 Wastewater Management

Wastewater will be deep sewerage (reticulated) with management by Water Corporation.

4.2 Stormwater Management Strategy

Stormwater management at the site is to be in accordance with Better Urban Water Management (WAPC, 2008), which guides the City of Kalamunda's principles for water quality and quantity management, as well as the Stormwater Management Manual for Western Australia (DoW, 2007).

Post development annual stormwater discharge volumes and peak flows are typically required to be maintained relative to pre development conditions and water quality improved with the aim of improving and restoring downstream ecological systems.

These principles will be the key guiding principles applied to the development of the site, particularly with respect to protecting the downstream Greater Brixton St wetland area.

With respect to post development stormwater management, there is no overarching DWER regional or district stormwater strategy which covers the site which would define a future arterial drainage strategy and acceptable flow rates for the site. Consistent with typical stormwater management practices, it is envisaged flow rates and paths will be required to be maintained post development. This implies flow from the site will continue to be directed towards the existing site outlets under Tonkin Hwy.

In terms of land take requirements for drainage post development for the site, an overall stormwater area of approximately 4.6 ha has been estimated for the site based on assuming 4.5% of developable land will be require for stormwater management.

The 4.5% estimate is based on previous Hyd2o experience with modelling in areas of similar land use and clearance to groundwater, and considering the low permeable soils in some areas as detailed in Douglas Partners (2020) will likely require lot based detention and connection systems rather than the use of soakwells to minimise future fill requirements. This will therefore increase stormwater land take at the estate scale compared to a soakwell based development.

The location of the BDNGPC adjacent to Tonkin Hwy is well positioned in terms of location and elevation for potential stormwater management use particularly for major event flood storage. The land within the pipeline corridor is estimated be 2.5 ha, indicating its potential to provide a considerable stormwater management role for the development. Hyd2o are aware of the BDNGPC being utilised for stormwater management in other developments.

With regard to water quality management, the development will be required to treat the first 15mm of runoff in biofiltration systems prior to infiltration. This land take is already considered in the total contributing area for stormwater above.

The proposed stormwater management system post development is summarised in Figure 8. Further details on the adopted stormwater management measures including their staging, distribution, sizing and location will be detailed in the LWMS as the LSP is developed.

Water quality treatment and detention areas and volumes for individual local catchments will be provided at LWMS stage based on refined modelling and detailed consideration of site specific geotechnical investigations. These sizings will reflect the outcomes of further agency discussions during the LWMS phase regarding utilising stormwater runoff to counteract any effects of declining rainfall on the wetlands via a strategic approach.

4.3 Groundwater Management Strategy

4.3.1 Fill and Subsoil Drainage

Development levels are generally not dominated by fill requirements to achieve adequate separation to groundwater, given the proximity of groundwater levels to natural surface.

Subsoil drainage is considered unlikely to be required, however should any be needed in limited areas (for example due to impermeable underlying soils), all flows would be treated prior to any off site discharge.

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 LWMS and UWMP and will be ultimately submitted for council approval at that stage.

4.3.2 Acid Sulphate Soils

Acid sulphate soil mapping has been previously discussed in Section 2.2.1 as being a moderate to low ASS risk across the site.

Management of acid sulphate soils (ASS) will be addressed by a separate study if required depending on possible disturbance and excavation depths for engineering services. Details regarding the outcomes of any ASS studies required will be included as part of later water management planning document for the site.

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).

4.4 Nutrient Management

Post development UNDO modelling of the site is detailed in Appendix E, showing the positive impact land use change at the site will have with respect to nutrient application and export in proximity to the Greater Brixton St wetlands.

The modelling results indicate land use change will result in nutrient inputs of 3715 kg/yr for TN and 581 kg/yr TP post development.

This indicates a considerable reduction in nutrient input within the site (previously detailed in Section 2.7) as a result of land use change, with an 8589 kg/yr (70%) reduction in TN input and 558 kg/yr (49%) reduction in TP input annually.

The resultant nutrient export was 94.2 kg/yr of TN and 8.1 kg/yr export of TP following development. This represents a significant 68% reduction in TN export and a 47% reduction in TP export to the environment post development.

These reductions are likely to provide considerable benefits for the environmental systems downstream of the site including the Greater Brixton St wetlands and Yule Brook

4.5 Staging

Staging of stormwater works to maintain a functioning stormwater management system for the site and the existing council drainage systems will be required.

Staging of stormwater changes will be implemented to ensure key hydrological performance criteria in relation to the receiving environment and key design objectives are maintained during the transition process.

Staging aspects of the development will be addressed in later stages of water management planning and include the identification of any temporary measures.

5. Implementation Framework

5.1 Considerations and Requirements for Local Planning

This document supports the proposed amendments to the Metropolitan Region Scheme to rezone the site from rural to urban. A number of additional documents will be required to progress further stages of planning and subdivision/development of the site.

Local Water Management Strategy's (LWMS's) will be required for the site to support the preparation of local structure plans. Subject to approval of a relevant LWMS, an Urban Water Management Plan (UWMP) will then need to be prepared as a condition of subdivision. Depending on the staging of development, several UWMP's may be required.

The preparation of all these future plans and the contained recommendations will be consistent with this DWMS, Better Urban Water Management (WAPC 2008), Stormwater Management Manual Western Australia (DoW, 2007), and other relevant DWER and City of Kalamunda guideline documents.

5.2 Monitoring

5.2.1 Pre Development Baseline

DWER typically require that prior to development an 18 month (minimum period, inclusive of 2 winters) groundwater and surface water monitoring programme is undertaken.

Baseline groundwater and surface water monitoring of existing conditions commenced in winter 2019 by Urbaqua on behalf of the City of Kalamunda and was completed in September 2020 (Urbaqua, 2020). Further monitoring by Hyd2o including the installation of additional bores within the site was commenced in winter 2020.

DWER have previously assessed the Urbaqua (2020) report and advised the program undertaken to be suitable and satisfy DWER's requirement for predevelopment monitoring.

A copy of DWER's advice is included as Appendix G.

Although no further predevelopment monitoring is necessary to meet DWER requirements, given the proximity of the site to the Greater Brixton St wetlands, a supplementary monitoring program to June 2022 is being undertaken to further assist in improving the hydrological understanding of the area and assist in facilitating improvements in water management in the wetlands proximity.

The program was developed in consultation with DBCA and is based on a review of review of previous monitoring data, Maddington Kenwick Strategic Employment Area environmental and monitoring reports, and previous DBCA reports, including Burke (2017). The program will provide:

- groundwater quality upstream and downstream of the site and review this in the context of groundwater quality closer to the wetland.
- surface water quality upstream and downstream of the site, and within the wetland where stormwater inflows occur.

The program focusses on the use of historically monitored sites where existing datasets can be built on and used to assist analysis and interpretation. Data will be assessed and reported on in the site's Local Water Management Strategy (LWMS).

Monitoring locations are shown in Figure 9. Ten bores will be monitored for levels monthly and water quality quarterly. Nine surface water sites will also be monitored. With respect to water quality monitoring parameters, in addition to nutrients and heavy metals, monitoring for traces of common herbicides and pesticides will also be undertaken.

The program will be coordinated with DBCA and opportunities for synergies assessed in terms of any further existing programs being undertaken in the area to maximise benefit.

5.2.2 Post Development

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 will therefore be 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 Kalamunda.

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. Post-development monitoring locations, trigger values and targets will be identified in the LWMS based on pre-development (existing) monitoring outcomes.

All water quality testing will be conducted by a NATA approved laboratory.

5.3 Funding and Ongoing Maintenance Responsibilities

Key implementation actions and responsibilities are detailed in Table 5.

The development and implementation of a Local Structure Plan and accompanying Local Water Management Strategy will be the responsibility of the site developer.

Ongoing funding and maintenance responsibilities will be appropriately detailed at LWMS and UWMP stages and will include a summary of responsibility for the developer, City of Kalamunda, DWER, and DBCA.

Table 5: Implementation Responsibilities

Implementation Action	Responsibility			
	Developer	DWER	City of Kalamunda	DBCA
Conduct supplementary predevelopment monitoring program	✓			
Preparation of LWMS to support local structure planning	✓			
Review and approval of LWMS		✓	✓	✓
Preparation of a UWMP for individual development stages	✓			
Review and approval of UWMP		✓	✓	✓
Construction of water management system and maintenance post construction until council handover	✓			
Long term water management system operation and maintenance			✓	
Conduct post development monitoring program and annual reporting	✓			
Review of monitoring data and annual reports		✓	✓	

6. References

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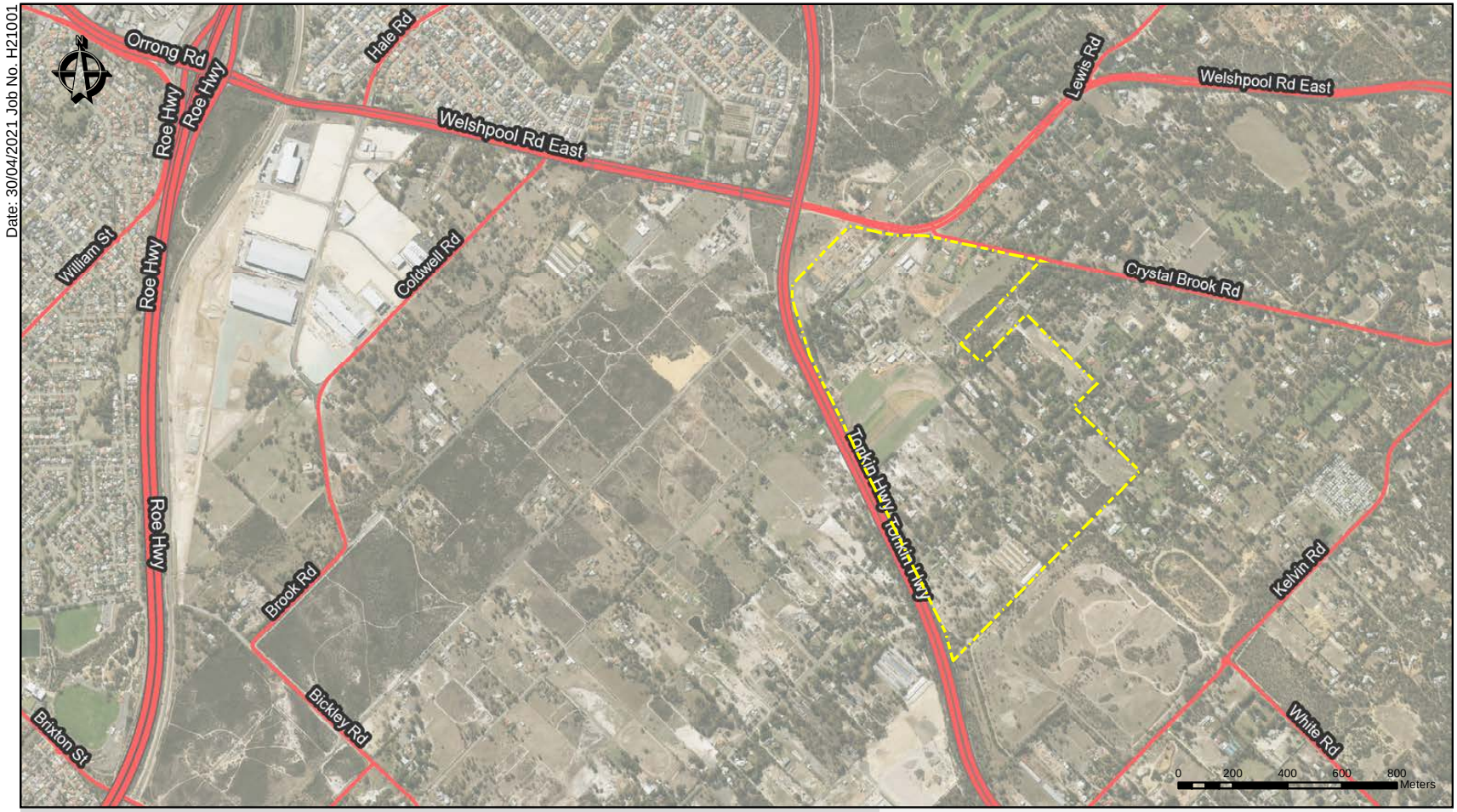
FIGURES



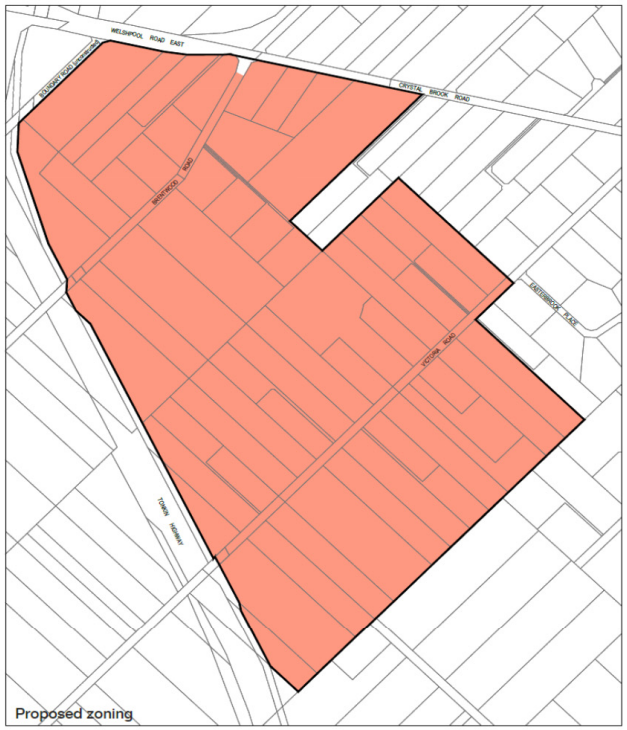
hyd2o

Wattle Grove South District Water Management Strategy

Location Plan

Figure 1

Date : 30/4/2021 Job No: H21001



KEY

Subject land

Region Scheme Zones and Reservations

Parks and Recreation
Primary Regional Road
Other Regional Road
Bush Forever
Urban
Industrial
Rural

KEY

Excluded from Rural zone and included in Urban zone

Proposed MRS Amendment
Wattle Grove South

Date: 8 March 2021 Scale: NTS@ A3 File: 20-119 PL1A MRS Amendment Staff: MR/LC Checked: MR

element.

Source: Element 2021

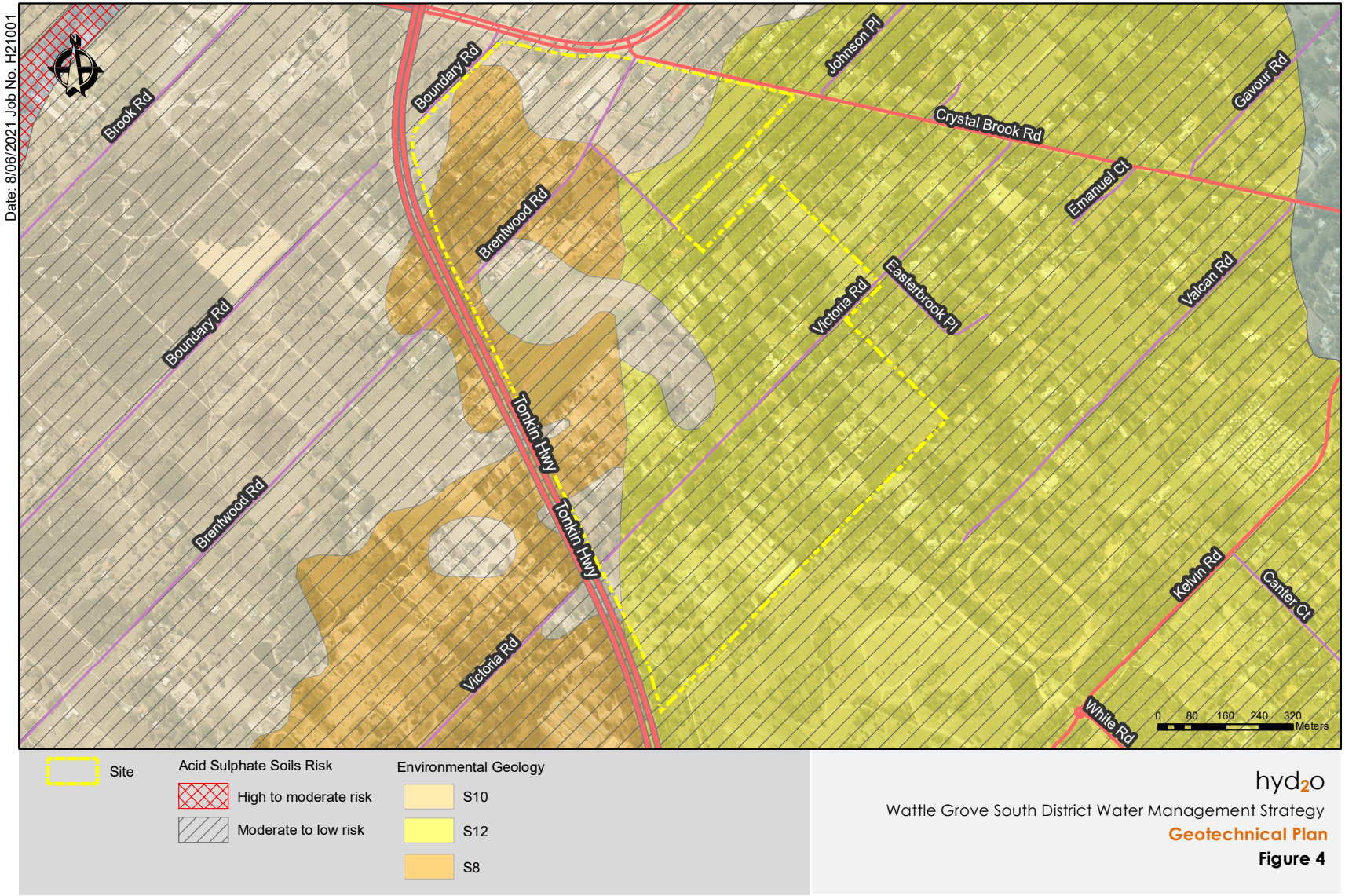
hyd2o

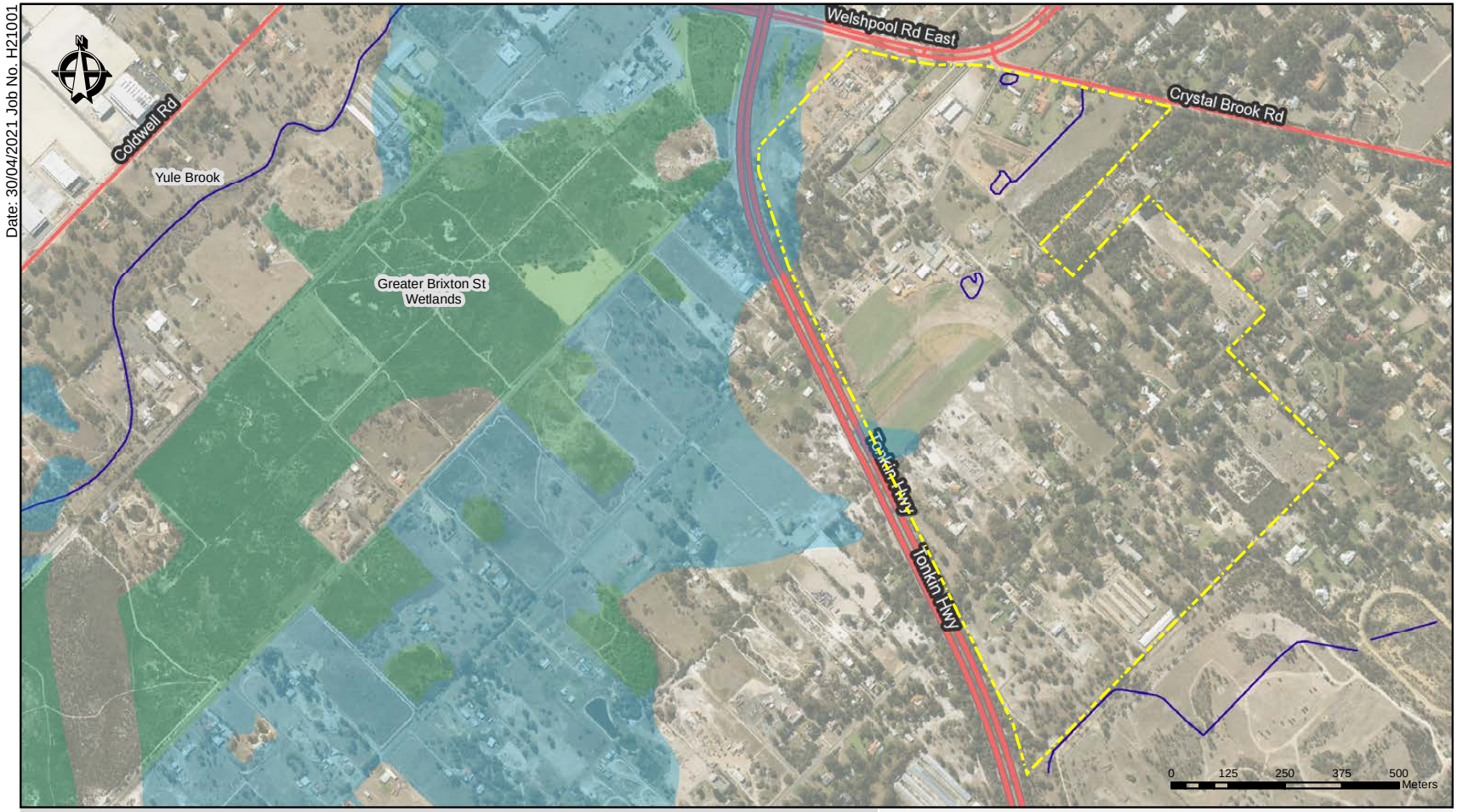
Wattle Grove South District Water Management Strategy

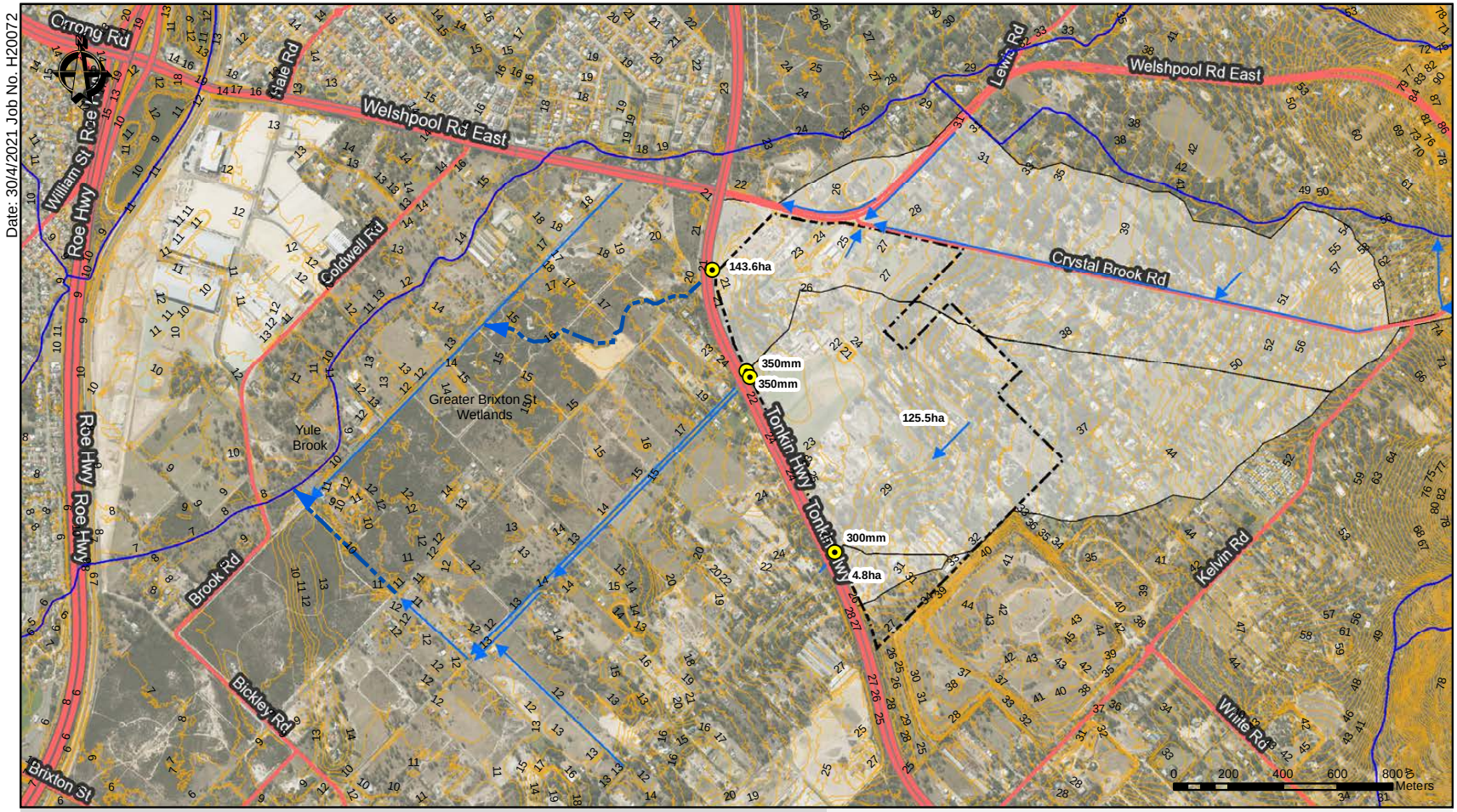
Proposed Metropolitan Region Scheme Amendment

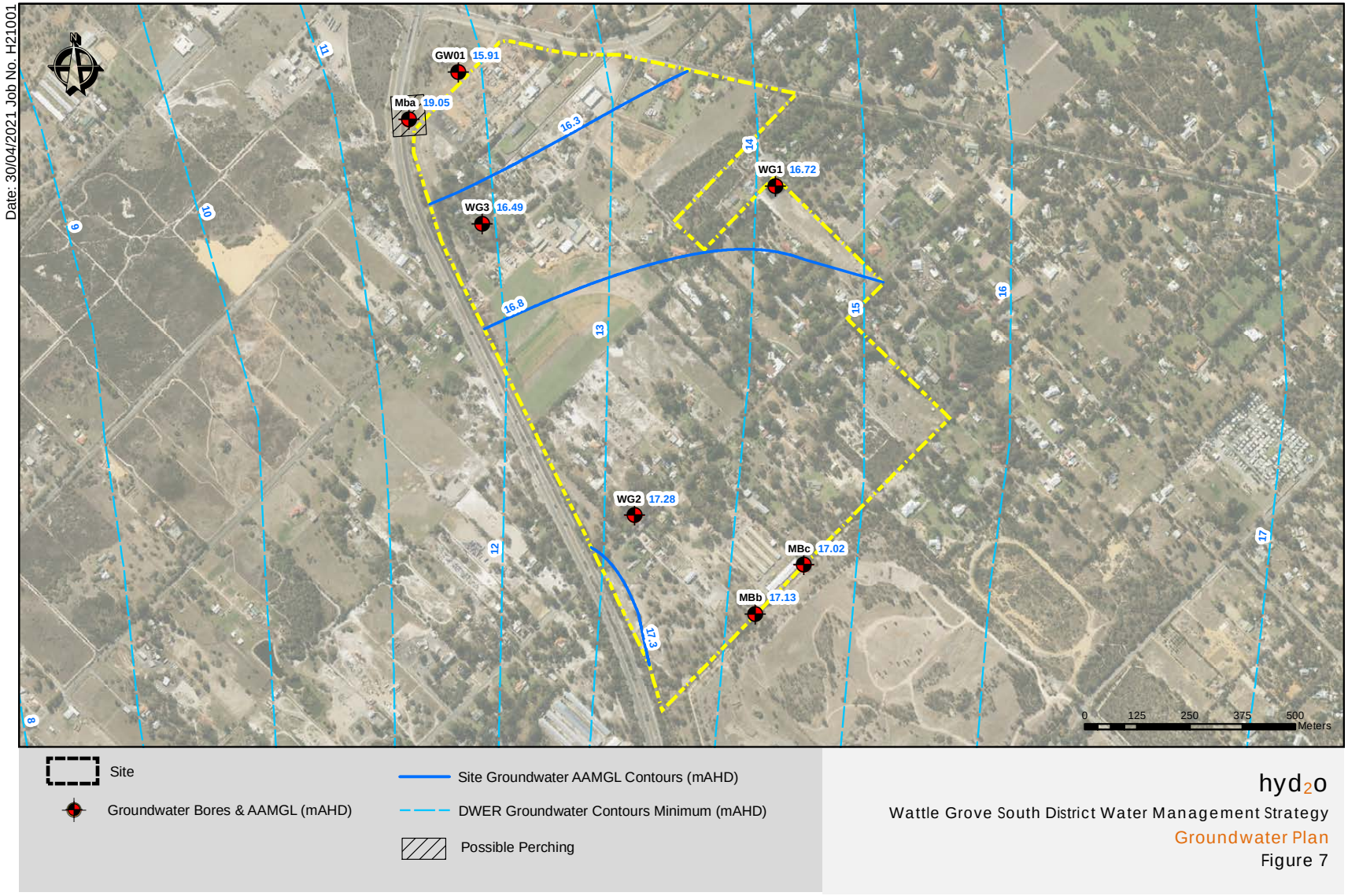
Figure 2


Date: 30/04/2021 Job No. H21001
Brook Rd
Boundary Rd
Brentwood Rd
Johnson Pl
Crystal Brook Rd
Gavour Rd
Emanuel Ct
Easterbrook Pl
Victoria Rd
Valcan Rd
Turf Farm
Former Poultry Farm
Tonkin Hwy
Kelvin Rd
Canter Ct
White Rd
Site
LiDAR Topography (mAHD)
0 125 250 375 500
Meters
hyd2o
Wattle Grove South District Water Management Plan
Site Conditions Plan
Figure 3


Date: 8/06/2021 Job No. H21001
N
Brook Rd
Boundary Rd
Brentwood Rd
Boundary Rd
Brentwood Rd
Tonkin Hwy
Tonkin Hwy
Victoria Rd
Victoria Rd
Easterbrook Pl
Johnson Pl
Crystal Brook Rd
Emanuel Ct
Gavour Rd
Valcan Rd
Kelvin Rd
Canter Ct
White Rd
0 80 160 240 320
Meters
Site
Acid Sulphate Soils Risk
High to moderate risk
Moderate to low risk
Environmental Geology
S10
S12
S8
hyd2o
Wattle Grove South District Water Management Strategy
Geotechnical Plan
Figure 4


Date: 30/04/2021 Job No. H21001
N
Welshpool Rd East
Crystal Brook Rd
Coldwell Rd
Yule Brook
Greater Brixton St Wetlands
Tonkin Hwy
Tonkin Hwy
0 125 250 375 500
Meters
Site
DWER Hydrography
Wetlands
Conservation
Resource Enhancement
hyd2o
Wattle Grove South District Water Management Strategy
Wetland Plan
Figure 5


Date: 30/4/2021 Job No. H20072
Orrong Rd
Hale Rd
Welshpool Rd East
Lewis Rd
William St
Roe Hwy
Coldwell Rd
Crystal Brook Rd
143.6ha
350mm
350mm
Greater Brixton St Wetlands
Yule Brook
125.5ha
Tonkin Hwy
300mm
4.8ha
Kelvin Rd
Brook Rd
Bickley Rd
White Rd
Brixton St
0 200 400 600 800 Meters
Site
Site Catchments
Stormwater Outlet
Open Drain
Flow Path
DWER Rivers/Hydrography
Topography
hyd2o
Wattle Grove South District Water Management Strategy
Surface Water Plan
Figure 6

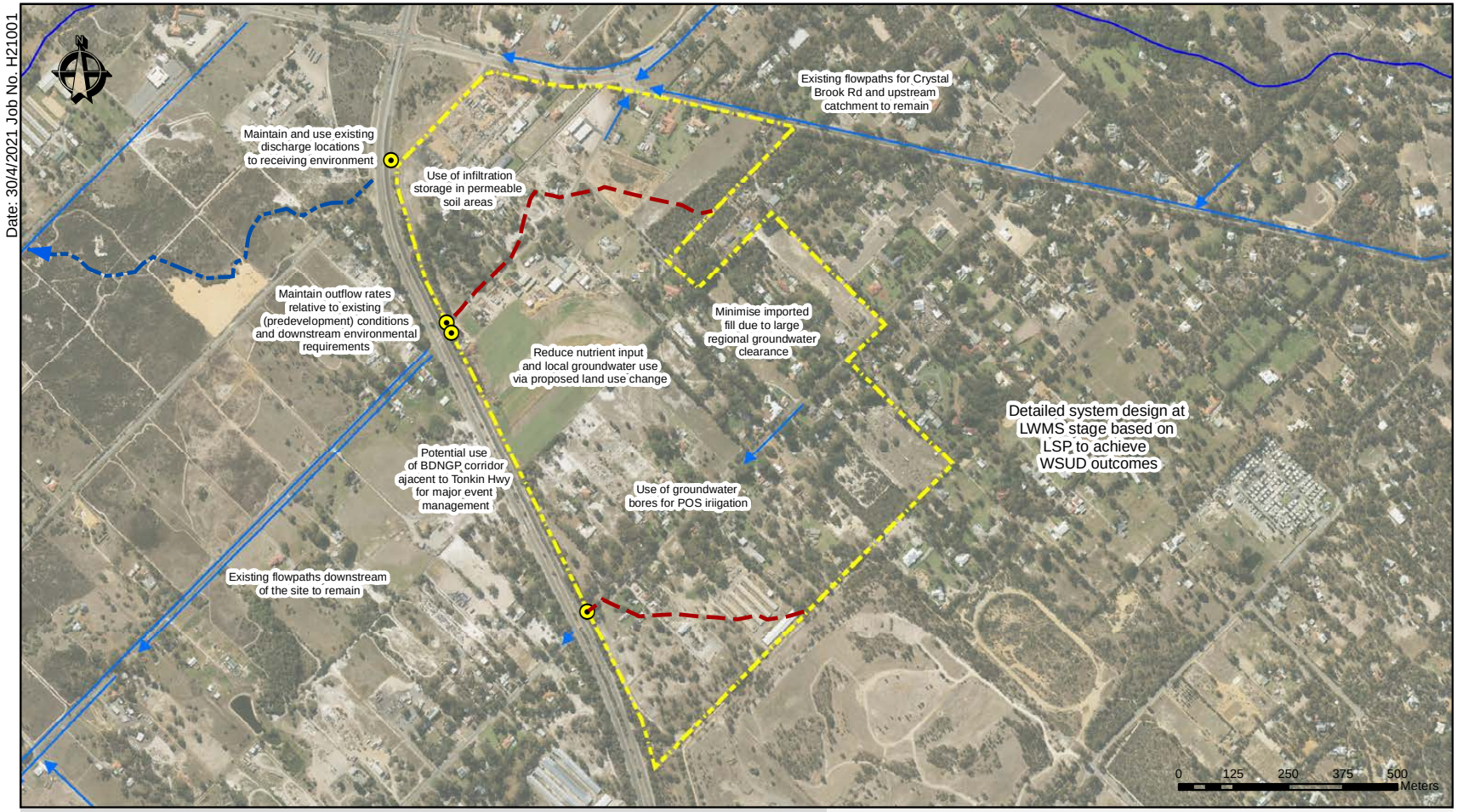


hyd2o

Wattle Grove South District Water Management Strategy

Groundwater Plan

Figure 7



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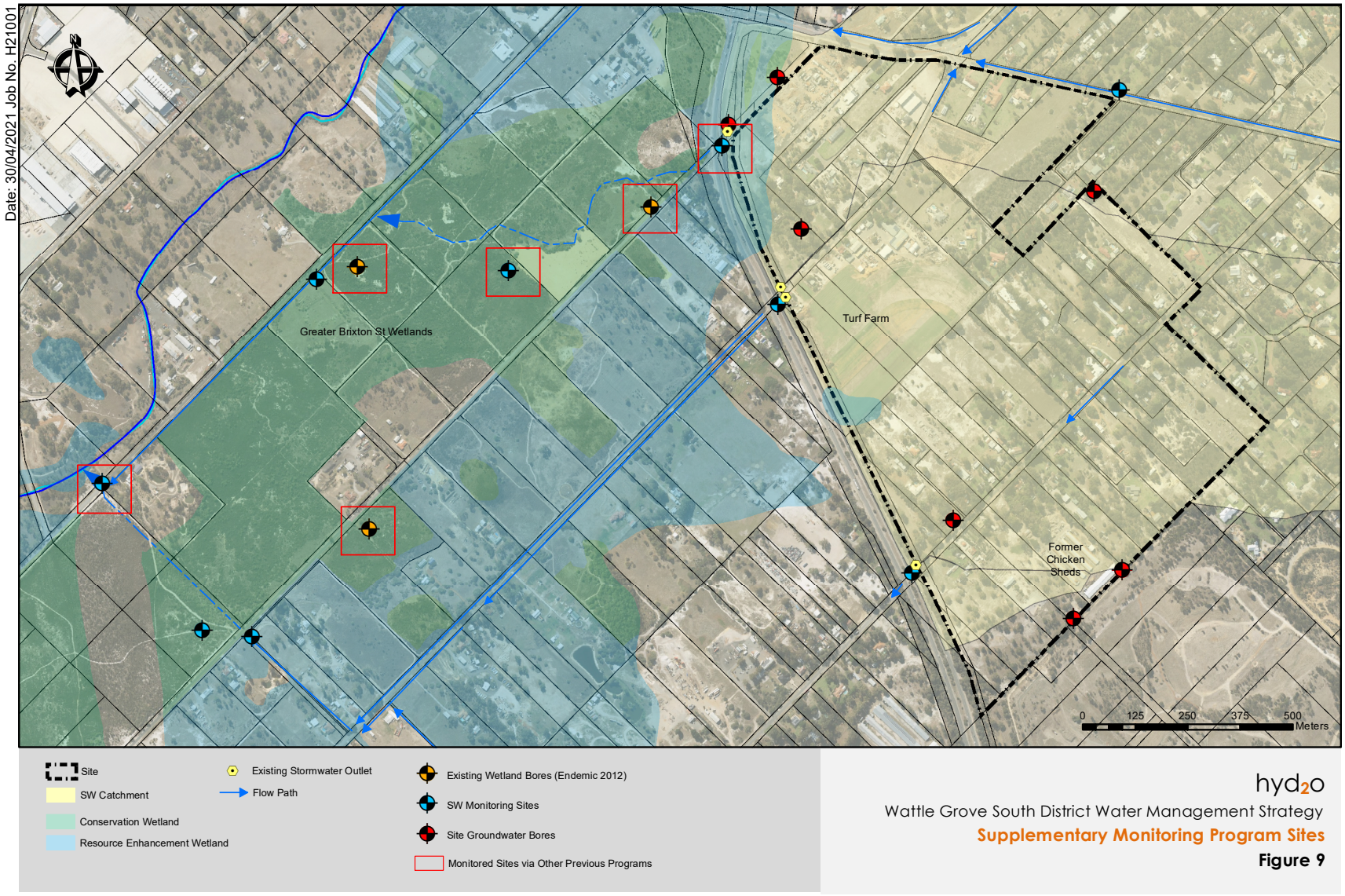
Wattle Grove South District Water Management Strategy

Stormwater Management Plan

Figure 8



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Wattle Grove South District Water Management Strategy

Supplementary Monitoring Program Sites

Figure 9

APPENDIX A
DWMS Checklist For Developers

District water management strategy guide

Use the guide below to assist with the completion of the DWMS. Tick the box where items have been met. If the item is not applicable to the DWMS, include N/A with explanation in the notes column. Provide any other relevant comments briefly in the notes column.

District water management strategy item	☑	**Notes**
Executive summary		
Describe proposed water management objectives and how the objectives will be met.	☑	refer Executive Summary
Planning background and previous studies		
Map the location of the site.	☑	Location or site context plan refer Figure 1
State which planning document the strategy is supporting.	☑	District structure plan if available refer Section 1.1, Table 1
Provide references to the key state and/or local policies, guidelines, strategies and their relevance.	☑	refer Section 1.2, Section 6
Design criteria		
Recognise water management principles, objectives and design criteria.	☑	refer Chapter 3, Table 4
Design objectives from previous water strategies and/or plans.	☑	refer Chapter 3, Table 4
Pre-development environment (identification of assets, risks and constraints)		
Describe site characteristics: provide preliminary desktop assessments and/or field investigations (if required)	☑	Include existing data refer Chapter 2
Describe climate.	☑	Description refer Section 2.1
Describe and map topography, landform and geotechnical conditions.	☑	Aerial photo refer Figure 3 refer Sections 2.1 & 2.2 Geotechnical plan refer Figure 4 Acid sulfate soil risk mapping refer Figure 4

District water management strategy item	☑	Notes
Describe the existing land use.	☑	Description refer Section 2.1
Identify environmental assets and their significance.	☑	Environmental plan plus supporting data where available refer Section 2.3, Figure 5
Detail the social, cultural and heritage considerations.		n.a.
Describe the hydrology and hydrogeology of the area: • surface water • groundwater • water-dependent ecosystems • water resource issues.	☑	Surface water hydrology plan refer Section 2.4, Figure 6 Groundwater and topographic contours plan (or depth to groundwater) refer Section 2.5, Figure 7 Waterways and wetlands plan refer Section 2.3, Figure 5 Indicative water balance (pre- and post-development water balances can be presented together – see below) refer Section 2.7
Describe existing drainage infrastructure and other infrastructure likely to affect management of water resources.	☑	Arterial drainage plan (if available) including local drainage refer Section 2.4, Figure 6
Post-development water management		
Identify the proposed broad scale management strategies that will address water resource issues and meet the objectives and design criteria.	☑	refer Section 4.2
Calculate an indicative water balance.	☑	Indicative water balance. May be presented as a diagram including pre- and post-development volumes with explanatory notes refer Section 4.4
Describe the impacts to water resources and/or impacts to proposed change in land use from water issues.	☑	refer Chapter 4, Figure 8
Surface water – Estimate land requirements for water management. – Identify water quality issues and scope for improvement. – Describe proposed strategy for management of small, minor and major surface flows.	☑	Include any existing data refer Appendix D refer Section 4.2 refer Section 2.6 refer Section 4.2
Describe groundwater levels, use, management and maintenance.	☑	Include data if available refer Section 2.5, Section 4.3, Figure 7

District water management strategy item	☑	**Notes**
Identify water-dependent ecosystems	☑	refer Section 2.3
Identify contamination issues – high risk acid sulfate soils, contaminated sites or areas with historical high nutrient and/or non-nutrient contaminants.	☑	Include data or plans if available refer Section 2.2 & 2.3, Figure 3, Section 2.6
Water services and efficiency initiatives		
Describe potable water supply – options including details of technical, environmental and regulatory feasibility – regulatory approvals, technical investigations and any obtained written approvals – recommendations for water efficiency and conservation	☑	Written evidence if obtained refer Section 4.1.1 & Section 4.1.2
Identify wastewater servicing – options including preferred option, location, treatment process, level of treatment, disposal, buffers and infrastructure – approvals and investigations required and any obtained written approvals – recommendations for water efficiency and conservation	☑	Written evidence if obtained refer Section 4.1.3
Identify non-potable (fit-for-purpose) water supply – non-potable water source options. Highlight preferred option with consideration of pre and post development water balance – approvals and investigations required and any obtained written approvals – recommendations for water efficiency and conservation	☑	Written evidence if obtained refer Section 4.1.1 & Section 4.1.2

District water management strategy item	☑	**Notes**
Implementation framework		
Describe commitments and obligations for the next stage of the planning process (e.g. LWMS). Identify issues that need specialised investigation and management for the subsequent LWMS. Make recommendations for implementing the DWMS.	☑	Commitments and obligations may be displayed in table format refer Chapter 5, Table 5

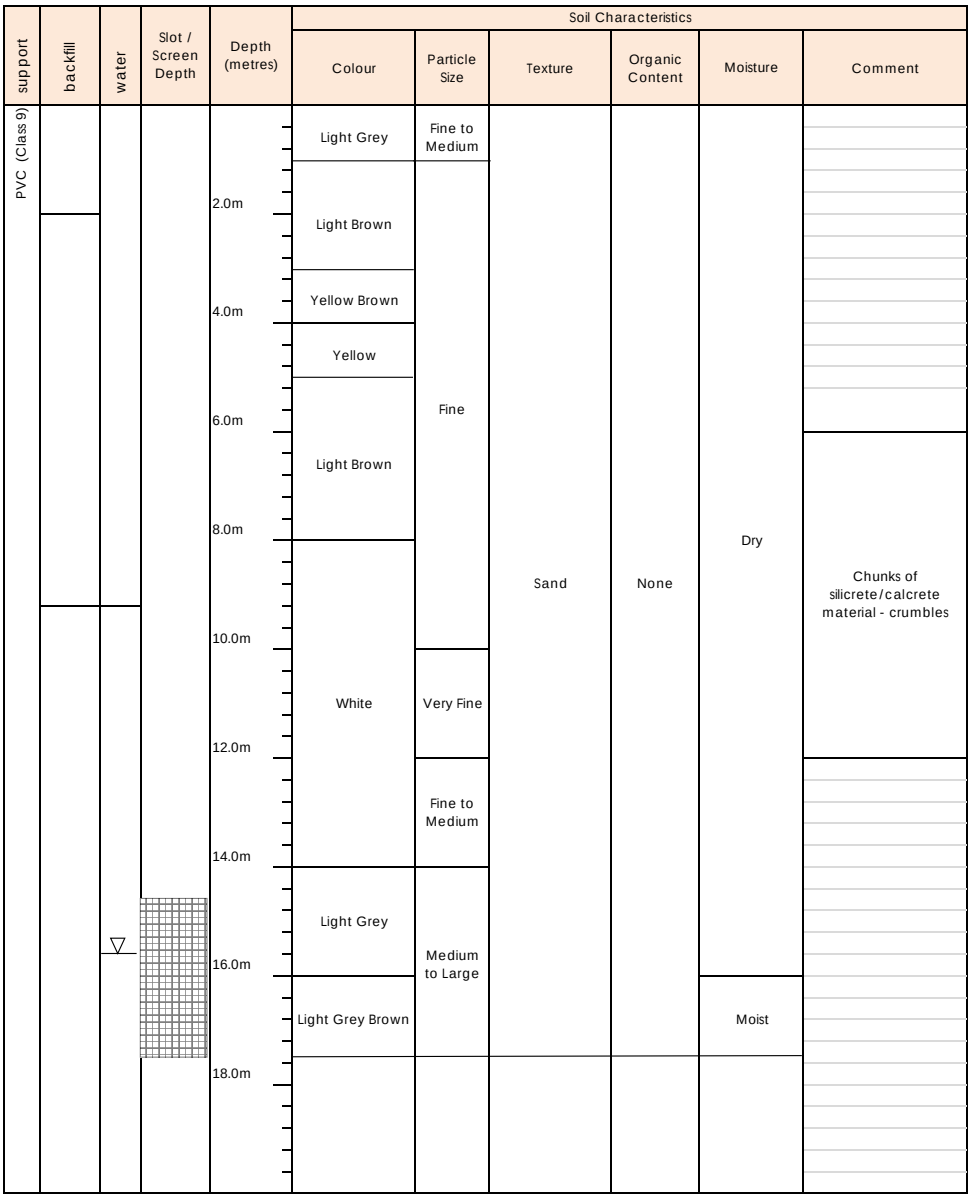
APPENDIX B
Hyd2o Bore Logs

Lithological Log

Hyd2o
Suite 6B 103 Rokeby Rd
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

				Bore Name
Date :	**19-11-20**	Job Number :	H20072	
Client :	**Hesperia**	Start Hole :	**7.30 am**	
Project:	**Wattle Grove South**	End Hole :	**10.30 am**	
Easting	**406115**	Logged by :	**SO**	**WG01**
Northing	**6457799**	Total Depth :	**17.5 m**	
Datum:	AHD	RL Top of Casing :	**32.1 mAHD**	
Drill type:	Drill Rig RAB	RL Nat Surface :	**31.45 mAHD**	
Hole diameter:	2.5 Inch			



COLOUR :	Black, White, Beige Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue Composition : Solid , Blemish, Mottle		**Static Water Level**
PARTICLE SIZE :	Fine, Medium, Course		
TEXTURE :	Sand, Loamy Sand, Clayey Sand Silt, Loam, Sandy Loam, Clayey Loam Clay, Sandy Clay	Date	23-11-20
		Stickup above NS (m)	0.65
ORGANICS :	High, Medium, Low	Water Level bTOC (m)	15.72
MOISTURE :	Dry, Slightly Moist, Moist, Saturated	Water Level bNS (m)	15.07

hyd2o HYDROLOGY

Lithological Log

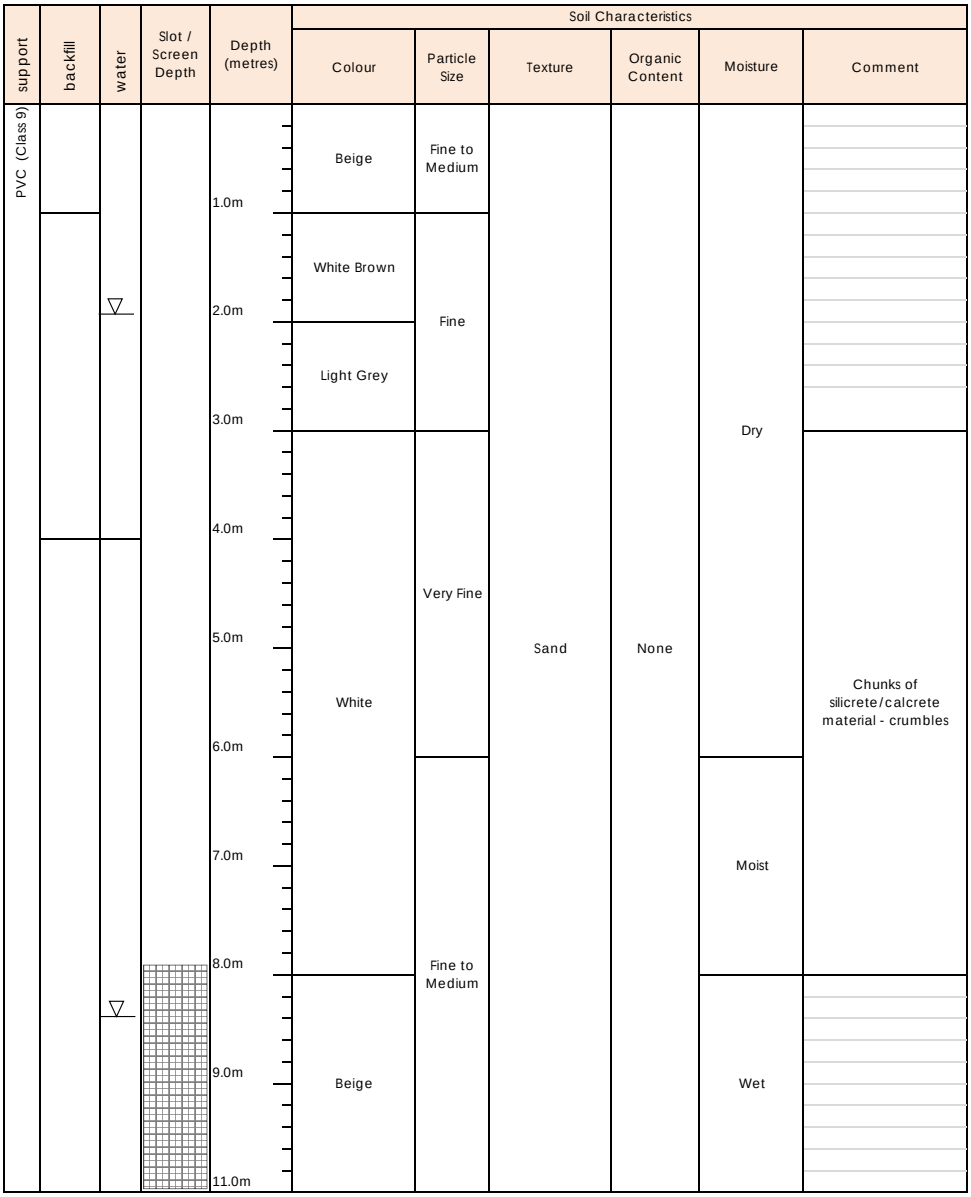
Hyd2o
Suite 6B 103 Rokeby Rd
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

Date :	**19-11-20**	Job Number :	H20072
Client :	**Hesperia**	Start Hole :	**10.30 am**
Project:	**Wattle Grove South**	End Hole :	**12.00 pm**
Easting	**405780**	Logged by :	**SO**
Northing	**6457018**	Total Depth :	**11 m**
Datum:	AHD	RL Top of Casing :	**26.12 mAHD**
Drill type:	Drill Rig RAB	RL Nat Surface :	**25.47 mAHD**
Hole diameter:	2.5 Inch		

Bore Name

WG02



COLOUR :	Black, White, Biege Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue Composition : Solid , Blemish, Mottle
PARTICLE SIZE :	Fine, Medium, Course
TEXTURE :	Sand, Loamy Sand, Clayey Sand Silt, Loam, Sandy Loam, Clayey Loam Clay, Sandy Clay
ORGANICS :	High, Medium, Low
MOISTURE :	Dry, Slightly Moist, Moist, Saturated

Static Water Level

Date	23-11-20
Stickup above NS (m)	0.65
Water Level bTOC (m)	9.18
Water Level bNS (m)	8.53

hyd2o HYDROLOGY

Lithological Log

Hyd2o
Suite 6B 103 Rokeby Rd
Subiaco, WA 6008

PO Box 1055
Subiaco WA 6904

				Bore Name
Date :	**19-11-20**	Job Number :	H20072	
Client :	**Hesperia**	Start Hole :	**12.30 pm**	
Project:	**Wattle Grove South**	End Hole :	**2.00 pm**	
Easting	**405419**	Logged by :	**SO**	**WG03**
Northing	**6457710**	Total Depth :	**8 m**	
Datum:	AHD	RL Top of Casing :	**22.97 mAHD**	
Drill type:	Drill Rig RAB	RL Nat Surface :	**22.32 mAHD**	
Hole diameter:	2.5 Inch			

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics					
					Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)				1.0m	White	Very Fine	Sand	None	Dry	
				2.0m	Beige	Fine to Medium				
				3.0m	White Grey	Fine			Slightly Moist	
				4.0m	Beige	Fine to Medium	Clayey Sand		Moist	
		▽		5.0m						
				6.0m		Very Fine				
				7.0m	White	Fine to Coarse	Sand			Quartz/Feldspar Minerals
				8.0m						

COLOUR : Black, White, Biege
Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
Composition : Solid , Blemish, Mottle

PARTICLE SIZE : Fine, Medium, Course

TEXTURE : Sand, Loamy Sand, Clayey Sand
Silt, Loam, Sandy Loam, Clayey Loam
Clay, Sandy Clay

ORGANICS : High, Medium, Low

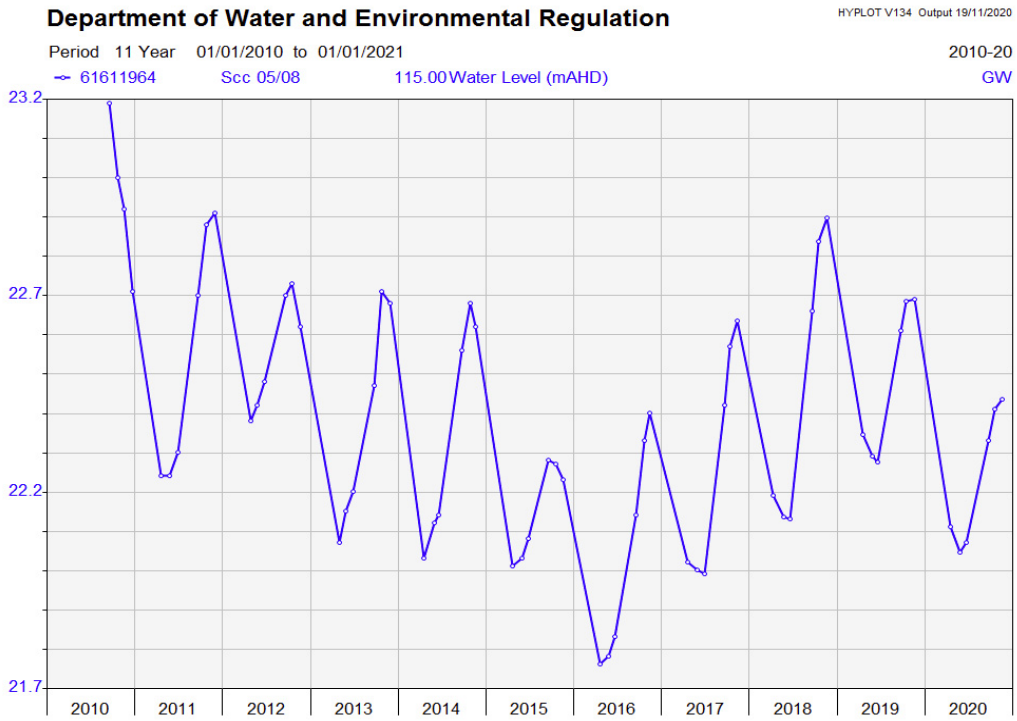
MOISTURE : Dry, Slightly Moist, Moist, Saturated

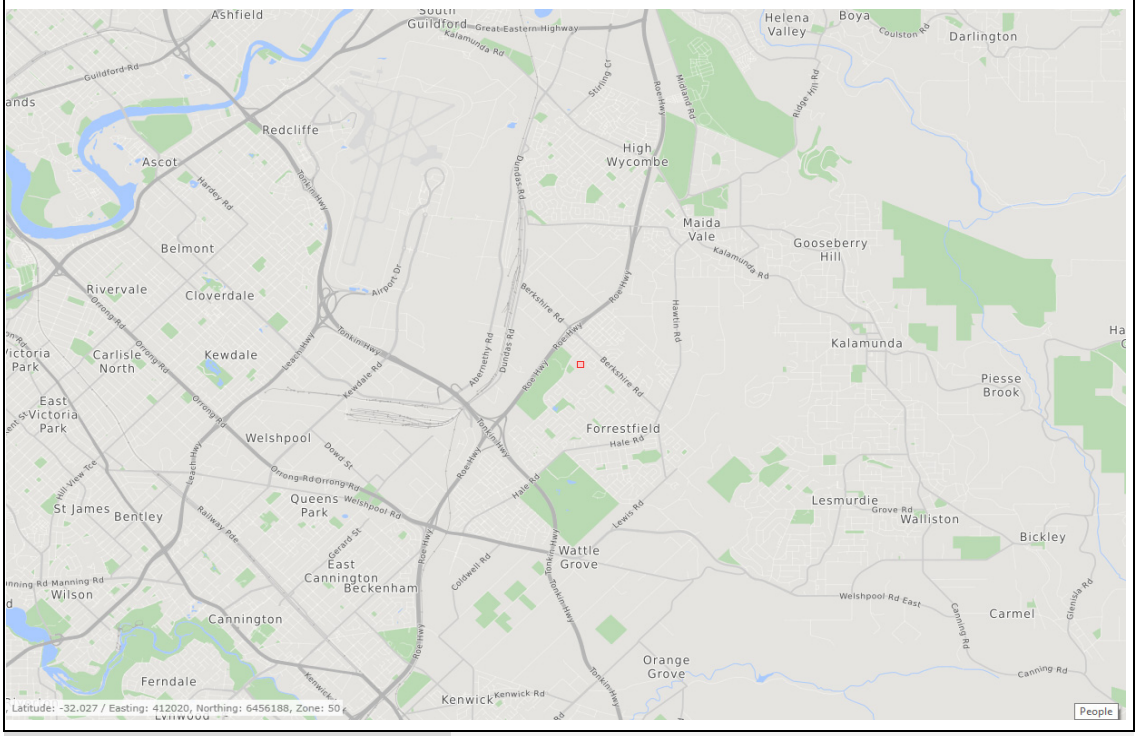
Static Water Level

Date	23-11-20
Stickup above NS (m)	0.65
Water Level bTOC (m)	6.82
Water Level bNS (m)	6.17

APPENDIX C
DWER Bore Hydrographs

Date :10/03/2021 Job No. H21001





Source: Department of Water and Environmental Regulation (2021)

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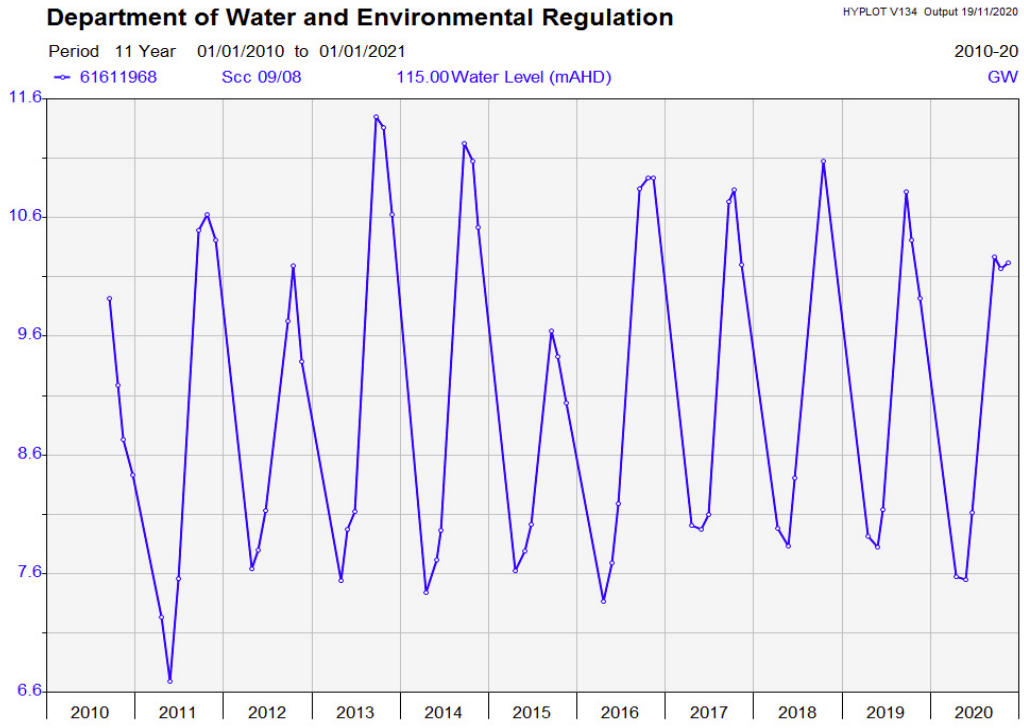
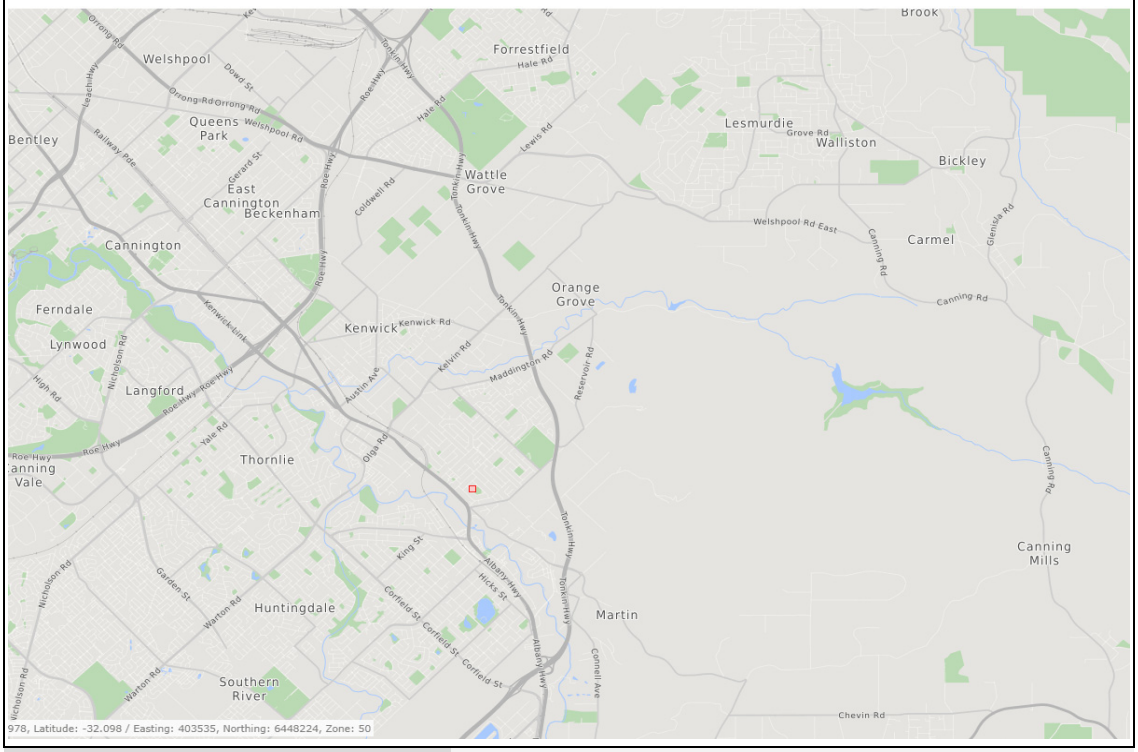
Wattle Grove South District Water Management Strategy

DWER Bore Hydrographs : SCC 05-08

Appendix C1

Date :10/03/2021 Job No. H21001





Source: Department of Water and Environmental Regulation (2021)

hyd2o

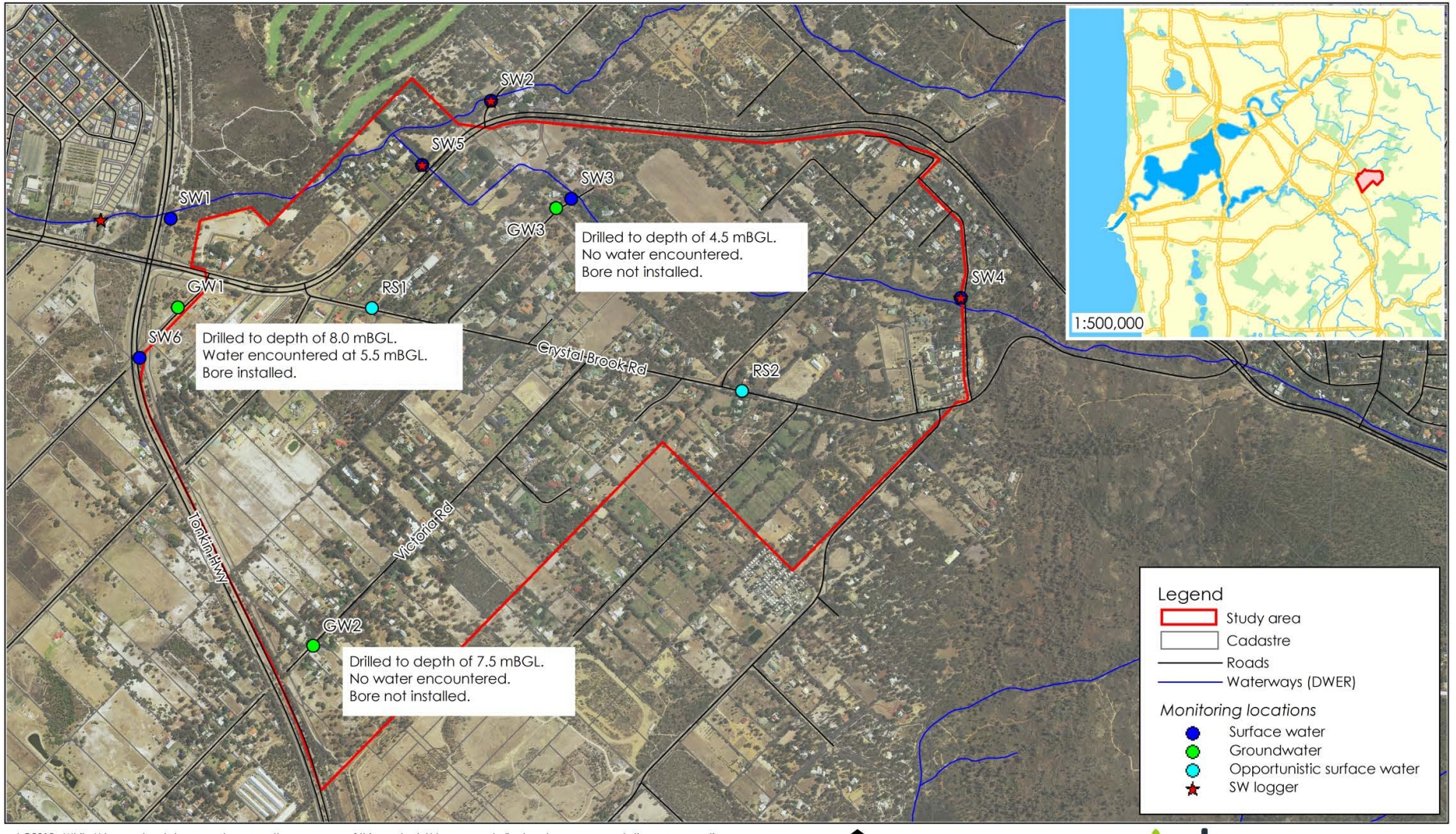
Wattle Grove South District Water Management Strategy

DWER Bore Hydrographs : SC 09-08

Appendix C2

APPENDIX D
Water Quality Monitoring Data

City of Kalamunda - Wattle Grove South Monitoring
Figure 1 - Monitoring sites



Data source: DWER, MRWA, DPLH, CoK, Created by: AT., Projection: MGA: zone 50.

0 500
metres
Scale 1:16,000 @ A4

urbaqua
land and water solutions

Wattle Grove South surface water quality monitoring results – 2019-2020

				IN SITU								LABORATORY								
				pH	EC (µS/cm)	Eh (mV)	DO (%)	DO (mg/L)	Salinity (ppt)	Temp (°C)	Turbidity (NTU)	TSS (mg/L)	TKN (mg/L)	TN (mg/L)	NH4 (mg/L)	NO3-N (mg/L)	NO2-N (mg/L)	NOx-N (mg/L)	TP (mg/L)	FRP (mg/L)
			LoR	-	-	-	-	-	-	-	<5	<5	<0.2	<0.2	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
SITE	Sampling date	Schedule	ANZG (2018)*	6.5 - 8.0	120 - 300	-	80 - 120	-	-	-	10-20	-	-	1.2	0.08	2.4	-	0.15	0.065	0.04
SW1	25-Jul-19	Jul	2019	8.07	558	180	105	10.7	0.27	14.6	-0.04	<5	<0.2	1.0	<0.02	0.86	<0.01	0.86	0.06	<0.01
	20-Aug-19	Aug	2019	7.82	519	38	101	10.6	0.25	14.1	-1.51	<5	0.4	1.2	<0.02	0.82	<0.01	0.82	0.07	<0.01
	3-Sep-19	Sept	2019	7.65	468	-279	78	7.8	0.23	15.3	-	6	<0.2	1.0	<0.02	0.82	<0.01	0.82	0.06	<0.01
	17-Sep-19	Sept	2019	7.46	549	-188	118	11.2	0.27	16.5	-	<5	<0.2	0.8	<0.02	0.75	0.01	0.76	0.05	<0.01
	1-Oct-19	Oct	2019	6.73	511	131	102	9.8	0.25	17.0	-0.57	<5	<0.2	0.8	<0.02	0.67	<0.01	0.67	0.05	<0.01
	20-Mar-20	Mar	2020	6.52	445	-39	26	2.3	0.21	21.5	-	<5	1.6	1.6	0.03	<0.01	<0.01	<0.01	0.11	<0.01
	19-Jun-20	Jun	2020	7.26	439	161	97	10.3	0.21	13.4	1.04	<5	0.3	0.5	<0.02	0.19	<0.01	0.19	0.06	<0.01
	10-Jul-20	Jul	2020	7.31	523	90	102	10.9	0.25	12.3	0.60	10	0.9	1.8	<0.02	0.91	<0.01	0.91	0.03	<0.01
	24-Jul-20	Jul	2020	7.29	541	194	102	10.8	0.26	13.1	0.70	<5	0.2	1.1	<0.02	0.88	<0.01	0.88	0.05	<0.01
	7-Aug-20	Aug	2020	7.43	552	161	105	11.4	0.26	12.1	0.80	<5	0.3	0.9	<0.02	0.62	<0.01	0.62	0.05	<0.01
	21-Aug-20	Aug	2020	7.65	540	139	104	10.7	0.26	13.7	1.43	<5	<0.2	1.2	<0.02	1.10	<0.01	1.10	0.05	<0.01
	4-Sep-20	Sept	2020	7.33	516	170	104	10.4	0.25	15.8	3.10	9	<0.2	0.9	0.02	0.81	<0.01	0.81	0.01	<0.01
	25-Sep-20	Sept	2020	7.65	514	251	106	10.2	0.25	16.9	6.53	<5	0.3	1.0	0.09	0.69	<0.01	0.69	<0.01	<0.01
SW2	25-Jul-19	Jul	2019	7.80	547	103	103	10.5	0.27	14.5	0.06	<5	0.2	1.2	<0.02	1.00	<0.01	1.00	0.05	<0.01
	20-Aug-19	Aug	2019	7.70	507	-34	101	10.4	0.24	14.7	-3.42	<5	0.4	1.4	0.06	0.99	<0.01	0.99	0.11	<0.01
	3-Sep-19	Sept	2019	7.48	468	20	76	7.6	0.23	15.2	-	8	<0.2	1.1	<0.02	0.95	<0.01	0.95	0.07	<0.01
	17-Sep-19	Sept	2019	7.65	543	-217	109	10.7	0.26	16.4	-	6	<0.2	1.1	<0.02	0.97	0.01	0.98	0.07	<0.01
	1-Oct-19	Oct	2019	7.20	490	125	100	9.7	0.24	16.7	-0.57	6	<0.2	1.0	<0.02	0.88	<0.01	0.88	0.06	<0.01
	20-Mar-20	Mar	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19-Jun-20	Jun	2020	7.01	452	177	97	10.3	0.22	13.0	0.52	<5	0.3	0.6	<0.02	0.31	<0.01	0.31	0.05	<0.01
	10-Jul-20	Jul	2020	7.31	529	93	102	10.8	0.26	12.5	2.60	8	1.1	2.0	<0.02	0.86	<0.01	0.86	0.02	<0.01
	24-Jul-20	Jul	2020	7.21	535	151	101	10.6	0.26	13.5	1.60	<5	0.3	1.3	<0.02	0.99	0.01	1.00	0.06	<0.01
	7-Aug-20	Aug	2020	7.27	553	165	102	11.1	0.27	11.9	2.40	<5	0.2	1.0	<0.02	0.83	<0.01	0.83	0.05	<0.01
	21-Aug-20	Aug	2020	7.59	535	116	101	10.4	0.26	13.8	2.38	<5	<0.2	1.4	<0.02	1.30	<0.01	1.30	0.05	<0.01
	4-Sep-20	Sept	2020	7.27	514	125	102	10.1	0.25	15.8	1.80	<5	<0.2	1.1	0.03	1.00	<0.01	1.00	<0.01	<0.01
	25-Sep-20	Sept	2020	7.54	568	275	105	10.2	0.25	16.4	1.61	<5	0.3	1.2	<0.02	0.93	<0.01	0.93	0.01	<0.01
SW3	25-Jul-19	Jul	2019	7.83	586	136	105	10.7	0.29	14.6	0.82	<5	0.2	0.6	<0.02	0.40	<0.01	0.40	0.06	<0.01
	20-Aug-19	Aug	2019	7.73	548	-39	103	10.7	0.26	14.4	-1.45	<5	0.4	0.8	0.06	0.44	<0.01	0.44	0.13	<0.01
	3-Sep-19	Sept	2019	6.70	457	-73	80	8.1	0.22	14.9	-	8	0.2	0.8	<0.02	0.58	<0.01	0.58	0.06	<0.01
	17-Sep-19	Sept	2019	7.59	542	-225	111	10.9	0.26	17.2	-	<5	0.3	0.6	<0.02	0.33	<0.01	0.33	0.06	<0.01
	1-Oct-19	Oct	2019	7.32	531	129	103	9.7	0.26	18.3	-0.26	<5	2.3	2.5	0.03	0.25	<0.01	0.25	0.07	<0.01
	20-Mar-20	Mar	2020	7.43	569	-3	96	8.0	0.29	21.9	-	27	0.9	1.1	0.05	0.23	<0.01	0.23	0.16	0.01
	19-Jun-20	Jun	2020	6.14	407	220	89	9.3	0.20	13.5	6.00	<5	0.5	0.6	0.04	0.07	<0.01	0.07	0.04	<0.01
	10-Jul-20	Jul	2020	7.33	495	107	98	10.5	0.24	12.1	2.32	8	1.2	1.4	0.04	0.21	<0.01	0.21	0.02	<0.01
	24-Jul-20	Jul	2020	7.21	563	155	98	10.4	0.27	12.9	1.50	<5	0.3	0.7	0.03	0.38	<0.01	0.38	0.08	<0.01
	7-Aug-20	Aug	2020	7.30	537	93	98	10.7	0.26	11.9	1.50	<5	0.2	0.4	0.02	0.17	<0.01	0.17	0.10	<0.01
	21-Aug-20	Aug	2020	7.74	549	135	101	10.6	0.27	13.1	1.67	<5	<0.2	0.7	<0.02	0.67	<0.01	0.67	0.08	<0.01
	4-Sep-20	Sept	2020	7.37	529	180	101	10.1	0.25	15.4	1.10	<5	<0.2	0.4	0.04	0.30	<0.01	0.30	0.01	<0.01
	25-Sep-20	Sept	2020	7.30	530	249	99	9.8	0.26	15.8	1.96	<5	0.5	0.6	0.04	0.15	<0.01	0.15	0.02	<0.01
SW4	25-Jul-19	Jul	2019	7.81	585	160	101	10.1	0.29	15.2	0.82	<5	0.2	0.7	<0.02	0.50	<0.01	0.50	0.06	<0.01
	20-Aug-19	Aug	2019	7.58	537	-53	99	9.9	0.26	15.3	-2.21	<5	0.3	0.8	0.05	0.50	<0.01	0.50	0.09	<0.01
	3-Sep-19	Sept	2019	7.32	495	-41	73	7.3	0.24	15.4	-	<5	<0.2	0.8	<0.02	0.68	<0.01	0.68	0.08	<0.01
	17-Sep-19	Sept	2019	7.48	530	-205	153	15.1	0.26	17.2	-	<5	<0.2	0.5	<0.02	0.48	<0.01	0.48	0.04	<0.01
	1-Oct-19	Oct	2019	7.14	492	124	96	9.2	0.24	17.6	-0.43	6	<0.2	0.4	<0.02	0.36	<0.01	0.36	0.08	<0.01
	20-Mar-20	Mar	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19-Jun-20	Jun	2020	6.56	527	188	88	9.5	0.60	14.0	0.32	<5	0.6	0.6	<0.02	0.05	<0.01	0.05	0.09	<0.01
	10-Jul-20	Jul	2020	6.93	556	31	95	9.9	0.27	13.4	2.06	16	1.1	1.4	<0.02	0.34	<0.01	0.34	0.02	<0.01
	24-Jul-20	Jul	2020	6.85	559	34	96	9.8	0.27	14.4	0.60	<5	0.2	0.7	<0.02	0.50	0.01	0.51	0.10	<0.01
	7-Aug-20	Aug	2020	6.75	568	126	98	10.4	0.27	12.5	0.50	<5	<0.2	0.4	<0.02	0.30	<0.01	0.30	0.12	<0.01
	21-Aug-20	Aug	2020	7.51	552	111	97	9.9	0.27	14.4	4.04	<5	<0.2	0.8	<0.02	0.80	<0.01	0.80	0.07	0.03
	4-Sep-20	Sept	2020	7.06	541	92	95	9.4	0.26	16.1	0.60	<5	1.7	2.1	0.04	0.43	<0.01	0.43	<0.01	<0.01
	25-Sep-20	Sept	2020	6.96	532	252	98	9.6	0.26	15.9	1.12	<5	0.4	0.7	0.03	0.31	<0.01	0.31	0.02	<0.01

Wattle Grove South – 2019-2020 Water monitoring report

				IN SITU							LABORATORY								
				pH	EC (µS/cm)	Eh (mV)	DO (%)	DO (mg/L)	Salinity (ppt)	Temp (°C)	Turbidity (NTU)	TSS (mg/L)	TKN (mg/L)	TN (mg/L)	NH4 (mg/L)	NO3-N (mg/L)	NO2-N (mg/L)	NOx-N (mg/L)	TP (mg/L)	FRP (mg/L)
				-	-	-	-	-	-	-	<5	<5	<0.2	<0.2	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
SITE	Sampling date	Schedule	LoR ANZG (2018)*	6.5 - 8.0	120 - 300	-	80 - 120	-	-	-	10-20	-	-	1.2	0.08	2.4	-	0.15	0.065	0.04
SW5	25-Jul-19	Jul	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20-Aug-19	Aug	2019	7.71	550	-40	101	10.5	0.26	14.1	0.35	<5	0.3	0.7	0.05	0.42	0.01	0.43	0.13	<0.01
	3-Sep-19	Sept	2019	7.74	477	-175	76	7.6	0.23	15.4	-	8	0.2	0.8	<0.02	0.60	<0.01	0.60	0.08	<0.01
	17-Sep-19	Sept	2019	7.61	522	-205	101	9.7	0.25	17.2	-	<5	<0.2	0.5	<0.02	0.33	0.01	0.34	0.04	<0.01
	1-Oct-19	Oct	2019	7.07	511	132	98	9.3	0.25	18.0	4.22	20	0.2	0.4	0.03	0.20	<0.01	0.20	0.09	<0.01
	20-Mar-20	Mar	2020	6.56	561	-37	46	3.9	0.27	19.4	-	<5	0.5	0.6	0.03	0.11	<0.01	0.11	0.21	0.05
	19-Jun-20	Jun	2020	6.84	407	121	81	8.6	0.20	12.9	4.28	<5	0.5	0.5	<0.02	0.04	<0.01	0.04	0.06	<0.01
	10-Jul-20	Jul	2020	7.23	497	94	100	10.6	0.24	12.5	1.97	<5	1.0	1.2	0.03	0.17	<0.01	0.17	0.04	0.01
	24-Jul-20	Jul	2020	7.22	562	153	101	10.6	0.27	13.6	1.20	<5	0.2	0.6	<0.02	0.35	0.01	0.36	0.09	<0.01
	7-Aug-20	Aug	2020	7.58	528	224	106	11.5	0.25	12.2	1.80	<5	0.2	0.3	<0.02	0.13	<0.01	0.13	0.09	<0.01
	21-Aug-20	Aug	2020	7.85	549	135	105	10.9	0.27	13.7	2.43	<5	<0.2	0.7	<0.02	0.63	<0.01	0.63	0.08	<0.01
	4-Sep-20	Sept	2020	7.41	528	130	103	10.2	0.25	15.9	3.40	<5	<0.2	0.4	0.05	0.27	<0.01	0.27	0.01	<0.01
	25-Sep-20	Sept	2020	7.28	535	270	101	9.5	0.26	17.5	2.07	<5	0.5	0.7	0.04	0.19	<0.01	0.19	0.05	0.03
SW6	25-Jul-19	Jul	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	20-Aug-19	Aug	2019	8.41	1,542	-67	122	11.6	0.77	18.5	7.01	<5	0.7	1.7	0.05	0.94	0.03	0.97	0.16	0.02
	3-Sep-19	Sept	2019	7.86	1,130	-166	82	7.7	0.56	17.6	-	14	0.8	1.6	<0.02	0.84	<0.01	0.84	0.18	0.03
	17-Sep-19	Sept	2019	9.01	1,405	-206	152	13.3	0.70	22.1	-	11	1.4	2.3	<0.02	0.97	0.01	0.98	0.09	0.01
	1-Oct-19	Oct	2019	8.11	1,325	136	148	12.3	0.66	24.3	2.25	16	0.6	2.1	0.08	1.50	0.03	1.50	0.15	<0.01
	20-Mar-20	Mar	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	19-Jun-20	Jun	2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Jul-20	Jul	2020	8.08	1,438	94	137	13.1	0.73	17.5	4.04	22	1.2	2.9	0.03	1.70	0.01	1.70	0.08	<0.01
	24-Jul-20	Jul	2020	7.35	1,684	228	113	10.9	0.85	17.5	1.60	7	0.4	3.9	0.03	3.50	0.03	3.50	0.16	<0.01
	7-Aug-20	Aug	2020	7.04	1,617	71	82	8.5	0.81	14.1	20.0	44	0.6	2.8	0.07	2.20	0.03	2.20	0.21	<0.01
	21-Aug-20	Aug	2020	7.60	1,743	162	132	12.7	0.89	16.9	6.76	13	0.4	3.3	<0.02	2.90	0.01	2.90	0.13	0.02
	4-Sep-20	Sept	2020	7.46	1,812	214	107	10.0	0.92	18.6	5.20	10	0.7	2.2	<0.02	1.50	0.01	1.50	0.05	<0.01
	25-Sep-20	Sept	2020	7.37	1,575	255	107	10.0	0.80	18.2	11.4	8	1.2	2.0	0.06	0.81	0.01	0.82	0.06	<0.01

				LABORATORY				
				Br (mg/L)	Cl (mg/L)	SO4 (mg/L)	Al (mg/L)	Fe (mg/L)
				<0.1	<5	<1	<0.01	<0.01
SITE	Sampling date	Schedule	LoR ANZG (2018)*	-	-	-	0.055 (pH>6.5)	0.7**
SW1	20-Mar-20	Mar	2020	0.2	82	28	0.22	0.67
	25-Sep-20	Sept	2020	0.4	110	27	0.02	0.07
SW2	20-Mar-20	Mar	2020	-	-	-	-	-
	25-Sep-20	Sept	2020	0.3	110	29	0.01	0.05
SW3	20-Mar-20	Mar	2020	1.0	310	34	<0.01	0.08
	25-Sep-20	Sept	2020	0.3	110	23	0.03	0.18
SW4	20-Mar-20	Mar	2020	-	-	-	-	-
	25-Sep-20	Sept	2020	0.3	130	24	0.03	0.09
SW5	20-Mar-20	Mar	2020	0.4	150	26	0.02	0.08
	25-Sep-20	Sept	2020	0.3	140	24	0.04	0.15
SW6	20-Mar-20	Mar	2020	-	-	-	-	-
	25-Sep-20	Sept	2020	0.9	360	120	<0.01	0.09

*ANZG 2018, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Governments and Australian state and territory governments, Canberra. Available at: <www.waterquality.gov.au/anz-guidelines>
Trigger values are for slightly disturbed lowland river systems in south-west Australia. NO3-N value is the Grading nitrate concentration as based on Hickey (2013). The ANZECC & ARMCANZ (2000) was erroneous (ANZG, 2018).
(Previously ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra)
**ANZG (2018) trigger levels for: Al=0.055 mg/L trigger value applicable for pH>6.5, Al=0.0008 mg/L trigger value applicable for pH<6.5; New Fe DGV for 95% protection (see June 2020 Technical brief for Total Iron in freshwater).

APPENDIX E
UNDO Nutrient Modelling

UNDO Modelling Wattle Grove South : 30/4/2021
Results Summary

Existing Land Use Modelling

	Area ha	INPUT TN kg/yr	INPUT TP kg/yr	EXPORT TN kg/yr	EXPORT TP kg/yr
Total	**106**	**12304**	**1139**	**293.2**	**15.2**

Post Development - Before WSUD Applied

	Area ha	INPUT TN kg/yr	INPUT TP kg/yr	EXPORT TN kg/yr	EXPORT TP kg/yr
Total	**106**	**3715**	**581**	**131.1**	**12.9**
% reduction to existing		**70%**	**49%**	**55%**	**15%**

Post Development - with Biofilters and Storages Applied

	EXPORT TN kg/yr	EXPORT TP kg/yr
Total	**94.2**	**8.1**
	68%	**47%**

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Project: Wattle Grove Pre Development Date: 30/04/2021

Version: Version 1.2.0.19289

Subregion name: Existing Land Use

Landuse	Percent (%)	Area (ha)	Input load Nitrogen (kg)	Input load Phosphorus (kg)
Residential	0	0.00	0.00	0.00
Industrial, commercial & schools	0	0.00	0.00	0.00
Rural living	67	71.02	4978.50	937.46
Public open space	30	31.80	6646.20	168.54
Road reserve	3	3.18	124.66	16.70

Total area (ha)	Total percent (%)
106.00	100

Nitrogen input (kg/yr)	Phosphorus input (kg/yr)
12303.74	1138.60

Nitrogen export (kg/yr)	Phosphorus (kg/yr)
293.28	15.22

Rural living

Landuse	Percent (%)	Area (ha)
Unrestricted	100	71.02
No livestock	0	0.00
No clearing apart from the housing pad	0	0.00

Total area (ha)	Total percent (%)
71.02	67

Nitrogen input (kg)	Phosphorus input (kg)
4978.50	937.46

Note: Commercial horticultre is not permitted in the rural living zone, due to spray drift buffers.

Public Open Space (POS)

Landuse	Percent (%)	Area (ha)
Native gardens	0	0.00
Non-native gardens	0	0.00
Not fertilised	0	0.00
Nature	0	0.00
Sport	0	0.00
Recreation	0	0.00
Golf course	0	0.00
Bowling green	100	31.80
Impervious	0	0.00
Water body	0	0.00

Total area (ha)	Total percent (%)
31.80	30

Nitrogen input (kg)	Phosphorus input (kg)
6646.20	168.54

Road reserve

Landuse	Percent (%)	Area (ha)
Roads	30	0.95
Road reserve - impervious	0	0.00
Road reserve - native garden	0	0.00
Road reserve - non-native garden	0	0.00
Road reserve - turf	35	1.11
Road reserve - not fertilised	35	1.11

Total area (ha)	Total percent (%)
3.18	3

Nitrogen input (kg)	Phosphorus input (kg)
124.66	124.66

Soil and drainage information

Type of drainage	**Open channel drains**	**Does it contain imported fill?**	**No**
Soil type	**Pinjarra**	**Does subregion contain onsite sewage diposal system?**	**Y**
Depth to groundwater (m)	**10**	Type of system installed	**Septic tank**
Groundwater slope (%)	**0.1**	No. of units installed	**60**
Soil PRI	**19.3**		

Note: Please attach the results of soil tests to this report when submitting.

Summary: Nutrient stripping devices

Treatment Name	Size (m²)	Treated area (ha)	Treating	N removed (kg/yr)	P removed (kg/yr)
Load removed				**0.00**	**0.00**
Net export				**293.28**	**15.22**

Summary: Nutrient load exports

Region	Area (ha)	P export (kg/yr)	N export (kg/yr)
Existing Land Use	106.00	15.22	293.28

PRE-TREATMENT LOAD (kg/yr)		LOAD REMOVED (kg/yr)		NET LOAD EXPORT (kg/yr)	
NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS
293.28	**15.22**	**0.00**	**0.00**	**293.28**	**15.22**

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Project:	Wattle Grove Post Dev	Date:	30/04/2021
		Version:	Version 1.2.0.19289

Subregion name: **Connected Areas**

Landuse	Percent (%)	Area (ha)	Input load Nitrogen (kg)	Input load Phosphorus (kg)
Residential	40	19.08	448.25	131.32
Industrial, commercial & schools	0	0.00	0.00	0.00
Rural living	0	0.00	0.00	0.00
Public open space	0	0.00	0.00	0.00
Road reserve	60	28.62	681.16	87.15

Total area (ha)	Total percent (%)
47.70	45

Nitrogen input (kg/yr)	Phosphorus input (kg/yr)
1378.88	225.62

Nitrogen export (kg/yr)	Phosphorus (kg/yr)
71.67	10.55

Residential

Size (m²)	Percent (%)	Area (ha)	Input load Nitrogen (kg)	Input load Phosphorus (kg)
<400	100	19.08	448.25	131.32
400-500 m²	0	0.00	0.00	0.00
501-600 m²	0	0.00	0.00	0.00
601-730 m²	0	0.00	0.00	0.00
>730 m²	0	0.00	0.00	0.00
Multiple dwellings	0	0.00	0.00	0.00

Total area (ha)	Total percent (%)
19.08	40

Nitrogen input (kg)	Phosphorus input (kg)
448.25	131.32

Road reserve

Landuse	Percent (%)	Area (ha)
Roads	40	11.45
Road reserve - impervious	30	8.59
Road reserve - native garden	5	1.43
Road reserve - non-native garden	0	0.00
Road reserve - turf	20	5.72
Road reserve - not fertilised	5	1.43

Total area (ha)	Total percent (%)
28.62	60

Nitrogen input (kg)	Phosphorus input (kg)
681.16	681.16

Soil and drainage information

Type of drainage	**Piped drainage**	**Does it contain imported fill?**	**No**
Soil type	**Pinjarra**	**Does subregion contain onsite sewage diposal system?**	**No**
Depth to groundwater (m)	**10**		
Groundwater slope (%)	**0.1**		
Soil PRI	**19.3**		

Note: Please attach the results of soil tests to this report when submitting.

Subregion name: **Infiltration Areas**

Landuse	Percent (%)	Area (ha)	Input load Nitrogen (kg)	Input load Phosphorus (kg)
Residential	35	20.41	479.38	140.44
Industrial, commercial & schools	30	17.49	787.92	171.84
Rural living	10	5.83	286.84	19.82
Public open space	25	14.58	476.60	14.14
Road reserve	0	0.00	0.00	0.00

Total area (ha)	Total percent (%)
58.30	55

Nitrogen input (kg/yr)	Phosphorus input (kg/yr)
2335.65	354.98

Nitrogen export (kg/yr)	Phosphorus (kg/yr)
59.39	2.37

Residential

Input load

Size (m²)	Percent (%)	Area (ha)	Nitrogen (kg)	Phosphorus (kg)
<400	100	20.41	479.38	140.44
400-500 m²	0	0.00	0.00	0.00
501-600 m²	0	0.00	0.00	0.00
601-730 m²	0	0.00	0.00	0.00
>730 m²	0	0.00	0.00	0.00
Multiple dwellings	0	0.00	0.00	0.00

Total area (ha)	Total percent (%)
20.405	35

Nitrogen input (kg)	Phosphorus input (kg)
479.38	140.44

Commercial, Industry and Schools

Landuse	Percent (%)	Area (ha)
Light industrial	0	0.00
Heavy industrial	0	0.00
Commercial / Offices	75	13.12
Schools	25	4.37
Public buildings	0	0.00

Total area (ha)	Total percent (%)
17.49	30

Nitrogen input (kg)	Phosphorus input (kg)
787.92	171.84

Rural living

Landuse	Percent (%)	Area (ha)
Unrestricted	0	0.00
No livestock	100	5.83
No clearing apart from the housing pad	0	0.00

Total area (ha)	Total percent (%)
5.83	10

Nitrogen input (kg)	Phosphorus input (kg)
286.84	19.82

Note: Commercial horticultre is not permitted in the rural living zone, due to spray drift buffers.

Public Open Space (POS)

Landuse	Percent (%)	Area (ha)
Native gardens	30	4.37
Non-native gardens	0	0.00
Not fertilised	0	0.00
Nature	30	4.37
Sport	0	0.00
Recreation	35	5.10
Golf course	0	0.00
Bowling green	0	0.00
Impervious	5	0.73
Water body	0	0.00

Total area (ha)	Total percent (%)
14.58	25

Nitrogen input (kg)	Phosphorus input (kg)
476.60	14.14

Soil and drainage information

Type of drainage	**Infiltration**	**Does it contain imported fill?**	**No**
Soil type	**Pinjarra**	**Does subregion contain onsite sewage diposal system?**	**No**
Depth to groundwater (m)	**10**		
Groundwater slope (%)	**0.1**		
Soil PRI	**19.3**		

Note: Please attach the results of soil tests to this report when submitting.

Summary: Nutrient stripping devices

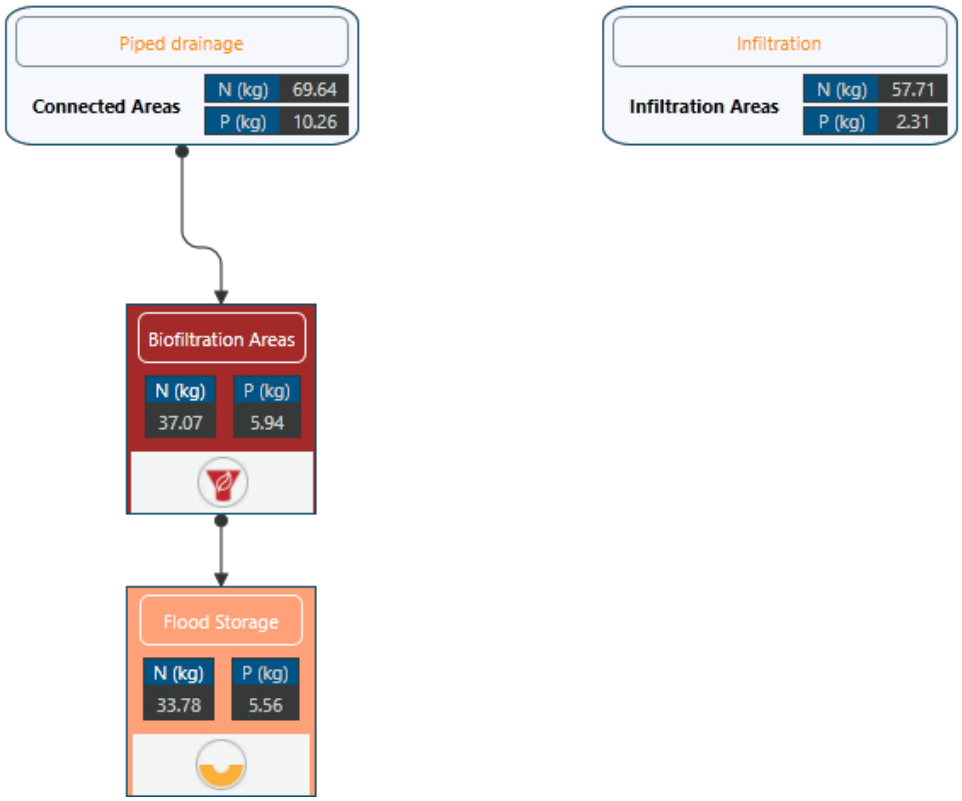
Treatment	Name	Size (m²)	Treated area (ha)	Treating	N removed (kg/yr)	P removed (kg/yr)
Biofilter	Biofiltration Areas	10000.00	47.70	Sandy soils – Runoff only (full lot connection)	33.47	4.43
Detention / infiltration basin	Flood Storage	30000.00	47.70	Sandy soils – Runoff only (full lot connection)	3.35	0.38
Load removed					**36.82**	**4.81**
Net export					**94.24**	**8.11**

Summary: Nutrient load exports

Region	Area (ha)	P export (kg/yr)	N export (kg/yr)
Connected Areas	47.70	10.55	71.67
Infiltration Areas	58.30	2.37	59.39

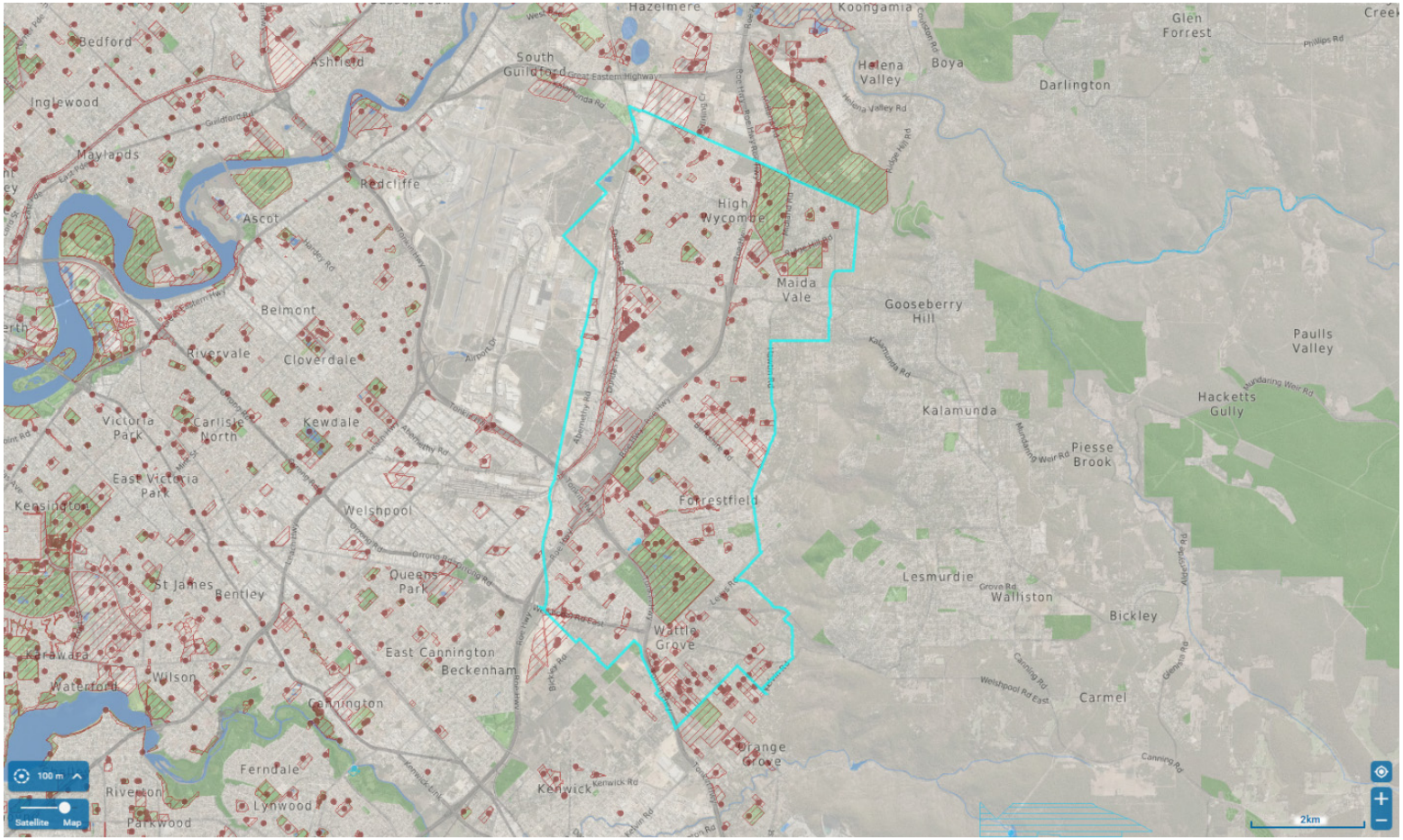
PRE-TREATMENT LOAD (kg/yr)		LOAD REMOVED (kg/yr)		NET LOAD EXPORT (kg/yr)	
NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS	NITROGEN	PHOSPHORUS
131.06	12.93	36.82	4.81	94.24	8.11

Treatment diagram

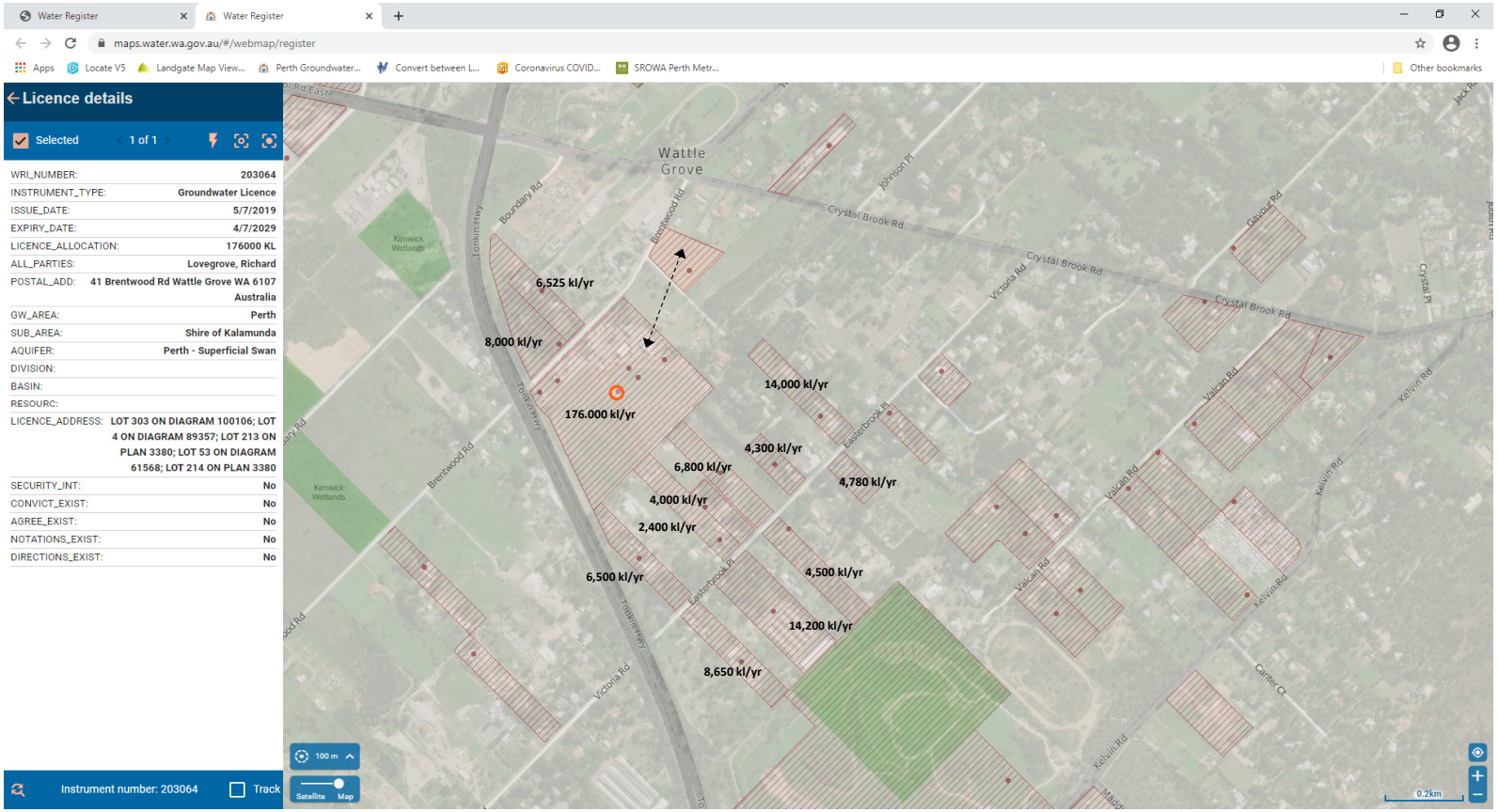


APPENDIX F
DWER Water Register Extracts

Extent of Perth Superficial – Shire of Kalamunda Groundwater Sub Area



Existing Site Groundwater Licence Locations & Volumes



APPENDIX G
DWER Monitoring Report Assessment Advice

Halinka Lamparski

From: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Sent: Monday, October 19, 2020 9:30 AM
To: Halinka Lamparski
Cc: Ross Perrigo
Subject: RE: City of Kalamunda – Wattle Grove South monitoring plan

Dear Halinka,

The Department of Water and Environmental Regulation (DWER) supports the early cessation of monitoring.

Regards

Jim Mackintosh

Department of Water and Environmental Regulation

Program Manager

Swan Avon Region

Planning Advice Section

T 08 6250 8043 |
E jim.mackintosh@dwer.wa.gov.au
Visit our website www.dwer.wa.gov.au

From: Halinka Lamparski <halinka@urbaqua.org.au>
Sent: Friday, 2 October 2020 9:16 AM
To: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Cc: Ross Perrigo <ross@urbaqua.org.au>
Subject: RE: City of Kalamunda – Wattle Grove South monitoring plan

Dear Jim,

Urbaqua have been undertaking surface water monitoring for the City of Kalamunda in Wattle Grove South since 2019. The proposed scope was confirmed with DWER (attached and email below) and works to date have included:

- Sampling at six monitoring sites across Yule Brook and Crystal Brook (and under Tonkin Highway)
- Sampling at a fortnightly frequency over the 2019 and 2020 winters, and one summer baseline sample was taken in March 2020
- Flow monitoring data collected using hydrostatic pressure probes and complementary channel surveys at four in-stream sites over the 2019 spring/summer and 2020 winter seasons

The monitoring data will be used to determine flow volumes and nutrient loads at key locations.

The program was going to run until April 2021, however, in recent discussions with the City there is a preference to wrap up the project and provide a final report ahead of a council meeting in early November. From the program this effectively removes further spring and summer flow monitoring.

We'd just like to confirm that the program to date satisfies DWER pre-development (baseline) monitoring requirements and there are no objections to ending the monitoring this month. Last summer we saw very little summer flow, so there appears little value in continuing the monitoring.

Don't hesitate to call should you wish to discuss.

Regards,

Halinka Lamparski
Senior Environmental Engineer
m: 0478 766 959 | p: 9328 4663 | f: 6316 1431

Please note I only work part time, on Wednesdays, Thursday & Fridays.

Urbaqua
land & water solutions
4/226 Carr Place Leederville 6007
www.urbaqua.org.au

Please follow our blog The Essential Current at:
http://essentialenvironmental.wordpress.com/

From: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Sent: Wednesday, October 2, 2019 12:59 PM
To: Ross Perrigo <ross@urbaqua.org.au>
Cc: Urbaqua <info@urbaqua.org.au>
Subject: Re: City of Kalamunda – Wattle Grove South monitoring plan

Dear Ross,

Thank you for your letter dated 25 September 2019 regarding the above proposal. The Department of Water and Environmental Regulation (DWER) supports the proposed monitoring plan.

Regards

Jim Mackintosh

Department of Water and Environmental Regulation
Program Manager
Swan Avon Region
Planning Advice Section
T 08 6250 8043 |
E jim.mackintosh@dwer.wa.gov.au
Visit our website www.dwer.wa.gov.au

Disclaimer: This e-mail is confidential to the addressee and is the view of the writer, not necessarily that of the Department of Water and Environmental Regulation, which accepts no responsibility for the contents. If you are not