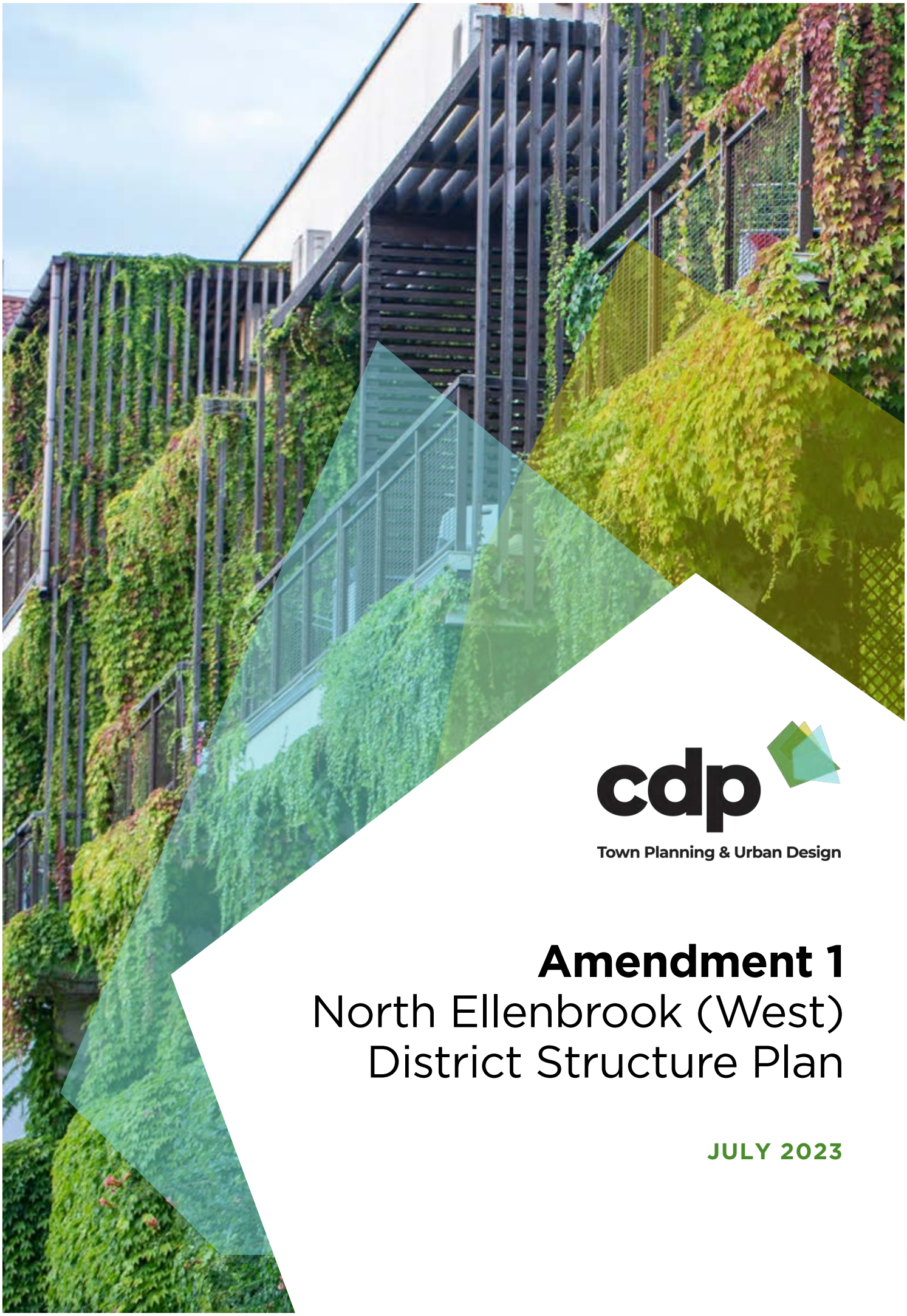

cdp

Town Planning & Urban Design

Amendment 1
North Ellenbrook (West) District Structure Plan

JULY 2023

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

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

Prepared for. Stockland
Level 12 Durack Centre
263 Adelaide Terrace
Perth 6000

p. +61 6141 8000
w. www.stockland.com.au

In Collaboration with.
RPS Group
Transcore
JDSi
Pracsys
Bushfire Prone Planning

DOCUMENT STATUS

Version	Comment	Prepared	Reviewed	Issued
4	FINAL	CH	KB	12/07/2023

Project Team.

Discipline	Consultant
Development Manager	Stockland
Town Planning and Urban Design	CDP
Environmental	RPS
Civil Engineering	JDSi
Traffic	Transcore
Economics & Retail/Industrial / Residential Needs Analysis	Pracsys
Hydrological	RPS
Bushfire	Bushfire Prone

ENDORSEMENT PAGE

Amendment 1 to the North Ellenbrook (West) District Structure Plan is prepared under the provisions of the *Planning and Development Act 2005*.

IT IS CERTIFIED THAT AMENDMENT 1 TO THE NORTH ELLENBROOK (WEST) DISTRICT STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

[DATE]

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

_____

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

_____ Witness

_____ Date

Executive Summary.

The North Ellenbrook (West) District Structure Plan (DSP) was approved by the Western Australian Planning Commission (WAPC) on 30 August 2022.

This Amendment 1 to the DSP proposes the following:

- Inclusion of additional land into the DSP area, being the balance of Lot 5892 located immediately to the south of the current DSP area; and
- Inclusion of additional roads in the areas immediately north of Lot 5892.

Lot 5892 has a total area of 163 hectares with a very small northern portion (approximately 5 hectares) already included in the DSP area. Accordingly, Amendment 1 proposes the inclusion of an additional 158 hectares into the DSP area. The whole of Lot 5892 is in single ownership. Amendment 1 will provide for an additional 2,200 – 2,500 dwellings within the DSP area, this equating to an additional 6,600 – 7,500 people. Amendment 1 to the DSP provides for additional residential land, additional primary school and an additional key area of environmental open space with clear road linkages to the future residents and amenities proposed to the north in the DSP.

Lot 5892 is currently operating as a silica sand quarry. Approximately 120.71 hectares of Lot 5892 is within a live mining tenement area (M70/326). The mining tenement, and associated extractive industry licence and clearing permit, allows for the extraction of silica sand and other construction-grade sands. Mining is taking place generally from east to west. To date, approximately 29 hectares of the mining tenement area have been cleared. The current approved sand mining operations are progressively removing existing vegetation and simultaneously modifying the existing landform in accordance with environmental and extractive industry approvals at a rate congruent with market demand.

As the majority of the site currently operates as a sand quarry, the removal of native vegetation will progressively take place over a large portion of the site as mining continues in order to remove the necessary and valuable sand resource. Therefore, as the majority of the site will be cleared as a result of current land use, it would be a logical and sequential extension of the proposed urban expansion envisaged for North Ellenbrook.

The inclusion of Lot 5892 into the proposed urban area would supplement and complement the development of the North Ellenbrook area as a viable and sustainable community supporting economic and social development in the North-East Sub-Region. Including Lot 5892 into the future urban area will also mitigate shortcomings in population forecasts in proximity to strategic employment centres such as the Bullsbrook Freight and Industrial Zone and Muchea Industrial Area, and to deliver economic and social benefits for the City of Swan and broader North-East Sub-Region.

Comprehensive analysis and modelling have confirmed that future urban development of the Lot 5892 as part of the DSP will:

- increase the catchment for critical community infrastructure and local businesses;
- utilise land that adjoins the development front and which will be predominantly cleared by approved sand mining activities;
- support the early delivery of the proposed Tonkin Highway interchange;
- support employment self-sufficiency within the sub-region by generating an additional local labour force of 3,529;

- support employment self-containment within the sub-region by reducing the shortfall in the local labour force required to meet a projected oversupply of strategic employment opportunities in the Bullsbrook Freight and Industrial Zone, and in so doing retain a larger share of income earned within the local economy; and
- utilise land that is predominantly cleared and that does not require imported fill, making it easier and more cost-effective to develop; thereby contributing to the supply of affordable and sustainable urban development;

The staging of development across Lot 5892 for urban purposes is expected to occur following the progression of sand mining and securing access and service infrastructure provision.

Amendment 1 to the DSP is presented in three parts as follows:

- **Proposed Amendments to the DSP**– This section outlines the proposed amendments to Parts One, Two and Three of the DSP.
- **Planning Report Amendment 1 to the DSP** – This section outlines all the relevant information for Lot 5892 that has informed the proposed Amendment 1 to the DSP.
- **Technical Appendices** – A number of technical reports have been completed to inform and support the proposed Amendment 1 to the DSP. These include:
  - Environmental Assessment Report
  - Bushfire Management Plan
  - District Water Management Strategy
  - North Ellenbrook Document Review
  - Transport Impact Assessment Addendum
  - Engineering Servicing Report

Contents.

1. Proposed Amendments to the District Structure Plan

1.1 Proposed Amendments to Executive Summary

The proposed Amendments to the Executive Summary of the DSP as outlined below:

Table 1: Proposed Amendments to Executive Summary

Item/Section	Proposed Amendment	DSP Page Reference
Paragraph 3	Update areas and dwelling and population yield to be as per the Structure Plan Summary included at Section 1.1.1 below.	Page iv
North Ellenbrook West District Structure Plan Summary	Replace Summary (table) with that provided in Section 1.1.1 below.	Page vi

1.1.1 Structure Plan Summary

Replace the North Ellenbrook (West) District Structure Plan Summary with the below.

Item	Data
Total Structure Plan Area	774 hectares
Estimated Dwelling Yield	6,200 – 7,000 dwellings
Estimated Population	18,600 – 21,000 people
Number of High Schools	1
Number of Primary Schools	4*
Estimated Commercial Floor Space *District Centre* *Neighbourhood Centre* *Local Centre*	 32,000 nett lettable area / ~ 10 hectares 3,300 net lettable area / ~ 2 hectares 2,400 nett lettable area *
Estimated Employment Construction Phase jobs Ongoing local employment	 13,600 jobs 1,665 jobs
Estimated Area Breakdown: • Urban Residential • Light Industrial / Service Commercial • Parkland / Open Space *New Parks and Recreation Reserves* *District Open Space* *Other Open Space*	 404.7 hectares 106 hectares 60 hectares 9 hectares (co-located with linear POS) 152.8 hectares

*Subject to final demand review at Local Structure Plan stage. An additional primary school may be required in the DSP area to cater for the ultimate dwelling yield. This matter will continue to be monitored, in consultation with the Department for Education, as local structure planning for the precincts proceeds and more certainty is available regarding dwelling yields and development staging which will inform whether there is a need for a 5th primary school and also the ideal location for that primary school if it is required.

1.2 Proposed Amendments to Part One - Implementation

Part One of the DSP provides the implementation component, contains the District Structure Plan Map and key development provisions applicable to the proposal. **Table 2** below summarises the amendments sought by to Part One of the DSP.

Table 2: Proposed Amendments to Part One

Item/Section	Proposed Amendment	DSP Page Reference
Introduction - Paragraph 5	Update Net Residential Area to be 404.7 hectares Update dwelling and population forecast to be as per the North Ellenbrook (West) District Structure Plan Summary included at Section 1.1.1 above.	Page 2
Section 3 – Paragraph 2	Edit to refer to five (5) Local Structure Plans.	Page 3
Section 3.3 – Paragraph 1	Edit to refer to five (5) Local Structure Plans.	Page 3
Section 4 – Paragraph 1	Edit to refer to five (5) Local Structure Plans.	Page 5
Section 4.7	Replace Section 4.7 Staging with new Section 4.7 Local Structure Plan Area 5 – Maralla Road as outlined below in Section 1.2.1 below.	Page 7
Section 4.8 (new)	Insert new Section 4.8 Staging as outined below in Section 1.2.2 below.	Page 7
Plan 1: North Ellenbrook (West) District Structure Plan	Replace Plan 1 with Plan 1A included at Section 1.2.3 below. The changes to the plan are listed below: • Include the balance of Lot 5892 within the DSP area providing residential land, a primary school, open space and road network as required. • Reduce the open space proposed in that part of Lot 5892 currently included in the DSP. • Provide an additional north-south neighbourhood connector road from Lot 5892 into Local Structure Plan Area 4 to connect with the east-west Integrator Arterial Road. • Provide an additional north-south Integrator Arterial Road from Lot 5892 along the existing Halden Road reserve to connect to the Integrator Arterial Road currently approved. • Include an additional note on the plan acknowledging that an additional primary school may be needed within the DSP area.	Page 8

1.2.1 Section 4.7

Replace Section 4.7 Staging with the below

4.7 Local Structure Plan Area 5 – Maralla Road

Local Structure Plan Area 5 – 'Maralla Road' incorporates approximately 158 hectares, being almost the entirety of Lot 5892 Halden Road. The LSP 5 area is located south of the LSP 4 area.

Key matters to be considered in preparation of the Local Structure Plan are:

- *Review the role and design function of Halden and Maralla Roads and the new east-west Neighbourhood Connectors;*
- *Confirm the location and specific requirements for the Primary School site with Department of Education;*
- *Review the design interface and functionality of the conservation category wetland open space having regard to its heritage, drainage, vegetation retention and open space integration functions;*
- *Review the role, demand, and land use mix to facilitate detailed planning of a potential Local Centre within the LSP area of approximately 1,200m2 nett lettable area;*
- *Review the interface to State Forest, Parks and Recreation Reserve and Bush Forever areas to the west and south of the LSP area in regard to land use, connectivity to existing access and the need for bushfire safety mitigation;*
- *Undertake a more detailed review of the Conservation Category Wetland to determine the need for and extent of wetland and open space retention requirements;*
- *Review status of any existing basic raw materials / extractive industry operations at Lot 5892 in regard to the following in the context of urban development staging:*
  - *Operation staging and life expectancy;*
  - *Access; and*
  - *Land use separation requirements.*
- *Confirm the need for local development and community infrastructure coordination that would require funding through a Development Contribution Plan.*

1.2.2 Section 4.8

Insert new Section 4.8 as follows:

4.8 Staging

Given the size and scale of the District Structure Plan area, development will occur over multiple stages as demand for residential land within the north-east corridor evolves. The DSP area is expected to be initially rezoned to 'Urban Deferred' under the MRS.

Staging of the development of the DSP area will be linked to the interchange, with the interchange required to be constructed and operational prior to the first stage of development. As such, the first stage of development is to occur with LSP Area 1 which is likely to comprise the residential area to the south and north of the District Centre, with the District Centre to be developed once an appropriate critical mass to sustain the viability of the centre has been established. Development is likely to extend southwards towards Lot 5892 in LSP Area 5 and northward towards Chudalup Road, being heading west to LSP Area 3 and subsequently LSP Area 4.

Staging of LSP Area 2 will be reviewed in context of the need for industrial / service commercial zoned land.

Final staging will be informed by infrastructure planning, landowner intentions and the need to provide orderly sequencing of development for bushfire risk mitigation. The availability of services and residential land demand will also help inform the lifting of urban deferment.

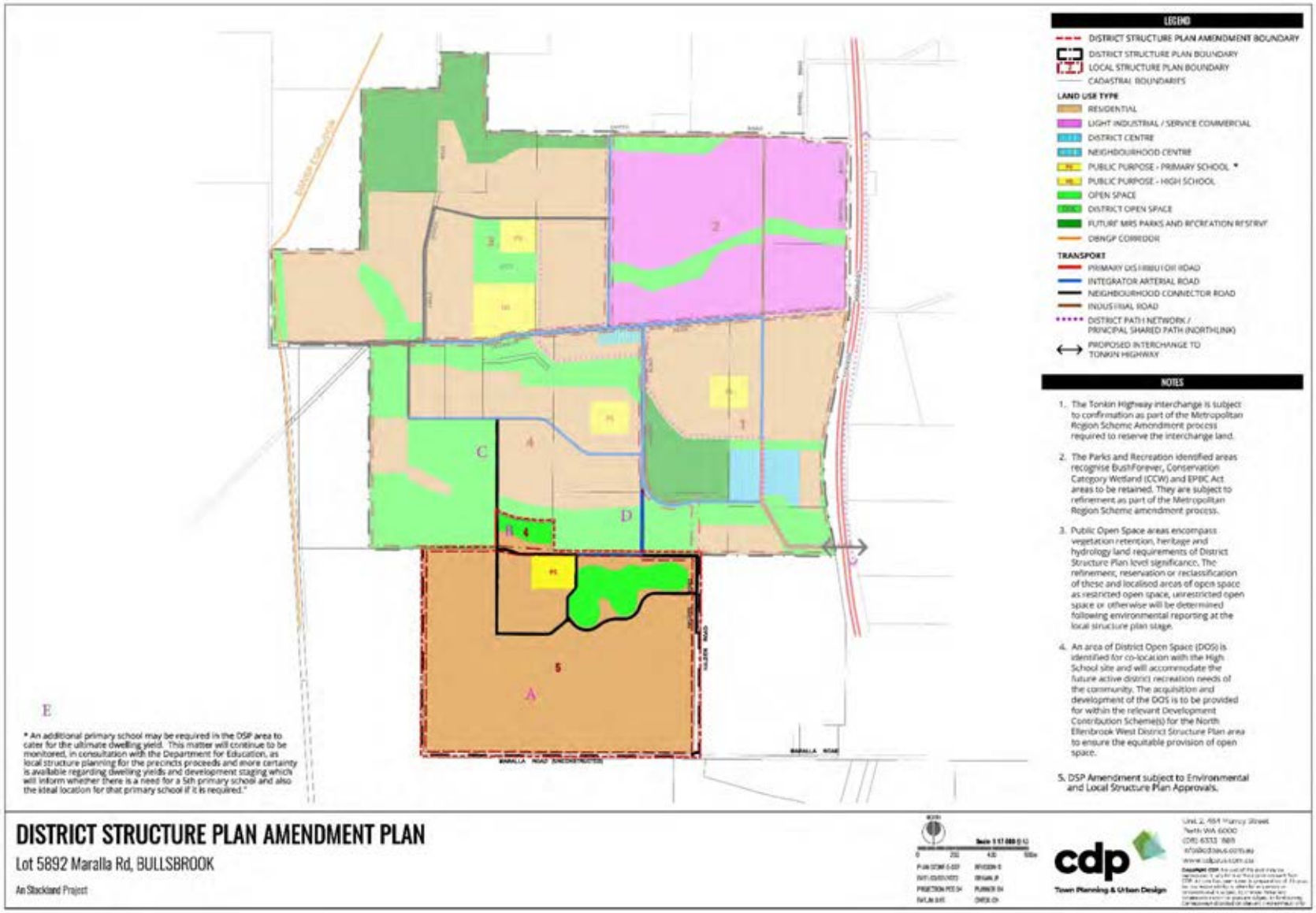
No traffic generating development will be supported within the DSP area until such time as the proposed interchange has been constructed and is operational.

1.2.3 District Structure Plan Map

Update Plan 1 to include Amendment 1 to the DSP – refer Plan 1A on the following page.

The changes to the DSP proposed by Amendment 1 are as follows:

Map Reference	
A	Include the balance of Lot 5892 within the DSP area providing residential land, a primary school, open space and road network as required.
B	Reduce the Open Space proposed in that part of Lot 5892 currently included in the DSP.
C	Provide an additional north-south neighbourhood connector road from Lot 5892 into Local Structure Plan Area 4 to connect with the east-west Integrator Arterial Road.
D	Provide an additional north-south Integrator Arterial Road from Lot 5892 along the existing Halden Road reserve to connect to the Integrator Arterial Road currently approved.
E	Include an additional note on the plan acknowledging that an additional primary school may be needed within the DSP area.



Plan 1A – Amendment 1 to District Structure Plan

1.3 Proposed Amendments to Part Two – Explanatory Report

Part Two of the DSP provides the supporting justification and rationale underpinning the requirements of Part One. Amendment 1 to the DSP only seeks to amend those aspects of Part Two which are of key consequence to the understanding and delivery of the DSP. As a result, the proposed amendments to 'Part 2 – Explanatory Section' are limited to those outlined in the **Table 3** below.

Table 3: Proposed Amendments to Part 2

Item/Section	Proposed Amendment	DSP Page Reference
General / Overall Text Amendments	Amend all text and sections in Part Two as required to reflect inclusion of Lot 5892 into the DSP, including all references to lot details, ownership, land areas, dwelling yields, population forecasts, existing land uses, zoning, planning strategies, planning policies, site conditions and constraints, land supply context, proposed land uses, proposed movement network, water management, employment and economic opportunities, servicing, staging, required planning processes etc	Various
General / Overall Text Amendments	Amend all text in Part Two as required to outline that the lodged MRS Amendment is exclusive of Lot 5892.	Various
General / Overall Text Amendments	Amend all text in Part Two as required to modify reference to sand mining on Lot 5892 in relation to separation distances, buffers, off site impacts, sequential land use etc, noting its inclusion in the DSP and future urban land use.	Various
Plan Amendments	Amend all report plans as required to reflect inclusion of Lot 5892 into the DSP,	Various
Replace Section 2.6.3	Replace Section 2.6.3 text with that provided below in Section 1.3.1.	Page 47
Section 4.10.7 (new)	Insert new section 4.10.7 – Local Structure Plan Area 5 – Maralla Road as per Section 1.3.2 below.	Page 82

1.3.1 Maralla Road Sand Quarry

The WAPC's *State Planning Policy 2.4 – Basic Raw Materials* ('SPP 2.4') seeks to guide the use and extraction of Basic Raw Materials (BRM) from land where such extraction is considered appropriate on planning and environmental grounds.

Lot 5892 is identified under the SPP 2.4 as 'Sites with Prior State Environment Minister Approval' with "the land being identified as having a 'Significant Geological Supply – Sand". In accordance with SPP 2.4, Lot 5892 is currently operated for the purposes of sand extraction.

It is proposed that the sand resource is removed from the site in accordance with current approvals prior to the land being developed for urban purposes as proposed by Amendment 1 to the DSP. In accordance with the objectives if SPP 2.4, it is intended that the BRM opportunity within Lot 5892 is realised whilst also

providing for the final intended urban land use proposed by Amendment 1 to the DSP. A sequential land use program will be established in this regard in order to manage the proposed land use transition, ensure that urban development does not encroach on or compromise the current extractive industry operations and future sand resource identified for extraction.

SPP 2.4 provides for sequential urban development following extraction of BRMs. It is noted that further detail will be required to demonstrate how sequential land use will be achieved within Lot 5892 and this is to be provided as part of the MRS Amendment, lifting if urban deferment and local structure planning processes. These future planning instruments will:

- Identify separation distances and establish transitional land uses and interface areas to protect the BRM from encroachment by urban land uses and avoid health risk and amenity implications for urban land uses; and
- Address sequential land use and demonstrate land staging and site remediation including identification of finished ground levels.

This is in accordance with policy measures contained within Section 6.2 of SPP 2.4.

1.3.2 Local Structure Plan Area 5 – Maralla Road

Precinct Description

Local Structure Plan Area 5 – 'Maralla Road' incorporates approximately 158 hectares, being almost the entirety of Lot 5892 Halden Road. The LSP 5 area is located immediately south of the LSP 4 area. Refer **Figure 18 - LSP Area 5.**

Character Statement

The Maralla Road LSP is to be characterised by the sites natural environmental wetland feature surrounded by a future local centre and primary school and a range of medium density residential development.

The LSP is to focus on creating a connection with the destination spaces to the north including the activity centre and employment lands. The LSP will also be based on creating strong visual and physical connections to bushland to the west and south as a key character of future residential space.

Local Structure Plan Requirements

Key matters to be considered in preparation of the Local Structure Plan are:

- Review the role and design function of Halden and Maralla Roads and the new east-west Neighbourhood Connectors;
- Confirm the location and specific requirements for the Primary School site with Department of Education;
- Review the design interface and functionality of the conservation category wetland open space having regard to its heritage, drainage, vegetation retention and open space integration functions;
- Review the role, demand, and land use mix to facilitate detailed planning of a potential Local Centre within the LSP area of approximately 1,200m2 nett lettable area;
- Review the interface to State Forrest, Parks and Recreation Reserve and Bush Forever areas to the west and south of the LSP area in regard to land use, connectivity to existing access and the need for bushfire safety mitigation;
- Undertake a more detailed review of the Conservation Category Wetland to determine the need for and extent of wetland and open space retention requirements;
- Review status of any existing basic raw materials / extractive industry operations at Lot 2382 (within the LSP 4 area) and Lot 5892 (within the LSP 5 area) in regard to the following in the context of urban development staging:

- Operation staging and life expectancy;
- Access; and
- Land use separation requirements.

- Confirm the need for local development and community infrastructure coordination that would require funding through a Development Contribution Plan.

1.4 Technical Appendices

A suite of technical appendices has been prepared to support Amendment 1 to the DSP, refer list below. These have been prepared as stand-alone documents and/or addendums to the technical appendices that form part of the approved DSP.

Appendix 1 Environmental Assessment Report

Appendix 2 Bushfire Management Plan

Appendix 3 District Water Management Strategy

Appendix 4 North Ellenbrook Document Review (Pracsys)

Appendix 5 Transport Impact Assessment Addendum

Appendix 6 Engineering Servicing Report

It is proposed that Appendices 1 – 3 and 5 – 6 are incorporated into Part Three – Technical Appendices of the DSP as addendums. Appendix 4 – North Ellenbrook Document review has been prepared to justify Amendment 1 specifically and it is not necessary or appropriate of this to be incorporated into the DSP.

2. Planning Report - Amendment 1 to North Ellenbrook (West) District Structure Plan

2.1 Introduction and Purpose

Amendment 1 to the DSP has been prepared on behalf of the joint venture between Stockland and the owners of Lot 5892 to facilitate the following amendments:

- Include the balance of Lot 5892 within the DSP area providing residential land, a primary school, open space and road network as required.
- Reduce the Open Space proposed in that part of Lot 5892 currently included in the DSP.
- Provide an additional north-south neighbourhood connector road from Lot 5892 into Local Structure Plan Area 4 to connect with the east-west Integrator Arterial Road.
- Provide an additional north-south Integrator Arterial Road from Lot 5892 along the existing Halden Road reserve to connect to the Integrator Arterial Road currently approved.
- Include an additional note on the plan acknowledging that an additional primary school may be needed within the DSP area.

This Amendment 1 report will guide future land use and development over Lot 5982 and provide a framework for rezoning's and local structure planning.

2.2 Land Description

2.2.1 Location

The additional land proposed for inclusion in the DSP, Lot 5892, is located immediately south of the DSP. It is located westwards of the Tonkin Highway and is bound by Halden Road and rural land holding to the east, Maralla Road and Parks and Recreation Reserve to the south and Parks and Recreation reserved land to the west.

Refer to **Figure 1 – Location Plan**.

2.2.2 Area, Land Use & Ownership

The additional land proposed to be included in the DSP comprises the balance of one (1) freehold lot (Lot 5892 Maralla Road, Bullsbrook) serviced by Halden Road and Maralla Road. Lot 5892 has a total area of approximately 163 hectares. A small northern portion of Lot 5892 (approximately 5 hectares) is already included within the DSP. Thus Amendment 1 proposes to include an additional 158 hectares into the DSP area.

Lot 5892 is currently operating as a silica sand quarry. Approximately 120.71 hectares of Lot 5892 is within a live mining tenement area (M70/326). The mining tenement, and associated extractive industry licence and clearing permit, allows for the extraction of silica sand and other construction-grade sands. Mining is taking place generally from east to west.

To date, approximately 29 hectares of the mining tenement area has been cleared. The current approved sand mining operations are progressively removing existing vegetation and simultaneously modifying the existing landform in accordance with environmental and extractive industry approvals at a rate congruent with market demand.

Refer **Figure 2 – Aerial Site Plan & Mining Tenement.**

2.2.3 Legal Description and Ownership

Lot 5892 is described as follows:

- L5892 Maralla Road, Bullsbrook
- Plan/Diagram: 208236
- Vol/Folio: 355/124A
- Owners: Stefanelli Nominees Pty Ltd and Brajkovich Holdings Pty Ltd

2.3 Planning Framework

2.3.1 Zoning & Reservations

Lot 5892 is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'General Rural' under the City of Swan Local Planning Scheme No.17 (LPS 17). Future amendments to the MRS and LPS 17 will be required to facilitate the development outcomes proposed by Amendment 1 to the DPS.

Refer **Figure 3 – MRS Zoning** and **Figure 4 – LPS 17 Zoning.**

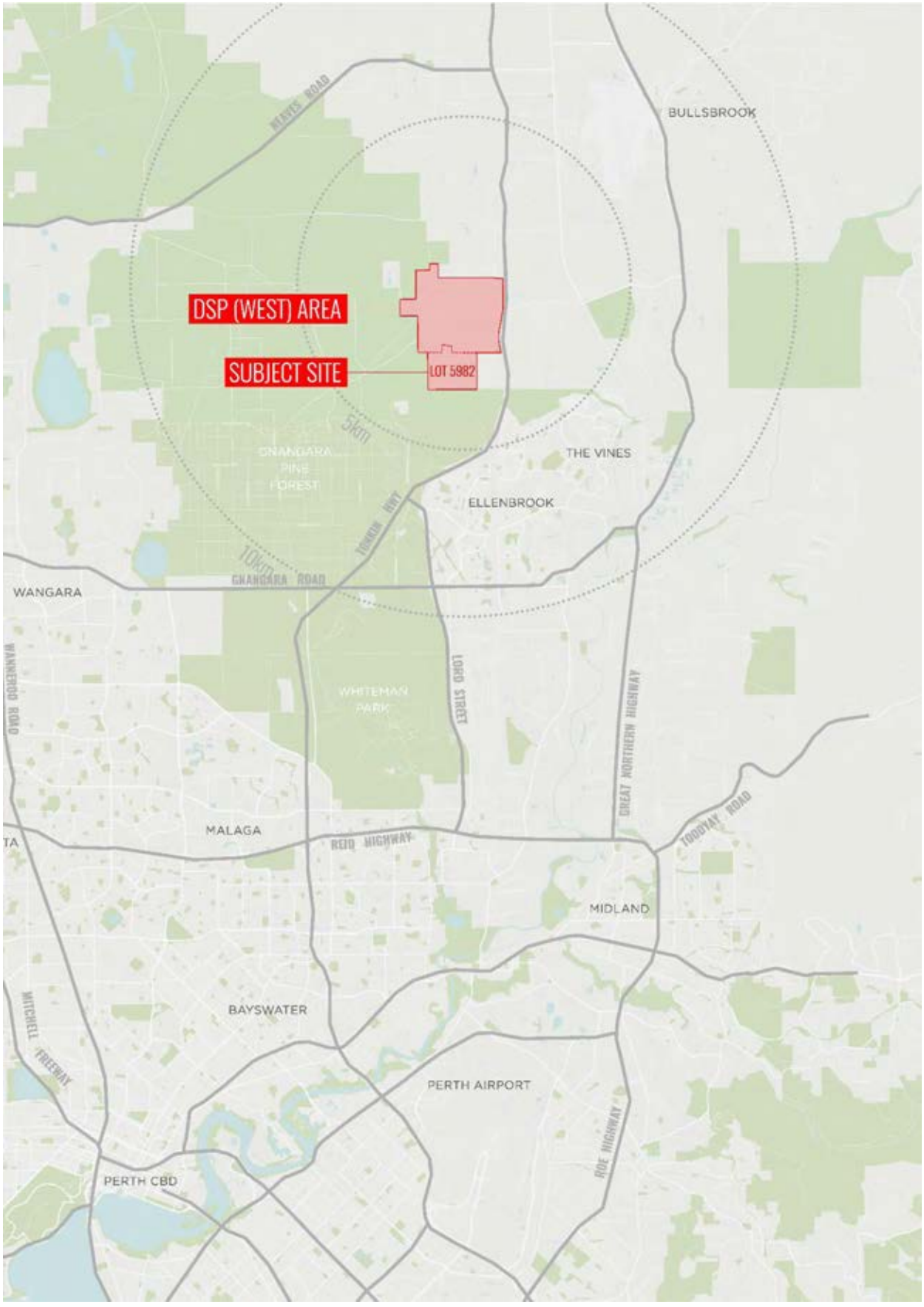


Figure 1 – Location Plan

Figure 2 – Site Plan & Mining Tenement

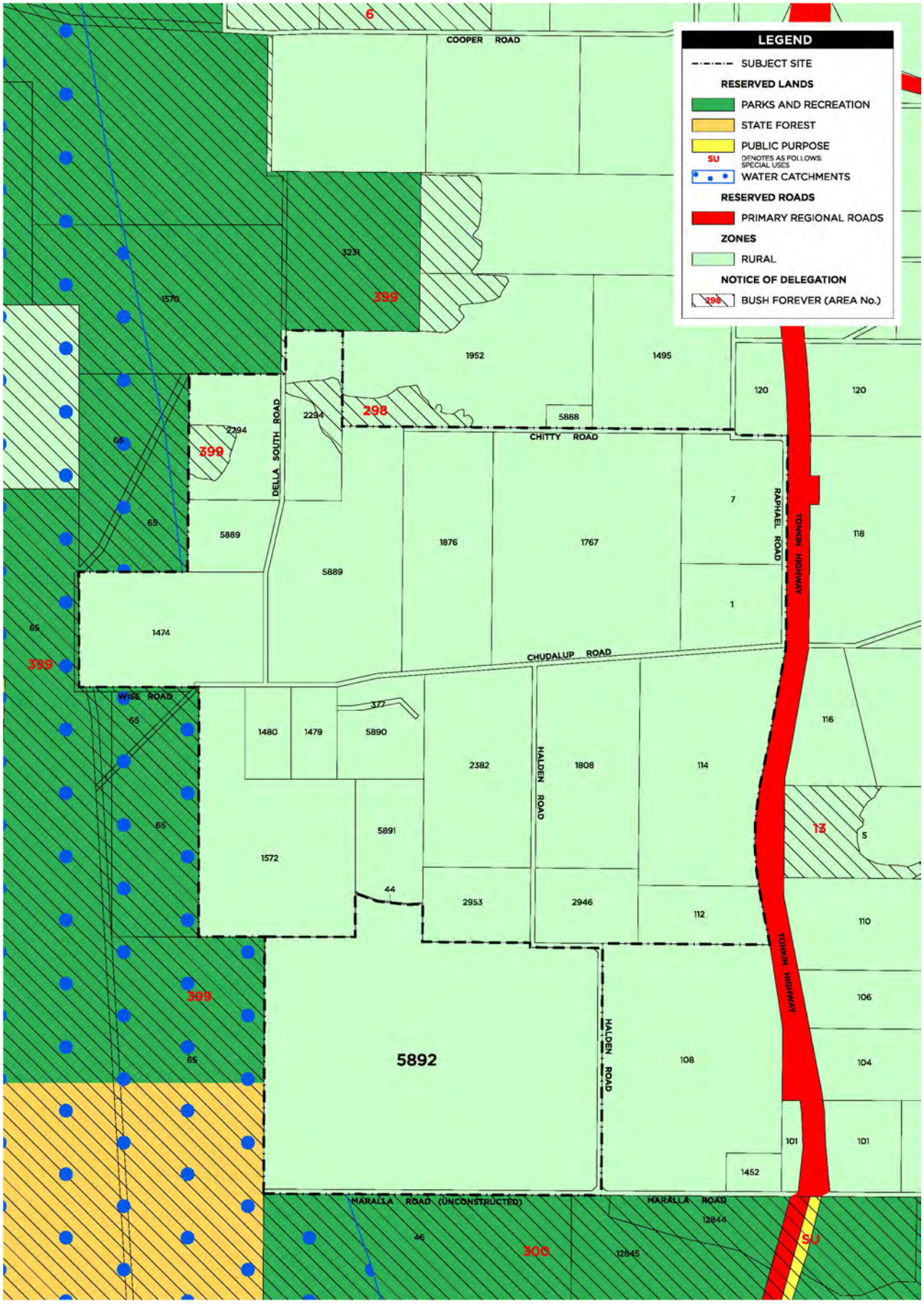


Figure 3 – Metropolitan Region Scheme

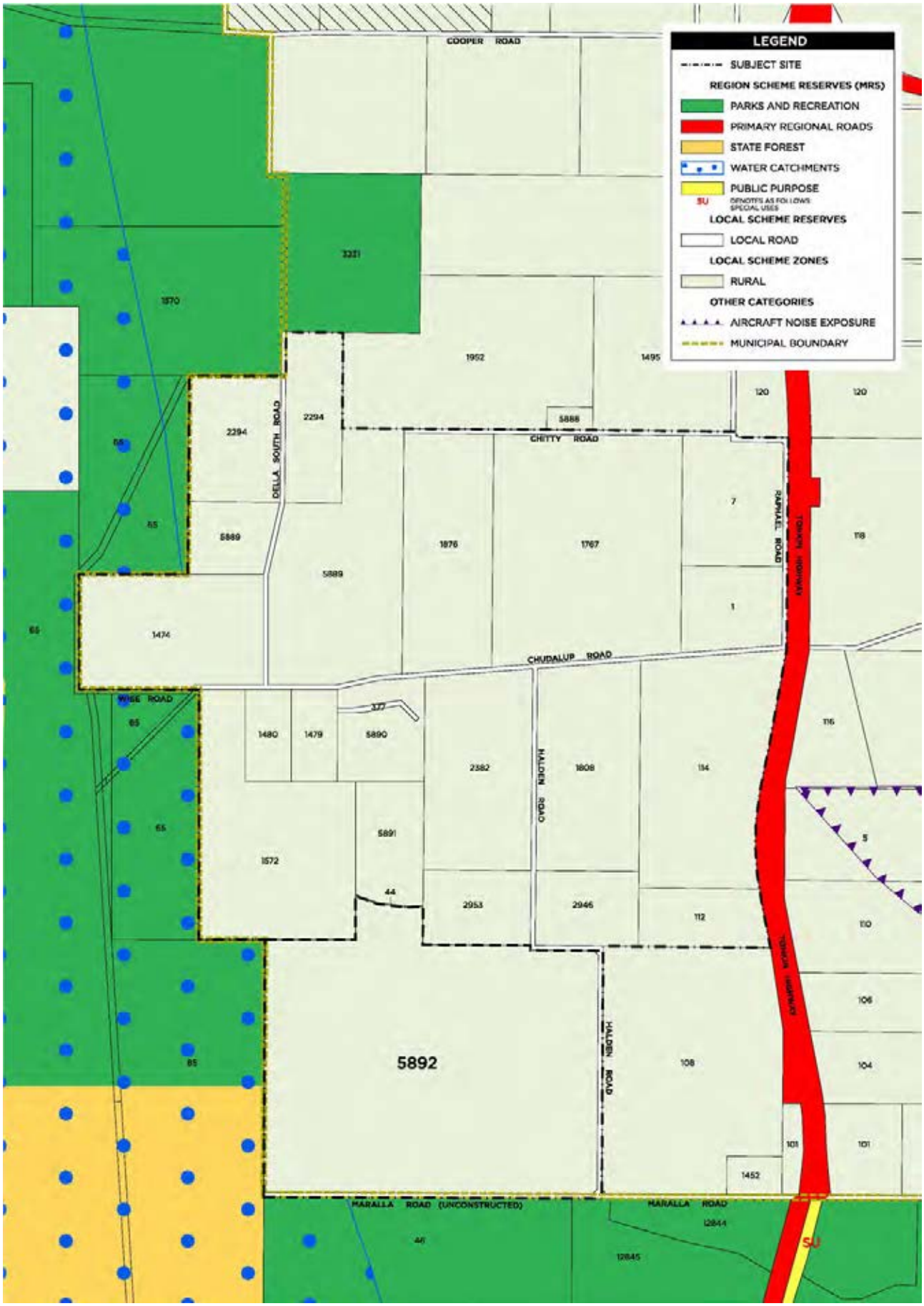


Figure 4 – City of Swan Local Planning Scheme No.17

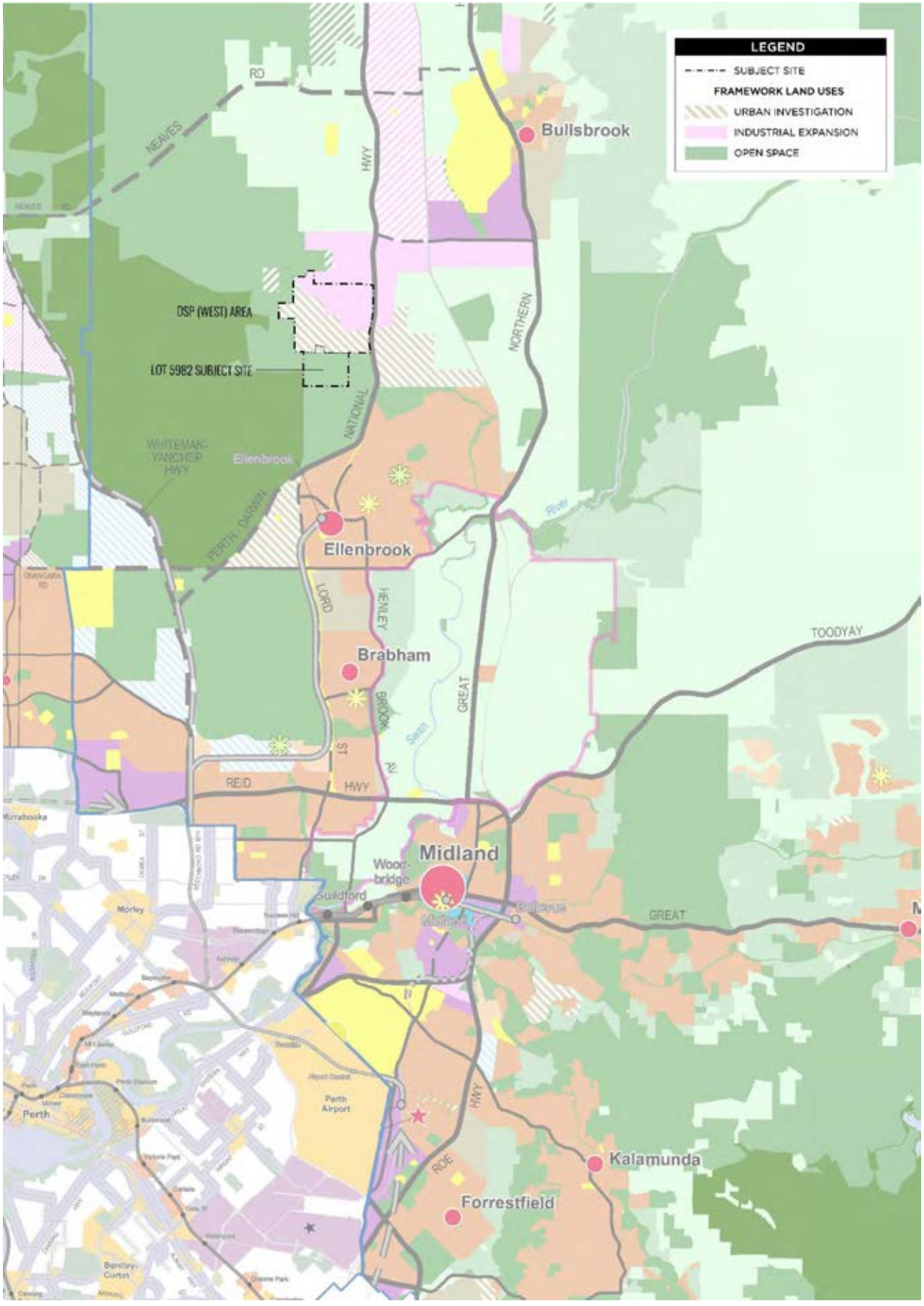


Figure 5 – North East Sub-regional Planning Framework

2.4 Regional & Sub Regional Planning

2.4.1 Perth & Peel @ 3.5 Million / North-East Sub-Regional Planning Framework

The *Perth and Peel @ 3.5 Million* (March 2018) suite of documents provide a framework for the development of the Perth and Peel regions as the population reaches an estimated 3.5 million by 2050.

The *North-East Sub-Regional Planning Framework* ('the Framework') recognises that the sub-region's population is predicted to more than double by 2050, growing from 209,156 people in 2011 to over 450,500 by 2050, with this growth to predominantly occur within the City of Swan.

The spatial plans forming part of the Framework identify Lot 5892 as 'Open Space', with only a small northern portion (5 hectares) of Lot 5892 identified as 'Urban Investigation'. The land immediately to the north of Lot 5892, which forms the current DSP area, is identified as 'Urban Expansion' and 'Industrial Expansion'. Land east of Lot 5892, to the east of the Tonkin Highway, is also identified as 'Urban Expansion'.

Refer **Figure 5** – North-East Sub-Regional Planning Framework.

2.5 Planning Strategies

2.5.1 City of Swan Local Planning Strategy

The City of Swan Local Planning Strategy does not identify Lot 5892 as 'Future Urban Area'.

Land to the immediate north of Lot 5892, being the DSP area, is identified as 'Future Urban Area' and 'Future Industrial Area' on the City of Swan Local Planning Strategy.

2.6 Planning Policies

2.6.1 State Planning Policy 2.4 – Basic Raw Materials

The WAPC's *State Planning Policy 2.4 – Basic Raw Materials* ('SPP 2.4') seeks to guide the use and extraction of Basic Raw Materials (BRM) from land where such extraction is considered appropriate on planning and environmental grounds.

Lot 5892 is identified under the SPP 2.4 as 'Sites with Prior State Environment Minister Approval' with "the land being identified as having a 'Significant Geological Supply – Sand". In accordance with SPP 2.4, Lot 5892 is currently operated for the purposes of sand extraction. The sand is a recognised resource that, within the provisions of *SPP 2.4: Planning for Basic Raw Materials* will be protected for the staged extraction of sand for the local community.

The extraction of sand is an interim land use. Post sand excavation the final land use is proposed to be urban as proposed by this Amendment 1 to the DSP. Subsequently, the sand mine's finished levels will reflect residential development engineering contours.

EPA Guidance "Separation Distances between Industrial and Sensitive Land Uses" lists the generic buffers for sand and limestone quarries as 300 - 500 metres depending on the extent of processing. A generic buffer relates to the distance at which there are unlikely to be any impacts without further investigations. It does not mean that smaller buffers are not acceptable.

In acknowledgement of the approved operational sand mine as an interim land use, a Staging Plan will be finalised and then implemented. The Staging Plan will incorporate a minimum separation distance from the progressive (and staged) sand extraction areas and the proposed staged residential development areas. The Staging Plan will establish the sand mine staging boundaries to maximise the setbacks to the closest (proposed) residential developments.

The following management response is proposed:

- Local Structure Plan: Sand mine final contours will comply with the final design contours for the residential development end use. A Sequential Land Use Plan will also be prepared. The purpose of this plan is to facilitate urban development while maintaining a buffer (consistent with the *EPA Guidance - Separation Distances between Industrial and Sensitive Land Uses*) from the operational excavation areas, noting that sand mining will be undertaken on staged basis across the tenement.

- Subdivision: Sequential Land Use Plan will be implemented which maintains a separation distance to the residential development staged areas

It is proposed that the sand resource is removed from the site in accordance with current approvals prior to the land being developed for urban purposes as proposed by Amendment 1 to the DSP. In accordance with the objectives if SPP 2.4, it is intended that the BRM opportunity within Lot 5892 is realised whilst also providing for the final intended urban land use proposed by Amendment 1 to the DSP. A sequential land use program will be established in this regard in order to manage the proposed land use transition, ensure that urban development does not encroach on or compromise the current extractive industry operations and future sand resource identified for extraction.

SPP 2.4 provides for sequential urban development following extraction of BRMs. It is noted that further detail will be required to demonstrate how sequential land use will be achieved within Lot 5892 and this is to be provided as part of the MRS Amendment, lifting if urban deferment and local structure planning processes. These future planning instruments will:

- Identify separation distances and establish transitional land uses and interface areas to protect the BRM from encroachment by urban land uses and avoid health risk and amenity implications for urban land uses; and
- Address sequential land use and demonstrate land staging and site remediation including identification of finished ground levels.

This is in accordance with policy measures contained within Section 6.2 of SPP 2.4.

2.6.2 State Planning Policy 3.7 – Planning in Bushfire Prone Area

Lot 5892 is identified as being within a 'Bushfire Prone Area' as per the Department of Fire and Emergency Service Map of Bushfire Prone Areas and as such, is subject to the provisions of *State Planning Policy 3.7 – Planning in Bushfire Prone Areas* ('SPP 3.7'). SPP 3.7 seeks to guide the implementation of risk-based planning to best mitigate the potential impact of bushfire on property and infrastructure. The Policy is accompanied by the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (December 2017) (the 'Guidelines').

In accordance with the requirements of SPP 3.7 and the associated Guidelines, Bushfire Prone Planning has prepared a Bushfire Management Plan (BMP) in support of Amendment 1 to the DSP. The primary purpose of the BMP is to act as a technical supporting document to inform planning assessment and provide guidance on how to plan for and manage the bushfire risk to the site through the implementation of a range of bushfire mitigation measures in accordance with the Guidelines.

The BMP concludes that the assessed bushfire risk is considered to be manageable and can be achieved by the identified stakeholders implementing and maintaining the bushfire risk management measures that are presented in the BMP. The proposal, as set out in the BMP has addressed the applicable legislation, policy, standards, and guidelines including the four elements of the Bushfire Protection Criteria of Location, Siting and Design, Vehicular Access, and Water Supply. The conclusion is that the proposal can meet all the requirements.

Refer **Appendix 2 - Bushfire Management Plan.**

2.6.3 Draft State Planning Policy 4.1 – Industrial Interface

The WAPC's Draft *State Planning Policy 4.1 – Industrial Interface* ('Draft SPP 4.1') (2009) seeks to provide for the safety and amenity of surrounding land uses while having regard to the rights of landowners potentially affected by identified land uses.

The policy considerations of the Draft SPP 4.1 do not preclude Amendment 1 to the DSP as proposed, though the policy is of direct relevance to the land use planning interface as Lot 5892 transitions from sand mining to proposed residential. Internal separation between ongoing

sand mining operations and future residential land uses is to be considered in detail as part of the ongoing planning for Lot 5892 as outlined in Section 2.6.1 of this report.

2.6.4 State Planning Policy 5.4 – Road and Rail Noise

The purpose of the WAPC's *State Planning Policy 5.4 – Road and Rail Noise* ('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.

The Acoustic Assessment provided as part of the DSP indicates that Lot 5892 is not adversely affected by noise permeating from the Tonkin Highway.

2.7 District Structure Planning

2.7.1 Industrial Land

The *Bullsbrook Townsite District Structure Plan* area is located approximately 3.5 kilometres to the north-east of the subject site and identifies 505 hectares of land for 'Industrial' purposes. The *draft Bullsbrook Freight and Industrial District Structure Plan* proposes an additional 2,900 hectares of land for industrial purposes. In addition, 1,100 hectares is identified within the *Muchea Employment Node Structure Plan*.

In summary, there is a significant amount of industrial land within the immediate vicinity of the subject site.

2.7.2 North Ellenbrook District Structure Plans (West and East)

The North Ellenbrook DSP's (West and East) were approved by the WAPC in November 2022.

A consolidated plan of the approved DSP's is included at **Figure 6.** These DSPs identify the key district level land uses and road networks required within North Ellenbrook.

2.8 Pre-Lodgement Consultation

The preparation of the draft DSP Amendment 1 has been informed through consultation with the Department of Planning, Lands and Heritage and the City of Swan.

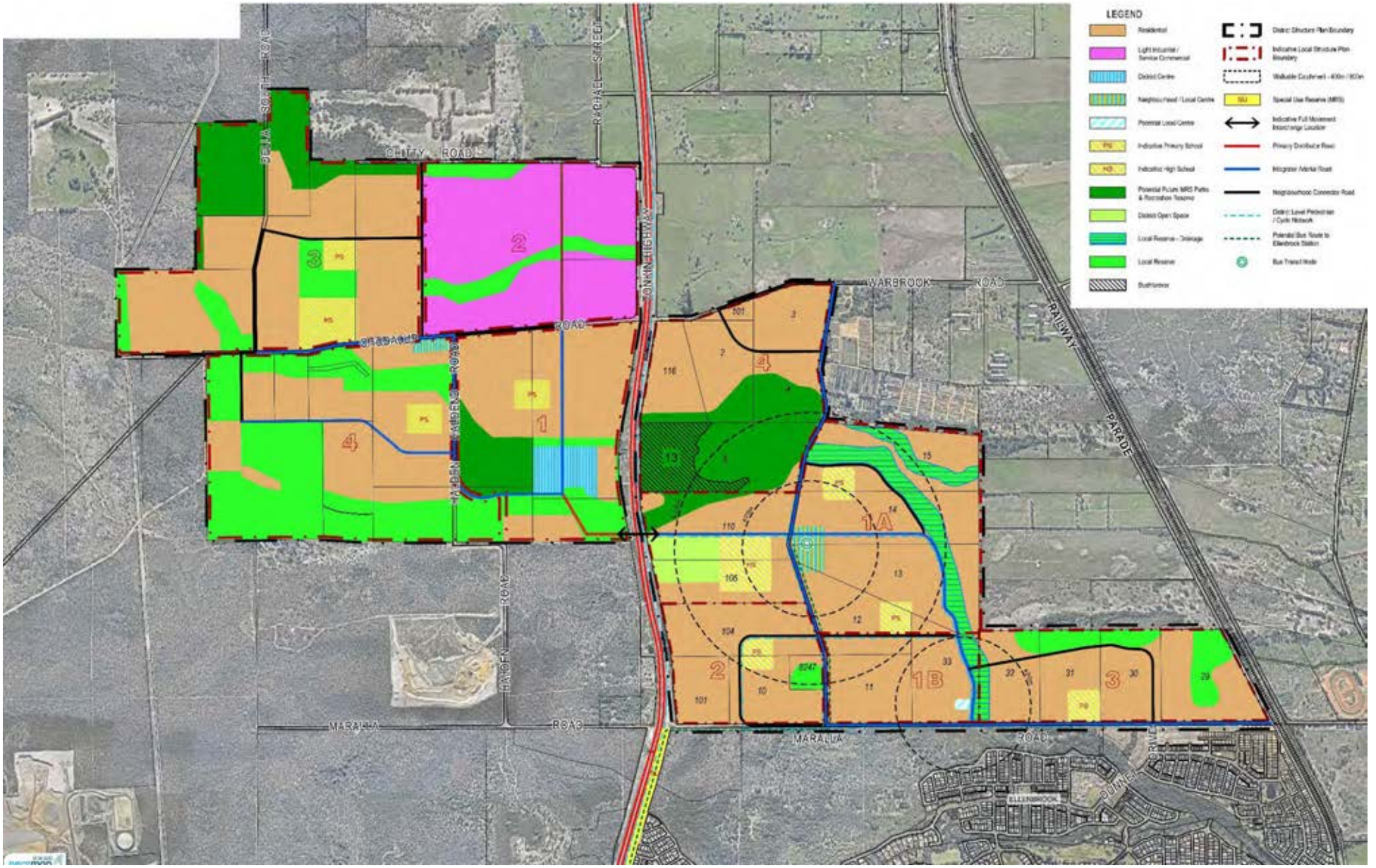


Figure 6 – North Ellenbrook District Structure Plans (West and East)

3. Site Conditions and Constraints

The following provides a summary of the environmental site conditions and constraints relating to the Lot 5892.

For further information, refer to the following reports:

- Environmental Assessment Report (**Appendix 2**)
- Bushfire Management Plan (**Appendix 3**)
- District Water Management Strategy (**Appendix 4**)

3.1 Topography and Geology

3.1.1 Topography

The site is underlain by the Bassendean dune landform, which is low in relief with minor variations in topography, translating to variable depth to the water table. Bassendean dunes generally consist of low hills of siliceous sand interspersed with poorly drained areas including both seasonal and permanent swamps. Bassendean dunes are well represented across the Swan Coastal Plain and are not considered to be a significant landform.

The natural topography of the site is undulating and ranges from approximately 50 metres Australian Height Datum (m AHD) to 76 m AHD. Current sand mining operations will progressively continue to alter the natural surface level.

Current approved sand mining operations are progressively modifying the landform in a manner that makes rehabilitation of vegetation to its former state an unlikely outcome. The approved extraction levels have been conservatively modelled at a minimum of 2m above the Department of Water's historical maximum recorded groundwater levels.

The approved extraction levels provide for the natural surface levels to be lowered by up to 20m. The finished extraction levels will facilitate the future development of Class A lots without the requirement for fill importation or significant earthworks. At the completion of sand mining within the tenement, the portion of the site subject to mining will be recontoured in accordance with the Mine Closure Plan to facilitate the agreed end land use which includes the potential for urban development.

3.1.2 Geology

Most of the site is mapped as Bassendean Sand; very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin. The northern portion of the site is mapped as sand over pebbly silt; sand as S8 overlying Mgs1 gravelly silt. Geology associated with the mapped Conservation Category Wetland comprises peaty clay; dark grey and black with variable sand content, of lacustrine origin.

3.1.3 Contaminated Sites

A search of DWER's Contaminated Sites Database undertaken in February 2022 did not identify any mapped contaminated sites within or proximate to the site.

The active use of the site for sand extraction activities is unlikely to be a source of any contamination to either soils or groundwater. On completion of sand extraction activities, any infrastructure on the site will be removed in accordance with the Mine Closure Plan.

3.1.4 Acid Sulphate Soils

A review of DWER's Acid Sulphate Soil (ASS) mapping indicates that the risk of ASS is 'moderate to low risk of ASS occurring within 3 metres of the natural soil surface' across most of the site, with a 'high to moderate risk' of ASS occurring within the mapped Conservation Category Wetland.

The risks associated with ASS can be appropriately mitigated through an ASS investigation which may be warranted at subsequent stages of planning. The risks associated with ASS will be reviewed further at the local structure planning and subdivision stages of the development.

3.2 Vegetation, Flora, and Fauna

3.2.1 Vegetation and Flora

Regional vegetation complex mapping across Lot 5892 indicates that vegetation comprises

Bassendean complex – North and Bassendean complex – North Transition.

A 2008 flora and vegetation survey undertaken by Cardno assessed most of Lot 5892, except for a small northern portion adjacent to the Sawpit Gully watercourse. A vegetation assessment was undertaken by RPS in spring 2020 over the northern portion of the site outside of the mining tenement area (M70/326), including the area not previously surveyed by Cardno (2008). The following vegetation units were identified across the site:

- *Banksia* Woodland
- *Xanthorrhoea* shrubland
- *Melaleuca* low woodlands

Refer **Figure 7** – Vegetation Mapping **Figure 8 - Environmental Elements** and further detailed mapping within the Environmental Assessment Report (**Appendix 2**).

Vegetation Condition

Most of the site was mapped by Cardno (2008) as "Excellent" with little disturbance and a minimal presence of weeds. The 2020 vegetation review of the northern portion of the site (outside of the sand mining tenement) by RPS identified most of the northern area was in "Very Good" condition.

Refer detailed mapping within the Environmental Assessment Report (**Appendix 2**).

Significant Flora & Communities

In 2016, the Commonwealth Minister for the Environment, formally recognised as a Matter of National Environmental Significance (MNES) the Banksia woodlands TEC. The RPS 2020 vegetation assessment confirmed the presence of Banksia woodland vegetation consistent with the EPBC Act Banksia woodlands MNES listing within Lot 5892.

Approximately 13.16 ha of this inferred Banksia woodlands TEC will be retained within open space proposed by this Amendment 1 to the DSP, this being within the Conservation Category Wetland core and buffer.

Cardno (2008) identified no Threatened flora species within the site, however the presence of one Priority flora species, *Stachystemon axillaris*, was reported. *Stachystemon axillaris* is not currently listed under either the Biodiversity Conservation Act 2016 (BC Act) or by the DBCA as a species of conservation significance.

The EPBC Act-listed *Caladenia huegelii* has been recorded proximate to the site. Due to the cryptic nature of orchid species (i.e., not flowering every year), a targeted spring search of the northern portion of the site outside of sand mining tenement was undertaken by RPS for specifically the EPBC Act-listed *Caladenia huegelii* on 14 September 2020. **No** *Caladenia huegelii* plants or any other orchid species of conservation significance were identified.

3.2.2 Fauna

A fauna assessment undertaken by zoologist Greg Harewood in December 2007 covered the portion of Lot 5892 subject to the sand mining tenement. In 2020, Terrestrial Ecosystems covered the northern portion of the site outside the tenement.

A total of 47 fauna species were observed (either directly or indirectly) during the Harewood (2007) field survey.

The open space proposed at the north western corner of Lot 5892 as part of Amendment 1 to the DSP provides a 'stepping stone' function for avian fauna species and local linkage for terrestrial fauna species to the open space areas / MRS Parks and Recreation Reserves in the DSP and the adjacent Bush Forever sites.

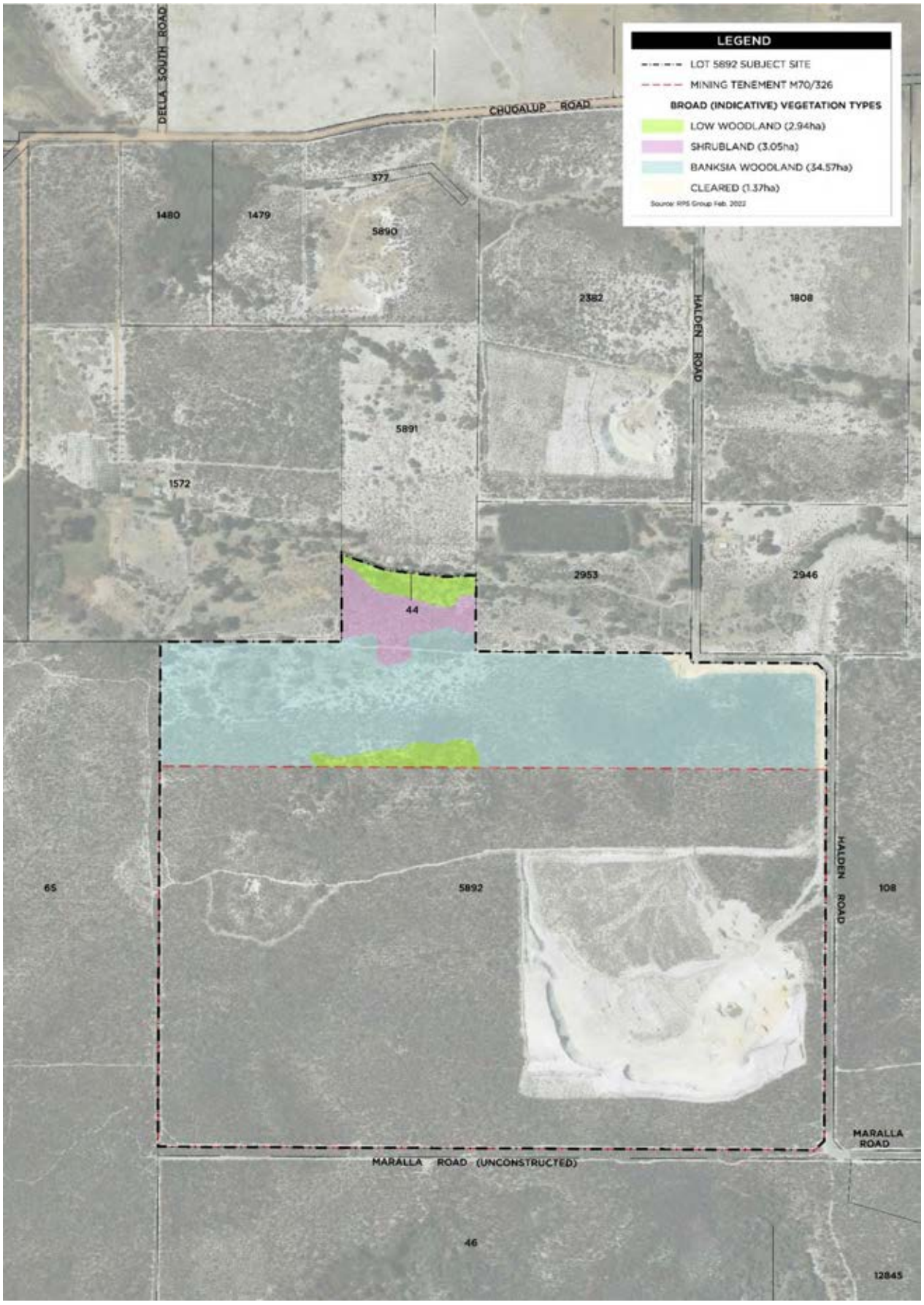


Figure 7 – Vegetation Mapping

Figure 8 – Environmental Elements

Black Cockatoos

Terrestrial Ecosystems identified that the northern portion of the site (outside of the sand mining tenement) comprised foraging habitat for Carnaby's black cockatoos, with evidence of foraging recorded within the Banksia woodland.

The site occurs within the modelled distribution of Carnaby's black cockatoo and forest red-tailed black cockatoo (DEE 2017). The Banksia woodland vegetation provides foraging opportunities for Carnaby's black cockatoo; however, it is considered unlikely that the site would provide foraging opportunities for the forest red-tailed black cockatoo due to the existing flora and vegetation values. No trees that would provide breeding or roosting opportunities for any black cockatoo species were identified on site by either Harewood (2007) or Terrestrial Ecosystems in 2020.

The proposed Amendment 1 to the DSP allows for the retention of up to 15.95 ha of intact fauna habitat in 'good or better' condition within open space, including 13.16 ha of high quality Carnaby's black cockatoo foraging habitat.

3.2.3 Reserves and Conservation Areas

There are no reserves or conservation areas within Lot 5892. However, the following two Bush Forever sites are located proximate to the site (refer **Figure 3**):

- To the west, Bush Forever Site No. 399 – Maralla Road Bushland, Ellenbrook Upper Swan (which forms part of the Gnangara-Moore River State Forest) is 4,150.9 ha in area;
- To the south, Bush Forever Site No. 300 – Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia 641.5 ha in area.

Bush Forever Site No. 300 is separated from the site by the unconstructed Maralla Road reserve to the south. The Bush Forever sites are reserved for 'Parks and Recreation' purposes under the MRS.

The site also abuts the Gnangara-Moore River State Forest to the west which is managed by the Department of Biodiversity, Conservation and Attractions and vested with the Conservation and Parks Commission under Section 5(1)(a) of the Conservation and Land Management Act 1984 ('CALM Act'). The details pertaining to the proposed interface to the State Forest will be reviewed at the local structure planning and subdivision stages of planning.

Stockland is committed to establishing an agreed interface management plan in collaboration with DBCA between the adjacent Bush Forever sites and the proposed urban development area. The purpose of the interface management plan would be to facilitate development while protecting the adjacent Bush Forever sites against the edge effects from the development and provide for appropriate bushfire hazard management.

3.2.4 Mitigation and Management

The current sand mining and proposed future urban development areas will avoid the native vegetation and fauna habitats within the 16.06 ha of wetland core and proposed 30m buffer areas within open space as proposed by Amendment 1 to the DSP.

The proposed open space contains 13.16 ha of inferred Banksia woodlands TEC and high quality Carnaby's black cockatoo foraging habitat.

Further opportunities to retain vegetation will be considered at the Local Structure Plan (LSP) stage. Additional flora and vegetation investigation will be undertaken as required. The key management framework will involve:

- Construction Management Plan
- Wetland Management Plan
- Interface Management Plan; and
- An Environmental Offsets Strategy.

3.3 Surface Water and Groundwater

3.3.1 Groundwater

The Maximum Groundwater Level (MGL) levels range from approximately 47 m AHD to 51.5 m AHD with the groundwater flowing in an easterly direction. The northern and eastern site areas have the lowest clearance to groundwater, i.e., less than two metres below ground level (mbgl), associated with wetland areas. The southern area

of the site has higher clearance to groundwater (up to 30 metres depth) associated with elevated sand dunes.

The depth to MGL reference above is based on surface topography prior to sand excavation. The finished mine floor level will be at least 2 metres above the MGL, hence subsoil drainage and fill importation are not expected to be required to control groundwater levels.

A portion of the site intersects the eastern edge of the Priority 3 of Gnangara Underground Water Pollution Control Area. There is a Priority 1 Public Drinking Water Source Areas (PDWSA) located immediately to the eastern border of the site. *State Planning Policy 2.2: Gnangara Groundwater Protection* identifies that urban land uses are acceptable within Priority 3 PDWSAs. The nearest public abstraction bore is approximately 2.4 km to the west.

3.3.2 Wetlands

A search of the DBCA's Geomorphic Wetlands of the Swan Coastal Plain dataset identified two mapped wetlands within the site.

- CCW (UFI 8907) located in the north eastern corner of the site
- REW (UFI 13387) located in the north of the site

Refer **Figure 9 – Wetlands**.

This Amendment 1 to the DSP proposes to retain the CCW (UFI 8907) and the REW 9UFI 13387), both with a buffer of 30m, within open space. Together, these wetlands (core and 30 metre buffer) cover 16.06 hectares within Lot 5892. Final wetland definition and buffers will be determined during the local structure planning process.

A 30-metre buffer to the CCW is considered appropriate on the basis that:

- Preliminary vegetation and hydrology investigations completed by RPS BBG (2005) determined that that there were no hydric soils associated with the wetland and concluded that 'the area is not a wetland or dampland and should not be mapped as such'.
- The flora and vegetation survey completed by Cardno (2008) identified Banksia woodland vegetation as aligning with the mapped extent of CCW (UFI 8907). Cardno (2008) did not identify any obligate wetland species within Banksia woodland vegetation and based on these results, concluded that 'the mapping of UFI 8907 is most likely erroneous'.

Sawpit Gully, a tributary of Ellen Brook, runs along the northern boundary of the site within the mapped extent of REW (UFI 13387). This area is included in the current DSP and a 30-metre buffer has been applied as provided for by the current DSP.

3.4 Heritage

3.4.1 Aboriginal Heritage

A search of the DPLH's Aboriginal Heritage Inquiry System undertaken in February 2022 identified one registered Aboriginal heritage site (site ID: 3525; site name: Ellen Brook Upper Swan; type: Mythological) broadly mapped over the eastern half of the site and significant extent of land east of the site (refer **Figure 10 - Aboriginal Heritage**).

An Aboriginal heritage and culture assessment is likely to be required to establish the actual extent of the broadly mapped registered Ellen Brook Upper Swan heritage site in relation to the site and hence determine any requirements under the *Aboriginal Cultural Heritage Act 2021*.

3.4.2 European Heritage

A search of the Heritage Council of Western Australia's inherit database and the City of Swan's Heritage List identified no listed heritage places within the site.

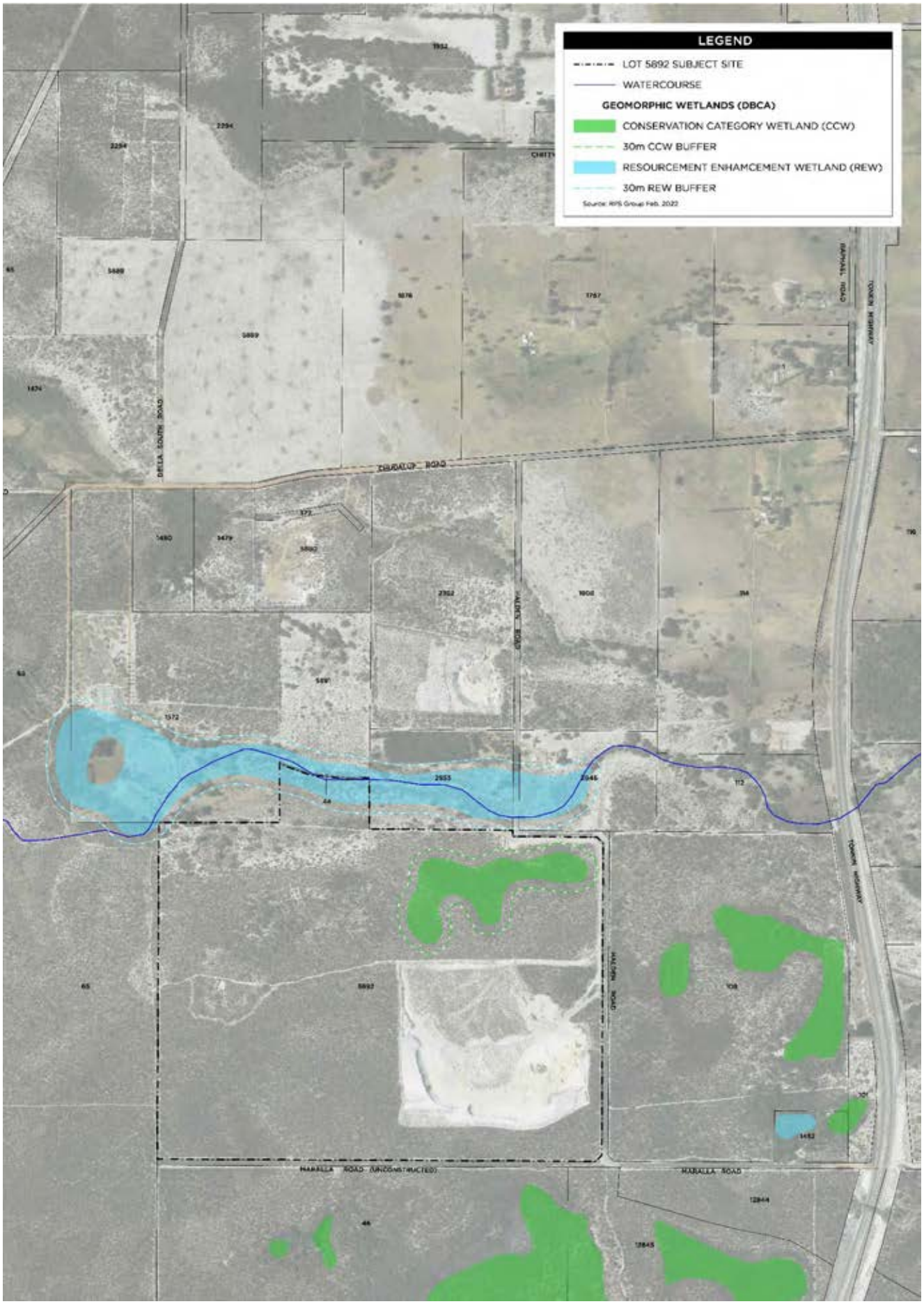


Figure 9 - Wetlands

Figure 10 – Aboriginal Heritage

4. Grounds for Urbanisation

It is submitted that there is a strong case for the urbanisation of Lot 5892.

Table 4 below details the approximate dwelling yield for the Amendment 1 area, based on a minimum average density target of 15 dwellings per gross urban hectare. Based on a total of 2,155 dwellings and an average household size of 3 people per household, this equates to an additional population of approximately 6.465 people. (Note – the average household size for Ellenbrook at the 2016 census was 3.0 (Source: Australian Bureau of Statistics)).

Table 4: Lot 5892 – Dwellings per Gross Hectare

LOT 5892 – DWELLINGS PER GROSS HECTARE	
Site Area	163 ha
Less Non-Residential Land Uses: • Public Purpose –Primary School • Environmental Constraints and Open Space	 • 3.5 ha • 15.8 ha
Total Non-Residential:	19.3 ha
Gross Urban Area:	143.7 ha
Total Dwellings @ 15 dwellings per gross urban hectare:	2,155 dwellings
Estimated Dwelling Range:	2,200– 2,500 dwellings

Urban development of Lot 5892 represents a logical extension of urban development from the current DSP and it would supplement and complement the development of the North Ellenbrook area as a viable and sustainable community supporting economic and social development in the North-East Sub-Region.

Urbanisation of the subject land would contribute to mitigating shortcomings in population forecasts in proximity to strategic employment centres such as the Bullsbrook Freight and Industrial Zone and Muchea Industrial Area. It would deliver economic and social benefits for the City of Swan and broader North-East Sub-Region.

As the site is identified for 'Significant Geological Supplies' (silica sand and construction grade sands) it currently operates as a sand quarry, These operations, necessary for the supply of basic raw materials, will result in the removal of native vegetation. Therefore, as already degraded land, it would be a logical and sequential extension of the proposed urban expansion envisaged for North Ellenbrook.

It is submitted that future urban development of the subject land will:

- increase the catchment for critical community infrastructure such as the proposed Ellenbrook Train Station and the proposed High Frequency Bus proposed under the DSP;
- utilise land that is closer to the development front and which will be predominantly cleared by approved sand mining activities, thereby limiting impacts on the natural environment by avoiding the need for additional clearing elsewhere to accommodate the required housing;
- support the funding model for the early delivery of the Tonkin Highway interchange;
- support employment self-sufficiency within the sub-region by generating a local labour force of 3,529 jobs;
- support employment self-containment within the sub-region by reducing the shortfall in the local labour force required to meet a projected oversupply of strategic employment opportunities in the Bullsbrook Freight and Industrial Zone, and in so doing retain a larger share of income earned within the local economy;
- generate an additional 6.465 residents, thereby supporting the viability of local businesses and community infrastructure;
- utilise land that is predominantly cleared and does not require imported fill, making it easier and more cost-effective to develop;

thereby contributing to the supply of affordable and sustainable urban development;

- The subject land is in single ownership and could be developed at the earliest opportunity.

4.1 Economic and Social Assessment

An economic and social assessment has been undertaken by Pracsys to provide key economic and social justification and rationale to support the inclusion of Lot 5892 into the DSP (refer **Appendix 5**). The following key points are relevant:

- Analysis indicates that the population forecasts for the area proximate to the Bullsbrook Freight and Industrial Zone will be inadequate to support the labour force needs of the centre at full build-out.
- The urbanisation of Lot 5892 will enable the required labour force to live in proximity to the strategic Bullsbrook Freight and Industrial Zone, helping to achieve the City's Employment Self-Sufficiency goal (85.8%) and facilitate timely development of the strategic industrial area.
- Urbanisation of Lot 5892 will provide an additional 6,660+ residents in North Ellenbrook and this will help to support the development and viability of community infrastructure, improving liveability outcomes for the whole of North Ellenbrook.

Other social and economic benefits associated with incorporating Lot 5892 in the DSP include:

- Proximity and access to strategic employment centres for future residents reducing Vehicle Travel Time and Vehicle Operating Costs.
- Improved housing affordability due to the reduced earthworks costs.
- Proximity and access to transport links including major State investment in METRONET.
- Increased retail expenditure in North Ellenbrook supporting district, neighbourhood, and local shopping centres.

4.2 Residential Land Needs and Supply

A Residential Needs Study (RNS) was completed in March 2020 to support the current DSP. The RNS was reviewed by Pracsys as part of Amendment 1 to the DSP and the proposed urbanisation of Lot 5892. Refer **Appendix 5** – North Ellenbrook Document Review. The review by Pracsys concluded the following:

- The Residential Needs Study (RNS) identified that the potential residential land supply to meet future housing needs may not be achievable and recommends an expansion of greenfield development capacity in the City of Swan, specifically in the identified sub-region. This supports the inclusion of Lot 5892 as part of the DSP.
- Lot 5892 would provide residential land with a high level of access to employment zones, a major highway and the planned nearby Ellenbrook Metronet service.
- The addition of Lot 5892 to the DSP will support the provision of affordable residential housing in the area. The sand excavation level currently provides greater than the 2-metre clearance above historic groundwater level necessary for urban or industrial development. This means that urban development of this land can be achieved without the need for imported fill, reducing earthwork costs from the $20,000-$25,000 currently in Brabham, Henley Brook, and Bennett Brook to approximately $5,000 per lot, saving $20,000 in building costs.

It is submitted that the proposed Amendment 1 to the DSP will contribute in a **positive manner** to the supply of residential land in the north east corridor, and particularly within the City of Swan. Further discussion and details on this matter are provided within **Appendix 5** – North Ellenbrook Document Review.

4.3 Support for Industrial Land

An Industrial Land Assessment (ILA) was carried out by Lucid Economics to support the DSP and review land requirements for future industrial use. The ILA was reviewed by Pracsys as part of Amendment 1 to the DSP in order to address the proposed inclusion of Lot 5892 into the DSP. Refer **Appendix 5** – North Ellenbrook Document Review. The review by Pracsys concluded the following:

- The key takeaway of the Assessment is that there is sufficient industrial land in the NESR to support identified demand and that the Bullsbrook Freight and Industrial Zone, positioned directly alongside the proposed North Ellenbrook development, will be a key strategic employment centre for the greater North-East Sub Region into the future.
- Lot 5892 is perfectly positioned to support this key industrial area by supplying local residents who are able to take full advantage of the emerging employment hub at their doorstep.
- It can be shown that there remains an oversupply of strategic employment opportunities compared to residential population. Unless further population can be supported proximate to the Bullsbrook Freight and Industrial Zone, such as within Lot 5892, labour will be sourced from outside the City of Swan, reducing the City's capacity to meet employment self-sufficiency (ESS) and increasing strain on road infrastructure.
- Enabling local strategic employment opportunities to be filled by local residents requires further residential development in the area.
- It is estimated the 6,600+ future residents at Lot 5892 will fill 1,010 strategic employment opportunities at the Bullsbrook Freight and Industrial Zone that would otherwise be imported from other LGAs. Providing the opportunity for workers to live close to their place of employment is a key strategic objective for both State and Local governments.

4.4 Activity Centres and Employment

The DSP contains an Activity Centres and Employment Strategy which provides recommendations regarding the provision of activity centres.

The Strategy was reviewed by Pracsys as part of Amendment 1 to the DSP in order address the proposed inclusion of Lot 5892 into the DSP. Refer **Appendix 5** – North Ellenbrook Document Review. The review by Pracsys concluded the following:

- The inclusion of Lot 5892 as a part of the DSP will improve the viability of commercial and community uses in North Ellenbrook West and reduce the potential for impacts from the DSP's proposed centres on existing activity centres.
- The development of Lot 5892 will improve the ratio of persons per facility in North Ellenbrook West, contributing to greater viability.
- The urbanisation of Lot 5892 will provide additional residents in proximity to the proposed uses in North Ellenbrook West. It will be a net contributor of demand for retail and non-retail uses in the area and will reduce the timeframe for facility viability in North Ellenbrook West. Development of the lot will also support facilities in the wider Sub-Region, providing increased population nearby to Ellenbrook and Bullsbrook.
- The development of Lot 5892 directly aligns with the objectives of the strategy through the following:
    - Provides an increase in population proximate to the Bullsbrook Freight and Industrial Zone with a new Tonkin Hwy interchange that will maximise access to employment opportunities;
    - The increase in population will support infrastructure viability allowing it to be developed at an earlier date; it will also improve liveability through greater activation of centres; and

- The increased population will boost demand for goods and services and support business investment.

- Amendment 1 to the DSP will provide positive net demand for retail and non-retail uses that will support the viability of commercial and community uses in North Ellenbrook and existing centres. It will also contribute directly to achieving positive economic outcomes aligned to the Strategy's objectives.

4.5 Conclusion

The grounds for urbanisation of Lot 5892 is provided is summarised below:

- It represents a logical extension of the future urban development immediately to the north under the approved DSP;
- It will support the achievement of dwelling targets identified for the area by the North East Sub Regional Planning Framework;
- It will support essential community, social and hard infrastructure delivery, development, and viability in the district;
- It will contribute to providing a proximate labour force for the industrial areas in Bullsbrook and Muchea and will contribute to achieving employment self-sufficiency within the district and within the City of Swan; and
- The majority of the site is currently being and will continue to be cleared as part of approved sand mining operations. Thus, the additional vegetation clearing to facilitate urbanisation is limited.

5. DISTRICT STRUCTURE PLAN AMENDMENT 1

5.1 Design Philosophy

Amendment 1 to the DSP embraces the design philosophy adopted for the current DSP. The following key points are relevant:

- The layout responds to the environmental characteristics of the site, ensures the retention of the key area of environmental value, responds to the proposed land uses and layout in the current DSP and the existing road network.
- The layout allows for urban development to be staged sequentially, corresponding to ongoing sand mining operations on the site. The design provides for a logical transition in land use.
- The proposed layout is based largely on a grid which allows for a well-connected and integrated community, pedestrian permeability and linking of community facilities.
- The location of a local centre to create a point of arrival and maximise activity and its exposure to passing trade.
- The movement network incorporates existing roads and proposed roads to the north in the DSP, with adjustments proposed to allow for a connection south into Lot 5892. The indicative road network has been aligned to terminate at areas of public open space, allowing for pedestrian access to recreational areas and safe pedestrian links to community services and amenity.
- Amendment 1 to the DSP supports one Primary School which has been located along the primary road connection and Open Space to ensure safe and direct accessibility. The Primary School is strategically located to allow for accessibility within their catchment area and proximity to Public Open Space.
- Public open space areas have equitably distributed throughout the site and will provide for active and passive recreation.
- The additional urban area will provide for a range of residential densities. Higher densities will be located close to areas of amenity and open spaces and also in proximity to the local centre. Traditional homes will make up the majority of the area whilst areas on the periphery of the site may allow for larger lots to interface with the existing bushland areas.

5.2 Objectives

In addition to the objectives presented in the current DSP, the objectives of Amendment 1 to the DSP are as follows:

- Justify the urbanisation of Lot 5892 and inclusion within the DSP;
- Provide a land use planning and infrastructure framework that further supports the growth and development of the north east corridor and North Ellenbrook to address urban land supply as required to meet increased demand;
- Establish a vision for the development of Lot 5892 and the transition from sand mining to urban development as a sequential land use programme; and
- Identify issues to be addressed and considered at more detailed level of structure planning.

5.3 Urban Design Response

The urban design response across Lot 5892 has resulted from an analysis of landform, wetlands, vegetation, future open space distribution, school site and local centre requirements, required movement networks and residential densities.

An Indicative Master Plan has been prepared over Lot 5892 – refer **Figure 11**.

Figure 11 – Indicative Master Plan

6. Land Use and Subdivision Requirements

6.1 Land Use

Amendment 1 to the DSP sets out high level land use zoning, open space, vehicle movements and servicing requirements for Lot 5892 which are to be further refined at the local structure planning stage. Refer **Figure 12**.

A summary of the key land uses and population across Lot 5892 is summarised in **Table 5** below:

Table 5: Land Use Summary Table – Additional DSP Area (balance of Lot 5892)

Item	Data
Total Additional DSP Area Proposed by Amendment 1	163 hectares
Area of each land use within additional DSP area (gross): - Residential - Commercial	 143.7 0.42
Estimated Residential Lot Yield	2,200 – 2,500 lots
Estimated population yield*	6,600 – 7.500
Number of High Schools	0
Number of Primary Schools	1
Estimated Commercial Floor Space	1,200m2 NLA
Estimated Labour Force	2,800 construction jobs 365 ongoing jobs
Reserves and Open Space	15.8 hectares

*Note: The estimated residential lot yield range has been calculated based on applying the dwelling per site area calculations stipulated under the Sub-Regional Framework and Liveable Neighbourhoods respectively, as follows:

- 15 dwellings per gross urban hectare:
    - Gross Urban Area: 143.7 hectares
    - Dwelling Yield: 2,155 dwellings
- 22 dwellings per gross site hectare:
    - Gross Site Area (subject to detailed design): 84.52 hectares
    - Dwelling Yield: 1,859 dwellings

An area of 106 hectares of 'Light Industrial' / 'Service Commercial' is proposed north of Lot 5892 in the DSP. This in response to the industrial allocation of land within the Sub-Regional Framework. No additional light industrial or service commercial land is proposed by Amendment 1 to the DSP. This consistent with the Sub-Regional Framework.

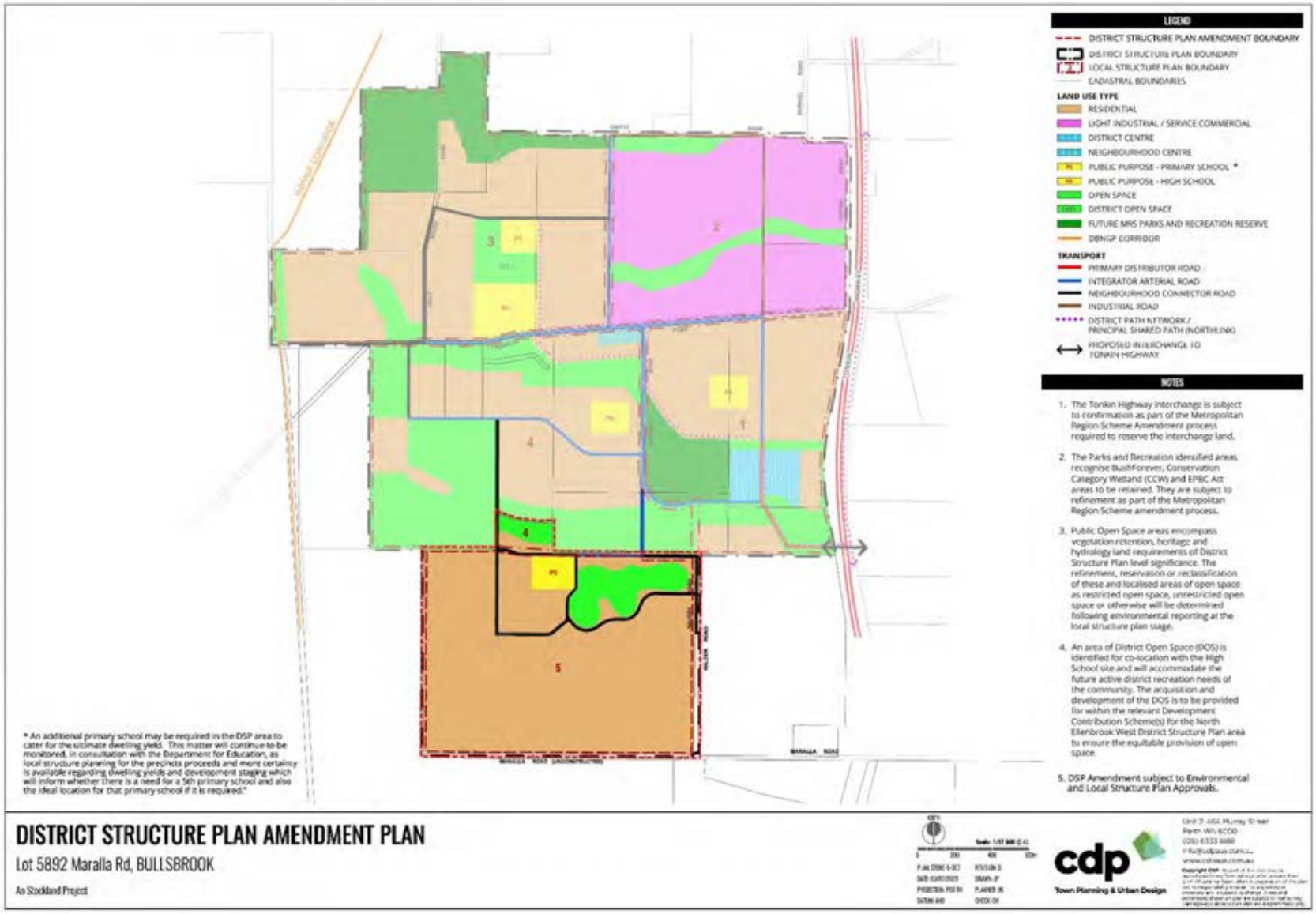


Figure 12 – Proposed Amendment 1 to the DSP

6.2 Residential

Amendment 1 to the DSP proposes an additional 143.7 hectares of land for urban residential purposes within the DSP area.

Based on a gross urban density of 15 dwellings per hectare, Amendment 1 to the DSP has the potential to provide an additional 2,200 – 2,500 dwellings, accommodating an additional population increase of approximately 6,600 – 7,500 people (based on an average household size of 3.0 in Ellenbrook at the 2016 census). The extent of residential land will be further refined through subsequent local structure planning. A local structure plan will be required to provide further detail with regard to the distribution of density to ensure the density targets outlined in the WAPC's Perth and Peel @ 3.5 Million and Liveable Neighbourhoods can be achieved.

Amendment 1 to the DSP seeks to ensure a diversity of housing opportunities within the amendment area, particularly in areas located in proximity to open spaces and activity centres which will allow for a variety of housing typologies. Opportunities for higher density development will provide housing choice and affordability, whilst supporting the future economic growth of the future commercial centres through North Ellenbrook. Traditional suburban homes will make up the majority of housing typologies through the area. Areas on the periphery of the development area will allow for larger, low density lots which respond to the bushland interface on the southern and eastern boundaries.

The dwelling target for the Amendment 1 area is 15 dwellings per gross urban hectare, consistent with the current DSP, noting the district and neighbourhood activity centres are proposed within the area to north.

Refer **Figure 13** – Residential Density

6.3 Open Space

Amendment 1 to the DSP provides for an open space network within Lot 5892 comprising the mapped Conservation Category Wetland (CCW) and Resource Enhancement Wetland (REW) and associated surrounding vegetation. The open space has been located to respond to the site's natural features, the CCW and REW and associated vegetation to ensure its ongoing protection.

The proposed CCW open space is located in proximity to the proposed open space to the north in the DSP area and therefore presents an opportunity to create synergies and linkages between the two spaces at more detailed levels of planning.

The proposed REW open space is located consistent with that shown on the DSP, however Amendment 1 to the DSP proposes to reduce the size of this open space to reflect the required 30 metre buffer for this wetland.

Refer **Figure 14** – Public Open Space

Additional areas of local open space will be provided for at the local structure planning stage comprising a mix of restricted and unrestricted open space. In accordance with Liveable Neighbourhoods, 10 per cent of the gross subdivisible area of residential neighbourhoods is to be given up for local public open space.

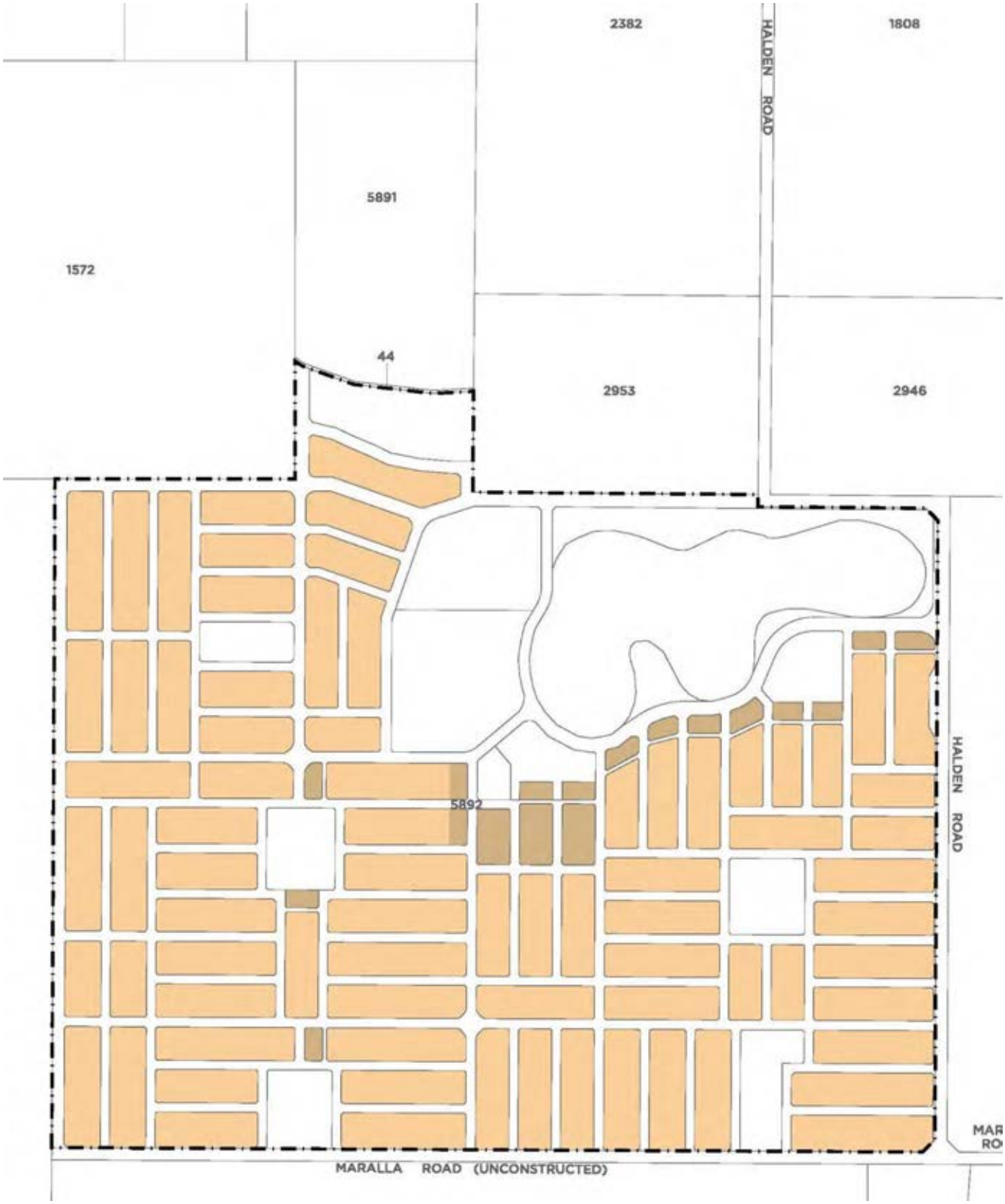


Figure 13 – Residential Density

Figure 14 – Open Space

6.3.1 Wetlands

Amendment 1 to the DSP proposes the retention of all Conservation Category Wetlands ('CCWs') and Resource Enhancement Wetlands (REWs) within Lot 5892, including a generic buffer of 30m, within open space. The exact wetland definition and buffers will be determined during the local structure planning process.

The northern most tip of Lot 5892, which is already included in the DSP, contains a Resource Enhancement Wetland (REW) UFI 13387. This wetland is degraded due to historical clearing and grazing activities which have occurred within this location. The REW may form part of the future public open space contribution for the area, however, as much of the REW is mapped as being in 'Degraded' and 'Completely Degraded' condition, subsequent planning provides an opportunity for the wetland classification to be reviewed and potentially downgraded. Should a wetland reclassification support the downgrading of the REW, the extent of open space shown within this northern area of Lot 5892 may be reduced. In the event that the REW classification is downgraded and therefore the extent of public open space is reduced, consideration will still be given to providing some form of open space at this location for drainage purposes given the low-lying nature of this portion of the site.

Refer **Figure 9 – Wetlands** and **Figure 12 – Amendment 1 to District Structure Plan.**

6.4 Education and Community Facilities

6.4.1 High Schools

A high school is provided for by the current DSP in the area north of Lot 5892.The 2,200 additional dwellings that will be created by Amendment 1 to the DSP does not warrant an additional high school. The WAPC's Policy DC 2.4 requires one high school for every 4 – 5 primary schools. There are 4 primary schools provided for by the DSP (including that proposed by Amendment 1) and thus one high school is deemed adequate.

6.4.2 Primary Schools

One primary school site is proposed within Lot 5892 to support the forecast additional population. This is in addition to the three (3) primary schools provided for by the DSP. The additional primary school proposed by Amendment 1 to the DSP will result in 4 primary schools across the entire DSP area (as amended). Based on the ratio of one (1) primary school per 1,500 dwellings, the 4 primary schools will accommodate the predicted total dwelling yield of 6,200 dwellings across the entire DSP area (as amended).

The location, configuration and size of the primary school site will be determined at the local structure plan stage in accordance with Liveable Neighbourhoods and in consultation with the Department of Education. The primary school is generally to be located along neighbourhood connectors where possible, to maintain strong vehicular connectivity to the residential and commercial areas. The primary school is also encouraged to be located adjacent to, or in close proximity to local centres to maximise walkability for pedestrians.

It is noted that an additional primary school may be required in the DSP area to cater for the ultimate dwelling yield. This matter will continue to be monitored in consultation with the Department for Education, as local structure planning for the precincts proceeds and more certainty is available regarding dwelling yields and development staging which will inform whether there is a need for a 5th primary school and also the location of that primary school if it is required.

Refer **Figure 15** – Education Facilities

6.4.3 Community Facilities

It is anticipated that the community facility requirements within Lot 5892 will form part of the future *North Ellenbrook West Community Infrastructure Plan* (refer Section 4.6.3 of the DSP). Local facilities within Lot 5892 will be planned for in conjunction with the local structure plan and will have regard for the identified primary school locations together with requirements for Neighbourhood Open Space, Neighbourhood Community Facilities, and local open space needs.

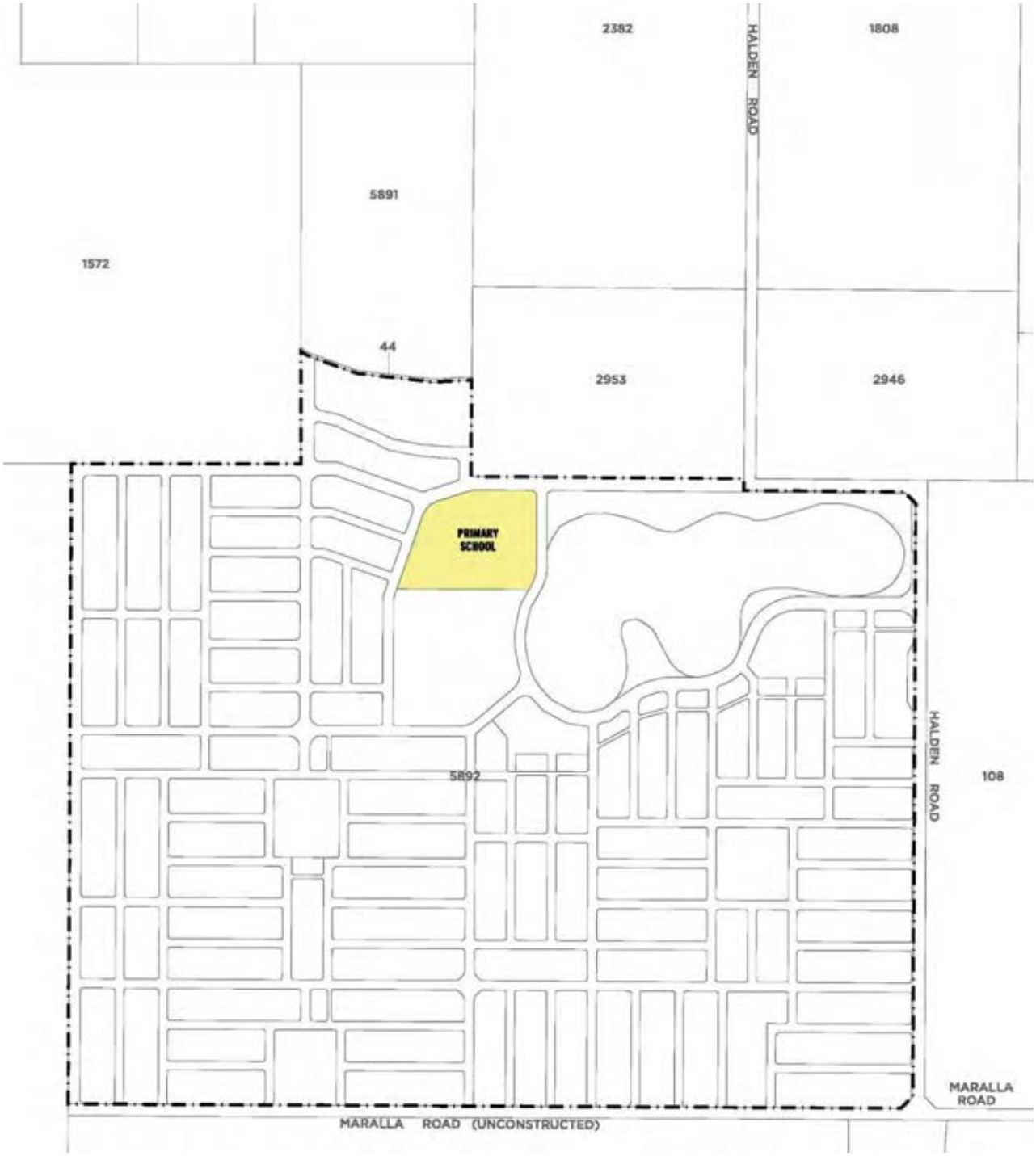


Figure 15 – Educational Facilities

6.5 Activity Centres and Employment

The DSP area provides for a district centre of approximately 32,000m2 net lettable area ('NLA') (in line with the recommendations of the Activity Centres and Employment Strategy report) and two smaller neighbourhood centre nodes, comprising 7,000m2 NLA and 3,300m2 NLA, respectively. The DSP also provides for a small local node within Precinct 3, in close proximity to the proposed Primary School, which may include uses such as childcare, medical centre or similar such small-scale commercial services.

It is envisaged a small local node will be developed within the Amendment 1 area (Precinct 5 - Lot 5892), of approximately 1,200m2 floorspace, the same size as the local node envisaged in Precinct 3. These centres are flexible in their location and will be determined at subsequent stages of planning.

6.5.1 Employment

The amount of employment created by the development of Lot 5892 as proposed by Amendment 1 to the DSP has been estimated by using mathematical ratios and extrapolating from the estimates provided within the DSP. The construction phase of development within the Amendment 1 area is expected to directly and indirectly support approximately 2,880 employment opportunities (in terms of full-time equivalent job years) over the development period. This has been calculated on a jobs per hectare basis using the 10,800 construction jobs created by the DSP which covers 611 hectares (i.e., 17.7 jobs per hectare). The development of the subject site will support ongoing employment opportunities locally and support existing and planned employment centres in the wider area (such as the planned and existing industrial areas to the north). Based on estimated non-residential uses and a home-based worker estimate as per the DSP documents, the subject site is expected to accommodate approximately 365 ongoing jobs. This has been calculated using the estimates presented in the DSP, developing basic ratios, and applying this to the land use and forecast population of Lot 5892 as required.

6.6 Movement Network

The following provides a summary of the existing, planned, and proposed movement network for Amendment 1 to the DSP area in addition to how this affects the current Transport Impact Assessment supporting the DSP (West) area. For further information, refer to the Transport Impact Assessment Addendum prepared by Transcore and included at **Appendix 6**.

6.6.1 Existing Road Network

Lot 5892 is located to the west of the Tonkin Highway and immediately south of the DSP area. It is bound on the eastern side and around its northeast corner by Halden Road. The southern boundary is the unconstructed road reserve of Maralla Road.

Maralla Road and Warbrook Road (further to the north) were both severed on the western side of Tonkin Highway when the Highway was constructed, so the only road access currently available to Lot 5892 is northwards through the DSP area via Halden Road – Warbrook Road – Raphael Road – Stock Road to the Tonkin Hwy / Stock West Road interchange, this being 4 kilometres north of Lot 5892.

6.6.2 Proposed Road Network

The proposed main arterial road network within Lot 5892 and the DSP area to the north is shown in **Figure 16**. Traffic volumes are shown on **Figure 17**. Both these figures are sourced directly from the Transport Impact Assessment Addendum prepared by Transcore. The proposed road network includes additional roads within the DSP area as required to provide necessary connections and linkage to the DSP main road network from Lot 5892. Additional roads are proposed within the DSP, these being required to provide a connection to the proposed urbanisation of the Lot 5892. An Integrator Arterial Road connection into the DSP area is proposed via an extension of Halden Road northwards into Precinct 1 of the DSP area to connect with the Integrator Arterial Road network proposed by the DSP. This road is proposed to be located within the existing Halden Road reserve.

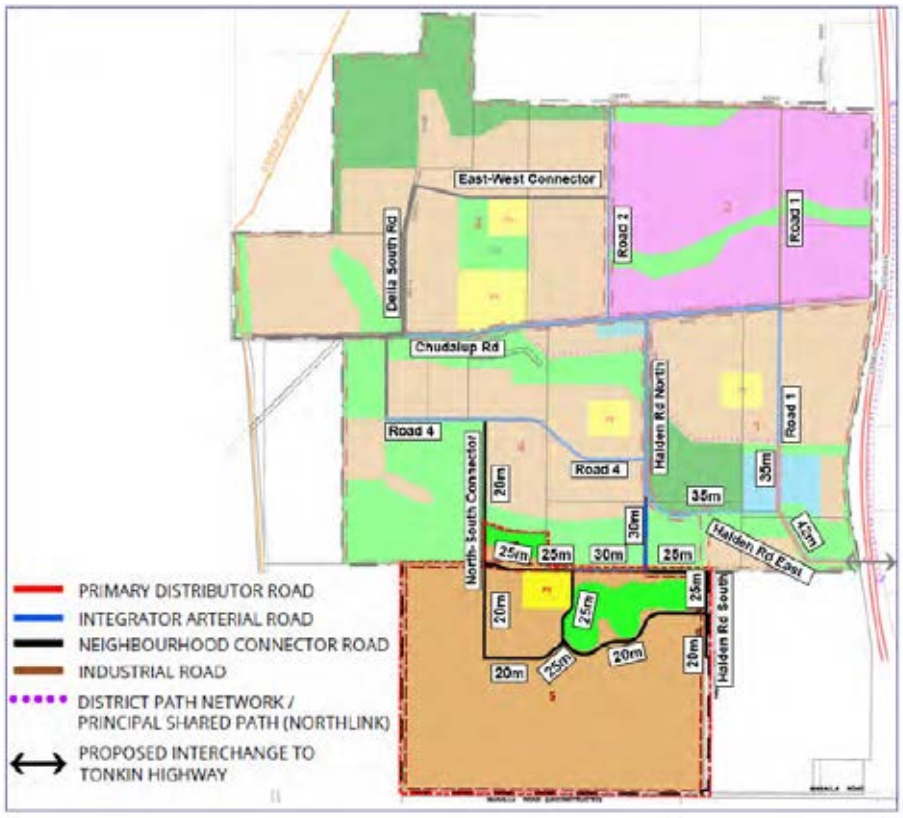


Figure 16 – Proposed Road Network (Source: Transcore)

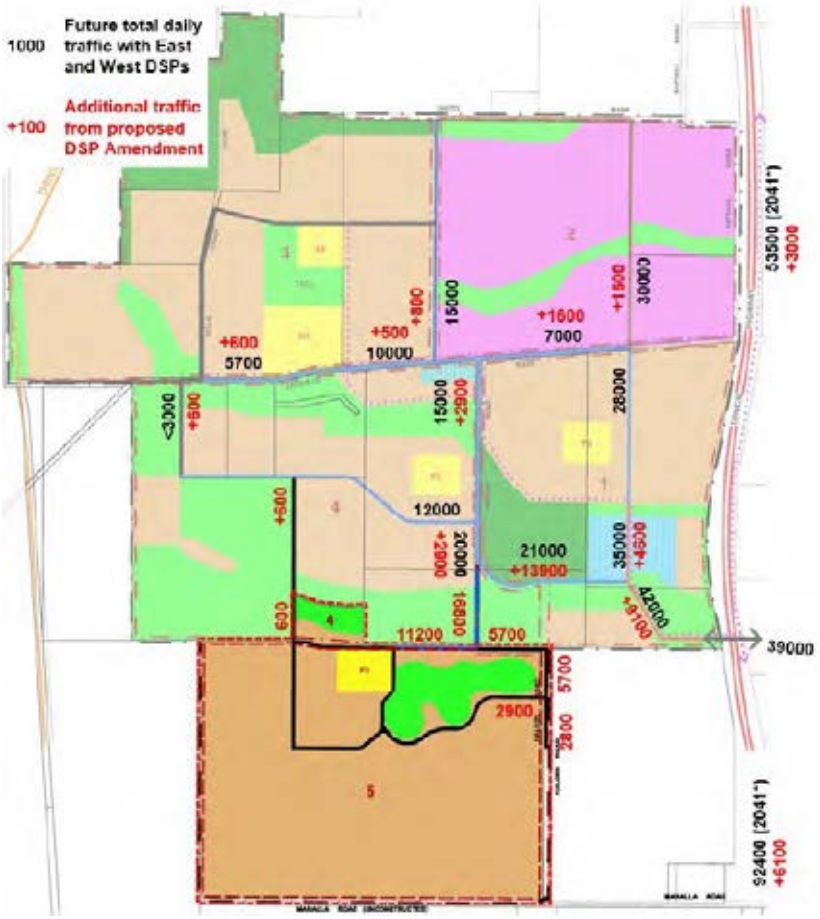


Figure 17 – Traffic Volumes (Source: Transcore)

A second Neighbourhood Connector road connection is proposed further west within Lot 5892 and extends northwards into Precinct 4 of the DSP.

The main road network proposed by Amendment 1 to the DSP responds to a district level of planning and comprises a simple network that connects Lot 5892 to the DSP area and the key land uses including the District Centre and high school. The proposed road network also provides connection and legibility within Lot 5892 with regard to access to the main areas of amenity such as the wetland open space and the future primary school.

The more detailed local road network will be developed at the local structure planning stage as detailed design progresses.

Proposed Tonkin Highway Interchange

The DSP provides for a new, grade-separated interchange with the Tonkin Highway, approximately 1.2km south of Chudalup Road, located almost immediately east of the northern boundary of Lot 5892.

MRWA's current estimated cost to develop the interchange is $100 million. It is noted that the Federal Government has committed $50 million towards the delivery of the interchange and the State Government allocated $25 million towards the delivery of the interchange. It is also noted that the funding gap will be covered by landowners within both eastern and western DSP's who have agreed to contribute a proportionate share of the $25 million balance (25%).

It is acknowledged that if Amendment 1 to the DSP is endorsed the land owner of Lot 5892 will also contribute to the cost of the interchange. Further arrangements between the landowners will be required in order to formalise an agreement on the contribution structure for the $25 million funding gap. The proportion of funding from each landowner will be determined based on 'need and nexus' and the principles established by *State Planning Policy 3.6 – Infrastructure Contributions*.

Halden Road East

The eastern section of Halden Road East is proposed as a Primary Distributor Road. This road section will accommodate traffic volumes in the order of 51,100 vpd. A 42m cross section is proposed for this section of Halden Road South.

The western section of Halden Road East is proposed as Integrator Arterial Road. This road section will accommodate traffic volumes in the order of 35,000 vpd. A 35m cross section is proposed for this section of road.

Halden Road West

The section of Halden Road west of Halden Road South is proposed to run along the northern boundary of Lot 5892. The central section of this road between the proposed Primary School and the existing Halden Road reserve will be an Integrator Arterial Road. This road section will accommodate traffic volumes 11,200 vpd. A 30m cross section is proposed for this section of road, based on the variation in traffic volumes.

Either side of this Integrator Arterial Road section, the road will function as a Neighbourhood Connector as traffic volumes will only be in the order of 5,700 vpd. The cross section can be reduced to 25m for these sections of road.

Halden Road North

The current Halden Road North Integrator Arterial Road proposed by the DSP is proposed to extend southwards to Lot 5892 as part of this Amendment 1 to the DSP, this within the existing 20m Halden Road reserve. This will be an Integrator Arterial Road to accommodate 16,800 vpd. A 30m cross section is proposed for this section of road, this requiring a 10m widening of the existing road reserve.

Halden Road South

Halden Road South, located along the eastern boundary of Lot 5892, is proposed as an Neighbourhood Connector. This road section will accommodate traffic volumes between 2,800 – 5,700 vpd. A 20 - 25m cross section would be suitable for this section of Halden Road South,

although this can be reduced when on-street parking is not required or is indented in the verge.

The southern section of Halden Road South carries significantly less traffic and will therefore operate as a local road.

North South Connectors

The proposed most eastern additional North-South Connector, including that portion proposed within the DSP and into Lot 5892 to the point of the proposed east-west Neighbourhood Connector in Lot 5892, will accommodate only 600 – 2,100 vpd. A cross section width of 20 metres has been proposed for this road, however this can be reduced if on-street parking is not required or is indented in the verge.

A north-south Neighbourhood Connector road is also proposed within Lot 5892 between the proposed primary school site and the wetland open space. This road will accommodate 6,200 – 6,600 vpd and have a cross section of 25m width.

East West Connectors

The proposed east-west connector road within Lot 5892 have been classified as Neighbourhood Connector roads, this based on traffic volumes in the order of 2,900 vpd. A 20 - 25m cross section would be suitable, however this can be reduced if on-street parking is not required or is indented in the verge.

6.6.3 Impact on DSP Roads

Additional traffic volumes on the DSP road network will be generated by the inclusion of Lot 5892 to the DSP (refer **Figure 17**). However, the approved road network (road classifications and road widths) within the DSP will be able to accommodate the additional traffic flows generated.

The only significant change required to proposed road classifications in the DSP as a result of including Lot 5892 into the DSP is to the main east-west road link to the proposed Tonkin Highway interchange. The road classification remains as a Primary Distributor, however traffic volumes along the section of this road immediately west of Tonkin Highway and the interchange will increase from 42,000 vpd to 51,100 vpd and will necessitate the widening of this section of road from 4 lanes to 6 lanes. The current DSP (West) proposes this section of road as a 35m cross section. However, this will be required to be widened to 42 metres to accommodate two additional traffic lanes. The cross sections are presented in the Transport Impact Assessment Addendum prepared by Transcore and included at **Appendix 6**.

6.6.4 Public Transport and MetroNet

The Primary Distributor, Integrator Arterial and Neighbourhood Connector roads provide suitable route options to accommodate future feeder bus routes to serve Amendment 1 to the DSP when such service is deemed appropriate by the Public Transport Authority in future.

6.6.5 Pedestrians and Cyclists

Amendment 1 to the DSP provides for adequate road reserves such that pedestrian and cyclist facilities can be accommodated in the future, as more detailed planning is undertaken within the area.

6.7 Water Management

6.7.1 District Water Management Strategy

A District Water Management Strategy (DWMS) has been prepared by RPS for the subject site to support Amendment 1 to the DSP (refer **Appendix 4** - District Water Management Strategy). Water management principles and objectives have been adapted for the site from the *North East Corridor Urban Water Management Strategy* (GHD 2007), *Better Urban Water Management* (WAPC 2008) and *Decision Process for Stormwater Management in Western Australia* (Department of Water and Environmental Regulation (DWER) 2017). This DWMS has been completed to address the objectives of BUWM (WAPC 2008) and demonstrate that the site can support future development in terms of water supply planning, flood mitigation, drainage management, groundwater management and water quality protection.

Stormwater Management

Integrated urban water management recognises that the urban water cycle should be managed as a single system and water supply, stormwater, wastewater, flooding, water quality and wetlands are interconnected (WAPC 2006). The aim of the stormwater management strategy, as per Water Sensitive Urban Design (WSUD) principles, is to:

- Protect natural systems
- Protect infrastructure
- Integrate stormwater treatment into the landscape to maximise the visual and recreational amenity of the development
- Protect water quality
- Maintain peak flows to pre-development rates if discharging off site
- Add value to the development.

The site will effectively manage stormwater quantity and quality generated from small, minor, and major events, incorporating best practice WSUD principles.

It is noted that the DWMS presents a preliminary drainage strategy and proof of concept at a high level. A conservative approach has been taken in the adoption of WSUD features given in the planning framework.

This is to ensure that POS areas, bio-retention basins and swales have been appropriately/ conservatively sized and credited (POS credits) to provide flexibility in the adoption of WSUD features at the local structure plan and detailed design stages. This conservative approach is taken primarily to address any planning concerns with the provision of POS.

The project team will further investigate WSUD features including kerb breaks and overland flow adjacent to POS, wetlands, and Sawpit Gully. Where practical, tree pits and media or roadside swales will be incorporated, and other at-source infiltration mechanisms will be considered at further design stages within selected road reserves where there is no crossover frontage for lots. Overland flow with infiltration as close to source as possible could be achieved in some catchments, however, the DWMS does not commit to these design elements as it has not been fully investigated or agreed with the City.

Groundwater Management

Pre-excavation groundwater is at significant depth beneath the site. The finished mine floor level will be at least 2 m above the pre-development MGL. Hence, subsoil drainage is not expected to be required to control groundwater levels.

Regarding groundwater quality management, the first 15 mm of rainfall run-off from connected impervious areas will be treated prior to infiltration in line with best practice.

Irrigation Water

A non-potable water supply will need to be sourced to service the irrigation requirements of future POS within the site. The site has a scarcity in groundwater resources, which is the preferred source for non-potable water supply.

In accordance with the City of Swan's guidelines for water irrigation requirements, the following irrigation benchmarks are to be targeted at the local structure plan stages:

- 60% of public open space areas to be irrigated at an average of 6,750 kL/ha/yr
- 80–90% of the district open space to be irrigated at 10,000 kL/ha/yr
- 20% of school sites to be irrigated at 6,750 kL/ha/yr.

The irrigation rate of 6,750kL/ha/yr has been applied to 60% of the general residential development POS areas including the POS co-located with the school (8.63 ha out of 14.38 ha), and to 20% of the school site itself (0.7 ha out of 3.5 ha). It is anticipated POS areas adjacent to wetlands will not require irrigation. Based on the total estimated area allocated to POS and the school, the estimated irrigation requirement is 62,950 kL/yr. This irrigation volume is a conservative estimate. Further refinement by landscape architects, in consultation with City of Swan, will be undertaken in future design stages, and consideration will be given to the design

criteria developed in the North-west corridor water supply strategy (DoW 2014).

A number of groundwater aquifers are present in the area; however, all aquifers are fully allocated and so any groundwater licences for the site would need to be obtained by transfer/trade with other groundwater users in the same groundwater subarea.

A review of the Water Register (DWER, 2022; accessed on 9 December 2022) indicates there are currently:

- 38 groundwater licences in the North Swan subarea of the Superficial aquifer
- 3 groundwater licences in the North Swan subarea of the Mirrabooka aquifer
- 221 groundwater licences in the Swan Confined subarea of the Leederville aquifer.

The site currently has a licensed groundwater allocation of 26,100 kL/yr for sand extraction purposes (GWL200141). This licence is from the North Swan subarea of the Superficial aquifer owned by Urban Resources Pty Ltd. It can be amended or traded to provide irrigation water for POS, however there will be a shortfall of some 36, 850 kL/yr. The current allocation volume would be sufficient to provide irrigation for the active open space for the proposed urban development. However, xeriscaping and other low water demand landscape treatments would be required for the remaining POS, if the shortfall in non-potable water supply for irrigation is not overcome.

It is recognised that licence trading is the preferred option for irrigation water supply, hence refinement of irrigation volumes is in the project's best interest and will be undertaken so that unnecessary allocation will not be purchased.

6.7.2 Local Water Management Strategy

Local Water Management Strategy ('LWMS') will be prepared in support of the Local Structure Plan and an Urban Water Management Plan ('UWMP') will be prepared as required by the standard condition of subdivision approval. The design objectives outlined in the DWMS form the basis for design criteria to be developed and reported in the LWMS. The design criteria of the LWMS are implemented through the final design concept presented in the UWMP.

Further investigations will be required at the local planning (LWMS) and subdivision (UWMP) stages including:

Local Water Management Strategy:

- Confirmation of potable water supply and wastewater servicing infrastructure
- Greater clarity on public open space irrigation requirements and securing a non-potable water supply
- Confirmation of the location of a proposed interchange along the Perth-Darwin National Highway on the site's eastern boundary and the impacts on water management on the site
- Confirmation of vegetation to be retained and wetland buffer requirements
- Refinement of post-development catchments and indicative locations and designs for bio-retention treatment areas (for the small rainfall event) and detention basins
- Confirmation of typical cross-sections and alignment of Sawpit Gully where relevant
- Surveying of waterways (i.e., generating long-section(s)) where relevant
- Confirmation of discharge points and peak allowable outflow rates
- Establish a Controlled Groundwater Level (CGL), if relevant, ensuring groundwater dependent ecosystems are not impacted
- Develop an Earthworks Plan including indicative lot levels
- Identify responsibilities and funding for implementing the approved LWMS
- Pre-development monitoring including two winter peaks, as described in Section 9.1.

Urban Water Management Plan:

- Confirmation of lot levels, drainage inverts, and clearances to flood levels and groundwater

- Development of trigger values for post-development groundwater quality
- Development of a contingency action plan in the event of exceedance of monitoring targets.

6.8 Infrastructure Co-ordination, Servicing and Staging

The following provides a summary of the existing and proposed servicing and infrastructure considerations for the subject site. An Engineering Servicing Report has been prepared by JDSi and is included as **Appendix 7**.

6.8.1 Topography and Earthworks

The finished extraction levels post sand mining will facilitate the future development of Class A lots without the requirement for fill importation or significant earthworks. The proposed earthworks strategy will result in savings of up to $20,000 per lot when compared against similar development sites in the locality that will require significant fill to realise the same site classification and required clearances to groundwater levels.

6.8.2 Drainage

A DWMS has been completed to address stormwater drainage across the site.

It is anticipated that the stormwater management strategy for the site will include the following:

- Maintain pre-development peak flow rates into and out of the site.
- Set habitable floor levels at least 0.3 m above the 1% AEP flood level of the urban drainage system.
- Utilise a pit and pipe network, or roadside swales where possible, to cater for flows up to 20% AEP rainfall events, while greater than 20% AEP flow will be conveyed via overland flow through the road network.
- Retain and infiltrate rainfall on site using basins and/or underground storage.
- The stormwater drainage design demonstrates that the land is capable of managing stormwater for all events up to the 1% AEP event.
- Controls used to improve stormwater quality will be included within roadside swales, open channels, and stormwater retention systems such as planting of specific vegetation and possible utilisation of an amended soil profile to assist in nutrient retention and breakdown.
- The use of native vegetation where practicable, minimal fertiliser application and soil amendment in major drainage areas will assist with the management of groundwater and surface water quality.

As the City of Swan will ultimately own and maintain all stormwater infrastructure the design and construction work will need to be undertaken in accordance with their guidelines and standards, as well as the Local Government Guidelines for Subdivisional Development (IPWEA).

6.8.3 Sewer

The subject land is located within the Water Corporation licensed area for operating sewerage services. The Water Corporation has advised that the site does not currently fall within a Water Corporation Sewer District, and that no wastewater planning has currently been undertaken for the advertised DSP area, as the area was only recently identified for potential urban development as part of the 2018 Sub - Regional Planning Framework.

Due to the zoning of the subject sites, they currently fall between two Water Corporation designated sewerage areas being Bullsbrook and Ellenbrook. Servicing strategies to be investigated will involve the installation of an internal standard gravity reticulation network to Water Corporation requirements to an external discharge point. The external discharge point will be subject to detailed design and Water Corporation's future strategic planning.

Preliminary discussions with Water Corporation have highlighted two possible sewer servicing strategies to service the site. Both strategies involve the installation of an internal standard gravity reticulation network and pumping station to Water Corporation requirements but dif fer in the means of their external discharge to mains sewer.

Strategy 1 would involve construction of a sewer pressure main (1800m) from the internal pumping station to a discharge chamber on Halden Road. Water Corporation have already planned to extend their gravity mains to this location. Due to the additional f lows an upgrade in size of the planned gravity sewer mains will be required.

Strategy 2 would involve the construction of a sewer pressure main (1300m) from the internal pumping station to a proposed discharge chamber at a high point on Maralla Road to the East . This option will require a 1.7km extension of the planned sewer gravity mains down Maralla Road from Sawpit Road.

Preliminary checks of cover and grade requirements under Tonkin Hwy have been positive. Due to the additional flows an upgrade in size of the planned gravity sewer mains from Sawpit Road to the Bullsbrook PS No 1 will be required.

Initial review suggests a Type 90 Pumping Station would be required to service the subject site area. A Type 90 Pumping Station consists of two pump sets located in a circular common wet -wells constructed of reinforced concrete with an internal diameter of 3.0m. This type of pumping station is used for permanent or temporary installations where the proposed ultimate pumping rate is more than 40L/s and does not exceed 90L/s.

6.8.4 Water

The subject land is located within the Water Corporation's licensed area for provision of a potable water supply service. The Water Corporation has advised that no water planning has currently been undertaken for the advertised DSP area, as the area was only recently identif ied for potential urban development as part of the 2018 Sub-Regional Planning Framework.

The North-East Sub-Regional Planning Framework (March 2018) outlines some planned improvements to the existing water supply system including the provision of new water tanks north-west of Ellenbrook (Gaskell Road, Lexia). The Ellenbrook reservoir will be the primary water storage facility to support future urban and industrial development in the northern parts of the sub -region.

Bullsbrook is also noted as requiring several new water tank sites, development of which will need to be staged over time to serve the proposed expansion of the townsite. The proposed route of the transfer main between the Gaskell Road and Bullsbrook Tanks is to be along the development's southern boundary within Maralla Road. This main should be of sufficient size to cater for the proposed development, however the possibility of this main being part of the future water planning solutions for the North Ellenbrook DSP's will be confirmed through discussions with the Water Corporation. Servicing of the individual lots would be via the installation of a series of reticulation mains as per Water Corporation standards.

There is also a significant existing water supply infrastructure system that services the Ellenbrook townsite. This includes a Water Corporation overhead tank that is located 2.7 km west of Ellenbrook and 3.8 km south of the proposed structure plan area. There are diameter 1200 mm and 900 mm trunk mains that cross the Perth to Darwin Highway that feed smaller reticulation mains for distribution. Whilst there is currently no potable water supply servicing the structure plan area (or agreement between the Water Corporation as service provider and the proponents with regard to development and financing of these essential services), it is anticipated that reticulation extensions will come from this supply with alignment in future road reserves heading north to the structure plan area.

Capital funding for the new reservoir outlet and associated distribution mains is currently not on the Water Corporations capital investment program. In liaison with the Water Corporation, the proponents will need to further investigate the infrastructure alignment and resolve funding of any water headworks to enable development of the land prior to the 'lifting of Urban Deferment' process.

As Lot 5892 is located directly between the current approved DSP for North Ellenbrook West and existing Water Corporation infrastructure, Lot 5892 can readily be incorporated into the North

Ellenbrook DSP west water planning investigation being undertaken by Water Corporation.

It is also to be noted that Water Corporation has only recently completed the installation of a DN400S /DN250 PVC distribution main from the existing Ellenbrook reservoir tank to the State's Centre for National Resilience. This new distribution main extends as a DN400 Steel pipeline to a location 700m immediately west of Lot 5892. The distribution main changes to a DN250 PVC main for the rest of the alignment along Warbrook Road to the currently closed Centre for National Resilience. The possibility of utilising this pipeline as a source for potable water for the Lot 5892 should be investigated.

6.8.5 Power

The North-East Sub-Regional Planning Framework (March 2018) outlines some planned improvements to the power reticulation network to cater for the planned urban development in the area. These works would see a new transmission line from the Muchea Zone Substation to a new Bullsbrook Substation with the proposed cable alignment along the eastern boundary of the subject land.

The anticipated power demands of the site are outlined in the Engineering Servicing Report prepared by JDSi (**Appendix 7)**.

Western Power's Network Capacity Mapping Tool (NCMT) forecasts the remaining capacity as for 2020 at the Muchea Substation to be 25-30MVA. However, access to the available capacity will be dependent on the installation of the planned 132kV transmission line and substation.

In the immediate term, there is an existing 22kV distribution overhead network approximately 700m north of the proposed development on Halden Road which may be suitable for connection of the development site's initial stages.

6.8.6 Gas

ATCO Gas own and maintain the existing underground gas network in the vicinity of the Development. Although no gas networks exist in the direct proximity of the subject sites it is expected that domestic reticulated gas will be progressively supplied as development progresses in the area.

Reticulated gas is not considered to be an essential service and as such is not required as a condition of subdivision. However, it is usual practice to install a gas reticulation network for a residential subdivision within a common civil services trench. If there is an extension required to connect to the nearest main or to bore under major roads the Developer will be required to pay for this as a headworks cost. All new gas installations will be designed by ATCO Gas and installed as part of the civil works.

6.8.7 Telecommunications

Whilst the site is not currently within NBN's rollout footprint, there are numerous development areas in proximity to the subject sites that will trigger expansion of the network without any significant backhaul costs applicable to this development. Similar to the other services reported in this assessment, it is anticipated that an interim servicing option can be achieved if required to service the initial stages of the development.

General communication services for the development will consist of the installation of a standard pit and pipe network in accordance with NBN Co guidelines and standards. The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

To progress the design and installation of a new communications network a New Development Application will need to be submitted to NBN and this agreement would confirm any Developer requirements. Developers will be required to cover the costs of trenching and ducting for the infrastructure, however NBN Co will cover the other costs of installing fibre infrastructure, including backhaul (subject to a feasibility assessment by NBN).

6.8.8 Staging and Implementation

Development will occur over multiple stages as sand mining progresses and as demand for residential land within the north-east corridor evolves. Lot 5892 is expected to be initially rezoned to 'Urban Deferred' under the MRS.

Development staging will likely commence in the eastern portion of the site, with primary access provided via the Tonkin Highway interchange, the road network within the DSP area to the north and Halden Road. Importantly, final development staging within Lot 5892 will respond to the progression of sand mining across Lot 5892, infrastructure planning, landowner intentions and the need to provide orderly sequencing of development for bushfire risk mitigation. The availability of services and residential land demand will also help inform the lifting of urban deferment.

6.9 Developer Contribution Arrangements

All commentary and information regarding future development contribution plan(s) and funding arrangement for the Tonkin Highway interchange that is included in the DSP is noted and acknowledged. It is agreed and noted that once included into the DSP, Lot 5892 will then also be included in any future development contribution plan(s) as required and other cost sharing arrangements for the interchange.

6.10 Other Requirements

There are several changes to the existing planning framework that need to be implemented prior to the Amendment 1 area being subdivided and developed. The implementation framework requires modifications to the MRS and LPS 17, as well as preparation of a local structure plan, prior to subdivision approval being sought.

6.10.1 Metropolitan Region Scheme Amendment

For Amendment 1 to be realised, the MRS will need to be amended. Lot 5892 is currently zoned 'Rural' under the MRS, and it will need to be rezoned to 'Urban' prior to progressing local structure planning, subdivision, and development.

Like the current DSP area, it is expected that Lot 5892 will be amended to 'Urban Deferred' initially given the likely timing for development and completion of infrastructure planning. The matters outlined in the approved DSP that require resolution prior to the lifting of 'urban deferment' are noted and acknowledged. In addition, it is noted that sequential land use planning in relation to the current sand mining operations will also need to be progressed prior to the lifting of urban deferment.

6.10.2 Local Planning Framework

Amendment

As part of the lifting of the Urban Deferred zone, the WAPC may concurrently rezone land under LPS 17, to a development zone pursuant to Section 126(3) of the *Planning and Development Act 2005*, to facilitate the preparation of a local structure plan. It is expected that this will be the preferred mechanism for amending LPS 17.

Local Structure Plan

Amendment 1 to the DSP identifies Lot 5892 in Local Structure Plan Area 5. A local structure plan is required to be prepared as outlined in the DSP. Once a Local Structure Plan has been approved by the WAPC, subdivision and development may proceed.

Local Structure Plan Area 5 – Maralla Road

Precinct Description

Local Structure Plan Area 5 – 'Maralla Road' incorporates approximately 158 hectares, being almost the entirety of Lot 5892 Halden Road. The LSP 5 area is located immediately located predominantly south of the LSP 4 area. Refer **Figure 18 - LSP Area 5.**

Character Statement

The Maralla Road LSP is to be characterised by the sites natural environmental wetland feature surrounded by a future local centre and primary school and a range of medium density residential development.

The LSP is to focus on creating a connection with the destination spaces to the north including the activity centre and employment lands. The LSP will also be based on creating strong visual and physical connections to bushland to the west and south as a key character of future residential space.

Local Structure Plan Requirements

Key matters to be considered in preparation of the Local Structure Plan are:

- Review the role and design function of Halden and Maralla Roads and the new east-west Neighbourhood Connectors;
- Confirm the location and specific requirements for the Primary School site with Department of Education;
- Review the design interface and functionality of the conservation category wetland open space having regard to its heritage, drainage, vegetation retention and open space integration functions;
- Review the role, demand, and land use mix to facilitate detailed planning of a potential Local Centre within the LSP area of approximately 1,200m2 nett lettable area;
- Review the interface to State Forrest, Parks and Recreation Reserve and Bush Forever areas to the west and south of the LSP area in regard to land use, connectivity to existing access and the need for bushfire safety mitigation;
- Undertake a more detailed review of the Conservation Category Wetland to determine the need for and extent of wetland and open space retention requirements;
- Review status of any existing basic raw materials / extractive industry operations at Lot 2382 (within the LSP 4 area) and Lot 5892 (within the LSP 5 area) in regard to the following in the context of urban development staging:
  - Operation staging and life expectancy;
  - Access; and
  - Land use separation requirements.
- Confirm the need for local development and community infrastructure coordination that would require funding through a Development Contribution Plan.

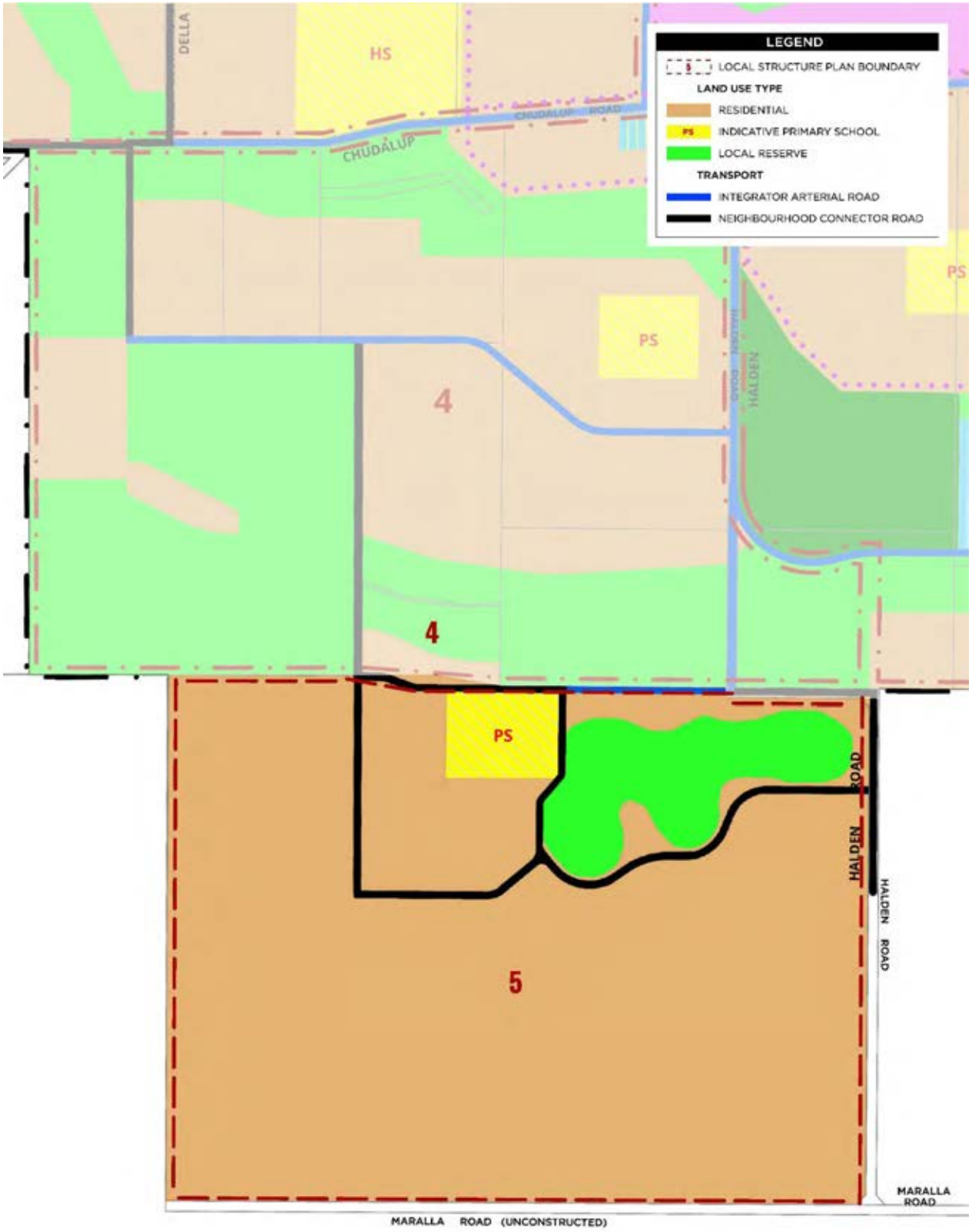


Figure 18 – LSP Area 5

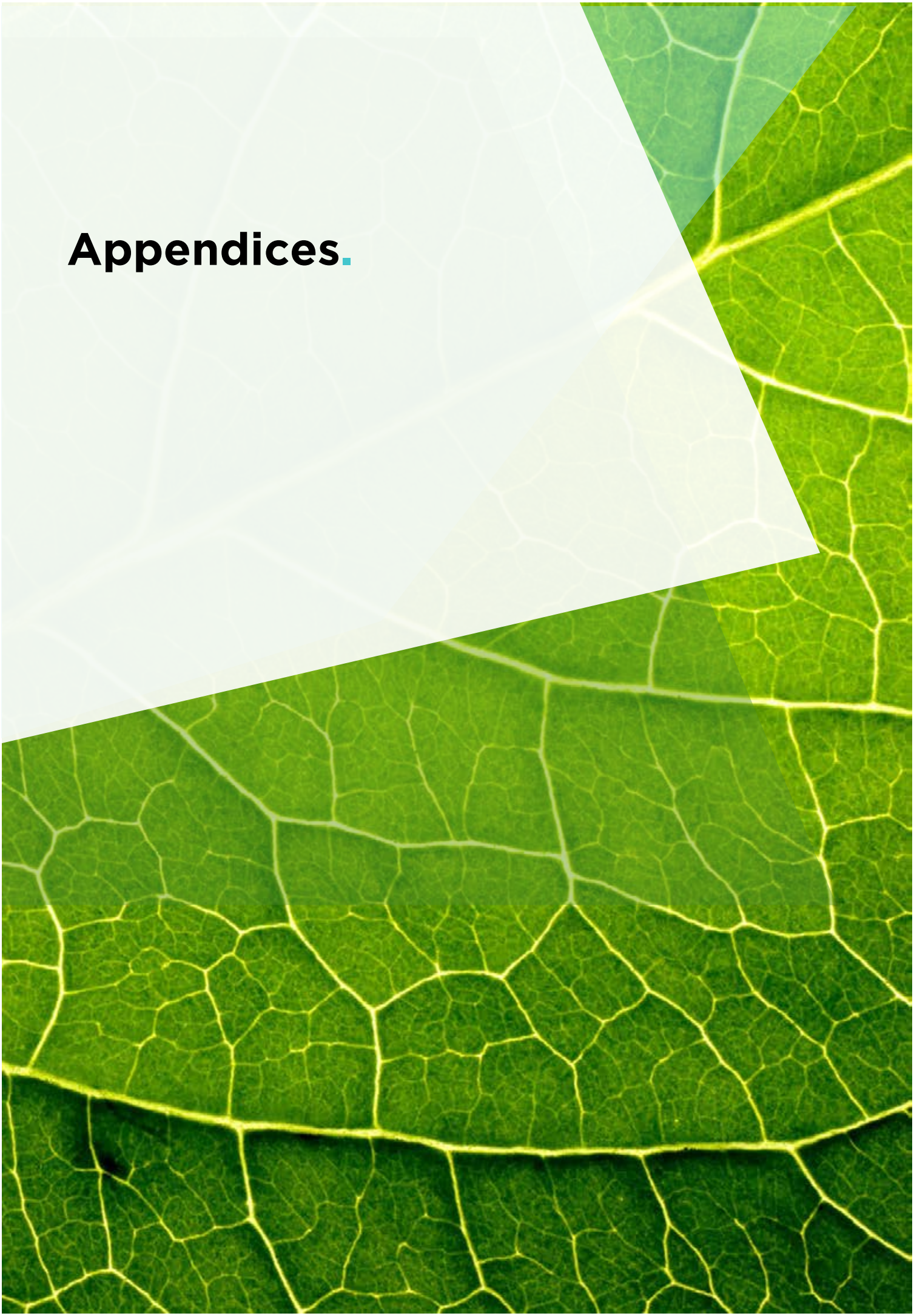
7. CONCLUSION AND SUMMARY

In conclusion, we respectfully request that the Western Australian Planning Commission favourably consider proposed Amendment 1 to the DSP. The planning and technical reporting prepared as part of Amendment 1 demonstrated that Lot 5892 is a logical and necessary extension of the approved DSP.

As land that will be predominantly cleared as a result of sand mining, it presents as a logical and sequential extension of the DSP area that does not necessitate large areas of additional vegetation clearing. There are no environmental, servicing, or other technical issues thar are not able to be addressed and managed appropriately through due process and high-quality urban design.

The inclusion of Lot 5892 into the DSP will make a necessary contribution to meeting population forecasts that are necessary to support community infrastructure and nearby employment centres at Bullsbrook and Muchea, with the key objective being to create employment self-sufficiency in the area.

Appendices.



Appendix 1
Environmental Assessment Report

NORTH ELLENBROOK (WEST) DISTRICT STRUCTURE PLAN AMENDMENT

Lot 5892 Environmental assessment report

AU213002415.001
Rev 1
21 March 2022

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev 0	Final for issue	JohHal	GilGla	GilGla	16/02/2022
Rev 1	Final for issue	GilGla	GilGla	GilGla	18/03/2022

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G. Glasson 21 March 2022

Prepared by:

RPS

Giles Glasson
Principal Scientist

Level 2, 27-31 Troode Street
West Perth WA 6005

T +61 8 9211 1111
E giles.glasson@rpsgroup.com.au

Prepared for:

Stockland

Tom Barry
Development Manager

Level 12, Durack Centre, 263 Adelaide Terrace,
Perth WA 6000

T +61 8 6141 8263
E tom.barry@stockland.com.au

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Figures
(contained within report text)

(compiled at rear of report)

EXECUTIVE SUMMARY

The North Ellenbrook region has been identified by the Western Australian Planning Commission (WAPC) as a future urban growth area located in Perth's North-East Corridor. In February 2021, Parcel Property prepared and submitted the draft North Ellenbrook (West) District Structure Plan (draft DSP) for 611 hectares (ha) of land in North Ellenbrook. The land subject to the draft DSP is located immediately west of Tonkin Highway (or 'NorthLink') and approximately 6.5 kilometres (km) to the north of the Ellenbrook town centre.

The draft DSP facilitates planning investigations in the North Ellenbrook Urban Investigation Area, as identified in the North-East Sub-regional Planning Framework (Department of Planning, Lands and Heritage (DPLH) 2018), and will guide future land uses, coordination of major infrastructure, activity centres, open space distribution and the protection of environmental assets.

The draft DSP is the result of consultation with local government, community and relevant government agencies and will provide a 20-year plus vision for urban growth, catering for future population of between 12,000 to 13,500 residents and creating up to 1,300 ongoing jobs.

Lot 5892 Maralla Road, Bullsbrook (the site) contains an approved sand mining tenement (M70/326), which comprises approximately 74% of the landholding (Figure A).

The site is located immediately south of and is contiguous with the draft DSP land (Figure B).

The site is zoned 'Rural' under the Metropolitan Region Scheme (MRS; Figure C). Consistent with the MRS zoning, the site under the City of Swan's Local Planning Scheme (LPS) No. 17 is zoned 'General Rural'.

Most of the site will be extensively cleared and recontoured because of the approved and ongoing sand mining activities. A minor northern portion of the site lies outside of the approved sand mining tenement and its existing environmental values will remain in place.

Purpose and scope of this report

The purpose of this Environmental Assessment Report (EAR) is to support the inclusion of the site (as an amendment) into the draft DSP, and ultimately its rezoning to 'Urban' under the MRS and 'Urban Development' under the City of Swan's LPS No. 17.

The scope of this EAR, consistent with the draft DSP Environmental Assessment Report (360 environmental 2021), is to:

- Review the key environmental issues relevant to the site.
- Identify the environmental features of the site through a review of existing information, desktop assessment and the results of the biological surveys.
- Provide the management intent to address the interface with the Department of Biodiversity Conservation and Attractions' (DBCA) managed landholdings.
- Identify potential environmental impacts and recommend mitigation and management measures.

Lot 5892 site context

The 162.88 ha site consists of the following key elements:

1. The 120.71 ha mining tenement area has been subject to mining of high-grade silica sand since 2013. The sand mine is operated by Urban Resources (a basic raw materials mining company), which is the "proponent" responsible for implementing:
    a. The sand mine's environmental approval (Ministerial Statement No. 956)
    b. Planning approvals (Extractive Industry Licence and Development Application)
    c. Mining approvals (Mining Proposal and Mine Closure Plan) – current approved mining footprint is 92 ha
2. Approximately 16.06 ha of wetland core and indicative buffer areas, with 12.78 ha situated within the northern portion of the site and 3.28 ha situated within the sand mining tenement. A minor portion (0.01 ha) of the indicative wetland buffer in the east remains cleared for firebreak / access track use

3. The 41.94 northern portion of the site. Outside the wetland core and indicative buffer areas, the remaining land extent is approximately 29.16 ha and consists of:
    a. 13.04 ha of intact native vegetation
    b. 16.12 ha of land that was historically cleared.

Adjacent land uses

The site is adjacent to the following DBCA managed landholdings to the:

- West – Bush Forever Site No. 399 – Maralla Road Bushland, Ellenbrook Upper Swan (which forms part of the Gnangara-Moore River State Forest) is 4,150.9 ha in area
- South – Bush Forever Site No. 300 – Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia 641.5 ha in area.

Parcel Property's draft DSP land is located directly to the north of the site.

The location of the above adjacent land uses is provided in Figure B.

Key environmental factors and values

This EAR addresses the following key environmental factors and associated values applicable to the site in accordance with the Environmental Protection Authority's (EPA) Statement of Environmental Principles, Factors and Objectives (EPA 2021):

- Flora and vegetation
    - Intact native vegetation representative of the Bassendean Complex-North vegetation complex
    - Vegetation representative of the Banksia woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia woodlands TEC)
    - Potential habitat for *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed *Caladenia huegelii*
- Terrestrial environmental quality
    - Potential occurrence of acid sulfate soils, based on regional risk mapping
    - A low risk of potential contamination because of historical land uses
- Terrestrial fauna
    - Various habitat types for a range of native fauna species
    - Carnaby's black cockatoo foraging habitat
- Inland waters
    - Mapped Core Conservation Wetland (CCW; UFI 8907) and a mapped portion of Resource Enhancement Wetland (REW; UFI 13387)
- Social surroundings
    - Surrounding land uses which may impact upon the amenity of the proposed future urban land uses within the site (i.e. Tonkin Highway (noise)).

Each of the environmental factors have been assessed to identify the potential impact of the proposed DSP concept plan and to determine management measures to minimise these impacts.

Draft District Structure Plan amendment

To guide the future planning of the site, a DSP concept plan has been proposed to address:

- Integration with the draft DSP and the Tonkin Highway regional road interchange

- Key environmental considerations (wetlands, inferred Banksia woodlands TEC, Carnaby's black cockatoo)
- Sequential land uses within the sand mining tenement.

The proposed DSP concept plan is provided in Figure D.

District Structure Plan tailored response

The proposed DSP concept plan provides a range of responses to suitably address the key environmental considerations identified by the WAPC for the North Ellenbrook 'Urban Investigation' area, as outlined in the North-East Sub-regional Planning Framework (DPLH 2018). Overall, the proposed DSP concept plan prioritises the following environmental outcomes:

- Mapped CCW and REW core and indicative buffer areas are proposed to be retained
- Provides a long-term conservation framework to protect mapped wetland areas within district open space
- Addresses the site's strategic location in relation to the existing and planned regional transport infrastructure
- Tonkin Highway / NorthLink WA and significant committed private sector investment at the South-Bullsbrook Industrial Area and Muchea Industrial Park will establish a strong employment corridor that can support and leverage greater numbers of a locally based resident labour force
- Urban development along the Tonkin Highway supports a future rapid transit link from the planned Ellenbrook railway station to Bullsbrook along the Tonkin Highway corridor
- A particular advantage of the site in response to the delivery of affordable housing is that the design levels of the mining operation within the tenement would enable its development without a requirement for importing sand material. Sand fill is typically the highest construction item cost for land development
- Water management objectives including drainage and nutrient management could be appropriately addressed through the land use planning process with the application of Water Sensitive Urban Design principles implemented and assessed through the Better Urban Water Management guidelines (Department for Planning and Infrastructure and WAPC 2008) framework.

Environmental outcomes

The following scopes of work were undertaken to inform the proposed DSP concept plan of the key environmental considerations, existing environmental approval areas and the environmental assessment and reporting requirements:

1. Preliminary flora, vegetation and fauna habitat assessment of the 41.94 ha northern portion of the site (outside of the sand mining tenement) were undertaken by RPS and Terrestrial Ecosystems in 2020
2. Review of state and Commonwealth flora, vegetation and fauna databases
3. Review of the following key environmental reports:
    a. Level 1 fauna assessment Mining Lease 70/326 (Harewood 2007)
    b. Proposed Sand Mine M70/326 Bullsbrook, Flora and Vegetation Survey Assessment (Cardno 2008)
    c. Environmental Management Plan Maralla Road Sand Mine (Cardno 2011a)
    d. North Ellenbrook, Level 2 Flora and Vegetation Survey (360 environmental 2012)
    e. Silica Sand Quarry – s.46 amendments to Ministerial Statement 024 (EPA 2013)
    f. Ministerial Statement No. 956
    g. District Structure North Ellenbrook (Bullsbrook), Environmental Assessment Report (360 environmental 2021).

The proposed DSP concept plan in combination with site assessments, existing local and regional environmental data and associated reports has been interrogated for the purpose of:

1. Defining the site's key environmental considerations
2. Determining the potential impacts from the proposed DSP concept plan
3. Establishing an environmental approvals and management framework.

The proposed DSP concept plan and environmental management framework address:

- After sand mining, sequential land uses within the tenement (which will be extensively cleared and recontoured after sand mining) are proposed to be urban. The sand mining tenement comprises approximately 74% of the site and has existing environmental approvals to clear the remnant native vegetation and modify the landforms to mine silica sand to within a minimum two metres clearance above historic groundwater levels. The proposed urban development presents an opportunity to secure a sequential land use at a location that has approved environmental impacts
- Focus for proposed future urban development is also centred upon an approximate 29.16 ha area in the northern portion of the site (outside of the sand mining tenement and the wetland core and indicative buffer areas). It consists of:
  - 13.04 ha of intact native vegetation
  - 16.12 ha of land that was historically cleared
- Includes 15.95 ha of wetland core and indicative buffer areas within district open space, including 3.28 ha of wetland core and indicative buffer area within the sand mining tenement
- Prioritises the retention of up to:
  - 15.94 ha of intact native vegetation / fauna habitat in 'good or better' condition
  - 13.16 ha of inferred Banksia woodlands TEC and high quality Carnaby's black cockatoo foraging habitat.

A summary of the retention of the key environmental values by the proposed DSP concept plan is provided in Table 1.

Table 1: Summary of retention outcomes provided by the proposed DSP concept plan

Environmental values	Indicative area (ha) within proposed DSP concept plan	Indicative area (ha) within proposed district open space
Intact native vegetation in 'good' or better condition	34.85*	15.94
Inferred Banksia woodlands TEC	28.85*	13.16
Carnaby's black cockatoo foraging habitat	34.57*	13.16
Mapped wetland core and indicative buffer areas	16.06	15.95
Total in district open space		**15.95**

*excludes sand mining tenement which has existing environmental approvals

The implementation of the proposed DSP concept plan will result in the following outcomes being realised:

- Retention and long-term management of the key environmental values including:
  - Wetlands
  - Inferred Banksia woodlands TEC
  - Carnaby's black cockatoo foraging habitat.
- Key aspects of the long-term management framework include:
  - Wetland Management Plan
  - Interface Management Plan
  - Construction Environmental Management Plan, including fauna relocation provisions
  - Environmental Offsets Strategy.

Further opportunities to avoid impacts to environmental values will be provided at the Local Structure Plan stage, where the location of additional local public open space areas can further consider opportunities to align with existing environmental values to enable their potential future retention. This may increase the ultimate conservation outcome for a range of environmental values, beyond that shown in the proposed DSP concept plan. Future urban development for the site will accommodate some retention (avoidance) of native vegetation in its design to be considered environmentally acceptable, as well as suitable environmental impact mitigation and offset considerations into any environmental approvals. These considerations do not fundamentally constrain the potential for the site to support future urban land uses and could be addressed through the land use planning and environmental approvals processes.

Planning and environmental approvals framework

To facilitate the implementation of the proposed DSP amendment, an overarching environmental assessment and management framework has been detailed in Figure 1. The environmental assessment and management framework acknowledge the approved sand mining activity within the mining tenement.

Future MRS (and subsequent LPS No. 17) amendments to rezone the site to an 'Urban' land use will automatically trigger a referral to the EPA under Section 48a of the *Environmental Protection Act 1986*.

The proposed clearing of Banksia woodlands TEC and Carnaby's black cockatoo foraging habitat will require specific assessments and then potentially a referral to the Commonwealth Department of Agriculture, Water and the Environment under the EPBC Act. These assessments will be underpinned by comprehensive detailed flora, vegetation, fauna, black cockatoo and hydrological investigations.

The framework aligns the key environmental impact assessments (inclusive of the baseline surveys), reporting and management plans to be implemented at the corresponding statutory planning assessment and EPA assessment stages.

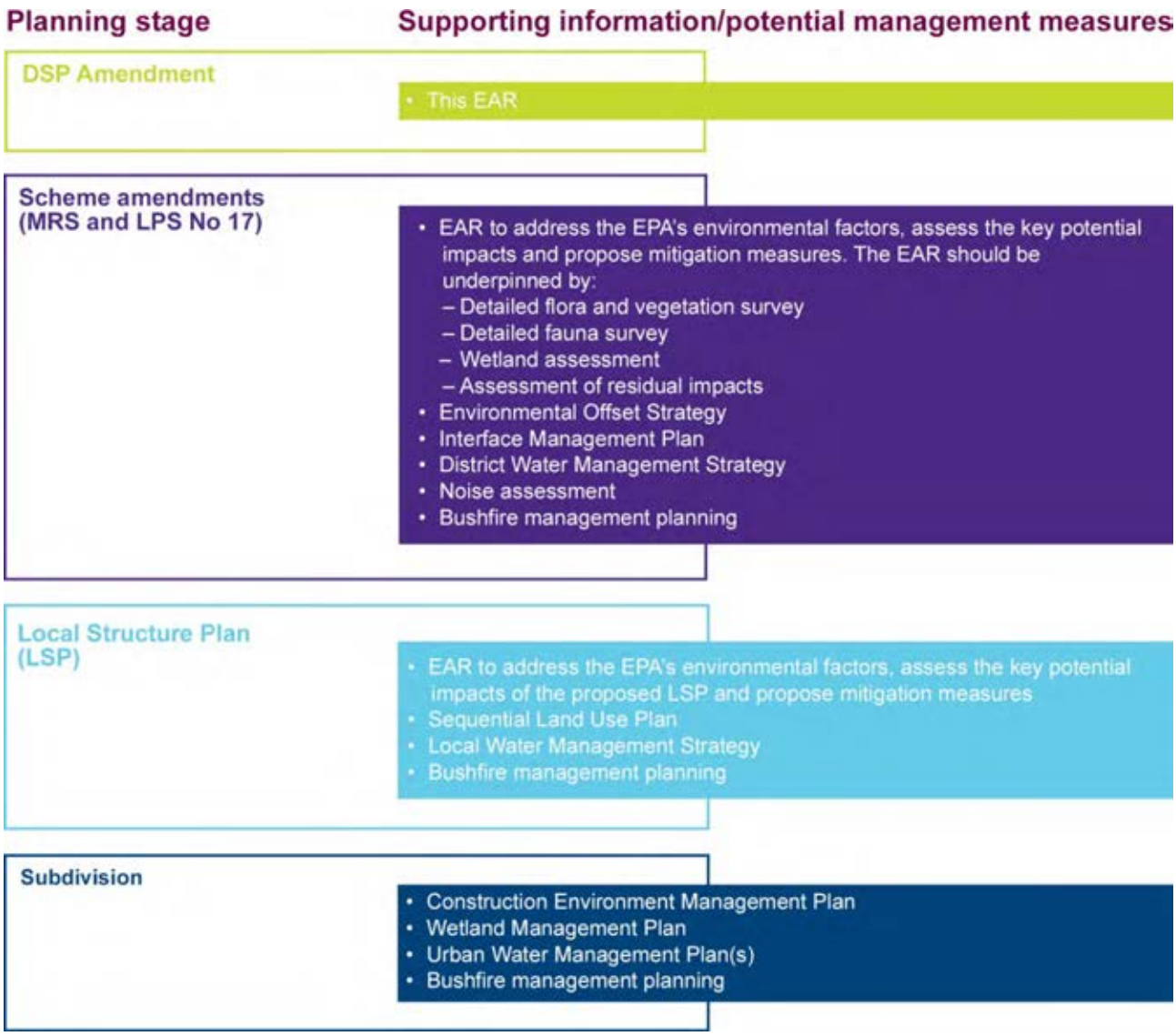

Figure 1: Environmental assessment and management framework to support future urban land uses

1 INTRODUCTION

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3. The 41.94 northern portion of the site. Outside the wetland core and indicative buffer areas, the remaining land extent is approximately 29.16 ha and consists of:
    a. 13.04 ha of intact native vegetation
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The key mining and environmental elements are presented spatially in Figure 2.

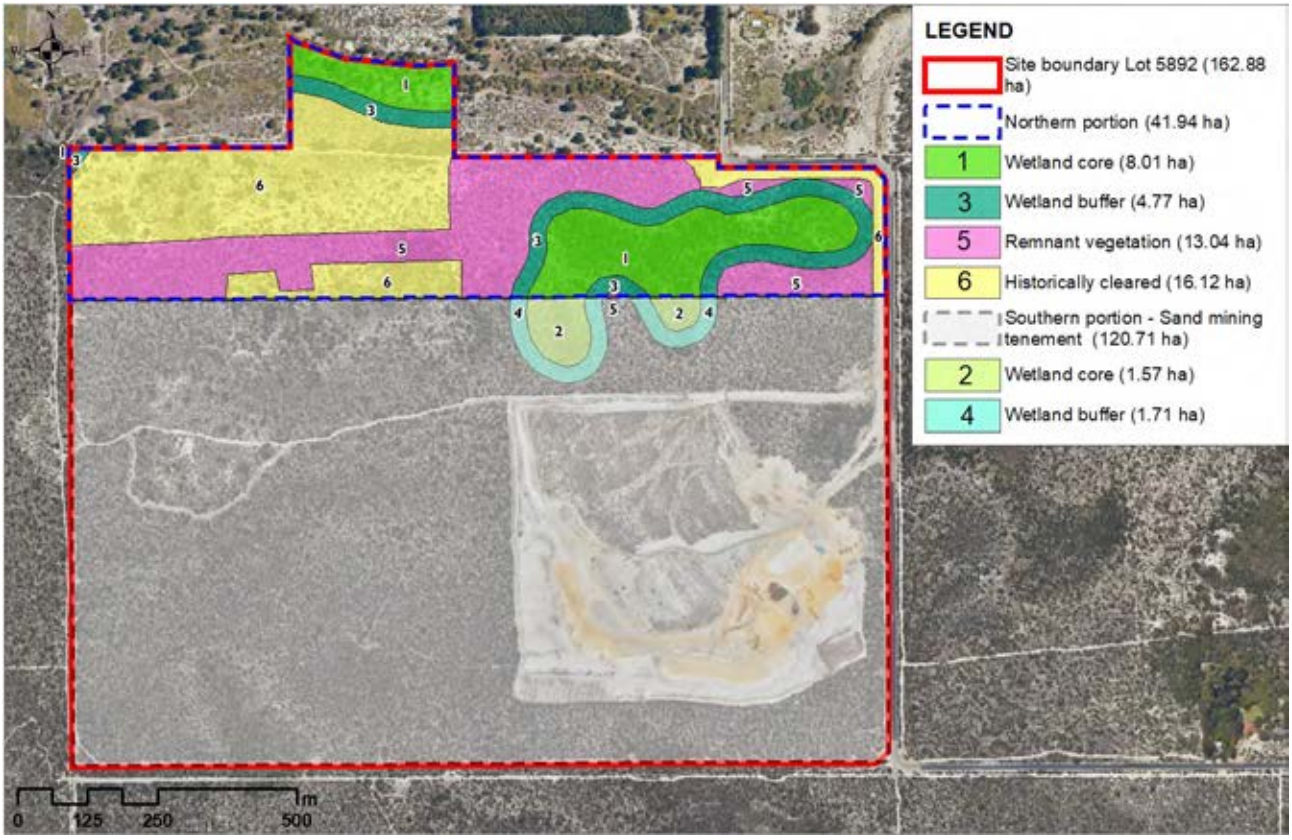

Figure 2: Key mining and environmental elements

A summary of the site's existing approval and land use status is provided in Table 2.

Table 2: Approval and land use status summary

Status	Area (ha)	Description
Lot 5892	162.88	Figure A
Southern portion subject to sand mining tenement (M70/326)		
Sand mining tenement M70/326 boundary / Ministerial Statement No. 956 approval boundary	120.71 (approved mining footprint is 92 ha)	Figure A
Wetland areas		
Wetland areas (1, 2, 3 + 4)	16.06	Figure 2
Wetland core (1 + 2)	9.58 • 8.01 is north of the sand mining tenement (1) • 1.57 is within the sand mining tenement (2)	Figure 2
Indicative wetland buffer (3 + 4)	6.48 • 4.77 is north of the sand mining tenement (3) • 1.71 is within the sand mining tenement (4)	Figure 2
Northern portion outside of sand mining tenement (M70/326)		
Land outside of the wetland core and indicative buffer areas (5 + 6)	Approximately 29.16 and consists of: • 13.04 of intact native vegetation (5) • 16.12 of land that was historically cleared (6)	Figure 2

1.2.1 Adjacent land uses

The site is adjacent to the following DBCA managed landholdings to the:

- West – Bush Forever Site No. 399 – Maralla Road Bushland, Ellenbrook Upper Swan (which forms part of the Gnangara-Moore River State Forest) is 4,150.9 ha in area
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1.3 Key environmental factors and values

This EAR addresses the following key environmental factors and associated values applicable to the site in accordance with the Environmental Protection Authority's (EPA) Statement of Environmental Principles, Factors and Objectives (EPA 2021):

- Flora and vegetation
  - Intact native vegetation representative of the Bassendean Complex-North vegetation complex
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Each of the environmental factors have been assessed to identify the potential impact of the proposed DSP concept plan and to determine management measures to minimise these impacts.

1.4 Draft District Structure Plan amendment

To guide the future planning of the site, a DSP concept plan has been proposed to address:

- Integration with the draft DSP and the Tonkin Highway regional road interchange
- Key environmental considerations (wetlands, inferred Banksia woodlands TEC, Carnaby's black cockatoo)
- Sequential land uses within the sand mining tenement.

The proposed DSP concept plan is provided in Figure D.

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The proposed DSP concept plan provides a range of responses to suitably address the key environmental considerations identified by the WAPC for the North Ellenbrook 'Urban Investigation' area, as outlined in the North-East Sub-regional Planning Framework (DPLH 2018). Overall, the proposed DSP concept plan prioritises the following environmental outcomes:

- Mapped CCW and REW core and indicative buffer areas are proposed to be retained
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- A particular advantage of the site in response to the delivery of affordable housing is that the design levels of the mining operation within the tenement would enable its development without a requirement for importing sand material. Sand fill is typically the highest construction item cost for land development
- Water management objectives including drainage and nutrient management could be appropriately addressed through the land use planning process with the application of Water Sensitive Urban Design principles implemented and assessed through the Better Urban Water Management guidelines (Department for Planning and Infrastructure and WAPC 2008) framework.

2 KEY ENVIRONMENTAL LEGISLATION AND POLICIES

2.1 State legislation

2.1.1 *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment.

The EP Act is administered by the EPA and the Minister for the Environment.

2.1.2 Other relevant legislation and regulations

The proposed DSP amendment will be required to comply with the requirements of other relevant of pieces of state legislation and regulations. Table 3 provides a summary of the key state legislation and regulations relevant to future development of the site for urban land uses.

Table 3: Key state legislation and regulations

State legislation and regulations	
Aboriginal Heritage Act 1972	*Contaminated Sites Act 2003*
Aboriginal Heritage Regulations 1974	*Environmental Protection Act 1986*
Biodiversity Conservation Act 2016	Environmental Protection (Clearing of Native Vegetation) Regulations 2004
Biodiversity Conservation Regulations 2018	*Land Administration Act 1997*
Bush Fires Act 1954	*Planning and Development Act 2005*
Conservation and Land Management Act 1984	*Mining Act 1978*
Conservation and Land Management Regulations 2002	*Rights in Water and Irrigation Act 1914*

2.1.3 Relevant guidelines and standards

Future development of the site for urban land uses will be subject to compliance with applicable guidance developed by the EPA to assist proponents and the public to understand the minimum requirements for the protection of the environment that the EPA expects to be met during the assessment process.

State planning policies (SPPs) are prepared under Part 3 of the *Planning and Development Act 2005* to provide planning policy control and guidance to project proponents. Future urban development within the site will be required to respond to relevant SPPs.

Table 4 details the key EPA standards, guidelines and SPPs relevant to future development of the site for urban land uses.

Table 4: Relevant EPA standards, guidelines, and state planning policies

Documents
EPA factor guidelines
Statement of Environmental Principles, Factors and Objectives (EPA 2021)
Environmental Factor Guideline: Flora and Vegetation (EPA 2016a)
Environmental Factor Guideline: Landforms (EPA 2018a)
Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016b)
Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c)
Environmental Factor Guideline: Inland Waters (EPA 2018b)
Environmental Factor Guideline: Social Surroundings (EPA 2016d)

Documents
EPA technical guidance
Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e)
Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)
EPA procedure, policy and guidance statements
Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2020b)
Environmental Protection (Western Swamp Tortoise Habitat) Policy 2011
Guidance for the Assessment of Environmental Factors: Assessment of Aboriginal Heritage (EPA 2004)
Guidance for the Assessment of Environmental Factors: Protection of the Western Swam Tortoise Habitat, Upper Swan/Bullsbrook (EPA 2006)
State planning policies
SPP 2.2: Gnangara Groundwater Protection (WAPC 2005)
SPP 2.4: Planning for Basic Raw Materials (DPLH and WAPC 2021a)
SPP 2.8: Bushland Policy for the Perth Metropolitan Region (WAPC 2010)
SPP 2.9: Water Resources (WAPC 2006)
SPP 3.7: Planning for Bushfire Risk Management (DPLH and WAPC 2015)
SPP 5.4: Road and Rail Noise (DPLH and WAPC 2019)

2.1.4 State Planning Policy 2.4: Planning for Basic Raw Materials

This policy recognises the need to extract basic raw materials prior to the advancement of urban or industrial developments. The intent of this policy is to facilitate extraction of basic raw materials that are used for such works as construction and road building.

2.2 Commonwealth legislation

2.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act protects Matters of National Environmental Significance (MNES) and is administered by the Commonwealth Minister of the Environment. MNES include:

- Listed threatened species and communities
- Listed migratory species
- Ramsar wetlands of international Importance
- Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Great Barrier Reef Marine Park
- Nuclear actions
- A water resource, in relation to coal seam gas development and large coal mining development.

If an action is likely to have a significant impact on any MNES, a referral to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) is required. The sand mine operation (within mining tenement M70/326) was approved under the EP Act and *Mining Act 1978* in 1988. The state approvals precede the promulgation of the EPBC Act in 1999. Therefore the sand mining tenement is exempt from further assessment and referral (based on the potential impacts to MNES) under the EPBC Act.

2.2.1.1 Matters of National Environmental Significance

The key potential MNES applicable to the site are:

- Banksia woodlands TEC
- Carnaby's black cockatoo
- Potential *Caladenia huegelii* habitat.

The impacts from the proposed future urban development on MNES is centred upon the following historical approvals and environmental attributes:

1. Current approved sand mining operations are progressively removing the native vegetation within the tenement (approximately 74% of the site) and simultaneously modifying the existing landform.
2. The proposed development area:
    a. Within the sand mining tenement is approximately 117.43 ha (noting the mining tenement area will be cleared because of the approved sand extraction operations)
    b. Outside the sand mining tenement is approximately 29.16 ha. This area includes approximately 13.04 ha of intact native vegetation, which represents inferred Banksia woodlands TEC and Carnaby's black cockatoo foraging habitat.

3 ENVIRONMENTAL FACTORS

3.1 Landforms

3.1.1 EPA objective

To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected (EPA 2021).

3.1.2 Relevant guidance

- Environmental Factor Guideline: Landforms (EPA 2018a)
- SPP 2.4: Planning for Basic Raw Materials (DPLH and WAPC 2021a).

3.1.3 Information sources reviewed

- Mining Proposal (Cardno 2009)
- Maralla Road Sand Mine Closure Plan (EnviroWorks Consulting 2014)
- Department of Mines, Industry Regulation and Safety (DMIRS) Basic Raw Materials mapping.

3.1.4 Description of the relevant environmental values

3.1.4.1 Landform and topography

The site is underlain by the Bassendean dune landform, which is low in relief with minor variations in topography, translating to variable depth to the water table. Bassendean dunes generally consist of low hills of siliceous sand interspersed with poorly drained areas including both seasonal and permanent swamps (Salama et al. 2005). Bassendean dunes are well represented across the Swan Coastal Plain and are not considered to be a significant landform (EPA 2018a).

The natural topography of the site is undulating and ranges from approximately 50 metres Australian Height Datum (m AHD) to 76 m AHD (Figure F). Sand mining within the tenement will progressively continue to alter the natural surface level.

The portion of the site subject to the sand mining tenement is mapped both as a ‘Significant Geological Supplies’ and ‘Extraction Sites’ by DMIRS. The northern portion of the site (outside of the sand mining tenement) is not subject to basic raw materials mapping (DMIRS 2022).

At the completion of sand mining within the tenement, the portion of the site subject to mining will be recontoured in accordance with the Mine Closure Plan (EnviroWorks Consulting 2014) to facilitate the agreed end land use.

3.1.5 Landform outcomes

Approximately 74% of the site is subject to an existing sand mine environmental and planning approvals. The operational sand mine will amend to current landform. At completion of sand mining within the tenement, the landform will be recontoured in accordance with the Mine Closure Plan (EnviroWorks Consulting 2014) to facilitate long-term end land use(s), this includes the potential for urban development.

Land disturbed by sand mining operations shall be rehabilitated to an acceptable environmental standard that ensures the maintenance of existing water quality and is compatible with the surrounding area and the intended final land use, e.g. future urban development. The planned final contours have been developed with future urban land use in mind and will unlikely require additional development works to accommodate the proposed future urban development.

3.2 Terrestrial environmental quality

3.2.1 EPA objective

To maintain the quality of land and soils so that environmental values are protected (EPA 2021).

3.2.2 Relevant guidance

- *Contaminated Sites Act 2003*
- Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016b)
- Assessment and Management of Contaminated Sites (Department of Environment Regulation (DER) 2014)
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER 2015b).

3.2.3 Information sources reviewed

- DMIRS regional geology mapping
- DWER's Acid Sulfate Soil (ASS) risk mapping
- DWER's Contaminated Sites Database.

3.2.4 Description of the relevant environmental values

3.2.4.1 Geology

Most of the site is mapped as sand; very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin. The northern portion of the site is mapped as sand over pebbly silt; sand as S8 overlying Mgs1 gravelly silt. Geology associated with the mapped CCW comprises peaty clay; dark grey and black with variable sand content, of lacustrine origin (Figure F).

3.2.4.2 Acid sulfate soils

ASS are naturally occurring soils containing iron sulfide minerals formed under saturated anoxic conditions. In an undisturbed state below the water table, these soils are benign and non-acidic. However, if the soils are exposed to the atmosphere through activities such as drainage, excavation or dewatering, the sulfides may react with oxygen to form sulfuric acid.

A review of DWER's ASS mapping indicates that the risk of ASS is 'moderate to low risk of ASS occurring within 3 metres of the natural soil surface' across most of the site, with a 'high to moderate risk' of ASS occurring within the mapped CCW (Figure G).

3.2.4.3 Contaminated sites

A search of DWER's Contaminated Sites Database undertaken in February 2022 did not identify any mapped contaminated sites within or proximate to the site.

The active use of the site is within the sand mining tenement (used for sand extraction activities) and is unlikely to be a source of any contamination to either soils or groundwater. On completion of sand extraction activities, any infrastructure on the site will be removed in accordance with the Mine Closure Plan (EnviroWorks Consulting 2014).

3.3 Inland waters

3.3.1 EPA objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA 2021).

3.3.2 Relevant guidance

- *Rights in Water and Irrigation Act 1914*
- Environmental Factor Guideline: Inland Waters (EPA 2018b)
- SPP 2.2: Gnangara Groundwater Protection (WAPC 2005)
- SPP 2.9: Water Resources (WAPC 2006)
- Operational policy 4.3: Identifying and establishing waterways foreshore areas (Department of Water (DoW) 2012.

3.3.3 Information sources reviewed

- DBCA's Geomorphic wetlands of the Swan Coastal Plain dataset
- DWER's Perth Groundwater Map
- DWER's Water Register.

3.3.4 Description of the relevant environmental values

3.3.4.1 Surface water

3.3.4.1.1 Wetlands

A search of the DBCA's Geomorphic Wetlands of the Swan Coastal Plain dataset identified two mapped wetlands within the site (Figure H). Table 5 provides a high-level description of the mapped wetlands.

Table 5: Geomorphic wetlands of the Swan Coastal Plain within the site

UFI	Classification	Wetland type	Description
8907	CCW	Dampland	• Located in the north-east corner of the site. • Cardno (2008) and the high-level vegetation assessment undertaken by RPS confirmed that this mapped wetland comprises Banksia woodland vegetation. • A 12.78 ha portion the wetland core and indicative buffer areas is within the northern portion of the site and 3.28 ha is within the sand mining tenement.
13387	REW	Floodplain	• Located in the north of the site. • Associated with the Sawpit Gully streamline, which runs along the site's northern boundary. • High-level vegetation assessment undertaken by RPS confirmed that this mapped wetland is comprised of *Melaleuca preissiana* low woodlands and *Xanthorrhoea preissii* shrubland.

3.3.4.1.2 Mapped CCW (UFI 8907)

A series of historical investigations have been completed for the mapped CCW (UFI 8907), and are summarised as follows:

- Preliminary vegetation and hydrology investigations completed by RPS BBG (2005) determined that that there were no hydric soils associated with the wetland and concluded that 'the area is not a wetland or dampland and should not be mapped as such'.
- The flora and vegetation survey completed by Cardno (2008) identified Banksia woodland vegetation as aligning with the mapped extent of CCW (UFI 8907). Cardno (2008) did not identify any obligate wetland species within Banksia woodland vegetation and based on these results, concluded that 'the mapping of UFI 8907 is most likely erroneous'.

Buffers are designed to protect wetlands from being impacted by development. The distance of a buffer will generally depend on the management category, and the land uses proposed around the wetland. Historically, a generic minimum 50 m buffer between development and CCWs and a 30 m buffer to REWs has been applied. No buffers to Multiple use wetlands apply, and they can generally be developed.

More recently the DBCA and EPA have been recommending that a minimum 50 m buffer is applicable for all CCWs and REWs. This general recommendation does not allow for development proposals to be assessed on-site specific environmental values.

A 30-metre indicative buffer between development and the mapped CCW (UFI 8907) has been adopted for the DSP amendment (Figure H). A 30-metre indicative buffer is considered appropriate given the above findings of RPS BBG (2005) and Cardno (2008) relative to the CCW mapping.

3.3.4.1.3 Sawpit Gully

Sawpit Gully, a tributary of Ellen Brook, runs along the northern boundary of the site within the mapped extent of REW (UFI 13387) (Figure H). The adoption of a 30-metre indicative buffer for REW (UFI 13387) is consistent with:

- DWER's Operational policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012), which identifies 30 metres as the minimum acceptable foreshore buffer width
- Draft DSP.

3.3.4.2 Groundwater

3.3.4.2.1 Depth and flow direction

The groundwater contours across the site are shown in Figure I.

The groundwater levels range from approximately 47 m AHD to 53 m AHD with the groundwater flowing in an easterly direction. The northern and eastern site areas have the lowest clearance to groundwater, i.e. less than two metres below ground level (mbgl), associated with wetland areas. The southern area of the site has higher clearance to groundwater (up to 30 metres depth) associated with elevated sand dunes.

The finished mine floor level will be at least two metres above the maximum groundwater level, hence subsoil drainage and fill importation are not expected to be required to control groundwater levels.

3.3.4.2.2 Quality

No groundwater quality monitoring has been undertaken at the site. However, some groundwater quality information has been obtained from DWER bores in the vicinity, of which 11 have been infrequently monitored (two to six samples per bore) between 1985 to 2000. Groundwater quality results have been compared to ANZECC and ARMCANZ (2000) freshwater guideline.

The DWER results indicate groundwater in the site vicinity is acidic (average pH 5.4) and fresh (total dissolved solids of 130 mg/L, albeit at one location only). Several bores recorded soluble ammonium (NH_4-N) above the stressor freshwater guideline (0.04 mg/L) with a mean of 0.14 mg/L. Only one bore was measured for filterable reactive phosphorus concentrations which recorded below the freshwater guideline.

3.3.4.2.3 Groundwater availability

The Water Register (DWER 2022) identifies that the unconfined superficial, semi-confined Mirrabooka and confined Leederville aquifers that underlie the site are fully allocated.

Urban Resources has an approved DWER groundwater abstraction licence for the sand mining tenement with an approved allocation of 26,100 kL from the Superficial aquifer.

Allocation from the existing approved DWER groundwater licence, or other proximate licence holders, could be transferred, or secured, to support site development and future public open space watering requirements.

3.3.4.2.4 Groundwater impacts to western swamp tortoise habitats

The nearest western swamp tortoise habitat is the Twin Swamps Nature Reserve located approximately 3 km north-east of the site. Based on the groundwater flow direction (easterly), groundwater from the site is unlikely to impact the habitat. The Ellen Brook Nature Reserve is about 5 km south-east of the site and is not hydro-geologically connected to Lot 5892.

3.3.4.2.5 Public drinking water source areas

A portion of the site intersects the eastern edge of the Priority 3 of Gnangara Underground Water Pollution Control Area. There is a Priority 1 Public Drinking Water Source Areas (PDWSA) located immediately to the eastern border of the site. SPP 2.2: Gnangara Groundwater Protection (WAPC 2005) identifies that urban land uses are acceptable within Priority 3 PDWSAs. The nearest public abstraction bore is approximately 2.4 km to the west.

3.3.5 Key site investigation and management actions

The sand mining operations within tenement M70/326 are being implemented in accordance with the following approvals:

- Mining Proposal (Cardno 2009)
- Mine Closure Plan (EnviroWorks 2014)
- Water Quality Protection Guideline for the Siting and Installation of Above Ground Bulk Fuel and Chemical Storage Facilities
- Retention of stormwater within the sand mining tenement
- Groundwater monitoring.

The proposed future urban development will implement the following management actions:

- A contemporary wetland assessment will be undertaken at scheme amendment stage to confirm the on-site specific environmental values of CCW (UFI 8907) and underpin buffer requirements.
- Prepare and implement Wetland Management Plan – with the objective of this management plan would focus is on the ecological values (e.g. flora, vegetation, wetland, fauna) maintained within the mapped wetland areas / district open space.
- Prepare and implement a Construction Environment Management Plan – the objective of this management plan is to manage construction activities to avoid accidental clearing or disturbance, introduction, fauna relocation and distribution of weeds and *Phytophthora* dieback during the construction work phase, noting this would be applied to the areas outside of the approved 120.71 ha mine tenement M70/326.

The proposed future urban development will comply with the Better Urban Water Management (DPI and WAPC 2008) framework through the preparation of the following strategies and plan to demonstrate best practice management of surface water (including wetlands) and groundwater:

- District Water Management Strategy (DWMS) will be prepared to support the MRS Amendment
- Local Water Management Strategy (LWMS) will be prepared at LSP stage
- Urban Water Management Plan (UWMP) will be prepared at subdivision stage.

3.4 Flora and vegetation

3.4.1 EPA objective

To protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA 2021).

3.4.2 Relevant guidance

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- Environmental Factor Guideline: Flora and Vegetation (EPA 2016a)
- Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e)
- SPP 2.8: Bushland Policy for the Perth Metropolitan Region (WAPC 2010).

3.4.3 Information sources reviewed

- Proposed Sand Mine M70/326 Bullsbrook, Flora and Vegetation Survey Assessment (Cardno 2008)
- North Ellenbrook, Level 2 Flora and Vegetation Survey (360 environmental 2012)
- A vegetation assessment of the northern portion of the site (outside of the sand mining tenement) undertaken was by RPS botanist Caroline Gill on 4 September 2020
- Targeted spring search of the northern portion of the site (outside of the sand mining tenement) was undertaken by RPS for the EPBC Act-listed *Caladenia huegelii* on 14 September 2020
- DPLH's Bush Forever site mapping.

The 2008 flora and vegetation survey (Cardno 2008) assessed most of the 162.88 ha site, except for a small northern portion (approximately 4.87 ha) adjacent to the Sawpit Gully watercourse.

A vegetation assessment was undertaken by RPS in spring 2020 to map the vegetation units and condition of the northern portion of the site outside of M70/326, including the small northern portion not surveyed by Cardno (2008). Further, RPS in September 2020, undertook a targeted flora search specifically for the EPBC Act-listed *Caladenia huegelii*.

Figure 3 presents the survey areas within the site subject to Cardno (2008) and RPS flora and vegetation surveys.

Figure 3: Flora and vegetation surveys

3.4.4 Description of the relevant environmental values

3.4.4.1 Regional vegetation mapping

A large part of the Swan Coastal Plain has been mapped for vegetation complexes by Heddle et al. (1980). Regional vegetation complex mapping across the 162.88 ha site indicates that vegetation comprises Bassendean complex – North and Bassendean complex – North Transition complexes (Heddle et al. 1980; Figure J).

A description and the remnant extent and reservation status of these vegetation complexes on the Swan Coastal Plain south of Moore River is provided in Table 6.

Table 6: Regional vegetation complexes

Regional vegetation complex	Description	Swan Coastal Plain IBRA Region		
		Pre-European extent (ha)	Current extent (ha)	% remaining
Bassendean complex – north	Vegetation ranging from a low open forest and low open woodland of Banksia species and *Eucalyptus todtiana* to low woodland of *Melaleuca* species and sedgelands which occupy the moister sites.	74,131	53,218	71.8
Bassendean complex – north transition	A transition complex of low open forest and low woodland of Banksia species and *Eucalyptus todtiana* on a series of high sand dunes. The understorey species reflect similarities with both the Bassendean-North and Karrakatta-North vegetation complexes.	17,644	16,069	91.1

(Source: EPA 2015)

The following objectives for regional vegetation complexes are outlined in Perth and Peel @ 3.5 million, Environmental impacts, risks and remedies (EPA 2015):

- Retain at least 10% of the original extent of vegetation complexes within ‘constrained areas' (i.e. intensely developed areas in the Perth Metropolitan Region).
- Retain at least 30% of the original extent of vegetation complexes within ‘unconstrained areas’ (i.e. Darling Plateau and rural zoned lands in the Peel region).

3.4.4.2 Bush Forever sites

The following two Bush Forever sites are located proximate to the site (Figure B):

- To the west, Bush Forever Site No. 399 – Maralla Road Bushland, Ellenbrook Upper Swan (which forms part of the Gnangara-Moore River State Forest) is 4,150.9 ha in area
- To the south, Bush Forever Site No. 300 – Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia 641.5 ha in area.

Figures B and D show that Bush Forever Site No. 300 is separated from the site by the unconstructed Maralla Road reserve to the south.

3.4.4.3 Site flora and vegetation values

The flora and vegetation values identified by Cardno (2008) within the sand mining tenement are anticipated to be permanently lost through clearing to facilitate sand mining processes, except for the mapped CCW core and indicative buffer area.

3.4.4.3.1 Vegetation units

Cardno (2008) identified the following vegetation units within the site:

- Woodland of *Banksia attenuata* and *B. menziesii* over *Eremaea pauciflora* var. *pauciflora* and *Scholtzia involucrate* over *Lyginia barbata*, *Hibbertia subvaginata* and *Hibbertia hypericoides* on grey/white sands of slopes and ridges
- Woodland of *Banksia attenuata* and *B. menziesii* with *B. illicifolia* over *Xanthorrhoea brunonis* over *Dasypogon bromeliifolius* and *Patersonia occidentalis* on grey / white sands of flats and lower slopes
- Low shrubland of *Xanthorrhoea brunonis* and *Eremaea pauciflora* var. *pauciflora* with emergent *Banksia littoralis, B. attenuata* and *B. menziesii* on grey sands of broad flats.

The Cardno (2008) vegetation unit mapping is presented in Figure 3.

The RPS 2020 vegetation review of the northern portion of the site (outside of the sand mining tenement) identified the following vegetation units:

1. *Melaleuca preissiana* low woodlands
2. *Xanthorrhoea preissii* shrubland
3. Banksia woodland (Figure K).

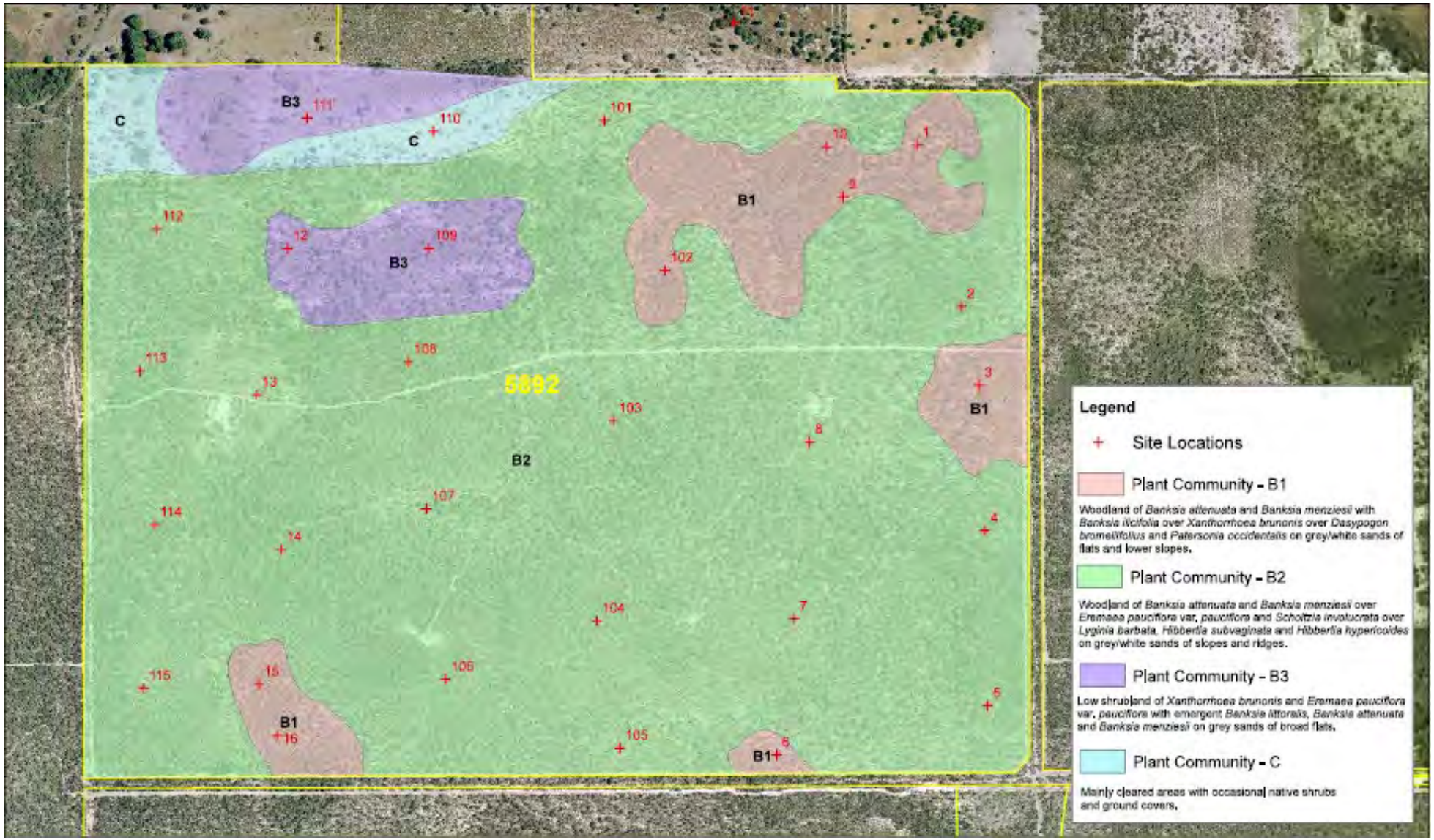

Figure 4: Vegetation unit mapping

3.4.4.3.2 Vegetation condition

Most of the site was mapped by Cardno (2008) as “Excellent” with little disturbance and a minimal presence of weeds. The only areas of major disturbance within the site were fire breaks and some access tracks. A corridor along the northern boundary was identified by Cardno (2008) to have been previously cleared and largely devoid of native species.

The *Xanthorrhoea* shrubland (B3 in Figure 3) varied between “Excellent” to “Degraded” condition (Figure 4).

The Banksia woodland vegetation (B1 and B2 in Figure 3) was generally in “Excellent” condition (Figure 4). There were dead (standing and fallen) mature Banksia trees. This may be due to the presence of *Phytophthora* dieback, which has been mapped for areas of Banksia woodland proximate to the site.

The Cardno (2008) vegetation condition mapping is presented in Figure 4.

The 2020 vegetation review of the northern portion of the site (outside of the sand mining tenement) identified most of the northern area was in “Very Good” condition, with only minor areas associated with historical clearing assessed as being in “Good to Degraded” condition by RPS (Figure L).

Figure 5: Vegetation condition mapping

3.4.4.3.3 Ecological communities

Cardno in 2008 and 360 Environmental (2012) identified the presence of Banksia woodland communities.

In 2016, the Commonwealth Minister for the Environment, formally recognised as a MNES the Banksia woodlands TEC. The RPS 2020 vegetation assessment confirmed the presence of Banksia woodland vegetation consistent with the EPBC Act Banksia woodlands MNES listing.

It is estimated there is approximately 28.85 ha of inferred Banksia woodland communities across the northern portion of the site (outside of the sand mining tenement). Approximately 13.16 ha of inferred Banksia woodlands TEC will be retained within district open space.

3.4.4.3.4 Threatened and Priority flora

Cardno (2008) identified no Threatened flora species within the site, however the presence of one Priority flora species, *Stachystemon axillaris*, was reported. *Stachystemon axillaris* is not currently listed under either the *Biodiversity Conservation Act 2016* (BC Act) or by the DBCA as a species of conservation significance.

The EPBC Act-listed *Caladenia huegelii* has been recorded proximate to the site. Due to the cryptic nature of orchid species (i.e. not flowering every year), a targeted spring search of the northern portion of the site outside of sand mining tenement was undertaken by RPS for specifically the EPBC Act-listed *Caladenia huegelii* on 14 September 2020. No *Caladenia huegelii* plants or any other orchid species of conservation significance were identified.

3.4.5 Flora and vegetation outcomes

The Minister for the Environment's statutory environmental approval for the silica sand mine (Ministerial Statement No. 956) allows for the clearing of native vegetation, associated fauna habitats and the modification of the landforms within the sand mining tenement. The Commonwealth DAWE has acknowledged the sand mining operation has "prior authorisation" under the EPBC Act and is therefore exempt from further assessment and approval(s) to potential impacts to MNES under the EPBC Act.

The sand mining and proposed future urban development areas will avoid the native vegetation and fauna habitats within the 15.95 ha of wetland core and buffer areas. Assuming most of the sand mining tenement (except for the 3.28 ha of CCW core and indicative buffer area) is cleared and mined in accordance with the existing environmental approval (Ministerial Statement No. 956) the focus for proposed future urban development is also centred upon an estimated 29.16 ha area in the north. The proposed DSP concept plan allows for the retention of up to 15.94 ha of intact native vegetation in 'good or better' condition, including 13.16 ha of inferred Banksia woodlands TEC.

Further opportunities to avoid impacts to environmental values will be provided at the Local Structure Plan (LSP) stage, where the location of additional local public open space areas can further consider opportunities to align with existing environmental values to enable their potential future retention. This may increase the ultimate conservation outcome for a range of environmental values, beyond that shown in the proposed DSP concept plan.

3.4.6 Key site investigation and management actions

The following additional flora and vegetation investigations are proposed:

- Detailed targeted flora and vegetation survey to support a future MRS (and LPS No. 17) rezoning; and in accordance with Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e)
- Assessment of the residual impacts to the EPBC listed Banksia woodlands TEC in accordance with the EPBC Referral Guidance Banksia woodlands of the Swan Coastal Plain ecological community (Department of the Environment and Energy (DEE) 2019)
- EPBC Act referral to the Commonwealth DAWE (if required), noting the detailed surveys and impact assessment(s) on the MNES will influence the final urban / LSP design. This includes avoidance (e.g. native vegetation retention within public open space areas) and mitigation measures (e.g. rehabilitation).

The key management framework would include:

- Prepare and implement a Construction Environment Management Plan – this management plan would focus on the management of construction activities to avoid accidental clearing or disturbance, introduction, fauna relocation and distribution of weeds and *Phytophthora* dieback during the construction work phase, noting this would be applied to the areas outside of the approved 120.71 ha mine tenement M70/326. The sand mining operation is subject to an approved Dust Management Plan and an Environmental Management Plan
- Prepare and implement a Wetland Management Plan – with the objective of this management plan would focus is on the ecological values (e.g. flora, vegetation, wetland, fauna) maintained within the mapped wetland areas / district open space
- Development of an Interface Management Plan in liaison with DBCA – the objective of this management plan would be to define the interface treatments (e.g. setbacks, lot product, barrier and fencing types, landscaping, roads) and the management of potential indirect impacts (or edge effects) to native vegetation within the Bush Forever sites from the proposed development areas
- The future urban development would provide hard barriers for example roads adjacent to the Bush Forever sites boundaries

- Establish public walk trails through Bush Forever Site No. 300 subject to agreement and in liaison with DBCA. This was an agreed interface outcome for the LWP Ellenbrook urban development. These trails would potentially link the site to the Ellenbrook urban development
- Develop and implement an Environmental Offsets Strategy in accordance with WA Environmental Offsets Guidelines (EPA 2014); and EPBC Act Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a).

3.5 Terrestrial fauna

3.5.1 EPA objective

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA 2021).

3.5.2 Relevant guidance

- *Environmental Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c)
- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a).

3.5.3 Information sources reviewed

- Level 1 fauna assessment Mining Lease 70/326 (Harewood 2007)
- Site visit undertaken by Terrestrial Ecosystems for the northern portion of the site (outside of the sand mining tenement) on 4 September 2020.

The fauna assessment undertaken by zoologist Greg Harewood in December 2007 covered the sand mining tenement. Terrestrial Ecosystems covered the northern portion of the site outside the tenement (Figure 5).

Figure 6: Fauna assessment boundaries

3.5.4 Description of the relevant environmental values

Bush Forever Site No. 300 has significant fauna value, with fauna records from MRWA's detailed fauna assessment for the Perth-Darwin National Highway (Tonkin Highway) adjacent to Maralla Road identifying it as a significant ecological linkage for southern brown bandicoots, western brush wallaby, western grey kangaroos, bobtail skinks, smaller skinks and emus.

3.5.4.1 Fauna habitats

Harewood (2007) identified the following two fauna habitat types within the site:

- Banksia low woodland over open heath to low open shrubland; most of the site comprises low woodland of *Banksia attenuata* over shrubland / heath of varying density and height. Stunted Eucalypts and other tree species are uncommon. The amount of groundcover, understorey and leaf litter varies considerably across this habitat type, ranging from non-existent to dense. Significant sized fallen logs are absent, as are significant habitat trees.
- Melaleuca low woodland: Low-lying areas located within the study area have a denser vegetation structure consisting of *Melaleuca pressiana* with associated Banksia forming a woodland over an open low heath to low shrubland. The low-lying areas appear to represent damplands that become seasonally waterlogged but not inundated except under extreme wet weather periods (i.e. they do not represent potential habitat for native fish species or the western swamp tortoise).

Consistent with the outcomes of the RPS flora and vegetation assessment, Terrestrial Ecosystems identified that the northern portion of the site (outside of the sand mining tenement) primarily comprised of Banksia woodland community (Figure M).

The Banksia woodland potentially provides habitat for a wide range of fauna including several significant fauna species:

- Jewelled sandplain ctenotus
- Western carpet python
- Black-striped snake
- Southern brown bandicoot
- Carnaby's black cockatoo.

3.5.4.2 Conservation significant fauna

A total of 47 fauna species were observed (either directly or indirectly) during the Harewood (2007) field survey. The conservation significant species identified by Harewood (2007) and 360 Environmental (2014) with potential to occur within the site are identified in Table 7.

Terrestrial Ecosystems identified that the northern portion of the site (outside of the sand mining tenement) comprised foraging habitat for Carnaby's black cockatoos, with evidence of foraging recorded within the Banksia woodland. No trees were identified by Terrestrial Ecosystems that would provide breeding or roosting opportunities for any black cockatoo species.

Table 7: Conservation significant species potentially occurring within the site

Species	Conservation status		Preferred habitats
	EPBC Act	BC Act 2016/ DBCA listing	
Mammals			
Dasyurus geoffroii (chuditch, western quoll)	Vulnerable	Schedule 1	Western quolls are restricted to the south-west of Western Australia and are generally found in most kinds of wooded habitat including eucalypt forest (especially jarrah), dry woodland and mallee shrublands. Western quolls den in hollow logs and burrows and have also been recorded in tree hollows and cavities (DAWE 2022a).
Isoodon fusciventer (quenda, southwestern brown bandicoot)	-	Priority 4	Southern brown bandicoots are broadly distributed near the south-west coast from Guilderton, north of Perth, to east of Esperance with a patchier distribution through the jarrah and karri forests, swan coastal plain and inland regions. Southern brown bandicoots are generally found in scrubby, often swampy, vegetation with dense cover up to 1 m high and on the Swan Coastal Plain are often associated with wetlands (Department of Environment and Conservation (DEC) 2012a).
Notamacropus irma (western brush wallaby)	-	Priority 4	The western brush wallaby's optimum habitat is open forest or woodland, particularly favouring open, seasonally to wet flats with low grasses and open scrubby thickets. Western brush wallabies are also found in some areas of mallee and heathland, however, is uncommon in karri forests (DEC 2012b).
Birds			
Apus pacificus (fork-tailed swift)	Migratory	Schedule 5	The fork-tailed swift is almost exclusively aerial, flying from less than one metre to at least 300 metres above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes are found above foothills or in coastal areas. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh (DAWE 2022b).
Calyptorhynchus banksii subsp. *naso* (forest red-tailed black cockatoo)	Vulnerable	Schedule 1	The forest red-tailed black cockatoo is endemic to south-west Western Australia in an area bounded by Gingin, Mt Helena, Christmas Tree Well, West Dale (rarely to Brookton), North Bannister (rarely to Wandering), Mt Saddleback, Kojonup, Rocky Gully, upper King River and Green Range (east of Albany). Forest red-tailed black cockatoos generally inhabit the dense jarrah (*Eucalyptus marginata*), karri (*E. diversicolor*) and marri (*Corymbia calophylla*) forests receiving more than 600 mm average rainfall annually; although this species has also been observed in a range of other forest and woodland types, including blackbutt (*E. patens*), wandoo (*E. wandoo*), tuart (*E. gomphocephala*), Albany blackbutt (*E. staeri*), yate (*E. cornuta*) and flooded gum (*E. rudis*) (DBCA 2017).
Calyptorhynchus baudinii (Baudin's black cockatoo)	Endangered	Schedule 1	Baudin's black cockatoo is found only in the extreme south-west of Western Australia in an area generally bounded by the 750 mm isohyet, extending from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Baudin's black cockatoo mainly occurs in eucalypt forests, especially jarrah, marri and karri forest, less frequently in woodlands of wandoo, blackbutt (*E. patens*), flooded gum, yate, partly cleared farmlands and urban areas including roadside trees and house gardens (DAWE 2022c).

Species	Conservation status		Preferred habitats
	EPBC Act	BC Act 2016/ DBCA listing	
Calyptorhynchus latirostris (Carnaby's black cockatoo)	Endangered	Schedule 1	Carnaby's black cockatoo is endemic to south-west Western Australia occurring from the Murchison River to Esperance, and inland to Coroow, Kellerberrin and Lake Cronion. Carnaby's black cockatoo foraging habitat includes native shrubland, kwongan heathland and woodland dominated by proteacous plant species including *Banksia* spp. *Hakea* spp. and *Grevillea* spp. Carnaby's black cockatoo is known to forage in pine plantations, eucalypt woodland, forest that contains foraging species and individual trees and small stands of these species (Department of the Environment 2014).
Falco peregrinis (peregrine falcon)	-	Schedule 4	The peregrine falcon is widely distributed throughout Australian habitats inclusive of woodlands, wetlands and open country, although they are generally absent from treeless and waterless deserts and dense forests peregrine falcons prefer cliff faces as nest sites (Birds Australia 2012).
Reptiles			
Neelaps calonotos (black-striped snake, black-striped burrowing snake)	-	P3	Black-striped snakes are generally found on coastal dunes and Banksia woodlands where it shelters in leaf litter under trees and shrubs and abandoned stick-ant nests (Bush et al. 2010)
Ctenotus gemmula (jewelled ctenotus)	-	P3	The jewelled ctenotus inhabits low very low vegetation in Banksia woodlands where it shelters in leaf litter under trees and shrubs and abandoned stick-ant nests (Bush et al. 2010)
Morelia spilota impricata (southern carpet python)	-	P4	Carpet pythons are most often seen at night or at dawn / dusk and are generally found in semi-arid coastal and inland habitats consisting of Banksia woodland, eucalypt woodlands, and grasslands. Carpet pythons are arboreal, terrestrial and rock dwelling and are known to shelter in burrows made by other animals, hollow logs and rock crevices (DEC 2012c).

3.5.4.2.1 Western swamp tortoise

The site is situated to the east of the Twins Swamp and Ellenbrook Nature reserves western swamp tortoise habitat and the Environmental Protection (Western Swamp Tortoise Habitat) Policy 2011 boundary, hence not subject to the environmental protection policy (Figure 6).

Given the relatively large separation distance between the site and the western swamp tortoise habitat, and that the site is hydraulically down-gradient of the western swamp tortoise habitat, it is considered unlikely that the development of the site for urban land uses would result in negative environmental consequences for the western swamp tortoise being realised.

Figure 7: Western swamp tortoise habitat and environmental protection policy boundary

Surface water run-off from the site is retained within local wetlands or drains to Sawpit Gully, either directly or via small tributaries traversing the downstream lots to the east. Sawpit Gully does not traverse the statutory western swamp tortoise area. It discharges to Ellen Brook downstream of the western swamp tortoise area and therefore is not considered to impact on western swamp tortoise habitats.

3.5.4.2.2 Black cockatoos

The site occurs within the modelled distribution of Carnaby's black cockatoo and forest red-tailed black cockatoo (DEE 2017). The Banksia woodland vegetation provides foraging opportunities for Carnaby's black cockatoo; however it is considered unlikely that the site would provide foraging opportunities for the forest red-tailed black cockatoo due to the existing flora and vegetation values. No trees that would provide breeding or roosting opportunities for any black cockatoo species were identified on site by either Harewood (2007) or Terrestrial Ecosystems in 2020.

3.5.5 Terrestrial fauna outcomes

The proposed DSP concept plan allows for the retention of up to 15.94 ha of intact fauna habitat in 'good or better' condition, including 13.16 ha of high quality Carnaby's black cockatoo foraging habitat.

District open space provides a 'stepping stone' function for avian fauna species and local linkage for terrestrial fauna species to the open space areas / MRS Parks and Recreation Reserves in the draft DSP and the adjacent Bush Forever sites.

3.5.6 Key site investigation and management actions

The following additional terrestrial fauna investigations are proposed:

- Detailed fauna survey and targeted black cockatoo assessment undertaken to support a future MRS (and LPS No. 17) rezoning; and in accordance with Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a), EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPaC 2012b) and Revised draft referral guideline for three threatened black cockatoo species (DEE 2017)
- Assessment of the residual impacts to the EPBC listed black cockatoos in accordance with the Commonwealth EPBC Act black cockatoo referral guidelines
- EPBC Act referral to the Commonwealth DAWE (if required), noting the detailed surveys and impact assessment(s) on the MNES will influence the final urban / LSP design. This includes avoidance (e.g. native vegetation retention within public open space areas) and mitigation measures (e.g. rehabilitation)
- The key management framework would include:
  - Prepare and implement Wetland Management Plan – with the objective of this management plan would focus is on the ecological values (e.g. flora, vegetation, wetland, fauna) maintained within the mapped wetland areas / district open space
  - Prepare and implement a Construction Environment Management Plan – the objective of this management plan is to manage construction activities to avoid accidental clearing or disturbance, introduction, fauna relocation and distribution of weeds and *Phytophthora* dieback during the construction work phase, noting this would be applied to the areas outside of the approved 120.71 ha mine tenement M70/326
  - Develop and implement an Environmental Offsets Strategy in accordance with WA Environmental Offsets Guidelines (EPA 2014); and EPBC Act Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a).

3.6 Social surroundings

3.6.1 EPA objective

To protect social surroundings from significant harm (EPA 2021).

3.6.2 Relevant guidance

- *Aboriginal Heritage Act 1972*
- *Fire and Emergency Services Act 1998*
- Environment Protection (Noise) Regulations 1997
- Environmental Factor Guideline: Social Surroundings (EPA 2016d)
- Guidance for the Assessment of Environmental Factors: Assessment of Aboriginal Heritage (EPA 2004)
- SPP 3.7: Planning for Bushfire Risk Management (DPLH and WAPC 2015)
- SPP 5.4: Road and Rail Noise (DPLH and WAPC 2019).

3.6.3 Information sources reviewed

- DPLH's Aboriginal heritage inquiry system
- Heritage Council of Western Australia's inherit database
- City of Swan's Heritage List
- Department of Fire and Emergency Services' (DFES) Map of Bushfire Prone Areas.

3.6.4 Description of the relevant social values

3.6.4.1 Aboriginal heritage and culture

A search of the DPLH's Aboriginal Heritage Inquiry System undertaken in February 2022 identified one registered Aboriginal heritage site (site ID: 3525; site name: Ellen Brook Upper Swan; type: Mythological) is broadly mapped over the eastern half of the site (Figure N) and significant extent of land east of the site.

Registered Aboriginal heritage sites are those that have been deemed to meet the definition of a site as per Section 5 or Section 39 of the *Aboriginal Heritage Act 1972*. Mapping of sites is sometimes broad as it includes a buffer zone around the heritage site or conceals the actual location of the heritage site.

An Aboriginal heritage and culture assessment is likely to be required to establish the actual extent of the broadly mapped registered Ellen Brook Upper Swan heritage site in relation to the site and hence determine any Section 18 notice requirements under the *Aboriginal Heritage Act 1978*.

3.6.4.2 Natural and historical heritage

A search of the Heritage Council of Western Australia's inherit database and the City of Swan's Heritage List identified no listed heritage places within the site.

3.6.4.3 Amenity

3.6.4.3.1 Aircraft noise

The site is located over 6 km to the south-west of RAAF Base Pearce and is outside of the Australia Noise Exposure Forecast contours published by the Department of Defence. However, the site does occur within an area where building heights are restricted to 90 metres in association with air base operations.

3.6.4.3.2 Traffic noise

The site is situated approximately 750 metres to the east of the Tonkin Highway / NorthLink WA. Traffic noise from the highway has the potential to impact potential future land uses within the site. To comply with SPP 5.4: Road and Rail Noise (DPLH and WAPC 2019), a noise assessment will be required to support future urban land uses within the site.

3.6.4.4 Bushfire

A search of DFES' Map of Bushfire Prone Areas identified that the entire site is mapped as a Bushfire Prone Area (Figure O).

The WAPC released SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015) to reduce the risk of bushfire to people, property and infrastructure. SPP 3.7 defines a bushfire-prone area as an area that has been designated by the Fire and Emergency Services Commissioner under Section 18 of the *Fire and Emergency Services Act 1998* (as amended) as an area that is subject, or likely to be subject, to bushfires.

To comply with SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015), bushfire management planning will be required to support future planning and development of the site.

3.6.4.5 Sand mine and sequential land use

The sand extraction is a recognised resource that, within the provisions of SPP 2.4: Planning for Basic Raw Materials (DPLH and WAPC 2021a), should be protected for the staged extraction of sand for the local community.

Basic raw materials include sand, clay, hard rock, limestone, and gravel together with other construction and road building requirements. A ready supply of basic raw materials close to development areas is required to keep down the cost of land development and the price of housing. Planning strategies, schemes and decision making should:

- Identify and protect important basic raw materials and provide for their extraction and use in accordance with SPP 2.4.
- Support sequencing of uses where appropriate to maximise options and resultant benefits to community and the environment.

The extraction of sand is an interim land use. Post sand excavation within the mining tenement, the final land use is proposed to be urban. Subsequently, the sand mine's finished levels will reflect the residential development engineering contours.

EPA guidance "Separation Distances between Industrial and Sensitive Land Uses" (EPA 2005) lists the generic buffers for sand and limestone quarries as 300 metres–500 metres depending on the extent of processing. A generic buffer relates to the distance at which there are unlikely to be any impacts without further investigations. It does not mean that smaller buffers are not acceptable.

In acknowledgement of the approved operational sand mine as an interim land use an updated Staging Plan will be finalised and then implemented. The Staging Plan will incorporate a minimum separation distance from the progressive (and staged) sand extraction areas and the proposed staged residential development areas. The Staging Plan will establish the sand mine staging boundaries to maximise the setbacks to the closest (proposed) residential developments.

The following management response is proposed:

- LSP: Sand mine final contours will comply with the final design contours for the residential development end use. A Sequential Land Use Plan will also be prepared. The purpose of this plan is to facilitate urban development while maintaining a buffer (consistent with the EPA's 2005 Separation Distances between Industrial and Sensitive Land Uses) from the operational excavation areas, noting that sand mining will be undertaken on staged basis across the tenement.
- Subdivision: Sequential Land Use Plan will be implemented which maintains a separation distance to the residential development staged areas.

3.6.5 Key site investigation and management actions

The key potential impacts to future urban development at the site focus upon:

- Amenity (Noise) impact from RAAF Base Pearce (located 6 km to the north from the site) and Tonkin Highway / NorthLink WA (located approximately 750 metres to the east of the site)
- Bushfire risk
- Sequential land use.

3.6.5.1 Reserves and Conservation Areas

The site is adjacent to the following DBCA managed landholdings (Figure B), to the:

- West – Bush Forever Site No. 399 – Maralla Road Bushland, Ellenbrook Upper Swan (which forms part of the Gnangara-Moore River State Forest) is 4,150.9 ha in area
- South – Bush Forever Site No. 300 – Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia 641.5 ha in area.

The Bush Forever sites contain extensive areas of representative Bankia woodland TEC, wetland ecosystems and black cockatoo habitat; and form part of a broad regional linkage for terrestrial fauna species across the North Ellenbrook landscape. Based a desktop review, the vegetation condition ranges from 'degraded' to 'pristine' with current impacts including weeds, feral animals, rubbish, tracks, fire damage and dieback. Uncontrolled access is currently contributing to the degradation of native vegetation within the Bush Forever sites.

Stockland is committed to establishing an agreed interface management plan in collaboration with DBCA between the adjacent Bush Forever sites and the proposed urban development area. The purpose of the interface management plan would be to facilitate development while protecting the adjacent Bush Forever sites against the edge effects from the development and provide for appropriate bushfire hazard management.

3.6.5.2 Amenity (noise)

The following management response is proposed:

- The proposed future urban development will be restricted to 90 metres in height in accordance with RAAF Base Pearce operational requirements.
- To comply with SPP 5.4: Road and Rail Noise (DPLH and WAPC 2019), a noise assessment of the Tonkin Highway / NorthLink WA will be undertaken to support future urban land uses and to identify if any noise management measures e.g. noise walls are required.

3.6.5.3 Bushfire

SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015) and the guidelines are applicable to every stage of the planning process. It is intended that bushfire planning and management measures be addressed as early as possible in the planning process, with the level of information provided being progressively more detailed. Accordingly, the following bushfire assessments and reporting will be adopted

- District Structure Plan / MRS Amendment / Local Planning Scheme Amendment: high level consideration of bushfire risk when identifying land for future investigation and/or potential development. A Bushfire Hazard Level assessment will be undertaken at this stage to inform the suitability of the site for re-zoning and the suitability of proposed future urban land use
- LSP: will be accompanied by a Bushfire Management Plan, which includes a Bushfire Hazard Level assessment or Bushfire Attack Levels (BAL) Contour Map. As the lot layout will be already determined, a BAL Contour Map showing the indicative BAL ratings will be undertaken to provide more detailed information with respect to the extent of the potential impacts on individual lots
- Subdivision: application(s) will be accompanied by a BAL Contour Map that indicates the likely BALs for the proposed lots.

4 IMPLICATIONS FOR FUTURE DEVELOPMENT

4.1 Environmental outcomes

In assessing the potential environmental impacts (from the proposed urban rezoning and separate to the approved sand mining) the following a hierarchical approach to manage the potential impacts was adopted:

- Avoidance: Measures taken to avoid the impact altogether
- Minimisation: Measures taken to reduce duration, intensity or extent of impact
- Management: Measures taken to prevent, mitigate potential impacts or rehabilitate areas
- Offset: Measures taken to compensate for any significant residual impact.

The above framework is then applied again to demonstrate that the impact on a particular environmental factor has been reduced to a level where the proposal is likely to meet the EPA's objective.

The proposed DSP concept plan in acknowledgement of the site's environmental values has actively avoided and / or minimised the impacts outside of the sand mining tenement to the following:

- Wetlands
- Inferred Banksia woodlands TEC
- Carnaby's black cockatoo foraging habitat.

Further opportunities to avoid impacts to environmental values will be provided at the LSP stage, where the location of additional local public open space areas can further consider opportunities to align with existing environmental values to enable their potential future retention. This may increase the ultimate conservation outcome for a range of environmental values, beyond that shown in the proposed DSP concept plan.

Future urban development for the site will accommodate some retention (avoidance) of native vegetation in its design to be considered environmentally acceptable, as well as suitable environmental impact mitigation and offset considerations into any environmental approvals. These considerations do not fundamentally constrain the potential for the site to support future urban land uses and could be addressed through the land use planning and environmental approvals processes.

Specifically, the proposed DSP concept plan and environmental management framework address:

1. Current approved sand mining operations are progressively removing the native vegetation within the tenement (approximately 74% of the site) and simultaneously modifying the existing landform. The sand mining tenement has been subject to an EPA formal environmental impact assessment in 1988 and a Section 46 review of the Ministerial Statement in 2013 to support the implementation of the silica sand mining operation.
2. Minister for the Environment's statutory environmental approval for the silica sand mine (Ministerial Statement No. 956) allows for the clearing of the native vegetation, associated fauna habitats and the modification of the landforms within the sand mining tenement.
3. After sand mining, sequential land uses within the tenement (which will be extensively cleared and recontoured after sand mining) are proposed to be urban. The sand mining tenement comprises approximately 74% of the site and has existing environmental approvals to clear the remnant native vegetation and modify the landforms to mine silica sand to within a minimum 2 metres clearance above historic groundwater levels. The proposed urban development presents an opportunity to secure a sequential land use at a location that has approved environmental impacts.
4. Focus for proposed future urban development is also centred upon an approximate 29.16 ha area in the northern portion of the site (outside of the sand mining tenement and the wetland core and indicative buffer areas). It consists of:
    a. 13.04 ha of intact native vegetation
    b. 16.12 ha of land that was historically cleared.
5. Includes 15.95 ha of wetland core and indicative buffer areas within district open space, including 3.28 ha of wetland core and indicative buffer area within the sand mining tenement.

6. Prioritises the retention of up to:
   - 15.94 ha of intact native vegetation / fauna habitat in 'good or better' condition
   - 13.16 ha of inferred Banksia woodlands TEC and high quality Carnaby's black cockatoo foraging habitat.
7. Mining and planning approvals (Mine Closure Plan (Cardno 2009) and the Rehabilitation and Revegetation Plan (Cardno 2011b)) outlined that from a regional perspective the focus has been on creating an improved land structure that will be suitable for future development. This has included urban, industrial and commercial development or providing area for intensive agricultural purposes. As such, the potential for sequential land use opportunities on impacted land (i.e. former sand mine site) should be considered and if future urban development be confirmed as a suitable end land use for the site.

4.1.1 Proposed regional and local reserves

The current approved sand mining operations are progressively removing the native vegetation within the tenement and simultaneously modifying the existing landform. The proposed development area outside of the sand mining tenement is approximately 29.16 ha. In acknowledgement of the existing sand mining approvals and operations, the proposed DSP concept plan will implement the following environmental guided responses:

1. The DSP amendment provides a district-level framework to achieve conservation outcomes for a range of environmental values, to be implemented through future stages of the urban development process. Spatially, the proposed DSP concept plan avoids potential impacts to significant environmental values and provides a long-term conservation framework to protect mapped wetland areas within district open space.
2. The district open space accommodates the following key environmental values:
   a. 15.95 ha of wetland core and indicative buffer areas
   b. 15.94 ha of intact native vegetation / fauna habitat in 'good or better' condition
   c. 13.16 ha of inferred Banksia woodlands TEC and high quality Carnaby's black cockatoo foraging habitat
   d. Provides a long-term local ecological linkage to the open space areas / MRS Parks and Recreation Reserves in the draft DSP and the adjacent Bush Forever sites.

Further opportunities to avoid impacts to environmental values will be provided at the LSP stage, where the location of additional local public open space areas can further consider opportunities to align with existing environmental values to enable their potential future retention. This may increase the ultimate conservation outcome for a range of environmental values, beyond that shown in the proposed DSP concept plan.

4.1.2 Implement management framework

The following management structure is proposed to the implemented in accordance with the sequential planning framework:

- MRS Scheme Amendment
  - Environmental Offset Strategy
  - Interface Management Plan
  - DWMS
- LSP
  - Sequential Land Use Plan
  - Bushfire Management Plan
  - LWMS
- Subdivision

- Construction Environment Management Plan
- Wetland Management Plan
- UWMP(s).

4.1.3 Environmental offset strategy

A comprehensive baseline assessment including surveys (in accordance with the EPA and Commonwealth DAWE guidelines) on conservation significant flora and vegetation and the EPBC Act MNES including, but not limited to will be undertaken:

- Wetlands
- Inferred Banksia woodlands TEC
- Adjacent conservation reserves (Bush Forever sites)
- Conservation significant flora
- Fauna survey including targeted black cockatoo assessment.

After this assessment, and in the context of the sand mining tenement's pre-existing environmental approvals, a decision on the residual impacts to MNES after avoidance, mitigation and management actions will be undertaken. The proposed development area outside of the sand mining tenement is approximately 29.16 ha. Approximately 16.12 ha of this land has been historically cleared, with 13.04 ha comprised of intact native vegetation.

The proposed DSP concept plan retains the following environmental assets within district open space including:

- Wetlands
- Inferred Banksia woodlands TEC (in 'very good' to 'excellent' condition)
- High quality Carnaby's black cockatoo foraging habitat.

Environmental offsets are actions that provide environmental benefits that counterbalance the significant residual environmental impacts or risks of a project. If it is determined after the impact assessment and in liaison with potentially the Commonwealth DAWE, EPA and DBCA that environmental offsets are required then an Offset Management Strategy will be prepared consistent with the WA Environmental Offsets Policy (Government of Western Australia 2011), the WA Environmental Offsets Guidelines (EPA 2014) and the Commonwealth Environmental Offsets Policy (DSEWPaC 2012a). The offset assessment would include an evaluation using the Commonwealth's Offsets Assessment Guide (the offset calculator).

4.1.4 Conclusion

There are no environmental considerations that would fundamentally constrain the site from supporting future urban land uses, with the proposed DSP amendment / concept plan not considered to be inconsistent with the overarching environmental planning strategies for the Perth region particularly regarding sequential land use. The current expansion of an approved sand mining operation across most of the site presents an opportunity to pursue a sequential land use, whereby land currently approved to be cleared for mining purposes could be subsequently used for future urban development.

The required stages to be advanced to support future urban land uses have been identified in Table 8 with the supporting information / potential management measures to be implemented identified for each stage in the planning framework.

Table 8: Environmental planning framework to support future urban land uses

Planning stage	Description	Supporting information / potential management measures
DSP Amendment	Planning submission to the WAPC requesting inclusion of the site as an 'Urban Investigation' area in the North-East Sub-regional Planning Framework.	This EAR.
Scheme amendments (MRS and LPS No.17)	Proposed MRS and LPS No.17 amendments are referred to the EPA for Assessment under Section 48a of the EP Act.	• Prepare an Environmental Assessment Report (EAR) to address the EPA's environmental factors, assess the key potential impacts and propose mitigation measures. The EAR should be underpinned by: – Detailed flora and vegetation survey undertaken in accordance with Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e) – Assessment of the residual impacts to the EPBC listed Banksia woodlands TEC in accordance with the EPBC Referral Guidance Banksia woodlands of the Swan Coastal Plain ecological community (DEE 2019) – EPBC Act referral to the Commonwealth DAWE (if required), noting the detailed surveys and impact assessment(s) on the MNES will influence the final urban design / LSP design. This includes avoidance (e.g. native vegetation retention within public open space areas) and mitigation measures (e.g. rehabilitation) – Detailed fauna survey and targeted black cockatoo assessment undertaken in accordance with Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a), EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPaC 2012b) and Revised draft referral guideline for three threatened black cockatoo species (DEE 2017) – A contemporary wetland assessment will be undertaken at scheme amendment stage to confirm the on-site specific environmental values of CCW (UFI 8907) and underpin buffer requirements. – Assessment of the residual impacts to the EPBC listed black cockatoos in accordance with the Commonwealth EPBC Act black cockatoo referral guidelines – EPBC Act referral to the Commonwealth DAWE (if required), noting the detailed surveys and impact assessment(s) on the MNES will influence the final urban / LSP design. This includes avoidance (e.g. native vegetation retention within public open space areas) and mitigation measures (e.g. rehabilitation) • Prepare and implement Environmental Offset Strategy in liaison with the Commonwealth DAWE, EPA and DBCA. • Development of an Interface Management Plan in liaison with DBCA – the objective of this management plan would be to define the interface treatments (e.g. setbacks, lot product, barrier and fencing types, landscaping, roads) and the management of potential indirect impacts (or edge effects) to native vegetation within the Bush Forever sites from the proposed development areas • DWMS in accordance with the Better Urban Water Management framework (DPI and WAPC 2008) • Noise assessment to address SPP 5.4: Road and Rail Noise (DPLH and WAPC 2019) • Bushfire management planning to address SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015)
LSP	Proposed LSP will require endorsement from the City of Swan / WAPC	• EAR to address the EPA's environmental factors, assess the key potential impacts of the proposed LSP and propose mitigation measures • Prepare and implement a Sequential Land Use Plan. The purpose of this plan is to facilitate urban development while maintaining a buffer (consistent with the EPA's 2005 Separation Distances between Industrial and Sensitive Land Uses) from the operational sand quarry areas • LWMS in accordance with the Better Urban Water Management framework (DPI and WAPC 2008) • Bushfire management planning to address SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015)
Subdivision	Proposed subdivision will require approval from the City of Swan / WAPC	• Prepare and implement a Construction Environment Management Plan • Prepare and implement Wetland Management Plan • Urban Water Management Plan(s) in accordance with the Better Urban Water Management framework (DPI and WAPC 2008) • Undertake management measures such as weed and/or dieback treatments, fencing or placing nesting boxes in liaison with DBCA within the surrounding Bush Forever sites • Bushfire management planning to address SPP 3.7: Planning in Bushfire Prone Areas (DPLH and WAPC 2015)

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Figures

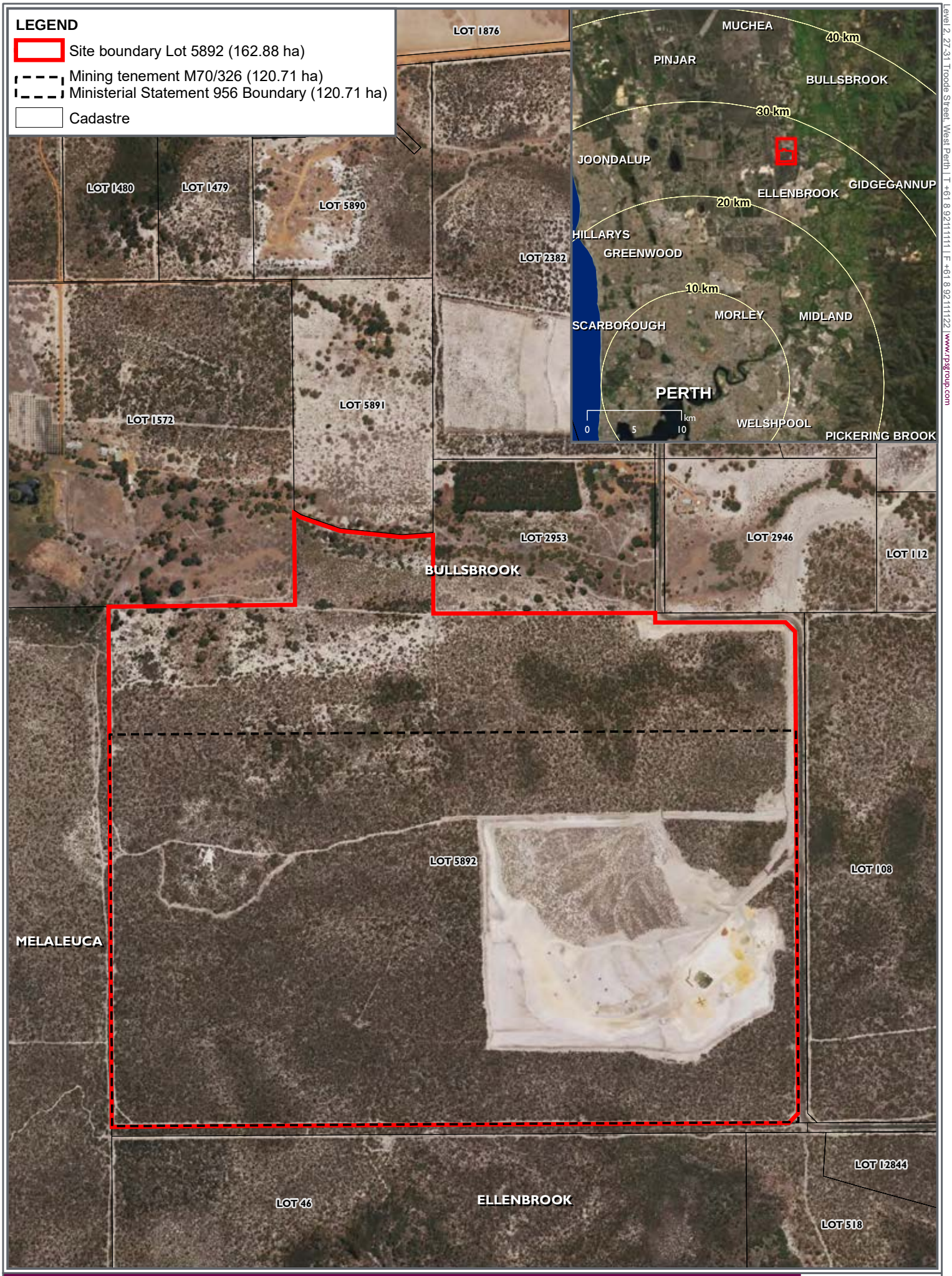

Figure A

Site location

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: L20181-001
Doc Number: 001
Date: 30.09.20
Scale: Map 1:10,000 Overview 1:500,000 @ A4
Created by: MA
Source: Imagery - Landgate

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LEGEND

- Site boundary Lot 5892 (162.88 ha)
- Mining tenement M70/326 (120.71 ha)
- Ministerial Statement 956 Boundary (120.71 ha)
- Bush forever area
- North Ellenbrook (West) DSP

399

13

300

Figure B

Approval boundaries

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 002
Date: 09.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

Document Path: G:\Jobs\E_Jobs\EWP20284 - Water Corp Reuse Sites\Figures EWP20284_001 Q003 Package 1_NW region\L20181-001_G_002_FigB_Approval Boundaries_220209.mxd

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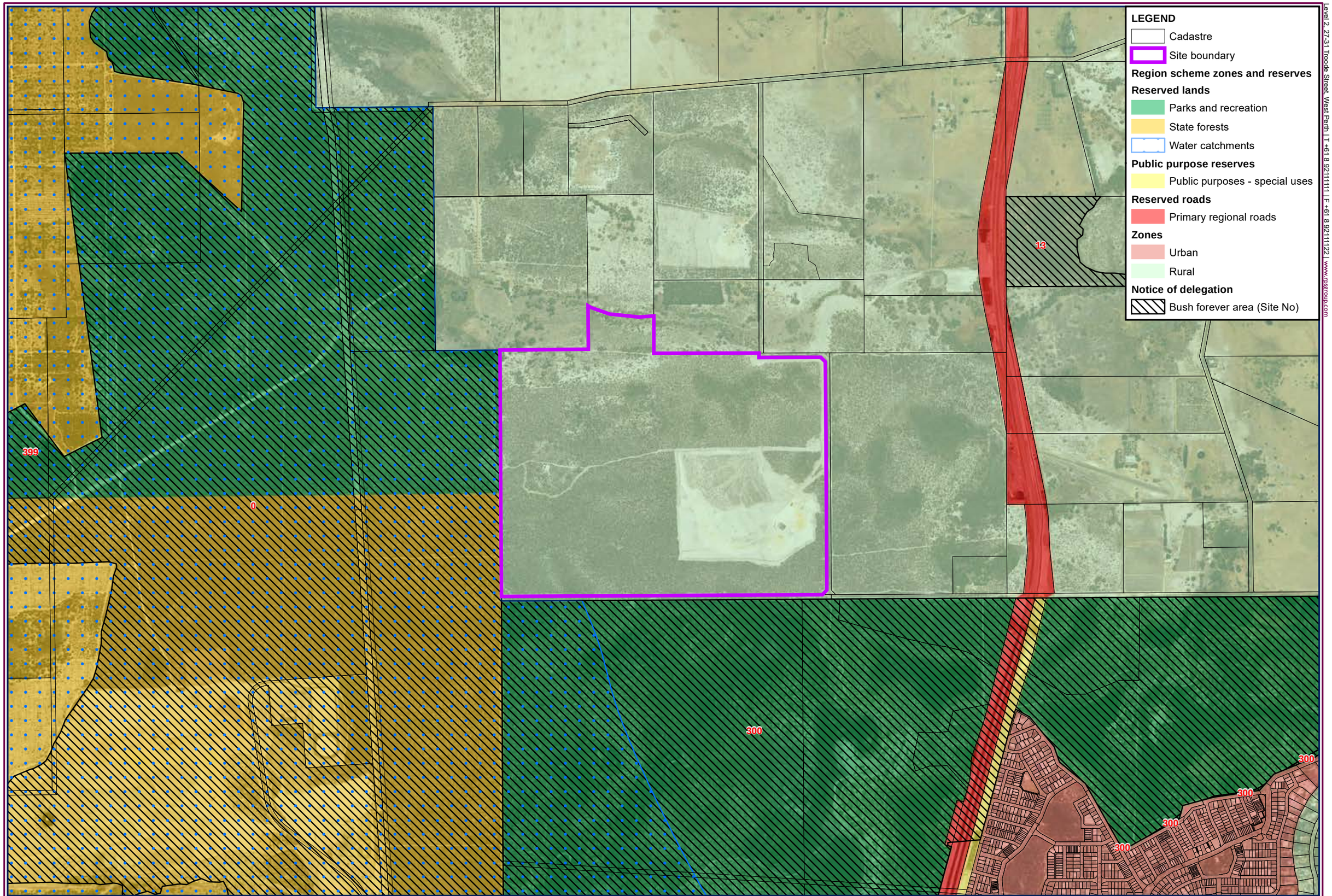

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Figure C

Metropolitan Region Scheme mapping

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: L20181-001
Doc Number: 003
Date: 26.11.20
Scale: 1:15,000 @ A3
Created by: MA

Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2020

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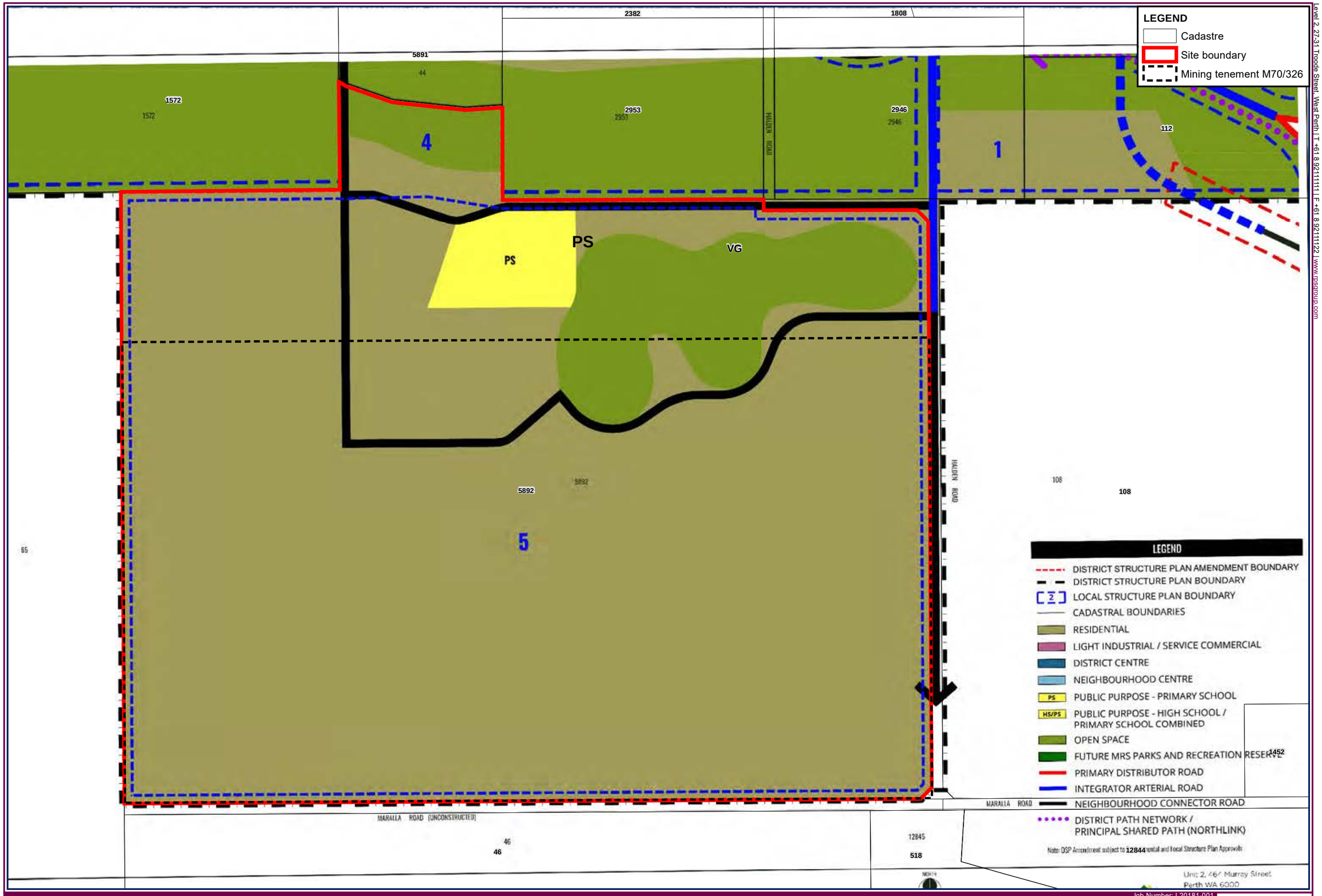

Figure D

Proposed District Structure Plan concept plan

GDA 1994 MGA Zone 50

0 60 120 240 m

Job Number: L20181-001
Doc Number: 009
Date: 14.02.22
Scale: 1:6,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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Unit 2, 467 Murray Street
Perth WA 6000

Document Path: G:\Jobs\L_Jobs\L20181 - Ardent Maralla Rd\Figures L20181-001\Figures AU213002415.001 - Maralla Road\L20181-001_G_009_FigD_Proposed District Structure Plan concept plan_220214.mxd

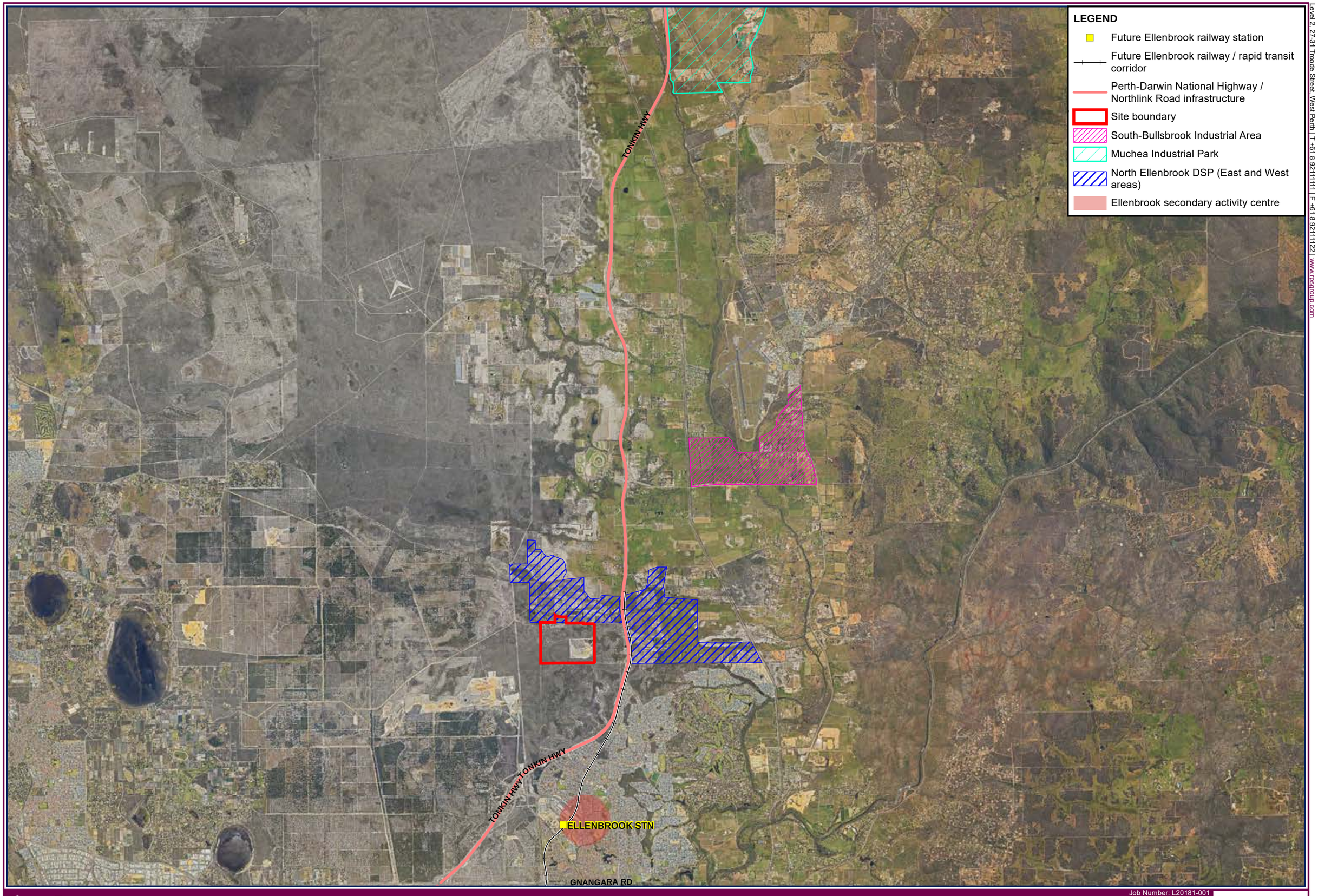

Figure E

Surrounding existing and future land uses

GDA 1994 MGA Zone 50

0 0.75 1.5 3 km

Job Number: L20181-001
Doc Number: 005
Date: 04.02.22
Scale: 1:90,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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LEGEND

Site boundary

Contour (mAHD)

Geology (DMIRS, 50K Mapsheets)

Cps - PEATY CLAY dark grey and black with variable sand content, of lacustrine origin

S10 - SAND over PEBBLY SILT - sand as S8 overlying Mgs1 gravelly silt

S8 - SAND - very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin

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Figure F

Topography and geology

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 010
Date: 14.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

Document Path: G:\Jobs\L_Jobs\L20181 - Ardent Maralla Rd\Figures L20181-001\Figures AU213002415.001 - Maralla Road\L20181-001_G_0010_FigF_Topo and Geology_220214.mxd

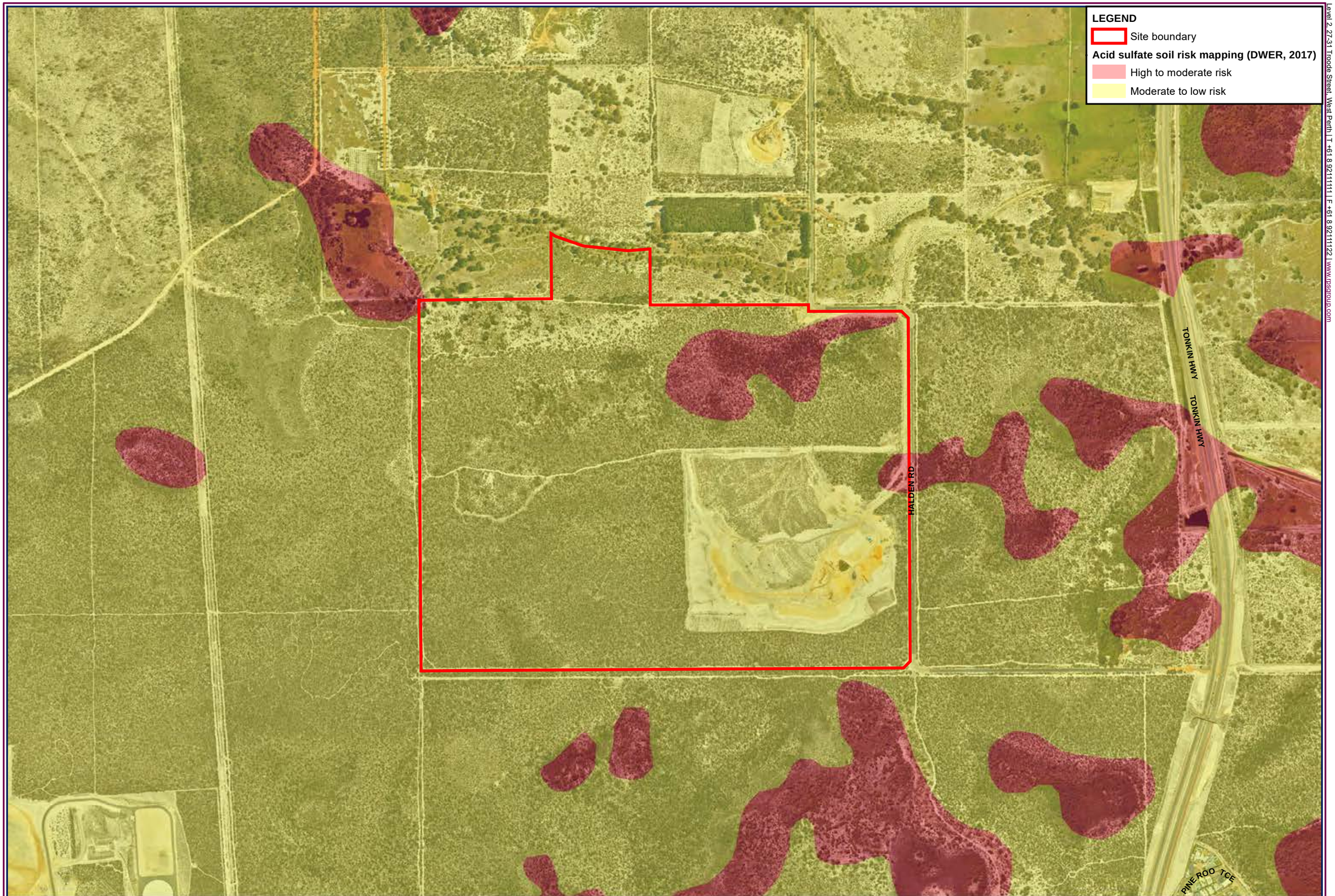

Figure G

Acid sulfate soils risk mapping

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 011
Date: 14.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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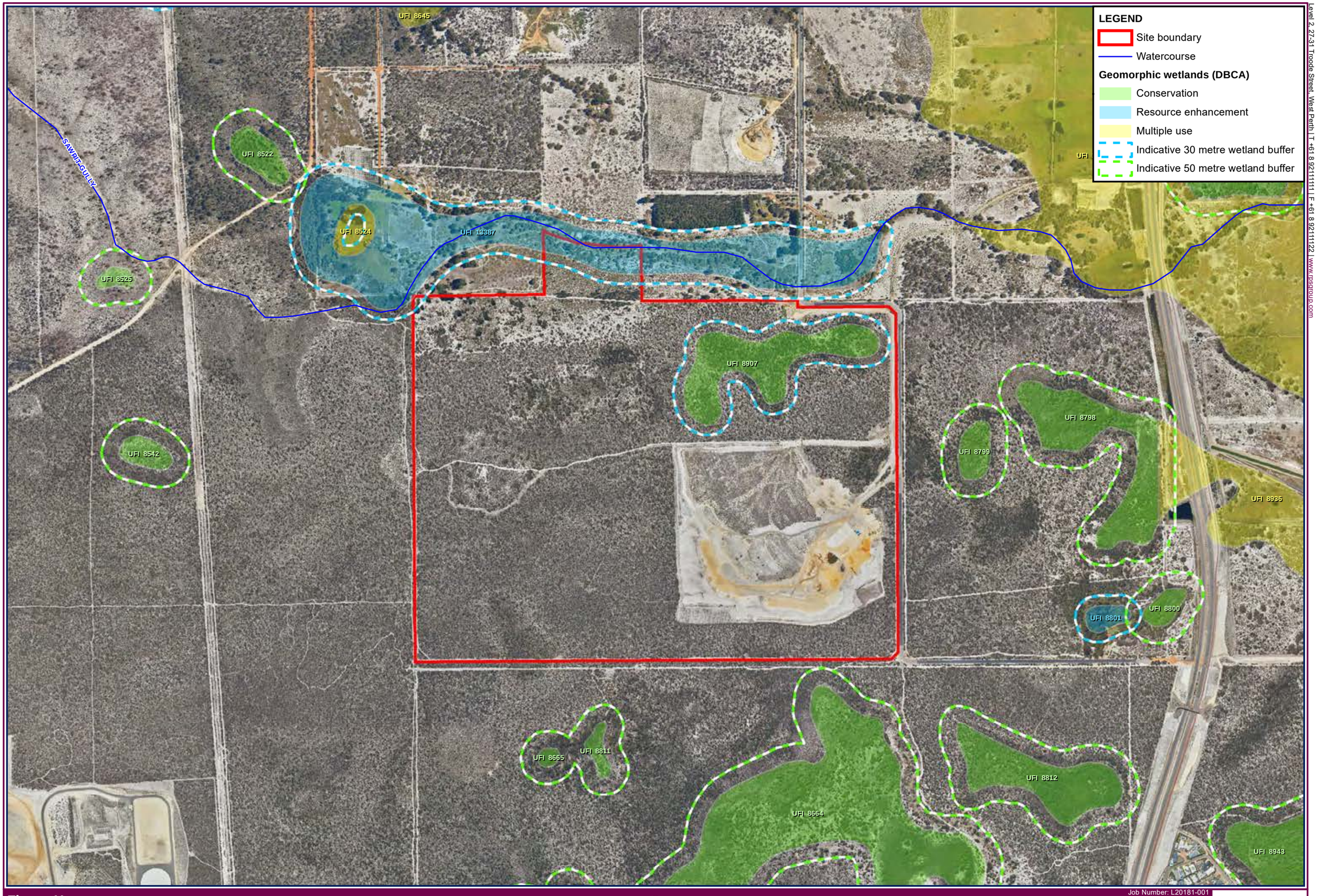

Figure H

Surface water features

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 013
Date: 14.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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LEGEND

Groundwater bore (DWER, 2019)

Historical maximum groundwater contour (mAHD)

Site boundary

Public drinking water source area PDWSA (DWER, 2020)

Priority 1

Priority 3

57 56 55 54 53 52 51 50 49 48 47 46 45

HALDEN RD

TONKIN HWY

TONKIN HWY

PINE ROO TCE

Figure I

Groundwater

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 014
Date: 14.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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LEGEND
Site boundary
Heddle vegetation complexes
Bush forever (DPLH, 2020)
Clearing regulations_ESAs (DWER)

BF Site: 13
Yanga Complex
Bassendean Complex-North
BF Site: 399
Bassendean Complex-North-\Transition Vegetation Complex
BF Site: 300

Figure J

Regional vegetation

GDA 1994 MGA Zone 50
0 75 150 300 m

Job Number: L20181-001
Doc Number: 007
Date: 14.02.22
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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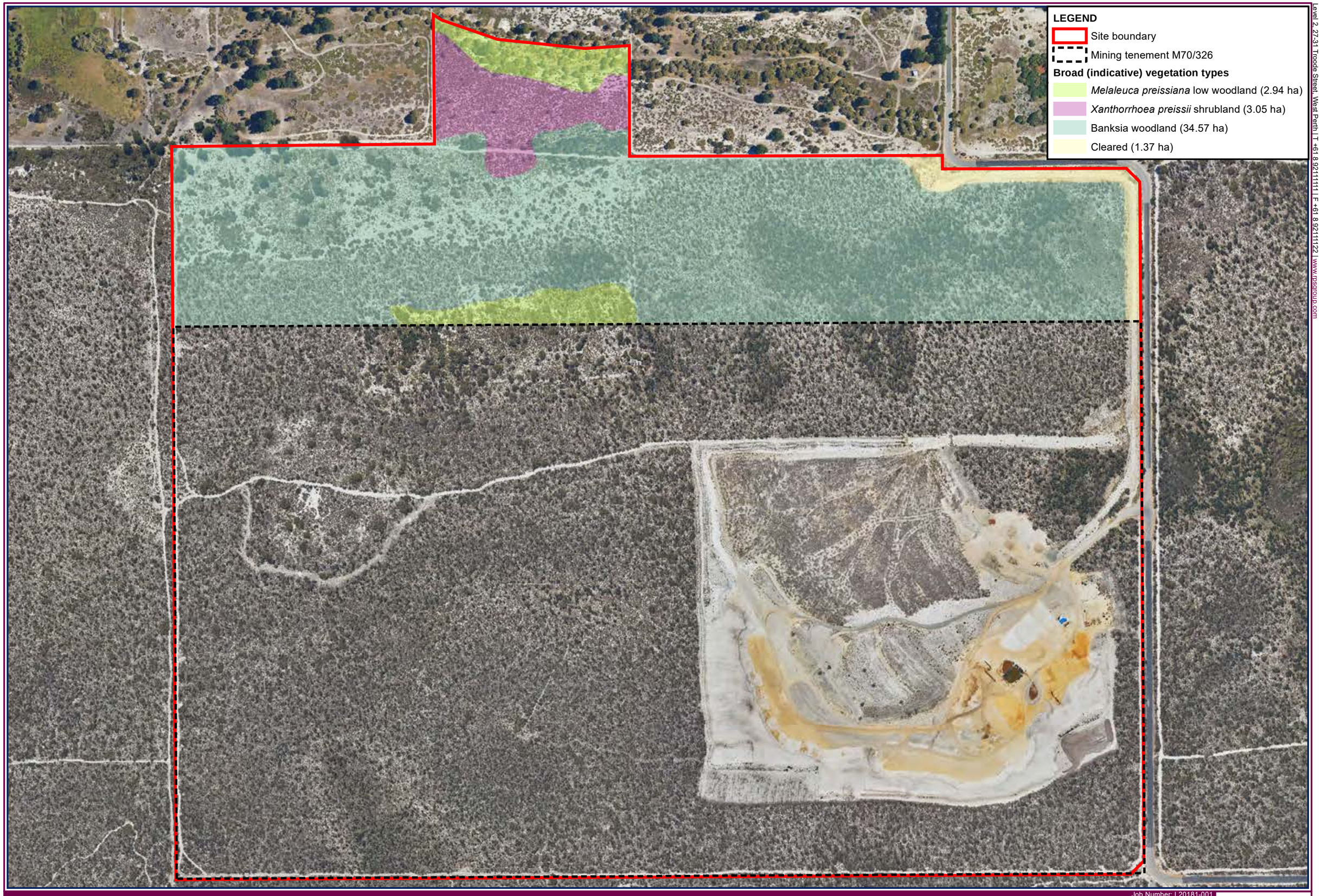

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Figure K

Broad (indicative) vegetation types

GDA 1994 MGA Zone 50

0 37.5 75 150 m

Job Number: L20181-001
Doc Number: 008
Date: 14.02.22
Scale: 1:5,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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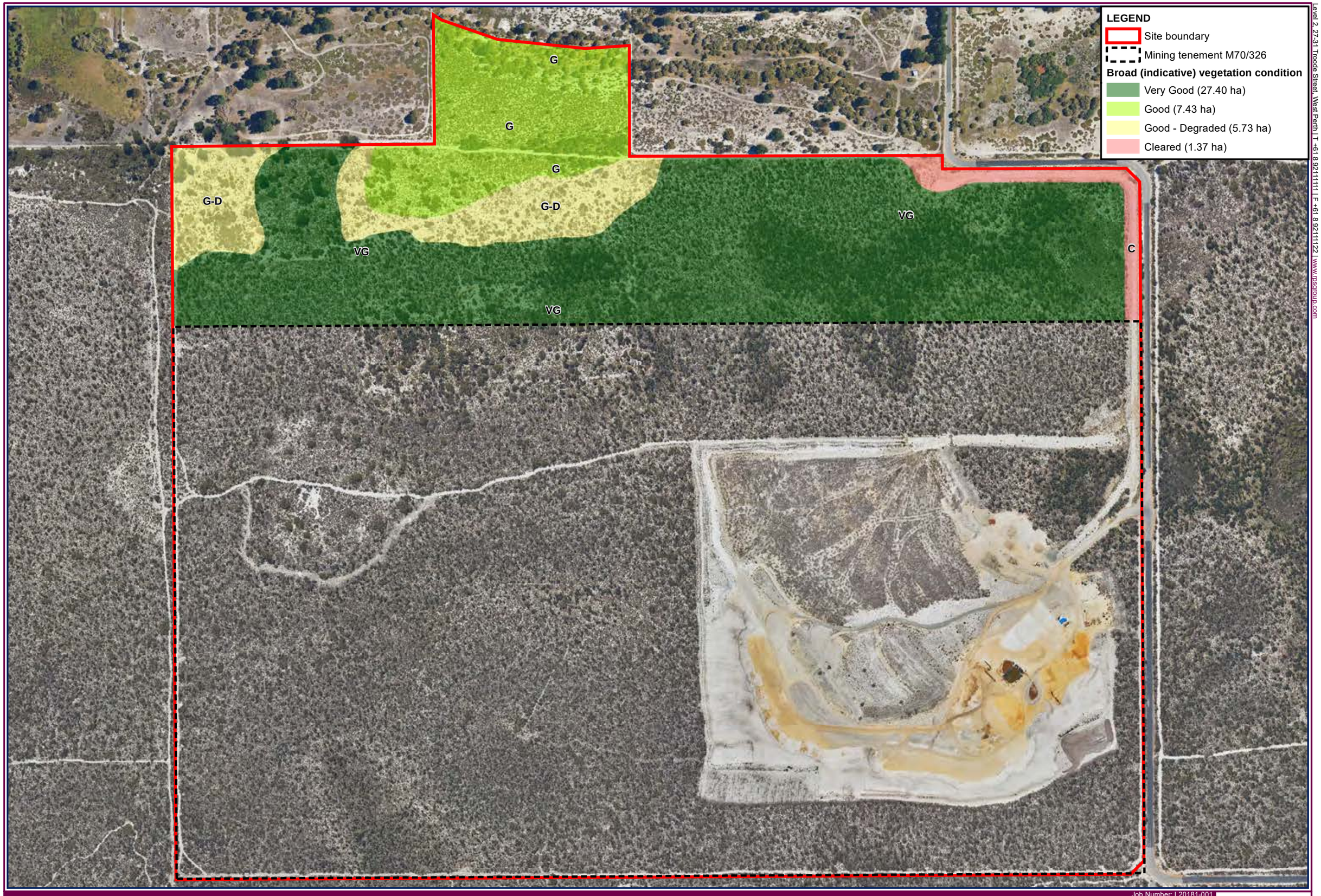

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Figure L

Broad (indicative) vegetation condition

GDA 1994 MGA Zone 50

0 50 100 200 m

Job Number: L20181-001
Doc Number: 009
Date: 14.02.22
Scale: 1:5,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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LEGEND
Site boundary
Mining tenement M70/326
Black cockatoo foraging habitat (34.57 ha)

Figure M

Broad (indicative) fauna habitats

GDA 1994 MGA Zone 50
0 50 100 200 m

Job Number: L20181-001
Doc Number: 012
Date: 14.02.22
Scale: 1:5,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, 2021

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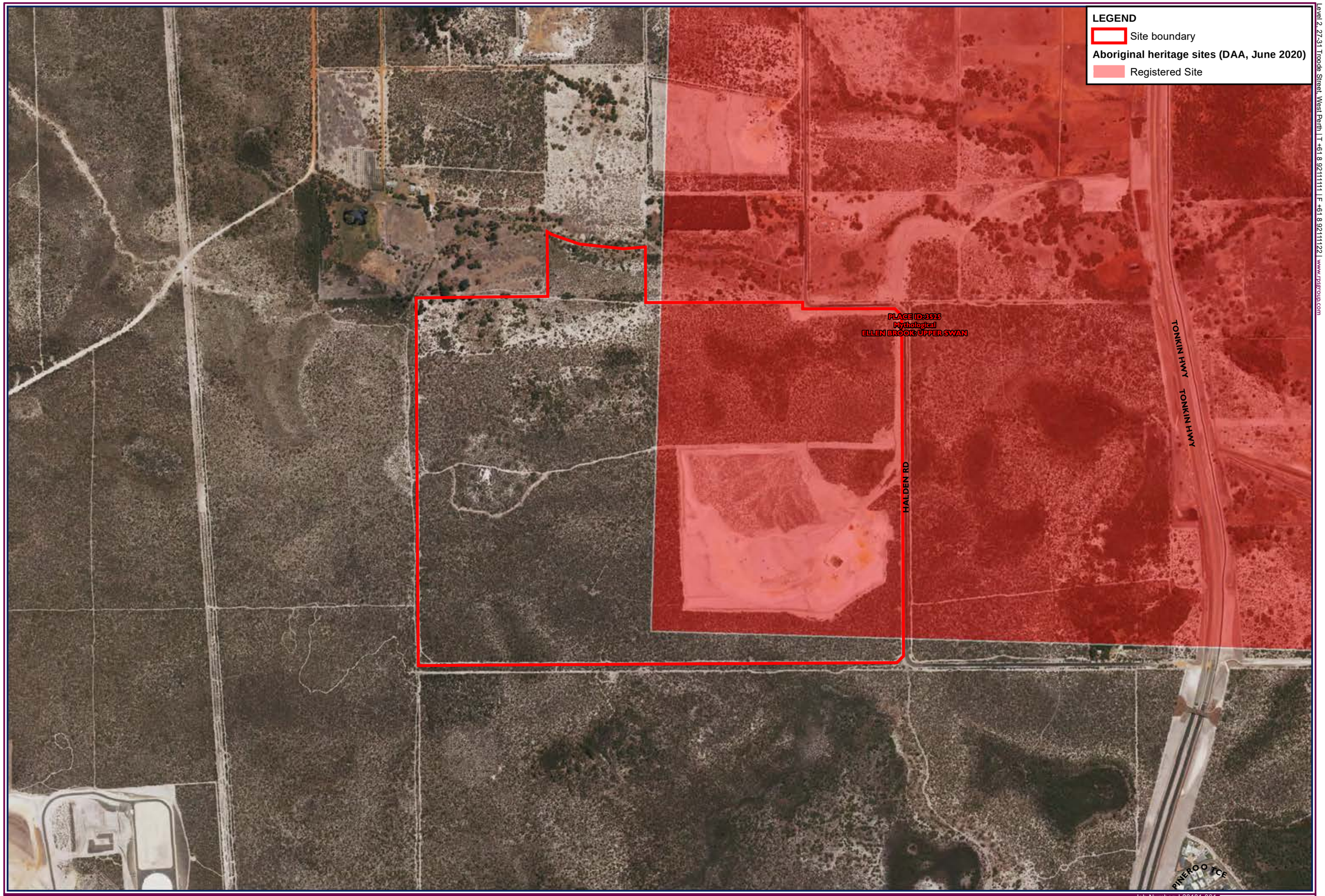

Figure N

Aboriginal heritage

GDA 1994 MGA Zone 50

0 75 150 300 m

Job Number: L20181-001
Doc Number: 014
Date: 30.09.20
Scale: 1:10,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

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Figure O

Bushfire prone area mapping

GDA 1994 MGA Zone 50

0 37.5 75 150 m

Job Number: L20181-001
Doc Number: 015
Date: 26.11.20
Scale: 1:5,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

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Appendix 2
Bushfire Management Plan

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: North Ellenbrook - Lot 5892 Maralla Road		
Suburb: Bullsbrook	**State:** WA	**P/code:** 6084
Local government area: City of Swan		
Description of the planning proposal: Strategic Level - District Structure Plan Amendment		
BMP Plan / Reference Number: 210548	**Version:** v1.0	**Date of Issue:** 18/02/2022
Client / Business Name: RPS Group		

Reason for referral to DFES	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 BPC elements)?	☐	☑

Is the proposal any of the following special development types (see SPP 3.7 for definitions)?

Unavoidable development (in BAL-40 or BAL-FZ)	☐	☑
Strategic planning proposal (including rezoning applications)	☑	☐
Minor development (in BAL-40 or BAL-FZ)	☐	☑
High risk land-use	☐	☑
Vulnerable land-use	☐	☑

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Strategic Level - District Structure Plan Amendment for a proposed change of land use to facilitate the development of a future (re-zoning and subsequent subdivision)of the subject land into a combination of land uses including Residential Areas, Activity Centres, Schools and Public Open Space Areas.

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Kathy Nastov	3	27794	2022
Company		**Contact No.**	
Bushfire Prone Planning		64771144	

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner K. Nastov **Date** 18/02/2022

Bushfire Management Plan

North Ellenbrook – District Structure Plan Amendment

Lot 5892 Maralla Road, Bullsbrook

City of Swan

Planning Stage:	Strategic Proposal - District Structure Plan Amendment
Planning Development Type:	Subdivision - Large Number of Lots
Bushfire Policy – Specific Development or Use Type:	SPP 3.7 - 6.2 Strategic planning proposals, subdivision and development applications

Job Number:	210548
Assessment Date:	3 February 2022
Report Date:	18 February 2022

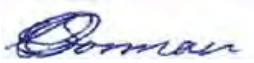
BPP Group Pty Ltd t/a Bushfire Prone Planning
ACN: 39 166 551 784 | ABN: 39 166 551 784

Level 1, 159-161 James Street
Guildford WA 6055

PO Box 388
Guildford WA 6935

08 6477 1144 | admin@bushfireprone.com.au

DOCUMENT CONTROL

PREPARATION		
Author:	Sarina Gorman (BPAD Level 2 - No. 42204)	
Co-Author:		
Review/Authorise:	Kathy Nastov (BPAD Level 3 - No. 27794)	

VERSION HISTORY		
Version	Version Details	Date
1.0	Initial Document – BMP (District Structure Plan Amendment)	18 February 2022
-		

DISTRIBUTION				
Destination	Version	No. Copies	Hard Copy	Electronic Copy
Person/Business: Giles Glasson – RPS Group Email: giles.glasson@rpsgroup.com.au	V1.0	1	☐	☒
Person/Business: Email:			☐	☐

TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

This Bushfire Management Plan has been prepared to accompany a District Structure Plan Amendment application for Lot 5892 Maralla Road, Bullsbrook in the City of Swan. The proposal is to facilitate future development (re-zoning and subsequent subdivision) of the subject land into a combination of land uses including Residential Areas, Activity Centres, Schools and Public Open Space Areas, ensuring the protection of biodiversity and enabling settlement in areas with acceptable bushfire risk.

Future development of the land will incorporate additional mitigation measures in accordance with the bushfire planning requirements through the implementation of subsequent further detailed bushfire management plans at the subdivision application stages.

The subject land, of approximately 163 hectares in total area is within a designated bushfire prone area and the proposal requires the application of State Planning Policy No. 3.7: Planning in Bushfire Prone Areas (SPP 3.7). The assessed bushfire risk is considered to be manageable and can be achieved by the identified stakeholders implementing and maintaining the bushfire risk management measures that are presented in this Plan.

The proposal, as set out in this Plan has addressed the applicable legislation, policy, standards and guidelines including the four elements of the Bushfire Protection Criteria of Location, Siting and Design, Vehicular Access and Water Supply. The determination is that the proposal can meet all the requirements.

Against the Bushfire Protection Criteria, the decision maker's assessment of a future Proposal will be on the basis of it being able to meet the Acceptable Solutions, as follows:

- For Element 1 'Location', the development is able to achieve the acceptable solution (by being located in an area that will on completion be subject to BAL-29 or less);
- For Element 2 'Siting and Design' any future Proposal is able to meet the acceptable solutions by habitable buildings being able to achieve an Asset Protection Zone (APZ) of sufficient size to ensure the radiant heat impact does not exceed BAL-29;
- For Element 3 'Vehicular Access', the location of the development area is able to meet the current acceptable solution A3.2a and E3.2a (provision of Multiple Access Routes in two different directions to two suitable destinations); and
- For Element 4 'Water', the Location of the Lots (once known) are able to achieve the acceptable solution. A reticulated water supply is currently not available to the subject site. It is anticipated however, that hydrants will be installed at regular intervals as part of this proposal.

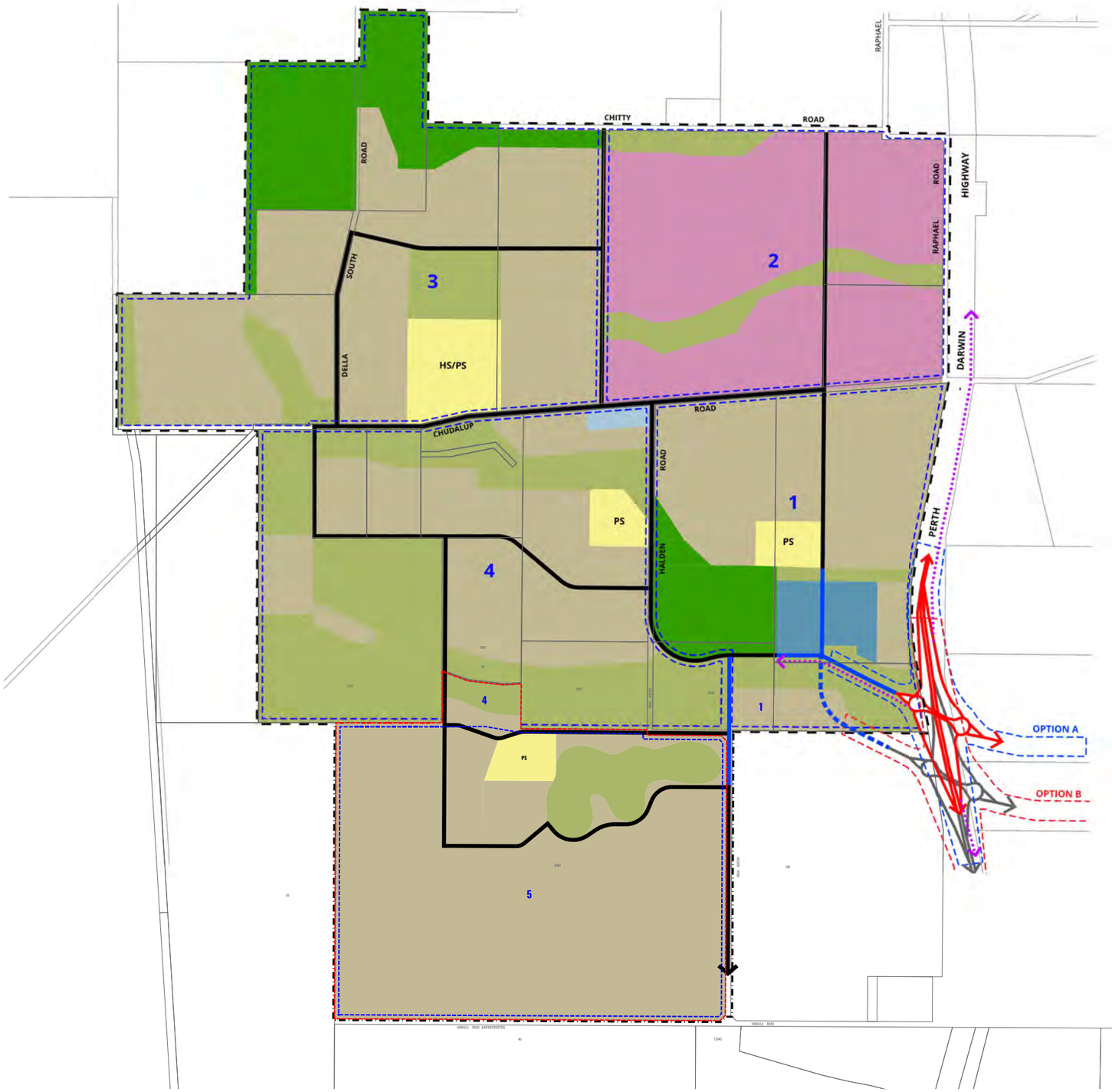
The vegetation within the boundaries of the subject site (consisting of a combination of Forest, Shrub, Scrub and Grassland) has been considered and it is anticipated that in the future (with the exception of the Conservation Category Wetland (CCW) and Resource Enhancement Wetland (REW) and their associated buffers, where vegetation will be retained, or revegetation works (where applicable) will take place) will be maintained in a low threat state. It will meet the requirements of AS3959-2018 requirements and will continue to be maintained in a low threat state as stipulated in the City of Swan Fire Hazard Reduction Notice.

Future buildings within 100 metres of classified vegetation will be required to be constructed to standards which correspond to the determined BAL's, as required by AS 3959-2018 Construction of buildings in bushfire prone areas. As this proposal does not identify the actual location of building works within each Lot, there may be a requirement to determine the BAL ratings for individual building works once a building site has been identified.

1 PROPOSAL DETAILS

1.1 Description and Associated Plans and Maps

Landowner / Proponent:	Stockland
Bushfire Prone Planning Commissioned to Produce the Bushfire Management Plan (BMP) By:	RPS Group
For Submission To:	City of Swan
Purpose of the BMP:	To accompany a District Structure Plan Amendment application
'Subject Land' Site Total Area:	Approximately: 163 hectares
No. of Existing Lots identified:	1
No. of Existing Reserves identified:	0
Description of the Proposed Development/Use:	
District Structure Plan Amendment to facilitate the development of the subject land into a combination of land uses including Residential Areas, Activity Centres, Schools and Public Open Space Areas.	
Staged Development and Management of Potential Bushfire Hazard Issues	
Strategic assessment to address the bushfire risk that considers the future potential development proposal.	



LEGEND

- DISTRICT STRUCTURE PLAN AMENDMENT BOUNDARY
- DISTRICT STRUCTURE PLAN BOUNDARY
- LOCAL STRUCTURE PLAN BOUNDARY
- CADASTRAL BOUNDARIES
- RESIDENTIAL
- LIGHT INDUSTRIAL / SERVICE COMMERCIAL
- DISTRICT CENTRE
- NEIGHBOURHOOD CENTRE
- PS — PUBLIC PURPOSE - PRIMARY SCHOOL
- HS/PS — PUBLIC PURPOSE - HIGH SCHOOL / PRIMARY SCHOOL COMBINED
- OPEN SPACE
- FUTURE MRS PARKS AND RECREATION RESERVE
- PRIMARY DISTRIBUTOR ROAD
- INTEGRATOR ARTERIAL ROAD
- NEIGHBOURHOOD CONNECTOR ROAD
- DISTRICT PATH NETWORK / PRINCIPAL SHARED PATH (NORTHLINK)

NOTES

1. The Perth-Darwin Highway interchange represents two preferred locations following detailed review of alternate option locations. It is subject to confirmation as part of the Metropolitan Region Scheme Amendment process required to reserve the interchange land.
2. The Parks and Recreation identified areas recognise BushForever, Conservation Category Wetland (CCW) and EPBC Act areas to be retained. It is subject to definition as part of the Metropolitan Region Scheme amendment process.
3. Public Open Space areas encompass vegetation retention, heritage and hydrology land requirements of District Structure Plan level significance. The refinement, reservation or reclassification of these and localised areas of open space as restricted open space, unrestricted open space or otherwise will be determined following environmental assessment at the local structure plan stage.
4. An area of District Open Space (DOS) is identified for co-location with the High School site and will accommodate the future active district recreation needs of the community. The acquisition and development of the DOS is to be provided for within the relevant Development Contribution Scheme(s) for the North Ellenbrook West District Structure Plan area to ensure the equitable provision of open space.
5. DSP Amendment subject to Environmental and Local Structure Plan Approvals.

DISTRICT STRUCTURE PLAN AMENDMENT PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

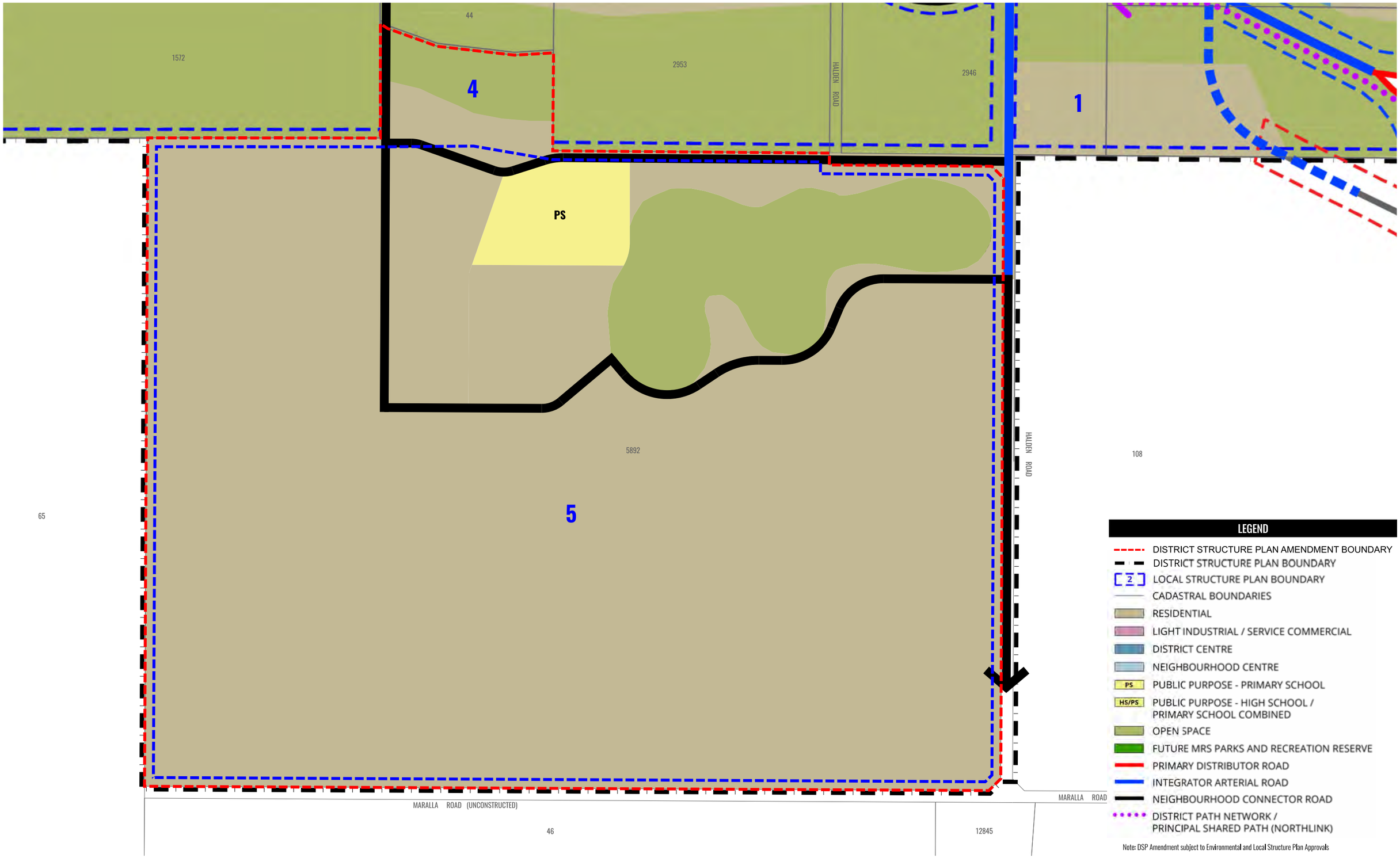
Scale: 1:17 500 @ A3

0 200 400 600m

PLAN: STONE-5-007 REVISION:
DATE: 09/02/2022 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

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



Note: DSP Amendment subject to Environmental and Local Structure Plan Approvals

DISTRICT STRUCTURE PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: STONE-2-001 REVISION: A

DATE: 09/02/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: BK

DATUM: AHD CHECK: CH

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

LEGEND

SUBJECT SITE	162.962ha
RESIDENTIAL	84.523ha
LOCAL ACTIVITY CENTRE	0.419ha
CONSERVATION CATEGORY WETLAND (CORE)	7.600ha
CONSERVATION CATEGORY WETLAND (BUFFER)	5.485ha
RESOURCE ENHANCEMENT WETLAND (CORE)	1.839ha
RESOURCE ENHANCEMENT WETLAND (BUFFER)	0.864ha
POS	18.532ha
PRIMARY SCHOOL	3.500ha
NEIGHBOURHOOD CONNECTOR ROAD RESERVE	5.567ha
LOCAL ROAD RESERVE	34.167ha
ROAD WIDENING	0.466ha

ASSUMPTIONS

- Concept Plan is subject to further detailed design, engineering, hydrology and survey.
- Concept plan based on preliminary 1% 1:1yr, 1.71% 1:5yr and 1.04% 1:100yr drainage (exclusive %'s), subject to hydrological assessment and approvals.
- Reduced CCW buffer from 50m to 30m buffer to CCW, subject to environmental assessment and approvals.
- 3m Halden Road Widening to the south and west of existing road reserve, based on future ultimate 23m Neighbourhood Connector A cross section, subject to Traffic Engineering investigation.
- Neighbourhood Connector Roads (23m wide NCA & 18m wide NCB), subject to Traffic Engineering investigation.
- Proposed Neighbourhood Connector Road north of CCW, subject to environmental approvals.
- 3.5m Public Primary School site, subject to negotiation and approval with Department of Education & Training.
- POS 5 proposed as a multi-use function sporting facility, subject to approvals.
- Retention of existing trees subject to Arborist assessment.
- Staging subject to further investigation and 300m sand mining buffers.
- No direct lot access along Neighbourhood Connector Road, between Halden Road and POS 9, subject to Traffic Engineering Investigation.
- POS Cell north and east of CCW treated as full credit, subject to assessment and approval.

CELL STRUCTURE PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: STONE-1-001 REVISION: D
DATE: 09/02/2022 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

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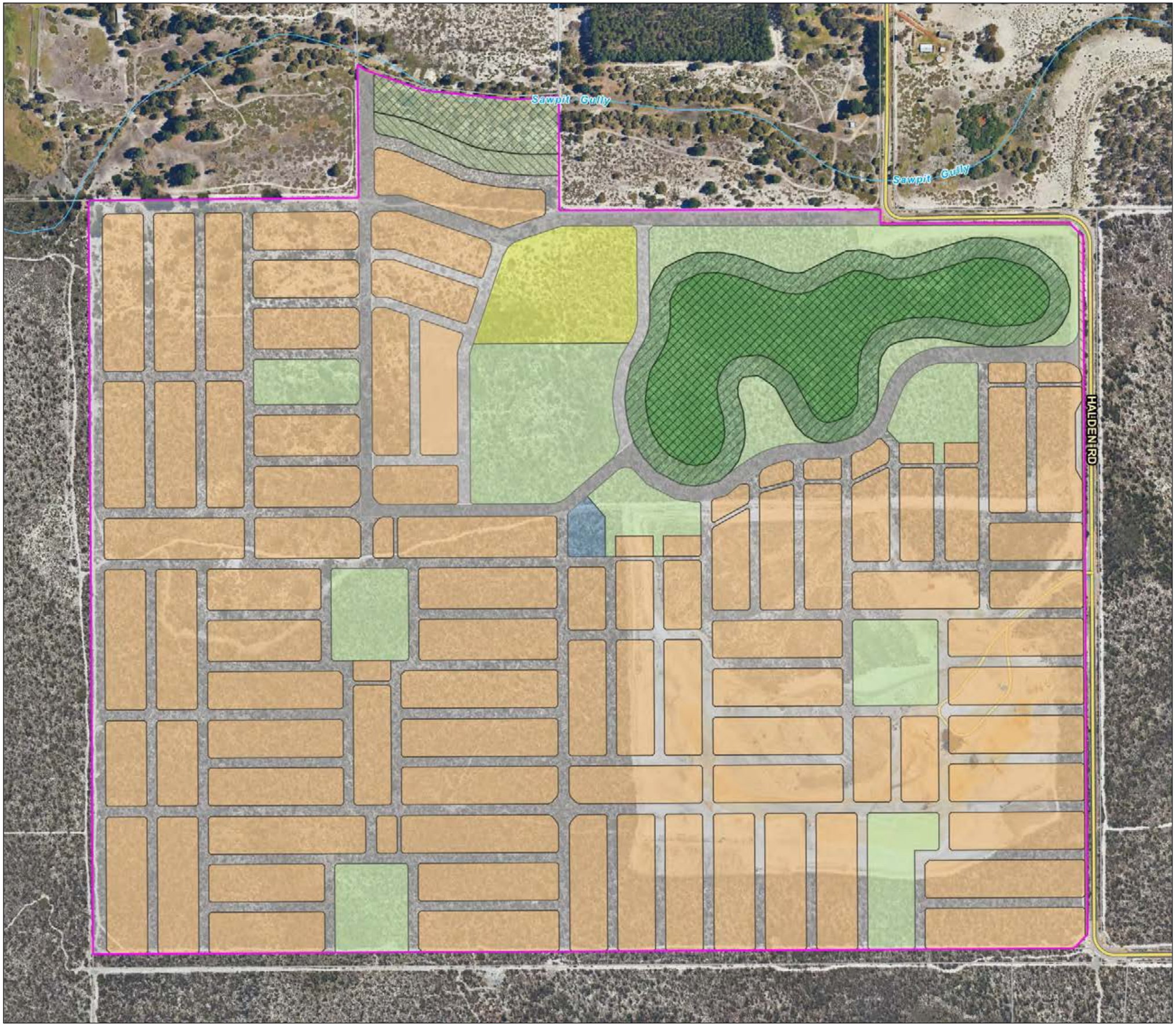


Figure 1.4

Subject Land Map

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

------ LEGEND ------

- Cadastre
- Subject Site

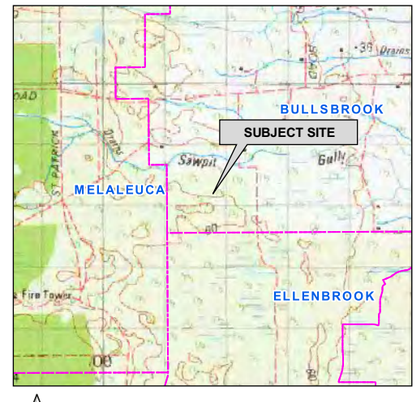
Proposal

- Residential Areas
- Activity Centre
- CCW Core
- CCW Buffer
- REW Core
- REW Buffer
- Primary School
- POS Areas
- Neighbourhood Connector Road
- Local Road Network
- Road Widening

0 50 100 150 200 250

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 17-02-2022
SCALE (A3): 1 : 5200

Figure 1.5

Location Plan

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

SUBJECT LAND

------ LEGEND ------

- Subject Site
- Local Government Authority
- Localities/Suburb

DFES Stations (DFES-023)

- Bush Fire Brigade
- Career Fire Rescue Service
- Volunteer Fire & Emergency Service
- Reserves

DBCA Legislated Lands & Waters

- Crown Freehold - Dept Managed
- Nature Reserve
- State Forest

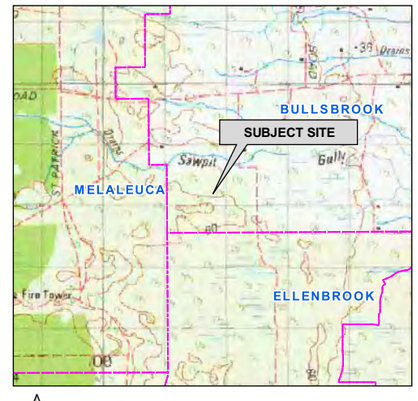
DBCA Lands of Interest (DBCA-012)

- Crown Freehold

0 1000 2000 3000 4000

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

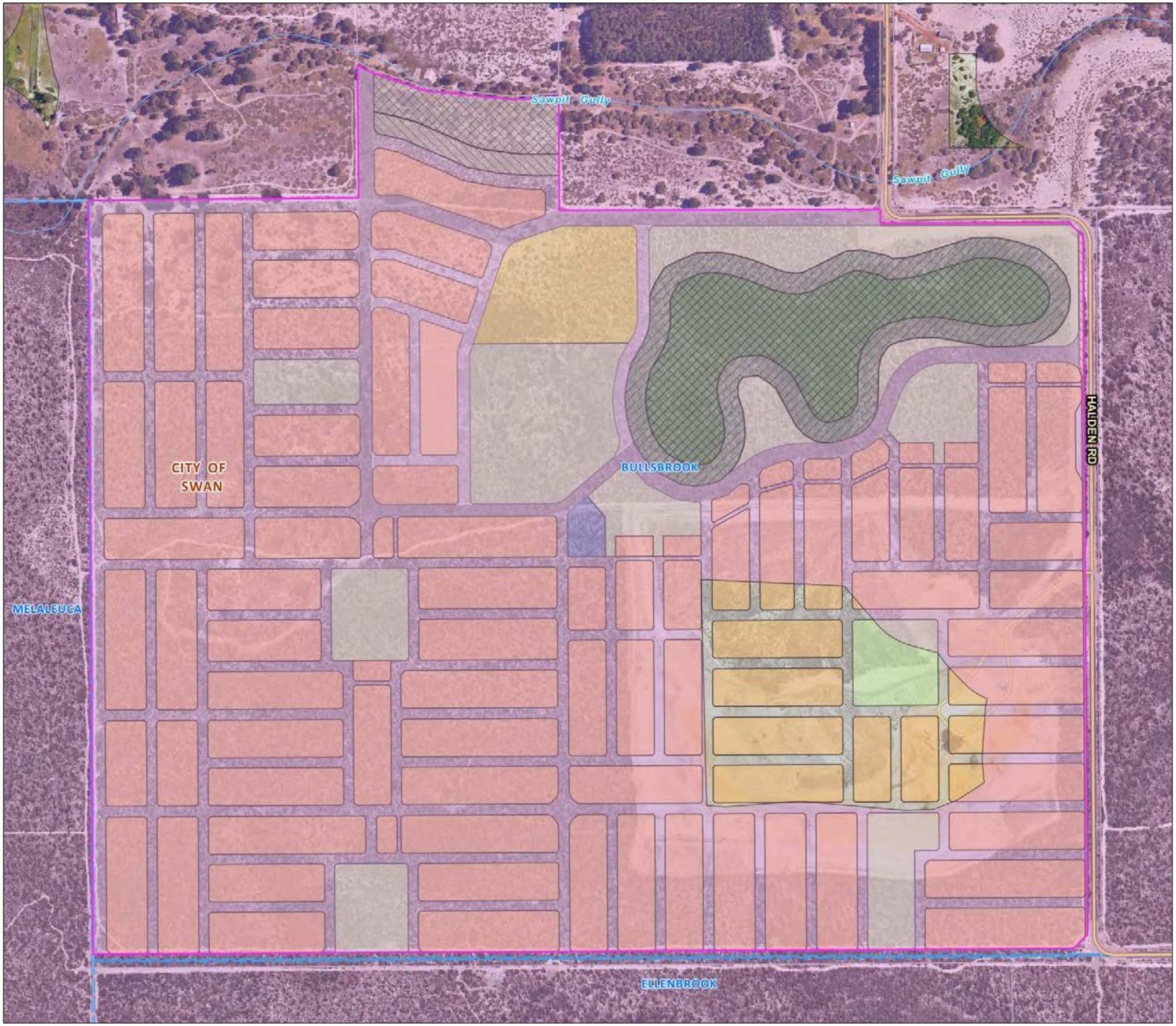
Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 18-02-2022
SCALE (A3): 1 : 60000

BUSHFIRE PRONE PLANNING

Figure 1.6

Bushfire Prone Areas

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan



------ LEGEND ------

- Bushfire Prone Areas
- Local Government Authority
- Localities/Suburb
- Cadastre
- Subject Site

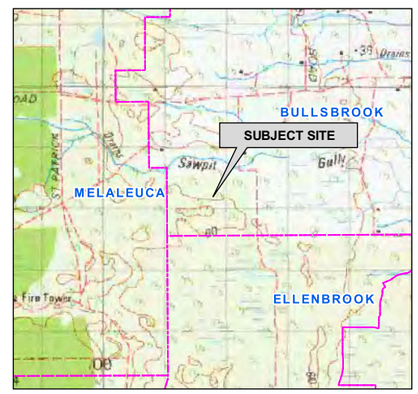
Proposal

- Residential Areas
- Activity Centre
- CCW Core
- CCW Buffer
- REW Core
- REW Buffer
- Primary School
- POS Areas
- Neighbourhood Connector Road
- Local Road Network
- Road Widening

0 50 100 150 200 250

Metres

------ LOCALITY ------



N

AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 17-02-2022
SCALE (A3): 1 : 5200

1.2 Existing Documentation Relevant to the Construction of this Plan

This section acknowledges any known reports or plans that have been prepared for previous planning stages, that refer to the subject area and that may or will impact upon the assessment of bushfire risk and/or the implementation of bushfire protection measures and will be referenced in this Bushfire Management Plan.

Table 1.1: Existing relevant documentation.

RELEVANT EXISTING DOCUMENTS		
Existing Document	Copy Provided by Client	Title
Local Planning Considerations	No	
Environmental Considerations	No	
Landscaping (Revegetation) Plan	No	
Bushfire	Yes	Desktop Due Feasibility and Diligence Conducted by Bushfire Prone Planning (Dated 30 June 2021)

2 ENVIRONMENTAL CONSIDERATIONS

2.1 Native Vegetation – Restrictions to Modification and/or Clearing

Many bushfire prone areas also have high biodiversity values. SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values (Guidelines s2.3).

There is a requirement to identify the need for onsite modification and/or clearing of native vegetation and whether this might trigger potential environmental impact/referral requirements under State and Federal environmental legislation. Confirmation that any proposed native vegetation modification and/or clearing is acceptable, should be received from the relevant agencies by the proponent and provided to the bushfire consultant for inclusion in the Bushfire Management Plan if it will influence the required bushfire planning assessments and outcomes. The following table details any potential environmental restrictions of which the author of this report is aware.

Table 2.1: Native vegetation and potential environmental considerations and restrictions.

NATIVE VEGETATION MODIFICATION / CLEARING - POTENTIAL ENVIRONMENTAL RESTRICTIONS IDENTIFIED				
Environmental Considerations / Features	Potential Mapping Data Source (SLIP / Local Planning)	Relevant to Proposed Development	Data Applied	Action Required
Onsite clearing of native vegetation is required.		Yes		
Environmental impact/referral requirements under State and Federal environmental legislation may be triggered.		Likely		
National Park / Nature Reserve	DBCA-011	No-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Conservation Covenant	DPIRD-023	Possible	Data Not Readily Available to Bushfire Consultant	Proponent to Seek Advice
Bush Forever Site	DPLH-019	No-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
RAMSAR Wetland	DBCA-010	No-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Geomorphic and Other Wetland	DBCA-011- 019, 040, 043, 044	Yes-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	Proponent to Seek Advice
Threatened and Priority Ecological Communities (TECs or PECs)	DBCA-038	No-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Threatened and Priority Flora including Declared Rare Flora (DRFs)	DBCA-037	No-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Land Identified as significant through a Local Biodiversity Strategy	LG - Intramaps	Yes-Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	Proponent to Seek Advice
Statement of how the identified environmental feature(s) is dealt with in this Bushfire Management Plan (and the location of relevant information):				

The assessments and bushfire protection measures detailed in the BMP, assume that environmental approval will be achieved or clearing permit exemptions will apply.

It is advised that the proponent seek further advice from an Environmental Consultant or the WA Department of Biodiversity Conservation and Attractions for further information on the condition and species contained within the proposed development area and the requirement for referral of the proposal.

Figure 2.1

Environmental Considerations

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

------ LEGEND ------

- Subject Site
- Reserves
- Bush Forever Sites

Clearing Regulations

- Clearing Regulations

DBCA Legislated Lands & Waters

- Crown Freehold - Dept Managed
- Nature Reserve
- State Forest

DBCA Lands of Interest (DBCA-012)

- Crown Freehold

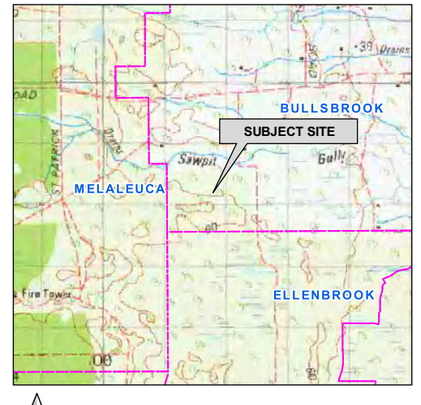
Geomorphic Wetlands Swan Coastal Plain

- Dampland
- Floodplain
- Lake
- No Longer a Wetland
- Not Assessed
- Palusplain
- Sumpland

0 1000 2000 3000 4000

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 18-02-2022
SCALE (A3): 1 : 60000

Development Design Considerations

Establishing development in bushfire prone areas can adversely affect the retention of native vegetation through clearing associated with the creation of lots and/or asset protection zones. Where loss of vegetation is not acceptable or causes conflict with landscape or environmental objectives, it will be necessary to consider available design options to minimise the removal of native vegetation.

Table 2.2: Development design.

MINIMISE THE REMOVAL OF NATIVE VEGETATION	
Design Option	Assessment / Action
Reduction of lot yield	N/A
Cluster development	N/A
Construct building to a standard corresponding to a higher BAL as per BCA (AS 3959:2018 and/or NASH Standard)	N/A
Modify the development location	N/A
Future buildings as part of this development proposal will consider achievable asset protection zones and corresponding bushfire attack level ratings, to a bushfire attack level rating of BAL-29, to minimise extensive clearing where native standing vegetation is of environmental significance.	
IMPACT ON ADJOINING LAND	
Is this planning proposal able to implement the required bushfire protection measures within the boundaries of the land being developed so as not to impact on the bushfire and environmental management of neighbouring reserves, properties or conservation covenants?	No
Future buildings as part of future re-zoning and subsequent subdivision proposal will consider achievable asset protection zones within the boundaries of the subject individual Lots. It is assumed for the purposes of assessment that Maralla Road to the south of the subject site will be constructed to meet the Bushfire Technical requirements established by the Guidelines to enable access to the Residential and POS areas at the southern portion of the site. In addition, it is reasonable to assume that vegetation along Halden road, immediately adjacent to the subject site will be modified to enable the widening of the road per the proposal.	
CONSIDERATION OF BUSHFIRE RISK (SUBDIVISION DESIGN)	
Is the proposal able to implement subdivision design to reduce risks relating to bushfire while considering future growth?	Yes
Road layout design, construction standards for buildings, clearing of land, vegetation management and the size and shape of building lots are under the control of planning and building systems. Through avoiding exposure to the bushfire hazards, risks to people and property are precluded. The clearing or modification of vegetation around new or existing structures or subdivision areas is a way to reduce radiant heat, flame contact and, to an extent, ember attack on buildings and structures. Large building lot sizes may allow for the retention of significant vegetation but result in retaining of higher levels of hazardous fuel loads and continuous vegetation conducive to fire run. Grouped smaller building lot sizes incorporating separation from hazards with road design and landscape treatments assist in reducing fuel loads and subsequent reduction in radiant heat and flame contact exposure.	

2.2 Retained Vegetation / Re-vegetation / Landscape Plans (including POS)

Riparian zones, wetland/foreshore buffers, road verges and public open space may have plans to re-vegetate or retain vegetation as part of the proposed development. Vegetation corridors may be created between offsite and onsite vegetation and provide a route for fire to enter a development area.

All retained/planned vegetation and its management will be considered in the development of future Bushfire Management Plans at the subdivision stages.

Is re-vegetation of riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?	Possible
*See comment below.	
Is the requirement for ongoing maintenance of existing vegetation in riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?	Possible
*See comment below	
Is a landscape plan required for the future proposed development?	Yes
Where future development proposals incorporate landscaping within the subject land, modification and/or replanted vegetation types, will require a landscape plan indicating how the vegetation will be configured and managed in perpetuity, so as not to increase the bushfire risk and limit ignition sources.	

*An approved Landscape Management Plan should be provided to demonstrate that the landowner/proponent responsible for the on-going management has an obligation to undertake mitigation works and the approving decision maker (i.e. local government and / or Department of Biodiversity, Conservation and Attractions) support the vegetation classification and management treatments assigned to the subject area.

3 POTENTIAL BUSHFIRE IMPACT ASSESSMENT

3.1 Assessment Input

3.1.1 Fire Danger Index (FDI) Applied

AS 3959:2018 Table 2.1 specifies the fire danger index values to apply for different regions. The values used in the model calculations are for the Forest Fire Danger Index (FFDI) and for which equivalent representative values of the Grassland Fire Danger Index (GFDI) are applied as per Appendix B. The values can be modified if appropriately justified.

Table 3.1: Applied FDI Value

FDI VALUE			
Vegetation Areas	As per AS 3959:2018 Table 2.1	As per DFES for the Location	Value Applied
1-12	80	N/A	80

3.1.2 Vegetation Classification and Effective Slope

Classification: Bushfire prone vegetation identification and classification has been conducted in accordance with AS 3959:2018 s2.2.3 and the Visual Guide for Bushfire Risk Assessment in WA (DoP February 2016).

When more than one vegetation type is present, each type is identified separately, and the applied classification considers the potential bushfire intensity and behaviour from the vegetation types present and ensures the worst case scenario is accounted for – this may not be from the predominant vegetation type.

The vegetation structure has been assessed as it will be in its mature state (rather than what might be observed on the day). Areas of modified vegetation are assessed as they will be in their natural unmodified state (unless maintained in a permanently low threat, minimal fuel condition, satisfying AS 3959:2018 s2.2.3.2(f) and asset protection zone standards). Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its revegetated mature state.

Effective Slope: Refers to the ground slope under each area of classified vegetation and is described in the direction relative to the view from the building or proposed development site. Effective slope is not the same as 'average slope', rather it is the slope which most significantly influences fire behaviour. This slope has a direct and significant influence on a bushfire's rate of spread and intensity.

Where there is a significant change in effective slope under an area of classified vegetation, that will cause a change in fire behaviour, separate vegetation areas will be identified to enable the correct assessment.

When the effective slope, under a given area of bushfire prone vegetation, will be different relative to multiple proposed development sites, then the effective slopes corresponding to the different locations, are separately identified.

Planned Re-vegetation/Landscaping Considerations/Public Open Space Management

Re-vegetation – It is assumed re-vegetation/re-planting will take place in both the CCW and REW Buffers. It is further assumed that these buffers will not be managed. As such, classification in accordance with As3959-2018 will be required. This will result in an eventual classification of Class A Forest at maturity.

Landscaping - Final landscaping detail will be addressed at the future development stages. If any such vegetation is excluded from classification due to proposed management, the subsequent BMP will ensure the obligation to manage to a minimal fuel, low threat state, in perpetuity, is created in the landowner responsibilities. For the purposes of assessment, it is assumed that the proposed POS Areas will be managed in a low threat state in perpetuity to ensure there is no increase in bushfire risk nor alter indicative BAL ratings indicated in this plan. They will meet AS3959-2018 s2.2.3.2 requirements, Schedule 1: Standards for Asset Protection Zones as stipulated in the Guidelines for Planning in Bushfire Prone Areas in conjunction with the City of Swan Fire Hazard Reduction Notice.

Excluded Bushfire Prone Vegetation

The exclusion of existing bushfire prone vegetation from classification includes areas that can reasonably be expected to remain as vegetation in a minimal fuel, low threat state or areas devoid of vegetation. Consequently, the potential bushfire impact is determined by bushfire prone vegetation at the strategic level in this District Structure Plan Amendment BMP. Future development of the Subject Land will incorporate areas of minimal fuel, low threat state, detail of which will be demonstrated in the BMP for the subsequent subdivision and/or development applications.

Table 3.2: Vegetation classification and effective slope.

ALL VEGETATION WITHIN 150 METRES OF THE PROPOSED DEVELOPMENT				
Vegetation Area	Identified Vegetation Types [1] or Description if 'Excluded'	Applied Vegetation Classification [1]	Effective Slope (degrees)[2] (AS 3959:2018 Method 1)	
			Assessed	Applied Range
1	Open tussock G-23; Sown pasture G-26; Open herbfield G-27; Sparse open herbfield G-28	Class G Grassland	0	upslope or flat
2	Open forest A-03; Low open forest A-04; Closed scrub D-13; Open scrub D-14	Class A Forest	0	upslope or flat
3	Closed heath C-10; Open heath C-11	Class C Shrubland	0	upslope or flat
4	Low woodland B-07; Closed scrub D-13; Open scrub D-14	Class D Scrub	0	upslope or flat
5	Low open forest A-04; Closed scrub D-13; Open scrub D-14	Class A Forest	0	upslope or flat
6	Sown pasture G-26; Open herbfield G-27	Class G Grassland	0	upslope or flat
7	Excluded – Non-Vegetated Areas	Excluded as per Section 2.2.3.2 (e) Non-Vegetated Areas	N/A	N/A
8	Low woodland B-07; Closed scrub D-13; Open scrub D-14	Class D Scrub	7.5	downslope >5-10
9	Closed heath C-10	Class C Shrubland	3.6	downslope >0-5
10	Closed heath C-10	Class C Shrubland	0	upslope or flat
11	Low woodland B-07; Closed heath C-10 Closed scrub D-13; Open scrub D-14	Class D Scrub	4	downslope >0-5
12	Low open forest A-04; Closed scrub D-13; Open scrub D-14	Class A Forest	4.8	downslope >0-5
Representative photos of each vegetation area, descriptions and classification justification, are presented on the following10 pages. The areas of classified vegetation are defined, and the photo locations identified on Figure 3.1, the vegetation and topography map.				
Note[1]: Descr8ibed and classified as per AS 3959:2018 Table 2.3 and Figures 2.3 and 2.4 (A)-(H) Note[2]: Effective slope measured as per AS 3959:2018 Section 2.2.5 and Appendix B Part B4				
Note [3]: It is assumed for the purposes of assessment that Area 7 will continue/remain either devoid of vegetation or be managed in a low threat state in perpetuity as development of the site progresses.				

VEGETATION AREA 1	
AS 3959:2018 Vegetation Classification Applied:	Class G Grassland
Vegetation Types Present:	Open tussock G-23; Sown pasture G-26; Open herbfield G-27; Sparse open herbfield G-28
Description/Justification:	Assessed as Grassland due to areas of grasses present in paddock/open areas. Although grasses may appear to be in a managed state or sparse in some sections, other sections do appear unmanaged. As such, the entire area/s have been classified as a precautionary measure with a worst-case scenario approach. There is the potential to become significantly unmanaged in the future. Foliage cover less than 10%.
Post Dev. Assumptions:	Grassland areas can be modified to less than 100mm in height within the development boundary.

Photo ID: 1

Photo ID: 2

Photo ID: 3

Photo ID: 4

VEGETATION AREA 1	
AS 3959:2018 Vegetation Classification Applied:	Class G Grassland
Vegetation Types Present:	Open tussock G-23; Sown pasture G-26; Open herbfield G-27; Sparse open herbfield G-28
Description/Justification:	Assessed as Grassland due to areas of grasses present in paddock/open areas. Although grasses may appear to be in a managed state or sparse in some sections, other sections do appear unmanaged. As such, the entire area/s have been classified as a precautionary measure with a worst-case scenario approach. There is the potential to become significantly unmanaged in the future. Foliage cover less than 10%.
Post Dev. Assumptions:	Grassland areas can be modified to less than 100mm in height within the development boundary.

Photo ID: 5

Photo ID: 6

Photo ID: 7

Photo ID: 8

VEGETATION AREA 2	
AS 3959:2018 Vegetation Classification Applied:	Class A Forest
Vegetation Types Present:	Open forest A-03; Low open forest A-04; Closed scrub D-13; Open scrub D-14
Description/Justification:	Mixed species of trees present inclusive of tall Banksia, Melaleuca and Pine. Trees with an average height of 10-15 metres. Canopy coverage greater than 50%. Understorey consists of unmanaged grasses, low shrub and low trees. NOTE: Zoom factor increased at Photo ID: 12 to obtain a suitable image. This is due to lack of access to the area.
Post Dev. Assumptions:	It is anticipated that sections of Area 2 within the boundaries of the subject site (with the exception of the Resource Enhancement Wetland Areas) will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 9

Photo ID: 10

Photo ID: 11

Photo ID: 12

VEGETATION AREA 2	
AS 3959:2018 Vegetation Classification Applied:	Class A Forest
Vegetation Types Present:	Open forest A-03; Low open forest A-04; Closed scrub D-13; Open scrub D-14
Description/Justification:	Mixed species of trees present inclusive of tall Banksia, Melaleuca and Pine. Trees with an average height of 10-15 metres. Canopy coverage greater than 50%. Understorey consists of unmanaged grasses, low shrub and low trees.
Post Dev. Assumptions:	It is anticipated that sections of Area 2 within the boundaries of the subject site (with the exception of the Resource Enhancement Wetland Areas) will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 13

Photo ID: 14

Photo ID: 15

Photo ID: 16

VEGETATION AREA 3	
AS 3959:2018 Vegetation Classification Applied:	Class C Shrubland
Vegetation Types Present:	Closed heath C-10; Open heath C-11
Description/Justification:	Unmanaged shrub averaging less than 2 metres in height. Mixed species composition. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 3 within the boundaries of the subject site (with the exception of the Resource Enhancement Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the REW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 17

Photo ID: 18

Photo ID: 19

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 4 within the boundaries of the subject with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the CCW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 20

Photo ID: 21

Photo ID: 22

Photo ID: 23

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 4 within the boundaries of the subject with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the CCW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 24

Photo ID: 25

Photo ID: 26

Photo ID: 27

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 4 within the boundaries of the subject with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the CCW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 28

Photo ID: 29

Photo ID: 30

Photo ID: 31

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 4 within the boundaries of the subject with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the CCW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 32

Photo ID: 33

Photo ID: 34

Photo ID: 35

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 4 within the boundaries of the subject with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals. In addition to the above, it is assumed for the purposes of assessment that natural re-seeding and/or revegetation will take place within the CCW Buffer. As it is unlikely to receive any form of maintenance, classification in accordance with AS3959-2018 is required. As such, an eventual classification of Class A – Forest has been applied as a precautionary measure with a worst-case scenario approach to this area.

Photo ID: 36

Photo ID: 37

Photo ID: 38

Photo ID: 39

VEGETATION AREA 5	
AS 3959:2018 Vegetation Classification Applied:	Class A Forest
Vegetation Types Present:	Low open forest A-04; Closed scrub D-13; Open scrub D-14
Description/Justification:	Forest dominant. Mixed species of trees present inclusive of tall Banksia and Melaleuca. Trees with an average height of up to 10 metres. Canopy coverage greater than 50%. Understorey consists of unmanaged grasses, low shrub and low trees.
Post Dev. Assumptions:	It is anticipated that sections of Area 5 within the boundaries of the subject site (with the exception of the Conservation Category Wetland Areas) will have some form of modification at the future development stage, resulting in a change in classification to 'Excluded' AS3959-2018 (f). This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 40

Photo ID: 41

Photo ID: 42

Photo ID: 43

VEGETATION AREA 6	
AS 3959:2018 Vegetation Classification Applied:	Class G Grassland
Vegetation Types Present:	Sown pasture G-26; Open herbfield G-27
Description/Justification:	Assessed as Grassland due to areas of grasses present in paddock/open areas. Although grasses may appear to be in a managed state or sparse in some sections, other sections do appear unmanaged. As such, the entire area/s have been classified as a precautionary measure with a worst-case scenario approach. There is the potential to become significantly unmanaged in the future. Foliage cover less than 10%.
Post Dev. Assumptions:	Grassland areas can be modified to less than 100mm in height within the development boundary.

Photo ID: 44

Photo ID: 45

Photo ID: 46

VEGETATION AREA 7	
AS 3959:2018 Vegetation Classification Applied:	Excluded as per Section 2.2.3.2 (e) Non-Vegetated Areas
Vegetation Types Present:	Non-Vegetated Areas
Description/Justification:	An existing Sand Quarry and public road network. Currently devoid of classifiable vegetation.
Post Dev. Assumptions:	Not Applicable.

Photo ID: 47

Photo ID: 48

Photo ID: 49

Photo ID: 50

Photo ID: 51

VEGETATION AREA 8	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia and Woolly Bush. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 8 within the boundaries of the subject site will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 52	Photo ID: 53

VEGETATION AREA 9	
AS 3959:2018 Vegetation Classification Applied:	Class C Shrubland
Vegetation Types Present:	Closed heath C-10
Description/Justification:	Unmanaged shrub averaging less than 2 metres in height. Mixed species composition. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 9 within the boundaries of the subject site will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 54	Photo ID: 55

VEGETATION AREA 10	
AS 3959:2018 Vegetation Classification Applied:	Class C Shrubland
Vegetation Types Present:	Closed heath C-10
Description/Justification:	Unmanaged shrub averaging less than 2 metres in height. Mixed species composition. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 10 within the boundaries of the subject site will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 56

Photo ID: 57

VEGETATION AREA 11	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Low woodland B-07; Closed heath C-10 Closed scrub D-13; Open scrub D-14
Description/Justification:	Scrub dominant. Unmanaged medium to tall shrub up to 6 metres in height, but no greater. Mixed species composition inclusive of low Banksia. Unmanaged grasses present also.
Post Dev. Assumptions:	It is anticipated that sections of Area 11 within the boundaries of the subject site will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 58

Photo ID: 59

Photo ID: 60

VEGETATION AREA 12	
AS 3959:2018 Vegetation Classification Applied:	Class A Forest
Vegetation Types Present:	Low open forest A-04; Closed scrub D-13; Open scrub D-14
Description/Justification:	Forest dominant. Mixed species of trees present inclusive of tall Banksia and juvenile Jarrah. Trees with an average height of up to 10 metres. Canopy coverage greater than 50%. Understorey consists of unmanaged grasses, low shrub and low trees.
Post Dev. Assumptions:	It is anticipated that sections of Area 12 within the boundaries of the subject site will have some form of modification at the future development stage. This is however, subject to applicable Environmental and Local Government Authority Approvals.

Photo ID: 61

Photo ID: 62

Figure 3.1

Vegetation Classification & Topography Map - (Existing)

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

------ LEGEND ------

- Photos
- Elevation (m)
- Subject Site

Proposal

- Land Use Areas - (Outline)

Assessment Area

- 150m Buffer

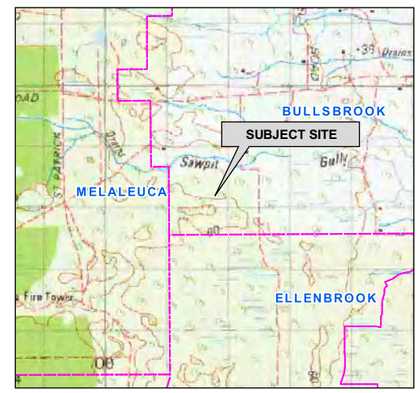
Classified Vegetation

- Class A - Forest
- Class C - Shrubland
- Class D - Scrub
- Class G - Grassland
- Exclusion 2.2.3.2

0 50 100 150 200 250

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 18-02-2022
SCALE (A3): 1 : 5700

BUSHFIRE PRONE PLANNING

3.1.3 Vegetation Separation Distance

The vegetation separation distance is the horizontal distance measured from the relevant parts of an existing building or a future building's planned location (within a lot), to the determined edge of an area of classified vegetation.

This separation distance applied to determining a Bushfire Attack Level (BAL) can be either:

- The *measured distance* – for which the location of the building relative to the edge of classified vegetation must be known. This will result in single determined BAL that will apply to a building. (The measured distance is a required calculation input); or
- A *calculated minimum and maximum distance (range)* that will correspond to each individual BAL. The calculated distances provide an indicative (or achievable) BAL for which the determined BAL will be dependent on the known location of the building relative to the edge of classified vegetation.

  The calculated range of distances corresponding to each BAL can be presented in different formats (tables or a BAL contour map), dependent on the form of information that is most appropriate for the proposed development/use. These distance ranges corresponding to BAL(s) will be presented in Section 3.2: 'Assessment Output".

For the proposed development/use, the applicable vegetation separation distances will be presented within the Bushfire Management Plan in this location:	In Section 3.2 'Assessment Output' as a table containing the calculated ranges of distance corresponding to each BAL and illustrated as a BAL Contour Map.

3.2 Assessment Output

UNDERSTANDING THE RESULTS OF THE BUSHFIRE IMPACT ASSESSMENT

Bushfire Attack Levels (BALs) – Their Application in the Building Environment is Different to the Planning Environment

In the building environment, a *determined BAL* is required for the proposed construction at the building application stage. This is to inform approval considerations and establish the bushfire construction standards that are to apply. An indicative BAL is not acceptable for a building application.

In the planning environment, through the application of SPP 3.7 and associated Guidelines, the deemed to satisfy requirement for a proposed 'development site' or sites (defined by the LPS Amendment Regulations 2015 as "that part of a lot on which a building that is the subject of development stands or is to be constructed"), is that a BAL-29 or lower rating can be achieved once all works associated with the proposal are completed. For planning approval purposes, an *indicative BAL* can provide the required information.

Determined Bushfire Attack Level

A determined BAL is to apply to an existing building or the 'development site' on which the building is to be constructed and not to a lot or building envelope. Its purpose is to state the potential radiant heat flux to which the building will be exposed, thereby determining the construction standard to be applied.

A determined BAL cannot be given for a future building whose design and position on the lot are unknown or the vegetation separation distance has not been established. It is not until these variables have been fixed that a determined BAL can be stated, and a BAL Certificate can be issued.

The one exception is when a building *of any dimension* can be *positioned anywhere* on a proposed lot (within R-Code building setbacks) or within a defined building envelope, and always remain subject to the same BAL, regardless of the retention of any existing classified vegetation either onsite or offsite.

Indicative Bushfire Attack Level

If a BAL is not able to achieve 'determined' status it will be an indicative BAL. It indicates the BAL that can be achieved by the proposed development/use. However, it is conditional upon an assessment variable(s) being confirmed at a later stage (e.g. the building location is established/changed, or vegetation is removed to establish the vegetation separation distance).

A BAL certificate cannot be issued for an indicative BAL – unless that BAL cannot vary (refer to 'Determined BAL' above).

In table form, a single or a range of indicative BAL(s) may be presented. If a single indicative BAL is stated for a defined area (i.e. the lot or building envelope), this will be the highest indicative BAL impacting the defined area.

In BAL contour map form (refer to Section 3.2.2), the illustrated BAL contours visually identify areas of land for which if any part of an existing or proposed building is located on that land and within the BAL contours, then the highest BAL affecting that building (or part of the land on which the building will be constructed), will be the indicative BAL that is to apply.

The BAL can only become a determined BAL once the actual location of that building on the land is known and/or the required minimum vegetation separation distance corresponding to the relevant BAL contour is established (refer to Table 3.2.2).

Table 3.2.1: Indicative BAL ratings – (Pre-Development)

MINIMUM SEPARATION DISTANCES REQUIRED TO RETAIN INDICATIVE, MAXIMUM, ACCEPTABLE BAL RATING – PRE-DEVELOPMENT				
Vegetation Area	Vegetation Classification	Effective Slope (degrees)	Maximum Acceptable BAL Rating	Required Separation Distances (metres)
1	Class G Grassland	upslope or flat	BAL-29	8m
2	Class A Forest	upslope or flat		21m
3	Class C Shrubland	upslope or flat		9m
4	Class D Scrub	upslope or flat		13m
5	Class A Forest	upslope or flat		21m
6	Class G Grassland	upslope or flat		8m
7	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
8	Class D Scrub	downslope >5-10		17m
9	Class C Shrubland	downslope >0-5		10m
10	Class C Shrubland	upslope or flat		9m
11	Class D Scrub	downslope >0-5		15m
12	Class A Forest	downslope >0-5		27m
Note[1]: Subject to any applicable Environmental Survey Works and approval from the Local Government Authority, it is possible for sections of Areas 1, 2, 3, 4, 5, 6, 8, 9, 10, 11 and 12 (within the boundaries of the subject site) to be re-classified to "Excluded AS3959:2018 2.2.3.2 (e&f)" once any applicable vegetation clearing/modification works can be conducted. Refer to Figure 3.2 – Vegetation Classification and Topography Map – (Post Development) and Figure 3.3 – BAL Contour Map – (Post Development).				
Note[2]: It is assumed for the purposes of assessment that Area 7 will continue/remain either devoid of vegetation or be managed in a low threat state in perpetuity as development of the site progresses.				

Table 3.2.2: Indicative BAL ratings – General Use Area & High Use Area - (Post-Development)

MINIMUM SEPARATION DISTANCES REQUIRED TO RETAIN INDICATIVE, MAXIMUM, ACCEPTABLE BAL RATING – POST-DEVELOPMENT				
Vegetation Area	Vegetation Classification	Effective Slope (degrees)	Maximum Acceptable BAL Rating	Required Separation Distances (metres)
1	Class G Grassland	upslope or flat	BAL-29	8m
*1	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
2	Class A Forest	upslope or flat		21m
*2	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
3	Class C Shrubland	upslope or flat		9m
*3	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
**3	Class A Forest	upslope or flat		21m
4	Class D Scrub	upslope or flat		13m
*4	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
**4	Class A Forest	upslope or flat		21m
5	Class A Forest	upslope or flat		21m
*5	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
**5	Class A Forest	upslope or flat		21m
6	Class G Grassland	upslope or flat		8m
*6	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
7	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
8	Class D Scrub	downslope >5-10		17m
*8	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
9	Class C Shrubland	downslope >0-5		10m
*9	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
10	Class C Shrubland	upslope or flat		9m
*10	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
11	Class D Scrub	downslope >0-5		15m
*11	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
12	Class A Forest	downslope >0-5		27m
*12	Excluded AS3959:2018 2.2.3.2 (e & f)	N/A		N/A
Note[1]: It is assumed for the purposes of assessment that Area 7 will continue/remain either devoid of vegetation or be managed in a low threat state in perpetuity as development of the site progresses.				
Note[2]: *1, *2, *3, *4, *5, *6, *8, *9, *10, *11 and *12 indicates vegetation subject to changes post development, with sections being reclassified to 'Excluded' AS3959-2018 (f)'. It is assumed for the purposes of assessment that these areas (where modified) will be maintained in a low threat state during the development process.				
Note[3]: **3, **4, **5 indicates vegetation subject to changes post development of this site as a result of revegetation works within the Conservation Category and Resource Enhancement Wetlands and their associated buffers. It is assumed for the purposes of assessment that these areas will not receive management. As such, sections are reclassified to Class A – Forest as a precautionary measure.				

Figure 3.2

Classified Vegetation & Topography Map - (Post Development)

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

------ LEGEND ------

- Photos
- Elevation (m)
- Subject Site

Proposal

- Land Use Areas - (Outline)

Assessment Area

- 150m Buffer

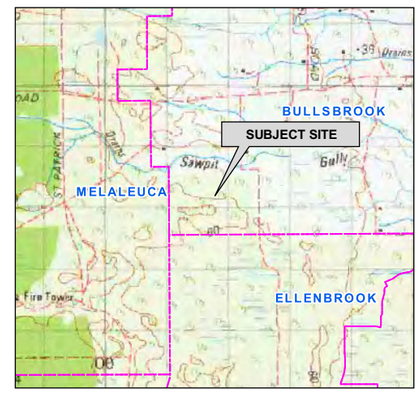
Classified Vegetation

- Class A - Forest
- Class C - Shrubland
- Class D - Scrub
- Class G - Grassland
- Exclusion 2.2.3.2

0 50 100 150 200 250

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 18-02-2022
SCALE (A3): 1 : 5700

BUSHFIRE PRONE PLANNING

3.2.1 Bushfire Attack Level Results - BAL Contour Map Format

INTERPRETATION OF THE BUSHFIRE ATTACK LEVEL (BAL) CONTOUR MAP

The contour map will present different coloured contour intervals extending from the areas of classified bushfire prone vegetation. These represent the different bushfire attack levels that will exist at varying distances away from the classified vegetation in the event of a bushfire in that vegetation.

The areas of classified vegetation to be considered in developing the BAL contours, are those that will remain as the intended end state of the subject development once earthworks, clearing and/or landscaping and re-vegetation have been completed (or each stage completed).

Each bushfire attack level corresponds to a set range of radiant heat flux that is generated by a bushfire. That range is defined by the AS 3959:2018 BAL determination methodology.

The width of each shaded BAL contour is a diagrammatic representation of the separation distances from the classified vegetation that correspond to each BAL for each separately identified area of classified vegetation. They have been calculated by the application of the unique site variables including vegetation types and structure, ground slope and applied fire weather.

(Refer to Section 3.2 'Understanding the Results of the Bushfire Impact Assessment' for the explanation of how BAL(s) for buildings will be assessed from the BAL Contour Map).

Construction of the BAL Contours

VEGETATION AREAS APPLIED TO THE DEVELOPMENT OF THE BAL CONTOUR MAP

All identified areas of classified vegetation have been applied with the following exceptions:

1. For Figures 3.2 and 3.3, all classified vegetation within the subject land (with the exception of the Conservation Category and Resource Enhancement Wetlands and their associated buffers), is excluded. BAL contours are constructed into the subject land from any classified vegetation outside of these areas.

This approach is applied to indicate the achievable bushfire attack levels within the specified land and the resultant area of developable land (i.e. subject to BAL-29 or less). It is based on the following assumptions:

1. Any classified vegetation within the lot (where applicable) can potentially be managed by the landowner to meet asset protection zone standards and dimensions corresponding to an indicated BAL; and
2. Each lot/s (where applicable) must be considered independent of what development may or may not take place on the adjoining lot.

Construction of the BAL Contours

Table 3.2.3: Vegetation separation distances applied to construct the BAL contours.

BAL CONTOUR MAP – APPLIED VEGETATION SEPARATION DISTANCES								
Derived from the Application of Method 1 BAL Determination Methodology (AS 3959:2018 Section 2, Table 2.5)[1]								
Vegetation Area	Vegetation Classification	Effective Slope (degrees)	BAL and Corresponding Separation Distance (m)					
			BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW
1	Class G Grassland	upslope or flat	<6	6-<8	8-<12	12-<17	17-<50	>50
*1	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Class A Forest	upslope or flat	<16	16-<21	21-<31	31-<42	42-<100	>100
*2	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	Class C Shrubland	upslope or flat	<7	7-<9	9-<13	13-<19	19-<100	>100
*3	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
**3	Class A Forest	upslope or flat	<16	16-<21	21-<31	31-<42	42-<100	>100
4	Class D Scrub	upslope or flat	<10	10-<13	13-<19	19-<27	27-<100	>100
*4	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
**4	Class A Forest	upslope or flat	<16	16-<21	21-<31	31-<42	42-<100	>100
5	Class A Forest	upslope or flat	<16	16-<21	21-<31	31-<42	42-<100	>100
*5	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
**5	Class A Forest	upslope or flat	<16	16-<21	21-<31	31-<42	42-<100	>100
6	Class G Grassland	upslope or flat	<6	6-<8	8-<12	12-<17	17-<50	>50
*6	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	Class D Scrub	downslope >5-10	<12	12-<17	17-<24	24-<35	35-<100	>100
*8	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Class C Shrubland	downslope >0-5	<7	7-<10	10-<15	15-<22	22-<100	>100
*9	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	Class C Shrubland	upslope or flat	<7	7-<9	9-<13	13-<19	19-<100	>100

*10	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	Class D Scrub	downslope >0-5	<11	11-<15	15-<22	22-<31	31-<100	>100
*11	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	Class A Forest	downslope >0-5	<20	20-<27	27-<31	37-<50	50-<100	>100
*12	Excluded AS3959:2018 2.2.3.2 (f)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Note[1]: It is assumed for the purposes of assessment that Area 7 will continue/remain either devoid of vegetation or be managed in a low threat state in perpetuity as development of the site progresses.								
Note[2]: *1, *2, *3, *4, *5, *6, *8, *9, *10, *11 and *12 indicates vegetation subject to changes post development, with sections being reclassified to 'Excluded' AS3959-2018 (f)'. It is assumed for the purposes of assessment that these areas (where modified) will be maintained in a low threat state during the development process.								
Note[3]: **3, **4, **5 indicates vegetation subject to changes post development of this site as a result of revegetation works within the Conservation Category and Resource Enhancement Wetlands and their associated buffers. It is assumed for the purposes of assessment that these areas will not receive management. As such, sections are reclassified to Class A – Forest as a precautionary measure.								

Figure 3.3

BAL Contour Map - (Post Development)

Lot 5892 on Plan / Diagram: P208236
Maralla Road
Bullsbrook
City of Swan

------ LEGEND ------

- Subject Site

Proposal

- Residential Areas
- Activity Centre
- CCW Core
- CCW Buffer
- REW Core
- REW Buffer
- Primary School
- POS Areas
- Neighbourhood Connector Road
- Local Road Network
- Road Widening

Assessment Area

- 100m Buffer
- 150m Buffer

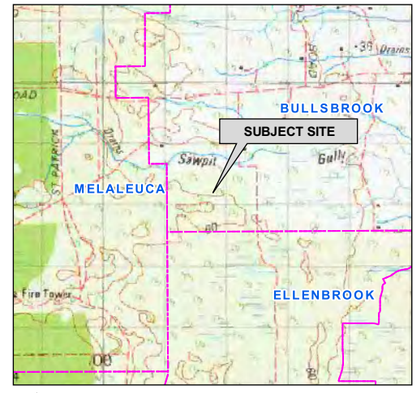
Bushfire Attack Levels

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 50 100 150 200 250

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Sarina Gorman 18-02-2022
SCALE (A3): 1 : 5700

BUSHFIRE PRONE PLANNING

3.2.2 Identification of Bushfire Hazard Issues Arising from the BAL Contour Map

While allotment layouts are not known at this stage, the proposal sets out various land use zones across the subject site. A BAL Contour Map has been used in lieu of a Bushfire Hazard Level (BHL) Assessment as it demonstrates in greater detail, that the development can be located in an area that will, on completion be subject to BAL-29 or below, subject to development design and location of allotments and associated structures.

IMPACT FROM VEGETATION – AS IT CURRENTLY EXISTS

The key assumption used to facilitate the determining of indicative Bushfire Attack Levels on the proposed development site is that vegetation onsite is under the control of the landowner and therefore can be removed or modified to present a low bushfire threat (Note: any proposed vegetation removal may be subject to Local Government approval, dependant on the lot's specific situation with respect to identified environmental protection areas and lot size).

Table 3.2.4: Land Use Zones currently subject to radiant heat levels corresponding to BAL-40 and/or BAL-FZ ratings that require consideration for development design and location of eventual allotments and associated structures.

LAND USE ZONES CURRENTLY SUBJECT TO RADIANT HEAT LEVELS CORRESPONDING TO BAL-40 AND/OR BAL-FZ	
Derived from the Application of Method 1 BAL Determination Methodology (AS 3959:2018 Section 2, Table 2.5)[1]	

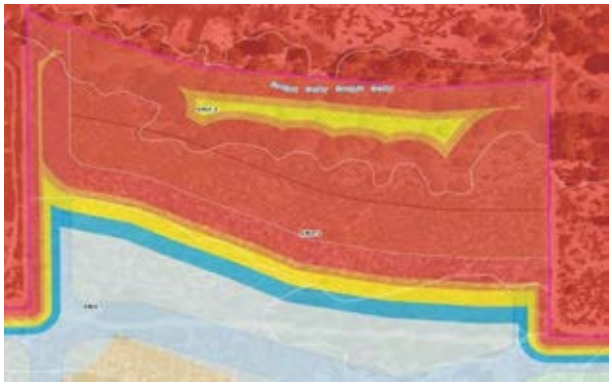
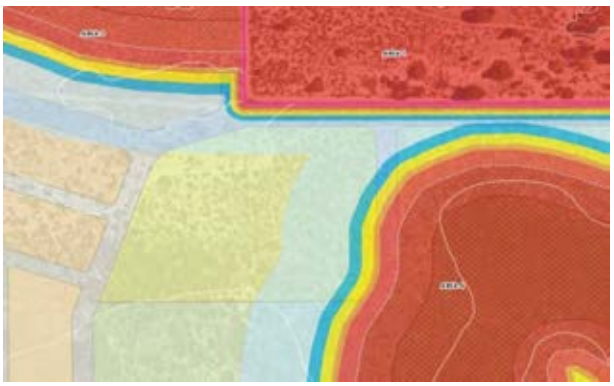

	

Photo ID: 1 – Residential Zone South of REW	Photo ID: 2 – Primary School Zone West of CCW

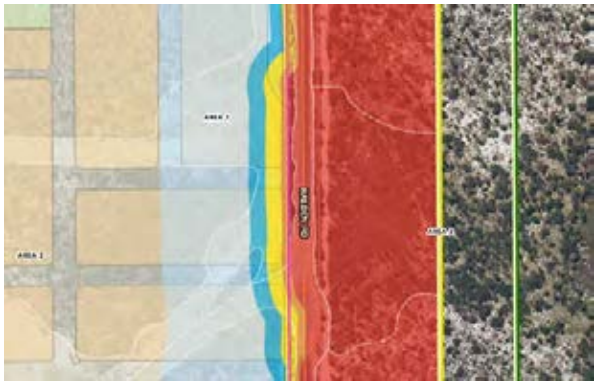



Photo ID: 3 – Residential Zone West of Neighbouring Allotment	

4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

In response to the Bushfire Management Plan requirements established by Appendix 5 of the Guidelines for Planning in Bushfire Prone Areas (WAPC 2021 v1.4), the following statements are made to assist in the understanding of whether the proposal is likely to be able to comply with the bushfire protection criteria now or in subsequent planning stages.

Spatial Context - Broader Landscape Considerations	
Wider road network and access constraints	At a local level, access options won't be limited to a single road in two directions to at least two suitable destinations once construction of the internal road network and surrounding road network connections to arterial roads have been completed. There is no access constraint for the subject site with regard to what is considered acceptable from a planning perspective, however, where development opportunities can increase local access options within the surrounding area, this would have merit that should be considered as benefiting a greater number of residents/occupants.
Proximity of settlements and emergency services	The subject site currently forms part of a large rural area. The closest Emergency services are located in Bullsbrook (17.7km and 18 minutes travel).
Bushfire prone vegetation types and extent (including conserved vegetation)	Significant extents of bushfire prone vegetation exist across the broader landscape as retained native vegetation (a combination forest, shrubland, scrub and grassland). The forest, shrub and scrub vegetation will produce significant embers and firebrands in a bushfire event primarily due to the type foliage and type of bark.
Topography and fire behaviour interactions.	The topography is undulating rather than rugged. Some areas of flat land, but slopes of zero (0) to five (5) degrees and five (5) to ten (10) do exist. Bushfire rates of spread can double for every ten degrees of upslope while downslopes will slow the rate of spread.
Potential for extreme fire behaviour and pyro convective events.	Possible extreme fire behaviour, due to vegetation types and connectivity of vegetation in its current, unmanaged state. Large landscape scale fire events are possible.
Environmental Considerations	
Constraints to implementing required and/or additional bushfire protection measures	The environment considerations have identified existing Conservation Category Wetlands (CCW) and Resource Enhancement Wetlands (REW) within the development boundary. Consideration to the allotment design layout will be given as to ensure that vegetation in these areas can be retained and ensure there is no increase in bushfire risk. Any retained native vegetation and/or proposed gardens, requires implementation of a landscape management plan to ensure ongoing mitigation treatments lessen the on-site bushfire threat and minimise ignition sources from direct (deliberate) or indirect (accidental) origin.
Provision of Access Within the Subject Site	
Potential constraints	Staging of future development will consider constraints to ensure establishing the required access to meet bushfire planning requirements.
Potential Bushfire Impacts	
Flame and radiant heat and ability to establish an APZ	Future development will implement a minimum of a BAL-29 dimensioned APZ (around habitable buildings and required structures) to be established within the individual lots. This will prevent flame contact from the classified vegetation. Application of the BAL-29 bushfire construction standard will mitigate the risks from radiant heat impact to what is considered an acceptable level.
Embers/firebrands, smoke and fire-driven wind	These will be the major impacts to the subject land. The appropriate protection measures of building construction and strict management of the APZ's will mitigate the risk to what is considered an acceptable level.

Issues to be Considered at Subsequent Planning Stages (additional assessments/documents)	
Specific land uses to be addressed	Land Use can be considered at the future development stage.
Additional assessments	N/A
Additional documents	Site specific Bushfire Management Plan for future subdivision proposals/development applications on the subject land that considers land use at that time.
Discretionary Decision Making and the Precautionary Principle (SPP 3.7 and Guidelines)	
Bushfire consultant consideration for further issues that need to be addressed?	Consideration for future staging of the land into various land uses through implementation of subsequent bushfire management plans to enable the creation of new lots at the localised level, to address bushfire risk.

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA ESTABLISHED BY THE GUIDELINES

For a development application to be considered compliant with SPP 3.7, it must satisfy (achieve) the intent of each of the four elements of the bushfire protection criteria. These criteria are established by the *Guidelines for Planning in Bushfire Prone Areas WAPC 2021 v1.4*). Compliance can be achieved by either:

- Meeting all applicable acceptable solutions corresponding to each element (i.e. the minimum bushfire protection measures that are deemed to satisfy planning requirements); or
- Where an acceptable solution cannot be met, by developing a performance solution that satisfies the established requirements.

5.1 Local Government Variations to Apply

Local governments may add to or modify the acceptable solutions of the Bushfire Protection Criteria (BPC) and/or apply technical requirements that vary from those specified in the Guidelines for Planning in Bushfire Prone Areas (WAPC). In such instances, this Proposal will be assessed against these variations and/or any specific local government technical requirements for emergency access and water. Refer to Appendices 2 and 3 for relevant technical requirements.

Will local or regional variations (endorsed by WAPC / DFES) to the applicable acceptable solutions established by the *Guidelines* apply to this Proposal?	N/A

Specific Local Government technical requirements where required to be applied will be addressed at the subsequent subdivision stage/s where requested by the local government.

5.2 Summary of Assessment Against the Bushfire Protection Criteria

SUMMARISED OUTCOME OF THE ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA					
Element of the Bushfire Protection Criteria	Basis for the Proposal Achieving Full Compliance with SPP 3.7			The Proposal Cannot Achieve Full Compliance with SPP 3.7	
	Acceptable Solutions Met		Achieves the Intent of the Element		
	All applicable solutions are fully met	All applicable solutions are not fully met. A merit-based assessment and/or a bushfire performance comparison of the proposals residual risk with that of the residual risk of the acceptable solution is conducted (refer Note 4)	A performance principle-based solution is applied	Bushfire planning development type that may not require full compliance is applied	An improvement in bushfire performance compared to the existing development is detailed (refer Note 4)
1. Location	✓			N/A	
2. Siting and Design of Development	✓				
3. Vehicular Access	✓				
4. Water	✓				

Note: The development proposal has been assessed:

1. Against the requirements established in Appendix 4 of the *Guidelines for Planning in Bushfire Prone Areas, WAPC 2021 v1.4 (Guidelines)*. The Guidelines are found at https://www.planning.wa.gov.au/8194.aspx; and
2. Applying the interpretation guidance provided in *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.
3. Applying any endorsed variations to the Guideline's acceptable solutions and associated technical requirements that have been established by the local government. If known and applicable these have been stated in Section 5.1 with the detail included as an appendix if required by the local government.
4. When non-compliant with SPP 3.7 and when appropriate, by utilising additional compliance pathways that include the application of merit-based assessment and comparative bushfire performance. The validity of this approach is derived from relevant decisions made by the responsible authorities (refer Appendix 4).

5.3 Assessment Detail

Element 1: Location	
Intent: To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	
Compliance: How the proposed development achieves the intent of Element 1:	Will be able to achieve the intent of the element by fully meeting all applicable acceptable solutions.
ASSESSMENT (COMPLIANCE) STATEMENTS For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2021 v1.4)* and apply the interpretation guidance established by the *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.	
Acceptable Solution: A1.1: Development Location	

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

The future development of the subject land can provide an area of land within each individual lot (once known) that can be considered suitable for development as BAL-40 or BAL-FZ construction standards will not be required to be applied. Subject to further Environmental Studies, this can meet the requirements established by Acceptable Solution A1.1 and its associated explanatory note.

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE POSITION STATEMENT

The position statement establishes that:

- The source of risk (the hazard) to be considered in Element 1 is the "level of bushfire exposure" from the type and extent of bushfire prone vegetation and the topography of the land on which it exists; and
- "Consideration should be given to the site context" which includes the land both "within and adjoining the subject site". The "hazards remaining within the site should not be considered in isolation of the hazards adjoining the site, as the potential impact of a bushfire will be dependent on the wider risk context."

The position statement also recognises:

- That the proposed development site and its surrounding land may be part of an area "identified for development or intensification of land use prior to the release of SPP 3.7"; consequently
- Consideration by decision-makers "should also be given to improving bushfire management of the site and surrounding area, thereby reducing the vulnerability of people property and infrastructure to bushfire"; and
- The application of mitigation measures to lessen the risk to the broader area would include improvements to the local road network (including emergency access ways), improvements/additions to firefighting water supply and increasing separation distance from the hazard.

The Hazard Within the Subject Land

The proposal is determining the suitability of, and to facilitate future development (re-zoning and subsequent subdivision) of the subject land into a combination of land uses including Residential Areas, Activity Centres, Schools and Public Open Space Areas. The development site currently lies within a bushfire prone area as defined by the OBRM map of Bushfire Prone Areas. It exists within an existing rural area (suburb of Bullsbrook). The removal or modification of classifiable vegetation will be required (subject to further environmental studies (where applicable) and approval by the Local Government) within the subject land.

Element 1: Location

The existing area is currently vegetated with vegetation being classified as Class A – Forest, Class D – Scrub, Class C - Shrubland and Class G - Grassland. The topography is undulating rather than rugged, however has a predominantly 'flat land' appearance over large areas. The impact of slopes under the vegetation will be dependent on a bushfire's direction of travel. A bushfire travelling upslope will have increased intensity and rate of spread.

Significantly intense bushfire behaviour is possible, particularly if vegetation within the subject land is ignited by bushfire in the adjoining hazards and they are involved together.

However, the ability to establish a BAL-29 dimensioned APZ within the lot's boundaries for future development removes the threat of greater levels of radiant heat or flame contact upon a future structure.

The primary bushfire threat from bushfire prone vegetation remaining within the subject land will be radiant heat and embers. This threat will be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of the APZ to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

The Hazard Adjoining the Subject Land

Bushfire prone vegetation within the area exists as retained native vegetation classified as Class A – Forest, Class C – Shrubland, Class D – Scrub and Class G - Grassland. The undeveloped land within the locality supports this vegetation. Non-vegetated areas (existing Sand Quarry and constructed road network) do exist.

The impact of the slope under the vegetation will be dependent on a bushfire's direction of travel, but slopes in the range of zero to five degrees downslope from the proposed lots do exist. Bushfire travelling upslope will have increased intensity and rate of spread. However, the adjoining land cannot be considered as rugged (which would present the potential for more extreme and variable fire behaviour).

Bushfire prone vegetation adjoining the existing subject land exists as native vegetation. The extent of this hazard is shown in Figures 3.2 and 3.3. These areas of vegetation are occurring under two scenarios:

1. Native vegetation that has been retained both on the subject land due to environmental significance and the adjoining land; and
2. A bush forever site that adjoins the southern and western boundaries of the subject land which would present the most significant extent of bushfire prone vegetation once development has been completed.

Consequently, the potential exists for intense bushfire behaviour to occur on heightened days of bushfire risk where low humidity and high temperatures occur. The potential bushfire impact on persons and property within the site will be an increase the level of ember attack and potential for running fire on site in the event of a bushfire.

This ember threat and subsequent running fire will be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of the BAL-29 dimensioned APZ's, to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

Element 2: Siting and Design of Development

Intent: To ensure that the siting and design of development (note: not building/construction design) minimises the level of bushfire impact.

Compliance: How the proposed development achieves the intent of Element 2:	Will be able to achieve the intent of the element at a later planning stage by fully meeting all applicable acceptable solutions.

ASSESSMENT (COMPLIANCE) STATEMENTS

For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2021 v1.4)* and apply the interpretation guidance established by the *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.

Acceptable Solution: A2.1: Asset Protection Zone

THE APZ - DEVELOPMENT SITING AND DESIGN PLANNING REQUIREMENTS

The necessary outcome of bushfire planning for development siting and design, is to ensure that a building can be located within the developable portion of any lot (i.e. outside those parts of the lot that form the required R-Code building setbacks, or any other excluded area), and be subject to potential radiant heat from a bushfire not exceeding 29 kW/m^2 (i.e. a maximum BAL of BAL-29).

This will be achieved when the size of the "low fuel area immediately surrounding a building", the asset protection zone (APZ), is large enough. This requires a certain separation distance to exist between the building and areas of classified vegetation. These are the BAL-29 APZ dimensions and they will vary dependent on site specific parameters.

The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity.

Where possible, planning for siting and design should incorporate elements that include non-vegetated areas (e.g. roads/parking/drainage) and/or formally managed areas of vegetation (public open space/recreation areas/ services installed in a common section of land), as either part of the required APZ dimensions or to additionally increase separation distances to provide greater protection. These elements create robust and easier managed asset protection zones.

THE ASSESSMENT

Future buildings on the subject land, at the subsequent development application stage, can be surrounded by an APZ that will ensure the potential radiant heat impact of a bushfire does not exceed 29 kW/m^2 (BAL-29). The required APZ specifications of width, location and management can be achieved through site planning and positioning of buildings.

Width: The required APZ dimensions to ensure buildings are subject to a maximum BAL of BAL-29 (measured from any external wall or supporting post or column to the edge of the classified vegetation), has been determined in Section 3.2 of this BMP and are:

BAL-29 APZ Dimensions		
Applicable to all Future Lots	Building to Vegetation Area *1	Minimum 8 metres
	Building to Vegetation Area **1	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area *2	Minimum 21 metres
	Building to Vegetation Area **2	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area *3	Minimum 9 metres

	Building to Vegetation Area **3	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area ***3	Minimum 21 metres
	Building to Vegetation Area 4	Minimum 13 metres
	Building to Vegetation Area **4	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area ***4	Minimum 21 metres
	Building to Vegetation Area *5	Minimum 21 metres
	Building to Vegetation Area **5	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area ***5	Minimum 21 metres
	Building to Vegetation Area 6	Minimum 8 metres
	Building to Vegetation Area **6	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area 8	Minimum 17 metres
	Building to Vegetation Area **8	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area *9	Minimum 10 metres
	Building to Vegetation Area **9	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area 10	Minimum 9 metres
	Building to Vegetation Area **10	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area *11	Minimum 13 metres
	Building to Vegetation Area **11	Excluded AS3959:2018 2.2.3.2 (f)
	Building to Vegetation Area 12	Minimum 27 metres
	Building to Vegetation Area **11	Excluded AS3959:2018 2.2.3.2 (f)

- * Indicates unmanaged vegetation that is also located outside of the subject land. Vegetation that is onsite is within the control of the subject site's landowner/s and therefore can potentially be removed or maintained to mitigate the bushfire risk, subject to any approval being required by a local government. With the exception of Maralla Road to the south of the subject site (it is assumed that this will be constructed to meet the Bushfire Technical requirements established by the Guidelines to enable access to the Residential and POS areas at the southern portion of the site), vegetation that is located offsite however, cannot be removed or modified for BAL reduction purposes as it is not within the control of the subject site landowner.
- ** Indicates vegetation subject to changes post development of this site, with the area/s being reclassified to 'Excluded' AS3959-2018 (f)'. This is the result of the implementation of Asset Protection Zones around any proposed structures and landscaping within the subject land. These areas are to be maintained to a low bushfire threat state in perpetuity in accordance with Schedule 1: Standards for Asset Protection Zones as stipulated in the Guidelines for Planning in Bushfire Prone Areas, AS3959-2018 s2.2.3.2 requirements and the City of Swan Fire Hazard Reduction Notice.
- *** Indicates vegetation subject to changes post development of this site, with the area/s being reclassified to as a result of potential revegetation works or natural re-seeding within the CCW and REW buffers with sections being reclassified to Class A – Forest.

APZ Location: Asset protection zones can be contained solely within the boundaries of the lots (where applicable). Onsite vegetation will be required to be modified/removed, the authority for which will need to be received from the local government.

Element 2: Siting and Design of Development

APZ Management: All vegetation that will require modification/removal and future management is onsite and therefore under the control of the landowner.

Retained vegetation within the APZ's will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines). The APZ specifications are also detailed in Appendix 1 and the City of Swan may have additional requirements established by their Fire Hazard Reduction Notice (Firebreak Notice).

THE APZ – REQUIRED DIMENSIONS TO SATISFY FUTURE BUILDING (AND ONGOING MANAGEMENT)

It is important for the landowner to be aware that the APZ dimensions that will be required to be physically established and maintained on the lot surrounding relevant future buildings, may be different to those for the BAL-29 APZ - which is the minimum dimension a planning proposal needs to show can be established to comply with SPP 3.7.

The actual APZ dimensions to be physically established and maintained, will be based on which of the following establishes the larger APZ dimension:

- The dimensions corresponding to the determined BAL of a building; or
- The APZ dimensions established by the local government's Firebreak Notice.

The dimensions of the APZ that are to be established are not known at this time, they will be stated within the future bushfire management plans at the subdivision stages.

For the future development on the site, any future buildings potential for determined BAL(s) lower than BAL-29 being achieved, will require greater sized APZ's. The APZ's are to be determined at the future subdivision stage.

Element 3: Vehicular Access	
Intent: To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event.	
Compliance: How the proposed development achieves the intent of Element 3:	Will be able to achieve the intent of the element at a later planning stage by fully meeting all applicable acceptable solutions.
ASSESSMENT (COMPLIANCE) STATEMENTS For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2021 v1.4).*	
Acceptable Solution: A3.1: Public Roads	
The existing sealed bitumen road network available to the proposed subdivision can provide a suitable trafficable transport route. The construction technical requirements established by the Guidelines and/or the local government for all proposed public roads both internal and external to the subject site (subject to relevant approvals) can and will be complied with. These requirements are set out in Appendix 2.	
Acceptable Solution: A3.2a: Multiple Access Routes	
The subject site currently only has one access route. Halden Road to the east is currently a No-Through Road. The proposed network as set out in Figures 1.1 and 1.4 ensures compliance with this Acceptable Solution can be achieved as this will provide access in two different directions to at least two different destinations. The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 2.	
Acceptable Solution: A3.2b: Emergency Access Way	
The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 2.	
Acceptable Solution: A3.3: Through Roads	
Halden Road to the east is currently a No-Through Road. To ensure compliance with this Acceptable Solution, the construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 2.	
Acceptable Solution: A3.4a: Perimeter Roads	
The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 2.	
Acceptable Solution: A3.4b: Fire Service Access Route	
N/A	
Acceptable Solution: A3.5: Battle-axe Access Legs	
N/A	
Acceptable Solution: A3.6: Private Driveways	
The proposed lots will have frontage to the internal subdivision road networks. In addition, there will be limited building setbacks due to their size/area. Increased driveway standards will not be required for this proposal.	

Element 4: Water	
Intent: To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	
Compliance: How the proposed development achieves the intent of Element 4:	Will be able to achieve the intent of the element at a later planning stage by fully meeting all applicable acceptable solutions.
ASSESSMENT (COMPLIANCE) STATEMENTS For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2021 v1.4).*	
Acceptable Solution: A4.1: Identification of Future Water Supply	
Where reticulated water supply will be available to the subject land, hydrants will be installed at the required intervals. Commercial – 100 metres, Residential – 200 metres, Rural Residential – 400 metres. The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 3.	
Acceptable Solution: A4.2: Provision of Water for Firefighting Purposes	
The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 3.	

5.4 Additional Bushfire Protection Measures

SUMMARY OF ADDITIONAL BUSHFIRE PROTECTION MEASURES (TREATMENTS) TO BE APPLIED		
Treatment Category	Brief Description	Intent the Treatment Has Been Developed to Help Achieve
Siting and Design	Locating future Land Use Zones, allotments and their associated buildings on the subject site where an APZ can achieve a minimum 29kW/m^2.	Avoid areas of BAL-40 or BAL-FZ to lessen the bushfire impact on the buildings and occupants.
Vehicular Access	Construction of internal public road networks (if applicable) within the subject site to achieve the requirements of Table 6 in the *Guidelines for Planning in Bushfire Prone Areas.*	Vehicular Access – To provide a safe operational environment for emergency services and while occupants are accessing or egressing the site.
Provision of Water	Dedicated water supply for fire-fighting operations and appropriate access for fire appliances.	To provide an adequate supply of water for fire-fighting operations should resources be available, and conditions are tenable to do so during a bushfire event, by the property manager and emergency services.

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE PROTECTION MEASURES

Table 6.1: BMP Implementation responsibilities prior to the issue of clearances.

Developer (Landowner) - Prior to Issue of Clearances		
No.	Implementation Actions	Development Clearance
Note: Planning approval may be conditioned with the requirements: 1. To place certain notifications on the certificates of title and the deposited plan, regarding the existence of this bushfire management plan and the obligations it creates; and 2. To provide certification of the implementation of certain bushfire protection measures established by this bushfire management plan.		
1	Condition (as per Code F1 of Model Subdivision Schedule, WAPC April 2020): Information is to be provided to demonstrate that the measures contained in Section 6; Tables 6.1 and 6.2 of this Bushfire Management Plan (version and date referenced in the condition), have been implemented during development works. This information should include a completed 'Certification by Bushfire Consultant' from the bushfire management plan. (Local Government)	☐
2	Condition (as per Code F2 of Model Subdivision Schedule, WAPC April 2020): A notification, pursuant to Section 165 of the *Planning and Development Act 2005*, is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows: *"This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and is/may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land."* (Western Australian Planning Commission).	☐
3	Construct the public roads to the standards stated in the BMP.	☐
4	Where Required - Construct the emergency access ways, fire service access routes and associated signs and gates to the standards stated in the BMP.	☐
5	Where Required - Install the reticulated water supply (hydrants) to the standards stated in the BMP.	☐
6	Where Required - Install the required strategic 50,000 litre water tank/s to the standards stated in the relevant acceptable solution and applying the guidance provided in Appendix 3 or to the specific requirements of the local government.	☐

Table 6.2: BMP Implementation responsibilities prior to lot sale, occupancy or building.

6.2 Landowner (Developer) - Prior to Sale of Lot(s)	
No.	Implementation Actions
1	Prior to sale and post planning approval, the entity responsible for having the BMP prepared should ensure that anyone listed as having responsibility under the Plan has endorsed it and is provided with a copy for their information and informed that it contains their responsibilities. This includes the landowners/proponents (including future landowners where the Plan was prepared as part of a subdivision approval), local government and any other authorities or referral agencies ('Guidelines' s4.6.3).
2	Prior to sale of the subject lots (where applicable), each individual lot is to be compliant with the City of Swan Fire Hazard Reduction Notice issued under s33 of the Bushfires Act 1954. This may include specifications for asset protection zones that differ from the Guideline's APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with. Refer to Appendix 1.
3	There is an outstanding obligation, created by this Bushfire Management Plan, for a site-specific Bushfire Management Plan at the future subdivision or development stage/s for the land use, at the subsequent subdivision/development application stage.

Table 6.3: Ongoing management responsibilities for the Landowner/Occupier.

6.3 Landowner/Occupier - Ongoing	
No.	Ongoing Management Actions
1	Maintain the Asset Protection Zone (APZ) surrounding existing buildings to the largest dimension as determined by either: • The dimensions corresponding to the determined BAL of a building; or • The dimensions corresponding to the local government's Firebreak Notice. Maintain the APZ to the above dimensions and to the standards established by the Guidelines (refer to Appendix 1) or as varied by the local government through their Firebreak Notice (refer to the following responsibility).
2	Comply with the City of Swan Fire Hazard Reduction Notice issued under s33 of the Bush Fires Act 1954. This may include specifications for asset protection zones that differ from the Guideline's APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with. Refer to Appendix 1.
3	Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with: 1. the requirements of the WA Building Act 2011 and the bushfire provisions of the Building Code of Australia (BCA); and 2. with any identified additional requirements established by this BMP or the local government.

Table 6.4: Ongoing management responsibilities for the Local Government.

6.4 Local Government - Ongoing	
No.	Ongoing Management Actions
1	Monitor landowner compliance with the Bushfire Management Plan and the annual Fire Hazard Reduction Notice (Firebreak Notice).

APPENDIX 1: TECHNICAL REQUIREMENTS FOR ONSITE VEGETATION MANAGEMENT

A1.1 Requirements Established by the Guidelines – Standards for Asset Protection Zones

(Source: Guidelines for Planning in Bushfire Prone Areas - WAPC 2021 v1.4 Appendix 4, Element 2, Schedule 1 and Explanatory Note E2)

DEFINING THE ASSET PROTECTION ZONE (APZ)

Description: An APZ is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level (by reducing fuel loads). The width of the required APZ varies with slope and vegetation and varies corresponding to the BAL rating determined for a building (lower BAL = greater dimensioned APZ).

For planning applications, the minimum sized acceptable APZ is that which is of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m² (BAL-29). It will be site specific.

For subdivision planning, design elements and excluded/low threat vegetation adjacent to the lot(s) can be utilised to achieve the required vegetation separation distances and therefore reduce the required dimensions of the APZ within the lot(s).

Defendable Space: The APZ includes a defendable space which is an area adjoining the asset within which firefighting operations can be undertaken to defend the structure. Vegetation within the defendable space should be kept at an absolute minimum and the area should be free from combustible items and obstructions. The width of the defendable space is dependent on the space, which is available on the property, but as a minimum should be 3 metres.

Establishment: The APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity.

The APZ may include public roads, waterways, footpaths, buildings, rocky outcrops, golf courses, maintained parkland as well as cultivated gardens in an urban context, but does not include grassland or vegetation on a neighbouring rural lot, farmland, wetland reserves and unmanaged public reserves.

[Note: Regardless of whether an Asset Protection Zone exists in accordance with the acceptable solutions and is appropriately maintained, fire fighters are not obliged to protect an asset if they think the separation distance between the dwelling and vegetation that can be involved in a bushfire, is unsafe.]

E2 Managing an Asset Protection Zone (APZ) to a low threat state

An APZ is a low fuel area maintained around a habitable building to increase the likelihood that it will survive a bushfire, by providing a defendable space and reducing the potential for direct flame contact, radiant heat exposure and ember attack.

Vegetation management within an APZ should provide defendable space and be maintained to a low threat state, in perpetuity, in accordance with the requirements outlined in Schedule 1.

The width of an APZ varies with slope and vegetation type, however it should only be as wide as needed to ensure the potential radiant heat impact of a bushfire does not exceed 29kW/m² (BAL-29), or 10kW/m² where a building is identified for use as an on-site shelter. An APZ is generally not required where a building or development site achieves 29kW/m² (BAL-29) or lower in its pre-development state (prior to any vegetation clearing or modification).

An APZ should include an area of defendable space immediately adjoining a building, that is kept free from combustible items and obstructions, within which firefighting operations can be undertaken to defend the structure. Where a lot contains a building envelope, it may not be necessary for the entire building envelope to achieve 29kW/m² (BAL-29) as this may result in significant unnecessary clearing. It is recommended that the BMP identifies that a sufficient APZ can be accommodated within the building envelope, with the development site and associated APZ to be determined at the development approval stage.

An APZ should be contained within the boundaries of the lot on which the building is situated, except in instances where it is demonstrated that the vegetation on the adjoining land is managed in a low threat state, as per cl. 2.2.3.2 of AS 3959, such as a road, managed park, rocky outcrop or a water body.

The siting of a habitable building and associated APZ should aim to minimise the clearing of vegetation. The BMP should demonstrate that the proposed APZ has minimised the unnecessary loss of vegetation or potential for conflict with landscape or environmental objectives; and complies with environmental approvals/exemptions (where necessary). A re-design or reduction in lot yield may be necessary to minimise the removal and modification of remnant vegetation.

It is recommended that development be located on flat areas or slopes less than 20 degrees (especially where classified vegetation is located downslope to a building) and away from ridge tops, crests or narrow gullies, as bushfire can spread rapidly in these areas. Circumstances where these locations may be suitable for development to occur include where the land is already cleared, and 29kW/m² (BAL-29) or lower can be achieved for the whole development site without the use of an APZ. To ensure soil stability within an APZ, vegetation removal on slopes exceeding 18 degrees is discouraged.

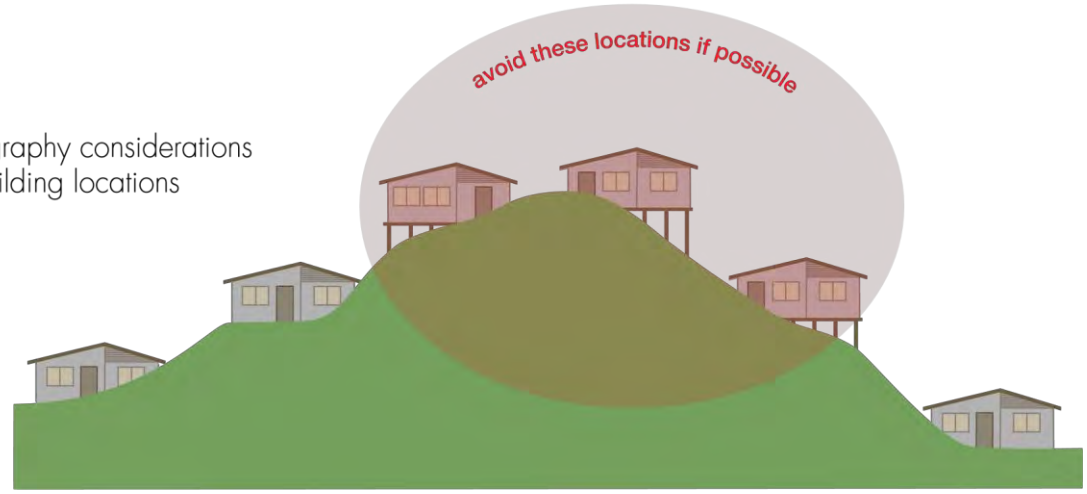


Figure 17: Topography considerations for building locations

(Source: Guidelines for Planning in Bushfire Prone Areas 2021, Appendix 4)

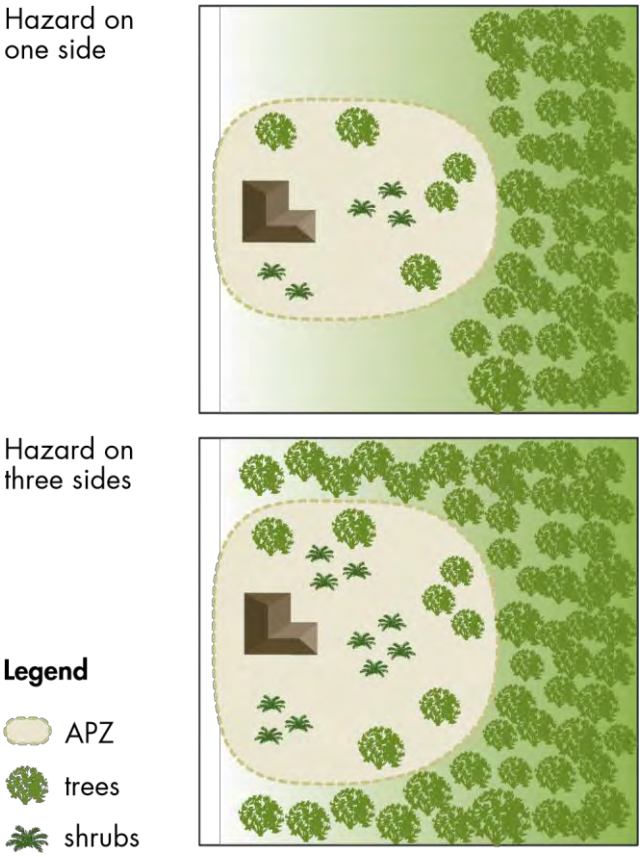
Fine fuel load should be maintained to less than two tonnes per hectare; however this is often a subjective assessment. Reducing fuel load levels does not necessarily require the removal of existing vegetation. A combination of methods can be utilised to reduce fuel load such as raking, weed removal, pruning, mulching and/or the removal of plant material.

A simple method to estimate fuel load is to roughly equate one tonne of fuel load per hectare as 100 grams per square metre. For example, two tonnes per hectare of leaf litter is roughly 200 grams of leaf litter per square metre and eight tonnes per hectare is roughly 800 grams. Eucalyptus leaf litter is approximately 100 grams per handful, so two handfuls of litter per square metre will roughly equate to two tonnes per hectare. Different types of fine fuel, like mulch or pine needles may be more or less than a handful, however the 100 grams per square metre rule of thumb can still be used.

The landowner or proponent is responsible for maintaining an APZ in accordance with Schedule 1 - Standards for Asset Protection Zones. Ongoing maintenance of an APZ is usually enforced through the local government firebreak notice issued under section 33 of the *Bushfires Act 1954*, and/or through a condition of a development approval, which requires the implementation of measures identified within a BMP.

A copy of the firebreak notice and Schedule 1 should be included in a BMP specifically as a how-to guide for the landowner, and to demonstrate to decision-makers that the measures outlined in the BMP to achieve the appropriate BAL rating through provision and ongoing management of an APZ, can be implemented.

Regardless of whether an Asset Protection Zone exists in accordance with the acceptable solutions and is appropriately maintained, it should be noted that fire fighters are not obliged to protect an asset if they think the separation distance between the dwelling and vegetation is unsafe.



(Source: Guidelines for Planning in Bushfire Prone Areas 2021, Appendix 4)

E2 Landscaping and design of an asset protection zone

Landscaping, design, and maintenance of an APZ in a bushfire prone area can significantly improve the bushfire resilience of a building. An APZ should not be seen as an area entirely cleared of vegetation, but as a strategically designed space that gives holistic consideration to how existing or proposed vegetation or non-combustible features interact with or affect the building's bushfire resilience.

A well designed APZ provides a greater level of vegetation management within the first few metres of a building with, for example, less vegetation or inclusion of non-combustible materials. The vegetation within the remainder of an APZ can increase further away from the building with carefully considered plant selection and landscaping techniques.

Strategic landscaping measures can be applied, such as replacing weeds with low flammability vegetation (refer to E2 Plant Flammability) to create horizontal and vertical separations between the retained vegetation. The accumulation of fine fuel load from different plants is an important consideration for ongoing maintenance in accordance with Schedule 1. For example, when planting ground covers under deciduous trees within an APZ, the total fine fuel load prescribed in Schedule 1 will include any dead plant material from ground covers and leaf litter from the trees.

Plant density and final structure and form of mature vegetation should be considered in the initial landscaping stages. For example, clumps of sapling shrubs planted at a density without consideration of future growth, may increase the bushfire risk as a clump will quickly grow to exceed 5m^2. It should be noted that in some cases, a single shrub in a mature state may be so dense as to fill a 5m^2 clump alone.

The location of plants within an APZ is a key design technique. Separation of garden beds with areas of low fuel or non-combustible material, will break up fuel continuity and reduce the likelihood of a bushfire running through an APZ and subjecting a dwelling to radiant heat or direct flame contact. It is important to note, where mature trees are separated from a building by six metres, but the canopy has grown to extend or overhang a building, maintenance and pruning to remove the overhanging branches should be undertaken without the entirety of the tree being removed.

Mulches used within the APZ should be non-combustible. The use of stone, gravel, rock and crushed mineral earth is encouraged. Wood mulch >6mm in thickness may be used, however it is recommended that it is used in garden beds or areas where the moisture level is higher by regular irrigation. These materials could be sourced from non-toxic construction and demolition waste giving the added benefit of reducing the environmental impact of any 'hard landscaping' actions.

Combustible objects, plants, garden supplies such as mulches, fences made from combustible material, should be avoided within 10 metres of a building. Vines or climbing plants on pergolas, posts or beams, should be located away from vulnerable parts of the building, such as windows and doors. Non-flammable features can be used to provide hazard separation from classified vegetation, such as tennis courts, pools, lawns and driveways or paths that use inorganic mulches (gravel or crushed rock). Consider locating firewood stacks away from trees and habitable buildings.

Incorporation of landscaping features, such as masonry feature walls can provide habitable buildings with barriers to wind, radiant heat and embers. These features can include noise walls or wind breaks. Use of Appendix F of AS 3959 for bushfire resistant timber selection within areas of 29kW/m^2 (BAL-29) or below, or the use of non-combustible fencing materials such as iron, brick, limestone, metal post and wire is encouraged.

In addition to regular maintenance of an APZ, further bushfire protection can be provided at any time

by: – ensuring gutters are free from vegetation;

- installing gutter guards or plugs;
- regular cleaning of underfloor spaces, or enclosing them to prevent gaps;
- trimming and removing dead plants or leaf litter;
- pruning climbing vegetation (such as vines) on a trellis, to ensure it does not connect to a building, particularly near windows and doors;
- removing vegetation in close proximity to a water tank to ensure it is not touching the sides of a tank; and/or
- following the requirements of the relevant local government section 33 fire break notice, which may include additional provisions such as locating wood piles more than 10 metres from a building.

Preparation of a property prior to the bushfire season and/or in anticipation of a bushfire is beneficial even if your plan is to evacuate. As embers can travel up to several kilometres from a bushfire and fall into small spaces and crevices or land against the external walls of a building, best practice recommends that objects within the APZ are moved away from the building prior to any bushfire event. Objects may include, but are not limited to: • door mats;

- outdoor furniture;
- potted plants;
- shade sails or umbrellas;
- plastic garbage bins;
- firewood stacks;
- flammable sculptures; and/or
- playground equipment and children's toys.

E2 Plant flammability

There are certain plant characteristics that are known to influence flammability, such as moisture or oil content and the presence and type of bark. Plants with lower flammability properties may still burn during a bushfire event but may be more resistant to burning and some may regenerate faster post-bushfire.

There are many terms for plant flammability that should not be confused, including:

- Fire resistant – plant species that survive being burnt and will regrow after a bushfire and therefore may be highly flammable and inappropriate for a garden in areas of high bushfire risk.
- Fire retardant – plants that may not burn readily or may slow the passage of a bushfire.
- Fire wise – plants that have been identified and selected based on their flammability properties and linked to maintenance advice and planting location within a garden.

Although not a requirement of these Guidelines, local governments may develop their own list of fire wise or fire-retardant plant species that suit the environmental characteristics of an area. When developing a recommended plant species list, local governments should consult with ecologists, land care officers or environmental authorities to ensure the plants do not present a risk to endangered ecological communities, threatened, or endangered species or their habitat.

When selecting plants, private landholders and developers should aim for plants within the APZ that have the following characteristics:

- grow in a predicted structure, shape and height;
- are open and loose branching with leaves that are thinly spread;
- have a coarse texture and low surface-area-to-volume ratio;
- will not drop large amounts of leaves or limbs, that require regular maintenance;
- have wide, flat, and thick or succulent leaves;
- trees that have bark attached tightly to their trunk or have smooth bark;
- have low amounts of oils, waxes, and resins (which will often have a strong scent when crushed); – do not produce or hold large amounts of fine dead material in their crowns; and/or – will not become a weed in the area.

Refer to the WAPC Bushfire and Vegetation Fact Sheet for further information on clearing and vegetation management and APZ landscaping, design and plant selection reference material.

Schedule 1: Standards for APZ

Fences: Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).

Fine Fuel Load (Combustible, dead vegetation matter <6 millimetres in thickness):

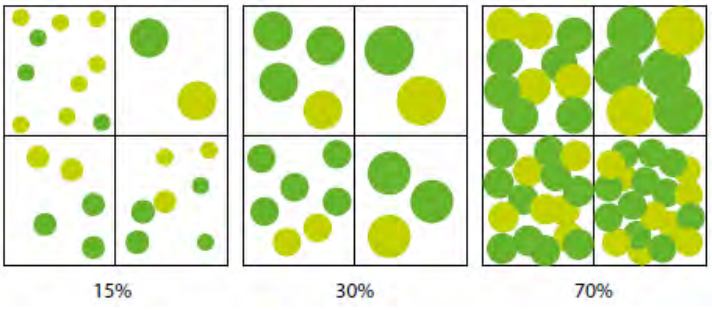
- Should be managed and removed on a regular basis to maintain a low threat state.
- Should be maintained at <2 tonnes per hectare (on average).
- Mulches should be non-combustible such as stone, gravel or crushed mineral earth or wood mulch >6 millimetres in thickness.

Example: Fine fuel load of 2 t/ha
(Image source: Shire of Augusta Margaret River's Firebreak and Fuel Reduction Hazard Notice)

Trees* (> 6 metres in height):

- Trunks at maturity should be a minimum distance of six metres from all elevations of the building.
- Branches at maturity should not touch or overhang a building or powerline.
- Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation.
- Canopy cover within the APZ should be <15 per cent of the total APZ area.
- Tree canopies at maturity should be at least five metres apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ.

Tree canopy cover – ranging from 15 to 70 per cent at maturity



(Source: Guidelines for Planning in Bushfire Prone Areas 2021, Appendix 4)

Shrub* and Scrub* (0.5 metres to 6 metres in height Shrub and Scrub >6 metres in height are to be treated as trees):

- Should not be located under trees or within three metres of buildings.
- Should not be planted in clumps >5 square metres in area.
- Clumps should be separated from each other and any exposed window or door by at least 10 metres.

Ground covers* (<0.5 metres in height. Ground covers greater than >0.5 metres in height are to be treated as shrubs):

- Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above.
- Can be located within two metres of a structure, but three metres from windows or doors if >100 millimetres in height.

Grass:

- Grass should be maintained at a height of 100 millimetres or less, at all times.
- Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.

Defendable Space: Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and non-combustible mulches as prescribed above.

LPG Gas Cylinders:

- Should be located on the side of a building furthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building.
- The pressure relief valve should point away from the house.
- No flammable material within six metres from the front of the valve.
- Must sit on a firm, level and non-combustible base and be secured to a solid structure.

** Plant flammability, landscaping design and maintenance should be considered – refer to explanatory notes*

A1.2 Requirements Established by the Local Government – the Firebreak Notice

The local government's current Firebreak Notice is available on their website, at their offices and is distributed as ratepayer's information. It must be complied with.

These requirements are established by the local government's Firebreak Notice created under s33 of the Bushfires Act 1954 and issued annually (potentially with revisions). The Firebreak Notice may include additional components directed at managing fuel loads, accessibility and general property management with respect to limiting potential bushfire impact.

If Asset Protection Zone (APZ) specifications are defined in the Firebreak Notice, these may differ from the Standards established by the Guideline's, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with.

The APZ dimensions to be physically established and maintained, will be based on which of the following establishes the larger APZ dimension:

- The dimensions corresponding to the determined BAL of a building (refer to Section 3.2 explanation of the 'planning' versus 'building' requirements and 'indicative' versus 'determined' BAL(s)); or
- The APZ dimensions established by the local government's Firebreak Notice.

A1.3 Requirements Recommended by DFES – Property Protection Checklists

Further guidance regarding ongoing/lasting property protection (from potential bushfire impact) is presented in the publication 'DFES – Fire Chat – Your Bushfire Protection Toolkit'. It is available from the Department of Fire and Emergency Services (DFES) website.

A1.4 Requirements Established by AS 3959:2018 – 'Minimal Fuel Condition'

This information is provided for reference purposes. This knowledge will assist the landowner to comply with Management Requirement No. 3 set out in the Guidance Panel at the start of this Appendix. It identifies what is required for an area of land to be excluded from classification as a potential bushfire threat.

"Australian Standard - AS 3959:2018 Section 2.2.3.2: Exclusions - Low threat vegetation and non-vegetated areas:

The Bushfire Attack Level shall be classified BAL-LOW where the vegetation is one or a combination of the following:

a) Vegetation of any type that is more than 100m from the site.

b) Single areas of vegetation less than 1ha in area and not within 100m of other areas of vegetation being classified vegetation.

c) Multiple area of vegetation less than 0.25ha in area and not within 20m of the site or each other or other areas of vegetation being classified vegetation.

d) Strips of vegetation less than 20m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20m of the site or each other, or other areas of vegetation being classified vegetation.

e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

f) *Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, (means insufficient fuel available to significantly increase the severity of a bushfire attack – for example, recognisable as short cropped grass to a nominal height of 100mm), mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks (single row of trees)."*

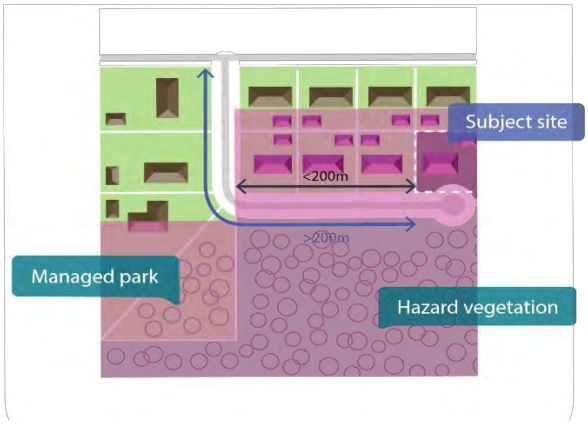
APPENDIX 2: TECHNICAL REQUIREMENTS FOR VEHICULAR ACCESS

Each local government may have their own standard technical requirements for emergency vehicular access, and they may vary from those stated in the Guidelines.

When required, these are stated in Section 5.1 of this bushfire management plan.

Requirements Established by the Guidelines – The Acceptable Solutions

(Source: Guidelines for Planning in Bushfire Prone Areas WAPC 2021 v1.4, Appendix 4)

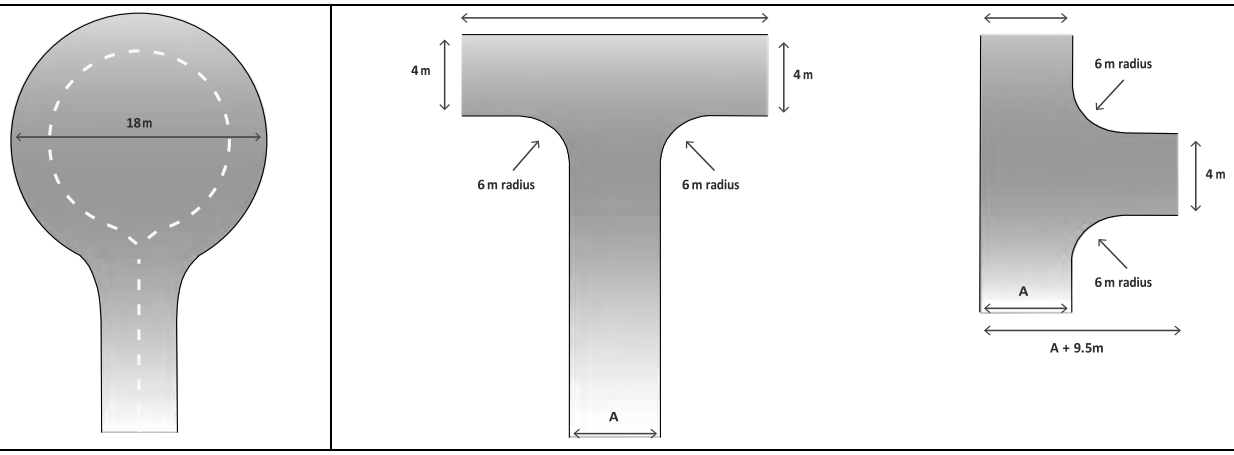
VEHICULAR ACCESS TECHNICAL REQUIREMENTS
Acceptable Solution 3.1: Public Roads *The minimum requirements under this acceptable solution are applicable to all proposed and existing public roads.* Public roads are to meet the minimum technical requirements in Table 6, Column 1. The trafficable (carriageway/pavement) width is to be in accordance with the relevant class of road in the Local Government Guidelines for Subdivisional Development (IPWEA Subdivision Guidelines), Liveable Neighbourhoods, Austroad standards and/or any applicable standards for the local government area.
Acceptable Solution 3.2a: Multiple Access Routes Public road access is to be provided in two different directions to at least two different suitable destinations with an all-weather surface (two-way access). If the public road access to the subject site is via a no-through road which cannot be avoided due to demonstrated site constraints, the road access is to be a maximum of 200 metres from the subject lot(s) boundary to an intersection where two-way access is provided. The no-through road may exceed 200 metres if it is demonstrated that an alternative access, including an emergency access way, cannot be provided due to site constraints and the following requirements are met: the no-through road travels towards a suitable destination; and • the balance of the no-through road, that is greater than 200 metres from the subject site, is wholly within BAL-LOW, or is within a residential built-out area.

Acceptable Solution 3.2b: Emergency Access Way *Where it is demonstrated that A3.2a cannot be achieved due to site constraints, or where an alternative design option does not exist, an emergency access way can be considered as an acceptable solution.* An emergency access way is to meet all the following requirements: • requirements in Table 6, Column 2; • provides a through connection to a public road; • be no more than 500 metres in length; and • must be signposted and if gated, gates must open the whole trafficable width and remain unlocked.

VEHICULAR ACCESS TECHNICAL REQUIREMENTS

Acceptable Solution 3.3: Through Roads

All public roads should be through-roads. No-through roads should be avoided and should only be considered as an acceptable solution where:

- it is demonstrated that no alternative road layout exists due to site constraints; and
- the no-through road is a maximum length of 200 metres to an intersection providing two-way access, unless it satisfies the exemption provisions in A3.2a of this table. A no-through road is to meet all the following requirements:
- requirements of a public road (Table 6, Column 1); and
- turn-around area as shown in Figure 24



Acceptable Solution 3.4a: Perimeter Roads

A perimeter road is a public road and should be provided for greenfield or infill development where 10 or more lots are being proposed (including as part of a staged subdivision) with the aim of:

- separating areas of classified vegetation under AS3959, which adjoin the subject site, from the proposed lot(s); and
- removing the need for battle-axe lots that back onto areas of classified vegetation.

A perimeter road is to meet the requirements contained in Table 6, Column 1. A perimeter road may not be required where:

- the adjoining classified vegetation is Class G Grassland;
- lots are zoned for rural living or equivalent;
- it is demonstrated that it cannot be provided due to site constraints; or
- all lots have frontage to an existing public road

Acceptable Solution 3.4b: Fire Service Access Route

Where proposed lots adjoin classified vegetation under AS3959, and a perimeter road is not required in accordance with A3.4a, a fire service access route can be considered as an acceptable solution to provide firefighter access, where access is not available, to the classified vegetation.

A fire service access route is to meet all the following requirements:

- requirements in Table 6, Column 3;
- be through-routes with no dead-ends;
- linked to the internal road system at regular intervals, every 500 metres; – must be signposted;
- no further than 500 metres from a public road;
- if gated, gates must open the required horizontal clearance and can be locked by the local government and/or emergency services, if keys are provided for each gate; and
- turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres.

VEHICULAR ACCESS TECHNICAL REQUIREMENTS

Acceptable Solution 3.5: Battle-axe Access Legs

Where it is demonstrated that a battle-axe cannot be avoided due to site constraints, it can be considered as an acceptable solution.

There are no battle-axe technical requirements where the point the battle-axe access leg joins the effective area of the lot, is less than 50 metres from a public road in a reticulated area.

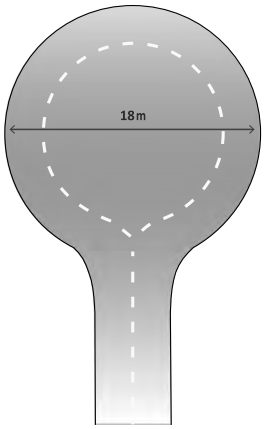
In circumstances where the above condition is not met, or the battle-axe is in a non-reticulated water area, the battle-axe is to meet all the following requirements:

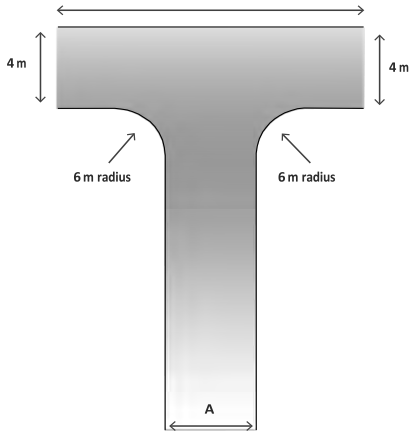
- requirements in Table 6, Column 4; and
- passing bays every 200 metres with a minimum length of 20 metres and a minimum additional trafficable width of two metres (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum six metres).

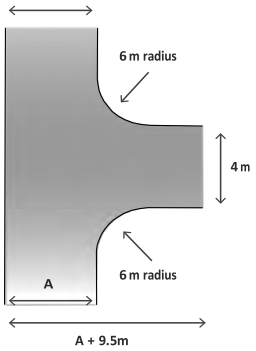
Acceptable Solution 3.6: Private Driveways

There are no private driveway technical requirements where the private driveway is:

- within a lot serviced by reticulated water;
- no greater than 70 metres in length between the most distant external part of the development site and the public road measured as a hose lay; and
- accessed by a public road where the road speed limit is not greater than 70 km/h. In circumstances where all of the above conditions are not met, or the private driveway is in a non-reticulated water area, the private driveway is to meet all the following require:
- requirements in Table 6, Column 4;
- passing bays every 200 metres with a minimum length of 20 metres and a minimum additional trafficable width of two metres (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum six metres); and
- turn-around area as shown in Figure 28 and within 30 metres of the habitable building.







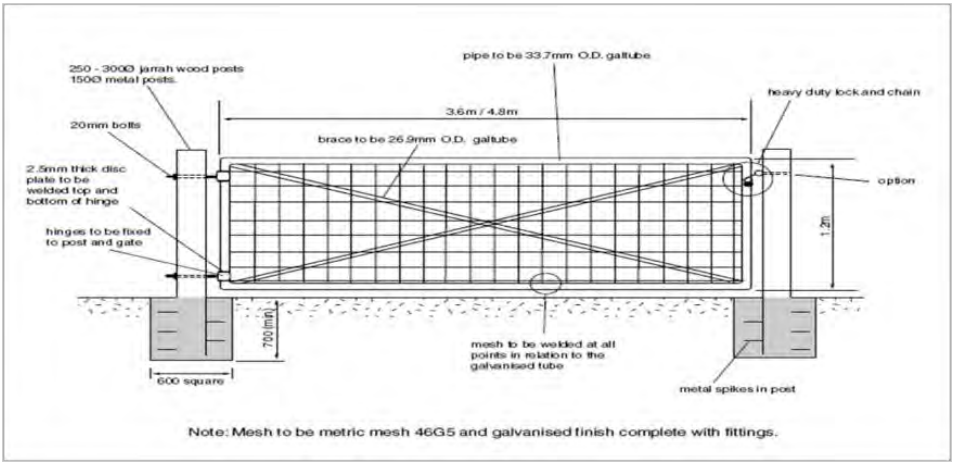
VEHICULAR ACCESS TECHNICAL REQUIREMENTS				
Technical Component	Vehicular Access Types			
	Public Roads	Emergency Access Way[1]	Fire Service Access Routes[1]	Battle-axe and Private Driveways[2]
Minimum trafficable surface (m)	In accordance with A3.1	6	6	4
Minimum Horizontal clearance (m)	N/A	6	6	6
Minimum Vertical clearance (m)	4.5			
Minimum weight capacity (t)	15			
Maximum Grade Unsealed Road[3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum Grade Sealed Road[3]		1:7 (14.3%)		
Maximum Average Grade Sealed Road		1:10 (10%)		
Minimum Inner Radius of Road Curves (m)		8.5		
Note[1]: To have crossfalls between 3 and 6%.				
Note[2]: Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision.				
Note[3]: Dips must have no more than a 1 in 8 (12.5% -7.1 degree) entry and exit angle				

VEHICULAR ACCESS TECHNICAL REQUIREMENTS – GATES AND SIGNS EXAMPLES

Gates

Design and construction to be approved by local government.

- Minimum width 3.6m
- Emergency access way gates must not be locked.
- Fire service access route gates may be locked but only with a common key that is available to local fire service personnel.
- Bollards will be to the local government specifications



Signs

Design and construction to be approved by the local government.

- Minimum height above ground of 0.9m.
- Lettering height to be 100mm.
- To display the words (as appropriate) "Emergency Access Only" or "Fire Service Access – No Public Access".
- Size 600mm x 400mm.
- Sign colour red, base (white) area is reflective background.
- Rounded corners, radius 20mm.
- White key-line 3mm wide, 3mm from outside edge.
- Suggested mounting hole 6mm diameter.

A1.5 Requirements Established by the Guidelines – Water Supply Dedicated for Bushfire Firefighting Purposes

(Source: Guidelines for Planning in Bushfire Prone Areas - WAPC 2021 v1.4 Appendix 4, Element 2, Schedule 1 and Explanatory Note E4)

E4 Use of Water Supply

Water supply for firefighting in the event of a bushfire can be provided on a lot for use by emergency services or for use by the landowner, if their Bushfire Survival Plan is to stay and defend their property. Water supply in the form of a dedicated standalone tank may be provided solely for use by emergency services, and/or a water supply may be provided for use by the landowner in the form of non-drinking water (garden or grey water for firefighting) or drinking water. It is important to note, that a combined tank of drinking water and water for firefighting purposes is not recommended. It is required to be separated in accordance with section 4.2.3 of AS/NZS 3500.1:2018. This requirement is necessary, as stagnant water may alter the quality of the drinking water and the emergency services, by law, may not be able to take water from the water supply to suppress a bushfire.

E4 Independent Water and Power Supply

Bushfires can directly impact a water service provider's equipment or pipes. As such, a reticulated water supply may not be reliable due to a reduction in water pressure or loss of supply. Where development is in a bushfire prone area (even if there is access to reticulated water), it is recommended that the landowner consider providing an additional water supply for use by emergency services.

Where a landowner intends on staying to defend their property during a bushfire event, as identified in their Bushfire Survival Plan, it is recommended that pumping equipment separate to the electricity network be provided. The pumping equipment could be a diesel or petrol-powered pump, or an electric pump if there is an onsite generator or backup power supply independent from electricity network grid.

It is recommended that combustion pumps should be a minimum 5hp or 3kW diesel or petrol powered pump and should be shielded against bushfire attack. Where an electric pump is used, a backup power supply independent from electricity network grid should be provided. A 3.7kw/12kw-h sized battery (14.8kw-h reserved solely for bushfire will power a 3.7kw system for 4 hours) with blackout protection or a generator should be provided.

E4 Strategic Water Supplies

Many local governments have a well-developed network of strategic water tanks for firefighting within their local government area. Given this, it is at the discretion of the local government to determine if the water supply within a locality, is sufficient to cater for an increasing population when a subdivision is proposed. Local governments are encouraged to work with their local emergency services to ensure the water needs for firefighting is understood.

Where a structure plan or subdivision proposes to create more than three but less than 24 lots, it is optional as to whether each lot is provided with a 10,000 litre tank or a strategic water tank is provided for the entire development. If 25 or more lots are proposed, then it is recommended that a 50,000 litre strategic water tank (for every 25 lots) is provided. For every lot additional to the 25, it is at the discretion of the local government whether they require an additional strategic water tank or for each lot to be provided with a 10,000 litre tank. For example, 37 proposed lots require two strategic water tanks, or a 10,000 litre tank on each lot, or a combination of both with a strategic water tank and 12 proposed lots with a 10,000 litre tank on each lot. Where the local government, following consultation with the local emergency services, is of the opinion that a strategic water tank is unnecessary, a 10,000 litre standalone tank per lot can be provided.

A strategic water tank should be located no more than 10 minutes from the subject site (20-minute turnaround time). The turnaround time is the time it takes from a lot to the water supply and return back to the lot, at legal road speeds. Where a strategic water tank has been provided at the subdivision stage and a development application is located within the 20-minute turnaround time of that (or another) strategic water source, then the decision-maker could remove the requirement for the provision of an additional water supply at the development application stage. Local government will need to consider whether the strategic water tank has the capacity to serve the lot identified in the development application i.e. what lots were identified at subdivision stage to be serviced by the strategic water tank. A landowner should enquire with their local government to determine whether a water supply on their lot will be required.

When there is fragmented ownership of a structure plan area, or when staging of a subdivision is to occur and the local government has determined that a strategic water tank is required, then the first stage should include arrangements for the installation of a water tank and the identification of land to be ceded to the local government authority (if applicable).

Where local planning scheme provisions provide for developer contributions for public infrastructure and the local government is supportive, then a cash-in lieu arrangement may be established for the provision of a strategic water tank.

Grouped dwellings may provide dedicated firefighting water supply in one standalone tank per lot or may provide one shared standalone tank with the accumulative amount of water needed, for the number of lots it will serve. For example, a development proposing three lots may either have three tanks of 10,000L (one per lot) or one tank with 30,000L (shared between three lots).

E4 Alternative Water Sources

A dam, river or other source may be considered a firefighting water source if it complies with DFES guidelines and it can be demonstrated that the water level will be maintained above the top of the highest fire brigade suction point in perpetuity, if it is expected that the water supply will be used by emergency services. Approval for the use of these types of water supplies are on a case-by-case basis and at the discretion of the decision maker, in consultation with emergency services and local government.

E4 Location of Water Tanks

A water tank should be located with consideration to surrounding vegetation and should avoid locations where the tank will be situated underneath existing vegetation or where vegetation will grow against or overhang the tank, as shown in Figure 30 below. Where a tank is located on the bushfire hazard side of a building, sufficient shielding for the protection of firefighters should be provided. In addition to the tank location, the fitting should be positioned and/or shielded from the bushfire hazard to allow access by emergency services. It is recommended that the fitting face away from the bushfire hazard and be within four metres of a hardstand area.

A good and bad example of landscaping around a water tank

(Source: Guidelines for Planning in Bushfire Prone Areas 2021, Appendix 4)

Schedule 2: Water Supply Dedicated for Bushfire Firefighting Purposes

2.1: Water supply requirements

Water dedicated for firefighting should be provided in accordance with Table 7 below and be in addition to water required for drinking purposes.

Table 7: Water supply dedicated for bushfire firefighting purposes

PLANNING APPLICATION	NON-RETICULATED AREAS
Development application	10,000L per habitable building
Structure Plan / Subdivision: Creation of 1 additional lot	10,000L per lot
Structure Plan / Subdivision: Creation of 3 to 24 lots	10,000L tank per lot or 50,000L strategic water tank
Structure Plan / Subdivision: Creation of 25 lots or more	50,000L per 25 lots or part thereof Provided as a strategic water tank(s) or 10,000L tank per lot

2.2: Technical requirements

2.2.1 Construction and design

An above-ground tank and associated stand should be constructed of non-combustible material. The tank may need to comply with AS/NZS 3500.1:2018.

Below ground tanks should have a 200mm diameter access hole to allow tankers or emergency service vehicles to refill direct from the tank, with the outlet location clearly marked at the surface. The tank may need to comply with AS/NZS3500.1:2018. An inspection opening may double as the access hole provided that the inspection opening meets the requirements of AS/NZS 3500.1:2018. If the tank is required under the BCA as part of fire hydrant installation, then the tank will also need to comply with AS 2419.

Where an outlet for an emergency service vehicle is provided, then an unobstructed, hardened ground surface is to be supplied within four metres of any water supply.

2.2.2 Pipes and fittings

All above-ground, exposed water supply pipes and fittings should be metal. Fittings should be located away from the source of bushfire attack and be in accordance with the applicable section below, unless otherwise specified by the local government.

2.2.2.1 Fittings for above-ground water tanks:

- Commercial land uses: 125mm Storz fitting; or
- Strategic water tanks: 50mm or 100mm (where applicable and adapters are available) male camlock coupling with full flow valve; or
- Standalone water tanks: 50mm male camlock coupling with full flow valve; or
- Combined water tanks: 50mm male camlock coupling with full flow valve or a domestic fitting, being a standard household tap that enables an occupant to access the water supply with domestic hoses or buckets for extinguishing minor fires.

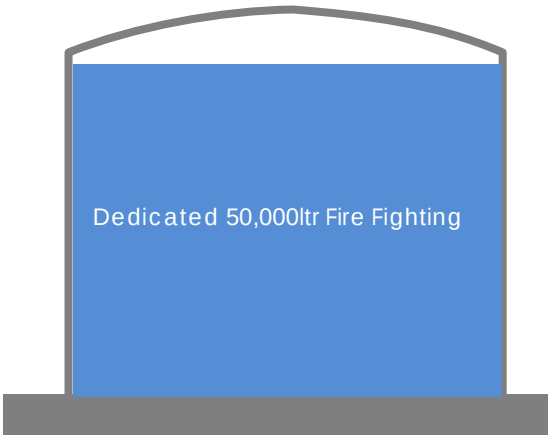
2.2.2.2 Remote outlets

In certain circumstances, it may be beneficial to have the outlet located away from the water supply. In such instances in which a remote outlet is to be used, the applicant should consult the local government and DFES on their proposal.

TECHNICAL REQUIREMENTS FOR STATIC WATER SUPPLY

(EXAMPLES ONLY – CHECK WITH LOCAL GOVERNMENT FOR VARIATIONS)

Example construction / coupling requirements from various sources including FESA (DFES) Operational Circular 07/2011 and Planning for Bushfire Protection Guidelines WAPC 2010]



Reticulated Areas

[Source: Guidelines for Planning in Bushfire Prone Areas WAPC 2021 v1.4, Appendix 4, Element 4]

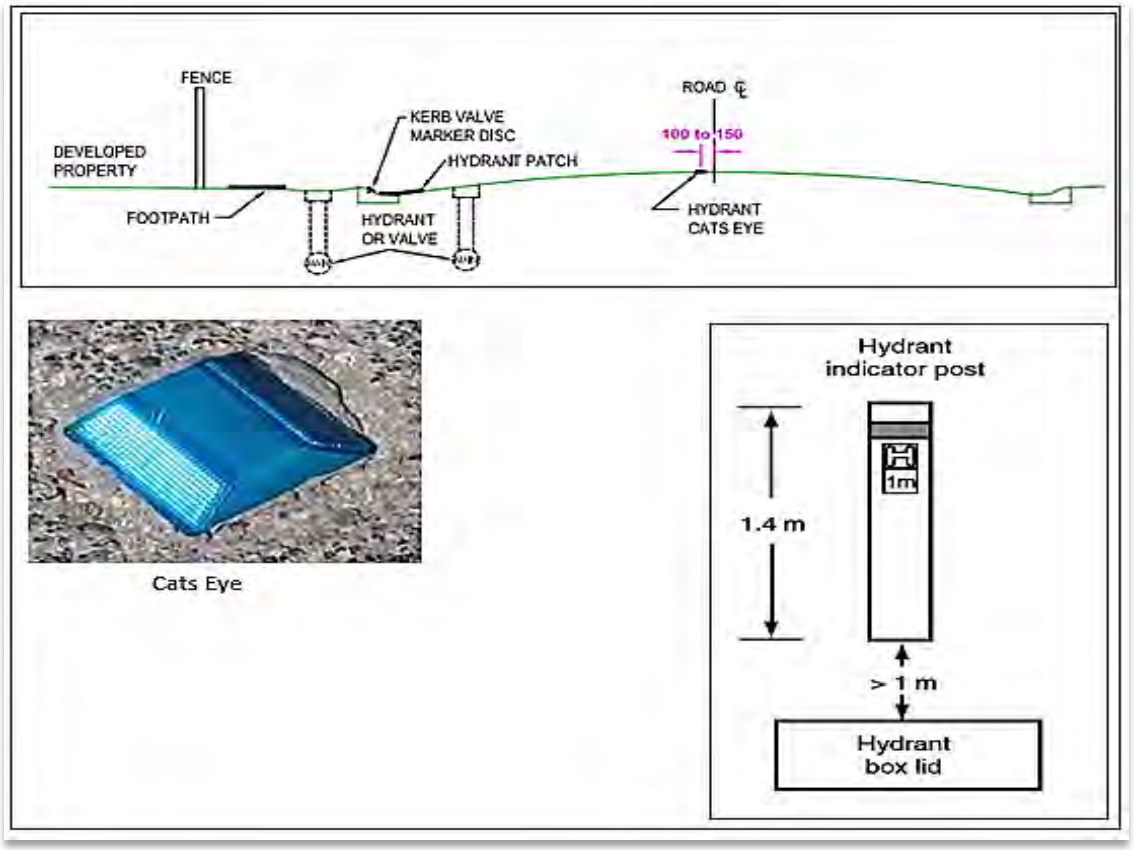
Where a reticulated water supply is existing or proposed, hydrant connection(s) should be provided in accordance with the specifications of the relevant water supply authority.

The requirement is to supply a reticulated water supply and fire hydrants, in accordance with the technical requirements of the relevant water supply authority and DFES.

Key specifications in the most recent version/revision of the design standard include:

- *Residential Standard* – hydrants are to be located so that the maximum distance between the hydrants shall be no more than 200 metres.
- *Commercial Standard* – hydrants are to be located with a maximum of 100 metre spacing in Industrial and Commercial areas.
- *Rural Residential Standard* – where minimum site areas per dwelling is 10,000 m² (1ha), hydrants are to be located with a maximum 400m spacing. If the area is further subdivided to land parcels less than 1ha, then the residential standard (200m) is to be applied.

Figure A4.1: Hydrant Location and Identification Specifications



APPENDIX 4: ALTERNATIVE PATHWAYS FOR COMPLYING WITH SPP 3.7

Bushfire Prone Planning, for applicable proposals, is sometimes required to apply argument for the application of compliance pathways that differ from those established by the Guidelines for Planning in Bushfire Prone Areas (WAPC v1.3) - these being meeting the acceptable solutions and developing performance principle-based solutions (alternative solutions).

These additional pathways include the application of merit based assessment and comparative bushfire performance. The validity of this approach is derived from relevant Tribunal hearings and Court cases. A key recent decision highlights many relevant factors and is detailed below.

The Tribunal decision in Bunnings Group Limited and Presiding Member of the Metro North West JDAP [2019] WASAT 121 references many of these and made its decisions. These include the following paraphrased relevant decisions. Decision makers will need to refer to the actual proceedings.

- [153] In considering the requirements of State Planning Policy 1: State Planning Framework (SPP1) in the application of SPP3.7, there is no basis on which provisions lower in the hierarchy (the Guidelines) should necessarily prevail over provisions higher in the hierarchy (SPP3.7).
- [141] The intent and objectives of policy (SPP3.7) can be infringed by the inflexible application of the provisions of the Guidelines.
- [99] The existence of the principle that policy should not be inflexibly applied means that it is open to the Tribunal to consider the proposed development through the applications of a merits review.
- [145] Application of the precautionary principle requires caution in departing from policy but doesn't preclude approval and provides for assessment on merit and the use of discretion.
- [122] One should be slow to depart from policies unless satisfied that good reason exists.
- [123] It cannot be accepted that, simply because a proposal contemplates a solution that is not contemplated by the Guidelines, the Tribunal cannot approve that proposal. To accept that proposition would amount to inflexibly applying policy.
- [230] The Tribunal finds a sound basis for departing from SPP 3.7 cl. 6.6.2 and Elements 1 and 2 of the Guidelines while being able to accord with the intent and relevant objectives SPP 3.7.
- [231] Finds against the inflexible application of SPP 3.7 and associated Guidelines.

Key to considerations is the Intent of SPP 3.7 which is:

> *"... to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure".*

Applying this risk based approach requires an appreciation that the overarching requirement is for:

1. Identification, analysis and evaluation of the risks from the threats of bushfire;
2. Comparison of these to the residual level of risk that will exist after any proposed bushfire protection measures are implemented (i.e. risk treatments); with
3. The intent being to arrive at a tolerable level of risk for the particular land use.

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Bush Fires Act 1954

City of Swan

Fire Hazard Reduction Notice (Firebreak Notice)

Notice to Owners and/or Occupiers of land situated within the City of Swan.

To assist in the control of bush fires, and pursuant to Section 33 of the Bush Fires Act 1954, all owners and occupiers of land within the City of Swan are required on or before the 1st day of November, 2021, or within 14 days of becoming an owner or occupier of land after that date, must meet the fire hazard reduction conditions described in this notice and maintain these conditions up to and including the 30th day of April, 2022.

1. All land up to 5,000m^2 (0.5 Hectares or 1.2 Acres)

1) Install and maintain an asset protection zone in accordance with the requirements specified in clause 13 of this notice.
2) Maintain all grass to a height of no greater than 10cm.
3) Areas of natural vegetation to be maintained at or below 8 tonnes per hectare.
4) Where a property is affected by an approved bushfire management plan, property owners must still comply with all requirements in this notice and with any additional requirements outlined within that plan.

2. All land between 5,000m2 and 25,000m2 (0.5 - 2.5 Hectares) or (1.2 - 6.2 Acres)

1) Install and maintain an asset protection zone in accordance with the requirements specified in clause 13 of this notice.
2) Install firebreaks immediately inside and adjacent to all external property boundaries. Firebreaks need to be 3 metres wide with a 4 metre vertical height clearance free from flammable materials and overhanging branches (see section 10 in this notice for further details).
3) Maintain all grass to a height of no greater than 10cm.
   a) If the land is stocked, the grass must be reduced and maintained to a height of no greater than 10cm by the 1st day of December.
4) Natural vegetation within 100 metres of buildings including attached and adjacent structures and essential infrastructure shall be maintained at or below 8 tonnes per hectare, by passive methods of fuel reduction that does not permanently remove or reduce the quantity or occurrence of the native plants, shrubs and trees within the subject area.
5) Where a property is affected by an approved bushfire management plan, property owners must still comply with all requirements in this notice and with any additional requirements outlined within that plan.

3. All land with an area greater than 25,000m^2 (2.5 Hectares or 6.2 Acres)

1) Install and maintain an asset protection zone in accordance with the requirements specified in clause 13 of this notice.
2) Install firebreaks immediately inside and adjacent to all external property boundaries. Firebreaks need to be 3 metres wide with a 4 metre vertical height clearance free from flammable materials and overhanging branches (see section 10 in this notice for further details).
   a) Properties over 100 hectares require additional firebreaks to divide the land into areas not exceeding 100 hectares.
3) Slash or mow grass to a height no greater than 10cm immediately adjacent to firebreaks to a minimum width of 3 metres.
   a) If the land is stocked, this grass must be reduced and maintained to a height of no greater than 10cm by the 1st day of December.
4) Natural vegetation within 100 metres of buildings including attached and adjacent structures and essential infrastructure shall be maintained at or below 8 tonnes per hectare, by passive methods of fuel reduction that does not permanently remove or reduce the quantity or occurrence of the native plants, shrubs and trees within the subject area.
5) Where a property is affected by an approved bushfire management plan, property owners must still comply with all requirements in this notice and with any additional requirements outlined within that plan.

4. Plantations

1) Install and maintain external and internal firebreaks, firebreaks that form compartments (cells), firebreaks and hazard reduction measures that protect neighbouring communities and essential infrastructure in accordance with the requirements of a fire management plan approved in writing by the City; or
2) Where no such approved fire management plan exists,
   a) Unless the City approves an alternative plan in writing in accordance with clause 4(2)(b), install and maintain external and internal firebreaks and firebreaks that form compartments (cells), and carry out all other firebreaks and hazard reduction measures which are required in accordance with the requirements and specifications within the Department of Fire & Emergency Services 'Guidelines for Plantation Fire Protection' 2011 publication; or
   b) If it is considered impractical for any reason to carry out the plantation requirements outlined above in clause 4 (2)(a), plantation owners and managers may apply in writing to the City to implement an alternative plan or measures in accordance with clause 4 of this notice.

5. Application to Vary Firebreak and Hazard Reduction Requirements

1) If it is considered impractical for any reason to clear firebreaks in a manner or location required by this notice, or to carry any fire hazard reduction work or measures required by this notice, you may apply in writing on or before the 1st of October, for approval to provide firebreaks in alternative positions or to take alternative measures to abate fire hazards on the land. Alternative firebreak application forms can be downloaded from the City of Swan website.
2) If permission is not granted in writing by the City prior to the 1st day of November, you shall comply with the requirements of this notice.
3) When permission for alternative firebreaks or fire hazard reduction measures has been granted, you shall comply with all conditions on the endorsed permit and maintain the land to the required standard throughout the period specified by this notice.
   a) Where a property is affected by an approved bushfire management plan, property owners must comply with any additional requirements and responsibilities outlined within that plan.

6. Fuel Dumps and Depots

Remove all flammable material within 10 metres of fuel dumps, fuel ramps or where fuel drums, whether containing fuel or not, are stored.

7. Hay Stacks

Clear and maintain a firebreak completely surrounding any haystack on the land, within 60 metres of the haystack.

8. Fire Service Access (Strategic Firebreaks)

1) Where under a written agreement with the City, or where depicted on an approved bushfire management plan Fire Service Access (Strategic Firebreaks) are required on the land, you are required to clear and maintain the Fire Service Access (Strategic Firebreaks) a minimum of 6 metres wide along the agreed alignment to provide restricted vehicular access to emergency services and authorised vehicles.
2) Fire Service Access (Strategic Firebreaks) must be free from flammable material and unimpeded by obstructions including boundary fences and gates unless approved in writing by the City.
3) Gates may only be secured with City of Swan Fire Service padlock.
4) Fire Service Access (Strategic Firebreaks) shall be graded to provide a continuous 4 wheel drive trafficable surface a minimum of 4 metres wide with a 1 metre shoulder on either side.
5) All branches must be pruned and obstacles removed to maintain a 4 metre vertical height clearance above the full 6 metre width of the trafficable surface.

9. Emergency Access Ways

1) Where under a written agreement with the City, or where depicted on an approved bushfire management plan, Emergency Access Ways are required on private land, you are required to clear and maintain a vehicular access way to a minimum of 6 metres wide along the agreed alignment.
2) Emergency access ways must be free from flammable material and unimpeded by obstructions including boundary fences and gates unless approved in writing by the City.
3) Gates on Emergency Access Ways must remain unlocked at all times.
4) Emergency Access Ways shall be graded and have suitable drainage to provide a minimum 6 metre wide continuous trafficable surface suitable for all types of 2 wheel drive vehicles.
5) All branches must be pruned and obstacles removed to maintain a 4 metre vertical height clearance above the full 6 metre

width of the trafficable surface.

10. Firebreak Construction

1) Firebreaks are to be developed and maintained clear of all obstacles and flammable materials to create a minimum of 3 metres wide trafficable surface suitable for 4 wheel drive vehicles.
2) Overhanging branches must be pruned to provide a 4 metre vertical clearance above the full width of the firebreak surface.
3) Boundary firebreaks must be aligned immediately inside and adjacent to the external property boundaries.
4) Alternative Firebreaks that are approved in writing by the City, or as depicted within a bushfire management plan approved in writing by the City, are to be constructed to the same standard as general firebreaks and must be constructed along the specified alignment.
5) Firebreaks must not terminate in a dead end.
6) Firebreaks may be constructed by ploughing, grading, raking, burning, chemical spraying or any other method that achieves the required standard.

11. Driveways

Where building sites are situated more than 50 metres from a public road,

1) Driveways must be maintained clear of all permanent obstacles and flammable materials to create a minimum 3 metre wide trafficable surface suitable for all types of 2 wheel drive vehicles.
2) Overhanging branches must be pruned to provide a 4 metre vertical clearance above the driveway.

12. Fuel Reduction – Natural Vegetation

1) Available bushfire fuels must be maintained at or below:
   a) Asset Protection Zones - 2 tonnes per hectare
   b) Hazard Separation Zones - 8 tonnes per hectare

      *This requirement only applies where HSZs are depicted within a Fire Management Plan approved in writing by the City.

   c) Natural Vegetation - 8 tonnes per hectare for areas of natural vegetation within 100 metres of buildings, attached and adjacent structures and essential infrastructure
2) Passive Fuel Reduction within natural vegetation may be achieved by burning, raking, pruning, weed management, removal of dead materials and any other approved method.
3) Permanent removal or partial clearing of natural vegetation including individual or groups of native grasses, shrubs or trees may only be carried out to meet the minimum requirements of this notice.
4) Permanent clearing of natural vegetation structures including individual plants, shrubs or trees, that exceeds the requirements of this notice or the specifications outlined within a bushfire management plan approved in writing by the City, is only permitted in accordance with the provisions and exemptions outlined within the Environmental Protection Act 1986, or with the approval of the Department of Water and Environmental Regulation and the City of Swan.

   Note: Advice and resources on how to measure and manage native vegetation fuel loads are available from the Department of Fire and Emergency Services or the City of Swan.

13. Asset Protection Zones Specification

Asset protection zones for habitable buildings and other assets must meet the following requirements:

1) Extends 20 metres out from any external walls of the building, attached structures, or adjacent structures within 6 metres of the habitable building, unless varied under an approved bushfire management plan.
2) On sloping ground the asset protection zone distance shall increase with 1 metre for every degree in slope on the sides of the building/ structure that are exposed to down slope natural vegetation.
3) Asset protection zone requirements only apply within the boundaries of the lot on which the asset is located and cannot be enforced across boundaries.
4) Recommendation Only - Asset protection zones predominantly consist of non-flammable managed vegetation, reticulated lawns and gardens and other non-flammable features.
5) All grass is maintained to or under 10cm.
6) Fuel loads must be reduced and maintained at 2 tonnes per hectare or lower.
7) The crowns of trees are to be separated where possible to create a clear separation distance between adjoining or nearby tree crowns. The separation distance between tree crowns is not required to exceed 10 metres. Clearing or thinning existing trees to create distances greater than 10 metres separation between tree crowns within an asset protection zone is not required or supported by this notice and requires approval from the Department of Water and Environmental Regulation and the City of Swan.
8) A small group of trees within close proximity to one another may be treated as one crown provided the combined

crowns do not exceed the area of a large or mature crown size for that species.

9) Trees are to be low pruned (or under pruned) to at least a height of 2 metres from ground.
10) No tree, or shrub over 2 metres high is planted within 2 metres of a building, especially adjacent to windows.
11) There are no tree crowns or branches hanging over buildings.
12) Clear and prune scrub to reduce to a sparse density (able to walk through vegetation with relative ease with minimal deviation around trees and shrubs).
13) Install paths or clear flammable or dry vegetation, debris and materials immediately adjacent to the building.
14) Wood piles and flammable materials stored a safe distance from buildings.

14. Burning

All burning must be carried out in accordance with the relevant provisions of this notice and the Bush Fires Act 1954, Health Act 1911 and the City's Consolidated Local Laws 2005.

Prohibited Period: All burning, including garden refuse and camping fires are prohibited.

Restricted Period: All burning requires a permit except for the burning of garden refuse and camping fires which are subject to the following conditions:

1) The fire must not be lit if the Fire Danger Rating is Very High or above, or if a Total Fire Ban or a Harvest and Vehicle Movement Ban is declared.
2) Only one fire is allowed at any time and it does not exceed 1 cubic metre in size.
3) No flammable material within 5 m of the fire.
4) The fire is only lit between 6 pm and 11 pm and completely extinguished by midnight.
5) At least one person capable of controlling the fire is in attendance at all times with adequate means of extinguishing the fire.

15. Cooking Fires

Fires for the purpose of cooking are exempt from burning period restrictions subject to the following conditions:

1) The fire must not be lit if the Fire Danger Rating is Very High or above, or if a Total Fire Ban or a Harvest and Vehicle Movement Ban is declared.
2) The fire is contained in a purpose built appliance and
   a) at a person's home; or
   b) an area is set aside for that purpose by the State Authority or City of Swan
3) No flammable material within 5 m of the fire.
4) At least one person capable of controlling the fire is in attendance at all times with adequate means of extinguishing the fire.

16. Compliance

1) In addition to the requirements of this notice, further works which are considered necessary by an Authorised Officer of the City may be required as specified in writing in a subsequent notice addressed to the land owner.
2) Where the owner or occupier of the land fails or neglects to comply with the requirements of this notice or a subsequent notice addressed to the land owner, the City of Swan may enter onto the land with workmen, contractors, vehicles and machinery to carry out the requisitions of the notice at the expense of the land owner.
3) Failure to comply with this notice and subsequent written notices may result in a penalty not exceeding $5,000, or the issue of a $250 infringement notice and liability for any costs incurred by the City in relation to works undertaken on behalf of the land owner
4) Where a property is affected by an approved bushfire management plan, property owners must still comply with all requirements in this notice and with any additional requirements outlined within that plan.

17. Definitions

'**Alternative Firebreak**' is a firebreak that is in an alternative position or alignment to the external boundaries of a property.

'**Alternative Firebreak Application**' is an application that may be made by a land owner to install firebreaks in an alternative position, or to carry out an alternative measures in lieu of general firebreaks.

'**Available Fuel**' is the bush fuel consisting of live and dead vegetation such as stubble, mulch, leaf litter, twigs, trash, scrub and other vegetation less than 6mm in diameter capable of carrying a running fire and will actually burn under prevailing conditions.

'**City**' means the City of Swan.

'**Buildings, Attached and Adjacent Structures**' means habitable buildings that are used as a dwelling, workplace, place of gathering or assembly, a building that is a car park, or a building used for the storage

or display of goods or produce for sale by whole sale in accordance with classes 1-9 of the Building Code of Australia. The term building includes attached and adjacent structures like garages, carports verandas or similar roofed structure(s) that are attached to, or within 6 metres of the dwelling or primary building.

'**Asset Protection Zone (APZ)**' is a low fuel area that is reduced of flammable vegetation and materials surrounding buildings and essential infrastructure to minimise the likelihood and impact that direct flame contact, radiant heat or ember attack may have on buildings and assets in the event of a bushfire. This area must extend out from the external walls of a building or asset a minimum of 20 metres.

'**Bushfire Management Plan**' or 'Fire Management Plan' is a comprehensive plan that may be placed on the certificate of title(s) of land that has been developed as a condition of development or subdivision. Bushfire Management Plans may become out dated and it's the responsibility of the property owner to review and keep them current. Where a property is affected by an approved bushfire management plan, property owners must still comply with all requirements in the Annual Fire Hazard Reduction Notice and with any additional requirements outlined within that plan.

'**Emergency Access Way**' is a two wheel drive trafficable, 6 metre wide access route to provide local residents, general public and emergency services alternative links to road networks at the end of cul-de-sacs or areas where access is limited during an emergency incident.

'**Essential Infrastructure**' or '**Critical Infrastructure**' means assets, infrastructure, systems and networks that provide essential services necessary for social and economic wellbeing and is typically public infrastructure. Assets and infrastructure, usually of a public nature, that generate or distribute electricity, water supply, telecommunications, gas and dams are typical assets that are essential to society and are often located in, or traverse areas that are prone to bushfires.

'**Firebreak**' is an area of land cleared of flammable material (see available fuel above) to minimise the spread of a bushfire and to provide access for firefighting services. For the purpose of this notice the term firebreak is a strip of land at minimum 3 metres with a 4 metres vertical clearance, constructed to provide a 4 wheel drive trafficable surface for access by emergency and authorised vehicles. Boundary firebreaks are installed immediately adjacent the external boundaries of a property.

'**Fire Hazard**' means accumulated fuel (living or dead) such as leaf litter, twigs, trash, bush, dead trees and scrub capable of carrying a running fire, but excludes standing living trees and isolated shrubs.

'**Hazard Separation Zone (HSZ)**' means an area extending out from an asset protection zone a distance of 80 metres unless otherwise specified, to create a graduated fuel reduction and separation from natural vegetation.

'**Natural Vegetation**' means natural areas of forest, woodland, shrubland, scrub, mallee or mulga.

'**Passive Fuel Reduction**' means lowering the amount of available fuel that will burn under prevailing conditions by means that will not permanently reduce or modify the structure or life cycle of plant, shrub, scrub or tree communities within an treated area. This is typically achieved by undertaking a cool, controlled burn of an area during cooler, damper months, or by physical removal of built up leaf litter, dead materials, weeds and slashing long dry grasses without damaging live native plants within the area.

'**Plantation**' is any area of native or exotic planted trees that exceeds three hectares in a gazetted town site, or elsewhere a stand of trees of 10 hectares or larger that has been planted and managed intensively for their commercial and environmental value. A plantation includes roads, firebreaks and small areas of native vegetation.

'**Fire Service Access (Strategic Firebreaks)**' is a firebreak that is 6 metres wide established to provide strategic access and links to road networks whilst providing a wider control/ containment line to protect town sites, estates and similar exposures during bushfire operations.

By order of the Council,

Leon van der Linde

Acting / Chief Executive Officer

City of Swan

Appendix 3
District Water Management Strategy

DISTRICT WATER MANAGEMENT STRATEGY

Lot 5892 Maralla Road, North Ellenbrook (West) District Structure Plan

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C. Corcoran 13 December 2022

Prepared by:

RPS

Joycelyn Siew
Senior Hydrologist

Level 3, 500 Hay Street
Subiaco, WA 6008

T +61 8 9211 1111
E water@rpsgroup.com.au

Prepared for:

Stockland

Tom Barry
Development Manager

Level 12, Durack Centre, 263 Adelaide Terrace
Perth WA 6000

T +61 8 6141 8263
E tom.barry@stockland.com.au

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Graphs

(contained within report text)

Appendices

SUMMARY

Lot 5892 Maralla Road, Bullsbrook (the site) is a ~163-hectare (ha) area located within the City of Swan in Bullsbrook, and it has an approved 120.7 ha sand mining tenement (M70/326) within the site (Figure A).

The site is immediately south of the North Ellenbrook (West) District Structure Plan (DSP) (Rowe Group, 2022) and west of the North Ellenbrook (East) DSP (CLE Town Planning + Design, 2022), both of which were advertised in 2021. Both DSP areas are identified as Urban Investigation in the *North-East Subregional Planning Framework* (DPLH, 2018).

The subject site is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'General Rural' under the City of Swan Local Planning Scheme No. 17 (LPS17). A minor 4.87 ha northern portion of the site is identified as 'Urban Investigation' in the framework (DPLH, 2018), with the balance of the site identified as 'Open Space'. As such it has not been identified as 'Urban Investigation' under the framework. Therefore, further planning and site-specific environmental investigations, including this District Water Management Strategy (DWMS), have been undertaken to support:

- The entire site (Lot 5892) being incorporated into the North-East Subregional Planning Framework 'Urban Investigation' area (DPLH, 2018)
- A future rezoning of the site to 'Urban' under the MRS and 'Development' (or similar) under LPS17.

The objective of the DWMS is to demonstrate that the land is capable of supporting the proposed land use change with best practice water management outcomes regarding stormwater and surface water management, groundwater management and water supply. This report provides broad level management strategies for future development.

The proposed development will incorporate total water cycle management principles and objectives guided by the Better Urban Water Management Framework (WAPC 2008). This has been completed by assessing the current hydrological characteristics of the site. A summary of the key DWMS elements detailed in this report is provided in Table 1.

Table 1: Key DWMS reporting elements

DWMS elements	Design objectives/comments
Planning background (Section 1.2)	• The site is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'General Rural' under the City of Swan Local Planning Scheme No. 17 (LPS17). This DWMS has been undertaken to support a proposed rezoning of the site to 'Urban' under the MRS and 'Development' (or similar) under LPS17.
Current land use (Section 3.1)	• Lot 5892 is 163 ha in area and contains a 120.7 ha sand mining tenement (M70/326). Outside of this, Lot 5892 contains ~20 ha of Conservation Category Wetland (CCW) and Resource Enhancement Wetland (REW) core and buffer areas, ~6.6 ha of historically cleared land and ~15.4 ha of intact native vegetation.
Topography (Section 3.4)	• The site topography ranges from ~ 50 mAHD to 76 mAHD. The highest elevations are found at the southern two-thirds of Lot 5892 (within the sand mining tenement). The topography on the eastern half of the site is currently altered by the sand mining activities.
Geology and soils (Section 3.5 and 3.6)	• Regional mapping indicates the site is generally located on Bassendean Sand. Some isolated areas of peaty clay are associated with wetland areas. • Regional acid sulfate soil (ASS) risk mapping shows the majority of the site has a moderate to low risk of ASS occurring within the top 3 m of the natural soil surface. Some areas within the mapped CCW in Lot 5892 have a high to moderate risk of ASS occurring within the top 3 m of the natural soil surface. • The site does not have any records of known or suspected contaminated sites in DWER's Contaminated Sites Database.
Groundwater (Section 3.12, 3.13)	• The site is located on the Gnangara groundwater system. The aquifers underlying the site include the Superficial (unconfined), Mirrabooka (semi-confined), Leederville (confined) and Yarragadee North (confined). • The site is on the Swan Groundwater Management area, which covers two management subareas including North Swan (Superficial and Mirrabooka aquifers) and Swan Confined (Leederville aquifer) • The maximum groundwater level (MGL) from the year 2000 range from approximately 47.0 to 51.5 mAHD and groundwater flows to the east.

DWMS elements	Design objectives/comments
	• The northern and eastern site areas have the lowest clearance to groundwater, i.e. less than 2 m below ground level, associated with wetland areas. The central area of the site has higher clearance to groundwater (up to 30 m depth) associated with elevated sand dunes. This depth to MGL is based on surface topography prior to sand excavation. The finished mine floor level will be at least 2 m above the MGL, hence, subsoil drainage is not expected to be required to control groundwater levels. • A portion of the site intersects the eastern edge of the Priority 3 Gnangara Underground Water Pollution Control Area (PDWSA). There is a Priority 1 PDWSA located immediately to the eastern border of the site. The nearest public abstraction bore is >2.4 km to the west.
Surface water hydrology and wetlands (Section 3.10, 3.11, 3.14)	• Sawpit Gully, a tributary of Ellen Brook, flows east along the northern boundary of the site. • Regional mapping shows two wetlands that are fully or partially within the site. These include one CCW and one REW. • The site is approximately 2.8 km west of the Western Swamp Tortoise EPP 2011 area. The only two natural western swamp tortoise habitats, the Twin Swamps Nature Reserve and the Ellen Brook Nature Reserve, are located approximately 3.8 km to the north-east and 5.8 km to the south-east of the site respectively.
Water source planning (Section 4)	• The site is located within the Water Corporation's licensed area for provision of a potable water supply service. The Water Corporation has advised that there is currently no water planning for residential development of the land north of Maralla Road or agreement between the Water Corporation as service provider and the proponents regarding development and financing of these essential services (Rowe Group 2022). However Water Corporation has advised that it may be possible that the water supply demands from the site could be serviced from the existing Ellenbrook Reservoir, subject to timing and rate of demand. • The POS irrigation requirement is broadly estimated at 62,950 kL/yr. There is one existing groundwater licence within the site, with a total allocation of 26,100 kL/yr, which is less than the development's POS irrigation requirements. All aquifers are fully allocated and so any groundwater licences for the site would need to be obtained by transfer/trade with other groundwater users in the same groundwater subarea. • The current allocation volume would be sufficient to provide irrigation for the active open space for the proposed urban development. However, xeriscaping and other low water demand landscape treatments would be required for the remaining POS, if the shortfall in non-potable water supply for irrigation is not overcome. • The site is located within the Water Corporation licensed area for operating sewerage services. The Water Corporation has advised that the site is currently outside their service area, however, future planning has commenced to provide a servicing strategy for waste water. It is assumed that the site will be a part of the Bullsbrook Sewer District and subject to the Water Corporation's conceptual wastewater planning for the North Ellenbrook (West) DSP. This wastewater planning allows for wastewater from both the North Ellenbrook (East) and North Ellenbrook (West) DSPs to be pumped from North Ellenbrook southwards into the Ellenbrook (Barrabmbie Way) Main transfer Waste Water Pump Station.
Water conservation strategies (Section 5)	• Water conservation will focus on reducing scheme water use through household water conservation, resident education and Waterwise landscaping. • It is proposed that POS areas will be irrigated from groundwater abstracted from the Superficial aquifer.
Stormwater management (Section 6)	• Small rainfall events (first 15 mm) will be managed and treated on site via soakwells and bioretention basins/swales. Bioretention basins/swales will be sized to at least 2% of the connected impervious catchment and designed in accordance with Vegetation guidelines for stormwater biofilters in the south-west of Western Australia (Monash University 2014) and Adoption Guidelines for Stormwater Biofiltration Systems (Payne et al. 2015). • Flows from rainfall events exceeding the small event (15 mm) will be attenuated in detention basins/swales or be directed into the wetlands at pre-development peak flow rates to maintain ecological flows into the wetlands. • The piped drainage system will be designed to convey the 20% AEP minor event to maintain the serviceability and amenity for roads and POS. • Flows exceeding the 20% AEP up to the 1% AEP will be conveyed via overland flow paths within road reserves • Building habitable floor levels to be minimum 0.3 m above the 1% AEP flood level in local detention basins/swales and minimum 0.5 m above the 1% AEP flood level in Sawpit Gully and nearby wetlands.

DWMS elements	Design objectives/comments
	• The 1% AEP peak flow discharge from the site to be maintained at pre-development peak flow rates at all discharge locations. • Discharge locations to mimic the pre-development hydrology. The site discharges north to Sawpit Gully, east under Halden Road and south to a Bush Forever site containing wetlands.
Groundwater management (Section 7)	• Pre-excavation groundwater is at significant depth beneath the site. The finished mine floor level will be at least 2 m above the MGL. • Subsoil drainage is not expected to be required to control groundwater levels, similarly it is not expected that fill importation will be required to raise lot levels. • The first 15 mm of rainfall run-off from impervious areas will be treated prior to infiltration in line with best practice.
Foreshore area report (Section 8)	• Mapped wetlands have been provided indicative 30 m buffers in the concept plan. The reduction from the typical 50 m buffer for the mapped CCW will be subject to a contemporary wetland assessment undertaken at scheme amendment stage. • Sawpit Gully will have at least a 30 m distance from developable areas and the mapped centreline of the waterway.
Future monitoring requirements (Section 9)	• Eighteen months, including two winter peaks of pre-development monitoring (groundwater and surface water levels and quality) is required for the LWMS. • Trigger values will be developed in the UWMP. • Post-development monitoring will be conducted for at least two years and results compared to targets to assess impacts from the development.

1 INTRODUCTION

1.1 Background

This District Water Management Strategy (DWMS) has been prepared to support a District Structure Plan (DSP) concept for Lot 5892 Maralla Road, Bullsbrook (the site), located within the City of Swan approximately 26 km north-east of the Perth CBD. The site is immediately south of the North Ellenbrook (West) DSP (Rowe Group, 2022) and east of the North Ellenbrook (East) DSP (CLE Town Planning + Design, 2022). The total site area is 163 hectares (ha), and it has an approved 120.7 ha sand mining tenement (M70/326). Approximately 30 ha of this lot has been cleared to date for sand mining activities.

The site is bound to the north by predominantly cleared land, to the south, west and east by native bushland.

The site location, including the mining tenement area, is shown in Figure A and the proposed DSP concept plan is shown in Appendix A.

1.2 Planning context

1.2.1 Zoning

The site is currently zoned 'Rural' under the Metropolitan Region Scheme (MRS) and 'General Rural' under the City of Swan Local Planning Scheme No. 17 (LPS17). A minor 4.87 ha northern portion of the site is identified as 'Urban Investigation' in the *North-east subregional planning framework* (DPLH, 2018), with the balance of the site identified as 'Open Space'. As such it has not been identified as 'Urban Investigation' under the framework. Further site investigations, including this DWMS, have been undertaken to support a proposal of rezoning the site to 'Urban' under the MRS and 'Development' (or similar) under LPS17.

1.2.2 Amendment to North Ellenbrook (West) DSP

The North Ellenbrook (West) DSP was previously prepared by Rowe Group and advertised in 2021. The Rowe Group (2022) DSP encompassed 23 freehold lots, including:

- Lots 112, 114, 1474, 1572, 1767, 1808, 1876, 5890 and 5891 Warbrook Road
- Lots 2946 and 2953 Halden Road
- Lots 1479, 1480 and 2382 Chudalup Road
- Lots 2294 and 5889 Della South Road
- Lots 1 and 7 Raphael Road
- A portion of Lot 5892 Maralla Road, north of Sawpit Gully.

This DSP is being lodged as an amendment to the existing North Ellenbrook (West) DSP (Rowe Group, 2022) to include the remainder of Lot 5892 Maralla Rd south of Sawpit Gully. The DSP amendment plan is shown in Appendix A.

A DWMS has been prepared by JDA (2022) to support the Rowe Group North Ellenbrook (West) DSP and has received approval from relevant agencies. The two DWMS areas (this RPS report and JDA (2022)) are divided by Sawpit Gully with different post-development catchments. The drainage management for the two sites are therefore independent of each other and have been addressed within their respective DWMS.

1.3 Key documents and previous studies

This report has been prepared with reference to the following guidance documents and their design objectives:

- *State Planning Policy 2.9: Water Resources* (WAPC 2006)
- *State Water Plan 2007* (Government of WA 2007)
- *Better Urban Water Management* (Western Australian Planning Commission 2008)

- *Guidelines for district water management strategies* (Department of Water 2013a)
- *Water resource considerations when controlling groundwater levels in urban development* (Department of Water 2013b).

Frameworks, management strategies and previous studies relevant to the site are listed below. The key outcomes and considerations for the site have been summarised from each document.

1.3.1 North-East Subregional Planning Framework (DPLH 2018)

The *North-East Subregional Planning Framework* ('the framework') (DPLH 2018) provides strategic guidance on land use, land supply, land development, environmental protection and infrastructure delivery for the north-east subregion to meet the growth demand for Perth and Peel @3.5 million. The following key considerations are identified in the framework:

- Best practice drainage and nutrient management
- Impacts, risks and management of Gnangara groundwater resources (existing Priority 3 Source Protection Area)
- Protection of Bush Forever areas and conservation category wetlands
- Protection of high value Carnaby's black cockatoo habitat and vegetation with 10–30% remaining in Perth and Peel regions
- Protection of threatened ecological communities and flora populations
- Off-site impacts on western swamp tortoise habitat Environmental Protection Policy (EPP)
- RAAF Base Pearce operations (Department of Defence)
- Transition/interface with regional open space areas
- Bushfire risk access to the regional road network
- Basic raw materials – sequential land use allowing for extraction of sand resources.

In the context of "best practice drainage and nutrient management", the framework states:

> Areas identified for future urban and industrial development in the framework will be required to address the management of drainage systems to ensure that biodiversity and ecological functions and water quality of wetlands and river systems are maintained, that people and property are protected from flooding and inundation, and that amenity of public open space is enhanced.
>
> This will require the incorporation of best practice water-sensitive urban design and nutrient management and may be required to include the use of detention basins and nutrient/sediment stripping facilities. Subsequent levels of planning for drainage in the sub-region will be guided by the regional water management strategy prepared to support the framework.

1.3.2 Regional water management strategy (Essential Environmental 2014)

A regional water management strategy (RWMS) highlighting key water considerations has been developed for the subregion. This strategy identifies a number of issues including water scarcity, irrigation for public open space (POS) and protection of public drinking water source areas. The RWMS is unpublished, however is referred to in the framework (DPLH 2018), which states:

> The regional water management strategy will inform subsequent stages of water planning in the subregion at the district and local levels which will be undertaken in accordance with the WAPC's Better Urban Water Management framework.

In the absence of this RWMS, it is appropriate to utilise the outcomes of the *North East Corridor Urban Water Management Strategy* (GHD 2007) to inform the DSP and DWMS.

1.3.3 North east corridor urban water management strategy (GHD 2007)

The *North east corridor urban water management strategy* (UWMS) (GHD 2007) was developed to support the North East Corridor structure plan. The site is located just outside of the North East Corridor structure plan; however it is within the UWMS study area.

The UWMS was completed at a time when state government agencies were proposing a more integrated approach to urban water management and land use planning. Under the proposed framework, a Regional Drainage and Water Management Strategy should support Regional Structure Plans and the UWMS states that it should be considered akin to a Regional Drainage and Water Management Strategy under the proposed framework:

> As a Regional Drainage and Water Management Strategy it should be used as the foundation for developing more detailed District and Local Drainage and Water Management Plans that will support District and Local Structure Plans.

1.3.3.1 Surface water

The UWMS provides specific nutrient water quality triggers for the Ellen Brook catchment that apply to the site. It discusses arterial drainage, identifies the surface water catchments, areas of shallow groundwater and environmental constraints. In relation to surface water quantity management, the UWMS specifies that pre-development flow rates will be maintained in the design of flood storages and downstream waterways are not to be impacted upon. It states:

> In developing District and Local Drainage and Water Management Strategies, existing waterways should be reviewed to assess their capacity to convey the increased run-off from major events. This may require streamflow monitoring or modelling. This stream capacity should form the basis for determining the necessary flood storage within the District Structure Plan Area.

1.3.3.2 Groundwater

In relation to groundwater management, the UWMS states that District Drainage and Water Management Strategies should provide guidance for controlled groundwater levels (CGLs). However, these should be reviewed in Local Drainage and Water Management Strategies at local structure plan scale to protect specific environmental values, and after the results of more detailed groundwater monitoring information is available. The UWMS also states:

> The District Drainage and Water Management Strategy will require groundwater modelling to investigate the effect of land use change on groundwater levels, to determine need for imported fill and subsoil drainage, to examine the potential use of shallow groundwater as a resource and to assess any potential impacts on wetlands and groundwater dependent ecosystems.

The finished mine floor level will be at least 2 m above the maximum groundwater level (MGL) calculated for the period 2000 to 2020. Hence, subsoil drainage and fill importation are not expected to be required to control groundwater levels at the site. Consequently no groundwater modelling is considered necessary to support development of the site.

The UWMS strategy is summarised in Table 2.

Table 2: Summary of UWMS strategy (GHD 2007)

Topic	Strategy
Water quantity	• Maintain the pre-development hydrology by managing run-off from rainfall up to the 1-year ARI event • Safe conveyance of run-off from extreme events, up to the 100-year ARI event • Ensure that the flood channel capacity of the receiving waterway is not exceeded.
Water quality	• Include specific water quality design targets • Run-off treatment for all flows up to the 1-year ARI event • Structural and non-structural measures
Groundwater management	• Nutrient export from the site will not be increased • Subsoil drainage is laid at or above the Controlled Groundwater Level (CGL) to protect groundwater dependent ecosystems • Although District Drainage and Water Management Plans should provide guidance for CGLs, these should be reviewed at local structure plan scale to protect specific environmental values and after the results of more detailed groundwater monitoring information is available
Wetland and waterways management	• Drainage must ensure protection of important wetlands
District Drainage and Water Management Plans	• It is recommended that as District or Local Structure Plans are prepared for the North East Corridor, they are supported by Drainage and Water Management Plans (DWMP)

1.3.4 Hydrological and nutrient modelling of the Swan Canning coastal catchments (DoW 2010)

The then Department of Water (DoW) used the Streamflow Quality Affecting Rivers and Estuaries (SQUARE) model to estimate flow and nitrogen and phosphorus loads from the Swan Canning coastal catchments into the rivers and estuaries. Water quality objectives for these catchments were defined based on the modelling and are the basis for the water quality targets set in the *Swan Canning Water Quality Improvement Plan* (Swan River Trust 2009).

2 WATER MANAGEMENT PRINCIPLES AND OBJECTIVES

The following principles and objectives have been adapted for the site from the *North east corridor urban water management strategy* (GHD 2007), *Better urban water management* (WAPC 2008) and *Decision process for stormwater management in Western Australia* (Department of Water and Environmental Regulation (DWER) 2017).

Table 3: DWMS principles and objectives

Key element	Principles	Objectives
Water conservation	• No potable water should be used outside of homes and buildings with the use of water to be as efficient as possible.	• Meet the *State Water Plan* (Government of WA 2007) water consumption target of 100 kL/ person/yr, including not more than 40–60 kL/ person/yr scheme water. • Irrigation of public spaces to be by groundwater or an alternate water supply scheme.
Water quantity	• Maintain the pre-development hydrologic regime and meet the ecological water requirements of the receiving environment. • Protection of property and infrastructure by the safe conveyance of excessive run-off from extreme events. This includes the protection of property and infrastructure within the DSP area as well as downstream and so needs to consider the impact of peak discharge from the study area	• Maintain ecological flows into important wetlands and western swamp tortoise habitats. • Design stormwater management systems to provide serviceability, amenity and road safety during minor rainfall events. • Maintain the 1% annual exceedance probability (AEP) pre-development flood regime (flood level, peak flow rates and storage volumes) • Safely convey run-off from extreme events up to the 1% AEP event and ensure that the flood channel capacity of the receiving waterway is not exceeded by retaining or detaining the run-off from storm events where appropriate. • Protect people and property from flooding by constructing building habitable floor levels with appropriate minimum clearances above the 1% AEP flood level.
Water quality	• Maintain surface water quality at pre-development levels and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the sub-catchment in which the development is located.	• Manage — retain and/or detain and treat (if required) — stormwater run-off from constructed impervious surfaces generated by the first 15 mm of rainfall at source as much as practical.
Groundwater management	• Protect buildings and other infrastructure by providing adequate separation from maximum groundwater levels • Maintain ground water quality at pre-development levels and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems in the sub-catchment in which the development is located.	• Maintain >2 m clearance from the pre-development MGL. • Nutrient export from the site will not be increased.

3 EXISTING ENVIRONMENT

3.1 Existing and historical land use

The site (Lot 5892) is currently zoned 'Rural' in the Metropolitan Region Scheme (MRS) and 'General Rural' in the City of Swan's LPS No. 17. A minor 4.87 ha northern portion of Lot 5892 is identified as 'Urban Investigation' in the *North-east subregional planning framework* (DPLH, 2018), with the balance of the site identified as 'Open Space'.

The earliest available imagery in 1965 shows the majority of the site comprised of remnant vegetation. Clearing within the north-west corner of the site occurred between the late 1960s and early 1970s. The clearing is associated with the establishment of various access tracks and agricultural pursuits.

3.2 Key site elements

The following provides the key elements for the sites, with further detail provided in the Preliminary Environmental Assessment Report (RPS, 2021a).

3.2.1 Lot 5892

Lot 5892 is 163 ha in area and consists of the following key elements:

1. A 120.7 ha sand mining tenement (M70/326), which represents 74% of the Lot 5892. The 120.7 ha mining tenement area has been subject to mining high grade silica sand since approximately 2013. The sand mine is operated by the Urban Resources (a basic raw materials mining company). Urban Resources is the "proponent" responsible for implementing the sand mine's environmental (Ministerial Statement No. 956), planning (Extractive Industry Licence and Development Application) and mining (Mining Proposal and Mine Closure Plan) approvals
2. A 20 ha Conservation Category Wetland (CCW) and Resource Enhancement Wetland (REW) core and buffer areas
3. The remaining 22 ha of the site, (located in the northern portion of the site outside of the 120.7 ha mining tenement and the 20 ha mapped wetland areas), consists of 6.6 ha of land that was historically cleared and approximately 15.4 ha of intact native vegetation.

The key elements of Lot 5892 are presented spatially in Figure 1.

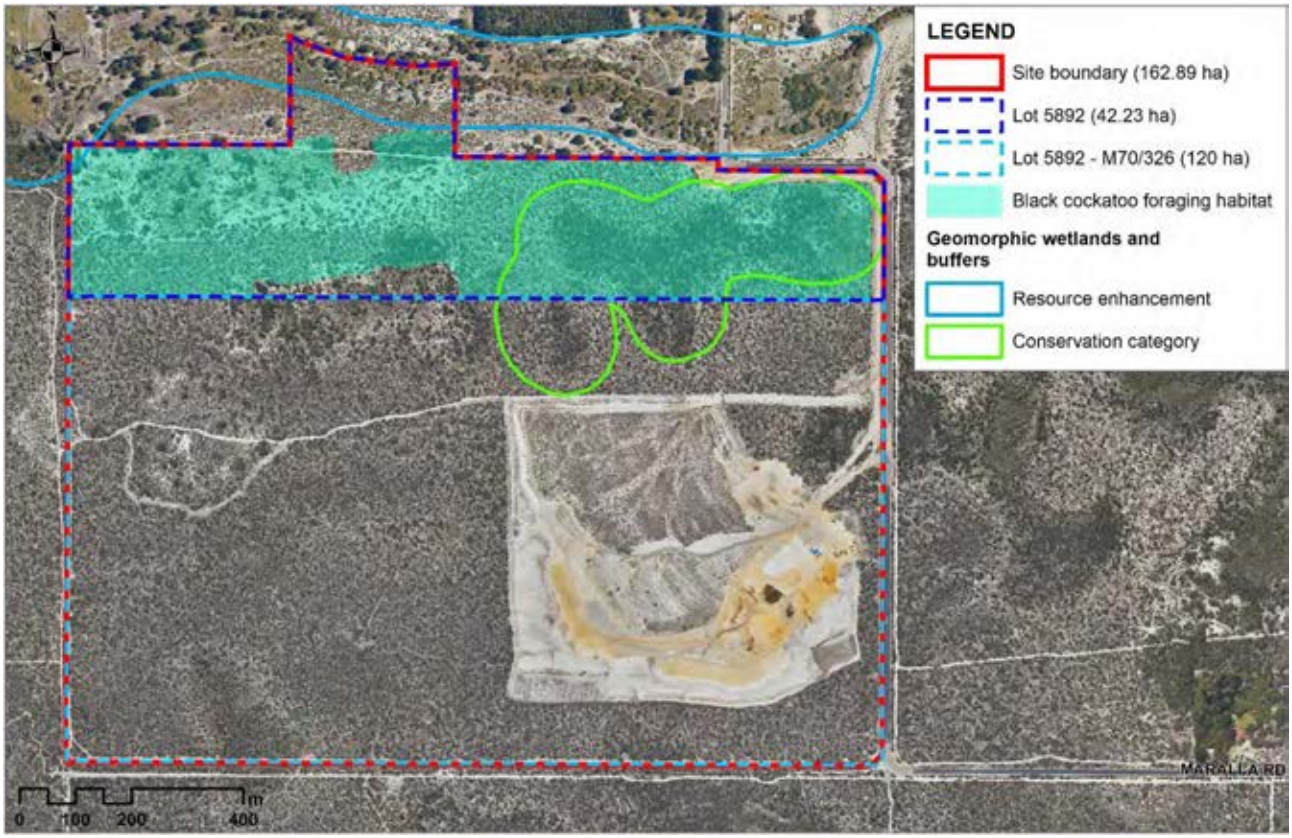
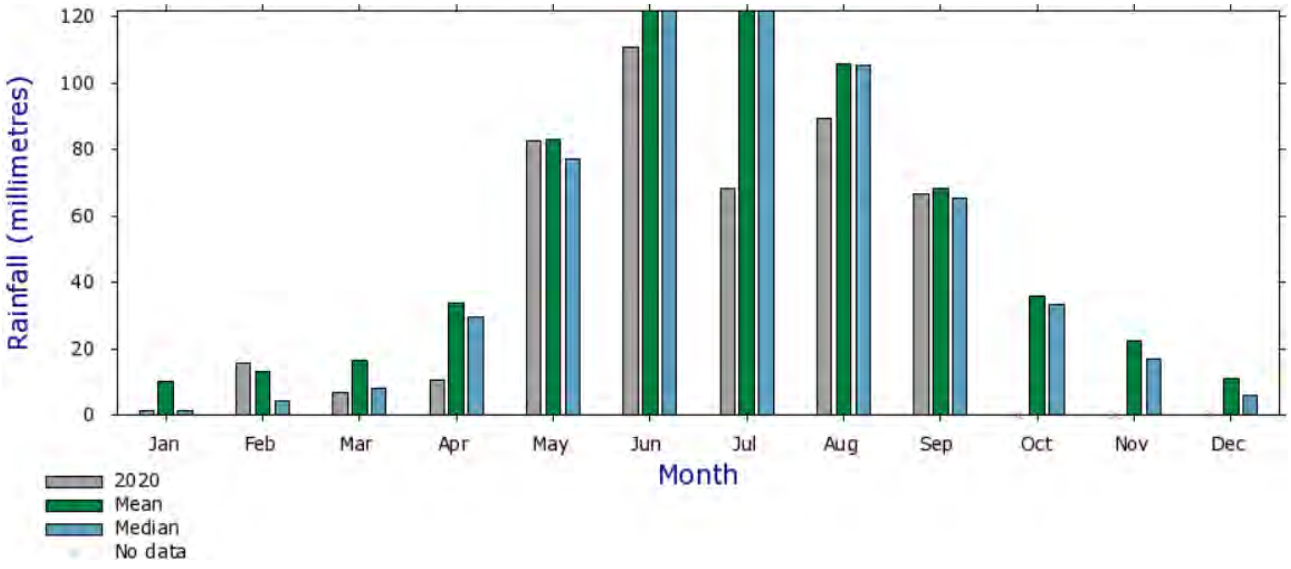


Figure 1: Lot 5892 Maralla Road key elements

3.3 Climate and rainfall

The site experiences a Mediterranean climate, characterised by a distinctly dry and hot summer, and a cold and wet winter. The closest rainfall station to the site is RAAF Base Pearce, WA (009053). The long-term average annual rainfall is 652.1 mm (from 1938 to 2020) with the highest rainfall recorded in July (average 132.8 mm) and the lowest rainfall observed in January (average 10.3 mm) as shown in Graph 1. The annual average temperature recorded is 25.3 °C with the hottest month being January (33.5 °C) and July is the coolest month (17.9 °C).



Graph 1: Mean monthly rainfall (BOM station 009053, 2000)

3.4 Topography

Regional LiDAR contours (DoW 2008) are shown in Figure B. The site topography ranges from approximately 50 mAHD to 76 mAHD. The highest elevations are found at the southern two-thirds of Lot 5892 (within the sand mining tenement). The topography on the eastern half of the site is currently altered by the sand mining activities.

3.5 Geology

3.5.1 Regional mapping

The Environmental Geology Series (Perth Sheet; Gozzard, 1986) indicates the site is generally Bassendean Sand; very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin. A small northern portion of the site is mapped as Bassendean Sand over pebbly silt, which represents the Guildford Formation. The Guildford Formation generally consists of brown silty and slightly sandy clay (Davidson, 1995). The geology associated with the mapped wetlands comprises peaty clay, dark grey and black with variable sand content, of lacustrine origin. Surface geology mapping is shown in Figure C.

Davidson (1995) indicates the Gnangara Sand is present at the bottom part of the superficial formations in the region and the base of the superficial formations is at an elevation of approximately -3 to 5 mAHD beneath the site. The Gnangara Sand is a pale grey, fine to coarse grained quartz sand with feldspar.

The superficial formations are underlain by the Poison Hill Greensand, Gingin Chalk, Molecap Greensand and the low permeability Kardinya Shale aquitard of the Osborne Formation. These formations above the Kardinya Shale form part of the Mirrabooka aquifer. The Poison Hill Greensand typically consists of silty sand that is unconsolidated, pale yellowish green, fine to coarse grained, very poorly sorted, well rounded and glauconitic. The Gingin Chalk is a pale grey to whitish green, slightly glauconitic chalk. The Molecap Greensand typically consists of sandstone that is yellowish-brown to greenish grey, fine to medium grained glauconitic and silty. The Mirrabooka aquifer is underlain by the Kardinya Shale, a low permeability shale that consists of dark green to black inter-bedded siltstone and shale. Table 4 describes the geological formations and members from youngest to oldest age.

Table 4: Geological formations, members and aquifers in the area

Formation	Member	Aquifer
Guildford Formation	NA	Superficial aquifer
Bassendean Sand	NA	
Gnangara Sand	NA	
Poison Hill Greensand	NA	Mirrabooka aquifer
Gingin Chalk	NA	
Molecap Greensand	NA	
Osborne Formation	Mirrabooka Member	
	Kardinya Shale	Confining unit
	Henley Sandstone	Leederville aquifer
Leederville Formation	Pinjar Member	
	Wanneroo Member	
	Mariginiup Member	
South Perth Shale	NA	Confining unit
Yarragadee Formation	NA	Yarragadee aquifer

3.5.2 Site investigations

Australian Groundwater Consultants completed a geological investigation across the Gnangara area in 1984 that included Lot 5892. The objective was to broadly define sand deposits (silica and aggregate sands) in regard to thickness, areal distributions, reserves, grades and marketability. The geotechnical investigation

across Lot 5892 included the drilling of 27 boreholes using a drill rig (tractor mounted Edson 2000) along three transects to depths up to ~15 m. The results found that Lot 5892 is underlain by well sorted medium grained silica sands. Sample locations and cross-sections as provided by Australian Groundwater Consultants (1984) are provided in Appendix B.

3.6 Acid sulfate soils

Regional acid sulfate soil (ASS) risk mapping is shown in Figure D. The majority of the site has a moderate to low risk of ASS occurring within the top 3 m of the natural soil surface. Some areas within the mapped CCW in Lot 5892 have a high to moderate risk of ASS occurring within the top 3 m of the natural soil surface.

3.7 Contaminated sites

The site does not have any records of known or suspected contaminated sites in DWER's Contaminated Sites Database. On completion of sand extraction activities within mining tenement M70/326, any infrastructure on the site will be removed in accordance with the Mine Closure Plan (EnviroWorks Consulting, 2014).

3.8 Heritage

One registered Aboriginal heritage site was identified across the eastern half of the site as shown in Figure E. Ellen Brook Upper Swan Registered Aboriginal Site 3525 was registered for mythological reasons.

There are no listed heritage places within Lot 5892 according to the Heritage Council of Western Australia's inherit database and City of Swan's Heritage List.

3.9 Bush Forever sites

There are two Bush Forever sites surrounding the southern and western boundaries as shown in Figure F. The southern site is the 4,151 ha Bush Forever Site No. 300 – Maralla Road Bushland, Ellenbrook Upper Swan and the western site is the 642 ha Bush Forever Site No. 399 – Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia.

3.10 Wetlands

The Department of Biodiversity, Conservation and Attractions' (DBCA) mapping of Geomorphic Wetlands of the Swan Coastal Plain confirms two wetlands that are fully or partially within the site (Figure F). The following points summarise the two mapped wetlands.

- One Conservation Category wetland (CCW) (UFI 8907) identified as a Dampland located within the north-east corner of Lot 5892. A high-level vegetation assessment undertaken by RPS in 2020 (RPS, 2021a) confirmed that this mapped wetland comprises Banksia woodland vegetation
- One Resource Enhancement wetland (REW) (UFI 13387) identified as a flood plain is located to the north of Lot 5892. This is associated with Sawpit Gully, which runs outside the northern boundary.

3.11 Western swamp tortoise

The western swamp tortoise is classified as critically endangered internationally (IUCN, 2010), critically endangered nationally (EPBC Act 1999), and at the state level as critically endangered (WA *Wildlife Conservation Act 1950*) and as fauna that is 'rare or likely to become extinct' (then Department of Environment and Conservation; DEC).

In response, the Environmental Protection Authority (EPA) developed the Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002 (Western Swamp Tortoise Habitat EPP) which was gazetted on 18 February 2003. This has since been revised as the Western Swamp Tortoise Habitat EPP 2011, gazetted on 14 February 2012, which supports the EPA's recommendations for the continued protection of the habitat.

The EPP identifies an area that constitutes tortoise habitat and lists activities that might degrade it. The Western Swamp Tortoise Habitat EPP differs from the EPBC Act as the EPP defines an area that contains the western swamp tortoise habitat as well as areas that are not considered to be western swamp tortoise habitat but could affect the habitat should detrimental factors be conducted in that area (EPA, 2010).

The site is approximately 2.8 km west of the EPP 2011 area (Figure G). The only two natural western swamp tortoise habitats, the Twin Swamps Nature Reserve and the Ellen Brook Nature Reserve, are located approximately 3.8 km to the north-east and 5.8 km to the south-east of the site respectively.

3.12 Public drinking water source areas

The *North-east subregional planning framework* (DPLH 2018) identifies the impacts, risks and management of Gnangara groundwater resources as a key consideration for the North Ellenbrook Investigation area.

Public Drinking Water Source Areas (PDWSAs) are shown in Figure H. A portion of the site intersects the eastern edge of the Priority 3 of Gnangara Underground Water Pollution Control Area. There is a Priority 1 PDWSA located immediately to the eastern border of the site. *Statement of Planning Policy 2.2 Gnangara Groundwater Protection* (WAPC 2005) identifies that urban land uses are acceptable within Priority 3 PDWSAs. The nearest public abstraction bore is >2.4 km to the west.

3.13 Groundwater

3.13.1 Aquifers

The site is part of the Gnangara groundwater system, which comprises several hydrogeological units (aquifers), including the:

- Unconfined Superficial aquifer
- Semi-confined Mirrabooka aquifer
- Confined Leederville aquifer
- Confined Yarragadee North aquifer.

Table 4 in Section 3.5.1 provides a summary of the aquifers in the vicinity of the site.

3.13.2 Groundwater levels

A search of the DWER Water Information Reporting (WIR) database shows no bores within the site, however 16 monitoring bores were identified within the site vicinity. The pre-development Average Annual Maximum Groundwater Level (AAMGL) and Maximum Groundwater Level (MGL) were calculated for the site using the groundwater levels obtained from the 16 DWER bores. The objective of calculating the AAMGL and MGL is to provide an understanding of the pre-development hydrology at the site. The calculation was made using water level records for the period 2000 to 2020 and utilised up to 21 annual peaks.

MGL contours and depth to MGL across the site are shown in Figure I. The MGL ranges from approximately 47.0 to 51.5 mAHD and groundwater flows in an easterly direction. The northern site areas have the lowest clearance to groundwater, i.e. less than 2 m below ground level (mbgl), associated with wetland areas. The central area of the site has higher clearance to groundwater (up to 30 m depth) associated with elevated sand dunes. The depth to MGL is based on surface topography prior to sand excavation which was taken from a digital elevation model (DEM) derived from a LiDAR five-metre grid (Geoscience Australia, 2021)[1]. The finished mine floor level will be at least 2 m above the MGL, hence subsoil drainage and fill importation are not expected to be required to control groundwater levels.

Monitored groundwater levels shown as bore hydrographs are included in Appendix C. The calculated AAMGL and MGL for each DWER bore are shown in Table 5. The MGL is an average 0.7 m above the AAMGL.

[1] Geoscience Australia states that its source datasets have been captured to standards that are generally consistent with the Australian ICSM LiDAR Acquisition Specifications, which require a fundamental vertical accuracy of at least 0.30m (95% confidence).

Table 5: Pre-development groundwater levels

Bore ID	Easting	Northing	Annual peaks	AAMGL (mAHD)	MGL (mAHD)
61611014	400645	6487878	21	51.16	51.91
61611017	400361	6489912	21	53.97	54.80
61611018	401216	6489911	21	54.36	55.17
61611035	401216	6487664	21	48.35	49.20
61611037	401630	6487719	21	48.11	48.70
61611041	402326	6490030	20	47.38	47.94
61611056	402636	6487725	21	46.43	47.01
61611058	403437	6487718	1	46.08	46.70
61611061	403399	6490139	1	42.76	43.39
61611065	404682	6487723	21	32.74	33.50
61611068	404467	6490340	21	35.61	36.11
61613201	401209	6486829	21	48.78	49.42
61613202	400246	6488345	21	52.99	53.87
61613214	401801	6487538	21	47.43	48.03
61613216	402824	6486433	21	46.35	46.89
61613217	402824	6486432	20	46.34	46.92

3.13.3 Groundwater quality

3.13.3.1 DWER bore monitoring

No groundwater quality monitoring has been undertaken at the site. However, some groundwater quality information was obtained from DWER bores in the vicinity, of which 11 have been infrequently monitored (2–6 samples per bore) between 1985 to 2000.

Groundwater quality results have been compared to ANZECC and ARMCANZ (2000) freshwater guideline (FWG) values for the following parameters:

- Physico-chemical parameters: pH, temperature (°C), total dissolved solids (TDS; mg/L)
- Nutrients: Soluble ammonium (NH_4-N) and filtered reactive phosphorus (FRP).

Results are summarised in Table 6, which also presents the Swan-Canning Water Quality Improvement Plan (SCWQIP; Swan River Trust 2009) targets for total nitrogen (TN) and total phosphorus (TP).

Table 6: Groundwater quality results

Location (date)	Sample no:	Temp (°C)	pH	TDS (mg/L)	TN	NO_x-N	NH_4-N	TP	FRP
ANZECC FWG (2000)		-	7-8.5	-	1.5	0.1	0.04	0.06	0.03
SCWQIP (SRT 2009)		-	-	-	1	-	-	0.1	-
61611014 (1985)	2	25	5.1	-	-	-	0.02	-	-
61611017 (1985)	2	25	7.3	-	-	-	0.03	-	-
61611018 (1985)	2	25	6.1	-	-	-	0.02	-	-
61611035 (1971)	2	20	6.6	130	-	-	-	-	-
61611037 (1985–1999)	5	21	4.6	-	-	-	<0.02	-	<0.01
61611041 (1985– 2000)	6	24	4.5	-	-	-	0.17	-	-
61611056 (1985)	2	25	4.3	-	-	-	0.09	-	-
61611058 (1985)	2	25	5.3	-	-	-	0.24	-	-
61611061 (1985)	2	25	5.4	-	-	-	0.4	-	-
61611065 (1985)	2	25	5.2	-	-	-	0.07	-	-
61611068 (1985)	2	25	5.3	-	-	-	0.3	-	-
Average		**24**	**5.4**	**130**	**-**	**-**	**0.14**	**-**	**<0.01**

Shading indicates guideline exceedance. All data in mg/L unless otherwise specified. - Indicates no data available. Values in brackets are monitoring periods.

The DWER results indicate groundwater in the site vicinity is acidic (average pH 5.4) and fresh (TDS 130 mg/L, albeit at one location only). Several bores recorded soluble ammonium (NH_4-N) above the stressor FWG (0.04 mg/L) with a mean of 0.14 mg/L. Only one bore was measured for FRP concentrations which recorded below the FWG.

JDA (2022) reports groundwater quality from a monitoring bore approximately 3 km north of the site (GNM 14). This bore has been monitored by DWER between August 2008 and August 2009. TN ranged from 1.3 to 2.3 mg/L and exceeded the SCWQIP and FWG targets, while TP ranged from 0.006 to 0.041 mg/L, which was below both guidelines.

3.13.3.2 North Ellenbrook (East) DSP area

In addition to the aforementioned DWER monitoring, nine bores were monitored in August 2019 as part of the North Ellenbrook (East) DWMS investigations immediately east of the site. The following summarises the mean concentration results from the nine monitoring bores (RPS, 2021b):

- pH: 5.5
- Electrical conductivity: (1,141 µS/cm; ~740 mg/L TDS (calculated))
- TN: 5.4 mg/L
- Nitrate/nitrite – nitrogen (NO_X-N): 0.36 mg/L
- NH_4-N: 0.26 mg/L
- TP: 2.0 mg/L
- FRP: 1.88 mg/L.

The monitoring results indicate groundwater at the North Ellenbrook (East) DSP area is acidic (average pH 5.5) and marginally fresh (EC generally <~1,000 µS/cm; ~650 mg/L) except for a monitoring bore (MW02) located at the north-eastern area of the DSP area, which has a notably higher salinity than all other bores (EC of 6,455 µS/cm; ~4,200 mg/L). TN levels exceed ANZECC and SCWQIP guidelines for eight of the nine bores but are <5 mg/L in all bores except for MW02, which is significantly higher at 29 mg/L. Similarly, phosphorus levels in this bore (TP of 14 mg/L, FRP 13 mg/L) are much higher than for all other bores (<1.5 mg/L).

The elevated nutrients are expected to be due to historical agricultural land use and flushing of natural soil nutrients associated with clearing. The notably higher salinity and nutrient concentrations in MW02 could be due to the nursery located immediately north and up-hydraulic gradient of that bore. Field observations have also noted that MW02 is located in and downstream of a low-lying area that would be frequently inundated, is visited by horses and has high organic content.

3.13.4 Groundwater impacts to western swamp tortoise habitats

The nearest western swamp tortoise habitat is the Twin Swamps Nature Reserve located approximately 3.8 km north-east of the site. Based on the groundwater flow direction (easterly), groundwater from the site is unlikely to impact the habitat.

The Ellen Brook Nature Reserve is about 5.8 km south-east of the site and is not hydrogeologically connected to the site.

3.14 Surface hydrology

3.14.1 Catchment hydrology

Sawpit Gully, a tributary of Ellen Brook, flows east along the northern boundary of the site. The Perth–Darwin National Highway (PDNH) runs north–south along the eastern boundary of the site, bisecting pre-development flow paths. Culverts along the PDNH (shown in Figure J) allow flows from the site to cross the PDNH and enter the downstream North Ellenbrook (East) DSP area. The DWMS (RPS 2021b) prepared to support the North Ellenbrook (East) DSP assessed upstream catchments (including a portion of this site) at a regional scale. The site's catchments generally align with that shown in the North Ellenbrook (East) DWMS (RPS 2021b), however some refinements have been made.

The site is characterised by many ridges and depressions in the topography, resulting in some catchments that drain internally and very little pre-development run-off from the site. Pre-development catchments are shown in Figure J and a breakdown of catchment areas are presented in Table 7.

Table 7: Pre-development catchment areas

Catchment	Area – total (ha)	Area – within site boundary (ha)
E	1,123	26.9
F1	110	73.0
F2	36	0
G	24	0
H	64	42.1
I	462	20.8
Total		**162.8**

Catchment IDs correspond with the regional catchment IDs used in the downstream North Ellenbrook (East) DWMS (RPS 2021b)

The pre-development flow paths and discharge points for the site's catchments are shown in Figure J and summarised as follows:

- Catchment E discharges north to Sawpit Gully (also a REW).
- Catchment F is split into two sub-catchments. In minor rainfall events, Catchment F1 drains internally to CCWs with no run-off discharge. However, in larger rainfall events, the wetlands and the whole of Catchment F (comprising catchments F1 and F2) discharges via the PDNH culverts.
- Catchment G is external to the site but has been shown for broader context; it drains to two wetlands located to the east before discharging via the PDNH culverts.
- Catchment H drains internally, retaining all rainfall on site.
- Catchment I drains via overland sheet flow towards the Bush Forever site to the south.

3.14.2 Perth-Darwin National Highway culverts

The PDNH culvert crossings were designed by BG&E (2018) to provide 100-year ARI serviceability without overtopping the PDNH. The detailed culvert schedule and PDNH engineering drainage plans are provided in Appendix D. The site discharges to two sets of culvert crossings, summarised in Table 8.

Table 8: Perth–Darwin National Highway culvert schedule

DWMS catchment	Structure number (BG&E 2018)	RCB culvert dimensions	Number of barrels + link slabs	Length (m)	Inlet invert level (mAHD)	Outlet invert level (mAHD)
E	CT19.65	2400 × 600	3+1	44.4	43.40	43.30
F	CT20.29	1200 × 375	4+2	42.0	45.30	45.19
	CP20.28	1200 × 375	4+2	12	45.04	45.01
G	CT20.64	1200 × 375	1	52.8	46.63	46.53

3.14.3 Pre-development flood modelling

The pre-development peak discharge rate from each catchment within the site has been modelled in XPSWMM. The 20% and 1% Annual Exceedance Probability (AEP) design storm events of durations between one hour and 72 hours were modelled. Peak discharge rates from each catchment are summarised in Table 9. Details of the modelling assumptions and parameters adopted have been documented in Appendix E.

Table 9: Pre-development peak discharge rates

Catchment	20% AEP critical storm duration (hrs)	20% AEP peak discharge (m^3/s)	1% AEP critical storm duration (hrs)	1% AEP peak discharge (m^3/s)
E	24	0.12	9	0.86
F1	-	0	9	2.02
F2	24	0.12	9	2.72*
G	24	0.04	9	0.27
H	-	0	-	0
I	24	0.13	9	1.01

Reported peak discharge rates are from the site only and do not include discharge from the wider catchment

* Catchment F2 peak discharge is inclusive of the discharge from catchment F1

3.14.4 Surface water levels and flow monitoring

Surface water monitoring has not been conducted at this site, however monitoring of Sawpit Gully downstream of the site was undertaken as part of the North Ellenbrook (East) DWMS (RPS 2021b). Five staff gauges were installed by RPS in 2019 along Sawpit Gully, shown in Figure K. Water levels and flow estimates were measured between June and October 2019.

Water levels measured are reported in Table 10. The base flow depth in Sawpit Gully is approximately 0.2 m. A peak base flow of approximately 20 L/s was estimated in Sawpit Gully in August 2019.

Table 10: Staff gauge water levels

Staff gauge ID	SG1	SG2	SG3	SG4	SG5
Bed level (mAHD)	41.37	35.86	26.13	27.33	28.70
Water depth (m)					
30/07/2019	0.23	0.14	0.19	0.20	-
27/08/2019	0.24	0.15	0.21	0.20	0.21
26/09/2019	0.24	0.13	0.16	0.14	0.15
31/10/2019	0.19	0.06	0.00	0.00	0.00
Water level elevation (mAHD)					
30/07/2019	41.60	36.00	26.32	27.53	-
27/08/2019	41.60	36.01	26.33	27.53	28.91
26/09/2019	41.60	35.98	26.29	27.46	28.85
31/10/2019	41.56	35.92	26.13	27.33	28.70

Note: - Indicates reading not recorded.

3.14.5 Surface water quality monitoring

As part of the adjacent North Ellenbrook (East) DWMS (RPS 2021b), surface water quality was sampled at three locations downstream of the site along Sawpit Gully (SG1 to SG3). Sampling locations are shown in Figure K. The sampling was undertaken on three occasions in June, August and September. Physico-chemical parameters were measured in the field and samples were sent to a NATA-accredited laboratory for analysis.

Results have been summarised in Table 11. Table 11 also presents the ANZECC and ARMCANZ (2000) FWG values and the SCWQIP targets for TN and TP.

Table 11: Surface water quality

Location	Date	Temp	pH	EC (µS/cm)	TN	NO_x-N	NH_4-N	TP	FRP
ANZECC (2000) FWG		-	7-8.5	-	1.5	0.1	0.04	0.06	0.03
SCWQIP (SCP 2009)		-	-	-	1	-	-	0.1	
LOR		-	-	-	0.1	-	0.005	0.05	0.005
SG1	25/06/2019	-	-	-	2.9	0.005	0.023	0.025	0.026
SG1	26/08/2019	13.1	6.0	542	2.3	0.05	0.025	0.05	0.028
SG1	26/09/2019	15	5.6	399	1.7	0.22	0.009	0.025	0.025
SG2	26/08/2019	14.2	4.7	477	2.1	0.0275	0.017	0.08	0.053
SG2	26/09/2019	16.7	4.6	364	2.2	0.22	0.027	0.07	0.052
SG3	25/06/2019	-	-	-	6.1	0.005	0.18	1.3	1.0
SG3	26/08/2019	14	6.1	772	4.3	0.05	0.01	0.54	0.4
SG3	26/09/2019	20.7	5.3	620	3.8	0.1	0.017	0.22	0.13
Average		**15.6**	**5.38**	**529**	**3.2**	**0.085**	**0.039**	**0.289**	**0.214**

Shading indicates guideline exceedance. All data in mg/L unless otherwise specified. Red text indicates results were below the limit of reporting (LOR); displayed values are half the LOR.

The monitoring results indicate surface water at the site is acidic (average pH 5.4) and fresh (average EC of 529 µS/cm; ~350 mg/L). TN and TP levels exceed ANZECC and SCWQIP guidelines at most locations (average 3.2 mg/L and 0.29 mg/L respectively).

3.14.6 Surface water impacts to western swamp tortoise habitats

Surface water run-off from the site is retained within local wetlands or drains to Sawpit Gully, either directly or via small tributaries traversing the downstream lots to the east. Sawpit Gully does not traverse the EPP area. It discharges to Ellen Brook downstream of the EPP area (Figure K) and therefore is not considered to impact on western swamp tortoise habitats.

4 WATER SOURCE PLANNING

4.1 Potable water supply

The site is located within the Water Corporation's licensed area for provision of a potable water supply service. The Water Corporation has advised that there is currently no water planning for residential development of the land north of Maralla Road or agreement between the Water Corporation as service provider and the proponents regarding development and financing of these essential services (Rowe Group 2022).

The Ellenbrook townsite has a significant existing water supply infrastructure system, including a Water Corporation overhead tank located approximately 3 km west of Ellenbrook and approximately 1.9 km south-south-west of the North Ellenbrook (West) DSP area. There are diameter 1,200 mm and 900 mm trunk mains that cross the Tonkin Highway that feed smaller reticulation mains for distribution. It is anticipated that reticulation extensions will come from this supply with alignment in future road reserves heading north to the North Ellenbrook (West) DSP area. Servicing of the individual lots will be via the installation of a series of reticulation mains as per Water Corporation standards.

Capital funding for the new reservoir outlet and associated distribution mains is currently not on the Water Corporation's capital investment program. In liaison with the Water Corporation, the proponents will need to further investigate the infrastructure alignment and resolve funding of any water headworks to enable development of the land prior to the 'lifting of Urban Deferment' process.

4.2 Non-potable water supply

4.2.1 Requirements

As per the water conservation principle of "no potable water should be used outside of homes and buildings with the use of water to be as efficient as possible" in *Better Urban Water Management* (WAPC 2008), a non-potable water supply will need to be sourced to service the irrigation requirements of POS within the site.

The *North West corridor water supply strategy* (DoW 2014) adopted a reduced irrigation rate of 6,750 kL/ha/yr (rather than the (then) standard 7,500 kL/ha/yr) to improve irrigation efficiencies. Although outside the strategy boundaries, the site has a similar scarcity in groundwater resources, which is the preferred source for non-potable water supply.

In accordance with the City of Swan's guidelines for water irrigation requirements, the following irrigation benchmarks are to be targeted at the local structure plan stages:

- 60% of public open space areas to be irrigated at an average of 6,750 kL/ha/yr
- 80–90% of the district open space to be irrigated at 10,000 kL/ha/yr
- 20% of school sites to be irrigated at 6,750 kL/ha/yr.

The irrigation rate of 6,750kL/ha/yr has been applied to 60% of the general residential development POS areas including the POS co-located with the school (8.63 ha out of 14.38 ha), and to 20% of the school site itself (0.7 ha out of 3.5 ha). It is anticipated POS areas adjacent to wetlands will not require irrigation. Based on the total estimated area allocated to POS and the school, the estimated irrigation requirement is 62,950 kL/yr. This irrigation volume is a conservative estimate. Further refinement by landscape architects, in consultation with City of Swan, will be undertaken in future design stages, and consideration will be given to the design criteria developed in the *North-west corridor water supply strategy* (DoW 2014).

4.2.2 Existing groundwater licences

The site is located within the Swan groundwater area. The following aquifers are present in the area:

- Perth – Superficial Swan (unconfined, North Swan subarea)
- Perth – Mirrabooka (semi-confined, North Swan subarea)
- Perth – Leederville (confined, Swan Confined subarea).

All aquifers are fully allocated and so any groundwater licences for the site would need to be obtained by transfer/trade with other groundwater users in the same groundwater subarea. A review of the Water Register (DWER, 2022; accessed on 9 December 2022) indicates there are currently:

- Thirty-eight groundwater licences in the North Swan subarea of the Superficial aquifer
- Three groundwater licences in the North Swan subarea of the Mirrabooka aquifer
- Two hundred and twenty-one groundwater licences in the Swan Confined subarea of the Leederville aquifer.

The site currently has a licensed groundwater allocation of 26,100 kL/yr for sand extraction purposes (GWL200141). This licence is from the North Swan subarea of the Superficial aquifer owned by Urban Resources Pty Ltd. It can be amended or traded to provide irrigation water for POS, however there will be a shortfall of some 36,850 kL/yr. The current allocation volume would be sufficient to provide irrigation for the active open space for the proposed urban development. However, xeriscaping and other low water demand landscape treatments would be required for the remaining POS, if the shortfall in non-potable water supply for irrigation is not overcome.

It is recognised that licence trading is the preferred option for irrigation water supply, hence refinement of irrigation volumes is in the project's best interest and will be undertaken so that unnecessary allocation will not be purchased.

4.3 Wastewater servicing

The site is located within the Water Corporation licensed area for operating sewerage services. The Water Corporation has advised that the site is currently outside their service area, however, future planning has commenced to provide a servicing strategy for wastewater. The Water Corporation has recently undertaken conceptual wastewater planning for North Ellenbrook and the wider West Bullsbrook Industrial area that identifies the North Ellenbrook (West) DSP within the Bullsbrook Sewer District (Rowe Group 2022). This wastewater planning allows for wastewater from both the North Ellenbrook (East) and North Ellenbrook (West) DSPs to be pumped from North Ellenbrook southwards into the Ellenbrook (Barrabmbie Way) Main transfer Waste Water Pump Station ('WWPS'). This solution will require the construction of a 900 mm diameter gravity sewer from the Barrambie Way WWPS northwards to a suitable high point to accept pumped flows from future station within North Ellenbrook. Capital funding for the sewer extension is currently not on the Water Corporation's five-year capital program. Should development proceed ahead of Water Corporation funding being allocated for the works, the proponent may elect to fully fund the extension of the necessary headworks infrastructure and WWPSs.

It is assumed that the site, proposed to be part of the North Ellenbrook (West) DSP, will be a part of the Bullsbrook Sewer District and subject to the Water Corporation's conceptual wastewater planning for the North Ellenbrook (West) DSP.

5 WATER CONSERVATION STRATEGIES

5.1 Targets

Water efficiency, reuse and recycling are integral components of total water cycle management (WAPC 2006). The State Water Plan (Government of Western Australia 2007) is a strategic policy and planning framework to meet the state's water demands to the year 2030. One of the key targets is to reduce scheme water consumption to 40–60 kL per person per year. The *Waterwise Perth Action Plan* (DWER 2019) has a target to reduce average annual scheme water to 110 kL per person per year and supersedes the target in the State Water Plan.

To meet this target, several water saving initiatives to reduce potable water use will be investigated and implemented within the development. The development will comply with the following objectives:

- No potable water should be used outside the homes and buildings where alternative water sources are available. Efficient use of scheme water should be achieved.
- Developments should aim to achieve a target of less than 110 kL of scheme water per person per year.
- Waterwise landscaping techniques should be employed in POS to reduce the irrigation requirement.

Methods that will be utilised to achieve these criteria include:

- Water efficient fixtures and fittings to be installed in households
- Irrigation of POS with groundwater or another alternative water supply
- Landscaping design will incorporate Waterwise native plants, hydro-zoning and xeriscaping to reduce irrigation demand and turf will be limited to areas of active recreation.

5.2 Household water conservation

The Building Code of Australia sets minimum standards of efficiency for water-using fixtures and fittings in homes. These include:

- All tap fittings, except bath outlets, garden taps and toilets must be a minimum 4-star WELS rated.
- All showerheads must be a minimum of 3-star WELS rated.
- An outdoor private swimming pool or spa associated with a Class 1 building must be supplied with a cover or blanket.
- All internal hot water outlets (such as taps, showers and washing machine water supply fittings) must be connected to a hot water system or a recirculating hot water system with pipes installed and insulated in accordance with AS/NS 3500.
- Lot owners will be encouraged to install grey water systems for the irrigation of individual household landscaping.
- Lot owners will be encouraged to install rainwater tanks. Rainwater tanks can be connected to water using fixtures such as toilets, washing machines and external taps to reduce potable water demand as well as assisting in reducing stormwater run-off.

5.3 Waterwise landscaping

While landscaping plans have not been prepared at this stage of the development, broad landscaping principles will be set to ensure waterwise features will be implemented in future designs. This will include but is not limited to:

- Minimising areas of turf to "kick about" recreation areas and active recreational areas
- Amended soil will be applied in POS areas
- Biofiltration areas will be planted with species selected from Vegetation Guidelines for Stormwater biofilters in the south-west of Western Australia (Monash University 2014)

- Garden beds will be mulched
- Hydro zoning and xeriscaping principles will be implemented
- Planting will consist of predominantly endemic native species
- Vegetated swales or living streams will be incorporated where possible as a Water Sensitive Urban Design structure for stormwater conveyance as well as providing ecological linkages
- Efficient use of fertilisers and pesticides.

Water-use efficiency for irrigation of POS will be enhanced through:

- Prioritising irrigation areas
- Best practice turf maintenance
- Optimal irrigation design and management including adjusting irrigation rates in accordance with weather and site-specific requirements.

6 STORMWATER MANAGEMENT

6.1 Drainage principles and criteria

Integrated urban water management recognises that the urban water cycle should be managed as a single system and water supply, stormwater, wastewater, flooding, water quality and wetlands are interconnected (WAPC 2006). The aim of the stormwater management strategy, as per Water Sensitive Urban Design (WSUD) principles, is to:

- Protect natural systems
- Protect infrastructure
- Integrate stormwater treatment into the landscape to maximise the visual and recreational amenity of the development
- Protect water quality
- Maintain peak flows to pre-development rates if discharging off site
- Add value to the development.

The site will effectively manage stormwater quantity and quality generated from small, minor and major events, incorporating best practice WSUD principles. Table 12 summarises the drainage criteria for several objectives based on *Stormwater management manual for Western Australia* (DoW 2004-2007) and *Decision process for stormwater management in Western Australia* (DWER 2017).

Table 12: Stormwater management design criteria

Objective	Criteria
Flood protection	• The 1% AEP peak flow discharge from the site to be maintained at pre-development peak flow rates at all discharge locations. • Flows exceeding the 20% AEP up to the 1% AEP will be conveyed via overland flow paths within road reserves • Building habitable floor levels to be a minimum 0.3 m above the 1% AEP flood level in local detention basins/swales and a minimum 0.5 m above the 1% AEP flood level in Sawpit Gully and nearby wetlands.
Serviceability	• Road drainage system to be designed so that roads will be passable in the 20% AEP event.
Ecological protection	• The 15 mm storm event to be managed and treated on-site via soakwells and bioretention basins/swales. • A minimum treatment area of 2% of the site's connected impervious areas will be provided. • The bioretention basins will be designed according to *Vegetation guidelines for stormwater biofilters in the south-west of Western Australia* (Monash University 2014) *and Adoption Guidelines for Stormwater Biofiltration Systems* (Payne et al. 2015). • Maintain ecological flows into important wetlands. Where pre-development catchments drained to wetlands, flows from rainfall events exceeding the small event (15 mm) will be directed into the wetlands at pre-development peak flow rates.
Mosquito management	• To reduce the risk from disease vector and nuisance insects, retained stormwater will be infiltrated within 96 hours to prevent mosquito breeding conditions.

It is noted that this DWMS presents a preliminary drainage strategy and proof of concept at a high level. A conservative approach has been taken in the adoption of WSUD features given in the planning framework. This is to ensure that POS areas, bio-retention basins and swales have been appropriately/conservatively sized and credited (POS credits) to provide flexibility in the adoption of WSUD features at the local structure plan and detailed design stages. This conservative approach is taken primarily to address any planning concerns with the provision of POS.

The project team will further investigate WSUD features including kerb breaks and overland flow adjacent to POS, wetlands and Sawpit Gully. Where practical, tree pits and media or roadside swales will be incorporated, and other at-source infiltration mechanisms will be considered at further design stages within selected road reserves where there is no crossover frontage for lots. Overland flow with infiltration as close to source as possible could be achieved in some catchments, however, the DWMS does not commit to these design elements as it has not been fully investigated or agreed with the City.

6.2 Post-development catchments

The post-development catchments have been defined with consideration given to the pre-development catchments, flow directions and discharge locations. There are ten post-development catchments within the site, which discharge directly to Sawpit Gully via the PDNH culverts to the east or to the Bush Forever site to the south. Catchments and flow directions are shown in Figures L and M. An indicative breakdown of the different land use types within each catchment is presented in Table 13. Detailed structure planning has not been undertaken yet and these areas are indicative only for the purposes of the modelling described in Section 6.4.

Table 13: Post-development catchment and land use areas (ha)

Catchment	Lot ≥300 m²	Lot <300 m²	Road reserve	Local centre	Primary school	POS	Wetlands/buffers and retained vegetation	Total
1	0.75	-	0.95	-	-	-	2.70	4.40
2	16.12	0.80	8.42	-	-	1.03	-	26.37
3	1.69	-	3.21	-	-	2.67	-	7.57
4	1.69	1.33	3.99	-	-	2.86	13.08	22.95
5	7.69	0.66	4.05	-	-	1.53	-	13.92
6	7.98	0.43	3.53	0.41	-	1.18	-	13.53
7	12.34	0.87	6.26	-	-	1.57	-	21.04
8	17.19	1.28	7.01	-	-	1.39	-	26.87
9	12.88	0.77	5.59	-	-	1.57	1.77	22.59
School	-	-	-	-	3.50	4.73	-	8.29
Total	**78.3**	**6.14**	**43.01**	**0.41**	**3.50**	**18.52**	**17.55**	**167.53**

6.3 Stormwater management strategy

6.3.1 Small event (15 mm) drainage

6.3.1.1 Lot drainage

The general principle for managing lot-generated run-off is for at least the first 15 mm of rainfall to be retained and infiltrated within the lot boundary using soakwells. The predominantly sandy in-situ soils and minimum 2 m clearance to the pre-development MGL following the conclusion of sand mining activities allows soakwells to be effectively used here.

As per City of Swan (2013) guidelines, residential lots greater than 300 m² are to provide soakwells sized for the first 15 mm of rainfall. Lots less than 300 m² may be connected directly to the City's drainage system as long as the downstream drainage infrastructure and stormwater treatment areas are designed accordingly. Group housing and commercial lots are to provide interconnected soakwells. Soakwells are to be located at the front of lots where possible and should be a minimum of 1.8 m from the building footings or property boundary.

6.3.1.2 Road reserve

The first 15 mm of rainfall from road reserves (as well as connected lots) will be managed in bioretention basins or swales located at various close-to-source locations throughout the development which are designed to retain, treat and infiltrate small rainfall events. Managing small rainfall events via close-to-source infiltration will effectively mimic the pre-development hydrological regime of the site and reduce both the volume and peak flow rate of stormwater discharging into the downstream watercourses (e.g. Sawpit Gully) and wetlands. The stormwater management plan for the 15 mm / 1 EY (exceedance per year) event, including indicative locations for biofiltration areas, is shown in Figure L.

Biofiltration areas will be sized to at least 2% of the equivalent connected impervious catchment area. Biofiltration areas will be planted with reeds, sedges and other plant species that will be selected based on their ability to uptake nutrients. The plant species will be selected from *Vegetation guidelines for stormwater*

biofilters in the south-west of Western Australia (Monash University 2014). The biofiltration areas will be designed in compliance with the *Adoption Guidelines for Stormwater Biofiltration Systems* (Payne et al. 2015). Biofiltration areas, along with other formal drainage infrastructure (i.e. pipes) are generally required to be located outside of wetlands and their associated buffers.

6.3.2 Minor event drainage

The objective of the minor event drainage is to maintain the serviceability and amenity of roads and POS in the 20% AEP event. The road drainage network will be designed to convey up to the 20% AEP flows to detention basins and swales located in POS or road verges. These flows will be attenuated within the detention basin/swale or discharge to a wetland as per the pre-development conditions. This maintains the ecological inflow into the wetlands which in turn provides stormwater storage and attenuation for the development.

Under the pre-development conditions, run-off from the 20% AEP event was either discharged off site or attenuated within wetlands on site. Post-development discharge locations and peak outflow rates for the 20% AEP event will mimic the pre-development hydrology of the site. The strategy for each catchment is outlined in Table 14. The 20% AEP stormwater management plan, including flow directions, is shown in Figure L.

Table 14: 20% AEP stormwater management

Catchment	Management strategy	Final discharge location	Peak discharge criteria (m^3/s)
1	Detained in swale	Sawpit Gully	0.12
2	Detained in POS basin		
School	Retained on site	-	-
3	Detained in CCW	East under Halden Road	0.07
4	Detained in CCW		
5	Detained in CCW		
6	Detained in CCW		
7	Detained in CCW		
8	Detained in POS basin	South to Bush Forever and CCWs	0.13
9	Detained in POS basin		

6.3.3 Major event drainage

For all rainfall events greater than the 20% AEP event up to and including the 1% AEP event, any run-off that does not infiltrate into the sandy soils will be conveyed via overland flow paths within the road carriageway to detention basins/swales located within POS or road verges. The maximum depth of water in detention basins will be 1.2 m unless otherwise agreed with the City of Swan and designed with appropriate public access and safety controls.

Post-development discharge locations and peak outflow rates for the 1% AEP event will mimic the pre-development hydrology of the site. The strategy for each catchment is outlined in Table 15. Outflow rates have been provided for each catchment as a guide, prorated based on catchment areas. However, there is flexibility to rebalance outflow rates between individual catchments within the site in response to catchment-specific opportunities or constraints, as long as the flow criteria at the final discharge point from site is met. The 1% AEP stormwater management plan, including flow directions, is shown in Figure M.

Table 15: 1% AEP stormwater management

Catchment	Management strategy	Outflow guidance rate (m^3/s)	Final discharge location	Peak discharge criteria (m^3/s)
1	Detained in swale	0.12	Sawpit Gully	0.86
2	Detained in POS basin	0.74		
School	Detained on site	0.14	East under Halden Road via CCW	1.50
3	Detained in swale & CCW	0.13		

Catchment	Management strategy	Outflow guidance rate (m^3/s)	Final discharge location	Peak discharge criteria (m^3/s)
4	Detained in POS basin & CCW	0.39		
5	Detained in POS basin & CCW	0.24		
6	Detained in POS basin & CCW	0.23		
7	Detained in POS basin & CCW	0.36		
8	Detained in POS basin	0.55	South to Bush Forever and CCWs	1.01
9	Detained in POS basin	0.46		

To protect from flooding, minimum habitable floor levels will be set to provide a minimum separation of 0.5 m above the 1% AEP flood level of Sawpit Gully and nearby wetlands and 0.3 m above the 1% AEP water level in local stormwater storages and road drainage systems.

6.4 Post-development drainage modelling

One of the overarching objectives of the stormwater management strategy is to maintain the pre-development hydrological regime as much as possible after development. To inform and support the strategy, 1D stormwater modelling of the pre-development and proposed post-development scenarios have been undertaken using XPSWMM. Results of the pre-development modelling have been presented in Section 3.14.3. Results of the post-development modelling are presented below. A memo outlining the parameters adopted and modelling assumptions is included in Appendix E.

6.4.1 Stormwater storages

The stormwater management strategy, as discussed in Section 6.3, is to retain and/or treat the first 15 mm of rainfall in biofiltration basins or swales. The 20% and 1% AEP flows are either detained and attenuated within a basin or swale or discharged into a wetland for further attenuation. The catchment-specific strategies for managing the 20% and 1% AEP flows are summarised in Table 14 and Table 15 respectively.

Modelling results for swales and basins are shown in Table 16. Indicative storage locations are shown in Figures L for the 15 mm and 20% AEP events and in Figure M for the 1% AEP event.

6.4.1.1 Note on Catchments 3 to 7

The strategy for Catchments 3 to 7 is to provide flow attenuation in both the local basin/swale and in the CCW located on site. There are no flow criteria for each individual catchment discharging to the CCW, however the final discharge from the CCW through the proposed culverts under Halden Road must meet the peak discharge criteria of 0.07 m^3/s in the 20% AEP and 1.50 m^3/s in the 1% AEP event.

To meet this final discharge criteria, the DWMS modelling has controlled the 1% AEP outflow rates from basins/swales to approximately the guidance outflow rates shown in Table 15. The 20% AEP flow has not been detained in these catchments as the CCW provides sufficient attenuation.

Though there is no requirement to detain the 20% and 1% AEP run-off locally within the catchment, the basins or swales should still be designed to safely contain the 20% and 1% AEP flows to maintain POS amenity and prevent flooding. The 20% and 1% AEP results for these catchments have been shown in *italics* in Table 16 to indicate that the results reflect water backing up within the basin/swale prior to discharge to the wetland and are not a detention requirement. The modelling undertaken at this stage is high-level, and these volumes will be refined as detailed design progresses.

6.4.1.2 Note on School Catchment

It is assumed that the school and co-located POS will retain the small event on site; storage requirements for the small event have not been modelled as part of the DWMS. Table 16 provides estimates of storage volumes required to retain the 20% AEP and detain the 1% AEP event. This excludes the run-off volume from the first 15 mm of rainfall (i.e. if the small event is being managed in the same basin as the 20% and 1% AEP events, the required storage volume will be higher).

Table 16: Modelling results for stormwater storages

Catchment	15 mm			20% AEP			1% AEP		
	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)	Volume (m^3)	Area (m^2)	Depth (m)
1	79	544	0.21	148	724	0.32	182	797	0.37
2	789	1844	0.50	1463	2214	0.83	2218	2594	1.14
3	218	1446	0.25	*378**	*1885**	*0.34**	*747**	*2632**	*0.50**
4	465	1140	0.50	*705**	*1307**	*0.69**	*1133**	*1582**	*0.98**
5	415	1048	0.50	*662**	*1229**	*0.70**	*1221**	*1593**	*1.09**
6	341	955	0.45	*574**	*1132**	*0.65**	*1333**	*1631**	*1.20**
7	621	1469	0.50	*1007**	*1706**	*0.74**	*1812**	*2152**	*1.16**
8	705	1753	0.50	1323	20/3	0.78	2280	2571	1.19
9	538	1419	0.45	1006	1704	0.74	1820	2150	1.16
School†	-	-	-	193	591	0.40	816	1113	1.15

*See Section 7.4.1.1. These modelled volumes reflect water backing up prior to discharge to the CCW and is not a detention requirement.

†See Section 7.4.1.2. These values do not include the run-off volume from the first 15 mm of rainfall, assumed to be managed on site by the school.

6.4.2 Wetlands

Outlet culverts from the on-site CCW are proposed to be installed under Halden Road to maintain pre-development flow paths (Figure J). As the CCW is providing a flood storage function, the culverts will also provide an overflow relief to protect the development from flooding.

Stormwater modelling was undertaken to size the culverts required to control peak outflows to the pre-development flow rate. A box culvert arrangement 0.3 m high by 4 m wide with an overflow invert level of 49.4 mAHD was modelled (Figure M). Post-development modelling results for the on-site CCW are presented in Table 17.

The 1% AEP top water level in the CCW is 49.72 mAHD. This provides approximately 300 mm clearance to the low point of the existing Halden Road adjacent to the CCW, estimated to be approximately 50 mAHD. Habitable floor levels are to have a minimum 500 mm clearance above this top water level.

Table 17: Post-development modelling results for CCW (UFI 8907)

Storm frequency	20% AEP	1% AEP
Critical duration (hr)	4.5	9
Volume stored in wetland (m^3)	2061	5626
Top water level (mAHD)	49.45	49.72
Peak outflow (m^3/s)	0.08	1.49

7 GROUNDWATER MANAGEMENT

As discussed in Section 3.13.2, pre-excavation groundwater is at significant depth beneath the site. The finished mine floor level will be at least 2 m above the pre-development MGL. Hence, subsoil drainage is not expected to be required to control groundwater levels.

Regarding groundwater quality management, the first 15 mm of rainfall run-off from connected impervious areas will be treated prior to infiltration in line with best practice.

8 WETLANDS AND FORESHORE AREA

Whilst buffer zones and foreshore areas are not explicitly notated on the DSP (Appendix A), they have been incorporated into the proposed open space shown on the DSP concept and are therefore provided for. In accordance with DWER (2013) *Guidelines for district water management strategies,* this section of the DWMS aims to identify all wetlands and waterways and their indicative buffers and foreshore areas. Additionally, this section of the DWMS aims to provide indicative foreshore area boundaries to guide more detailed investigations and planning at later stages of the planning process in line with DWER's *Operational policy 4.3: Identifying and establishing waterways foreshore areas* (DoW 2012).

8.1 Wetland buffers

Wetlands, as mapped in DBCA's geomorphic wetland database, are shown in Figure F, with the typical 30 m buffer for REWs and 50 m buffer for CCWs also shown. The rationale for the wetland buffers that the DSP (Appendix A) has adopted is addressed in the following sections.

8.1.1 Mapped CCW (UFI 8907)

A series of historical investigations have been completed for the mapped CCW (UFI 8907), and are summarised as follows:

- Preliminary vegetation and hydrology investigations completed by RPS BBG (2005) determined that that there were no hydric soils associated with the wetland and concluded that "the area is not a wetland or dampland and should not be mapped as such".
- The flora and vegetation survey completed by Cardno (2008) identified Banksia woodland vegetation as aligning with the mapped extent of CCW (UFI 8907). Cardno (2008) did not identify any obligate wetland species within Banksia woodland vegetation and based on these results, concluded that "the mapping of UFI 8907 is most likely erroneous".

Buffers are designed to protect wetlands from being impacted by development. The distance of a buffer will generally depend on the management category, and the land uses proposed around the wetland. Historically, a generic minimum 50 m buffer between development and CCWs and a 30 m buffer to REWs has been applied. No buffers to Multiple use wetlands apply, and they can generally be developed.

More recently the DBCA and EPA have been recommending that a minimum 50 m buffer is applicable for all CCWs and REWs. This general recommendation does not allow for development proposals to be assessed on site-specific environmental values.

A 30-metre indicative buffer between development and the mapped CCW (UFI 8907) has been proposed for the DSP amendment (Appendix A). A 30-metre indicative buffer is considered appropriate given the above findings of RPS BBG (2005) and Cardno (2008) relative to the CCW mapping.

A contemporary wetland assessment will be undertaken at scheme amendment stage to confirm the on-site specific environmental values of CCW (UFI 8907) and underpin buffer requirements.

8.1.2 Sawpit Gully / REW (UFI 13387)

Sawpit Gully, a tributary of Ellen Brook, runs along the northern boundary of the site within the mapped extent of REW (UFI 13387) (Figure F). The adoption of a 30-metre indicative buffer for REW (UFI 13387) is consistent with:

- DWER's *Operational policy 4.3: Identifying and establishing waterways foreshore areas* (DoW 2012), which identifies 30 metre as the minimum acceptable foreshore buffer width
- Draft DSP.

8.2 Foreshore area

8.2.1 Policy context

Operational policy 4.3: Identifying and establishing waterways foreshore areas (DoW 2012) states that there is no minimum buffer width required to a foreshore area. Foreshore buffers provide an additional barrier to slow down or limit the passage of contaminants. Operational Policy 4.3 also states that at the regional and district level of land planning, indicative foreshore area boundaries are required to guide more detailed investigation and planning at later stages of the planning process. Exact foreshore area boundaries are identified at the local planning level, unless there are high risk (such as potentially polluting) land uses, significant site constraints or unless detailed district structure planning is being undertaken.

It is anticipated that site-specific foreshore area assessments will be undertaken as part of future, more detailed stages of the land use planning process (most likely at the local structure planning stage) to confirm the exact extent of required foreshore reserves, where applicable. The proponent commits to accurately identify the foreshore areas in consultation with DWER and DBCA and will present a Foreshore Area Report within a future LWMS that supports a Local Structure Plan.

8.2.2 Sawpit Gully

Sawpit Gully is in a proclaimed surface water area and is the primary natural waterway in the region. It is not located within the site but abuts a small portion of the northern boundary and is as close as 20 m outside the north-west corner of the site (Figure F). To the north of Lot 5892, Sawpit Gully is associated with a mapped REW. Sawpit Gully ultimately discharges into Ellen Brook approximately 4 km downstream (south-east) of the site.

8.2.3 DSP designated foreshore area

Sawpit Gully will be provided at least a 30 m distance from developable areas and the mapped centre line of the waterway. The DSP as provided in Appendix A is not considered a detailed plan. The concept plan (Appendix A) shows the Open Space surrounding Sawpit Gully, which is indicative at this DSP stage. This designated area has been informed by flora and fauna assessments of the relevant northern area of Lot 5892 outside of Mining Tenement M70/326. These include:

- A vegetation assessment of the northern portion of Lot 5892 outside of mining tenement M70/326 undertaken by RPS on 4 September 2020 (RPS, 2021a)
- Targeted spring search of the northern portion of Lot 5892 outside of mining tenement M70/326 undertaken by RPS for the EPBC Act-listed *Caladenia huegelii* on 14 September 2020 (RPS, 2021a)
- Site visit undertaken by Terrestrial Ecosystems for the northern portion of Lot 5892 outside of mining tenement M70/326 on 4 September 2020

A flora and vegetation survey undertaken by Cardno (2008) assessed most of Lot 5892, except for a small northern portion (approximately 4.87 ha) adjacent to the Sawpit Gully watercourse. The extent of Lot 5892 surveyed by Cardno (2008) is currently identified as ‘Open Space’ in the *North-east subregional planning framework*, whilst the extent of Lot 5892 not surveyed by Cardno (2008) is currently identified for ‘Urban Investigation’.

A vegetation assessment was undertaken by RPS in spring 2020 to map the vegetation units and condition of the portion of Lot 5892 outside of M70/326, including the small northern portion not surveyed by Cardno (2008). Further, RPS in September 2020, undertook a targeted priority flora survey (specifically for *Caladenia huegelii*). Figure 2 below presents the survey areas subject to the Cardno (2008) and RPS (2020) surveys.

The high-level vegetation assessment of the northern portion of Lot 5892 identified that the majority consists of Banksia woodland, with minor extents of *Xanthorrhoea preissii* shrubland and *Melaleuca preissiana* low woodland. The majority of the northern area is in “Very Good” condition, with the north-west portion of Lot 5892 assessed as being in “Good” or “Good to Degraded” condition (Figure N).

A site visit undertaken by Terrestrial Ecosystems in 2020 (cited in RPS, 2021a) identified that the northern portion of Lot 5892 outside of mining tenement M70/326 comprised foraging habitat for black cockatoos, with evidence of black cockatoos (likely Carnaby's black cockatoo) foraging within the Banksia woodland. No trees were identified by Terrestrial Ecosystems that would provide breeding nor roosting opportunities for black cockatoo species. The area surveyed by Terrestrial Ecosystems is the same as that surveyed for vegetation by RPS, as shown in Figure 2 below.

Figure 2: Flora and vegetation surveys

8.2.4 Future approval requirements

It is anticipated that site-specific foreshore area assessments will be undertaken as part of future, more detailed stages of the land use planning process (most likely at the local structure planning stage) to confirm the exact extent of required foreshore reserves, where applicable. The proponent commits to accurately identify relevant foreshore areas in consultation with DWER and DBCA and will present the Foreshore Area Report within a future LWMS that supports a Local Structure Plan.

The Foreshore Area Report supporting the future LWMS may be required to complete a biophysical assessment of Sawpit Gully, and present the preliminary engineering and landscape design, and the proposed foreshore area.

9 MONITORING REQUIREMENTS

9.1 Pre-development monitoring

Existing DWER monitoring has been utilised to estimate the MGL from 2000 (Section 3.13.2). However, no recent groundwater monitoring has been completed within the site boundary. In addition to the long-term DWER monitoring data, it is proposed that monitoring over two winter peaks will be undertaken to inform local structure planning. It is proposed to undertake monitoring from the following locations, as per the schedule in Table 18.

- Groundwater
  - Three existing DWER monitoring bores located to the south of the site (61611035, 61611037, 61611056). If these bores are unable to be accessed additional bores would be installed within the site close to their locations
  - Five proposed monitoring bores, labelled NWE01 to NWE05 in Figure O
- Surface water
  - At the northern outlet to Sawpit Gully (SW01)
  - At the CCW within Lot 5892 (SW02).

The existing and proposed groundwater and surface water monitoring locations are shown in Figure O.

Table 18: Pre-development monitoring schedule

Parameters		Frequency	Monitoring locations
Groundwater	Levels	Monthly over winter period, covering at least two annual groundwater peaks	NWE01–NWE05, 61611035, 61611037, 61611056
	Quality • Physico-chemical: EC, pH, temperature • Nutrients: TN, NH_4-N, NO_x-N, TP, FRP • Dissolved metals: Al, As, Cd, Cr, Fe, Mn, Ni, Se, Zn	Quarterly for at least 18 months	
Surface water	Levels and baseflows	Minimum monthly when flowing or water present. Continuous level logger suggested for higher resolution data.	SW01–SW02
	Quality • Physico-chemical: EC, pH, temperature • Nutrients: TN, NH_4-N, NO_x-N, TP, FRP • Dissolved metals: Al, As, Cd, Cr, Fe, Mn, Ni, Se, Zn • TSS	Twice yearly when flowing, typically July and September	

Water samples will be collected and sent to a NATA-accredited laboratory for analysis of nutrients, dissolved metals and TSS. It is recommended that physico-chemical parameters are measured in the field.

Pre-development monitoring allows for baseline conditions to be established and site-specific trigger values to be set. This monitoring would also be used to identify potential areas that are affected by elevated nutrients. Trigger values will be finalised at UWMP stage as per ANZECC and ARMCANZ (2000) guidelines and SCWQIP (SRT 2009) targets.

9.2 Post-development monitoring

The duration of post-development monitoring will be determined at LWMS and UWMP stages to assess any potential impacts from the development. It is recommended that a similar schedule to Table 18 is followed to allow for comparison with pre-development conditions.

Groundwater quality results will be compared to the trigger values developed as per ANZECC and ARMCANZ (2000) guidelines at UWMP stage.

Surface water quality should aim to meet the targets set in the SCWQIP (SRT 2009). However it is acknowledged that due to the existing land use, the pre-development water quality may currently exceed these targets, and it may take some time following development and establishment of the bio-treatment areas for a new equilibrium to be reached. Post-development surface quality should at a minimum be better than pre-development levels.

A contingency action plan will be provided in the UWMP that outlines remedial actions and responsible parties should post-development monitoring results exceed the relevant targets.

10 FURTHER INVESTIGATIONS

This DWMS has been completed to address the objectives of BUWM (WAPC 2008) and demonstrate that the site can support future development in terms of water supply planning, flood mitigation, drainage management, groundwater management and water quality protection.

Local Water Management Strategies (LWMSs) and Urban Water Management Plans (UWMPs) will need to be prepared as part of the water management and land planning process to support further stages. Further investigations will be required at the local planning (LWMS) and subdivision (UWMP) stages including:

LWMS:

- Confirmation of potable water supply and wastewater servicing infrastructure
- Greater clarity on public open space irrigation requirements and securing a non-potable water supply
- Confirmation of the location of a proposed interchange along the Perth-Darwin National Highway on the site's eastern boundary and the impacts on water management on the site
- Confirmation of vegetation to be retained and wetland buffer requirements
- Refinement of post-development catchments and indicative locations and designs for bio-retention treatment areas (for the small rainfall event) and detention basins
- Confirmation of typical cross-sections and alignment of Sawpit Gully where relevant
- Surveying of waterways (i.e. generating long-section(s)) where relevant
- Confirmation of discharge points and peak allowable outflow rates
- Establish a Controlled Groundwater Level (CGL), if relevant, ensuring groundwater dependent ecosystems are not impacted
- Develop an Earthworks Plan including indicative lot levels
- Identify responsibilities and funding for implementing the approved LWMS
- Pre-development monitoring including two winter peaks, as described in Section 9.1.

UWMP:

- Confirmation of lot levels, drainage inverts, and clearances to flood levels and groundwater
- Development of trigger values for post-development groundwater quality
- Development of a contingency action plan in the event of exceedance of monitoring targets.

LWMS and UWMP reports should be prepared according to the interim, *Developing a local water management strategy* (DoW 2008b) and *Urban water management plans, Guidelines for preparing plans and for complying with subdivision conditions* (DoW 2008c) respectively.

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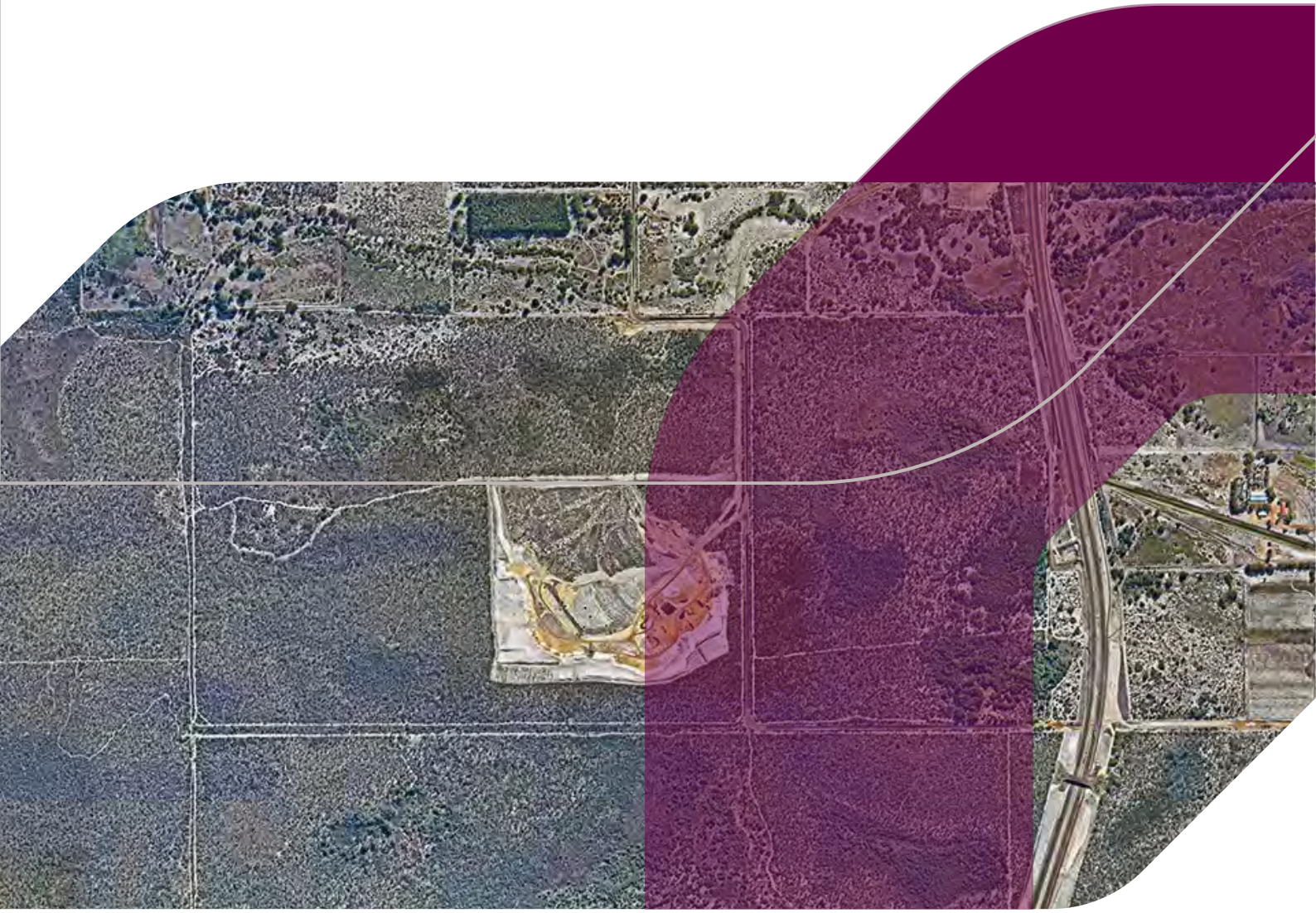
Figures



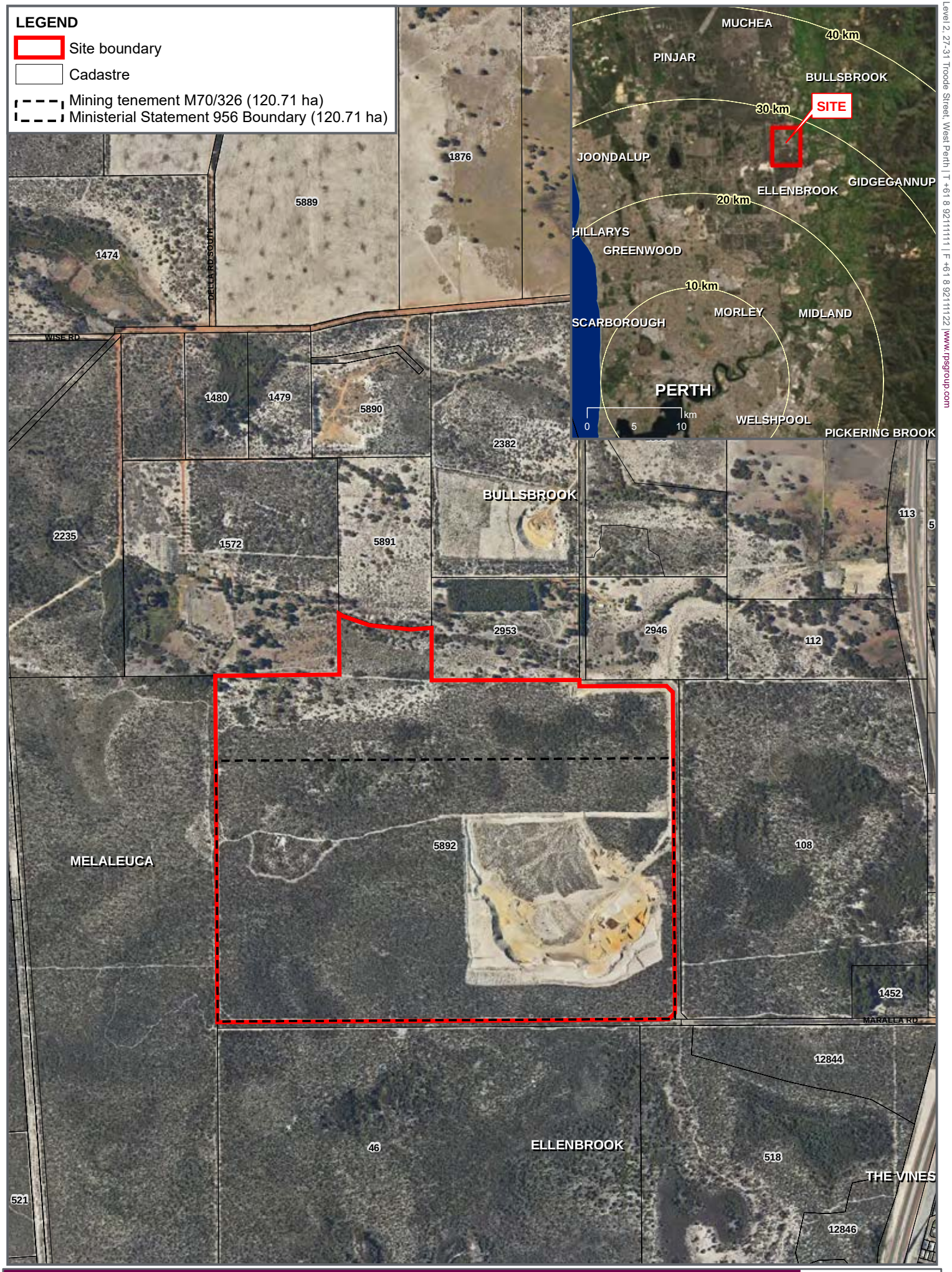


Figure A

Site location

GDA 1994 MGA Zone 50

0 125 250 500 m

Job Number: WS2584-001
Date: 23.02.22
Scale: Map 1:15,000 Overview 1:500,000 @ A4
Created by: RL
Source: Imagery - Landgate 2021

Level 2, 27-31 Troode Street, West Perth | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com

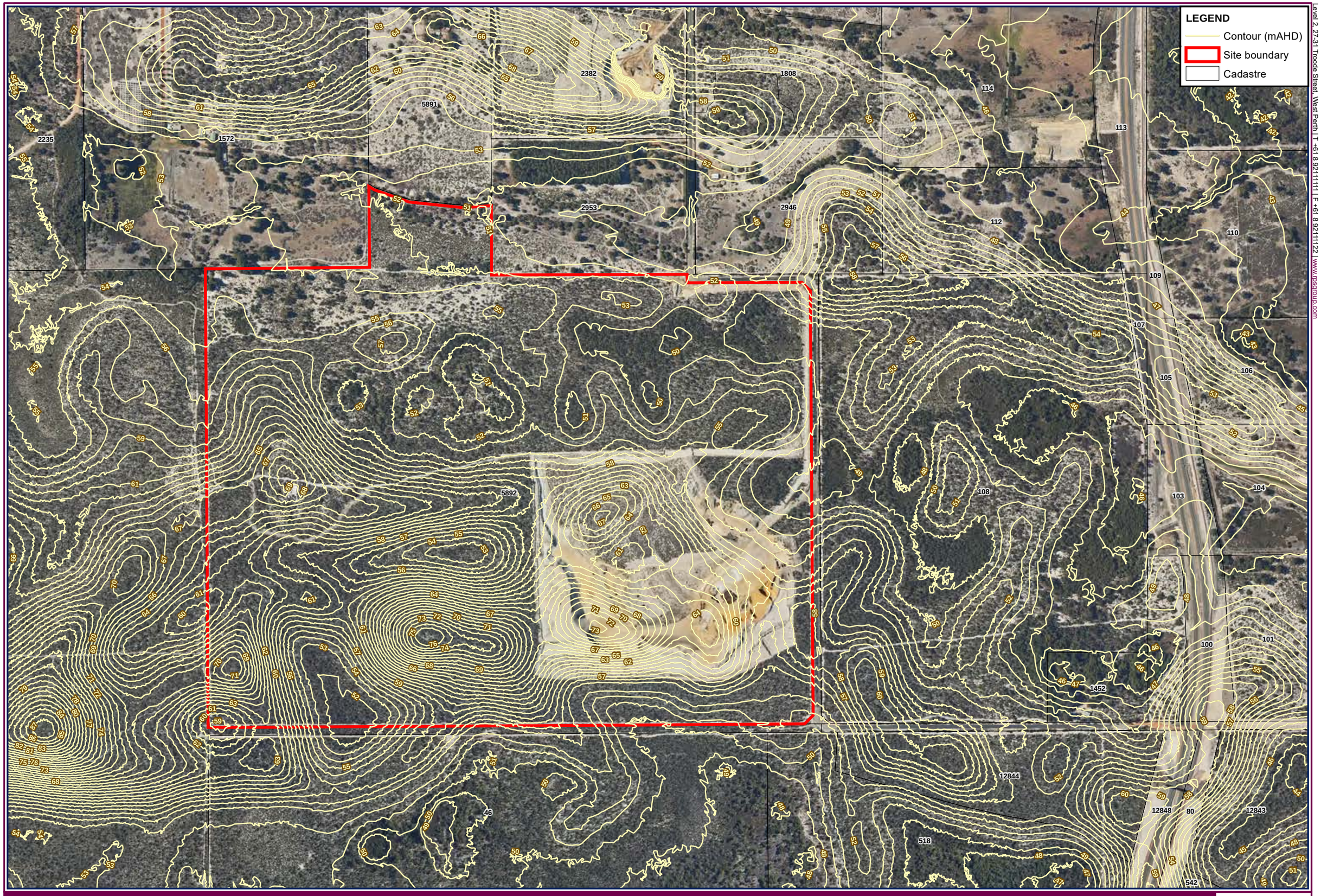


Figure B

Topography

GDA 1994 MGA Zone 50

0 50 100 200 m

Job Number: WS2584-001
Date: 23.02.22
Scale: 1:8,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

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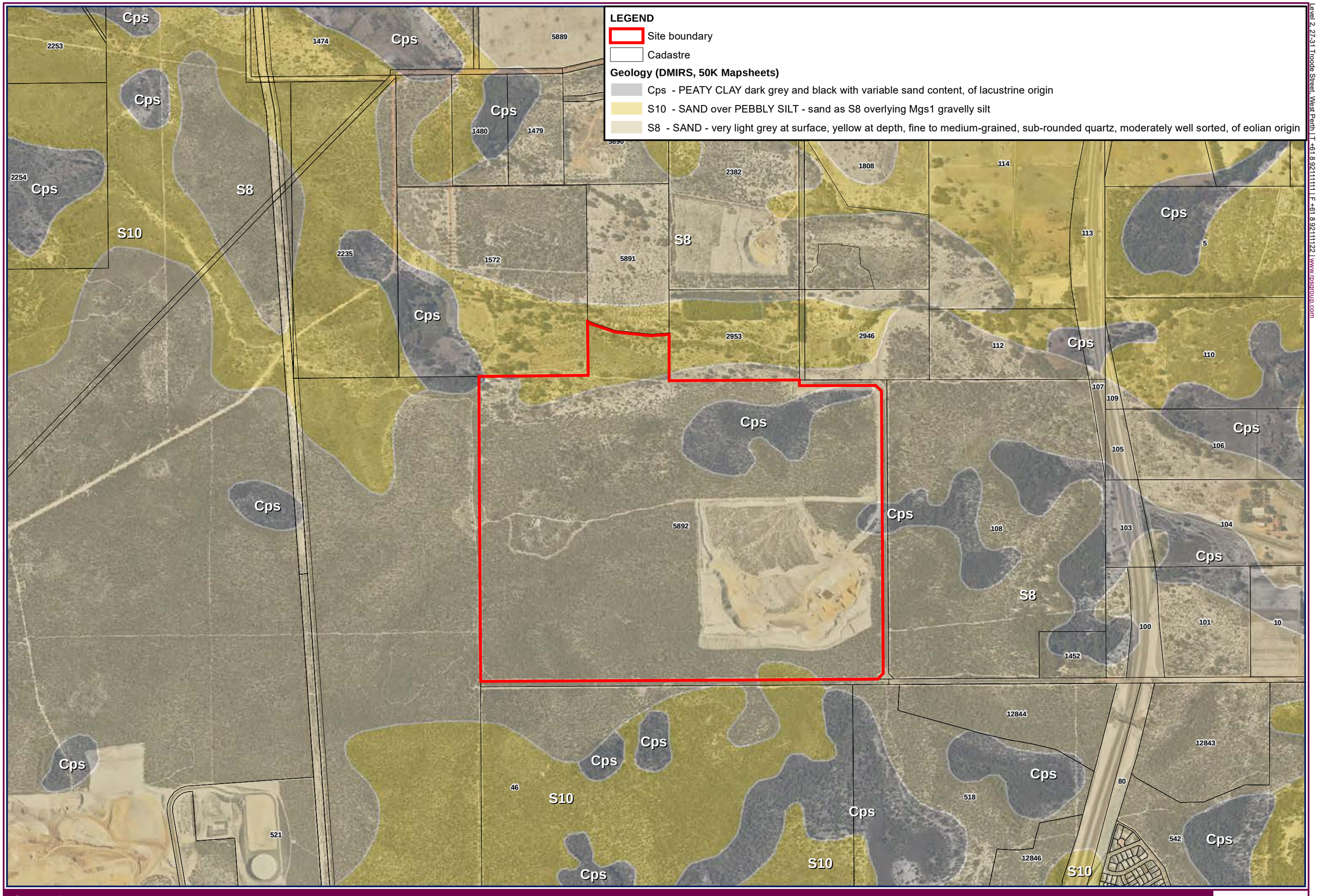

Figure C

Surface geology

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: WS2584-001
Date: 23.02.22
Scale: 1:12,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigC_Surface geology_2220223.mxd

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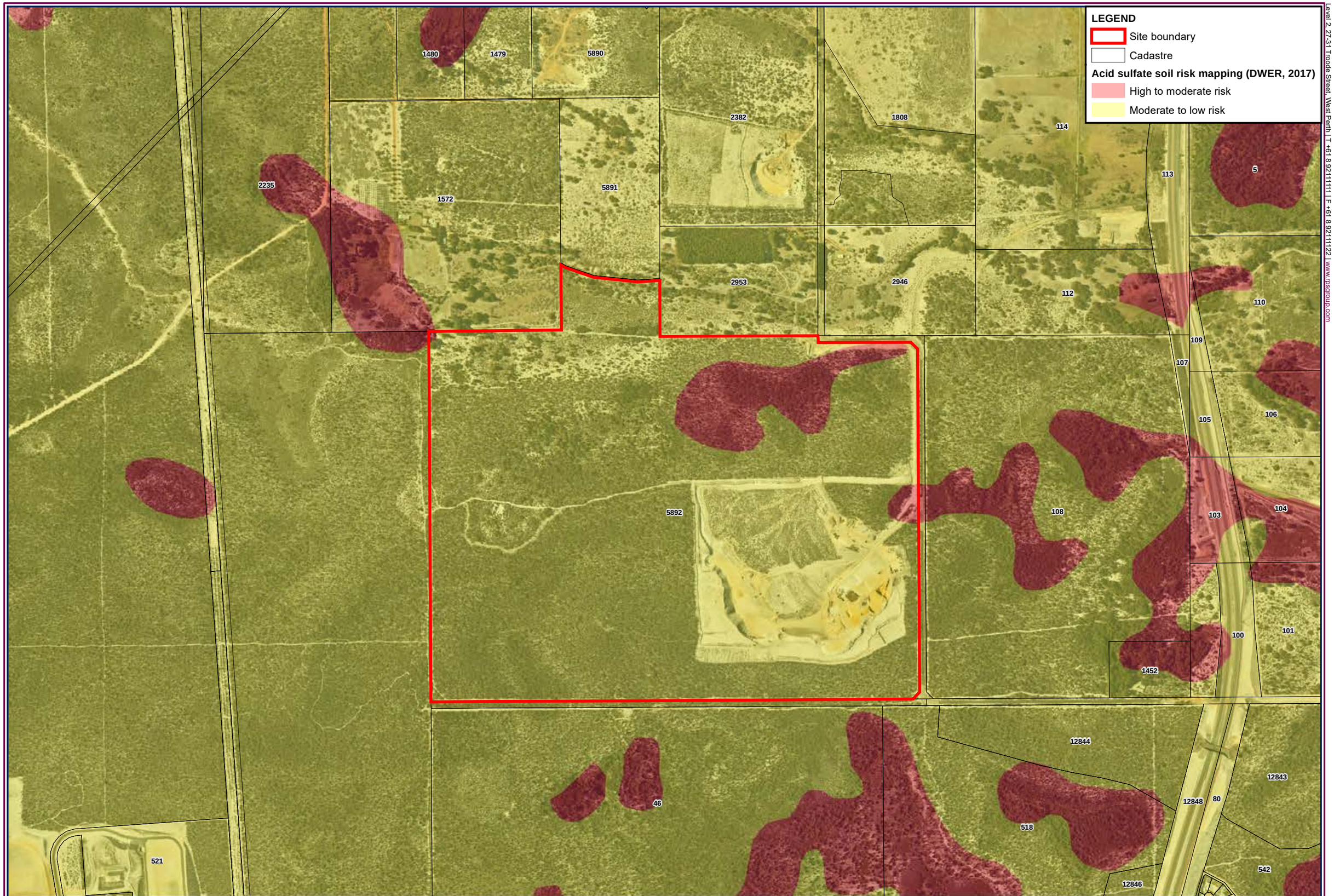

Figure D

Acid sulfate soils risk mapping

GDA 1994 MGA Zone 50

0 75 150 300 m

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Date: 23.02.22
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Created by: RL
Source: Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigD_ASS mapping_220223.mxd

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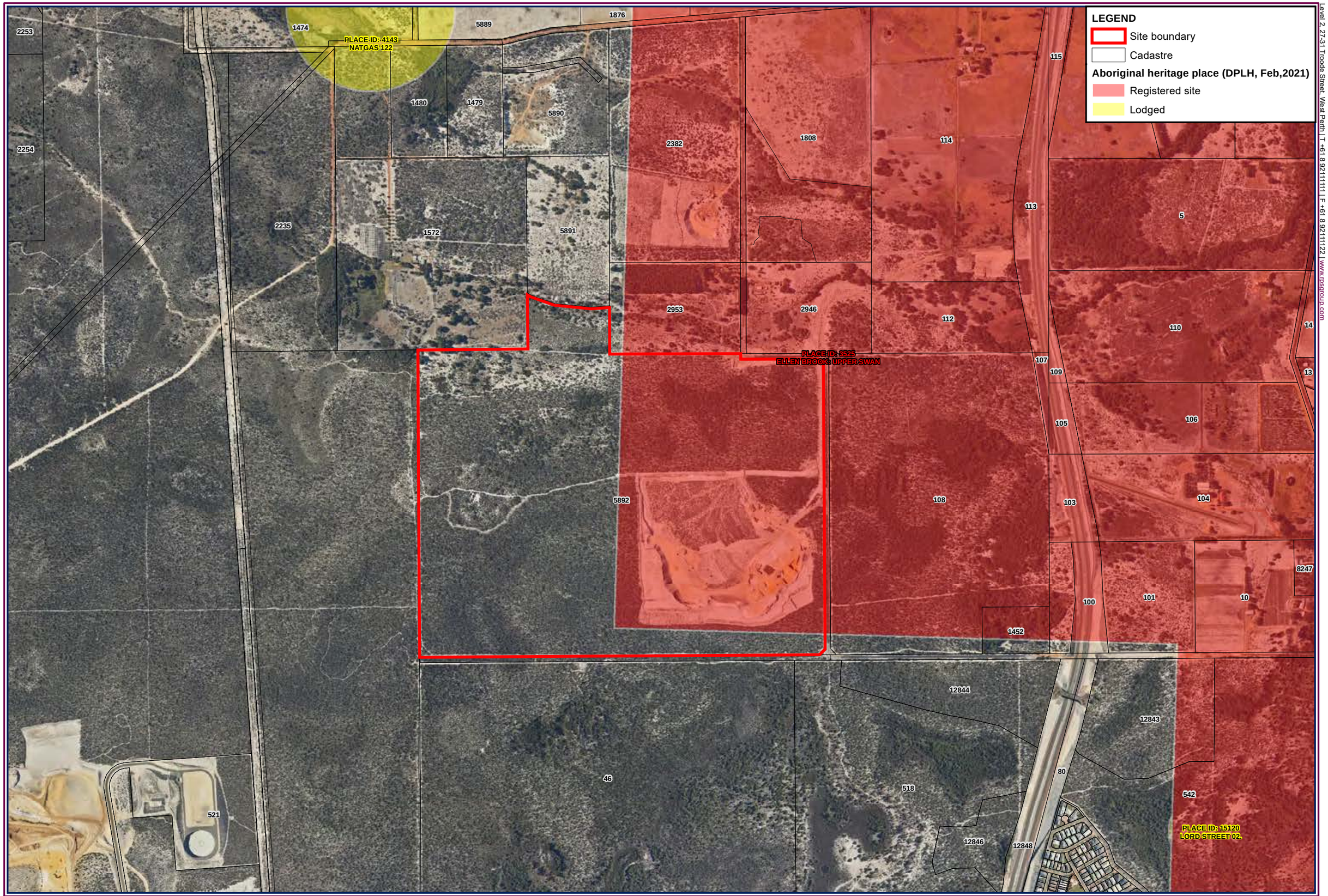

Figure E

Aboriginal heritage

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: WS2584-001
Date: 23.02.22
Scale: 1:12,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

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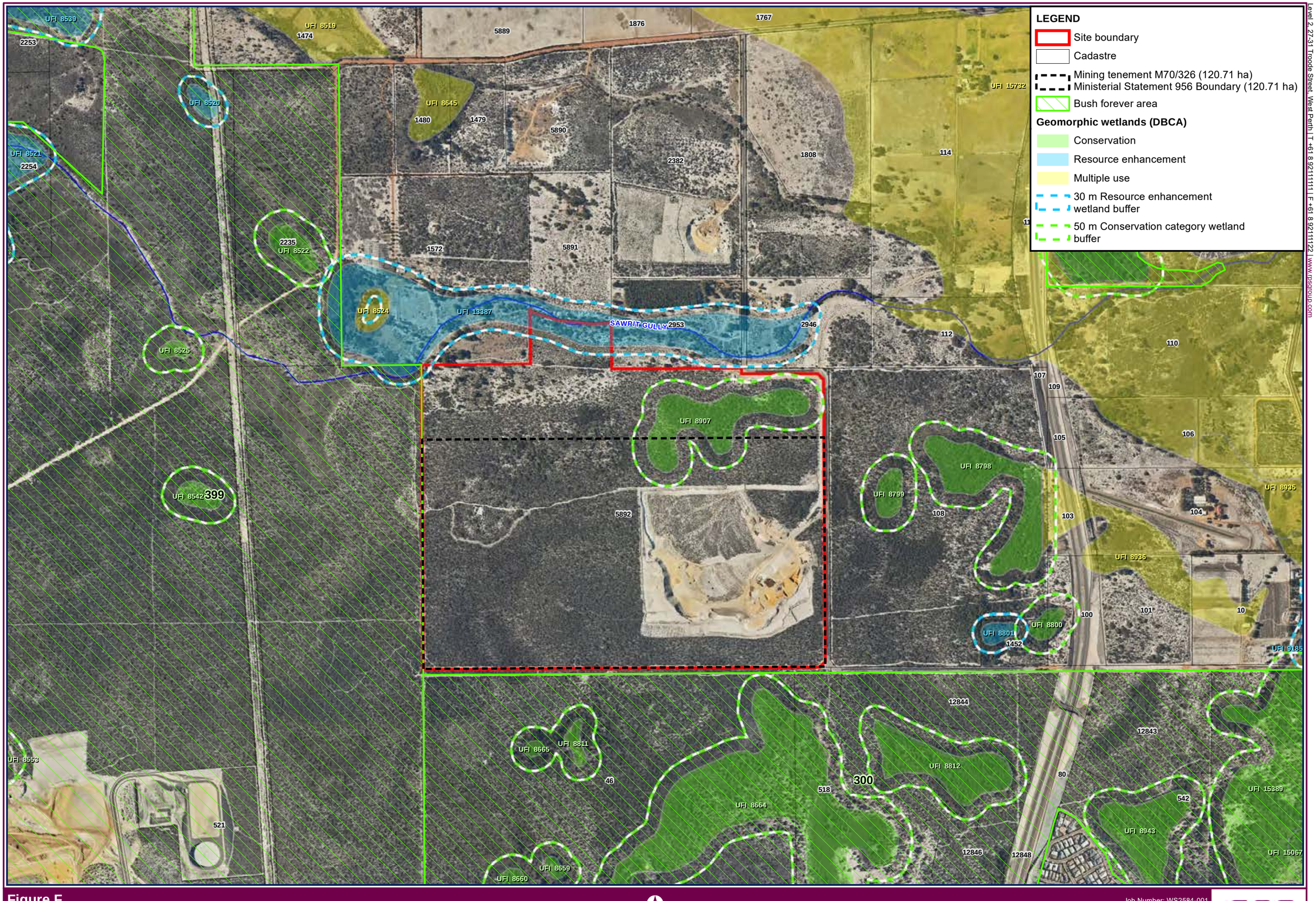

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Figure F

Bush Forever and geomorphic wetlands

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: WS2584-001
Date: 23.02.22
Scale: 1:12,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

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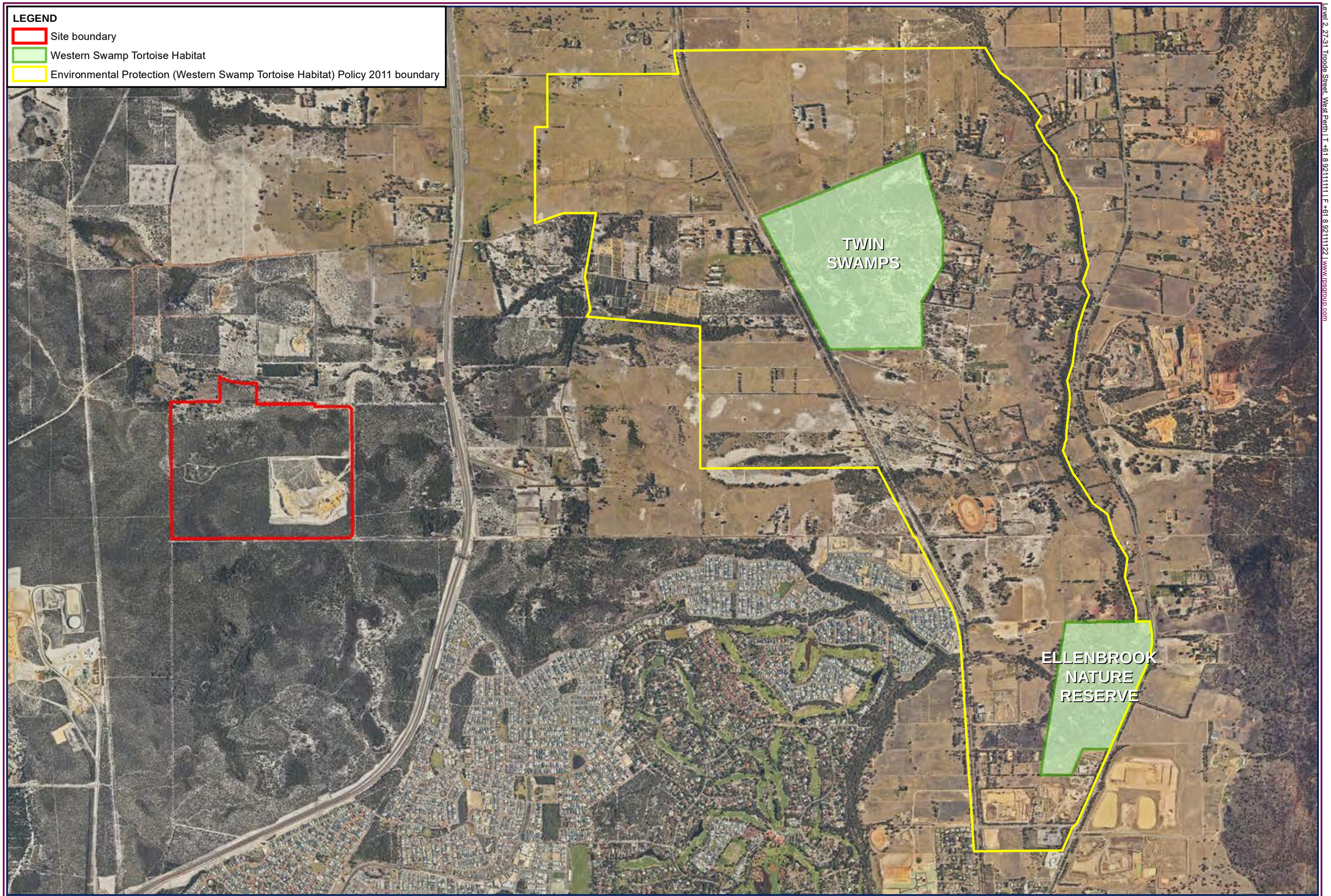

Figure G

Environmental Protection (Western Swamp Tortoise Habitat) Policy 2011 boundary

GDA 1994 MGA Zone 50

0 250 500 1,000 m

Job Number: WS2584-001
Date: 24.02.22
Scale: 1:27,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigG_EP Western Swamp Tortoise_220224.mxd

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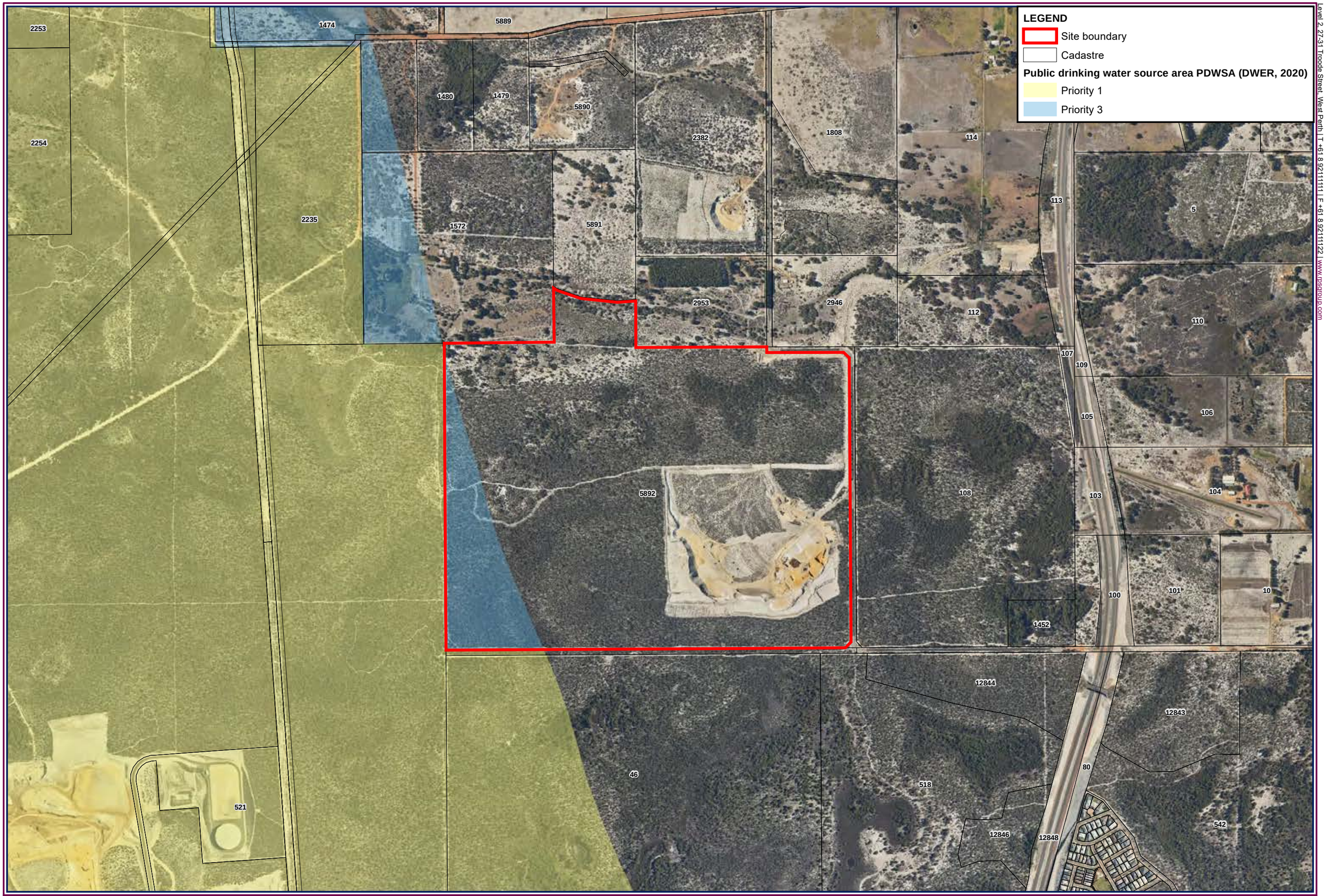

Figure H

Public drinking water source areas

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: WS2584-001
Date: 24.02.22
Scale: 1:12,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigH_Public Drinking Water Source Areas_220224.mxd

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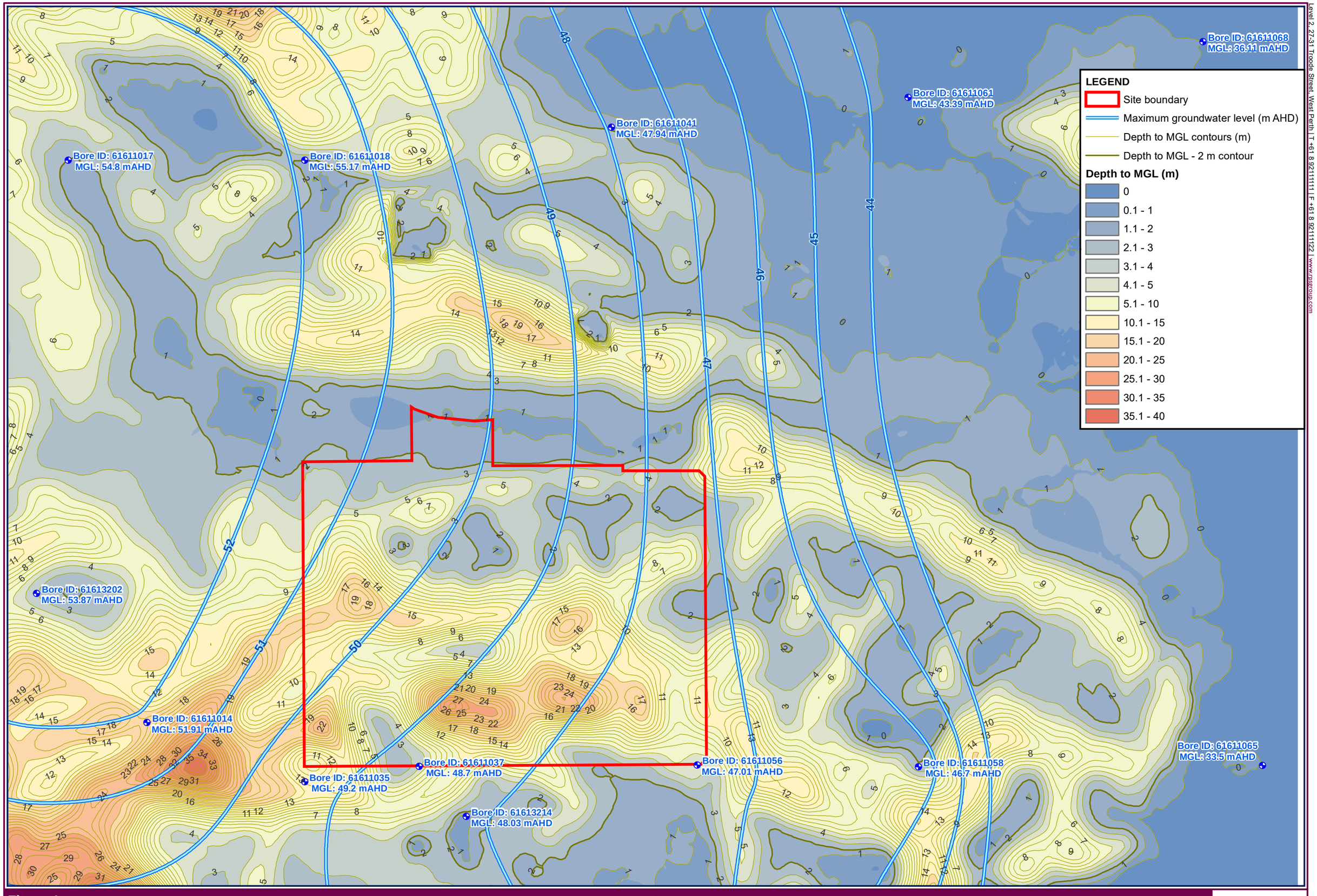

Figure I

Maximum groundwater level (MGL)

Job Number: AU213002584.001
Date: 09.03.22
Scale: 1:12,000 @ A3
Created by: JS
Source: Orthophoto - Landgate, Oct 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigI_MGL _220309.mxd

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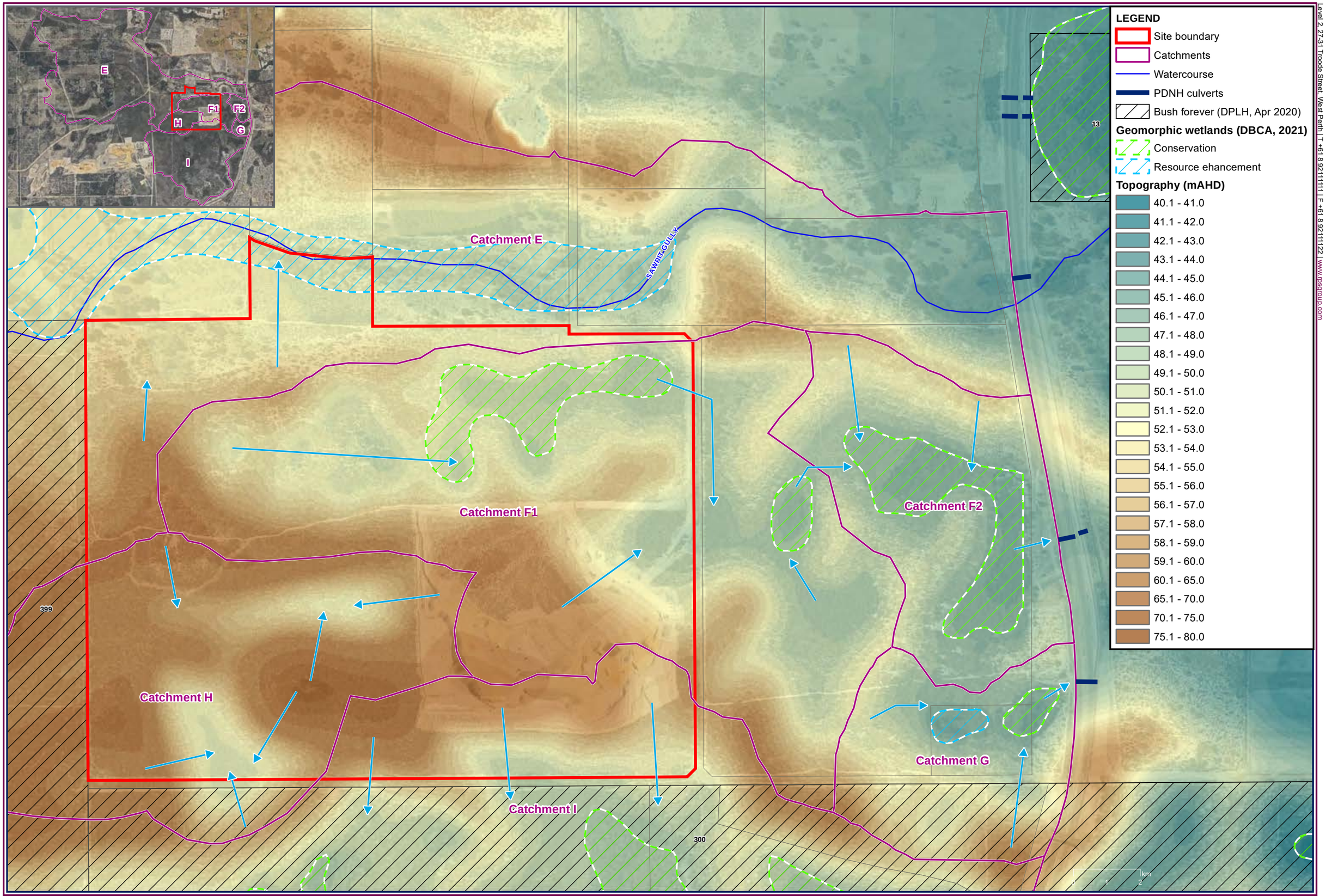

Figure J

Pre-development catchments

GDA 1994 MGA Zone 50

0 100 200 400 m

Project Number: WS2584-001
Date: 24.02.22
Scale: 1:8,000 @ A3
Created by: JS

Source: Cadastre - Landgate, 2021 Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigJ_Predev catchments_220224.mxd

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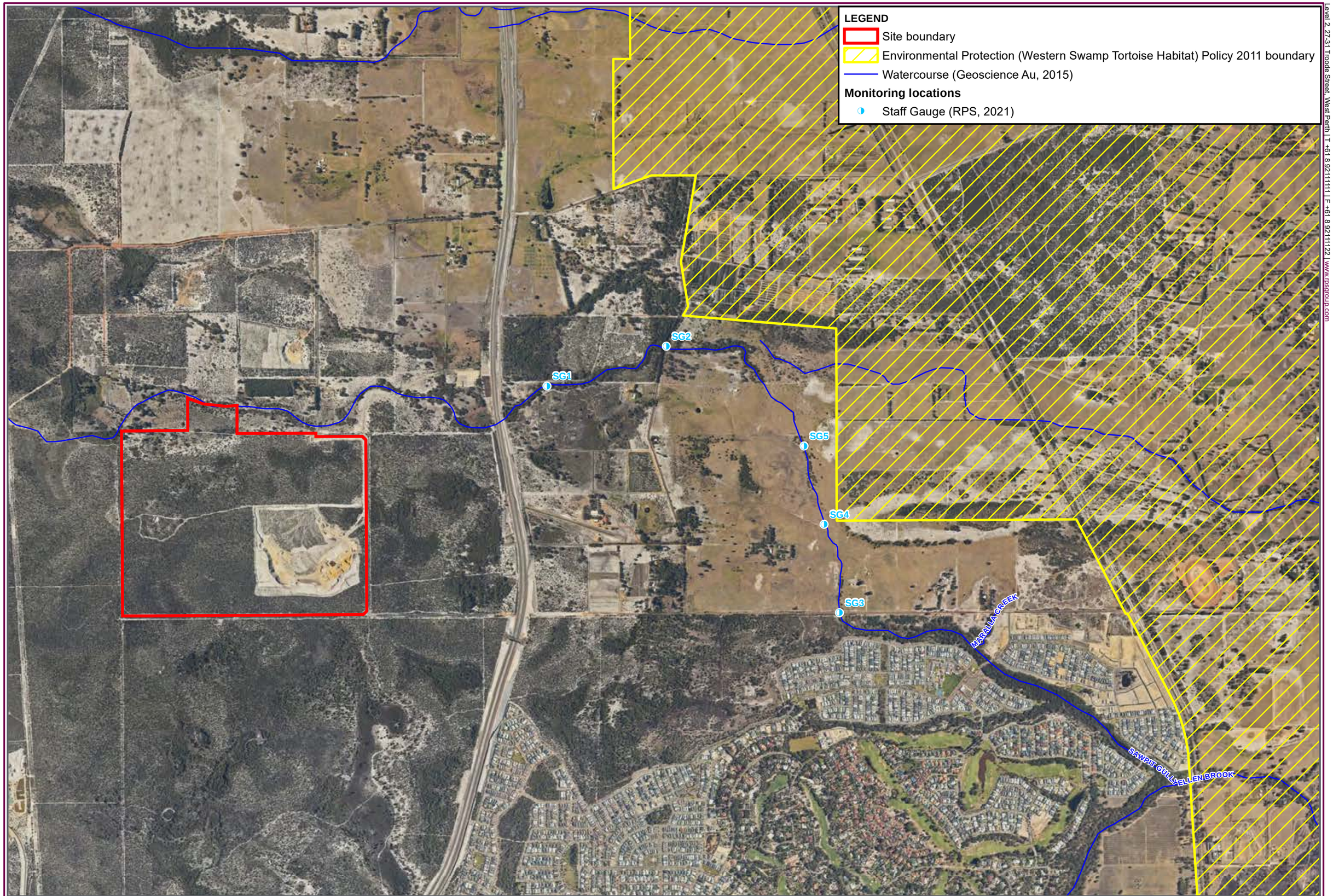

Figure K

Pre-development surface hydrology

GDA 1994 MGA Zone 50

0 250 500 1,000 m

Job Number: WS2584-001
Date: 24.02.22
Scale: 1:20,000 @ A3
Created by: JS

Source: Orthophoto - Landgate, Jan 2021; Monitoring locations - District Water Management Strategy: North Ellenbrook, RPS 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigK_Predevelopment_surface_hydrology_220224.mxd

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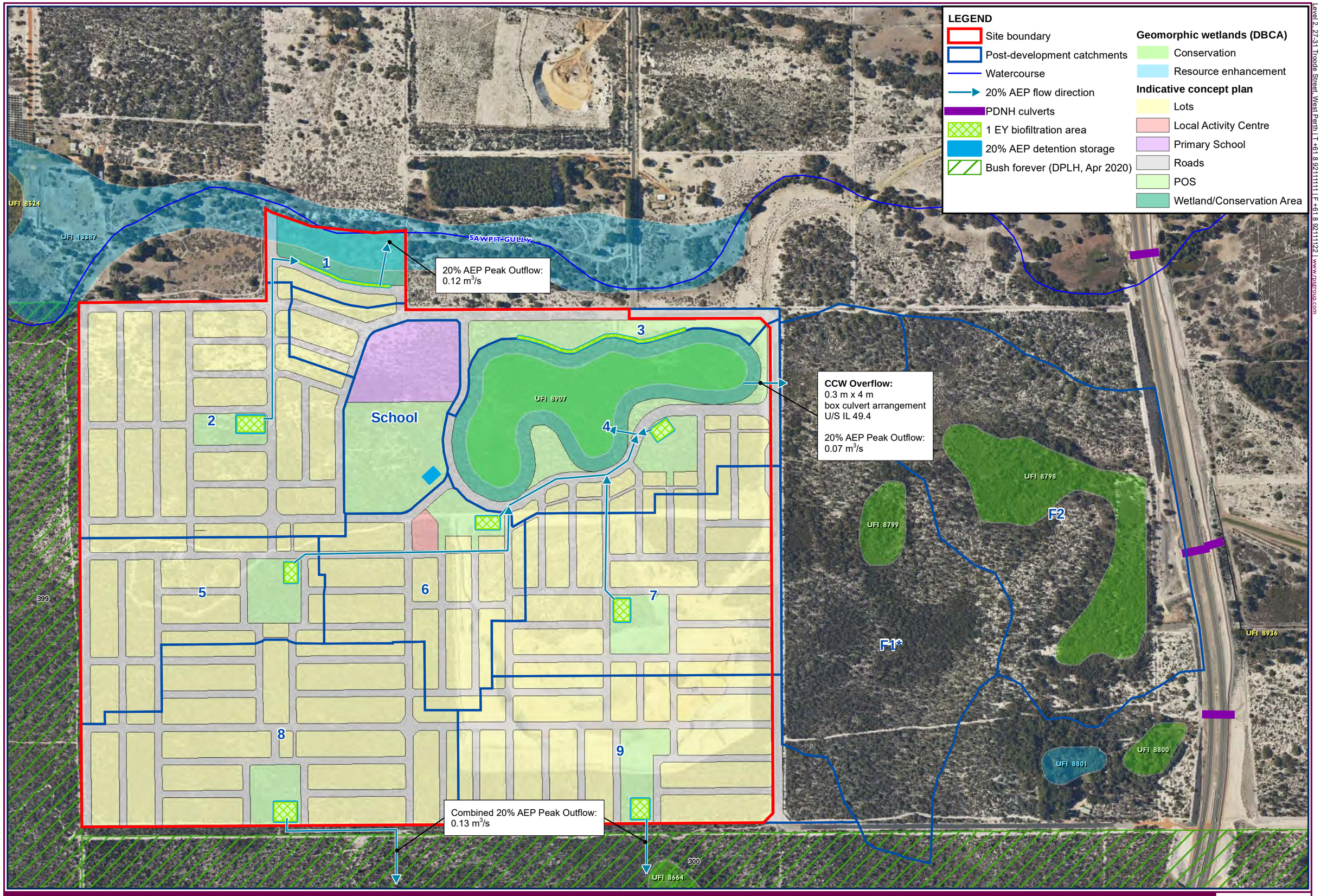

Figure L

1 EY and 20% AEP stormwater management

GDA 1994 MGA Zone 50

0 90 180 360 m

Project Number: WS2584-001
Date: 24.02.22
Scale: 1:7,000 @ A3
Created by: JS

Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigL_1EY_20AEP_stormwater management plan_220224.mxd

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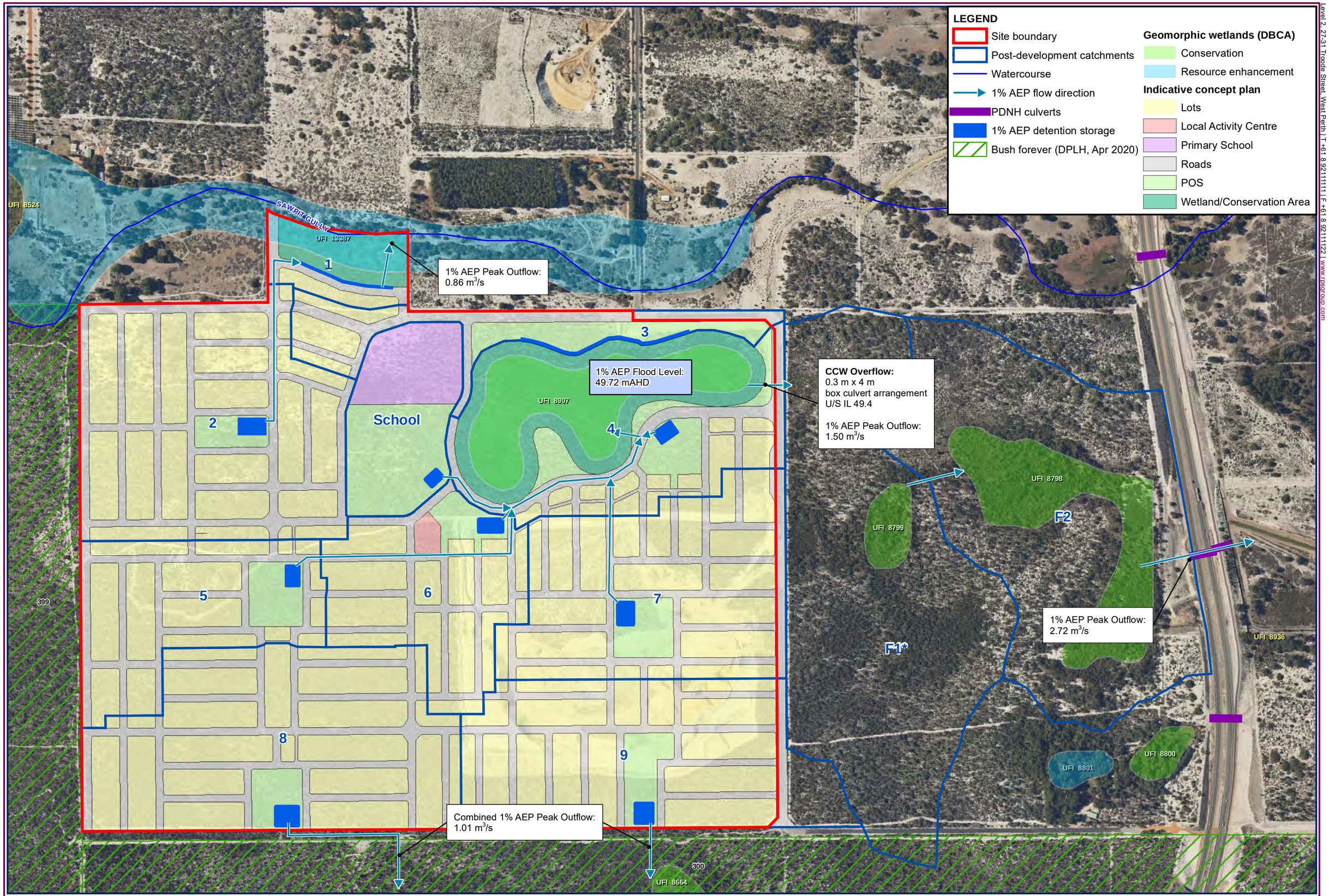

Figure M

1% AEP stormwater management plan

GDA 1994 MGA Zone 50

0 90 180 360 m

Project Number: WS2584-001
Date: 24.02.22
Scale: 1:7,000 @ A3
Created by: JS

Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigM_1AEP_stormwater management plan_220224.mxd

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Figure N

Broad (indicative) vegetation condition

GDA 1994 MGA Zone 50

0 50 100 200 m

Job Number: WS2584-001
Date: 24.02.22
Scale: 1:6,500 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

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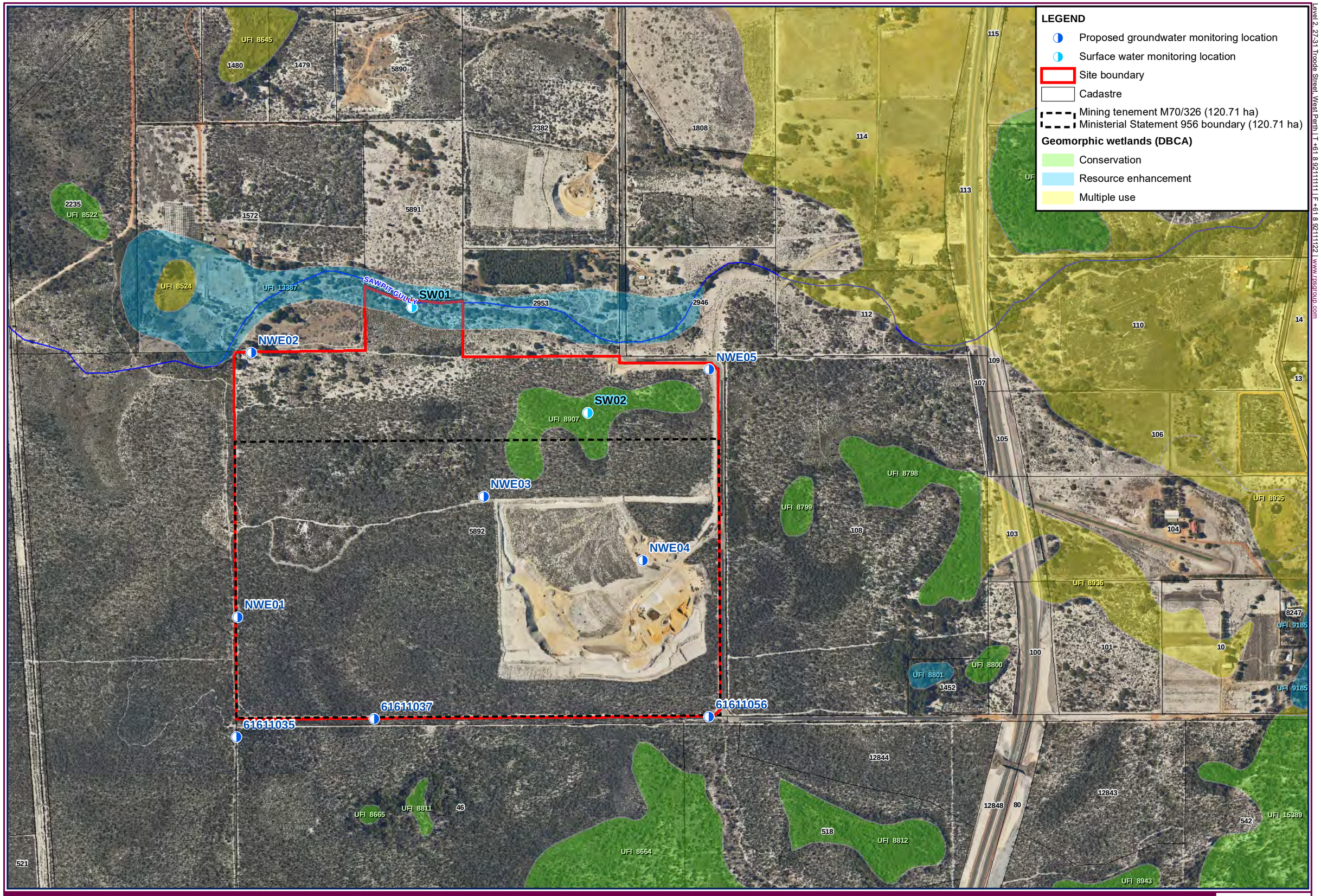

Figure O

Proposed monitoring locations

GDA 1994 MGA Zone 50

0 100 200 400 m

Job Number: WS2584-001
Date: 24.02.22
Scale: 1:10,000 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2021

Document Path: G:\Jobs\WS_Jobs\WS2584 STOCKL NW Ellenbrook DWMS Update\Figures WS2584_001\WS2584-001_G_FigO_Proposed monitoring locations_220224.mxd

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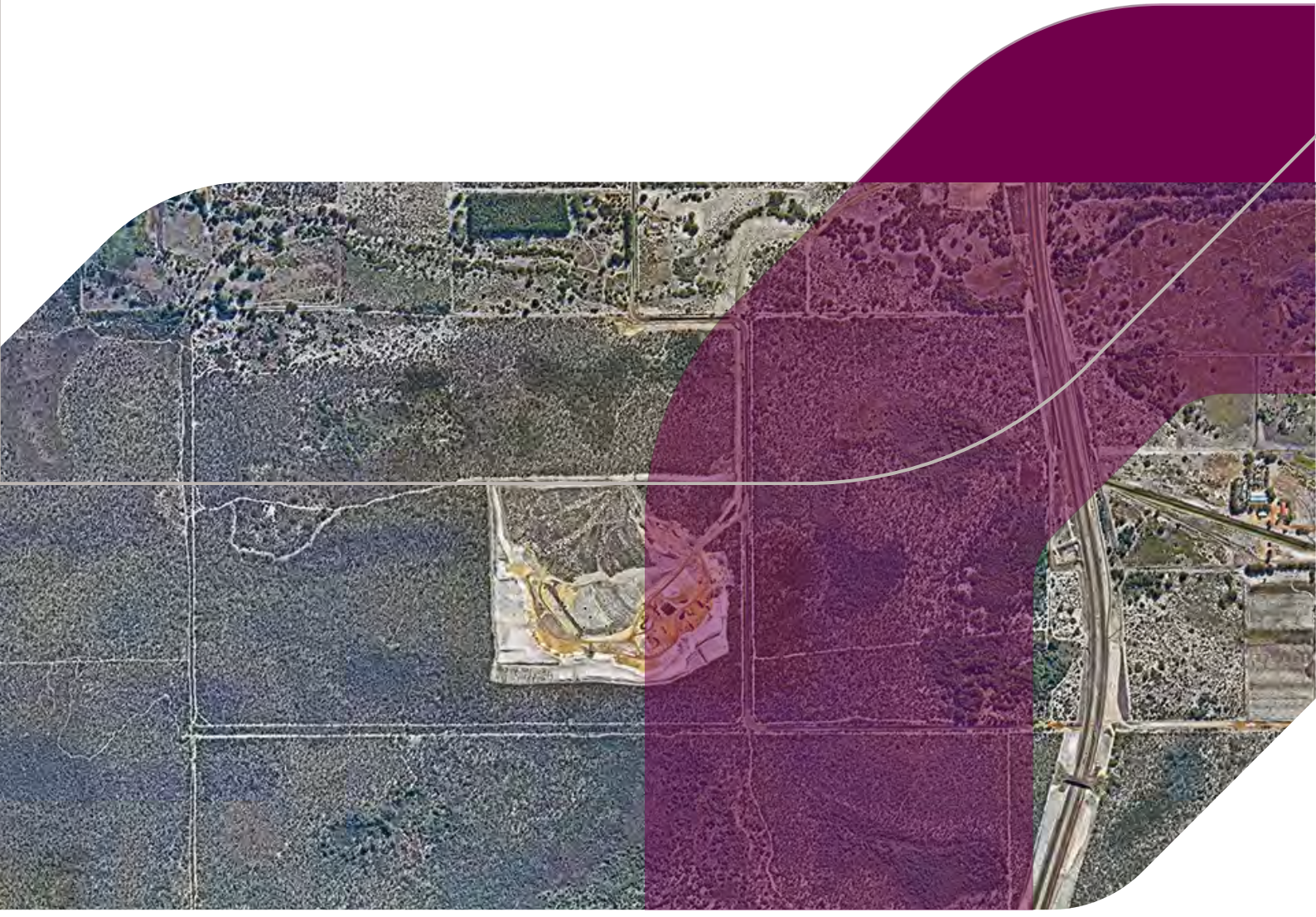
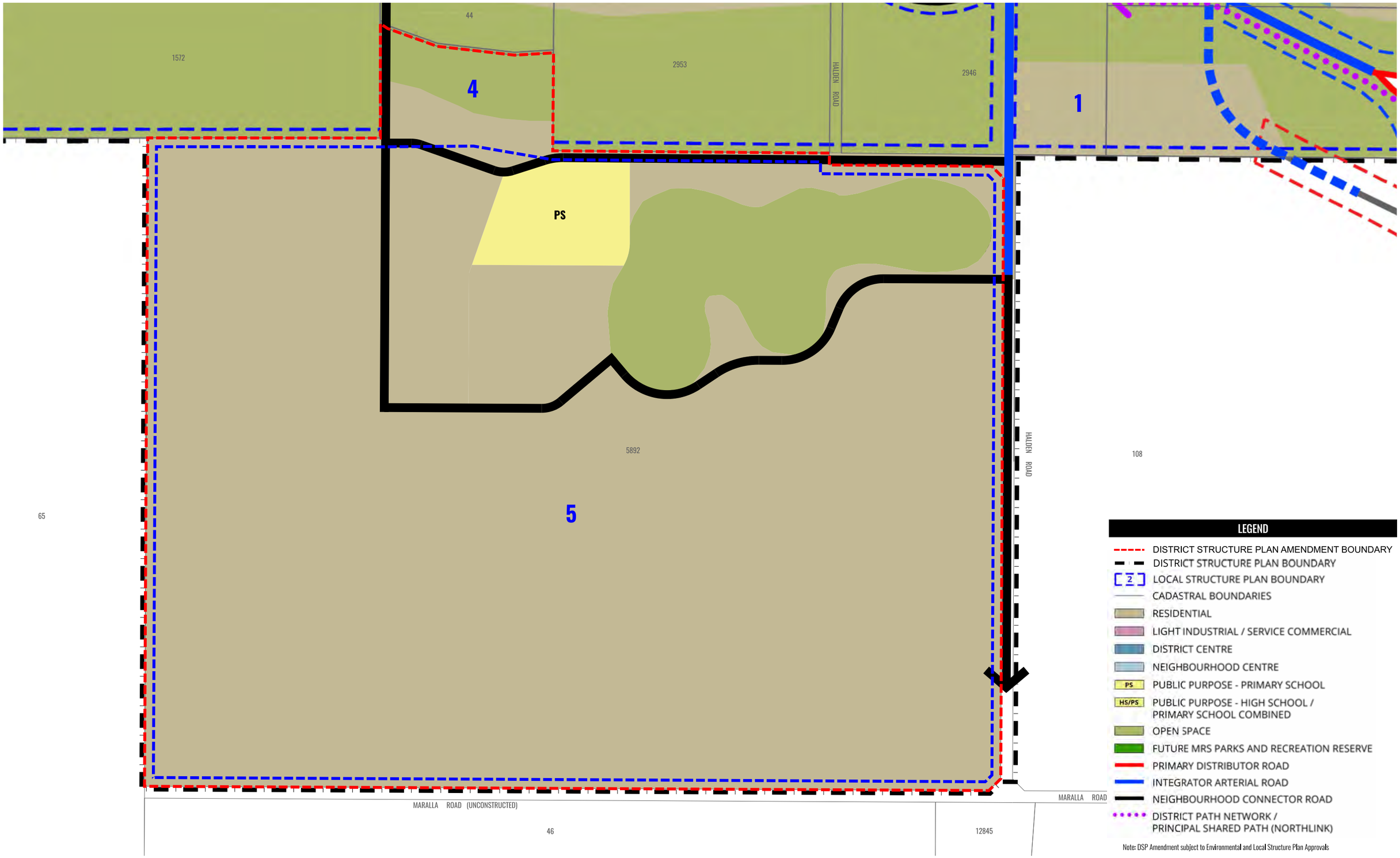
Appendix A
District structure plan concept





Note: DSP Amendment subject to Environmental and Local Structure Plan Approvals

DISTRICT STRUCTURE PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: STONE-2-001 REVISION: A

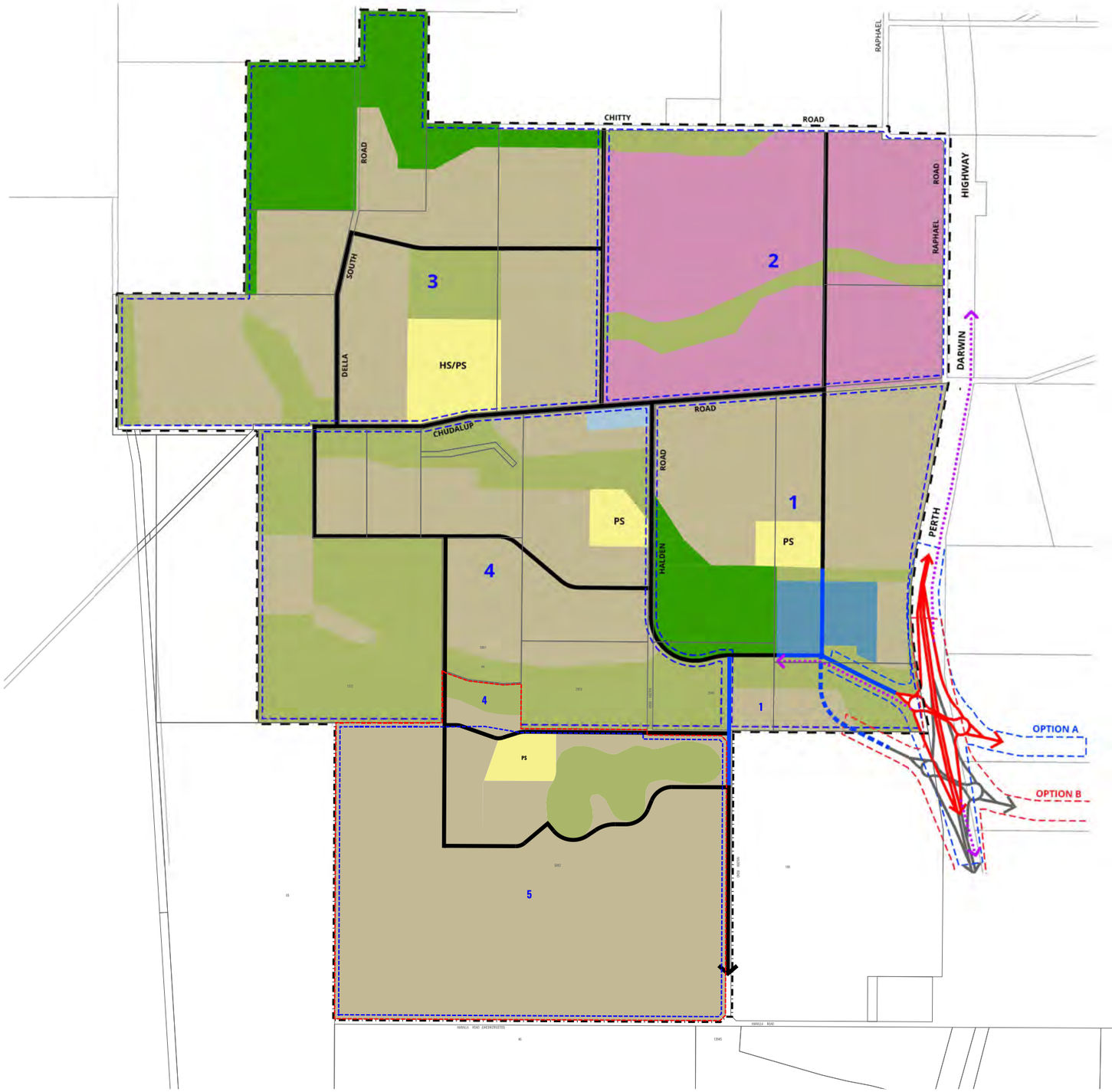
DATE: 09/02/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: BK

DATUM: AHD CHECK: CH

cdp Town Planning & Urban Design

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



LEGEND

- DISTRICT STRUCTURE PLAN AMENDMENT BOUNDARY
- DISTRICT STRUCTURE PLAN BOUNDARY
- LOCAL STRUCTURE PLAN BOUNDARY
- CADASTRAL BOUNDARIES
- RESIDENTIAL
- LIGHT INDUSTRIAL / SERVICE COMMERCIAL
- DISTRICT CENTRE
- NEIGHBOURHOOD CENTRE
- PS — PUBLIC PURPOSE - PRIMARY SCHOOL
- HS/PS — PUBLIC PURPOSE - HIGH SCHOOL / PRIMARY SCHOOL COMBINED
- OPEN SPACE
- FUTURE MRS PARKS AND RECREATION RESERVE
- PRIMARY DISTRIBUTOR ROAD
- INTEGRATOR ARTERIAL ROAD
- NEIGHBOURHOOD CONNECTOR ROAD
- DISTRICT PATH NETWORK / PRINCIPAL SHARED PATH (NORTHLINK)

NOTES

1. The Perth-Darwin Highway interchange represents two preferred locations following detailed review of alternate option locations. It is subject to confirmation as part of the Metropolitan Region Scheme Amendment process required to reserve the interchange land.
2. The Parks and Recreation identified areas recognise BushForever, Conservation Category Wetland (CCW) and EPBC Act areas to be retained. It is subject to definition as part of the Metropolitan Region Scheme amendment process.
3. Public Open Space areas encompass vegetation retention, heritage and hydrology land requirements of District Structure Plan level significance. The refinement, reservation or reclassification of these and localised areas of open space as restricted open space, unrestricted open space or otherwise will be determined following environmental assessment at the local structure plan stage.
4. An area of District Open Space (DOS) is identified for co-location with the High School site and will accommodate the future active district recreation needs of the community. The acquisition and development of the DOS is to be provided for within the relevant Development Contribution Scheme(s) for the North Ellenbrook West District Structure Plan area to ensure the equitable provision of open space.
5. DSP Amendment subject to Environmental and Local Structure Plan Approvals.

DISTRICT STRUCTURE PLAN AMENDMENT PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

Scale: 1:17 500 @ A3

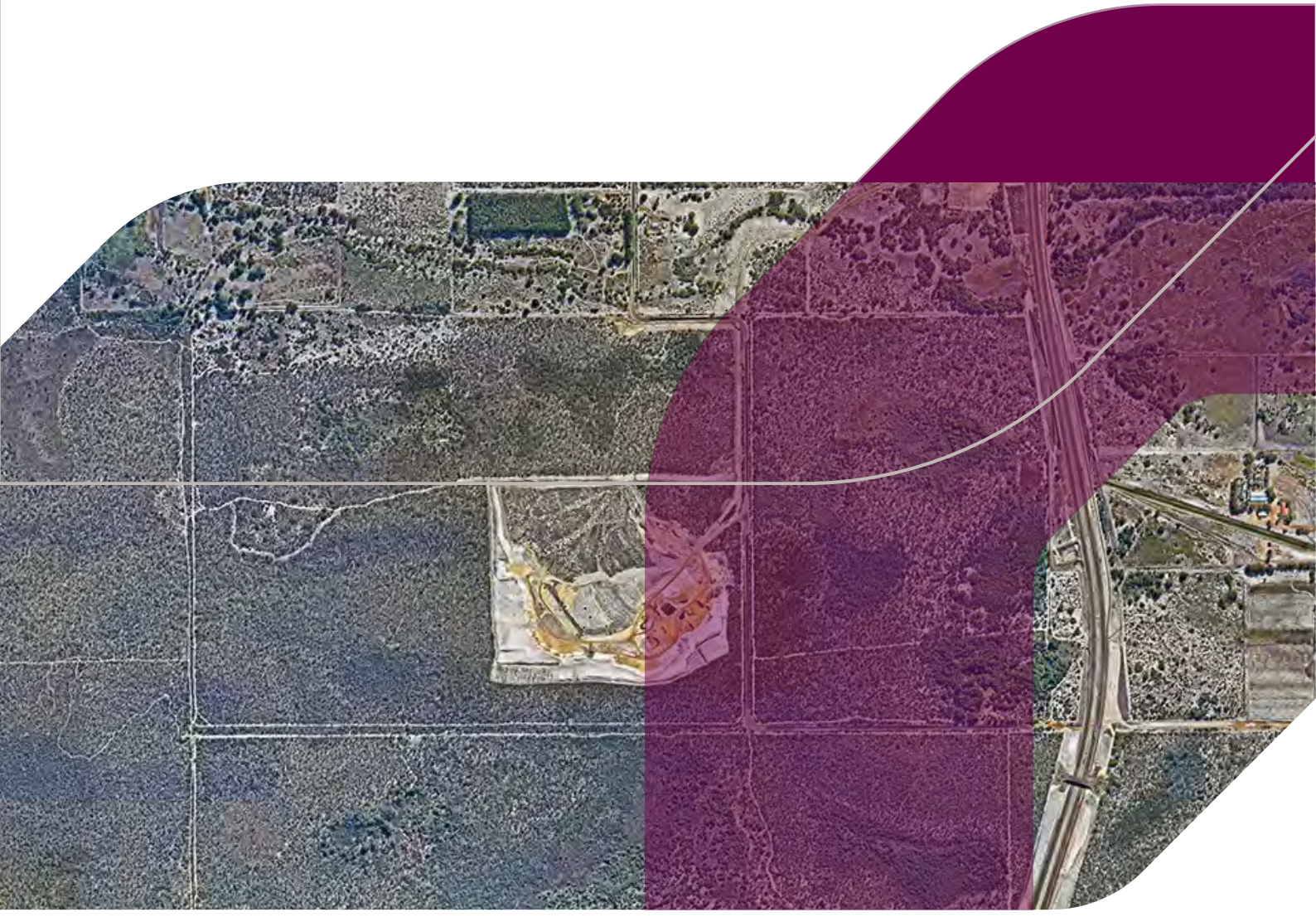
0 200 400 600m

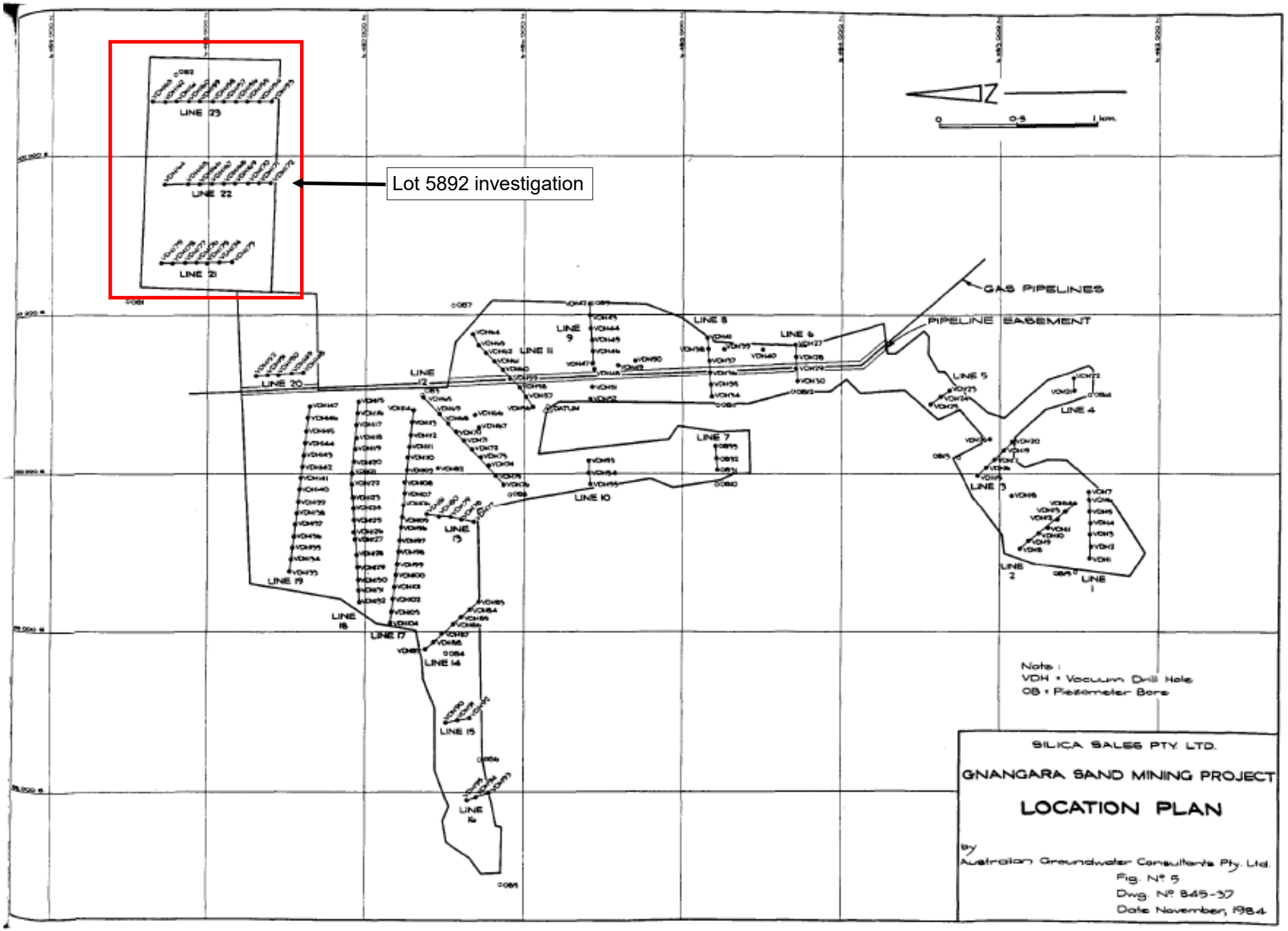
PLAN: STONE-5-007 REVISION:
DATE: 09/02/2022 DRAWN: JP
PROJECTION: PCG 94 PLANNER: BK
DATUM: AHD CHECK: CH

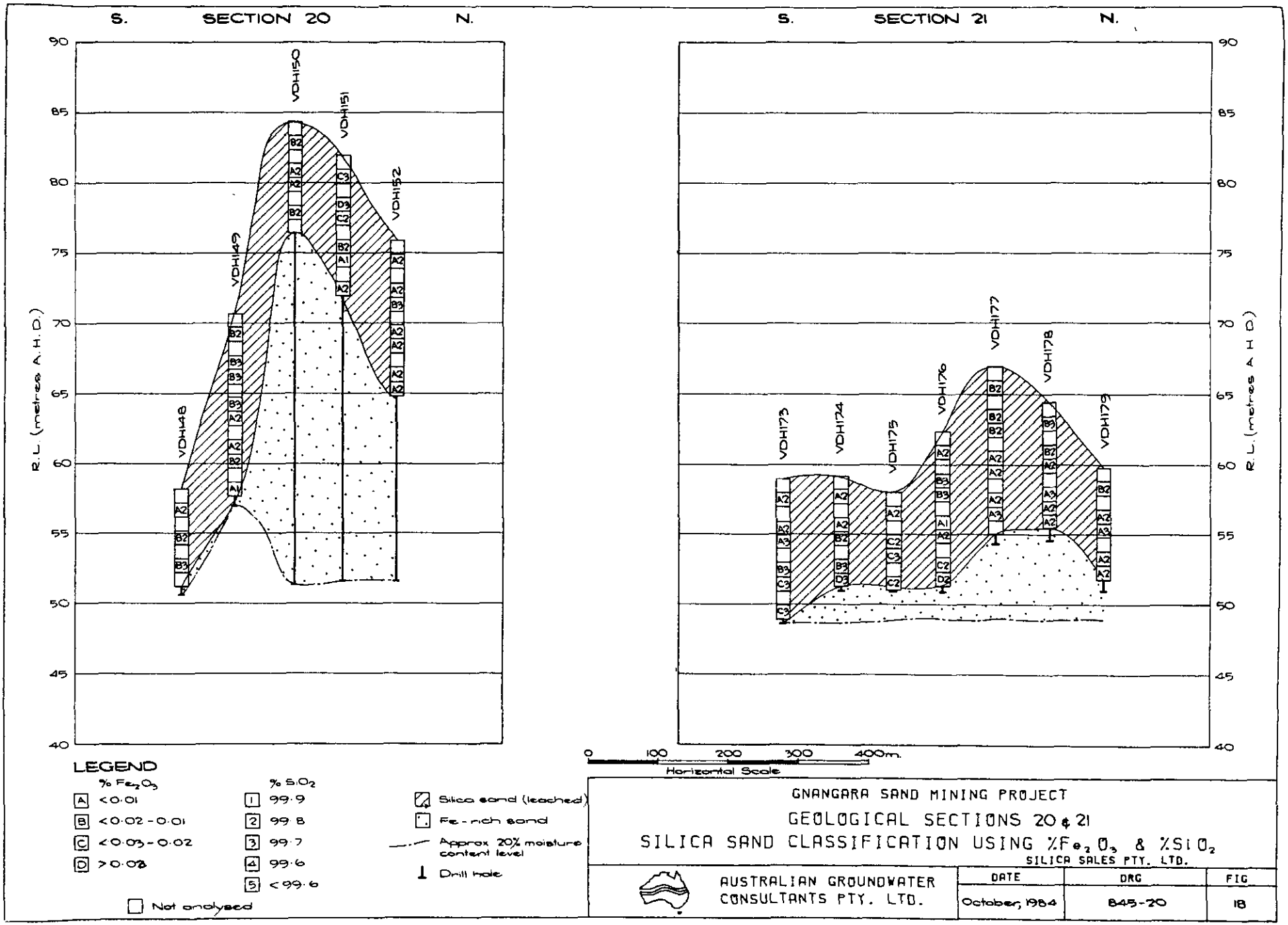
cdp Town Planning & Urban Design

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

Appendix B
Geotechnical testing locations




Lot 5892 investigation
LINE 25
LINE 22
LINE 21
LINE 20
LINE 12
LINE 11
LINE 9
LINE 8
LINE 6
LINE 7
LINE 10
LINE 5
LINE 4
LINE 3
LINE 2
LINE 1
LINE 13
LINE 19
LINE 18
LINE 17
LINE 14
LINE 15
LINE 16
GAS PIPELINES
PIPELINE EASEMENT
DATUM
0 0.5 1 km.
Note :
VDH = Vacuum Drill Hole
OB = Piezometer Bore
SILICA SALES PTY LTD.
GNANGARA SAND MINING PROJECT
LOCATION PLAN
By
Australian Groundwater Consultants Pty. Ltd.
Fig. No 5
Dwg. No 849-37
Date November, 1984



GNANGARA SAND MINING PROJECT

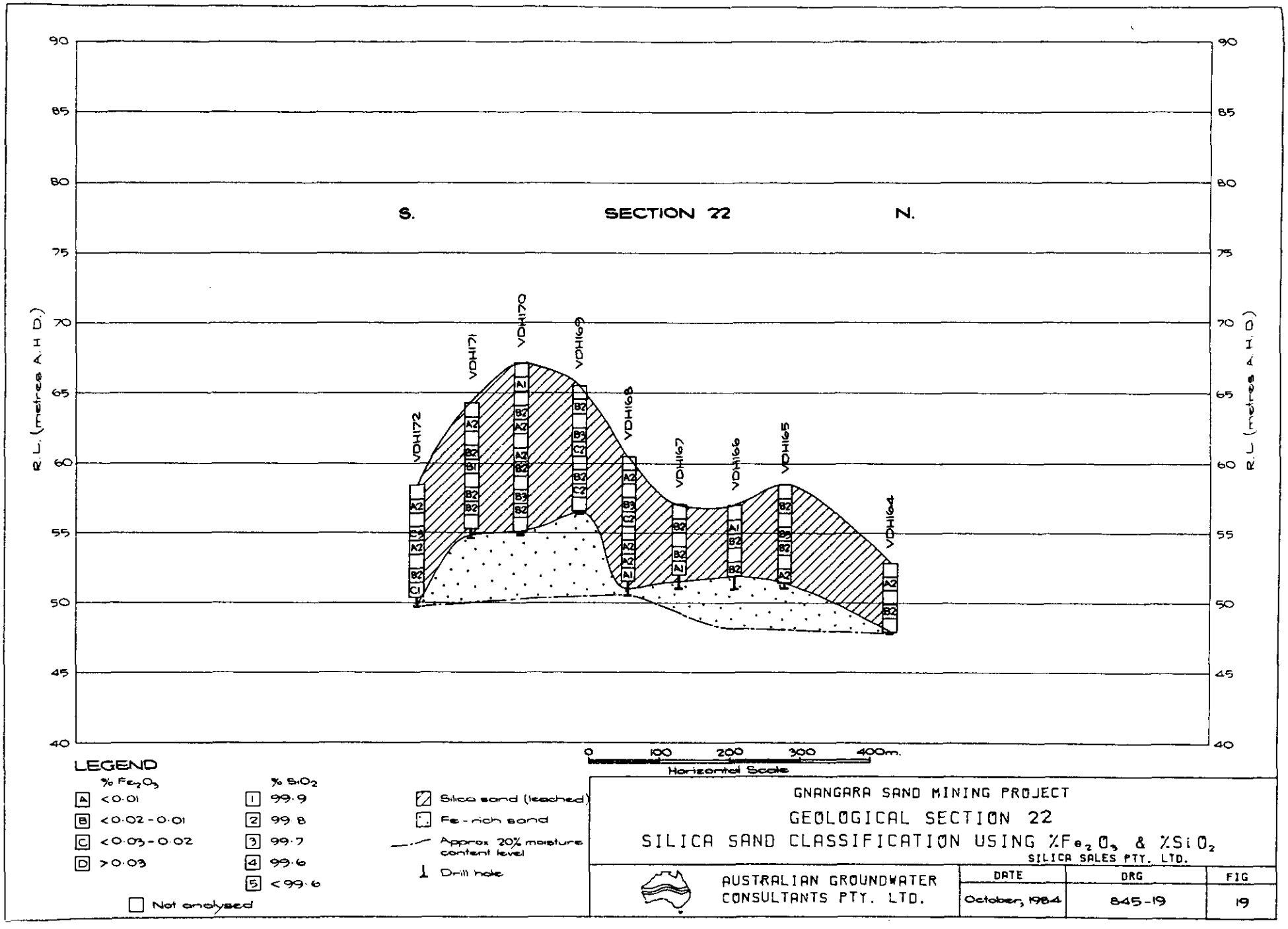
GEOLOGICAL SECTIONS 20 & 21

SILICA SAND CLASSIFICATION USING % Fe_2O_3 & % SiO_2

SILICA SALES PTY. LTD.

AUSTRALIAN GROUNDWATER CONSULTANTS PTY. LTD.

DATE	DRG	FIG
October, 1984	845-20	18



GNANGARA SAND MINING PROJECT

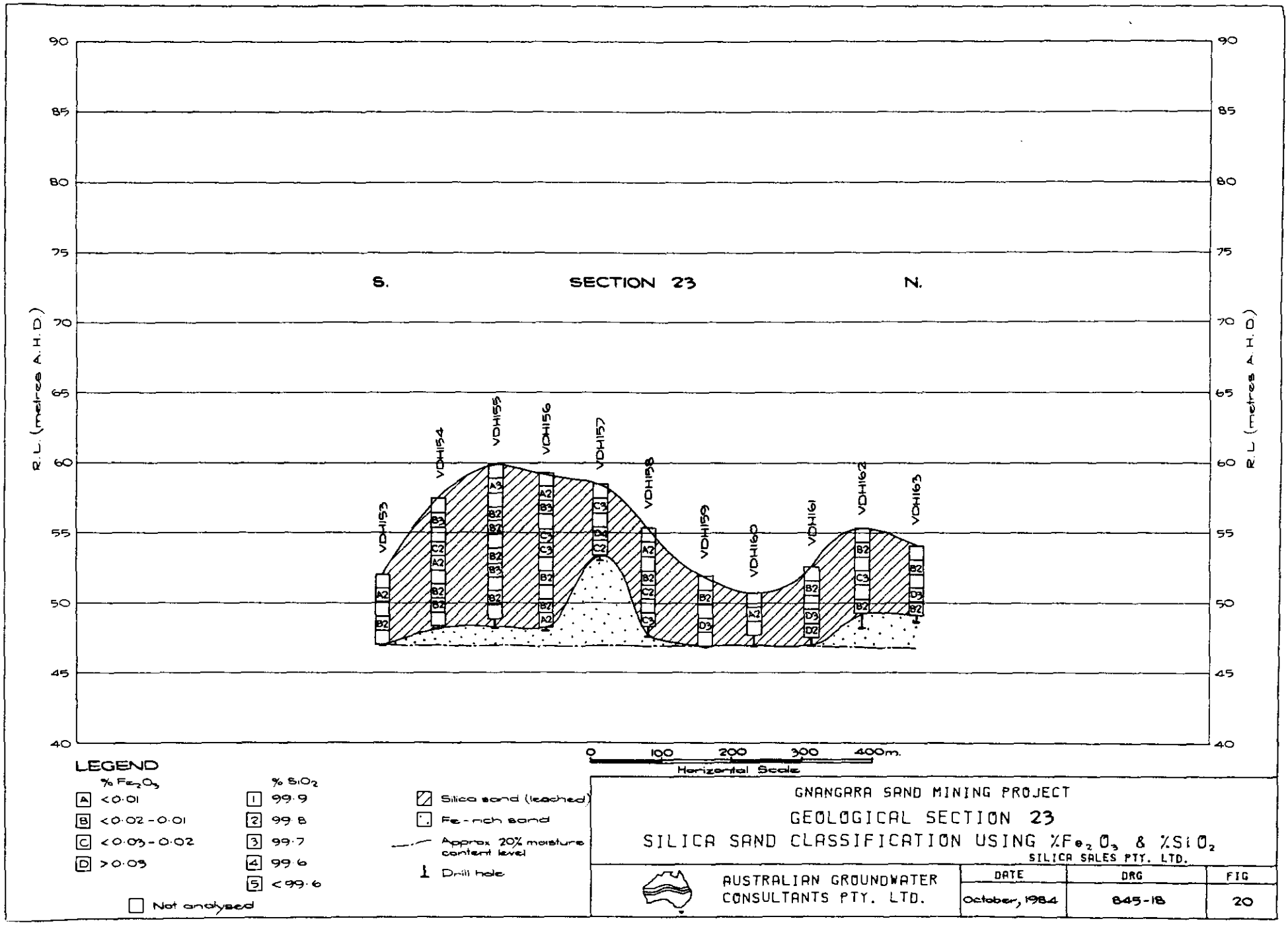
GEOLOGICAL SECTION 22

SILICA SAND CLASSIFICATION USING $\%Fe_2O_3$ & $\%SiO_2$

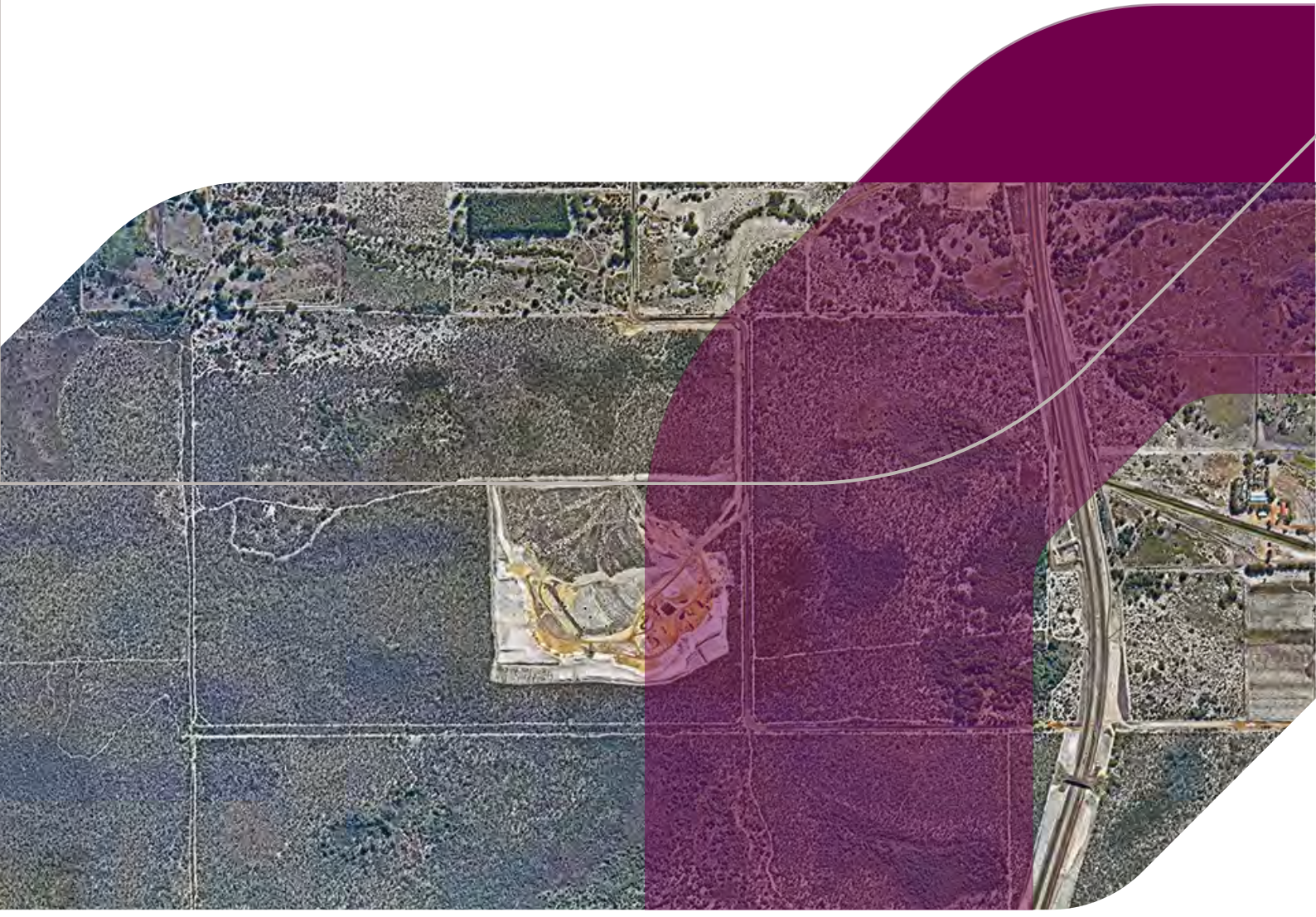
SILICA SALES PTY. LTD.

AUSTRALIAN GROUNDWATER CONSULTANTS PTY. LTD.

DATE	DRG	FIG
October, 1984	845-19	19

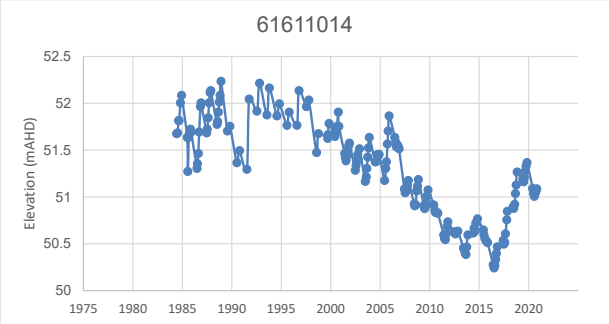

S.
SECTION 23
N.
R.L. (metres A.H.D.)
90
85
80
75
70
65
60
55
50
45
40
VDH153
VDH154
VDH155
VDH156
VDH157
VDH158
VDH159
VDH160
VDH161
VDH162
VDH163
0
100
200
300
400m.
Horizontal Scale
LEGEND
% Fe_2O_3
A <0·01
B <0·02 - 0·01
C <0·03 - 0·02
D >0·03
% SiO_2
1 99·9
2 99·8
3 99·7
4 99·6
5 <99·6
Not analysed
Silica sand (leached)
Fe-rich sand
Approx 20% moisture content level
Drill hole
GNANGARA SAND MINING PROJECT
GEOLOGICAL SECTION 23
SILICA SAND CLASSIFICATION USING % Fe_2O_3 & % SiO_2
SILICA SALES PTY. LTD.
AUSTRALIAN GROUNDWATER CONSULTANTS PTY. LTD.
DATE
October, 1984
DRG
845-18
FIG
20

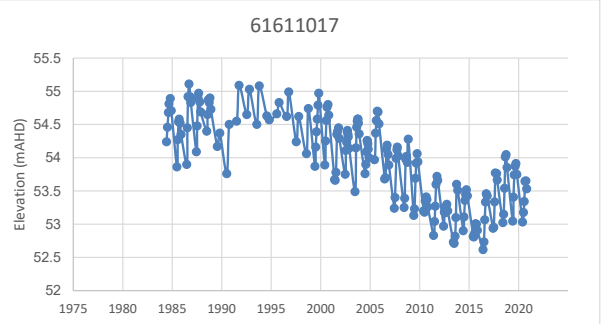
Appendix C
Groundwater monitoring hydrographs

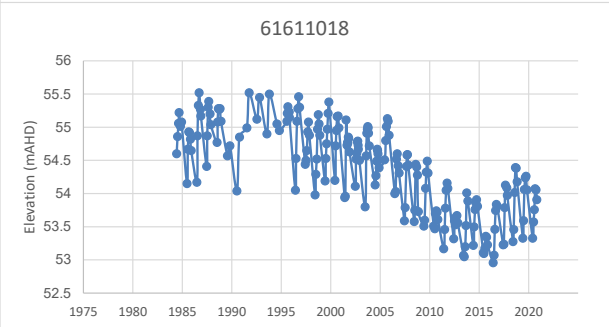


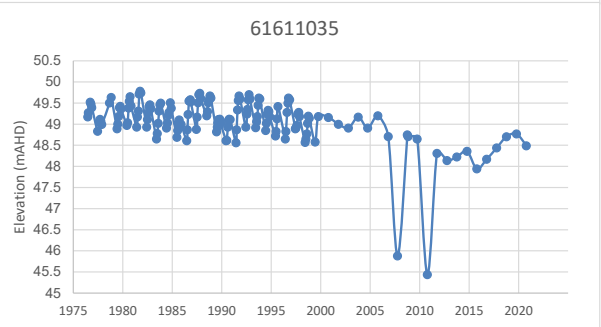
APPENDIX C: GROUNDWATER MONITORING HYDROGRAPHS

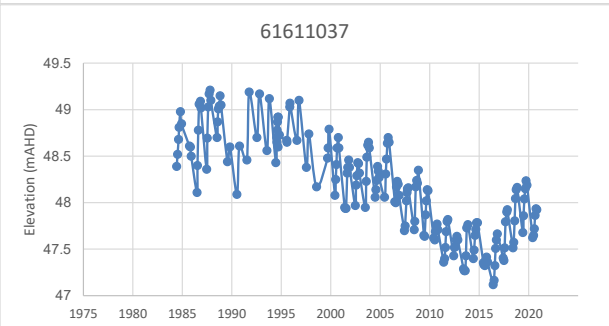
Bore hydrographs

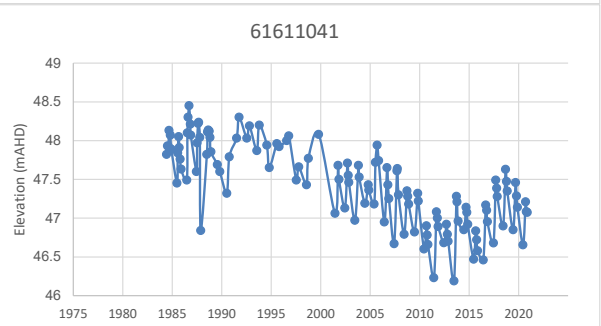


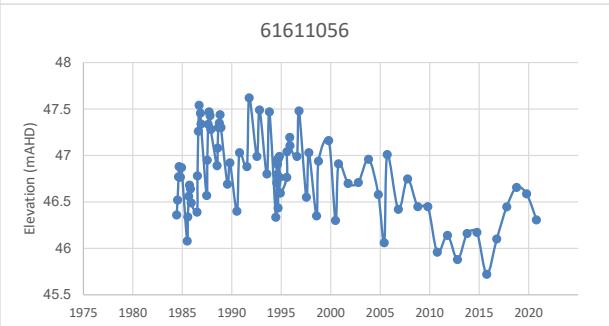


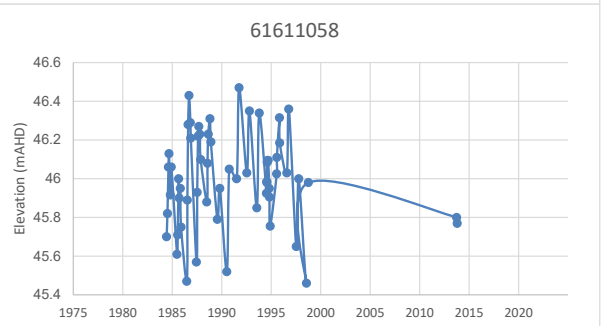






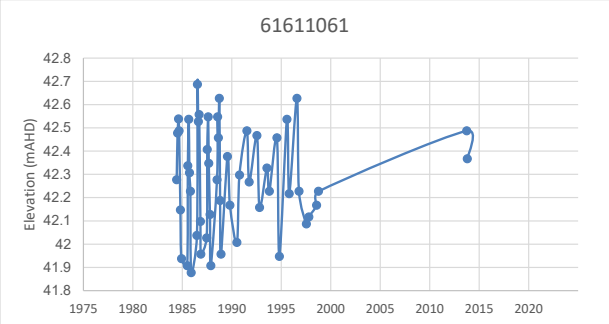


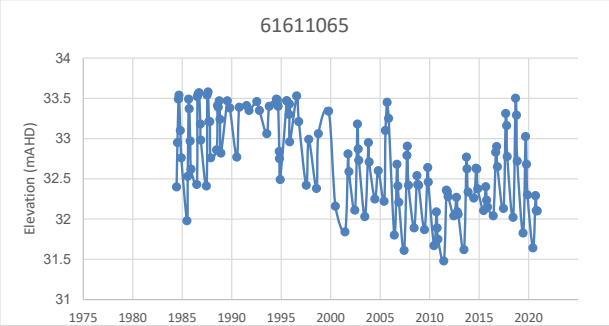


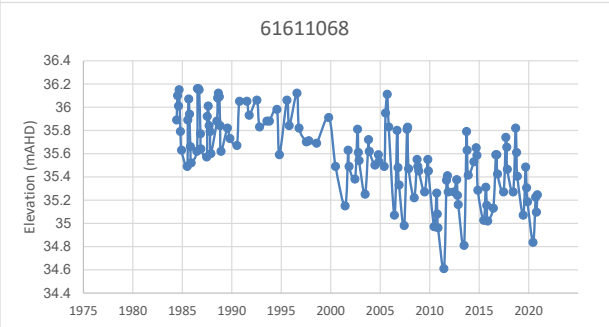


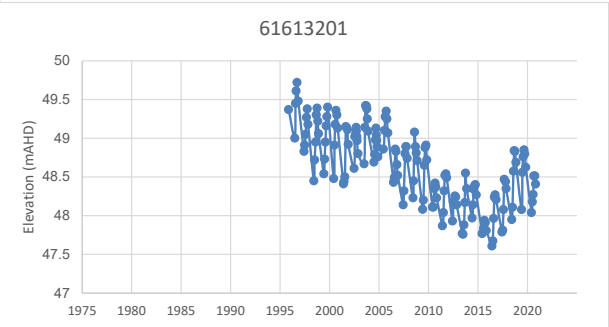
APPENDIX C: GROUNDWATER MONITORING HYDROGRAPHS

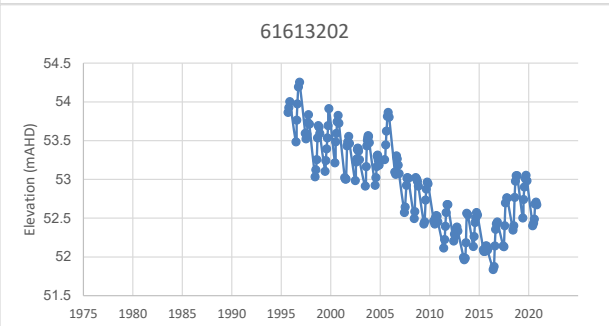
Bore hydrographs

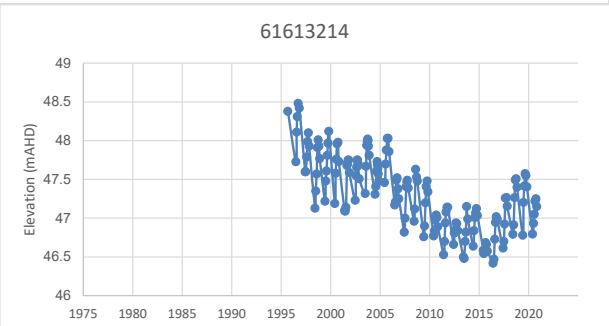


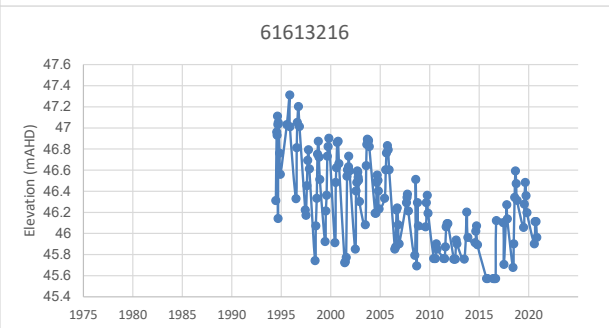


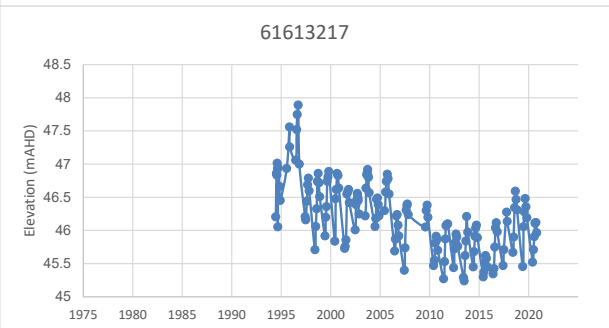




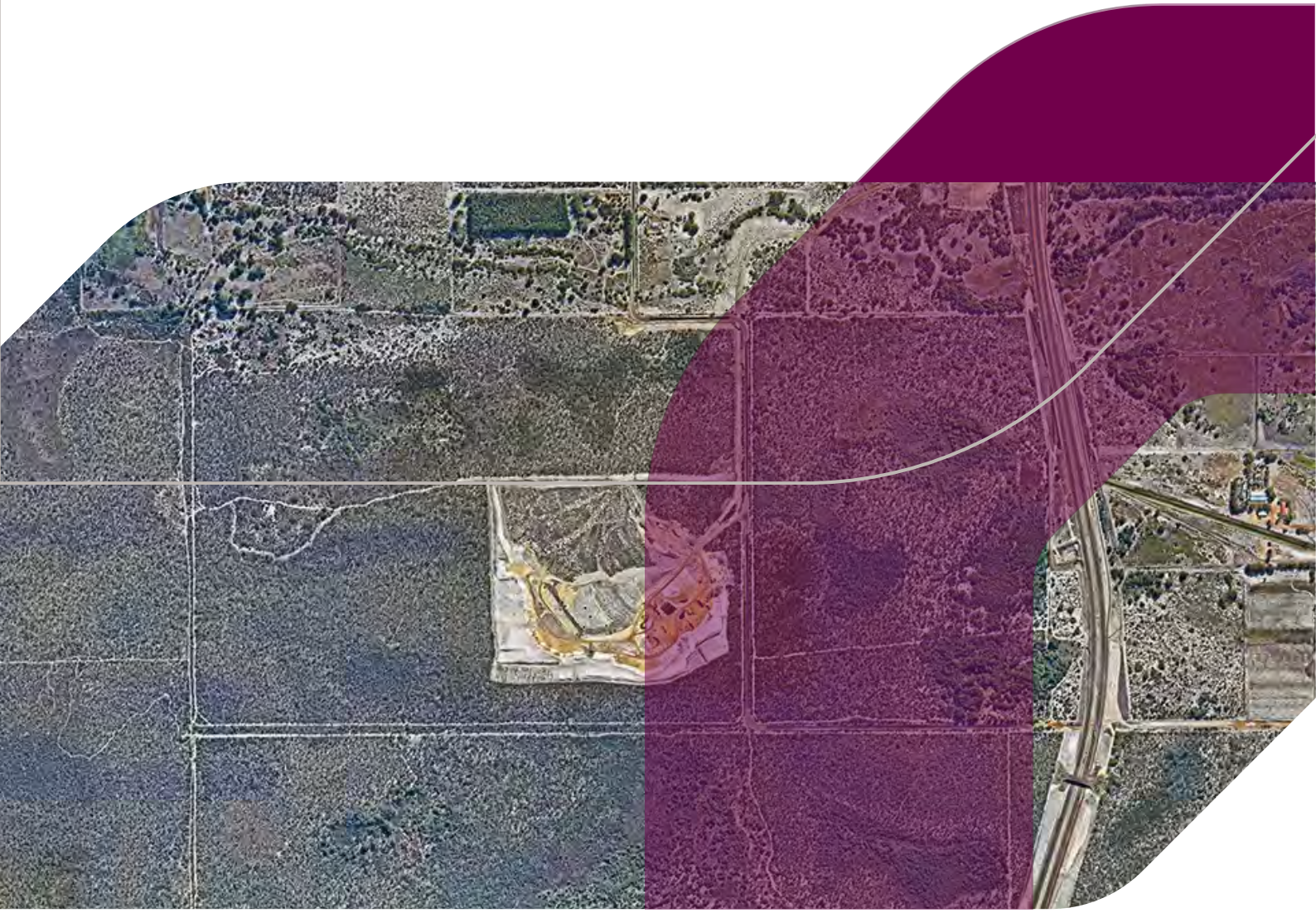


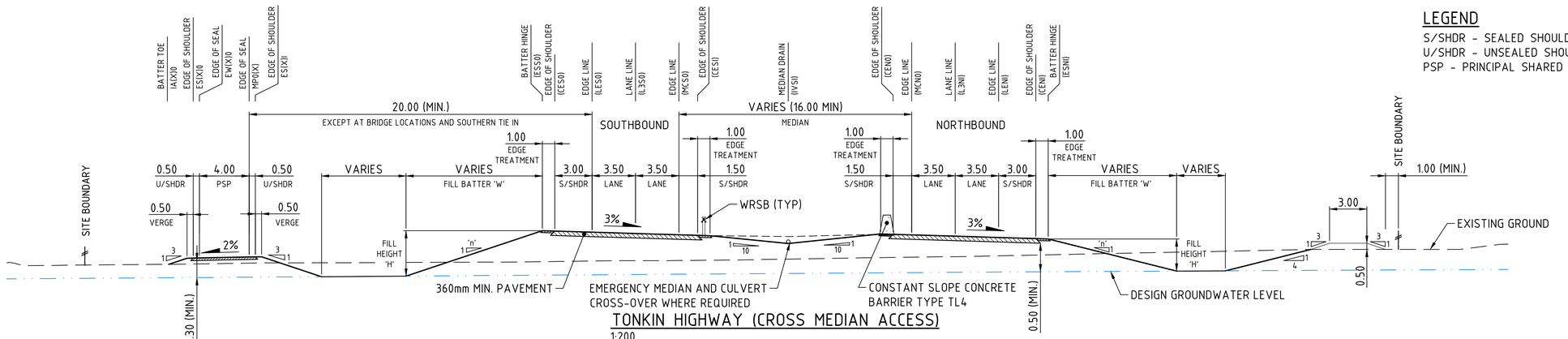




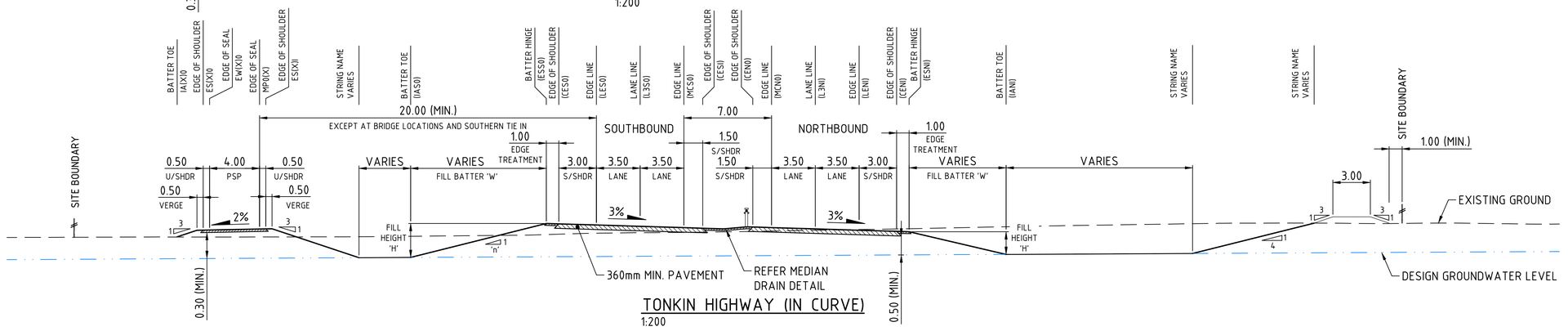


Appendix D
PDNH drawings

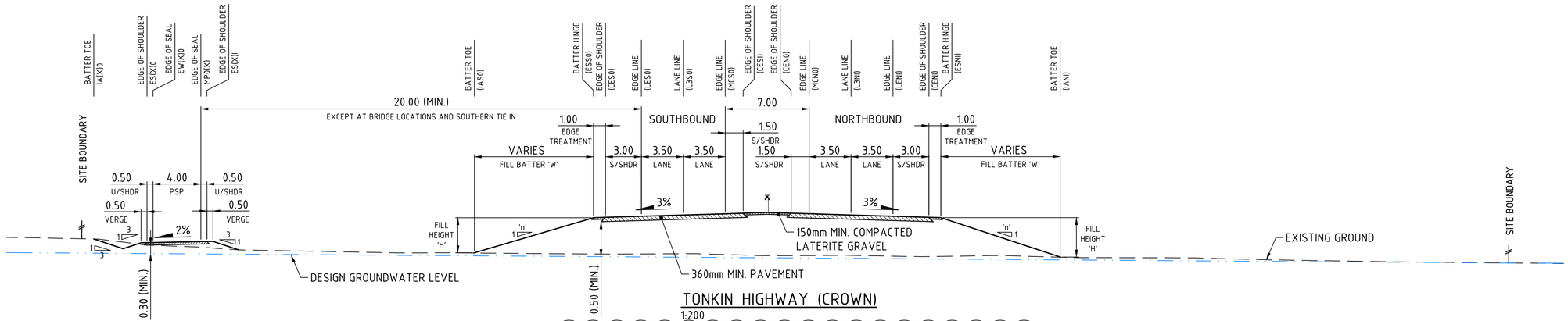




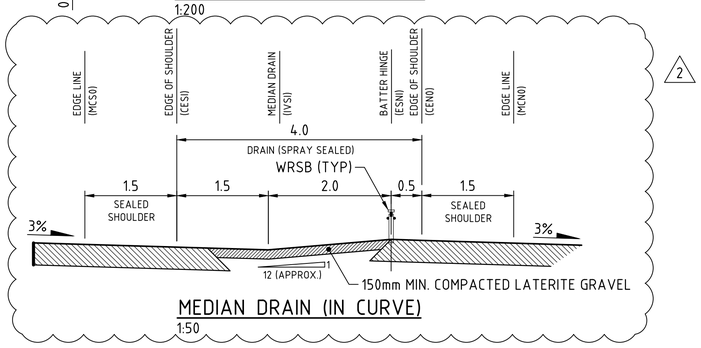
TONKIN HIGHWAY (CROSS MEDIAN ACCESS)
1:200



TONKIN HIGHWAY (IN CURVE)
1:200



TONKIN HIGHWAY (CROWN)
1:200



MEDIAN DRAIN (IN CURVE)
1:50

LEGEND

S/SHDR - SEALED SHOULDER
U/SHDR - UNSEALED SHOULDER
PSP - PRINCIPAL SHARED PATH

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. KERBED HIGHWAY VERGES MUST BE COMPACTED WITH 150mm THICK COMPACTED LATERITE TO A MINIMUM OF 1.2m FROM THE BACK OF KERB.
3. FOR PAVEMENT DETAILS REFER TO PAVEMENT AND SURFACING PLANS.
4. FOR SETOUT DETAILS REFER TO DESIGN MODEL.
5. FILL BATTER SLOPES GREATER THAN 2.5m HEIGHT AND STEEPER THAN 1:4 ARE TO BE PROTECTED BY ROAD SAFETY BARRIERS.
6. WHERE BATTER SLOPES OF INTERSECTING EMBANKMENTS MEET, THE INTERFACE SHALL BE ROUNDED.
7. FOR DETAILS OF TOPSOIL RESPREAD REFER TO LANDSCAPING PACKAGE, DESIGN AREA 180. DRAWING INDEX PROVIDED ON DRG No. NL3-LAN-180-LA-DG-0000. TREATMENT DESCRIPTIONS INCLUDING TOPSOIL PROVIDED IN DESIGN REPORT No. NL3-LAN-180-LA-RP-0003.
8. MX STRING LEVELS TO FINAL SURFACE LEVEL.
9. FOR PAVEMENT EDGE DETAILS REFER TO DRG No. NL3-BGE-000-PV-DG-0003.

ALL CUT BATTERS ARE 1 IN 4 UNLESS NOTED OTHERWISE

FILL HEIGHT 'H' mm	FILL BATTER 1 IN 'n'	FILL BATTER WIDTH 'W' mm	
0 - 660	TABLE DRAIN		
660 - 1000	1 IN 6	0 - 6,000	
1000 - 1500	1 IN 6 TO 1 IN 4	6,000	
1500 - 2500	1 IN 4	6,000 - 10,000	
2500 - 3333	1 IN 4 TO 1 IN 3	10,000	*REFER NOTE 5.
3333+	1 IN 3	10,000+	*REFER NOTE 5.

FILL BATTERS

No.	DESCRIPTION	APPROVED & DATE
2	MEDIAN DRAIN DETAIL MODIFIED	AM 04.07.18
1	NOTE ADDED	AM 29.06.18
0	ISSUED FOR CONSTRUCTION	CR 27.03.18

AMENDMENTS

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office*—
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	D. RICHELIEU	03/18
CHECKED	C. RAMM	03/18
APPROVED	P. THOMPSON	11.05.18

DRAWING STATUS: IFC

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED R. DENHAM 14.05.18

CPB CONTRACTORS

PROJECT MANAGER S. NICOLAY 21.05.18
DESIGN MANAGER A. WHITESIDE 21.05..18

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT MANAGER Y. SIDDIQUI 22.05.18
PROJECT DIRECTOR R. ARNOTT 22.05.18

mainroads WESTERN AUSTRALIA

LOCAL AUTHORITY CITY OF SWAN (109) SHIRE OF CHITTERING (502)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE: TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
RD 601 - MAIN LINE AND PSP
TYPICAL CROSS SECTIONS
SHEET 1

DRAWING No. NL3-BGE-601-RD-DG-0051 REV 2

SCALE: 1:200 1:50 A1

CLASS ROCK	T†	LOR×
NONE	-	-
FACING	500	3000
LIGHT	750	3000
1/4 TONNE	1000	5000

TABLE 1: CULVERT OUTLET ROCK PROTECTION

× MINIMUM LENGTH OF ROCK
† THICKNESS OF ROCK

NOTES

1. TOTAL BARREL LENGTH OF R.C.B. CULVERTS ARE BASED ON A MULTIPLE OF 1.2m.
2. TOTAL BARREL LENGTH OF R.C.P. CULVERTS ARE BASED ON A MULTIPLE OF 2.44m.
3. CULVERT LOCATION AND INVERT LEVELS TO BE CONFIRMED BY MAIN ROADS REPRESENTATIVE PRIOR TO CONSTRUCTION.
4. FOR CULVERT REFERENCE POINT LOCATION REFER TO DRG No. NL3-BGE-000-DR-DG-0010.
5. R.C.B CULVERT END TREATMENTS AS PER MAIN ROADS STD DRG No's 201131-0064 TO 0066, 201131-0084 TO 0086 INCLUDING CULVERT SPANS > 1200mm.
6. R.C.P CULVERT END TREATMENTS AS PER MAIN ROADS STD DRG No. 200131-061.
7. FOR R.C.B CULVERTS REFER TO DRG No. NL3-BGE-000-DR-DG-0011 FOR BASE SLAB DETAILS.
8. ADDITIONAL PROTECTIVE MEASURES FOR CULVERTS INSTALLED IN 'AGGRESSIVE' ENVIRONMENTS SHALL BE IN ACCORDANCE WITH SPECIFICATION 404.
9. WHERE NUMBER OF BARRELS AND LINK SLABS COLUMN IS A SINGLE NUMBER (I.E. 10) IT INDICATES THAT ONLY 10 BARRELS OF CROWN UNITS CAN BE USED. WHERE A 'NUMBER + NUMBER' IS USED (IE 3+2) IT INDICATES THAT 3 CROWN UNIT BARRELS + 2 LINK SLAB BARRELS CAN BE USED, OR ALTERNATELY 5 CROWN UNIT BARRELS.
10. WHERE HEADWALLS ARE WIDER THAN EXISTING CHANNEL, LOCALLY BATTER TO EXISTING SURFACE 1V:6H.
11. FOR CULVERT END TREATMENTS DEPRESSED BELOW EXISTING SURFACE BATTER BACK AT 1V:10H WHERE REQUIRED.
12. FOR SKEWED MULTI BARREL R.C.B CULVERTS UTILISING LINK SLABS REFER TO MAIN ROADS STD DRG No. 201131-0084 FOR ARRANGEMENT OF BARRELS AND LINK SLABS.
13. POSITIVE OFFSETS FROM THE REFERENCE STRING ARE TO THE RIGHT OF THE REFERENCE STRING IN THE DIRECTION OF INCREASING CHAINAGE. NEGATIVE OFFSETS ARE TO THE LEFT OF THE REFERENCE STRING.
14. SKYLIGHT SETOUT BASED ON 1.2m R.C.B UNIT LENGTHS UNLESS NOTED OTHERWISE IN CULVERT SCHEDULE.

			CULVERT TYPE								INLET								OUTLET										
			PIPES			R.C.B										REFERENCE POINT							REFERENCE POINT				GROUND CONDITIONS REFER TO NOTE 8	BASE SLAB TYPE REFER TO NOTE 7	COMMENTS
STRUCTURE NUMBER	REF. LINE	CHAINAGE	PIPE DIAMETER (mm) AND CLASS	NUMBER OF BARRELS	PIPE TYPE	WIDTH (mm)	HEIGHT (mm)	NUMBER OF BARRELS + LINK SLABS	SKEW (DEGREES)	OVERALL LENGTH OF CULVERT(m)	SIDE L=LEFT R=RIGHT	OFFSET FROM REF LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	EASTING	NORTHING	ROCK PROTECTION REF TABLE 1	SIDE L=LEFT R=RIGHT	OFFSET FROM REF LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	EASTING	NORTHING	ROCK PROTECTION REF TABLE 1			
CT12.90	MCS0	12905.6				2400	1200	2	0	38.4	R	22.70	39.76	0.5	5.6	65689.525	294657.730		L	-15.702	39.63	0.5	5.6	65727.924	294657.490		AGGRESSIVE	P	
CT12.90	MCS0	12905.6				1200	1200	4	0	38.4	R	22.70	39.76	0.5	5.6	65689.525	294657.730		L	-15.702	39.63	0.5	5.6	65727.924	294657.490		AGGRESSIVE	J	CT12.90 ALTERNATE CULVERT CONFIGURATION
CT13.18	MCS0	13115	450-2	1	RCP				0	34.16	R	20.13	42.23	0.3	1.8	65690.782	294448.318		L	-14.026	42.18	0.3	1.8	65724.941	294448.104		NON-AGGRESSIVE	-	
CT13.72	MCS0	13719	450-2	1	RCP				0	45.14	R	26.37	43.22	0.4	2.2	65680.759	293844.369		L	-18.765	42.90	0.5	2.6	65725.897	293844.086		NON-AGGRESSIVE	-	
CT14.26	MCS0	14220	450-2	2	RCP				-2	40.26	R	24.98	43.93	0.4	2.2	65620.996	293355.297		L	-15.282	43.86	0.4	2.2	65660.117	293345.789		NON-AGGRESSIVE	-	
CT14.75	MCS0	14763				900	375	1	-1	37.2	R	22.13	44.39	0.5	2.3	65517.102	292818.786		L	-15.07	43.94	0.5	2.3	65554.298	292819.031		NON-AGGRESSIVE	D	
CT17.24	MCS0	17238.5				1200	600	2	5	64.8	R	43.03	39.31	0.5	3.2	65586.923	290370.453		L	-21.767	39.11	0.5	3.2	65651.709	290369.158	FACING	NON-AGGRESSIVE	J	
CT17.33	MCNA	774				900	375	1	-4	15.6	R	8.54	40.17	0.5	2.3	65608.058	290293.412		L	-7.059	40.00	0.5	2.3	65592.552	290291.712		NON-AGGRESSIVE	C	
CT17.34B	MCS0	17339				1200	450	1	-4	70.8	R	43.51	39.60	0.4	2.2	65592.939	290263.846		L	-27.286	39.31	0.4	2.2	65663.184	290272.692	FACING	NON-AGGRESSIVE	J	
CT17.44	MCSA	327.5				900	375	1	-2	13.2	R	6.93	39.71	0.5	2.3	65659.037	290184.720		L	-6.267	39.68	0.4	1.9	65671.991	290187.256		NON-AGGRESSIVE	C	
CT17.45A	MCNA	640.3				900	375	1	0	15.6	L	-6.54	39.92	0.4	1.9	65598.954	290158.634		R	9.062	39.78	0.4	1.9	65614.539	290159.299		NON-AGGRESSIVE	C	
CT17.45B	MCS0	17443.2				900	375	1	-10	55.2	R	20.57	39.78	0.3	1.5	65621.172	290160.767		L	-34.634	39.65	0.4	1.9	65675.068	290172.692		NON-AGGRESSIVE	D	
CT17.51	MP06	1232				900	375	1	20	25.2	R	18.06	39.77	0.4	1.9	65670.552	290102.823		L	-7.137	39.66	0.3	1.5	65694.393	290094.660		NON-AGGRESSIVE	C	
CT17.53A	MASP	4				900	375	1	0	30	L	-2.89	40.07	0.3	1.5	65622.680	290065.945		R	27.114	39.96	0.5	3.5	65621.964	290095.936	FACING	NON-AGGRESSIVE	D	TRAVERSABLE END TREATMENT ON OUTLET. REFER TO MRWA STD DRAWING 200531-0010
CT17.53B	MASN	13				900	375	1	0	21.6	L	-3.28	40.00	0.3	1.5	65662.900	290063.167		R	18.32	39.77	0.4	1.9	65661.605	290084.726		NON-AGGRESSIVE	C	TRAVERSABLE END TREATMENT ON INLET. REFER TO MRWA STD DRAWING 200531-0010
CT17.75	MCS0	17744.7				900	375	1	0	52.8	R	38.10	40.37	0.5	3.5	65610.842	289863.527		L	-14.702	40.03	0.5	2.3	65663.639	289863.938		NON-AGGRESSIVE	D	
CT17.76	MCSA	661.7				900	375	1	0	12	L	-3.52	40.30	0.3	1.5	65681.538	289853.577		R	8.482	40.12	0.3	1.5	65669.539	289853.499		NON-AGGRESSIVE	C	
CT17.85A	MCS0	17856				900	375	1	-1	46.8	R	32.14	40.66	0.4	1.9	65616.938	289752.135		L	-14.66	40.32	0.5	2.3	65663.734	289752.703		NON-AGGRESSIVE	D	
CT18.05	MCS0	18042				1200	375	2	0	64.8	R	25.73	41.32	0.3	1.5	65621.755	289566.760		L	-39.073	40.91	0.3	1.5	65686.551	289566.186		NON-AGGRESSIVE	J	
CT18.46	MCS0	18461.3	450-2	1	RCP				-2	48.8	R	31.75	42.35	0.4	4.7	65598.426	289150.009		L	-17.048	42.23	0.4	3.8	65647.108	289146.622		NON-AGGRESSIVE	-	TRAVERSABLE END TREATMENT ON INLET AND OUTLET. REFER TO MRWA STD DRAWING 200531-0010
CT18.62	MCS0	18570.3				1200	375	3+1	0	50.4	R	33.67	42.22	0.5	2.3	65583.444	289044.349		L	-16.732	42.10	0.5	2.3	65633.346	289037.282		NON-AGGRESSIVE	J	
CT18.78	MCS0	18792				900	375	1	0	38.4	R	23.87	43.43	0.4	1.9	65555.525	288825.233		L	-14.532	43.20	0.5	2.3	65593.369	288818.722		NON-AGGRESSIVE	D	
CT19.23	MCS0	19223				1200	375	2	0	39.6	R	23.34	43.65	0.4	1.9	65513.350	288393.269		L	-16.258	43.62	0.5	2.3	65552.936	288392.212		NON-AGGRESSIVE	J	
CT19.27	MCS0	19267.5				1200	450	3+2	0	40.8	R	23.60	43.45	0.4	2.2	65512.228	288348.434		L	-17.202	43.28	0.4	2.2	65553.025	288347.950		NON-AGGRESSIVE	J	
CT19.65	MCS0	19654.5				2400	600	3+1	0	44.4	R	21.18	43.40	0.5	3.2	65535.131	287959.483		L	-23.219	43.30	0.4	2.8	65579.226	287964.671		NON-AGGRESSIVE	P	DUAL USE CULVERT. FAUNA LEDGE 0.3m ABOVE CULVERT INVERT. REFER TO NL3-BGE-000-DR-DG-0008 FOR DETAILS
CT19.78	MCS0	19781.9	450-3	1	RCP				0	32.94	L	-12.00	43.94	0.3	1.8	65585.589	287837.693		R	20.936	43.86	0.3	1.8	65553.068	287832.458		NON-AGGRESSIVE	-	
CT20.29	MCS0	20288.5				1200	375	4+2	0	42	R	27.51	45.30	0.5	2.3	65637.823	287332.465		L	-14.495	45.19	0.5	2.3	65679.126	287340.084	FACING	NON-AGGRESSIVE	J	
CT20.64	MCS0	20637.5				1200	375	1	0	52.8	R	31.70	46.63	0.4	1.9	65675.935	286991.676		L	-21.098	46.53	0.5	2.3	65728.735	286991.756		NON-AGGRESSIVE	J	DUAL USE CULVERT. FAUNA LEDGE 0.075m ABOVE CULVERT INVERT. SKYLIGHT AT 10.69m OFFSET. REFER TO NL3-BGE-000-DR-DG-0008 FOR DETAILS
CT20.65	MCS0	20637.5	450-2	1	RCP				0	51.24	L	-	45.76	0.3	1.8	65668.418	286963.625		R	-	45.21	0.3	1.8	65668.787	287014.861		NON-AGGRESSIVE	-	

CULVERT SCHEDULE - MAIN LINE

SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18

AMENDMENTS

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office*—
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	D. WILLIAMSON	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		

DRAWING STATUS: IFC

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED DATE

CPB CONTRACTORS

PROJECT MANAGER DATE
DESIGN MANAGER DATE
PROJECT MANAGER DATE
PROJECT DIRECTOR DATE

INFRASTRUCTURE DELIVERY DIRECTORATE

mainroads WESTERN AUSTRALIA

LOCAL AUTHORITY: SHIRE OF CHITTERING (502)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE: TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
CULVERT SCHEDULE - MAINLINE
SHEET 2

DRAWING No. NL3-BGE-701-DR-DG-0212 REV 0

CLASS ROCK	T†	LOR×
NONE	-	-
FACING	500	3000
LIGHT	750	3000
1/4 TONNE	1000	5000

TABLE 1: CULVERT OUTLET ROCK PROTECTION

× MINIMUM LENGTH OF ROCK
† THICKNESS OF ROCK

NOTES

1. TOTAL BARREL LENGTH OF R.C.B. CULVERTS ARE BASED ON A MULTIPLE OF 1.2m.
2. TOTAL BARREL LENGTH OF R.C.P. CULVERTS ARE BASED ON A MULTIPLE OF 2.44m.
3. CULVERT LOCATION AND INVERT LEVELS TO BE CONFIRMED BY MAIN ROADS REPRESENTATIVE PRIOR TO CONSTRUCTION.
4. FOR CULVERT REFERENCE POINT LOCATION REFER TO DRG No. NL3-BGE-000-DR-DG-0010.
5. R.C.B CULVERT END TREATMENTS AS PER MAIN ROADS STD DRG No's 201131-0064 TO 0066, 201131-0084 TO 0086 INCLUDING CULVERT SPANS > 1200mm.
6. R.C.P CULVERT END TREATMENTS AS PER MAIN ROADS STD DRG No. 200131-061.
7. FOR R.C.B CULVERTS REFER TO DRG No. NL3-BGE-000-DR-DG-0011 FOR BASE SLAB DETAILS.
8. ADDITIONAL PROTECTIVE MEASURES FOR CULVERTS INSTALLED IN 'AGGRESSIVE' ENVIRONMENTS SHALL BE IN ACCORDANCE WITH SPECIFICATION 404.
9. WHERE NUMBER OF BARRELS AND LINK SLABS COLUMN IS A SINGLE NUMBER (I.E. 10) IT INDICATES THAT ONLY 10 BARRELS OF CROWN UNITS CAN BE USED. WHERE A 'NUMBER + NUMBER' IS USED (IE 3+2) IT INDICATES THAT 3 CROWN UNIT BARRELS + 2 LINK SLAB BARRELS CAN BE USED, OR ALTERNATELY 5 CROWN UNIT BARRELS.
10. WHERE HEADWALLS ARE WIDER THAN EXISTING CHANNEL, LOCALLY BATTER TO EXISTING SURFACE 1V:6H.
11. FOR CULVERT END TREATMENTS DEPRESSED BELOW EXISTING SURFACE BATTER BACK AT 1V:10H WHERE REQUIRED.
12. FOR SKEWED MULTI BARREL R.C.B CULVERTS UTILISING LINK SLABS REFER TO MAIN ROADS STD DRG No. 201131-0084 FOR ARRANGEMENT OF BARRELS AND LINK SLABS.
13. POSITIVE OFFSETS FROM THE REFERENCE STRING ARE TO THE RIGHT OF THE REFERENCE STRING IN THE DIRECTION OF INCREASING CHAINAGE. NEGATIVE OFFSETS ARE TO THE LEFT OF THE REFERENCE STRING.
14. SKYLIGHT SETOUT BASED ON 1.2m R.C.B UNIT LENGTHS UNLESS NOTED OTHERWISE IN CULVERT SCHEDULE.

			CULVERT TYPE								INLET								OUTLET								GROUND CONDITIONS REFER TO NOTE 8	BASE SLAB TYPE REFER TO NOTE 7	COMMENTS
			PIPES			R.C.B										REFERENCE POINT								REFERENCE POINT					
STRUCTURE NUMBER	REF. LINE	CHAINAGE	PIPE DIAMETER (mm) AND CLASS	NUMBER OF BARRELS	PIPE TYPE	WIDTH (mm)	HEIGHT (mm)	NUMBER OF BARRELS + LINK SLABS	SKEW (DEGREES)	OVERALL LENGTH OF CULVERT(m)	SIDE L=LEFT R=RIGHT	OFFSET FROM REF LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	EASTING	NORTHING	ROCK PROTECTION REF TABLE 1	SIDE L=LEFT R=RIGHT	OFFSET FROM REF LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	EASTING	NORTHING	ROCK PROTECTION REF TABLE 1			
CP14.26	MP04	2729.7	450-3	2	RCP				-2.00	7.32	R	1.705	43.78	0.4	2.2	65677.073	293340.189		L	-5.615	43.72	0.4	2.2	65684.180	293338.437		NON-AGGRESSIVE	-	
CP14.58	MP04	2992	450-2	1	RCP				0.00	9.76	R	2.999	44.09	0.3	1.8	65605.379	293087.819		L	-6.76	43.98	0.3	1.8	65614.877	293085.578		NON-AGGRESSIVE	-	
CP14.75	MP04	3261				900	375	1	-1.00	8.40	R	2.267	43.80	0.4	1.9	65572.769	292818.848		L	-6.132	43.72	0.4	1.9	65581.169	292818.869		NON-AGGRESSIVE	C	
CP17.24	MP06	956				1200	600	2	-5.00	9.60	R	2.798	39.09	0.4	2.8	65668.785	290371.930		L	-6.802	39.06	0.3	2.4	65678.230	290373.647		NON-AGGRESSIVE	I	
CP17.34	MP06	1048.4				1200	450	1	0.00	8.40	R	2.257	39.27	0.3	1.8	65677.062	290280.199		L	-6.143	39.26	0.3	1.8	65685.440	290280.800		NON-AGGRESSIVE	G	
CP17.45	MP06	1154				900	375	1	-10.00	8.40	R	2.332	39.63	0.4	1.9	65683.001	290174.434		L	-6.068	39.62	0.4	1.9	65691.206	290176.234		NON-AGGRESSIVE	A	
CP17.56	MP06	1280	450-2	1	RCP				0.00	8.54	R	2.105	39.98	0.3	1.8	65684.910	290048.998		L	-6.432	39.75	0.3	1.8	65693.446	290048.903		NON-AGGRESSIVE	-	
CP17.75	MP06	1426				900	375	1	-55.00	40.80	R	31.026	39.99	0.5	2.3	65669.275	289877.721		L	-9.773	39.64	0.3	1.5	65692.972	289910.932		NON-AGGRESSIVE	D	
CP17.85	MP06	1576				900	375	1	-1.00	21.60	R	16.07	40.30	0.5	2.3	65669.898	289752.848		L	-5.53	40.22	0.5	2.3	65691.497	289753.033		NON-AGGRESSIVE	C	
CP18.07	MP06	1804				900	375	1	0.00	7.20	R	1.614	41.47	0.3	1.5	65681.124	289525.432		L	-5.585	41.37	0.3	1.5	65688.320	289525.632		NON-AGGRESSIVE	A	
CP18.46	MP06	2181.8				900	375	1	-18.00	8.40	R	2.195	42.22	0.3	2.7	65664.072	289147.354		L	-6.205	42.15	0.3	1.5	65672.292	289149.084		NON-AGGRESSIVE	A	TRAVERSABLE END TREATMENT ON INLET. REFER TO MRWA STD DRAWING 200531-0010
CP18.62	MP06	2340.6				1200	375	4	0.00	9.60	R	2.919	42.12	0.3	1.5	65642.315	288991.375		L	-6.68	42.06	0.3	1.5	65651.793	288989.850		NON-AGGRESSIVE	I	
CP18.78	MP06	2503				900	375	1	0.00	7.20	R	1.743	42.97	0.5	2.3	65615.707	288830.714		L	-5.456	42.89	0.5	2.3	65622.799	288829.475		NON-AGGRESSIVE	A	
CP19.23	MP06	2945				1200	375	2	0.00	8.40	R	2.15	43.53	0.4	1.9	65568.901	288392.138		L	-6.25	43.45	0.4	1.9	65577.300	288392.065		NON-AGGRESSIVE	I	
CP19.27	MP06	2990				1200	450	3+2	2.00	9.60	R	2.705	43.16	0.5	2.6	65567.961	288347.239		L	-6.895	43.12	0.4	2.2	65577.552	288346.821		NON-AGGRESSIVE	I	
CP20.28	MP06	3998.7				1200	375	4+2	0.00	12.00	R	3.967	45.04	0.5	2.3	65686.401	287347.679	FACING	L	-8.033	45.01	0.3	1.5	65698.208	287349.824		NON-AGGRESSIVE	I	
CM00.02	MP0A	242.4				1200	375	1	0.00	8.40	L	-3.227	47.44	0.5	2.3	65941.628	286762.965		R	5.162	47.00	0.3	1.5	65941.623	286754.577		NON-AGGRESSIVE	I	

CULVERT SCHEDULE - PSP

SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18
	AMENDMENTS	

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office—*
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	D. WILLIAMSON	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		
DRAWING STATUS	IFC	

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED DATE

CPB CONTRACTORS

PROJECT MANAGER DATE
DESIGN MANAGER DATE

THE GOVERNMENT OF WESTERN AUSTRALIA
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT MANAGER DATE
PROJECT DIRECTOR DATE

LOCAL AUTHORITY: SHIRE OF CHITTERING (502)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

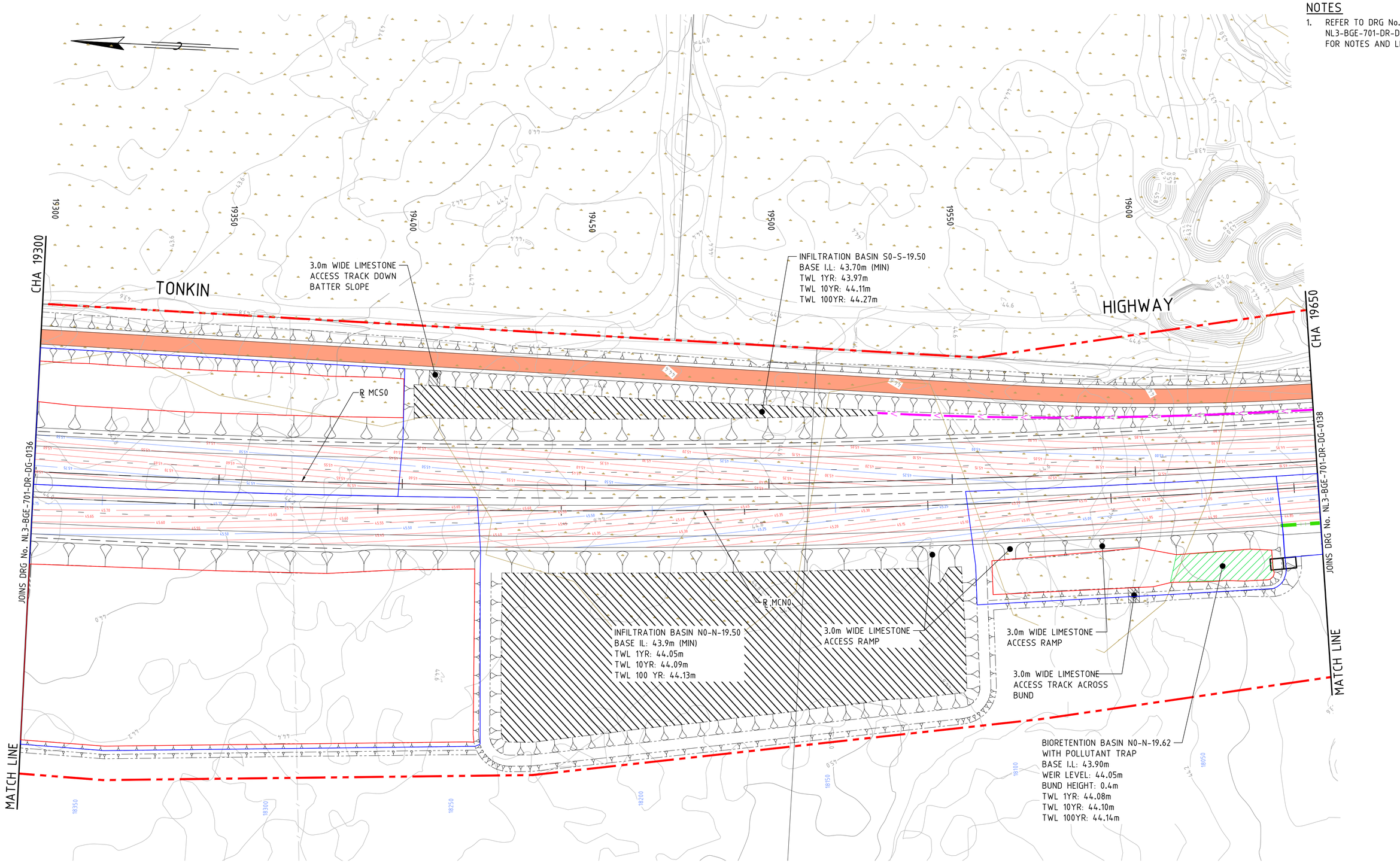
PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE:
TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
CULVERT SCHEDULE - PSP
SHEET 2

DRAWING No.: NL3-BGE-701-DR-DG-0214
REV: 0

NOTES

1. REFER TO DRG No. NL3-BGE-701-DR-DG-0100 FOR NOTES AND LEGEND



PLAN
1:500

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SCALE 1:500 A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18

AMENDMENTS

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office*—
484 Murray St, Perth WA 6000
P /+61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	J. BRUCKNER	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		

DRAWING STATUS: IFC

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED DATE

CPB CONTRACTORS

PROJECT MANAGER DATE
DESIGN MANAGER DATE

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT MANAGER DATE
PROJECT DIRECTOR DATE

LOCAL AUTHORITY: CITY OF SWAN (109)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

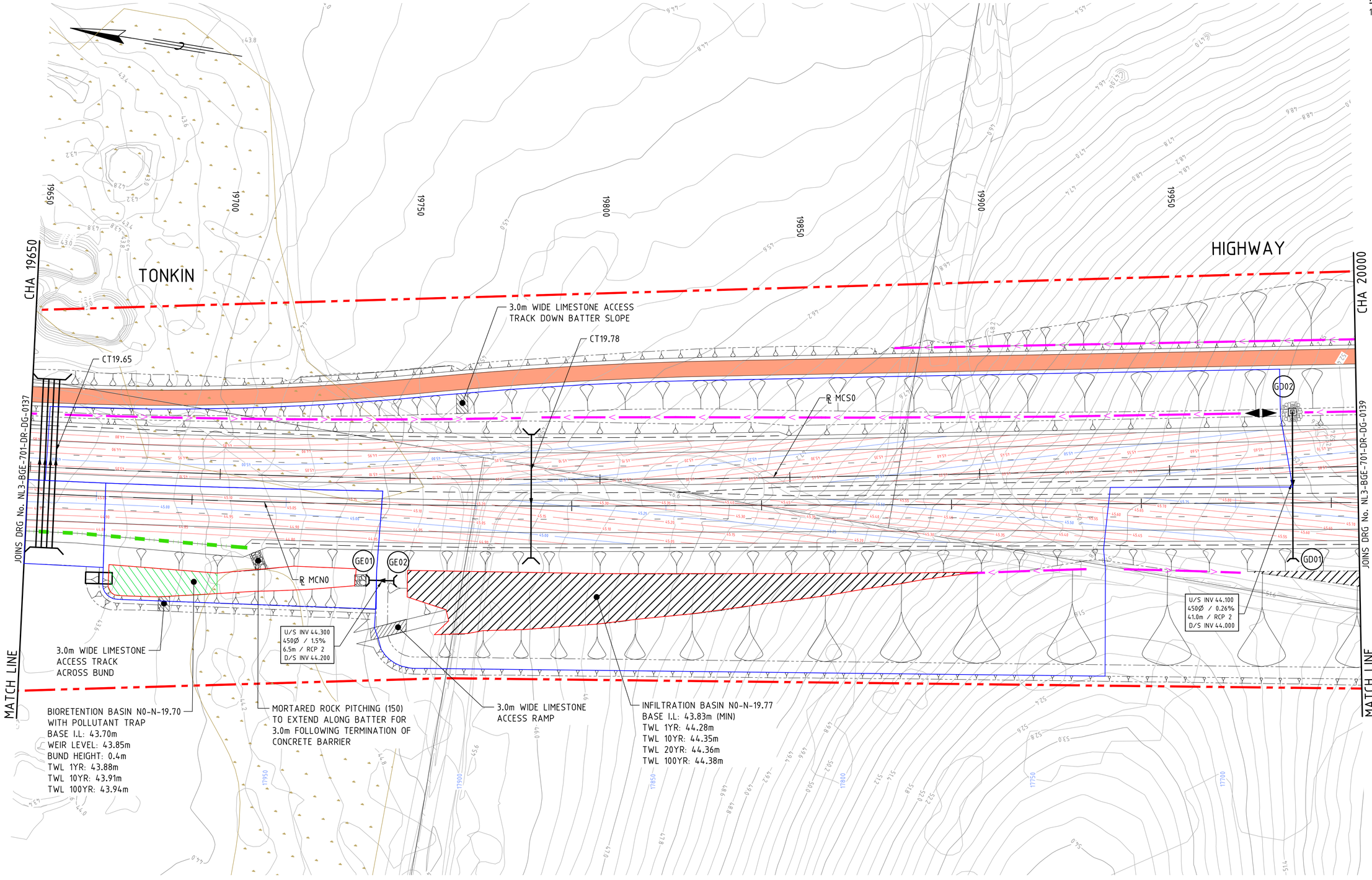
PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE:
TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
DRAINAGE PLAN
SHEET 37

DRAWING No. NL3-BGE-701-DR-DG-0137 REV 0

NOTES

1. REFER TO DRG No. NL3-BGE-701-DR-DG-0100 FOR NOTES AND LEGEND



PLAN
1:500

1:500

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SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18

AMENDMENTS

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office—*
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	J. BRUCKNER	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		
DRAWING STATUS	IFC	

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

CPB CONTRACTORS

INFRASTRUCTURE DELIVERY DIRECTORATE

mainroads WESTERN AUSTRALIA

VERIFIED DATE

PROJECT MANAGER DATE

DESIGN MANAGER DATE

PROJECT MANAGER DATE

PROJECT DIRECTOR DATE

LOCAL AUTHORITY: CITY OF SWAN (109)

MAIN ROADS RESPONSIBILITY AREA

MRWA DRAWING NUMBER

PROJECT TITLE: NORTHLINK WA STAGE 3

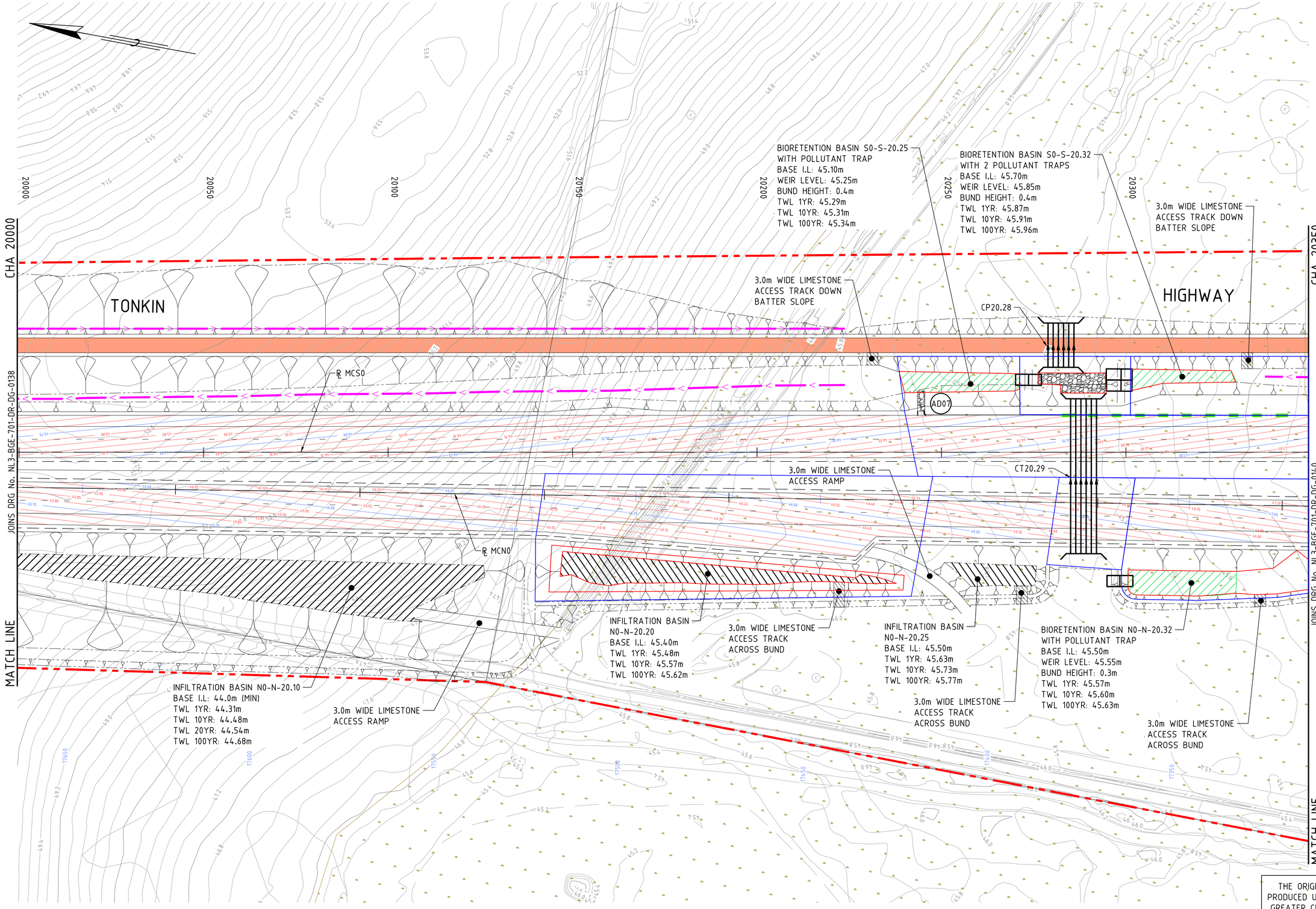
DRAWING TITLE: TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
DRAINAGE PLAN
SHEET 38

DRAWING No. NL3-BGE-701-DR-DG-0138

REV 0

NOTES

1. REFER TO DRG No. NL3-BGE-701-DR-DG-0100 FOR NOTES AND LEGEND



PLAN
1:500

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1:500 SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18
	AMENDMENTS	

METADATA

GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

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P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	J. BRUCKNER	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		
DRAWING STATUS	IFC	

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

CPB CONTRACTORS

INFRASTRUCTURE DELIVERY DIRECTORATE

VERIFIED DATE
PROJECT MANAGER DATE
DESIGN MANAGER DATE
PROJECT MANAGER DATE
PROJECT DIRECTOR DATE

LOCAL AUTHORITY: CITY OF SWAN (109)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE:
TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
DRAINAGE PLAN
SHEET 39

DRAWING No. NL3-BGE-701-DR-DG-0139 REV 0

NOTES

1. REFER TO DRG No. NL3-BGE-701-DR-DG-0100 FOR NOTES AND LEGEND

CHA 20350

CHA 20700

TONKIN HIGHWAY

SKYLIGHT FOR DUAL USE CULVERT. REFER TO CULVERT SCHEDULE FOR FURTHER DETAILS

CT20.64

CT20.65

℄ MCS0

℄ MCN0

AE02

AE01

AC02

AC01

U/S INV 44.150
450Ø / 0.54%
27.808m / RCP 2
D/S INV 44.000

U/S INV 45.380
450Ø / 0.50%
27.839m / RCP 2
D/S INV 45.240

INFILTRATION BASIN N0-N-20.41
BASE I.L: 44.0m (MIN)
TWL 1YR: 44.56m
TWL 10YR: 44.93m
TWL 100YR: 45.34m

3.0m WIDE LIMESTONE ACCESS RAMP

JOINS DRG No. NL3-BGE-701-DR-DG-0139

JOINS DRG No. NL3-BGE-701-DR-DG-0141

MATCH LINE

MATCH LINE

20350 20400 20450 20500 20550 20600 20650

17500 17200 17150 17100 17050 17000

PLAN
1:500

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1:500 SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18
	AMENDMENTS	

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office*—
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	J. BRUCKNER	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		
DRAWING STATUS	IFC	

Kellogg Brown & Root Pty Ltd
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ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED DATE

CPB CONTRACTORS

PROJECT MANAGER DATE

DESIGN MANAGER DATE

INFRASTRUCTURE DELIVERY DIRECTORATE

PROJECT MANAGER DATE

PROJECT DIRECTOR DATE

mainroads WESTERN AUSTRALIA

LOCAL AUTHORITY: CITY OF SWAN (109)

MAIN ROADS RESPONSIBILITY AREA

MRWA DRAWING NUMBER

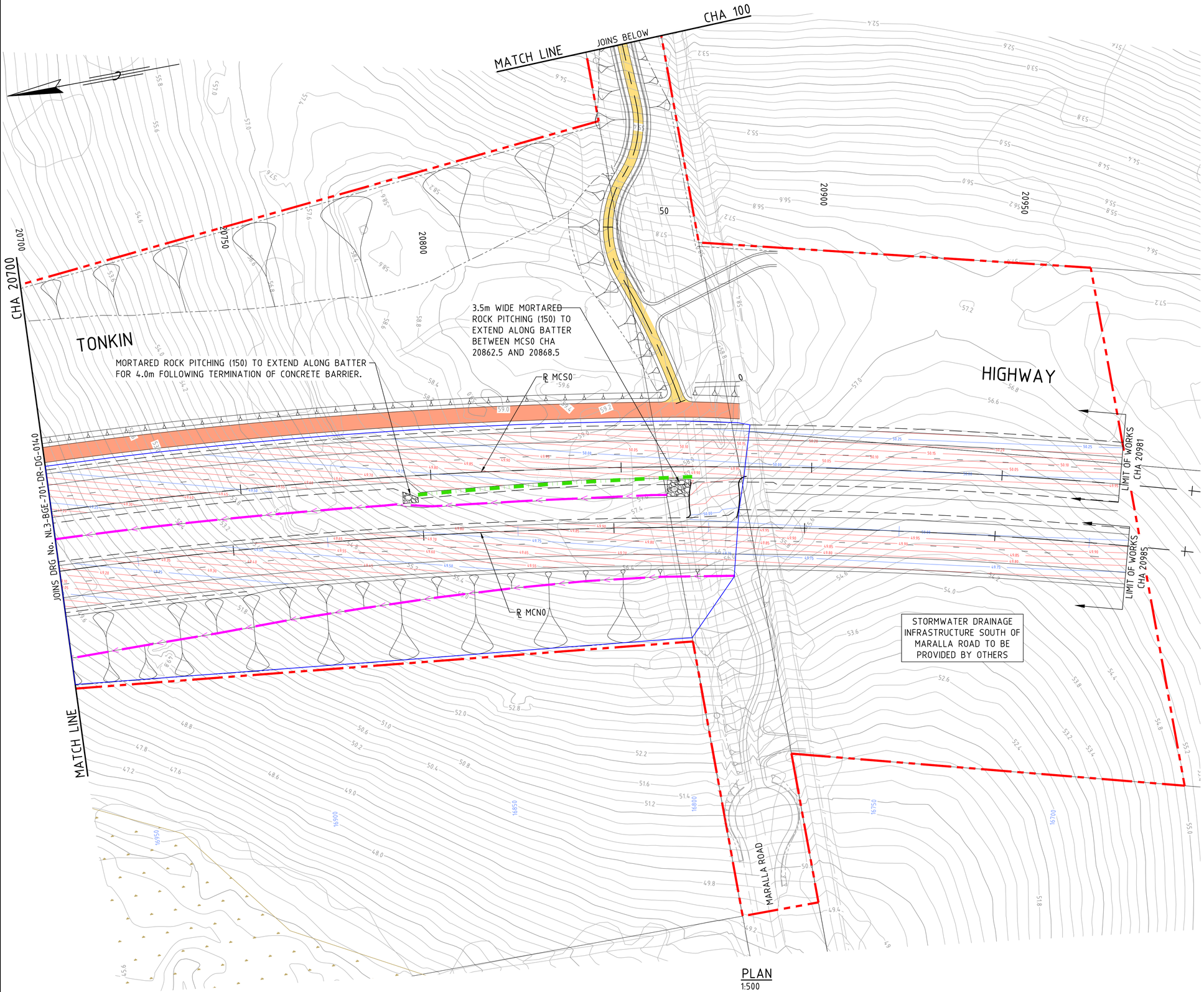
PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE: TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
DRAINAGE PLAN
SHEET 40

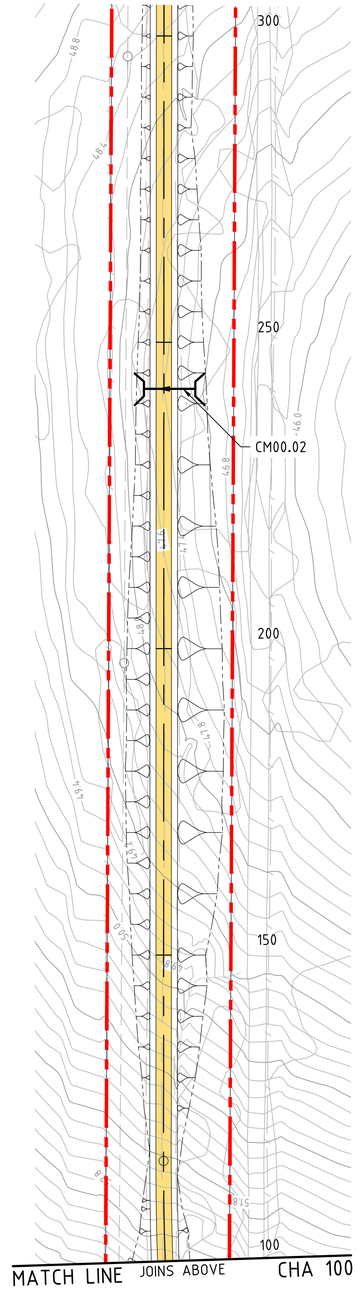
DRAWING No. NL3-BGE-701-DR-DG-0140 REV 0

NOTES

1. REFER TO DRG No. NL3-BGE-701-DR-DG-0100 FOR NOTES AND LEGEND



PLAN
1:500



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SCALE A1

No.	DESCRIPTION	APPROVED & DATE
0	ISSUED FOR CONSTRUCTION	CR 28.03.18

AMENDMENTS

METADATA	
GROUND SURVEY STANDARD:	67-08-43
DATE OF CAPTURE:	2015
MAPPING SURVEY STANDARD:	67-08-44
DATE OF CAPTURE:	2015
MAIN ROADS PROJECT ZONE:	PCG94
HEIGHT DATUM:	AHD

Perth *Office*—
484 Murray St, Perth WA 6000
P / +61 8 6364 3300
E / info@bgeeng.com
bgeeng.com—

BG&E DOC No: P17077

DRAWN	G. CLARKE	03/18
DESIGNED	J. BRUCKNER	03/18
CHECKED	M. WIEZEL	03/18
APPROVED		

DRAWING STATUS: IFC

Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
Level 15, 300 Murray St, Perth
Western Australia 6000

VERIFIED DATE

PROJECT MANAGER DATE
DESIGN MANAGER DATE

CPB CONTRACTORS

PROJECT MANAGER DATE
PROJECT DIRECTOR DATE

INFRASTRUCTURE DELIVERY DIRECTORATE

mainroads WESTERN AUSTRALIA

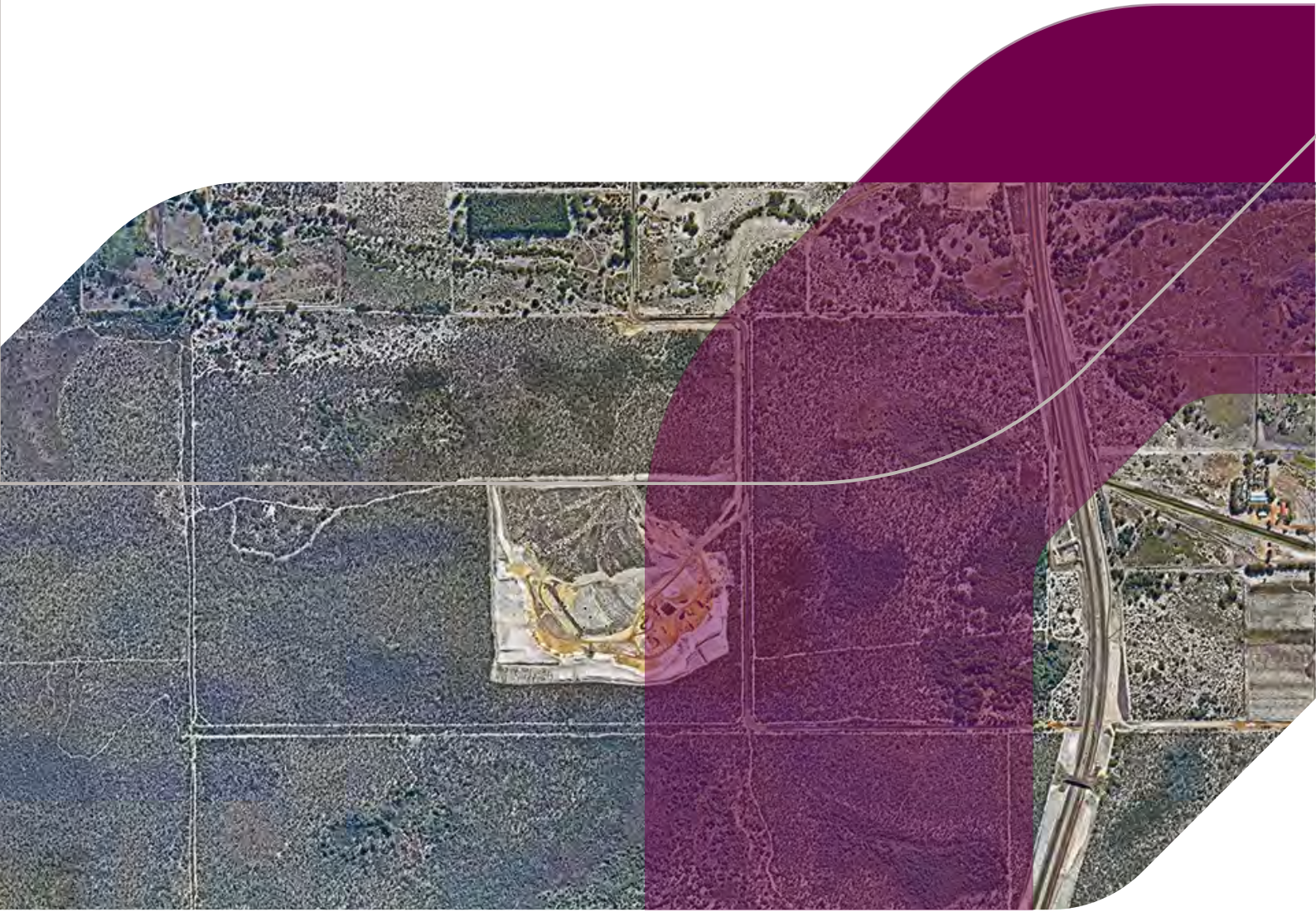
LOCAL AUTHORITY: CITY OF SWAN (109)
MAIN ROADS RESPONSIBILITY AREA
MRWA DRAWING NUMBER

PROJECT TITLE: NORTHLINK WA STAGE 3

DRAWING TITLE:
TONKIN HIGHWAY H017 (0.00 SLK TO 20.99 SLK)
DR 701 - MAIN LINE AND PSP
DRAINAGE PLAN
SHEET 41

DRAWING No. NL3-BGE-701-DR-DG-0141 REV 0

Appendix E
Stormwater modelling (RPS 2022)



MEMO

Date: 4 June 2021
Pages: 7 inc. this page
Regarding: Lots 5892 and 108 Maralla Road, Bullsbrook DWMS

Lots 5892 and 108 Maralla Road, Bullsbrook DWMS – stormwater modelling

1 Introduction

Stormwater modelling in XPSWMM was undertaken to support preparation of the District Water Management Strategy (DWMS) for Lots 5892 and 108 Maralla Road, Bullsbrook, herein referred to as 'the site'. The pre-development and post-development scenarios were modelled, and the adopted parameters and assumptions have been documented in this memo.

A Flood Modelling Report (RPS 2019) was previously prepared to support the downstream, adjacent North Ellenbrook (East) DWMS. The Flood Modelling Report (RPS 2019) included an assessment of the regional upstream catchments which includes this site. Many of the modelling assumptions that were applied to this area in RPS (2019) have been adopted for this modelling exercise to maintain consistency between the two DWMS areas.

2 Modelling assumptions

2.1 Rainfall

Design rainfall events were modelled as per the methodology in Australian Rainfall and Runoff (Ball *et al.* 2019). Complete storms including median pre-bursts were used, with temporal patterns and Intensity-Frequency-Distribution (IFD) data obtained from the ARR Data Hub and Bureau of Meteorology (BoM) respectively.

2.1.1 Areal reduction factors

Design rainfall values are derived from rainfall data measured at a particular point and therefore do not take into account spatial variability and the likelihood that average rainfall intensity over a very large catchment area will be lower than the design rainfall intensity estimated for a particular point. Areal reduction factors (ARFs) allow the conversion of average point design rainfall values to areal estimates.

ARFs were applied to the design rainfall based on a total catchment area of approximately 2.46 km^2 (the site area).

2.2 Infiltration losses

Pre-development loss rates were obtained from the ARR Data Hub. These loss rates are suitable for rural catchments and are calculated for the complete storm, which includes pre-burst rainfall. The loss rates adopted are summarised in Table 1.

Table 1: Adopted infiltration parameters

Land use	Initial loss (mm)	Continuing loss (mm)	Manning's n
Pre-development			
Rural - vegetated	42.0	3.1	0.132
Post-development			
Residential lots	19	4	0.1
Residential lots <300 m^2	3	0.8	0.02
Road reserves	4.5	1.3	0.02
Schools/commercial	19	4	0.05
Public open spaces	30	5	0.03
Wetlands	19.1	2.3	0.132

2.3 Pre-development catchment storage

The pre-development site is characterised by many ridges and depressions in the topography, resulting in some catchments draining internally and storing surface water runoff within local wetlands (Figure 1). Catchment F1 has two conservation category wetlands (CCWs) that provide storage for runoff in minor storm events. The CCWs provide some attenuation in larger storm events prior to overflowing into Catchment F2. Catchment F2 also has a CCW that provides some flow attenuation.

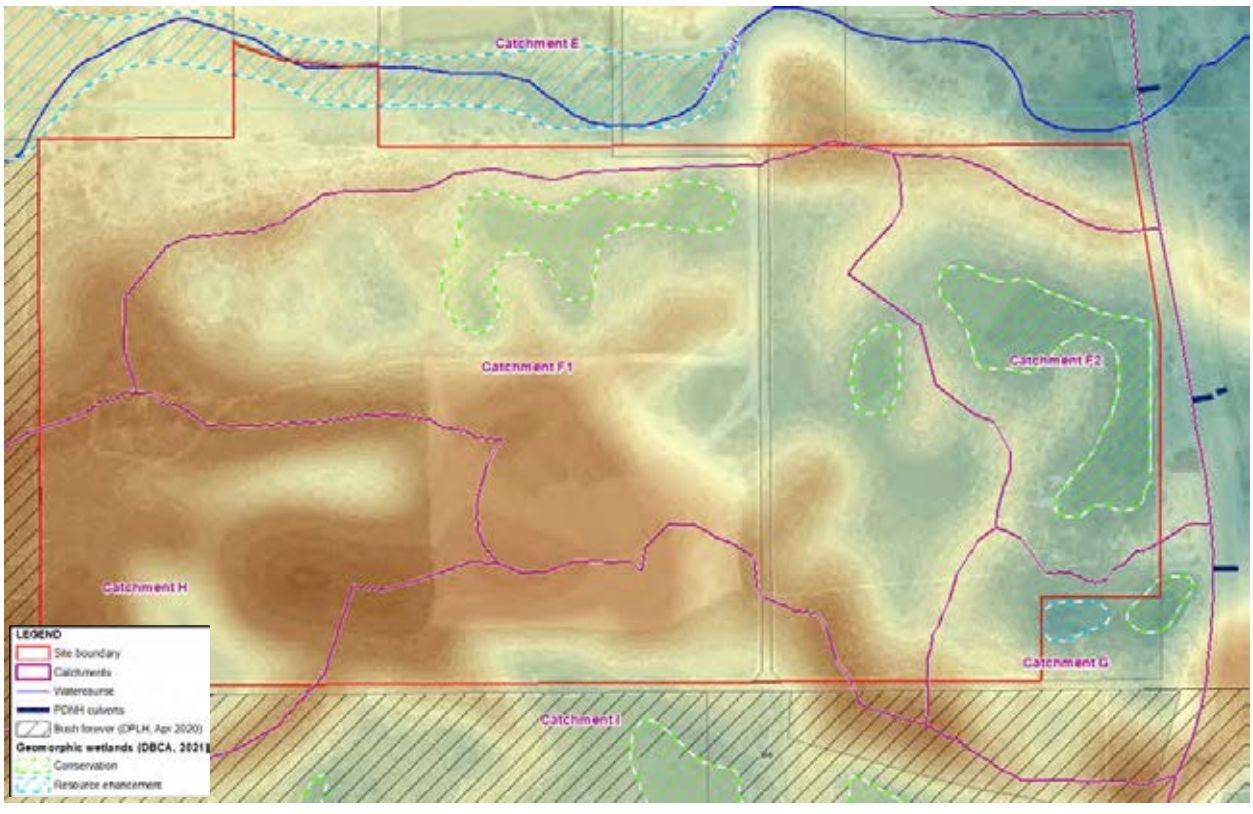


Figure 1: Pre-development catchments

Storage was modelled within Catchments F1 and F2 to simulate the attenuation provided by the CCWs and assess when the catchment overflows. The stage-storages were estimated from 5 m LiDAR data and are tabulated in Table 2 (for Catchment F1) and Table 3 (for Catchment F2).

Table 2: Catchment F1 stage-storage

Depth (m)	Area (ha)	Storage volume (m^3)
0	0.000	0
0.1	0.027	10
0.2	0.085	63
0.3	0.154	181
0.4	0.226	370
0.5	0.343	652
0.6	0.418	1032
0.7	0.482	1482
0.8	0.557	2000
0.9	0.629	2593
1	0.726	3270
1.1	0.835	4050
1.2	0.960	4947
1.3	1.114	5983
1.4	1.273	7175
1.5	1.733	8672

Catchment F1 modelled invert was 47 mAHD

Table 3: Catchment F2 stage-storage

Depth (m)	Area (ha)	Storage volume (m^3)
0	0	0
0.1	0	0.1
0.2	0.005	2.0
0.3	0.274	107

Catchment F2 modelled invert was 45.3 mAHD

2.4 Catchment F1 to Catchment F2 overflow

In the 20% AEP event, Catchment F1 drains internally, retaining all runoff on site. Overflow to Catchment F2 occurs in the 1% AEP event. The overflow path has been modelled as a natural channel. The channel profile, taken as a cross-section from 5 m LiDAR, is shown in Table 4. A manning's n of 0.132 was adopted for the channel, reflecting the heavy vegetation in the existing landscape. The overflow invert is assumed to be approximately 48.5 mAHD.

Table 4: Catchment F1 to Catchment F2 natural channel profile

Chainage (m)	Stage / elevation (mAHD)
0.00	50.95
4.36	50.70
8.73	50.58
13.09	50.39
17.46	50.16
21.82	49.94
26.19	49.74
30.55	49.55
34.92	49.37
39.28	49.20
43.65	49.11
48.01	49.00
52.38	48.86
56.74	48.74
61.11	48.63
65.47	48.51
69.84	48.39
74.20	48.28
78.57	48.19
82.93	48.13
87.30	48.09
91.66	48.08
96.03	48.12
100.39	48.21
104.76	48.31
109.12	48.40
113.48	48.44
117.85	48.50
122.21	48.67
126.58	48.86
130.94	49.13
135.31	49.37
139.67	49.57
144.04	49.65
148.40	49.74
152.77	49.94
157.13	50.11
161.50	50.14
165.86	50.35
170.23	50.54
174.59	50.71

2.5 Post-development wetland storage

Post-development catchments are shown in Figure 2. Three of the catchments contain CCWs that form part of the stormwater drainage management strategy, providing storage and attenuation of flows.

Storage was modelled within the wetlands to simulate the attenuation provided by the CCWs, and assess wetland flood levels and when the wetland overflows. The stage-storages were estimated from 5 m LiDAR data and are tabulated in Table 5 (for the Catchment 4 CCW) and Table 6 (for the Catchment 11 CCW). The Catchment 10 CCW is the same as what was modelled for the pre-development Catchment F2 (Table 3).

Overflow from the Catchment 4 CCW to the Catchment 11 CCW will be by a set of box culverts 0.3 m high by 8.4 m wide with an upstream invert of 49.4 mAHD. These culverts were sized to ensure that the 1% AEP flood level in the Catchment 4 CCW is below 49.7 mAHD, providing a 300 mm clearance to the road.

There are no changes to the overflow from the Catchment 11 CCW to the Catchment 10 CCW. This has been modelled in the same way as the pre-development Catchment F1 to Catchment F2 overflow as described in Section 2.4.

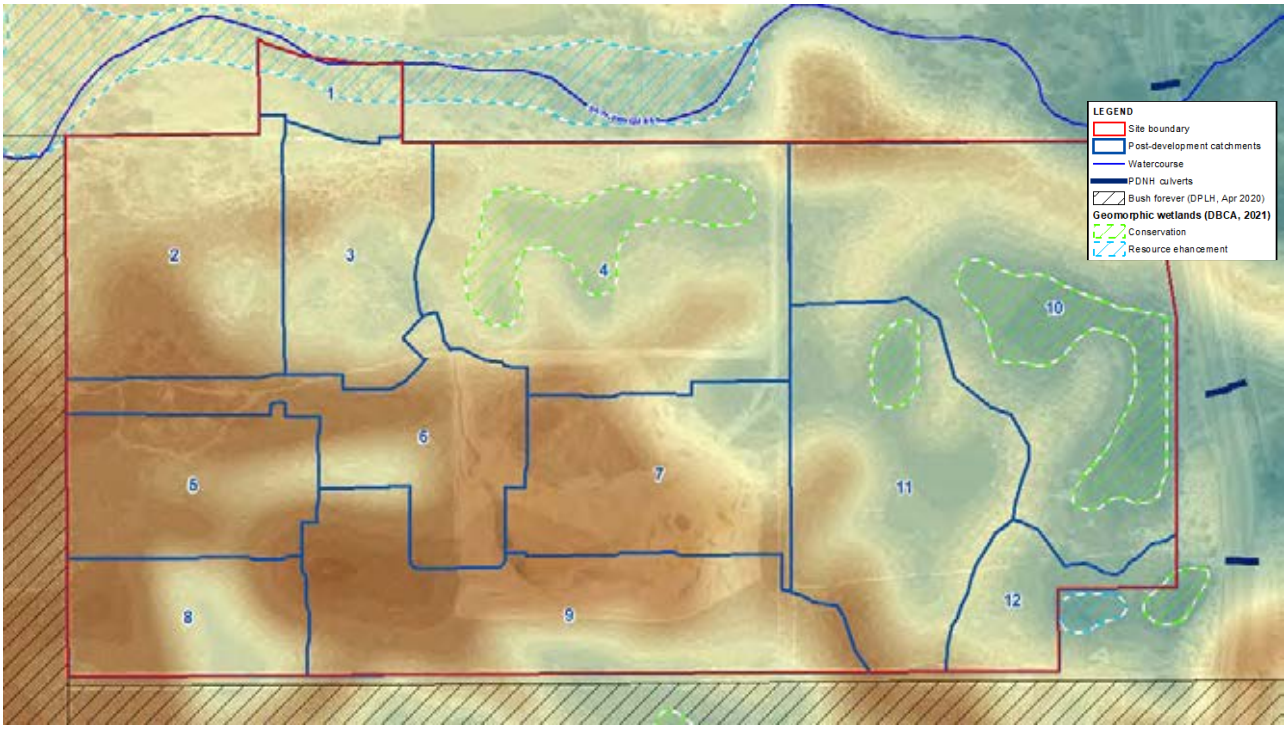


Figure 2: Post-development catchments

Table 5: Catchment 4 CCW stage-storage

Depth (m)	Area (ha)	Storage volume (m^3)
0	0.010	0
0.1	0.466	230
0.2	0.713	823
0.3	0.931	1645
0.4	1.147	2685
0.5	1.359	3939
0.6	1.580	5409
0.7	1.804	7096
0.8	2.129	9046
0.9	2.668	11429

Catchment 4 CCW modelled invert was 49.1 mAHD

Table 6: Catchment 11 CCW stage-storage

Depth (m)	Area (ha)	Storage volume (m^3)
0	0.033	0
0.1	0.081	70
0.2	0.149	184
0.3	0.235	374
0.4	0.343	665
0.5	0.421	1048
0.6	0.491	1505
0.7	0.562	2034
0.8	0.640	2633
0.9	0.735	3315
1	0.848	4106
1.1	0.969	5013
1.2	1.123	6057
1.3	1.290	7259
1.4	1.758	8748
1.5	2.444	10812
1.6	3.415	13804
1.7	4.114	17572
1.8	4.879	22050
1.9	5.870	27411

Catchment 11 CCW modelled invert was 47.1 mAHD

2.6 Basin infiltration rates

The following infiltration rates were adopted to account for infiltration within stormwater storages:

- 0 mm/hr in wetlands

- 80 mm/hr (~2 m/day) in Catchment 1 swale
- 125 mm/hr (3 m/day) in all other basins located in S8 sand (as per the regional surface geology mapping).

These rates are considered conservative and will have to be refined as detailed design progresses and site geotechnical investigations are undertaken.

3 References

RPS 2019, *Flood modelling report – North Ellenbrook*, prepared for Lendlease, report ref. EWP18103.007 Rev 0, 17 December 2019.

Appendix 4
North Ellenbrook Document Review (Pracsys)

pracsys.

STOCKLAND PTY LTD

North Ellenbrook Document Review

March 2022

Document Control				
Document Version	**Description**	**Prepared By**	**Approved By**	**Date Approved**
v 1.0	Draft Review	Reid Quekett	Dawson Demassiet-Huning	25.02.2022
v 2.0	Final Review	Reid Quekett	Dawson Demassiet-Huning	04.03.2022

CONTENTS

1 BACKGROUND

Pracsys has been engaged by Stockland Pty Ltd to conduct a review of the appendix documents of the Draft North Ellenbrook (West) District Structure Plan (DSP)[1], and to report on any conflicts and alignments between these appendices and the proposed urbanisation of Lot 5892 Maralla Road in North Ellenbrook. The review will be provided in support of the inclusion of Lot 5892 as an amendment to the DSP.

1.1 Proposed Development

The concept plan for Lot 5892 has identified the potential to develop 2,253 residential dwellings supporting approximately 6,759 residents, a primary school, a local activity centre, an interchange for Tonkin Hwy and a significant amount of public open space, while preserving wetlands (Figure 1).

An economic and social analysis has indicated this development will be economically sustainable, creating population-driven employment opportunities in the City of Swan and providing labour force for the strategic Bullsbrook Freight and Industrial Zone.

1.2 Review Layout

The following sections provide an understanding of the economic and social assessment that was undertaken in support of the DSP amendment and assesses the findings against the DSP appendices. The structure of the review is as follows:

- Summary of the Economic and Social Assessment Report
- Overview and comparison with the Industrial Land Assessment
- Overview and comparison with the Residential Needs Study
- Overview and comparison with the Activity Centre and Employment Strategy

The comparisons include a summary of the main findings from each DSP document, a summary of how the urbanisation of Lot 5892 aligns with the relevant document and a tabular comparison of key points that demonstrate the suitability of amending the DSP to include Lot 5892.

[1] https://dplh.wa.gov.au//DepartmentofPlanningLandsHeritage/media/Documents/Information_services/District%20and%20Regional%20Planning/District%20structure%20plans/DSP_N_Ellenbrook_North-Ellenbrook-West-District-Structure-Plan.pdf

Figure 1. Proposed Development

Source: CDP Town Planning and Urban Development 2021

2 ECONOMIC AND SOCIAL ASSESSMENT SUMMARY

An economic and social assessment has been prepared to provide a rationale to support the inclusion of Lot 5892 Maralla Road in North Ellenbrook as an amendment to the current Draft District Structure Plan.

The following section outlines the key economic and social justification for the urbanisation of Lot 5892. The remaining sections provide a comparison of the economic and social assessment with the appendix documents of the current Draft District Structure Plan to address the suitability of the inclusion of Lot 5892 as part of the DSP.

2.1 Labour Force for Bullsbrook Freight and Industrial Zone

The North-East Sub-Region has an employment self-sufficiency (ESS)[2] target of 85.8% for 2050, above the level estimated in 2011 of 80.3%. To increase the level of ESS in the area, the North-East Sub-Region needs to accurately plan the distribution of future population in proximity to strategic employment centres, such as the Bullsbrook Freight and Industrial Zone.

Analysis indicates that the population forecasts for the area proximate to the Bullsbrook Freight and Industrial Zone will be inadequate to support the labour force needs of the centre at full build-out. In total, it is estimated the area will require an additional 16,759 residents above current projections to support strategic employment at full build-out. The urbanisation of Lot 5892 will support development at the Bullsbrook Freight and Industrial Zone by providing an additional 6,759 residents proximate to the industrial zone that in turn will support the City achieving its ESS target (Figure 2).

Figure 2. City of Swan Employment Self-Sufficiency with and without Urbanising Lot 5892

Indicator	Scenario without Urbanising Lot 5892	Scenario with Urbanising Lot 5892
Population	243,939	250,698
Labour Force	123,121	126,434
Employment Self-Sufficiency	**85.0%**	**85.1%**
Jobs	104,611	107,633
Population-Driven Employment	74,650	76,662
Strategic Employment	29,962	30,972

Source: ABS Census 2016, Forecast ID 2021, Pracsys 2021

Figure 2 demonstrates that urbanisation of Lot 5892 will enable the required labour force to live in proximity to the strategic Bullsbrook Freight and Industrial Zone, helping to achieve the City's ESS goal and facilitate timely development of the strategic industrial area.

[2] ESS represents the ratio of local jobs to residents and an increase demonstrates that employment growth is outpacing labour force growth in the area

2.2 Community Infrastructure

The analysis has identified that including Lot 5892 in the DSP will help to support the development of a range of community infrastructure in North Ellenbrook. Parks and Leisure Australia provides population guidelines for the development of community infrastructure. The current 30,000 residents proposed for North Ellenbrook East and West do not meet or only just meet the population guidelines for a range of community infrastructure, including:

- Maternal and Child Health Services
- Indoor Sports and Recreation Centre
- Lawn Bowls Centre
- Aquatic Facilities – Indoor/Outdoor

Urbanisation of Lot 5892 will provide an additional 6,759 residents in North Ellenbrook and this will help to support the development and viability of community infrastructure, improving liveability outcomes for the whole of North Ellenbrook.

2.3 Additional Economic and Social Benefits

Urbanisation of Lot 5892 is associated with a number of liveability and economic outcomes. Social and Economic benefits that are associated with incorporating Lot 5892 in the DSP include:

- Proximity and access to strategic employment centres for future residents reducing Vehicle Travel Time and Vehicle Operating Costs
- Improved housing affordability due to the reduced earthworks costs
- Proximity and access to transport links including major State investment in METRONET
- Increased retail expenditure in North Ellenbrook supporting local shopping centres
- Support for already approved developments in North Ellenbrook

For the reasons mentioned above, inclusion of Lot 5892 in the DSP is considered economically and socially beneficial for the City of Swan and wider North-East Sub-Region.

3 INDUSTRIAL LAND ASSESSMENT

3.1 Document Overview and Findings

The Industrial Land Assessment (ILA) was carried out by Lucid Economics on behalf of Parcel Property and aimed to assess whether the land in North Ellenbrook outlined in the DSP would be needed for future industrial use. The document looked at future industrial supply and demand studies for the area, including:

- Industrial Land Needs Study (June 2008)[3]
- Economic and Employment Lands Strategy (EELS) (April 2012)[4]
- Economic and Employment Land Monitor (April 2015)[5]
- North-East Sub-regional Planning Framework (March 2018)[6]

After review of these documents, the ILA concludes that based on historical evidence and industrial land market fundamentals, demand for industrial land in smaller and less-developed areas of the North-East Sub-Region (NESR) may take longer to be realised compared to the studied projections.

The ILA concludes that Industrial land demand in the very near term will be supported by developments in Hazelmere, Forrestfield, and Malaga, and that the strategic industrial locations at the Bullsbrook Freight and Industrial Zone (2650 ha) and Muchea Industrial Park (1,1150 ha) will be key to supporting much of the future industrial land demand in the NESR. The ILA concluded that the 270 ha of land in the DSP would not be required to support industrial land demand and would be more suited to the uses proposed in the DSP.

3.2 Project Alignment

The inclusion of Lot 5892 as an amendment to the North Ellenbrook West DSP is supported by the main points of the Industrial Land Assessment. The key takeaway of the Assessment is that there is sufficient industrial land in the NESR to support identified demand and that the Bullsbrook Freight and Industrial Zone, positioned directly alongside the proposed North Ellenbrook development, will be a key strategic employment centre for the greater North-East Sub Region into the future. Lot 5892 is perfectly positioned to support this key industrial area by supplying local residents who are able to take full advantage of the emerging employment hub at their doorstep.

The Bullsbrook Freight and Industrial Zone will create a significant amount of strategic employment opportunities. The Economic and Social Assessment supporting the amendment to include Lot 5892 in the DSP estimates the level of employment created by the area at 43,000 jobs, 18,700 of which being strategic

[3] https://www.water.wa.gov.au/__data/assets/pdf_file/0003/5196/90263.pdf
[4] https://www.wa.gov.au/system/files/2021-07/EELS_Report.pdf
[5] https://www.wa.gov.au/system/files/2021-07/EELS_monitor.pdf
[6] https://www.dplh.wa.gov.au/getmedia/0c8b1bf4-5fc7-4bd0-946f-156cb78016d3/FUT-PP-North-West_Sub_Region_March2018

based on benchmarking with the employment mix of similar areas. This is a conservative figure compared to the estimate of 50,000 employment opportunities provided by Macroplan to support the DSP.

Taking both estimates as a range of possible employment opportunities created by the Bullsbrook Freight and Industrial Zone and comparing this with estimates of labour supply growth in the employment catchment area[7], it can be shown that there remains an oversupply of between 2,559 and 5,635 strategic employment opportunities compared to residential population (Figure 3). Unless further population can be supported proximate to the Industrial Zone, labour will be sourced from outside the City of Swan, reducing the City's capacity to meet employment self-sufficiency (ESS) and increasing strain on road infrastructure.

Figure 3. Employment Requirements for Catchment Population Growth

Employment Scenarios	Employment	Strategic Employment	Strategic Employment Labour from Population Growth	Additional Strategic Jobs
Pracsys Estimation	42,945	18,728	16,169	2,559
Macroplan Estimation	50,000	21,804	16,169	5,635

Source: DPLH 2016, ABS 2016, WA Tomorrow 2021, Macroplan 2019

Enabling local strategic employment opportunities to be filled by local residents requires further residential development in the area. It is estimated the 6,759 residents at Lot 5892 will fill 1,010 strategic employment opportunities at the Bullsbrook Freight and Industrial Zone that would otherwise be imported from other LGAs. Providing the opportunity for workers to live close to their place of employment is a key strategic objective for both State and Local governments. The proposed amendment to include Lot 5892 as part of the North Ellenbrook West DSP aligns with the findings of the ILA.

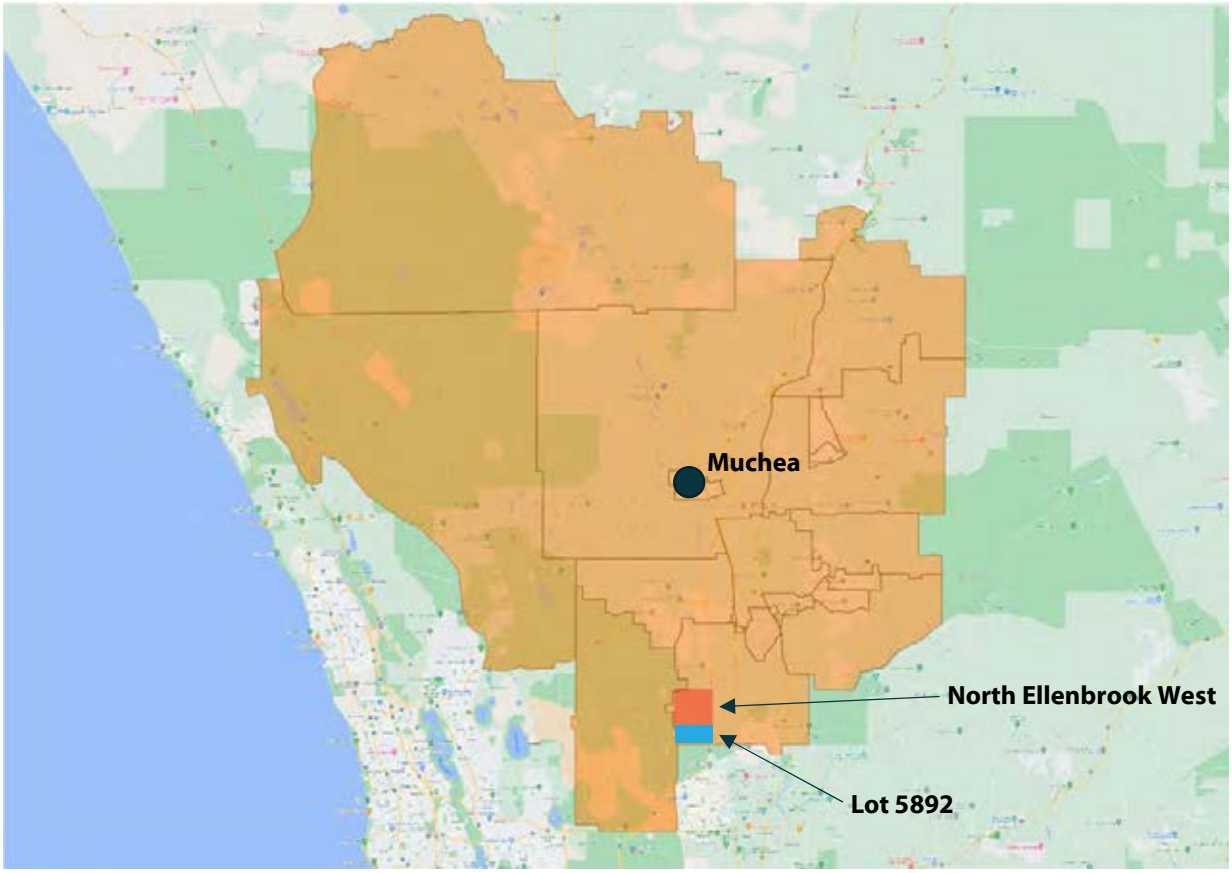
3.3 Specific Alignments

Key points	Alignment
The EELS and Northeast Sub-regional Planning Framework (NESRPF) overestimates future industrial land demand.	Much of the likely future industrial demand will come from Bullsbrook Freight and Industrial Zone which is further developed than other areas. Lot 5892 will not reduce industrial land supply in this area and will provide additional residents to fill the employment opportunities available.
Given the overestimate of future industrial demand and considerable industrial supply in Muchea and Bullsbrook Freight and Industrial Area, 270ha of North Ellenbrook will not be required for industrial use.	There will be an oversupply of 2,559 to 5,635 strategic employment jobs in the Bullsbrook Freight and Industrial Area. The addition of Lot 5892 to North Ellenbrook West DSP will fill 1,010 strategic jobs, contributing to ESS targets.

[7] Section 4.3 in the North Ellenbrook DSP Amendment Economic & Social Assessment

Key points	Alignment
Muchea Industrial Park land area (1,150ha) not included in NESRPF and can accommodate considerable industrial demand.	Muchea industrial land's labour demand is not considered in the analysis of urbanising Lot 5892. If Muchea industrial park land area is included, then more strategic employment is created nearby with an employment catchment including North Ellenbrook (Figure 4). If any of the residents of North Ellenbrook are employed in Muchea, then more residents are needed to support the Bullsbrook Freight and Industrial Area. This supports the inclusion of Lot 5892 as part of the DSP to accommodate the required residential population.
Industrial developments in Bullsbrook and Muchea are very advanced and will be able to provide supply for likely all of the future demand for industrial land in the North-East Sub-region.	The Bullsbrook Freight and Industrial Area will require expanded residential capacity at both the DSP area and Lot 5892. This residential capacity will enable workers to live in proximity to their place of employment, support industrial strategic employment and contribute to meeting the ESS targets in the City of Swan.

Figure 4. Muchea 16.2km employment SA1 catchment



Source: QGIS 2022, ABS 2016

4 RESIDENTIAL NEEDS STUDY

4.1 Document Overview and Findings

The Residential Needs Study (RNS) was conducted by Urbis on behalf of Parcel Property and aimed to assess the opportunity for North Ellenbrook to help meet future housing needs in the wider North-East Corridor. The study used population growth forecasts published by WA Tomorrow and forecast.id to determine whether the current pipeline of dwelling supply would be able to meet the needs of the future population in the region.

The study found that there is expected to be strong population growth and housing need in the North-East Corridor over the coming decades, and the vast majority of this growth is expected to be accommodated within the greenfield areas between Dayton and Bullsbrook, identified as the Sub-Region in the RNS.

The RNS identified dwelling projections in the City of Swan that estimated an increase of 63,500 over the 2016 to 2050 period. As the State Government has set a target of 21,690 additional infill dwellings over this period, the RNS identified a need to accommodate approximately 42,000 greenfield dwellings in new urban areas in the City over the 2016 to 2050 period. The RNS indicated the infill targets as ambitious meaning there could be a requirement for more than 42,000 greenfield dwellings.

The RNS identified there are limited opportunities for new greenfield developments in the rest of the North-East Corridor with major constraints for some identified development areas. The RNS concluded that the Sub Region, and specifically the North Ellenbrook DSP, will play a major role in meeting the North-East Corridor's greenfield housing needs.

4.2 Project Alignment

The Residential Needs Study (RNS) recommendation to expand greenfield development capacity in the City of Swan, specifically in the identified sub-region, is aligned with the inclusion of Lot 5892 as part of the North Ellenbrook West DSP. The RNS identified that the North-East Corridor will run out of developable lot supply by 2039 without rezoning the North Ellenbrook area to allow for greenfield residential development supply. The North Ellenbrook West development should allow greenfield supply to be extended to 2050 if all identified developments proceed to their development potential. The RNS identifies that many other development areas in the North-East Corridor are either mostly developed or are constrained, which means the potential supply may not be achievable; this further supports the need for supply through the inclusion of Lot 5892 in the North Ellenbrook West DSP. Additionally, Lot 5892 provides supply with a high level of access to employment zones, a freeway and the planned nearby Ellenbrook Metronet service.

The RNS further highlights the importance of affordable housing and diversity of housing. The addition of Lot 5892 to the DSP will provide greater supply and potential for diversity of housing. It will also support the provision of affordable residential housing in the area due to the designed extraction limits for mining

operations on the lot. The excavation level currently provides greater than the 2-metre clearance above historic groundwater level necessary for urban or industrial development. This means that urban development of this land can be achieved without the need for imported fill, reducing earthwork costs from the $20,000-$25,000 currently in Brabham, Henley Brook and Bennett Brook to approximately $5,000 per lot, saving $20,000 in building costs.

The amendment to include Lot 5892 as part of the North Ellenbrook West DSP aligns with the RNS.

4.3 Specific Alignments

Key points	Alignment
Need more than 42,000 greenfield dwellings in the pipeline between 2016-2050 to support housing choice and affordability.	Inclusion of Lot 5892 in the DSP will provide a higher margin for error in lot supply given potential constraints identified by the RNS at other developments.
Lack of supply reduces housing affordability.	The addition of Lot 5892 to the DSP will increase the supply of available, low-cost land in the City of Swan, improving housing affordability.
Limited population aging in the Sub Region with large number of families.	The percentage of residents aged 20-49 in similar greenfield estate Ellenbrook is 48.5%, compared to Greater Perth's 43.6%. It is beneficial for an area with a high percentage of young working age people to be located in close proximity to employment such as the Bullsbrook Freight and Industrial Area. It is expected that families with working aged persons will continue to demand houses in the North Ellenbrook area, necessitating further lot supply from Lot 5892.
Need to increase house price variability in the North-East Corridor for greater diversity in housing choice.	Increasing the availability of dwellings in the region through the urbanisation of Lot 5892 will increase the potential for housing diversity. The low land prices will allow for even greater diversity through more affordable housing across all dwelling types.
There should be a short-term stock of land of at least 8 years supply in the Sub-Region to ensure adequate supply.	Addition of Lot 5892 to the DSP will increase the supply pipeline of available lots in a high demand residential area that is nearby to employment centres and local community services. It will also account for potentially constrained developable land in other areas.
Constraints on timely land supply of available lots.	Lot 5892 is owned by a single landowner and does not face many of the other land availability constraints which would hinder lot supply such as existing land uses and environmental issues.

Key points	Alignment
Larger development areas experience higher market shares and sales rates.	Lot 5892 is owned by a single landowner enabling the development to experience improved sales rates. Additionally, the inclusion of Lot 5892 to the District Structure Plan will likely support the DSP as a whole in achieving higher market share and sales rates.
Including North Ellenbrook in the supply pipeline increases the supply of lots from running dry in 2038/39 to 2049/50.	Including Lot 5892 in the North Ellenbrook DSP will help to provide a margin of error in meeting lot supply pipeline should there be constraints on any of the future developments in the NESR. Additionally, it provides the supply in a strategically desirable location that will likely experience higher demand for lots due to its proximity to key employment centres.
The notable periods of relatively lower supply coincided with high price growth (i.e. 2007-08 and 2011-12) which suggests that lower land supply can lead to lot price inflation.	Higher quality and a higher diversity of residential offerings could be made more affordable should appropriate supply be provided. Including Lot 5892 as part of the DSP provides both increased supply and lower development costs to support housing affordability.
The level of Urban and Urban Deferred land at any point in time should be adequate to ensure the short-term supply can be maintained. This should equate to at least twice the short-term supply benchmark (i.e. minimum 18,000 lots).	Lot 5892 will provide a buffer to meet lot supply requirements in a highly suitable location for residential development. This area is likely to experience higher demand for lots due to its proximity to employment, therefore higher levels of supply are warranted.

5 ACTIVITY CENTRES AND EMPLOYMENT STRATEGY

5.1 Document Overview and Findings

The Activity Centres and Employment Strategy study was conducted by Urbis on behalf of Parcel Property. It assesses the provision of future activity centres in and around the North Ellenbrook West site and provides guidance for realising positive economic outcomes through the development.

Commercial and community infrastructure are commonly located at Activity Centres and are supported by the population within an Activity Centre's catchment. The North Ellenbrook East and West District Structure Plans include the development of a number of Activity Centres to support the proposed 30,000 residents in the area (Figure 5).

Figure 5. Proposed Activity Centre Hierarchy for North Ellenbrook East and West

Proposed Centres	Location	Floorspace (m^2 of NLA)[8]
District Centre	North Ellenbrook West	32,000m^2
Neighbourhood Centre	North Ellenbrook West	7,000m^2
Neighbourhood Centre	North Ellenbrook East	3,300m^2
Local Centres	North Ellenbrook East & West	1,200m^2

Source: Urbis 2020

The Strategy demonstrates that the existing urban residential land in the areas surrounding the North Ellenbrook West DSP will support the viability and growth of existing centres; the North Ellenbrook West DSP's population would provide a net increase in retail expenditure to existing centres and support future centres incorporated within the North Ellenbrook West DSP. The strategy identifies population growth within the subject site through the rezoning of North Ellenbrook West and any associated retail spending leakage would support the expansion of regional employment centres earlier than envisaged.

The Strategy also considered a number of other commercial centres and community facilities identified as part of the North Ellenbrook West DSP to support the planned population. These are critical in providing the expected liveability for a new development and will contribute to the uptake of lots in the DSP (Figure 6).

Figure 6. North Ellenbrook (West) Non-Retail Uses

Non-Retail Use	Estimated Capacity at North Ellenbrook (West)
Medical and Allied Health Services	3,300m^2
Child Care Centres	1,900m^2

[8] NLA is Net Lettable Area

Non-Retail Use	Estimated Capacity at North Ellenbrook (West)
Suburban Offices	950m^2
Private Entertainment and Recreation Uses	2,800m^2
Service Industry	12,000m^2
Primary School	4
Secondary School	1
Multi-Purpose Community Centre	1
Sub-District Recreation Facility	1

Source: Urbis 2020

The Employment Strategy component of the document provides objectives and actions to support delivery of the DSP. The strategy highlights four key objectives:

- Maximising access to local employment opportunities within the North-East corridor
- Delivering required infrastructure and services in a timely manner to catalyse private sector investment and support liveability
- Attracting private sector investment in urban and business development projects
- Delivering a diversity of housing options that meet the needs of residents with different lifestyles and life stages

These objectives guide the strategies action plan for facilitating positive economic outcomes through development of the North Ellenbrook West DSP, highlighting the key roles for both private and public stakeholders in achieving the desired outcomes.

5.2 Project Alignment

The proposed development at Lot 5892 will provide an additional 6,759 residents,[9] a primary school, and a local centre to the North Ellenbrook area, supporting the viability of the larger centres in North Ellenbrook West and the wider Sub-Region (Figure 8).

The inclusion of Lot 5892 as a part of the North Ellenbrook West DSP will provide a net contribution towards the activity centres identified in the DSP. This means that Lot 5892 will generate demand for commercial and community services above what is planned to be developed at the lot. This will improve the viability of commercial and community uses in North Ellenbrook West and reduce the potential for impacts from the DSP's proposed centres on existing activity centres.

The additional residents of the proposed development at Lot 5892 will be serviced by a small 1,500m^2 – 5,000m^2 Local Activity Centre to provide for the daily shopping needs of residents (Figure 8). The expenditure generated by the residents will be greater than what is required by a local centre to be viable, even if all

[9] Based on an expected average three (3) persons per dwelling

5,000m^2 was shop/retail floorspace.[10] The effect will be to create additional demand at the North Ellenbrook West District and Neighbourhood centres, and at existing centres. This aligns with Draft State Planning Policy 4.2 (Draft SPP4.2) objectives of maintaining the priority of an activity centre hierarchy. Local centres are meant to provide for the daily shopping needs of residents with higher order centres providing for more weekly goods and service needs as well as a greater diversity of employment. The proposed uses on Lot 5892 respect the Draft SPP4.2 requirements for activity centre hierarchy and will contribute to greater vibrancy and viability of higher order centres both in the DSP and those that already exist (i.e. Ellenbrook Secondary Centre).

The Strategy provides benchmarks for the provision of commercial and community facilities to support residential population. The identified uses were relevant to North Ellenbrook West only with detailed breakdown of some uses at North Ellenbrook East not available and therefore not included (Figure 7). The development of Lot 5892 will improve the ratio of persons per facility in North Ellenbrook West, contributing to greater viability.

Figure 7. Capacity for Non-Retail Uses, North Ellenbrook (West)

Non-Retail Use	Benchmark persons per m^2	Estimated Capacity at North Ellenbrook	Persons per m^2	With Lot 5892
Medical and Allied Health Services	5 - 7	3,300m^2	4.1	6.1
Child Care Centres	8 - 13	1,900m^2	7.1	10.6
Suburban Offices	2 - 20	950m^2	14.2	21.3
Private Entertainment and Recreation Uses	3 - 7	2,800m^2	4.8	7.2
Service Industry	0.5 - 2	12,000m^2	1.1	1.7
Non-Retail Use	**Benchmark per unit**	**Provision within North Ellenbrook**	**Population/ Dwellings per unit**	**With Lot 5892**
Primary School	1,500 dwellings	4	1,125 dwellings	1,351 dwellings[11]
Secondary School	6,500-7,000 dwellings	1	4,500 dwellings	6,753 dwellings
Multi-Purpose Community Centre	25,000 persons	1	13,500 persons	20,259 persons
Sub-District Recreation Facility	25,000-50,000 persons	1	13,500 persons	20,259 persons

Source: DPLH Land Use and Employment Survey; Community Infrastructure Plans (misc.); Urbis 2020; Pracsys 2022

The current plan for North Ellenbrook West predicts a total population of between 12,000 and 13,500 people, making up a total 4,000 to 4,500 dwellings at full buildout. The Residential Needs Study expects development

[10] A local centre will generally support a variety of uses; the assumption of 100% shop/retail is hypothetical and unrealistic, it is used only to emphasise the demand created by the residential population.
[11] Including the additional primary school planned for Lot 5892

of lots to start between by 2026, with full buildout being completed by 2041[12]. Based on this schedule and assuming the maximum population level of 13,500 is achieved, it would take until almost 2041 for the development to meet population guidelines for a number of non-retail uses, with others failing to reach the population benchmark for supported development even once development of lots at North Ellenbrook West is complete, such as the secondary school and community centre. The urbanisation of Lot 5892 will provide additional residents in proximity to the proposed uses in North Ellenbrook West. It will be a net contributor of demand for retail and non-retail uses in the area and will reduce the timeframe for facility viability in North Ellenbrook West. Development of the lot will also support facilities in the wider Sub-Region, providing increased population nearby to Ellenbrook and Bullsbrook.

The development of Lot 5892 directly aligns with the objectives of the strategy through the following:

- Provides an increase in population proximate to the Bullsbrook Freight and Industrial Zone with a new Tonkin Hwy interchange that will maximise access to employment opportunities
- The increase in population will support infrastructure viability allowing it to be developed at an earlier date; it will also improve liveability through greater activation of centres
- The increased population will boost demand for goods and services and support business investment
- With lower land costs, Lot 5892 is able to provide all dwelling sizes at a lower cost, supporting housing affordability

The proposed amendment will provide positive net demand for retail and non-retail uses that will support the viability of commercial and community uses in North Ellenbrook and existing centres. The amendment will also contribute directly to achieving positive economic outcomes aligned to the Strategy's objectives. Developing Lot 5892 aligns with the North Ellenbrook West DSP.

[12] Urbis, 2020: https://www.dplh.wa.gov.au/DepartmentofPlanningLandsHeritage/media/Documents/Information_services/District%20and%20Regional%20Planning/District%20structure%20plans/DSP_N_Ellenbrook_Appendix-4-Residential-Needs-Study.pdf

Figure 8. North Ellenbrook West DSP Proposed Amendment Plan

Source: CDP Town Planning and Urban Design 2021

5.3 Specific Alignments

Key points	Alignment
Based on current observed spending patterns in the total trade area, the build out population in the main trade area is estimated to support approximately $509 million retail expenditure.	Using the Economic and Social Assessment for Lot 5892[13], it can be calculated that the extra 2,253 dwellings at Lot 5892 will conservatively provide an additional $52.5 million in retail spending to support activity centre viability. Even if all of the proposed 5,000m^2 local centre was retail, it would only require a maximum of $46 million to be viable.[14] This means there will be a minimum net increase in expenditure of $6.5 million for other centres.
The degree to which the service commercial uses can be accommodated within North Ellenbrook (West) will be influenced by the development within the industrial areas to the north and within the Ellenbrook town centre.	The development at Lot 5892 will also influence and increase the viability of these services in North Ellenbrook West.
A turnover impact assessment was not undertaken given the early stage of development of competitive centres, uncertain timing of the proposed centres and given this assessment does not propose any changes that would undermine the planned/existing hierarchy. Furthermore, a retail impact assessment is not a requirement of a district structure plan as per SPP 4.2.	Development at Lot 5892 will mitigate the potential impact of any development in North Ellenbrook West by providing a net increase in expenditure to support the activity centre hierarchy.
The development of the subject site will support ongoing employment opportunities locally and support existing and planned employment centres in the wider area (such as the industrial areas to the north). Based on estimated non-residential uses and a moderate home-based worker estimate, the subject site is expected to accommodate approximately 1,300 jobs.	Residential development in Lot 5892 will support existing employment centres and will support the viability of centres in North Ellenbrook West, making it a more vibrant place and increasing community sustainability.

[13] $448 dollars per week average household retail expenditure

[14] Based on the average of the ACES estimate for Supermarket and other Shop Retail productivity ($/m^2) of $10,000m^2 and $8,500m^2. A local centre will generally support a variety of uses; the assumption of 100% shop/retail is hypothetical and unrealistic, it is used only to emphasise the demand created by the residential population.

Key points	Alignment
Strategic objectives: 1. Maximise access to local employment opportunities within the North-East corridor. 2. Deliver required infrastructure and services in a timely manner to catalyse private sector investment and support liveability. 3. Attract private sector investment in urban and business development projects. 4. Deliver a diversity of housing options that meet the needs of residents with different lifestyles and life stages.	Lot 5892 directly align with the objectives of the strategy through the following: 1. Providing an increase in population proximate to the Bullsbrook Freight Industrial Zone with a new Tonkin Hwy interchange will maximise access to employment opportunities 2. The increase in population will support infrastructure viability allowing it to be developed at an earlier date; it will also improve liveability through greater activation of centres 3. The increased population will boost demand and support business investment 4. With lower land costs[15] Lot 5892 is able to provide all dwelling sizes at a lower cost, supporting housing affordability
Deliver frequent public transport services in a timely manner in this growth area.	Increased residential population in the area will support frequency and economic viability of public transport.
Support coworking space development, business networking and support services.	6,759 more people in residential developments at Lot 5892 will provide more people in the labour force, including persons who run their business from home and entrepreneurs. These persons will contribute to supporting shared spaces and services.
Support liveability through development of recreation, entertainment, leisure, health and retail amenities and services.	The additional population provided by Lot 5892 with limited competing offering (a local centre) will increase the viability of theses uses in North Ellenbrook West.
Advocate for state and federal government funding for key hard and soft infrastructure.	Increased population will reduce the cost per person of infrastructure development and site servicing and improve the argument for infrastructure funding.

[15] Due to lower earthworks costs as highlighted in section 3.2

Key points	Alignment
Support the attraction of private education providers to North Ellenbrook.	There is one primary school and no secondary school planned for Lot 5892. The 6,759 increase in residents will boost demand for private primary and secondary schools in the North Ellenbrook West development, making private education provision more attractive.
Identify and target strategic businesses and services to establish in the District Centre.	Increasing the population serviced by the planned North Ellenbrook West District Centre will increase the attractiveness of the centre for a wider range of business and services, supporting the viability of operators at the Centre.

Appendix 5
Transport Impact Assessment Addendum

Engineering a better future for over 20 years!

North Ellenbrook (West) DSP Amendment

Transport Impact Assessment Addendum

PREPARED FOR:
Stockland

July 2023

Document history and status

Author	Revision	Approved by	Date approved	Revision type
R White	r01	B Bordbar	14/03/2022	
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Author: Robin White

Project manager: Behnam Bordbar

Client: Stockland

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REPORT FIGURES

1 Introduction

1.1 Background

The approved North Ellenbrook (West) and North Ellenbrook (East) District Structure Plans (DSP) propose to rezone land north of Ellenbrook for future urban development.

Stockland are proposing an Amendment to the North Ellenbrook (West) DSP to include an additional property (Lot 5892 Maralla Road) on the southern side of that DSP area. This property will be referred to as the DSP Amendment area or Lot 5892 in this report.

1.2 Scope of this report

A Transport Impact Assessment (TIA) report[1] was previously prepared for the North Ellenbrook (West) DSP in January 2021. A North Ellenbrook West DSP TIA Addendum 1 (dated 20 July 2022) was subsequently prepared to address the changes between the draft and final (approved) versions of the North Ellenbrook (West) DSP.

This new report is therefore presented as an Addendum to that 2021 TIA report and July 2022 Addendum 1 to document the changes resulting from the proposed DSP Amendment to include Lot 5892 into this DSP area.

This TIA Addendum is therefore structured under the same section headings as the 2021 TIA report and should be read in conjunction with that 2021 TIA report and July 2022 Addendum 1.

[1] Proposed District Structure Plan, Various Lots for North Ellenbrook West, City of Swan – Transport Impact Assessment (Final-Rev1, January 2021, DVC)

2 Existing Site Conditions

2.1 Location

The North Ellenbrook (West) DSP area is located immediately west of Tonkin Highway and northwest of the existing Ellenbrook townsite. Lot 5892 is located immediately south of this DSP area, as shown in **Figure 1.** This figure shows the site location in relation to zones and reservations in the Metropolitan Region Scheme (MRS).

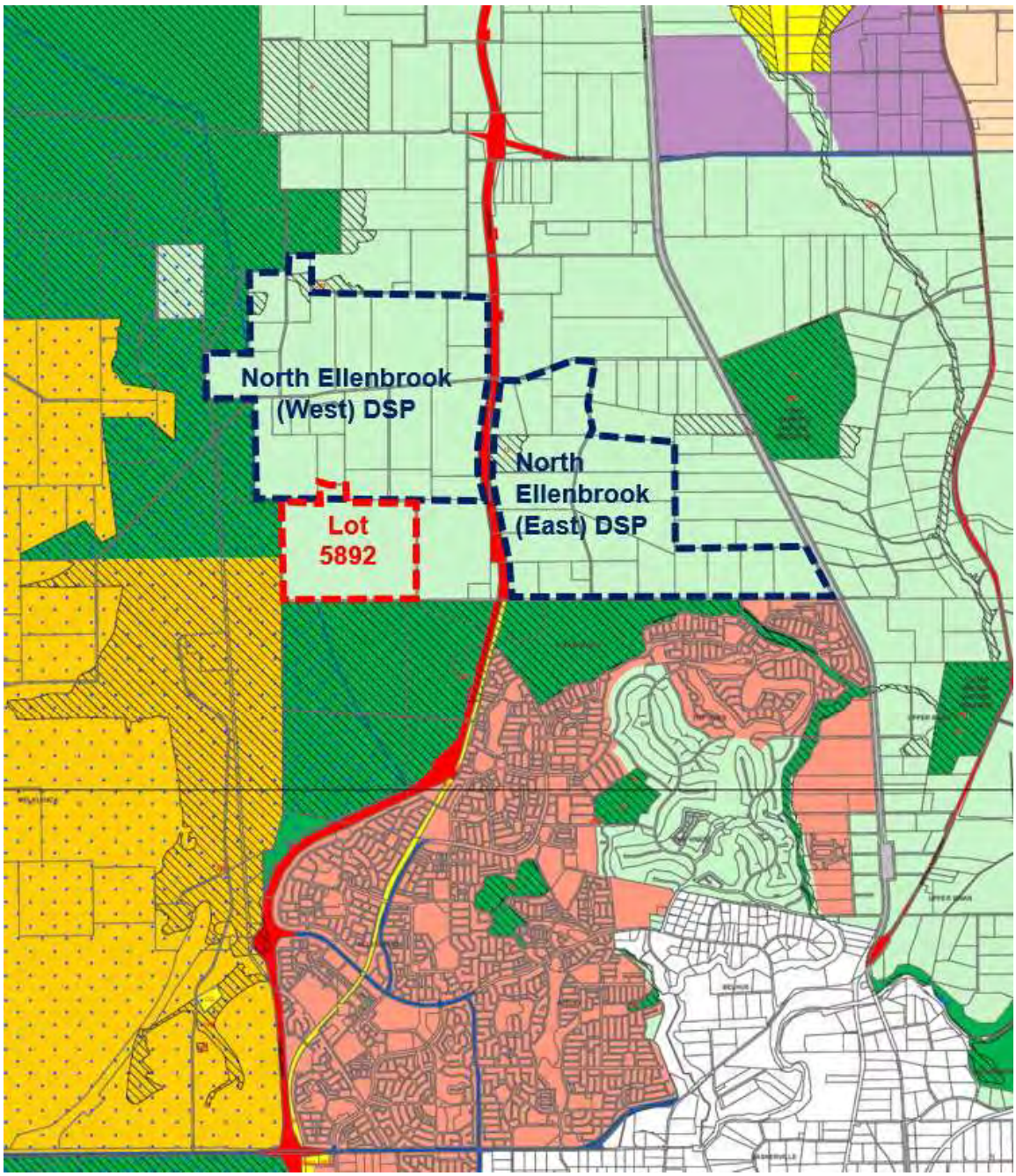


Figure 1: Site Location

2.2 Current land uses

Lot 5892 is currently zoned Rural under the MRS, as shown in **Figure 1**.

Lot 5892 is undeveloped land apart from an area in the southeast quadrant where sand extraction is currently occurring with access from Halden Road on the eastern side of this property.

Figure 2: Existing Land Use

2.3 Existing road network

The existing road network and its classification in the Main Roads WA functional road hierarchy is illustrated in **Figure 3**.

Lot 5892 is bounded on the eastern side and around its northeast corner by Halden Road. The southern boundary of this property is the unconstructed road reserve of Maralla Road.

Maralla Road and Warbrook Road (further to the north) were both severed on the western side of Tonkin Highway when the Highway was constructed, so the only road access currently available to Lot 5892 is northwards through the North Ellenbrook (West) DSP area via Halden Road – Warbrook Road – Raphael Road – Stock Road to the Tonkin Hwy / Stock West Road interchange 4 kilometres north of Lot 5892.

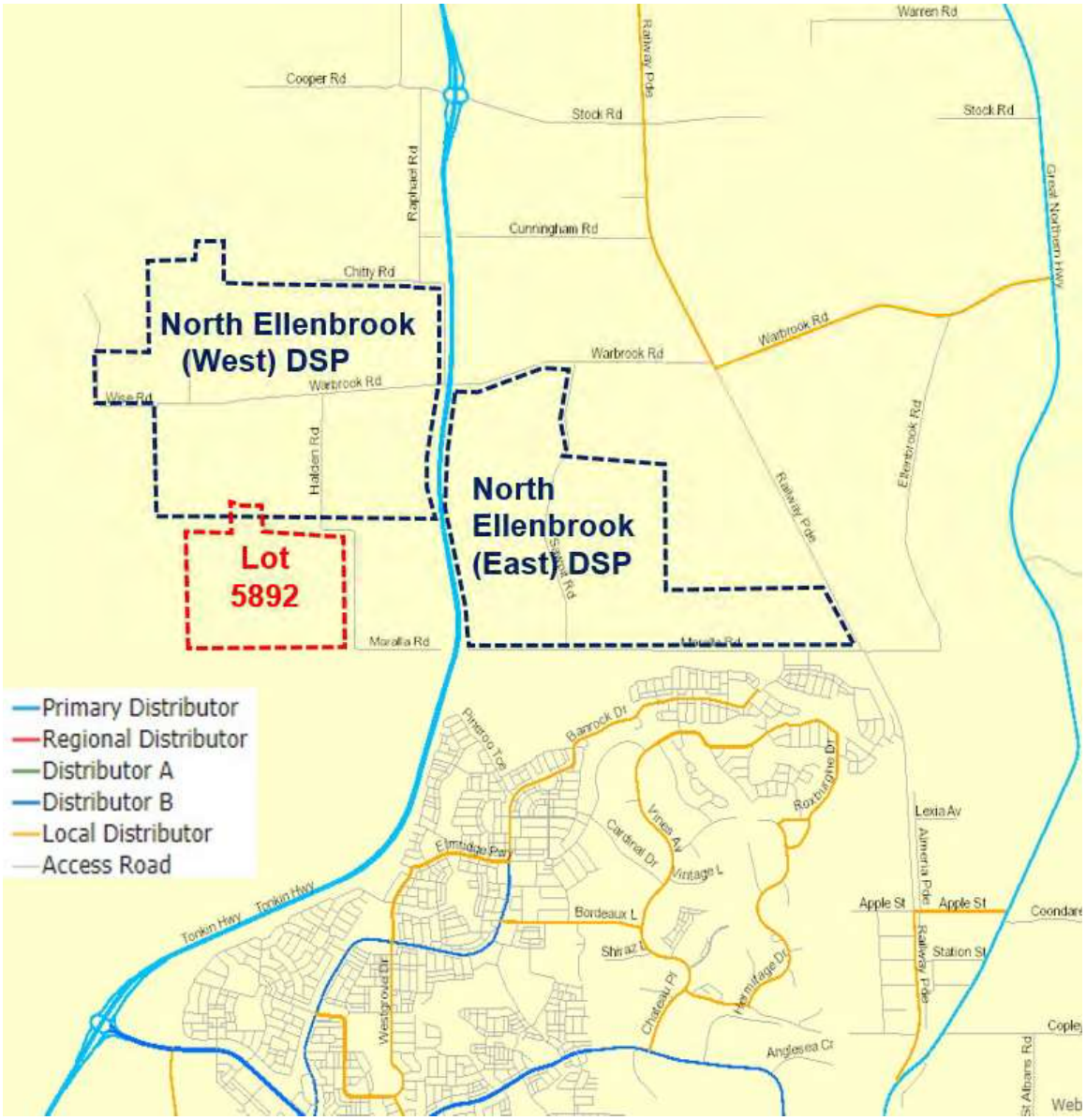


Figure 3: Existing Road Hierarchy

Halden Road is constructed as a two-lane rural road with 8.5m sealed width adjacent to Lot 5892. The bend around the northeast corner of Lot 5892 is widened and marked as two 5m traffic lanes and 1-metre sealed shoulder width on both sides.

2.4 Planned changes to the road network

Refer to section 2.4 of the 2021 TIA report.

3 District Structure Plan Amendment

3.1 Proposed development

The 2021 TIA report indicates the North Ellenbrook (West) DSP area is anticipated to accommodate approximately 4,500 dwellings, 106 hectares of industrial / service commercial land, one high school, three primary schools, a district centre and a neighbourhood centre.

The proposed DSP Amendment plan is included at **Appendix A** of this Addendum report and the proposed cell structure plan for the DSP Amendment area is included at **Appendix B**.

The proposed DSP Amendment area is anticipated to accommodate approximately 2,250 dwellings, a primary school and a Local Activity Centre site of approximately 0.412 hectares site area.

For the purposes of this transport impact assessment, it is assumed the primary school would be a standard pattern primary school designed for 540 students and the Local Activity Centre would be a local shopping centre of approximately 1500m^2 floor area.

3.2 Traffic generation

The 2021 TIA report has adopted a residential trip generation rate of 9 vehicles per day (vpd) per dwelling based on the NSW *Guide to Traffic Generating Developments*. That residential trip rate has therefore been adopted for the traffic assessment in this Addendum report as well

The WAPC *Transport Impact Assessment Guidelines* provides a peak hour trip rate for schools of 1.0vph per student, which equates to 2vpd per student as the daily trip rate for schools.

The NSW *Guide to Traffic Generating Developments* provides a daily trip rate of 121vpd per 100m^2 gross lettable floor area for shopping centres less than 10,000m^2 in size.

Accordingly, the traffic generated by the proposed land uses in the DSP Amendment area would be as follows:

- Residential: 2250 dwellings @ 9vpd/dwelling = 20,250vpd
- Local centre: 1500m^2 @ 121vpd/100m^2 = 1,815vpd
- Primary school: 540 students @ 2vpd/student = 1,080vpd

Given the proposed location of the primary school and local centre within this DSP Amendment area it is anticipated that virtually all of the trips to this primary school and local centre would only come from within this DSP Amendment area, so the total

traffic flows into and out of the DSP Amendment area would be approximately 17,355vpd.

3.3 Through trips

Section 3.3 of the 2021 TIA report evaluates through traffic volumes through the DSP area based on MRWA ROM traffic modelling for 2041.

The location of the DSP Amendment area at the southern edge of the DSP area means that there will not be any through traffic that would travel through this DSP Amendment area.

3.4 Trip distribution

The 2021 TIA report estimates that 55% of the home-based trips (i.e. residential trip generation) would remain within the DSP area and the remaining 45% would travel to/from external destinations.

It assigned those internal trips as 30% to the industrial zone, 60% to the district centre and 10% to the neighbourhood centre within the DSP area. It assigned external trips as 65% on Tonkin Hwy south and 35% on Tonkin Hwy north.

Those trip distribution principles have been adapted for the proposed DSP Amendment area as follows:

- 55% of residential trips are purely internal within the DSP area (including DSP Amendment area) and the other 45% travel to/from external destinations.
- 9% (1810vpd) to/from local activity centre in DSP Amendment area.
- 5.3% (1080vpd) to/from primary school in DSP Amendment area.
- 5.3% (1080vpd) to/from high school in DSP area.
- 23.7% (4790vpd) to/from district centre in DSP area.
- 11.8% (2390vpd) to/from industrial zone in DSP area.
- 30.1% (6100vpd) to/from Tonkin Hwy south.
- 14.8% (3000vpd) to/from Tonkin Hwy north.

3.5 Proposed internal and external road network

The proposed main arterial road network in the Amended DSP area is shown in the proposed District Structure Plan Amendment Plan in **Figure 4**. The main access into the DSP Amendment area will be via the existing Halden Road alignment north of the DSP Amendment area. This connects to the integrator arterial road network within the DSP area, which will connect to the Tonkin Highway interchange that is planned for the DSP area.

The existing Halden Road alignment north of the DSP Amendment area provides access into the centre of the DSP area and there is also a proposed secondary road

link northwards into the DSP area further to the west, which will be particularly useful for travel between the high school site and the DSP Amendment area, as well as providing the required second access route for emergency situations such as bushfires.

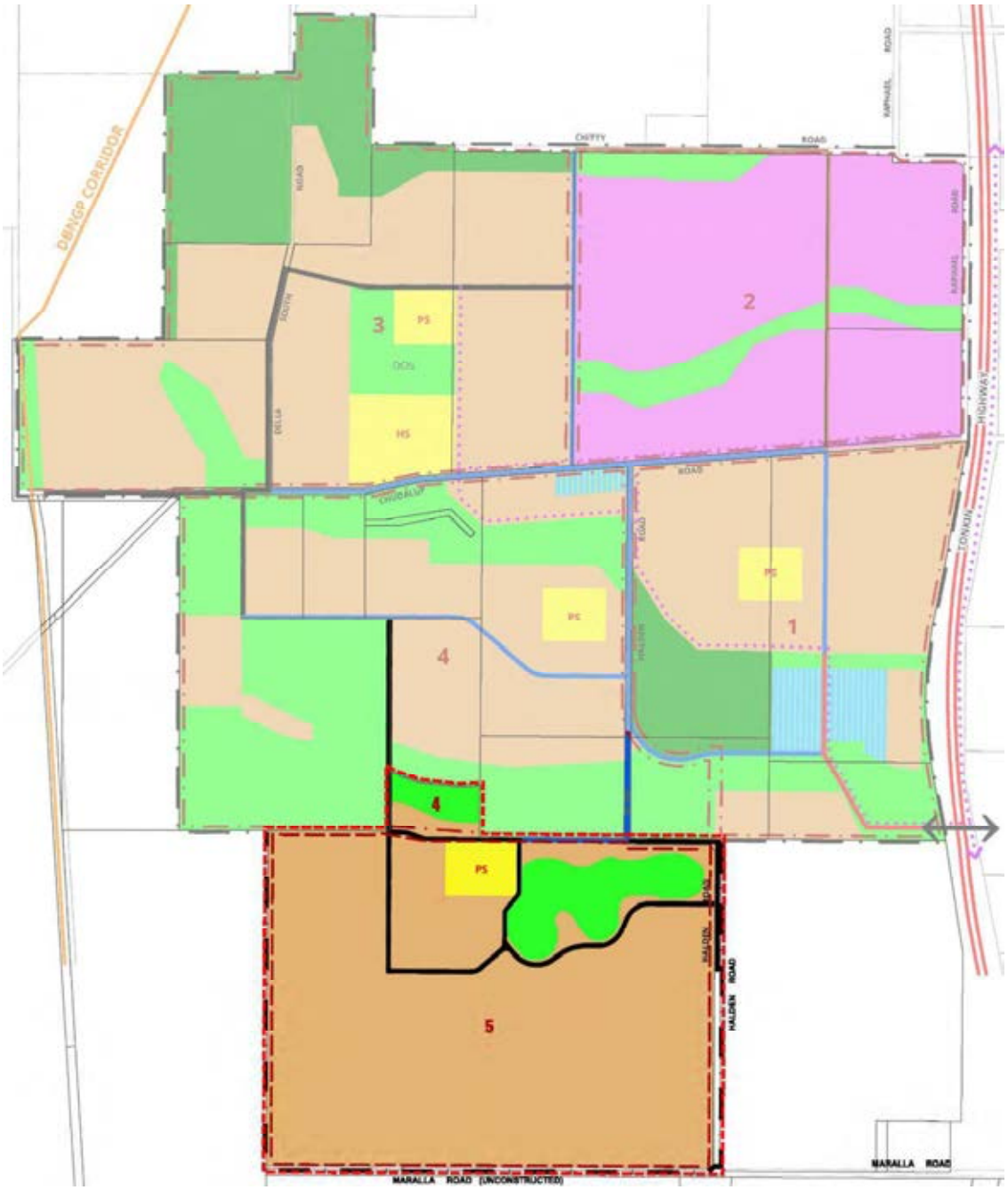


Figure 4: Proposed DSP Amendment Plan

3.6 Trip assignment

Daily traffic flows from each zone in the DSP Amendment area have been assigned onto the local road network in the DSP Amendment area and the arterial road network of the overall Amended DSP area shown in **Figure 4** in accordance with the trip distribution discussed in section 3.4 above, to determine the additional traffic volumes that will be generated on that road network by the proposed DSP Amendment land uses.

Figure 5 shows the future daily traffic flows from the 2021 TIA report or as amended in the July 2022 TIA Addendum 1 (black numbers), and the additional daily traffic flows (red numbers) that will be generated on the DSP road network by the proposed DSP Amendment area.

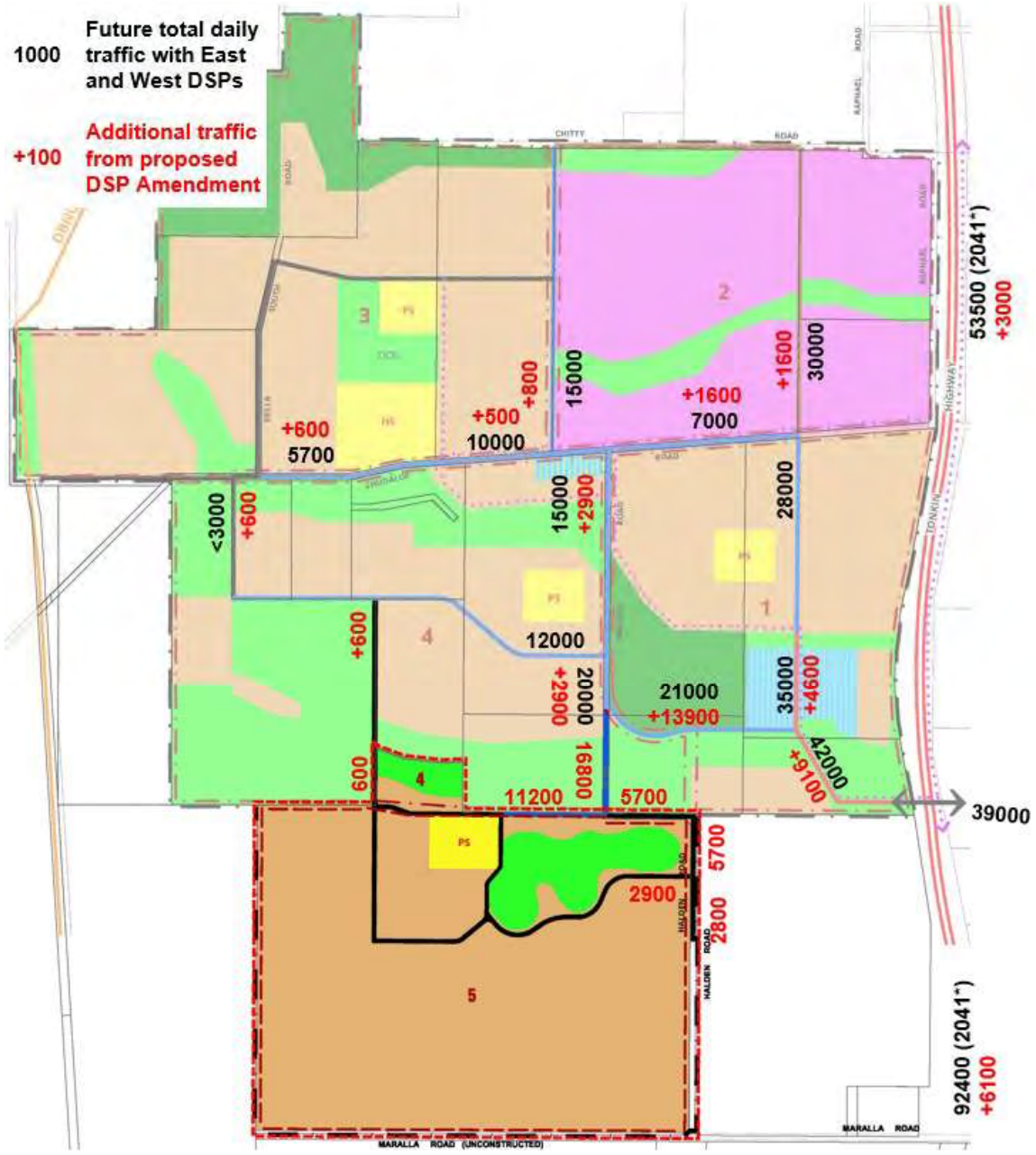


Figure 5: Future daily traffic with proposed DSP Amendment

Figure 6 shows future daily traffic flows on the internal local road network within the DSP Amendment area. There will not be any additional external traffic component in this DSP Amendment area so these will be the total daily traffic flows in this area.

Figure 6: Future daily traffic in the proposed DSP Amendment area

3.7 Internal Road Reserves

The internal road classifications in the DSP area are discussed in detail in section 3.7 of the 2021 TIA report and summarised in Figure 3.6 of that report. For convenience (to allow comparison) that Figure 3.6 is reproduced below as **Figure 7** in this TIA Addendum.

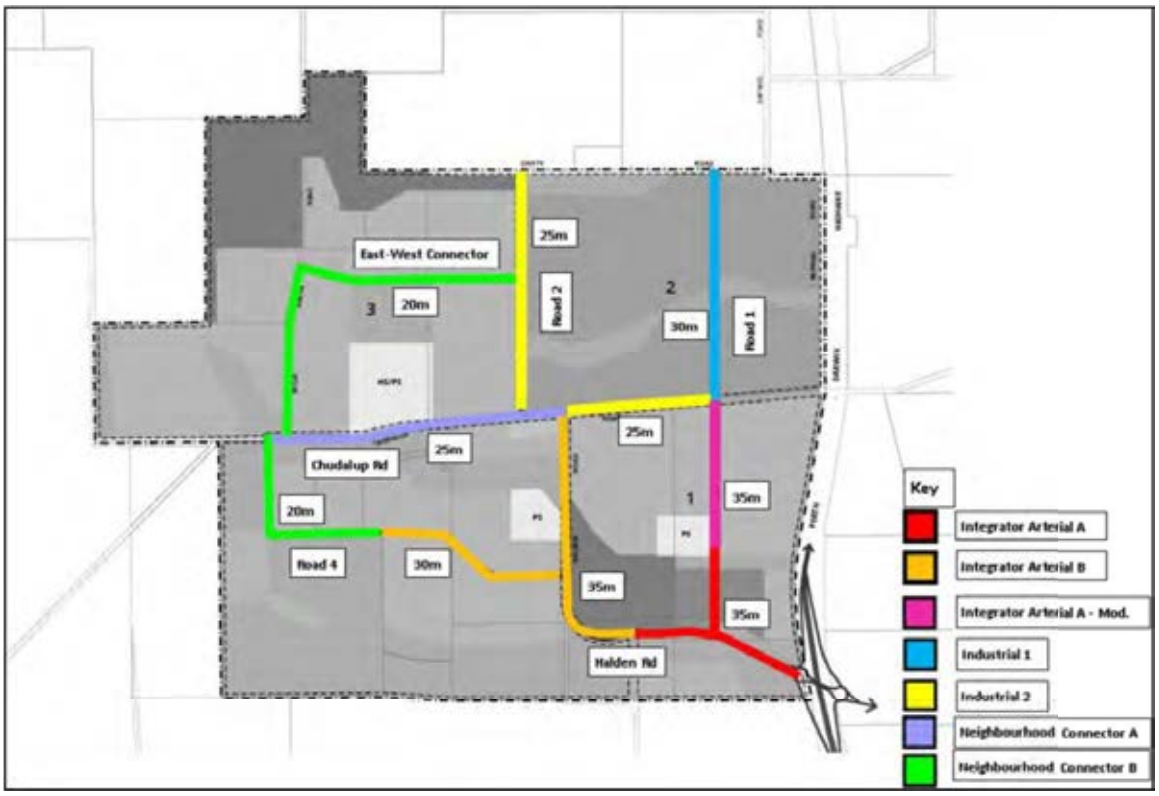


Figure 7: Proposed Road Classifications without DSP Amendment

However, the final approved DSP has significantly altered the planned road hierarchy within the DSP area, as shown in **Figure 8**. The DSP plan only shows a simplified road hierarchy and does not distinguish between different types of Integrator Arterials, or different types of Neighbourhood Connectors. The road section numbering shown on **Figure 8** is as adopted by DVC in their North Ellenbrook West DSP TIA Addendum 1. (Refer to that Addendum for details of the revised road hierarchy and widths – the DSP road hierarchy plan shown in **Figure 7** is not updated in that TIA Addendum.) Note that road sections 1 and 10 on **Figure 8** are now upgraded to Primary Distributor Road.

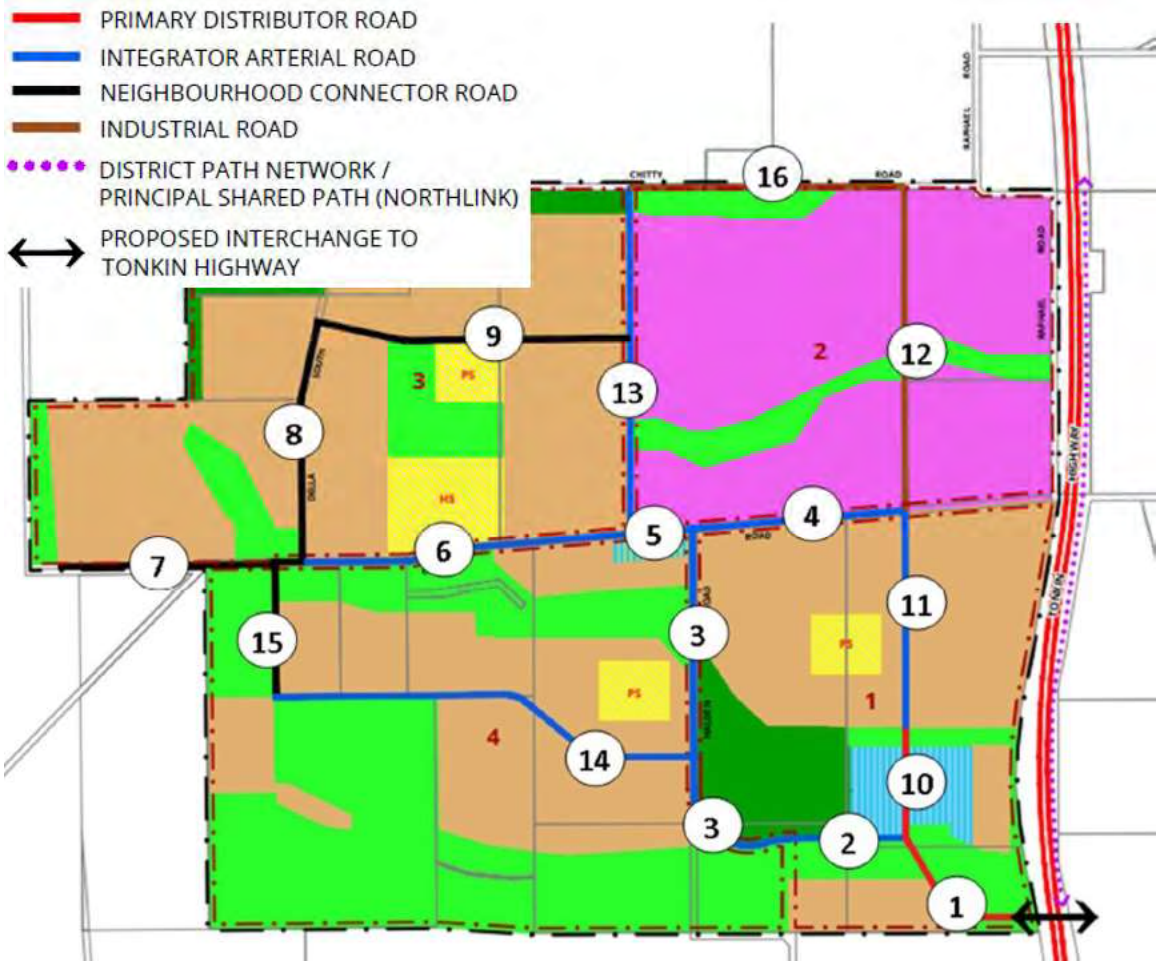


Figure 8: Road Classifications in Approved DSP

The amended version of that road classifications plan (with the proposed DSP Amendment area included) is shown in **Figure 9.**

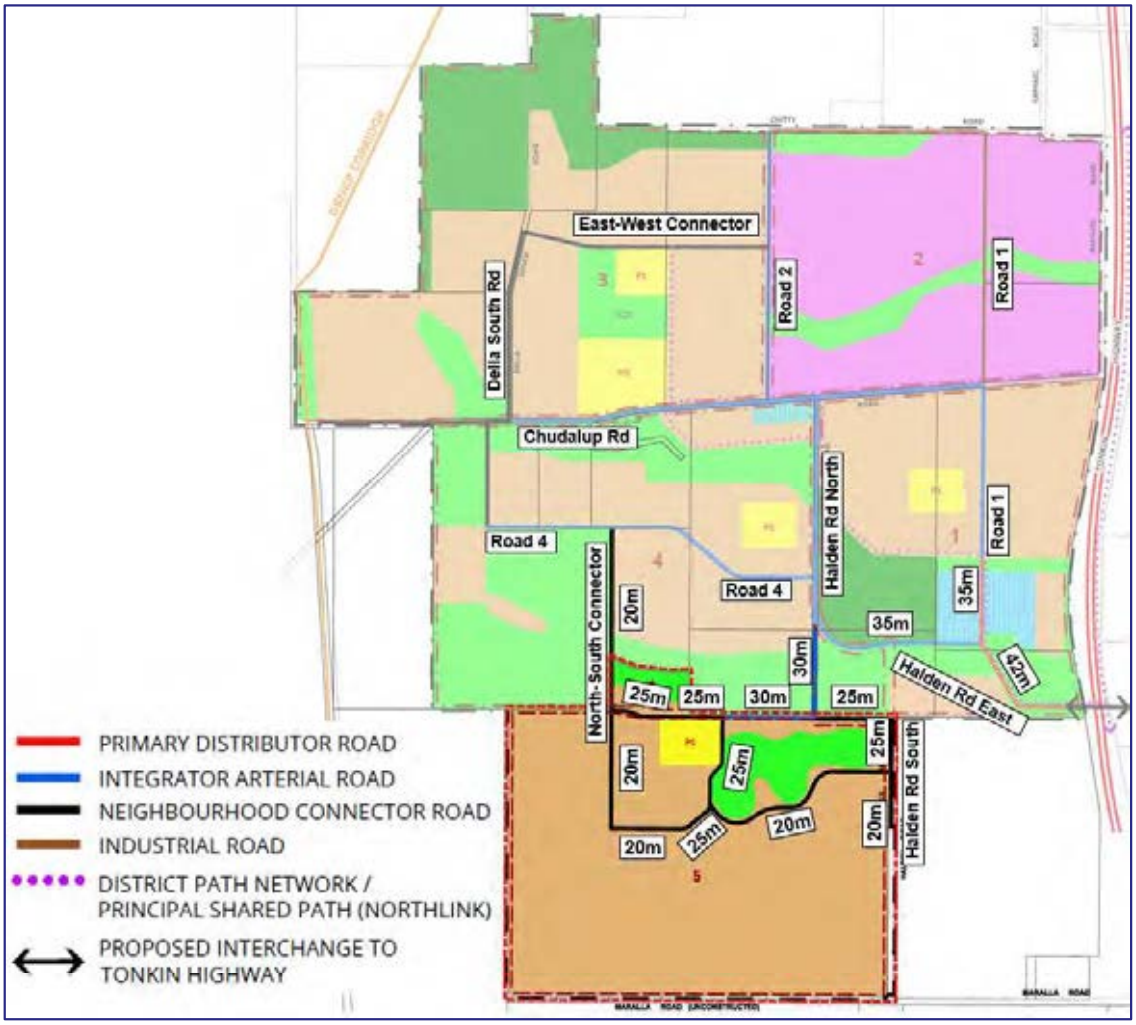


Figure 9: Proposed Road Classifications with DSP Amendment

A slightly different road naming system is introduced in **Figure 9** to distinguish the northern and southern sections of Halden Road (existing) and the new eastwards road link to Tonkin Highway (which is now labelled Halden Rd East).

In the 2021 DSP TIA report Halden Road East traffic volumes range from 23,000 (reduced to 21,000vpd in the North Ellenbrook West DSP TIA Addendum 1) to 42,000vpd and this section was proposed as the 35m Integrator Arterial A (4-lanes) depicted in **Figure 11** below. The additional traffic from the DSP Amendment area will increase those traffic volumes to 34,900vpd (west of Road 1) and 51,100vpd (west of Tonkin Hwy). The western section (west of Road 1) is still within the previous traffic volume range so no change in road classification or width is proposed on that western section. However, the eastern section (west of Tonkin Hwy) will need to be widened to 6-lanes to accommodate the additional traffic volume. Accordingly, the cross section in **Figure 10** below is increased by 7m to a total of 42m to accommodate two additional 3.5m traffic lanes.

These are the only significant changes required to proposed road classifications in the current DSP area as a result of the proposed DSP Amendment, apart from the road

connection southwards to the DSP Amendment area (shown on **Figure 9** as the new North-South Connector).

The road cross-sections shown in **Figures 10 to 18** below are sourced from the 2021 TIA report. The July 2022 TIA Addendum 1 does not revise these road cross-section diagrams but does refer to slightly different total road reserve widths for various sections of road. Accordingly, the reader is advised to cross-check against the information provided in Table 3 of that July 2022 TIA Addendum 1.

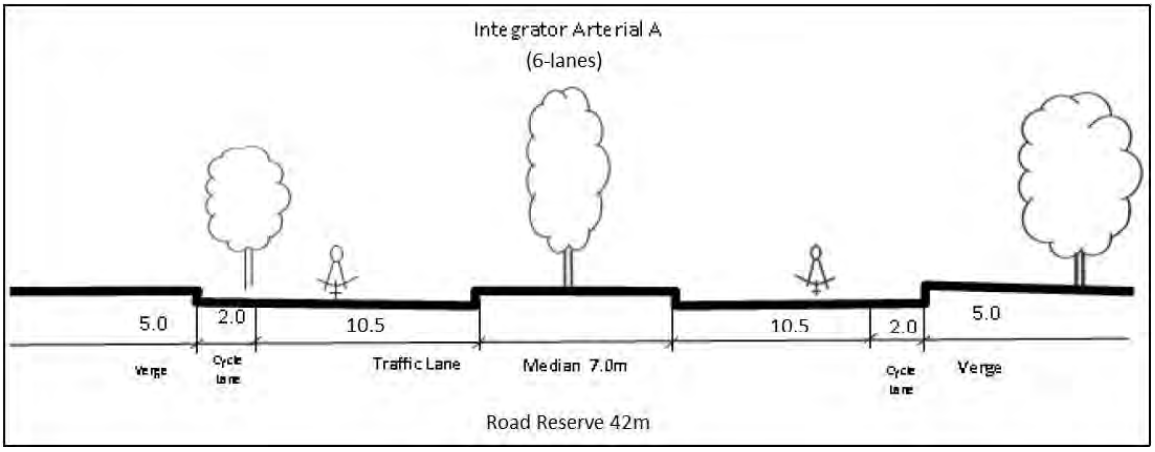


Figure 10: Proposed Cross Section – 42m Integrator Arterial A (6-lanes)

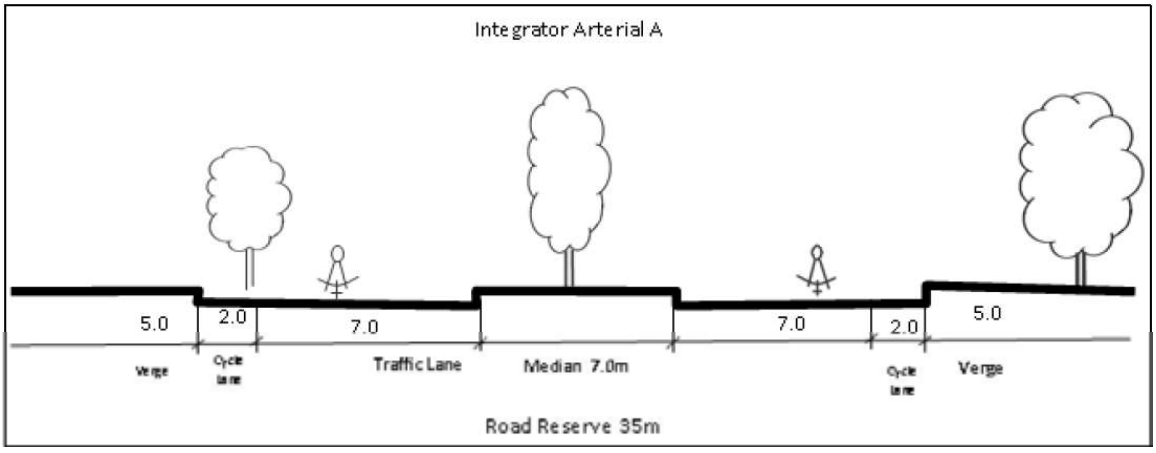


Figure 11: Proposed Cross Section – 35m Integrator Arterial A (4-lanes)

Figure 11 is Figure 3.7a in the 2021 DSP TIA report. (Refer sections 3.7.1 and 3.7.4 of the 2021 DSP TIA report.)

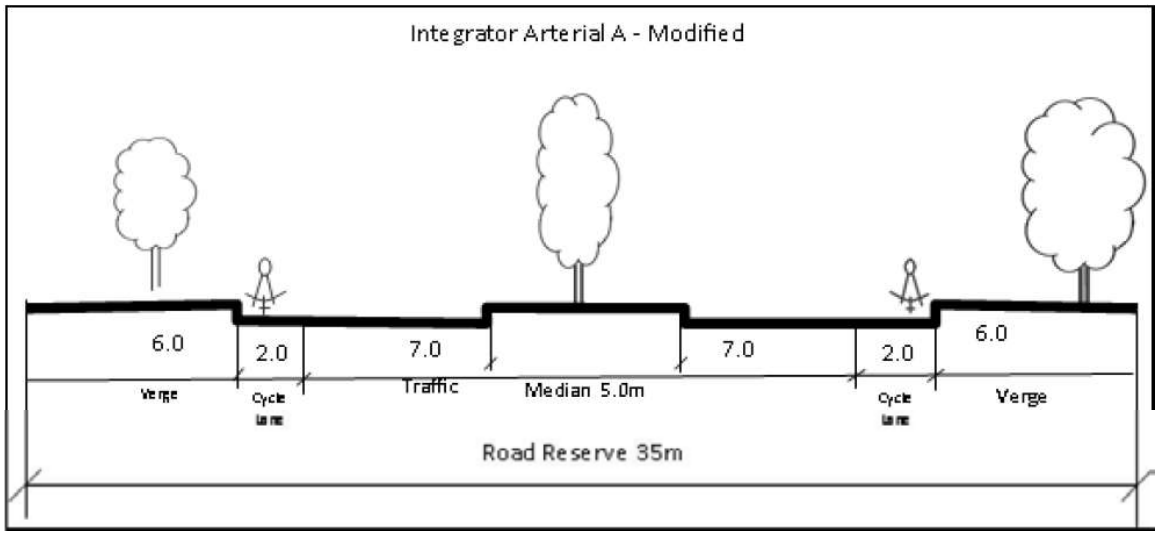


Figure 12: Proposed Cross Section – 35m Modified Integrator Arterial A (4-lanes)

Figure 12 is Figure 3.7f in the 2021 DSP TIA report. (Refer section 3.7.4 of the 2021 DSP TIA report.)

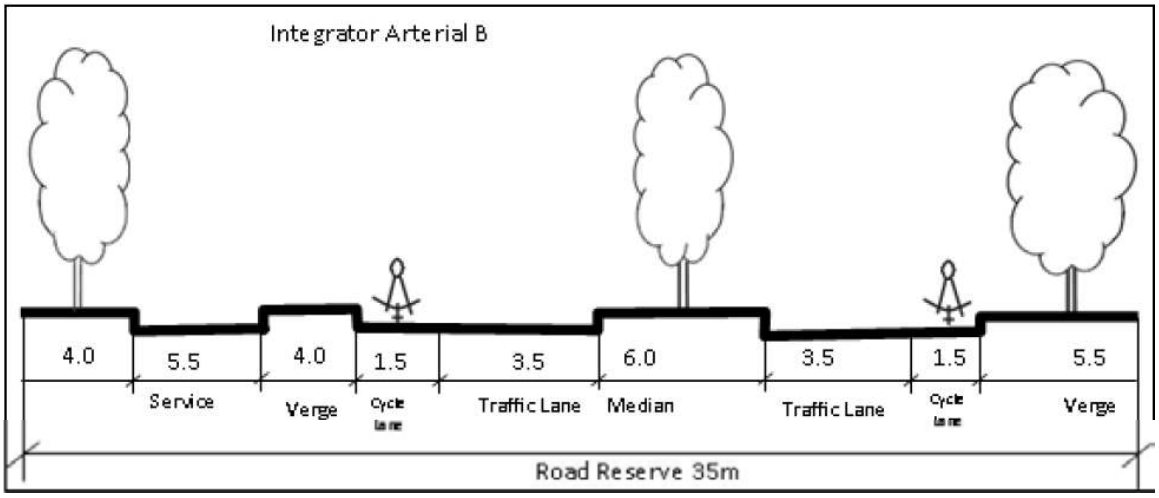


Figure 13: Proposed Cross Section – 35m Integrator Arterial B (2-lanes)

Figure 13 is Figure 3.7b in the 2021 DSP TIA report. (Refer section 3.7.1 of the 2021 DSP TIA report.)

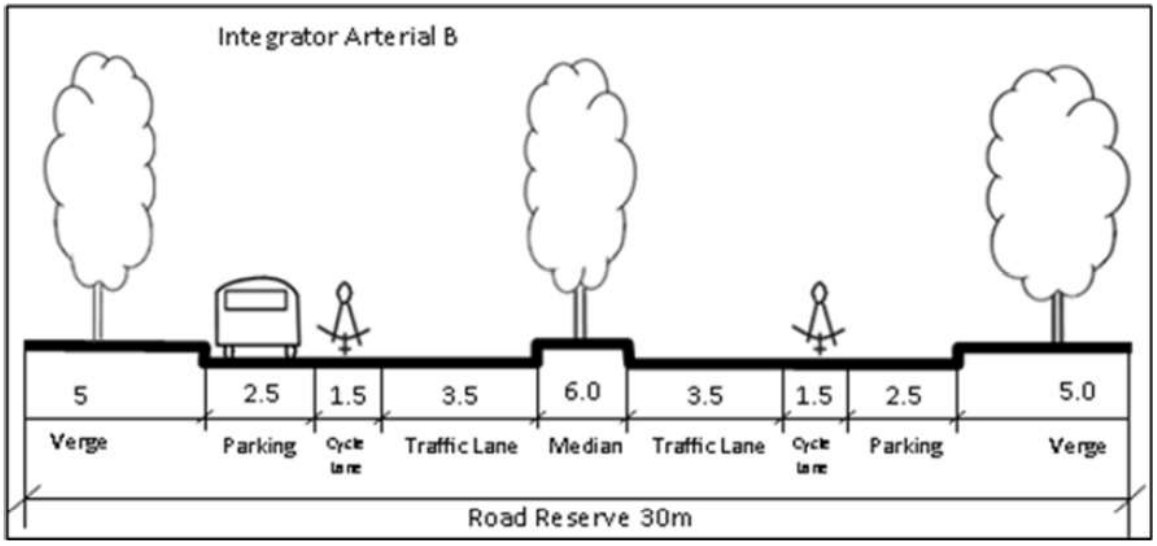


Figure 14: Proposed Cross Section – 30m Integrator Arterial B (2-lanes)

Figure 14 is Figure 3.7h in the 2021 DSP TIA report. (Refer section 3.7.6 of the 2021 DSP TIA report.) This 30m Integrator B cross section would be suitable on the section of Halden Rd immediately north of the DSP Amendment area and along the northern boundary of the DSP Amendment area between Halden Road north and the Primary School site, as shown in **Figure 9**, although the on-street parking bays may be omitted where parking is not required on one or both sides, such as abutting bushland.

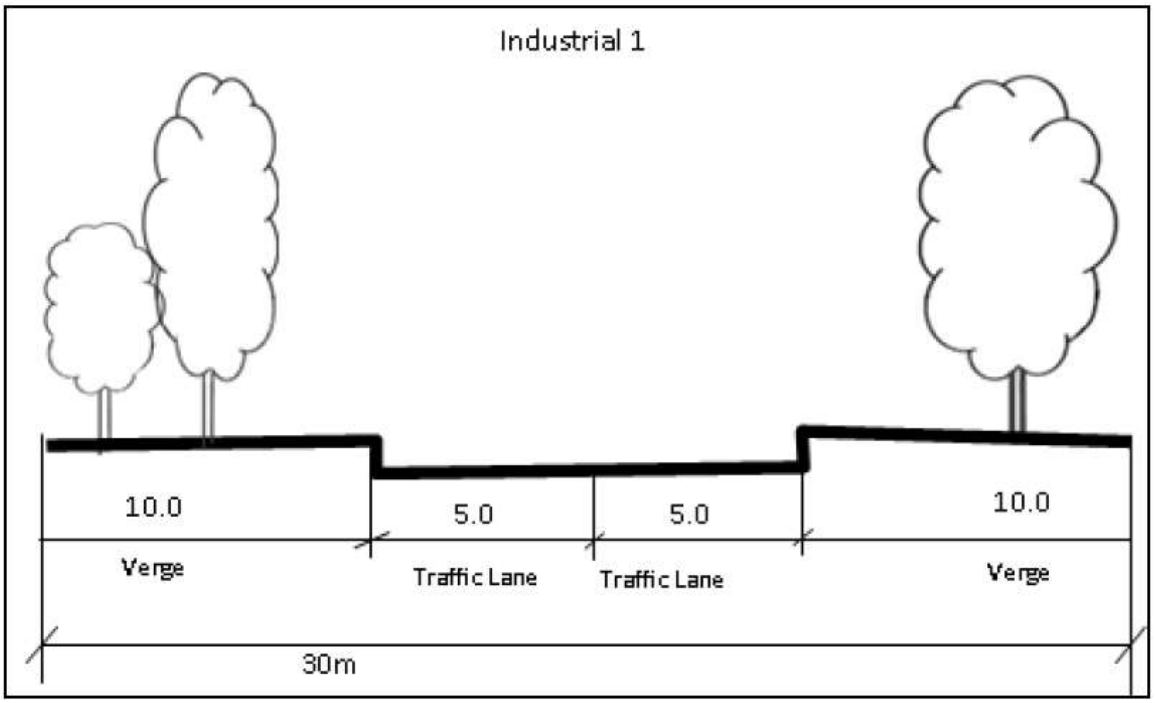


Figure 15: Proposed Cross Section – 30m Industrial Road

Figure 15 is Figure 3.7g in the 2021 DSP TIA report. (Refer section 3.7.4 of the 2021 DSP TIA report.)

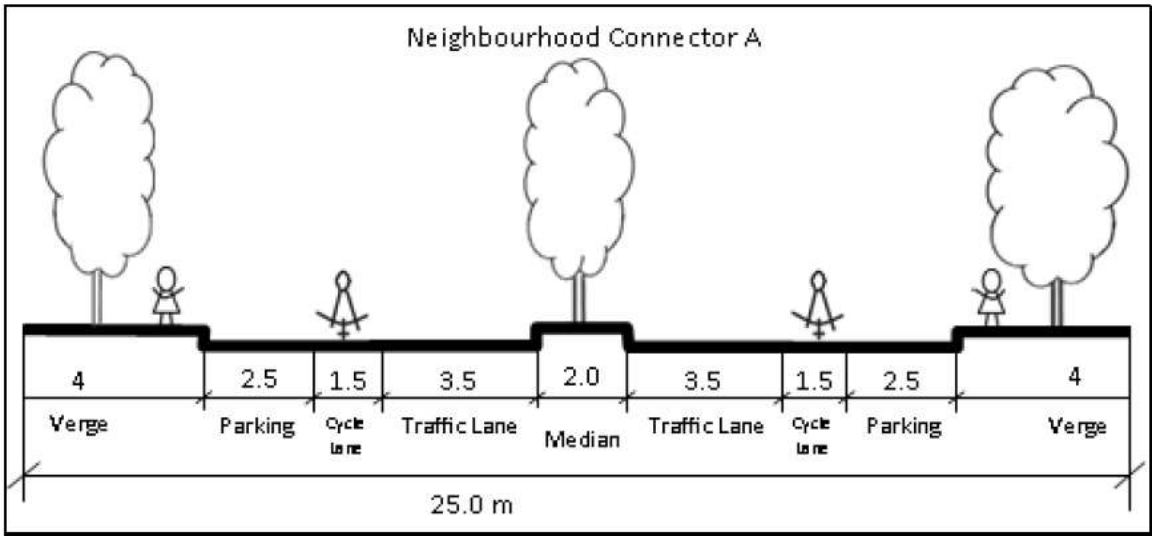


Figure 16: Proposed Cross Section – 25m Neighbourhood Connector A

Figure 16 is Figure 3.7d in the 2021 DSP TIA report. (Refer sections 3.7.2 and 3.7.3 of the 2021 DSP TIA report.)

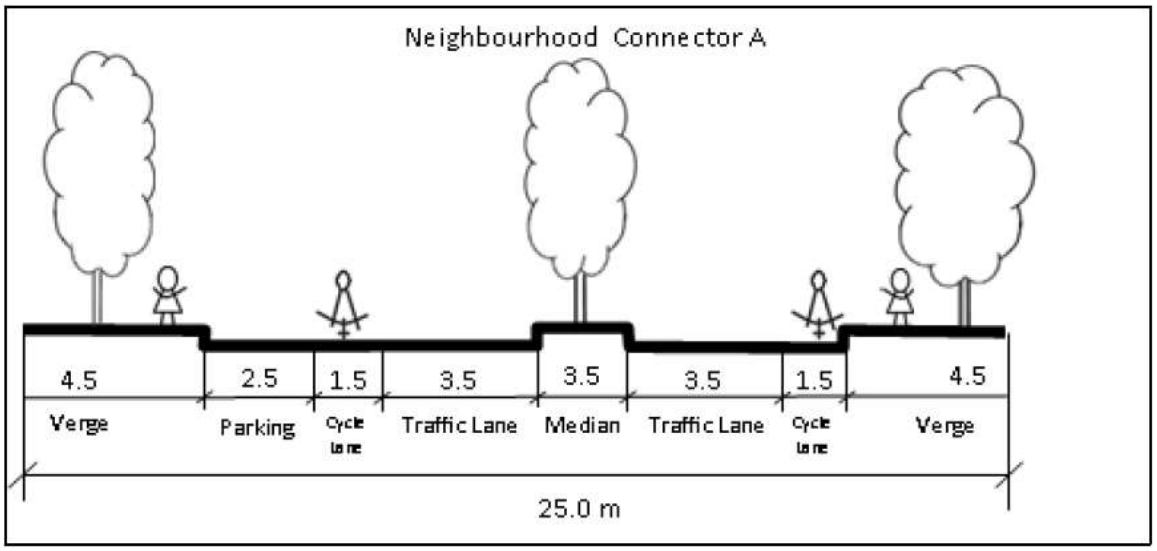


Figure 17: Proposed Cross Section – 25m Modified Neighbourhood Connector A

Figure 17 is Figure 3.7c in the 2021 DSP TIA report. (Refer sections 3.7.2 and 3.7.5 of the 2021 DSP TIA report.)

Figure 16 or **Figure 17** would represent suitable cross sections for the Neighbourhood Connector A roads in the DSP Amendment area that are shown in **Figure 9**. **Figure 16** represents a standard Neighbourhood Connector A where the abutting land uses warrant parking on both sides of the road but **Figure 17** would be appropriate where parking is not required on one side, such as abutting bushland.

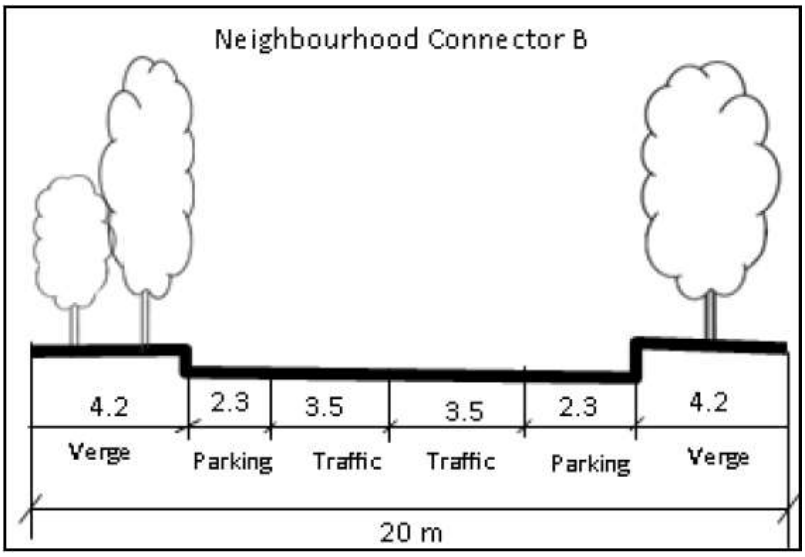


Figure 18: Proposed Cross Section – 20m Neighbourhood Connector B

Figure 18 is Figure 3.7e in the 2021 DSP TIA report. (Refer sections 3.7.2 and 3.7.6 of the 2021 DSP TIA report.)

This Neighbourhood Connector B cross section would also be appropriate on the North-South Connector Road into the DSP Amendment area and other sections of Neighbourhood Connector B shown on **Figure 9**, although the parking lane may be omitted where the road abuts bushland.

The WAPC Liveable Neighbourhoods policy allows for the combined verge/parking lane width to be reduced to 5.5m where parking is indented in the verge, allowing the total road reserve width to be reduced accordingly. The same principle would be applicable where there was no requirement for parking bays at all, so there is potential to reduce the overall road reserve width adjacent to bushland areas, if required. This would potentially apply to the 30m Integrator B (**Figure 14**), 25m Neighbourhood Connector A (**Figure 17**) and 20m Neighbourhood Connector B (**Figure 18**) at suitable locations within the DSP Amendment area.

3.8 Sustainable Transport

3.8.1 Pedestrians and Cyclists

The discussion on this subject in the 2021 DSP TIA report also applies to the DSP Amendment area.

Planning for this area will be in accordance with the principles set out in the WAPC *Liveable Neighbourhoods* policy.

3.8.2 Public Transport

The discussion on this subject in the 2021 DSP TIA report also applies to the DSP Amendment area.

The Neighbourhood Connector and Integrator Arterial roads shown in **Figure 9** provide suitable route options to accommodate future feeder bus routes to serve the DSP Amendment area when such service is deemed appropriate by the Public Transport Authority in future.

4 Summary

The approved North Ellenbrook (West) and North Ellenbrook (East) District Structure Plans (DSP) rezone land north of Ellenbrook for future urban development. Stockland are seeking an Amendment to the North Ellenbrook (West) DSP to include an additional property (Lot 5892 Maralla Road) on the southern side of that DSP area.

A Transport Impact Assessment (TIA) report was previously prepared for the North Ellenbrook (West) DSP in January 2021. A North Ellenbrook West DSP TIA Addendum 1 dated 20 July 2022 was subsequently prepared to address the changes between the draft and final (approved) versions of the North Ellenbrook (West) DSP.

This new report is therefore presented as an Addendum to that 2021 TIA report and July 2022 Addendum to document the changes resulting from the proposed DSP Amendment to include Lot 5892 into this DSP area.

The proposed DSP Amendment area is anticipated to accommodate approximately 2,250 dwellings, a primary school and a 0.412 hectare Local Activity Centre site.

The primary school and local activity centre are anticipated to have catchment areas corresponding to the DSP Amendment area and are not anticipated to generate significant additional traffic flows outside of the DSP Amendment area.

The additional residential area will generate daily traffic flows of approximately 20,250vpd with approximately 1,890vpd being internal trips within the DSP Amendment area, 9,260vpd to and from the rest of the DSP area and approximately 9,100vpd to and from external destinations via Tonkin Highway.

The existing 20m road reserve of Halden Road immediately north of the DSP Amendment area would need to be widened to 30m as an Integrator B arterial road connection into the DSP Amendment area and a new north south road link (20m road reserve) further to the west is proposed as a secondary access into the DSP Amendment area.

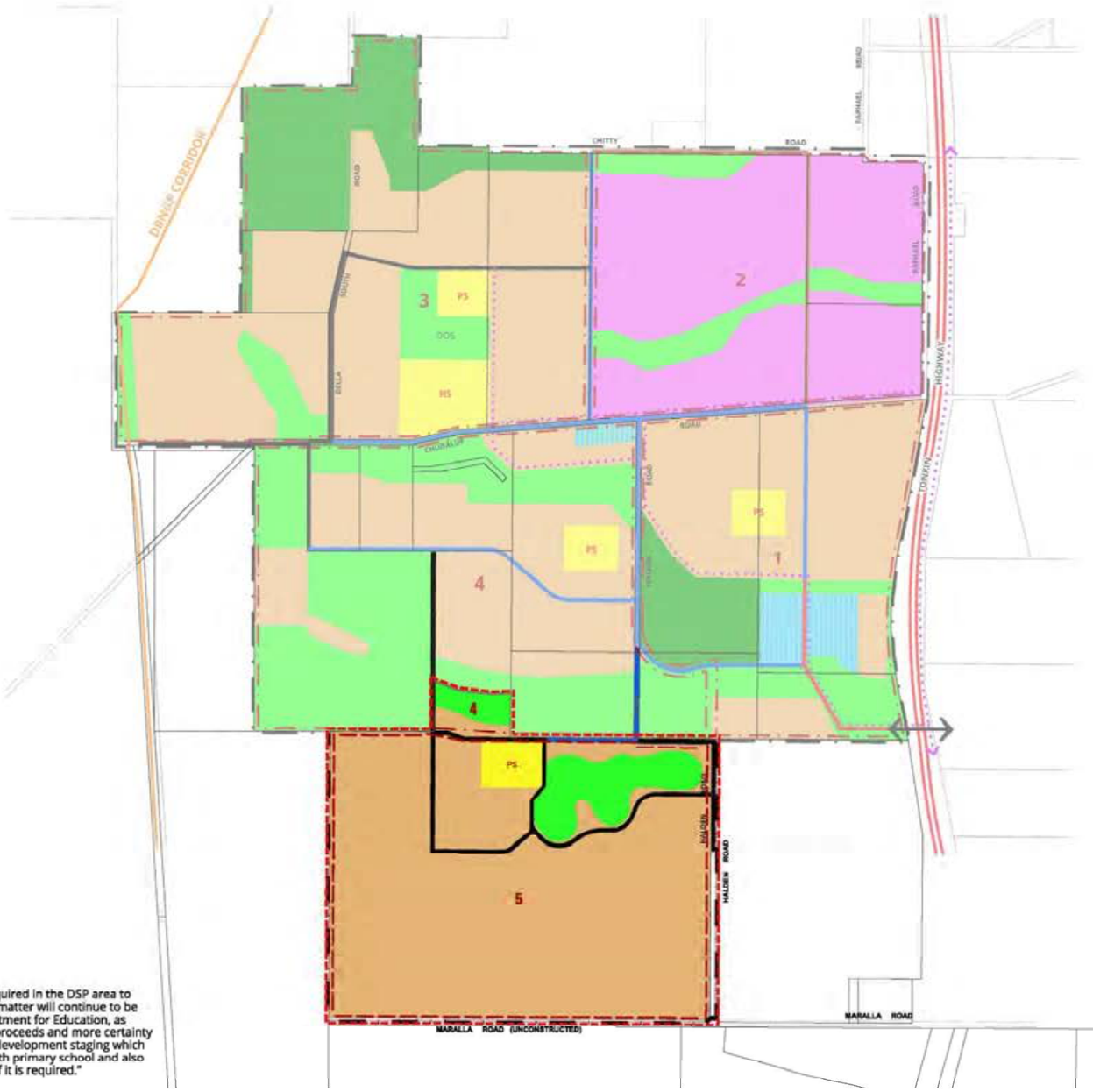
The planned road network within the rest of the DSP area will generally be able to accommodate the additional traffic flows generated by the DSP Amendment area without needing to widen the planned roads. However, the exception is the main east west road link to the Tonkin Highway interchange that is planned for these two DSP areas. The section immediately west of Tonkin Highway will need to accommodate approximately 51,000vpd and would need to be widened to 6-lanes instead of the 4-lanes divided standard currently planned in the North Ellenbrook (West) District Structure Plan. This would require that road reserve to be widened by 7 metres to accommodate those two additional traffic lanes, which is anticipated to be able to be accommodated without any significant difficulty.

Appendix A

NORTH ELLENBROOK (WEST) DSP AMENDMENT PLAN

transcore

Engineering a better future for over 20 years!



LEGEND

- DISTRICT STRUCTURE PLAN AMENDMENT BOUNDARY
- DISTRICT STRUCTURE PLAN BOUNDARY
- LOCAL STRUCTURE PLAN BOUNDARY
- CADASTRAL BOUNDARIES

LAND USE TYPE

- RESIDENTIAL
- LIGHT INDUSTRIAL / SERVICE COMMERCIAL
- DISTRICT CENTRE
- NEIGHBOURHOOD CENTRE
- PS PUBLIC PURPOSE - PRIMARY SCHOOL *
- HS PUBLIC PURPOSE - HIGH SCHOOL
- OPEN SPACE
- DOS DISTRICT OPEN SPACE
- FUTURE MRS PARKS AND RECREATION RESERVE
- DBNGP CORRIDOR

TRANSPORT

- PRIMARY DISTRIBUTOR ROAD
- INTEGRATOR ARTERIAL ROAD
- NEIGHBOURHOOD CONNECTOR ROAD
- INDUSTRIAL ROAD
- DISTRICT PATH NETWORK / PRINCIPAL SHARED PATH (NORTHLINK)
- PROPOSED INTERCHANGE TO TONKIN HIGHWAY

NOTES

1. The Tonkin Highway interchange is subject to confirmation as part of the Metropolitan Region Scheme Amendment process required to reserve the interchange land.
2. The Parks and Recreation identified areas recognise BushForever, Conservation Category Wetland (CCW) and EPBC Act areas to be retained. They are subject to refinement as part of the Metropolitan Region Scheme amendment process.
3. Public Open Space areas encompass vegetation retention, heritage and hydrology land requirements of District Structure Plan level significance. The refinement, reservation or reclassification of these and localised areas of open space as restricted open space, unrestricted open space or otherwise will be determined following environmental reporting at the local structure plan stage.
4. An area of District Open Space (DOS) is identified for co-location with the High School site and will accommodate the future active district recreation needs of the community. The acquisition and development of the DOS is to be provided for within the relevant Development Contribution Scheme(s) for the North Ellenbrook West District Structure Plan area to ensure the equitable provision of open space.
5. DSP Amendment subject to Environmental and Local Structure Plan Approvals.

* An additional primary school may be required in the DSP area to cater for the ultimate dwelling yield. This matter will continue to be monitored, in consultation with the Department for Education, as local structure planning for the precincts proceeds and more certainty is available regarding dwelling yields and development staging which will inform whether there is a need for a 5th primary school and also the ideal location for that primary school if it is required."

DISTRICT STRUCTURE PLAN AMENDMENT PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

NORTH

Scale: 1:17 600 @ A3

0 200 400 600m

PLAN: STONE-5-007 REVISION: D

DATE: 03/07/2023 DRAWN: JP

PROJECTION: PCG 94 PLANNER: BK

DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

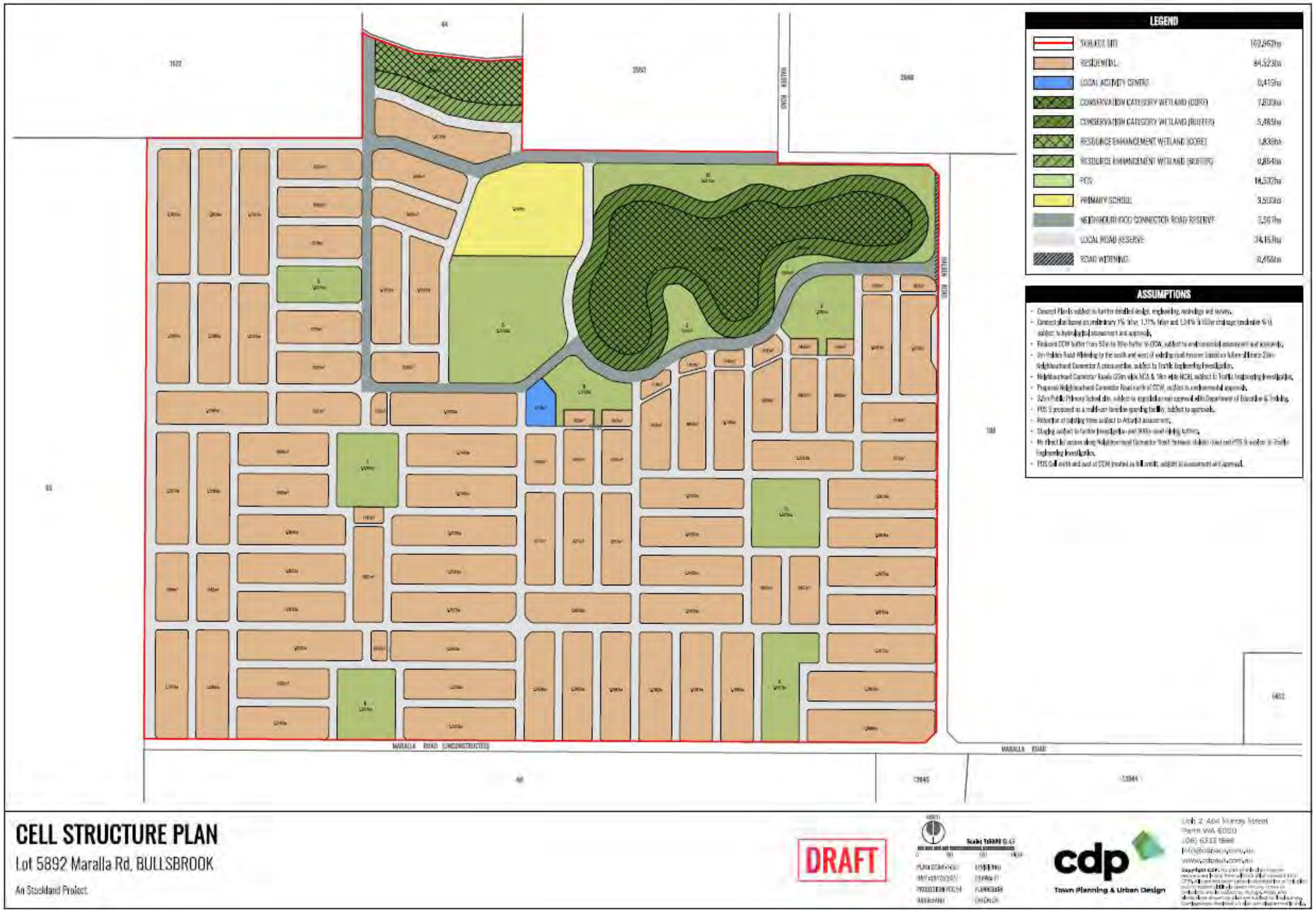
Unit 2, 464 Murray Street
Perth WA 6000
(08) 6333 1888
info@cdpaus.com.au
www.cdpaus.com.au

Appendix B

DSP AMENDMENT AREA CELL STRUCTURE PLAN

transcore

Engineering a better future for over 20 years!


LEGEND
SUBJECT SITE 162.862ha
RESIDENTIAL 84.523ha
LOCAL ACTIVITY CENTRE 0.413ha
CONSERVATION CATEGORY WETLAND (CORE) 7.803ha
CONSERVATION CATEGORY WETLAND (BUFFER) 5.485ha
RESOURCE ENHANCEMENT WETLAND (CORE) 1.838ha
RESOURCE ENHANCEMENT WETLAND (BUFFER) 0.864ha
POS 18.532ha
PRIMARY SCHOOL 3.503ha
NEIGHBOURHOOD CONNECTOR ROAD RESERVE 5.267ha
LOCAL ROAD RESERVE 34.167ha
ROAD WIDENING 0.456ha
ASSUMPTIONS
Concept Plan is subject to further detailed design, engineering, modelings and surveys.
Connect plan based on preliminary 1% 24hr, 1.11% 24hr and 5.04% 24hr climate (exclusive 4%), subject to hydrological assessment and approvals.
Retained CCW buffer from 50m to 30m buffer to CCW, subject to environmental assessment and approvals.
20m Maralla Road Widening to the south and west of existing road reserve based on future ultimate 25m Neighbourhood Connector A cross section, subject to Traffic Engineering investigation.
Neighbourhood Connector Roads (25m wide MCA & 18m wide NCB), subject to Traffic Engineering investigation.
Proposed Neighbourhood Connector Road north of CCW, subject to environmental approvals.
3.5ha Public Primary School site, subject to negotiation and approval with Department of Education & Training.
POS 3 proposed as a multi-use recreation sporting facility, subject to approvals.
Retention of mature trees subject to Arborist assessments.
Staging subject to further investigation and detailed staging advice.
My Street (or various along Neighbourhood Connector Road between Maralla Road and POS 3) subject to Traffic Engineering investigation.
POS 3 will north and east of CCW treated as full credit, subject to assessment and approval.
MARALLA ROAD (UNCONSTRUCTED)
MARALLA ROAD
CELL STRUCTURE PLAN
Lot 5892 Maralla Rd, BULLSBROOK
An Stockland Project
DRAFT
cdp
Town Planning & Urban Design
Unit 2 464 Murray Street
Perth WA 6000
(08) 6332 1888

Appendix 6
Engineering Servicing Report

JDSi
CONSULTING ENGINEERS

P: 08 9227 0595
F: 08 9227 8617

Level 1, 432 Murray St,
Perth WA 6000

PO Box 7483
Cloisters Square PO
WA 8650

jdsi.com.au

Engineering Servicing Report

LOT 5892 MARALLA ROAD BULLSBROOK

Stockland

JDS201899_Rev E

July 2023

INTEGRITY

We are open, honest, and consistent in our principles and conduct, so we're able to build trusted relationships with our clients and partners.

RESPECT

We treat everyone with respect and dignity and develop relationships founded on understanding and trust.

ACCOUNTABILITY

We always assume responsibility for our actions and make decisions in line with our economic, social, and ethical obligations.

EXCELLENCE

We pursue excellence in everything we do, challenging ourselves to look beyond the obvious and ensure ongoing improvement.

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Table of Contents

Appendices

DOCUMENT REVIEW					
Revision	Date Issued	Issue Type	Written By	Reviewed By	Approved By
Rev A	14/5/21	For Review	JG	SF	
Rev B	1/6/21	Issued for Final Review	JG	BW	
Rev C	3/6/21	Issued for DSP	JG	BW	SF
Rev D	2/3/22	Issued for DSP	JG	BW	
Rev E	6/7/23	Issued for DSP	BW		

1 Introduction and Key Objectives

JDSi Consulting Engineers (JDSi) have been commissioned by Stockland to prepare the Engineering Servicing Report to support a Business Case and future District Structure Planning applications for the proposed residential subdivision across the land holding. JDSi understand the proposed development consists of the following:

- 2200-2400 dwellings.
- Small local retail Precinct
- Primary School Site
- Public Open Space (POS) and new road and pedestrian networks.

Refer ***Appendix A*** DSP Concept Plan.

The investigations undertaken and preparation of the report have been largely based on desktop studies and some preliminary advice from the service authorities. The information is current as of February 2022 and may be subject to change as development progresses in the area.

The report summarises the results of a review of the civil and electrical engineering related elements of the development. The key objectives of this report are to:

- Provide commentary on the proposed development and background to the existing site location and conditions.
- Provide commentary on any earthworks and remediation required within the development area.
- Provide commentary on the existing roads, drainage, and utility services infrastructure within the vicinity of the development.
- Provide commentary on the proposed road network and any upgrades required to facilitate the proposed development.
- Provide commentary on the overall stormwater drainage strategy for the proposed development.
- Document the Water Corporation's servicing requirements for sewer and water reticulation.
- Document Western Power's servicing requirements for electrical reticulation.
- Document servicing requirement for telecommunication and gas reticulation.

2 Study Area

The subject site is located in the suburb of Bullsbrook and is in close proximity to residential housing within Ellenbrook. The site is bounded by Halden Road to the east, Maralla Road to the south and undeveloped land to the north and west.

The subject site is currently zoned General Rural under City of Swan's Local Planning Scheme No. 17 and is noted as Open Space within the North-East Sub-Regional Planning Framework (March 2018). The site has a total area of 162.98ha and is subject to an active mining tenement for sand extraction.

Figure 1: Site Location

The review undertaken has been based on a desktop study of existing services information and aerial imagery. The review is also based on bringing the necessary services to the sites to facilitate the creation of fully serviced lots generally in line with the concept structure plan below:

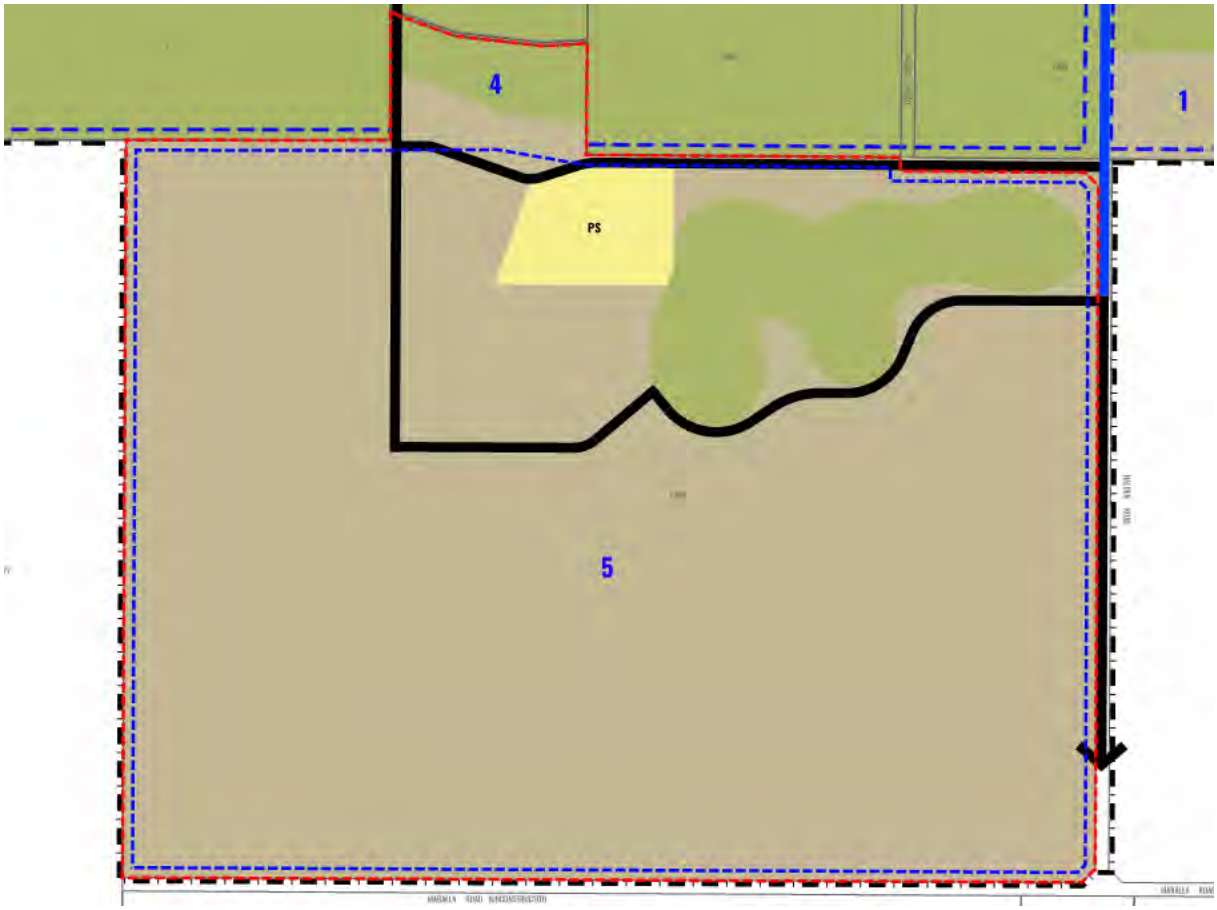


Figure 2: District Structure Plan

2.1 Topography

A topographical survey for the site has been undertaken by MNG and indicates that the existing surface levels vary from approximately 46m AHD to 76m AHD. The lower elevations of the site i.e. 46m AHD to 50m AHD generally coincide with the identified CCW's located on the subject sites. The site is generally undulating with the higher peaks and steeper slopes generally present over the southern half of the subject sites.

Refer ***Appendix B*** Feature Survey.

2.2 Groundwater

The site is included in the Department of Water and Environmental Regulation's (DWER) online Perth Groundwater Atlas. Based on the DWER's recorded groundwater levels the Historical Maximum Groundwater Level varies across the site, from approximately 53mAHD in the north-west corner to 47mAHD in the south-east corner. Groundwater flow is generally in a south-easterly direction.

JDSi understand that RPS have been commissioned to undertake further hydrological studies on the site, including detailed assessment of groundwater levels to inform the development.

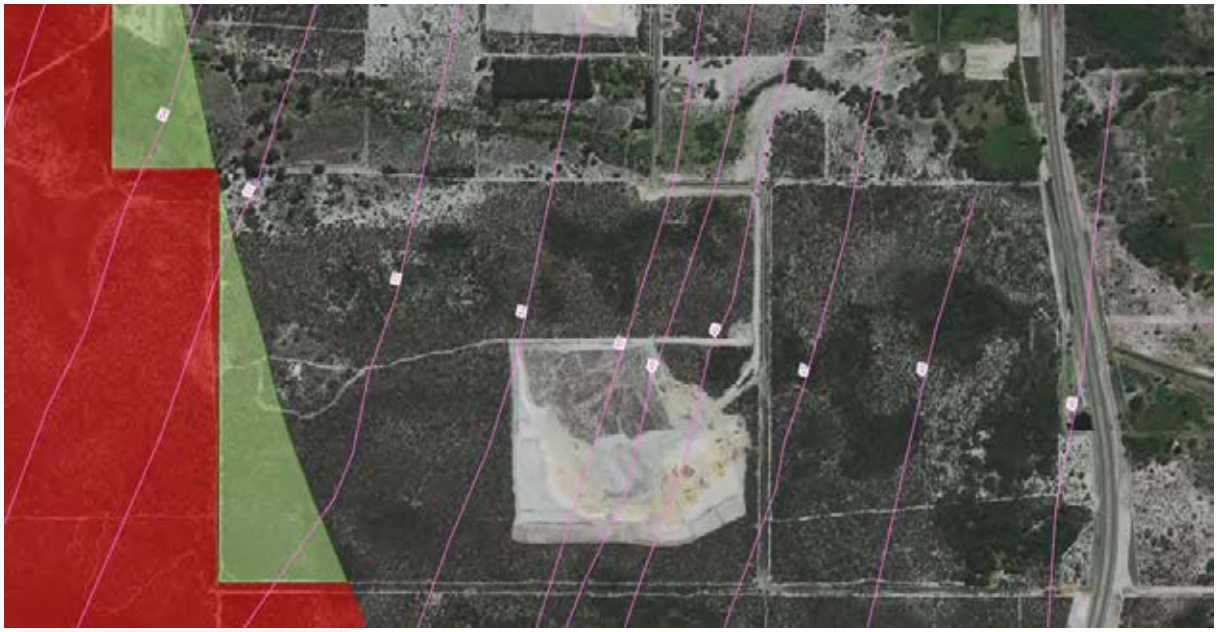


Figure 3: Maximum GWL and UWPCA – DWER

Part of the subject site falls within the Gnangara Underground Water Pollution Control Area (UWPCA). Developers within a UWPCA need to fulfill their legal responsibilities including those covering 'land use' planning, environmental, health and building permit matters. The Department of Water and Environmental Regulation is responsible for managing and protecting Western Australia's water resources. Activities and land use in these areas are restricted and subject to the Department of Water and Environmental Regulation approval processes in accordance with the Western Australian Planning Commissions current State Planning Policy 2.7.

2.3 Geological Conditions

Published geological maps (Ref. Perth Metropolitan Region 1:50,000 Environmental Geology Series: Muchea) for the area indicates that the near surface geology, in its undisturbed natural state, comprises:

- Sand derived from Bassendean Sand (Bassendean Sand, S8) for the majority of the site, this unit is described as very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz moderately well sorted of eolian origin.
- Peaty Clay (Cps) - dark grey and black with variable sand content of lacustrine origin.

On site geotechnical investigation will be required to inform the detailed design for the site but it is anticipated that highly permeable Bassendean Sand extends to depths well below those required to facilitate construction works on site.

2.4 Acid Sulphate Soils

Acid Sulphate Soil mapping compiled by Department of Water and Environmental Regulation indicates the site is generally located within an area of "*moderate to low risk of acid sulphate soils occurring within 3 m of natural soil surface*". All excavation works and dewatering in ASS must be carefully managed to avoid any potential damage to surrounding land and water ways.

Risk Class

1 – High to moderate risk of ASS occurring within 3m of natural soil surface

2 – Moderate to low risk of ASS occurring within 3m of natural soil surface but high to moderate risk of ASS beyond 3m of natural soil surface

Figure 4: WAPC ASS Mapping

3 Earthworks

3.1 Pre-Development Sand Mining

Lot 5892 is being actively mined for silica and general-purpose sand. The approved mining tenement covers 120ha. The total area of the site is 163h. Mining is taking place progressively from east to west. Lot 5892 is part of an extensive area that has been identified within a Significant Geological Supply for sand (SPP 2.4). Figure 5 shows Lot 5892 and the extent of this Significant Geological Supply, along with other SPP 2.4 extraction areas.

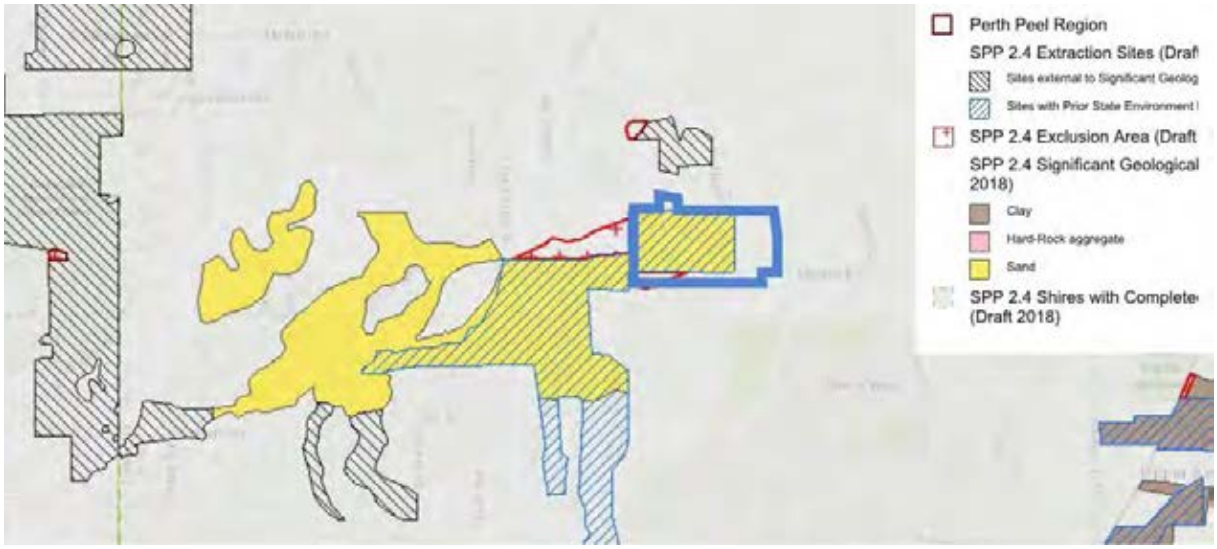


Figure 5: Significant Geological Supply - Basic Raw Materials

Mining for basic raw materials on private land is generally exempt from the tenement licensing requirements of the Mining Act, however silica sand is defined as a mineral under the Mining Act and as a basic raw material under SPP 2.4, and requires both a Mining Licence and a planning approval under the Planning and Development Act. Regardless of what Act the mine product is licensed under the 'mining operations' are required to comply with Department of Mines, Industry Regulation and Safety (DMIRS) under the Mining Act.

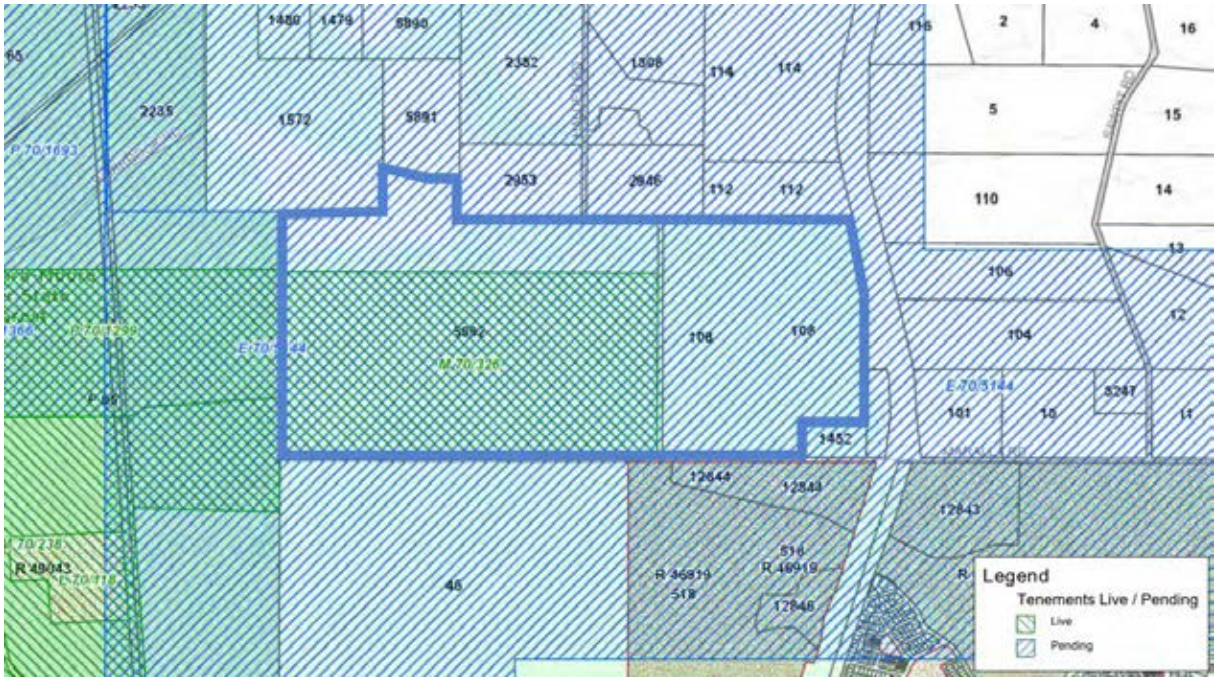


Figure 6: Mining Leases

Mining on Lot 5892 was originally approved in 1988 but excavation did not commence until about 2012. The holder of Mining Licence 70/326, issued under the Mining Act 1978, is Stefanelli Developments Pty Ltd, the owner of Lot 5892. The tenant and mine operator is Urban Resources Pty Ltd. The extent of the licensed area is depicted on Figure 6.

The mine also has an Extractive Industries Licence issued by the City of Swan and approval to commence development from the WAPC, which is required as a result of a Clause 32 resolution under the MRS for all extractive industries applications on land zoned 'Rural' in the MRS.

Current approved sand mining operations are progressively removing up to 120ha of Banksia woodland from Lot 5892 and simultaneously modifying the landform in a manner that makes rehabilitation of vegetation to its former state an unlikely outcome. The approved extraction levels have been conservatively modelled at a minimum of 2m above the Department of Water's historical maximum recorded groundwater levels. Refer ***Appendix C*** Approved Extraction Levels.

3.2 Earthworks

General topography extends from lower flats to undulating hill formations ranging from 46m AHD to 76m AHD. The natural vegetation occurring on the sites is classified as the Bassendean Complex-Central and North. This vegetation ranges from low open forest and low woodland of Banksia to low woodland of Melaleuca and sedge lands with part of Lot 5892 located over a Priority 3 (P3) Conservation Category Wetland (CCW).

As previously mentioned, Lot 5892 is subject to an active mining tenement for sand extraction which will see up to 120ha of vegetation stripped and natural surface levels lowered by up to 20m. These approved sand extraction works will be undertaken as per the approved extraction levels (refer ***Appendix C***). The finished extraction levels will facilitate the future development of Class A lots without the requirement for fill importation or significant earthworks.

The developable portions of both lots will have sufficient separation to Maximum Ground Water Levels and are classified as having a Moderate to Low Risk of Acidic Sulphate Soils. However, any ground disturbing work in the vicinity of the CCW's may need to be assessed and possibly managed in accordance with the following DWER guides:

- Identification and investigation of acid sulphate soils and acidic landscapes (June 2015)
- Treatment and management of soil and water in acid sulphate soil landscapes (June 2015)

The proposed earthworks strategy will result in savings of up to $20,000 per lot when compared against similar development sites in the locality that will require significant fill to realise the same site classification and required clearances to groundwater levels.

4 Wastewater Reticulation

The subject land is located within the Water Corporation licensed area for operating sewerage services. The Water Corporation has advised that the site does not currently fall within a Water Corporation Sewer District, and that no wastewater planning has currently been undertaken for the advertised DSP area, as the area was only recently identified for potential urban development as part of the 2018 Sub-Regional Planning Framework.

Due to the zoning of the subject sites, they currently fall between two Water Corporation designated sewerage areas being Bullsbrook and Ellenbrook. Servicing strategies to be investigated will involve the installation of an internal standard gravity reticulation network to Water Corporation requirements to an external discharge point. The external discharge point will be subject to detailed design and Water Corporation's future strategic planning.

Preliminary discussions with Water Corporation have highlighted two possible sewer servicing strategies to service the site. Both strategies involve the installation of an internal standard gravity reticulation network and pumping station to Water Corporation requirements but differ in the means of their external discharge to mains sewer.

Strategy 1 would involve construction of a sewer pressure main (1800m) from the internal pumping station to a discharge chamber on Halden Road. Water Corporation have already planned to extend their gravity mains to this location. Due to the additional flows an upgrade in size of the planned gravity sewer mains will be required.

Strategy 2 would involve the construction of a sewer pressure main (1300m) from the internal pumping station to a proposed discharge chamber at a high point on Maralla Road to the East. This option will require a 1.7km extension of the planned sewer gravity mains down Maralla Road from Sawpit Road. Preliminary checks of cover and grade requirements under Tonkin Hwy have been positive. Due to the additional flows an upgrade in size of the planned gravity sewer mains from Sawpit Road to the Bullsbrook PS No 1 will be required.

Initial review suggests a Type 90 Pumping Station would be required to service the subject site area. A Type 90 Pumping Station consists of two pump sets located in a circular common wet-wells constructed of reinforced concrete with an internal diameter of 3.0m. This type of pumping station is used for permanent or temporary installations where the proposed ultimate pumping rate is more than 40L/s and does not exceed 90L/s.

5 Water Reticulation

The subject land is located within the Water Corporation's licensed area for provision of a potable water supply service. The Water Corporation has advised that no water planning has currently been undertaken for the advertised DSP area, as the area was only recently identified for potential urban development as part of the 2018 Sub-Regional Planning Framework.

The North-East Sub-Regional Planning Framework (March 2018) outlines some planned improvements to the existing water supply system including the provision of new water tanks north-west of Ellenbrook (Gaskell Road, Lexia). The Ellenbrook reservoir will be the primary water storage facility to support future urban and industrial development in the northern parts of the sub-region (refer Figure 7). Bullsbrook is also noted as requiring several new water tank sites, development of which will need to be staged over time to serve the proposed expansion of the townsite.

The proposed route of the transfer main between the Gaskell Road and Bullsbrook Tanks is to be along the development's southern boundary within Maralla Road. This main should be of sufficient size to cater for the proposed development, however the possibility of this main being part of the future water planning solutions for the North Ellenbrook DSP's will be confirmed through discussions with the Water Corporation. Servicing of the individual lots would be via the installation of a series of reticulation mains as per Water Corporation standards

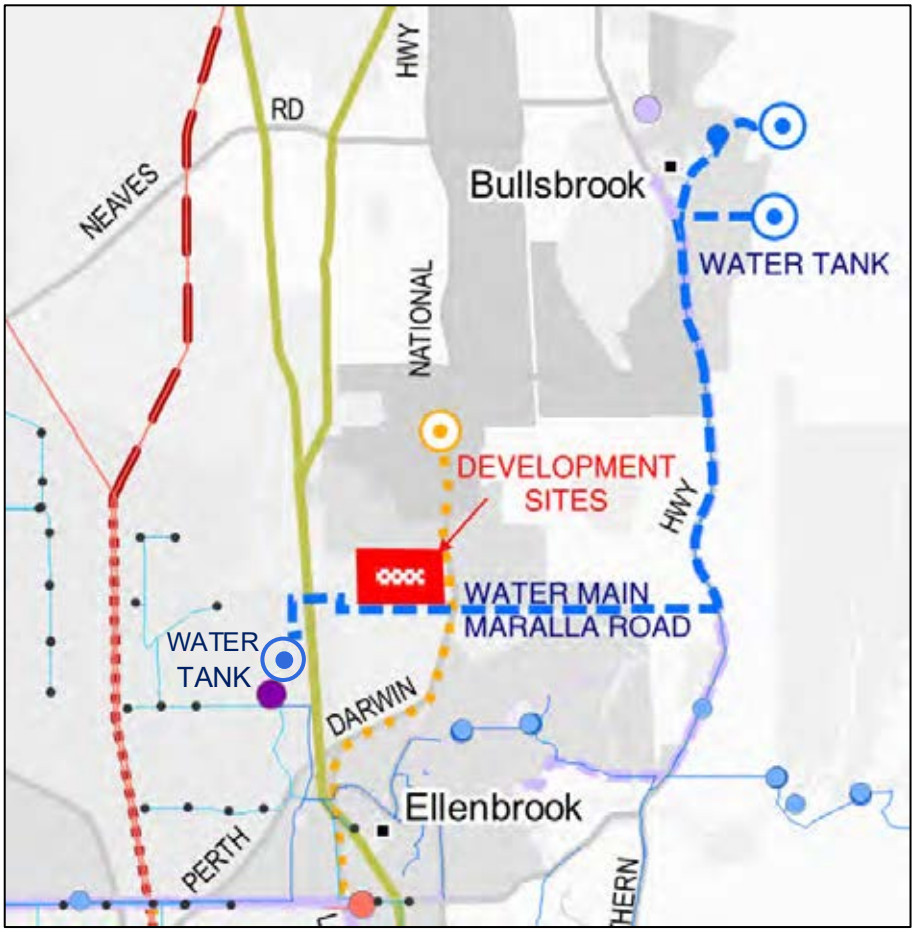


Figure 7: Plan 8 - North-East Sub-regional Planning Framework

There is also a significant existing water supply infrastructure system that services the Ellenbrook townsite. This includes a Water Corporation overhead tank that is located 2.7 km west of Ellenbrook and 3.8 km south of the proposed structure plan area. There are diameter 1200 mm and 900 mm

trunk mains that cross the Perth to Darwin Highway that feed smaller reticulation mains for distribution. Whilst there is currently no potable water supply servicing the structure plan area (or agreement between the Water Corporation as service provider and the proponents with regard to development and financing of these essential services), it is anticipated that reticulation extensions will come from this supply with alignment in future road reserves heading north to the structure plan area.

Capital funding for the new reservoir outlet and associated distribution mains is currently not on the Water Corporations capital investment program. In liaison with the Water Corporation, the proponents will need to further investigate the infrastructure alignment and resolve funding of any water headworks to enable development of the land prior to the 'lifting of Urban Deferment' process.

As Lot 5892 is located directly between the current approved DSP for North Ellenbrook West and existing Water Corporation infrastructure, Lot 5892 can readily be incorporated into the North Ellenbrook DSP west water planning investigation being undertaken by Water Corporation.

It is also to be noted that Water Corporation has only recently completed the installation of a DN400S / DN250 PVC distribution main from the existing Ellenbrook reservoir tank to the State's Centre for National Resilience. This new distribution main extends as a DN400 Steel pipeline to a location 700m immediately west of Lot 5892. The distribution main changes to a DN250 PVC main for the rest of the alignment along Warbrook Road to the currently closed Centre for National Resilience. The possibility of utilising this pipeline as a source for potable water for the Lot 5892 should be investigated.

6 Roadworks

The surrounding road network is under the control of the City of Swan and as such all works on and abutting the public roads will be subject to their approval. The existing roads abutting and surrounding the development are generally considered to be a rural standard. Tonkin Hwy abuts Lot 108 along the eastern boundary. Tonkin Hwy is a 'Red' category road and falls under the control of MRWA. Currently access to the subject land is via the Stock Road and Tonkin Hwy interchange approximately 5 kilometres to the north.

Based on the current proposed plans, access to the Development site will be via existing Halden Road and future road connections into the advertised DSP. Access off Tonkin Hwy is proposed to be at one of the two proposed interchange options in the advertised DSP.

The preferred location for the interchange is the southern option due to the following:

- It affects only one landowner
- Construction costs will be lower due to Tonkin Hwy being in 'cut' at this location and additionally the interchange will not clash with the existing watercourse which is the case with the northern option.
- A more direct access to an existing road to the west, "Halden Road".

The new road network within the development will be consistent with standard residential developments including kerbed and asphalted pavements and road cross-sections will be designed to align with the existing landform. In all cases the road cross sections will be designed to cater for utility services on standard verge alignments and appropriate stormwater management strategies.

It is expected that surrounding roads such as Halden Road and Maralla Road will require upgrades to urban residential standards.

JDSi understand that a Transport Impact Assessment would be required to be completed to inform any future Scheme Amendments and Local Structure Planning.

7 Stormwater Drainage

Urban Water Management (UWM) is now a key part of any development process incorporating principles of integrating water and land use planning, considering all water sources in water planning, integrating water use and natural water processes and a total catchment integration of natural resource use and management (Ref. Stormwater Management Manual for Western Australia, DOW, April 2004 the State Water Strategy 2003 and the State Water Plan 2007).

Stormwater drainage management is a major component of an overall UWM strategy for which achievement of the principles of the plan may be facilitated through the application of Water Sensitive Urban Design (WSUD) techniques during planning, design, and construction of urban development projects. Objectives of WSUD include but are not limited to the following:

- Detention of stormwater rather than rapid conveyance to maintain pre development flows for quantity management.
- Use of vegetation for filtering purposes and nutrient stripping for quality management.
- Use of stormwater to conserve potable water; and
- Water efficient landscaping.

JDSi understand that a DWMS would be required to be completed to inform any future Scheme Amendments and Local Structure Planning.

It is anticipated that the stormwater management strategy for the site will include the following:

- Maintain pre-development peak flow rates into and out of the site.
- Set habitable floor levels at least 0.3 m above the 1% AEP flood level of the urban drainage system.
- Utilise a pit and pipe network, or roadside swales where possible, to cater for flows up to 20% AEP rainfall events, while greater than 20% AEP flow will be conveyed via overland flow through the road network.
- Retain and infiltrate rainfall on site using basins and/or underground storage.
- The stormwater drainage design demonstrates that the land is capable of managing stormwater for all events up to the 1% AEP event.
- Controls used to improve stormwater quality will be included within roadside swales, open channels, and stormwater retention systems such as planting of specific vegetation and possible utilisation of an amended soil profile to assist in nutrient retention and breakdown.
- The use of native vegetation where practicable, minimal fertiliser application and soil amendment in major drainage areas will assist with the management of groundwater and surface water quality.

As the City of Swan will ultimately own and maintain all stormwater infrastructure the design and construction work will need to be undertaken in accordance with their guidelines and standards, as well as the Local Government Guidelines for Subdivisional Development (IPWEA).

8 Power Supply

8.1 Existing Power Network

The following advice is based on a JDSi desktop study and support information obtained from the Western Power NCMT (Network Capacity Mapping Tool) online database.

The North-East Sub-Regional Planning Framework (March 2018) outlines some planned improvements to the power reticulation network to cater for the planned urban development in the area. These works would see a new transmission line from the Muchea Zone Substation to a new Bullsbrook Substation with the proposed cable alignment along the eastern boundary of the subject land (refer Figure 8).

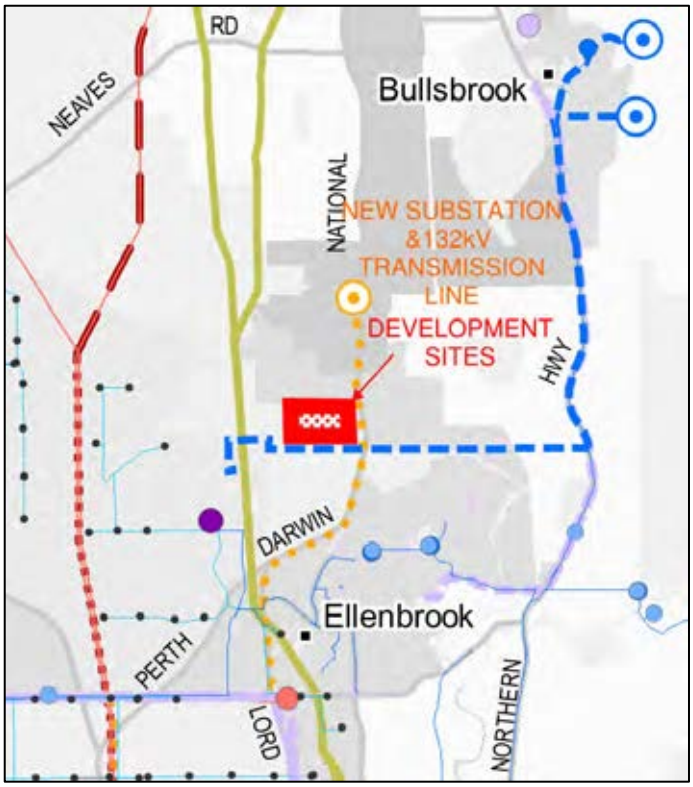


Figure 8: Plan 8 - North-East Sub-regional Planning Framework

8.2 Proposed Power Network

The anticipated power demands of the site can be broken up as follows:

Lot 5892				
Load Type	**Information**	**Load (kVA)/lot**	**No. Lot**	**Total (kVA)**
Residential	Western Power DADMD Calculator	4.7	2208	10,378
Commercial	Western Power UDS Manual	200/hectare	0.5hectares	100
Primary School	Western Power UDS Manual	250	1	250
POS	Western Power UDS Manual	5	9	45
Proposed Total Load				**10,773**

Table 1: Power Load Breakdown – Lot 5892

Western Power's Network Capacity Mapping Tool (NCMT) forecasts the remaining capacity as for 2020 at the Muchea Substation to be 25-30MVA. However, access to the available capacity will be dependent on the installation of the planned 132kV transmission line and substation.

In the immediate term, there is an existing 22kV distribution overhead network approximately 700m north of the proposed development on Halden Road which may be suitable for connection of the development site's initial stages.

9 Gas

ATCO Gas own and maintain the existing underground gas network in the vicinity of the Development. Although no gas networks exist in the direct proximity of the subject sites it is expected that domestic reticulated gas will be progressively supplied as development progresses in the area.

Reticulated gas is not considered to be an essential service and as such is not required as a condition of subdivision. However, it is usual practice to install a gas reticulation network for a residential subdivision within a common civil services trench. If there is an extension required to connect to the nearest main or to bore under major roads the Developer will be required to pay for this as a headworks cost. All new gas installations will be designed by ATCO Gas and installed as part of the civil works.

10 Telecommunications

Whilst the Site is not currently within NBN's rollout footprint, there are numerous development areas in close proximity to the subject sites that will trigger expansion of the network without any significant backhaul costs applicable to this development. Similar to the other services reported in this assessment, it is anticipated that an interim servicing option can be achieved if required to service the initial stages of the development.

General communication services for the development will consist of the installation of a standard pit and pipe network in accordance with NBN Co guidelines and standards. The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

To progress the design and installation of a new communications network a New Development Application will need to be submitted to NBN and this agreement would confirm any Developer requirements. Developers will be required to cover the costs of trenching and ducting for the infrastructure, however NBN Co will cover the other costs of installing fibre infrastructure, including backhaul (subject to a feasibility assessment by NBN).

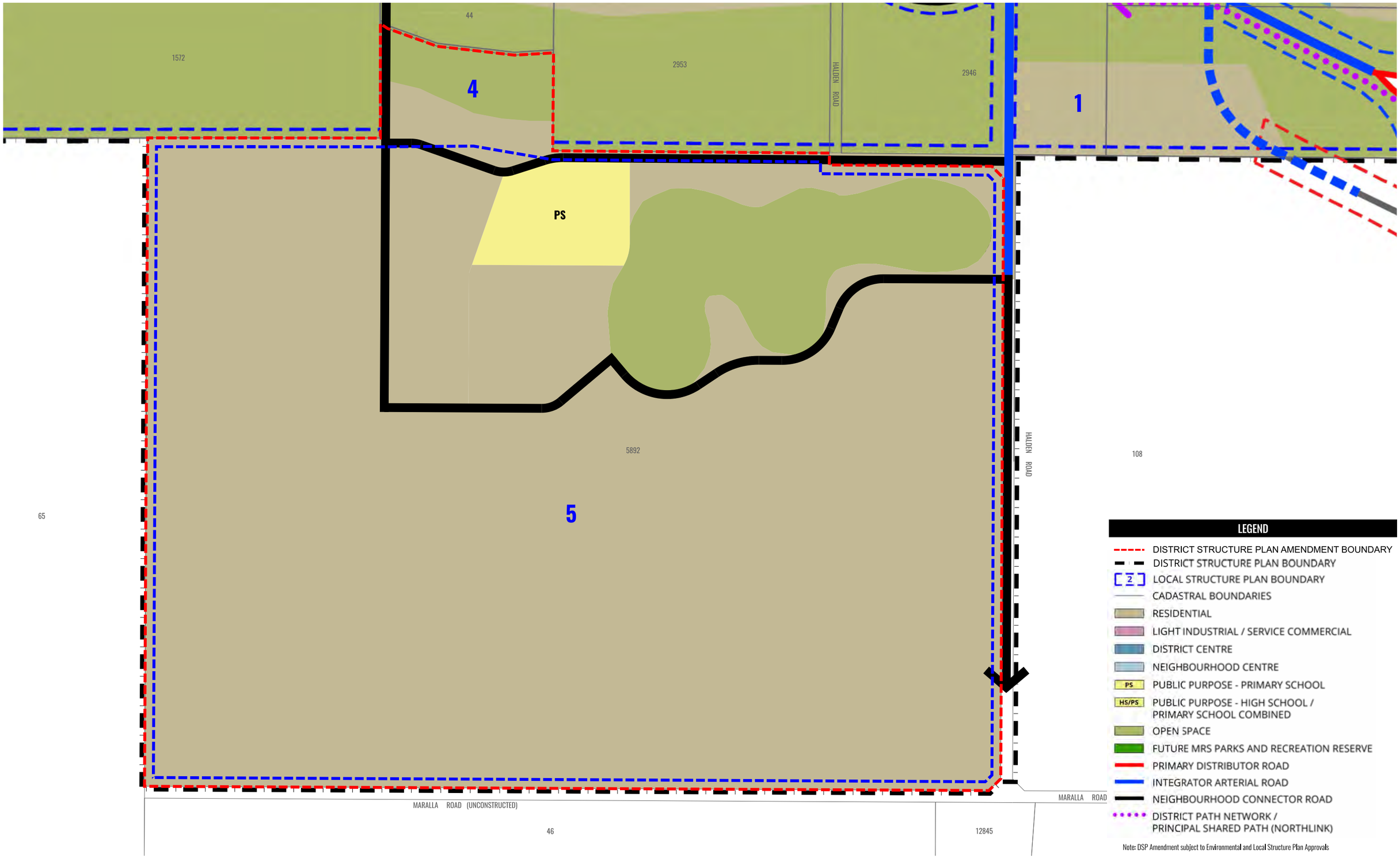
11 Disclaimer

JDSi have undertaken this assessment based on a desktop study and preliminary discussions with service authorities and subsequently assumptions have been made which, if incorrect, have the potential to change the assessment and/or recommendations. Major cost implications exist through factors which cannot be assured at this time including, but not limited to, upgrading and provision of utility services, conditions of development, Local Authority Scheme Requirements, ground conditions and timing of adjacent developments.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office.

APPENDIX A
DISTRICT STRUCTURE PLAN



Note: DSP Amendment subject to Environmental and Local Structure Plan Approvals

DISTRICT STRUCTURE PLAN

Lot 5892 Maralla Rd, BULLSBROOK

An Stockland Project

DRAFT

NORTH

Scale: 1:6000 @ A3

0 60 120 180m

PLAN: STONE-2-001 REVISION: A

DATE: 09/02/2022 DRAWN: JP

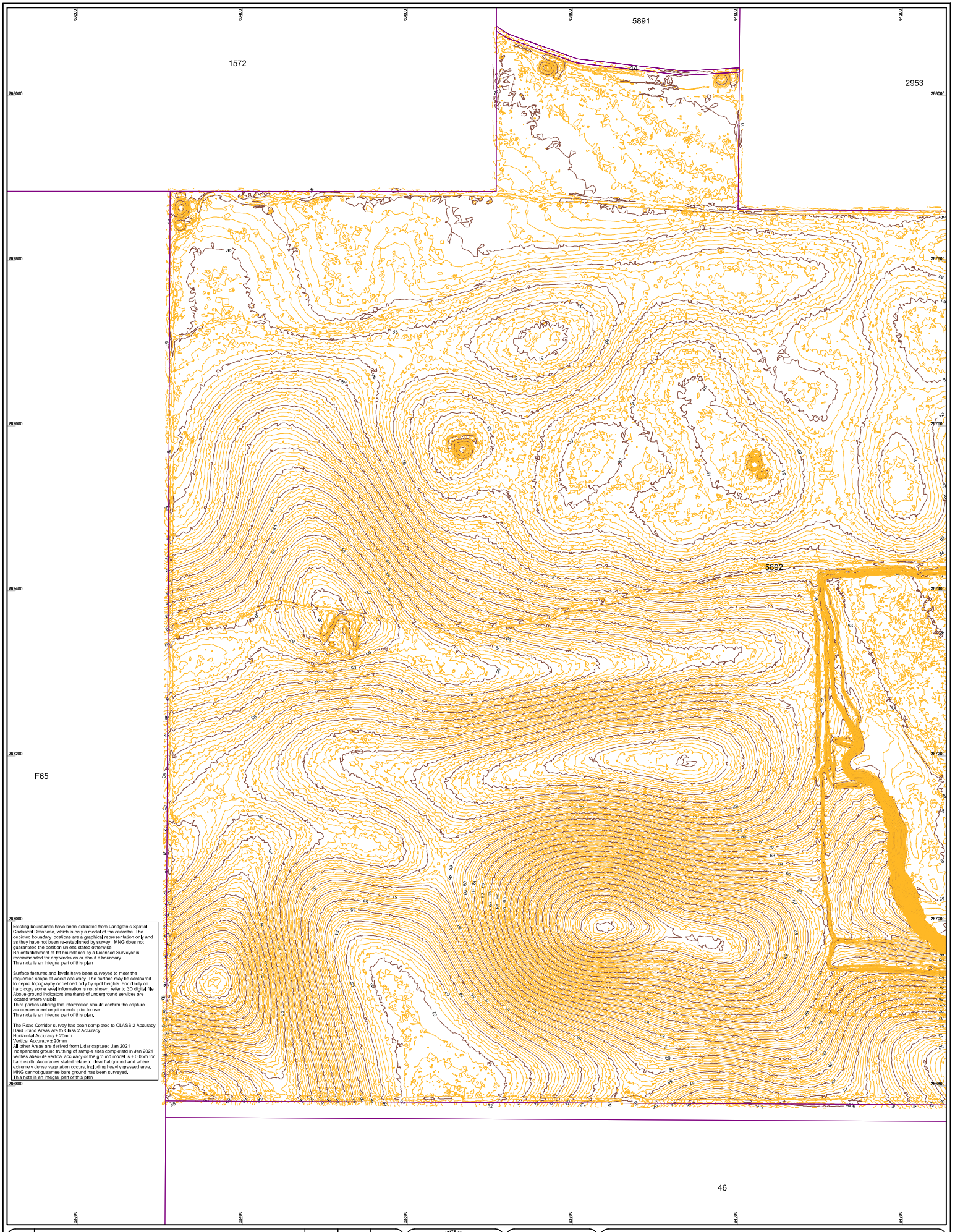
PROJECTION: PCG 94 PLANNER: BK

DATUM: AHD CHECK: CH

cdp Town Planning & Urban Design

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

APPENDIX B
FEATURE SURVEY



Existing boundaries have been extracted from Landgate's Spatial Cadastral Database, which is only a model of the cadastre. The depicted boundary locations are a graphical representation only and as they have not been re-established by survey, MNG does not guaranteed the position unless stated otherwise.
Re-establishment of lot boundaries by a Licensed Surveyor is recommended for any works on or about a boundary.
This note is an integral part of this plan

Surface features and levels have been surveyed to meet the requested scope of works accuracy. The surface may be contoured to depict topography or defined only by spot heights. For clarity on hard copy some level information is not shown, refer to 3D digital file. Above ground indicators (markers) of underground services are located where visible.
Third parties utilising this information should confirm the capture accuracies meet requirements prior to use.
This note is an integral part of this plan.

The Road Corridor survey has been completed to CLASS 2 Accuracy
Hard Stand Areas are to Class 2 Accuracy
Horizontal Accuracy ± 20mm
Vertical Accuracy ± 20mm
All other Areas are derived from Lidar captured Jan 2021
Independent ground truthing of sample sites completed in Jan 2021 verifies absolute vertical accuracy of the ground model is ± 0.05m for bare earth. Accuracies stated relate to clear flat ground and where extremely dense vegetation occurs, including heavily grassed area, MNG cannot guarantee bare ground has been surveyed.
This note is an integral part of this plan.

Rev.	Description	Drawn	Date	Checked
A	Initial Issue	DRD	07/05/2021	CAY

Surveyor:- JBL
Survey Date:- 30/04/2021
Precal/Cad:- SCDB

LOT 5892 MARALLA ROAD
BULLSBROOK
DETAIL SURVEY (Sheet 1 of 2)

CLIENT: **STOCKLAND DEVELOPMENT PTY LTD**

The contents of this plan are current and correct as of the date stated within the revision panel. All conditions and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

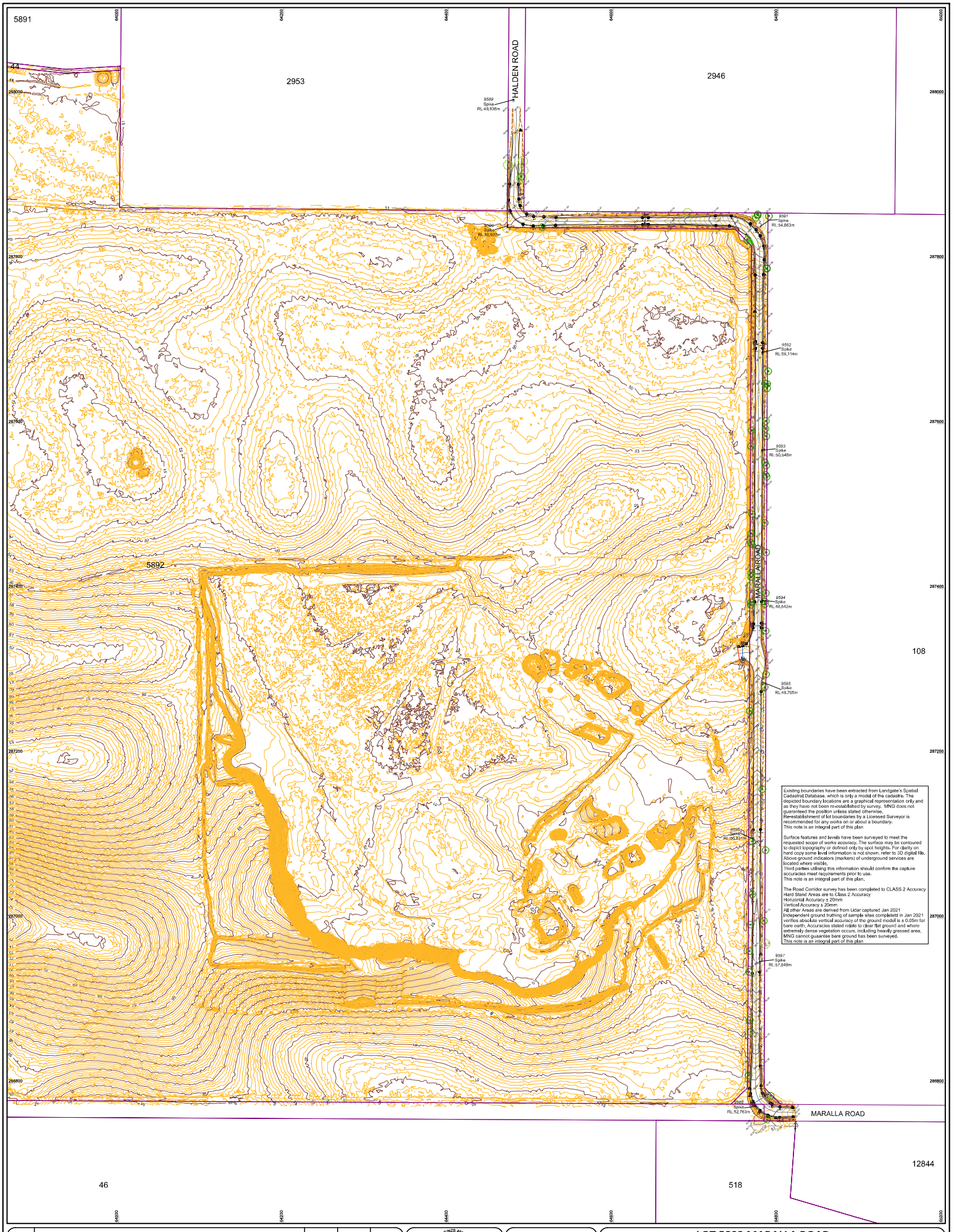
SCALE 1:2000 @ A1
0 50 100 150 200
ALL DISTANCES ARE IN METRES
For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

The boundaries shown on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Existing easements, encumbrance or interest are not depicted and a title search is recommended to obtain this information. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.

MCMULLEN NOLAN GROUP
Level 1, 2 Sabre Crescent
Jandakot, W.A. 6164
PO Box 3526, Success
W.A. 6964, Australia
Offices in: Perth | Melbourne | Kimberley| South West WA
Tel: (08) 6436 1599
Fax: (08) 6436 1500
info@mngsurvey.com.au
www.mngsurvey.com.au
ABN 90 009 363 311

Project Mngr	Charles Younge	Datum	PCG94 / AHD

Job Number	Type	Plan Number	Revision
104027	DE	003	A



Rev.	Description	Drawn	Date	Checked
A	Initial Issue	DRD	04/05/2021	CAY

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ALL DISTANCES ARE IN METRES
For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

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Surveyor:- JBL
Survey Date:- 30/04/2021
Precal/Cad:- SCDB

LOT 5892 MARALLA ROAD BULLSBROOK DETAIL SURVEY (Sheet 2 of 2)

CLIENT: **STOCKLAND DEVELOPMENT PTY LTD**

The contents of this plan are current and correct as of the date stated within the revision panel. All amendments and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

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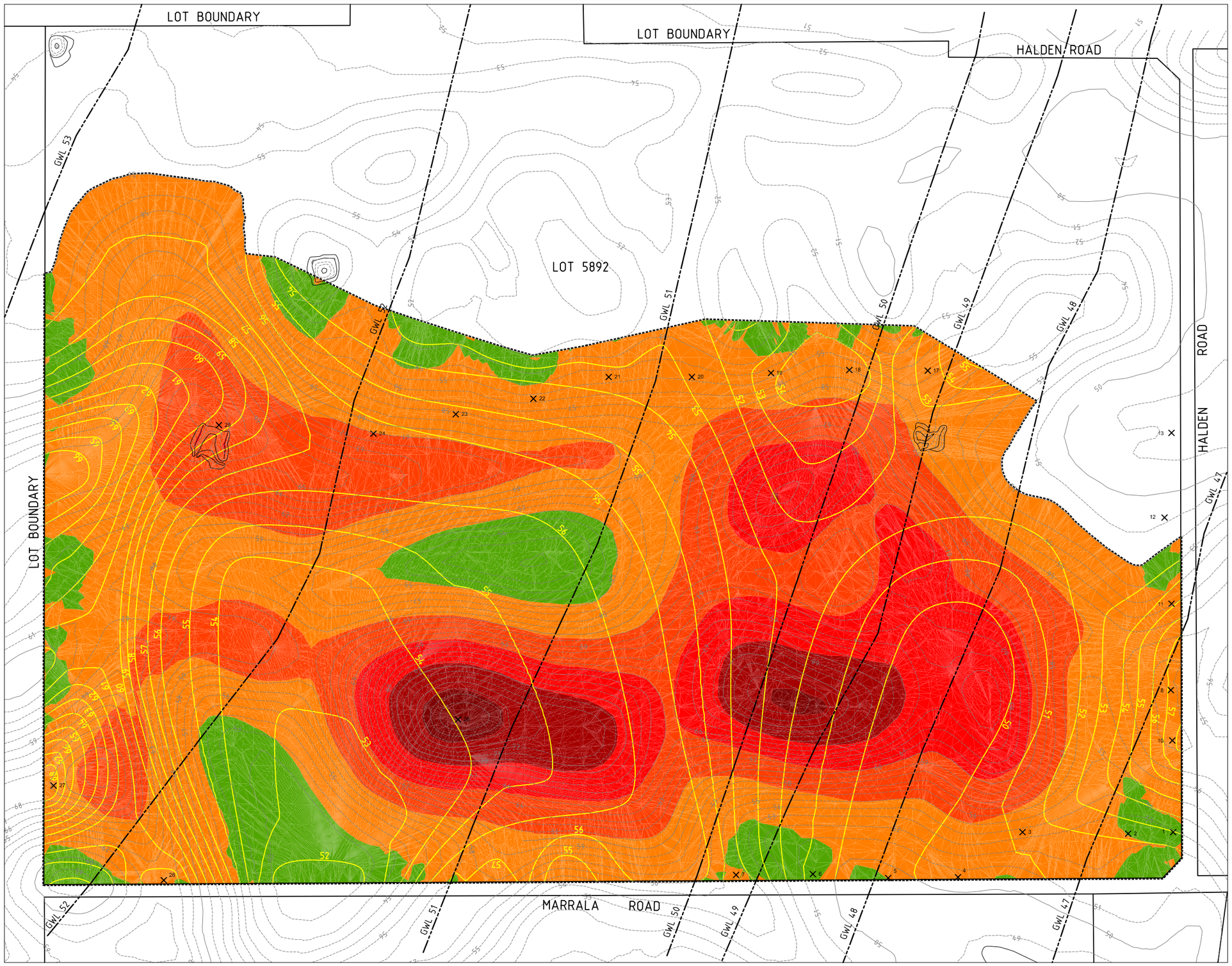
Level 1, 2 Sabre Crescent
Jandakot, W.A. 6164
PO Box 3526, Success
W.A. 6964, Australia
Offices in: Perth | Melbourne | Kimberley| South West WA
Tel: (08) 6436 1599
Fax: (08) 6436 1500
info@mngsurvey.com.au
www.mngsurvey.com.au
ABN 90 009 363 311

Project Mngr	Charles Young	Datum	PCG94 / AHD

Job Number	Type	Plan Number	Revision
104027	DE	003	A

APPENDIX C
APPROVED EXTRACTION LEVELS



PLAN
SCALE 1:4000

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SHOWN.

LEGEND

- LIMIT OF SAND EXCAVATION WORKS
- 50 EXISTING CONTOURS
- 50 FINISHED SURFACE CONTOUR (1.0m INTERVAL)
- ×23 DRILL LOG LOCATIONS
- GWL 48 GROUND WATER LEVEL (HISTORICAL MAX)

DEPTH KEY

CUT
- 20.0m TO 25.0m
- 15.0m TO 20.0m
- 10.0m TO 15.0m
- 5.0m TO 10.0m
- 0.0m TO 5.0m

FILL
- 0.0m TO 5.0m

VOLUMES

TOTAL CUT	5360000m³
TOTAL FILL	74000m³
PLAN AREA	103.5Ha

metres
0 80 160 240 320m
SCALE 1:4000

REV	DATE	DRAWN	CHECKED	APPROVED	REVISION DESCRIPTION	REFERENCE DRAWINGS
A	22.08.07	DAH	JHG	MB	ISSUED FOR CLIENT REVIEW	

NOTE
This drawing shall be preliminary only until the approved sections are signed.

JDSi
INFRASTRUCTURE & LAND DEVELOPMENT
3/5 Tully Road, East Perth Western Australia 6004
P: (08) 9225 4110 F: (08) 9225 4121

CLIENT:
BRAJKOVICH HOLDINGS
STEFANELLI NOMINEES

PROJECT:
LOT 5892 MARALLA ROAD

DRAWING TITLE:
EARTHWORKS PLAN

DRAWN: DAVID HELLMUTH			
DESIGNED: JASON GRAY	SCALE: 1:4000		
PROJECT MANAGER: MICK BEAVERSTOCK	DATUM: AHD	CO-ORDS: MGA 94	
JDSi PROJECT No.: JDS07027	DRAWING No: C100	REVISION: A	

Town Planning & Urban Design

p. 08 6333 1888

e. info@cdpaus.com.au

a. 2/464 Murray St,
Perth WA 6000

PO Box 8002
Cloisters Square 6850

cdpaus.com.au