

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret
River

Project No: EP18-128(10)

**Prepared for Wallcliffe House Pty Ltd
November 2023**

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Document Control

Doc name: Water Management Plan Lot 101 (no. 752) Wallcliffe Road, Margaret River					
Doc no.: EP18-128(10)—041d EC					
Version	Date			Reviewer	
1	October 2023	Enson Chen	ETC	Dave Coremans	DPC
	For project team review				
A	October 2023	Kirsten Knox	KK	Kirsten Knox	KK
	Minor typographical updates following client review				
B	October 2023	Dave Coremans	DPC	Dave Coremans	DPC
	Updated to include project team comments				
C	November 2023	Kirsten Knox	KK	Dave Coremans	DPC
	Updated to include minor project team comments.				
D	November 2023	Kirsten Knox	KK	Dave Coremans	DPC
	Updated to address minor project team comments.				

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Executive Summary

Wallcliffe House Pty Ltd (the proponent) are proposing to redevelop Lot 101 Wallcliffe Road, Margaret River (herein referred to as 'the site') for tourism purposes. The site is located within the Shire of Augusta Margaret River and is approximately 5.2 ha in size and is found approximately 8 km south-west of the Margaret River townsite. The site is generally bounded by the Margaret River and associated riparian vegetation to the north-west, a nature reserve to the south and existing tourism land uses and residences to the east.

The site contains one of the original farms and homesteads built by the Bussell family (known as 'Wallcliffe House') with the construction of the buildings commenced in 1858. It included a number of sandstone and ancillary buildings, as well as significant cultivated gardens and grounds. The buildings were significantly damaged by a bushfire in 2011, and while these are no longer in use, the cultivated gardens and grounds surrounding the buildings have continued to be maintained to a high standard.

MJA Studio and See Design Studio have prepared a draft concept plan to support the development of the site, which is intended to be a world-class boutique hotel that respects and enhances the cultural heritage and history of the site, its location as well as integration and reconnection to the existing endemic landscape.

This development application water management strategy (WMS) has been prepared to identify the water management approach to support the proposed development.

Water will be managed using an integrated water cycle management approach, which has been developed using the philosophies and design approaches described in the *Stormwater Management Manual for Western Australia*.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving waters and their ecosystems. Characteristics of the existing environment within the site have been investigated. In summary, the environmental investigations conducted to date indicate that:

- Long term climatic averages indicate that the site receives 951.7 mm on average annually with the majority of rainfall received in May to August.
- The site slopes towards Margaret River with an average grade between 10-15%. Existing ground levels range from 2 m Australian height datum (AHD) to 64 mAHD.
- The site soils include limestone outcrops/pinnacles at various locations, surficial layers of fill overlying sand or limestone, natural dune sand and shallow layers of sand overlying clayey sand associated with weathering of granite (in the eastern portion of the site adjacent to Margaret River).
- Soil permeability of shallow soils ranges between 0.4 m/day to >25 m/day. Permeability of limestone has been measured at between 8m/day and 12 m/day.
- The site is not identified as having any risk of acid sulfate soils (ASS) based on the available regional mapping and is unlikely to be a consideration based on the site characteristics.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



- Given the proximity to the coast (located 600 m to the west of the site), assets either below the 5 mAHD contour or at a horizontal distance of 200 m from the coast may potentially be exposed to coastal processes such as storm surge, inundation and erosion based on the outcomes of the Shire of Augusta Margaret River Coastal Hazard Risk Management and Adaption Plan (CHRMAP).
- There are no waterways or surface flow channels present on site, and frequent and minor event runoff is likely to infiltrate within the site at or close to source. Major event runoff would likely result in some sheet flow over both impermeable and permeable surfaces given the steep slope of the site.
- The site is immediately adjacent to the Margaret River and associated riparian vegetation.
- There are no wetlands located within the site.
- Groundwater levels beneath the site range between 0.43 mAHD at the western/ north west boundary adjacent to Margaret River to 3.78 mAHD at the site centre.
- The site is underlain by the Wallcliffe surficial aquifer, which provides a sustainable groundwater resource of approximately 22,000 kL per annum.
- Historical land use of the site has included low density agriculture, a residence, and tourism-related purposes.

The overall objective for integrated water cycle management for the development is to maintain the pre-development hydrological regime. This WMS has adopted an integrated water cycle management approach to manage:

- Potable water supply – there is an existing connection to potable water provided by the Water Corporation which will be upgraded and utilised for the proposed development.
- Wastewater servicing – an onsite wastewater treatment plant (WWTP) with infiltration onsite of treated water. This WMP also includes a site and soil evaluation to support the proposed wastewater servicing approach, and to demonstrate that the site can comply with the intent of AS1547:2012
- Non-potable water supply – will be supplied by groundwater, which has historically been used for irrigation purposes within the site and is extracted from the surficial Wallcliffe aquifer beneath the site.
- Surface water management – which will adopt an at source infiltration approach, consistent with the historical approach to water management at the site.
- Groundwater – management will be passive and will avoid interaction with underlying groundwater levels. Groundwater quality will be improved removing historical agricultural uses, and by addressing surface water quality using a water sensitive urban design approach, which mimics natural processes at the surface and at source.
- Flood protection – to be addressed by ensuring that the development is located above the elevation identified to be higher risk (i.e. above 5 mAHD).

The proposed criteria and the manner in which they are proposed to be achieved are presented in **Table E 1**. The elements summarised in **Table E 1** demonstrate that the site can be developed for the intended use.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table E 1: Water management criteria and compliance summary

Management Aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of Implementation
Water supply, conservation, and wastewater	WC1	Use appropriate non-potable water sources for irrigation	Utilise locally sourced groundwater to meet irrigation demand	Proponent	Currently and following construction
	WC2	Minimise potable water use	Use of water efficient appliances.	Proponent	Construction
			Use of water efficient fittings.	Proponent	Ongoing
			Only non-potable water to be used for irrigation	Proponent	Ongoing
Wastewater	WW1	Ensure appropriate management of wastewater	Design and implement on onsite wastewater treatment system which appropriately addresses nutrients	Proponent	Construction and ongoing
Stormwater management	SW1	Floor levels of habitable buildings at or above the elevation identified to mitigate future coastal processes risk	Floor levels of habitable buildings will be located above the predicted future coastal hazard risk elevation.	Proponent	Detailed drainage design
	SW2	Manage the small rainfall event runoff at source	Low profile swales used to treat and infiltrate frequent event runoff	Proponent	Detailed design
			High permeability of soils adjacent to paved areas used for infiltration	Proponent	Detailed drainage design
			Soakwells used to infiltrate roof and some paved area runoff	Proponent	Detailed drainage design
	SW3	Manage runoff from minor and major rainfall events to control erosion	Pavement and impermeable areas to be directed to permeable portions of the site where they will infiltrate	Proponent	Detailed drainage design

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table E 1: Water management criteria and compliance summary (continued)

Management Aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of Implementation
Stormwater management (continued)	SW4	Adopt a passive at-source approach to stormwater management infrastructure	Soakwells, minor verge swales and infiltration within permeable portions of the site. No formal infiltration basins are proposed be constructed	Proponent	Detailed drainage design
	SW5	Utilise appropriate non-structural measures to reduce nutrient loads	Ongoing management of nutrient inputs from fertilisers to include use of slow-release fertilisers and monitoring to guide fertiliser application (e.g., visual monitoring, leaf and tissue analysis)	Proponent	Currently and ongoing
			Maintenance and responsive management of any effluent disposal system to maintain nutrient discharge targets	Proponent	Following construction and ongoing
Groundwater management	GW1	Stormwater infiltration infrastructure to be located at least 500 mm above highest known groundwater level	Infiltration structures will be >3.1 m AHD to provide at least 500 mm clearance from highest known groundwater levels beneath the site.	Proponent	Construction
	GW2	Buildings to be protected from groundwater inundation	Buildings to be located at or above 2.6 m AHD, which will ensure that these are above potential groundwater inundation.	Proponent	Construction

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table of Contents

1	Introduction	1
1.1	Background	1
1.2	Town planning context	1
1.3	Purpose of this report	1
1.4	Policy framework	1
1.5	WMS objectives	2
2	Proposed development.....	3
3	Pre-development Environment	4
3.1	Climate	4
3.2	Topography	4
3.3	Geotechnical conditions	4
3.3.1	Geology	4
3.3.2	Site investigations	5
3.3.2.1	CMW Geosciences Geotechnical Investigation	5
3.3.2.2	2020-2023 Douglas Partners Geophysical and Geotechnical Investigations	5
3.3.2.3	Emerge Associates	7
3.3.3	Soil permeability	7
3.3.4	Acid sulfate soils	9
3.4	Coastal processes	9
3.5	Hydrology	9
3.5.1	Surface water	9
3.5.1.1	Margaret River	10
3.5.1.2	Margaret River Water quality	11
3.5.1.3	Wetlands	12
3.5.2	Groundwater	12
3.5.2.1	Groundwater levels	12
3.5.2.2	Groundwater quality	16
3.5.2.3	Wallcliffe Surficial aquifer	17
3.6	Existing and historical land use	18
3.7	Summary of existing environment	18
4	Design Criteria and Objectives	20
4.1	Integrated water cycle management	20
4.2	Water supply and conservation	21
4.3	Wastewater management	21
4.4	Surface water management	21
4.5	Groundwater management	21
5	Water Supply and Conservation	22
5.1	Fit for purpose water use	22
5.1.1	Potable supply	22
5.1.2	Groundwater	22
5.1.3	Stormwater harvesting	23
5.2	Water conservation measures	23
5.2.1	Water efficient fixtures and appliances	23
5.2.2	Waterwise gardens	23
6	Wastewater Management Strategy	25
6.1	Expected wastewater demand	25

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



6.2	Options assessment	26
6.3	Onsite wastewater treatment plant	27
6.3.1	System summary	27
6.3.2	Chemical dosing	27
6.3.3	Membrane filtration.....	28
6.3.4	Effluent polishing	28
6.3.5	Maintenance	28
6.3.6	Buffer storage	28
6.3.7	Monitoring	28
6.3.8	Backup electricity	28
6.3.9	Effluent disposal requirements.....	29
6.3.10	Treatment system separation	29
6.4	Site and soil evaluation	29
6.4.1	Summary of relevant site conditions	29
6.4.2	Design loading rate and land application area.....	30
6.4.3	Contingency in design	32
6.4.4	Risk reduction measures	32
6.5	Nutrient balance	33
7	Stormwater Management Strategy	36
7.1	Site stormwater management measures.....	36
7.2	Control of impacts to Margaret River	36
8	Groundwater Management Strategy.....	37
8.1	Groundwater level management.....	37
8.2	Groundwater quality management	37
9	Management and Maintenance Plan	38
9.1	Management objectives	38
9.2	Nutrient and water quality	38
9.3	Monitoring and maintenance	39
10	Implementation Plan	40
10.1	Reporting	40
10.2	Roles and responsibilities	40
10.3	Funding	40
10.4	Review.....	40
11	References	41
11.1	General references	41
11.2	Online references.....	42

Figures

Figure 1: Locality Plan

Figure 2: Topography and Groundwater Contours

Figure 3: Soil Landscape Mapping and Test Pit Locations

Figure 4: Acid Sulfate Soil Risk Map

Figure 5: Proposed Treated Water Infiltration Locations

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Appendices

Appendix A

Wallcliffe House concept plan

Appendix B

Douglas Partners Geotechnical Investigation

Appendix C

Pump Test – Western Irrigation 2022

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Abbreviations

Table A1: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid sulfate soils
BGL	Below ground level
BGS	Below ground surface
BUWM	Better Urban Water Management
CHRMAP	Coastal Hazard Risk Management and Adaption Plan
CPT	Cone penetration tests
DLR	Design loading rate
EC	Electrical conductivity
LTV	Long-term trigger value
MGL	Maximum groundwater level
NWQMS	National Water Quality Management Strategy
RWT	Rainwater tanks
TN	Total nitrogen
TP	Total phosphorous
TWL	Top water level
WELS	Water efficiency labelling and standards
WMS	Water management strategy
WSUD	Water sensitive urban design
WWG	Water wise gardens
WWTP	Wastewater treatment plant

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table A2: Abbreviations – Organisations

Organisations	
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity Conservation and Attractions
DoH	Department of Health
DWER	Department of Water and Environmental Regulation
SAMR	Shire of Augusta Margaret River
WAPC	Western Australian Planning Commission
WC	Water Corporation of Western Australia

Table A3: Abbreviations – units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m	Metre
m ²	Square metre
m AHD	Metres in relation to the Australian height datum
mm	Millimetre
°C	Degrees Celsius
mg/L	Milligrams per litre
mS/cm	Millisiemens per centimetre
µS/cm	Microsiemens per centimetre

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



1 Introduction

1.1 Background

Wallcliffe House Pty Ltd (the proponent) are proposing to redevelop Lot 101 Wallcliffe Road, Margaret River (herein referred to as 'the site') for tourism purposes and is located within the Shire of Augusta Margaret River.

The site is approximately 5.2 ha in size and is located approximately 8 km south-west of the Margaret River townsite. The site is generally bounded by the Margaret River and associated riparian vegetation to the north-west, a nature reserve to the south and existing residential and tourism (chalet and camping land uses) to the east (which includes the Margaret River rowing club). The location and boundaries of the site are shown in **Figure 1**.

1.2 Town planning context

The site is currently zoned as 'tourism' (and 'tourist area') under the Shire of Augusta Margaret River LPS No.1.

1.3 Purpose of this report

It is important that the manner in which stormwater runoff from developed areas is managed to avoid flooding and protect the environment is clearly documented early in the planning process. This approach provides the framework for actions and measures to achieve the desired outcomes at the development stage of a project. The development approval (DA) application details the water management approach to support the proposed redevelopment, and this Water Management Plan supports the DA.

1.4 Policy framework

There are a number of State and Local Government policies of relevance to the site. These policies include:

- *Government Sewerage Policy* (DPLH 2019)
- *State Planning Policy 2.9 Water Resources* (DPLH 2021)
- *Draft State Planning Policy 2.9 Planning for Water* (Government of WA 2022)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009)
- *Planning Bulletin No. 83: Planning for Tourism* (WAPC 2013)

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that urban developments should aim to achieve. These are key inputs that relate either directly or indirectly to the site and include:

- *National Water Quality Management Strategy (NWQMS)* (ANZECC and ARMCANZ 2000)

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



- *Australian Runoff Quality* (Engineers Australia 2006)
- *Stormwater Management Manual for Western Australia* (DWER 2022)
- *Better Urban Water Management (BUWM)* (WAPC 2008)
- *Australian Rainfall and Runoff* (Ball J et al. 2019)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *Draft Margaret River Protection Strategy* (SAMR 2018)
- *Australian Standard 1547:2012 Onsite Domestic Wastewater Management* (SAI Global 2012)

1.5 WMS objectives

This WMS has been developed in consideration of the objectives and principles detailed in BUWM (WAPC 2008). It supports the redevelopment of the site, and is based on the following major objectives:

- Protect the high amenity values provided by Margaret River and surrounds.
- Provide a broad level water management framework to support future redevelopment.
- Ensure appropriate treatment of wastewater from the site is provided.
- Incorporate appropriate best management practices into the drainage system that address the environmental and stormwater management issues identified.
- Minimise ongoing operation and maintenance costs for the proponent.
- Develop a water supply and conservation strategy for the site that will consider the supply available.
- Gain support from DWER and Shire of Augusta Margaret River for the proposed method to manage water within the site and which avoids potential impacts on downstream areas.

Detailed objectives for water management within the site are further discussed in **Section 4**.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



2 Proposed development

MJA Studio have prepared a concept plan to detail the proposed redevelopment of the site, which is provided in **Appendix A**.

The site is intended to be developed as a boutique hotel that will accommodate up to 25 keys (62 guests) and is intended to respect and acknowledge the cultural heritage and history of the site, its location as well as the existing landscape values. The principles being adopted will see new buildings be located within the footprint of the existing fire damaged buildings (which could not be restored), as well being constructed throughout the site including new guest cottages and suites, an operations building and wastewater treatment plant, guest and staff parking, an estate management office, a guest spa and supporting utility infrastructure.

The proposed new buildings aim to retain the 'essence' of the former buildings as much as possible by utilising the natural local limestone blocks as well as masonry, timber framing and rammed earth. The existing mature cultivated gardens and areas of remnant vegetation within the site are proposed to be retained, although some modification to this vegetation may be required as part of development.

The development of the site necessitates upgrades to the capacity of existing services. The upgrades include wastewater treatment and disposal, potable water supply, firefighting water supply, electricity, and communication services. In particular, the management of wastewater will be upgraded from the former domestic-scale system to one that is suitable for the proposed development and that will minimise the potential for nutrients to enter the surrounding environment.

The stormwater management infrastructure will be passive and will be integrated into the design of the site. There will be no requirement for a large formalised drainage system as sheet flow and localised infiltration will be adopted, consistent with the historic function and design of the site.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



3 Pre-development Environment

3.1 Climate

The closest weather station to the site which records rainfall and temperature data is located in Witchcliffe (Bureau of Meteorology (BoM) station number 9746), situated approximately 11.7 km south-east of the site. Based on weather data collected from 1999 to 2021 at the Witchcliffe station, the local area experiences an average of 951.7 mm of annual rainfall, as detailed in **Table 1**. Temperature data is also recorded at the Witchcliffe station, indicating the highest a mean maximum temperature of 27.1°C is in February, while the mean minimum temperature of 8.2°C is in July and August (BoM 2023).

Table 1: Median (decile 5) annual rainfall from 1919 to 2023 at Witchcliffe (station number 9746) (BoM 2023)

Witchcliffe	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Median rainfall (mm)	12.3	12.2	27.8	62.6	132.3	179.7	194.1	157.7	108.7	63.8	34.7	17.9	951.7

3.2 Topography

The topography of the site slopes down from Wallcliffe Road in the east towards Margaret River in the west-north-west. Existing ground levels range from 2 m Australian height datum (AHD) along the western boundary adjacent to Margaret River, to 12 mAHD at its northern extent, 22 mAHD in the south west near the Wallcliffe Cliffs and 64 mAHD at the south eastern extent (i.e., closest to Wallcliffe Road). The land generally slopes from southeast to northwest, with an average grade between 10-15%. The site includes small localised flat portions where the landscape has presumably been modified to accommodate historical habitation of the site.

Topographic contours of the site are shown in **Figure 2**.

3.3 Geotechnical conditions

3.3.1 Geology

Geological mapping for the Cowaramup – Mentelle area (DME 2000) area indicates that the land is underlain by the Leeuwin Complex comprising fresh to weathered granite. It also indicates that the hills immediately to the west of the site are comprised of the Spearwood Dunal system, being sand over calcarenite (coarse grained limestone).

Geotechnical site investigations (CMW Geosciences 2018; Douglas Partners 2021, 2022, 2023) indicated that the ground conditions encountered were generally aligned with the regional mapping, with the exception that the sand of the Spearwood Dunal system extends into the site.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Soil landscape mapping (compiled by the Department of Primary Industries and Regional Development (DPIRD)) indicates the site is within the 'Gracetown low slopes phase' soil landscape which is described as 'deep yellow brown siliceous sands over limestone' (i.e. Spearwood Sands), which is shown in **Figure 3**.

3.3.2 Site investigations

3.3.2.1 CMW Geosciences Geotechnical Investigation

The site geology and soils were investigated by CMW Geosciences (2018). The investigation included a site walkover, nine hand auger boreholes to facilitate onsite infiltration testing (using a falling head method), twelve test pits to 0.5 m – 3.0 m below ground surface (BGS) and dynamic cone penetrometer tests in accordance with AS1289.6.3.2. The locations of test pits and augered bores are shown in **Appendix B**.

In summary, the soils observed beneath the site included:

- The presence of limestone outcrops/pinnacles at various locations.
- Surficial layers of fill overlying sand and limestone.
- Fill within some test pits comprised sand and limestone cobbles and boulders.
- Loose to medium dense sand fill overlying natural dune sand to the maximum depth investigated of 2.8 m. The sand (fill and natural) was logged as dark brown to black with fines and organics (<5% by weight).
- Sand over shallow limestone was encountered on the natural slopes with outcropping limestone visible on adjacent portions of the slope. Further north, the limestone ceases to outcrop, and a deeper (>1.2 m) layer of sand was observed.
- Natural dune sand in the north-eastern portion of the site, east of the existing pond and east of the existing boat house.
- A shallow layer of sand overlying a clayey sand residual soil, associated with the weathering of the granite in the eastern portion of the site, towards the shore of the river.

3.3.2.2 2020-2023 Douglas Partners Geophysical and Geotechnical Investigations

Douglas Partners conducted multiple investigations between 2020 and 2023 and these are summarised in **Table 2**. The location of testing undertaken are shown in **Figure 3** and in the geotechnical reports contained in **Appendix B**.

Table 2: Douglas Partners Geotechnical and Geophysical Investigations (2020-2023)

Time	Scope of Work
8 th – 10 th September 2020 (Douglas Partners 2020)	• Seismic refraction (SR) for the depth to various rock types • Ground Penetrating Radar (GPR) to target karstic features and map the depth to rock. • Multi-channel Analysis of Surface Waves (MASW) to aid in the interpretation of the SR and GPR • Eight geophysical survey transects

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table 2: Douglas Partners Geotechnical and Geophysical Investigations (2020-2023) (continued)

Time	Scope of Work
30 th and 31 st August 2021 (Douglas Partners 2021)	• Six hand augered boreholes • Perth sand penetrometer (PSP) testing adjacent to these boreholes • Six in-situ infiltration tests
24 th and 26 th January 2022 (Douglas Partners 2022)	• Four diamond core bore holes • 21 cone penetration tests (CPT) (10 CPTs within the upper portions of the site and 11 CPTU's (cone piezocone penetration test) within the lower portion of the site) • 13 test pits • Six hand auger boreholes • PSP tests • Four geophysical survey transects • Six in situ infiltration tests • Soil and rock laboratory analysis
15 th and 16 th February 2023 (Douglas Partners 2023)	• 15 CPTs • Excavation of six test pits • Drilling of four hand auger boreholes • PSP tests • Eleven in-situ infiltration tests • Falls head tests within an existing monitoring well • Laboratory testing

In summary, the ground conditions encountered at the site are summarised as:

- **Sandy topsoil (Unit 0)** – Fine to coarse grained sand, 100 mm to 200 mm thick, with silt and various amounts of gravel, roots, and rootlets, encountered at some test locations.
- **Sandy fill (Unit 1)** – Encountered to depths up to 1.6 m, variably compacted and fine to medium grained sand, grey-brown, with various amounts of silt at several locations. Some of this fill is likely disturbed soils from previous land usage. The fill also included some gravelly sand and gravelly clayey sand layers from the surface to a depth of 0.6 m BGL in 2022 investigation.
- **Residual sand of the Spearwood System (Unit 2)** – Comprised of fine to medium grained sand, grey-yellow-orange-brown, with trace silt, limestone cobbles and gravel, encountered at depths up to 9.5 m BGL at all deeper test locations during the 2022 and 2023 investigations. Natural sand was generally medium dense to dense, however very loose to loose zones of 0.3 m to 6 m thick were recorded at some test locations, at depths of between 1.5 – 9.5 m BGL. A zone of very low density (possibly void within very weakly cemented sand) was found between 4.5 m and 4.7 m depth at test location 14 during the 2023 investigation but is considered to be localised without impacts on the proposed development.
- **Limestone of the Spearwood System (upper portions of the site only) (Unit 3)** – Very weakly to strongly cemented, very low to very high strength underlying the unit 2, encountered to a depth up to 14.5 m BGL (limit of 2022 investigation). Sand zones observed to varying depths between 0.6 m and 2.3 m in thickness within the limestone rock. A localised void or rock discontinuity, likely infilled with very loose sand was found at depth of 6.6 m BGL at test location 5, over a 0.6 m depth interval during the 2023 investigation.
- **Residual soils of the Leeuwin Complex (Unit 4)** – Observed at the lower portions of the site beneath the Unit 2 sand soil and as a thin layer underlying the Unit 3 limestone further southeast mid-slope. It consisted of clayey sand, clayey sandy gravel, sandy silt, silty sand, clay,

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



and sandy clay. This soil type encountered to a depth of 13.4 m BGL within the lower portions of the site and reduced in thickness between 0.1 – 0.7 m in the upper portions of the site.

- **Granulite and granite of the Leeuwin Complex (Unit 5)** – Encountered underlying Unit 4 residual soils, extending to the maximum termination test depth of 20 m.

A conceptual cross section of the measured and anticipated ground conditions beneath the potential infiltration and lower portions of the site, based on the geotechnical and geophysical investigations performed across the site, is shown in **Plate 1**.

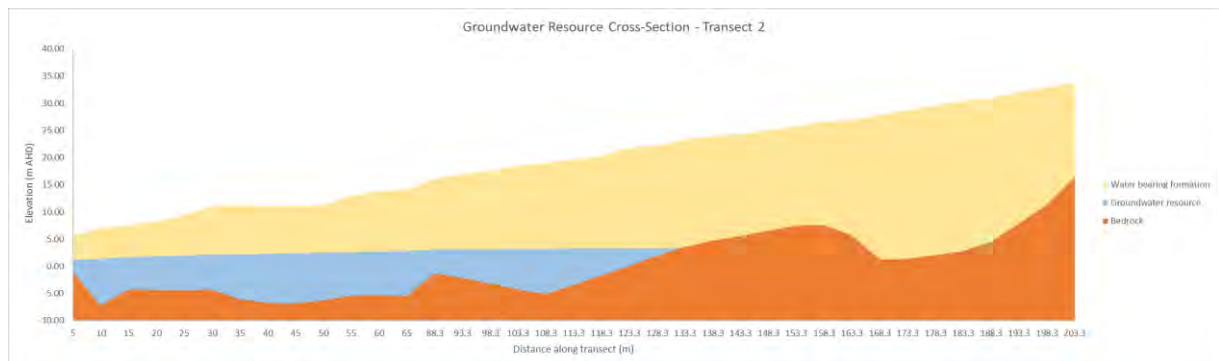


Plate 1: Conceptual model of the ground conditions beneath the site (Emerge Associates 2022)

3.3.2.3 Emerge Associates

Emerge Associates drilled nine boreholes MW01 to MW08 and MW04D and installed eight groundwater monitoring wells.

The ground conditions were generally consistent with CMW Geosciences and Douglas Partners geotechnical investigations, being logged as natural sand to depths of between 3 m and 9 m, overlying limestone (calcarene of Spearwood System). Two monitoring wells (MW04 and MW06) encountered different soil profiles, MW04 observed silty clay to a depth of 5 m BGL overlying sandy clay to the test termination depth of 7.5 m BGL, whereas MW06 recorded silty clay to a depth of 2 m BGL overlying the natural sand.

3.3.3 Soil permeability

A number of in-situ infiltration tests using falling head method were carried out within shallow sand (Unit 1) and sand fill (Unit 2), at depths of between 0.5 m and 2.0 m during the Douglas Partners 2020-2023 investigations. The results are summarised in **Table 3** and the locations of the testing undertaken are shown in **Figure 3**. The permeability of the soils underlying the site indicate that the majority of the site will be suitable to use onsite infiltration measures, with permeability of shallow soils recorded >25 m/day. The deeper soil profile/limestone has also been permeability tested, with onsite measurement of the limestone at depth recording permeability between 8 and 12 m/day.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table 3: Summary of In-situ permeability testing

Investigation	Test Location	Depth (m)	Measured Permeability (m/day)*	In-situ Condition of the Tested Material
Douglas Partners (2021)	1	2.0	>25	Unit 2: Sand, trace silt, medium dense
	2	2.0	2.6**	
	3	2.0	0.4**	
	4	2.0	4.9	
	5	2.0	8.5	
	6	2.0	4.1	
Douglas Partners (2022)	5	1.0	>25	Unit 2: Sand, trace silt, medium dense
	6	1.0	0.7**	Unit 1: Fill/sand
	9	1.3	13	Unit 2: Sand, trace silt, medium dense
	15	1.0	12	
	20	1.0	15	Unit 1: Fill/sand
	24	1.0	>25	Unit 2: Sand, trace silt, medium dense
Douglas Partners (2023)	16	1.6	18	Unit 2: Sand, trace silt, medium dense
	17	0.5	14	
	18	1.6	>25	
	19	1.8	>25	
	20	0.6	11	Unit 1: Fill/sand, dark grey-brown, with silt, medium dense
		1.5	>25	Unit 2: Sand, trace silt, medium dense
	21	1.6	22	
	22	2.0	>25	
	23	2.0	>25	
	24	2.0	10	
	25	2.0	9	
	52	14	8-12	Limestone of deeper soil profile

*Hvorslev's method.

**Lower infiltration rates at test locations 2, 3 and 6 were likely attributed to the presence of limestone at testing depth.

The infiltration testing undertaken demonstrates that infiltration at source approaches are appropriate for the site.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



3.3.4 Acid sulfate soils

The site is not identified as having any risk of acid sulfate soil (ASS) based on the available regional mapping prepared by the Department of Water and Environment Regulation (DWER). Margaret River, adjacent to the northern boundary of the site, is identified as having a low to moderate risk of ASS within 3 m of the natural soil surface. Given no disturbance of Margaret River is proposed, and construction works within the site are unlikely to occur below the permanent groundwater table, ASS is unlikely to be a risk requiring management.

Available ASS mapping for the site is shown in **Figure 4**.

3.4 Coastal processes

The site is situated approximately 600 m east of the coastline, with the development located adjacent to Margaret River (which meanders to the river mouth for approximately 1.2 km from the site) and is seasonally open to the ocean.

The Shire of Augusta Margaret River commissioned the preparation of a *Coastal Hazard Risk Management and Adaption Plan* (CHRMAP) (Shore Coastal 2015) to provide strategic guidance on management and adaptation in key coastal settlements that may be exposed to coastal processes such as storm surge, inundation and erosion.

The CHRMAP (Shore Coastal 2015) considered Prevelly and the areas near the mouth of the Margaret River, and while estuarine flooding for Margaret River was not specifically identified as an issue, it was indicated that assets located up to the 5 m AHD contour or at a horizontal distance of 200 m from the coast may be exposed to coastal processes (i.e. storm surge, inundation and erosion) during the 100-year planning period. While portions of the site are located below the 5 m AHD contour, the habitable floor levels of buildings are located above 5 m AHD. Based on current predictions, the proposed development is unlikely to be significantly impacted by coastal storm surge or inundation.

3.5 Hydrology

3.5.1 Surface water

There are no waterways or surface flow channels present on site.

Runoff from most rainfall events is expected to infiltrate at source within the sandy layer of soils present. Major rainfall events (e.g. 1% AEP event) may result in localised sheet flow due to the steep slope of the site. The historical development has included some minor runoff capture features which have been integrated into small portions of paved areas, and infiltrate locally. The majority of paved areas within the site discharge to permeable areas immediately adjacent to the pavement via sheet flow where it infiltrates to the existing soils.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



3.5.1.1 Margaret River

The Margaret River, a major perennial watercourse, is located directly adjacent to the western boundary of the site. While the topography of the site would direct extreme rainfall event runoff towards Margaret River (as indicated above), runoff from the majority of rainfall events is expected to infiltrate at source within the sandy layer of soils. The location of Margaret River is shown on **Figure 1**.

The portion of the Margaret River adjacent to the site forms part of the lower reaches of the River, with the river mouth (where it connects with the Indian Ocean) located approximately 1.2 km west of the site (based on the meandering river channel). Margaret River retains a diversity of habitats including pools, riffles, cascades, low flow channels, floodplains, and backwaters.

Riparian vegetation values associated with the Margaret River is largely located outside the site boundary and is located between the site and the waterbody of the River. The width of the riparian vegetation adjacent to the site varies between 0 m and 25 m, with a small portion of the site having direct access to Margaret River.

The hydrology of Margaret River and its catchment has been summarised by the former Department of Water (now DWER) in the Margaret River Hydrology Summary (DoW 2008). The nearest flow gauging station is significantly upstream at Willmots Farm (approximately 6.2 km north east of the site), and the report is more focussed on annual flows, rather than event based (peak) flows and levels in Margaret River.

The Willmots Farm gauging station (station number 610001) recorded an average annual discharge volume of 77,387 ML between 21 May 1970 and 27 September 2023. According to the representative hydrograph (**Plate 2**) of Margaret River (DWER 2011), it regularly ceases to flow during summer and early autumn (between December and April). This is evidenced by the flow discharge data at the Willmots Farm gauging station, which recorded an average 113.7 day no-flow period between 2000 and 2023.

The peak flood levels are more likely to be influenced by coastal processes (tide, storm surge, seasonal formation of sand bar blocking the River) than flow rates within Margaret River, and preliminary guidance regarding potential peak water elevation at the coast is provided in the Shire of Margaret River CHRMAP (Shore Coastal 2015).

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River

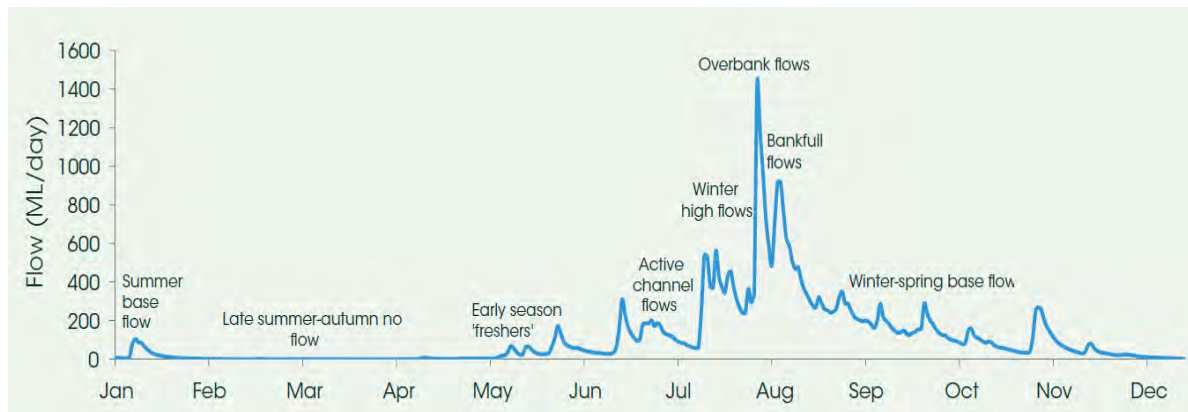


Plate 2: Representative Hydrograph of Margaret River (DWER 2011)

3.5.1.2 Margaret River Water quality

There is no long-term surface water quality data available for the Margaret River in proximity to the site, however Emerge Associates conducted surface water monitoring at immediately adjacent upstream and downstream locations of Margaret River on a quarterly basis between August 2022 and May 2023. The surface water sampling locations are shown in **Figure 2** and results summaries in **Table 4**. The NWQMS (ANZECC and ARMCANZ 2000) guideline for slightly disturbed lowland rivers in Southwest Australian is provided for reference, though it is noted that given Margaret River is the downstream end of a historically rural catchment these trigger values may not be appropriate.

Table 4: Surface water quality summary

Sampling Location	Sampling Time	pH	EC (mS/cm)	TN (mg/L)	TP (mg/L)
NWQMS		6.5-8.0	0.12-0.3	1.2	0.065
Upstream	August 2022	7.61	506	0.4	0.02
	November 2022	8.04	24,467	0.2	0.2
	February 2023	7.74	28,377	0.7	0.09
	May 2023	7.46	26,133	0.6	0.04
	Average	7.71	19,871	0.5	0.09
Downstream	August 2022	7.67	586	0.5	0.02
	November 2022	8	35,114	0.1	0.1
	February 2023	7.5	28,352	0.4	0.07
	May 2023	7.31	26,250	0.5	0.01
	Average	7.62	22,576	0.4	0.05

The results indicate that nearby Margaret River is considered neutral to slightly alkaline with pH ranging from 7.31 to 8.04. Electrical conductivity (EC) levels vary from 506 to 35,114 mS/cm and are elevated as compared to NWQMS guidelines at both upstream and downstream surface water

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



sampling locations between November 2022 and May 2023. The high EC values in summer and autumn are likely attributed to the high evaporation and non-flow period at the Margaret River. The low EC values are likely associated with the heavy rainfall in winter months.

Total nitrogen (TN) concentrations range from 0.1 to 0.7 mg/L and are low in comparison to NWQMS guidelines at both upstream and downstream locations. Total phosphorus (TP) concentrations range from 0.01 to 0.2 mg/L and are elevated in comparison to NWQMS guidelines at upstream (in November 2022 and February 2023) and downstream (in November 2022) sampling locations. The highest nutrient concentrations occur at the upstream sampling location in summer (November 2022 and February 2023).

3.5.1.3 Wetlands

No wetlands of national or international significance were identified within the site or nearby.

The *Geomorphic Wetlands Leeuwin Naturaliste Ridge and Donnybrook to Nannup* (DBCA-043) and *Geomorphic Wetlands South West* (DBCA-040) indicates that there are no geomorphic wetlands identified within the site.

3.5.2 Groundwater

3.5.2.1 Groundwater levels

The site is within the Busselton-Capel Groundwater Area and the Cape to Cape North subarea.

Groundwater levels have been measured at the site since 2021, with the installation of eight monitoring bores by Emerge Associates. The locations of the bores (bores MW01 to MW08) are shown on **Figure 2**.

Data loggers were installed in MW01, MW02, MW03 and MW04 in 2021. The objective was to characterise existing groundwater levels and to determine if local groundwater levels reflected river levels.

Figure 2 shows the 'maximum groundwater level contours' which is the highest elevation recorded at each location during the monitoring period between June 2021 and May 2023. The groundwater contours were further refined by levels measured at the existing bores and additional measurements from Douglas Partners (2022, 2023) in February 2022 and in February 2023. Contours were then extrapolated further north and south to allow an estimation of the size of the groundwater resource beneath the site.

The peak groundwater levels recorded ranged between 2.43 mAHD to 3.78 mAHD. A summary of the peak groundwater levels is provided in **Table 5**.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table 5: Groundwater measurement summary

Monitoring well ID	Date of peak GWL	Minimum GWL (mAHD)	Peak GWL (mAHD)	Range in GWL (m)
MW01	11/06/2022	0.43	2.43	2
MW02	07/06/2022	0.90	2.48	1.58
MW03	02/02/2022	1.48	2.73	1.25
MW04	20/09/2021	2.62	3.78	1.16

The data from the dataloggers has been plotted with groundwater elevation (in mAHD) over time (see **Chart 1**, **Chart 2**, **Chart 3** and **Chart 4**).

The groundwater data is likely influenced by atmospheric pressure and other small scale diurnal fluctuations, which could vary the measured depth by approximately 400 mm from a low pressure system to a high pressure system. The groundwater level fluctuations appear to reflect River levels following large rainfall events, suggesting that there is some measure of connectivity with Margaret River. MW01, located immediately adjacent to the River, showed the largest groundwater level fluctuation ranging between 0.43 mAHD to 2.43 mAHD. This indicates a strong connectivity to the River and MW01 appears to be more influenced by tidal variations and river levels following rainfall events than the other three bores.

Groundwater levels become higher moving further up the hill and away from the River, following the localised topography. Separation between the natural soil surface and groundwater increases at the same time. This is illustrated by the soil profile developed based on site geophysical investigations shown in **Appendix B**.

Note that there are some differences in the time steps chosen to record data to enable an assessment of the data which best represents groundwater fluctuation and if the bores were influenced by tides or River levels. Regardless of the time step all data is still within the time range required to obtain a clear picture of groundwater levels, fluctuations, and River level influences.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River

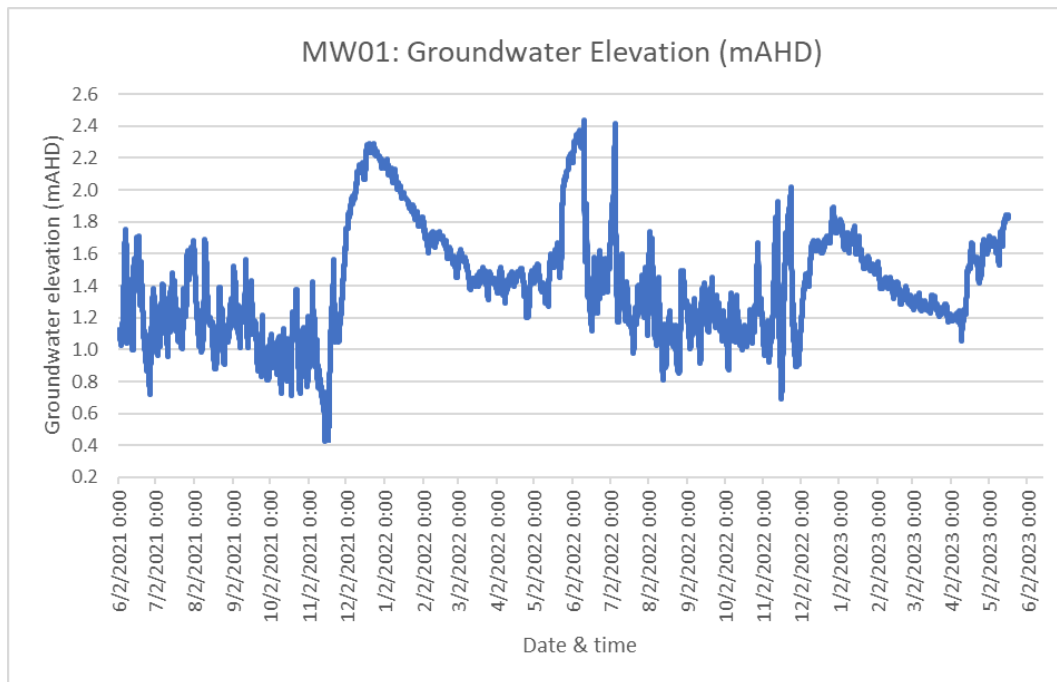


Chart 1: Groundwater levels recorded between June 2021 to May 2023 at MW01.

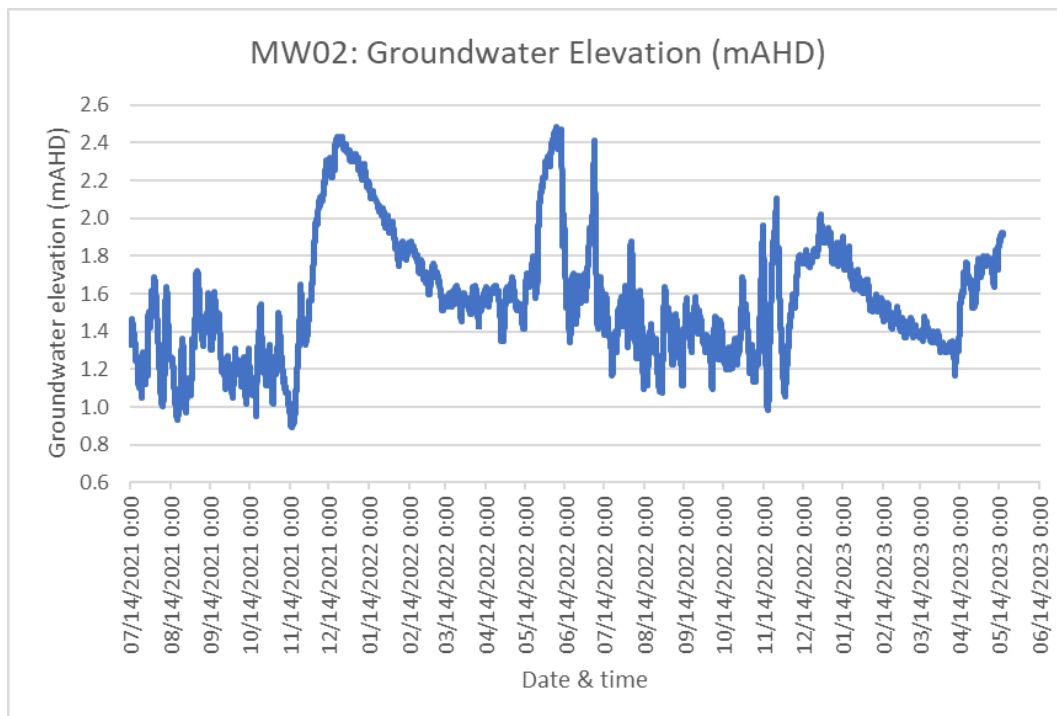


Chart 2: Groundwater levels recorded between July 2021 to May 2023 at MW02.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River

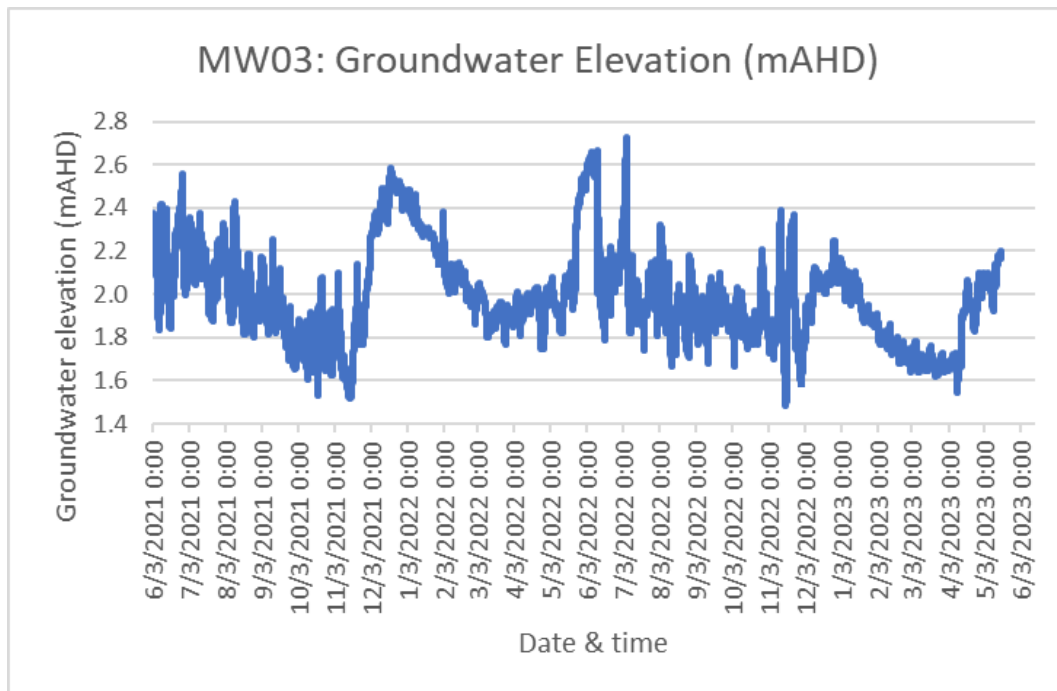


Chart 3: Groundwater levels recorded between June 2021 to May 2023 at MW03.

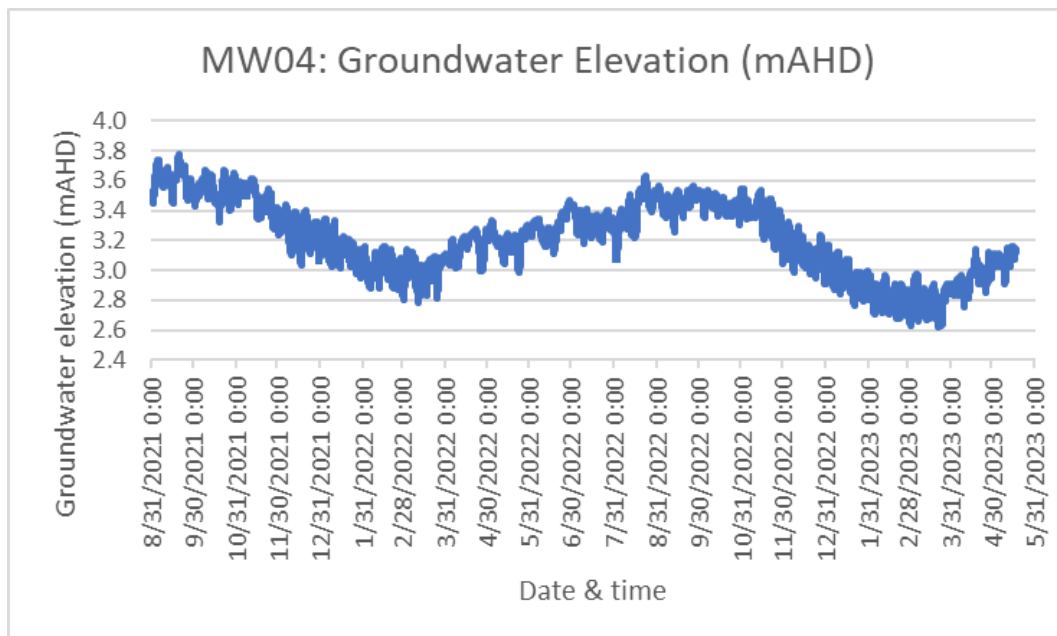


Chart 4: Groundwater levels recorded between August 2021 to May 2023 at MW04.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Based on the measured groundwater levels it can be inferred that the groundwater resource has a strong connection to the River, however given the reduced extent of variation at MW04 (furthest from the River) it can be inferred that the influence of the River diminishes with increasing distance. This suggests that the groundwater resource may be susceptible to River water intrusion if over-extraction were to occur close to the River, but that extract further from the River will be less susceptible.

Production bores (PB01 and PB02, shown in **Figure 2**) within the site have been installed to depth of approximately 8 m BGL to 13 m BGL (approximately -3 m AHD to -11 m AHD). These depths were determined via down hole camera inspection by Western Irrigation in January 2022 (Western Irrigation 2022). This indicates that the depth of groundwater resource likely varies across the site, but that the base of the water bearing formation is at least approximately -3 m AHD to -11 m AHD.

3.5.2.2 Groundwater quality

There is no long-term groundwater quality monitoring data available for the site, however shallow groundwater has historically been utilised to irrigate landscaped portions of the site, and the condition of irrigated vegetation is excellent (from a plant health perspective). Based on this, it is inferred that the quality of groundwater is appropriate for long term irrigation of vegetation and landscaped areas.

Western Irrigation (2022) undertook a bore assessment of the two existing production bores servicing Wallcliffe House in January 2022, water samples were collected intermittently throughout pump testing. The water samples collected during the step test have been adopted as the most representative groundwater quality, as water quality would have been less disturbed due to reduced drawdown. The laboratory analysis from the production bores is summarised in **Table 6**, and the full laboratory results are contained in **Appendix C**. Whilst the assessment of production bore integrity focused on irrigation parameters, subsequent testing undertaken by Emerge Associates has adopted a broader range of water quality analytes.

Table 6: Laboratory results of groundwater samples collected prior to step test being undertaken

Bore	pH	EC (mS/cm)	Total Alkalinity – Bicarbonate (mg/L)	Hardness (mg)	Total dissolved salts (TDS) (mg/L)	Fe (mg/L)
PB01	7.4	1.47	260	320	810	0.07
PB02	7.2	1.96	290	390	1080	0.23

As shown in **Table 6** both production bores returned similar water quality results and indicate a suitable source of water for long term irrigation.

Groundwater quality monitoring was also conducted by Emerge Associates at eight bores (MW01-MW04, PB02, MW04D, MW07 and MW08) between August 2022 and May 2023. **Table 7** summarises the measured nutrient concentrations at the site with the bore locations shown in **Figure 2**. Whilst not intended for groundwater, to provide some context the measured groundwater characteristics

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



are compared with NWQMS guidelines (ANZECC and ARMCANZ 2000) for slightly disturbed lowland rivers in Southwest Australia and long-term trigger values (LTVs) in irrigation water.

Table 7: Measured groundwater quality

Bore ID		pH	EC (mS/cm)	TN (mg/L)	TP (mg/L)
NWQMS – Lowland River		6.5-8.0	0.12-0.3	1.2	0.065
NWQMS – LTV in irrigation water		-	-	5	0.05
MW01	Average	7.18	1,872	8.1	2.33
MW02	Average	7.37	1,622	3.9	2.99
MW03	Average	7.18	1,777	0.6	0.45
MW04	Average	7.43	1,317	3.9	2.04
PB02	Average	7.57	1,458	3.2	0.01
MW04D	May 2023	7.81	1,293	3	0.01
MW07	May 2023	7.71	2,527	1.2	0.44
MW08	May 2023	7.54	1,848	3.8	0.14

The results show that the groundwater beneath the site presents a neutral pH condition and EC values range from 1,301 to 2,527 mS/cm. TN concentrations range from 0.4 to 9.6 mg/L and are elevated in comparison to NWQMS guidelines for lowland rivers and LTV irrigation water in six of the eight bores (MW01, MW02, MW04, PB02, MW04D and MW08). TP concentrations range from 0.01 to 4.97 mg/L and also exceed NWQMS guidelines in six of the eight bores (MW01, MW02, MW03, MW04, MW07 and MW08). The highest nutrient concentrations occur in the northern and central region of the site at MW01, MW02 and MW04, however it is noted that TP is not reflected in the deeper parts of the groundwater resource (at PB02, MW04D).

Whilst recorded nutrient concentrations in the shallow portion of the underlying groundwater resource, the nutrient concentrations in groundwater do not appear to have negatively affected nutrient concentrations in Margaret River, which remain generally low.

3.5.2.3 Wallcliffe Surficial aquifer

The site is located within the Leeuwin Complex which is classified as surficial and fractured rock aquifers. During the *Hydrogeological Assessment* (Emerge Associates 2022), a thin weathered zone and overlying surficial deposits were identified beneath the site that holds a groundwater resource. This resource, referred to as the Wallcliffe Surficial Aquifer relies on the infiltration of rainfall from the contributing recharge catchment area.

The Wallcliffe Surficial aquifer beneath the site was assessed in the *Hydrogeological Assessment* (Emerge Associates 2022) to determine the volume of the groundwater resource available to support irrigation. The Wallcliffe aquifer is recharged by a 58 ha catchment uphill to approximately

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Wilderness Road by rainfall and is recharged between 5,500 kL/year to 44,100 kL/year, depending on the assumptions used (% recharge of rainfall, size of catchment, etc.). The median calculated recharge has been adopted as the sustainable recharge of the Wallcliffe Aquifer at approximately 22,100 kL/year; this considers potential impacts of climate change and rainfall variation.

Based on this assessment and adopting a conservative approach to maintain a sustainable yield, the sustainable yield available beneath the site is estimated to be 22,079 kL per annum.

3.6 Existing and historical land use

A review of available historical aerial imagery indicates that a majority of the site was cleared of native vegetation prior to 2004 (Landgate 2018). The site historically supported one of the original farms and homesteads built by the Bussell family (known as 'Wallcliffe House') with construction of the buildings commenced in 1858. The site included a number of large sandstone buildings, dairy, and ancillary buildings, as well as a significant mature cultivated garden. It has supported agricultural, residential and tourism land uses since 1858.

The previously existing buildings within the site were destroyed by a bushfire in 2011. They include the original Wallcliffe House (built between 1855 and 1865) in the centre of the site and the dairy located to the north-east of the original Wallcliffe House. West of Wallcliffe House was a large dwelling (the former Chaney Residence) which was built in the early 2000s. South of the large dwelling was a rectangle building which was possibly used as a service building.

The landscaped portion of the site (around the existing buildings) has been earthworked and retained (terraced) to create flat building platforms, lawns, and garden beds. Immediately north of the dairy is an extensive area of grassed lawn and a small (dry) dam. South and east of the dairy the elevation of the site rises relatively steeply.

The site has not been used for residential or tourism purposes since the 2011 Margaret River bushfire significantly damaged the buildings discussed above, however, the gardens and grounds have continued to be maintained to a high standard since this time.

3.7 Summary of existing environment

In summary, the environmental investigations conducted to date indicate that:

- Long term climatic averages indicate that the site receives 951.7 mm on average annually with the majority of rainfall received in May to August.
- The site slopes towards Margaret River with an average grade between 10-15%. Existing ground levels range from 2 m AHD to 64 m AHD.
- The site soils include limestone outcrops/pinnacles at various locations, surficial layers of sandy topsoil/fill overlying sand or limestone. In the lower portion of the site adjacent to Margaret River, the surficial layer is underlain by a layer of clayey sand, sandy silt, silty sand, and clay, overlying granitic bedrock.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



- Soil permeability of shallow soils ranges between 0.4 m/day to >25 m/day. Deeper limestone has a measured permeability of 8-12 m/day.
- The site is not identified as having any risk of ASS based on the available regional mapping and is unlikely to be a consideration based on the site characteristics.
- Given the proximity to the coast (located 600 m west of the site), assets either below the 5 m AHD contour or at a horizontal distance of 200 m from the coast may potentially be exposed to coastal processes such as storm surge and inundation based on the outcomes of the CHRMAP.
- There are no waterways or surface flow channels present on site, and frequent and minor event runoff is likely to infiltrate within the site at or close to source. Major event runoff would likely result in some sheet flow over both impermeable and permeable surfaces given the steep slope of the site.
- The site is immediately adjacent to the Margaret River and associated riparian vegetation.
- There are no wetlands located within the site.
- Groundwater levels beneath the site vary from 0.43 mAHD to 3.78 mAHD based on observations of four bores between June 2021 and May 2023.
- The site is underlain by the Wallcliffe Surficial aquifer, which provides a sustainable groundwater resource of approximately 22,000 kL per annum.
- Historical land use of the site has included low density agriculture, a residence, and tourism-related purposes.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



4 Design Criteria and Objectives

4.1 Integrated water cycle management

The *State Water Strategy* (Government of WA 2003) endorses the promotion of integrated water cycle management and application of water sensitive urban design (WSUD) principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

The key relevant principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater, and groundwater
- Integrating water and land use planning
- Allocating and using water sustainably and equitably
- Integrating water use with natural water processes.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Design objectives for Wallcliffe House will deliver best practice outcomes in terms of:

- Potable water supply
- Wastewater servicing and management
- Non-potable water supply sustainability
- Surface water management and water sensitive urban design
- Groundwater management
- Flood protection.

The first step in applying integrated water cycle management in catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of National and State policies and guidelines and site specific studies undertaken in and around the site, as detailed in **Section 1.4**.

The design criteria discussed in the following sections are based on the assessment of the existing environment within the site, with the aim of achieving the outcomes discussed above.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



4.2 Water supply and conservation

This WMS proposes the following water supply and wastewater management design criteria:

Criteria WC1 Use appropriate non-potable water sources for irrigation

Criteria WC2 Minimise potable water use

The manner in which these objectives will be achieved is further detailed in **Section 5**

4.3 Wastewater management

The principle behind the wastewater management system is to provide appropriate servicing of the site, whilst also mitigating risk to the downstream environment.

Criteria WW1 Ensure appropriate management of wastewater

The manner in which these objectives will be achieved is further detailed in **Section 6**.

4.4 Surface water management

The principles behind surface water management at the site are to ensure surface water is appropriately treated and that Margaret River (as described in **Section 3.5**) is not detrimentally affected by the development. This WMS proposes the following stormwater design criteria:

Criteria SW1 Floor of habitable buildings to at or above the elevation identified to mitigate future coastal processes risk

Criteria SW2 Manage the small rainfall event runoff at source

Criteria SW3 Manage runoff from minor and major rainfall events to control erosion

Criteria SW4 Adopt a passive at-source approach to stormwater management infrastructure

Criteria SW5 Utilise appropriate non-structural measures to reduce nutrient loads

The manner in which these objectives will be achieved is further detailed in **Section 7**.

4.5 Groundwater management

This WMS proposes the following groundwater management criteria:

Criteria GW1 Stormwater infiltration infrastructure to be located at least 500 mm above highest known groundwater level

Criteria GW2 Buildings to be protected from groundwater inundation

The manner in which these objectives will be achieved is further detailed in **Section 8**.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



5 Water Supply and Conservation

5.1 Fit for purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that water is not wasted. Fit-for-purpose principles have been utilised in the water conservation strategy for the site.

5.1.1 Potable supply

The site is serviced by potable water from the Water Corporation's supply network, and is currently delivered via a 150 mm distribution pipeline located along the eastern side of the Wallcliffe Road reserve. The site currently has a 20 mm diameter domestic connection, which will need to be increased to suit the proposed development. The development will require a suitably sized header tank designed to maintain supply for a stipulated period of time during a power-outage.

5.1.2 Groundwater

The *Water Register* (DWER 2023) indicates that the site is located in the Busselton-Capel groundwater area, within the Cape to Cape North subarea. The formation beneath the site is recorded as the Combined Leeuwin Surficial/fractured rock aquifer, and there is 'limited information' available regarding the allocation status of this resource.

As indicated in Section 3, the Wallcliffe Surficial aquifer exists beneath the site. It has a measured capacity of approximately 70,000 kL and a sustainable yield of approximately 22,100 kL/year; this considers potential impacts of climate change and rainfall variation.

DWER has granted an allocation to take 16,500 kL/year of groundwater (GWL207725) and the use is guided by a Groundwater Operating Strategy (GOS) that has been approved by DWER in 2022.

The irrigation system on the site is currently supplied from two low-yielding and shallow bores positioned into the Wallcliffe Surficial aquifer. One bore is near the dam in the northern portion of the site and the other is near the south western corner. Extracted groundwater is pumped to two tanks located west of Wallcliffe Road near the access driveway into the site. These two tanks then irrigate the site by gravity. The irrigation system has historically been operated three days per week in summer and anecdotally the tanks rarely if ever run dry.

The future development of the site will be supported by a replacement extraction location, positioned further from the River than the current extraction points but within the same groundwater resource. The location has yet to be finalised however installation of the bore and subsequent extraction will comply with the requirements of the *Rights in Water and Irrigation Act* 1914.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



5.1.3 Stormwater harvesting

The roof areas of the proposed development provide an opportunity to harvest rainfall for later non-potable uses within the site. To do so would likely require localised collection from each roof area and harvested water would need to be pumped to a central storage location. Stormwater harvesting is not required to deliver the project and therefore is not currently detailed within the site designs. However, future development within the site may incorporate rainwater harvested from roof surfaces. This is identified now as a potential water source that could assist in achieving resilience in meeting non-potable needs within the site.

5.2 Water conservation measures

Waterwise gardening (WWG) principles, and water efficient fixtures and appliances (WEFA) will be used to ensure that the development minimises the use of water overall, as well as implementing alternative fit-for-purpose supply options (discussed in **Section 5**).

5.2.1 Water efficient fixtures and appliances

Significant reductions in internal water uses can be achieved with the use of WEFA which will be utilised in all buildings within the site.

5.2.2 Waterwise gardens

The development will undertake a variety of WWG measures to limit water use. The following methods and approaches will be considered:

- Maintain the existing established landscaped areas, which will minimise disturbance to the site, water use, and nutrient requirements typically required to establish such areas.
- Retain existing native vegetation wherever possible.
- The adoption of water wise species, with a focus on using local native water wise species or if necessary species from regions with similar climates.
- Additional turf areas to be minimised where possible.
- The irrigation system will be designed to be staged to only irrigate those areas that require it, including landscaped gardens and turfed lawns.
- Irrigation will not be undertaken if there has been recent rainfall and soil moisture conditions indicate that it is not warranted.
- Soil amendments/improvements will be utilised where required to minimise water repellence and the efficient uptake of water by plants.
- Established native vegetation that does not require additional water will not require permanent irrigation and if it were necessary (e.g. due to extreme weather conditions), this would be done so by contingency irrigation (e.g. temporary or hand-held irrigation).
- A trickle feed irrigation system will be implemented where possible to ensure conservative water use.
- Irrigation will only occur between 6 pm to 9 am, except for the establishment of newly planted areas and only for a period of up to 28 consecutive days, commencing from the day of planting.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



- Operation of the irrigation system will be electronically controlled, with regular reviews of the irrigation programme in response to weather conditions.
- Regular inspections and maintenance will be undertaken to ensure minimal losses via damaged infrastructure.
- Each abstraction point will have an approved water meter attached to monitor water usage.

Irrigation requirements across the site will be minimised by utilising WWG practices in all planted areas. Where possible, planting will occur during winter in all development landscaped areas to remove the need for establishment irrigation and maximise plant survivability. It is noted that much of the site already contains mature landscaped areas, and the establishment phase is anticipated to be limited to areas that may be disturbed as part of construction and/or are associated with the new buildings.

Irrigation will utilise the fit-for-purpose sources detailed in **Section 5**, thus achieving **Criteria WC1** and **WC2**.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



6 Wastewater Management Strategy

The site was historically served by on-site domestic-scale treatment units. These systems will be located then suitably and properly decommissioned. Development of the site will increase the demand for wastewater collection and disposal. Wastewater will be collected from each new building by means of gravity property sewers to one or several small pump stations that each in turn will pump the wastewater to a single facility.

6.1 Expected wastewater demand

The anticipated wastewater volumes have been based on an annual water demand assessment that has accounted for the following uses/services:

- Hotel guests (at full capacity) – 62 guests
- Staff (during peak times) – 67 per day (which accounts for permanent and potential ad hoc staff)
- Main kitchen/restaurant – 180 sittings per day
- Tea Room and Bar
- Guest spa facility – 25 uses per day
- Incidental laundry
- Ancillary uses (bin washdown, car wash, etc.)

The anticipated patronage and wastewater generation is summarised in **Table 8**.

Table 8: Anticipated wastewater generation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Season	Peak	Peak	Shoulder	Shoulder	Shoulder	Off peak	Off peak	Off peak	Shoulder	Shoulder	Shoulder	Peak
Occupancy	79%	79%	67%	67%	67%	57%	57%	57%	67%	67%	67%	79%
Daily wastewater	18.8kL	18.8kL	14.5kL	14.5kL	14.5kL	13.5kL	13.5kL	13.5kL	14.5kL	14.5kL	14.5kL	18.8kL

Based on the occupancy detailed in **Table 8** (varying between 57 % and 79%), the annual wastewater generated is anticipated to be approximately 5,700 kL/year. However, and as discussed in **Section 6.3.9**, the system and disposal of wastewater has been designed based on 100% occupancy year round.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



6.2 Options assessment

The approach to wastewater management has considered three options:

1. Connection to Water Corporation infrastructure at Gnarabup has been investigated. The nearest potential outfall to accept wastewater pumped from the site to the Water Corporation operated Prevelly wastewater treatment plant is an existing wastewater pump station located opposite and to the west of the intersection of Chuditch Place and Bandicoot Close, approximately 2.5 km south of the site (referred to as the 'Chuditch Place PS'). A private pressure main would be required to be installed and located along the road reserves of Wallcliffe Road then Chuditch Place. This would discharge into the wastewater system near the Chuditch Place PS. The Water Corporation have indicated that whilst in principle the proposal may be feasible the current system does not have the capacity to accept additional flows (without system upgrade). The Gnarabup option is not technically feasible as it would have a downhill pressure main gradient, which would not be accepted by the Water Corporation to their system.
2. Connection to Water Corporation infrastructure near the western edge of Margaret River townsite. It is uncertain whether the Water Corporation infrastructure has the capacity to accept wastewater from the site. This would require the site to pump wastewater via a pressure main along Wallcliffe Road, to either near Farrelly Street or possibly along a slightly shorter pressure main to near the intersections with Wallcliffe Road and either Tyrone Loop or Mansfield Avenue. The length of the pressure main will be about 6.5 km to 7 km depending on the route.

A fundamental Water Corporation design prerequisite with a private wastewater pressure main is that the main conveys wastewater to minimise the chance of the sewage going septic, and as such should turn over at least once per day. With the relatively low flows from the development, this requirement would not be achieved within such a long pipe section. Detention times in the pressure main are likely to be longer which may create a risk of odour issues at the discharge point, and therefore Option 2 is not considered to be technically viable.

3. Onsite wastewater treatment and disposal via a Fujiclean system. A proprietary package wastewater treatment plant (WWTP) will provide the core treatment of the raw wastewater. As well as a biological treatment process for the treatment of organic matter, the WWTP also includes nitrification and denitrification processes for nitrogen removal.

An onsite wastewater system will need to be able to dispose of/manage the treated/recycled water within the site and at an appropriate distance from Margaret River. It will also need to mitigate the risk that nutrients could potentially migrate towards Margaret River. The system will also need to operate in a spatially constrained site and be managed in the context of the ongoing operations of a resort style development.

Option 3 is considered to be the most feasible and is the only practically implementable option.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



6.3 Onsite wastewater treatment plant

The wastewater treatment system will achieve tertiary treatment of effluent as described in detail in the *Engineering Aspects* report (Civil Group 2023) and also summarised in the following sections.

6.3.1 System summary

Package WWTPs are extremely common for premises outside of the Water Corporation's licence area as well as remote locations/mine camps and can treat domestic strength wastewater to a treated effluent suitable for basic liquid effluent disposal methods (such as low exposure risk recycled water reuse applications). Solids accumulated in package WWTPs are routinely removed via vacuum truck for off-site treatment and disposal. The proposed treatment system at Wallcliffe House is a Fujiclean system that will treat the wastewater to a much higher quality than a conventional septic tank (which are still very common throughout the Margaret River and broader Southwest region). In addition to the package WWTP, the Fujiclean system proposed for Wallcliffe House will be accompanied by an effluent polishing plant to provide further filtration and treatment of the effluent produced from the package WWTP. The polishing plant includes membrane filtration and chemical dosing to remove phosphorous. Membrane filtration also removes a high fraction of viruses, pathogens, and other microorganisms from the treated effluent. The high-quality effluent (both from a chemical and biological perspective) means that a wider range of disposal methods are appropriate to be considered.

Based on the typical specification for this type of system, the proposed package WWTP will achieve TN concentrations of <10 mg/L, and following the additional polishing proposed TP concentrations will be reduced to <1 mg/L. An important final step will be applied during the infiltration of treated water, whereby an engineered soil media designed for its ability to further remove phosphorous will be installed beneath effluent infiltration areas. Based on manufacturers advice the use of the soil media beneath the infiltration areas will result in near total (99%) removal of phosphorous until such time as the media is exhausted. For the purposes of the nutrient balance (**Section 6.5**) a more modest 90% reduction has been assumed. The lifespan of the media is influenced by depth of soil media and concentration of phosphorous in effluent. Initial calculations indicate that the media will need to be replaced approximately every four to five years to continue to provide full removal of phosphorous (pending occupancy).

The effluent quality produced from the proposed package WWTP, polishing plant and proposed approach to infiltration will therefore be of a higher quality than that generated from utility-operated wastewater treatment plants in Western Australia.

6.3.2 Chemical dosing

Chemical dosing of treated effluent for chemical phosphorous removal is not common due to the cost and resultant sludge generated. Most utility operated WWTPs in WA rely only on biological phosphorous removal in the core treatment process, resulting in a typical total effluent phosphorous of 5 mg/L in metropolitan areas, and >10 mg/L in regional areas.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



6.3.3 Membrane filtration

Membrane filtration of all treated effluent will be adopted however is rare even for utility operated WWTPs. Membrane filtration involves very small filtration apertures, removing essentially all particulate solids from the effluent (a total suspended solids of <1 mg/L is expected). For most utility operated WWTPs, filtration of final effluent is undertaken via screen filter or disc filter, which have a filtration aperture >100 times larger than membranes. With such filtration, a total suspended solids of 20 mg/L is acceptable and in accordance with recycled water guidelines. Membrane filtration is typically reserved only for high demand applications (e.g., industrial process water supply, or indirect potable reuse) or where sensitive environmental receptors are nearby (i.e. Margaret River).

6.3.4 Effluent polishing

The effluent polishing plant proposed for the Wallcliffe House WWTP will generate low volumes of sludge due to the chemical removal of phosphorous. The dosed chemical causes soluble species (of which phosphorous is one) to precipitate out of solution as a solid, which can then be filtered. The waste stream from the polishing plant will be fed to the sludge dewatering plant, which thickens and dewateres the sludge to the degree whereby it is suitable for offsite disposal to landfill as a solid. The dewatered liquid is recovered back to the effluent polishing plant for further treatment.

6.3.5 Maintenance

Whilst the Fujiclean system is very low maintenance (a 'set and forget' system), the overall system will incorporate operation and maintenance agreements with equipment vendors to ensure that the system operates reliably to a high standard suited to the development and as required by current legislation.

6.3.6 Buffer storage

Buffering storage will also be incorporated into the system to provide contingency storage in the event of maintenance, power outage, or fault with individual system components.

The buffer storage will be incorporated before and after the package WWTP and will ensure there is time for an operator to attend the site and for brief power outages. This will safeguard the surrounding environment from potential wastewater spillage or overflow.

6.3.7 Monitoring

The system will be monitored by both hotel staff and the maintenance contractor to respond in a timely manner. Maintenance contracts will be set up to ensure response times are stipulated and guaranteed and the system is then designed to suit this.

6.3.8 Backup electricity

Backup electricity and suitable buffer-storage tanks will be incorporated into the wastewater system to avoid any risk of overflow spillage entering the environment (in particular Margaret River) in case

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



of a breakdown of part of the system. A back-up generator will ensure constant electricity supply to the wastewater system in the event of prolonged power outages.

6.3.9 Effluent disposal requirements

Land application systems typically discharge wastewater via soil absorption systems (e.g., flatbed leach drains) or irrigation systems (e.g., subsurface irrigation or surface irrigation). The method by which wastewater is dispersed to the land influences the amount of land required for application.

Based on the expected daily generation of wastewater, a maximum system demand has been estimated to be 24 kL/day (based on 100% occupancy), though this could be as low as 13.5 kL/day during off peak times. As described in **Section 6.1**, occupancy is expected to vary from approximately 57 % during off peak to 79 % during peak times, and therefore the assessment using 100 % occupancy is conservative.

The suitability of the land to accept the anticipated wastewater stream is assessed in **Section 3.3**.

6.3.10 Treatment system separation

The GSP stipulates that on-site sewage systems are not to be located within 100 m of a drainage system that discharges directly into a waterway or significant wetland without treatment. The key consideration is the setback from Margaret River. The site has recently been thoroughly investigated via intrusive site investigations (see **Section 3.3.2** and **3.3.3**) involving test pitting and infiltration testing at the proposed locations of subsurface infiltration systems. The investigations confirmed that there are three locations within the 'Arrivals Paddock' that provide sufficient infiltration capacity, and which are in excess of 100 m from Margaret River foreshore. The proposed locations of the infiltration cells in relation to the River are shown on **Figure 5** with site plans contained in **Appendix A**.

6.4 Site and soil evaluation

6.4.1 Summary of relevant site conditions

The characteristics of the site that are relevant to the disposal of treated effluent within the site are discussed in **Section 3**, and summarised in **Table 9**, which is based on AS1547:2012 Table K1 potential site limitations.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table 9: Site and soil evaluation summary

Site characteristic	Summary	Disposal implications
Topography/slope	Site ranges from 2 mAHD to 64 mAHD with a slope of 15% generally steep slope towards the River	The site is too steep for recycled water disposal methods that rely on shallow/flat infiltration areas or surface irrigation.
Soil depth	Soil depth beneath potential infiltration areas is >20 m	20 m soil provides more than enough profile to provide additional treatment and to store effluent during long periods of wet weather
Soil category and permeability	Shallow soils are sand and limestone, limestone increasing with depth, overlying strongly to weakly weathered granite with decreasing permeability. Permeability in shallow sand soils >25 m/day	Site soils are considered as Category 1, permeability suitable for onsite infiltration of recycled water
Depth to groundwater	Portions of the site next to the River have >2 m separation, however portions of the site >100 m from the river have >20 m clearance above groundwater	Depth to groundwater at locations >100 m from the river is >2 m, providing a deep soil profile and long pathway for effluent
Duration of continuous soil saturation	Soils are moderate to highly permeable and not seasonally saturated	No impediment imposed by duration of soil saturation
Dispersive soil	Soils have high measured permeability and are not sodic	No impediment imposed by soil sodicity
Site area	5.2 ha, mostly vegetated/landscaped	The site has a large enough spatial extent to facilitate infiltration of recycled water
Proximity to environmental assets	Margaret River immediately adjacent to the site	Approximately 30% of the site >100 m from the River, and the proposed infiltration areas (within the 'Arrival Paddock') are >100 m from the River
Other nearby resource users	No other users of the Wallcliffe Aquifer	No impediment imposed by other land users

In summary of the site conditions, onsite infiltration of recycled water is suitable given the permeable nature of soils located >100 m from Margaret River and deep profile of permeable soils. However, infiltration measures should be subsurface and have a consolidated depth profile (i.e. along a topographical contour) given the slope of the site.

AS1547:2012 indicates that where slope is a design constraint consideration should be provided to risk of erosion, buildability, and seepage. These factors can be appropriately managed in the design of subsurface infiltration cells.

6.4.2 Design loading rate and land application area

Substantive guidance is provided to onsite effluent disposal system design and effluent disposal by the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 and AS 1547:2012. It is however noteworthy that the tertiary system proposed for use (as described in **Section 6.3**) is significantly more sophisticated than a typical residential septic or secondary treatment system, and therefore warrants additional consideration.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



When considering the sizing of the land application area for the site AS1547:2012 recommends selecting an appropriate design loading rate (DLR) from the values presented in Table L1. When selecting an appropriate DLR (based on the site soils and permeability) it is recommended to use a conservative value if there is uncertainty regarding the capacity of the site to accommodate on-site wastewater disposal. Based on the site soil investigations (see **Section 3.3**) and the recommended treatment system a DLR of 50 mm/day would be appropriate. However, given the steep slope of the site (> 15 %) towards Margaret River a more conservative approach to DLR selection has been made resulting in a DLR of 30 mm/day based on Table L1.

Using the selected DLR, the maximum trench width of 2.53 m and a peak daily design flow rate (see **Table 8**) the required length of leach drains can be determined using the formula given in Section L4.2 of AS1547:2012. Best on this information the required length of leach drains to effectively treat the peak daily flow rate would be 330 lineal metres and have a spatial footprint of 575 m² for the infiltration of treated effluent.

Due to the steep topography of the site, a traditional (e.g., infiltration trench, flatbed leach drains or other similar) approach is not possible, and therefore the treated/recycled water is proposed to be infiltrated within subsurface cells/leach drains. These will utilise infiltration cells such as EcoAID, Tunnelwell or Stormtech cells generally consistent with those shown in Figure L2 from AS 1547:2012 and will be sized to provide sufficient void space to accommodate 24 kL of infiltration storage (maximum daily wastewater generation). Measured infiltration rates at the proposed cell locations (see **Section 3.3.3**) indicate that this volume would readily infiltrate into the underlying soils within 24 hours. This is based on a design permeability of 5 m/day, which is significantly less than the measured permeability of ~25m/day in the shallow soil profile and 8-12 m/day in lower permeability limestone areas (noting that the preferred locations Are those with a sandy profile and high permeability).

The land area required for these cells would be approximately 60 m², significantly less than that calculated by AS1547:2012 methodology, however, the portion of the site that the proposed infiltration cells will be located (referred to the arrivals paddock and immediate surrounds) and which is >100 m from the River is approximately 16,000 m², which is approximately 28 times the surface area indicated a required by AS1547:2012, and therefore the site has sufficient land area to achieve the intent and objectives of AS1547:2012. This area is shown in **Figure 5**.

With the proposed treatment area being located on a steep slope consideration of stormwater surface runoff is required so that the leach drains do not become hydraulically overloaded, thereby reducing the overall effectiveness of the system. As specified in Section 5.5.3.6 of AS1547:2012, when subsurface solutions are proposed on steep slopes, bund or cutoff drains are recommended upslope of each drain to ensure that surface runoff is directed around subsurface infiltration systems. Therefore, either vegetation cover, built form or localised landforms are utilised upslope of the proposed infiltration locations.

Given the soil profile underlying the infiltration cells (permeable sandy/limestone soils >20 m) and the large area of the site, the approach proposed is consistent with the stated intent of AS1547:2012, which is to meet the performance objectives for the on-site system of providing sufficient capacity to

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



receive, treat and absorb all treated wastewater flows within the site boundary in an effective and sustainable manner which protects public health and the environment.

6.4.3 Contingency in design

To provide additional standby capacity, and also redundant service capacity, three 24 kL storage cells are proposed (i.e., triple the maximum daily capacity will be provided). These will be approximately 24 m in length, approximately 2 m wide and will be installed along the topographic contour at locations that have been tested to confirm infiltration capacity. The use of these will be rotated as required to suit operational and maintenance needs. This is greater than the additional 100% reserve area recommended by AS1547:2012 (see Section 5.5.3.4) and suits the sensitive nature of the surrounding environment in the vicinity of the land application areas.

Based on the assessment of wastewater demand and the expected occupancy, the proposed disposal system will provide almost four times the anticipated capacity required during peak times and over five times the anticipated capacity required during off-peak times.

6.4.4 Risk reduction measures

A summary of relevant risk reduction measures applicable to the site and the selected wastewater treatment solution are provided in **Table 10**, which is based on AS1547:2012 Tables A1 and A2, and presents the measures taken to reduce the risks associated with the development.

Table 10: Design risk reduction measures for the site

Potential Risk	Potential cause	Risk mitigation measure
Wastewater system hydraulic failure	Inadequately sized wastewater treatment system and undersized land application area	• Designing for maximum daily wastewater generation rather than likely peak wastewater volumes • Use of a conservative approach for land application area sizing • Provide additional contingency storage
Biological failure from power outage causing cessation of pumps and aerators	Loss of power which stops the operation of the treatment system. This can cause a backup of wastewater and reduce the effectiveness of the system	• Backup generators are required for the treatment system • Additional storage provided within buffer tanks • Contingency/management plans are in place in case of loss of power • Staff are made aware of contingency planning in case of loss of power
High rainfall or torrential downpours	Excessive surface runoff can hydraulically overload the land application areas	• Use of built form or localised landforms to direct surface runoff around land application areas

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Table 10: Design risk reduction measures for the site (continued)

Potential Risk	Potential cause	Risk mitigation measure
Wastewater biological failure from washout of bacteria	Inadequate hydraulic design of the wastewater system (i.e. undersized, inappropriate treatment system, etc.)	• Designing for a larger hydraulic loading than anticipated • Additional storage provided within buffer tanks • Use of a conservative approach to the sizing of land application area • Provide multiple disposal area to provide contingency within the system
Site constraints	Steep slopes located within proposed land application area	• Conservative approach taken for selection of DLR • Appropriate selection of disposal system for the steep slopes (i.e. subsurface disposal) • Install disposal systems perpendicular to the fall of the slope
Clogged outlet filters	Inadequate servicing of wastewater system	• Implementation of a regular monitoring and maintenance program • Conservative estimate of maximum wastewater flows within system • Flow balancing across disposal locations to ensure even distribution of hydraulic loads
Sludge and scum solids fill tank and overflow to soakage field	Irregular pump/maintenance schedule, undersized wastewater treatment system	• Implementation of a regular monitoring and maintenance program • Follow maintenance schedule as per manufacturers specifications
Build-up of excessive solids to land application area	High organic loading and insufficient settling of solids within wastewater treatment system	• Provision of a contingency land application area for additional disposal area • Implementation of a regular monitoring and maintenance program
Uneven distribution system/broken/damaged distribution lines	Traffic over land application area	• Minimise compaction during installation • Ensure land application area is protected by fences/barriers • Ensure 'no-go' areas are specified in the monitoring and maintenance program

6.5 Nutrient balance

In order to assess the potential nutrient load that may be directed to the downstream environment, and to determine if this will provide an acceptable outcome, and nutrient mass balance analysis has been undertaken. The mass balance assesses a worst-case outcome, combining the following circumstances and assumptions:

- 100% occupancy for a three-month period
- No flow within Margaret River for a three-month period
- Flow from wastewater treatment system directly enters the Wallcliffe Aquifer and River as a combined system

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



- No additional attenuation provided by natural processes that could be expected within the soil profile
- Nutrient concentrations in the River are consistent with those measured and constant throughout the assessment period (TN 0.425 mg/L TP 0.069 mg/L)
- Adjacent portion of the River that water could interact with is 9 ha at an average 3 m depth providing 270,000 kL of potential storage
- The Wallcliffe Aquifer is 69,300 kL of potential storage
- Varied nutrients measured in the Wallcliffe Aquifer are temporary as the source of these (historical agricultural land use) has been removed.
- Wastewater treatment system outputs (to the infiltration cells) are TN 10 mg/L and TP 1 mg/L
- Additional polishing achieved by soil media beneath infiltration cells removing 90% of phosphorous, therefore resulting TP concentration being infiltrated is 0.1 mg/L.

Based on the nutrient mass balance undertaken, the following results are noted:

- Existing (static) nutrient mass in the River: TN 115 kg, TP 19kg.
- Nutrient mass in recycled water (prior to filtration through treatment media): TN 21.6 kg, TP 2.16 kg.
- Resulting nutrient concentration in Wallcliffe Aquifer/Margaret River over 3 month no flow period: TN 0.51 mg/L TP 0.070 mg/L.
- When anticipated occupancy rates are adopted the nutrient concentrations in Wallcliffe Aquifer/Margaret River over 3 month no flow period reduces to TN 0.49 mg/L TP 0.0694 mg/L.

In order to provide a holistic project assessment, the nutrient application that may be expected to maintain the high standard of landscaping evident at the site has also been considered. Whilst native vegetation and unfertilised garden beds will be the typical approach adopted, based on the maintenance of the approximate extents of traditional style landscaping the following nutrient inputs can be determined:

- Landscaped area requiring fertiliser input: 1.2 ha.
- Fertiliser rate 60.6 kg/ha/year TP 10.2 kg/ha/year (based on UNDO Tool combined 'non-native gardens', 'sport', 'native vegetation').
- Assume 75% plant uptake of applied nutrients and 25% of nutrients applied are leached.
- Nutrient output from the site is consistent throughout the year.
- No further attenuation is provided by movement through soil and the aquifer.
- Nutrient mass leached from fertiliser use over three-month period: TN 4.54kg, TP 0.765kg
- Resulting nutrient concentration in Wallcliffe Aquifer/Margaret River over 3 month no flow period when combined with wastewater outputs: TN 0.52 mg/L TP 0.072 mg/L.

The nutrient mass balance for both treated/recycled water and other anticipated uses (fertiliser) shows that the potential nutrient concentrations that might be experienced in the Wallcliffe Aquifer and Margaret River are marginally above the existing nutrient concentrations. It is noted that the potential nutrient concentrations that might occur as a result of developing the site are well below (by an order of magnitude) the maximum levels that have already been recorded in Margaret River adjacent to the site (see **Section 3.5**).

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



In summary:

1. The nutrient (mass) outputs from the site are orders of magnitude less than the existing nutrients recorded in the Wallcliffe Aquifer and in Margaret River.
2. The combined Wallcliffe Aquifer and Margaret River provide a very large receiving environment, of which the daily treated/recycled wastewater output is 0.0071 % of the total receiving environment volume.
3. Combined nutrients from treated/recycled water and potentially leached fertiliser will cause a very slight increase in nutrient concentrations however this will be within the recorded natural variability of nutrients within the Wallcliffe Aquifer and in Margaret River.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



7 Stormwater Management Strategy

Stormwater runoff from the site is already being managed at source, and in accordance with best practice. The access road to the site for example is unkerbed and runoff sheet flow moves away from the pavement into the adjoining landscaped or natural bush areas. This has ensured that direct discharge of runoff to Margaret River does not occur.

7.1 Site stormwater management measures

The stormwater management strategy proposed for the site is to retain and treat the small event runoff at source, with larger events infiltrating locally in surrounding permeable areas. The stormwater management approach has been determined in consultation with Shire of Augusta Margaret River and DWER and is consistent with the historical approach taken within the site.

The proposed development will lead to some additional impermeable surfaces, mainly associated with the rooves on new buildings (e.g. the workshop and carparking areas). However, this is unlikely to change the peak runoff rates significantly, even in a major storm event. WSUD practices will be adopted in the design of the stormwater management system, including:

- **Soakwells.** Roof runoff will be captured and infiltrated in soakwells or may be harvested for onsite non-potable use. Runoff exceeding the capacity of these measures will be conveyed on the surface to the nearest surrounding permeable portion of the site where it will infiltrate.
- **Surface based flow.** All pavement areas will be graded, shaped, and managed to dispose of runoff by surface/sheet flow without the need for a formal piped network.
- **Localised infiltration.** Low profile sheet flow over natural or landscaped surfaces will avoid the need for large bio-retention or detention basins.
- **Vegetated swales adjacent to road pavement.** These have been designed to capture and treat the minor amounts of hydrocarbons and sediments that may occur on these areas.
- **Erosion control.** Localised areas adjacent to pavement require some minor erosion control, particularly where the pavement is steep. This will take the form of rock spawls or local material shaped to slow down runoff and to avoid erosion.
- **Localised direction to infiltration areas.** Some localised pavement areas may be collected via gully grate and directed to soakwell/subsurface infiltration as currently occurs on site.

7.2 Control of impacts to Margaret River

All drainage and erosion control structures are located within the site boundary and do not extend into the Margaret River and associated riparian vegetation (which is largely outside the site boundary). New planting and landscape treatments within the site will be provided consistent with the treatment requirements of the structures and in consideration of the vegetation within the site, surrounding area, and the Margaret River to ensure protection of these values.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



8 Groundwater Management Strategy

The principle behind the groundwater management strategy for the site is to maintain or improve groundwater quality.

8.1 Groundwater level management

As discussed in **Section 3**, the underlying groundwater is at least 2.4 m BGL for most of the site. The site will not require active groundwater controls. Rather, buildings and the base of any infiltration structures will all easily achieve an appropriate clearance above groundwater, on the basis that the habitable floor of buildings will be above the elevation identified for future coastal hazard risk, which is much higher than known groundwater.

8.2 Groundwater quality management

The main objective of the management of groundwater quality is to maintain or improve the existing groundwater quality. This can be achieved by reducing the total nutrient load to groundwater from sources within the development and via treatment of surface runoff prior to infiltrating to groundwater. The absence of historical agricultural activities within the site can be expected to provide a large benefit in reduction of nutrient inputs to the site.

The further reduction of nutrient loads to groundwater will be achieved by the following measures:

- Ensuring that the wastewater approach considers and appropriately treats nutrients.
- Retain existing landscaped areas and native vegetation wherever possible.
- Apply WWG principles to design of additional landscaped areas.
- Minimise fertiliser use to establish and maintain vegetation within existing and new landscaped areas, such that nutrient loss to groundwater is minimised.
- Direct stormwater to vegetated swales/permeable portions of the site.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



9 Management and Maintenance Plan

9.1 Management objectives

The design and construction of WSUD features will be undertaken in a manner that promotes the long-term health of the structural measures. These often require active ongoing management, particularly in the first years after construction, to ensure that they continue to provide their intended functions. This also incorporates a monitoring regime to provide guidance to the management actions which will ensure that the overall objectives are met. The overall management objectives are to:

- Maintain the wastewater treatment system to minimise nutrients being discharged to the environment.
- Maintain WSUD features including vegetated swales and erosion control measures.
- Minimise ongoing non-potable (irrigation) water use.
- Ensure that the system remains in an appropriate and sustainable condition.

The overall objective will be achieved through the implementation of a number of management actions that will be carried out at regular intervals. As the works are part of a private development with no areas to be handed over to the Shire of Augusta Margaret River, no timeframe for continuation of management and maintenance is specified, however the proponent commits to maintaining the development to the level detailed in this WMP. The key areas that will be addressed through the implementation of this management plan are discussed in the following sections.

9.2 Nutrient and water quality

Nutrient inputs will be managed to ensure that the water quality leaving the site is appropriate. Ongoing measures that will be utilised to control nutrient inputs and therefore groundwater quality will include:

- Use of slow-release fertilisers where appropriate
- Use of appropriate monitoring/testing to inform fertiliser application (e.g. visual monitoring, leaf and tissue analysis, etc.)
- If applicable, monitoring and management of any treated wastewater that may be used/infiltrated within the site to ensure that it meets expected water quality parameters
- Ongoing maintenance of wastewater management systems to ensure that the outputs meet the required specifications
- Erosion and sediments.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



The ongoing management and maintenance of the stormwater management system will include:

- Periodic visual inspection of the vegetated swales, infiltration systems (soakwells) and the entire site for erosion and sedimentation
- Removal of built-up sediments in response to observations
- Repair of any significant erosion in response to observations.

9.3 Monitoring and maintenance

The overall condition of the development and wastewater treatment system will be monitored during regular maintenance which will be implemented after the completion of the civil and landscaping works and will be ongoing.

Visual assessments will be regularly undertaken to monitor the overall condition of the development, with the aim to ascertain that the maintenance activities (as detailed in **Section 9**) are achieving the management and maintenance objectives. The monitoring undertaken will guide/refine the maintenance of the site.

The site maintenance and management will remain the responsibility of the proponent. Once the concept design and approach to servicing the site has been refined and detailed design progressed, a monitoring and maintenance schedule will be developed and implemented. The monitoring and maintenance schedule will address issues such as:

- Fertiliser control regime
- Weed management and removal
- Turf management
- Sediment management
- Erosion management.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



10 Implementation Plan

10.1 Reporting

It is anticipated that there will be the requirement to undertake ongoing monitoring and to prepare and implement a maintenance schedule for the onsite wastewater management system. If required, monitoring and reporting of the wastewater treatment system will occur to ensure the specifications are in line with any required approval and operating licence. No other reporting is proposed.

10.2 Roles and responsibilities

This WMP provides a framework that the proponent can utilise to assist in implementing an integrated water cycle management strategy that has been based upon site-specific investigations and is consistent with relevant State and Shire of Augusta Margaret River policies. The responsibility for working within the framework established within this WMP rests with the proponent.

10.3 Funding

As the site constitutes a single landholding, the development will be funded by the proponent.

10.4 Review

This WMP is not proposed to be reviewed unless the proposed development undergoes significant change (i.e., increase in impervious areas throughout the site) post-lodgment of the WMP. If the development is substantially modified, drainage requirements may need to be reviewed and the criteria proposed revised to ensure that all are still appropriate.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



11 References

11.1 General references

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC and ARMCANZ) 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, National Water Quality Management Strategy, Commonwealth of Australia, Canberra.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Editors) 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

CMW Geosciences 2018, *Geotechnical Investigation Report - Proposed Building Development Wallcliffe House, Prevelly, WA*.

Douglas Partners 2020, *Geophysical Investigation for Subsurface Geological Mapping - Wallcliffe House, 752 Wallcliffe Road, Margaret River Western Australia, 70585, O*.

Douglas Partners 2021, *On-site Sewage Disposal Assessment*, 96717.01.

Douglas Partners 2022, *Geotechnical Investigation - Proposed Wallcliffe House Redevelopment, 752 Wallcliffe Road Margaret River WA, R.001, O*.

Douglas Partners 2023, *Potential Treated Water Infiltration Areas - 752 Wallcliffe Road, Margaret River, WA, R.001.Rev0*.

Department of Planning, Lands and Heritage (DPLH) 2021, *Draft State Planning Policy 2.9 Planning for Water Guidelines*, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) 2011, *Ecological Water Requirements of the Margaret River*, Perth.

Department of Water and Environmental Regulation (DWER) 2017, *Decision Process for Stormwater Management in Western Australia*, Government of Western Australia, Perth.

Department of Water and Environmental Regulation (DWER) 2022, *Stormwater management manual of Western Australia*, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) 2023, *Water Register*, <<https://maps.water.wa.gov.au/#/webmap/register>>.

Emerge Associates 2022, *Hydrogeological Assessment*, EP18-128(09)--026 AJI, 1.

Engineers Australia 2006, *Australian Runoff Quality: A guide to Water Sensitive Urban Design*, National Committee for Water Engineering, Engineers Australia, Canberra.

The Civil Group 2023, *Engineering Aspects Wallcliffe House Margaret River*, Application for Development Approval Report

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management*, Western Australian Planning Commission.

Western Australian Planning Commission (WAPC) 2009, *Planning Bulletin No. 64 Acid Sulfate Soils*, January 2009, Perth.

Western Irrigation Pty Ltd 2022, *Bore Assessment - Wallcliffe House Site*.

11.2 Online references

Bureau of Meteorology (BOM) 2023, Weather and Climate Statistics, viewed 9 October 2023
<<http://www.bom.gov.au/climate/data/>>.

Department of Water and Environmental Regulation (DWER) 2023, Water Register, viewed 9 October 2023, <[http:// https://maps.water.wa.gov.au/#/webmap/register](http://https://maps.water.wa.gov.au/#/webmap/register)>.

Water Management Plan

Lot 101 (no. 752) Wallcliffe Road, Margaret River



This page has been left blank intentionally.

Figures



Figure 1: Locality Plan

Figure 2: Topography and Groundwater Contours

Figure 3: Soil Landscape Mapping and Test Pit Locations

Figure 4: Acid Sulfate Soil Risk Map

Figure 5: Proposed Treated Water Infiltration Locations

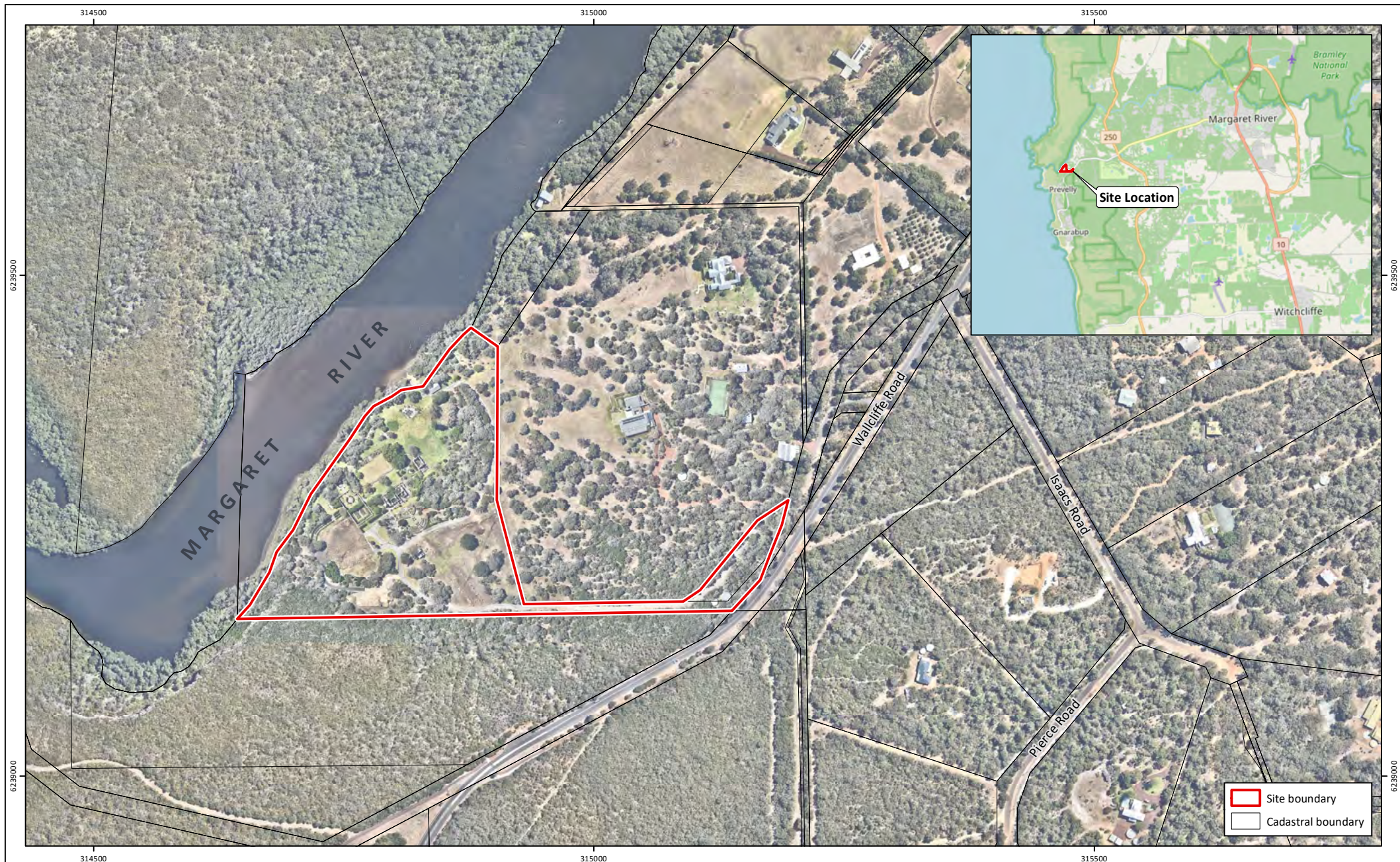


Figure 1: Locality Plan

Project: Development Application Water Management Plan
 Lot 101 (no. 752) Wallcliffe Road, Margaret River
Client: Wallcliffe House Pty Ltd

Plan Number:
 EP18-128(10)-F52
Drawn: GAR
Date: 03/10/2023
Checked: BPB
Approved: DPC
Date: 19/10/2023



0 100 200
 Metres
 Scale: 1:5,000@A4
 GDA 1994 MGA Zone 50



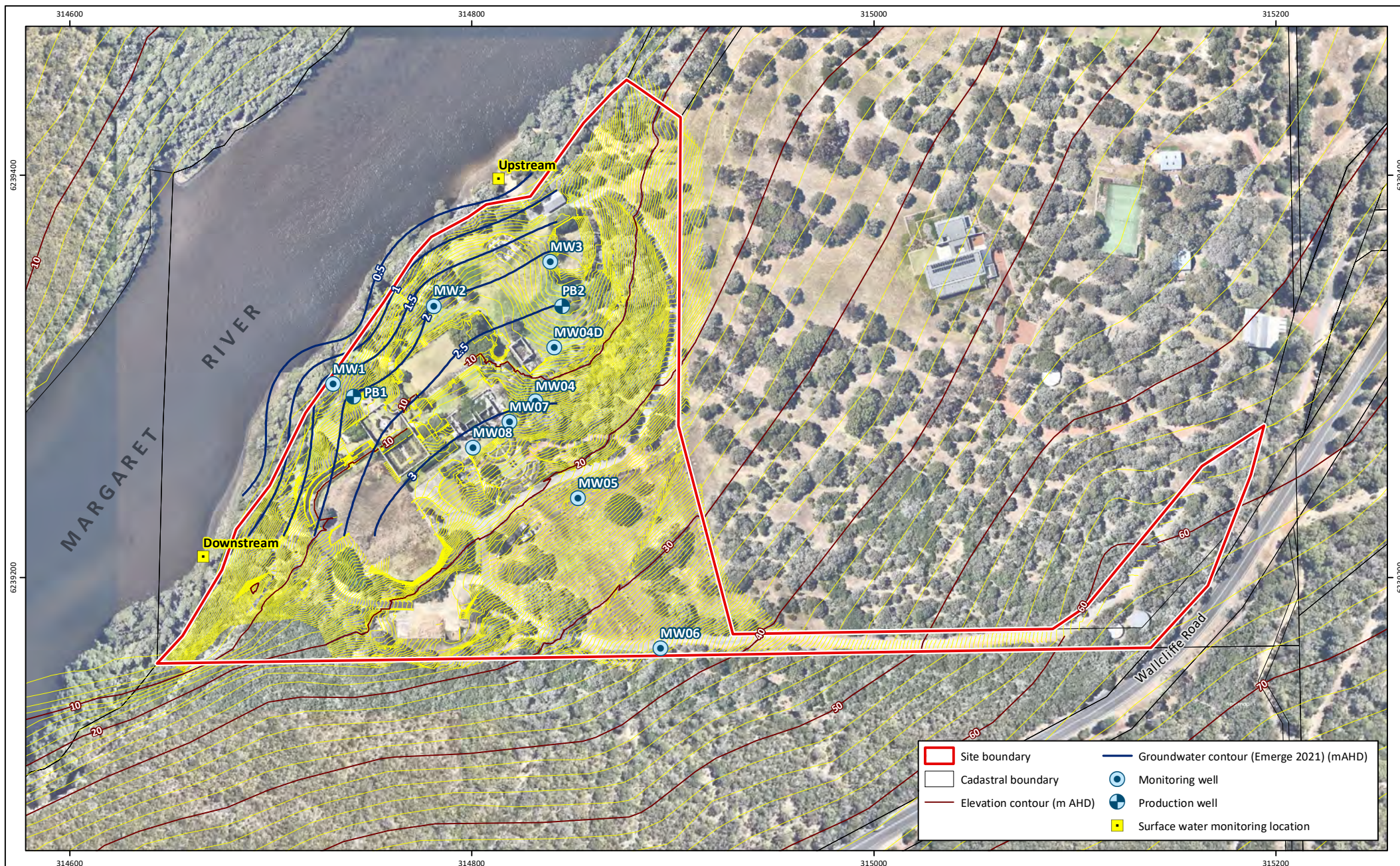


Figure 2: Topography and Groundwater Contours

Project: Development Application Water Management Plan
 Lot 101 (no. 752) Wallcliffe Road, Margaret River
Client: Wallcliffe House Pty Ltd

Plan Number:
 EP18-128(10)-F53
Drawn: GAR
Date: 03/10/2023
Checked: BPB
Approved: DPC
Date: 19/10/2023



0 50 100
 Metres
 Scale: 1:2,500@A4
 GDA 1994 MGA Zone 50

emerge
 ASSOCIATES

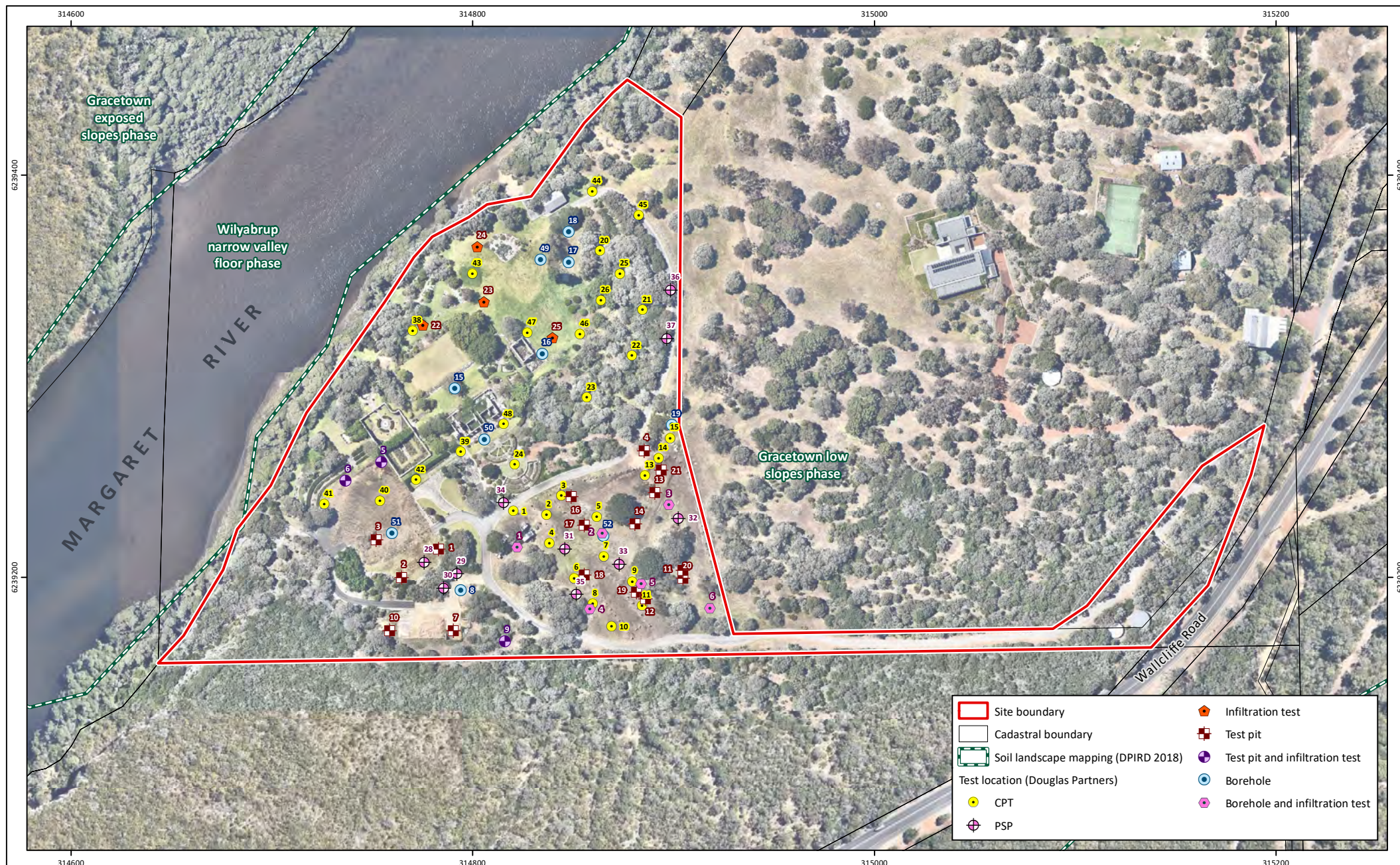


Figure 3: Soil Landscape Mapping and Test Pit Locations

Project: Development Application Water Management Plan
 Lot 101 (no. 752) Wallcliffe Road, Margaret River

Client: Wallcliffe House Pty Ltd

Plan Number:
 EP18-128(10)-F54

Drawn: GAR

Date: 03/10/2023

Checked: BPB

Approved: DPC

Date: 19/10/2023



0 50 100
 Metres

Scale: 1:2,500@A4

GDA 1994 MGA Zone 50

emerge
 ASSOCIATES

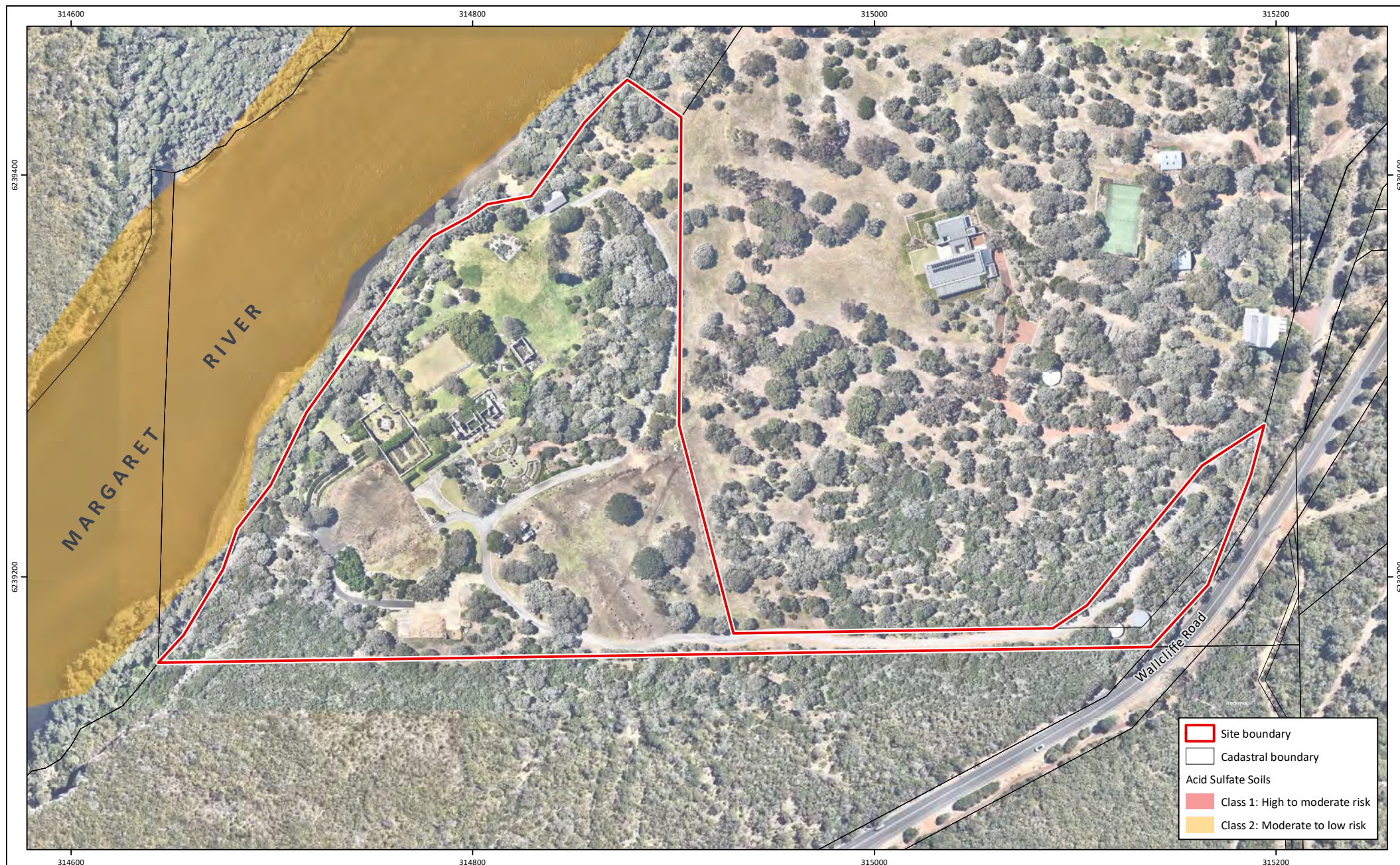


Figure 4: Acid Sulfate Soil Risk Map

Project: Development Application Water Management Plan
 Lot 101 (no. 752) Wallcliffe Road, Margaret River
Client: Wallcliffe House Pty Ltd

Plan Number:
 EP18-128(10)--F55
Drawn: GAR
Date: 03/10/2023
Checked: BPB
Approved: DPC
Date: 19/10/2023



0 50 100
 Metres
 Scale: 1:2,500@A4
 GDA 1994 MGA Zone 50

emerge
 ASSOCIATES

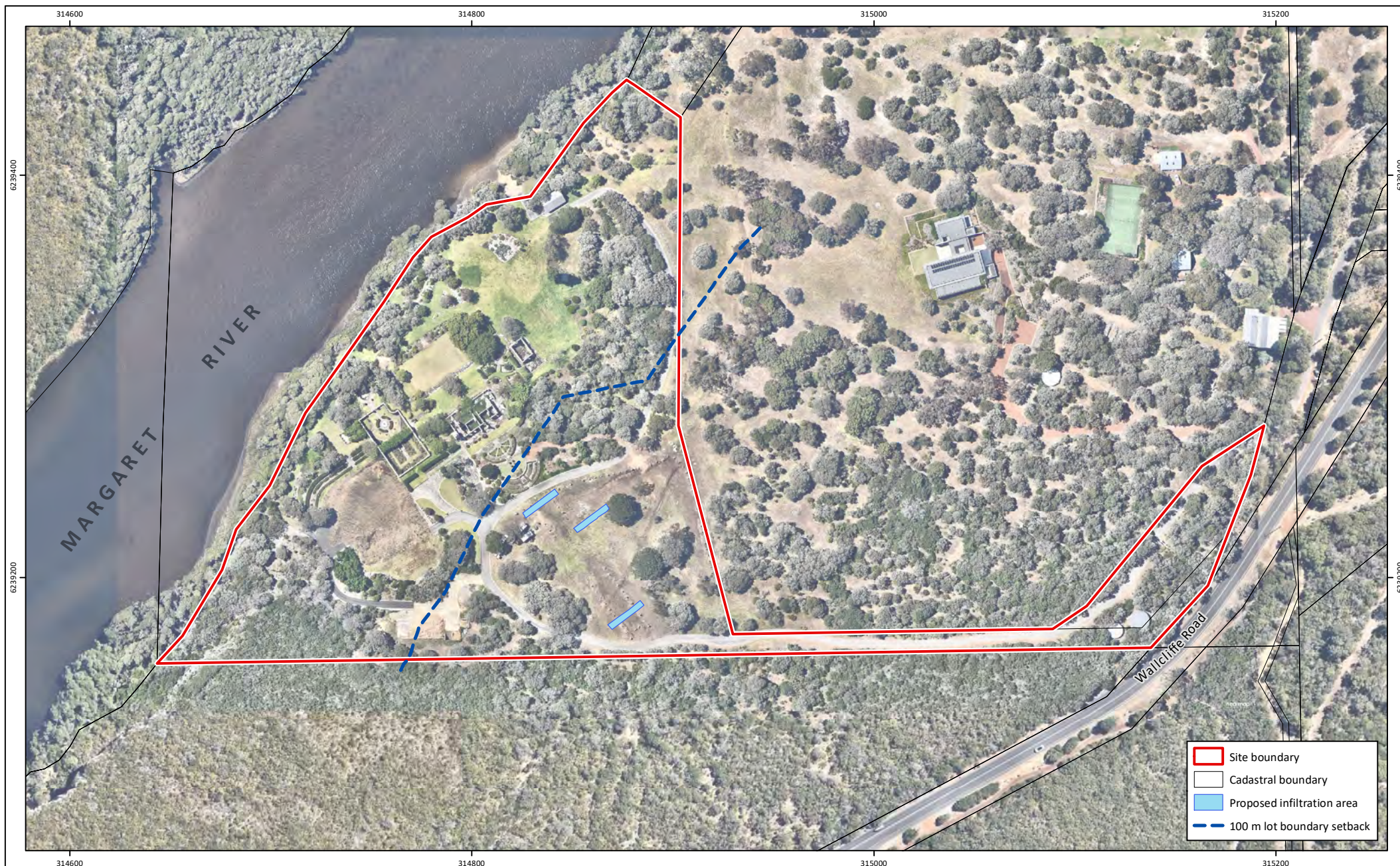


Figure 5: Proposed Treated Water Infiltration Locations

Project: Development Application Water Management Plan
Lot 101 (no. 752) Wallcliffe Road, Margaret River

Client: Wallcliffe House Pty Ltd

Plan Number:
EP18-128(10)--F56

Drawn: GAR

Date: 03/10/2023

Checked: BPB

Approved: DPC

Date: 19/10/2023



Appendix A

Wallcliffe House concept plan



Appendix B

Douglas Partners Geotechnical Investigation



Appendix C

Pump Test – Western Irrigation 2022



