APPENDIX C
LOCAL WATER MANAGEMENT STRATEGY

360 environmental

Lots 52 and 2979 Illareen Road and Lots 50 and 51 Kojonup-Katanning Road, Katanning

Local Water Management Strategy

Prepared for:

Cordite Investments Pty Ltd

July 2019

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
2258 AA	Internal Draft	SBO	-	-	-	-
2258 AB	Client Draft	SBO	JJ	-	Electronic	16/02/2018
2558 AC	Client Review Update	SBO	JJ	-	Electronic	08/03/2018
2558 AD	Addressing DWER Comments	SBO	JJ	-	Electronic	20/04/2018
2558 AE	Addressing SoK Comments	KL	-	NL	Electronic	19/06/2019
2558 AF	Addressing SoK Comments – revised Figure	KL	-	SH	Electronic	04/07/2019

BUWM LWMS Checklist

Local Water Management Strategy Item	Deliverable	☑	Comments
Executive Summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Executive Summary provided	☒	
Introduction			
Total water cycle management – principles & objectives Planning background Previous studies	Planning background Previous studies	☒	
Proposed Development			
Structure plan, zoning and land use.	Site context plan Structure plan	☒	
Landscape – proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape plan	☐	
Design Criteria			
Agreed design objectives and source of objective		☒	
Pre-development Environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☐	
Site conditions – existing topography/ contours, aerial photo underlay, major physical features	Physical features	☒	
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	☒	
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	☒	
Surface Water – topography, 1% floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface water flood areas	☒	
Groundwater – topography, pre development groundwater levels and water quality, test bore locations		☐	
Water Use Sustainability Initiatives			
Water efficiency measures – private and public open spaces including method of enforcement		☒	
Water supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance	Water supply strategy	☒	
Wastewater management	Proposed wastewater management system	☒	
Stormwater Management Strategy			
Flood protection – peak flow rates, volumes and top water levels at control points, 1% flow paths and 1% detentions storage areas	1% AEP event management	☒	

Local Water Management Strategy Item	Deliverable	☑	Comments
Manage serviceability – storage and retention required for the critical 20% AEP storm events Minor roads should be passable in the 20% AEP event		☐	
Protect ecology – detention areas for the first 15 mm rainfall event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	Structural and non-structural best management practice and treatment trains	☒	
Groundwater Management Strategy			
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones		☐	
Actions to address acid sulfate soils or contamination		☐	
The Next Stage – Subdivision and Urban Water Management Plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.	UWMP recommendations.	☒	
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☐	
Implementation			
Developer commitments		☒	
Roles, responsibilities, funding for implementation		☒	
Review		☐	

Executive Summary

360 Environmental Pty Ltd (360 Environmental) has been commissioned by Cordite Investments Pty Ltd (the client) to prepare this Local Water Management Strategy (LWMS) to accompany the submission of a Local Structure Plan (LSP) for Lots 52 and 2979 Illareen Road and Lots 50 and 51 Kojonup-Katanning Road, Katanning.

The LSP is approximately 235 hectares (ha) and includes 71 rural residential Lots ranging in size from 1 ha to 16 ha. The LSP is located immediately west of the Katanning town centre within the Shire of Katanning. The LSP is surrounded by rural and rural residential lots and is bounded by Kojonup-Katanning Road to the north, Illareen Road to the west and Prosser Street to the east.

The LWMS has been developed in accordance with the Better Urban Water Management guidelines (WAPC 2008). Water will be managed using a total water cycle management approach, which has been developed using philosophies and design approaches described in the Stormwater Management Manual for Western Australia (DoW 2007).

The depth to groundwater is 2 m to 5 m below ground level. Illareen Creek exists in the south of the site and two unnamed ephemeral creek lines occur in the north. Formalised protection zones along the creek lines have been included in the LSP to provide adequate flood protection and to also protect the existing riparian vegetation.

Potable water will be provided by upgrading and extending the Water Corporations existing potable water infrastructure to the LSP and wastewater disposal will rely on a combination of traditional septic tanks and aerobic treatment units (ATU's) where suitable. The upgrading and extension of existing Water Corporation infrastructure will also provide a suitable water source for firefighting purposes, if ever required.

Due to the large block sizes and limited earthworks, the increase in impermeable surfaces will be minimal. The drainage strategy for the site includes the retention of the first 15 mm of stormwater within Lots using soakwells and road side swales. In events greater than this, existing overland flow paths will be maintained, and the 20% and 1% AEP will be detained within roadside swales.

Abbreviations

A	
AEP	Average Exceedance Probability
ASS	Acid Sulfate Soil
B	
BMP	Best Management Practices
BUWM	Better Urban Water Management
D	
DFES	Department of Fire and Emergency Services
DPIRD	Department of Primary Industries and Regional Development
DoW	Department of Water
DWER	Department of Water and Environmental Regulation
E	
EP	The Client
G	
GSWA	Geological Survey Western Australia
H	
Ha	Hectares
L	
LWMS	Local Water Management Strategy
LSP	Local Structure Plan
LPS5	Local Planning Scheme No 5
M	
mAHD	metres Australian Height Datum
mbgl	metres below ground level
MMP	Management and Maintenance Plan
S	
site	52 and 2979 Illareen Road and Lots 50 and 51 Kojonup-Katanning Road, Katanning
SoK	Shire of Katanning
U	
UWMP	Urban Water Management Plan
W	
WA	Western Australia
WAPC	Western Australia Planning Commission
WCWA	Water Corporation Western Australia
WSUD	Water Sensitive Urban Design

Table of Contents

1 Introduction 1
1.1 Background 1
1.2 LWMS Objectives 1
2 Proposed Development 1
2.1 Planning Context 2
2.2 Policy Framework 2
2.3 Previous Studies 2
3 Existing Environment 4
3.1 Land Use 4
3.2 Topography 4
3.3 Climate 5
3.4 Geotechnical 5
3.5 Groundwater 5
3.6 Surface Water 6
3.7 Environmental 8
3.8 Risk Assessment 8
4 Design Criteria and Objectives 10
4.1 Total Water Cycle Management 10
4.2 Water Conservation 10
4.3 Stormwater Management 10
4.4 Groundwater Management 11
5 Water Sustainability Initiatives 13
5.1 Development Water Sources 13
5.2 Wastewater Management 14
6 Stormwater Management Strategy 16
6.1 Proposed Stormwater Management Strategy 16
6.2 Post Development Stormwater Management 16
7 Groundwater Management Strategy 19
7.1 Groundwater Level Management 19
7.2 Groundwater Quality Management. 19
8 Protection of Receiving Environments 20
9 Management and Maintenance Plan 21
10 Requirement for an Urban Water Management Plan 23
11 Implementation 24
11.1 Roles and Responsibility 24
13 References 25

List of Tables

Table 1: Risk Management 9
Table 2: Proposed Design Criteria 12
Table 4: Road Reserve Parameters 16
Table 5: Minimum Swale Cross-Section Parameters 17
Table 6: Swale Drain Times 18
Table 7: Maintenance Schedule and Responsibility for Management Actions 22
Table 9: Roles and Responsibilities 24

List of Plates

Plate 1: Historic Land Use 4
Plate 2: Rainfall and Temperature 5
Plate 3: Illareen Creek, January 2018 7
Plate 4: Road Reserve Cross-Section 17

List of Figures

Figure 1: Location Plan
Figure 2: Katanning Local Structure Plan
Figure 3: Site Topography
Figure 4: Geotechnical Information
Figure 5: 1% AEP Flood Extent
Figure 6: Bushfire Prone Areas
Figure 7: Native Vegetation
Figure 8: Acid Sulfate Soils

List of Appendices

Appendix A Geotechnical Survey
Appendix B Aquifer Allocation Report

1 Introduction

1.1 Background

Cordite Investments Pty Ltd (the client) has commissioned 360 Environmental Pty Ltd (360 Environmental) to complete a Local Water Management Strategy (LWMS) to support the Local Structure Planning for the development of Lots 52 and 2979 Illareen Road and Lots 50 and 51 Kojonup-Katanning Road, Katanning (the site). The LSP extends across Lots 50 and 51, however these will remain undeveloped.

The site is approximately 235 ha and is located immediately west of the Katanning town centre in the Shire of Katanning (SoK)The site is bounded by rural and rural residential lots and resides below the Kojonup-Katanning Road. A site location plan is presented in Figure 1 and the LSP is provided on Figure 2.

It is important that the mechanisms and overall strategy for the management of stormwater runoff is documented clearly and early in the planning process. This then provides the framework to be adopted in achieving the desired water management outcomes at the subdivision stage. The development of a LWMS is an appropriate mechanism to establish the conceptual designs and management approaches for flood mitigation, effective stormwater management and sustainable development.

1.2 LWMS Objectives

The LWMS for the site has been developed to address the following objectives:

- Assess the sites existing hydrological and hydraulic conditions
- Undertake a desktop study of the current land use and conditions
- Develop a stormwater management strategy for the site which takes into account the downstream environment where necessary
- Develop and document strategies for relevant hydrological conditions including water conservation, groundwater protection and environmental conservation
- Development of a water balance model to provide estimated water use requirements suitable for the LSP stage of development
- Gain support from the Shire for the proposed strategy to manage stormwater and potential impacts across the site.

2 Proposed Development

The site is proposed to consist of 71 rural residential lots varying between 1 ha and 16 Ha in size the northern area of the site is proposed to consist of 1-2 ha lots and the central and south east are proposed to contain 2-4 ha lots. The south west portion proposes 3-5 ha lots and the far south 8-16 ha lots.

Access to the development is proposed via two existing parallel roads, Illareen Road (west) and Prosser Street (east), that runs south of Kojonup-Katanning Road. Five unnamed major roads are proposed to service the development internally.

An additional road (cul de sac) has been provided in the south west corner of the LSP to provide access to the southern Lots for firefighting purposes. The road and lot layout will allow for minimal crossings over the existing creekline protection areas and will minimise the protection areas from being located within Lots.

2.1 Planning Context

The four lots located within the site boundary are currently zoned as "rural residential" under the Local Planning Scheme No. 5 (LPS5). A Local Structure Plan (LSP) (Figure 2) has been developed to coordinate the provision and planning for future development at the site.

2.2 Policy Framework

There are a number of State Government documents that relate to the site including;State Water Plan (Government of Western Australia (WA) 2007);

- Acid Sulfate Risk Mapping (Department of Environment Regulation (DER) online resource)
- State Planning Policy No 3: Urban Growth and Settlement (WA Planning Commission (WAPC) 2006)
- Liveable Neighbourhoods (WAPC 2007).

In addition to the above documents, there are a number of published guidelines and standards available that provide direction regarding the objectives which stormwater management should aim to achieve. These are key inputs and include:

- Decision Process for Stormwater Management in Western Australia (DWER 2017)
- National Water Quality Management Strategy (ANZECC 2000)
- Stormwater Management Manual of Western Australia (DWER 2007)
- Better Urban Water Management (BUWM) (WAPC 2008).

These guidance documents, together with information from the SoK and DWER, were reviewed to determine the likely data requirements for the site.

2.3 Previous Studies

The environmental characterisation of the site is based on a desktop assessment, field visit by 360 Environmental and a review of the following site documents:

- Environmental Assessment and Management Strategy (Land Assessment, 2017)
- Lot 52 and Lot 2979 Illareen Road, Katanning Proposal for Rural Subdivision (Peritas Group, 2017).

A number of broad level information sources that describe the site have provided a regional context to the LWMS. These were reviewed in order to gather suitable background information for the site, and also to provide an indication of the issues requiring further and more detailed investigation. The background information was sourced from a variety of references, including:

- DWER Water Information (WIR) Database Search
- WA Atlas Database Search
- Hydrology of the Blackwood River Catchment (De Silva et al., 2000)
- Australian Soil Resource Information System (CSIRO, 2014)
- Katanning Flood Assessment (Opus, 2014).

3 Existing Environment

3.1 Land Use

A majority of the site is currently being used for agricultural purposes. It appears there are two houses and agricultural sheds located at the site and a Bed and Breakfast (Wandoo Lodge) located in the north. Several farm dams have been constructed across the site to provide water for agricultural operations.

Illareen Creek is located in the south of the site and two unnamed ephemeral creek lines exist along the northern boundary, both creek lines are lined by dense vegetation.

3.1.1 Land Use Change

Aerial imagery is available from 1997 to 2017 (Plate 1). Images from 2006 to 2017 show four artificial overland paths between the centre and the north of the site which are not present in the 1997 image. There are no other noticeable changes to the site use, vegetation and development for the past 20 years.

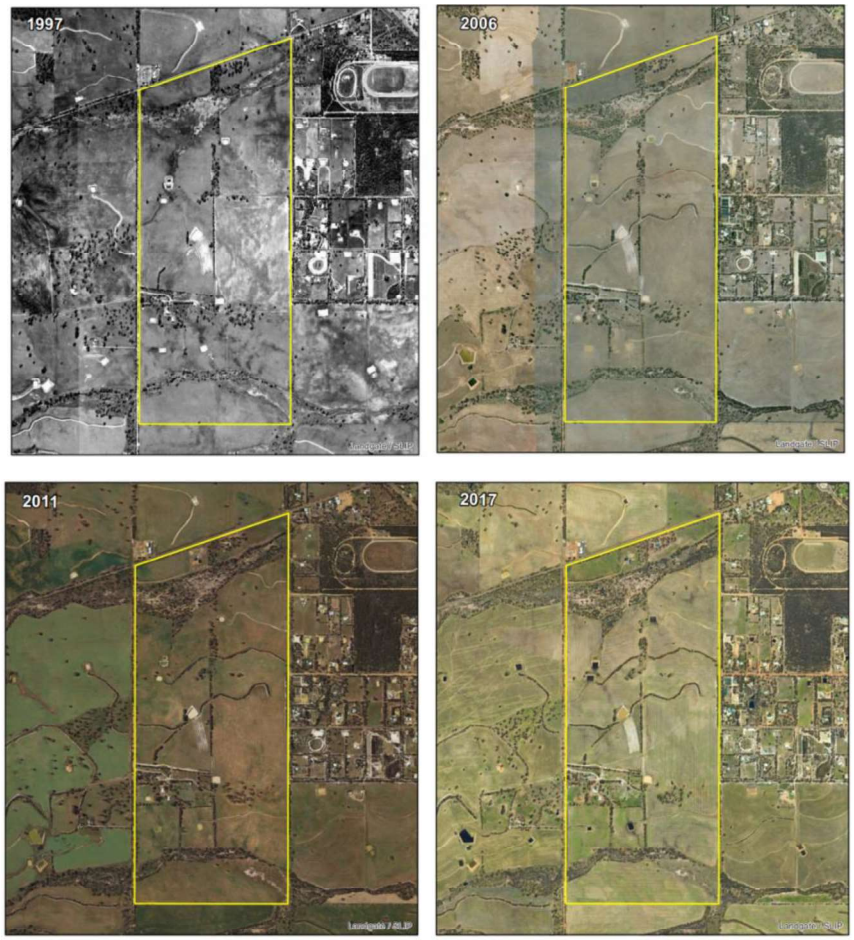


Plate 1: Historic Land Use

3.2 Topography

The site has a central crest which has an elevation of 325 mAHD, with land on either side of the crest falling to the northern and southern site boundaries as shown in Figure 4

3.3 Climate

The closest weather station is the Katanning weather station (010916) approximately 6.5 km east of the site, which provides data since 1999 (Bureau of Meteorology (BoM) 2013a). Plate 2 represents the total monthly rainfall and the monthly mean maximum temperatures recorded between 1999 and 2017. This shows that rainfall has decreased over the last ten years, however, temperature is relatively steady year to year. Katanning currently has a mean annual rainfall of 480.4 mm/yr and an average maximum temperature of 22.1 °C.

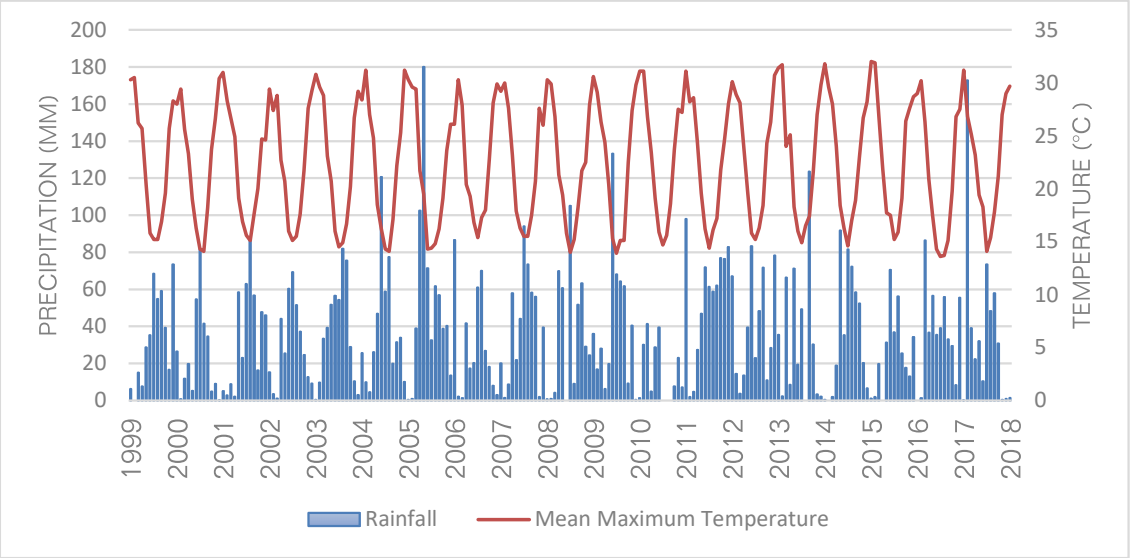


Plate 2: Rainfall and Temperature

3.4 Geotechnical

The 1:250,000 Geological Survey of Western Australia (GSWA) maps (2016) shows that the northern half of the site consists of colluvium and minor alluvium and the southern half consists of biotite granite and adamellite (Figure 5).

Land Assessment (2017) conducted a field survey which included soil sampling using a hand auger at 12 locations within the site. The results show that the local geology mainly consists of sandy/loamy duplex soils with clayey subsoils. A large portion of the site was found to consist of low permeability soils. Further details of the soil sampling are provided in Appendix A.

It is proposed that in-situ soil permeability testing is conducted for the site. Details are to be provided in the UWMP.

3.5 Groundwater

3.5.1 Aquifers

The site is located within the Karri subarea of the Karri Area. Groundwater resources below this region feature four aquifer systems. In descending order from the natural surface these are:

- Combined- Fractured Rock West- Alluvium
- Combined- Fractured Rock West- Calcrete
- Combined- Fractured Rock West- Palaeochannel
- Combined- Fractured Rock West- Fractured Rock.

The aquifer report requested from DWER shows that there is a total of 1.481 ML of allocated volume (Appendix B). Communications with DWER confirmed that all of the resources do not have an abstraction limit.

The site is located within a non-proclaimed area for groundwater under the Rights in Water and Irrigation Act 1914. Only abstraction of groundwater from artesian aquifers is subject to licensing from the DWER.

3.5.2 Groundwater Levels

The groundwater level for this site is identified to be between 2 meters below ground level (mgbl) and 5 mbgl (De Silva et al, 2000). No recent data was available in the water information reporting tool by DWER. The site visit and aerial images did not show any signs of water logging outside the creek lines to indicate that groundwater level might be a significant issue.

3.5.3 Groundwater Quality

3.5.3.1 Regional

A 1:250,000 hydrogeology groundwater salinity map by the Department of Water (DoW) 2013 indicated that the site is located in an area with saline groundwater, ranging between 7,000 mg/L and 14,000 mg/L. No other data by the DWER was found.

3.6 Surface Water

Illareen Creek is located in the south of the site and two unnamed, ephemeral creeklines are located in the north of the site. A number of grade banks intercept and direct surface water to several dams located at the site.

A site visit by 360 Environmental staff confirmed Illareen Creek and the unnamed creeklines in the north are ephemeral.

3.6.1 Flooding

3.6.1.1 Illareen Creek

During a site visit, Ilareen Creek was estimated to be 0.5 m to 1 m deep with a channel width that fluctuates between 1 m and 3.5 m. Plate 3 shows the Illareen Creek.

Plate 3: Illareen Creek, January 2018

According to a flood assessment by Opus completed in 2014[1], Illareen Creek is part of the Coblinine River system and is at risk of flooding during a 1% Average Exceedance Probability (AEP) event (see Figure 7). The projected surface area of the flood was estimated to be 7.5 ha, which is noted to be contained within the denser riparian vegetation along the creek.

A tributary to this creek is noted within the site boundary (Figure 7). This tributary extends approximately 350 m across the site, flowing in a southerly direction towards Illareen Creek.

3.6.1.2 Unnamed Creek

The northern ephemeral creek lines are part of the Coblinine River system and are similarly at risk of flooding during the 1% AEP storm event (Opus, 2014, Figure 7). The surface area of the flood was estimated to be over 13.5 ha, again contained within the native vegetation along the creek line.

The northern creek also has a tributary within the site boundary, which extends approximately 900 m and flows northerly towards the creek (Figure 7).

3.6.2 Surface Water Quality

A search of the DWER's online Water Information Reporting database found no recent surface water quality data is available within close proximity to the site.

[1] Advice provided by DWER (12 March 2018): The flood study has not been formally reviewed by DWER, however a informal assessment of the study indicates the modelling/mapping to be suitable regional scale mapping. Further modelling and mapping is likely to be required at future stages.

3.7 Environmental

The site is in a remote location outside of the Perth greater region, therefore the information available on the environmental features within and surrounding the site is limited. The following environmental features were identified.

3.7.1 Bushfire Prone Areas

The site is located within a bushfire prone area (Department of Fire and Emergency Services (DFES), 2017). The extent of the area can be seen in Figure 2.

3.7.2 Native Vegetation

Native vegetation is present within the site (Department of Agriculture and Food Western Australia (DAFWA), 2017). The extent of the area can be seen in Figure 3.

The Shire's LPS5 indicates that no clearing of remnant vegetation is permitted unless approved by the local government.

3.7.3 Acid Sulfate Soils

The site is classified as low probability/high confidence of Acid Sulfate Soils (ASS) risk (CSIRO, 2014). See Figure 6.

3.8 Risk Assessment

3.8.1 DWER Risk Assessment

The size and level of detail required in BUWM (Better Urban Water Management) reporting depends on the constraints of the site and the level of risk these pose to the development. Table 1 provides a guide to the level of detail required for each risk category.

Table 1: Risk Management

Risk Category	Site Conditions	Information Requirements
Low	• Depth to groundwater (>5 m) • Infiltrate on site • No offsite discharge or regional drainage issues.	*Minimum* Demonstrate the management of water will be consistent with State Planning Policy 2.9: Water Resources, the Stormwater management manual for Western Australia and Decision process for stormwater management in WA. Note that the policy is being reviewed and the latest version should be used when it is available. *Limited* Site assessment to determine management responses in terms of the surrounding (sub) catchment. On site monitoring and demonstration of representative sampling. *Comprehensive* Detailed modelling and investigations. Full BUWM checklist to be addressed in detail.
Medium	• Depth to groundwater (between 1.2 and 5 m) • Offsite discharge to local and/or regional system • No regional bushland or significant wetland or waterway issues • Medium acid sulfate soil risk • Contains natural waterways.	
High	• Depth to groundwater (<1.2 m) • Proposed off-site drainage with potential adverse effects on wetlands or waterways • Contains a floodplain • Known contaminated site • High acid sulfate soil risk • Contains any part of a conservation category wetland or its buffer • Contains environmentally significant waterways.	

3.8.2 Site Risk Assessment

Based on the geotechnical, hydrological and environmental information, the site can be considered as posing a medium level of risk, based on the DoW's Guidance Note 3 (DoW, 2013). The site conditions fulfil this criterion by:

- contains natural waterways (ephemeral)
- Depth to groundwater is between 2 and 5 mbgl.

4 Design Criteria and Objectives

4.1 Total Water Cycle Management

Total water cycle management recognises the finite limit to a region's water resources, and the inter-relationships between the uses of water and its role in the natural environment. The State Water Plan (Government of Western Australia 2007) endorses the promotion of total water cycle management and application of Water Sensitive Urban Design (WSUD) principles to provide improvement in the management of stormwater, and to increase the efficient use of existing water supplies. Total water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Stormwater management design objectives should therefore seek to deliver better outcomes in terms of:

- Non-potable and potable water consumption
- Stormwater management
- Flood management.

The overall objective for preparing a total water cycle management plan is to mitigate flooding, minimise sediment transport and maintain an appropriate water balance.

4.2 Water Conservation

The overall aim of total water cycle management includes the sustainable consumption of potable water and consideration of all water sources. Therefore, the use of water within the development will be minimised wherever possible.

The design criteria to aid conservation of water are presented in Table 2.

4.3 Stormwater Management

The overall guiding document for the development of stormwater management strategies is the Stormwater Management Manual of Western Australia (DWER 2007). The Decision Process for Stormwater Management in Western Australia (DWER 2017) provides guidance on how urban development can achieve compliance with the objectives, principles and delivery approach outlined in the Stormwater Management Manual of Western Australia.

Historically the site was used for agricultural purposes and is sparsely vegetated. Changing land use from agricultural to rural residential can have implications for both the quantity and quality of stormwater runoff generated on the site. Changes to these aspects of stormwater can have impacts on local and downstream environments that require consideration. The overall aim of the LWMS is to ensure that any potential impacts on the local and downstream environments from land use changes and subsequent development are minimised and or managed appropriately.

4.3.1 Stormwater Flow

Stormwater retention and detention structures must be designed in accordance with the Stormwater Management Manual of Western Australia (DWER 2007) and Australian Rainfall and Runoff (Engineers Australia 1997). BUWM (WAPC 2008) advocates a water quantity management principle where pre-development peak flows are maintained post development. Design criteria to manage stormwater flow across the site is provided in Table 2.

4.3.2 Stormwater Quality

Water treatment systems and WSUD structures must be designed in accordance with the Stormwater Management Manual of Western Australia (DWER 2007) and Australian Runoff Quality (Engineers Australia 2006). BUWM (WAPC 2008) advocates a water quality management principle where existing surface water quality is maintained as a minimum, and preferably improved prior to discharge offsite.

The primary objective for this LWMS is to avoid further deterioration of water quality within the receiving downstream environment. Design criteria are presented in Table 2.

4.4 Groundwater Management

The overall objectives for groundwater management are to minimise changes to the underlying groundwater level and quality as a result of development. BUWM (WAPC 2008) advocates a water quality management principle where existing groundwater quality is maintained as a minimum, and preferably improved prior to discharge offsite.

The groundwater management design criteria are presented in Table 2.

Table 2: Proposed Design Criteria

Design Criteria	
Water Conservation	Meet a household consumption target of less than 100 kL per year per person.
	Minimise water requirements through use of water efficient appliances and irrigation systems.
Stormwater Flow	Collect and infiltrate the first 15 mm of stormwater runoff from impervious surfaces within lots as close to source as possible. Maintenance of overland flow paths for storm events greater than this.
	Ensuring the 1% AEP event can be contained within the road reserve with a minimum 300 mm freeboard to finished floor level of adjacent properties.
Stormwater Quality	Treatment of runoff prior to discharge by infiltrating the first 15 mm of stormwater on site.
	Apply appropriate structural and non-structural measures to minimise the transportation of sediments offsite and reduce applied nutrient loads.
Groundwater Management	Ensuring that sufficient clearance is maintained between building levels and the groundwater table.
	Minimise risk of nutrient enrichment of downstream receiving water bodies from groundwater sources.
	Ensure that groundwater quality leaving the site is at least the same, or better, than the water entering the site.

5 Water Sustainability Initiatives

5.1 Development Water Sources

Water Corporation mains are present along Prosser Street and currently service the rural residential lots to the east. Upgrades and extension of the existing Water Corporation infrastructure will be completed to provide potable water to the site.

The upgrading and extension of existing Water Corporation infrastructure will also provide a suitable water source for firefighting purposes, if ever required.

The LSP does not include areas of Public Open Space requiring irrigation of landscaping. A groundwater license for the irrigation of landscaping is not likely to be required.

The Department of Water and Environmental Regulations (DWER) has confirmed that a license to abstract groundwater for irrigation or dust suppression is not required, as the site is located within a non-proclaimed groundwater area. Water Conservation Measures

5.1.1 Potable Water

Potable water for households within the development will be supplied by upgrading and extending existing Water Corporation infrastructure to the LSP. The Household Water Use Calculator (City of Melbourne, 2003) was used to estimate the water use per household. The calculated amount of water used per household was approximately 95 kL per annum. This was based on the following assumptions;

- There are 2.6 people per household (Australian Bureau of Statistics, 2016)
- Water efficient taps, showers and washing machines are used (see Section 5.1.1.1)
- Irrigation will be limited
- General water use was set to 200 L per week.

5.1.1.1 Water Efficient Appliances

Household water use efficiency will be achieved using water efficient appliances. Table 3 provides a comparison of water uses for standard appliances versus water efficient appliances. The water efficient appliances have been used in the water balance investigation.

Table 3: Water Efficient Appliances

Appliance	Water Consumption	
	Standard Device	Water Efficient Device
Toilet	12 L/flush	4 L/flush
Washing Machine	130 L/wash	40 L/wash
Shower Head	15 – 25 L/minute	6 – 7 L/minute
Taps	15 – 18 L/minute	5 – 6 L/minute

The water conservation strategy proposes all dwellings use water efficient appliances. Water efficient shower heads and tap fittings are already mandated as part of the Building Code of Australia (ABCB, 2016), however, although not mandated the uptake of other devices will be encouraged through education from the developers at the point of sale.

5.1.1.2 Water Efficient Gardens

The reduction in water irrigation by employing water efficient garden measures can significantly reduce the total water usage of the lot. The following water efficiency measures can be used on lot gardens:

- Gardens should include large permeable areas such as gravel, dry creek bed features or swales limiting the amount of turfed area within the design. The use of mulch or gravel as alternatives to turf should also be advocated
- Where planting is proposed, plants should be local native species and garden beds should be mulched to 75 mm with a product certified to Australian Standard AS 4454 (2012)
- Installing an irrigation system that was designed and installed according to best practices for water efficiency. The controller should be able to irrigate different zones with different irrigation rates. Emitters should disperse coarse drops or be subterranean.

5.2 Wastewater Management

Wastewater disposal will rely on a combination of traditional septic tanks where suitable and aerobic treatment units (ATU's).

All ATU's must be in accordance with the Department of Health Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units and must comply with the Shire's guidelines.

It is noted that DWER supports the proposal for ATU systems, however, notes that the draft Government Sewerage Policy (WAPC 2016) requires a minimum primary level of treatment, unless the number of units proposed may have unacceptable cumulative impacts.

In addition, the following additional considerations are required to be addressed at later stages of planning:

- The Shire of Katanning should approve the proposal given it is responsible for regulating ATU use and must have sufficient administrative capacity to undertake these duties
- A licensed service agent will be required to undertake regular maintenance of the proposed system. Availability of this service within the region should be taken into account when specifying a system for land owner installation.

Further details should be provided at subdivision stage of the proposed development.

6 Stormwater Management Strategy

6.1 Proposed Stormwater Management Strategy

The proposed development includes 71 lots ranging in size from 1 ha to 16 ha and four internal roads to service the lots. The increase in impervious surfaces and therefore increase in stormwater runoff rates from the LSP will also be minimal.

The overall stormwater management strategy for the site includes

- maintaining the pre-development flow paths
- retaining the first 15 mm of rainfall from impervious surfaces
- detaining the 1% AEP event through the use of roadside swales and providing creekline protection areas for flood and riparian zone management.

6.2 Post Development Stormwater Management

6.2.1 Lots

Soakwells will be installed on each lot sized to retain the first 15 mm of runoff generated from the building footprint.

6.2.2 Roads

The roads were identified from the LSP and are detailed in table 4 below.

Table 4: Road Reserve Parameters

Road ID	Road Length (m)	Road Reserve Width (m)	Road Width (m)	Total Verge Width (m)	Road Reserve Area (m^2)
Road A	1160	26	6	20	30,160
Road B	1114	26	6	20	28,964
Road C	990	26	6	20	25,740
Road D	425	26	6	20	11,050
Road E	780	26	6	20	20,280

Swales are proposed to manage stormwater runoff from the road reserves. The runoff volumes for the 1% AEP storm event were obtained from XPSTORM using Laurenson's method. Table 5 shows the resulting runoff volumes based on the XPSTORM analysis and the approximate minimum swale cross-section parameters required to store the runoff volume. A 300 mm freeboard from the 1% AEP TWL and the habitable floor level of the lots will be provided and investigated further during the detailed design phase of the project at sub division. Modelling showed the 1% AEP critical storm duration was 1 hour for Road A and B and 30 minutes for Road C, D and E.

Table 5: Minimum Swale Cross-Section Parameters

Runoff Source	Runoff Volume (m^3/s)	Swale Cross-section Parameters			
		Width of Base Level (m)	Top Width (m)	Depth (m)	Side Slope
Road A	886.68	1.1	6.1	0.55	1:5
Road B	664.08	1.1	6.1	0.55	1:5
Road C	792.12	0.4	5.4	0.55	1:5
Road D	338.04	0.4	5.4	0.55	1:5
Road E	624.18	0.4	5.4	0.55	1:5

It was assumed that the roads slope 1% and the infiltration rate for the swale was 200 mm/hr for a vegetated swale.

For land preservation and to allow placement of services in road reserves, it is proposed that the stormwater runoff from all roads is discharge into one swale. The runoff volumes obtained from XPSTORM show that one roadside swale is sufficient to manage the runoff from each road. Plate 5 shows the cross-sectional view of the conceptual swale.

It is proposed that additional storm water modelling is completed to support the detailed design of the road and drainage network. The detailed design will be included in future UWMP's.

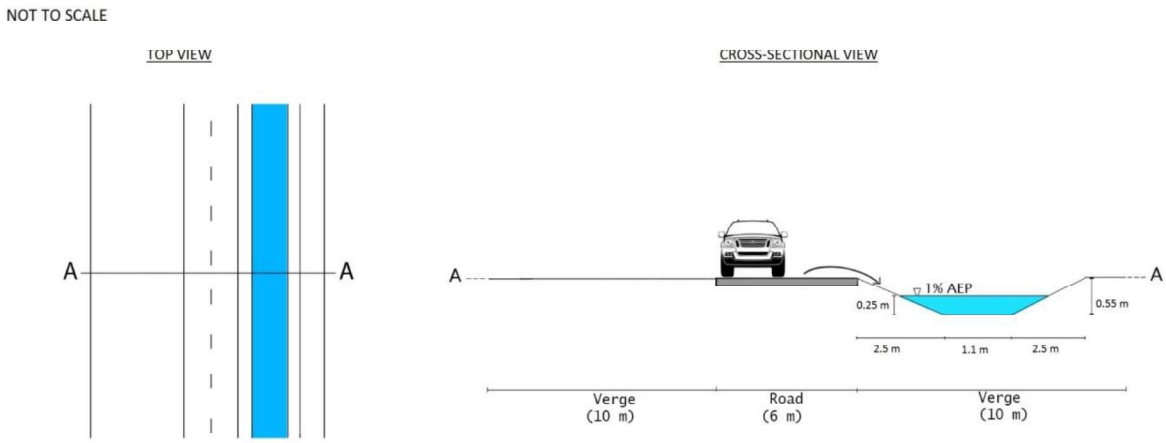


Plate 4: Road Reserve Cross-Section

6.2.3 Swale Drain Times

To ensure sufficient capacity within designed basins should rainfall events of magnitude occur back to back the Urban Water Resources Centre (2008) has produced a series of recommended emptying time criteria for drainage infrastructure. For a 1% AEP event, the recommended drain time is 3.5 days (84 hours).

The swale drain times for the 1% AEP event are shown in Table 6.

Table 6: Swale Drain Times

Swale	1% AEP Swale Emptying Time (hours)
Road A Swale	1.5
Road B Swale	1.5
Road C Swale	1
Road D Swale	1
Road E Swale	1

6.2.4 Development in the 1% AEP Floodplain

Flood protection zones along Illarren Creek, and the unnamed ephemeral tributaries have been provided in the LSP to provide adequate flood management and protection to existing riparian zones. All adjacent lots to the flood protection zones will be large enough to allow the development footprint of any habitable spaces to be located outside the floodway. No development within the 1% AEP floodplainis proposed. Native vegetation in the riparian zones along all waterways and creeklines have also been included in the protection zones.

The areas marked as creekline protection zones on the LSP exceed beyond the modelled 1% flood extent (floodplain) to include areas of existing riparian vegetation.

6.2.5 Post Development Flows

It is necessary that the 1% AEP is safely conveyed to the creeklines. Due to minimal change in impervious area for the development, the change in post development flows is likely to be negligible.

Earthworks to construct roads and provide flat building envelopes is likely to be required only. The current landform and flowpaths will be maintained where possible. Stormwater will enter the waterways at controlled locations and appropriate erosion control measures will be implemented to prevent scouring and erosion.

The detailed design of erosion control structures will be provided at the detailed design stage (subdivision).

7 Groundwater Management Strategy

7.1 Groundwater Level Management

Indicative groundwater levels for the site, presented in Section 3.5.2 show that groundwater is located between approximately 2 and 5 mbgl.

The groundwater closer to the surface is expected to be at areas of lower natural surface elevation within catchments, where the ephemeral creeks are located. It is recommended that the building envelope is located at the higher topographical areas and that stormwater is discharged at sufficient distance from the lower elevated areas in order to prevent a rise in groundwater levels.

It is proposed that the UWMP provide a more detailed assessment on the likely impact the development may have on groundwater levels, once detailed earthwork plans have been produced for the site.

7.2 Groundwater Quality Management.

Redevelopment of the site to rural residential has the potential to cause a deterioration of groundwater quality if not appropriately managed. This could come from the introduction of:

- Septic tanks
- Animal manure
- Pesticides
- Liquid disposal
- Chemical wastes
- Fertilisers

7.2.1 How the Development Proposes to Manage These Risks

The development is limited to rural residential purposes and the wastewater is proposed to be treated by ATU tanks. The principle contamination risks to the site are limited to:

- Fertilisers and pesticides application in gardens/agricultural areas
- Animal waste
- Accidental fuels spills.

7.2.1.1 Fertiliser Application and Animal Waste Risk Management

Due to the change in land use from agricultural to rural residential, it is anticipated that the use of fertiliser will be reduced post development when compared to current application rates. While animal husbandry may be a land use post development, the size of the proposed lots will limit animal numbers to volumes which are unlikely to cause significant impacts on groundwater quality.

8 Protection of Receiving Environments

The proposed water management systems are designed to treat stormwater of any contaminants prior to releasing it back to the environment.

Protection of the aquifer involves managing the post development use of nutrients and the export of pollutants off site. A treatment train approach, including the use of structural and non-structural controls, will be implemented to achieve this protection.

Non-structural controls are an essential part of the treatment train process as these contribute to the reduction of stormwater volumes and pollutants. These differ from structural controls as they are not fixed, permanent infrastructure and can offer relatively inexpensive and flexible approaches (DoW 2004-2007).

For this site, the following non-structural controls may be implemented:

- Planning: residential lot density
- Construction: erosion and dust control
- Maintenance: street sweeping, maintenance of stormwater infrastructure.

Structural controls for the site will be implemented to retain and infiltrate all the 1% AEP events. This involves implementing the use bio-retention systems, such as bio-retention swales, to manage and treat the runoff from impervious areas. These methods are based on the Stormwater Management Manual of Western Australia (DoW, 2004-2007). Specific targets for improvement in water quality will be detailed in the UWMP.

Stormwater from minor rainfall events will be collected and infiltrated as close to source as possible using soakwells and roadside swales. Road side swales will be sized to detain events up to the 1%AEP event to pre-development conditions and stormwater will continue to enter Ilareen Creek and the ephemeral creek lines in major rainfall events at designated locations which incorporate appropriate erosion control measures.

9 Management and Maintenance Plan

The design and construction of the stormwater management system has been undertaken in a manner that promotes the longterm health of the associated WSUD features. Additionally, these areas often require active ongoing management, particularly in the first years after construction to ensure that the features continue to provide the designed function.

A Management and Maintenance Plan (MMP) should be produced for the development which outlines the management actions required during the initial years. The overall objective of the MMP is to provide guidance on how to:

- Maintain the amenity and function of the stormwater management system
- Minimise the potential for environmental impacts and disturbance to surrounding residents in the longer term
- Ensure that the system is in an appropriate and sustainable condition at the point of management handover.

This MMP should include:

- A suitable monitoring regime
- Provide guidance on the actions required to ensure that the overall objective is met.

The proposed stormwater management strategy follows the principle that all of the 1% AEP event is to be managed locally. As such the key areas that will be addressed through the implementation of this management plan are:

- Nutrients and water quality
- Gross pollutants and sediments
- Vegetation.

9.1.1 Nutrients and Water Quality

Structural measures proposed within this LWMS maximise the removal of nutrients from stormwater flows. The proposed stormwater system includes infiltration at source of the first 15mm and provides detention of minor and major rainfall events using roadside swales. The combination of these components provides sufficient treatment to remove contaminants and pollutants from runoff.

9.1.2 Gross Pollutants and Sediments

Gross Pollutants can potentially introduce health risks and reduce the overall visual amenity of the swales.

Swales will trap gross pollutants and are to be removed by non-structural measures. This includes ongoing management and maintenance of gross pollutants to minimize the

generation of gross pollutants collected in the stormwater system. Examples of this ongoing maintenance include:

- Periodic visual inspection of roadside swales
- Manual removal of gross pollutants trapped in swales.

These actions and the manner in which they should be implemented are detailed in Table 7.

Table 7: Maintenance Schedule and Responsibility for Management Actions

Action	Timing	Location	Responsibility
Use of Slow Release fertiliser	When planted	Swales	Landscape Contractor
Harvest of nutrient removing vegetation	As required	Swales	Maintenance Contractor
Vegetate swales	During construction of the stormwater management system	Drainage features	Landscape contractor
Inspect for gross pollutants and sediments	Minimum quarterly	Swales	Maintenance contractor
Remove gross pollutants and sediments	In response to observations		
Dispose of waste to an approved facility	Following removal of gross pollutants	Offsite disposal facility	
Provide street sweeping	Monthly – Especially during the building phase	Entire site to prevent/reduce amount of sediment entering the swales	Shire
Visually monitor for infill planting requirements	Quarterly	Swales	Maintenance Contractor

10 Requirement for an Urban Water Management Plan

The requirement to undertake preparation of more detailed water management plans is generally imposed as a condition of subdivision. It is noted DWER consider the low density of development proposed at the site negates the need for a UWMP. If the Shire require a UWMP or similar to be undertaken this reporting should follow the guidance provided in the Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions (DWER 2008) and the recommendations of this LWMS.

While strategies have been provided within this LWMS that address planning for water management within the site, it is a logical progression that future subdivision designs and the supportive UWMP will provide further information including:

- Provide details of in-situ permeability testing for the use of ATU's
- Earthworks plan and detailed design of the road reserves including the road side swlaes
- Implementation of water conservation strategies
- Construction period management strategies
- Further details regarding the potable water supply and wastewater management system.

A summary of the objectives for the UWMP is provided in Table 8.

Table 8: UWMP Objectives

Objective	Requirement
In-situ permeability soil testing	Provide details on the propose in-situ permeability soil testing and test locations.
Swale design	Provide details on the final design of the swale.
Water Conservation	Provide further details on water conservation strategies.
Potable Water and Sewerage Services	Further details about potable water supply
	Details of the ATU placement and constraints.

11 Implementation

11.1 Roles and Responsibility

This LWMS provides a framework that the proponent can utilise to assist in implementing stormwater management methods that have been based on site specific investigations, are consistent with relevant State policies and have been endorsed by the Shire. The responsibility for working within the framework established within the LWMS rests with the proponent and contractors, although it is anticipated the future management actions beyond the proposed management timeframes will be the responsibility of the Shire.

An appropriate implementation plan which includes a monitoring and maintenance schedule will be detailed in the future UWMP (or similar). The complete subdivision of the site is expected to occur over a minimum period of 15 years. The timing and areas of the LSP to be subdivided will be driven by market demands which are difficult to determine at this stage.

Table 9 details the roles and responsibilities for water management during the subdivision and construction phase of the development and post-development, again further details will be provided in the future UWMP (or similar)

Table 9: Roles and Responsibilities

Action	Developer	Shire
Preparation of UWMP	✓	
Assessment / Approval of the UWMP (or similar)		✓
Construction of Stormwater System	✓	
Maintenance and Street Sweeping Prior to Handover	✓	
Maintenance and Street Sweeping Following Handover		✓

13 References

Australian Bureau of Statistics 2016, Census QuickStats. Available at: http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/5?opendocument

Australian Bureau of Statistics 2011, Average Floor Area of New Residential Dwellings. Available at: http://www.abs.gov.au/ausstats/abs@.nsf/featurearticlesbytitle/8BB3F6B866BC35CECA2578A000153026?OpenDocument

Bureau of Meteorology (BoM) 2013a, Climate Data Online Database, Government of Australia. Available at: http://wir.water.wa.gov.au/SitePages/SiteExplorer.aspx

Bureau of Meteorology (BoM) 2016, Intensity-Frequency-Duration Database, Government of Australia. Available at: http://www.bom.gov.au/water/designRainfalls/ifd/

City of Melbourne 2003, Household water Use Calculator. Available at: https://www.melbourne.vic.gov.au/SiteCollectionDocuments/water-use-household-calculator.pdf

CSIRO 2014, ASRIS Australian Soil Resource Information System. Available at:

http://www.asris.csiro.au/themes/AcidSulfateSoils.html

Department of Agriculture and Food (DAF) 2017, Native Vegetation Extent (DPIRD-005)

Department of Mines, Industry Regulation and Safety (DMIRS) 2016, Geological Survey of Western Australia. Geocortex Viewer. Available at: https://geoview.dmp.wa.gov.au/GeoViews/?Viewer=GeoVIEW

Department of Water (DoW) 2013, 1:250 000 hydrogeology groundwater salinity.

Department of Water (DoW) 2004-2007, Stormwater Management Manual for Western Australia, Government of Western Australia

Department of Water (DoW) 2017, Decision Process for Stormwater Management in WA, Government of Western Australia.

Department of Water (2012). Perth Groundwater Atlas. Available at: http://www.water.wa.gov.au/idelve/gwa/

Department of Water (DoW) 2013, Better Urban Water Management Guidance Note Series: Guidance Note 3: Preparation and Assessment of Water Management Reports, Government of Western Australia.

Elizabeth M. Shaw 1994, Hydrology in Practice, Third Edition, Rainfall-Runoff Relationships, p317.

Engineers Australia (2006), Australian Runoff Quality.

Government of Western Australia (2007), State Water Plan.

Institution of Engineers, Australia (Engineers Australia) 1987, Australian Rainfall and Runoff, Government of Australia

J. De Silva, R.A. Smith, J.L. Rutherford and L. Ye (2000), Hydrology of the Blackwood River Catchment, Western Australia: Waters and Rivers Commission Hydrogeological Record Series Report HG 6.

Land Assessment (2017), Lots 52 & 2979, Illareen Rd, Shire of Katanning, Environmental Assessment & Management Strategy.

Opus (2014), Katanning Flood Assessment.

Peritas Group (2017), Lot 52 and Lot 2979 Illareen Road, Katanning Proposal for Rural Subdivision. Engineering Servicing Report PC17193.

The Shire of Katanning 2018, Local Planning Scheme No. 5

Urban Drainage and Flood Control District 2017, Urban Storm Drainage Criteria Manual: Volume 1 Management, Hydrology, and Hydraulics, p6-6.

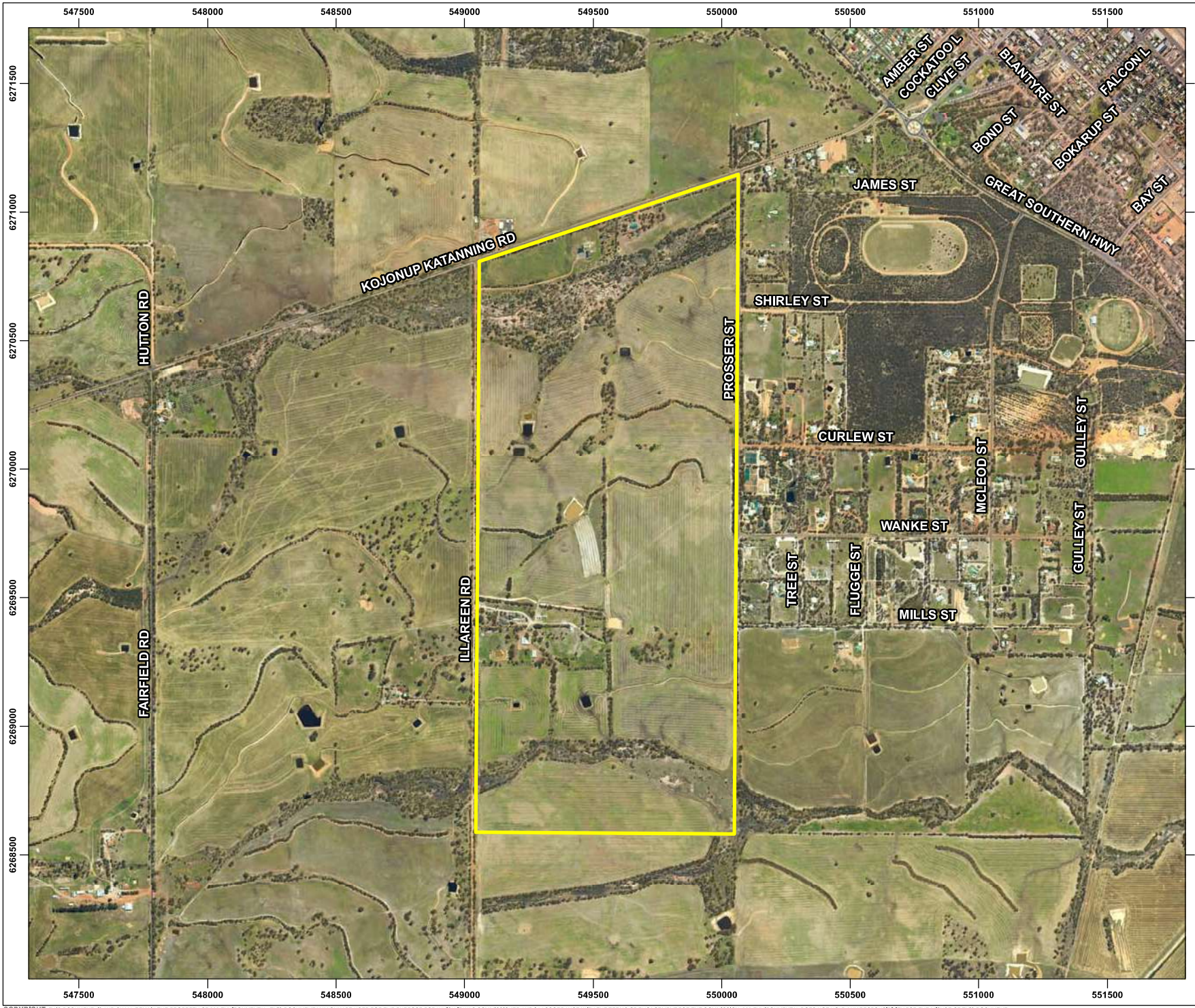
Western Australian Planning Commission (WAPC) 2015, State Planning Policy 3.1– Residential Design Codes.

Western Australian Planning Commission (WAPC) 2008, Better Urban Water Management, Government of Western Australia.

Western Australian Planning Commission (WAPC) 2016, Government Sewerage Policy. Government of Western Australia.

Water Corporation Western Australia (WCWA) 2003, Domestic Water Use Study

FIGURES



Legend

Project Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500 Meters

1:20,000 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	22/01/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

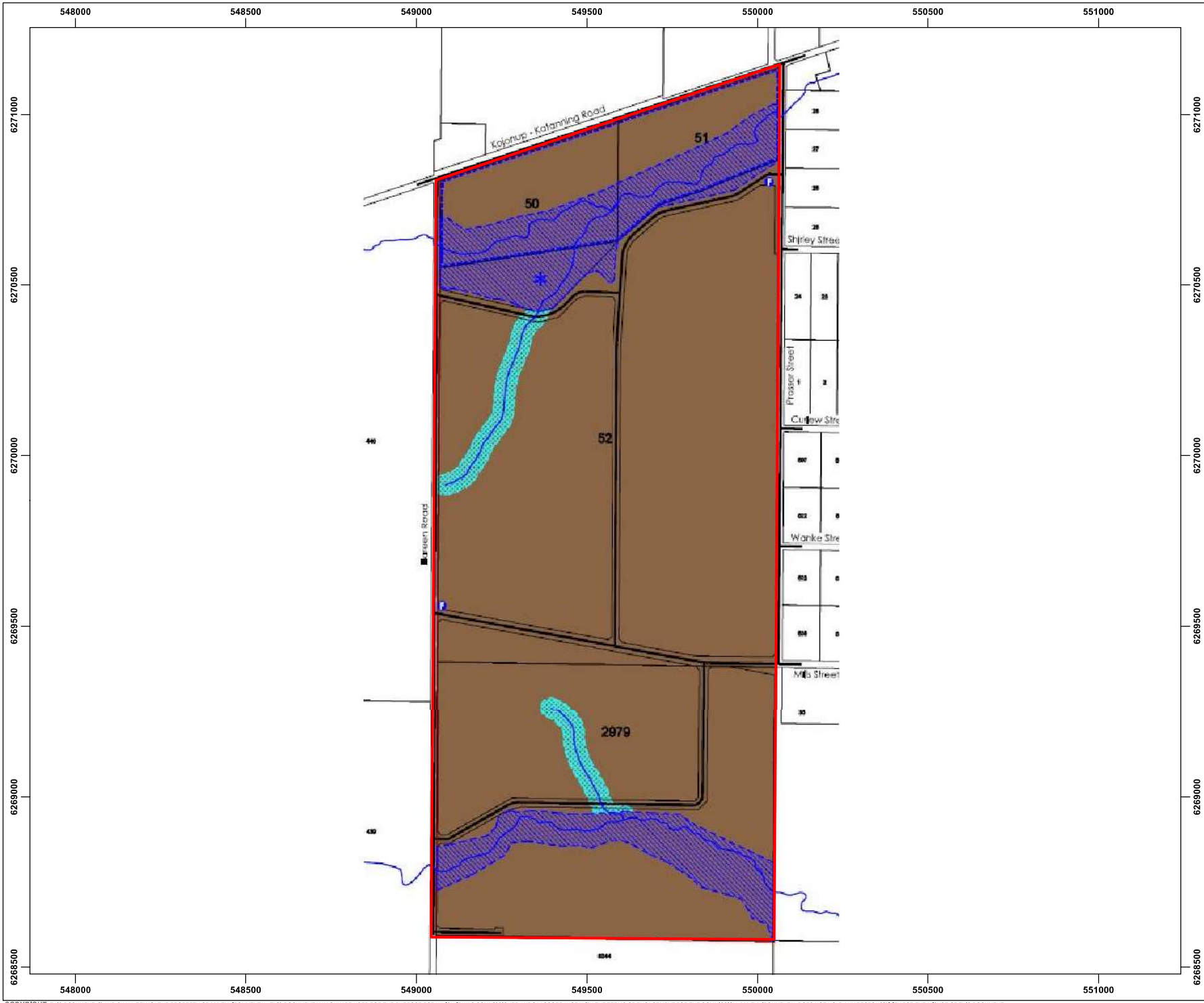
CREATED	CHECKED	APPROVED	REVISION
SL	SL	JJ	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 1 - Location Plan

K:\Projects\5.0 SWA\2558 2558 Katanning LWMS\Figures\2558 F1 Site Location.mxd



Legend

- SUBJECT SITE
- RURAL RESIDENTIAL ZONE
- PORTION OF LOT 52 TO BE AMALGAMATED WITH LOT 50
- INDICATIVE SITES FOR FIRE-FIGHTING WATER TANKS (IN ACCORDANCE WITH THE REQUIREMENTS OF THE GUIDELINES FOR PLANNING IN BUSHFIRE PRONE AREAS)
- CREEK LINE PROTECTION (1% AEP FLOOD EXTENT AND ADJACENT VEGETATION)
- CREEK LINE TRIBUTARIES (60m PROTECTION AREA)
- TECHNICAL REPORTS / STRUCTURE PLAN TO BE UPDATED PRIOR TO DEVELOPMENT

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500 N
Meters
1:15,000 @ A4

LOCALITY MAP

PROJECT ID	DATE
2558	17/06/2019

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

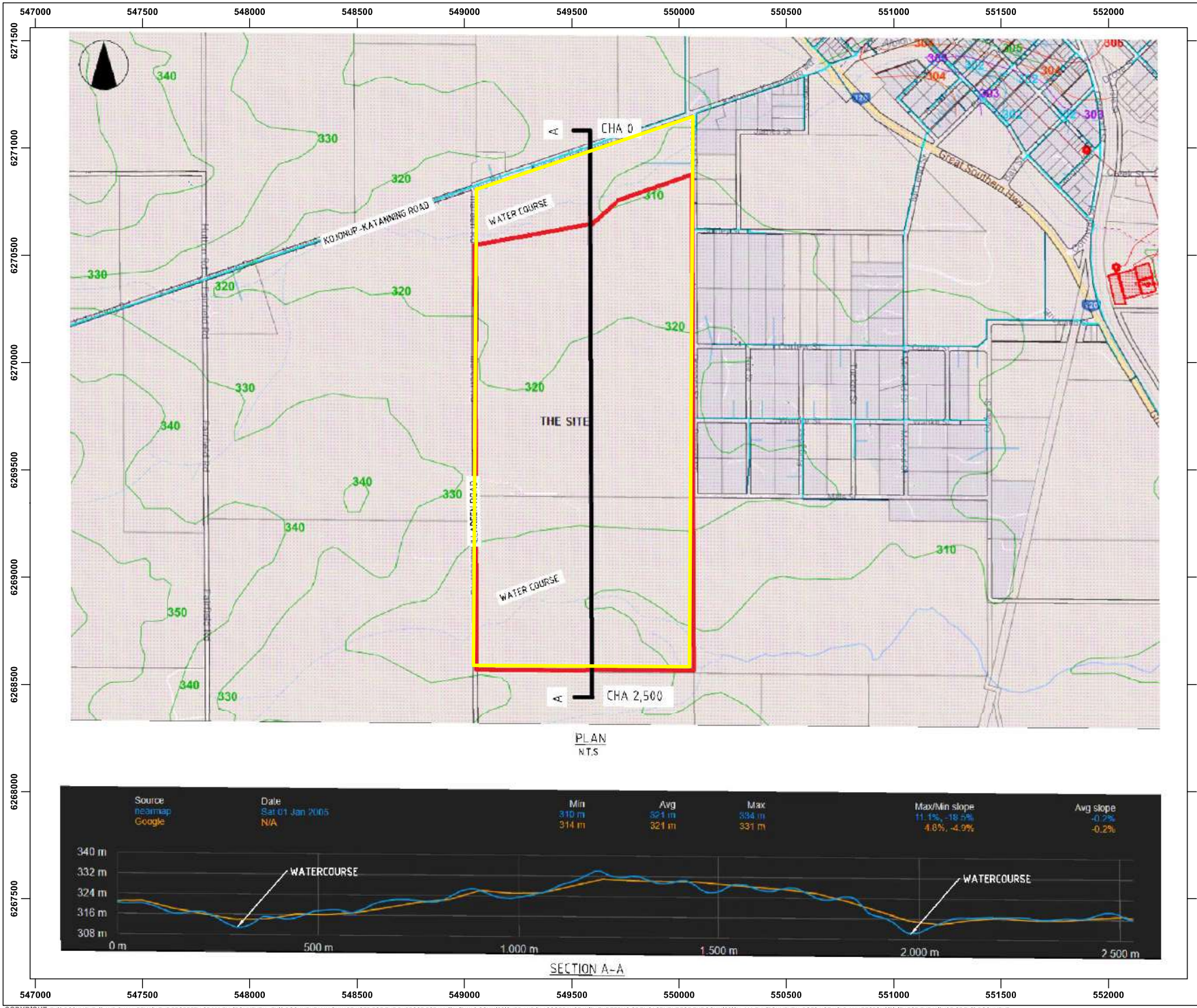
CREATED	CHECKED	APPROVED	REVISION
SL	SL	KL	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 2
Katanning Local Structure Plan

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F2 Katanning Local Structure Plan.mxd



Legend

Project Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ELEVATION SOURCED GEOSCIENCE AUSTRALIA 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2018
(© Western Australian Land Information Authority 2018)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500
Meters
1:23,957 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	4/07/2019

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

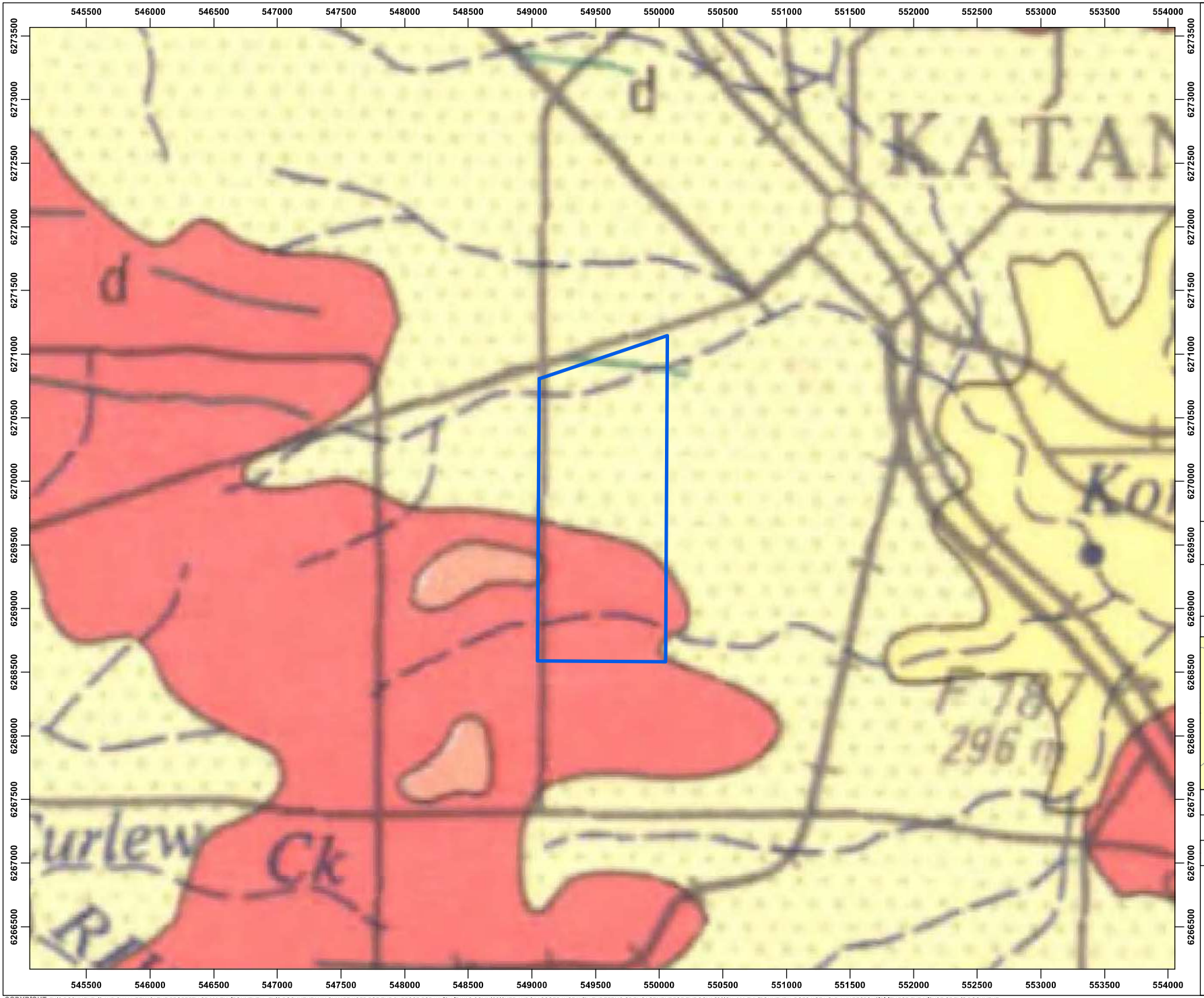
CREATED	CHECKED	APPROVED	REVISION
SL	SL	KL	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 3 Topography

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F4 Site Topography.mxd



Legend

- Project Boundary
- Age - Biotite Granite and adamellite;medium and coarse, even-grained; locally foliated
- Qc - Colluvium and minor alluvium - silt, sand and gravel; generally on slopes adjoining rock and laterite

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- GEOLOGY DATA SOURCED DMP 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 500 1,000 Meters
1:40,000 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	16/02/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	SL	JJ	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 4
Geotechnical Information

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F6 Geotechnical Information.mxd

Legend

- Project Boundary
- 1% AEP Flood Extent
- Minor River

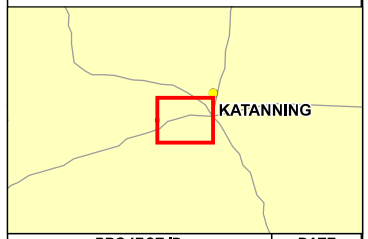
- NOTE: THIS FIGURE IS BASED ON THE INFORMATION PROVIDED FROM KATANNING FLOOD ASSESSMENT (OPUS, 2014).
- POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500
Meters
1:20,000 @ A4

N

LOCALITY MAP



PROJECT ID	DATE
2558	20/04/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SBO	SBO	JJ	1

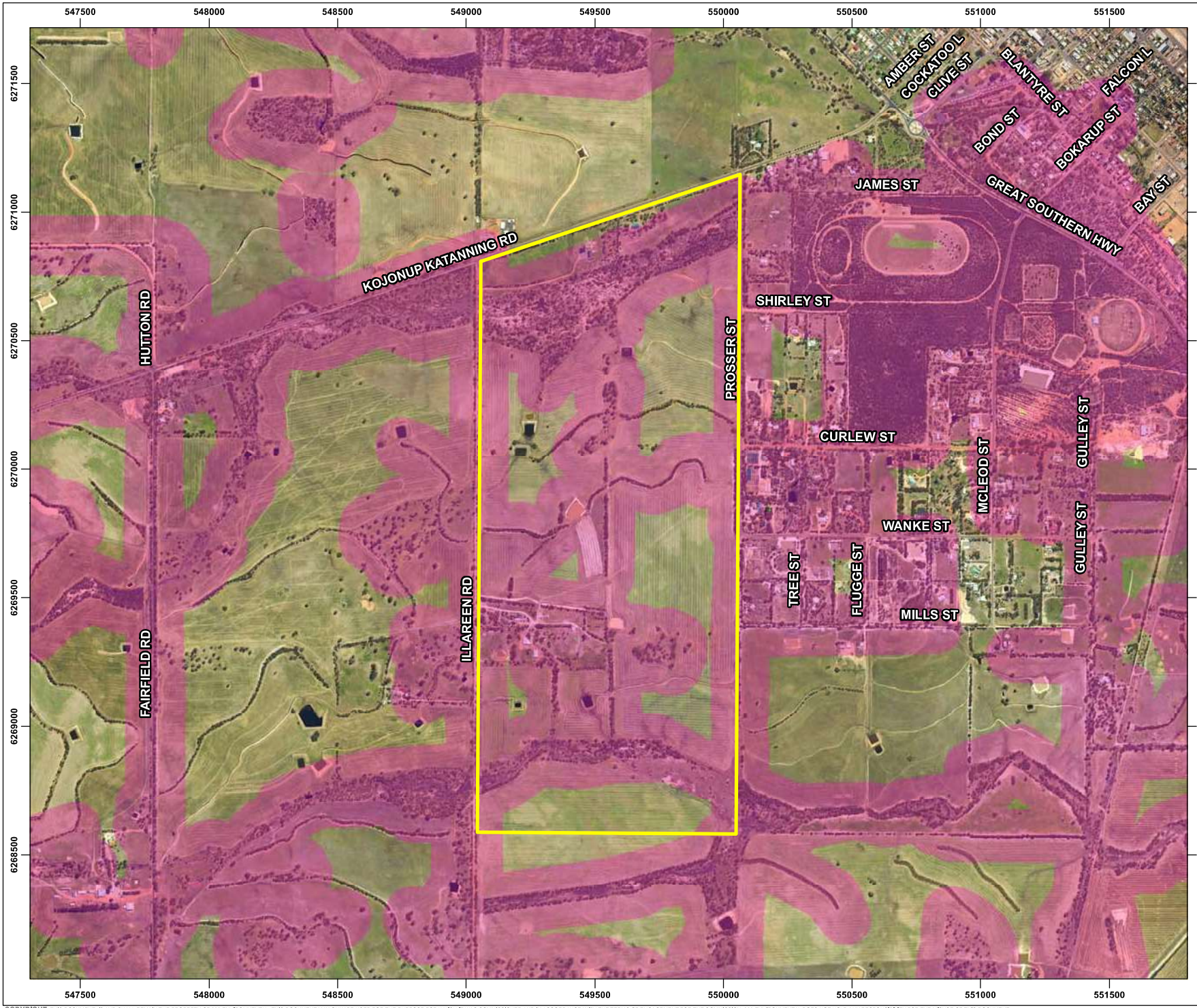
Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 5

1% AEP Flood Extent

Z:\5. SWA\5.2 Projects\2558 Katanning LWMS\Technical\Drafting\2558 F7 Flood Extent.mxd



Legend

- Project Boundary
- Bushfire Prone Areas

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- BUSHFIRE PRONE AREAS SOURCED OBRM 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500 Meters

1:20,000 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	9/02/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

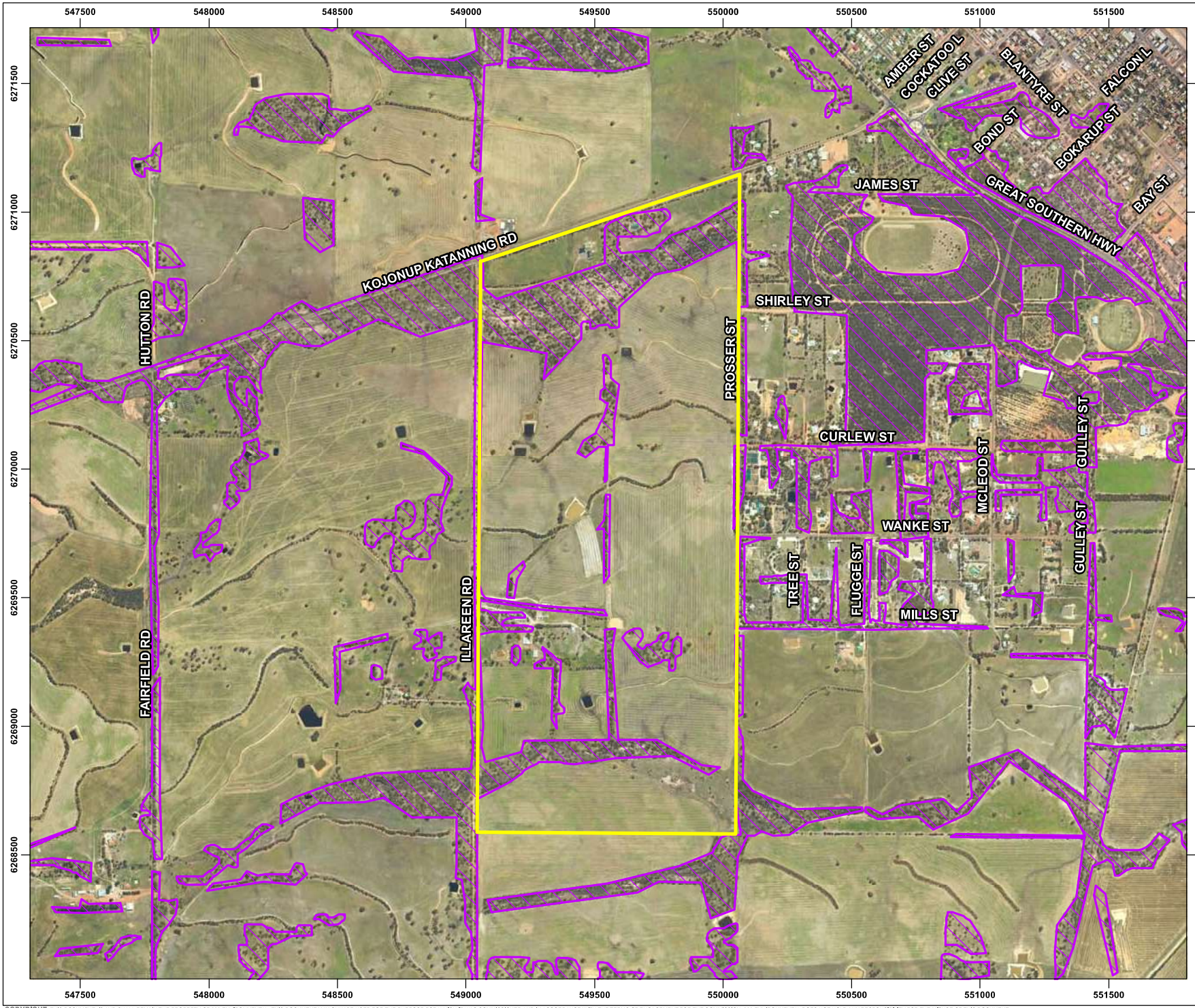
CREATED	CHECKED	APPROVED	REVISION
SL	SL	JJ	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 6
Bushfire Prone Areas

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F2 Bushfire Prone Areas.mxd



Legend

- Project Boundary
- Native Vegetation Extent

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- NATIVE VEGETATION SOURCED DAFWA 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500 Meters
1:20,000 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	16/02/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

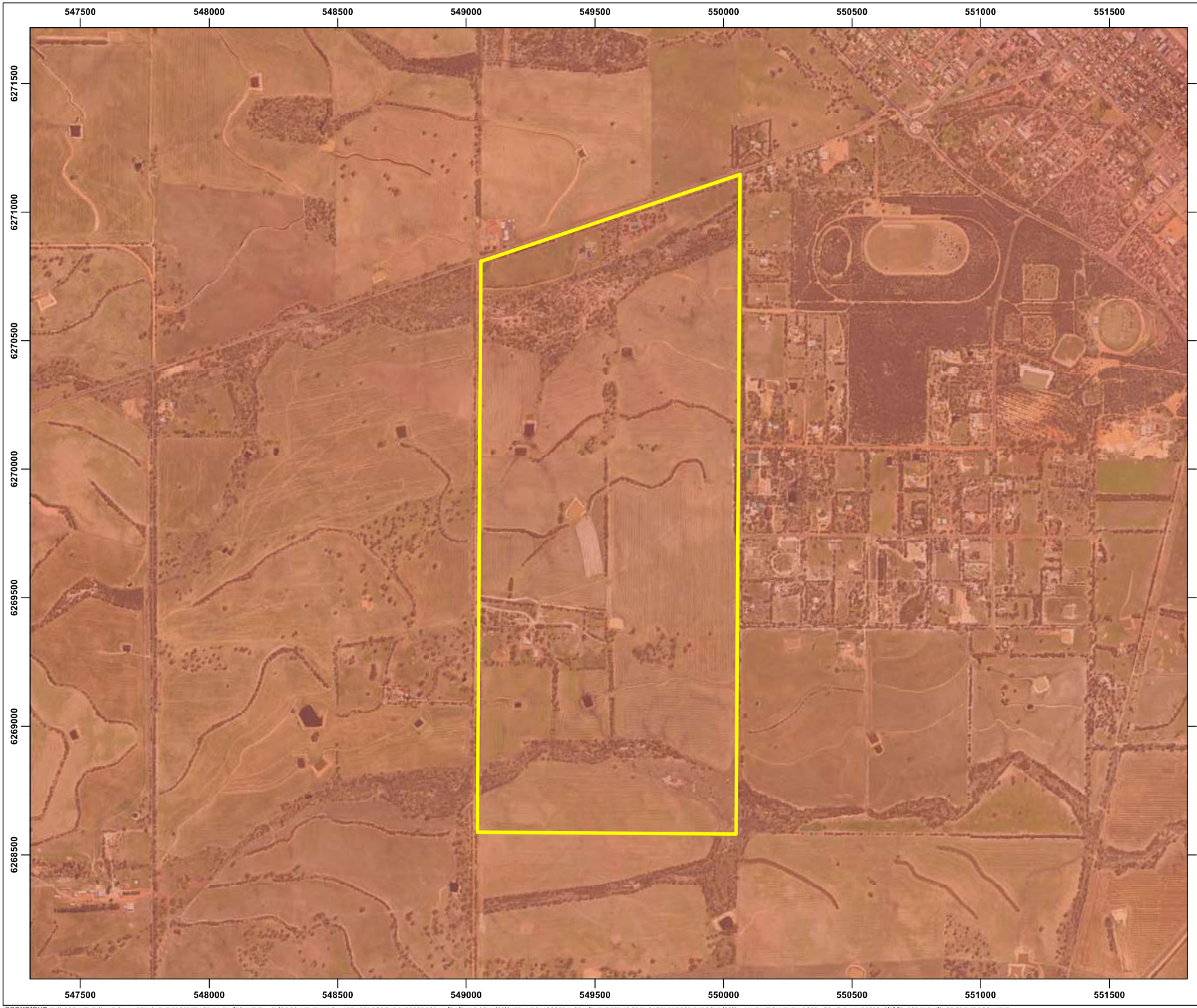
CREATED	CHECKED	APPROVED	REVISION
SL	SL	JJ	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

Figure 7 Native Vegetation

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F3 Native Vegetation.mxd



Legend

- Project Boundary
- Low probability, High confidence ASS

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ASS SOURCE CSIRO 2018
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2017 (© Western Australian Land Information Authority 2017)

360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 250 500
Meters
1:20,000 @ A4

N

LOCALITY MAP

PROJECT ID	DATE
2558	16/02/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
SL	SL	JJ	0

Lots 50-52 and 2979 Illareen Road, Katanning

Local Water Management Strategy

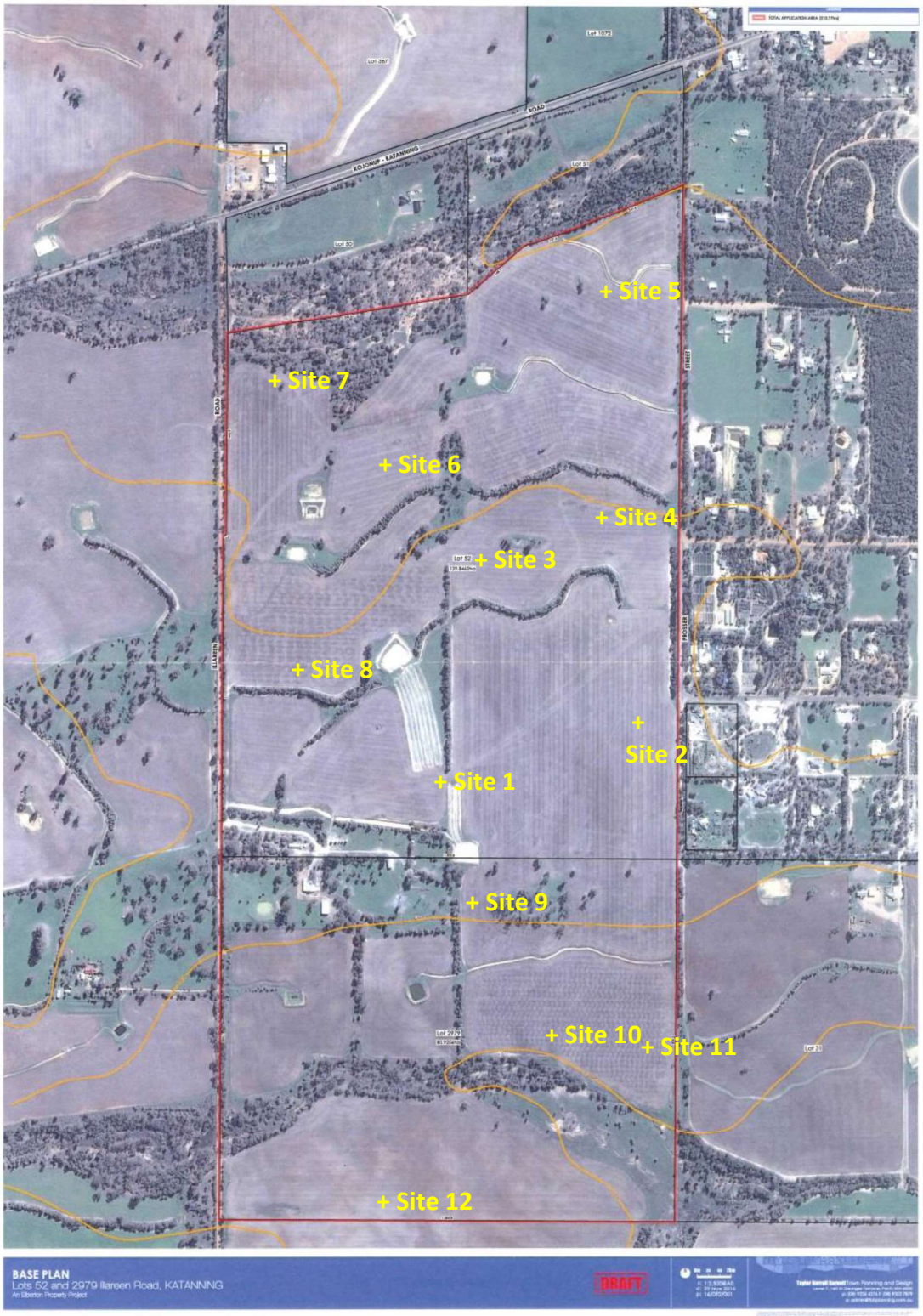
Figure 8 Acid Sulfate Soils

K:\Projects\5.0 SWA\2558 Katanning LWMS\Figures\2558 F5 Acid Sulfate Soils.mxd

APPENDIX A

Geotechnical Survey

DRAFT ATTACHMENT A



SOIL SITE SUMMARY

Soil Site No	Easting	Northing	Elevation m AHD	Soil landscape[1]	Landform[2]	Soil Group[3]	Qualifier[3]	Other	LMU
Site 1	50 H 549501	6269562	253 m	Ca2	Crest 0 - 2%	Grey shallow sandy duplex	Subsoil clay at 20 cm	Clay pH 5.5, ECe 133 mS/m	C1
Site 2	50 H 550017	6269693	337 m	Ca2	Upper-slope (4%)	Grey shallow sandy duplex	Subsoil clay at 25 cm	Clay pH 5.6, ECe 70 mS/m	S1a
Site 3	50 H 549643	6270075	341 m	Ca2	Mid-slope (3-4%)	Yellow brown shallow loamy duplex	Subsoil clay at 20 cm	Clay pH 5.7, ECe 68 mS/m	S2
Site 4	50 H 549911	6270212	335 m	Ca2	Upper-slope (3%)	Yellow brown deep sandy duplex	Subsoil clay at 35 cm. Few gravels	Clay pH 5.8, ECe 72 mS/m	S1b
Site 5	50 H 549903	6270651	326 m	Ca2	Footslope (2%)	Yellow brown deep sandy duplex	Subsoil clay at 45 cm. Few gravels	Clay pH 5.9, ECe 102 mS/m	F1
Site 6	50 H 549372	6270265	325 m	Ca2	Mid-slope (3%)	Red shallow loamy duplex	Subsoil clay at 15 cm	Clay pH 5.8, ECe 86 mS/m	S2
Site 7	50 H 549176	6270451		Ca2	Footslope (2%)	Yellow brown shallow loamy duplex	Subsoil clay at 20 cm		F2
Site 8	50 H 549203	6269806		Ca2	Upper-slope (2%)	Yellow brown deep sandy duplex	Subsoil clay at 35 cm		S1b

Soil Site No	Easting	Northing	Elevation m AHD	Soil landscape[1]	Landform[2]	Soil Group[3]	Qualifier[3]	Other	LMU
Site 9	50 H 549593	6269240	327 m	Ca2	Mid-slope (4%)	Grey deep sandy duplex	Subsoil clay at 40 cm	Clay pH 5.8, ECe 67 mS/m	S1b
Site 10	50 H 549776	6269000	321 m	Ca2	Non-incised drainage depression (4% sideslope)	Grey shallow sandy duplex	Subsoil clay at 15 cm with coarse gravel and stone		Dn
Site 11	50 H 549954	6268927	321 m	Ca2	Mid-slope (4-5%)	Red brown shallow loamy duplex	Subsoil clay at 15 cm with coarse gravel and stone	Clay pH 5.9, ECe 80 mS/m	S2
Site 12	50 H 549337	6268591	325 m	Ca2	Crest 0 - 2%	Yellow brown shallow loamy duplex	Subsoil clay at 15 cm with common Fe gravel	Clay pH 5.9, ECe 73 mS/m	C2

FOOTNOTES

1. Soil-landscape units are from 1: 50 000 scale DAFWA mapping by Percy (2000).

2. Landform descriptors used here are as described by van Gool et al (2005).

3. **Soils** (and qualifiers) classified according to WA Soil Group nomenclature of Schoknecht and Pathan(2013).

APPENDIX B

Aquifer Allocation Report

Government of Western Australia
Department of Water and Environmental Regulation

Resource Allocation Report

(All Volumes in kL)

Water Online

Data Last Refreshed : **17 Jan 2018**
Rows Returned :**12**

As Of Date : 17 Jan 2018
Resource Type : Ground Water Resource
Allocation Planning Area : All
Management Area : Karri
Management Sub Area : All
Allocation Category : Total Licensable
Component : General

Management Area	Management Sub Area	Resource	Component	Component Status	Allocation Limit	Allocated Volume	Committed Volume	Remaining Volume	% Allocated and Committed	Additional Requested
Karri	Karri	Karri, Karri, Combined - Fractured Rock West - Alluvium	General	G4	0	471,000	0	**-471,000**	**0.00%**	
Karri	Karri	Karri, Karri, Combined - Fractured Rock West - Calcrete	General	G4	0	0	0	**0**	**0.00%**	
Karri	Karri	Karri, Karri, Combined - Fractured Rock West - Fractured Rock	General	G4	0	45,750	0	**-45,750**	**0.00%**	
Karri	Karri	Karri, Karri, Combined - Fractured Rock West - Palaeochannel	General	G4	0	964,250	0	**-964,250**	**0.00%**	394,000
					0	**1,481,000**	**0**	**-1,481,000**	**0.00%**	**394,000**

REGISTER EXTRACT INFORMATION

The Department of Water and Environmental Regulation is committed to quality service to its customers and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document. However changes in circumstances after time of publication may impact the quality of this information.

360 environmental

10 Bermondsey Street West Leederville WA 6007 **t** (+618) 9388 8360 **f** (+618) 9381 2360
PO BOX 14, West Perth WA 6872
w 360environmental.com.au **e** admin@360environmental.com.au

people • planet • professional