Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your ref: J6195e
Our ref: RF14675
PA: 17036
Enquiries: Mark Hingston

JDA Consultants Hydrologists
PO Box 117
Subiaco WA, 6008

Attn: Scott Wills

Dear Scott

RE: *Treeby (Banjup) - Strategic District Water Management Strategy*

Thank you for the Treeby (Banjup) - Strategic District Water Management Strategy (DWMS) received in October 2017. The Department of Water and Environmental Regulation (DWER) has reviewed the plan and is satisfied with the document subject to any further comments from the City of Cockburn.

Water Resource Advice Only
The Department of Water has recently merged with the Department of Environment Regulation and Office of the Environmental Protection Authority to create the new agency Department of Water and Environmental Regulation.

The former agencies are in the process of amalgamating their functions. Until this fully occurs, please note that the advice in this correspondence pertains only to water resource matters previously dealt with by the Department of Water.

If you wish to discuss the above further please contact Mark Hingston at the DWER Mandurah Office on (08) 9550 4222.

Yours sincerely

M. Hingston

for Jane Sturgess
A/Program Manager – Land Use Planning
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November 8, 2017

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Perron Developments Pty Ltd

Treeby (Banjup) Strategic District Water Management Strategy

October 2017

JDA Consultant Hydrologists

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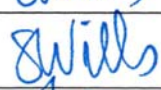
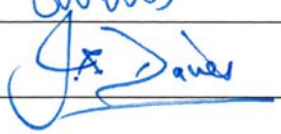
Checked by	Scott Wills		05 October 2017
Approved by	Jim Davies		05 October 2017

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

EXECUTIVE SUMMARY

Lots 1, 2, 4, 140, 820 and 9004 Armadale Rd; Lot 1 Ghostgum Avenue; Lots 131, 132, 467, 500 and 9002 Jandakot Road; Lots 62 to 75 Skotsch Rd; and Lots 139, 468, 533, 614 and 800 Warton Road, Banjup have historically supported several rural and quarrying land uses including sand extraction and brick manufacturing with considerable clearing of vegetation and substantial quantities of sand removed. The area is hydrologically unconstrained with free draining sandy soils, clearance to groundwater, moderate to low risk of Acid Sulphate Soils (ASS), and no regional surface water features.

The primary constraint to rezoning is the P1 and P2 Water Protection Zone which covers a portion of the Study Area. Urban development is listed as an incompatible land use within P1 or P2 areas. With appropriate controls in place, urban development is compatible with a P3 classification. The DoW is the lead agency in protecting catchments for water supply in WA.

The reclassification of the land from P2 to P3 Water Protection Zone (with the retention / application of P1 zone over retained bushland) will occur upon rezoning of land to Urban under the MRS. Consideration of groundwater impacts will occur as part of the rezoning process, with the implementation of best practice water sensitive design to include the dot points enlisted below:

- Identification of a Study Area within the Draft South Metropolitan Peel Sub Regional Framework and classification of this land within short to medium term development timeframes.
- The proximity of the site to a high order Activity Centre, Railway Station and Freeway Interchange.
- The site represents a logical extension of development east of the developing Calleya Estate.
- A large portion of the site has been cleared and disturbed for sand quarrying operations.
- Consolidated ownership of sites enabling master planning and application of best practice urban water management.
- Service infrastructure within the area can accommodate the additional urban development.
- Compliance with the criteria for urbanisation included within State Planning Policy 2.3 – Jandakot Groundwater Protection (WDPC, 2011).

A number of initiatives will be applied to limit any potential groundwater impacts associated with urban development, including:

- Extension of deep sewer to all lots;
- Application of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Provision of lot types which maximise land use efficiency and reduce excessive garden area and hence fertiliser and pesticide use;
- Encourage home purchasers to use native plants for landscaping (which will also reduce fertiliser and pesticide use);
- Use of promotional information to land purchasers aimed at raising awareness of water issues;
- An on-going monitoring programme;
- Exclusion of high risk land uses from the development area (e.g. service station).

The information provided in the Strategic District Water Management Strategy (SDWMS) demonstrates that the Study Area can support urban development and best practice urban water management.

SUMMARY OF SDWMS DESIGN OBJECTIVES

Key Guiding Principles

- Provide a framework for the preparation of future LWMS
- Facilitate implementation of sustainable best practice urban water management
- Provide integration with planning processes and clarity for agencies involved with implementation
- Protection of infrastructure and assets from flooding and inundation
- Encourage environmentally responsible development

Category	SDWMS Objectives
Stormwater Management	• Non-structural measures to reduce applied nutrient loads • At source retention of 1yr 1hr ARI events • On site infiltration of all stormwater runoff of at least 5yr ARI and 100yr ARI where suitable.
Groundwater Management	• No management of groundwater levels is requires (subsoil drainage) • Finished levels to provide sufficient separation to groundwater to allow infiltration of stormwater on-site to enhance recharge to the Jandakot Mound. • Limit impacts to Bush Forever and wetland sites. • Limit groundwater abstraction. • Manage fertiliser and pesticide application in streetscapes and POS areas using soil amendments, appropriate plant selection, limiting turf areas and maintenance management plans.
Water Conservation and Sustainability	• Ensure that non-potable water supply systems are considered as part of an integrated water supply; • Household target water use of 100 kL/person/year; • Scheme water target use of 40-60 kL/person/year • Use of waterwise landscaping practices both at development and lot scale.
Water Quality	• Adopt nutrient load reduction design objectives for stormwater runoff • Use of amended soils and ephemeral bio-retention systems to treat stormwater.
Monitoring	• Pre-development monitoring to inform decisions at LWMS stage • Post-development programme to ensure water quality targets are met.

1. INTRODUCTION

This Strategic District Water Management Strategy (SDWMS) has been prepared by JDA Consultant Hydrologists on behalf of Perron Developments Pty Ltd. The SDWMS area comprises Lots 1, 2, 4, 820 and 9012 Armadale Rd; Lot 1 Ghostgum Avenue; Lots 9016, 9021, 131, 467 and 500 Jandakot Road; Lots 62 to 75 Skotsch Rd; and Lots 139, 468, 140 and 614 Warton Road, Banjup comprising a total area of approximately 461 ha (Figure 1), herein referred to as the Study Area.

The Study Area is located within the City of Cockburn, approximately 19 km south of Perth and 2.5 km from Cockburn Central and the Kwinana Freeway.

This SDWMS has been prepared to provide a coordinating framework and to guide the key requirements for water sensitive urban design. The preparation of this SDWMS has been prepared in consultation with relevant stakeholders.

1.1 Planning Context

1.1.1 Drinking Water Source Protection Areas

The site is located in the Jandakot Underground Water Pollution Control Area (JUWPCA) (DoW, 2013c).

The JUWPCA occupies a total area of 7400 ha, including more than 4000 ha within the City of Cockburn. The JUWPCA was Proclaimed in 1975 under the Metropolitan Water Supply Sewerage and Drainage Act 1909. Water from the Jandakot mound is extracted by the Water Corporation as part of the Perth Metropolitan integrated water supply system (IWSS) (WAPC, 1998).

The DoW is the lead agency in protecting catchments for water supply in Western Australia. The Department supports the Australian Drinking Water Quality Guidelines (ADWQG) barrier approach to water quality protection, with catchment management the first barrier of protection. Subsequent barriers are water storage, treatment and disinfection. The catchment management measures are also supported by Wellhead Protection Zones (WPZ) around public water supply wells. Two public water supply production wells are located within the Study Area, one on the western boundary (P2, UWPCA) and one on the eastern boundary (P1, UWPCA); see Figure 2. These production wells (located in the UWPCA) currently require a WPZ of 300 m radius. WPZ's are generally circular (unless information is available to determine a different shape or size) (DoW, 2009a).

Water Quality Protection Note 36 (WQPN) (DoW, 2009a) sets out the groundwater catchment priority classification system. Water Quality Protection Note 25 (DoW, 2016) sets out land use compatible with Public Water Source Priority areas.

Priority 1 (P1) – P1 source protection areas are defined to ensure no degradation of the water source. P1 areas are declared over land where the high quality drinking water is the prime beneficial land use protected in accordance with the objective of risk avoidance.

Priority 2 (P2) – P2 source protection areas are defined to ensure there is no increased risk to the water source. P2 areas are generally declared over land with low intensity development such as pasture which already exists. Public water supply protection is of a high priority relative to other land use values protected in accordance with the objective of risk minimisation.

Priority 3 (P3) – P3 source protection areas are defined where it is necessary to manage the risk of pollution to the water source where other land use such as residential areas occur. P3 areas generally have the requirement of using best management practices and connection to deep sewerage. P3 areas are protected in accordance with the objective of risk management.

Other information provided in the WQPN includes (DoW, 2009a):

- DoW's advice on land and water based activities in proclaimed Public Drinking Water Source Areas (PDWSA);
- Best Management Practices (BMPs) guidance used to protect water quality in PDWSAs;
- Overview of legislation, policies and processes used to protect PDWSAs; and
- The development of a multi-agency guideline designed to balance views of community, industry and government, in order to maintain a reliable safe public drinking water supply.

1.1.2 Land Use Zoning

Lots 131, 500 Jandakot Road, 62 to 75 Skotsch Road, and Lots 2 and 4 Armadale Road are currently zoned 'Rural – Water Protection'; Lots 140, 139, 468, 614 and 800 Warton Road are zoned 'Parks and Recreation' and; Lots 467 Jandakot Rd and 139 Warton Road are zoned 'Public Purpose (Special Uses)' under the Metropolitan Region Scheme (MRS) (Figure 2). Implementation of the DSP would see Lots 2, 4 and 131 as 'Urban'.

Lots 1, 9021, 9016 and 9012 were rezoned 'Urban' under Metropolitan Region Scheme Amendment 1221/4, 1 gazetted in January 2013. The site is currently undergoing subdivision (Calleya Estate) in line with water management plans prepared for the site. The plans include an approved District Water Management Strategy (Emerson Stewart, 2011), Local Water Management Strategy (PDC, 2013) and Urban Water Management Plan (UWMP).

Lot 821 Ghostgum Avenue has recently been rezoned to 'Urban' under the MRS and includes a DWMS (Hyd2o, 2013).

Lots 2, 4 and 131 have been identified as 'Urban Investigation' within Perth and Peel @ 3.5 Million Draft Sub-Regional Spatial Framework (Structure Plan). An MRS rezoning application is currently being considered by WAPC for Lots 2 and 4, also supported by a DWMS (JDA, 2015).

The urban area demarcated as Lot 131 within the DSP reflects a refinement to the area illustrated within the draft Perth and Peel @ 3.5 Million Sub Regional Planning Framework. The refinement is based on a detailed review of the site undertaken as part of the DSP exercise and is consistent with a detailed submission made on the draft Frameworks documents during public advertising. The revised boundary has been the subject of consultation with the Department of Planning and other agencies and is subject to formal determination through the finalisation of the Frameworks documents and subsequent rezoning.

This SDWMS supports the Treeby District Structure Plan as shown on Figure 3. This SDWMS consolidates background information and provides broad direction to inform preparation of Local Water Management Strategies.

1.1.3 Land Use Rezoning

The primary constraint to rezoning is the P1 and P2 Water Protection Zone which covers a portion of the Study Area. Urban development is not a compatible land use within P1 or P2 areas. With appropriate controls in place, development is compatible with a P3 classification.

The reclassification of the land from P2 to P3 Water Protection Zone (with the retention / application of P1 over retained bushland) will occur upon rezoning of land to Urban under the MRS. Consideration of groundwater impacts will occur as part of the rezoning process, with the implementation of best practice water sensitive design to include the following additional dot points enlisted below:

- Identification of a Study Area within the Draft South Metropolitan Peel Sub Regional Framework and classification of this land within short to medium term development timeframes.
- The proximity of the site to a high order activity centre, railway station and freeway interchange.
- The site represents a logical extension of development east of the developing Calleya Estate.
- A large portion of the site has been cleared and disturbed for sand quarrying operations.
- Consolidated ownership of sites enabling masterplanning and application of best practice urban water management.
- Service infrastructure within the area can accommodate the additional development.
- Compliance with the criteria for urbanisation included within State Planning Policy 2.3 – Jandakot Groundwater Protection (WDPC, 2011).

1.1.4 Relevant Documents

Key documents used to guide the SDWMS are:

- State Planning Policy No. 2.3: Jandakot Groundwater Protection Policy (WAPC, 1998)
- Better Urban Water Management (WAPC, 2008);
- Stormwater Management Manual for Western Australia (Department of Water, 2009b); and
- Liveable Neighbourhoods (WAPC, 2007).

2. SITE CHARACTERISTICS

2.1 Land Use

The Study Area includes former sand quarries and brick manufacturing sites, semi-rural residential lots, remnant native vegetation, Rose Shank Reserve, Banjup Memorial Reserve and Cockburn Fremantle Pistol Club. The sand extraction has included in gradual clearing of vegetation with substantial quantities of sand removed. Three surface expressions of groundwater exist as a result of sand extraction, described in Section 2.7 below.

2.2 Rainfall

The long term average annual rainfall (1972 to 2016) at the closest Bureau of Meteorology's monitoring site, Jandakot Aero (Station No: 009172) located approximately 2.5 km to the north of the Study Area, is 824.3 mm. The short term (2003 to 2016) average annual rainfall is 726.9 mm, a decrease of approximately 12%, with most of the reduction occurring during the winter months.

2.3 Topography

Topographic mapping from Landgate (DoW, 2013d) shows a mixture of undulating and steep rises with elevations ranging from 28 to 42 mAHD (Figure 4). The steep rises are a result of the previous sand extraction carried out across the Study Area.

2.4 Surface Geology

Surface geology mapping by Gozzard (1986) is shown on Figure 4.

The surface geology of the Study Area is classified by Gozzard as Bassendean Sands (S8 and S10). S8 sand is described as very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin. S10 sand is described as S8 sands, but occurring as a thin veneer over clayey sands of the Guildford Formation.

2.5 Acid Sulphate Soils

The WAPC *Planning Bulletin No. 64* (2009) classifies the Study Area as having moderate to low risk of actual acid sulphate soils (AASS) or potential acid sulphate soils (PASS) occurring at depths < 3m from the soil surface (DoW, 2013a) (Figure 5).

2.6 Contamination

The status of the resolution of contamination issues for the Study Area is summarised in the Environmental Assessment report prepared by 360 Environment (2016). Parts of some lots within the Study Area have been sources for sand extraction while the remainder are covered with native vegetation. There is a relatively small potential for lots that have been quarried to be contaminated as a result of chemical and hydrocarbon storage.

Contamination studies have been performed over parts of the Study Area particularly Lot 4 and Calleya and these issues are being addressed as required by the Contaminated Sites Act 2003. Boral Pty Ltd is responsible for the ongoing testing and remediation of the isolated hydrocarbon spills on Lot 4 within the Study Area. Boral Pty Ltd is currently undertaking testing and remediation in consultation with a contaminated sites auditor and the Department of Water and Environment Regulation (DWER).

Consequently, contamination issues will be dealt with in a manner consistent with the requirements of the Contaminated Sites Act 2003.

2.7 Wetlands and Significant Vegetation

Geomorphic Wetland mapping (DoW, 2013b), Figure 6 shows there are three (3) Resource Enhancement Wetlands (REW) and one (1) Conservation Category Wetland (CCW) within the Study Area.

Bush Forever site 390 currently occupies 172 ha of the Study Area. The final boundary is subject to a negotiated planning solution in order to manage the integration of the Bush Forever with the planning and design of the urban development.

Impacts to the wetlands and significant vegetation will be mitigated through the implementation of the following management measures:

- Retention of wetlands within regional and local POS areas within the DSP;
- Provision of appropriately sized buffers for the wetlands. These will be defined at Local Structure Planning stage through consultation with the City of Cockburn and DPaW;
- Overarching Open Space Masterplan;
- Wetland Management Plan;
- Bushfire Management Plan;
- Local Water Management Strategy; and
- Urban Water Management Plan.

It should be noted that the artificial water bodies within the site are not natural wetlands and will be in-filled during the development. Infilling the water bodies would ideally be undertaken in summer when water levels tend to be at their lowest.

Further detailed investigations through the LWMS and UWMP may identify opportunities to integrate stormwater management in the wetlands, including storage of minor rainfall events within wetland buffers and overflow into wetlands in less frequent rainfall events.

2.8 Surface Water Hydrology

No natural surface water features are present across the Study Area. Groundwater expressions are found in three locations and are the result of previous sand extraction (Figure 6).

2.9 Hydrogeology

2.9.1 Superficial Aquifer

The superficial aquifer in this region is referred to as the Jandakot Mound, and extends over an area of approximately 522 km^2. The aquifer has a maximum thickness of 40 m and includes three formations which are, in order of increasing depth: Bassendean Sand, Gnangara Sand and Ascot Formation. Aquifer transmissivities range between 200 to 1000 m^2/d (Davidson, 1995).

The formations are highly permeable with horizontal hydraulic conductivity ranging between 10 to 50 m/d. In the Jandakot area, where limonite cement (coffee rock) is present, horizontal hydraulic conductivity may reduce to less than 10 m/d (Davidson & Yu, 2008). Site specific investigations completed to date indicate limonite cement is more extensive than indicated on regional mapping (Emerson Stewart, 2011 and JDA, 2013). Given the extent of the limonite mapped over Calleya and Lot 4, Armadale Road, we would expect the limonite to be present to some extent at Lot 131 and the other lots further east.

Seasonal fluctuations in the water table may be several metres, consistent with Perth's winter-dominated rainfall pattern. Groundwater levels from 1975 to 2015, captured from DoW JM bores series, show groundwater levels between 21.96 and 27.96 mAHD (Table 1). Maximum (DoW, 1997) and minimum (DoW, 2004) groundwater contours shown on Figure 7 are generally consistent with the values in Table 1.

TABLE 1: DOW GROUNDWATER MONITORING BORE DATA

Bore	Period of Record	Minimum Recorded (mAHD)	Maximum Recorded (mAHD)
JM19	1975-2015	24.29	27.96
JM22	1975-2010	24.50	26.92
JM25	1975-1995	23.74	25.91
JM26	1975-2015	24.91	27.56
JM27	1975-2015	21.96	26.22
JM45	1975/2015	22.70	25.83

2.9.1.1 Ministerial Statement 688

Ministerial Statement 688, established in 1992, provides a framework for the management and abstraction of groundwater for public and private water supply from the Jandakot Mound, with provision for environmental requirements (EPA, 1992). As part of the conditions twenty-three sites across the Jandakot Mound have Ministerial water level criteria to ensure the protection of environmental assets.

For the 2008 to 2011 monitoring period thirteen out of the twenty-three sites breached the relevant criteria (DoW, 2012) as a result of declining rainfall and groundwater abstraction by existing users.

Seven sites (8284/8284B, JM19, JM45, JM14, JM16, JM8 and JM7) located near the top of the Jandakot Mound are in close proximity to the Study Area. Three sites, JM19, JM45 and JM14, have all breached Ministerial Conditions with the latest breach in 2011.

2.9.1.2 Groundwater Quality

Water quality is not measured in DoW monitoring bores. Water quality is measured by Water Corporation to inform treatment of public water supply abstracted from production bores across the mound.

Water quality information presented in Water Corporation (2006), states that the water quality of the Jandakot Mound has consistently been good, with the exception of iron and colour, and has generally met Australian Drinking Water Quality Guideline (ADWQG) values. The absence of thermotolerant coliforms indicates that there has not been any pathogenic contamination of the wellfield, despite a large percentage of the UWPCA being privately owned (Water Corporation, 2006), which includes P3 urban areas.

Although there has been no evidence of contaminants reaching the groundwater, many activities throughout the Control Area, including irrigated parks and uncontrolled domestic activities on residential properties, are considered medium management priorities (major to significant risks) because of their potential to transmit contaminants to the groundwater. Controls currently in place have improved protection and there has been no observed increase in risk since the 1998 assessment (Water Corporation, 2006).

2.9.1.3 Non-Potable Supply for Land Development

The Study Area is located within the Jandakot groundwater management sub-areas of Airport and Canning Vale. As of 14 September 2017 the available water allocation in the Superficial Aquifer is summarised in Table 2.

TABLE 2: GROUNDWATER AVALIABILITY

Aquifer Sub Area	Allocation Limit	Licenced Allocation	Committed Volume	% Committed & Allocated
Superficial Swan - Airport	790,000 kL	1,041,975kL	50,500 kL	138.29%
Superficial Swan – Canning Vale	310,000 kL	68,325kL	0 kL	22.04%

Calleya Estate is located in the Airport sub-area. The remainder of the Study Area is within the Canning Vale Sub-area and the available allocation is expected to be sufficient for implementation of the DSP, as outlined in Section 3.3.1.

The use of local groundwater resources for non-potable supply within the Study Area will be considered as part of future LWMS's. If considered appropriate, the implementation of the strategy should take into consideration bore design to ensure the installation of the wells do not create unwanted contaminant pathways through the aquifer.

2.9.2 Leederville Aquifer

The Leederville Aquifer is of Cretaceous age and consists of interbedded sandstone, siltstone and shales made up by the Mariginiup, Wanneroo and Pinjar Members and the Henley Sandstone Formation. It is separated from the overlying Superficial Aquifer by the Kardinya Shale, which acts as a confining bed between the two aquifers (Davidson & Yu, 2008).

The Leederville aquifer is a major regional water resource of good quality water. Underneath the Jandakot Mound, groundwater salinity is typically <500 mg/L. Jandakot production bore J105 screened in the Leederville Aquifer has the highest concentration of bicarbonate (compared to other Jandakot drinking water production bores) with a concentration of 200 mg/L. Dissolved iron concentrations from the production bores generally exceed Australian Drinking Water Guidelines (Davidson, 1995).

2.9.3 Yarragadee Aquifer

The South Perth Shale underlies the Leederville Aquifer and acts as the confining bed between the Leederville and Yarragadee aquifers (Davidson, 1995).

The Yarragadee aquifer is a major regional water resource of generally good quality water. South of Perth salinities vary between 1000 and 2000 mg/L. Dissolved iron levels are generally below Australian Drinking Water Quality Guidelines (Davidson, 1995).

3. DISTRICT WATER MANAGEMENT STRATEGY

3.1 Groundwater Management

3.1.1 Existing Groundwater Expressions

Sand extraction from the site has resulted in some areas where the groundwater is exposed at surface. Excavations are to be filled in as part of future development so that groundwater is no longer exposed.

3.1.2 Fill and Groundwater Controls

Based on the DoW maximum groundwater contours (1997), Figure 8 highlights the areas within Study Area which are likely to encounter groundwater within 2m of natural surface (approximately 15% of the Study Area). With the exception of localised surface water expressions in Catchment 1 and 4 (see Figure 9), there is expected to be a sufficient depth of sand (>2m) within the majority of the Study Area to allow development with adequate separation to groundwater (see Figure 8). This will be confirmed by a more detailed analysis of earthworks at LWMS stage.

3.2 Stormwater Management

For the Study Area the following key objectives will apply:

- Minimise changes in hydrology to prevent impacts on receiving environments.
- Manage water flows from major events to protect infrastructure and assets.
- Apply the principles of WSUD.

Minor Drainage System

Due to the elevation and sandy soils that characterise the site, many of the best practice stormwater management strategies presented in the Stormwater Management Manual for Western Australia (DoW, 2009) are appropriate and can be implemented.

These strategies include;

- Retention of rainfall events up to the 1yr ARI 1 hour duration at source via infiltration.
- Retention of rainfall events up to the 5yr ARI high in the catchment using rain gardens, swales, tree pits and other contemporary water infiltration techniques.
- The use of vegetation and amended soils within infiltration systems to treat stormwater runoff and improve the quality of stormwater infiltrating to the groundwater table.

Major Drainage System

The major drainage systems across all catchments will manage rainfall events greater than the 5yr ARI, up to the 100 yr ARI. With the exception of Catchment 1 (Lot 131) all previous DWMS and LWMS documents prepared for existing and proposed MRS zoned ‘Urban’ lots have included stormwater modelling carried out. The results of these analyses are presented in Table 3 and shown on Figure 9, with a summary of stormwater management during major rainfall events across all catchments provided below.

The design strategy is consistent with the objectives provided in the Stormwater Management Manual (DoW, 2007). Key points of the major drainage system strategy are as follows:

- All lot finished levels will have a minimum 0.3 m clearance above the estimated 100yr ARI flood level of the retention storages;

- Roads graded to direct flow to the lowest point in the catchment; and
- At the low point (where practical), verges graded to drain flows off the street into the retention storage.
- Using road levels and grading to convey major storm events away from houses and other key infrastructure.
- In general where land area and distance to groundwater (>2 m) allows (see Figures 8 and 9) the 100yr ARI should preferentially be retained onsite and infiltrated within Public Open Spaces (POS).

Catchment 1 *(Calleya Estate)* - Lot 9002, 9004 & 132

Emerson Stewart (2011) conducted the stormwater management assessment for the Calleya Estate. The stormwater design by Emerson (2011) allowed for all events greater than the 5yr ARI to be directed via overland flow paths (within the road reserve) to POS infiltration areas, and overflow into the main trunk drain. The trunk drainage system discharges into the Atwell drain and ultimately into Thompson Lake. Discharges into Thompson Lake (via the Atwell drain) from Calleya Estate has been approved by the EPA (WAPC, 2016) and the DoW.

Catchment 2 – Lot 821

Preliminary stormwater modelling using the PONDS infiltration model was performed by Hyd2o (2013) to determine appropriate stormwater management requirements to infiltrate the 100 year ARI on site.

The design strategy adopted in Catchment 2 is consistent with the Better Urban Water Management principles which guides City of Cockburn's (CoC) water quality management. Consistent with the CoC's design principles no discharge will occur from the site for events up to the 100 year ARI, with all stormwater retained and infiltrated onsite (Hyd2o, 2013). Further detailed design at the LWMS stage will refine their distribution, sizing and locations.

Catchment 3 – Lot 131

Preliminary modelling of the 100yr ARI stormwater infiltration storage for Lot 131 (Catchment 3) was performed by JDA using the infiltration model MODRET.

Results from modelling the 100yr ARI found that 19,670 m^3 of rainfall runoff is required to be stored and infiltrated onsite. Figure 8 indicates there is sufficient depth to groundwater to implement this strategy.

More detailed analysis, additional site information (e.g. groundwater levels) and more refined analysis, as part of the future LWMS is required.

Catchment 4 – Lot 4

Preliminary modelling of the 100yr ARI stormwater infiltration storage for Lot 4 (Catchment 4) was performed by JDA (2015) using the infiltration model MODRET.

Results from modelling the 100yr ARI found that 18,700 m^3 is required to be stored and infiltrated onsite. The stormwater infiltration requirement for the 100yr ARI represents approximately 4% of the developable area. Figure 8 indicates there is sufficient depth to groundwater to implement this strategy.

Catchment 5

Catchment 5 (Figure 9) is not proposed for urban development and preliminary stormwater storage has not been assessed.

TABLE 3: STORAGE DATA FOR THE CRITICAL 100YR ARI RAINFALL EVENT

Catchment	1[1]	2[2]	3	4[3]
Catchment Area (ha)	153.0	20.5	64.7	61.9
Assumed Impervious Area (ha)	53.0	8.2	20.9	18.6
Top Water Level Area (m^2)	36,545	4700	21,385	20,000
Stored Volume (m^3)	21,870	3300	19,670	18,700

1- PDC (2013)
2- Hyd2o (2013)
3- JDA (2015)

JDA does not take responsibility for the content of reports by PDC (2013) and Hyd2o (2013).

3.3 Water Source Planning & Conservation

3.3.1 Water Supply

Residential Lots

In order to minimise any potential impact on the groundwater resource the development will aim to:

- Utilise scheme water as the main water supply for residents.
- Appropriately manage bore use through structure planning and community education.

Public Open Spaces

The use of local groundwater resources for non-potable supply within the Study Area will be considered in more detail as part of the LWMS. An initial estimate of the amount of groundwater required for POS irrigation was calculated based on a residential area of 253 ha. Assuming a rate of 7,500 kL/yr an indicative water demand for irrigation of approximately 25 ha of irrigated residential POS would be 187,500 kL/yr plus an additional 3 ha or 22,500 kL/yr for the open areas/gardens within the school sites. The combined total annual irrigation volume is 210,000 kL/yr. The allocation estimate will be refined as part of the LWMS.

An allocation of 241,675 kL/yr is available in the Canning Vale sub-area (Table 2), which should be sufficient supply for most of the Study Area. The Airport sub-area is overallocated (Table 2) which may impact Calleya Estate. The Calleya development is well progressed and we expect arrangements to secure a water licence are also well progressed.

3.3.2 Wastewater Management

The Water Corporation has advised that this site falls outside of a planned sewerage scheme and therefore a reticulated wastewater supply is not immediately available. An approved MRS amendment would facilitate sewer reticulation scheme planning by the Water Corporation.

The project engineers have indicated that wastewater servicing is likely to come from Armadale Rd, via a connection at Liddelow Rd, south-east of the site. Two pump stations will likely be required to meet demand for the Study Area. Pump stations are a compatible land use with conditions in P3 areas, as presented in WQPN 25, Table 3 (DoW, 2016)

3.3.3 Water Conservation Measures

The objective for water conservation is to minimise use of water and maximise water use efficiency where possible. This objective can be achieved at both the development and lot scale and is identified in the State Water Plan (Government of Western Australia, 2007) as a priority item for potable water. The State Water

Plan target for household water use is 100 kL/person/year (potable and non-potable water), with a consumption target for scheme water of 40-60 kL/person/year (potable water).

Consistent with the State Water Plan, the main objectives for the development are:

- Avoid use of potable water for irrigation in POS areas
- Reduce household water use to not more than 100 kL/person/year
- Minimise use of potable water where drinking water quality is not essential.
- Household consumption targets for in-house potable water use of 40-60 kL/person/yr.

Development Scale

Development scale water conservation measures appropriate for the site include:

- Strategic planning (orientation, shape, elevation etc.) of irrigation areas such as pocket parks, active and passive public open space areas, and road reserves to minimise long-term irrigation demand.
- Where possible co-locate facilities with significant irrigation demand.
- Within irrigation areas, the use of waterwise landscaping practices including hydrozoning, mulching, soil amendments, water retention products and installation of appropriate water efficient irrigation fixtures.
- Retain and where appropriate rehabilitate native bush areas.

Lot Scale

Lot scale water conservation measures appropriate for the site include;

- Increased residential density, including smaller lots with reduced ex-house irrigation areas.
- Buildings constructed to current Building Codes of Australia (BCA) water efficiency standards and the State Government 5 Star Plus Scheme. These include using AAA rated appliances such as toilets, washing machines, dishwashers, water saving showerheads, taps and toilets and sub-surface irrigation. The Water Corporation's Waterwise Rebate Program will also assist in encouraging the purchase of waterwise AAA rated appliances.
- Initiatives to encourage waterwise landscaping of residential lots including hydrozoning, mulching, soil amendments, water retention products and installation of appropriate irrigation fixtures.

4. IMPLEMENTATION FRAMEWORK

4.1 Local Structure Planning

The water management planning requirements for the various stages of land use planning are set out in Better Urban Water Management (WAPC, 2008) and include a Local Water Management Strategy (LWMS) in support of the Local Structure plan and an Urban Water Management Plan (UWMP) as a condition of subdivision approval. The design objectives outlined in this DSWMS 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.

4.2 Monitoring Requirements

Pre-development monitoring for a minimum two year period is required to support rezoning applications as outlined in BUWM. At the end of the two-year program the results should be submitted to the Department of Water and City of Cockburn and utilised to assist preparation of the LWMS's.

A post development monitoring program will be developed at the LWMS stage. The monitoring program will be designed to allow a quantitative assessment of the hydrological impacts of the proposed development within the Study Area. Post-development monitoring program will include measurement of groundwater levels and quality for comparison to pre-development levels.

4.3 Funding and Responsibilities

The key roles and responsibilities for the implementation of this SDWMS are presented in Table 4 below.

TABLE 4: SUMMARY OF RESPONSIBILITIES OF FUNDING

Management Issue	Responsibility and Funding		
	Developer	Department of Water	City of Cockburn
Pre-development monitoring	✓		
Preparation of LWMS	✓		
Approval of LWMS		✓	✓
Preparation of UWMP	✓		
Approval of UWMP		✓	✓
Construction of urban infrastructure	✓		
Long-term maintenance of stormwater management system			✓
Post-development monitoring	✓		

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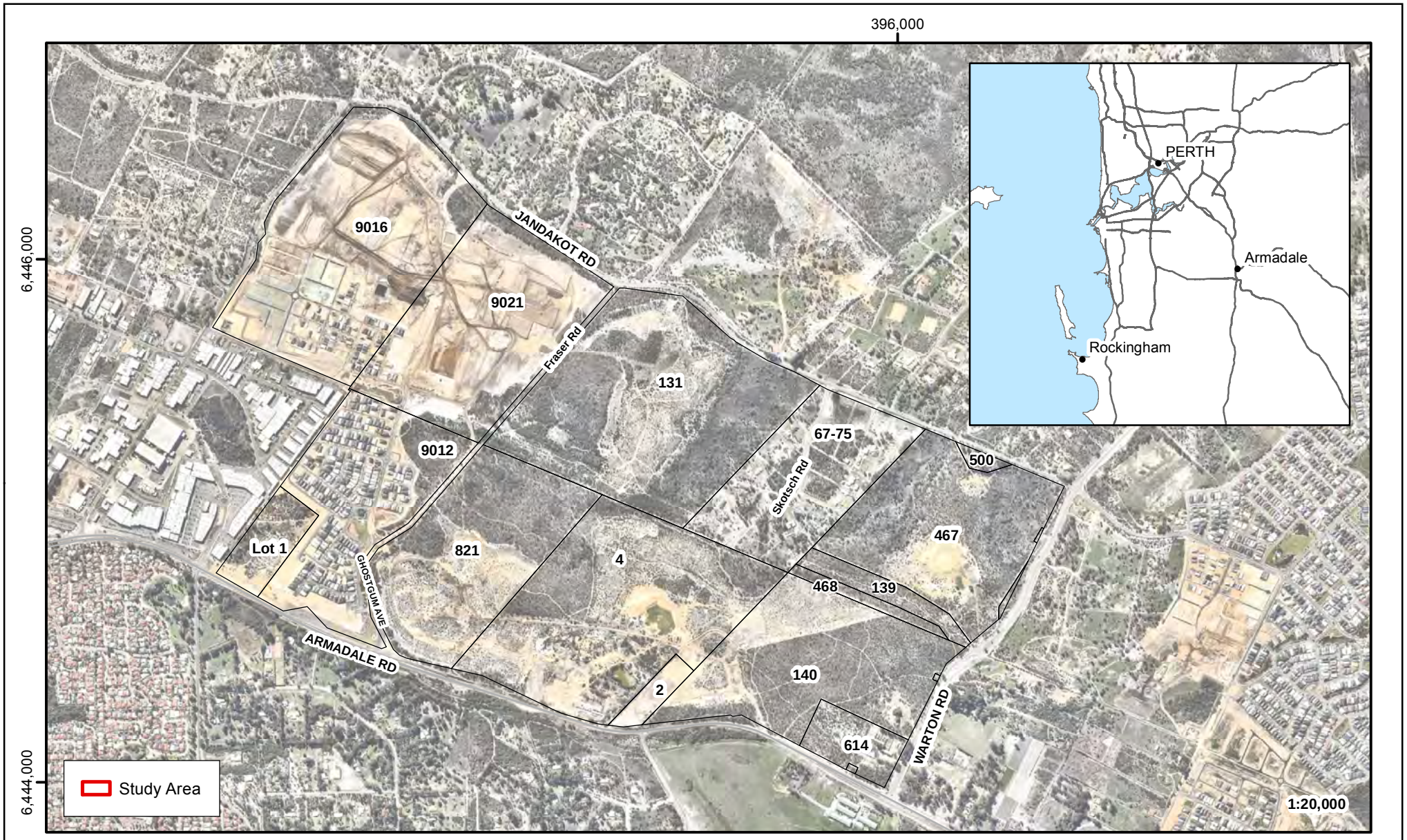
Figures



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

Job No. J6195

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N

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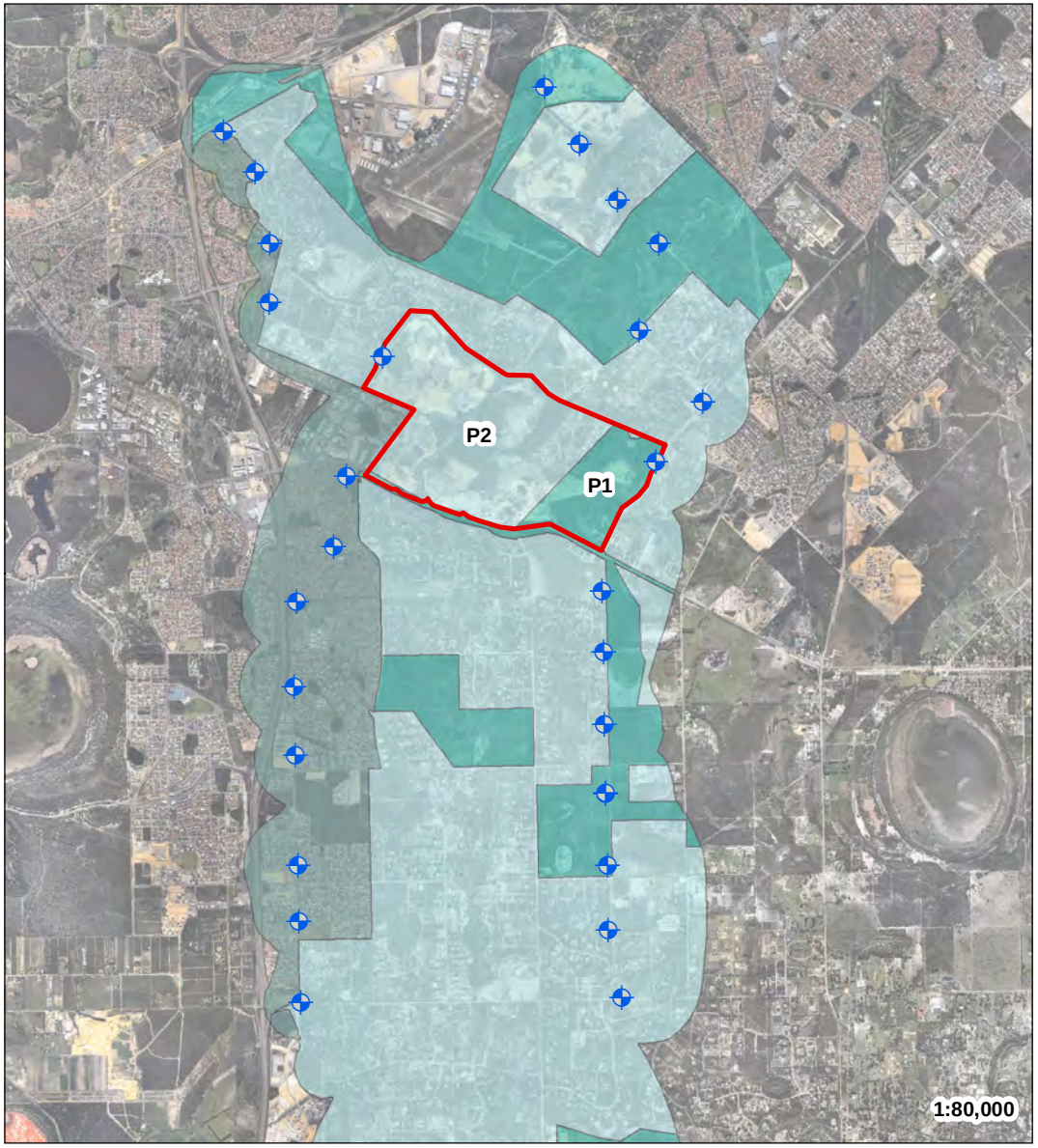
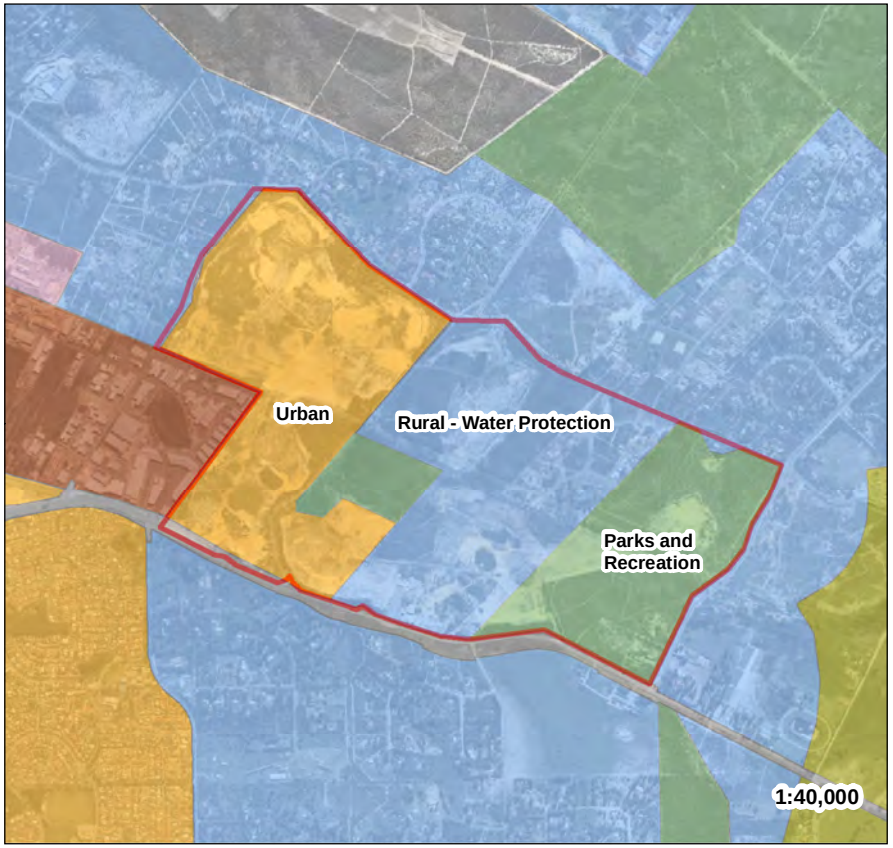
Treeby Strategic District Water Management Plan

Figure 1: Location Plan





Study Area
Jandakot Mound Production Bores

Underground Water Pollution Control Areas
P1
P2
P3

MRS Land Zonings
Industrial
Parks & Recreation
Primary Regional Roads
Public Purposes (SECWA)
Public Purposes (Special Uses)
Rural
Rural - Water Protection
Urban

Data Source: DoW (2013c), DoP (2012)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

0 0.75 1.5 3 4.5 6 Kilometres

N

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Treeby Strategic District Water Management Plan

Figure 2: Underground Water Pollution Control Areas and Regional Planning

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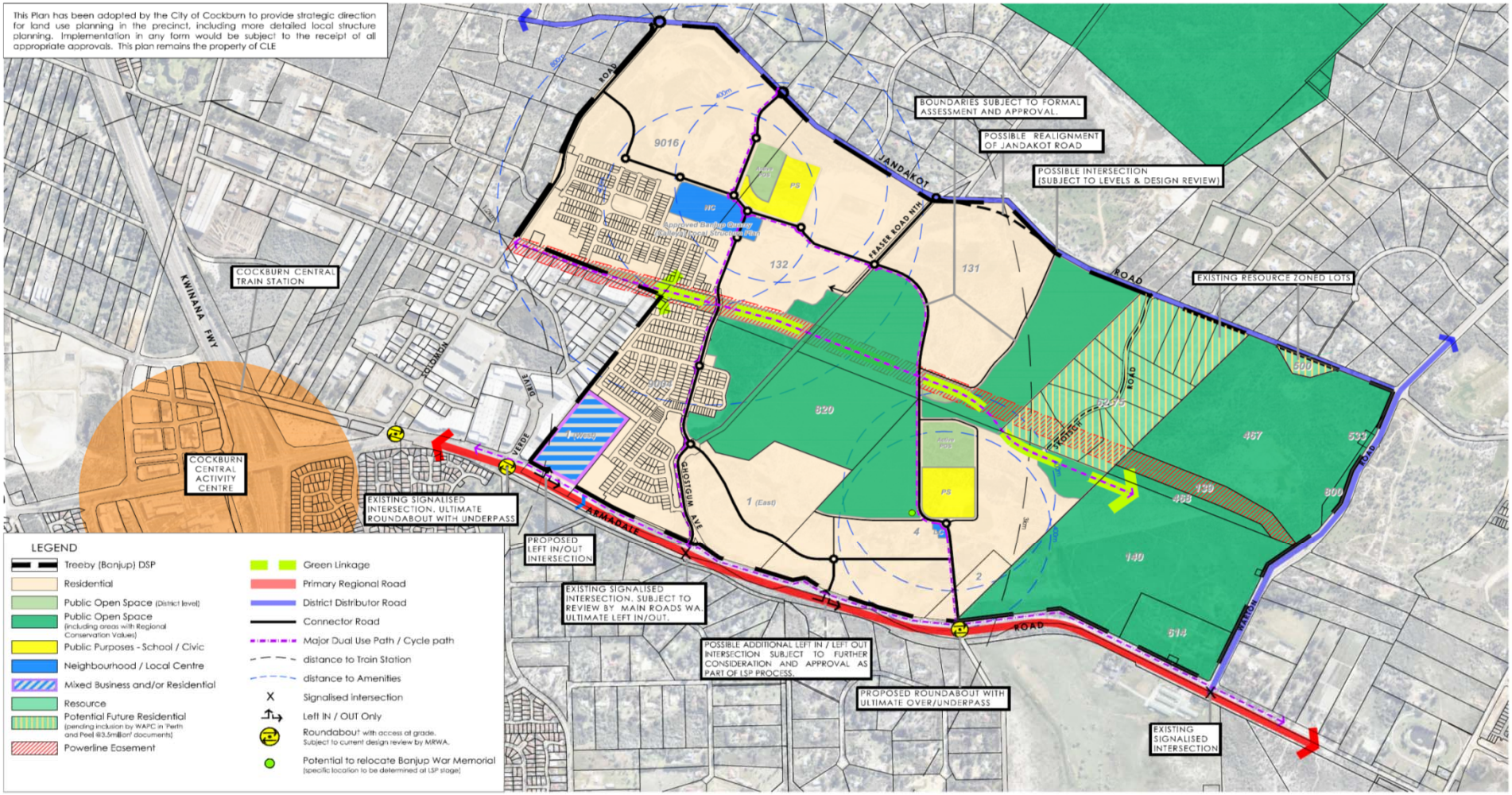
CLE TOWN PLANNING + DESIGN



2310-122F-01 (29.09.2017), NTS

TREEBY (BANJUP) DISTRICT STRUCTURE PLAN

Banjup, City of Cockburn

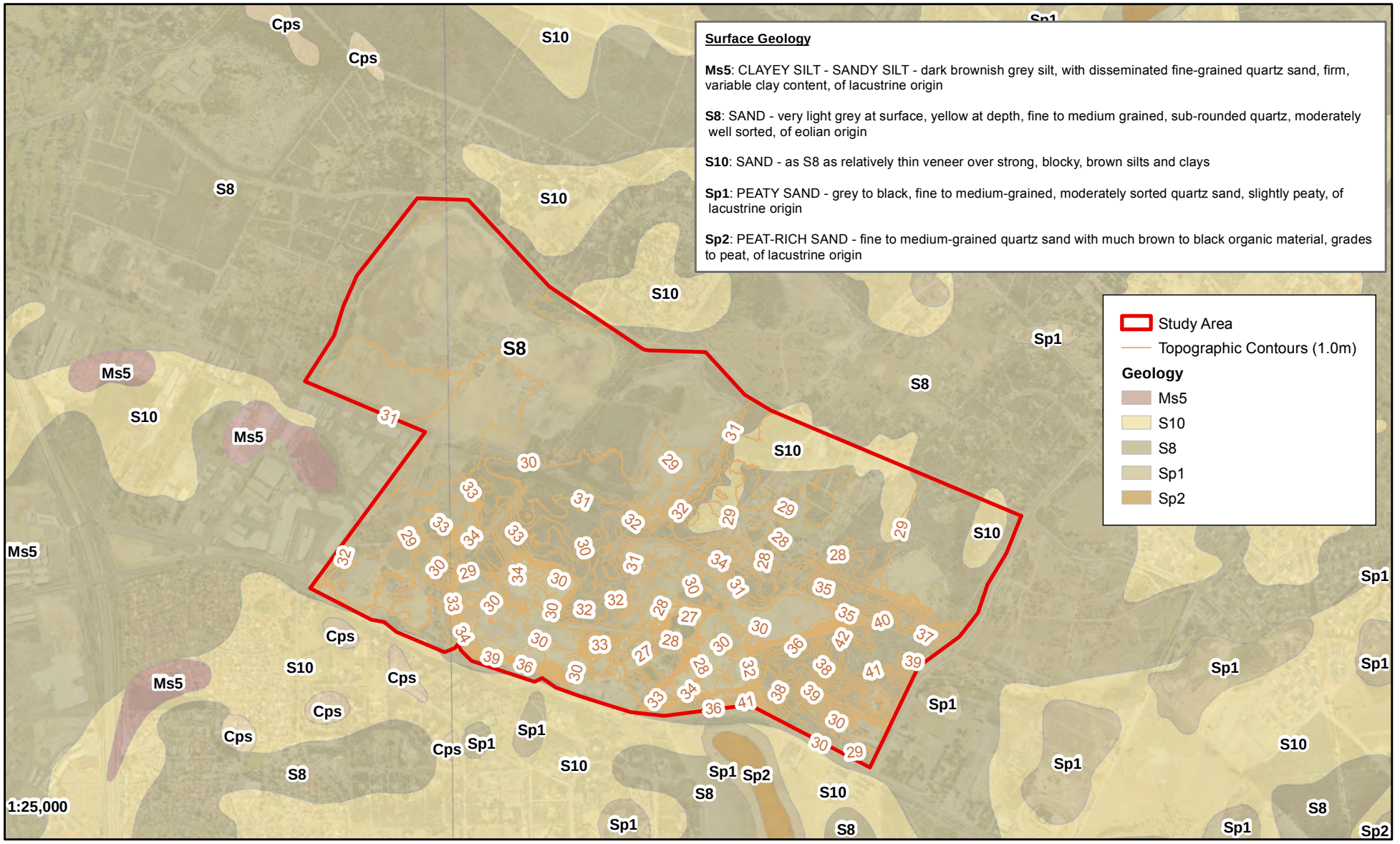
JDA Consultant Hydrologists

Job No. J6195

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 3: Concept Plan



Data Source: DoW (2013d), Gozzard (1986)

Coordinate System: GDA 94, Zone 50

Job No. J6195

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N

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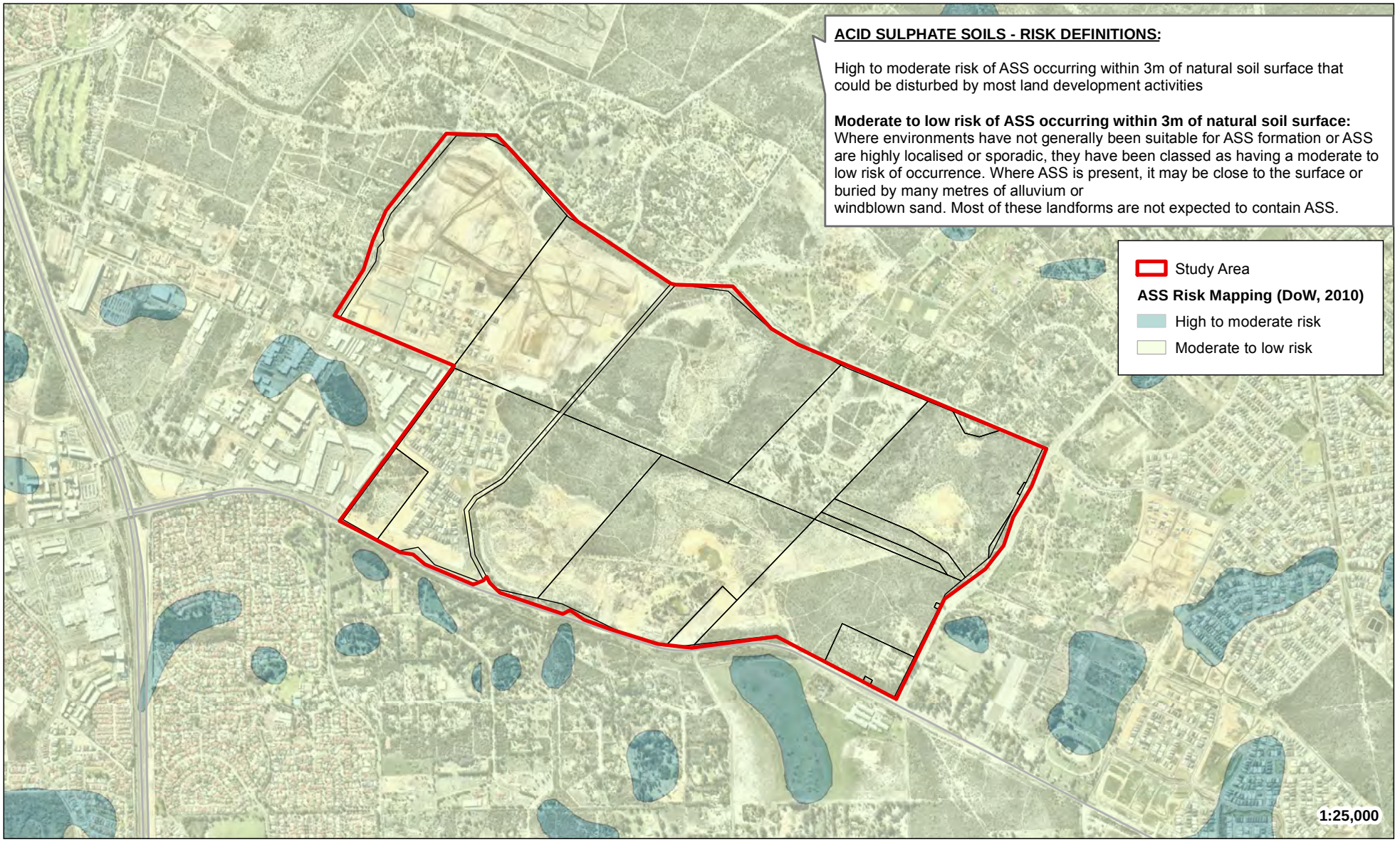
Treeby Strategic District Water Management Plan

Figure 4: Topography and Surface Geology



Data Source: Nearmap (2016), DoW (2013a)

Coordinate System: GDA 94, Zone 50

Job No. J6195

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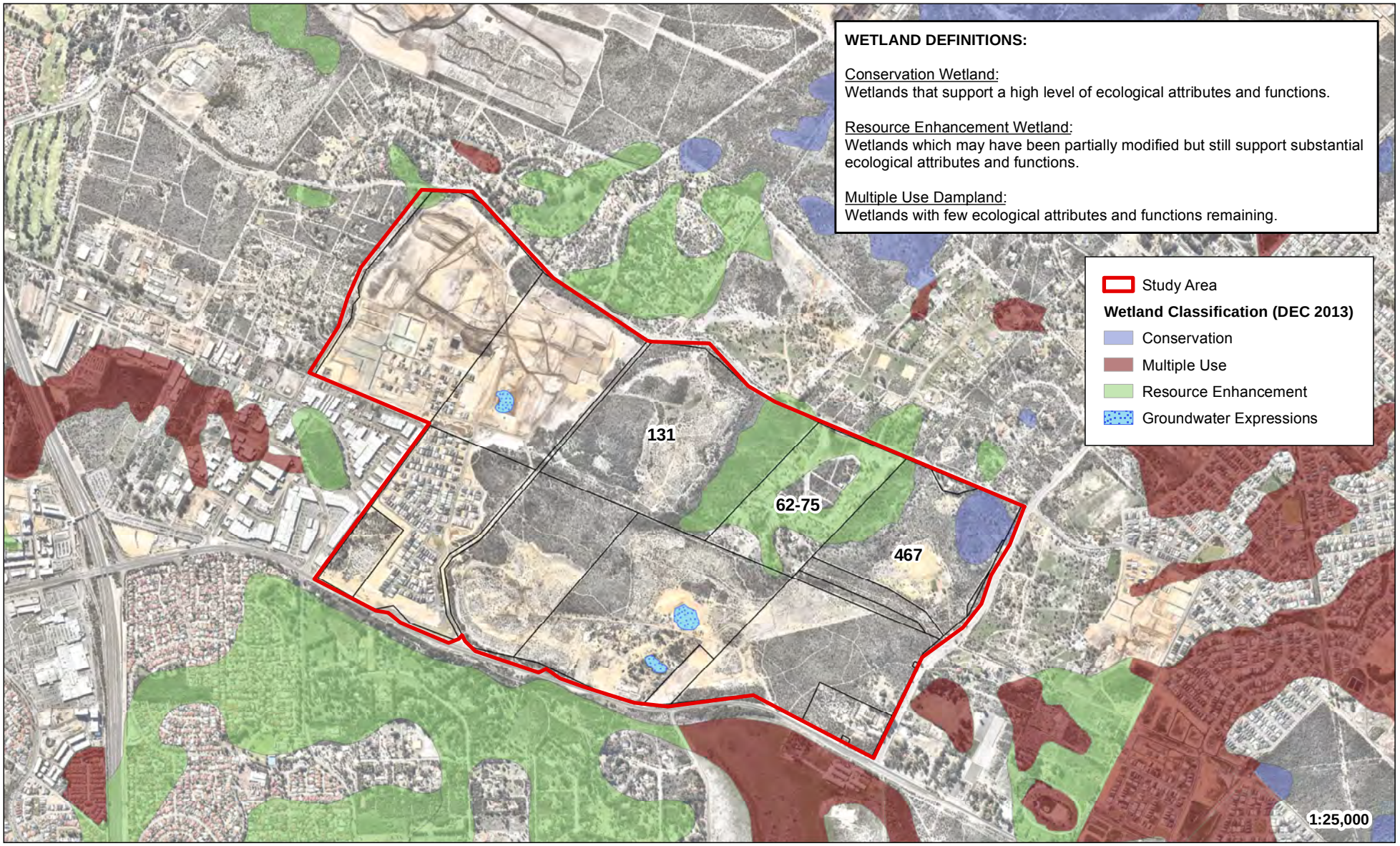
Treeby Strategic District Water Management Plan

Figure 5: Acid Sulphate Soils



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Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

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N

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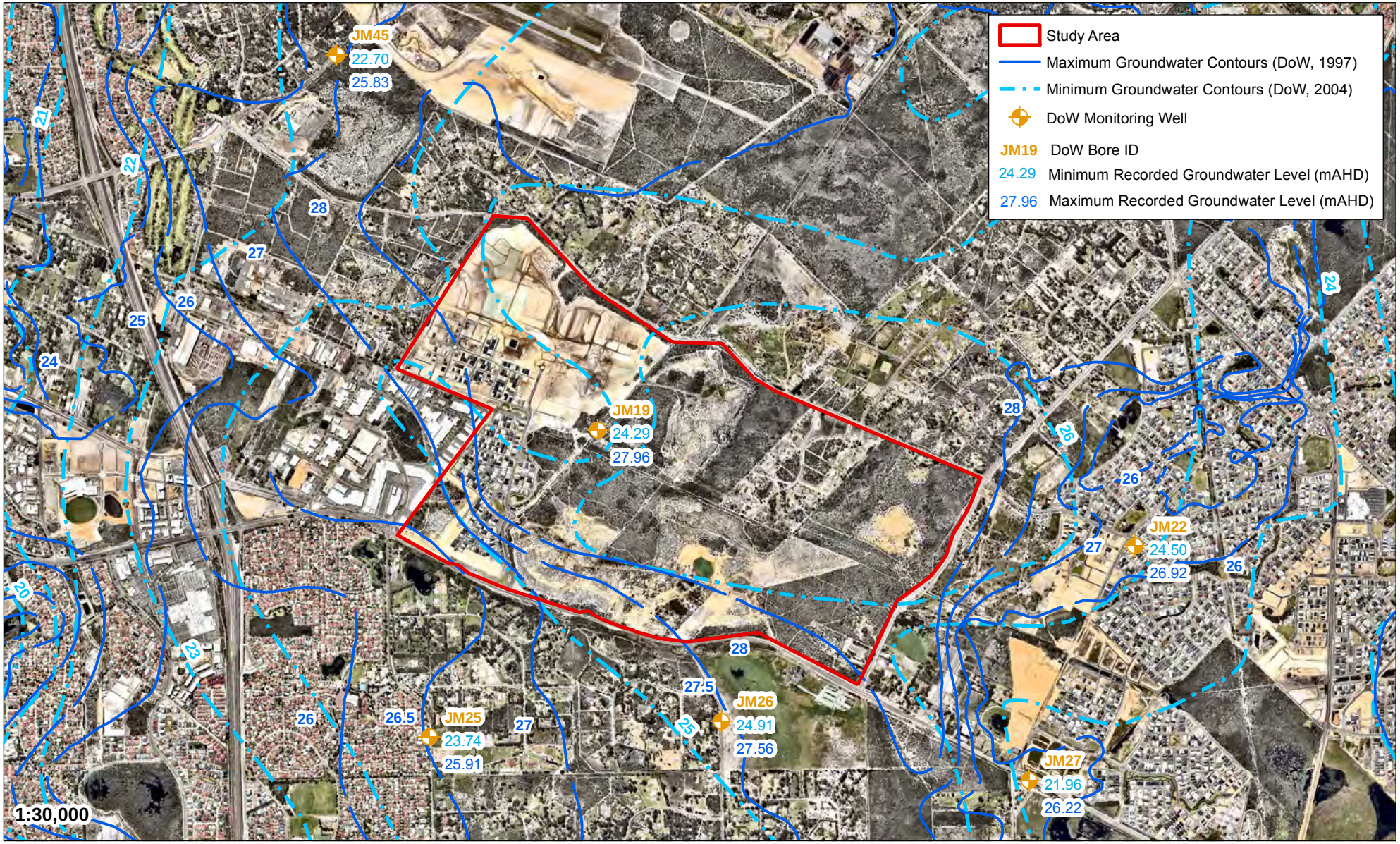
Treeby Strategic District Water Management Plan

Figure 6: Wetlands



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195
Scale: 1:30,000 @A4

0 500 1,000 1,500 2,000 Metres

N

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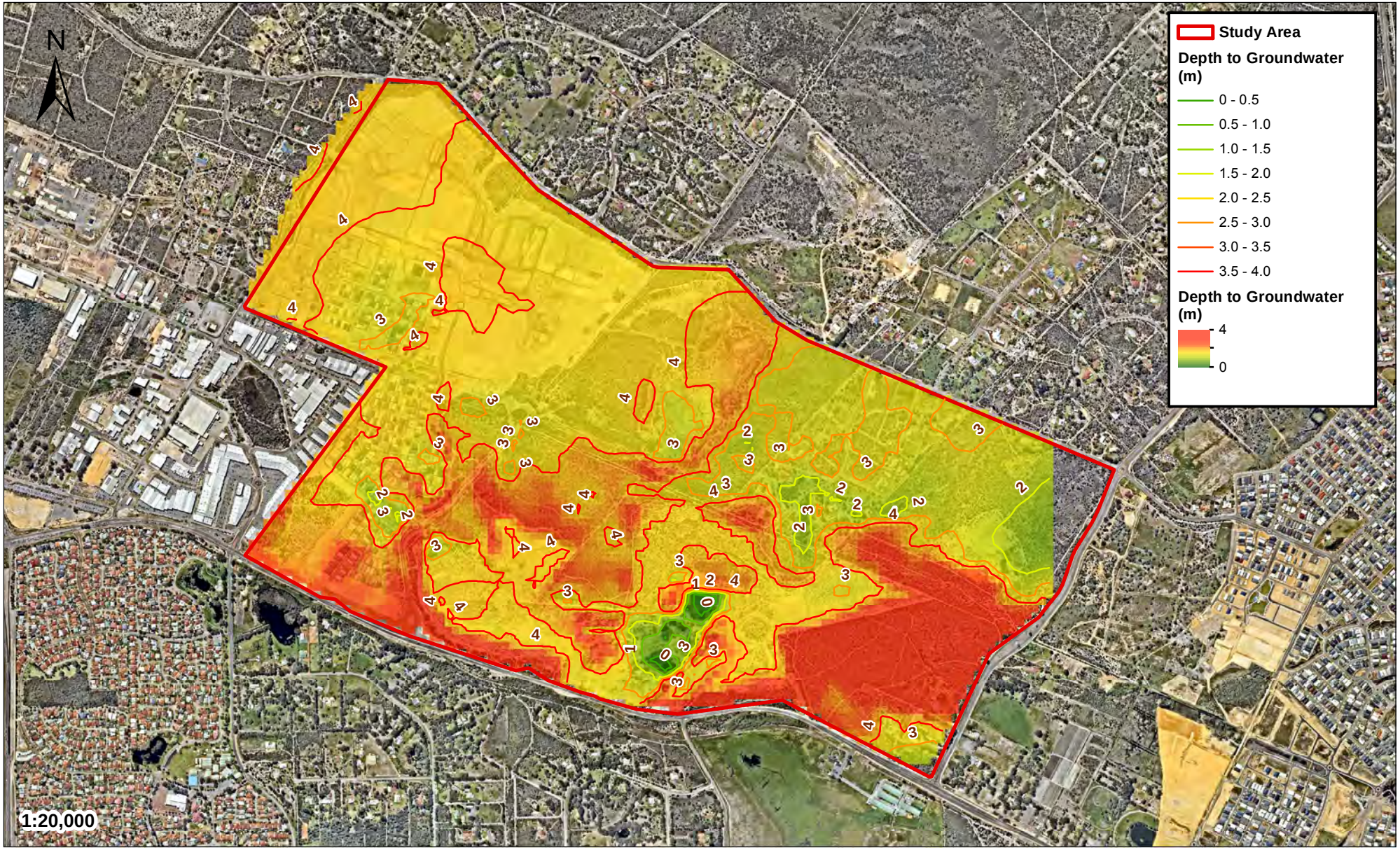
Treeby Strategic District Water Management Strategy
Figure 7: Minimum and Maximum Groundwater Levels



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

0 500 1,000 1,500 2,000 Meters

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Figure 8: Depth to Estimated Max Groundwater Elevation

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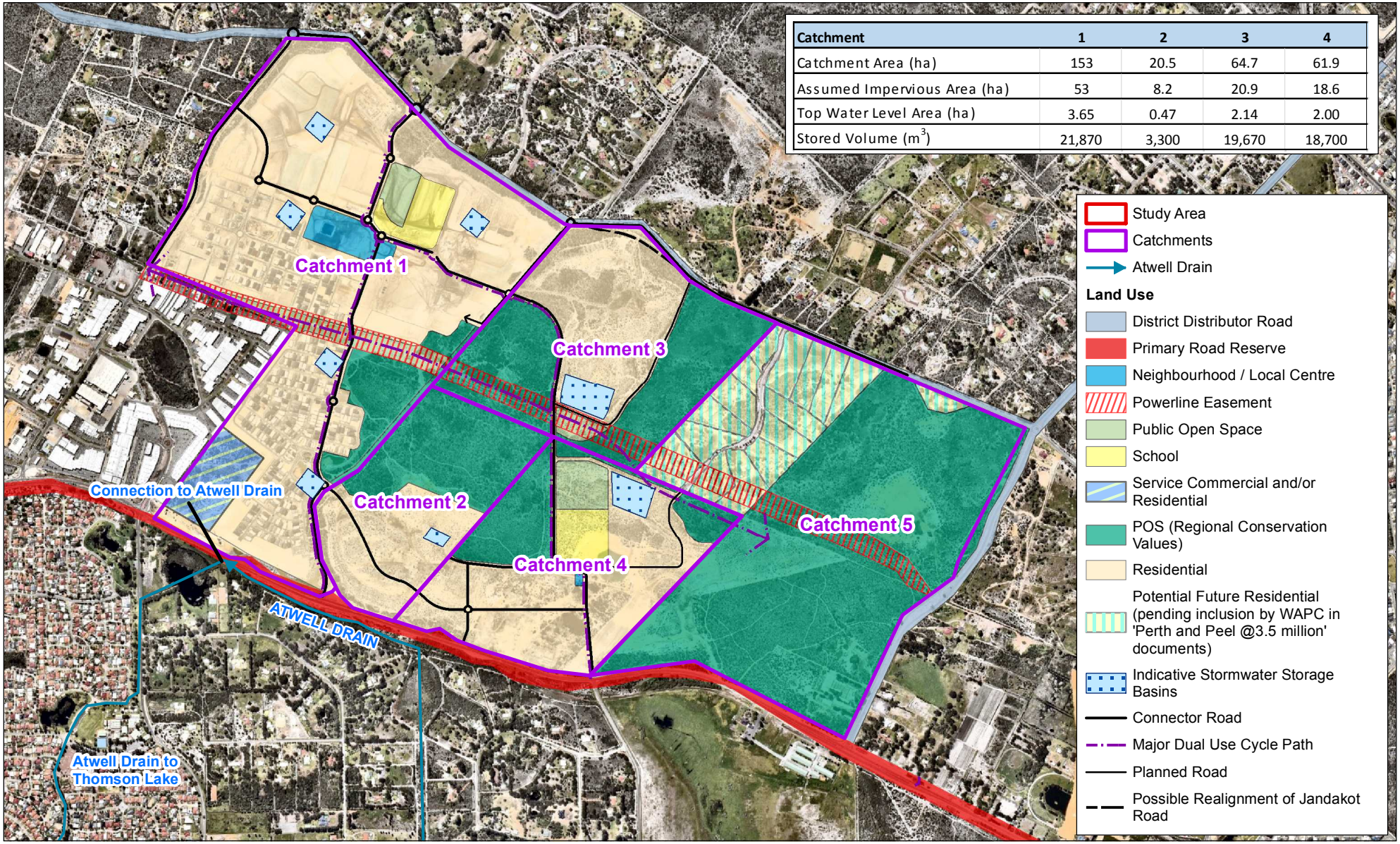
Version: 1, Version Date: 04/09/2025



Catchment	1	2	3	4
Catchment Area (ha)	153	20.5	64.7	61.9
Assumed Impervious Area (ha)	53	8.2	20.9	18.6
Top Water Level Area (ha)	3.65	0.47	2.14	2.00
Stored Volume (m^3)	21,870	3,300	19,670	18,700

Data Source: Nearmap (2016), CLE (2016), PDC (2013), Hyd2o (2013), JDA (2015)

Coordinate System: GDA 94, Zone 50

Job No. J6195
Scale: 1:20,000 @A4

0 400 800 1,200 1,600 Metres

N

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Treeby Strategic District Water Management Strategy
Figure 9: Stormwater Management Plan

APPENDIX A

Infiltration Basin Modelling Results

MODRET - Summary Results

Job: Lot 131 Jandakot Rd, SDWMS Date : 19/05/2016 Performed by : RD

Basin: Catchment 3

Catchment Area 1	20.9 EIA	ha
Catchment Area 2		ha
Top Elevation	29.8	mAHD
Base Elevation	28.8	mAHD
Base Length	120	m
Base Width	150	m
Depth	1	m
Batter	1 in 6	
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	26.8	mAHD
Base of Aquifer	-20	mAHD

Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)
28.8	0	18000
28.9	1815	18325
29.0	3665	18655
29.1	5547	18985
29.2	7460	19320
29.3	9410	19655
29.4	11395	19995
29.5	13410	20340
29.6	15460	20685
29.7	17545	21035
29.8	19670	21385

Duration	1 Yr ARI			5 Yr ARI			10 Yr ARI			100 Yr ARI		
	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)
0.5hr										28.84	18120	7950
1hr										28.94	18450	9905
3hr										29.10	18985	13795
6hr										29.19	19320	17055
12hr										29.32	19655	21770
24hr										29.50	20340	28740
48hr										29.70	21035	38420
72hr										29.80	21385	44090

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