WATER and STORMWATER MANAGEMENT PLAN

CHALET RIGI RESTAURANT, PIESSE BROOK, KALAMUNDA, WA 6076

DECEMBER 2019

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Report Prepared for: Fallright Property Unit Trust

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ABBREVIATIONS AND ACRONYMS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Rainfall Incidence
ASARP	As Soon as reasonably practicable
ASRIS	Australian Soil Resource Information System
ATU	Aerobic Treatment Unit
bgl	Below ground level
BOD	Biochemical Oxygen Demand
cfu	Colony-forming Unit
DBCA	WA Department of Biodiversity, Conservation and Attractions
DEP	Department of Environmental Protection
DFES	WA Department of Fire and Emergency Services
DIR	Design Irrigation Rate
DOH	WA Department of Health
DOW	WA Department of Water (now DWER)
DPLH	Department of Planning, Lands and Heritage
DWER	WA Department of Water and Environmental Regulation
E. coli	Escherichia coli
EHO	Environmental Health Officer
GAWS	Goldfields and Agricultural Water Supply
kPA	Kilopascal
K_{SAT}	Saturated Hydraulic Conductivity / Indicative Permeability
LOR	Limit of Reporting
LUMS	Land Use and Water Management Strategy (Middle Helena LUMS)
NATA	National Association of Testing Authorities
P2	Priority 2 Water Source Protection Area
PDWSA	Public Drinking Water Source Area
PIA	Primary Irrigation Area
PRI	Phosphorous Retention Index
RFC	Residual Free Chlorine
SIA	Secondary Irrigation Area
SLIP	Shared Location Information Platform
Spp	Species
STPP	Sodium Tripolyphosphates
TDS	Total Dissolved Solids
The City	The City of Kalamunda
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrate
TP	Total Phosphorous
TSS	Total Suspended Solids
WAPC	Western Australian Planning Commission
WQPN	Water Quality Protection Note
WRC	Waters and Rivers Commission
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

This Water and Stormwater Management Plan has been produced to address potential risks to water quality from the proposed reopening of Chalet Rigi restaurant. It is designed to satisfy the requirements of the City of Kalamunda for an appropriate Water Management Plan to be put in place to protect the Middle Helena catchment and to provide support for their approval to reopen the existing restaurant.

Through development and implementation of this Plan, the site owners aim to apply best practice management for water quality and public health and to incorporate water source education and awareness initiatives into future restaurant operations.

This Plan finds that long term sustainable on-site wastewater disposal for up to 480 people can be successfully achieved at Chalet Rigi with negligible impact on the surrounding catchment. Considerations to this conclusion include:

- Use of a Department of Health approved wastewater treatment unit (BioMAX C80 ATU).
- Exemption from the sewer connection requirement of the Government Sewerage Policy and Approval for an ATU installation by the Minister for Health (dated July 2019).
- Provision of as-built plans and certification from a licensed and appropriately qualified installer following installation of the BioMAX C80 on site.
- Underlying soil classification of Category 4 (Clay Loams) suitable for effluent irrigation over a total area of 4,120 m^2.
- Conservative adherence to minimum setback distances – in most instances, proposed setback distances are greater than those required by the Department of Health and City of Kalamunda.
- Appropriate landscaping and vegetation of the irrigation area to ensure that effluent is retained in soils within the irrigation area and does not migrate into surrounding areas.
- Signed maintenance agreement for ongoing quarterly inspection and maintenance of the BioMAX C80 and irrigation system by a licensed maintenance provider.
- Ongoing annual monitoring of surrounding water bodies including Hackett's Gully and Piesse Brook to assess long term water quality.
- Design and installation contingencies in the BioMAX C80 ATU that allow for failures in the system or shutdowns due to maintenance.
- Best practice stormwater management practices to prevent mixing of stormwater and wastewater.
- Administrative and operational controls to reduce identified risks and protect patrons, staff and neighbouring residents.
- Adherence to all relevant guidelines, regulations and conditions specified in the July 2019 Department of Heath ATU Approval.

In November 2019, a site visit was held with Evergreen Consultancy and a representative of BioMAX Pty Ltd who will install the system at Chalet Rigi. The BioMAX representative confirmed that the BioMAX C80 ATU and irrigation system can be successfully installed on site as proposed in this Water Management Plan.

This Water and Stormwater Management Plan has addressed all comments raised by the City of Kalamunda, Department of Health, and Department of Water Environment and Regulation and complies with all relevant guidelines, regulations and the July 2019 Department of Heath ATU Approval.

1. INTRODUCTION

1.1. Background

Chalet Rigi is a purpose-built Swiss-style restaurant located in Piesse Brook within the City of Kalamunda, WA. It had a significant 30-year history as a popular tourist attraction before it ceased operation in 2002. The site's owner, Fallright Property Unit Trust (Fallright), purchased it in 2006 and has since undertaken a renovation and expansion program to improve its amenity prior to reopening the restaurant.

Chalet Rigi is located within the Bickley Valley in the Perth Hills, only a short 10-minute drive from Kalamunda town centre (refer **Figure 1**). The surrounding Bickley Valley and Carmel wine region has a strong tourism focus and is characterised by wineries, cideries and orchards, surrounded by national parks, state forest, and world-class biking and walking trails.

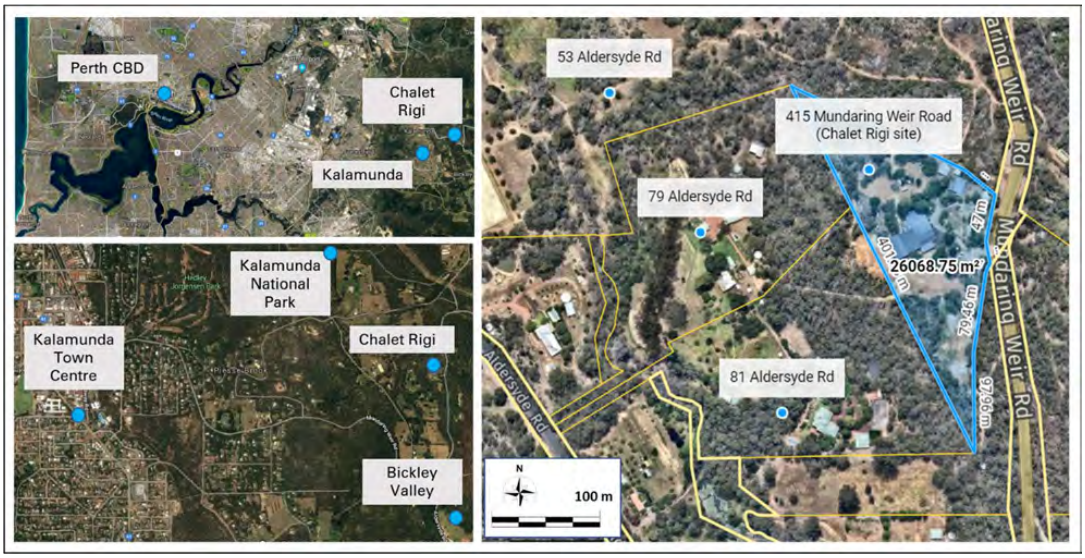

Figure 1 Site Location and Surroundings

Like most properties in the Perth Hills, Chalet Rigi is not connected to mains sewerage. During previous restaurant operations, Chalet Rigi used subsurface leachate drains to discharge wastewater on-site. In reopening the restaurant, Fallright intend to install an on-site water treatment system, or Aerobic Treatment Unit (ATU), to treat wastewater to an appropriate standard before recycling it for irrigation.

In September 2019, Fallright engaged Evergreen Consultancy WA (Evergreen) to produce a comprehensive Water Management Plan to address all potential risks to onsite and offsite water quality in support of the reopening of Chalet Rigi restaurant.

1.2. Previous Works and Approvals

→ **Since 2010** - numerous technical studies have been undertaken at Chalet Rigi to support the installation of an ATU, including water sampling, geotechnical investigations, soil characterisation and permeability testing.

→ **November 2012** - WA Department of Health (DOH) and City of Kalamunda approved a licence permitting the installation of an ATU suitable for up to 350 people (refer **Appendix A**). Subsequent communications with the Department of Liquor and Gaming indicated they would support a licence for up to 980 people. However, the ATU licence expired in 2014 during redevelopment of the restaurant and the project stalled.

→ **December 2018** - the project resumed with a new application to the City for an ATU system. Due to improving technologies since 2012, Fallright changed the proposed ATU to a DOH-approved BioMAX C80 suitable for up to 480 people, or an additional 130 people (+ 37%) from the 2012 approval. In response, the City requested additional technical information to enable them to assess the application.

→ **May 2019** - an *Addendum Water Management Report* was produced by Evergreen to supplement the 2012 Stass *Wastewater Treatment Report* previously approved by the City and DOH. The Addendum provided updated information on the ATU design, treatment technology, and stormwater management.

→ **June 2019** – Deputy Premier and WA Minister for Health, Hon Roger Cook MLA, granted Chalet Rigi an exemption from the sewer connection requirement of the *Government Sewerage Policy*. The Minister is satisfied that sewer connection is not viable at the site and is prepared to support the installation of an on-site wastewater system. The Minister also advised that the DOH consider the BioMAX C80 wastewater system, with a maximum capacity of 14,400L/day servicing 480 people as proposed, to be adequate and that the property is capable of wastewater disposal safely on-site on 4,120 m^2 of irrigation disposal area.

The DOH subsequently issued a licence approving the installation of a BioMAX C80 ATU, suitable for up to 480 people per day, subject to compliance with DOH conditions. Refer **Appendix B** for the current DOH approval and **Appendix C** for the BioMAX C80 Technical and Maintenance Manual. The approval is valid for a period of two years - if the works are not completed after 2 years from the date of the approval (22 July 2019), a new application would be required.

→ **July 2019** - the City requested formal comment from internal and State departments (DOH, DWER, DBCA, DFES, Water Corporation) and undertook consultation with neighbouring residents. Note: consultation incorrectly referred to previous restaurant operations as approved for 80 people – the prior approval granted by the City of Kalamunda, dated November 2012, was for 350 people.

→ **August 2019** - the City presented the community consultation feedback, including several concerns raised by neighbouring residents over the proximity of the proposed irrigation system to Hackett's Gully Creek and protection of water quality.

→ **September 2019** - DWER raised queries regarding wastewater and stated that in accordance with the 2010 *Middle Helena Land Use and Water Management Strategy (LUMS),* DWER suggest that all restaurants in the Middle Helena Catchment should be limited to a maximum of 50-80 people per day (including staff). This equates to 1 person per 18 m^2 of restaurant floor area at Chalet Rigi. The DWER Director General advised Fallright in September 2019 that the City may elect to support the DOH's approval for 480 people, providing it can satisfy itself that an appropriate Water Management Plan is in place to protect the catchment area (refer **Appendix D**).

→ **Early October 2019** – an on-site meeting was arranged by the City of Kalamunda and was attended by the City's consultant, Fallright, and Evergreen Consultancy. The meeting concluded that in order to apply best practice management for water quality in the Middle Helena catchment, the irrigation area could be split into more than one area and moved away from the northern site corner to increase distance from Hackett's Gully and avoid granite outcrops. This would require additional geotechnical investigation to confirm that the new areas had a similar geology and absorption capacity.

→ **Mid October 2019** - additional soil permeability testing was completed which confirmed similar geology and soil permeability in alternative on-site irrigation areas.

1.3. Scope of Work

The scope of work comprised the production of this Water and Stormwater Management Plan, including:

- Review and summarise previous technical documentation and correspondence.
- Undertake additional geotechnical investigations and soil permeability testing.

- Identify revised dispersal areas based on updated permeability information.
- Identify and address all potential risks to water quality from the existing land use and proposed reopening of the restaurant, including consideration of:
  - ATU design, water treatment process and technology
  - Geology, hydrogeology and soil permeability field testing
  - Wastewater loadings and effluent management
  - Nutrient budget and effluent disposal field details
  - Management of irrigation and nutrients from landscaped areas
  - Management of stormwater from carparks and roads
  - Baseline water quality conditions in surrounding water courses
  - Potential impacts and mitigation measures if proposed management systems fail

The required scope of work was provided by the City of Kalamunda following the October 2019 site meeting. This Water and Stormwater Management Plan addresses all previous comments raised by the City of Kalamunda, Department of Health, and Department of Water Environment and Regulation and complies with all relevant guidelines, regulations and the July 2019 Department of Heath ATU Approval.

1.4. Objectives

This Water and Stormwater Management Plan has been produced to address potential risks to water quality from the proposed reopening of Chalet Rigi restaurant.

It is designed to satisfy the requirements of the City of Kalamunda for an appropriate Water Management Plan to be put in place to protect the Middle Helena catchment and to provide support for their approval to reopen the existing restaurant.

Through development and implementation of this Water Management Plan, Fallright aim to apply best practice management for water quality and public health and to incorporate water source education and awareness initiatives into future restaurant operations.

1.5. Review of Previous Information

Technical documentation, approvals and correspondence reviewed as part of the current works included:

Technical Documentation

- November 2019, Chem Centre Phosphate Retention Index Testing (**Appendix F**)
- Oct 2019, Structerre, Geotechnical Investigation and Soil Permeability Testing, Chalet Rigi (**Appendix E**)
- Sept 2019, Evergreen Consultancy, Water Quality Monitoring (**Appendix G**)
- May 2019, Evergreen Consultancy, Addendum Water Management Plan, Rev 1
- April 2019, BioMAX, Model C80 Wastewater Treatment System, Technical Maintenance Manual (**Appendix C**)
- April 2019, Galt Geotechnics, Email clarifications to DOH (**Appendix D**)
- March 2019, Galt Geotechnics, Assessment of Areas for Effluent Disposal – Technical Memo (**Appendix D**)
- June 2012, Stass Environmental, Wastewater Treatment Report, Chalet Rigi (**Appendix D**)
- Feb 2012, Stass Environmental, Wastewater Treatment Report, Chalet Rigi

Approvals

- July 2019, DOH, Approval to Construct or Install an Apparatus for the Treatment of Sewage at 415 Mundaring Weir Road, dated 22 July 2019, approval no: 200:18 (**Appendix B**)

- Letter from Deputy Premier Hon Roger Cook MLA, Minister for Health, dated 20 June 2019 (**Appendix B**)
- November 2012, Shire of Kalamunda, Local Government Report – Chalet Rigi, containing November 2012 DOH approval for 350 patrons **(Appendix A**)

Correspondence (**Appendix D**)

- 16 Oct 2019, Email from Director of Development Services, City of Kalamunda
- 24 Sept 2019, Letter from Director General, DWER
- 19 Sept 2019, Letter from Premier of Western Australia, Hon Mark McGowan
- 9 Sept 2019, Letter from Planning Manager, Swan Avon Region, DWER
- 7 Aug 2019, Letter from Executive Director, Environment Health, DOH
- 31 July 2019, Letter from Senior Planning Officer, Swan Region, DBCA
- 12 July 2019, Letter from Development Planner, Water Corporation
- 10 April 2018, Letter from Water Design International regarding capability of BioMAX

Copies of the above documents are presented in **Appendices A - G** for completeness. However, this Water Management Plan is designed to be a standalone consolidated document, summarising all previous information into a single all-encompassing Water Management Plan.

During production of this document, review was also undertaken of the following reference material:

- AS/NZS 1547:2012, On-site Domestic Wastewater Management
- City of Kalamunda (2018) Stormwater Design Guidelines: Subdivisional & Property Development
- City of Kalamunda (undated) Guidelines for Installing Septic Tanks and Leach Drains
- DEP & WRC (2002) Environmental Management Guidelines for Vineyards
- DOH (2001) Code of Practice for Design, Manufacture, Installation and Operation of ATUs
- DOH (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia
- DOW (2019) Water Wise Perth: A Growing City responding to Climate Change. Two Year Action Plan
- DOW (2016) WQPN. 25: Land Use Compatibility Tables for Public Drinking Water Source Areas
- DOW (2016) WQPN 70: Wastewater Treatment and Disposal – Domestic Systems
- DOW (2013) Guidance Note 3: Preparation and Assessment of Water Management Reports
- DOW (2012) WQPN 88: Rural Tourist Accommodation
- DOW (2008) Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions
- DOW (2007) Mundaring Weir Catchment Area Drinking Water Source Protection Plan, No. 69
- DOW (2006) WQPN 79: Rural Restaurants, Cafés and Taverns near Sensitive Water Resources
- DWER (2019) Operational Policy 13: Recreation within Public Drinking Water Source Areas
- DWER and DBCA (2018) Helena River: Swan Canning Catchment Nutrient Report 2018
- Eastern Hills Catchment Management Program (2014) Helena River: Action Plan 2012 – 2022
- Eastern Hills Catchment Management Program (2012) Eastern Hills Catchment Management Plan
- Ecoscape (2011) Mundaring Weir Water Supply Interpretation Precinct Design
- Gerritse, R. (2002) Movement of Nutrients from Onsite Wastewater Systems in Soils
- WA Government (1996) Government Sewerage Policy – Perth Metropolitan Region
- WA Government (1974) Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations
- WAPC (2010) Middle Helena Catchment Area Land Use and Water Management Strategy (LUMS)
- WAPC (2003) Statement of Planning Policy No 2.7. Public Drinking Water Source Policy. Prepared under Section 5AA of the Town Planning and Development Act 1928.

2. SITE SETTING

2.1. Site Location

Chalet Rigi (the site) is located at 415 Mundaring Weir, Piesse Brook, within the Local Government Authority of the City of Kalamunda. The total site area is 7 acres (approx. 26,069 m^2). The central portion of the site contains the existing restaurant building, garages, outhouses, and landscaped gardens, whilst the northern and southern portions of the site comprise bushland (refer **Figure 2**).

The total restaurant area is approximately 1,450 m^2 of which 850 m^2 is the existing restaurant building and 600 m^2 is the proposed outdoor restaurant area. Except for a small walkway to access the external ablutions, the ground cover within the beer garden is natural unsealed ground. Sealed ground surfaces are limited to two existing bitumen driveways connecting the restaurant with Mundaring Weir Road and forming an area of less than 1,000 m^2.

Figure 2 Site Layout and Infrastructure

Chalet Rigi is neighboured to the east by Mundaring Weir Road, and to the north, south and west by neighbouring rural properties and bushland. The neighbouring property to west (81 Aldersyde Rd) belongs to the Chalet Rigi landowner, and the properties are connected via an informal footpath.

Chalet Rigi is located within the Bickley Valley in the Perth Hills, only a short 10-minute drive from Kalamunda town centre. The surrounding Bickley Valley and Carmel wine region has a strong tourism focus and is characterised by wineries, cideries and orchards, surrounded by national parks, state forest, and biking and walking trails.

2.2. Climate

The local area is characterised by a mild Mediterranean climate. Meteorological conditions vary seasonally with rainfall, temperature and wind patterns following a well-defined annual cycle of hot dry summers and mild wet winters. Most of the rainfall occurs in winter between June and August. Between 2014 and 2018, the average annual rainfall in Kalamunda was 1071 mm/year (BOM, 2019).

3. GEOLOGICAL SETTING

3.1. Topography

The Darling Plateau, or Darling Range, rises to an average elevation of 390 m AHD to the east of the Swan Coastal Plain and Perth Metro in a region known as the Perth Hills. Chalet Rigi is located on the Darling Scarp at the interface between the Darling Plateau and the Swan Coastal Plain. Site topography slopes from a high point in the east (191 m AHD) towards the west (185 m AHD) and northern and southern site corners (180 m AHD). The area containing the restaurant building is relatively flat. Topographical contours provided on the Landgate Shared Location Information Platform (SLIP) are presented in **Figure 3**.

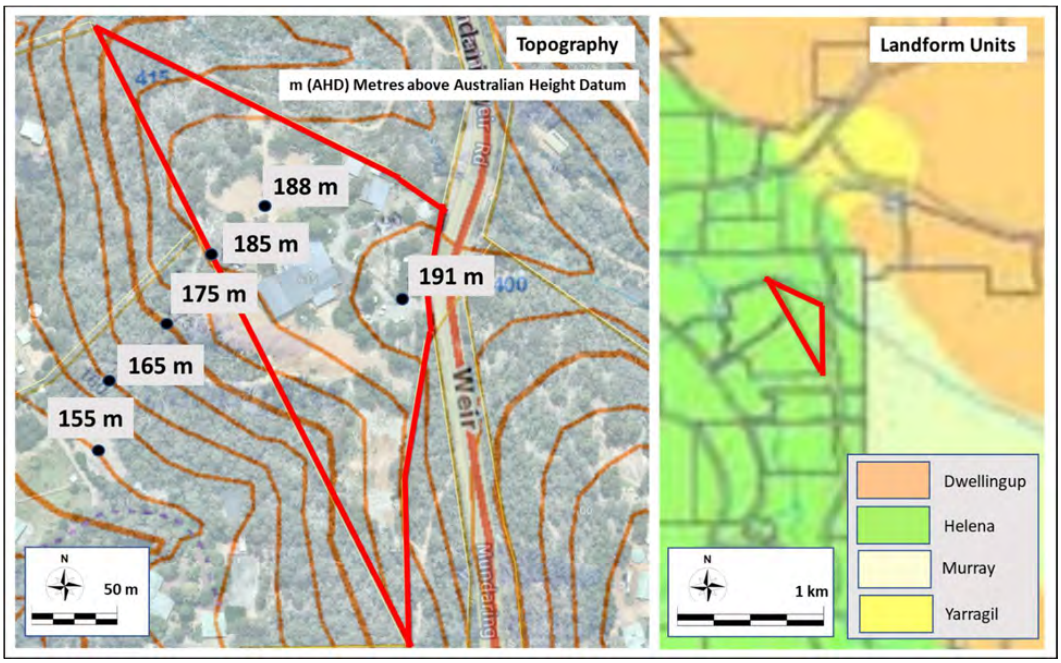

Figure 3 Topography and Landform Unit

3.2. Geology and Landform

3.2.1. Regional

Most of the Darling Plateau overlies ancient granites of the Yilgarn Block. The 1:50,000 Environmental Geology map (Mundaring) identifies an underlying bedrock comprised of fine-coarse grained granite, granodiorite and adamellite. The undulating lateritic Plateau has three landform units: Dwellingup (ridges and upland areas); Yarragil (valleys); and Munbup (ridges and uplands overlaying bedrock) (LUMS, 2010).

The lateritic uplands of the Plateau's surface are dissected by the major valley systems of the Helena River (flowing west)) and its largest tributary, Piesse Brook (flowing north). These make up the Helena landform (major river valley) and the Murray landform (tributary valleys). The Helena landform, characterised by major 'V' shaped river valleys with steep slopes, is dominant in the area surrounding Chalet Rigi (refer **Figure 3** for landform mapping provided by the Mapping and Geospatial Data Unit of the Department of Planning (now DPLH)) (LUMS, 2010). The ridges and uplands are mostly covered by a thin layer of relatively infertile laterite (hard 'cap rock') and gravel. The valleys contain superficial deposits (soils) of varying thickness with localised outcrops of granite and gneisses at surface (LUMS, 2010).

The site is not considered to have a high probability of acid sulphate soils occurrence according to Australian Soil Resource Information System (ASRIS) mapping accessed in October 2019.

3.2.2. Local Conditions

Geotechnical investigations have confirmed the presence of at least 1.5 m of superficial deposits (soils) overlying the granite basement in the central and southern areas of the site. The soils mainly comprise sandy clay loam and gravelly clay loam with localised clayey sand, clayey gravel and sandy gravel.

The granite basement comes to the surface as granite outcrops along the northern and western site boundary (refer **Figure 4**). The granite boulders serve as a unique site feature and as such, consideration has been given to how they will be retained and featured in the Chalet Rigi development, and not compromised by the disposal of wastewater.

The remainder of the site is overlain by superficial deposits and is free from granite at surface. There are some areas of reworked fill, comprising sandy clay loam and clayey sand, which have been used to flatten the ground level along the fire break on the western site boundary.

3.3. Geotechnical Investigations

3.3.1. February 2019, Galt Geotechnics

Geotechnical investigations were undertaken by Galt Geotechnics in February 2019 to assess geology, soil conditions and shallow groundwater presence, and identify areas suitable for effluent dispersal. Works included a site inspection, drilling of boreholes to a maximum depth of 1.5 m, excavation of text pits to 0.9 m and soil sampling. Note: Galt (2019) erroneously reports borehole depth as 0.5 m – this was corrected to 1.5 m in an email from Galt dated 30 April 2019 (refer **Appendix D** for report and coms).

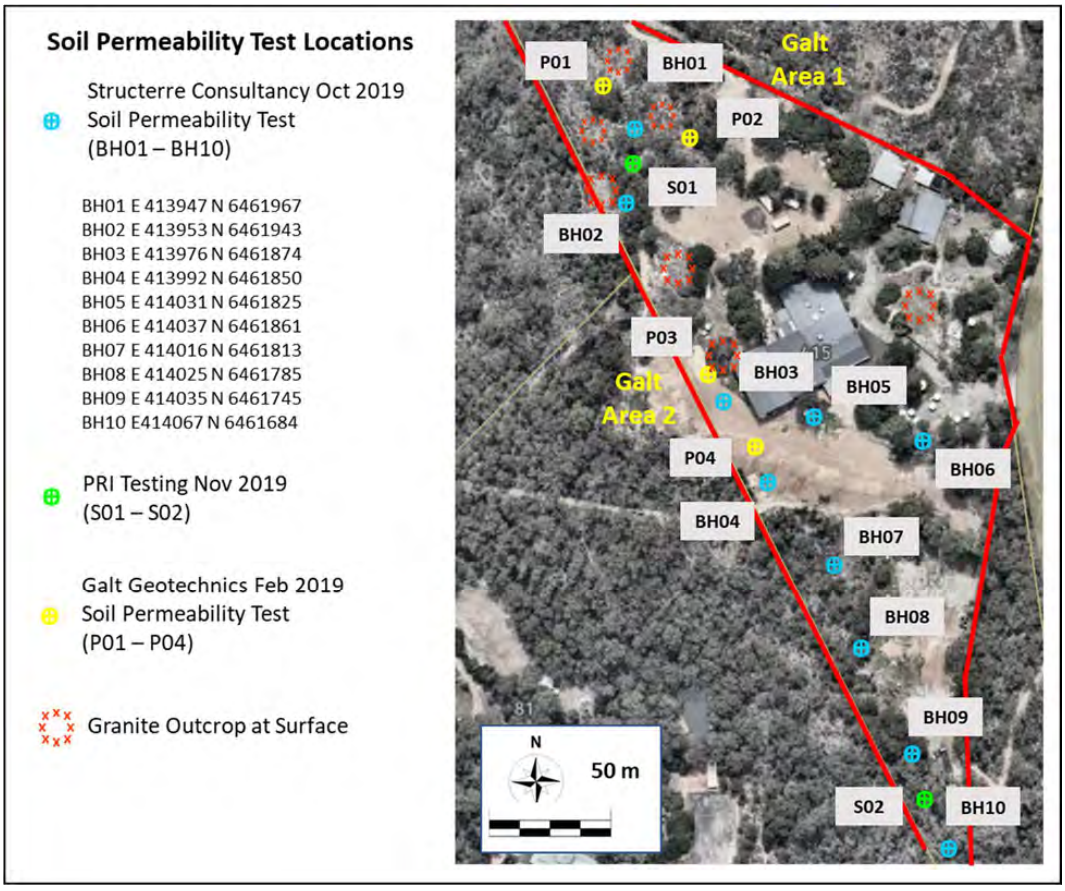

Figure 4 Geotechnical Investigations

Four constant head permeability tests were undertaken to assess soil permeability, or the rate of water flow under laminar flow conditions through porous soil. Testing was undertaken at depths of between 0.45 m – 0.9 m in accordance with AS/NZS 1547:2012 methodology. The soils were pre-saturated to assess conditions during the rainy winter season and tests were completed in two areas: 'Area 1' in the north (P01-P02) and 'Area 2' in the centre (P03-P04). Refer **Figure 4** for testing locations.

The investigation confirmed the presence of superficial deposits of gravelly silt and a sandy clay loam to at least 1.5 m, with fine to medium grained gravel at approximately 20–30 % occurrence in the silt. Shallow groundwater was not encountered, and the holes were reported to be dry. The soil permeability testing indicated a range of hydraulic conductivity (k) values:

- Area 1: 1.06 – 1.09 m per day equating to a Soil Category 4 "Clay Loams" in accordance with AS/NSZ 1547:2012
- Area 2: 0.007 – 0.02 m per day equating to a Soil Category 6 "Medium to Heavy Clays"

Galt concluded that Area 1 was suitable for irrigation in its current state as it has suitable geology and is relatively flat. Galt also noted that Area 2 was due to be levelled with 1 -2 m of fill to create a flat area, and assuming a granular fill material was used, Area 2 would also be suitable for effluent dispersal.

Based on the above, the northern portion of the site was selected as the preferred irrigation location. Note: Area 2 was levelled sometime between April – September 2019 as part of mandatory fire break clearing in order to improve access for fire trucks in the event of an emergency.

3.3.2. October 2019, Structerre

Geotechnical investigations were undertaken by Structerre in October 2019 to assess geology and soil permeability, with the intention of confirming the suitability of alternative dispersal areas away from northern site boundary. The Structerre bore logs and test data is presented in full in **Appendix E**.

Works included a site walkover, drilling of 10 boreholes to a maximum depth of 1.65 m, and completion of 10 constant head permeability tests at depths of between 0.9 – 1.5 m (refer **Table 1**). Testing was undertaken in accordance with AS/NZS 1547:2012 methodology including pre-saturation of unsealed ground. Refer **Figure 4** in **Section 3.3.1** for test locations.

Augering confirmed the presence of sandy clay loam and clayey sands across most of the site to depths of at least 1.65 m. A granular fill of sandy gravel was observed in BH3, BH4, and BH8, comprising the fill material used to level the fire break on the steepest sections of the western site boundary. Groundwater was not encountered, and the soil was reported to be dry to moist.

Location	Test Depth (m)	Geology	Permeability (K_{SAT}) (m/day)	Soil Category (AS 1547:2012)
BH1	1.15	Sandy clay LOAM	0.36	4 – Clay Loams
BH2	0.95	Gravelly clay LOAM	0.30	4 – Clay Loams
BH3	1.00	Clayey GRAVEL (fill)	1.21	4 – Clay Loams
BH4	1.50	Sandy GRAVEL (fill)	1.05	4 – Clay Loams
BH5	1.40	Sandy GRAVEL	1.12	4 – Clay Loams
BH6	1.50	Sandy clay LOAM / weathered granite	0.03	5 – Light Clay
BH7	1.20	Silty SAND	0.15	4 – Clay Loams
BH8	1.30	Silty SAND	0.12	4 – Clay Loams
BH9	1.00	Sandy clay LOAM	0.32	4 – Clay Loams
BH10	1.50	Clayey SAND	0.85	4 – Clay Loams

Table 1 Soil Permeability Tests, October 2019

The testing reported saturated hydraulic conductivity (K_{SAT}) values equating to a Soil Category 4 "Clay Loam" in accordance with AS/NZS 1547:2012 and the previous Galt permeability testing. All locations were confirmed to be suitable for irrigation except for BH6, where the sandy clay loam was up to 2 orders

of magnitude less permeable than other locations. Visual inspection of the soils at BH6 suggested it could be heavily weathered granite, therefore BH6 was excluded as a potential irrigation site.

3.3.3. November 2019, Evergreen Consultancy

Ancient and highly weathered soils with very low levels of natural phosphorus dominate much of Australia, particularly WA, where the laterite gravel soils are some of the most acutely phosphorus deficient in the world. Phosphorous is an essential element for plant growth although phosphorous can impact on waterways. ATU effluent contains phosphorous and so a measure of the soil's ability to retain or leach phosphorous is needed to ensure it is appropriately managed.

Phosphorus Retention Index (PRI) analysis is a direct measure of the soil's ability to either adsorb and retain (otherwise known as "fix") phosphorous, or to leach phosphorous. The phosphorus fixation properties of soil may be described by the following PRI values:

- Negative PRI Desorbing (phosphorous will leach from soils)
- 0 – 2 Weakly adsorbing
- 2 – 20 Moderately adsorbing
- 20 – 100 Strongly adsorbing
- > 100 Very strongly adsorbing

Two soil samples were collected from the proposed irrigation areas at Chalet Rigi and submitted to Chem Centre at Curtin University for PRI analysis. Refer **Figure 4** in **Section 3.3.1** for test locations. The laboratory results are presented in full in **Appendix F** and summarised in **Table 2**.

Sample ID	Sample Depth	Geology	PRI (mL/g)	Stones % > 2 mm	Interpretation
S01	0.0 – 0.25 m	Sandy clay loam	590	7.7	Very strongly adsorbing
S02	0.0 – 0.25 m	Sandy clay loam	66	62.3	Strongly adsorbing

Table 2 Phosphorous Retention Index Testing, October 2019

The results show that the natural sandy and gravelly clay loams at Chalet Rigi range between strongly adsorbing and very strongly adsorbing of phosphorous. The PRI range of 66 – 590 mL/g is consistent with published data which indicates that sandy and clay loam soils in WA have a PRI ranging between 30 - 1,000 (WRC, 1998). As such, the soil has a natural ability to fix phosphorous without the need for added soil improvements. Soils with a strongly adsorbing PRI will reduce nutrient export from the irrigation area and help to prevent phosphorous from leaching into stormwater or surface water bodies.

3.4. Vegetation

3.4.1. Regional

Within the surrounding State Forest and National Parks, the landform units and soil types typically control vegetation characteristics in combination with slope, aspect, rainfall and land use. The predominant vegetation type in the Helena landform is open wandoo woodland (*Eucalyptus wandoo*) on the valley slopes and floors although vegetation cover is highly variable and often contains jarrah-marri forest (*E. marginata* and *Corymbia calophylla*), yarri (*E. patens*), bullich (*E. megacarpa*) and ghost gum (*E. laeliae*).

Outside of State forest and National Park, the land has mostly been cleared for horticultural and other agricultural purposes. Limited remnant vegetation remains in areas of private ownership. Clearing has caused the invasion of weeds along the banks of the Helena River.

3.4.2. Local

Natural bushland is present in the northern and southern portions of the site, whilst the centre of the site containing the restaurant building has some landscaped gardens established by the previous owner.

The predominant vegetation type on-site is jarrah-marri forest (*E. marginata* and *C. calophylla*) with some wandoo woodland in the northern corner of the site (*E. wandoo*). Several grass trees are also present (*Xanthorrhoea*) in the north of the site and native wildflowers were observed in October 2019. The natural bushland in the northern and southern portion of the site is in good condition and along with the adjacent granite boulders, has a good aesthetic value.

A wide variety of common residential plant species were observed in the landscaped gardens including native frangipani, Japanese honeysuckle, bougainvillea, roses, geraniums, irises and ivy. Areas of natural bushland contained several non-native species, likely to be garden escapees from the landscaped gardens or surrounding residential gardens.

4. REGIONAL HYDROLOGY AND DRAINAGE

4.1. Regional Catchment

Chalet Rigi is in the Helena River catchment, which flows from the east across the Darling Ranges and through the Swan Coastal Plan to join the Swan River in Guildford. The Helena originates in the Shires of York, Beverley and Northam, and flows west through the Helena Valley before discharging into the upper Swan. Its major tributary, Piesse Brook, originates from the highlands in the southeast and travels northwest before its confluence with the Helena River south of Darlington.

The catchment is treated as three separate sub-catchments; the Upper, Middle and Lower, due to the presence of major water supply dams and widely varying land use. Land use in the Upper and Middle catchments is predominantly natural bushland, State forest and National Parks, with several farms and horticultural plantations. Conversely, land use in the Lower Helena is mostly residential with light industrial. A DWER monitoring station is positioned in the Lower Helena before the Swan confluence.

Chalet Rigi is in the Middle Helena catchment, where uplands and river valleys are the main geomorphic feature of the undisturbed topography. The catchment is dissected by the major valley systems of the Helena (flowing westwards) and Piesse Brook (flowing northwards). Land use in the Middle and Lower Helena is shown in **Figure 5,** as adopted from the DWER & DBCA (2018) *Helena River: Swan Canning Catchment Nutrient Report*.

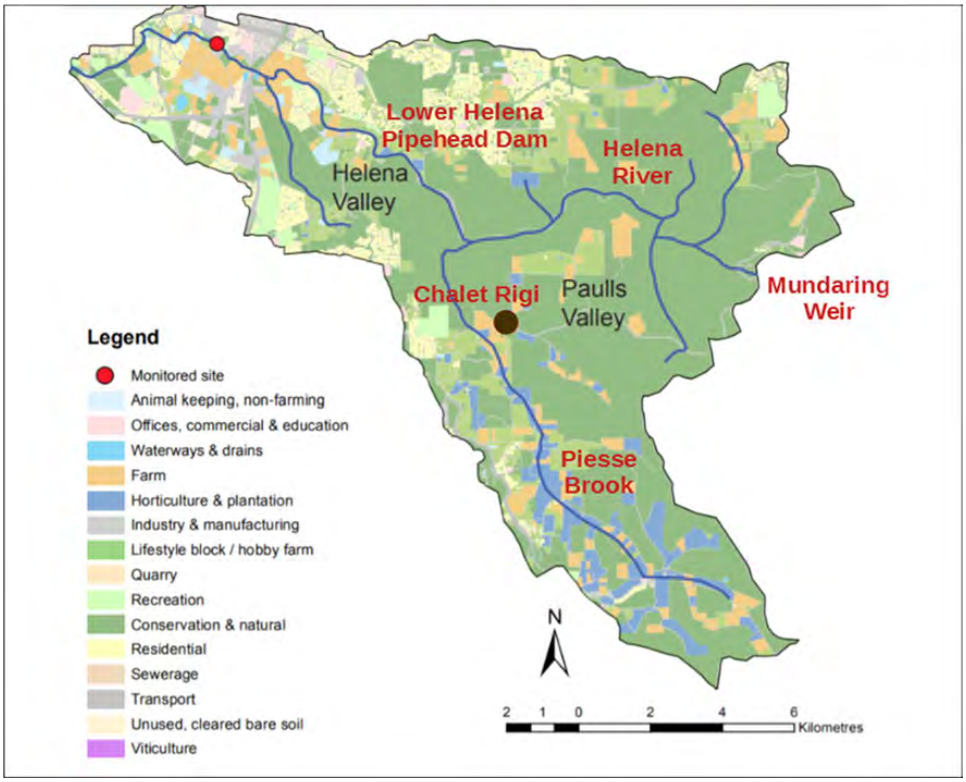

Figure 5 Hydrology: Middle and Lower Helena Catchment

The Helena is an ephemeral river system and flows only during the wetter months between June and January. In summer, the river channel is reduced to a series of intermittent pools and exposed dry riverbed. The average annual flow between 2012 and 2015 was 5.1 gigalitres (no data collected after 2015) (DWER & DBCA, 2018).

The Helena contributes less than 1% to the long-term average flow of the Swan due to major upstream extraction activity (LUMS, 2010). The river's flow regime has been significantly altered to capture water for public use, including the construction of several private dams and two major drinking water supply dams:

- **Mundaring Weir** (aka Helena River Reservoir or Lake C.Y. O'Connor Lake) is located between the Upper and Middle catchments.
- **Lower Helena Pumpback Dam** (aka Lower Helena Diversion Dam, Pipehead Dam or Lower Dam) is located between the Middle and Lower catchments.

The Helena River has significant ecological value and provides habitat for several plant and animal species. During most winters, the river experiences flushing flows that are vital for fish breeding and migration, suppressing weeds, and scouring sediment from riffles and pools.

4.2. Flood Risk Mapping

Review of the DWER online WA Floodplain Mapping tool indicates that the site is not located within an area considered to be at risk of flooding.

4.3. Groundwater

Chalet Rigi is in the Middle Helena Catchment, where hydrology is dominated by surface water flows. Groundwater tends to make a relatively minor contribution to flow in the Helena River system (DWER & DBCA, 2018). Shallow groundwater was not encountered during previous geotechnical investigation. It is anticipated to be present at significantly greater depths owing to the site's raised elevation (approx. 190 m AHD), although perched water may be present during the wetter seasons due to granite and potential clayey soils at depth.

4.4. Public Drinking Water Source Area (PDWSA)

The Middle Helena catchment has been allocated as a water supply area known as the *Middle Helena Public Drinking Water Source Area (PDWSA)*. Mundaring Weir is a large manmade waterbody (6.76 km^2 area) located approximately 7 km east of Chalet Rigi. It was created over 115 years ago by damming the Upper Helena and provides potable water to over 100,000 people in Perth and the Eastern Goldfields. Most of the treated water is pumped hundreds of kilometres east via the "Golden Pipeline", providing the sole water resource for the Goldfields and Agricultural Water Supply (GAWS) scheme.

All surface water drainage from the Middle Helena is captured in the smaller Lower Helena Pumpback Dam, located 11.8 km downstream of Mundaring Weir. The Lower Dam was constructed in 1971 and provides a water supply resource for the Mundaring Weir via a pumpback pipeline. The dam can supply between 25-40% of the Weir's annual inflow (LUMS, 2010).

The Middle Helena is allocated as a **Priority 2 (P2) Water Source Protection Area** under the *Country Areas Water Supply Act* of 1947 (otherwise known as a *Rural Water Protection Zone*). P2 areas are defined "*to ensure that there is no increased risk of pollution to the water source*". As such, land-use in P2 areas needs to be carefully managed to protect the water source.

The demand for protecting drinking water and ecological values of both the Helena and Swan Rivers prompted the development of the *Middle Helena Land Use and Water Management Strategy (LUMS)* by the DOW in 2010. The LUMS set the precedent with regards to water management in the catchment, including the 2019 DWER guidance document *Operational Policy 13 Recreation within Public Drinking Water Source Areas on Crown Land*, which offers recommendations for recreation in the PDWSA.

Over the decades before and during the LUMS publication, there was a notable decline in water quality in Mundaring Weir. In response, the Mundaring Water Treatment Plant (WTP) was opened in 2014 to sustain increasing water demands and meet Australian drinking water standards. The WTP comprises a $300M

public-private partnership and includes facilities for pre-treatment, filtration, chlorination, stabilisation and fluoridation of up to 240,000 m^3 of water per day. All water intended for human consumption within the PDWSA, including that within Hackett's Gully, Piesse Brook and the Lower Helena Dam, is treated at the Mundaring WTP to drinking water standard before distribution to potable supply. It is noted that the 2010 LUMS does not consider the impacts on water quality resulting from treatment at Mundaring WTP.

4.5. Recreational Land Use in PDWSA

The Middle Helena catchment is facing increasing pressure from urban spread, agricultural diversification and demands for recreation opportunities close to Perth in the tourism precincts of Kalamunda and Mundaring. Careful management is needed to encourage land use and development that protect water quality and maintain its suitability as a drinking water source.

The WAPC's *State Planning Policy 2.7* (2003) states that "*Land uses and developments in all priority source protection areas that have the potential to impact detrimentally on the quality and quantity of public drinking water supplies should not be permitted unless it can be demonstrated that such impacts can be satisfactorily managed.*"

The LUMS confirms that restaurants, cafes and exhibition centres are "**compatible**" with Priority 2 areas providing they adhere to specific conditions; mainly that the on-site wastewater disposal "*be consistent with Government Sewerage Policy: Perth Metropolitan Region, and that each development be assessed on an individual basis to consider site characteristics and management*". This recognises the desire of the community and the Kalamunda and Mundaring LGAs to promote recreational tourism in the catchment.

The LUMS identifies potential risks posed by a restaurant in the Middle Helena catchment as nutrients and pathogens from wastewater disposal, and contaminated run-off (hydrocarbons and sediment) from car parks. However, these risks are deemed manageable subject to adoption of best management practice, including use of grease traps and appropriate stormwater management (LUMS, 2010).

The LUMS specifically identifies the desire to establish more eateries in the catchment, noting "*A number of wineries are already established in the catchment and there is a desire for these establishments to provide food in addition to wine tastings. Other facilities that may be considered include cafés, tea rooms, restaurants, art galleries and museums".*

This is echoed in June 2019 correspondence from the Deputy Premier and Minister for Health, Hon Roger Cook MLA, who in granting the ATU approval for Chalet Rigi, stated: *"Given the circumstances and interest generated by the development to boost local tourism and create new jobs in the area, the development [Chalet Rigi] is beneficial to the local community and is worthy of my support."*

However, in their latest guidance, *Operational Policy 13*, DWER offer no specific mention of restaurants. The policy covers a wide range of "recreational activities" e.g. bushwalking, cycling, coach tours, camping, picnicking. Yet the only mention of built infrastructure is "recreational facilities" which include "*built installation, building or form that provides a particular service to enable a recreation activity, such as camp sites, car parks, food and drink services, toilets, tracks or trails.*" Policy 13 does not mention restaurants, wineries, museums, galleries or other built infrastructure that are the recreational activity.

As an advisory body, the default position is that DWER do not recommend new or expanded built facilities in the Middle Helena Catchment. However, the DWER are an advisory agency and not a regulatory body (such as DOH), and the City of Kalamunda may elect to support the DOH's approval for 480 people, **providing it can satisfy itself that an appropriate Water Management Plan is in place to protect the catchment**. This was confirmed in correspondence from the DWER's Director General on 24 September 2019, which states "*Should this proposal be supported by the City, then a water management plan would need to be developed to fully address the increased risks, and the development would be subject to conditions to manage these*" (refer **Appendix D**).

4.6. Local Surface Water Bodies

The nearest surface water course to Chalet Rigi is Hackett's Gully Creek, a small tributary of Piesse Brook. It originates at the top of Mount Gungin in the Greenmount State Forest, almost 4 km southeast of Chalet Rigi. The creek flows in a north-westerly direction, passing within 23 m of the northern site corner at its closest point (refer **Figure 6**). It flows into Piesse Brook approximately 250 m downstream of Chalet Rigi.

Piesse Brook passes within 220 m west of the site boundary at its closest point. It flows via Rocky Pool, through State forest, Kalamunda National Park, and several private properties, before joining the Helena River almost 3 km northwest of Chalet Rigi. As with the Helena River, both Hackett's Gully and Piesse Brook are ephemeral – water flow is seasonal and entirely absent in the summer months.

Figure 6 Local Surface Waters

Piesse Brook's confluence with the Helena River is 800 m upstream of the Lower Helena Dam. The long-term average flow from Piesse Brook, including Hackett's Gully, is 8,300 megalitres/year, or 61% of the Helena River flow downstream of Mundaring Weir (13,500 ML/year at Lower Dam) (LUMS, 2010).

Water quality within Piesse Brook and Hackett's Gully Creek is characterised by elevated nutrients (nitrogen) and microbial pathogens/faecal contamination via *Escherichia coli or E. coli*.

- **Nitrogen** enters water sources through leaching of fertilisers, septic tanks and faeces from grazing cattle. Nitrate and nitrite (ions of nitrogen) can increase cause algal blooms in water.
- **Microbial pathogens** such as *E. coli* enter water sources through direct contact with people and domestic animals (e.g. dogs/cattle), typically via direct transfer of faecal material. Most types of *E. coli* are harmless – their presence only suggests that disease causing organisms may be present.

Water sampling by the DOW between 2002 – 2009 reported *E. coli* in 100% of samples from Piesse Brook, whilst 100% of samples collected between 20007 – 2009 at Lower Dam contained *E. coli* (LUMS, 2010). *E. coli* is a facultatively anaerobic bacterium that generally originates in the intestines of warm-blooded animals. *E. coli* counts in the Lower Dam and Piesse Brook are generally higher than in other Hills drinking water catchments due to land use activities such as cattle grazing (LUMS, 2010).

4.7. Surface Water Monitoring

In September 2019, Evergreen collected surface water samples from three locations along Hackett's Gulley Creek and one location on Piesse Brook to assess local surface water quality. Sample locations were chosen to be reflective of baseline conditions prior to the ATU being installed at Chalet Rigi. The location of the samples is shown on **Figure 6** in **Section 4.5** and on **Plates 1 – 8** below.

- **HG Source** – Hackett's Gully upstream of commercial nursery (source is further east on Mt Gungin)
- **HG Upstream –** immediately upstream of Chalet Rigi at Mundaring Weir Road bridge
- **HG Downstream –** immediately downstream of Chalet Rigi
- **Piesse Brook –** downstream of the Hackett's Gully confluence (same location as 2011 sampling)

Plate 1 HG Source

Plate 2 Commercial nursery at HG Source

Plate 3 HG Upstream

Plate 4 HG Upstream

Plate 5 HG Downstream

Plate 6 HG Downstream

Plate 7 Piesse Brook

Plate 8 Piesse Brook

Samples were collected in laboratory supplied bottles and analysed for water quality parameters at NATA accredited Analytical Reference Laboratory (ARL). Analytes was selected to characterise baseline conditions in local surface waters prior to ATU installation, including parameters stipulated in the 2019 DOH ATU approval and other "best practice" quality parameters. The full suite of analytes is presented in **Table 3** alongside the laboratory detection limit.

Water Quality Parameter	Rationale	Detection Limit
Biological Oxygen Demand (BOD)	2019 DOH ATU approval	< 20 mg/L
pH	2019 DOH ATU approval	-
Faecal Coliforms (*E. coli)*	2019 DOH ATU approval	< 10 cfu/100ml
Residual Free Chlorine (RFC)	2019 DOH ATU approval	< 0.5 mg/L
Total Suspended Solids (TSS)	2019 DOH ATU approval	< 30 mg/L
Ammonia - N	Best practice	<0.2 mg/L
Conductivity	Best practice	<0.01 mS/cm
Total Dissolved Solids (TDS)	Best practice	< 5 mg/L
Total Kjeldahl Nitrogen (TKN)	Best practice	<0.2 mg/L
Total Nitrogen (TN)	Best practice	<0.2 mg/L
Nitrate N	Best practice	<0.01 mg/L
Nitrite	Best practice	<0.01 mg/L
Total Phosphorous (TP)	Best practice	<0.01 mg/L

Table 3 Surface Water Quality Analysis

The results of the September 2019 water quality sampling are presented in **Table 4** compared against the required water quality criteria stipulated by the 2019 DOH approval for the Chalet Rigi ATU.

Parameter	Water Quality Recommended by DOH	HG Source	HG Upstream	HG Downstream	Piesse Brook
BOD	< 20 mg/L	<5	<5	<5	<5
E. coli	< 10 cfu/100ml	**68**	**13**	**21**	**160**
pH	6.5 – 8.5	**6.4**	6.6	6.6	7.1
RFC	< 0.5 – 2.0 mg/L	0.02	0.01	0.03	0.01
TSS	< 30 mg/L	17	<5	9	15
Ammonia as N	- mg/L	<0.02	0.03	0.03	<0.02
Conductivity	- mS/cm	0.58	0.50	0.52	0.40
TDS	- mg/L	280	270	250	240
TKN	- mg/L	0.4	2.7	<0.2	<0.2
TN	- mg/L	1.5	3.1	0.6	1.2

Parameter	Water Quality Recommended by DOH	HG Source	HG Upstream	HG Downstream	Piesse Brook
Nitrate	- mg/L	1.1	0.4	0.4	1.2
Nitrite	- mg/L	<0.01	<0.01	<0.01	<0.01
TP	- mg/L	0.09	0.08	0.06	0.08

Table 4 Surface Water Quality Monitoring, September 2019

As anticipated, all samples contained elevated concentrations of faecal coliforms as *E. coli*. Concentrations were highest in Piesse Brook, at up to 16 times greater than DOH criteria for ATU effluent. In Hackett's Gully, *E. coli* concentrations were highest adjacent the commercial nursery (HG Source). The presence of *E. coli* confirms that faecal matter is likely to be present in local surface waters, although the source is unknown, and that disease-causing organisms may be present.

Results were also compared against water quality standards achieved by the BioMAX C80 ATU in controlled DOW testing (**Table 5**). These standards are considered representative of future effluent quality at Chalet Rigi. The results are also displayed as a % difference between surface water quality and BioMAX C80 effluent.

Parameter	BioMAX Effluent	HG Source		HG Upstream		HG Downstream		Piesse Brook	
BOD	< 20 mg/L	<5		<5		<5		<5	
E. coli	< 10 cfu/100ml	**68**	**580%**	**13**	**30%**	**21**	**110%**	**160**	**1500%**
pH	6.5 – 8.5	**6.4**	**1.5%**	6.6		6.6		7.1	
RFC	< 0.5 mg/L	0.02		0.01		0.03		0.01	
TSS	< 30 mg/L	17		<5		9		15	
TN	<10 mg/L	1.5		3.1		0.6		1.2	
TP	<2 mg/L	0.09		0.08		0.06		0.08	

Table 5 Surface Water Quality compared with BioMAX C80 Effluent

The results demonstrate that water in Piesse Brook contains faecal coliforms at a concentration of over 1500% greater than those in effluent emitted by BioMAX systems. Similarly, Hackett's Gully contains faecal coliforms at concentrations ranging between 30% and 580% greater than BioMAX effluent.

The September 2019 results were also compared against water quality sampling completed by Stass Environmental at Piesse Brook in 2011, as presented in **Table 6**. No previous sampling was undertaken at Hackett's Gully and only a limited suite of parameters was analysed in 2011.

Parameter / Units	Units	Piesse Brook 5/9/11	Piesse Brook 3/10/11	Piesse Brook 18/10/11	Piesse Brook 3/9/19
BOD	mg/L	-	-	-	<5
E. coli	cfu/100 mL	**-**	**-**	**-**	**160**
pH	-	6.9	7.5	7.1	7.1
RFC	mg/L	-	-	-	0.01
TSS	mg/L	-	-	-	15
Ammonia as N	mg/L	<0.2	0.03	0.015	<0.02
Conductivity	mS/cm	0.49	0.62	0.57	0.40
TDS	mg/L	280	310	320	240
TKN	mg/L	0.5	0.8	0.65	<0.2
TN	mg/L	2.2	8.0	5.7	1.2
TP	mg/L	0.04	-	0.03	0.08

Table 6 Comparison of 2011 and 2019 Piesse Brook Water Quality Sampling

The results indicate a similar water quality in 2011 and 2019, with no significant changes in nutrient levels, pH or conductivity. The analytical laboratory documentation for the 2019 sampling is presented in **Appendix G**.

Fallright have committed to undertake post-development surface water monitoring for a minimum of 5 years following reopening of the restaurant such that ongoing water quality can be monitored. The monitoring will be undertaken annually in September 2019 (post-winter conditions) at the above four locations, with samples tested for the analytes specified in **Table 3**.

5. WASTEWATER TREATMENT

5.1. Introduction

All wastewater generated on-site, including grey water from the kitchen and hand washing facilities and black water from the ablutions, will be captured and treated using a closed BioMAX C80 ATU wastewater treatment system. The ATU will treat wastewater to remove contaminants and sterilize it before discharging it on-site through a subsurface drip irrigation system. BioMAX systems are designed to comply with all DOH specifications for ATU systems as presented in AS/NZS 1547:2012 and the 2001 DOH *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units*.

The BioMAX system will be supplied and installed by BioMAX Pty Ltd. BioMAX is a Western Australian business that has been an industry leader in provision of wastewater treatment since the technology was originally developed in 1984. In 1989, the company was formed to make this environmentally sustainable technology widely available throughout WA. After rigorous testing of its prototype at the WA Water Authority sewerage treatment plant in Spearwood, the WA DOH issued BioMAX with the first operating license in WA, and they have continued to specialise in wastewater disposal systems ever since.

The manufacturer's operation and maintenance guidelines, including the designer's loading, system capacity, wastewater producing fixtures, and mitigation/control measures, are presented in **Appendix C.**

5.2. System Design

The BioMAX C80 ATU system comprises of 8 x 2.5 m diameter concrete tanks that contain the anaerobic and aerobic chambers (or bioreactors) the clarification and disinfection chambers and the pump-out units. There are 5 main treatment chambers containing the following:

1. **Anaerobic Treatment Chamber** (20,640 L) – Tanks 1, 2 and 3.
2. **Aerobic Treatment Chamber** (20,160 L) – Tanks 4, 5 and 6, a Busch air blower (model SB0310D2) designed to pump 4000 L / min of air at 120 kPA absolute, and aeration diffusers.
3. **Clarification Chamber** (4.23 m^2 surface area) – Tank 7 comprising a central conical hopper (55° slope) and an automatic sludge/skimmer return mechanism.
4. **Disinfection Chamber** (3,800 L) – Tank 8 and a standard BioMAX twin turret gravity flow chlorinator designed for 200 g trichloroisocyanuric acid tablets (industrial disinfectant).
5. **Pump-Out Chamber** – also contained within Tank 8 and containing a Grundfos AP stainless steel three phase automatic submersible pump (model 1250.11.3) designed to pump 3.5 L / sec, and a float control switch.

Treated water from BioMAX systems, also known as "effluent", is DOH approved for on-site dispersal through a subsurface drip irrigation system within a suitable sized irrigation area dependent on surface geology (refer **Section 6**).

5.3. Treatment Technology

The BioMAX C80 five stage treatment process is described below and summarised in **Figure 7**.

1. Anaerobic Chamber (or Primary Chamber)

Untreated wastewater flows into the Anaerobic Chamber (Tanks 1 – 3), where approximately 30-50% of the solids settle out on the bottom and are converted into sludge by naturally occurring bacteria. This is called anaerobic digestion - a common wastewater management process by which microorganisms break down biodegradable material in the absence of oxygen. The chamber has a water depth of 2 metres and

is adequately sized to enable the microorganisms to maintain enough mass without additional products. Fats and grease form a 'scum layer' on the water surface. This layer is a normal occurrence and helps to keep odours inside the tank. Any floating material remains in the chamber to undergo further digestion.

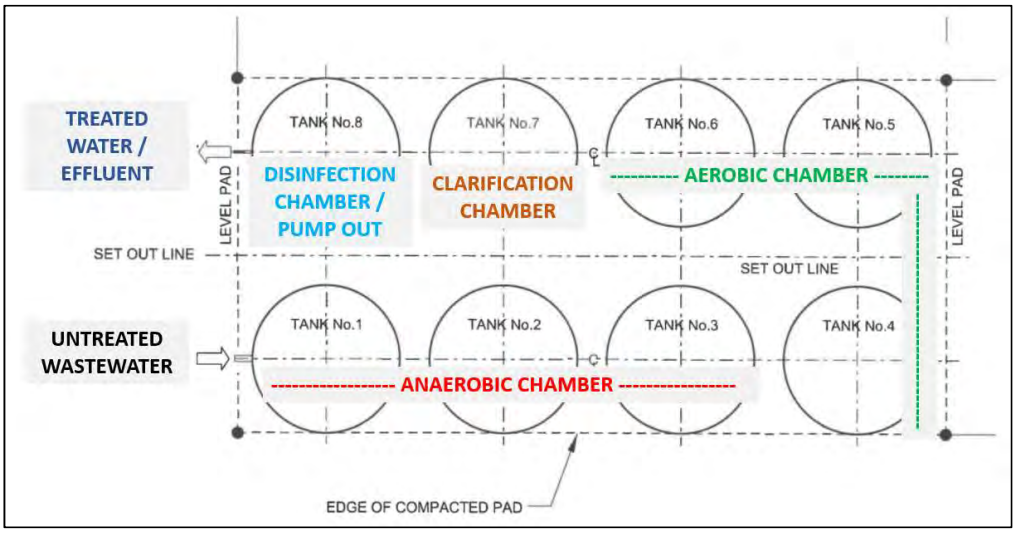

Figure 7 BioMAX Treatment Technology and System Design

2. Aerobic Chamber (or Aeration Chamber)

After primary treatment, wastewater flows into the Aerobic Chamber (Tanks 4 – 6), where air is pumped through it. Air is pumped by an air blower and via aeration diffusers, to maintain oxygenated (aerobic) conditions. The air flow causes the oxygenated liquid to move through the chamber and pass through packs of submerged organic media, containing a biological film of aerobic microorganisms. The aerobic microorganisms digest the colloidal and dissolved solids and convert them to carbon dioxide and a biological sludge (known as "floc"). The aeration diffusers are positioned below the submerged organic media packs and deliver more than the required 2.4 kg of oxygen per kg of BOD per day.

3. Clarification Chamber (or Settling Chamber)

The aerated wastewater then flows into a hopper bottomed Clarification Chamber, where the biological sludge is allowed to settle out under quiescent conditions. Any settled sludge or floating material is returned to the Anaerobic Chamber via an automatic sludge/skimmer return mechanism to undergo further digestion. The treated liquid is drawn off from just below surface level before entering the Disinfection Chamber.

4. Disinfection Chamber (Chlorine Contact)

The water enters the Disinfection Chamber and passes through an automatic gravity chlorinator which purifies the water using an industrial disinfectant (trichloroisocyanuric acid). The liquid remains in the Disinfection Chamber and in contact with the disinfectant for a minimum of 30 minutes to ensure total sterilization (bacterial die-off) and prevent algae growth following discharge.

5. Pump-out Chamber

Following disinfection, the treated effluent flows into the Pump-out Chamber where a submersible pump discharges effluent from the system. The system reticulates as demand dictates. The automatic submersible pump is controlled by a float switch which is designed to operate and shut down as the level of effluent rises and falls in the chamber.

A simplified schematic of the treatment process is presented in **Figure 8**.

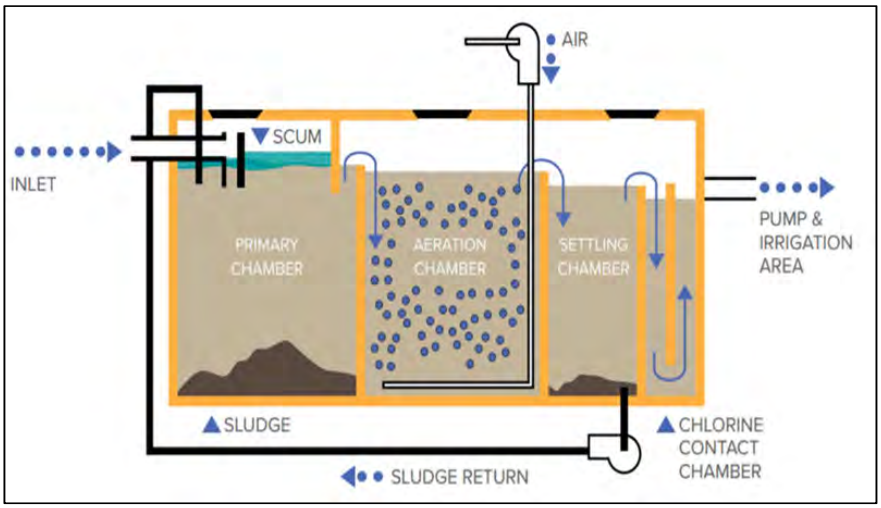

Figure 8 Simplified Schematic of BioMAX Treatment Technology

5.4. Design Loading and Effluent Standards

The BioMAX C80 ATU can process up to 14,400 L of water per day. Based on WA legislation contained within the 1974 *Health* (*Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations* s29(1) "restaurants in frequent use" must allow for use of 30 L of water per person. Therefore, the BioMAX C80 is capable of processing wastewater for 480 people per day including staff. This is reflected in the 2019 DOH ATU approval for 480 people per day including staff.

Treated effluent from BioMAX systems exceeds all water quality standards for irrigation, as proven by controlled testing undertaken by the DOH, including biochemical oxygen demand, faecal coliform organisms, residual free chlorine, pH, total nitrogen and phosphorous and suspended solids. The BioMAX system's design loading and treated effluent standards are presented in **Table 7** (refer **Appendix C**).

Parameter	Measured Value
Design Loading	
Total flow in 24 hours	14,400 litres (L) / day
Maximum BOD in 24 hours	4,800 g
Maximum flow in 30 minutes	3,600 L
Maximum flow in 2 hours	7,200 L
Earthworks Footprint	12 m x 6 m
Treated Effluent Standards	
Biochemical Oxygen Demand (BOD)	< 20 mg/L
Total Suspended Solids (TSS)	< 30 mg/L
Faecal Coliforms (E. coli)	< 10 cfu/100 ml
Residual Free Chlorine (RFC)	< 0.5 mg/L
pH	6.5 – 8.5 (neutral)
Total Phosphorous (TP)	< 2 mg/L
Total Nitrogen	< 10 mg/L

Table 7 BioMAX C80 ATU Plant Specification

5.5. Construction and Installation

The ATU will be installed in the north of the site adjacent the bitumen driveway (refer **Figure 9**).

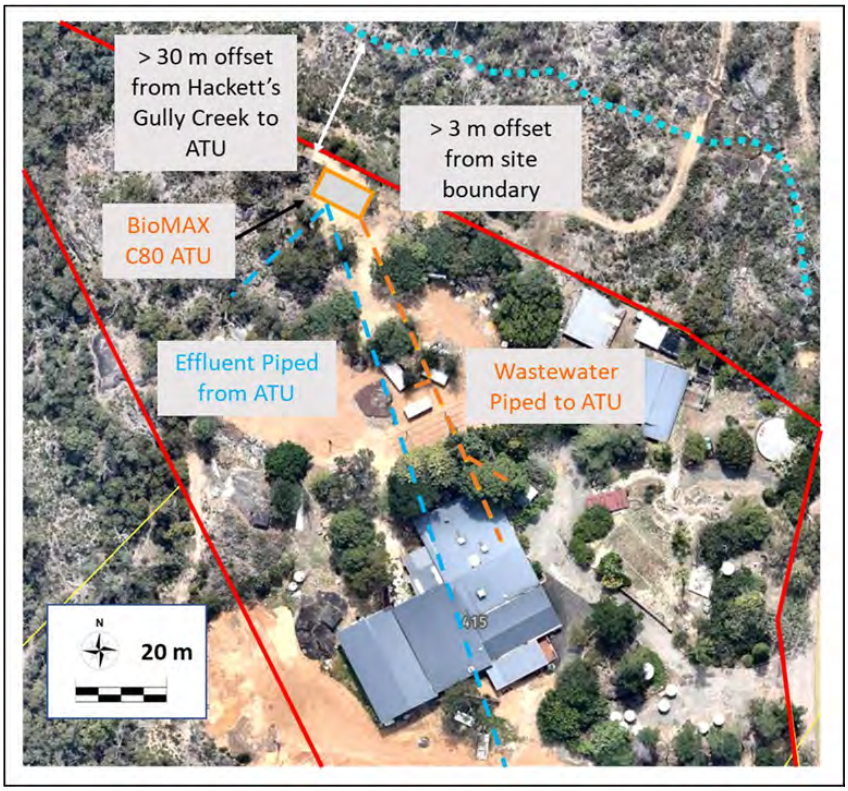

Figure 9 Proposed Location of ATU

The location was selected predominantly to allow ease of vehicular access for maintenance, monitoring, pump-outs and in the event of a system failure or emergency. It is also located within an area not regularly trafficked by the public and away from the restaurant building, main car park and access routes. The ATU's location will give adequate separation from all buildings and site infrastructure, both existing and future, to comply with setbacks and clearance distances specified in bylaws and regulations.

The ATU will be installed onto a flat concrete pad with a footprint of 6m x 12m. Geotechnical investigations have confirmed that the site is underlain by a sandy clay loam which is suitably stable to support the installation of the ATU as per the manufacturer's instructions. A schematic cross section provided by BioMAX is presented in **Figure 10** and a typical BioMAX installation is shown in **Figure 11.**

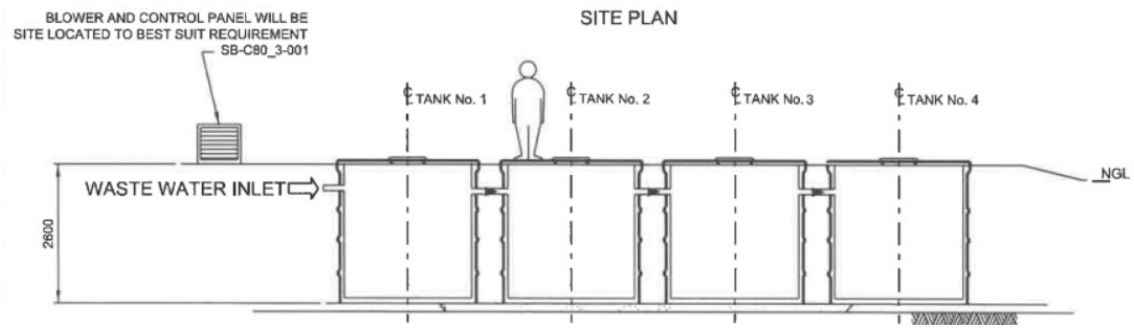

Figure 10 Schematic Section of BioMAX C80 ATU installation

Figure 11 Typical BioMAX C80 Installation

The ATU will be installed by certified representatives of the licensed system manufacturer. To meet performance objectives for the construction and installation of ATUs as specified in AS/NZS 1547:2012, the system will:

- Comprise materials, pipes, bends junctions, fittings and fixtures that are free from defects.
- Be assembled or constructed so that the joints and junctions are watertight.
- Be authorised and installed in accordance with the AS 3500 National Plumbing and Drainage Code and in a manner that preserves the integrity of the system.
- Have a serviceable life of at least 15 years.

Mechanical and electrical components are exempt from the 15-year minimum life requirement providing all such components are readily accessible for maintenance or replacement. The manufacturer must nominate the anticipated life of any element of the system that has a serviceable life of less than 15 years.

In November 2019, a site visit was held with Evergreen and a representative of BioMAX Pty Ltd who will install the system at Chalet Rigi. The BioMAX representative confirmed that the BioMAX C80 ATU can be successfully installed on site as proposed.

In accordance with the 2019 DOH ATU approval for Chalet Rigi, as-constructed plans and written certification that the ATU has been installed in accordance with the Code of Practice for the Design, Manufacture, Installation and Operation of ATUs are to be submitted to the City of Kalamunda's Environmental Health Officer (EHO) after installation. The system must then be inspected and approved by the City of Kalamunda's EHO before it can be used.

The person who completes the construction or installation of the ATU system shall notify the City of Kalamunda's EHO to arrange an inspection of the as-constructed system and obtain a permit for its use. All works will be left open (i.e. not covered with soil) and available for an appropriate visual inspection by the EHO. It is an offence under section 107(4) of the Health Act, 1911 to use ATU apparatus before it has been inspected and a permit to use issued.

5.6. Maintenance and Monitoring

Whilst the operation and maintenance requirements of BioMAX systems are not onerous, all ATUs are required by law to be regularly maintained by an approved service contractor to ensure optimum performance and efficiency and reduce operating risks. The objective of maintaining, and monitoring an on-site ATU system is to ensure that the ATU:

- Protects and enhances public health

- Achieves environmental management objectives for land, and water resources
- Is checked regularly that it is operating as intended

To minimise any public health and environmental risks when operating ATUs, they must be maintained so that the discharge criteria for the reclaimed effluent are always satisfied.

In accordance with the 2019 DOH ATU approval for Chalet Rigi, a signed maintenance agreement by an authorised ATU service person (BioMAX Pty Ltd representative) and the property owner (Fallright) is to be submitted to the City of Kalamunda's Environmental Health Officer before a Permit to Use can be issued.

This agreement is presented in **Appendix H** and will also be submitted to the City of Kalamunda separately. It ensures that satisfactory arrangements are in place for maintenance of the ATU by an authorised person in accordance with manufacturer requirements. All maintenance shall be certified by the authorised person and no person shall carry out maintenance on the ATU unless authorised to do so.

Maintenance of the ATU will be carried out at intervals of not more than 3 months between each service. The 3 monthly maintenance schedules will include a comprehensive set of tests and checks, including:

- Sludge build-up
- Turbidity
- Chlorination equipment and free chlorine residual value, replenish chlorine tablets
- Clean air blower and filter pads - air supply to aeration tank, flow distribution and slime growth on filter media
- Noise levels from electric motors, pumps, and aerator
- Check alarm systems for air supply, water level and chlorine tablet supply
- Clean effluent filter (cartridge in effluent pipeline)
- Drip irrigation lines and spray jets
- Inspect dispersal area including vegetation condition and evidence of surface water

In addition, the air blowers should be serviced annually and the aerobic chambers de-sludged as required (anticipated to be after 5 – 7 years of operation).

Damaged, malfunctioning equipment will be repaired or replaced as soon as practicable without impacting the continued operation of the ATU.

A maintenance report will be prepared after each inspection, with a copy being maintained by Fallright and duplicate copies being provided to the City of Kalamunda and DOH. The report should identify any unusual circumstances or defects discovered during servicing. Full records are required to be kept by the property owner for at least 10 years.

The BioMAX C80 alarm warning system, comprising a red flashing light and warning siren, allows immediate review of the failure and adoption of appropriate mitigation measures. The audio alarm has muting device fitted to the ATU control panel such that the siren may be silenced following identification of a problem to reduce noise impacts to neighbouring properties. **Should any alarm be activated on the system, the approved maintenance provider should be contacted immediately**.

5.7. BioMAX Advantages

The BioMAX C80 is designed to provide several inherent advantages over other ATU systems currently on the market in Australia.

- BioMAX systems have only two mechanical components that could fail: an air bower in the Aerobic Chamber and discharge pumps in the Pump-out Chamber, making them less susceptible to risks associated with mechanical failure.
- BioMAX C80 tanks are constructed from thick 50 mPA concrete with high strength and corrosion resistance.
- The process within the Aerobic Treatment Chamber differs from ordinary suspended growth systems in that it is more stable and allows growth of anaerobic microorganisms beneath the biological film of aerobic microorganisms. This greatly reduces accumulation of biological sludge.
- The multiple compartment design of the Aerobic Chamber (Tanks 1 – 3) ensures there is no short circuiting of the system, preventing the possibility of partially-treated wastewater passing to the Clarification Chamber.
- By using only one pump (similar systems on the market use two), the potential for pump failure and the need to carry critical spare parts is reduced.
- BioMAX is a closed system, and therefore will return the same volume of water that is put in. There is no wastage, leakage or loss, which also means no odour escapes from the system.
- Unlike septic tanks and other below ground soakage systems, the BioMAX is not subject to the constraints of gravity. It uses a pump to discharge effluent, allowing flexibility to direct treated water to different irrigation locations as required. The BioMAX also eliminates the health problems associated with winter flooding of septic tanks.
- BioMAX ATUs enable recycling of treated wastewater through production of sterile, clear and odourless effluent that is fit for purpose for non-potable use, enabling it to be recycled to irrigate landscaped areas. Recycling of treated wastewater for non-potable and potable uses, such as irrigation and passive aquifer recharge, is a vital component of the State's current and future focus on water management for protecting water availability for generations to come.
- The use of a subsurface drip system for irrigation of the effluent has the added benefit of preventing the need to disturb the native bush and natural vegetation meaning less damage to the surrounding ecosystem.

6. EFFLUENT IRRIGATION SYSTEM

In WA, ATUs that incorporate a disinfection mechanism (such as the BioMAX C80), are permitted to disperse treated wastewater ("effluent") into dedicated on-site irrigation areas (otherwise known as land application areas). The effluent is dispersed into the top layers of soil to provide in-soil treatment of the remaining effluent residuals and increase nutrient uptake by plants. This allows the treated water to be recycled, greatly reducing the carbon footprint of water disposal compared to more traditional methods (e.g. pump and treat off-site).

6.1. Irrigation System

Irrigation systems generally comprise either above-ground spray heads or in-ground subsurface drippers (also known as sub-soil or sub-strata) to disperse effluent within designated irrigation areas:

1. Subsurface drip irrigation - dripper lines are buried in the topsoil at shallow depth
2. Surface drip irrigation - dosing lines are laid on prepared ground and covered in bark/mulch
3. Spray irrigation – above-ground heads distribute effluent over the surface of the ground

Subsurface drippers are positioned just beneath the soil horizon at depths of 100-250 mm to allow evapotranspiration in the shallow topsoil layer.

The proposed methodology for Chat Rigi is a **subsurface drip irrigation system**, in accordance with the 2019 DOH ATU approval. The drip system will be located at a depth of around 150 mm below ground and will be distributed from a system of pressure compensating drip emitters into the overlying topsoil layer.

Subsurface drip irrigation systems are typically preferred for treated effluent as they eliminate the risk of spray drift and aerosol inhalation, particularly on windy days. AS/NZS 1547:2012 states that subsurface drip irrigation systems in areas with Category 3 to 5 soils (Chalet Rigi has Category 4 soils), must be installed in an adequate depth of topsoil to slow water soakage and assist with nutrient reduction. This should comprise a minimum of 150 mm of *in-situ* or imported good-quality topsoil which will store the effluent and support the growth of evergreen vegetation to maximise evapotranspiration.

6.2. Irrigation Area Size

Previous geotechnical investigations undertaken at Chalet Rigi (refer **Section 3.3**) have identified an underlying soil type of **Category 4 Clayey Loam** as defined in Tables L1/M1 of AS/NZS 1547:2012. This value corresponds with a recommended Design Irrigation Rate (DIR) of 3.5 mm per day.

A DIR is an 'areal' loading rate applied to the area of a subsurface drip irrigation system. The DIR depends on the soil category and are defined in AS/NZS 1547:2012 to represent a conservative approach for sizing of treated wastewater irrigation areas.

Assuming a maximum treatment capability of 14,400 L/day and a soil classification DIR of 3.5, a dispersal area of at least 4,114 m^2 is suitable for effluent irrigation as per AS/NZS 1547:2012. This figure is stated as **4,120 m^2** in the ATU approval granted by the DOH in July 2019.

The irrigation area may be made up from a single area, or several individual areas which when combined make up a total of 4,120 m^2. Separate areas are preferred as they give greater flexibility in the system for maintenance and periods of fluctuating use. Once approved by the City of Kalamunda, the irrigation areas may not be altered or reduced in size without obtaining their prior approval.

6.3. Irrigation Area Location

6.3.1. Location Rationale

The location of irrigation areas forms an integral component of wastewater management It was previously intended to locate the irrigation area in the northern site corner. However, the October 2019 site meeting concluded that in order to apply best practice and mitigate DWER and community concerns, the irrigation area could be split into more than one area and moved further south. This would increase the distance from Hackett's Gully and avoid granite outcrops in the north, whilst also providing greater flexibility e.g. rotating irrigation schedules to cope with fluctuating usage and the ability to shutdown sections for maintenance. Consideration was given to the following contributing factors in order of importance.

1. Distance to surface water bodies

In accordance with the 2019 DOH ATU approval, all effluent irrigation areas must remain at least 30 m distance from local surface waters, in this case, Hackett's Gully Creek.

2. Presence of granite outcrops

The granite boulders in the north of the site are resistant and totally impermeable, meaning water cannot seep into them. Granite is unsuitable for any irrigation area due to the complete lack of hydraulic seepage and evapotranspiration - effluent will simply run-off the surface and plants will not grow on the exposed rock. As such, the irrigation areas need to avoid granite outcrops in the north of the site entirely.

3. Presence of stormwater infrastructure

Whilst using effluent to irrigate the existing landscaped gardens would be preferable, it is not possible due to stormwater infrastructure in and adjacent to the gardens. This includes above and below ground drains and several large above-ground (some partially submerged) water storage tanks. Water within these tanks is collected from rainwater falling on the site's buildings and is used to irrigate the landscaped gardens and provide firefighting supplies. The irrigation system must be located away from all stormwater infrastructure to prevent any of the waters mixing. This includes treated effluent entering the stormwater drainage and stormwater entering the irrigation area and increasing hydraulic loading.

4. Presence of steep slopes or embankments

Whilst the central area of the site to the west of the restaurant deck was initially identified as a potential irrigation area, this part of the site contains the steepest sloping ground (to the west). Significant earthworks and vegetation clearing would be required to flatten and secure the ground, and a slope of 1 in 10 would not be achievable within the constraints of the site boundary in some areas. This area was therefore considered unfeasible for irrigation and was excluded from further consideration.

6.3.2. Principal and Secondary Irrigation Areas

Two individual irrigation areas will be used to make up the required 4,120 m^2 – a principal irrigation area in the south of the site and a smaller secondary area in the north of the site. The combined irrigation areas make up 4,327 m^2 which includes the required 4,120 m^2 plus a 5% contingency of 207 m^2 located next to SIA. The irrigation areas are presented on **Figure 12** and **Figure 13** and described in **Table 8**.

Name	Size (m^2)	Soil Category	Geology	Distance to HG Creek	Topography	Vegetation
Principal Irrigation Area (PIA)	3,216	4 Clay Loams	Natural soils of sandy clay LOAM to >1.5 m depth. Isolated to no granite at surface.	> 150 m distance	Moderately sloping – average 28% slope to the southwest	Native bushland

Name	Size (m^2)	Soil Category	Geology	Distance to HG Creek	Topography	Vegetation
Secondary Irrigation Area (SIA)	1,111	4 Clay Loams	Natural soils of sandy clay LOAM to >1.5 m depth. Granite at surface to the north.	> 50 m distance	Relatively flat – average 10% slope to the northwest	Native bushland
SIA comprises:	*904* *207*	*Sub Area A – remainder of required minimum disposal area* *Sub Area B – 5% contingency*				
TOTAL	**4,327**	**Includes 4,120 m^2 minimum area + 5% contingency (207 m^2)**				

Table 8 Details of Proposed Irrigation Areas

Principal Irrigation Area (PIA) is located in the south of the site in an area covered by native bushland. It is the largest and preferential irrigation area due to:

- The large intervening distance to Hackett's Gully Creek (over 150 m to the north).
- The lack of granite outcrop at surface.
- The large intervening distance from the restaurant building, outdoor seating area and regularly trafficked areas of the site e.g. roads and paths.
- The lack of underlying services and stormwater drainage infrastructure.

With a total area of 3,126 m^2, PIA can receive up to 10,941 L of treated effluent per day, or 76% of the maximum daily capacity of 14,400 L. This equates to 364 people at 30 L each day, or 2,548 people over 7 days. When combined staff and patron numbers remain below 364 people per day, irrigation will be directed to the PIA only. It is likely that PIA will accept all wastewater produced by the restaurant during midweek (Monday – Thursday), with only a small proportion being directed to the SIA during the later parts of the day on weekends IF the figure of 364 is exceeded.

Secondary Irrigation Area (SIA) is located in the north of the site. It is the smaller of the two areas and is located over 40 m from Hackett's Gully Creek in an area covered by native bushland. There are granite outcrops at surface in the locality of the area but not within the SIA. SIA will typically be utilised only when on-site person numbers go above 364 or to allow for maintenance or shutdown of PIA.

The SIA includes a contingency area of 5% - this area will be installed as a functional irrigation system but will not be used unless in the event of an emergency.

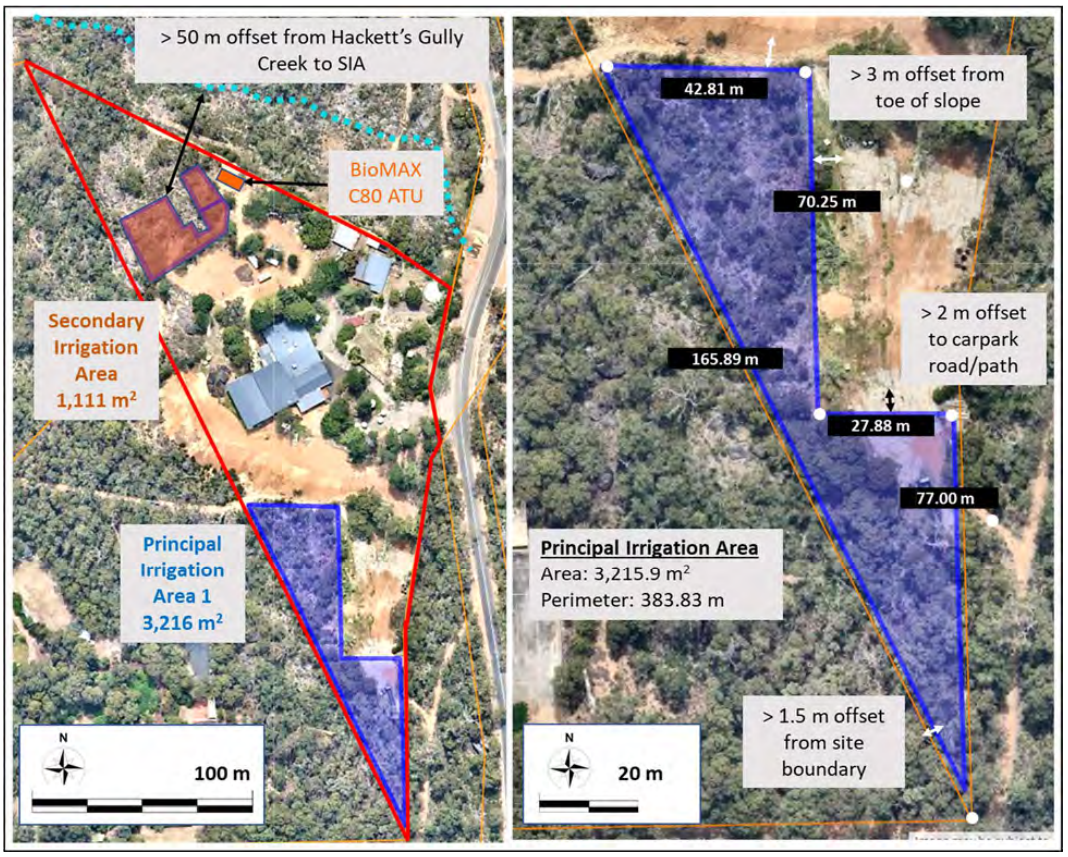

Figure 12 Principal Irrigation Area Location, Size and Dimensions

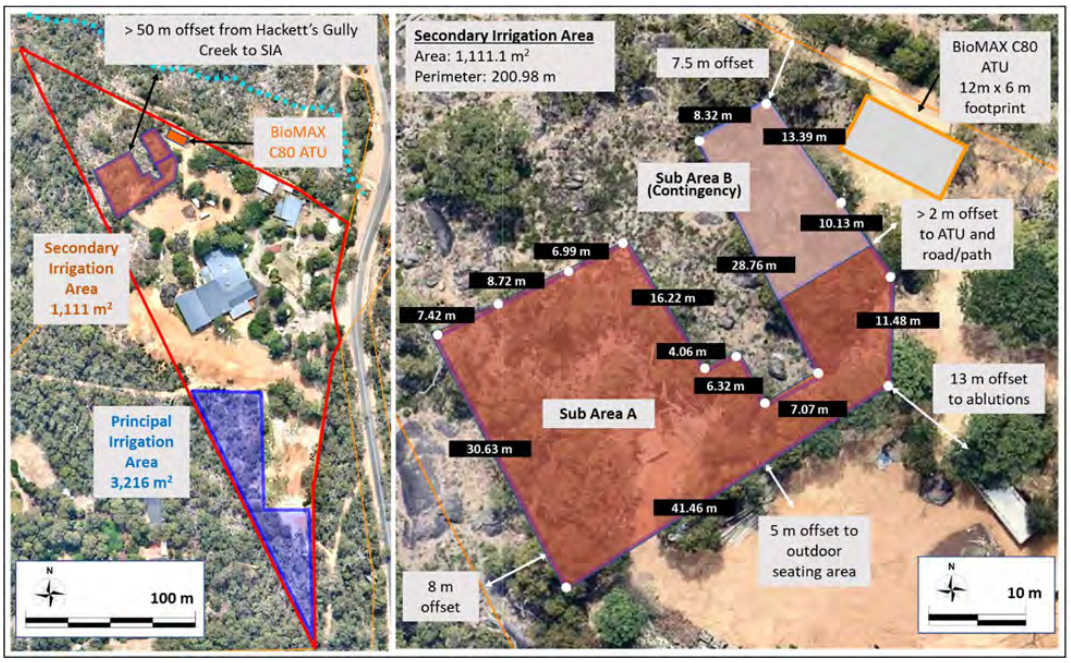

Figure 13 Secondary Irrigation Area Location, Size and Dimensions

6.4. Landscaping

In their current condition, PIA slopes moderately to the southwest, with an average slope of around 28%, while SIA is relatively flat with a slight slope of around 10%, Topography mapping of the irrigation areas as provided by Landgate SILIP are presented in **Figure 14**.

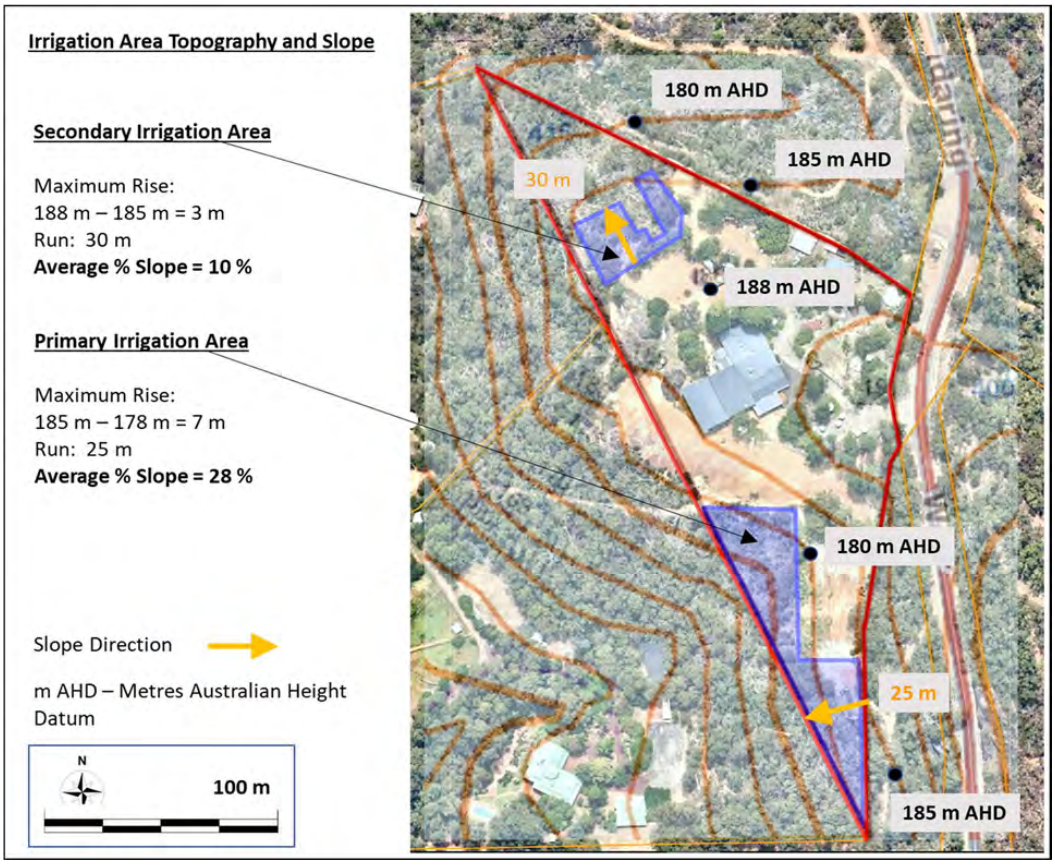

Figure 14 Topography and Slope of Irrigation Areas

The 2019 DOH ATU approval for Chalet Rigi specifies that any irrigation area with a ground level of greater than 10% slope or 5.7 degrees must be terraced. This is because DIRs specified in AS/NZS 1547:2012 only apply to irrigations systems located on flat to moderate slopes of up to 10%. Flat irrigation areas are necessary to ensure that effluent is retained within the soils of the irrigation area for sufficient time to reduce any contaminant loading (e.g. nutrients and pathogens). Steeper slopes would reduce the irrigation area's effectiveness by resulting in less hydraulic seepage into the ground and greater surface run-off.

PIA has a moderate slope of 28% to the southwest and as such, terracing will be required to level the ground to within 10% slope. Terracing involves cutting a sloped area into a series of successively receding flat surfaces or platforms and is a relatively simple and common agricultural practice in hilly areas. Terracing will prevent surface runoff, decrease soil erosion and support the growth of vegetation.

Whilst SIA has an average slope of 10%, careful inspection will be required to ensure that any localised undulating areas are flattened. Existing vegetation within SIA should be retained wherever possible.

Both irrigation areas will be landscaped to prevent pooling of effluent or surface runoff from the areas. To ensure that the drip system operates at maximum efficiency, topsoil will be applied to the soil to a

minimum depth of 150 mm and suitable plants capable of effecting a high evapotranspiration rate must be maintained. Vegetation suitable for the transpiration of reclaimed effluent and salt and nutrient tolerant (refer **Section 6.6**), will be planted over the areas to supplement the existing vegetation.

The landscaping will be undertaken by a suitably experienced person with appropriate machinery. Where possible, hand tools should be used to prevent over compaction of the soils in the irrigation areas. Existing vegetation should be retained where possible, with the terracing constructed to accommodate for and incorporate the large trees and shrubs.

Once operational, the irrigation areas will continue to resemble native bushland, albeit with flatter ground level in the south of the site, and a denser and more biodiverse vegetation species.

6.5. Vegetation Cover

It is important to maintain good vegetation cover over the full extent of the irrigation areas to maximise evapotranspiration, reduce soil erosion and reduce nutrient loading in the soils.

Natural bushland is present across both irrigation areas comprising jarrah-marri forest (*E. marginata* and *C. calophylla*). Native shrubs and grass trees (Xanthorrhoea) are also present and some wildflowers were observed in October 2019. The areas also contain several non-native flowering plants, likely to be garden escapees from the landscaped gardens on site or surrounding residential gardens.

The vegetation cover should be regularly inspected and maintained to ensure vegetation density remains sufficiently high. Topsoil cover should also be maintained at the minimum required thickness (150 mm) to slow water soakage, avoid puddling and run-off, and increase vegetation growth and nutrient reduction.

If additional plants are required to increase vegetation density, particularly following terracing in PIA, they should be selected to promote evapotranspiration and suit site conditions including:

- Tolerance of phosphates and salts. Avoid the Proteaceae family such as Banksia, Grevillea and Hakea species and instead opt for Westringia, Eremophila, and Acacia species.
- Water tolerance during times of irrigation and system non-use.
- Evergreen and fast-growing dense foliage that does not have a dormant phase to encourage increased evapotranspiration and water take-up by plants.
- Fire resistant or retardant to reduce bushfire risk.

AS/NZS 1547:2012 provides recommended species for planting in ATU irrigation areas, however most of the suggested species are non-native and some are considered a pest/weed in WA e.g. oleander, pampas grass and certain species of acacia wattle. It is recommended that any additional species planted at Chalet Rigi be native to the south-west of WA where possible, in order to support local ecosystems, increase biodiversity and improve the natural aesthetic appeal of the landscape.

Species that often escape landscaped areas and become invasive in the bush should be avoided, including Geraldton Wax. New large tree species should not be planted in or too close to the irrigation area as the roots can damage or block the irrigation system (existing large trees with pre-established root systems are acceptable). No fruit, vegetable or other edible plant may be planted in the irrigation areas.

A list of indicative plant species for the irrigation areas is presented below. Most species are native to Australia (mostly to WA), chosen to satisfy the above criteria, and widely available at local nurseries.

Taller shrubs and trees

- Acacia saligna
- Acacia extensa
- Melaleuca lanceolate
- Agonis flexuosa
- Melaleuca preissiena
- Corymbia calophylla

- Eucalyptus marginate Eucalyptus patens

Native Shrubs

- Taxandria linearifolia Calistachys lanceolata
- Acacia urophylla Acacia nervosa
- Eucalyptus Melaleuca nesophila
- Melaleuca huegelii Spyridium globulosum
- Viminaria juncea Gastrolobium ebracteolatum
- Logan vaginalis Leptospermum erubescens
- Kumzea glabrescens Dodonea spp
- Calothamnus spp Callistemon spp

Non native – flowering species

- Hibiscus Dwarf magnolias
- Camelias Dwarf elm and maple
- Lomandra longifolia Dianella spp
- Dietes spp New Zealand flax
- Nonedible citrus Olive
- Hibbertia scadens Abelia
- Jasmine and Star Jasmine Roses such as Banksia Rose and trailing roses

Regular visual inspections of both irrigation areas will be undertaken during the 3 monthly maintenance services, including a check of drip irrigation lines and spray jets, evidence of surface water pooling or runoff, and vegetation condition. Damaged, malfunctioning equipment will be repaired or replaced as soon as practicable without impacting the continued operation of the system.

6.6. Setback Distances

Irrigation areas must achieve minimum setback distances from certain features such as surface water, buildings, boundaries and paved areas, to avoid human exposure to effluent. The irrigation areas will be installed to comply with the most conservative setback distance specified by the regulatory authorities (City of Kalamunda and DOH) and in most instances, offer a greater setback than the required minimum. Setback distances are demonstrated on **Figure 12** and **Figure 13** and described in **Table 9**.

Asset	Recommended Setback	PIA Setback	SIA Setback	Rationale
Surface Water	30 m	**> 150 m**	**> 50 m**	The July 2019 DOH ATU approval specifies a minimum 30 m setback. Minimum setback in AS/NZS 1547:2012 is 15 m. DWER recommend at least 100 m setback. Refer **Section 6.7.1**.

Asset	Recommended Setback	PIA Setback	SIA Setback	Rationale
Site Boundaries	1.5 m	**> 1.5 m**	**> 7.5 m**	Minimum setback in AS/NZS1547:2012 is 1.5 m. The inner 1.5 m from the perimeter must remain clear of small trees and shrubs such that a 3 m fire break is maintained from the site boundary in accordance with City of Kalamunda guidelines and Section 33 of the *Bushfire Act 1954*. Refer **Section 6.7.2** below.
Escarpments / Embankments	3.0 m	**> 3 m**	**> 100 m**	Or 45 ° angle from toe of wall, whichever is greater, as specified in AS/NZS 1547:2012.
Site Buildings	1.8 m	**> 40 m**	**>13 m**	City of Kalamunda guidelines specify 1.8 m. Minimum recommended setback in AS/NSZ 1547:2012 is 2 m..
Recreational Areas	3.0 m	**> 40 m**	**> 5 m**	Minimum setback in AS/NZS 1547:2012 is 3 m for subsurface dripper irrigation. Recreational areas include outdoor seating areas and children's play areas.
Paths and Roads	1.8 m	**> 2 m**	**> 2 m**	City of Kalamunda guidelines specify 1.8 m. Not stated in AS/NZS 1547:2012
BioMAX ATU System	1.8 m	**> 120 m**	**> 2 m**	City of Kalamunda guidelines specify 1.8 m. Not stated in AS/NZS 1547:2012
Groundwater	1.2 m	**> 30 m**	**> 30 m**	City of Kalamunda guidelines specify 1.2 m vertical offset from groundwater. Minimum vertical setback recommended in AS/NZS 1547:2012 is 500 mm from the winter/wettest groundwater table.

Table 9 Irrigation Area Setback Distances

6.6.1. Surface Water Setback

The Department of Health are the regulatory body under the Health Act 1911 and they have provided approval for a 30 m setback distance from surface water bodies in the 2019 ATU approval (refer **Appendix B**). DWER provide advice to the government and suggest a 100 m setback from surface waters.

The system has been designed such that the Primary Irrigation Area (PIA) will accept at least 76% of the effluent at a setback distance of 150 m – greater than both the DOH and DWER setback distances. Only the Secondary Irrigation Area (SIA) has a setback of less than 100 m, but at 50 m setback, it is more conservative that the DOH required setback and will only be used less than 24% of the time. DWER are an advisory agency and not a regulatory body (such as DOH) so therefore, the City may elect to support the DOH's condition for a reduced setback distance providing it can satisfy itself that an appropriate Water Management Plan is in place to protect the catchment area (refer **Appendix D**).

The SIA is located just over 50 m from Hackett's Gully Creek at its closest point. This setback distance is considered acceptable due to the following mitigating circumstances:

- SIA will only be used for irrigation when on-site person numbers go above 364 per day or when PIA is undergoing maintenance or shutdowns. This represents just 24% of effluent assuming the

site is operated at maximum capacity (480 persons) every day. Depending on patronage numbers, it is likely that the SIA will not be used during midweek and that only a small proportion of effluent will be directed to the SIA during the later parts of the day on busy weekends.

- Effluent will be dispersed over several individual stations in the SIA to maintain the greatest possible distance from Hackett's Gully Creek. The first station will be located to the far west of the area at greater than 75 m from Hackett's Gully Creek.
- SIA is hydraulically distinct. The underlying soil characteristics and flat topography of the area will ensure that effluent travels vertically down into the soil or is lost to the atmosphere via evapotranspiration. Surface water runoff will be negligible, and effluent will not be discharged outside of the irrigation area. Groundwater is present at significant depths (<30 m) and does not provide a water source for the nearby Hackett's Gully Creek. Finally, irrigation is subsurface which prevents airborne transfer of effluent through mist or sprays.
- Hackett's Gully Creek and receiving waters Piesse Brook and Helena River, are ephemeral water bodies meaning water flow is seasonal and entirely absent in the summer months. A reduced setback is generally recognised as acceptable for ephemeral waters, for example, the Environmental Management Guidelines for Vineyards produced by the Department of Environmental Protection and Waters and Rivers Commission suggests a minimum setback of 100 m for permanent water bodies and 50 m for ephemeral water bodies (DEP & WRC (2002)).
- Vegetation clearing will be strictly limited within the SIA to reduce soil erosion, encourage evapotranspiration and create a waterway buffer. Existing vegetation will be retained where possible, with irrigation constructed to accommodate for and incorporate the large trees and shrubs. Vegetation density will be maintained, and an effort made to enhance the overall habitat through careful species selection.

6.6.2. Site Boundary Setback

AS/NSZ 1547:2012 states that irrigation areas must have a minimum setback distance of 1.5 m from the site boundary. In accordance with City of Kalamunda guidelines and Section 33 of the Bushfire Act 1954, Chalet Rigi must maintain a 3 m perimeter firebreak that is clear from vegetation and able to be trafficked by emergency vehicles in the event of a bushfire.

Under the proposed irrigation system, the SIA is located at least 7.5 m from any site boundary, allowing ample space for the firebreak outside of the irrigation area.

Some parts of the PIA are located at 1.5 m from the site boundary. In order to satisfactorily comply with bushfire regulations:

- The inner 1.5 m of the western and southern boundaries of the PIA will be cleared to make up the required 3 m. This area will remain free from understory species e.g. shrubs, ferns, climbing plants and small trees. As per other rural properties located in Piesse Brook, large forest canopy species will remain only providing they are easily navigable with an emergency vehicle.
- In the event of a bushfire, vehicular access to the firebreak on the southern boundary will be readily available through a gate in the carpark to the immediate north. This gate be closed shut but unlocked and will have clear signage stating "NO ENTRY UNLESS IN EVENT OF EMERGENCY".

The installation of an on-site irrigation system results in several benefits that reduce overall bushfire risks:

- In its current condition, vehicular access would be difficult along some parts of the western firebreak due to the naturally sloping topography (around 28% slope). Flattening of the ground level to accommodate the irrigation system will vastly improve vehicular access in the event of an emergency.
- The irrigation system will result in an overall increase in soil moisture over time which will help to cool the ground and act as a natural firebreak to prevent or slow the spread of bushfires.

Following any emergency event that requires vehicle access to the firebreaks within PIA, a thorough inspection of the irrigation system should be carried out to assess and repair all damages to the system.

6.7. Installation

The irrigation system will be installed by a licensed and certified plumber in collaboration with the installers of the ATU system (BioMAX Pty Ltd). To meet the performance objectives for the construction and installation of ATUs as specified in AS/NZS 1547:2012, the irrigation system will:

- Be constructed using polyethylene complying with AS 2698-2:2000 Plastics Pipes and Fittings for Irrigation and Rural Applications.
- Comprise materials, pipes, bends junctions, fittings and fixtures that are free from defects.
- Be assembled so that joints are watertight to avoid the likelihood of blockages or leaks.
- Be supported, jointed, and protected to avoid the likelihood of penetration of roots.
- Be constructed to avoid the likelihood of damage from superimposed loads or ground movement and not in a trafficked area.
- Be positioned to ensure that effluent is not applied at rates which exceed the absorption capacity of the soil.
- Provide reasonable access for routine system maintenance and clearing of blockages.
- Be authorised and installed in accordance with the AS 3500 National Plumbing and Drainage Code in a manner that preserves the integrity of the system.

As outlined in the City's publication *Guidelines for Installing Septic Tanks and Leach Drains*, a minimum separation of 3.6 m must be maintained between dripper lines and all dripper lines must run parallel with the land contours.

The irrigation areas will be on plumbed onto separate pumping rotations to ensure maximum flexibility over how each area is controlled and operated. Effluent will also be dispersed over several separate stations within each irrigation area to allow staging of water release.

In November 2019, a site visit was held with Evergreen and a representative of BioMAX Pty Ltd who will install the system at Chalet Rigi. The BioMAX representative confirmed that the irrigation system can be successfully installed on site as proposed.

In accordance with the 2019 DOH ATU approval for Chalet Rigi, as-constructed plans and written certification that the ATU's irrigation system has been installed in accordance with the Code of Practice for the Design, Manufacture, Installation and Operation of ATUs are to be submitted to the City of Kalamunda's EHO after installation. The system must then be inspected and approved by the City of Kalamunda's EHO before it can be used.

The person who completes the construction or installation of the irrigation system shall notify the City of Kalamunda's EHO to arrange an inspection of the as-constructed system and obtain a permit for its use. All works will be left open (i.e. not covered with soil) and available for an appropriate visual inspection by the EHO. The irrigation system may not legally be used before it has been inspected and a permit to use issued.

7. NUTRIENT BEHAVIOUR

7.1. Effluent Loading and Flow Paths

Irrigation systems dispose of effluent in two ways:

- Absorption and hydraulic seepage into the underlying soils
- Evapotranspiration into the atmosphere

The ratio of hydraulic seepage to evaporation is highly site-specific and depends on many complex and interrelated factors including climate, season, soil type, ground level, vegetation density, cloud coverage and time of day.

At Chalet Rigi, the irrigation areas will comprise vegetated flat surfaces with a thick layer of topsoil overlying sandy clay loams and located in a Mediterranean climate dominated by high temperatures and low humidity/rainfall. Groundwater is likely to be present at depths of greater than 30 m. As such, the predominant flow path will be absorption and hydraulic seepage into the underlying soils.

Most of the applied effluent will move vertically downward into the soil until it reaches field capacity – the point at which excess water has drained away and soil moisture remains held in the soil. It is not considered likely that effluent will migrate sufficiently deep enough to enter the regional aquifer. A smaller but not insignificant amount of effluent will be expended through evaporation from the soil and transpiration from plants.

Hydraulic loading will be greater in the winter months due to increased precipitation falling onto the irrigation area, although this may be balanced be reduced patronage (and water use) at the restaurant. Hydraulic seepage will also be slower towards the end of winter due to prior saturation of soil pore spaces during precipitation events. Inspection of the irrigation areas for pooling or waterlogging will be particularly important in winter and after storm events.

The two main contaminant sources associated with ATU effluent are nutrients (e.g. nitrogen and phosphorous) and biological contamination in the form of microbial pathogens (e.g. E. Coli). Nutrients can lead to eutrophication (algal blooms) in nearby surface water if not properly managed and allowed to migrate off-site, whilst E. Coli can present a health risk to humans if consumed.

The irrigation system at Chalet Rigi has been designed to reduce risks associated with potential contaminants including:

- Flat surface and lack of stormwater drainage to ensure effluent is retained within the irrigation area and to prevent water runoff outside of the irrigation area.
- Most effluent will be directed to the Primary Irrigation Area which is located over 150 m from Hackett's Gully Creek.
- Layer of at least 150 mm thickness of topsoil over irrigation areas to:
    - Encourage hydraulic seepage vertically into the underlying clay loam sands
    - Enhance microbial processes in the upper soil layers that reduce nutrient loadings e.g. denitrification, nitrification
    - Encourage vegetation growth
- Dense native vegetation cover to:
    - Take-up excess soil nutrients and salts (in appropriate species)
    - Increase evapotranspiration rates
    - Reduce soil erosion and loss of soil structure

7.2. Nutrients

Domestic wastewater contains nitrogen (N) as well as phosphorus (P) in inorganic and organic forms, derived from urea in urine and human solid wastes and cleaning agents. However, in rural-residential areas, nutrient inputs are often dominated by other sources rather than on-site wastewater disposal. This was demonstrated in an extensive Western Australian study on domestic septic tanks (which have no active mechanism of treating wastewater or removing nutrients) (Gerritse, 2002). For example, the study demonstrated that keeping one horse per rural-residential property adds the equivalent of 3 domestic septic tanks to nutrient inputs.

The desirability of nutrient removal in a wastewater treatment system varies depending on the characteristics of the receiving environment. In most situations, the residual nutrient content in the effluent will "feed" the vegetation in the irrigation area and be adsorbed ("taken up") in the soil. In general, control of phosphorus inputs is considered more crucial in the long term compared to nitrogen which is usually be removed by natural biological fixation processes (Gerritse, 2002).

7.2.1. Phosphorous

Phosphorous forms a much lesser number of inorganic compounds than nitrogen and most are not volatile. In effluent, the dominant species of dissolved inorganic phosphorus is phosphate (HnPO4 (n-3)).

Phosphorus compounds in water are readily adsorbed onto the surrounding soils and, depending on soil type, generally stays very close to where it was applied. Phosphorus is relatively immobile and not readily leached from soils (except for deep sandy soils which have low adsorption capacity). Tests on loamy and clay soils with a history of phosphorous fertiliser application show a rapid reduction in phosphorus with depth (Gerritse, 2002).

Phosphorous mobility depends solely on the phosphorus fixing ability of the underlying soils (i.e. rates of adsorption). Phosphorus will move in the same direction as the effluent but at a slower velocity as it sorbs onto the surrounding soil. Phosphate is retained strongly in most soil types, mainly by aluminium and iron oxides, and retention increases almost proportionally to the Al and Fe oxide content. The nature of adsorption is such that with increasing phosphorous concentration in the soil solution, the mobility of phosphate increases as there are fewer binding sites for adsorption (Gerritse, 2002).

Unlike nitrogen, phosphorus in wastewater effluent is not transformed or reduced by microbial reactions.

API testing undertaken in November 2019 demonstrates that the natural sandy and gravelly clay loams at Chalet Rigi are "strongly adsorbing" and "very strongly adsorbing" of phosphorous. The PRI range of 66 – 590 mL/g is consistent with published data and confirms that on-site soils have a natural ability to fix phosphorous without the need for added soil improvements (refer **Section 3.3**).

7.2.2. Nitrogen

Nitrogen forms a much greater number of inorganic compounds than phosphorus, some of which are volatile. Examples include nitrate, nitrite and ammonium. In effluent, the dominant species of nitrogen under oxygenated conditions is nitrate (NO_3).

Nitrogen compounds in water are adsorbed by organic materials in the soils and readily denitrified in most soils under low oxygen conditions as typified by those underlying the Chalet Rigi irrigation areas. Unlike phosphorus, inorganic nitrogen compounds are readily transformed by microbial oxidation and reduction processes that "break-down" and remove nitrogen through loss of nitrogen gas. This occurs when microorganisms in the soils use inorganic nitrogen compounds as a source of oxygen. The two main microbial processes are:

- **Nitrification**: Oxidation of ammonium to nitrite and then to nitrate under oxygenated conditions.
- **Denitrification**: Oxidation of nitrate to nitrogen gas under deoxygenated conditions.

Both processes can occur simultaneously in soils and sometimes, nitrification and denitrification can occur sequentially. These processes have been shown to remove up to 100% of nitrogen within a few metres from the point of disposal in Perth Hills soils (Gerritse, 2002). The irrigation areas at Chalet Rigi have been designed to retain effluent as long as possible to ensure maximum nutrient reduction.

7.2.3. Summary

Treated effluent from a BioMAX C80 ATU contains the following nutrient concentrations:

- Total Phosphorous (TP): 0 - 2 mg/L
- Total Nitrate (TN): 0 - 10 mg/L

Analysis shows that around 25% of phosphorous contained within untreated wastewater is removed during treatment within a BioMAX ATU, likely being adsorbed in the biomass in the anaerobic and aerobic chambers. The remainder of phosphorous within the effluent will be adsorbed into the soils of the irrigation area, demonstrated to be "strongly" to "very strongly" adsorbing, and will be retained within with no leaching outside of the irrigation area.

With nitrogen, almost complete nitrification takes place within the aerobic chamber of the BioMAX followed by denitrification in the anaerobic chamber and then within the soils of the irrigation area, in addition to nitrogen take-up by plants in the irrigation area (BioMAX, 2019).

In their September 2019 correspondence, DWER raised concerns with BioMAX output of 10 mg/L of total nitrogen, and directly compared it with the ANZECC Guidelines for Fresh and Marine Water Quality (Oct 2000) of 0.45 mg/L. It is noted that it is inappropriate to compare effluent concentrations directly with ANZECC criteria, unless the effluent was being directly discharged into the creek.

Assuming a properly installed irrigation system (e.g. flat and thick topsoil), effluent will travel vertically through the soils underlying the irrigation area, allowing greater than 80% of nitrogen species to be removed from the soil through nitrification and denitrification processes. Further nitrogen removal (10-15%) will occur through nutrient take-up from vegetation, which is maximised through the use of a subsurface dripper system which discharges all effluent into the potential root zone of the vegetation.

It is noted that baseline total nitrogen concentrations within Hackett's Gully Creek (0.6 – 3.1 mg/L), are up to 8 times greater than the ANZECC Guidelines for Fresh and Marine Water Quality (0.45 mg/L).

Additional mitigating factors are that the system is unlikely to be used at maximum capacity everyday

7.3. Microbial Pathogens

Human intestinal bacteria, viruses, protozoa, and helminths are removed and inactivated in the soil by adsorption, straining, desiccation, and microbial processes which enable retention in soils and degradation of both harmless gut organisms and pathogens over time. This is facilitated by maintaining aerobic (unsaturated) conditions in the soil and use of appropriate setback distances.

8. Operational Considerations

Once operational, the irrigation areas will continue to resemble native bushland, albeit with flatter ground level in the south of the site, and a denser and more biodiverse vegetation species. As such, it will be important to maintain a high level of administrative control to prevent accidental access to the areas by restaurant patrons, staff or contractors. Administrative requirements are presented in **Table 10**.

Requirement	Rationale
ATU effluent must be only be dispersed via an approved irrigation system.	ATU effluent is unsuitable for human contact or consumption. Whilst ATU effluent has undergone chlorination, it can still contain pathogenic microorganisms, some of which are chlorine resistant. Therefore, it must only be dispersed onto the dedicated irrigation areas. Effluent must not be surface irrigated in areas used for recreational purposes (e.g. lawns). It is unsuitable for irrigation onto vegetable gardens or food crops. Effluent may not be used for any other purpose other than irrigation within the dedicated areas.
The irrigation system must be in a permanently designated and maintained irrigation area.	The irrigation area will be maintained for the purposes of effluent dispersal and system maintenance only. It should not be used for any purposes that compromise system effectiveness or access. The irrigation area boundaries must be clearly defined and delineated by appropriate vegetation, fencing or other type of border. This is particularly important for SIA which is located 5 m from the outdoor restaurant area. Signage and boundaries will need to be clearly defined to ensure there is no accidental interaction with restaurant patrons and the irrigation system. No part of the subsurface drip system will be paved or built over.
Public access to irrigation areas must be prohibited to prevent accidental traffic and damage to the system.	Don't allow livestock, children, pets or vehicles to access the irrigation areas and do not allow vehicles to drive through or park on them. At least two warning signs should be posted within each irrigation area advising that effluent is being used for irrigation and is not suitable for human contact. The signs should be on a white background with red lettering of at least 20 mm in height and worded as follows: "WARNING – RECLAIMED EFFLUENT NOT SUITABLE FOR HUMAN CONTACT OR CONSUMPTION"
All care must be taken to prevent accidental damage to the system.	Don't plant large trees in or too close to the disposal area as they can shade the area and the roots can damage the absorption trench or irrigation system.

Table 10 Operational Considerations for Irrigation Systems

The following recommendations are made with regards to operational management of the restaurant to ensure maximum efficient of the wastewater treatment system.

Kitchen

- Don't use garbage disposal units or put food scraps down the drain. Scrape food waste off dishes, instead of rinsing them with water. Use sink strainers to prevent food accidentally going down the drain.
- Avoid disposing of excess sodium down the train e.g. beverages or liquid that contain salts. Excess sodium can degrade soil quality in the irrigation area causing damage to soil structure, reducing soil pore spaces, give a greasy texture (hydrophobic) and reduce drainage capacity. Excess sodium also restricts plant growth resulting in lower levels of evapotranspiration.
- Don't wash or rinse your dishes with running water; use a tub or plug the sink.

- Only operate the dishwasher when necessary and adjust the water level to suit the size of the load. Consider purchasing a water-efficient dishwasher.
- Don't pour fats, oils or grease down the sink. Wipe pots and pans of grease before washing.
- Don't rinse fruit and vegetables under running water, use a bowl of water.
- Keep a bottles of drinking water in the fridge instead of always running the tap for water.

General

- Conserve water – the more water you use, the more wastewater you have to treat and dispose of. Don't leave taps running unnecessarily when washing dishes or hands.
- Don't use caustic soda or drain cleaners to unblock pipes and drains and don't flush excessive amounts of chemicals such as bleach, nappy sanitiser, caustic chemicals, corrosive fluids, pesticides or disinfectant down the drain as they can destroy the bacteria that breaks down the wastewater. Do not allow paints, automotive oils and greases or any matter designated as trade waste or industrial liquid waste to enter the wastewater system.
- Don't flush nappies, tampons, condoms or other large items down the toilet as they do not break down and may block the ATU system.
- Don't dispose of medicines or antibiotics down the drain.
- Avoid where possible, the use of:
    - Detergents that advertise whitening, softening and enzymatic power
    - Detergents which include boron, borax, chlorine, bleach, sodium perborate and sodium trypochlorite (salts) bulking agents, sodium tripolyphosphates (STPP), phosphorus, phosphates, polyphosphates, phosphate builders and acids.
- Use liquid detergents (instead of powders) or products which use potassium salts as they produce better quality, less saline greywater. Where possible, use natural cleaning products such as bicarbonate soda and vinegar.

9. STORMWATER MANAGEMENT

Stormwater is water flowing over ground surfaces (runoff) in natural streams and drains as a direct result of rainfall over a catchment. It consists of rainfall runoff and any material (dissolved or suspended) mobilised in its path of flow.

When stormwater is absorbed into soil, it is filtered and ultimately replenishes aquifers or surface water bodies. However, heavy rainfall, or that hitting saturated ground, creates excess surface water which "runs off" across ground surfaces and into stormwater drainage, carrying physical debris and litter, eroded soil (suspended solids) and a mixture of dissolved contaminants e.g. chemicals, nutrients, salts and microbes. As such, water bodies have the potential to be contaminated by stormwater drainage.

Detaining water and removing pollutants is the primary purpose of stormwater management. In urbanised areas, impervious surfaces such as pavement and roofs prevent precipitation from soaking into the ground. Instead, water runs rapidly overland into storm drains and can cause flooding, erosion, turbidity (muddiness), overflow and infrastructure damage. By adopting good design principles, stormwater can be captured and recycled to maintain or restore natural hydrology. This includes:

- **Pervious surfaces** that are porous and allow rain to soak into the soil e.g. road and paving.
- **Grey infrastructure** such as culverts, gutters, storm sewers and conventional piped drainage
- **Blue/Green infrastructure** that protects, restores, or mimics the natural water cycle e.g. drainage swales and basins.

At a regional level, management of stormwater drainage is particularly important within a P2 water protection area to reduce the outflow of contaminants, primarily sediment and nutrients, into nearby surface water bodies. From a site perspective, adequate stormwater management is crucial to ensuring that wastewater and stormwater do not mix. This includes preventing any treated effluent from entering and contaminating the stormwater drainage system and preventing stormwater from entering the irrigation area and increasing hydraulic loading beyond the irrigation area capacity.

In accordance with City of Kalamunda guidelines, stormwater management is required to ensure that:

1. The increased runoff generated from impervious areas does not adversely impact downstream properties, including storm events up to the one percent annual exceedance probability (1% AEP).
2. The water volumes, flow rates, time of concentration, and water quality support the functions of the greater catchment.

The 1% AEP is also referred to as the one-hundred-year Average Rainfall Incidence (1 in 100 ARI).

9.1. Ground Cover

In urban and developed areas, impervious surfaces such as pavement, road and building roofs prevent precipitation from naturally soaking into the ground. Instead, water runs into storm drains, sewer systems and drainage ditches and can cause flooding, erosion, turbidity (or muddiness), sewer system overflow, and infrastructure damage unless properly controlled.

The total site area is approx. 26,069 m^2, the majority of which comprises undeveloped and unsealed bushland. The restaurant area comprises 1,450 m^2 of which 850 m^2 is the restaurant building and 600 m^2 is the beer garden. Except for a small raised walkway containing access to the ablutions, the ground cover within the beer garden is unsealed pervious ground.

Sealed ground surfaces on the site are limited to a bituminised/hardstand driveway connecting the restaurant with Mundaring Weir Road (refer **Figure 2**). The sealed driveway forms an area of less than 1,000 m^2 and was in place when Fallright purchased the property.

Fallright have purposely restricted the amount of sealed impervious surfaces on the site in order to decrease the volume and velocity of stormwater runoff that will need to be managed and to maximise the natural setting of the site. These management measures include:

- Not extending the bitumen hardstand beyond its existing footprint
- Use of compacted gravel surface, which allows infiltration, to form driveways and carparking areas

When taking into consideration the area of the restaurant and the hardstand driveway, the total area of sealed impermeable surfaces on the site is approx. 1,850 m^2. Assuming a highly conservative value of 2,500 m^2 to account for other on-site buildings such as the historical residence and garage, less than 10% of the total site area is covered by impervious surfaces.

9.2. Topography

Site topography slopes from a high point in the east (191 m AHD) towards the west (185 m AHD) and northern and southern site corners (180 m AHD) (refer **Figure 3**). The area containing the restaurant building is relatively flat. Surface runoff generally follows land topography unless it is intercepted by stormwater drainage infrastructure, which is located in the areas surrounding the exiting site buildings.

9.3. Stormwater Collection

Fallright aim to capture and recycle as much stormwater as possible in the existing stormwater drainage system and reuse it in the site's fire management system and for irrigation of the gardens.

All stormwater landing on the restaurant roof is funnelled into roof box gutters before being gravity fed into 2 x 9 KL holding tanks located adjacent the building (refer **Figure 2**). Stormwater captured in the holding tanks is pumped automatically to a main 50 KL storage tank located on the northeast site boundary via a series of holding tanks (10 KL and 2 KL). Stormwater landing on the roof of the garage and outhouses is also collected in a 9 KL holding tank and pumped automatically to the 50 KL storage tank. When the main 50 KL storage tank is full, an automatic gauge allows stormwater to be pumped back through the system to balance levels amongst the smaller holding tanks. Total capacity of the stormwater storage system is 89 KL.

Water within these tanks is utilised for irrigation of the landscaped gardens and maintained for firefighting supplies if necessary.

If the tanks are collectively at maximum capacity, rainwater overflow is discharged into an existing natural drainage creek running along the western site boundary, which flows into a drainage dam located on the adjacent property to the west of the site (also owned by Fallright). The drainage dam is a closed system which does not connect to any surface water bodies and is not groundwater fed. Its purpose it to allow infiltration of excess surface water run-off in a controlled manner during the winter months.

9.4. Road and Carpark Drainage

Most on-site roads and carparks on site are constructed from pervious compacted gravel, meaning that rainfall can infiltrate directly through the permeable ground cover. The small area of bitumen driveway is designed such that stormwater flows towards the edge of the road, preventing pooling on the hardstand and allowing flow towards areas where stormwater can infiltrate the open ground.

Stormwater runoff in the carpark area to the south (crushed gravel surface) will be directed into a small drainage swale located in the centre of the car park containing natural vegetation. The swale will retain excess runoff from the carpark, filter pollutants from vehicles using the car park, allow suspended solids to settle out, and allow greater time and surface area for seepage into the underlying soils. Small drainage channels or sumps with trafficable lids will be located along the western boundary of the carpark and

used to capture any residual stormwater run-off. These sumps will flow through a grease trap before being allowed to drain to ground.

9.5. ATU and Irrigation Area Drainage

Terracing and flattening of the irrigation areas will be used to reduce surface runoff velocity and increase vertical infiltration into the soil profile of any stormwater that falls onto the irrigation area.

The ingress of surface water drainage seeping into the irrigation areas will be carefully controlled and prevented. All storm or surface water drainage will be diverted away from the irrigation area, and stormwater infrastructure will be excluded from the area.

Where seepage into the irrigation areas may occur due to natural topography of the surrounding land, cut-off trench drains or diversion drains will be installed up-slope to divert surface water away from the irrigated area.

In the north of the site, a spoon drain and connected grease trap will be used to capture and filter any runoff from the road, ensuring that stormwater runoff does not come into contact with the ATU system.

As-constructed surveyed plans of the stormwater drainage infrastructure will be produced following construction and installation of the ATU, irrigation system and carparking areas.

9.6. Vegetation

To avoid excessive surface runoff during an unusual storm event, vegetated drainage paths and vegetated buffers will be used to prevent contaminant transport and land erosion. These will be located alongside the edges of impervious surfaces and surfaces that are heavily trafficked e.g. the bitumen driveway, the carpark and roads/footpaths.

Vegetated drainage paths and vegetated buffers remove most nutrients from stormwater, trap suspended sediments, and encourage nutrient retention in the soils through absorption in accumulated organic material and increased root activity. Recent studies in Australia have shown that both natural vegetation and grassy filter strips can trap around 90% of the sediment and nutrients moving from upslope land. Well vegetated strips can include water tolerant species such as native grasses and reeds, shrubs and trees, and even woody debris to filter out sediment and reduce contamination from nutrients. Vegetation species should be carefully selected to suit site conditions with a list of salt and nutrient tolerant species provided in **Section 6.5.**

Clearing of vegetation will be avoided wherever possible, except where considered central to the proposed development or in accordance with bushfire regulations. Revegetation will be promoted throughout the site, including planting of additional species within the irrigation areas to increase plant density and establishment of defined vegetated drainage paths.

10. COMUNITY ENGAGEMENT

The installation of an ATU at Chalet Rigi caused some concern within the local community with regards to the potential contamination of Hackett's Gully Creek. Community support is very important for a development of this nature, and efforts should be made by Fallright to alleviate concerns through provision of technical information to the community.

It is recommended that Fallright make this Water Management Plan available upon request such that more comprehensive details are available should they be desired by the community. This could include neighbouring residents, City of Kalamunda Councillors, the Kalamunda State Member of Parliament and local Friends of Piesse Brook group.

11. WATERWISE SUSTAINABILITY

BioMAX ATUs enable recycling of treated wastewater through production of sterile, clear and odourless effluent that is fit for purpose for non-potable uses and exceeds stringent water quality parameters set by the DOH, enabling it to be used to irrigate landscaped areas. Recycled water used for environmental benefits with unlikely human exposure, as described above, is classified by the DOH as having an "Extra Low" exposure risk (DOH, 2011).

As WA's climate continues to dry and population continues to increase, the role of wastewater treatment plants (WWTPs) is changing rapidly. Resource recovery is essential through WWTP production of recycled water, biosolids and biogas. Recycled treated water is a precious commodity and is used in a variety of applications, from irrigation of recreational grounds, urban forests and wetlands, to horticulture and industrial processes, through to recharge of aquifers for replenishment of drinking water.

The State Government is rapidly recognising that falling groundwater levels and increased salinity in our aquifers, caused by over-abstraction and a changing climate, means that access to clean water, both for potable and non-potable uses, is a problem that will likely face all generations of Western Australians. Recycling of treated water from WWTPs is acknowledged as crucial to managing Perth's decreasing rainfall and associated run-off into Perth's surface water dams.

This position is reflected in the 2011 DOH publication "*The Guidelines for the Non-potable Uses of Recycled Water in WA*" which state that wastewater can no longer be considered 'waste' to be discarded but a resource with potential value if used in a 'fit for purpose' manner, i.e. non-potable uses such as open space irrigation, toilet flushing and a variety of industrial and agricultural uses. Furthermore, reusing wastewater allows conservation of high-quality water for drinking and other specialised high value uses.

In August 2017, the DOH gave Water Corporation approval to commence a landmark aquifer "recharge" project whereby recycled wastewater from the Beenyup WWTP is injected into Perth's Gnangara aquifer where it can be redrawn by Water Corporation to provide drinking water for Perth's metro suburbs. The approval was granted from DOH on the basis that water produced by the WWTP was fit for purpose and meets Australian guidelines for drinking water quality.

In October 2019, the DOW released a publication entitled "*Waterwise Perth – A 2 Year Action Plan*" as part of the McGowan Government's co-ordinated response to the impacts of climate change in a growing city. The south-west of Australia is one of the most impacted places on the planet by climate change and for Perth to remain a beautiful, green and liveable city in the future, we must act now (DOW, 2019).

The *Waterwise Perth Action Plan* sets targets to respond to the major impacts of climate change on water resources and liveability to support the 3.5 million population anticipated to reside in Perth by 2050. The plan includes increased use of recycled water as well as all government-led urban development projects in Perth and Peel to be 100 % waterwise.

There is no doubt that recycling of treated wastewater for non-potable and potable uses, such as irrigation and passive aquifer recharge, is a vital component of the State's focus on water management. Providing treated wastewater quality is proven fit for purpose through analytical testing, it should form a crucial mechanism for protecting water availability and quality for generations to come.

BioMAX ATUs enable recycling of treated wastewater to allow it to be used to irrigate landscaped areas. Recycled water used for environmental benefits with unlikely human exposure, as described above, is classified by the DOH as having an "Extra Low" exposure risk (DOH, 2011).

As per the current DOH ATU approval, the treated effluent at Chalet Rigi is to be disposed of in a designated irrigation area and cannot be used for other 'beneficial purposes' such as toilet flushing until an approved **Recycling Water Management Plan** has been issued by the DOH. Fallright are encouraged to investigate the production of an appropriate Recycling Water Management Plan in the future such that they may recycle the treated effluent for use in toilet flushing or dust suppression as required.

12. Risk Management and Control Measures

A Risk Level Matrix was used to analyse the potential risks posed by operation of the ATU system at Chalet Rigi, including likelihood of a hazardous event occurring in a specified time frame and the severity of the consequences should the hazard occur and cause harm to public health or the environment (refer **Figure 15**).

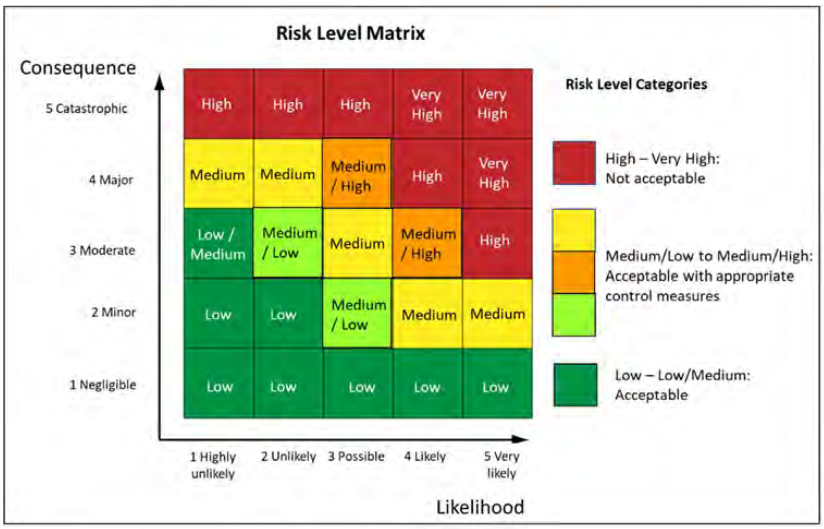

Figure 15 Risk Assessment: Risk Level Matrix

Definitions of consequence and likelihood levels are presented in **Table 11**.

Level	Definition
Consequence	
Negligible	No injuries, damage, environmental or operational impacts. No response required.
Minor	Environment: Contained environmental impact on-site, no off-site impacts. People: Injury requiring minor first aid or medical attention, no long-term effect. Public perception: Community interest generated. Operations: Minor damage to infrastructure/process, potential slowdown of operations. Response: Requires minor attention or causes minor inconvenience.
Moderate	Environment: Uncontained but repairable environmental impacts on-site only. People: Injury requiring significant first aid or medical attention, no long-term effect. Public perception: Interest raised, no marked concern, public image untarnished. Operations: Minor damage to infrastructure/process resulting in an organisational slowdown or minor idle time. Response: Requires attention with impacts lasting several days.
Major	Environment: Uncontained but repairable impact off-site. People: Severe injury or disability requiring hospitalisation, potential long-term effect. Public perception: Marked sustained interest, concern expressed, reputation damaged. Operations: Significant damage to infrastructure and major idle time. Response: Requires urgent attention with impacts lasting several days to weeks.
Catastrophic	Environment: Significant and non-repairable impact to the off-site environment. People: Severe long-term injuries, disability or loss of life. Public perception: Medium-long term reaction, reputation damaged beyond repair. Operations: Loss of a critical infrastructure component or stoppage of operations. Response: Requires urgent attention, widespread impacts lasting weeks/months and potentially permanently.

Level	Definition
Likelihood	
Very unlikely	May happen, frequency of greater than every 5 years
Unlikely	Might happen every couple of years
Possible	Might happen between once and a few times a year
Likely	A regular monthly occurrence
Very likely	An almost-guaranteed daily or weekly occurrence

Table 11 Risk Assessment – Consequence and Likelihood Definitions

The risk level matrix combines consequence and likelihood of hazard occurrence to produce a defined risk level. This risk level can then be used to rank and prioritise identified risks and assist with their management through various risk reduction control measures. Risks identified as "low" can usually be accepted without any form of risk reduction measures, whilst risks identified as "high" are usually unacceptable. Risks identified as "medium" are generally acceptable with appropriate risk reduction measures in place and with regular monitoring and review.

A risk assessment for the operation of the ATU system at Chalet Rigi is presented in **Table 12** alongside recommended risk reduction measures to ensure risks are adequately controlled. Should conditions or processes on-site change significantly, the risk assessment should be reviewed to ensure it is still reflective of the consequences and likelihood of hazardous events occurring.

Potential Risk	L.	C.	Risk Level	Risk Reduction Measures	L.	C.	Risk Level
Overflow of ATU by untreated wastewater or sludge or scum due to mechanical failure of pumps or inadequate pump-out of solids.	Possible	Moderate	**Medium**	**Design:** BioMAX C80 has in-built emergency storage capacity of over 24 hours (18,000 L) to ensure problems can be rectified before overflow. An alarm system (red flashing light and siren) is provided to warn of high-water level in the ATU. Should an alarm be activated, or an overflow be suspected, the approved maintenance provider will be contacted **immediately**. The approved provider is in the Perth region and less than 30 minutes travel distance from the site. **Operation/Maintenance:** Avoid discharging solid or organic material into the wastewater system e.g. food scraps, sanitary products etc. Scrape food waste off dishes, instead of rinsing them with water. Do not pour fats, oils or grease down the sink. Use physical barriers e.g. sink strainers. Provide alternative facilities for staff and patrons e.g. sanitary disposal units. Encourage water-wise consumption of water e.g. turn taps off whilst washing hands, refillable water bottles in the fridge, wash fruit and vegetables in a bowl, use a water efficient dishwasher. De-sludge the aerobic chambers as required (after 5 – 7 years or sooner if required). Complete regular 3-month maintenance services by an approved provider, including water/sludge levels and pump performance. Undertake recommended repairs as soon as reasonably practicable (ASARP). **Administration:** Educate staff and customers through procedures, training and signage. Clearly display emergency contact details for staff.	Highly Unlikely	Moderate	**Low / Medium Risk**

Potential Risk	L.	C.	Risk Level	Risk Reduction Measures	L.	C.	Risk Level
Discharge of partially treated effluent due to damaged treatment process caused by accidental chemical discharge into the system.	Possible	Moderate	**Medium**	**Operation/Maintenance** Do not, under any circumstances, allow paints, automotive oils and greases, or trade/industrial liquid wastes to enter the system. Do not use caustic soda or drain cleaners to unblock pipes and drains. Do not pour fats, oils or grease down the sink and wipe pots and pans before washing. Do not dispose of medicines or antibiotics down the drain. Avoid bleach, sanitisers, caustic chemicals, corrosive fluids and disinfectants. Use low-sodium and low-phosphate cleaning products and avoid those that contain boron, borax, chlorine, bleach, sodium perborate and sodium trypochlorite (salts), sodium tripolyphosphates (STPP), phosphorus, phosphates, polyphosphates, phosphate builders, acids and bulking agents. Where possible, use natural cleaning products such as bicarbonate soda and vinegar. Avoid discharging organic material into the wastewater system e.g. food scraps. Scrape food off dishes. Use physical barriers e.g. sink strainers. If chemicals are accidentally poured down a drain, contact the system manufacturer for advice immediately. Additional live bacteria may be required to replace or boost the bacteria in your system - various bacterium strains are available to purchase from BioMAX. If fats, oils or greases enter the system, use a dedicated product such as BioMAX GREASE AWAY to mitigate the effects. **Administration:** Educate staff and customers through procedures, training and signage.	Highly Unlikely	Moderate	**Low / Medium Risk**
Discharge of untreated effluent due to chemical dosing failure and reduced disinfection capability.	Unlikely	Moderate	**Medium / Low**	**Design:** For conservatism, the BioMAX C80 chlorinator is calibrated for above-capacity water usage. An alarm system is provided to warn of low chlorine stocks in the ATU. Should an alarm be activated, the approved maintenance provider will be contacted **immediately**. The approved provider is in the Perth region and less than 30 minutes from the site. **Operation/Maintenance:** Chlorine is provided to cover maximum capacity and includes a built-in safety factor to ensure stocks last between the 3-month service periods. Complete regular 3-month maintenance services by an approved provider including inspect chlorinator and chlorination equipment, check free chlorine residual value and replenish chlorine stocks. Undertake any recommended repairs ASARP. **Administration:** Educate staff through procedures, training and signage. Clearly display emergency contact details for staff.	Highly Unlikely	Moderate	**Low / Medium Risk**

Potential Risk	L.	C.	Risk Level	Risk Reduction Measures	L.	C.	Risk Level
Discharge of partially treated effluent due to mechanical failure of blowers or short-circuiting of treatment process.	Unlikely	Moderate	**Medium / Low**	**Design:** The multiple compartment design of the aerobic chamber (Tanks 1 – 3) ensures there is no short circuiting of the system and prevents partially-treated wastewater passing to the clarification chamber. An alarm system is provided to warn of pump failure in the ATU. Should an alarm be activated, the approved maintenance provider will be contacted **immediately**. The approved provider is in the Perth region and less than 30 minutes from the site. **Operation/Maintenance:** Complete regular 3-month maintenance services by an approved provider, including clean air blower and filter pads, check air supply to aeration tank, flow distribution and slime growth on filter media. Undertake any recommended repairs ASARP. **Administration:** Educate staff through procedures, training and signage. Clearly display emergency contact details for staff.	Highly Unlikely	Moderate	**Low / Medium Risk**
Reduced drainage/ evapotranspiration capacity in irrigation areas due to soil salinization e.g. damaged soil structure, hydrophobic conditions, reduced porosity, and restricted plant growth.	Unlikely	Moderate	**Medium / Low**	**Operation/Maintenance:** Ensure sufficient topsoil depth (150 mm) and plant density is maintained to increase in-soil treatment and provide erosion control. Choose vegetation species that are salt and phosphate tolerant. Where necessary, apply additional topsoil up to 250 mm. Avoid discharging excess sodium through kitchen and bar operations e.g. liquid food or beverages. Use low-sodium and low-phosphate cleaning products and avoid those that contain boron, borax, chlorine, bleach, sodium perborate and sodium trypochlorite (salts), STPP, phosphorus, phosphates, polyphosphates, phosphate builders, acids and bulking agents. Where possible, use natural cleaning products such as bicarbonate soda and vinegar. Liquid detergents (instead of powders) or products with potassium salts are preferable as they produce less saline greywater. Complete regular 3-month maintenance services by an approved provider, including check of drip irrigation lines, spray jets, irrigation areas and vegetation condition for evidence of salt build-up/deposits or degraded vegetation growth. Undertake any recommended repairs ASARP. **Administration:** Educate staff through procedures, training and signage.	Highly Unlikely	Moderate	**Low / Medium Risk**

Potential Risk	L.	C.	Risk Level	Risk Reduction Measures	L.	C.	Risk Level
Treatment process damaged by extended periods of vacancy e.g. low patron numbers or site evacuation, or by intermittent periods of high loading e.g. high customer numbers following quieter periods.	Possible	Minor	**Medium / Low**	**Design:** BioMAX C80 is not sensitive to changes in hydraulic load. It is designed to cope with a larger capacity of wastewater than specified and sudden increases following quieter periods. This includes excess storage capacity, built-in redundancy and reserve capacity of pumps and compressors. BioMAX C80 contains an "activated sludge mechanism" which continually refines and recycles wastewater internally. This continuous return of biological sludge from the clarification chamber to the anaerobic chamber via the automatic sludge/skimmer return mechanism ensures continuous fluid movement through the system, even with zero inflow. This keeps the system "live" during periods of extended vacancy and ensures there is no system damage in the event of unforeseen shutdowns. When the amenities are in use again, the BioMAX will continue to operate as normal. **Operation/Maintenance:** Keep system operational and "live" during any site evacuations or closures. Complete regular 3-month maintenance services by an approved provider to ensure optimum system health. Undertake any recommended repairs ASARP. **Administration:** Educate staff through procedures, training and signage.	Highly Unlikely	Minor	**Low Risk**
System shutdown due to power failure caused by storm, bushfire or unplanned outage	Possible	Minor	**Medium / Low**	**Design:** BioMAX C80 is gravity-fed so wastewater can continue to flow into the system in the event of a power failure. The system has the capacity to treat wastewater at the normal rate for at least 48 hours until power is restored, during which time a back-up generator could be sourced should the power remain off and the system still be required at full capacity. **Operation/Maintenance:** Complete regular 3-month maintenance services by an approved provider to ensure optimum system health. Undertake any recommended repairs ASARP. **Administration:** Educate staff through procedures, training and signage. Clearly display emergency contact details for staff. Provide staff with information on where/how to source a back-up generator in the event of an emergency.	Highly Unlikely	Minor	**Low Risk**

Potential Risk	L.	C.	Risk Level	Risk Reduction Measures	L.	C.	Risk Level
Reduced drainage/ evapotranspiration capacity in irrigation areas due to damaged irrigation system (e.g. clogged distribution points, leaking or damaged pipes) caused by unauthorised traffic of area, tree roots, storm damage or other.	Possible	Minor	**Medium / Low**	**Design:** Use materials, pipes, bend junctions and fittings that are free from defect and assembled to be watertight. Construct and install the irrigation system so it is protected from root ingress and minor ground movements. Minimise compaction during installation by avoiding the use of heavy earthwork machinery. The irrigation system should be authorised and installed in accordance with AS 3500 National Plumbing and Drainage Code. Provide reasonable access to allow visual inspection, routine system maintenance and clearing of blockages. Ensure the irrigation area is well delineated and protected by fencing, railings, vegetation planting, landscape design or other barrier methods. Do not plant additional large tree species in or too close to the irrigation area as the roots can damage or block the irrigation system (existing trees with established roots are acceptable). Complete a commissioning trial to ensure equal pressure and distribution and prevent blow outs in the irrigation system. **Operations/Maintenance** Emphasize the strict prohibition of access to the irrigation areas through staff procedures and training and adequate signage for customers. Do not allow livestock, pets or any vehicle to access or traverse the irrigation areas. Regularly inspect the irrigation areas for signs of damaged lines or infrastructure – repair/replace ASARP if identified.	Highly Unlikely	Minor	**Low Risk**

Table 12 On-site Wastewater Management Risk Assessment and Control Measures

13. REFERENCES

Australian Standard AS/NZS 1547:2012 On-site Domestic Wastewater Management

Australian Standard AS 2698-2:2000 Plastics Pipes and Fittings for Irrigation and Rural Applications

BioMAX Pty Ltd (2019) Model C80 Wastewater Treatment System, Technical and Maintenance Manual, Rev 1, 8 April 2019

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City of Kalamunda (undated) Stormwater Design Guidelines for Subdivisional and Property Development

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Eastern Hills Catchment Management Program (2012) Eastern Hills Catchment Management Plan

Ecoscape (2011) Mundaring Weir Water Supply Interpretation Precinct Design, produced for Water Corporation WA

Evergreen Consultancy WA (2019) Water Quality Monitoring, September 2019

Evergreen Consultancy, Addendum Water Management Plan, Rev 1, May 2019

Galt Geotechnics (2019) Email clarifications to DOH dated April 2019

Galt Geotechnics (2019) Technical Memorandum: Assessment of Areas for Effluent Disposal, Chalet Rigi Restaurant Development, 415 Mundaring Weir Road, Piesse Brook, J1901021 001 TM Rev0, 15 March 2019

Gerritse, R. (2002) Movement of Nutrients from Onsite Wastewater Systems in Soils

Sheppard Design & Drafting Services (2019) Site Plans, Figures 1 – 7 and Annexures 1 – 2 dated 16 April 2019

Stass Environmental (2012) Wastewater Treatment, Chalet Rigi Restaurant Kalamunda, WA, June 2012

Stass Environmental (2012) Wastewater Treatment, Chalet Rigi Restaurant Kalamunda, WA, February 2012

Structerre (2019) Geotechnical Investigation and Soil Permeability Testing, Chalet Rigi

WA Department of Health (2019) Approval to Construct or Install an Apparatus for the Treatment of Sewage at 415 Mundaring Weir Road, dated 22 July 2019, approval no: 200:18

WA Department of Health (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia, available online at: http://ww2.health.wa.gov.au/Articles/N_R/Recycled-water

WA Department of Health (2001) Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (ATU's) , available online at http://ww2.health.wa.gov.au/Articles/U_Z/Water-legislations-and-guidelines

WA Department of Water and Environmental Regulation (2019) Operational Policy 13: Recreation within Public Drinking Water Source Areas on Crown Land

WA Department of Water and Environmental Regulation and WA Department of Biodiversity, Conservation and Attractions (2018) Helena River: Swan Canning Catchment Nutrient Report 2018

WA Department of Water (2019) Water Wise Perth: A Growing City responding to Climate Change. Two Year Action Plan

WA Department of Water (2016) Water Quality Protection Note No. 25: Land Use Compatibility Tables for Public Drinking Water Source Areas

WA Department of Water (2016) Water Quality Protection Note No. 70: Wastewater Treatment and Disposal – Domestic Systems

WA Department of Water (2013) Guidance Note 3: Preparation and Assessment of Water Management Reports

WA Department of Water (2012) Water Quality Protection Note No. 88: Rural Tourist Accommodation

WA Department of Water (2008) Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions

WA Department of Water (2007) Mundaring Weir Catchment Area Drinking Water Source Protection Plan, Report No. 69

WA Department of Water (2006) Water Quality Protection Note No. 79: Rural Restaurants, Cafés and Taverns near Sensitive Water Resources

Water Design International (2018) Letter subject: Statement on the Water Quality achieved by the BioMAX C60, C80 and C120 Waste Water Treatment Systems, 10 April 2018

WA Government (1996) Government Sewerage Policy – Perth Metropolitan Region

WA Government (1974) Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations

Western Australian Planning Commission (2010) Middle Helena Catchment Area Land Use and Water Management Strategy (LUMS)

Western Australian Planning Commission (2003) Statement of Planning Policy No 2.7. Public Drinking WATER Source Policy. Prepared under Section 5AA of the Town Planning and Development Act 1928.

Water and Rivers Commission (1998) Datasheet on soil amendment for lining infiltration systems (BMP R2), A Manual for Managing Urban Stormwater Quality in Western Australia

14. LIMITATIONS

This report is dated 9 December 2019. The report is restricted to the agreed-upon Scope of Works stated in Section 1.3 of this report. No representations or warranties are made concerning the nature of any other substance on the Site other than the observations stated in this report.

In preparing this report, Evergreen Consultancy WA has relied upon certain verbal information and documentation provided by the Client (Fallright) and/or third parties. Except as discussed, Evergreen Consultancy did not attempt to independently verify the accuracy or completeness of that information.

All aerial imagery is supplied by Near Maps and is dated October 2019.

15. APPENDICES

Appendix A Previous ATU Approval (2012)

Appendix B Current ATU Approval (2019)

Appendix C BioMAX C80 ATU Technical and Maintenance Manual

Appendix D Previous Technical Documentation and Correspondence

Appendix E 2019 Structerre Borehole Logs and Soil Permeability Testing Results

Appendix F Phosphorous Retention Index Testing Documentation

Appendix G 2019 Surface Water Monitoring Analytical Laboratory Documentation

Appendix H BioMAX C80 ATU Signed Maintenance Agreement

APPENDIX A

Previous ATU Approval (2012)

File Number:	98/10
Date:	4/10/2012
Officer:	Kerry Fleming

shire of kalamunda

Local Government Report

Memo To: Executive Director, Public Health

Subject: **Local Government Report – Chalet Rigi, 415 Mundaring Weir Rd, Piesse Brook, Kalamunda**

Please find enclosed an "Application to Construct or Install an Apparatus for the Treatment of Sewage" at Chalet Rigi, 415 Mundaring Weir Road, Piesse Brook, Kalamunda along with 3 copies of a site plan showing the location of the apparatus and the relevant fees.

Premises Details

Number of Users	350
Type of Premises	Commercial - Restaurant
Purpose Description	To service restaurant

System Details

System Type	Aerobic Treatment Unit (ATU) (2x 3400mm, 1x 2400mm and 1x 1800mm diameter tanks) - specifications attached
Manufacturer/Brand	Bio Systems 2000 PTY LTD
Details of existing systems on lot	There is an existing caretakers dwelling on the property which has an existing effluent disposal system

Site Details

Slope (disposal area)	1:4-1:6
Soil type	Gravel/Laterite
Topography	Sloping
Lot size	2.60690 ha
Water Supply type	reticulated mains

As on site effluent disposal can be achieved* and it complies with the State Government Sewerage Policy, this application is supported by the Shire's Health Service which recommend approval be granted.

Should you require further information please do not hesitate to contact myself on kerry.fleming@kalamunda.wa.gov.au or 9257 9ext.

Yours faithfully,

Environmental Health Officer

* please refer to attached letter from DoH dated 10/5/2010

DEPARTMENT OF HEALTH APPROVED 26 NOV 2012 EDPH OF WA

HCN 11 OCT 2012 MAILROOM

APPENDIX B

Current ATU Approval (2019)

The Hon Roger Cook MLA
Deputy Premier
Minister for Health; Mental Health

Our Ref: 60-17042

Mr Milan Bevk
Business Development Manager
Saferight
mbevk@saferight.com.au

Dear Mr Bevk

Thank you for your email of 17 May 2019 regarding redevelopment of the Chalet Rigi located at 415 Mundaring Weir, Piesse Brook, and your request on behalf of the restaurant owners for exemption from the sewer connection requirement of the Government Sewerage Policy (GSP).

The Department of Health (DOH) is satisfied that sewer connection is not viable to serve the proposed development and is prepared to support the installation of an on-site wastewater system. The DOH further advises that the Biomax C80 wastewater system with a maximum capacity of 14,400L/day, servicing 480 people per day as proposed is adequate and that the property is capable of disposing of the wastewater safely on-site on 4,120sqm of irrigation disposal area.

Given the circumstances and interest generated by the development to boost local tourism and create new jobs in the area, the development is beneficial to the local community and is worthy of my support. Accordingly, I am prepared to grant the development an exemption from the sewer requirement and allow the use of an on-site wastewater system, subject to compliance with the conditions imposed by the DOH.

Please note that this is an exemption to the requirements of the GSP only and does not exempt requirements of other legislation, including the *Planning and Development Act 2005*.

I trust this will now enable the development to proceed.

Yours sincerely

HON ROGER COOK MLA
DEPUTY PREMIER
MINISTER FOR HEALTH; MENTAL HEALTH

20 JUN 2019

13th Floor, Dumas House, 2 Havelock Street, WEST PERTH WA 6005
Telephone: +61 8 6552 6500 Facsimile: +61 8 6552 6501 Email:Minister.Cook@dpc.wa.gov.au

Government of **Western Australia**
Department of **Health**

HEALTH ACT 1911
HEALTH (TREATMENT OF SEWAGE AND DISPOSAL OF
EFFLUENT AND LIQUID WASTE) REGULATIONS 1974 (Reg 4A(5)(a))

APPROVAL TO CONSTRUCT OR INSTALL AN APPARATUS FOR THE TREATMENT OF SEWAGE

Approval is hereby granted to the Applicant: **Gordon McCormack**

to construct or install the apparatus for the treatment of sewage located at

Lot or Pt No: **3, House No. 415** Street: **Mundaring Weir Road**

Suburb: **Piesse Brook** Local Government: **City of Kalamunda**

TYPE OF WASTEWATER SYSTEM

Aerobic Treatment Unit: Biomax C80 (14.4KL/day) to optional pump tank to 4,120m^2 subsurface irrigation. Maximum capacity is for 14,400 litres per day or 480 patrons/persons including staff.

CONDITIONS OF APPROVAL:

The following water quality criteria shall be met for the system:

Parameter	Specification
Total Suspended Solids	< 30mg/l
Biological Oxygen Demand	< 20mg/l
Faecal Coliforms (*E.*Coli)	< 10cfu/100ml
Residual Free Chlorine	0.5mg/l – 2.0mg/l
pH	6.5 - 8.5

The use of holding tanks for the storage or management of wastewater or effluent is not permitted for this development, any future developments of this land or as part of this approval or future proposals. Any increase in wastewater volumes will require another Ministerial Exemption and upgrade of the onsite wastewater system subject to the site being capable of allowing for any such increase in wastewater volumes.

The disposal area shall ensure that there is a minimum separation of 500mm is achieved from the irrigation pipes to the winter/wettest ground or perched water tables.

Wastewater system is not to be located in trafficable areas;

Wastewater system not to be located at a distance less than 30 metres from any well, stream or underground source of water intended for consumptions by humans;

The irrigation disposal area with a slope greater than 10% or 5.7 degrees shall be terraced;

The disposal area is not to be located on land prone to waterlogging or subject to floodwater inundation;

(ATU) shall be a minimum of 6.0 metres from a well, bore or any water course;

ATU shall be a minimum of 1.8 metres from the surface irrigation disposal area;

Environmental Health
All correspondence PO Box 8172 Perth Business Centre Western Australia
Grace Vaughan House 227 Stubbs Terrace SHENTON PARK WA 6008
Telephone (08) 9388 4999 Fax (08) 9388 4955
28 684 750 332

ATU to be installed and constructed in accordance with the Code of Practice for the Design, Manufacture, Installation and Operation of ATUs;

Storm water and subsoil drainage (where installed) shall be discharged away from the cell soakage area and oil separator to be approved by Local Government;

Warning signs to surround the perimeter of the reticulated irrigation area/s;

High level audio-visual warning alarms to be provided to indicate a malfunction in the pumps in the surge control and effluent discharge tanks. The audio alarm shall have a muting device and shall be fitted to the ATU control panel;

A signed maintenance agreement by an authorised ATU service person and the owner of the property is to be submitted to the Local Government Environmental Health Officer before a Permit to Use can be issued;

As constructed pans and written certification that the unit has been installed in accordance with the Code of Practice for the Design, Manufacture, Installation and Operation of ATUs (if different from approval) are to be submitted to the Environmental Health Officer at the Council before the apparatus may be used;

If the wastewater volume increases or the population increases then the system shall be increased accordingly after discussions with the Local Environmental Health Officer;

The wastewater treatment system should be monitored regularly and a maintenance program implemented accordingly after discussions with the Local Environmental Health Officer;

All materials, pipes, bends junctions, fittings and fixtures shall be sound and free from defects and shall be authorised and installed in accordance with the AS 3500 National Plumbing and Drainage Code;

Treated effluent is to be disposed of in the submitted designated irrigation area and cannot be used for other 'beneficial purposes' such as dust suppression or toilet flushing until an approved Recycling Water Management Plan has been issued by the Department of Health;

Adherence to conditions on the Local Government Report Form;

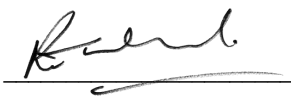
This approval is valid for a period of two years. If the works are not completed after 2 years from the date of this approval, the applicant is required to submit a new application;

The person who completes the construction or installation of the apparatus shall notify the above Local Government Environmental Health Officer to arrange an inspection and obtain a permit to use the apparatus;

All works shall be left open (not covered with soil) and available for an appropriate inspection;

It is an offence under section 107(4) of the *Health Act,* 1911 to use an apparatus before it has been inspected and a permit to use the apparatus issued;

The owner has the responsibility to maintain the system on a regular basis for the life of the system;

DELEGATE OF CHO: 

DATE: 22 July 2019 **APPROVAL No: 200.18** **RECEIPT No: 87403831264**

(200.18 - CO Kalamunda - Chalet Riggi - Lot 3 Hse 415 Mundaring Weir Road Piesse Brook ATU as amended F II - JN1819)

APPENDIX C

BioMAX C80 ATU Technical and Maintenance Manual

BioMAX®
WASTEWATER RECYCLING SYSTEMS

Install ANYWHERE with ease

MODEL C80

WASTEWATER TREATMENT SYSTEM

TECHNICAL AND MAINTENANCE MANUAL

Revision No.	Description	Date	Approval	Approval
0	Issued for use	1 Jul 17	C Durrant	
1	Issued for use	8 Apr 19	C Durrant	

BioMAX Pty. Ltd.
9 Elmsfield Road, Midvale WA. 6056
Phone (08) 9250 7733 Fax (08) 9250 5844
E-mail : Campbell@biomax.com.au

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2. PLANT SPECIFICATIONS

2.1 Hydraulic Load Estimates

The C80 maximum possible wastewater loading is 14,400 L/day

2.2 Design Loading

Total Flow in any 24 hours	: 14,400 L/day
Maximum BOD_5 per day	: 4,800 g
Maximum flow in 30 minutes	: 3,600 Litres
Maximum flow in 2 hours	: 7,200 Litres

2.3 Effluent Standards

The BioMAX C80 wastewater treatment system is designed to produce treated effluent of the following quality under standard operating and testing conditions.

Biochemical Oxygen Demand	: ≤20 mg/L
Total Suspended Solids	: ≤30 mg/L
Faecal Coliforms	: ≤10cfu /100mL
Residual Free Chlorine	: >0.5 mg/L
pH	: 6.5 – 8.5
Total Phosphorous	: ≤2 mg/L
Total Nitrogen	: ≤10 mg/L

3.0 PROCESS DESCRIPTION

The following process description and schematic flow diagram will assist in the understanding of the treatment processes used for the BioMAX Wastewater Treatment Plant.

The Wastewater Treatment Plant is divided into five principal chambers.

a) Anaerobic chamber-anaerobic treatment
b) Aerobic chamber-aerobic treatment
c) Clarification chamber-sludge settlement and removal
d) Disinfection chamber-contact time with chlorine
e) Pump out chamber- discharge to disposal system

3.1 Anaerobic Chamber

Raw wastewater is initially received into the anaerobic chamber. Approximately 30-50% of the suspended solids settle out in this chamber where they undergo anaerobic digestion. The anaerobic digestion process is carried out by micro organisms that have the ability to feed, grow and multiply in the absence of free oxygen. In addition settled sludge and skimmed material returned from the clarification chamber are further digested in this chamber. The plant is sized to enable these micro organisms to maintain a sufficient population naturally without the need for the addition of proprietary biological products.

3.2 Aerobic Chamber

The partially treated wastewater, still containing the colloidal and dissolved solids which represent approximately 65% of the pollution loading, flows from the anaerobic chamber to the aerobic chamber. Air is introduced to the liquid in this chamber by means of an aerator and diffusers, maintaining aerobic (free dissolved oxygen) conditions. The oxygen enriched effluent flows about packs of submerged media having a large surface area on which bacteria and other micro organisms thrive, forming a biological film. These micro organisms have a different growth process to those in the anaerobic chamber in that they utilise the dissolved oxygen in the effluent, while consuming the dissolved and colloidal organic matter as food to create new cell growth and stable oxidised products. The air pattern causes the liquid in the chamber to pass through the media in a discreet flow pattern and to have intimate contact with the micro organisms.

The process differs from ordinary suspended growth systems in that it is more stable and also allows the growth of sub surface anaerobic micro organisms beneath the surface film of aerobic micro organisms. This allows anaerobic bacterial action to check the media growth, thereby reducing the biological sludge accumulation. Nevertheless as the thickening of the material on the media occurs, some sloughing off will take place.

The multiple compartment design of the aerobic chamber ensures that no short circuiting can occur, preventing the possibility of partially treated wastewater passing to the clarification chamber. The diffused aeration system allows the air to be introduced below the media packs.

Basically the reaction in the aerobic chamber converts the dissolved and non-settleable (colloidal) solids into carbon dioxide and a biological floc, which under quiescent conditions will settle.

3.3 Clarification Chamber

Following aeration effluent flows into a circular, hopper bottomed clarification chamber, where the biological floc (or sludge) settles under quiescent conditions. Settled sludge from the bottom of the chamber and floating material are returned to the anaerobic chamber. From the clarification chamber the effluent is drawn off below surface level and flows through the chlorinator to the disinfection chamber.

This continuous return of sludge to the anaerobic chamber ensures continuous fluid movement in the plant even with zero inflow and keeps the system "live" during periods of extended vacancy.

3.4 Disinfection Chamber

The discharge from the clarification chamber passes through an automatic gravity chlorinator. The chlorinator is calibrated for above normal water usage. Chlorine stocks are provided to cover maximum usage with built in safety factors to cover all foreseeable circumstances between the service periods.

The disinfection chamber is designed to provide a minimum of 30 minutes contact time between the effluent and chlorine to ensure achievement of bacterial die-off.

3.5 Pump-out Chamber

After disinfection, the treated effluent enters the pump out chamber. The submersible pump in this chamber is automatically controlled by a level switch to operate and shut down as the level of the effluent rises and falls.

3.6 Alarms

The BioMAX has two mechanical components: an air blower and discharge pumps. An alarm is provided to warn of failure of either of these components. The plant has an inbuilt emergency storage of approximately two days at normal flow to ensure that any problem can be rectified before overflow occurs.

4.0 PLANT DESCRIPTION

The treatment plant consists of eight (8), 2.5m diameter concrete tank modules that contain the anaerobic and aerobic bioreactors, the clarification chamber, the disinfection chamber and the pump out chamber.

Major Plant Components

Anaerobic Chamber Capacity 20,640 Litres

Contained in the first, second and third of the eight concrete tank modules.
The anaerobic chamber has a water depth of 2.0m.

Aeration Chamber Capacity 20,160 Litres

Contained in the fourth, fifth and sixth concrete tank modules. Air blower used: Busch Model SB0310D2, designed to pump in 4000 L/min of air at 120 kPa absolute.

The diffused air aeration system delivers more than the required 2.4kg of oxygen per kg of BOD_5 per day, through the submerged attached growth media packs positioned above the diffusers.

Clarification Chamber Surface Area 4.24 m^2

Contained in the seventh of the concrete tank modules.
The circular chamber has a central conical hopper with 55 degree slope. An automatic sludge/skimmer return mechanism continuously returns the sludge and skimmed material to the primary chamber.

Disinfection Chamber Capacity 3,800 Litres

Contained in the eighth and last of the concrete tank modules.
The standard BioMax twin turret gravity flow chlorinator is designed for tablet chlorination using Trichloro Isocyanuric acid (200g) tablets to disinfect the effluent and to control algae growth in the irrigation system.

Pump Out Chamber

Also contained in the eighth of the concrete tank module is the pump-out chamber equipped with a Grundfos AP 12.50.11.3 automatic submersible pump controlled by a float switch. The pumping rate at 12m delivery is about 3.5 L/sec.

Emergency Buffer Capacity 18,000 Litres

5.0 OPERATION AND MAINTENANCE

5.1 Introduction

It is a requirement of the Health Department of Western Australia that these systems be regularly maintained by an approved service contractor. Should an alarm be activated, the approved maintenance provider should be contacted immediately. The plants have in built storage to allow judicious use of wastewater facilities to continue.

The operation and maintenance requirements are not unduly onerous and it is essential that they be carried out diligently. Inadequate attention can quickly see the system's performance suffer. Keeping the system in a clean condition will ensure that odour and insect nuisances are kept to a minimum and will improve the overall efficiency of the system.

The system has two mechanical components, a side channel air blower and submersible pumps. An alarm system is installed to detect loss of air pressure (potentially compressor failure) and high water level in the plant (potentially pump failure)

5.2 Operating Requirements

In brief the operating requirements are:-

Daily

Respond to any alarm calls

Quarterly

Comprehensive service- including:
- Clean air blower, air filter pads:
- Check alarm operation:
- Check aeration system:
- Clean down system:
- Replenish chlorine tablets:
- Clean effluent filter:

Annually

Service air blowers

Periodically

De-sludge anaerobic chambers

Alarm

The alarm contains a red flashing light. The lighting up of the red warning light indicates malfunctioning of the air system or indicates a high water level in the pump-out chamber.

6.0 MAINTENANCE

6.1 Check list for trouble shooting

Indication	Cause	Action
System not operating	Circuit breaker on main board or electrical control unit tripped.	Check compressors and pump, replace if necessary and reset the circuit breaker.
Water level unusually high in main tank/ clarification tanks.	Blockage or break in outlet pipe work.	Flush out the block through the inspection opening / repair the broken pipe.
Odour from the system	Sludge return not adjusted correctly, causing sludge accumulation in clarification tanks.	Increase the air supply into the sludge return setting.
	Sludge return set too high, causing increased flow into the clarifiers.	Reduce the air supply to the sludge return setting.
WATER and AIR ALARMS		
System not operating	Circuit breaker in electrical control unit tripped.	Check compressors and pump, replace if necessary and reset circuit breaker
AIR ALARM		
Air Blowers not operating	Isolating switch turned off.	Turn on isolating switch.
	Circuit breaker in electrical control unit tripped.	Check compressors, replace if necessary & reset overload.
	Air Blower failure	Repair/replace.
Air Blowers operating	Insufficient water in aerobic chamber to operate pressure sensor.	Fill aerobic chamber to normal operating level.
Air system disconnected or leaking.	Air piping or joint failure.	Rectify & try to guard against a recurrence.
Alarm operating with a satisfactory supply of air to aerobic chamber.	Air tube to pressure sensor kinked, blocked or disconnected.	Reconnect air tube, straighten air tube.
WATER ALARM		
Pump not operating	Isolating switch turned off	Turn on isolating switch
	Overload in pump control box tripped	Check pump, replace if necessary and reset overload
	Pump float switch jammed in "off" position	Reposition pump
	Pump failure	Repair pump

Pump operating	Pump blockage	Clear blockage
	Inflow greater than pump rate	Check plumbing
	Alarm float "hung up" or faulty	Check & replace if necessary
	Filter blocked	Clean filter

6.2 Scheduled Maintenance

Chlorine Level

A free residual chlorine level of 0.5 mg/l is desirable only when the treated effluent is subjected to the use for above-surface (spray) disposal.

- Measure free residual chlorine level of effluent from disinfection chamber during period of heavy usage, using chlorine test kit as per manufacturer's instructions.

Chlorine Supply

- Check chlorine feed. Replenish supply. **Do not mix different types of chlorine**

Clarifier

Sludge return valve should be adjusted to give a continuous return flow to the anaerobic chamber. Service the clarifier as follows while the system is operating:

- If any floating material (scum) is on surface of clarifier, turn sludge return valve to off position and fully open skimmings return valve till all material has been removed.
- Turn skimmings return valve to the off position and fully open sludge return valve. Use scraper blade and gently scrape down sidewalls of clarifier to remove any built up material. Initially this will suspend material in clarifier and for a short time give the effluent a cloudy appearance.
- Leave sludge return on full for five minutes or until returned sludge colour becomes clear again.
- Reset the sludge return valve to approximately half open position to give continuous return flow to anaerobic chamber.

Aeration System

- Check condition of air blower. Ensure housing and in particular, vents are clean.

- Check air delivery system and adjust valves in aerobic chamber to give an even air pattern over the surface of the chamber. Adjustment should be carried out with all valves initially fully open, gradually throttling individual valves to achieve desired pattern. It will be necessary to also fine tune the sludge and skimmer valves in conjunction with this process.

- Check air alarm is operational by removing the air tube to the pressure sensor on the electrical control unit.

Effluent Disposal System

- Dismantle and clean filter on pumping line

- Check disposal area

- Check air release valves.

6.3 General

- Clean down system by keeping covers clear of soil etc, especially around access openings.

- Hose down tank internals to get rid of solid organic deposits where necessary.

Periodically

- Desludge anaerobic chambers. It is anticipated that this will be required after five to seven years of operation. Desludging requires a Licenced Liquid Waste Contractor to access the anaerobic chambers through the manhole covers and pump out contents.

6.4 Air Blower (refer to Appendix C)

Number of = **1**	Model:	**SB 0310D2**
Make: **Busch**	Motor:	**4.3 kW, Three phase**

6.5 Discharge Pump (refer to Appendix D)

Number of = **1**	Model:	**AP-12.50.11.3**
Make: **Grundfos**	Motor:	**1.9 kW, Three phase**

7.0 CARE OF SYSTEM

The BioMAX, in common with other wastewater treatment systems, uses natural biological processes to carry out the stabilisation of the organic waste matter produced by "domestic type" activity.

The following information is provided so that the optimum operation of the total system is maintained.

The normal use of household cleansing products in accordance with manufacturers' directions should not affect the biological processes in the system.

DON'TS

- Don't indiscriminately use and dispose of bleaching, disinfecting and caustic cleaning agents in large quantities into the system.
- Don't use the system for the disposal of drugs (ie. Antibiotics etc) solvents, paints, oil, excessive amounts of grease, or chemicals.
- Don't dispose of non-biodegradable material (ie. Sanitary napkins etc.) into the system

DO'S

- Do use environment friendly products whenever possible, eg. Non toxic cleaning agents, biodegradable low sodium detergents etc.

8.0 CERTIFICATE OF WARRANTY

BioMAX certifies that the BioMAX Model C80 Aerobic Treatment Unit has been designed constructed and installed to conform to the Plant Specifications on page 3 of this manual and the Plant Description on page 6.

BioMAX maintains a limited Parts & Labour Warranty on its equipment as follows:

- Ten (10) years' warranty against structural failure due to faulty materials or workmanship on any concrete/fibreglass/PVC components manufactured or assembled by BioMAX
- Electrical & Mechanical Equipment: The side channel air blower and the submersible pump that are part of the system will have warranty as offered by the respective manufacturers, which is for a period of twelve months, starting from the month of installation and starting of use of the equipment.

Conditions

1 No claim under this warranty shall be deemed to be acceptable unless done so in writing.

2 No claim under this warranty shall be valid unless the equipment has been used for the purpose that it was intended, and it is used and maintained strictly in accordance with the manufacturers' instructions and as per the layout provided with the equipment.

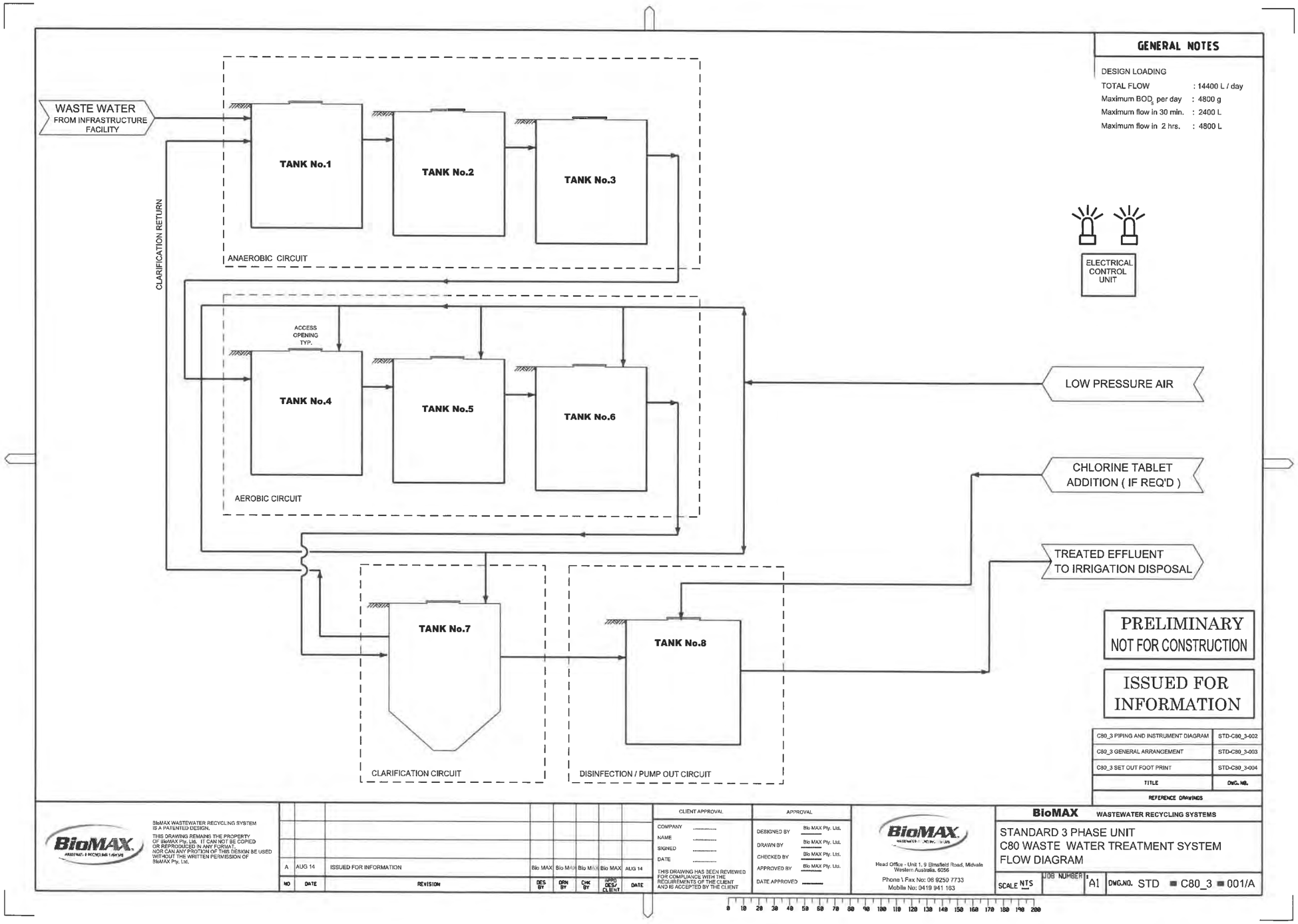
3 Claims under this warrant shall be directed to: The Managing Director BioMAX Pty Ltd., PO Box 462 Midvale, Western Australia, 6936, AUSTRALIA.

4 Only claims notified within seven (7) days of detection will be recognised. Warranty period shall commence from the date of delivery of the equipment.

5 BioMAX reserves the right to repair the failed component or provide the purchaser with a replacement component, as it deems necessary.

For BioMAX

Campbell Durrant


GENERAL NOTES
DESIGN LOADING
TOTAL FLOW : 14400 L / day
Maximum BOD_5 per day : 4800 g
Maximum flow in 30 min. : 2400 L
Maximum flow in 2 hrs. : 4800 L
WASTE WATER
FROM INFRASTRUCTURE FACILITY
TANK No.1
TANK No.2
TANK No.3
ANAEROBIC CIRCUIT
CLARIFICATION RETURN
ACCESS OPENING TYP.
TANK No.4
TANK No.5
TANK No.6
AEROBIC CIRCUIT
ELECTRICAL CONTROL UNIT
LOW PRESSURE AIR
CHLORINE TABLET ADDITION (IF REQ'D)
TREATED EFFLUENT TO IRRIGATION DISPOSAL
TANK No.7
TANK No.8
CLARIFICATION CIRCUIT
DISINFECTION / PUMP OUT CIRCUIT
PRELIMINARY
NOT FOR CONSTRUCTION
ISSUED FOR INFORMATION
C80_3 PIPING AND INSTRUMENT DIAGRAM STD-C80_3-002
C80_3 GENERAL ARRANGEMENT STD-C80_3-003
C80_3 SET OUT FOOT PRINT STD-C80_3-004
TITLE DWG. NO.
REFERENCE DRAWINGS
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NO DATE REVISION DES BY DRN BY CHK BY APPD DES/ CLIENT DATE
CLIENT APPROVAL
COMPANY .....
NAME .....
SIGNED .....
DATE .....
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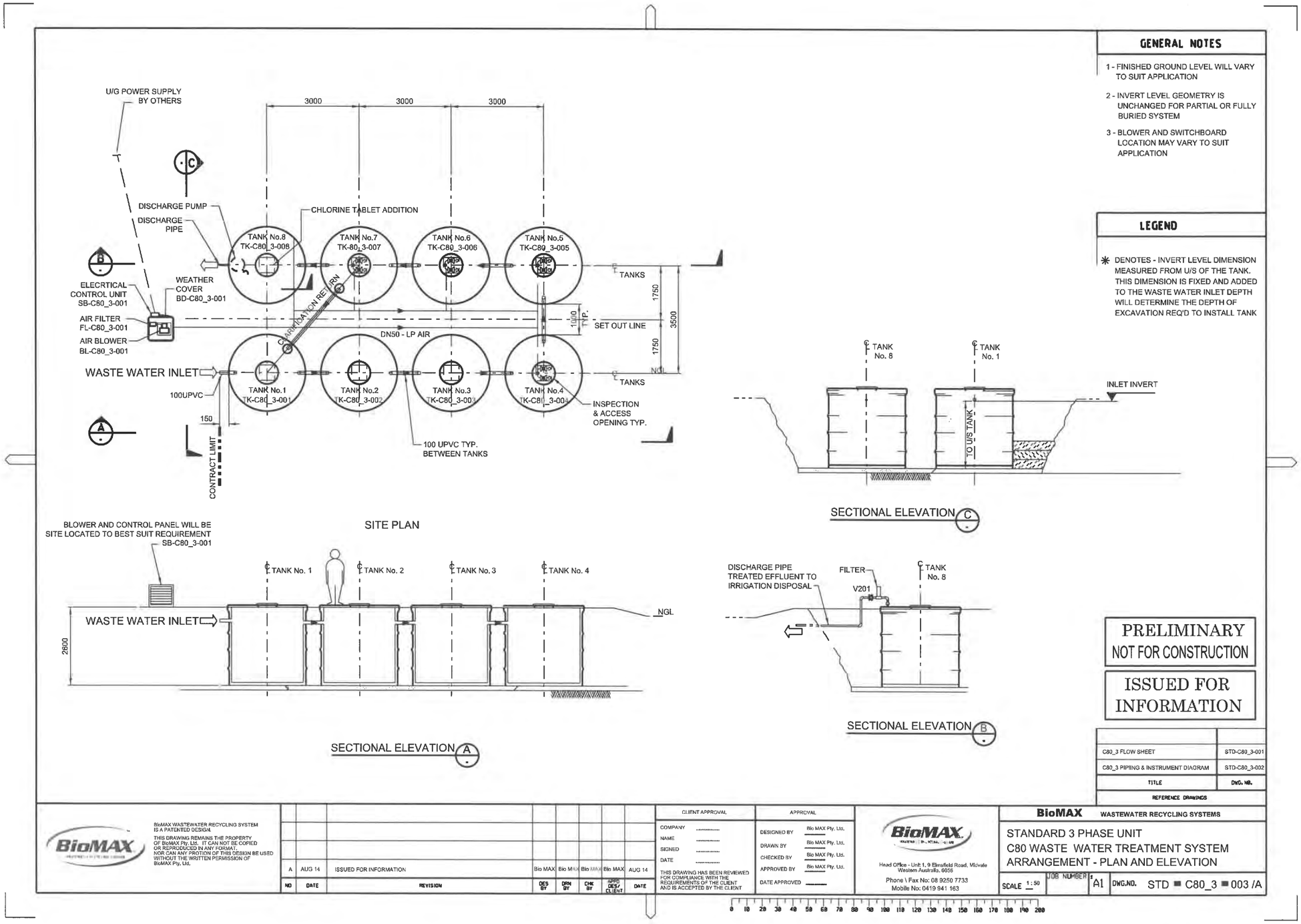
DESIGNED BY Bio MAX Pty. Ltd.
DRAWN BY Bio MAX Pty. Ltd.
CHECKED BY Bio MAX Pty. Ltd.
APPROVED BY Bio MAX Pty. Ltd.
DATE APPROVED .....
Head Office - Unit 1, 9 Elmsfield Road, Midvale Western Australia, 6056
Phone \ Fax No: 08 9250 7733
Mobile No: 0419 941 163
BioMAX WASTEWATER RECYCLING SYSTEMS
STANDARD 3 PHASE UNIT
C80 WASTE WATER TREATMENT SYSTEM
FLOW DIAGRAM
SCALE NTS
JOB NUMBER :
A1
DWG.NO. STD ■ C80_3 ■ 001/A
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200


U/G POWER SUPPLY BY OTHERS
3000
3000
3000
DISCHARGE PUMP
DISCHARGE PIPE
CHLORINE TABLET ADDITION
TANK No.8 TK-C80_3-008
TANK No.7 TK-80_3-007
TANK No.6 TK-C80_3-006
TANK No.5 TK-C80_3-005
TANKS
1750
100 TYP.
SET OUT LINE
3500
1750
TANKS
ELECRTICAL CONTROL UNIT SB-C80_3-001
WEATHER COVER BD-C80_3-001
AIR FILTER FL-C80_3-001
AIR BLOWER BL-C80_3-001
CHARGE/DISCHARGE RETURN
DN50 - LP AIR
WASTE WATER INLET
100UPVC
150
TANK No.1 TK-C80_3-001
TANK No.2 TK-C80_3-002
TANK No.3 TK-C80_3-003
TANK No.4 TK-C80_3-004
INSPECTION & ACCESS OPENING TYP.
100 UPVC TYP. BETWEEN TANKS
CONTRACT LIMIT
GENERAL NOTES
1 - FINISHED GROUND LEVEL WILL VARY TO SUIT APPLICATION
2 - INVERT LEVEL GEOMETRY IS UNCHANGED FOR PARTIAL OR FULLY BURIED SYSTEM
3 - BLOWER AND SWITCHBOARD LOCATION MAY VARY TO SUIT APPLICATION
LEGEND
* DENOTES - INVERT LEVEL DIMENSION MEASURED FROM U/S OF THE TANK. THIS DIMENSION IS FIXED AND ADDED TO THE WASTE WATER INLET DEPTH WILL DETERMINE THE DEPTH OF EXCAVATION REQ'D TO INSTALL TANK
TANK No. 8
TANK No. 1
INLET INVERT
TO U/S TANK
SECTIONAL ELEVATION C
BLOWER AND CONTROL PANEL WILL BE SITE LOCATED TO BEST SUIT REQUIREMENT
SB-C80_3-001
SITE PLAN
TANK No. 1
TANK No. 2
TANK No. 3
TANK No. 4
WASTE WATER INLET
NGL
2600
SECTIONAL ELEVATION A
DISCHARGE PIPE TREATED EFFLUENT TO IRRIGATION DISPOSAL
FILTER
V201
TANK No. 8
SECTIONAL ELEVATION B
PRELIMINARY NOT FOR CONSTRUCTION
ISSUED FOR INFORMATION
C80_3 FLOW SHEET STD-C80_3-001
C80_3 PIPING & INSTRUMENT DIAGRAM STD-C80_3-002
TITLE DWG. NO.
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CLIENT APPROVAL
COMPANY
NAME
SIGNED
DATE
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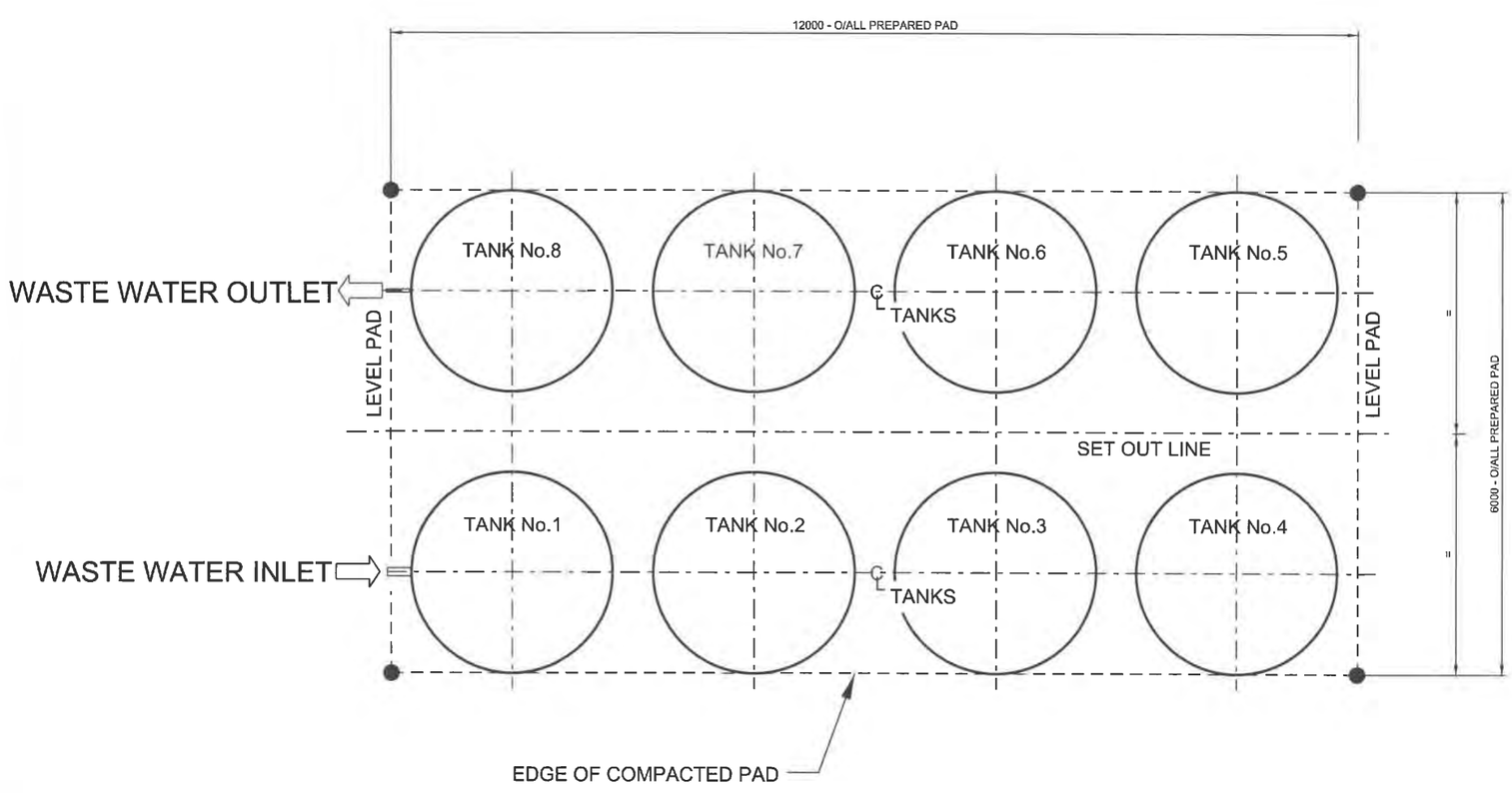
DRAWN BY Bio MAX Pty. Ltd.
CHECKED BY Bio MAX Pty. Ltd.
APPROVED BY Bio MAX Pty. Ltd.
DATE APPROVED
Head Office - Unit 1, 9 Elmsfield Road, Midvale Western Australia, 6056
Phone \ Fax No: 08 9250 7733
Mobile No: 0419 941 163
BioMAX WASTEWATER RECYCLING SYSTEMS
STANDARD 3 PHASE UNIT
C80 WASTE WATER TREATMENT SYSTEM
ARRANGEMENT - PLAN AND ELEVATION
SCALE 1:50
JOB NUMBER
A1
DWG.NO. STD ■ C80_3 ■ 003 /A
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200



SITE PLAN

GENERAL NOTES

1 - ORIENTATION FOR WASTE INLET, OUTLET & POWER SUPPLY MAY VARY TO SUIT SITE APPLICATION

2 - LOCATION & ORIENTATION FOR AIR PUMP AND SWITCH BOARD MAY VARY TO SUIT APPLICATION

3 - EXCAVATION DIMENSIONS INDICATED FOR BELOW GROUND INSTALLATION ARE MINIMUM REQUIREMENT ONLY. CONSULT WITH A SOIL ENGINEER TO CONFIRM SOIL STABILITY FOR SAFE EXCAVATION PRIOR TO DIGGING.

4 - CONSULT WITH YOUR SHIRE COUNCIL FOR ADVISE AND APPROVAL. PRIOR TO INSTALLATION

5 - FINISHED GROUND LEVEL WILL VARY TO SUIT APPLICATION

6 - INVERT LEVEL GEOMETRY IS UNCHANGED FOR PARTIAL OR FULLY BURIED SYSTEM

7 - COMPACTED LEVEL PAD TO BE PREPARED FOR TANK INSTALLATION

8 - TOP 150mm THICK LAYER OF PAD SHALL BE FINISHED WITH RIVER SAND

PRELIMINARY
NOT FOR CONSTRUCTION

ISSUED FOR INFORMATION

C80_3 FLOW SHEET	STD-C80_3-001
C80_3 PIPIING & INSTRUMENT DIAGRAM	STD-C80_3-002
C80_3 ARRANGEMENT	STD-C80_3-003
TITLE	DWG. NO.
REFERENCE DRAWINGS	

NO	DATE	REVISION	DES BY	DRN BY	CHK BY	APPD DES/ CLIENT	DATE
A	AUG 14	ISSUED FOR INFORMATION	Bio MAX	Bio MAX	Bio MAX	Bio MAX	AUG 14

CLIENT APPROVAL

COMPANY .....
NAME .....
SIGNED .....
DATE .....

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APPROVAL

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DRAWN BY	Bio MAX Pty. Ltd.
CHECKED BY	Bio MAX Pty. Ltd.
APPROVED BY	Bio MAX Pty. Ltd.
DATE APPROVED	.....

Head Office - Unit 1, 9 Elmsfield Road, Midvale Western Australia, 6056
Phone \ Fax No: 08 9250 7733
Mobile No: 0419 941 163

BioMAX WASTEWATER RECYCLING SYSTEMS

STANDARD 3 PHASE UNIT
C80 WASTE WATER TREATMENT SYSTEM
SITE SET OUT FOOT PRINT

SCALE 1:50 | JOB NUMBER: | A1 | DWG.NO. STD ■ C80_3 ■ 004 / A

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

APPENDIX D

Previous Technical Documentation and Correspondence

16 Oct 2019, Email from Director of Development Services, City of Kalamunda

24 Sept 2019, Letter from Director General, DWER

19 Sept 2019, Letter from Premier of Western Australia, Hon Mark McGowan

9 Sept 2019, Letter from Planning Manager, Swan Avon Region, DWER

7 Aug 2019, Letter from Executive Director, Environment Health, DOH

31 July 2019, Letter from Senior Planning Officer, Swan Region, DBCA

12 July 2019, Letter from Development Planner, Water Corporation

10 April 2018, Letter from Water Design International regarding capability of BioMAX

April 2019, Galt Geotechnics, Email clarifications to DOH

March 2019, Galt Geotechnics, Assessment of Areas for Effluent Disposal – Technical Memo

June 2012, Stass Environmental, Wastewater Treatment Report, Chalet Rigi

APPENDIX E

2019 Structerre Borehole Logs and Soil Permeability Testing Results

STRUCterre consulting engineers

Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH01**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	413947
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461967

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		SC: Clayey SAND: fine grained, low plasticity, with silt, with gravel, trace organic material (fine roots), brown	L				D	
		Sandy Clay Loam: fine to medium grained, medium to high plasticity, with sand, with silt, trace gravel, yellow/brown	F - St				D to M	
1		*mottled cream/red/brown*						
		Terminated at 1.65 m						
2								
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

WA | QLD | NSW | VIC

1 Erindale Road, Balcatta, Western Australia 6021 | PO Box 792, Balcatta, Western Australia 6914

Phone (+618) 9205 4500 | Fax (+618) 9205 4501 | Email wageotecheng@structerre.com.au | Web www.structerre.com.au

ABN 71 349 772 837 Zemla Pty Ltd ACN 008 966 283 as trustee for the Young Purich and Higham Unit Trust trading as Structerre Consulting Engineers

STRUCterre consulting engineers

Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH02**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	413953
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461943

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		Sandy Clay Loam: fine to medium grained, medium plasticity, with organic material (fine roots),trace gravel, yellow/brown	F - St				D to M	
1		Gravelly Clay Loam: medium grained, low plasticity, with sand, pale yellow/brown/cream						
		Terminated at 1.10 m						
2								
3								

Remarks

1. Termination reason: Refusal - interpreted on stiff clay
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Client Saferight Pty Ltd

Test No. **BH03**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	413976
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461874

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		SP: Sandy GRAVEL: fine to medium grained, non-plastic, with clay, trace silt, trace organic material (fine to medium roots), brown (FILL)	D				D to M	
		GP: Clayey GRAVEL: fine to medium grained, low to medium plasticity, with sand, with organic material (medium roots & wood chips), trace silt, brown						
1		Terminated at 1.00 m						
2								
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH04**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	413992
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461850

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
0		GP: Sandy GRAVEL: fine to medium grained, non-plastic to low plasticity, with clay, trace silt, trace organic material (fine roots & bark chips), brown (FILL)	D				D to M	
1		Terminated at 1.50 m						
2								
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Client Saferight Pty Ltd

Test No. **BH05**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414031
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461825

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		Sandy Clay Loam: fine to medium grained, low to medium plasticity, with silt, trace gravel, pale brown (FILL)	St - VSt				M	
1		GP: Sandy GRAVEL: fine to medium grained, non-plastic to low plasticity, with clay, trace silt, yellow/brown	D - VD				D to M	
		Terminated at 1.40 m						
2								
3								

Remarks

1. Termination reason: Refusal - interpreted on dense gravel
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH06**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414037
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461861

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		Sandy Clay Loam: fine to medium grained, medium to high plasticity, with silt, pale yellow/brown	St				D to M	
1								
		Terminated at 1.50 m						
2								
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH07**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414016
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461813

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		SP: SAND: fine to medium grained, non-plastic, with silt, trace clay, pale yellow/brown	MD - D				D to M	
1		SM: Silty SAND: fine to medium grained, non-plastic, yellow/brown	VD				M	
		Terminated at 1.20 m						
2								
3								

Remarks

1. Termination reason: Refusal - interpreted on cemented ground
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH08**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414025
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461785

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		SC: Clayey SAND: fine to medium grained, low to medium plasticity, with silt, trace organic material (fine roots), pale brown (FILL)	L					
		SC: Clayey SAND: fine to medium grained, medium to high plasticity, with silt, trace gravel, mottled yellow/brown/cream	D - VD				M	
1		SP: Silty SAND: fine to medium grained, non-plastic to low plasticity, trace gravel, pale yellow/brown					D to M	
		Terminated at 1.30 m						
2								
3								

Remarks

1. Termination reason: Refusal - interpreted on cemented ground
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH09**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414035
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461745

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm 5 10 15 20	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		SC: Clayey SAND: fine to medium grained, low to medium plasticity, with silt, with organic material (fine to medium roots),yellow/brown	D					
		Sandy Clay Loam: fine to medium grained, medium to high plasticity, with silt, pale yellow/brown	St - VSt				D to M	
1		Terminated at 1.00 m						
2								
3								

Remarks

1. Termination reason: Refusal - interpreted on stiff clay
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Road, Piesse Brook

Client Saferight Pty Ltd

Test No. **BH10**

Project No.	S936784	**Logged By**	Ben Wilson	**Machine**	Soil Retrieval Probe	**Easting**	414067
Job No.	S936784-A	**Date**	10/10/2019	**Hole Dia.**	65mm	**Northing**	6461684

Depth	Graphic	Stratum Description	Consistency	DCP Blows/150mm (5 10 15 20)	Samples Depth	Samples Type	Moisture	Water Level
		Topsoil:						
		Sandy Clay Loam: fine to medium grained, medium to high plasticity, with silt, trace organic material (fine roots), red/ brown	St				M	
1		SC: Clayey SAND: fine to medium grained, low to medium plasticity, with silt, yellow/brown	VD					
		Terminated at 1.50 m						
2								
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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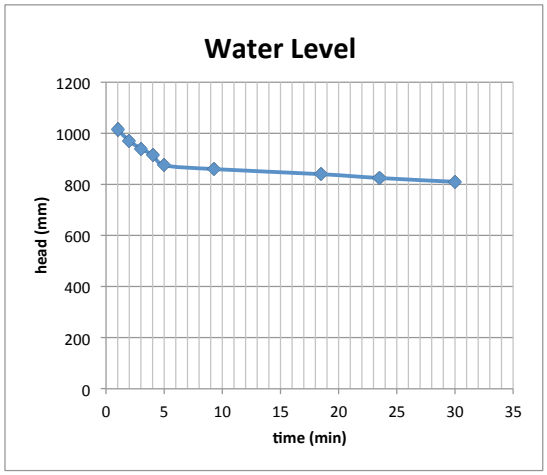
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E413947
Percolation No:	PERC 1	Operator:	BEW	Test Date:	10/10/19	N6461947

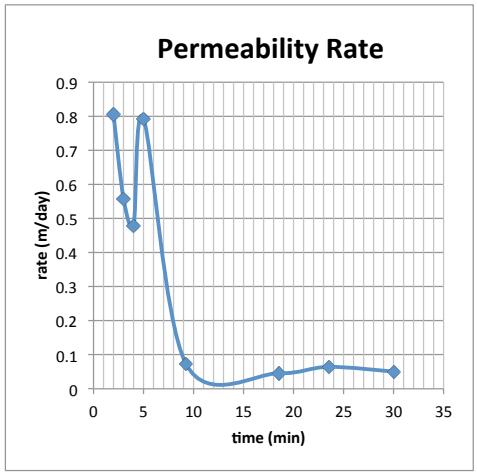
Diameter (mm)	50
Depth (mm)	1150

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	135	1015			
2	180	970	0.55916656	9.3194E-06	0.80519984
3	210	940	0.38719277	6.4532E-06	0.55755759
4	235	915	0.33209315	5.5349E-06	0.47821413
5	275	875	0.55043475	9.1739E-06	0.79262604
9.25	290	860	0.05007862	8.3464E-07	0.07211321
18.5	310	840	0.03130191	5.2170E-07	0.04507474
23.5	325	825	0.04433004	7.3883E-07	0.06383526
30	340	810	0.03471633	5.7861E-07	0.04999151
		Average	0.24866426	4.1444E-06	0.35807654
		Entire Interval	0.09581277	1.5969E-06	0.13797039





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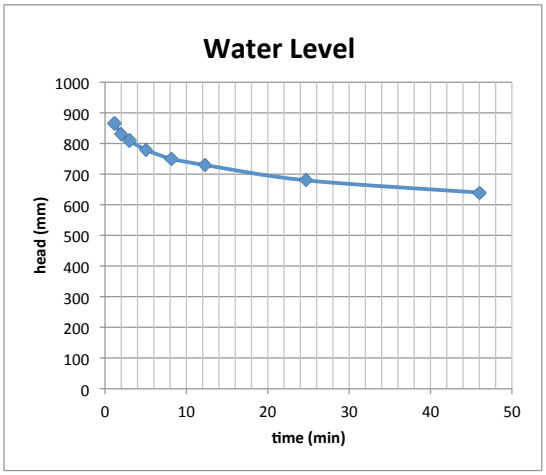
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E413953
Percolation No:	PERC 2	Operator:	BEW	Test Date:	10/10/19	N6461943

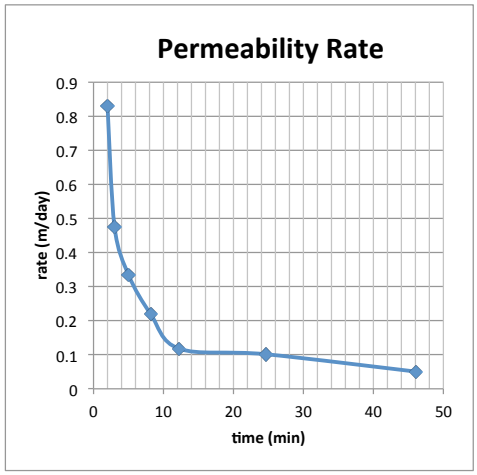
Diameter (mm)	50
Depth (mm)	950

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1.17	85	865			
2	118	832	0.57664433	9.6107E-06	0.83036784
3	140	810	0.32958273	5.4930E-06	0.47459914
5	170	780	0.23196414	3.8661E-06	0.33402836
8.17	200	750	0.15199792	2.5333E-06	0.21887701
12.25	220	730	0.08134129	1.3557E-06	0.11713146
24.67	270	680	0.07008491	1.1681E-06	0.10092227
46	310	640	0.03482788	5.8046E-07	0.05015215
		Average	0.21092046	3.5153E-06	0.30372546
		Entire Interval	0.08251539	1.3753E-06	0.11882216





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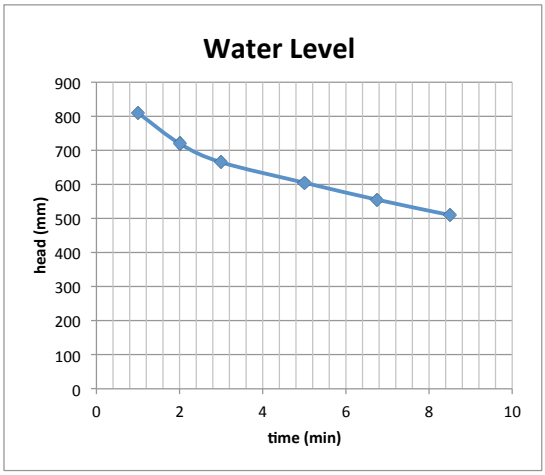
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E413976
Percolation No:	PERC 3	Operator:	BEW	Test Date:	10/10/19	N6461874

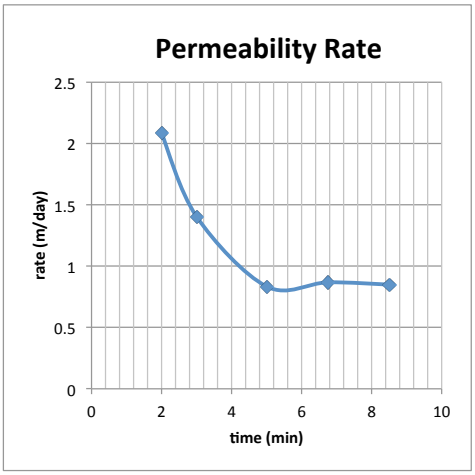
Diameter (mm)	50
Depth (mm)	1000

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	190	810			
2	280	720	1.44693798	2.4116E-05	2.08359069
3	335	665	0.97457697	1.6243E-05	1.40339084
5	395	605	0.57891485	9.6486E-06	0.83363739
6.75	445	555	0.60245372	1.0041E-05	0.86753336
8.5	490	510	0.5894501	9.8242E-06	0.84880814
		Average	0.83846672	1.3974E-05	1.20739208
		Entire Interval	0.75535685	1.2589E-05	1.08771386





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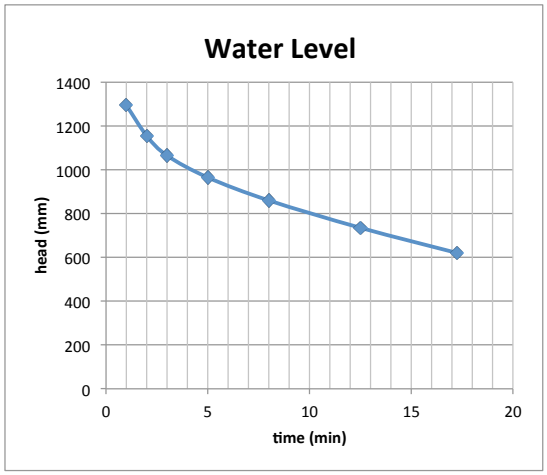
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E413992
Percolation No:	PERC 4	Operator:	BEW	Test Date:	10/10/19	N6461850

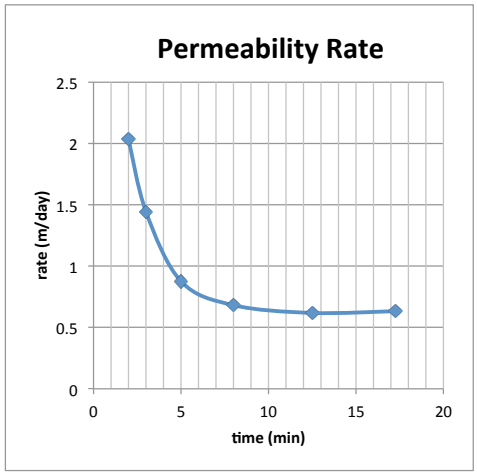
Diameter (mm)	50
Depth (mm)	1500

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	205	1295			
2	345	1155	1.41406324	2.3568E-05	2.03625106
3	435	1065	1.0016388	1.6694E-05	1.44235987
5	535	965	0.60806987	1.0134E-05	0.87562061
8	640	860	0.47295025	7.8825E-06	0.68104836
12.5	765	735	0.42904097	7.1507E-06	0.617819
17.25	880	620	0.43912246	7.3187E-06	0.63233634
		Average	0.72748093	1.2125E-05	1.04757254
		Entire Interval	0.55798207	9.2997E-06	0.80349417





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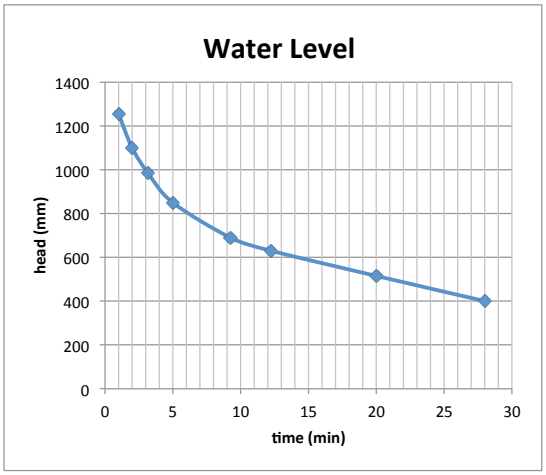
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E414031
Percolation No:	PERC 5	Operator:	BEW	Test Date:	10/10/19	N6461825

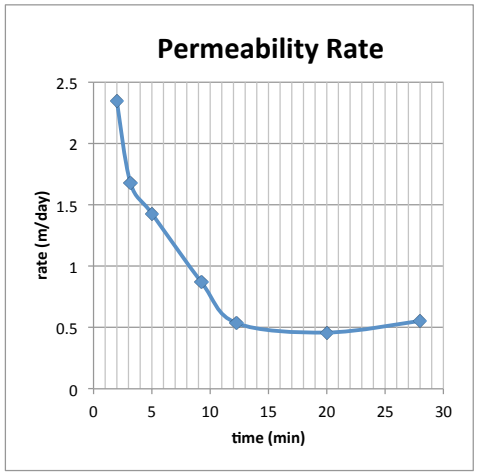
Diameter (mm)	50
Depth (mm)	1400

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	145	1255			
2	300	1100	1.62862852	2.7144E-05	2.34522506
3.17	415	985	1.16442698	1.9407E-05	1.67677485
5	550	850	0.99217036	1.6536E-05	1.42872533
9.25	710	690	0.60282171	1.0047E-05	0.86806327
12.25	770	630	0.37157647	6.1929E-06	0.53507011
20	885	515	0.31773635	5.2956E-06	0.45754034
28	1000	400	0.38380715	6.3968E-06	0.55268229
		Average	0.78016679	1.3003E-05	1.12344018
		Entire Interval	0.51912279	8.6520E-06	0.74753682





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Inspect & Investigate Energy Assessment Environmental

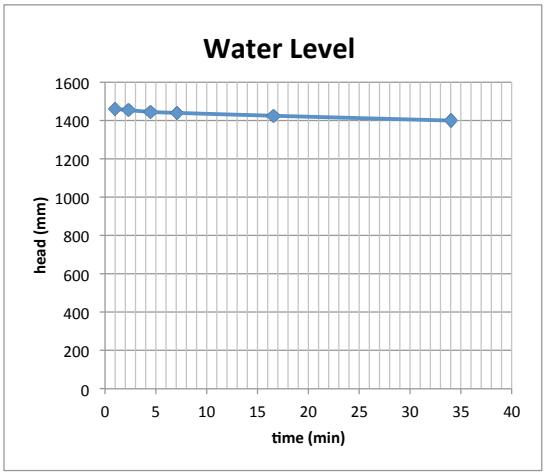
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E414037
Percolation No:	PERC 6	Operator:	BEW	Test Date:	11/10/19	N6461861

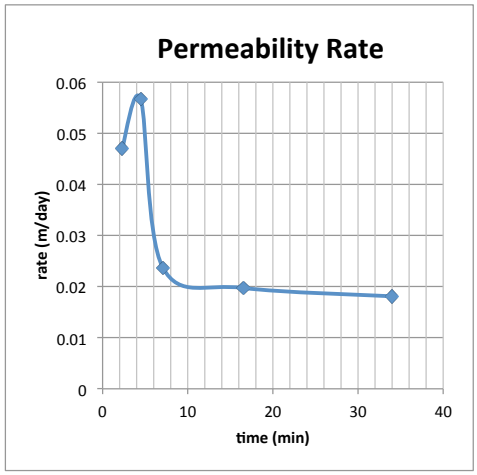
Diameter (mm)	50
Depth (mm)	1500

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	40	1460			
2.3	45	1455	0.0326687	5.4448E-07	0.04704293
4.47	55	1445	0.03934307	6.5572E-07	0.05665402
7.08	60	1440	0.01643952	2.7399E-07	0.02367291
16.55	75	1425	0.01368672	2.2811E-07	0.01970888
34	100	1400	0.01255345	2.0922E-07	0.01807696
		Average	0.02293829	3.8230E-07	0.03303114
		Entire Interval	0.01574006	2.6233E-07	0.02266568





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Residential Geotechnical Commercial & Infrastructure
Inspect & Investigate Energy Assessment Environmental

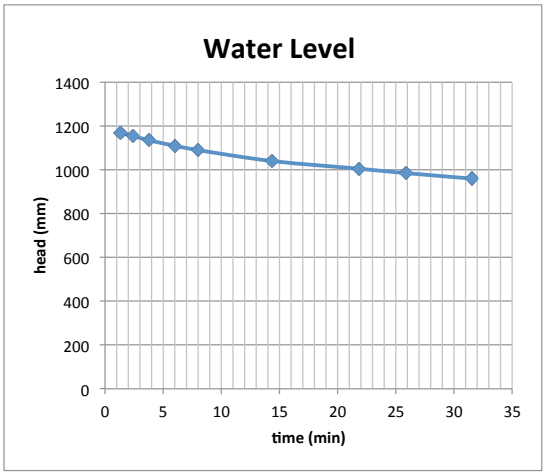
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E414016
Percolation No:	PERC 7	Operator:	BEW	Test Date:	11/10/19	N6461813

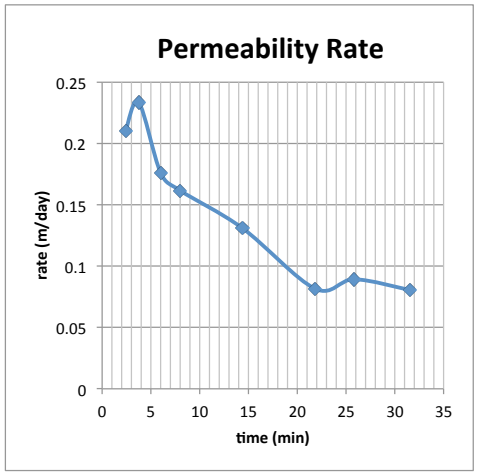
Diameter (mm)	50
Depth (mm)	1200

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1.33	30	1170			
2.42	45	1155	0.14623622	2.4373E-06	0.21058016
3.75	65	1135	0.16221474	2.7036E-06	0.23358923
6	90	1110	0.12223662	2.0373E-06	0.17602074
8	110	1090	0.11223643	1.8706E-06	0.16162046
14.37	160	1040	0.09097319	1.5162E-06	0.13100139
21.83	195	1005	0.05660469	9.4341E-07	0.08151075
25.83	215	985	0.06196713	1.0328E-06	0.08923267
31.5	240	960	0.05589413	9.3157E-07	0.08048755
		Average	0.10104539	1.6841E-06	0.14550537
		Entire Interval	0.08091504	1.3486E-06	0.11651766





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Residential Geotechnical Commercial & Infrastructure
Inspect & Investigate Energy Assessment Environmental

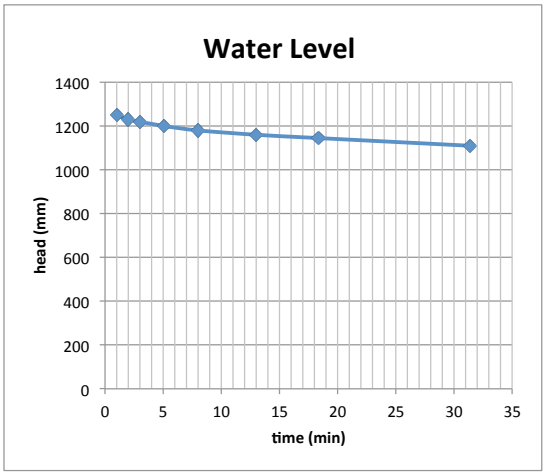
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E414025
Percolation No:	PERC 8	Operator:	BEW	Test Date:	11/10/19	N6461785

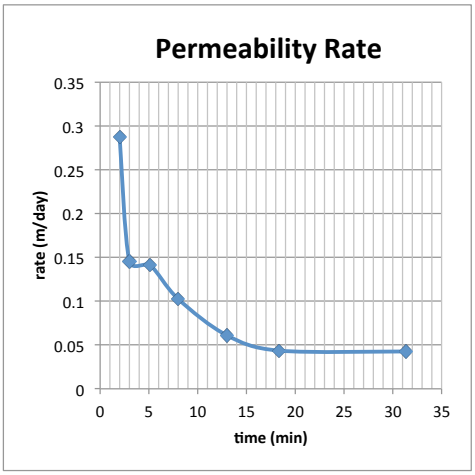
Diameter (mm)	50
Depth (mm)	1300

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	50	1250			
2	70	1230	0.19938094	3.3230E-06	0.28710856
3	80	1220	0.10089725	1.6816E-06	0.14529204
5.08	100	1200	0.09820863	1.6368E-06	0.14142042
8	120	1180	0.07112041	1.1853E-06	0.10241339
13	140	1160	0.04223683	7.0395E-07	0.06082104
18.33	155	1145	0.03016243	5.0271E-07	0.04343389
31.33	190	1110	0.02949009	4.9150E-07	0.04246573
		Average	0.08164237	1.3607E-06	0.11756501
		Entire Interval	0.04838592	8.0643E-07	0.06967572





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Residential Geotechnical Commercial & Infrastructure
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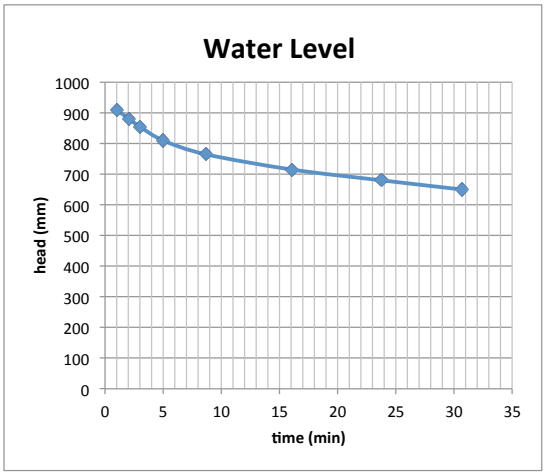
Client:	SAFERIGHT Pty Ltd		Job No:	S936784	Project No:	S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook				GPS:	E414035
Percolation No:	PERC 9	Operator: BEW	Test Date:	11/10/19		N6461745

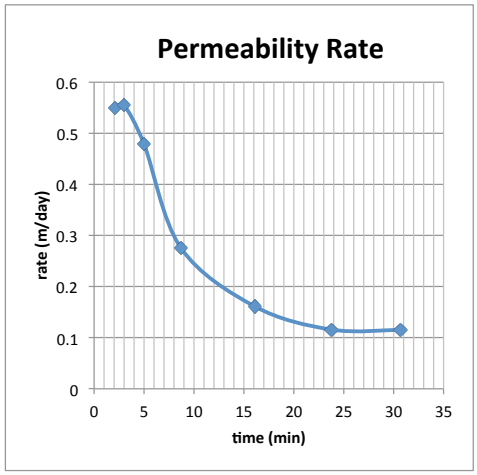
Diameter (mm)	50
Depth (mm)	1000

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	90	910			
2.08	120	880	0.38221927	6.3703E-06	0.55039575
3	145	855	0.38558567	6.4264E-06	0.55524336
5	190	810	0.33254517	5.5424E-06	0.47886504
8.66	235	765	0.1919456	3.1991E-06	0.27640166
16.08	285	715	0.11185145	1.8642E-06	0.16106609
23.75	320	680	0.08026468	1.3377E-06	0.11558113
30.66	350	650	0.08002525	1.3338E-06	0.11523636
		Average	0.22349101	3.7249E-06	0.32182706
		Entire Interval	0.13936916	2.3228E-06	0.20069158





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Phone (+618) 9205 4500 | Fax (+618) 9205 4501 | Email wageotecheng@structerre.com.au | Web www.structerre.com.au
ABN 71 349 772 837 Zemla Pty Ltd ACN 008 966 283 as trustee for the Young Purich and Higham Unit Trust trading as Structerre Consulting Engineers

DOC:GE:5.4.001

STRUCterre consulting engineers

Residential Geotechnical Commercial & Infrastructure
Inspect & Investigate Energy Assessment Environmental

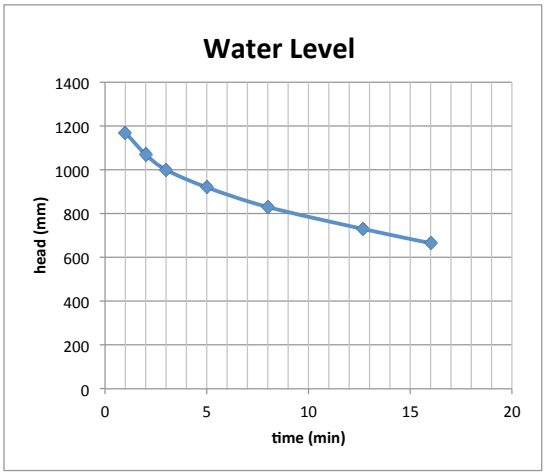
Client:	SAFERIGHT Pty Ltd			Job No:	S936784	Project No: S936784-A
Project:	Chalet Rigi Proposed Extensions & Alterations - #415 Mundaring Weir Rd, Piesse Brook					GPS: E4140367
Percolation No:	PERC 10	Operator:	BEW	Test Date:	11/10/19	N6461684

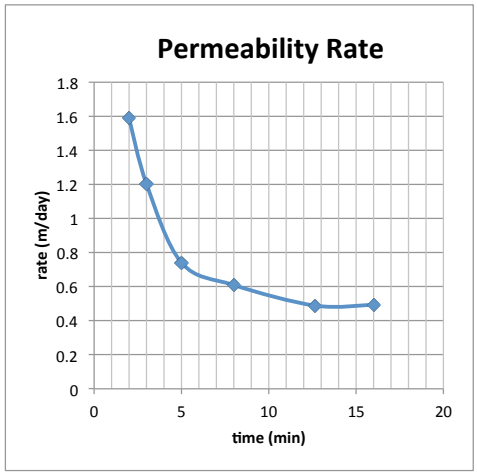
Diameter (mm)	50
Depth (mm)	1500

Inverted Auger Hole
(Porchet Method)

$$K = 1.15r\,\frac{\log\left(h_0 + \frac{r}{2}\right) - \log\left(h_1 + \frac{r}{2}\right)}{t}$$

Time (min)	Depth (mm)	Head (mm)	k (mm/min)	k (m/s)	k (m/day)
1	330	1170			
2	430	1070	1.10323078	1.8387E-05	1.58865232
3	500	1000	0.8346951	1.3912E-05	1.20196095
5	580	920	0.5138515	8.5642E-06	0.73994616
8	670	830	0.42242309	7.0404E-06	0.60828925
12.66	770	730	0.33854329	5.6424E-06	0.48750234
16	835	665	0.34247928	5.7080E-06	0.49317017
		Average	0.59253717	9.8756E-06	0.85325353
		Entire Interval	0.46362605	7.7271E-06	0.66762151





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Site 1

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STRUCterre consulting

DOC: GS4.1.8 REV 5

Site 2

STRUCterre consulting

DOC: GS4.1.8 REV 5

Site 3

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DOC: GS4.1.8 REV 5

Site 4

4 of 9

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Site 5

5 of 9

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Site 7

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DOC: GS4.1.8 REV 5

Site 8

STRUCterre consulting

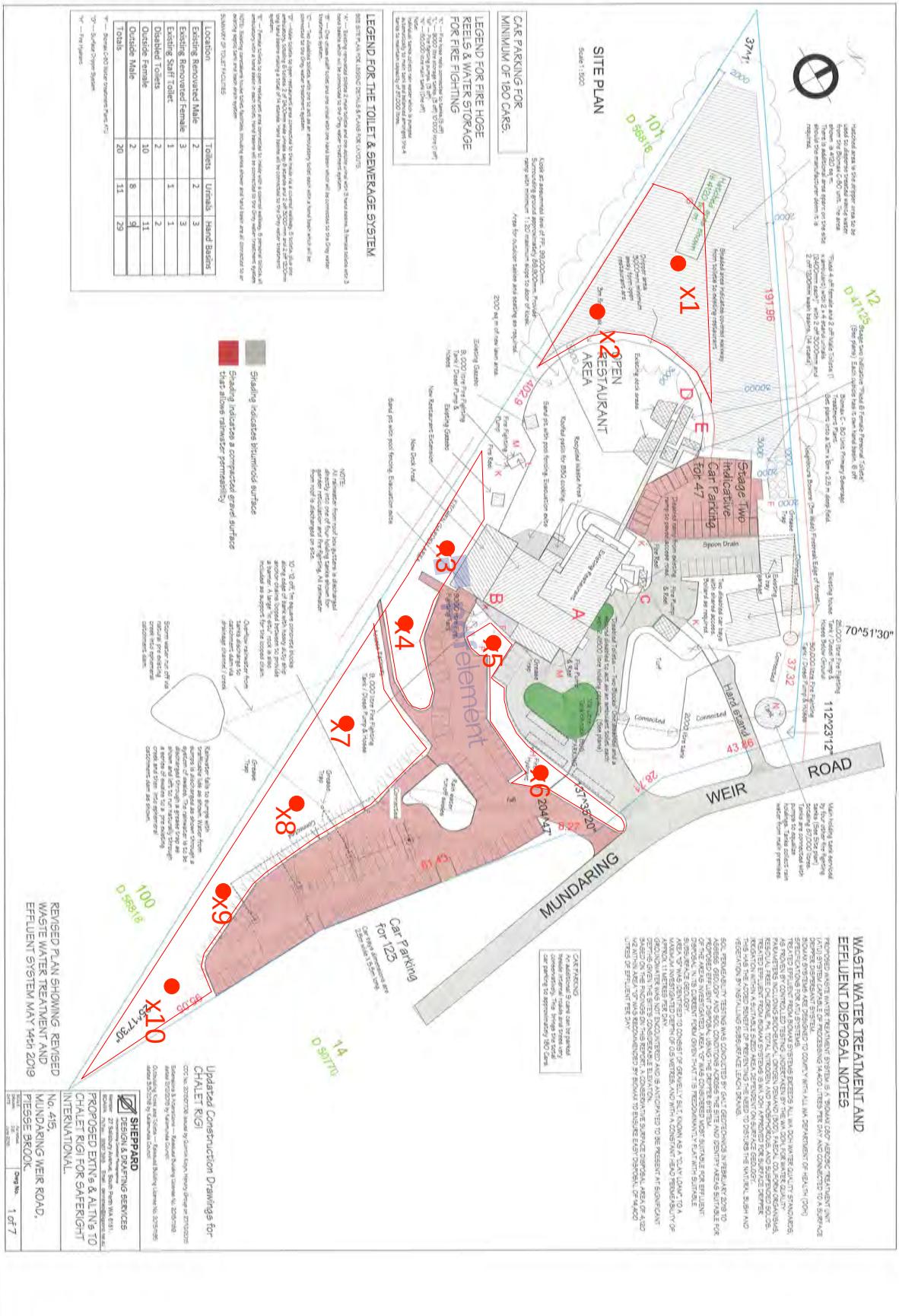
DOC: GS4.1.8 REV 5

Site 9

STRUCterre consulting

DOC: GS4.1.8 REV 5

Site 10


SITE PLAN
Scale 1:500
CAR PARKING FOR MINIMUM OF 160 CARS.
LEGEND FOR FIRE HOSE REELS & WATER STORAGE FOR FIRE FIGHTING
LEGEND FOR THE TOILET & SEWERAGE SYSTEM
Location | Toilets | Urinals | Hand Basins
Existing Renovated Male | 2 | 2 | 3
Existing Renovated Female | 3 | 3
Existing Staff Toilet | 1 | 1 | 1
Disabled Toilets | 1 | 1 | 2
Outside Female | 10 | 2 | 11
Outside Male | 2 | 8 | 9
Totals | 20 | 11 | 29
Shading indicates bituminoid surface
Shading indicates a compacted gravel surface that allows rainwater permeability
OPEN RESTAURANT AREA
Stage Two Indicative Car Parking for 47
Car Parking For 125
Element
MUNDARING WEIR ROAD
Hard stand
Spoon Drain
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
70^51'30"
112^23'12"
REVISED PLAN SHOWING REVISED WASTE WATER TREATMENT AND EFFLUENT SYSTEM MAY 14th 2019
WASTE WATER TREATMENT AND EFFLUENT DISPOSAL NOTES
Updated Construction Drawings for CHALET RIGI
SHEPPARD
DESIGN & DRAFTING SERVICES
No. 415 MUNDARING WEIR ROAD, PIESSE BROOK.
PROPOSED EXTN's & ALTN's TO CHALET RIGI FOR SAFERIGHT INTERNATIONAL
1 of 7

APPENDIX F

Phosphorous Retention Index Testing Documentation

ChemCentre

Inorganic Chemistry Section

Report of Examination

PO Box 1250, Bentley Delivery Centre
Bentley WA 6983
T +61 8 9422 9800
F +61 8 9422 9801
www.chemcentre.wa.gov.au
ABN 40 991 885 705

Purchase Order: Chalet Rigi 001
Your Reference:
ChemCentre Reference: 19S2202 R0

Evergreen Consultancy WA
1885 Ryecroft Rd
Glen Forrest WA

Attention: Francesca Flynn

Final Report on 2 samples of soil received on 21/11/2019

LAB ID	Client ID and Description
19S2202 / 001	S01_0.0-0.25
19S2202 / 002	S02_0.0-0.25

Analyte		Stones	P
Method		(>2mm)	PRI
Unit		%	mL/g
Lab ID	Client ID		
19S2202/001	S01_0.0-0.25	7.7	590
19S2202/002	S02_0.0-0.25	62.3	66

Analyte	Method	Description
Stones	(>2mm)	Stones - sieved particles greater than 2 mm (sample preparation method manual 3.3.2)
P	PRI	Phosphorus Retention Index by method S15

The results apply only to samples as received. This report may only be reproduced in full.

Unless otherwise advised, the samples in this job will be disposed of after a holding period of 30 days from the report date shown below.

Results for soil analysis are reported on an air-dry (40C) less than 2 mm basis, whereby stones are removed (material >2mm) by sieving. When stone content is deemed significant the result is recorded and reported. Unless otherwise specified, all analytes (except Stones) are reported in the listed concentrations and on a dry, less than 2 mm basis. Stones are reported on a dry, whole sample basis.

Phosphorus Retention Index (PRI) is a measure of the ability of soil to retain or leach applied phosphate.

PRI is defined as the ratio P ads : P eq where P ads is the amount of phosphorus adsorbed by soil (µg P/g soil) .

The phosphorus fixation properties of soil may be described by the following PRI values:

PRI

negative	desorbing (P leaching)
0 - 2	weakly adsorbing
2 - 20	moderately adsorbing
20 - 100	strongly adsorbing
>100	very strongly adsorbing

Barry Price
Snr Chemist & Research Officer
Scientific Services Division
26-Nov-2019

APPENDIX G

2019 Surface Water Monitoring Analytical Laboratory Documentation

ARL Group
Proudly Western Australian

ARL ProMicro EcoDiagnostics

LABORATORY REPORT

Job Number: 19-14503
Revision: 00
Date: 16 September 2019

ADDRESS: **Saferight**
42 Belmont Ave
Belmont WA 6104

ATTENTION: Mark McCormack

DATE RECEIVED: 3/09/2019

YOUR REFERENCE: Saferight

PURCHASE ORDER: Inv: 145782

APPROVALS:

Paul Nottle	Sean Sangster	Sam Becker	Wafa Hanna
Organics Manager	Inorganics Supervisor	Inorganics Manager	Microbiologist

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
Inhouse - Chlorine	Chlorine(Free and Total) analysis in accordance with Hach Po
ARL No. 330	Persulfate Method for Simultaneous Determination of TN & TP
ARL No. 308	Total Phosphorus in Water by Discrete Analyser
ARL No. 303	Ammonia in Water by Discrete Analyser
ARL No. 313/319	NOx in Water by Discrete Analyser
ARL No. 311	Nitrite in Water by Discrete Analyser
ARL No. 014	pH in Water
ARL No. 019	Conductivity and Salinity in Water
ARL No. 017	Total Dissolved Solids
ARL No. 016	Total Suspended Solids
ARL No. 011	Biochemical Oxygen Demand
AS 4276.7 (PM 4.3)	Thermotolerant Coliforms and E. coli by Membrane Filtration

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

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Saferight *LABORATORY REPORT*
Job No: 19-14503 *Revision: 00* *Date: 16/09/19*

Misc. Organics in Water		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Free Chlorine	0.01	mg/L	0.02	0.01	0.03	0.01

Total Nitrogen in Water		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Total Kjeldahl Nitrogen	0.2	mg/L	0.4	2.7	<0.2	<0.2
Total Nitrogen	0.2	mg/L	1.5	3.1	0.6	1.2

Total Phosphorus in Water		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Total Phosphorus	0.01	mg/L	0.09	0.08	0.06	0.08

Ions by Discrete Analyser		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Ammonia-N	0.02	mg/L	<0.02	0.03	0.03	<0.02
Nitrate-N	0.01	mg/L	1.1	0.40	0.41	1.2
Nitrite-N	0.01	mg/L	<0.01	<0.01	<0.01	<0.01

Physical Parameters		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
pH	0.1	pH units	6.4	6.6	6.6	7.1
Conductivity	0.01	mS/cm	0.58	0.50	0.52	0.40
Total Dissolved Solids	5	mg/L	280	270	250	240
Total Suspended Solids	5	mg/L	17	<5	9	15

Biochemical Oxygen Demand		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Biochemical Oxygen Demand	5	mg/L	<5	<5	<5	<5

Water Microbiology		Sample No	19-14503-1	19-14503-2	19-14503-3	19-14503-4
		Sample Description	HG Souce	HG Upstream	HG Downstream	Piesse Brook
		Sample Date	3/09/2019	3/09/2019	3/09/2019	3/09/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
E. Coli	1	CFU/100mL	68	13	21	160

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should

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Saferight *LABORATORY REPORT*
Job No: 19-14503 *Revision: 00* *Date: 16/09/19*

be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

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Quality Control Report

Job Number: 19-14503
Date: 16/09/2019

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

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www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-14503
Date: 16/09/2019

ARL Environmental and Analytical Laboratory

Free/Total Chlorine in Water

Holding Time Criteria	Date	
Extracted	4/09/2019	
Analysed	4/09/2019	
Duplicate Analysis (19-14503-4)	**RPD (%)**	**Limits (%)**
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Free Chlorine	<0.01	0.01

Total Nitrogen in Water

Holding Time Criteria	Date	
Extracted	4/09/2019	
Analysed	5/09/2019	
Duplicate Analysis (19-14381-2)	**RPD (%)**	**Limits (%)**
Total Nitrogen	0	50
Duplicate Analysis (19-14472-13)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	0	200
Total Nitrogen	0	200
Duplicate Analysis (19-14533-8)	**RPD (%)**	**Limits (%)**
Total Nitrogen	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Total Kjeldahl Nitrogen	<0.2	0.2
Total Nitrogen	<0.2	0.2
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Total Kjeldahl Nitrogen	<0.2	0.2
Total Nitrogen	<0.2	0.2
Matrix Spike (19-14381-2)	**Recovery (%)**	**Limits (%)**
Total Nitrogen	96	80 - 120
Matrix Spike (19-14472-13)	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	95	80 - 120
Total Nitrogen	95	80 - 120
Matrix Spike (19-14533-8)	**Recovery (%)**	**Limits (%)**
Total Nitrogen	92	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	103	80 - 120
Total Nitrogen	103	80 - 120
Total Kjeldahl Nitrogen	97	80 - 120
Total Nitrogen	97	80 - 120

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Quality Control Report

Job Number: 19-14503
Date: 16/09/2019

ARL Environmental and Analytical Laboratory

Total Phosphorus in Water

Holding Time Criteria	Date	
Extracted	4/09/2019	
Analysed	5/09/2019	
Duplicate Analysis (19-14533-8)	**RPD (%)**	**Limits (%)**
Total Phosphorus	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Total Phosphorus	<0.01	0.01
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Total Phosphorus	<0.01	0.01
Matrix Spike (19-14533-8)	**Recovery (%)**	**Limits (%)**
Total Phosphorus	92	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Phosphorus	91	80 - 120
Total Phosphorus	91	80 - 120

Ions in Water

Holding Time Criteria	Date	
Analysed	6/09/2019	
Duplicate Analysis (19-14503-1)	**RPD (%)**	**Limits (%)**
Nitrite-N	0	200
Duplicate Analysis (19-14653-1)	**RPD (%)**	**Limits (%)**
Nitrite-N	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Nitrite-N	<0.01	0.01
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Nitrite-N	<0.01	0.01
Matrix Spike (19-14503-1)	**Recovery (%)**	**Limits (%)**
Nitrite-N	103	80 - 120
Matrix Spike (19-14653-1)	**Recovery (%)**	**Limits (%)**
Nitrite-N	101	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Nitrite-N	100	80 - 120
Nitrite-N	100	80 - 120

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Quality Control Report

Job Number: 19-14503
Date: 16/09/2019

ARL Environmental and Analytical Laboratory

Ammonia in Water

Holding Time Criteria	Date	
Analysed	5/09/2019	
Duplicate Analysis (19-14503-1)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Duplicate Analysis (19-14653-1)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Ammonia-N	<0.02	0.02
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Ammonia-N	<0.02	0.02
Matrix Spike (19-14503-1)	**Recovery (%)**	**Limits (%)**
Ammonia-N	101	80 - 120
Matrix Spike (19-14653-1)	**Recovery (%)**	**Limits (%)**
Ammonia-N	108	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Ammonia-N	101	80 - 120
Ammonia-N	101	80 - 120

TDS and TSS in water

Holding Time Criteria	Date	
Analysed	4/09/2019	
Duplicate Analysis (19-14533-7)	**RPD (%)**	**Limits (%)**
Total Dissolved Solids	0	25
Total Suspended Solids	2	25
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Total Dissolved Solids	<5	5
Total Suspended Solids	<5	5
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
Total Dissolved Solids	90	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Suspended Solids	102	80 - 120

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Quality Control Report

Job Number: 19-14503
Date: 16/09/2019

ARL Environmental and Analytical Laboratory

Physical Parameters

Holding Time Criteria	Date	
Analysed	4/09/2019	
Duplicate Analysis (19-14503-4)	**RPD (%)**	**Limits (%)**
pH	0	25
Conductivity	0	25
Duplicate Analysis (19-14538-3)	**RPD (%)**	**Limits (%)**
pH	0	25
Blank Analysis	**Result (pH units)**	**Limit (pH units)**
pH	5.5	0.1
Conductivity	<0.01	0.01
Blank Analysis	**Result (pH units)**	**Limit (pH units)**
pH	5.5	0.1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
pH	100	95 - 105
Conductivity	100	95 - 105
pH	100	95 - 105

Biochemical Oxygen Demand

Holding Time Criteria	Date	
Extracted	5/09/2019	
Analysed	10/09/2019	
Duplicate Analysis (19-14346-1)	**RPD (%)**	**Limits (%)**
Biochemical Oxygen Demand	0	200
Duplicate Analysis (19-14637-1)	**RPD (%)**	**Limits (%)**
Biochemical Oxygen Demand	0	200
Duplicate Analysis (19-14668-2)	**RPD (%)**	**Limits (%)**
Biochemical Oxygen Demand	0	200
Blank Analysis	**Result (mg/L)**	**Limit (mg/L)**
Biochemical Oxygen Demand	<5	5
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Biochemical Oxygen Demand	107	80 - 120

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ARL
Analytical Reference Laboratory

CHAIN OF CUSTODY

46-48 Banksia Road WELSHPOOL WA 6106
Ph: +61 8 6253 4444 www.arlwa.com.au

Client: SAFERIGHT	Date Results Required By: Standard TAT (Please specify a time frame or number of working days)	Purchase Order No:
Contact Name: MACK MCCORMACK		ARL Quote No:
Address: 42 Belmont Ave, Belmont, WA 6104	Email Reports To: mack@saferight.com.au francesca@evergreenconsultancy.com.au	LABORATORY USE ONLY
Phone No: 0408261537	Email Invoices To: mack@saferight.com.au finance@saferight.com.au	Payment Method:
Fax No:		Invoice No: 145782
Project Reference: WQM Sept 2019		
Comments		

ARL Job Number: 19-14503 Temperature of Samples: 15.2°C

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers
-1	HG Source	3.9.19	Water	3
-2	HG Upstream	3.9.19	Water	3
-3	HG Downstream	3.9.19	Water	3
-4	Piesse Brook	3.9.19	Water	3

ANALYSIS REQUIRED

All samples to be tested for:

- ✓ pH
- ✓ BOD
- ✓ TSS
- ✓ TDS
- ✓ Residual free chlorine
- ✓ Conductivity
- ✓ Nitrate as N
- ✓ Nitrate as NO_3
- ✓ Total Kjeldahl Nitrogen
- ✓ Ammonia
- ✓ Total Phosphorous
- ✓ E. Coli

Samples Relinquished By: Mack McCormack On: 3/9/19 At: Signed:

Samples Received By: Maya H. On: 3/9/19 At: 11:20 Signed:

APPENDIX H

BioMAX C80 ATU Signed Maintenance Agreement

Install ANYWHERE with ease

MAINTENANCE AGREEMENT

Customer Number: **C3604**

This agreement between the title holders **Gordon McCormack** hereinafter called the Customer and **BioMAX Pty Ltd** 1/9 Elmsfield Road, Midvale, WA 6056, hereinafter called the Company, for the maintenance of the **Biomax C80** Aerobic Treatment Unit hereinafter called the System installed at **415 Mundaring Road, Piesse Brook** within the Local Authority of: **Shire of Kalamunda**
For one year from the date of commissioning of the system and continuing thereafter until cancellation in writing by either party at the initial rate of **$250.00** per quarter for service plus any consumable items required (see Clause 2) and which is to operation under the following conditions and during such extension period.

1. Once during each three months of the Term agreed the Company shall inspect the System and carry out the work as detailed on the form and report to the Customer, Local Authority and where deemed necessary The Health Department of Western Australia the outcome of the inspection.
2. The Company will invoice the Customer for the inspection and replenishment of Chlorine Tablets and replacement items and the Customer shall make payment within 30 days (EOM) of receipt of said Invoice. The Company reserves the right to charge interest on overdue accounts and debt collection fees will be charged to the Customer. The Company will also charge for any items outside the normal scope of work (E.g. Water Samples will be charged at cost to the Customer).
3. If the Customer requests the Company to carry out work to the system other than that specified in Clause 1, above, or provided for the specimen then the Customer will pay the Company's reasonable additional charges for such work and any necessary materials. Also the Customer will pay the Company reasonable addition charges for work done and material supplied to Clause 1, above, where the need for work and materials arises from negligent or wilfully damaging actions of any person or from the System being required to bear a workload which extraordinary for the size of the property on site, or from interfering with the System in any way or from the Customer's failure to advise of any alarm warning or any other malfunction or failure to comply with the agreement.
4. The Customer acknowledges that it is a requirement to have the system maintained in accordance with the Health Act and acknowledges their responsibility to notify BioMAX in the event of the property being sold so that the agreement may be transferred to the new owner.
5. Sewerage servicing is G.S.T. free (all other consumables/labour attracts G.S.T at the current rate). Our Terms of Trade are net 30 days (EOM) from the date of invoice.
6. Please sign and post this agreement (retain copy for your records) to PO Box 462, Midland DC, WA 6936

Dated this 15th Day of August, 2019

For and on behalf of Customer

...../Signature

For Campbell Durrant
Biomax Pty Ltd

...../Print name

Unit 1-9 Elmsfield Road
Midland WA 6056
BIOMAX PTY LTD
ABN: 27 009 331 006

PO Box 462
Midland DC WA 6936

Phone: (08) 9250 7733
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