Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6175/2018/1
Applicant	TMC Witchcliffe Pty Ltd
ACN	632 933 263
File Number	DER2018/001493
Premises	Witchcliffe Eco Village WWTF 10437 Bussel Highway WITCHCLIFFE WA 6286 Part of Lot 2807 on Deposited Plan 203076 Certificate of Title Volume 1482 Folio 919 As defined by the coordinates in Schedule 1 of the Works Approval As defined by the Premises maps in Appendix 1
Date of Report	24 September 2019

1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
Works Approval Holder	TMC Witchcliffe Pty Ltd
m^3	cubic metres
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Risk Event	As described in *Guidance Statement: Risk Assessment*
WWTF	Wastewater treatment facility

2. Purpose and scope of assessment

An application for Works Approval (Application) was received from Technology Management Consulting Australasia Pty Ltd trading as T.M.C. Australasia Pty Ltd (the Applicant) on 1 October 2018. The Application relates to the construction of a sewage treatment facility for the proposed Witchcliffe Ecovillage development. Up to 160m^3/day is proposed to be treated at the facility with the treated water proposed to be discharged to a plantation through irrigation.

The Applicant holds signed authorisation from the land holders as the Applicant and representative for the works approval at Lot 2807 Bussell Highway, Witchcliffe. The Applicant will be the superintendent for the sewage scheme construction.

This Decision Report presents an assessment of potential environmental and public health risks from emissions and discharges from the construction and operation of the Premises. As a result of this review, a Works Approval has been granted (Issued Works Approval) (Attachment 1).

Table 2: Documents and Information submitted during the assessment process

Document/information description	Date received
Witchcliffe Eco Village Works approval application form	1 October 2018
Witchcliffe Eco Village Attachments	
Attachment 6A – Geotechnical Study	
Witchcliffe Eco Village Structure Plan September 2017	19 February 2019
Sewerage License Areas Plan, February 2019	
Staged Development Witchcliffe Ecovillage WWTF	
Relationships and Associations	
DWER Application Form – Section 2	
DRAFT Commissioning Plan V2, February 2019	
Sustainable Settlements Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019	
Appendix A – Geotechnical Report Witchcliffe, Galt Geotechnics, 23 December 2015	
Appendix B – Soil sampling	
Appendix C – Hydrology and Groundwater Plan (September 2017)	
Appendix E – Effluent Irrigation Plan	
Witchcliffe Ecovillage – DWER Works Approval Supporting Information (Including Water Balance)	22 February 2019
Cover Letter - DWER response to draft Works Approval July 2019	17 July 2019
Attachment 1 – Prescribed Premises Boundary and monitoring bores	
Attachment 2 – Acid Sulphate Soils and Irrigation Area Geotechnical Investigation	
Attachment 3 – Licence Area Plan	
Attachment 4 – Irrigation Area Plan	
Attachment 5 – Draimad Dewatering Unit	
Attachment 6 – Soil Sampling Results	
Attachment 7 – Site Geotechnical Investigation	
Attachment 8 – Soil Testing Parameters Summary	
Revised Letter - DWER response to draft Works Approval	23 July 2019
Email Correspondence – RE: Application for a works approval – draft instrument and Decision report – W6175/2018/1 TMC Witchcliffe Pty Ltd	28 August 2019

3. Background

The Witchcliffe Ecovillage is a proposed development which will surround the existing township of Witchcliffe on the Eastern side. The development site is approximately 119Ha and upon completion will have an equivalent population of approximately 946. It is proposed that sewage generated within the development will be treated and re-used for the beneficial irrigation of a commercial crop on land contained within the development site boundary.

The works are proposed to commence in 2020.

The works will cause the site to be considered a Prescribed Premises for the purposes of Part V of the EP Act triggering the requirement for a works approval for the related installation and construction works. Subsequent to construction and commissioning, a licence will be required to operate the Premises.

Table 3: Classification of Premises

Classification of Premises	**Description**	***Approved Premises production or design capacity or throughput***
Category 54	Sewage facility: premises – (a) On which sewage is treated (excluding septic tanks); or (b) From which treated sewage is discharge onto land or into waters.	160m^3 per day

4. Overview of the Premises

4.1 Operation

The Application is for a wastewater treatment facility (WWTF) for the treatment of sewage from the Witchcliffe Eco Village to a maximum of 160m^3/day with the treated water discharged to a plantation (via irrigation). The Application states that the estimated/actual throughput for the Premises will be 130m^3/day with the site anticipated to operate for a period of 25 years.

The treatment process is based on mobbing bed bioreactor technology (MBBR). The package plant is pre-built overseas and arrives as a unit ready for installation. The treatment is arranged in a number of independent trains each with its own control system and blower array. Operational signals and alarms are relayed to a Supervisory Control and Data Acquisition (SCADA) control system. The WWTF will be largely automated with a programmable logic control (PLC)/SCADA system. The plant will have remote monitoring and control capability as well as critical alarm notification.

Screened wastewater is delivered across the available trains. Only two trains will be installed under Stage 1 with additional trains to be installed as the estate develops and comes online. Individual MBBR trains can be shut down for maintenance while the remaining trains are fully operational.

The entire compound is security fenced with remote video monitoring. The site is attended by one operator, part-time as required.

4.1.1 Process diagram

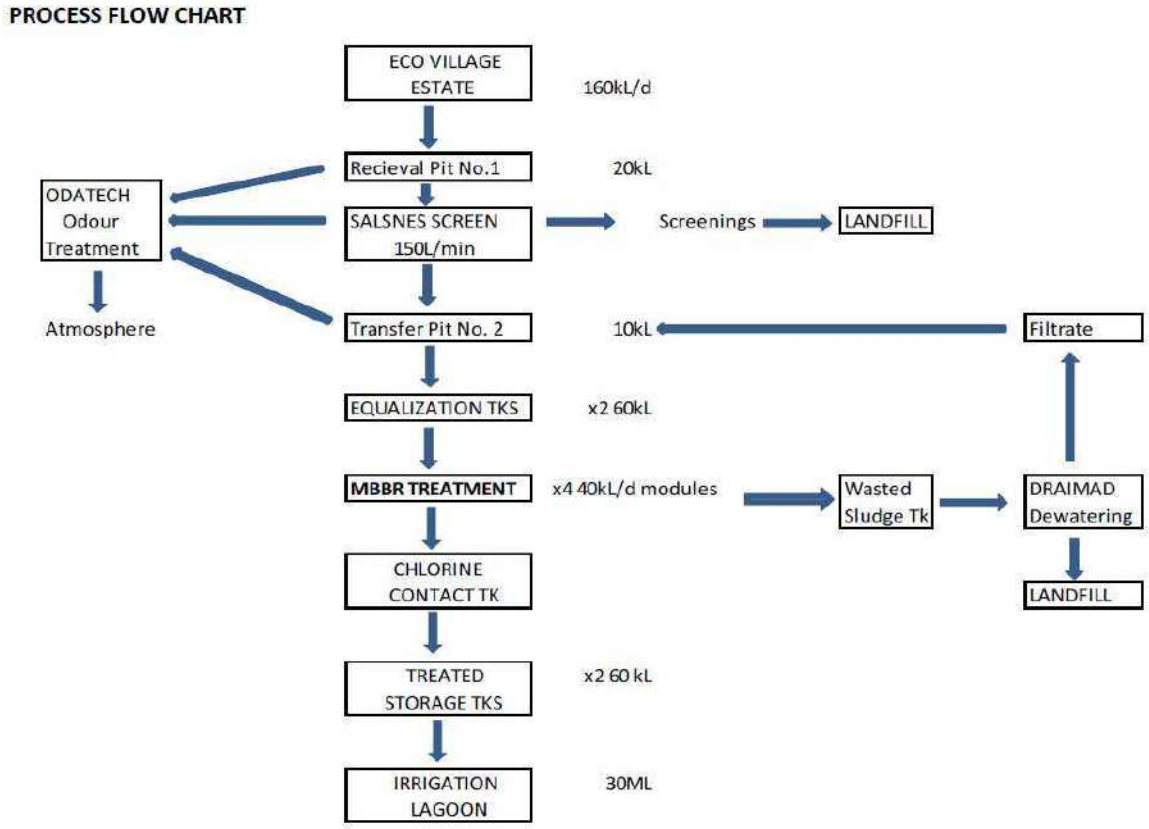


Figure 1: Process Flow Diagram (PFD) and basic general arrangement drawing as well as indicative layout drawing

Note: Space for a 4th bio-reactor has been allowed to allow flexibility in the n+1 redundancy configuration of the plant.

4.1.2 Process description

Receival sumps:

The sewage network throughout the Witchcliffe estate is connected by several pump stations which convey wastewater to the WWTF receiving sump (22kL) which is fitted with dual duty and standby grinder pumps. The sump directs wastewater to the screening unit by float controls.

Screening unit/Inlet screens:

The inlet screens will minimise the solids entering the flow balance tank and the downstream process. All sewage entering the WWTF will pass through the screens. The solids removed are washed and dewatered prior to discharge into screening bins for disposal to an approved landfill off-site. The bins are emptied as required.

In the event of a screen blockage the sewage will overflow to the sludge tank where it may be pumped back into the screens for re-processing once the fault has been rectified or can be tankered off-site in the event of a longer duration outage.

Screened wastewater from the screening unit is discharged to a below ground transfer pit and then pumped to the flow balance tanks.

Flow balance tank:

A wastewater flow balance tank (FBT) or tanks will be used to buffer flows and provide a steady feed stream to the biological reactor. The FBT also allows for dilution and/or neutralisation of

any contaminant in the wastewater that might be harmful to the biological process. The FBT also provides a mechanism to temporarily halt processing of wastewater should there be a problem with the downstream equipment.

Screened wastewater will be pumped to the biological reactors based on the level in the flow balance tank (sewage available) and the level in the biological reactor (capacity available). A mixer will be used to keep the solids in suspension and prevent “short-circuiting” within the FBT.

In the initial stage of the development, sewage will be tankered directly from the FBT and removed off-site for disposal.

Odour control:

A biofiltration odour scrubber will be installed to treat the foul air from the inlet screens and the FBT’s.

Biological treatment:

The bioreactor contents (Mixed Liquor) includes raw sewage and activated sludge, and it provides the environment for aerobic organisms to feed on the matter in the wastewater thereby breaking down the biological content. This ensures the BOD of the treated wastewater is within specification.

Nitrification occurs when organic matter is consumed and nitrogen from ammonia, ammonium and organic nitrogen is converted to nitrites and then to nitrates. Some nitrates are then further biologically converted to nitrogen gas, resulting in the treated water total nitrogen concentration being within the quality specification.

For this to occur, the following parameters need to be maintained within optimum ranges within the bioreactor:

- Aqueous Dissolved Oxygen (through process air blowers); and
- Sludge Concentration (manage mixed liquor concentration through period wasting).

A coagulant is also added to the bioreactor for the chemical precipitation of phosphorous within the system, which accumulates within the waste sludge for disposal. This ensures the treated water achieves the required total phosphorous target.

Soils/liquids separation:

Following the biological treatment the activated sludge will undergo a solids/liquids separation. This is achieved via clarification. In the clarification zone the solids are settled to the bottom of the tank and pumped back into the bioreactor, the clear or treated water is decanted.

Chlorine disinfection:

As treated water exits the MBBR modules under gravity it comes in contact with solid chloride prior to entry into the Chlorine contact tank.

Primary disinfection is via solid trichloride cyanuric acid tablets that sit in a cassette, as water enters the treated water chamber it contacts the tablets which slowly dissolve to achieve the required free chloride concentration. Additionally, stored treated water is circulated through an electrolysis unit to convert the chloride to chlorine and maintain the required free chlorine residual.

Recycled water storage and distribution/irrigation:

A recycled water storage tank will receive treated water from the WWTF. All irrigation will be undertaken with water from the treated water storage tank. Where recycled water production is greater than the irrigation demand, the treated water storage tank will overflow to the wet weather storage dam.

A set of irrigation pumps will draw water from the treated water tanks and discharge to the

irrigation area. The pump system will act as a pressure sustaining pump set. The irrigation system has been designed as a high volume low velocity dripper system. Irrigation may be utilised in the case of high wet weather storage dam levels in order to ensure there is no uncontrolled discharge from the storage dam.

Wet weather storage:

The recycled water from the development is only proposed to be re-used for irrigation. The irrigation demand is heavily seasonal and as such during the warmer months the demand for recycled water is higher than the sewage flow from the development and conversely in the cooler months the demand for recycled water is much lower than the sewage flow. The wet weather storage dam has been sized to store the recycled water across the low demand period for re-use in the warmer months. Water from the storage dam will be passed through an additional filtration system to polish the water and remove any solids or algae growth from the storage dam and returned to the recycled water storage tank for irrigation.

The level of the wet weather storage dam will be monitored and maintained to allow space for rain events. In the instance that the wet weather storage dam level becomes high, irrigation will be initiated to allow for controlled discharge of the recycled water across the irrigation area via forced irrigation. Irrigation under this scenario would still be in compliance with the Nutrient Irrigation Management Plan (NIMP) (see Section 7.1).

Chemical storage and dosing:

Various chemicals are typically required for sewage treatment, recycled water production and cleaning. These chemicals will be stored in appropriately sized tanks, taking into consideration the type and consumption. The tanks, along with the chemical dosing pumps will be located within separate bunded areas. The chemicals that may be used and their purposes are described in Table 4 below:

Table 4: Chemical type and purpose

Chemical	Purpose
Coagulant	Used to precipitate phosphorous and aid in the settling of solids (e.g. Alum)
Trichloride or similar	Used for final disinfection of the treated recycled water
Polymer	Flocculant used in the dewatering process.

(Table 4 – Chemical type and purpose' Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Sludge disposal:

Waste activated sludge (WAS) is periodically removed from the biological process. This maintains the concentration of the mixed liquor suspended solids and the health and efficiency of the bioreactor. The waste activated sludge is pumped to the sludge holding tank (waste aerated sludge tank) where it is periodically aerated to allow for further digestion of the sludge. The thickened sludge is then pumped to the dewatering system where the sludge fills geofabric bags. The dry solids are transported off-site for disposal, the "filtrate" from the dewatering system is returned to the head of the treatment plant for processing.

Control:

The WWTF will be largely automated with PLC/SCADA system. The plant will have remote monitoring and control capability as well as critical alarm notifications.

4.2 Infrastructure

The Premises will contain five buildings:

- Building A – containing the Salsness filter and solids handling with Odotech odour control system;
- Building B – containing the Draimad dewatering unit and sludge bag drying; and
- Building C, D & E – transportables to serve site office, ablutions and laboratory.

The compound measures 40.5m x 28.0m (1.142 ha) and contains all process equipment. The entire compound will be security fenced with remote video monitoring.

The base processing unit as a moving bed bioreactor MBBR is 40kL/day, the full development will include x4 MBBR units to process a total design volume 160kL/day. The minimum volume each unit can process is 10kL/day to a maximum 40kL/day.

The package plant is pre-built overseas and arrives as a unit ready for installation. Each unit is 11.5 metres long and 2.2 metres in diameter with a height of 4 metres including walk way and railing.

Figure 2. Photographic example of MBBR trains to be installed

The Application states that all infrastructure will be designed and installed in accordance with the latest revision of relevant Australian standards, water industry codes/guidelines (i.e. WSAA), and/or manufacturer's recommendation. Where there is no specific standard, code, guideline or manufacturer recommendation, the infrastructure will be designed and installed in accordance with industry best practice for the water industry in Australia.

The Application states that materials of construction will be chosen with consideration given to the influent and effluent characteristics as well as the local environment. The design life of key infrastructure components is noted below in Table 5.

Table 5: Design life of key components

Item	Design life (years)	Item	Design life (years)
Buildings	>30	Protective coatings	>15
Tanks (including roof)	>25	Pumps	>15
Pond liner	>25	Electrical and control	>15
Pipework, fittings and valves	>20	Instruments	>10

('Table 2 – Design life of key components', Withcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Table 6: Premises infrastructure (refer to Premises maps in Appendix 1)

Ref	Infrastructure	Site Layout Plan Reference
Prescribed Activity Category 54		
The treatment of sewage from the Witchcliffe Eco Village up to a maximum of 160 m^3/day and the discharge of treated water to plantation.		
1.	Hardstand – • Unless otherwise specified on the design plans, the hardstand will be 150mm thick gravel basecourse compacted to minimum 98% MMDD	Witchcliffe Eco Village WWTF Layout: • Hard Stand And Parking
2.	WWTF receiving sump (Receival Pit No.1) – • Prefabricated as a fully engineered concrete tank with a height of 2,600mm, width 2,400mm and length 4,400m; • 22kL capacity • Fitted with duty and standby effluent pumps • The sump directs wastewater to the screening unit by float controls.	Witchcliffe Eco Village WWTF Layout: • Pit 1
3.	Inlet screens (Salsnes Screen) – • Consisting of a Salsnes filter that combines solids separation, sludge thickening and dewatering in one process • Fully automatic designed for primary treatment in municipal applications, made to meet European Council Directive 91/271/EEC (May 21st 1991) regarding urban wastewater treatment • Installed duty only • Level indication and alarm notification of inlet screen high level (blockage) • Sized to meet peak instantaneous flow from the development sewer network • Odour control through the enclosed design and connection pipe for ventilation	Witchcliffe Eco Village WWTF Layout: • Screen Room
4.	Biofiltration odour scrubber (Odatech Odour Treatment) – • Biofiltration odour scrubber to treat foul air from the inlet screens and the flow balance tank/s.	Witchcliffe Eco Village WWTF Layout: Odourtech Odour Control (x2)
5.	Transfer pit (Transfer Pit No. 2) – • 11kL below-ground transfer pit • Fitted with duty and standby vortex pumps	Witchcliffe Eco Village WWTF Layout: • Pit 2
6.	Bunded Tank Farm – A bunded tank farm is to be constructed on site to house all above-ground reinforced fiberglass tanks.	Witchcliffe Eco Village WWTF Layout: • Bunded Tank Farm

	• Overall dimensions: 29.3m by 7.4m; bunding 1.1m (238.5kL) approximately 90% of total tank volume • Tank farm floor constructed of reinforced concrete with rammed earth walls, graded to allow drainage back to the facilities raw water receival pit (Pit 1). • All pumps mounted on 500mm plinths with pipe work mounted as above ground attached to the bund wall. Consisting of the following tanks: • Flow balance tank/s (Buffer Tk 1 and Buffer Tk 2) • Waste aerated sludge tank (WAS Tk) • Treated water tank/s (Treated Tk 1 and Treated Tk 2)	
7.	<u>Flow balance tank/s (FBT) –</u> • Located within the Bunded Tank Farm • 60kL above ground reinforced fibre glass tank expandable to x2 60kL storage • Tanks constructed and designed to hold liquid with a specific gravity of 1.5 • The FBT capacity will be designed to receive a nominal 24 hours feed • Bioreactor feed pumps installed duty/standby • Mixer installed duty only to keep the solids in suspension and prevent 'short-circuiting' within the FBT. • Level indication and alarm notification of FBT high level • Fitted with odour control and internal mixing to limit sludge settlement • Connection for tanker pump out within bunded area	Witchcliffe Eco Village WWTF Layout: • Buffer Tk 1 • Buffer Tk 2
8.	<u>Biological Treatment/Reactor (MBBR Package Plants)–</u> • The treatment is arranged in a number of independent trains each with its own control system and blower array, operational signals and alarms relayed to the SCADA central control. • Each train (MBBR unit) is 11.5 metres long and 2.2 metres in diameter (walk way and railing increase the height to 4 metres). • The bioreactor contents includes raw sewage and activated sludge (mixed liquor), and it provides the environment for aerobic organisms to feed on the matter in the wastewater thereby breaking down the biological content. This ensures the BOD of the treated water is within specification. • Screened wastewater is delivered across the available trains by up to four supply pumps, initially in stage 1 only 2 trains will be installed to be expanded as the estate develops and comes on line • A sequencing controlled PLC evenly divides the wastewater load across the MBBR package plants over 24	Witchcliffe Eco Village WWTF Layout: • MBBR0 • MBBR1 • MBBR2 • MBBR3 • MBBR4

	hours.
	• The following parameters need to be maintained within optimum ranges within the bioreactor:
	  ○ Aqueous Dissolved Oxygen (through process air blowers)
	  ○ Sludge Concentration (manage mixed liquor concentration through periodic wasting)
	• After processing, treated water is discharged to x2 60kL reinforced fiberglass storage tanks (Recycled water storage tanks).
	• Trains can be shut down for maintenance while the remaining trains are fully operational.
	• Turbidity sensors alert the operator of abnormal process conditions relaying the signal to the control room process computer.
	• Wasted sludge (WAS) is removed from the MBBR via air lift pumps to the WAS transfer tank.	

9.	<u>WAS tank –</u> • Wasted sludge from the MBBR's will be stored in a 23kL reinforced above-ground fibre glass tank capable of holding material of specific gravity 1.5 • Fitted with aeration to maintain biological activity pre-dewatering • Sludge dewatering is managed by a 4 bag DRAIMAD dewatering system storing dried sludge in customized 20kg bags. Sludge can be composted or disposed to the local municipal tip.	Witchcliffe Eco Village WWTF Layout: • WAS Tk and WAS Transfer Tk
10.	<u>DRAIMAD dewatering system –</u> • Capable of dewatering sludge generated from the WWTF • Dewatered sludge is produced directly into bags which require manual removal from the unit and disposal • The longer sludge remains in the bags, the more weight it loses by evaporation • Fitted with sludge detection level sensors	Witchcliffe Eco Village WWTF Layout: • Dewatering Room
11.	<u>Chlorine contact tank –</u> • Minimum 9.9kL capacity glass fibre reinforced plastic water storage tank. • Free chlorine analyser • Primary disinfection via solid trichloride cyanuric acid tablets which dissolve to achieve 0.5-1mg/L free chloride. • Stored treated water circulated through an electrolysis unit to convert the chloride to chlorine and maintain free chlorine residual. • Allowance to "top-up" chlorine in the stored treated water tanks on a needs basis via injection of 12.5% liquid	Witchcliffe Eco Village WWTF Layout: • Chlorine Contact Tk

	chlorine.	
12.	Recycled water storage tank/s – • Receives treated water from the treatment plant • 60kL volume reinforced fiberglass tanks constructed and designed to hold liquid with a specific gravity of 1.5 • Tank dimensions: height 3,400mm, diameter 4,880mm • Level indication • Irrigation pump-set to draw water from the treated water tanks and discharge to the irrigation area • An online chlorine meter monitors the free chlorine level in the storage tanks and will alert the operator of low levels requiring action. As each tank is filled, a sample is collected for discharge compliance then transferred offsite to the village irrigation dam. • Where recycled water production is greater than the irrigation demand, the treated water storage tank will overflow to the wet weather storage dam.	Witchcliffe Eco Village WWTF Layout: • Treated Tk 1 • Treated Tk 2
13.	Wet weather storage dam/irrigation dam/effluent lagoon – • 1.5mm HDPE lined dam • Sized to store the recycled water across the low demand period for re-use in the warmer months • Sized to eliminate risk of uncontrolled overtopping in wet weather (30ML) • Filtration system to polish the water and remove any solids or algae growth from the storage dam prior to returning to the recycled storage tank for irrigation • Recirculation pump to transfer water to the treated water storage tank via the filtration system. • No public access to the recycled water dam	Witchcliffe Ecovillage Sewage Treatment and Reuse Site Layout Plan: • 30ML Effluent Lagoon
14.	Chemical storage and dosing – • Tanks along with the chemical dosing pumps will be located within separate bunded areas. • Tanks will be appropriately sized taking into consideration the chemical type and consumption. • The Dewatering Room will provide facilities to store coagulant (potable std) <50kg powder • The screening room will store up to 100kg of Tricchor tablets stored in plastic drums (25kg capacity)	Witchcliffe Eco Village WTF Layout: • Dewatering Room • Screening Room
15.	Site fencing – • The WWTF site and treated water storage lagoon is fenced with a minimum 2m high chainmesh fence • The effluent irrigation area is fenced with 0.9m high rural fencing.	N/A

16.	Irrigation system – • High volume low velocity dripper system which contains effluent irrigation wholly within the nominated irrigation area • Largely automated system • Irrigation pump set to be a variable speed constant pressure system which will draw water from the irrigation tank only. • Actuated and manual isolation valves incorporated throughout the irrigation network to allow for staged irrigation, maintenance and air release from the network as required. • Weather station to provide real-time data to assist with irrigation programming • Soil moisture sensors • Irrigation flow rate data logging	Wastewater Irrigation System Plan
17.	Emergency overflow dam – • In the event of a screen blockage, the sewage will overflow to the emergency storage pond where it may be pumped back into the screens for re-processing once the fault has been rectified or can be tankered off-site in the event of a longer duration outage. • 100m^3 capacity • Constructed of clay with permeability of $1.0x10^{-9}$ m/s	Witchcliffe Eco Village WWTF Layout: • Emergency overflow dam
18.	Groundwater monitoring bores	Irrigation Area Site Plan: • Monitoring Bore 1 • Monitoring Bore 2 • Monitoring Bore 3 • Monitoring Bore 4
	Other activities	
19.	Site facilities	Witchcliffe Eco Village WWTF Layout: • Site ablutions • Site Lab • Site Office & Control Room

4.3 Construction and commissioning

The Application states that due to the time lag between the first Lot connection to sewer and infill of the scheme, the WWTF has been designed in stages.

The base processing unit is a moving bed bioreactor (MBBR) at 40kL/day, the full development will include four MBBR units to process a total design volume of 160kL/day.

A smaller 10kL/day MBBR module is proposed to be installed in stage 1.5 to allow sewer scheme processing from the first lot connection as an interim to the first 40kL/day MBBR unit coming online. The smaller unit will remain in service to 120kL/day then decommissioned in the final stage and/or stay online for alternate purposes.

The commissioning process is divided into stages to reflect the estate development. The commissioning process for the entire plant will be completed over a number of years.

Commissioning of each stage of the treatment plant is anticipated to be undertaken over a three week period, this period will then be followed by a six week validation period to ensure that the plant continues to meet the design performance parameters. The validation period will only commence once the plant has met its commissioning requirements (evidenced by both records and performance).

During the commissioning and validation periods water produced from the WWTF is anticipated to be discharged to the wet weather storage dam and then reprocessed upon completion of validation.

The Application notes that a detailed Commissioning Plan will be provided to DWER prior to commencement of commissioning.

The anticipated sampling frequencies and locations across the validation period are identified in Table 7 below.

Table 7: Validation requirements for the WWTF

System	Parameter	Measured by	Frequency
Sewage inlet	Wastewater flow	PLC/SCADA	Continuous
Discharge of treated water storage tank	Total Suspended Solids (TSS)	NATA lab	Once/week
	Biochemical Oxygen Demand (BOD_5)	NATA lab	Once/week
	Total Nitrogen (TN)	NATA lab	Once/week
	Total Phosphorous (TP)	NATA lab	Once/week
	E.coli	NATA lab	Once/week
	pH	NATA lab	Once/week

('Table 5 – Validation requirements for the RWP', Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

The plant will be operated by the construction contractor in conjunction with the plant operators during the commissioning and validation period. Remote monitoring and control will also be utilised to ensure any incidents during this period are managed and rectified.

Operation and maintenance manuals will be provided by the contractor prior to commissioning which will detail start-up and shutdown procedures for the plant including in emergencies.

Table 8 below and Figures 3 - 7 outline the details and schematics of each stage.

Table 8: WWTF staging

Stage	Anticipated completion[1]	Capacity (kL/day)	Description
1 / 1.5	2020	10	Works: • General earth works • Construction of hardstand • Installation of WWTF Receiving Sump (Pit 1) and Transfer Pit (Pit 2) fitted out with pumps level and flow sensors • Installation of Screen Room and Salsnes press (Inlet Screens) • Installation of Biofiltration Odour (Odourtech Odour Control) • Construction of Bunded Tank Farm • Installation of FBT Tank 1 (Buffer Tk 1) equalisation and bunding, level sensors and mixer • Construction of Emergency Overflow Dam • Installation of WAS Transfer Tank • Installation of Chlorine Contact Tank • Installation of a 10kL/day MBBR process train (MBBR0) • Installation of control room and stage 1 SCADA control • Construction of treated storage tank (Treated Tk 2) and associated equipment • Construction of dewatering room • Installation of DRAIMAD dewatering unit and associated equipment • Construction of Wet Weather Storage Dam • Construction/installation of irrigation system and irrigation areas • Construction of entry road and parking • Construction of perimeter fence Commissioning: Commissioning of selected equipment including Salsnes, Odatech and controls by contracted suppliers/installers. 1. Initial commissioning tested with dam water to confirm operation of controls and signals back to the SCADA control. 2. Wastewater from the sewer scheme enters the WWTF 1 and processed to confirm Salsnes operation of screening and dewatering operation to manufacturers' specification. Equipment signed off by Works Approval holder as fully operational within the commissioning log. A 10kL/day MBBR is seeded with local winery activated sludge and begins processing of stored sewer wastewater commissioned at 2kL/day progressing to 4kL/day through to the design specification of 10kL/day. The small MBBR is identical to the 40kL/day MBBR units with materials and equipment. The prime difference is size and number of blowers (air capacity). 3. Treated effluent tested for compliance by NATA laboratory 4. Once compliance certificate received, treated wastewater discharged to irrigation dam 5. Non-conforming product transferred via gravity feed to Pit 2 and reprocessed. 6. Treated effluent tested for compliance by NATA laboratory Steps 4 to 6 repeated until compliance achieved. Operation: Under Stage 1/1.5, inflow from the sewer network is screened and stored in a circulated equalisation tank, the screened wastewater is then processed in a 10kL/day MBBR. Treated water is stored onsite and tested for compliance before being

Stage	Anticipated completion[1]	Capacity (kL/day)	Description
			discharged to the irrigation lagoon.
2	2020	40	Works: • Installation of FBT Tank 2 (Buffer Tk 2) • Installation of 40kL/day MBBR process train (MBBR No. 2) • Connection of pumps, sensors and monitoring equipment Commissioning: Stage 2 commencing as inflow rate approaches 10kL/d (20-30 households connected to sewer line). Load progressively transferred from the small 10kL/d MBBR to the larger 40kL/d MBBR. The larger MBBR is seeded with activated sludge. 1. MBBR No.2 seeded with activated sludge exiting the smaller MBBR 2. MBBR No.2 blowers and transfer lines tested to manufacturers' compliance 3. MBBR No.2 initial processing of screened effluent exiting the estate at 10kL/day rate, approximately 400L/hr. 4. Signals and data collection to SCADA controls confirmed. 5. Treated effluent collected in Treated tank for approximately 5 days (50kL) 6. Treated effluent tested for compliance by NATA laboratory 7. Once received of compliance certificate, treated water is discharged to irrigation dam 8. Non-conforming product is transferred via gravity feed to Pit 2 and reprocessed. 9. Small 10kL/day MBBR decommissioned and relocated onsite. 10. Steps 4 to 6 repeated until compliance achieved. *Sludge commissioning:* On collection of 10-15kL of wasted activated sludge in the WAS tank, the DRAIMAD dewatering unit is commissioned. Conditions of commissioning to follow the manufacturers' instructions. The time period to collect the required volume of sludge for dewatering is 6-12 months from the day of commissioning MBBR 1 & 2. Sludge 0.5-1% solids dewatered to 10-12% in 24hrs; 20% within 1 week; up to 90% in 6-8months. Dewatered bags of sludge are to be placed in storage for further dewatering (transpiration) for approximately 6 months before disposal to an authorised landfill. The bags will be stored in a roofed area to the rear of the tank farm. Operation: Load to the 40kL/day MBBR is progressively increased from 10kL/d in 5kL/d increments to maximum load at 40kL/d. Treated water produced prior to validation will be stored in the storage dam and retreated once plant validation is complete. Irrigation will be direct from the treated water tanks from completion of validation until stored water has been retreated. Early stage irrigation flows are to be supplemented with winery waste water. Plant will be validated once sewage flow reaches 10kL/day.
3	2023	120	Works: • Installation of 2x 40kL/day MBBR process trains (MBBR2 and MBBR3) • Installation of second Recycled Water Storage Tank (Treated Tk 1) • Connection of pumps, sensors and monitoring equipment

Stage	Anticipated completion[1]	Capacity (kL/day)	Description
			Commissioning: 1. MBBR No.2 seeded with activated sludge 2. MBBR No.2 blowers and transfer lines tested to manufacturers' compliance 3. MBBR No.2 initial processing of screened effluent exiting the estate at 10kL/day rate, approximately 400L/hr. 4. Signals and data collection to SCADA controls confirmed. 5. Treated effluent collected in Treated tank for approximately 5 days (50kL) 6. Treated effluent tested for compliance by NATA laboratory 7. Once received of compliance certificate, treated water is discharged to irrigation dam 8. Non-conforming product is transferred via gravity feed to Pit 2 and reprocessed. 9. Steps 4 to 6 repeated until compliance achieved. Operation: Inflow from the FBT into MBBR No.2 gradually increased to 60% of manufacturers' maximum flow rate 24kL/day while following steps 6 and 7 of the commissioning process. Inflow is fully processed suitable for transfer to the irrigation dam to a maximum 120kL/day.
4	2025	160	Works: • MBBR No. 4 installed (as required) Commissioning: 1. MBBR No.4 seeded with activated sludge 2. MBBR No.4 blowers and transfer lines tested to manufacturers' compliance 3. MBBR No.4 initial processing of screened effluent exiting the estate at 10kL/day rate, approximately 400L/hr. 4. Signals and data collection to SCADA controls confirmed. 5. Treated effluent collected in Treated tank for approximately 5 days (50kL) 6. Treated effluent tested for compliance by NATA laboratory 7. Once received of compliance certificate, treated water is discharged to irrigation dam. 8. Non-conforming product is transferred via gravity feed to Pit 2 and reprocessed. 9. Steps 4 to 6 repeated until compliance achieved Operation: Inflow into MBBR No. 4 gradually increased to manufacturer's maximum flow rate or until discharge specification achieved 75% of target.

Notes:
1. Based on forecast occupancies. May be adjusted to align with development growth
2. Irrigation system may be installed prior to stage 1 and operated on stormwater to establish crop prior to commencement of the recycled water scheme.

(Based on 'Table 3 – Treatment Plant Staging', Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

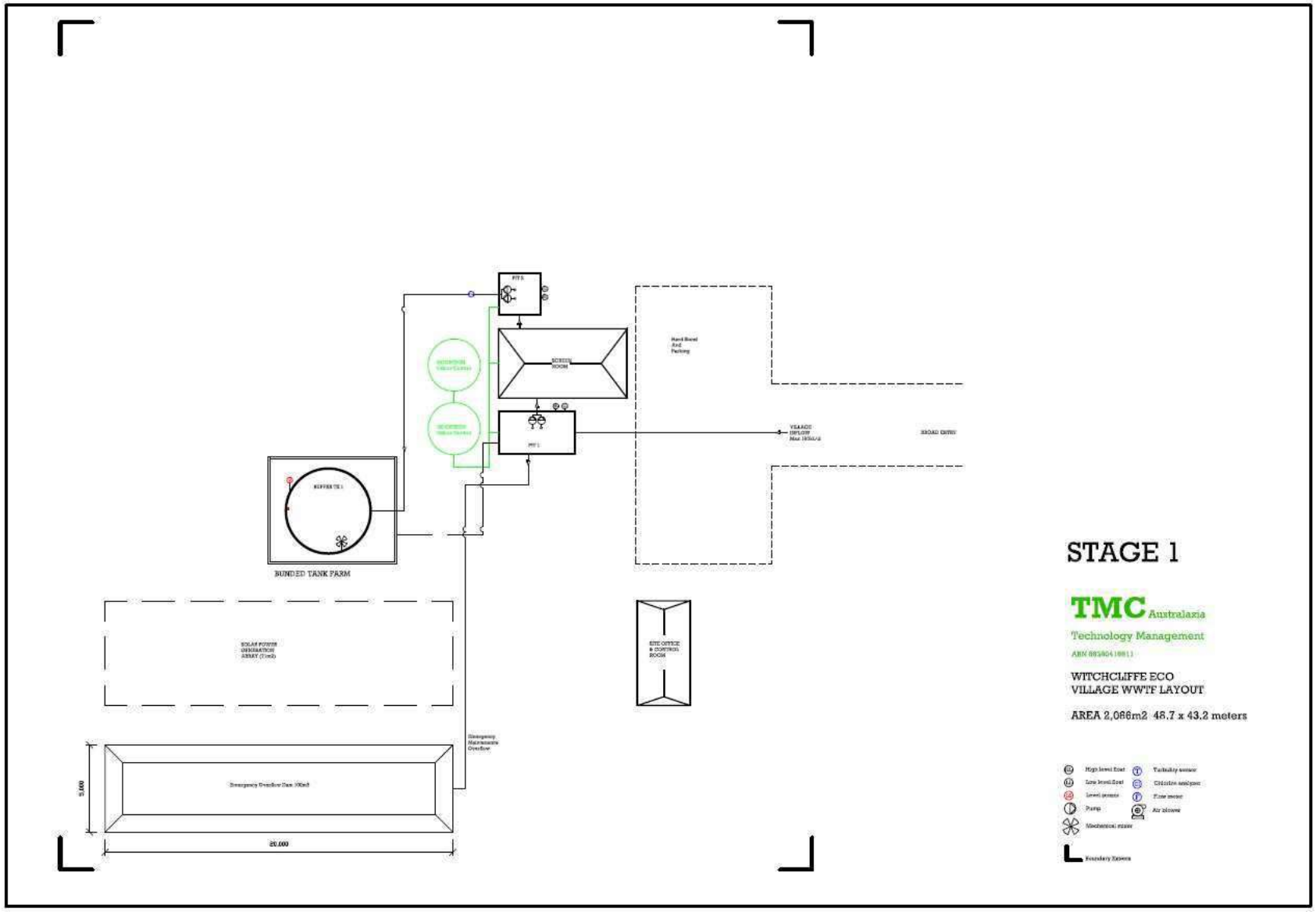


Figure 3: WWTF Stage 1

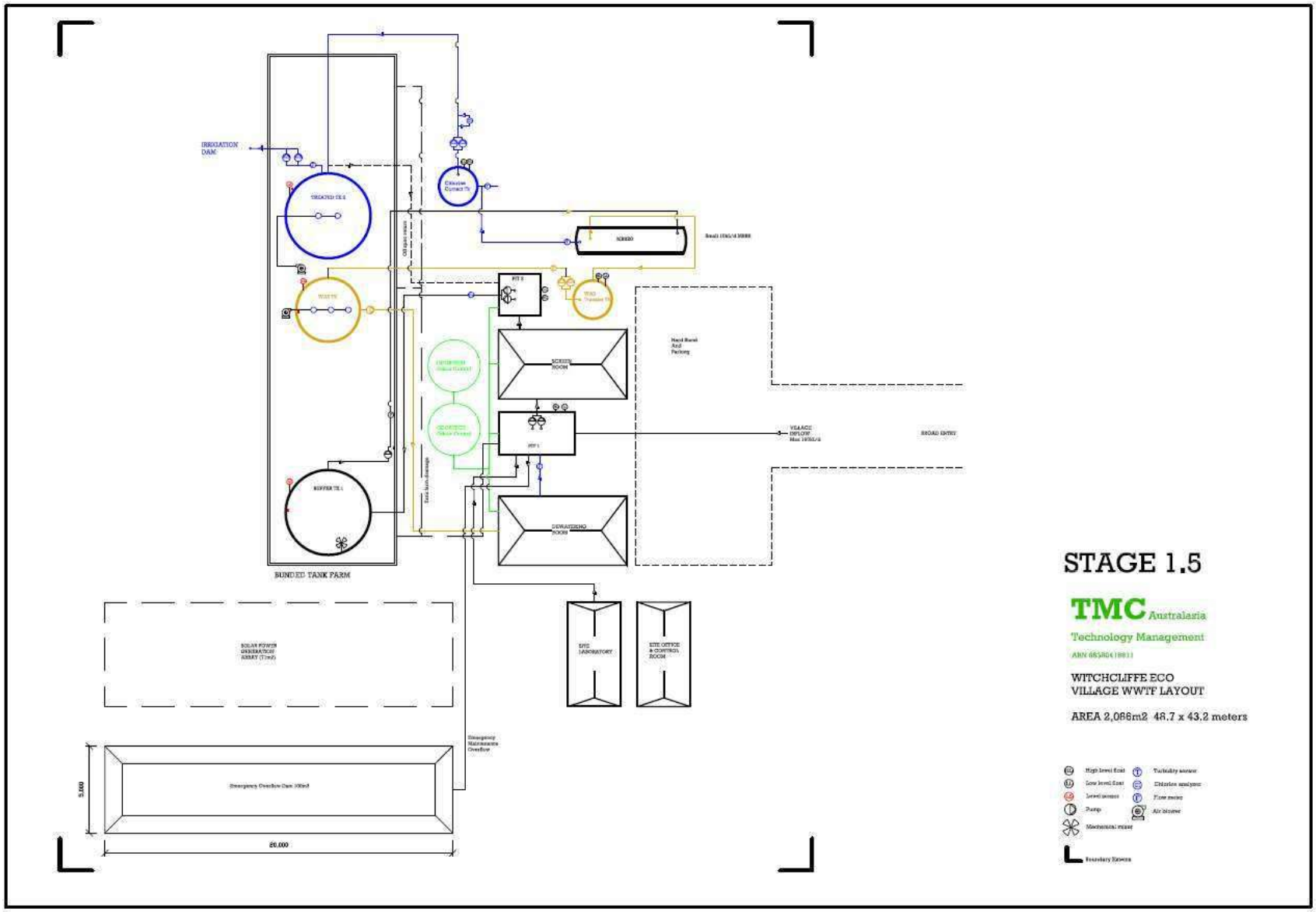


Figure 4: WWTF Stage 1.5

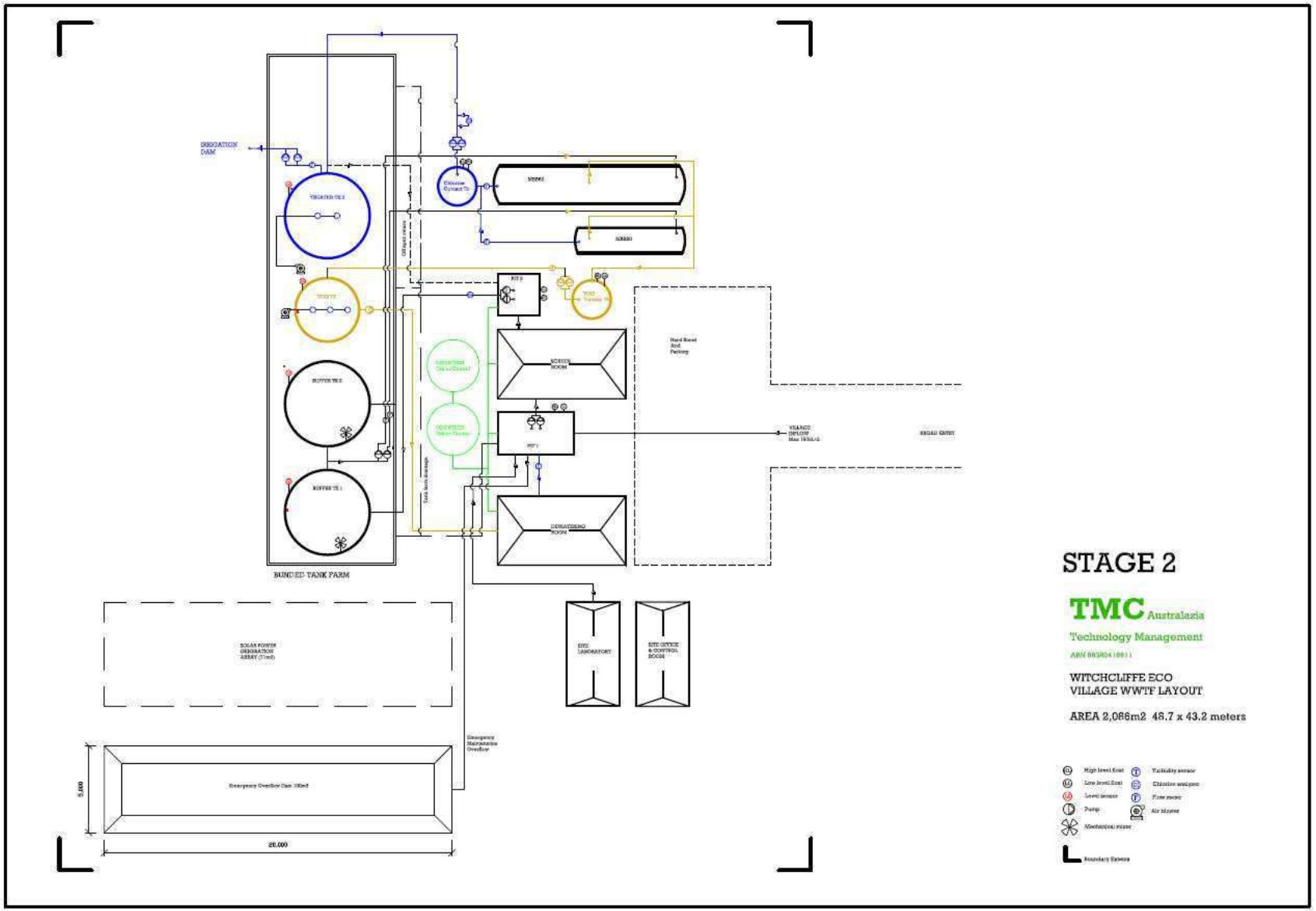


Figure 5: WWTF Stage 2

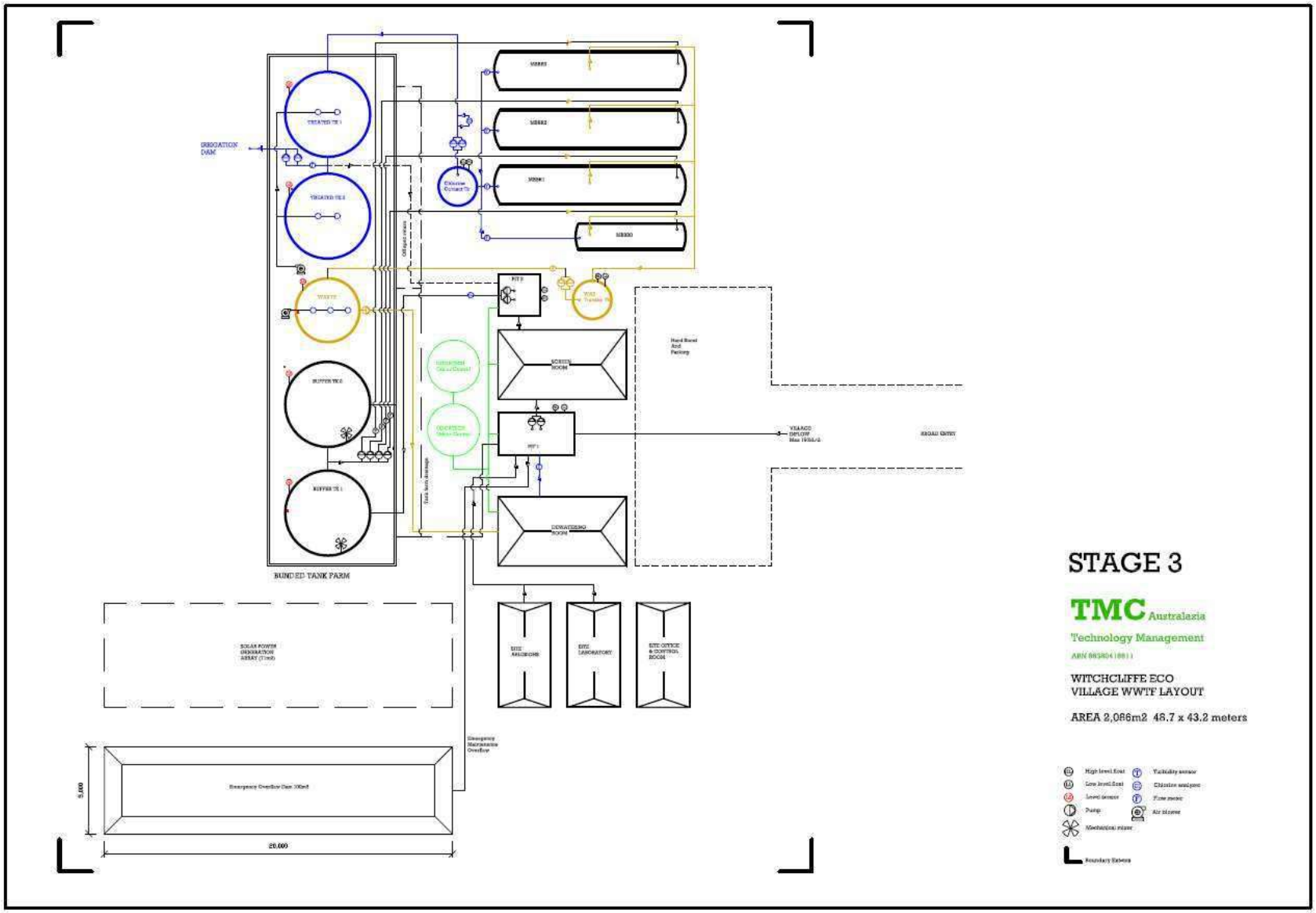


Figure 6: WWTF Stage 3

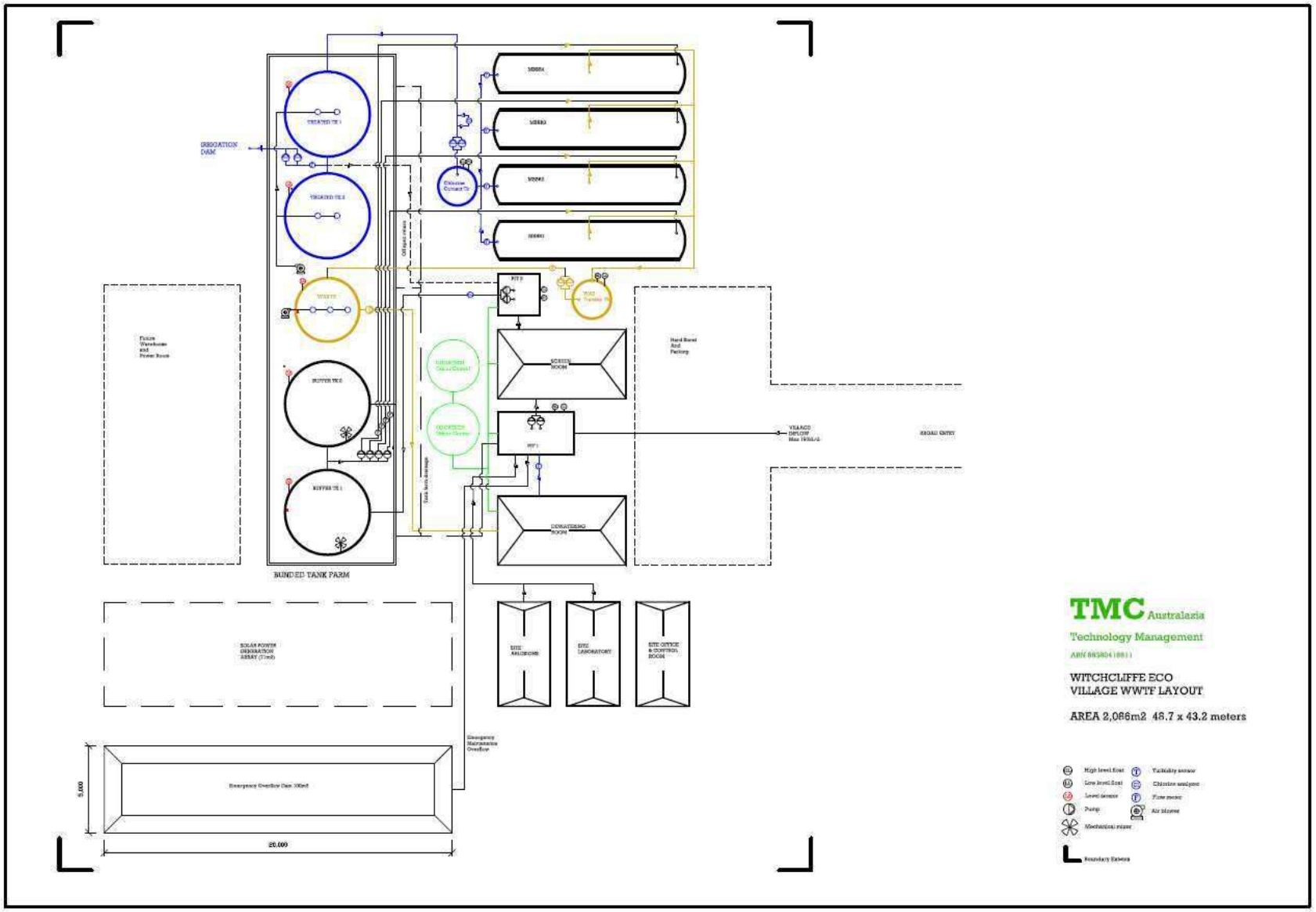


Figure 7: WWTF Stage 4

4.4 Exclusions to the Premises

The sewage network throughout the Witchcliffe estate is connected by several pump stations conveying waste water to the WWTF receiving sump. The design and construction of the sewer network is outside the scope of this works approval.

5. Legislative context and other approvals

Relevant approvals

Legislation	Number	Approval
Department of Health – *Health Act 1911*	DoH approval pending	The Department of Health (DoH) considers the use of recycled water for surface irrigation. The DoH have advised that they have no objection to the proposal and that the Applicant has submitted the proposal to the Department for separate assessment and approval. A licence to operate the WWTF will not be granted until a final permit from the DoH has been issued after complying with all conditions of the approval in principal including commissioning and validation of the plant.
West Australian Planning Commission – *Planning and Development Act 2005*	SPN 2083	The Witchcliffe Eco Village Structure Plan was approved by the WA Planning Commission on 10 January 2018 and expires on 10 January 2028. The Shire of Augusta Margaret River advised that the proposal accords with the above Structure Plan. This Structure Plan identifies the proposed site of the treatment facility and associated effluent lagoon as “Special use Zone – Ecovillage Wastewater Treatment and Depot”.
Shire of Augusta Margaret River – *Planning and Development Act 2005*	N/A	Under Section 137 of the *Water Services Act 2012*, the Applicant is exempt from the requirement (under the *Planning and Development Act 2005*) to obtain development approvals for Public water Works under a Local Planning Scheme. The Applicant has advised that the WWTF was incorporated in the Shire of Augusta Margaret River Witchcliffe Eco Village planning permission.

6. Environmental siting

The proposed Witchcliffe Ecovillage Project is located on Lots L2812 and L2807 Bussell Highway (the Premises), to the east of the existing Witchcliffe townsite covering a total area of 119.1ha. The WWTF is located at the southern end of the development.

The site is bounded by Mill Road to the north, Davis Road to the south and the Bussell Highway to the west. Along the eastern boundary is open pasture to the north and bushland along the southern half. The Augusta-Margaret River (Davis Road) shire landfill facility located immediately to the south of the Premises.

Most of the site has been cleared and at present, the northern lot is being used for grazing while the southern lot is used for grazing and viticulture. A couple of residential dwellings are present towards the northern end of the site and a large shed is present towards the centre of the southern lot.

There are three ephemeral drainage courses, draining eastwards across the site. There is a relatively large dam in the middle (50ML) and a smaller dam across the northern creek line (Geotechnical Study, December 2015).

Refer to Premises maps in Appendix 1

Table 9: Residential and sensitive receptors and distance from activity boundary

Residential and sensitive premises	Distance from Prescribed Premises
Rural dwellings (zoned priority agriculture)	Approximately 42m south-west of Premises boundary (approximately 260m from WWTF site)
Village centre	Approximately 490m north of Premises boundary (approximately 850m from WWTF site)
Future development	Directly adjacent of Premises boundary (approximately 900m north of WWTF site)
Parks and recreation reserve	Approximately 42m west of Premises boundary (approximately 250m north-west of WWTF site)
L6989/1997/13 – Davis Road Putrescible Landfill (Category 64)	Directly south of the Premises boundary
Agricultural lots (zoned priority agriculture)	Approximately 45m west and 160m east of Premises boundary

Table 10: Environmental receptors and distance from activity boundary

Environmental receptors	Distance from Prescribed Premises and environmental value
Chapman Brook	650m east of Premises boundary (approximately 1,180m east of WWTF site)
Minor Non-Perennial Watercourse	220m south of Premises boundary (approximately 270m south of WWTF site)
Groundwater	The site is located in the Blackwood Groundwater Area and the Lower Blackwood River Surface Water Area. The Applications states that groundwater observed across the site is perched groundwater in the superficial aquifer. The superficial aquifer is present within the sandy upper surface layer which extends up to 2m deep overlying low permeability sandy clay. Groundwater level monitoring has been carried out at the site with depths to maximum perched water levels ranging from 0m to 2.3m. The southern part of the site is well drained with sandy and gravelly soils, greater surface grades and depth to groundwater of 0.8m and greater. Surface water is present during the winter in the central and western parts of the site. The Geotechnical investigation encountered groundwater within seven of the test pits at depths of between 1.0m and 2.6m. This was generally inferred to be perched water on top of hard clayey layers or laterite.

Environmental receptors	Distance from Prescribed Premises and environmental value
Acid sulfate soils	DWER's GIS mapping indicates a medium to low risk of Acid Sulfate Soils (ASS) at the Premises. Additional investigations have been undertaken by the Applicant which have concluded that further investigation or management of soils for ASS will not be required at the Premises (see Section 6.4.2)
Threatened fauna	465m north-west of Premises boundary

6.1 Topography

The Application states that the site is typically flat to gently undulating with the surface elevation ranging from about RL 65m AHD in the middle of the eastern boundary to RL 86m AHD in the north-west corner (Geotechnical Study, December 2015).

The site is flat to gently sloping. The irrigation area is located in the south western corner of the site. The irrigation areas generally have a slope of 1-2% and fall towards the creek line that crosses the site form the eastern boundary. Surface run-off from the irrigation area will discharge into the 80ML stormwater storage dam.

6.2 Hydrology

The Application provides that the site lies at the north western extreme of the Chapman Brook catchment with no surface water inflow onto the site. Drainage from the site moves in an easterly direction onto adjoining farmland.

The properties support three main and one minor watercourse. The watersheds of each of the watercourses originate on site (with some minor off-site inflow to the northern most creek line) and flows into the Chapman Brook through properties to the east.

The southern creek line that passes through the irrigation area contains a mix of vegetated and cleared areas that have undergone significant revegetation by the Applicant.

The property has shire approval for a third dam approximately 80ML in size that is yet to be constructed.

6.3 Groundwater

The Application provides that groundwater observed across the site is perched groundwater in the superficial aquifer. The superficial aquifer is present within the sandy upper surface layer which extends up to 2m deep overlying low permeability sandy clay. The depth to groundwater is affected by surface features and local variations in the aquifer profile.

The southern part of the site is well drained with sandy and gravelly soils, greater surface grades and depth to groundwater of 0.8m and greater.

Groundwater level monitoring was carried out at the adjacent Witchcliffe Ecovillage development site with depths to maximum winter water levels ranging from 0m to 2.3m. Higher winter ground water levels were observed in close proximity to waterways with the majority of the site recording winter water levels at a depth of greater than 0.5m.

Specific groundwater levels beneath the proposed Premises area were not identified during the groundwater level monitoring. Information provided in the Application indicates that groundwater was intercepted at a depth of approximately 0.6m and 1.0mbgl in 2016/2017 in close vicinity to the boundary of the proposed Premises area. Information in the Application also suggests that there is potential for seasonal fluctuations with groundwater levels

generally at their highest during the winter months.

6.4 Geology

As part of the Application, a geotechnical investigation was conducted by Galt Geotechnics Pty Ltd for the proposed Witchcliffe Ecovillage Project.

Based on the materials encountered within the test pits, the investigation considered the subsurface conditions to be relatively consistent across the majority of the site with the typical soil profile comprising of the following:

- Silty SAND/SAND/Sandy GRAVEL (SM/SP/GP), fine to medium grained sand, fine to medium grained gravel, rounded to sub-angular, up to 30% non-plastic fines, pale brown to pale grey, locally very weakly cemented, trace roots and rootlets, generally medium dense to very dense, generally dry, present from the surface extending to depths of between 0.3m and 2.0m; overlying
- Clayey SAND/Gravelly Clayey SAND/Clayey Sandy GRAVEL (SC/GC), 30% to 70% fine to medium grained sand, 20% to 40% low to medium plasticity clay fines, generally pale grey/orange brown/pale brown locally stained red-brown, variably iron cemented[i], locally with up to 40% iron-cemented, fine to coarse grained gravel, localised COBBLE to BOULDER sized concentrations, firm to hard, generally dry, locally moist to wet, extending to the maximum depth of investigation of 2.9m.

6.4.1 Irrigation area

The soils encountered in the irrigation area were predominantly a 0.5m – 1.2m layer of silty-sand overlying clayey-sand.

Further sampling for the soil was undertaken which found that the soils are slightly acidic and with relatively low nutrient levels. The suitability of the in-situ soils for recycled water irrigation is summarised in the following table.

Table 11: Soil assessment for recycled water irrigation

Parameter	Value	Interpretation
pH	6.1-6.9	Slightly acidic: lime addition may be required depending on plantation requirements
Electrical Conductivity	59.9-84.7µS/cm	Non-saline
Exchangeable Sodium Percentage	0.92-1.42%	Non-sodic soil
Base Saturation	50-70%	Moderate
Cation exchange capacity	10.84-15.93meq/100g of soil	Moderate capacity for nutrient/pollutant retention

('Table 1 – Soil assessment for recycled water irrigation', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

From the soil assessment, some soil amendments may be required for the establishment of the crop including the addition of Lime and Dolomite.

6.4.2 ASS Assessment

ASS risk mapping indicates that the site is located in an area having moderate to low risk of ASS occurrence.

A Geotechnical Investigation was undertaken by Galt Geotechnics in December 2015. The investigation report provided that based on the results of the field testing, it is considered unlikely that actual acid sulfate soils are present at the site. However given that the results of some of the field tests (12 of 72 samples) were within the assessment criteria for potential acid sulfate soils (PASS), PASS may be present across the site.

A detailed ASS investigation was recommended if excavations extend below the groundwater table and if more than 100m^3 of material is proposed to be excavated. The Applicant confirmed in further correspondence dated 17 July 2019 that more than 100m^3 of material would require removal for the treated water winter storage dam and a further ASS study had been undertaken at the site.

The additional ASS study undertaken in September 2017 by Galt Geotechnics found that the adopted net acidity criterion of 0.1%S was not exceeded at any of the 10 test pit locations investigated and that no visual or olfactory evidence of ASS presence was noted during the investigation. As such, further investigation or management of soils for ASS was determined to not be required at the site.

6.5 Climate

The Witchcliffe area has a mild Mediterranean climate characterised by warm summers and relatively mild winters. Rainfall predominantly falls during the winter period.

Rainfall and evaporation data for the Witchcliffe area suggest that there would be about a six month period when evapotranspiration exceeds rainfall.

Table 12: Witchcliffe climate data

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Maximum Temperature (°C)	26.5	27.2	25.7	22.6	19.7	17.5	16.4	16.8	17.4	19.6	22.9	24.7
Mean Minimum Temperature (°C)	14	14.4	13.1	11.1	9.8	8.8	8.1	8.2	8.6	9.3	10.9	12.4
Mean Rainfall (mm)	10.7	9.3	26.8	63.9	140	170.8	197.3	156.1	115.1	61.7	34	17.8
Mean number of days of rain >1mm	1.6	2.5	4.1	7.9	12.5	15.7	19.3	16.8	14.8	9.5	5.8	3

('Table 2 – Witchcliffe climate data', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

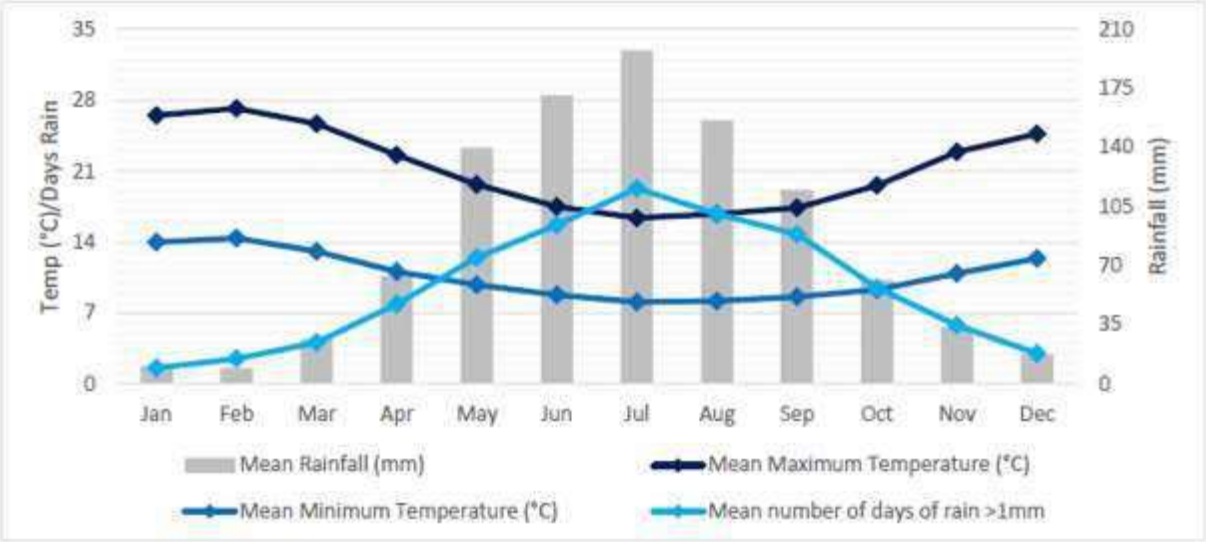


Figure 8: Witchcliffe climate statistics

(Source: 'Figure 1 – Witchcliffe climate statistics'', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

7. Risk assessment

Table 13: Risk assessment – construction and commissioning

Risk Event					Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**	**Applicant controls**					
Construction, mobilisation and positioning of infrastructure	**Dust**: associated with vehicle movements on unsealed access roads and construction and position of new buildings, plant and infrastructure including associated earthworks.	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Dust transported by air (wind dispersion) to sensitive receptors resulting in potential health and amenity impacts	The preliminary risk matrix provided as part of the Application identifies 'adoption of standard industry dust control measures particularly during construction' The Applicant advised that dust control measures comprise: • Site area for stripping and earthworks to be minimised; • Works to be suspended during unfavourable wind conditions or a water cart to be used to reduce dust emissions	Minor	Unlikely	Medium	Dust emissions caused by installation and construction of the works are likely to cause minimal off-site impacts on a local scale given the distance to sensitive receptors and extent of the works.	**Works Approval -** Condition 8 has been included to ensure visible dust does not pass the Premises boundary. The *Environmental Protection (Unauthorised Discharges) Regulations 2004* will also apply. **Licence** – N/A
	Noise: associated with construction activities including vehicle movements, construction and positioning of new buildings, plant and infrastructure and associated earthworks.	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Noise transmitted through air to sensitive receptors resulting in potential amenity impacts	None specified	Minor	Unlikely	Medium	Noise emissions are expected to cause minimal offsite impacts on a local scale given the distance to sensitive receptors and the limited duration of the works.	**Works Approval -** Regulatory controls not required, the *Environmental Protection (Noise) Regulations 1997* apply. **Licence –** N/A
	Acid sulfate soils: from the disturbance of acid sulfate soils releasing toxic metals and arsenic and potentially hydrogen sulphide gas emissions	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Toxic metals and arsenic transmitted through land, air and waters resulting in potential acidification of groundwater, wetlands and waterways and health and amenity impacts of people at the nearest residence.	None specified-(see section 6.4.2)	Moderate	Possible	Medium	ASS investigations for the site indicate that ASS may become an issue where excavations extend below the groundwater table and if more than 100m^3 of material is proposed to be excavated. A detailed ASS investigation was recommended if this was to occur.	**Works Approval –** N/A **Licence** – N/A
Commissioning of WWTF infrastructure	**Noise**: from the operation of the WWTF and associated infrastructure under the commissioning phase	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Noise transmitted through air to sensitive receptors resulting in potential amenity impacts	The preliminary risk matrix provided as part of the Application indicates that noise generating equipment over a certain threshold will be fitted with acoustic covers and/or located inside a building as required and that blowers/ compressors are to be located within equipment building	Minor	Unlikely	Medium	Noise emissions are expected to cause minimal offsite impacts on a local scale given the distance to sensitive receptors and siting of noisy equipment within an enclosed building.	**Works Approval –** Conditions 1-4. The Applicant's controls requiring blowers and compressors to be located within the equipment building will be conditioned in the Works Approval. The *Environmental Protection (Noise) Regulations 1997* also apply. **Licence** – N/A
	Odour: from the treatment of sewage under the commissioning phase	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Via air/wind dispersion resulting in amenity impacts	The WWTF will operate continuously so there is no long term storage of sewage. The primary sources of odour (FBT and Inlet screens) will be connected to an odour control system.	Moderate	Possible	Medium	Odour impacts are expected to be low given the WWTF is fitted with odour controls however, given the distance to sensitive receptors odour emissions may result in amenity impacts where controls fail or are not sufficient.	**Works Approval –** Conditions 1-4. The Applicant controls for installation of odour control infrastructure will be conditioned in the Works Approval. **Licence** – N/A

Risk Event					Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**	**Applicant controls**					
Commissioning of irrigation infrastructure	**Discharge to land:** Treated sewage (nutrient rich effluent) discharged to land via irrigation during commissioning	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Soil, direct discharge and overland flows Nutrient load and impacts on native vegetation health, reduction in soil quality resulting in plant death	Treated sewage will not be irrigated during the commissioning period.	N/A	N/A	N/A	N/A - Treated sewage will not be irrigated during commissioning of infrastructure.	**Works Approval –** Condition 14. Treated wastewater will not be authorised for discharge through irrigation under the Works Approval. **Licence -** N/A
	Human exposure to contaminants: Treated sewage (nutrient rich effluent) discharged to land via irrigation during commissioning	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Via air/wind dispersion leading to physical contact with exposed wastewater resulting in human health impacts Direct contact and ingestion of harmful pathogens in the wastewater which may cause gastroenteritis, spread disease or create other public health impacts	Treated sewage will not be irrigated during the commissioning period.	N/A	N/A	N/A	N/A – Treated sewage will not be irrigated during commissioning of infrastructure.	**Works Approval –** Condition 14. Treated wastewater will not be authorised for discharge through irrigation under the Works Approval. **Licence -** N/A

Table 14: Risk assessment – operation

Risk Event					Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**	**Applicant controls**					
Operation of WWTF	**Noise:** associated with the operation of the WWTF	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Noise transmitted through air to sensitive receptors resulting in potential amenity impacts	All noise generating equipment fitted with acoustic covers a required Blowers/compressors located within equipment building	Minor	Unlikely	Medium	Noise impacts are expected to be minimal offsite given the distance to sensitive receptors and siting of noisy equipment within an enclosed building.	**Works Approval –** Conditions 1-4. Infrastructure requirements conditioned in works approval. **Licence** – The maintenance of specified infrastructure will be required under Licence conditions. The *Environmental Protection (Noise) Regulations 1997* also apply.
	Odour: associated with effluent treatment and disposal	Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Via air/wind dispersion resulting in amenity impacts	The WWTF will operate continuously so there is no long term storage of sewage. The primary sources of odour (FBT and Inlet screens) will be connected to an odour control system.	Moderate	Possible	Medium	Odour impacts are expected to be low given the WWTF is fitted with odour controls however, given the distance to sensitive receptors odour emissions may result in amenity impacts where controls fail or are not sufficient.	**Works Approval –** Conditions 1-4. Applicant controls for installation of odour control infrastructure will be conditioned in the Works Approval. **Licence** - Requirements for maintenance of the odour control infrastructure will be included in the Licence.
	Sewage spill (containment breach): resulting from pipe rupture or overtopping of containment infrastructure	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Soil, direct discharge and overland flows resulting in increased nutrient load and potential impacts on native vegetation health, reduction in soil quality resulting in plant death	Infrastructure controls (e.g. bollards for vehicle protection, location of tankering connections in bunded areas) Diversion to emergency overflow dam if required There are minimal impervious surfaces throughout the plant that could allow for contaminated run-off from the site.	Moderate	Unlikely	Medium	The risk of unplanned discharges to land by breach of containment infrastructure is unlikely given the infrastructure controls proposed by the Applicant.	**Works Approval –** Conditions 1-4. Specified infrastructure will be required to be constructed/installed under the Works Approval. **Licence** – The maintenance of specified infrastructure will be required under Licence conditions.
Chemical storage holding tanks	**Chemical spills:** Breach of containment tanks or rupture of pipes resulting in chemical discharge to land	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Soil, direct discharge and overland flows resulting in potential impacts on native vegetation health, reduction in soil quality resulting in plant death	All chemical storage areas will be covered and bunded. The tanker connection bund will allow for pumping back to the head of the plant. There are minimal impervious surface throughout the plant that could allow for contaminated run-off from the site.	Moderate	Rare	Medium	The risk of unplanned discharges to land by breach of containment infrastructure is unlikely given the infrastructure controls proposed by the Applicant.	**Works Approval –** Conditions 1-4. Specified infrastructure will be required to be constructed/installed under the Works Approval. **Licence** – The maintenance of specified infrastructure will be required under Licence conditions.
Contaminated stormwater	**Contaminated stormwater:** Stormwater contaminated with wastewater or chemicals	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Stormwater may become contaminated with wastewater or chemicals onsite. Soil, direct discharge and overland flows resulting in potential impacts on native vegetation health, reduction in soil quality resulting in plant death	All chemical storage areas will be covered and bunded. The tanker connection bund will allow for pumping back to the head of the plant. There are minimal impervious surfaces throughout the plant that could allow for contaminated run-off from the site.	Moderate	Rare	Medium	Stormwater is unlikely to come into contact with chemicals on the Premises given infrastructure controls in place. In the event of stormwater becoming contaminated, it will be contained onsite.	**Works Approval –** Conditions 1-4. Specified infrastructure will be required to be constructed/installed under the Works Approval. **Licence** – The maintenance of specified infrastructure will be required under Licence conditions.

Risk Event					Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**	**Applicant controls**					
Wet weather storage dam	**Overtopping**: storage pond	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Seepage through soil to groundwater	1.5mm HDPE lined pond sized to cater for wet weather events Further controls detailed in Section 7.1	Moderate	Rare	Medium	The wet weather storage dam will only be utilised where treated wastewater production exceeds the irrigation demand. Water stored in this pond has already been treated through the WWTF MEDLI modelling has been carried out to determine the appropriate size for the pond, overtopping of the pond would only occur in exceptional circumstances.	**Works Approval –** Conditions 1-4. Specified infrastructure will be required to be constructed/installed under the Works Approval. **Licence** – Requirements for the maintenance of specified infrastructure will also be included in the Licence.
Irrigation of treated wastewater	**Pathogens**: release of pathogens via airborne water droplets from irrigation and/or direct contact with irrigation mist (ingestion)	Human receptors Residential receptors - nearest residence located 42m south-west of Premises boundary, approximately 260m from the WWTF site	Direct contact and ingestion of harmful pathogens in the wastewater which may cause gastroenteritis, spread disease or create other public health impacts.	No public access to plant or irrigation area (buffer to site boundaries, boundary fencing of irrigation area and signposting to indicate the use of recycled water) Water quality (diversion of off-spec water quality to be diverted to the start of the process for re-processing. Chlorination/disinfection occurs prior to irrigation occurring Additional controls are detailed in the NIMP (see Section 7.1)	Minor	Unlikely	Medium	The water quality specifications provided in the Application for the WWTF are within the low-risk exposure levels as identified in the Department of Health's *Guidelines for the Non-potable Uses of Recycled Water in Western Australia*. A review of the NIMP has been included in Section 7.1.1 below.	**Works Approval –** Conditions 12 – 16. Commissioning under the Works Approval will ensure appropriate effluent criteria is met prior to commencement of irrigation. Conditions 1-6 and 17-19 include requirements for the installation of groundwater monitoring bores in specified locations at the Premises and the requirements to determine baseline groundwater quality conditions (prior to commencing irrigation of treated wastewater). **Licence –** Controls relating to effluent quality will be included in the Licence and/or within a DoH approval for the site. Periodic monitoring of ambient groundwater will be required under the Licence which will include monitoring for traces of pathogens and nutrients in groundwater.

Risk Event					Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**	**Applicant controls**					
	Increased nutrient loading: Treated wastewater discharged to land via irrigation resulting in increased nutrient loads in soil	Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary Soils, crops and vegetation in irrigation area	Direct discharge of treated wastewater to land by irrigation can cause cumulative contamination of the land, affect plant growth and cause off-site impacts on neighbouring properties and ecological systems and infiltrate into groundwater.	Controls are detailed in the NIMP (see Section 7.1) Additional controls including	Moderate	Possible	Medium	A review of the NIMP has been included in Section 7.1.1 below. Given the potentially shallow groundwater in the area, it is possible for groundwater to become contaminated with increased nutrient loads if the irrigation is not managed appropriately.	**Works Approval –** Conditions 1-6 include requirements for the installation of groundwater monitoring bores in specified locations at the Premises to assess potential impacts to groundwater from irrigation. As a minimum, bores will need be required within the irrigation area, up-hydraulic gradient of the irrigation area and between the irrigation area and the creek line. Conditions 17-19 require baseline groundwater monitoring to commence prior to commencing irrigation of treated wastewater. **Licence** - DWER will require the volume of irrigated treated wastewater and its application rate to be limited so that neither the nutrient loading nor the hydraulic loading of the area to be irrigated is exceeded. The nitrogen concentration of wastewater will also be limited under licence conditions. Monitoring of boron in the wastewater stream will also be conditioned in the Licence given the sensitivity of avocadoes to boron in excess of 0.7mg/L. Leaf tissue testing and an assessment of the vegetative cover in the irrigated plantation may be required as part of licence conditions to demonstrate that sufficient nitrogen is being taken up by vegetation. Ambient groundwater monitoring and soil monitoring requirements will also be included in the Licence.
	Overland flow of irrigated wastewater: Treated wastewater discharged to land in excessive volumes that cause pooling and run-off	On-site soils and surrounding land Crops and vegetation in irrigation area Groundwater approximately 0-2.3mbgl Surface waters 220m south and 650m east of Premises boundary	Discharge of treated wastewater to land by irrigation in excessive volumes that the soil cannot accommodate, causing leaching, pooling or run-off which may result in accumulation of contaminants in the soil at the Premises, impacts to nearby threatened ecological communities, or contamination of groundwater system and/or surface water system.	Run-off on the site is collected in three water storage dams (two existing, one to be constructed) and bypass structures provide stream flows downstream. Additional controls including application rates are defined in the NIMP (see Section 7.1)	Moderate	Unlikely	Medium	A review of the NIMP has been included in Section 7.1.1 below.	**Works Approval** – Conditions 9-11. Soil validation testing will be required as part of the Works Approval to confirm the proposed irrigation area is suitable for wastewater irrigation on a long-term basis. **Licence –** DWER will require the volume of irrigated treated wastewater and its application rate to be limited as part of licence conditions so that neither the nutrient loading nor the hydraulic loading of the area to be irrigated is exceeded.

7.1 Discharges to Land - Nutrient Irrigation and Management Plan

A Nutrient Irrigation and Management Plan (NIMP) has been provided with the Application. The NIMP notes that the document is considered a live document and may be updated in line with any changes to the recycled water or irrigation schemes, or the regulatory requirements related to those schemes.

Irrigation area

A 9Ha area to the south of the development has been nominated for the establishment of the recycled water plant and the treated effluent irrigation area. The combined area of the recycled water plant and the wet weather storage dam is approximately 0.6Ha. The remaining 8.4Ha is proposed to be planted with a commercial fruit crop. An avocado plantation has been used as the basis for the modelling and design of the scheme.

The irrigation area is located in the south-western corner of the site. The irrigation areas generally have a slope of 1-2% and fall towards the creek line that crosses the site from the eastern boundary and will discharge into the 80ML stormwater storage dam.

The area to be irrigated with treated effluent has been designed to maintain buffers from the following:

- Public access areas adjacent to the irrigation area (5 metres from access roads)
- The intermittent creek line passing through the irrigation area (30 metres)
- Neighbouring private agricultural plots (5 metres from property boundaries)

Proposed irrigation method and scheduling

Irrigation of the crop plantation will be undertaken by drip irrigation via high flow, low velocity drip irrigators. The drip irrigation system will ensure that there is no spray drift from the site and the treated effluent irrigation is contained wholly within the nominated irrigation area. The larger diameter nozzle points also reduce the likelihood of blockages in the system. It is intended that irrigation will be largely automated with minimal requirements for operator intervention.

The irrigation system will incorporate the following controls:

- Weather station to provide real time data to assist with irrigation programming
- Soil moisture sensors
- Irrigation flow rate data logging.

Irrigation will be applied to meet the soil demand, whilst maintaining a small buffer of soil water deficit to accommodate rainfall. Typical soil water deficit triggers which may be used would be 15/10mm, which means at a soil water deficit of 15mm, 10mm of irrigation would be applied.

The control system for the site will utilise climate data from the weather station (to be located at the WWTF) and soil moisture monitoring stations to inform decisions on irrigation.

Regular auditing of the irrigation area will be undertaken to ensure the following:

- The recycled water is being contained entirely on-site
- There is no pooling of water or areas of accumulation
- The irrigation system is in good working order ensuring an even irrigation pattern.

A maximum application depth of 10mm/day has been adopted. The irrigation system

design allows a maximum application rate of 5.33mm/hour.

Storage and management of excess recycled water

Treated water from the recycled plant will be discharged to a treated water storage tank which will in turn discharge to the 30ML wet weather storage dam where the volume of treated wastewater exceeds irrigation requirements.

The storage dam has been sized to store water across the winter period where irrigation demand is low without overtopping. Water from the storage dam will be passed through a filtration unit prior to discharge to the irrigation system.

The NIMP states that modelling shows that typically the dam has sufficient capacity to avoid overflow events and that the dam will be designed with sufficient freeboard to capture and rainfall event (see Table 21 and Figure 9). The level of the dam may be managed by undertaking additional irrigation during lower demand periods to ensure that is no uncontrolled overflow of dam water.

As irrigation is scheduled based on the soil moisture content, irrigation will not occur during rain events or during conditions where soils exhibit high moisture content.

Land capability assessment

See Section 5 for the environmental siting of the Premises.

Recycled water quality

Sewage from the development will be captured and treated to a quality suitable for “Low Risk” applications as defined in the *Guidelines for the Non-Potable Uses of Recycled Water in Western Australia*).

The NIMP states that water quality will by driven by the regulatory requirements and the capability of the irrigated land and crop. There should be no nutrient export from the site from the irrigation scheme. The design treated water quality is summarised in Table 15 below.

Table 15: Recycled water quality

Parameter	Units	State[1]	National[2]	Design
Biological Oxygen Demand (BOD_5)	mg/L	<20	<20	<20
Total suspended solids (TSS)	mg/L	<30	<30	<30
Total Nitrogen (TN)	mg/L	-	-	<20
Total Phosphorus (TP)	mg/L	-	-	<5
pH	-	6.5-8.5	-	6.5 to 8.5
E-coli	cfu/100mL	<1000	<100	<100
Free chlorine residual	mg/L	0.2 to 2.0	-	0.2 to 1.0

NOTES:
1) As per *“Low risk in “Department of Health, Guidelines for the Non-Potable Uses of Recycled Water in Western Australia”*
2) As per *“Use – Commercial food crops, crops with no ground contact and skins removed before consumption”* in Table 3.8 of *“Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1), 2006”.*

(‘Table 3 – Recycled water quality’, Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

MEDLI Modelling

The Applicant has undertaken water nutrient and salt modelling using the Model for Effluent Disposal using Land Irrigation (MEDLI). MEDLI was used to conduct long-term continuous daily water, nutrient and salt balance modelling for the irrigation area.

The parameters in Table 16 below have been used for the MEDLI modelling.

Table 16: Design treated water quality parameters for the RWP

Parameter	Units	Value	Comments
Wastewater flow	kL/day	160	Sewage flow only, does not include return flow from WAS dewatering
Total Suspended Solids (TSS)	mg/L	<30	
Biochemical Oxygen Demand (BOD_5)	mg/L	<20	
Total Nitrogen (TN)	mg/L	<20	
Total Phosphorous (TP)	mg/L	<5	
pH	-	6.5-8.5	
E.coli	cfu/100mL	<100	Australian Guidelines for Water Recycling
Irrigation flow	kL/day		Flow to the irrigation area

('Table 1 – Design treated water quality parameters for the RWP, Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Two separate MEDLI modelling scenarios were developed for the assessment of the irrigation area:

1. Tree plantation
2. Orchard inter-row pasture

Only the tree plantation MEDLI has been utilised to determine the irrigation demands.

A small area of the orchard inter-row pasture has also been modelled to determine the nutrient uptake rates. The NIMP states that from a scheme performance standpoint there will not be a reliance on the inter-row pasture for nutrient removal, however it will have an impact so was included in the overall mass balance.

The Applicant undertook a literature review relating to avocado tree nutrient uptake and fertilisation practices to determine a conservative set of nutrient uptake values. The values in Table 17 below were applied for the avocado plantation and used in the mass balance for the scheme.

Table 147: Avocado tree nutrient uptake

Parameter	Value	Units	Source/comments
Nitrogen uptake	7	kg/tonne harvested fruit	*Avocado Growing*, Agfact H6.1.1, Third edition 2003, JF Dirou, NSW Agriculture
Phosphorous uptake	1.5	kg/tonne harvested fruit	*Avocado Growing*, Agfact H6.1.1, Third edition 2003, JF Dirou, NSW Agriculture

('Table 4 – Avocado tree nutrient uptake', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

Table 18 provides results of the MEDLI modelling for irrigation demands for average wet and dry years at the Premises. These have been determined using the mean 5th and 95th percentile years from the 40 years the MEDLI modelling was completed over (1977 – 2016 inclusive).

Table 18: Irrigation demands

Avocado tree 70% green cover (mm//Ha/month)			
Month	Wet (5%ile)	Average	Dry (95%ile)
Jan	113.5	147.0	173.4
Feb	68.5	88.7	104.7
Mar	43.7	56.6	66.8
Apr	32.2	41.7	49.2
May	9.3	12.1	14.3
Jun	1.5	1.9	2.2
Jul	.5	0.6	0.7
Aug	1.9	2.5	2.9
Sep	8.7	11.3	13.3
Oct	36.3	47	55.5
Nov	67.0	86.8	102.4
Dec	105.1	136.1	160.6

Avocado tree 70% green cover (mm//Ha/month)			
Month	Wet (5%ile)	Average	Dry (95%ile)
Totals	488.4	632.2	746.0
ML/ha/year	4.8	6.3	7.5
Totals (ML/year)	41.0	53.1	62.7

('Table 5 – Irrigation demands', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

Table 19: Monthly modelled irrigation demands

			Average Year	
Month	Sewage Flow - Resi (ML)	Sewage Flow Total	Irrigation demand - POS	RW excess/deficit
January	4.076	4.076	12.348	-8.284
February	3.682	3.682	7.451	-3.780
March	4.076	4.076	4.754	-0.690
April	3.945	3.945	3.503	0.430
May	4.076	4.076	1.016	3.048
June	3.945	3.945	0.160	3.773
July	4.076	4.076	0.050	4.014
August	4.076	4.076	0.210	3.854
September	3.945	3.945	0.949	2.984
October	4.076	4.076	3.948	0.116
November	3.945	3.945	7.291	-3.358
December	4.076	4.076	11.432	-7.368
Total	**47.995**	**47.995**	**53.113**	**-5.262**

(Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Table 20: Yearly modelled irrigation demands

				Average Year		
Year	Lots Developed	Raw sewage (ML)	RW internal use (ML)	RW irrigation lot only (ML)	RW irrigation demand (ML)	RW excess/deficit (ML)
2020	25	1.374	0.000	0.000	27.348	-25.978
2021	75	5.285	0.000	0.000	53.113	-47.844
2022	125	10.771	0.000	0.000	53.113	-42.375
2023	175	16.358	0.000	0.000	53.113	-36.804
2024	225	23.687	0.000	0.000	53.113	-29.497
2025	275	30.743	0.000	0.000	53.113	-22.462
2026	325	36.172	0.000	0.000	53.113	-17.050
2027	375	41.601	0.000	0.000	53.113	-11.637
2028	379	44.501	0.000	0.000	53.113	-8.746
2029	379	45.867	0.000	0.000	53.113	-7.384
2030	379	46.919	0.000	0.000	53.113	-6.335
2031	379	47.274	0.000	0.000	53.113	-5.981
2032	379	47.630	0.000	0.000	53.113	-5.626
2033	379	47.902	0.000	0.000	53.113	-5.355
2034	379	47.995	0.000	0.000	53.113	-5.262
2035	379	47.995	0.000	0.000	53.113	-5.262

(Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Nutrient management

Long term modelling (40 years) of the inter-row pasture included daily modelling of the site nutrient balance, including leaching of dissolved nitrate and phosphate in addition to the long-term accumulation of bound phosphates through soil sorption. The model used site specific data on phosphorous sorption capacity and soil characteristics.

The NIMP states that the modelling indicated that the proposed irrigation strategy will not result in any measureable nutrient leaching over the 40-year period. A small amount of leaching is shown in the initial phase of the model which relates to existing organic nitrogen levels in the soil.

The modelling showed no saturation of phosphorous over the modelling period (see Figure 10).

Salinity and Sodicity

The MEDLI modelling did not show any salinity issues for the irrigation area over the modelled period. The NIMP notes that the soil textures and heavily seasonal rainfall pattern mean that impacts on plant growth due to the accumulation of salts is unlikely.

The sand-based soils present within the irrigation area are not prone to sodicity impacts. Recycled water does have the potential to alter sodicity risks. Monitoring of recycled water and electrical conductivity will be undertaken in addition to soil Exchangeable Sodium Percentage.

Water Balance and End state mass balance modelling figures

Table 21: Pond overflow diagnostics

Pond Overflow diagnostics		
Average volume of overflow	279.62	kL/year
Average no. days pond overflows	2.175	days/year
Average duration of overflow (days)	7.25	days
luent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated)	99.48	%
Probability of at least 90% reuse	100	%

(Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

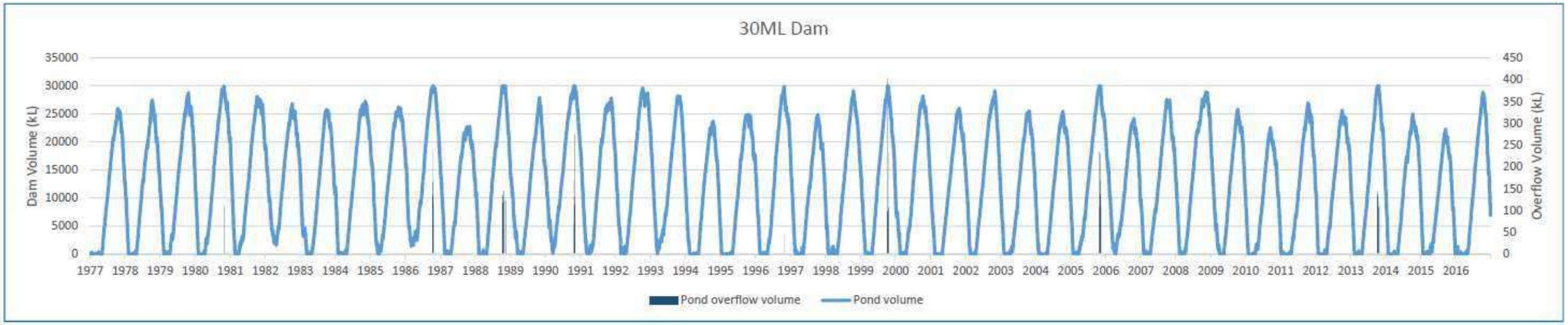


Figure 9: Modelled pond overflow occurrences

(Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

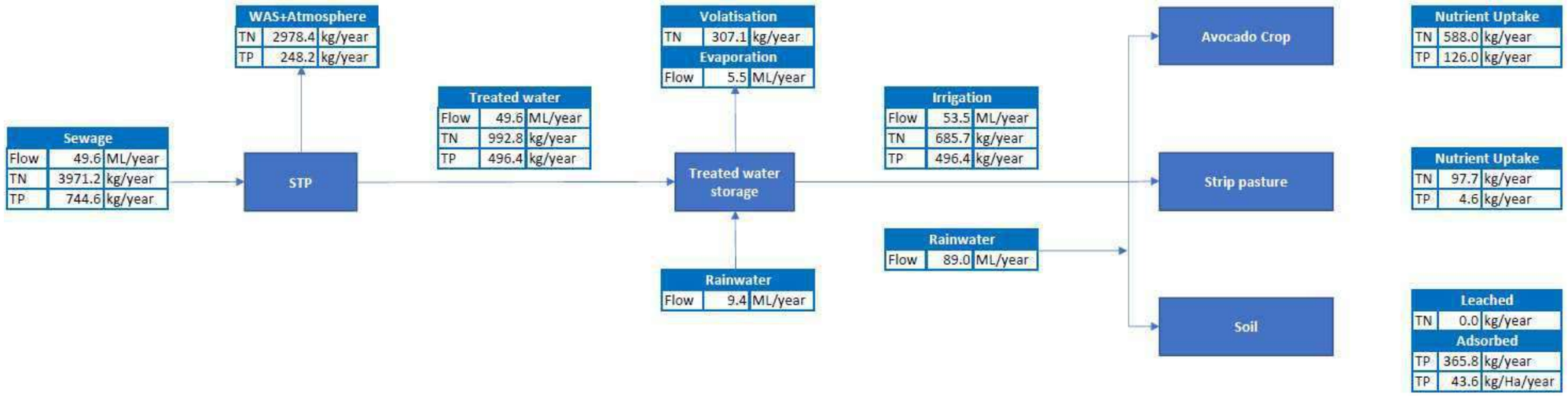


Figure 10: End state mass balance

(Witchcliffe Ecovillage DWER Works Approval Supporting Information, August 2018)

Monitoring Program

The NIMP states that in addition to monitoring of day to day performance and compliance for the irrigation system, a broader monitoring program will be conducted to monitor impacts on local and downstream receiving waters and groundwater resources. It will be designed in accordance with the *ANZECC Water Quality Guidelines* as a Before, After, Control, Impact (BACI) program.

The purpose of this monitoring program is to enable detection of any impacts of recycled water irrigation in relation to background water quality and any water quality objectives for the regions.

The following broad forms of monitoring are proposed.

- Long-term trend monitoring of soil health, nutrient levels and contaminant concentrations at a number of rotated reference sites.
- Nutrient budget monitoring including crop yields and nutrient content.
- Use of weather station and climate data in conjunction with soil moisture monitoring to validate the irrigation schedule and water balance.
- Precautionary Monitoring of shallow (unconfined) groundwater quality.
- Utilisation of relevant water quality data from whole of scheme monitoring program.

The current proposed monitoring program is summarised in the following program. Where monitoring indicates long-term impacts relating to specific parameters are minor or non-existent, the frequency and number of sites for monitoring may be reduced as appropriate. Inversely, where monitoring identified elevated concentrations of pollutants beyond nominated thresholds, monitoring intensity may be increased temporarily to assist in establishing the cause and a solution.

Table 152: Proposed monitoring program

Category	Parameter	Nominal Sample Locations (at end State)	Sampling Type	No Sub samples	Frequency	Total Samples per Year (at end State)
Soil Monitoring	pH	2	Physical Sample	1	Annual	8
	Electrical conductivity					
	Organic matter					
	Cation analysis (cation %, ESP, SAR, ECEC)			1		
	Plant available nutrients					
	Heavy metals			1		
	Chloride					
	P sorption			1 subsoil		
Groundwater[1]	pH	2	Grab sample	1	Quarterly	8
	Electrical conductivity					
	Sodium Adsorption Ratio					
	Total Suspended Solids TN (NOx, TKN, Ammonia)					
	TP (+ phosphate)					
	E. coli					
	Chloride					
	Trace elements[3]					
	Pesticides[3]					
	Insecticides[3]					
Crop Sampling[2]	Dry matter (t/ha)	1 per harvest	Physical sample	2		2
	Phosphorus					
	Nitrogen					
	Potassium					
	Trace elements					

NOTES:

1. Groundwater sampling may not be feasible due to lack of groundwater availability during Summer and Autumn. Requirement to be reviewed prior to licence application
2. Crop sampling method to be confirmed upon commencement of cropping operation. Leaf tissue analysis may be utilised in place of crop analysis
3. Testing only included if application undertaken in previous 12 months

('Table 7 – Monitoring program', Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019)

7.1.1 NIMP Technical review

Hydraulic Loading

The land area required to accommodate a wastewater flow rate of 160m^3/day has been calculated at about 5.5ha utilising the equation from Section 5.1.5 of US EPA (2006). This is assuming that wastewater irrigation only takes place during months where the rate of evapotranspiration rom the soil exceeds the rate of rainfall infiltration (i.e. where there is a water deficit in the soil profile) and that wastewater is stored during wet periods of the year.

The estimated land area of approximately 5.5 ha is smaller than the available area of 8.4 ha

which would suggest that sufficient land is available to accommodate the proposed hydraulic loading rate.

However, this assessment does not consider whether there are any specific constraints in the soil profile beneath the irrigation area that could limit irrigation rates in at least part of the site. Information from the geotechnical investigations that were carried out throughout the Ecovillage site suggest that these constraints are likely to include:

(i) The thickness of granular soil materials that overlie a ferruginous hardpan layer (lateritic duricrust) that is known to underlie much of the site; and

(ii) The shallow depth of groundwater beneath some parts of the site.

The NIMP for the proposed Witchcliffe wastewater irrigation scheme was developed with negligible soil data from the actual irrigation area. Additionally, the soil investigations that were undertaken at the Witchcliffe Ecovillage site were mostly carried out for a geotechnical assessment of the site and did not adequately assess the suitability of these materials for wastewater disposal.

Figure 1, which has been compiled from soil and groundwater investigations at the site, shows that there are extensive areas of the Witchcliffe Ecovillage site where there is a limited thickness of granular soil materials overlying a shallow hardpan layer and where there is a shallow depth to groundwater, especially in the southern half of the site. Of particular concern, however, is the limited number of soil test-pits and monitoring bores within the proposed irrigation area in the south-western corner of the Ecovillage site.

This limited availability of soil and groundwater information from the proposed wastewater irrigation area means that it is not possible to definitively indicate that this area of land is suitable for this activity and that irrigation can be managed without periodically causing surface pooling of water.

Consequently, additional investigations are recommended in this area to demonstrate soil materials beneath the area have suitable physical and chemical properties to enable wastewater to be discharged to land on a sustainable basis.

Additional geotechnical testing and assessment -

The Applicant provided an additional report and soil monitoring results in response to the draft Works Approval and Decision Report. The report indicates that constant-head permeameter tests were carried out at five locations across the site to a depth of approximately 0.5m. The Applicant has also undertaken an assessment of the soil testing parameters against the New South Wales Department of Environment and Conservation Environmental Guideline *Use of Effluent by Irrigation*, 2003 and noted that no severe limitations to the irrigation site were identified.

DWER has reviewed the additional information provided and notes that whilst no severe limitations were identified with soils in the irrigation area, the number of soil samples from the irrigation area itself is still quite limited. As such, DWER considers it appropriate that additional soil testing is undertaken to validate the suitability of the soil for long-term irrigation purposes.

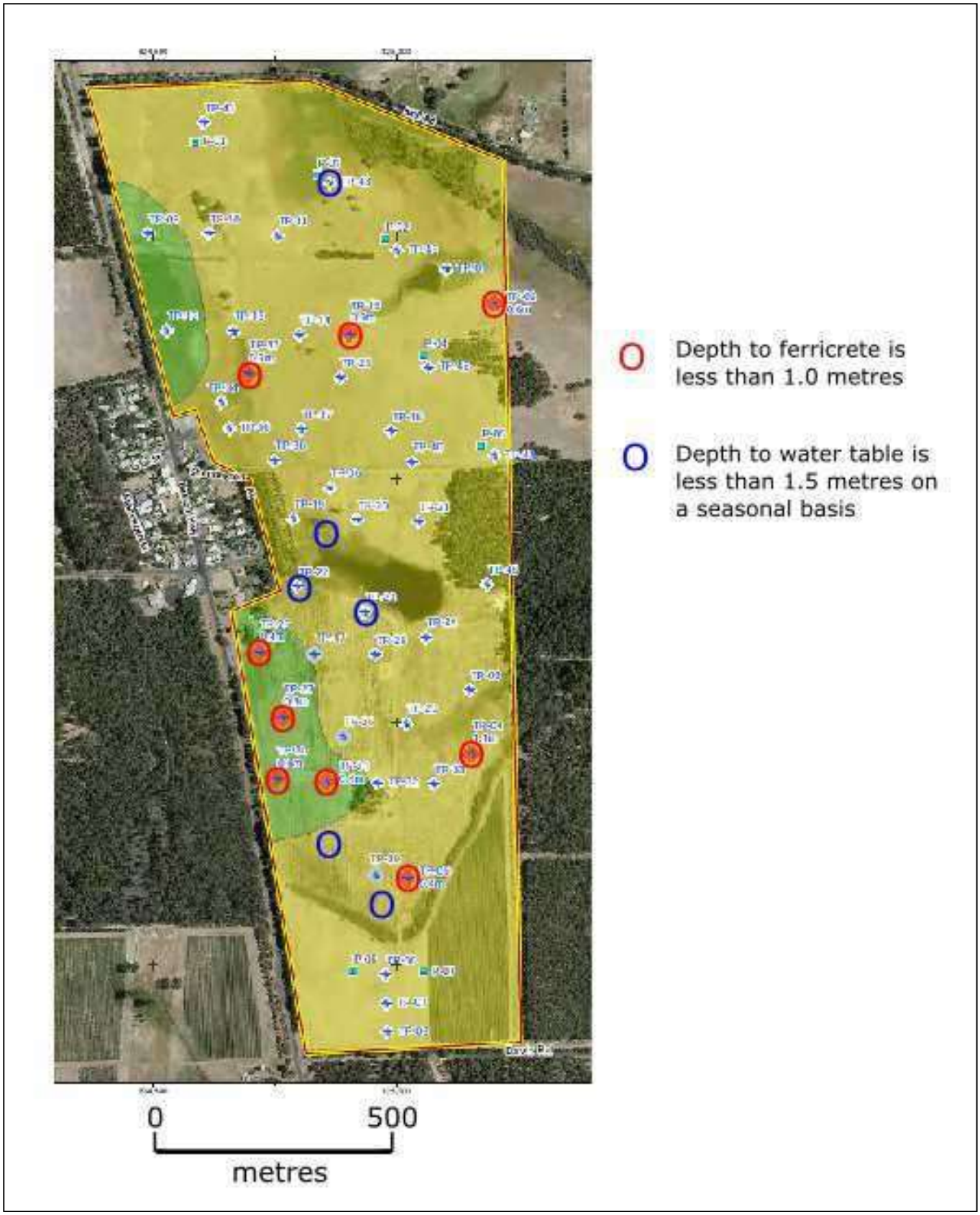


Figure 11. Data from soil test-pits and groundwater monitoring bores showing areas where the depth to the ferruginous hardpan is less than 1.0 metres and where the depth to groundwater is less than 1.5 metres

Nitrogen loading

Appropriate nitrogen loading rates for a proposed wastewater irrigation scheme are usually determined by undertaking a detailed mass-balance of all inputs and outputs of this nutrient for a specific crop. The NIMP indicates that a mass-balance calculation has been undertaken using the wastewater irrigation model MEDLI, however insufficient information was provided in the report to indicate the assumptions that were made to undertake the modelling.

The NIMP report indicated that the nitrogen uptake by avocado fruit is about 7 kg per tonne of harvested fruit. Assuming that 30 tonne of fruit are produced per hectare per year, this equates to approximately 210 kg N/ha/a removal in fruit. This would suggest that there is a relatively low risk of nitrogen seepage to groundwater beneath the irrigation area provided that irrigation is avoided or carefully regulated during winter months when soils are near their field capacities.

However, this mass balance is highly dependent on the amount of fruit produced by trees annually. Therefore, if fruit yields from the irrigated trees are less than 30 tonne/ha/a, the Applicant would be required to undertake leaf tissue testing and an assessment of the vegetative cover in the irrigated plantation to demonstrate that sufficient nitrogen is being taken up by vegetation to balance the discharge of this nutrient to land by wastewater. A licence condition will also be set to ensure the concentration of Nitrogen in the wastewater should not exceed 20mg/L.

Phosphorus loading

The NIMP report indicated that the phosphorus uptake by avocado fruit is about 1.5 kg per tonne of harvested fruit. Assuming that 30 tonne of fruit are produced per hectare per year, this equates to about 45 kg N/ha/a removal in fruit. This would suggest that there is a relatively low risk of phosphorus seepage to groundwater beneath the irrigation area provided that irrigation is avoided or carefully regulated during winter months when soils are near their field capacities.

Proposed monitoring program

Limited information has been provided in the NIMP about:

- The proposed monitoring program for the wastewater production system;
- Where groundwater samples will be collected (it is not clear from the document whether monitoring bores already exist at the site) or the range of analytes that will be measured in samples; and
- How and where soil samples will be collected.

The monitoring program outlined in section 6 of the NIMP document appears to be very limited for a food-crop.

Additional monitoring will be specified in the Licence, this monitoring will be generally consistent with the default monitoring program outlined in the technical guidance document “Use of Effluent by Irrigation” published by the Department of Environment And Conservation (NSW) in 2003 (NSW DEC, 2003) and will include soil monitoring requirements.

Avocados are very sensitive to boron concentrations greater than 0.7 mg/L in irrigation water. As such, monitoring of boron in the wastewater stream will also be conditioned in the Licence.

Contingency plan

Although avocados are a high-value crop, the production of fruit and the health of these trees that are irrigated with wastewater can be reduced by elevated concentrations of nitrogen, chloride and boron in the wastewater stream (Stemke, 2016). Avocado trees are also highly susceptible to infection by *Phytophthora* fungal species which can cause the death of trees in plantations. Given these potential problems, growing avocados may not be a sustainable strategy for managing the disposal of wastewater from the Witchcliffe Ecovillage, and in the

longer-term other crops such as a *Eucalypt* plantation may be required to take-up nutrients from the wastewater stream produced from this development area.

The Applicant should prepare a contingency plan for irrigating an alternative crop in the event that the proposed avocado irrigation plan is not successful.

Key findings:

- Preliminary assessment suggests that the irrigation area will be sufficiently large to accommodate the proposed irrigation rate. However, there is insufficient soil data from this part of the Premises to conclusively demonstrate this;
- Whilst no severe limitations to the irrigation area have been identified during the applicant's assessment of the area, soil investigations to date have not been focused on the suitability of the area for irrigation purposes and have been limited in the number of samples in the irrigation area itself. Soil validation testing requirements will be required as part of the Works Approval to further validate that the soils in the irrigation area are appropriate for sustainable long-term irrigation purposes.
- Preliminary mass-balance assessments for N and P suggest that the nutrient application rates will be adequately taken-up by the irrigated avocado trees provided that high fruit yields are sustained. Leaf tissue testing and an assessment of the vegetative cover in the irrigated plantation may be required to demonstrate that adequate nutrient balances for the irrigation scheme are being maintained;
- The proposed monitoring program is considered to be too limited for an irrigated food-crop of this type, and therefore additional monitoring will be specified in the Licence; and
- A contingency plan will need to be developed for irrigating an alternative crop in the event that wastewater quality problems and disease limits the ability of avocadoes to take-up nutrients from wastewater at the Premises.

7.1.2 Contingency Plan

The Applicant has provided a contingency plan for irrigating an alternative crop in the event that the proposed avocado irrigation plan is not successful. The contingency plan is as follows:

1. While commercial avocado plantations in the region are well proven as a viable commercial irrigated horticulture crop, avocados have not been used in Western Australia for treated wastewater effluent irrigation. The success of avocados may be compromised by operational requirements associated with regulatory approvals, salt concentrations in the treated effluent higher than expected affecting soil salinity and disease issues such as phytophthora cinnamomi which affects avocado root health.
2. Approximately ⅓ of the irrigation area will be established with an avocado plantation at the outset of the project. At least a further ⅓ of the irrigation area will be established with mixed high growth rate eucalypts at the outset. The remainder of the irrigation area will be established prior to the WWTF exceeding a flow rate of 100kL/day and selection of plantation species will be guided by the outcomes of the first stages of the plantation.
3. Treated effluent from the initial stages of operation of the WWTF will be irrigated on the avocado plantation. If any operational issues arise or if avocado health is compromised, irrigation of treated effluent can be transferred to the eucalypt woodlot area.
4. At least one third of the plantation area will be retained as eucalypt woodlot until performance of the avocado plantation is well established with a minimum 7 years of successful operation of irrigating avocados with treated effluent.

5. If poor production and growth of avocado trees occurs in parts of the plantation, or if there is an area where avocado tree deaths occur, these areas will be replanted with eucalypt woodlot to maintain nutrient uptake capacity of the plantation.
6. If isolated avocado tree deaths or health issues occur, the operator is not obliged to replace avocado trees with eucalypts but may replace avocado trees with new avocado trees to maintain the production and nutrient uptake of the plantation.
7. If there is widespread poor avocado tree performance and tree deaths through the plantation, the operator will replant the entire irrigation area with eucalypt woodlots.
8. Woodlots will be planted and managed as per CSIRO guidelines for effluent irrigated plantations.
9. The plantation operator may establish other horticultural crops as an alternative to replanting avocados areas with a eucalypt woodlot in the event of poor performance of the avocado crop, however the plantation operator will prepare updated NIMP and RWQMP documentation to ensure the new crop will meet nutrient uptake and health requirements prior to planting any alternative crops other than eucalypt woodlot.
10. This contingency plan should not prevent the consideration of new methods and technology in addressing deficiencies in the avocado plantation. For example national and international efforts are focussing on development of new phytophthora resistant rootstocks which may further increase the viability of avocados for effluent irrigation in the future if any deficiencies are observed with the current plantation.

8. Determination of Works Approval conditions

The conditions in the issued Works Approval in Attachment 1 have been determined in accordance with the *Guidance Statement: Setting Conditions*.

Table 3 provides a summary of the conditions to be applied to this Works Approval.

Table 23: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and equipment Conditions 1, 2, 3, 4, 5 and 6	These conditions are valid, risk-based and contain appropriate controls (see Section 7 of this Decision Report).
Emissions Condition 7	This condition is valid, risk-based and consistent with the EP Act.
Dust management Condition 8	These conditions are valid, risk-based and contain appropriate controls (see Section 7 of this Decision Report).
Soil validation testing Conditions 9, 10 and 11	
Commissioning Monitoring and Reporting 12, 13, 14, 15 and 16	
Baseline Groundwater Monitoring 17, 18 and 19	
Record-keeping 20 and 21	These conditions are valid, risk-based and consistent with the EP Act.

9. Consultation

Method	Comments received	DWER response
Application advertised on DWER website	None received	N/A
Direct interest stakeholders notified	Refer to Appendix 2	Refer to Appendix 2
Applicant notified of first draft	Refer to Appendix 2	Refer to Appendix 2
Applicant notified of second draft	Refer to Appendix 2	Refer to Appendix 2

10. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this decision report (summarised in Appendix 3).

Based on this assessment, it has been determined that the Issued Works Approval will be granted for a period of five years subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

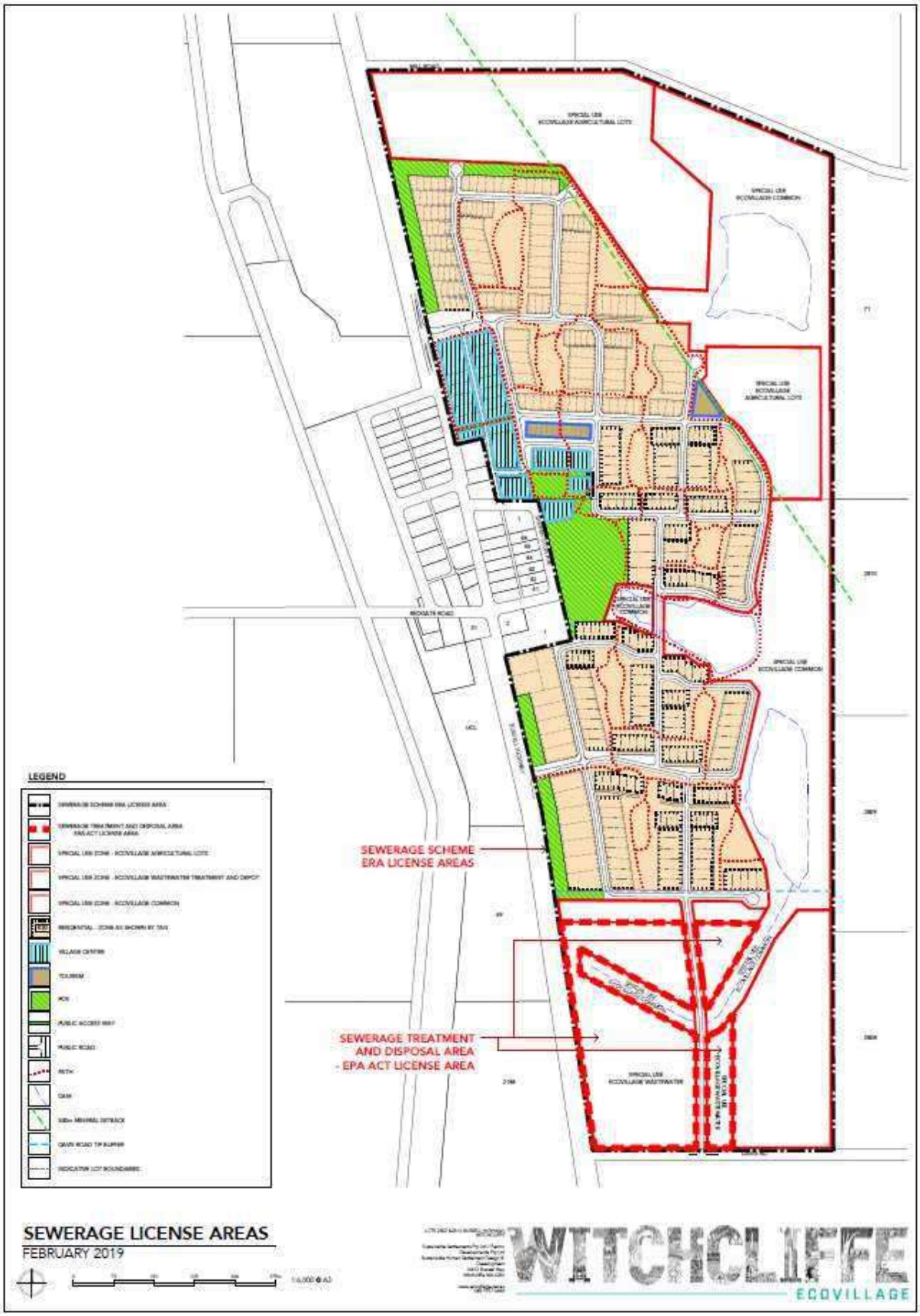
The Works Approval will cover all stages of construction and commissioning. Irrigation of the treated wastewater will be managed under Licence conditions.

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the approval under the EP Act.

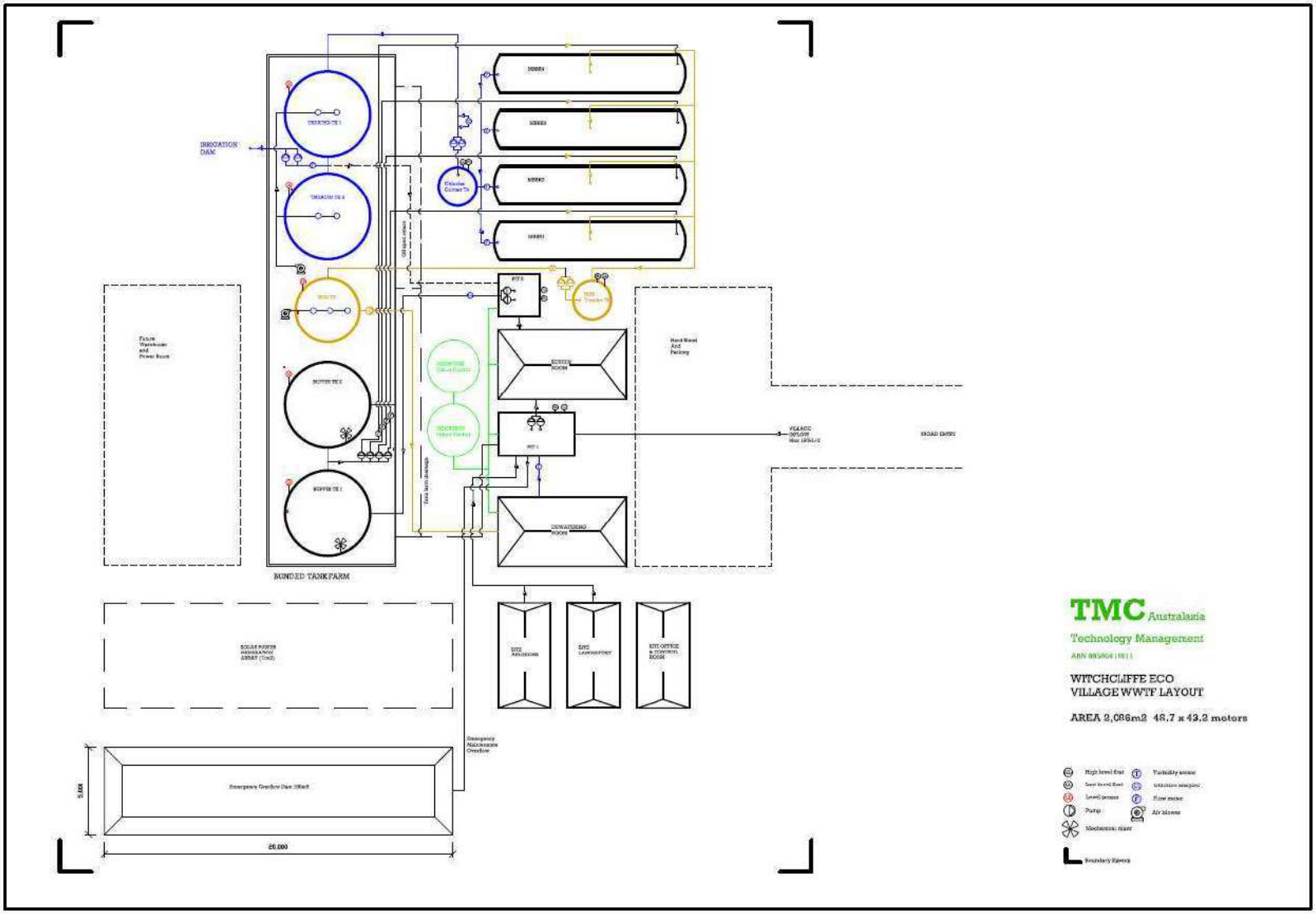
A/SENIOR MANAGER WASTE INDUSTRIES
REGULATORY SERVICES
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

Appendix 1: Premises maps

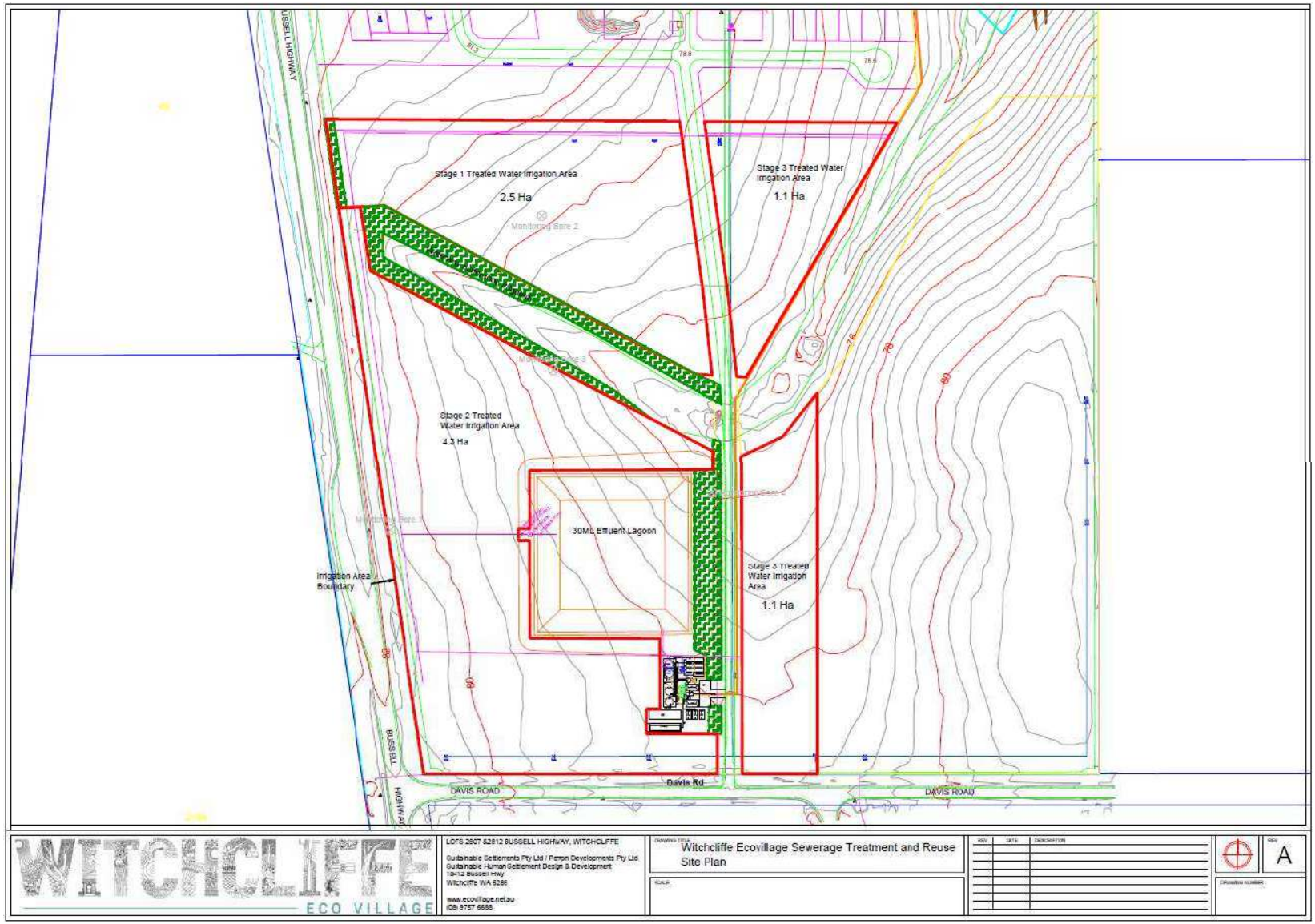
Premises Map



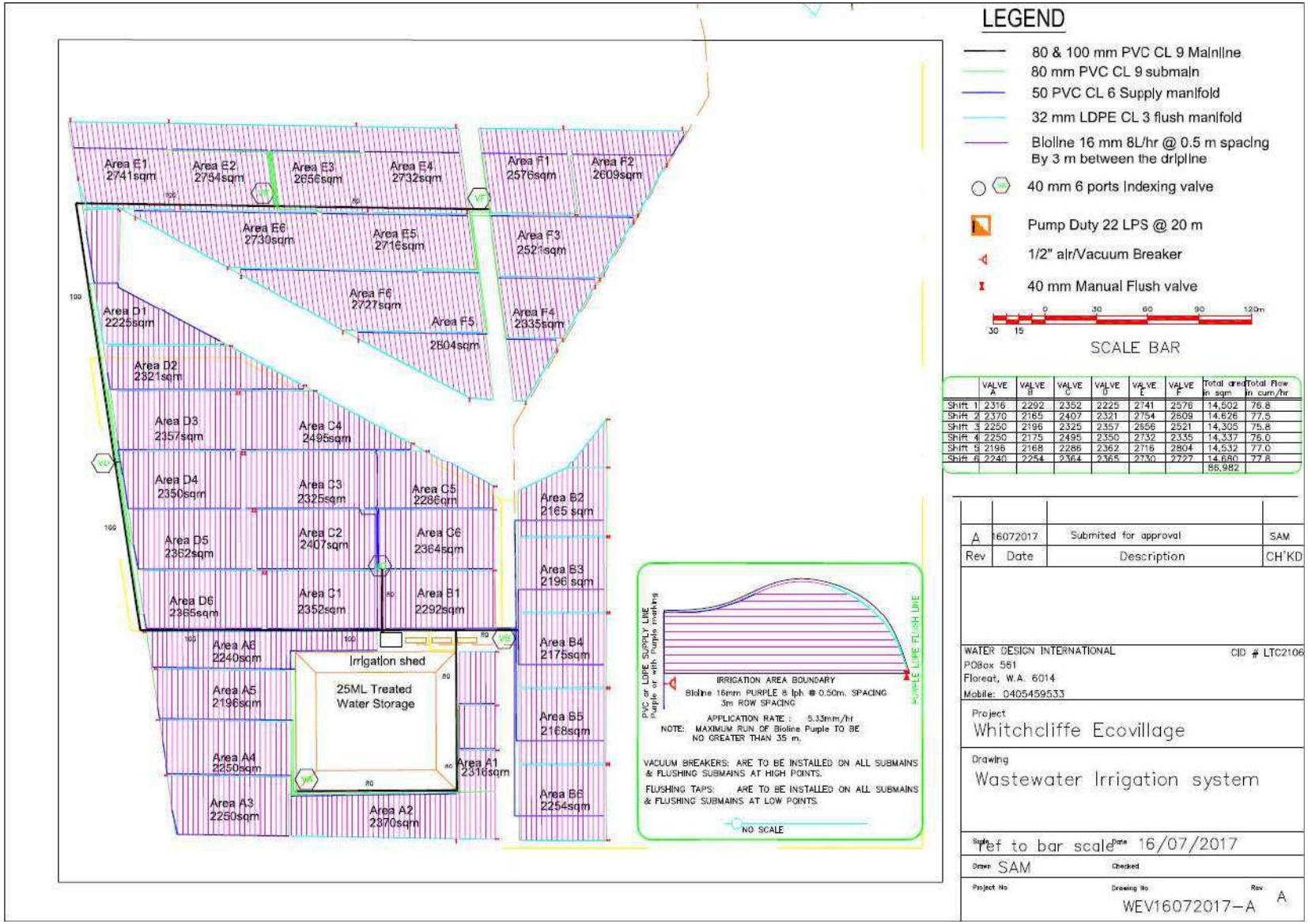
Witchcliffe Eco Village WWTF Layout



Witchcliffe Ecovillage Sewage Treatment and Reuse Site Layout Plan



Wastewater Irrigation System Plan



Appendix 2: Summary of consultation comments

Application consultation

Stakeholder	Comment	DWER response
Department of Health (DoH)	The DoH has no objection to the proposal. The Applicant has submitted the proposal to the DOH for separate assessment and approval.	Noted. The DoH may impose controls in addition to DWER which the Applicant will be required to adhere to.
Shire of Augusta-Margaret River	The Shire provided that the proposal accords with the relevant Structure Plan approved by the Western Australian Planning Commission in January 2018. This Structure Plan identifies the proposed site of the treatment facility and associated effluent lagoon as “Special use Zone – Ecovillage Wastewater Treatment and Depot’. With respect of the need for additional planning approvals, the *Water Services Act 2012* (section 137) provides an exemption from the need to obtain development approvals under the *Planning and Development Act 2005*, as such, if the proponent becomes licensed under this Act, the Shire is of the understanding that further approvals will not be required.	Noted.

Applicant consultation – 17 July 2019

Works Approval condition / Decision Report section	Comment	DWER response
Works Approval - Information/clarification requested by DWER		
Page 1 - Works Approval Holder	Applicant advised that a new company TMC Witchcliffe Pty Ltd has now been formed which would be the most appropriate holder of the Works Approval. The Applicant provided an ASIC extract and copies of agreements which indicates that TMC Witchcliffe Pty Ltd will be in occupational control of the works.	Works Approval Holder/Applicant has been revised to TMC Witchcliffe Pty Ltd
Conditions 9 and 10 – Acid Sulfate Soils Investigation DWER requested clarification on the extent of excavations required (i.e. if excavations are to extend below the groundwater table and more than 100m^3 of material is proposed to be excavated). Additional ASS investigation conditions were required where this was to occur.	Excavations required for the treated water winter storage will exceed 100m^3. A preliminary ASS risk assessment has previously been carried out for the site which identified potential ASS soils. Subsequently, a more detailed ASS assessment was carried out by Galt Geotechnical which concluded "The adopted net acidity criterion of 0.1%S was not exceeded at any of the 10 test pit locations investigated. Furthermore, no visual or olfactory evidence of ASS presence was noted during our investigation. Based on the findings of the study, we do not consider that any further investigation or management of soils (for ASS specifically) will be required at the site." A copy of the investigation report was provided. Given that further detailed investigation has already been undertaken and confirmed that ASS are not present, the Applicant requested removal of this condition.	Noted, Section 6 of this Decision Report has been revised with the provision of the additional Acid Sulfate Soils and Irrigation Area Geotechnical Investigation. Conditions 9 and 10 which required an Acid Sulfate Soils Investigation to be undertaken have been removed from the Works Approval.
Conditions 15 to 18 – Commissioning DWER requested clarification as to the timeframes for commissioning of each stage.	The Applicant advised that commissioning timeframes will be dependent on timeframes for dwelling construction and occupation and subsequent flow generation in order to produce the minimum flows required for commissioning. Given that this will be influenced by external factors such as sales rates and dwelling construction by third parties, it is requested that the commissioning period for stage 1 be extended to 12 months. Commissioning periods of three	Noted, conditions in the works approval relating to commissioning have been amended to allow a 12-month commissioning period for Stage 1.

Works Approval condition / Decision Report section	Comment	DWER response
	months for subsequent stages will be satisfactory.	
Schedule 1 – Premises Map DWER requested a revised map encompassing the whole area on which the relevant activity on the prescribed premises takes place and from which emissions and discharges from that activity would occur.	Applicant provided a revised Premises map. The Prescribed Premises area is annotated “Sewage Treatment and Disposal Area – EPA Act License area”. The area has been updated for consistency with the irrigation area plan. The sewerage scheme area for ERA licensing under the Water Services Act is also included on the plan but does not constitute part of the Prescribed Premises.	The Works Approval has been updated with the revised map.
Schedule 1 - Irrigation Area Site Plan DWER requested confirmation that the irrigation plan correctly identified all irrigation areas and requested confirmation as to the sizing of the effluent lagoon.	The Applicant advised that the irrigation plan correctly identifies the irrigation area however the winter storage lagoon was revised from 25ML to 30ML based on the results of the water balance and MEDLI model prepared by Permeate Partners and the position of the storage lagoon and treatment plant has been updated with progress of the detailed design. An updated irrigation area plan showing the revised irrigation lagoon sizing and position has been provided.	Noted, the Irrigation Plan has been updated and references to 25ML removed in the Decision Report and Works Approval.
Schedule 1 - Groundwater Monitoring Locations – DWER requested the Applicant provide a groundwater monitoring bore plan of the groundwater monitoring network prior to the Works Approval Granting. The network must include a minimum of three groundwater monitoring wells located in the following areas: • Within the irrigation area; • Up-hydraulic gradient of the irrigation area; and	The Applicant provided a revised site plan which included the location of four groundwater monitoring bores.	Noted, the revised plan and groundwater monitoring bore locations have been included in the Works Approval and Decision Report.

Works Approval condition / Decision Report section	Comment	DWER response
• Between the irrigation area and the creek. Consideration was also needed for including groundwater monitoring bores adjacent to storage infrastructure (e.g. wet weather storage dam)		
Schedule 1 – Premises boundary DWER requested the premises boundary co-ordinates	Applicant provided CAD file with boundary co-ordinates.	DWER does not have the software available to access the CAD format file. PDF version of map requested.
Schedule 2 - Infrastructure and Requirements - Hardstand specifications DWER requested the Applicant provide details/specifications of hardstand and parking area and the extent of hardstand within the WWTF.	The Applicant advised that unless otherwise specified on the design plans, hardstand shall be 150mm thick gravel basecourse compacted to 98% Maximum Modified Dry Density (MMDD).	Noted, the Decision Report and Works Approval have been revised to reflect this.
Schedule 2 - Infrastructure and Requirements - Emergency Overflow Dam liner specifications DWER requested the Applicant provide further specifications in respect of the liner for the emergency overflow dam.	The Applicant advised that the overflow is to be constructed of clay with permeability of $1.0x10^{-9}$ m/s (note no liner)	Noted, the Decision Report and Works Approval have been revised to reflect this.
Schedule 2 - Infrastructure and Requirements Site plan reference to chemical storage and dosing areas	The Applicant advised that the dewatering room will provide facilities to store coagulant (potable std), <50kg powder. The screening room will store up to 100kg of Tricchor tablets 100g stored in plastic drums 25kg capacity.	Noted, the Decision Report has been revised to reflect this.
Schedule 2 - Infrastructure and Requirements - Stormwater storage dams –	Stormwater storage dams are not located within the Prescribed Premises Boundary.	Noted, the stormwater storage dams have been removed from the scope of the works approval. Specifications for these are managed under the

Works Approval condition / Decision Report section	Comment	DWER response
Applicant to confirm if stormwater storage dams are located within the Prescribed Premises Boundary		WAPC Approval for the site.
Schedule 2 – Infrastructure and requirements DWER requested the site plan reference to site fencing	The Applicant advised that the WWTF site and treated water storage lagoon is fenced with a minimum 2m high chainmesh fence and the effluent irrigation area is fenced with 0.9m high rural fencing.	Noted, the specifications have been amended in the Decision Report and Works Approval.
Schedule 2 – Infrastructure and requirements Waste aerated sludge transfer tank specifications	Specifications provided by Applicant	Noted, specifications have been amended in the Decision Report and Works Approval.
Schedule 2 – Infrastructure and requirements Chlorine contact tank specifications	Specifications provided by Applicant	Noted, specifications have been amended in the Decision Report and Works Approval.
Schedule 2 – Infrastructure and requirements DRAIMAD dewatering unit specifications	Specifications provided by the Applicant in an attachment.	Noted, specifications have been amended in the Decision Report and Works Approval.
Schedule 2 – Infrastructure and requirements Wet weather storage dam site plan reference and confirmation of size	The wet weather storage dam (treated water storage lagoon) is 30ML in size. An updated site plan has been provided by the Applicant.	Noted, the Works Approval has been amended to include the revised site plan.
Schedule 2 – Infrastructure and requirements Applicant to confirm that the sizing of irrigation area is at least 8.4Ha in size.	The Applicant confirmed that the total prescribed area is 10.3Ha in area and that at least 8.4Ha is available within this area for irrigation.	Noted, the Works Approval has been amended to include the revised irrigation plan.

Works Approval condition / Decision Report section	Comment	DWER response
Decision Report Table 8 – WWTF Staging Applicant to confirm when the 10kL/day MBBR unit will be decommissioned and relocated and if the 10kL/day unit is considered as additional throughput capacity through additional stages	The 10kL/day MBBR unit will remain onsite to seed additional 40kL/day MBBR units. When all four 40kL/day MBBR units are operational, the 10kL/day unit will be decommissioned. The 10kL/day unit may be stored onsite until it is disposed but does not form part of the design capacity of the final 160kL/day plant.	Noted, the Decision Report and Works Approval have been revised to reflect this.
Decision Report Table 8 – WWTF Staging Applicant to advise where bags of sludge will be stored for drying	An area to the rear of the tank farm and adjacent to the solar array will have a roofed area approximately 4x8m to store sludge bags for drying.	Noted, the Decision Report has been revised to reflect this.
Decision Report Section 6.3 - Groundwater Applicant to confirm statement about groundwater fluctuation	Applicant confirmed that the statement regarding groundwater and groundwater fluctuation is correct	Noted, no changes required.
Decision Report – Table 13 Risk assessment – construction and commissioning Dust emissions during construction, mobilisation and positioning of infrastructure. DWER requested the Applicant to provide details of dust control measures to be adopted (e.g. use of water carts)	The Applicant advised that dust control measures comprise: - Site area for stripping and earthworks to be minimised Works to be suspended during unfavourable wind conditions or a water cart to be used to reduce dust emissions	Noted, dust control measures have been included in the Decision Report.
Decision Report – Table 13 Risk assessment – construction and commissioning	No construction noise control measures are proposed	Noted, no changes required.

Works Approval condition / Decision Report section	Comment	DWER response
Applicant to provide details of construction noise control measures if any		
Decision Report – Table 13 Risk assessment – construction and commissioning Applicant to confirm if more than 100m^3 is required to be excavated or if groundwater will be intercepted that may cause potential acid sulfate emissions	As per above. More than 100m^3 is required to be excavated for the treated water storage lagoon, however the removal of these conditions is requested as an ASS investigation has already been carried out.	Noted, as per previous response.
Decision Report – Table 13 Risk assessment – operation The preliminary risk matrix provided as part of the Application indicates that all noise generating equipment will be fitted with acoustic covers as required and that blowers/compressors are to be located within equipment building – Applicant to confirm/provide controls.	The Applicant requested minor rewording of the condition. The Application of 'all noise generating equipment' is excessive as equipment that generates low noise levels should not require acoustic covers. Request rewording to identify only equipment over a certain threshold requires acoustic covers and/or location inside a building.	Noted, as per previous response above.
Items flagged for reconsideration		
Conditions 11, 12 and 13 – Soil Suitability Investigation The works approval must obtain the services of a qualified soil-scientist to undertake a soil investigation in accordance with the methodologies indicated in the Australian Soil and Land Survey Handbook to demonstrate the suitability of the soil materials beneath the irrigation area have suitable physical	The Applicant advised that a geotechnical investigation including soil testing to determine the suitability of the soil in the irrigation area for irrigation of treated effluent was carried out by Galt Geotechnical in accordance with the requirements of the Department of Health Western Australia and is included in Attachment 2. Agronomic soil testing was carried out by SWEP Laboratories to determine the soil suitability and soil amendments required for optimum growth of the proposed crops. Copies of the soil testing and assessment of the soil testing results was included as part of the nutrient irrigation management plan	Noted, insufficient soil data from the proposed irrigation area was provided in the NIMP and supporting documentation provided to DWER to conclusively demonstrate the suitability of the area and soils for wastewater irrigation on a long-term basis. Section 7.1.1 of the Decision Report has been revised incorporating information provided in the additional geotechnical investigation and takes into consideration the assessment against the

Works Approval condition / Decision Report section	Comment	DWER response
and chemical properties to enable wastewater to be discharged to land on a sustainable basis.	(NIMP). A copy of the agronomic soil testing results have also been included with this response as Attachment 6. A further comprehensive site geotechnical investigation including PRI (phosphorous retention index testing) has also been carried out and is included in Attachment 7. A summary of soil parameters from the test reports referencing the recommended soil parameters from the NSW Department of Environment and Conservation Guidelines for Use of Effluent by Irrigation is included as Attachment 8 demonstrating that no severe limitations apply to the site. The assessment of the soil in the irrigation area forms a fundamental component of this application and demonstrates that the site is suitable for irrigation for the intended purposes. Applying this condition fails to recognise the information that has already been provided and unnecessarily defers the decision on this key issue to a further process. It is requested that this condition be removed.	NSW Guidelines. Whilst it is noted that there were no severe limitations identified for the irrigation area in the assessment, the number of soil test pits from the irrigation area is still limited. As such, validation soil testing requirements are considered appropriate to fully characterise the proposed irrigation site.
Schedule 2 – Infrastructure and requirements WWTF receiving sump to be fitted with two dual duty and standby grinder pumps	Duty and standby grinder pumps are installed as part of the sewer conveyance network that is provided by the licensed water service provider and is regulated under the Water Services Act. All discharge to the WWTF is via grinder pumps in the sewer conveyance system, no gravity sewer discharges directly to the WWTF. As such, grinder pumps in the WWTF are unnecessary and this condition should be removed.	Noted, these requirements were included to be consistent with information provided in the Application. The requirement for standby grinder pumps has been removed.
Schedule 2 – Infrastructure and requirements Existing dam to be upgraded to 40ML stormwater retention dam	We presume this refers to the 30ML effluent storage lagoon. We note that this is not a stormwater retention dam, although seasonal rainfall over the surface area of the storage has been accounted for in water balance models. The sizing of this dam at 30ML has been verified by independent modelling undertaken by Permeate Partners.	Noted, this referred to one of the stormwater retention dams as detailed in the Application DWER received, not the effluent storage lagoon. As confirmed previously, the stormwater dams are located outside of the Prescribed Premises boundary and as such, this requirement is no

Works Approval condition / Decision Report section	Comment	DWER response
	An arbitrary increase to 40ML is not supported. Furthermore, the dam size of 30ML is conservative, being based on Perth scheme water consumption rates observed in South West towns, no allowance for reduced consumption in dwellings serviced by rainwater tanks which is applicable in this case as Witchcliffe has no scheme water connection and all dwellings are serviced by rain water tanks. In addition the modelling makes no allowance for grey water reuse within lots which is permitted under DOH (WA) guidelines and is encouraged in this development for landscaping within lots to assist with more efficient use of rainwater. As such, we request this condition be removed.	longer applicable. The WAPC Approval conditions include the requirement to ensure that stormwater is contained on-site or appropriately treated and connected to the local drainage system as managed by the relevant Local Government Authority.
Schedule 2 – Infrastructure and requirements 70-80ML dam to be constructed on the southern creek line	This dam is outside of the prescribed premises area and the condition has no bearing on the works approval application. Notwithstanding, we confirm that the dam on the southern creek line has been constructed.	Noted. As above, this requirement is no longer applicable.
Schedule 2 – Infrastructure and requirements Entire compound to be security fenced with remote video monitoring	Please clarify that this relates only to the WWTF compound and not the entire prescribed area which includes the irrigation area Provision of security fencing greater than standard rural fencing and remote video monitoring is not supported for the irrigation area.	Noted, this requirement was based on information provided in the Application. The requirements for site fencing and remote video monitoring have been revised in the Works Approval and Decision Report.
Schedule 2 – Infrastructure and requirements Wet Weather storage Dam – • 1.5mm HDPE lined dam • 30ML capacity	Dam construction recently completed on the site (June 2019) has identified high quality kaolin clay present that would be suitable for lining the storage dam. The use of on-site materials presents a more sustainable solution than use of synthetic polymer liners that require periodical replacement, thus we request that “or 300mm thick compacted clay liner permeability $<10^{-9}$m/s” be added as an alternative lining option in the works approval.	Noted, the Works Approval and Decision Report have been revised to allow for a compacted clay liner that achieves a minimum permeability of $1x10^{-9}$ m/s.
Schedule 2 – Infrastructure and	Water from the storage dam may be irrigated directly from	Noted, this requirement was included based on

Works Approval condition / Decision Report section	Comment	DWER response
requirements • Filtration system must be capable of polishing the water to remove any solids or algae from the storage dam prior to returning to the recycled storage tank for irrigation	the storage dam without the need to return to the recycled storage tank. Request that the wording be amended to remove reference to returning to the storage tank. Irrigation direct from the storage dam when possible will reduce double handling and reduce energy consumption making the process more efficient.	information provided in the Application. Irrigation direct from the storage dam will be allowed under the Licence provided monitoring demonstrates the water is suitable for irrigation purposes without additional treatment. This will be conditioned under the operational Licence for the Premises.
Schedule 2 – Infrastructure and requirements The irrigation system and irrigation area must be designed and constructed so as to meet the following specification: • Sealed above-ground irrigation tank including residual chlorine top-up to help maintain the quality of water in the irrigation tank	The provision of residual chlorine irrigation water is detrimental to soil microbiology and can be detrimental to some chlorine sensitive crops such as avocadoes. While the applicant may be required to provide residual chlorine for the irrigation system to satisfy DoH conditions, this is a low risk system, details are still being negotiated with the DoH and there is no requirement for residual chlorine on environmental grounds, thus it is requested that the requirement for residual chlorine levels be removed from the Works Approval.	Noted, this requirement was set consistent with the information provided in the Application. Limits relating to chlorine were not set in the Works Approval. The requirement for residual chlorine top-up has been removed from Schedule 2 however it is noted that this may still be imposed as a requirement by the Department of Health.
N/A	The Applicant also wished to emphasise that the avocado orchard and its high PRI soils will safely take up all of the TP entering the plant in raw sewage as demonstrated by the nutrient modelling provided. If there is insufficient P in the irrigation water for the avocadoes and any other plants growing in the orchard due to limits imposed in approvals for the WWTF; then that shortage would need to be made up by use of additional fertilisers. We seek consideration of a more flexible and sustainable approach that permits increased nutrient levels in the treated effluent if monitoring results identify the need for additional nutrients in the plantation.	Noted, these aspects may be considered further during the licensing stage of the assessment. The limits included in Table 3 of the Works Approval are consistent with the design parameters provided in the NIMP as part of the Application. Irrigation of the treated wastewater is not authorised under the Works Approval and as such, limits around this will be further considered and specified in the operational licence for the Premises.
N/A	Another consideration is the staged nature of the development and its wastewater system. There will be no risk of excessive nitrogen and phosphorous loadings to the	Noted, as above, these aspects may be considered further during the licensing stage of the assessment.

Works Approval condition / Decision Report section	Comment	DWER response
	orchard until at least Stage 2 and possibly Stage 3 of the development are built and operation. The Applicant would be happy to work with DWER on an approach that permits higher nutrient levels initially and uses monitoring results from the time of establishment with nutrient reductions added to the treatment train if problems are emerging.	

Applicant comments – 28 August 2019

Works Approval condition/ Decision Report section	Comment	DWER response
Draft Works Approval		
Definitions	MBBR definition should read – "Moving Bed Bioreactor", not "Mobbing Bed Bioreactor".	Noted and amended.
Condition 12 - Contingency plan development	Applicant provided details of a contingency plan for the irrigation of an alternative crop if avocado irrigation is not successful.	Noted, the contingency plan has been included in Section 7.1.2 of the Decision Report. The requirement for the development of a contingency plan has been removed from the Works Approval.
Condition 15 – Commissioning monitoring requirements	The testing lab have informed that the lab is NATA accredited for Effluent ISO 17025	Noted.
	The Applicant advised that the BOD test will be difficult to manage every week as it's a five day test. The Applicant requested the conditions be changed to COD that can be completed well within one day together with the other tests. The correlation between COD and BOD is high.	Noted. BOD is the most widely used and accepted parameter for discharges from municipal wastewater treatment plants whereas COD limits are usually set for waste water discharges from industrial waste water treatment plants at premises such as chemical manufacturing where the primary components of the effluent are chemical based. The relationship between these

Works Approval condition/ Decision Report section	Comment	DWER response
		parameters will vary with the nature and type of waste steam, so it is unreliable to assume a ratio (BOD:COD) without first undertaking analyses for each parameter to get a reliable ratio to use.
Schedule 1 - Premises boundary coordinates	Applicant provided co-ordinates for the Premises boundary.	The Works Approval has been revised to include the Premises boundary co-ordinates provided.
Schedule 2 – Infrastructure requirements	Delete reference to 'Citech' from Schedule 2. Citech is a propriety brand of SCADA and other brands of equipment which satisfy monitoring and control requirements are available and the works approval should not limit use of brand/supplier of this equipment.	Noted and amended.
	Please delete reference to a sealed above ground tank from the requirements for 'irrigation system and irrigation areas'. This function is fulfilled by the Recycled Water Storage Tanks which are already listed in Schedule 2. In addition, irrigation of treated water from the wet weather storage dam which requires filtration prior to irrigation can be drawn directly from the storage dam, filtered and irrigated without the need for an additional storage tank.	Noted and amended.
	Please note that the irrigation area will be developed progressively as water is available for irrigation. Drip irrigation infrastructure would not be put in place for the entire area at the outset.	Noted, the works approval has been amended to reflect this.
	WWTF Receiving Sump - There is no reference to pumps. This pit will have duty and standby effluent pumps	Noted and amended.
	Transfer Pit – Please modify the pump description as effluent pumps duty and standby.	Noted and amended
	Bunded Tank Farm – The aim is to have all solid walls within the complex as rammed earth to make the site more rural	Noted, the Decision Report and Works Approval have been revised to consider the variation in

Works Approval condition/ Decision Report section	Comment	DWER response
	and in sync with the region – can the construction material be changed. The Applicant confirmed by email correspondence dated 5 and 6 September 2019 that the floor will remain concrete with the bunds only to be constructed of rammed earth. The rammed earth is suitable for load bearing external walls and concrete and chemicals are added to the mix to meet building codes.	construction material.
	Flow Balance Tank – feed pumps are positive displacement only duty i.e. each MBBR unit is fed by individual pumps via a common manifold	Noted and amended.
	Software is referenced as Citech SCADA, Citech is a proprietary product while SCADA is a generic description of the software function. Can reference to Citech be deleted	Noted and amended as above.
	Wet Weather Storage Dam – "Fitted with circulation pump allowing water to be transferred to the treated water storage tank via a filtration system". This is incorrect, the dam is 30ML and the treated tanks in total 120kL it would be impossible to operate. Please change to "Fitted with irrigation pumps and filtration system to supply irrigation field".	Noted and amended.
	Irrigation System and Irrigation Areas – 'sealed above ground irrigation tank" there are no tanks post lagoon. Water is pumped direct from the lagoon through a filtration system to the irrigation drippers.	Noted and amended as above.
Decision Report		
Section 4.3 - Timing of works	The Applicant noted that the timing of the commencement of works has been delayed due to delays with approvals and	Noted, the Decision Report has been revised to reflect the changed timeframes.

Works Approval condition/ Decision Report section	Comment	DWER response
	Stage 1 will now commence in 2020.	

Appendix 3: Key documents

Document title	In text ref	Availability
Witchcliffe Eco Village Works Approval Application Form	the Application	DWER records (A1738113)
Witchcliffe Eco Village Attachments		DWER records (A1738114)
Attachment 6A – Geotechnical Study	Geotechnical Study	DWER records (A1738115)
Sustainable Settlements Witchcliffe Ecovillage - DWER Works Approval Supporting Information	Works Approval Supporting Information	DWER records (A1769087)
Witchcliffe Eco Village Structure Plan, September 2017	Structure Plan	DWER records (A1766894)
Sewerage License Areas Plan, February 2019	Sewerage Licence Areas Plan	DWER records (A1766892)
Staged Development Witchcliffe Ecovillage WWTF	Staged Development Schematics	DWER records (REPORT19/145)
Relationships and Associations	Relationships and Associations	DWER records (A1766886)
DWER Application Form – Section 2	DWER Application Form Section 2	DWER records (A1766883)
DRAFT Commissioning Plan V2, February 2019	Draft Commissioning Plan	DWER records (A1766882)
Sustainable Settlements Witchcliffe Ecovillage Nutrient and Irrigation Management Plan, February 2019	Nutrient and Irrigation Management Plan	DWER records (A1766880)
Appendix A – Geotechnical Report Witchcliffe, Galt Geotechnics, 23 December 2015	Geotechnical Report	DWER records (1766870)
Appendix B – Soil sampling	Soil Sampling	DWER records (A1766873)
Appendix C – Hydrology and Groundwater Plan, September 2017	Site Hydrology and Groundwater Plan	DWER records (A1766870)
Appendix E – Effluent Irrigation Plan	Effluent Irrigation Plan	DWER records (A1766879)
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