Rio Tinto –Hope Downs HD1 Project Sewage Treatment Plant Design Overview, Process Certification And Functional Description

Rev	Date	Author	Description	Checked	Approved
0	06/09/2024	[redacted]	FINAL	[redacted]	

ISO 9001 certified Equal Assurance
AS 4801 certified Equal Assurance
ISO 14001 certified Equal Assurance

ecoFarmer | RWTS REMOTE WATER TREATMENT SERVICES

PROJECT INFORMATION

CLIENT INFORMATION	
Name	[redacted]
Company	Calibre – Rio Tinto
Date	06/09/2024
Position	Senior Environmental Advisor
Phone	[redacted]
Email	[redacted]

PROJECT INFORMATION	
Project Name	800 person Accommodation Village Sewage Treatment System
Document #	TBA
Project ID number	TBA
Location	The HD1S construction camp Site will be located in the Greater Hope Downs (GHD) region, near the HD1 Mining Hub, approximately 120 km north-west from the town of Newman WA, via Great Northern Highway and HD1 mine access road.
RWTS Internal Job No.	TBA
Contract No.	TBA
Production Volume	250 Kl per day of Raw Sewage – plus Reverse Osmosis Brine - @ 120KL PER DAY
Assembly	Biological Waste Water Treatment System Multiple Train SBR Ecofarmer 1250 SNR STD

DESIGN CERTIFICATION INFORMATION

CLIENT: Rio Tinto

PRINCIPAL: Hope Downs HD1 Accommodation Village – via Newman WA

CONTRACT No: 2024003

SCOPE OF WORK: 800 Person Sewage Treatment System

1 x Fabricated sewage treatment plant including poly storage tanks for Balance, Treated Effluent and Chlorine Contact including effluent disposal field.

The sewage treatment packaged has been designed and constructed by Remote Water Treatment Services Pty Ltd, 186 New Cleveland Rd, Tingalpa 4173, ABN: 72 143 206 820.

Remote Water Treatment Service Pty Ltd (RWTS) hereby certify that the Biological Waste Water Treatment System Ecofarmer 250 Multiple Train Sewage treatment system has been designed for site specific operating conditions for the Rio Tinto HD1 800 person Sewage Treatment System Project – and hereby certify that the system has been designed to provide the quality of effluent as set out further in this documentation. This certificate certifies that all items listed below comply with the equipment and workmanship requirements of the RWTS engagement order including standard specification.

- AS1547:2012 - On-site domestic Wastewater Management – Accepted by RWTS
- AS1546.3:2017 - On-site domestic Wastewater Treatment Plants – Accepted by RWTS
- AS1170 - Structural Design for steel fabricated reactors
- AS4020:2002 & AS2070 - Poly tank material for food contact
- AS4766:2006 - Tank manufacturing guidelines
- AS3500.2:2015 Plumbing – Sanitary signed off on by WA contracted plumber
- AS1657:2013 – Ladders and Platforms
- AS3990 – Mechanical Equipment – Steel work

GENERAL PROJECT OVERVIEW

Rio Tinto is expanding the Hope Downs Project and requires an increase in Accommodation requirements to meet project targets.

The intent is to install a new facility – allowing for 800 persons – with a waste treatment Capacity of 250 kl per day to be treated, and up to a total of 120 kl per day of reverse osmosis reject to be discharged/blended with the treated wastewater to the irrigation area. Total irrigated volume of up to 370 m3 day.

The new STP is to be designed to provide ongoing reliable service and to minimise maintenance requirements and ensure ease of operation whilst maintaining reliable effluent quality and daily production.

The below table **outlines the New Additional Wastewater Treatment Facility Characteristics Summary**

Location	Facility located at, Greater Hope Downs (GHD) region, near the HD1 Mining Hub, approximately 120 km north-west from the town of Newman WA, via Great Northern Highway and HD1 mine access road WA
Maximum Throughput	Maximum sewage throughput capacity of the new combined facility – 250,000 L/day
Storage Tanks	5 x 50,000 litre poly chlorine contact/Irrigation storage tanks – 5 x 50,000 litre Raw Sewage Storage Tanks – 1 x 50,000 Waste Activated Sludge Storage Tank.
Irrigation Area	10.6 Hectares or 106,000 square metres maxim DIR 3.50mm/day including RO Brine Blend
Key Nutrient Outputs	BOD < 20 mg/l Total N < 20 mg/l Total P < 7.5 mg/l Suspended Solids < 30 mg/l E-Coli/Coliform < 1000 cfu/100 ml EC < 2000 us/cm
Existing Soil Type	Clay Loam throughout

The average daily inflow to the system is 250,000 ltrs, as a result – the system has a maximum design EP of 1250 persons @ 200 litres per person per day, or 800 ep @ 310 litres per person. Hydraulically, the system is capable of a nominal 250,000 litres per day – and has the biological capacity to treat up to 1250 persons.

	Raw Influent	Treated and blended Effluent Required
ADWF (m^3/day)	**250 m^3**	**370 m^3** Max Flow -
BOD (mg/L)	300	<20
SS (mg/L)	300	<30
Total N (mg/L)	80	<20
NH3 – N (mg/L)	60	< 1
Total P (mg/L)	20	<7.5
Coliforms (units/100 mL) -	-	<1000
Dissolved Oxygen (mg/L)	**-**	**> 2**
Free Chlorine residual (mg/L)	**< 0.2 -**	**0.2-2.0**
Ph	6.5 – 8.5	6.5 – 8.5

As a result, the following design loads are to be used for the site for **the Ecofarmer 1250 SBR Hybrid WWTP** :

Site input basis of design for long term process stability is as follows:

- Peak load - 800 persons – at 310 litres per person per day peak – and high range concentrations of 420 mg/l BOD, 100 mg/l TN and 20 mg/l TP. = 248,000 litres per day maximum total hydraulic load.

- Realistic load - @ 80% of the above Peak Load figures as an average once the site is established over the next few years = 198,000 litres per day.

- Initial Average Load on start up will be @ 50% - 60 % of the above realistic load at 100,000 litres to 120,000 litres per day.

Biologically – we use the following data for equivalent persons – which are industry standard figures and realistic as seen in the field:
EP – BOD = 60 grams per person per day
EP – TN = 16 grams per person per day

Daily – Final Initial load BOD = 50.40 KGS
Daily - Final Initial Load TN = 9.6 kgs
Daily - Final Initial Load = 120 kl
EP *Equivalent* Total = **600 Persons**

Daily – Final Realistic load BOD = 67.20 KGS
Daily - Final Realistic Load TN = 12.80 kgs
Daily - Final Hydraulic Realistic Load = 160 kl
EP *Equivalent* Total = **800 Persons**

Daily – Final Peak load BOD = 84.00 KGS
Daily - Final Peak Load TN = 16.00 kgs
Daily - Final Hydraulic Peak Load = 200 kl
EP *Equivalent* Total = **1000 Persons**
Final design range is therefore:
Nominal Biological Range of 600 EP TO 800 EP
Nominal Hydraulic Range of 120,000 litres per day up to 200,000 litres per day
Plus a peak **biological reserve** – Peak average of 25% = **200 persons additional capacity**
Plus a peak **hydraulic reserve** – Peak average of 25% = **50,000 ltrs day additional capacity**.

As a result, the following design loads are to be used for the site for **this Ecofarmer Train** – with the new combined system using Five Ecofarmer 250 Trains:

BOD	= 87.50 kgs/day BOD
Total Ammonia Nitrogen	= 16.00 kgs
Total Phosphorous	= 4.0 kgs
Suspended Solids	= 90.0 kgs
Daily Hydraulic Load Max Available	= 250,000 litres

It is noted that the target environmental design output for nutrients and effluent quality is as follows:

- SS < 30 mg/l
- BOD < 20 mg/l
- TN < 20 mg/l
- TP < 7.5 mg/l
- Total Coliform < 1000 cfu/100 ml
- **EC <2000 us/cm**

This effluent quality requirement is typical for Low Risk.

Individual Ecofarmer 250 Train Design Details
Influent Criteria Specified as follows:

- 50,000 litres per day
- 17.5 kgs per day BOD
- 15 kgs per day Suspended Solids
- 4.0 kgs per day Ammonia Nitrogen
- 1.25 kgs per day Phosphorous

Bioreactor Sizing

A hydraulic retention time (H.R.T) of 24 hours under maximum operating conditions (50kL/day).

Carbon dosing (Sucrose) may not be required in high loading periods as the F:M ratio should be sufficient, however may be required in low loading periods to meet the Nitrogen release limit of 20mg/L. GANDEN recommends investigation during commissioning to determine the requirement for carbon addition.
Alum dosing will be required to meet the Phosphorus release limit of 5 mg/L.

Process Design Workings SBR 250

Target operating MLSS is to be 3000mg/L at bottom water level (i.e. decant level) which will result in a correction of Active Biomass as follows: -
Total system biomass = 3000mg/L x Vol @ BWL (41.60kL) = 124.8kg

Maximum Loading
System design loading (Max.) = 17.5 kg/day
Food: Mass Ratio (average) = 0.13
Carbon addition (sugar dosing) not required.

Average Loading
System design loading (average) = 8.4kg/day
Food: Mass Ratio (average) = 0.067
Carbon addition will be required.

Low Loading (50EP)
System design loading (min) = 3.5kg/day
Food: Mass Ratio (min) = 0.028.
Carbon addition will be required.

Ratios and Equations

Target operating MLSS: 3500 mg/l – working range of 1200mg/l to 4500 mg/l

SBR Biological Process Area – Cycling Height: 50,837 litres

SBR Biological Process Area – Decant Height: 38,437 litres

Active Biomass: at 3500 mg/l = 3500 x 38,437 = 135000000 / 1000000 = 134.52 kg

Design Load: **250 EP @ 70 grams BOD/ep/day** and a maximum of 200 litres per ep/day
Design load is therefore 17,500 grams per day or 17.5 kg per day and a maximum hydraulic load of 50,000 litres per day with 10% redundancy.

The basis of design is 250 persons at a maximum daily hydraulic throughput of 50,000 litres.

Food/Mixed liquor (FM) Ratio: 17.5/134.52 = 0.130 with a working range of 0.050 to 0.150

Available Cycles per day: 6 x 4 hour cycles – minimum available aeration time of 130 minutes per 4 hour cycle

Oxygen delivery available per cycle: 130 minutes or 2.17 hours @ 5.46 kg per hour = 11.83 kg per cycle

AOTR Testing has been completed and checked inhouse at RWTS to determine aeration transfer efficiency of the aeration package designed for the system. Our system design uses a reflected/rebound flow path from the outlet of the venturi units – reflecting and recycling off an internal wall of the system creating additional mixing and air retention – which has resulted in improved oxygen transfer rates at the system working depth.

The following figures reflect the as tested values:

At an air delivery rate of 2600 litres per minute, @ an AOTR of **35 grams of o2 /m3/hr air delivered** this equates to an AOTR of **5.46 kgs/hr**. 2600 litres per minute air delivery **is the expected minimum available**, 2 x Mazzei 4091 Venturi @ 1011 ltrs per minute motive liquid flow ea @ 1.41 Bar feed pressure at the venturi inlet.

The feed pressure, air delivery rate and aeration timing is all fully adjustable – allowing flexibility and the ability to optimise aeration control.

Actual Demand Calculations are as follows:

50,000 litres per day / 6 cycles = 8,333 litres per cycle / plus Purge allowance of 300 litres

8,633 x 300 mg/l BOD = 2916 grams BOD per cycle x 1.2 (O2 Take up requirement) = 3500 grams

8,633 x 80 mg/l NH3 = 690.64 grams Ammonia Nitrogen Per Cycle x 4.6 (O2 Take up requirement) = 3176.94 grams

Actual Total Base Demand per cycle = 6676.95 grams or 6.68 kgs / 2.50 hrs = 2970 grams per hour actual demand, or **3.0 kgs/hr.**

Aeration Oxygen Requirements
Aeration calculations for the SOTR/hr and based on the Peak Load Operation (4.00-hour cycle), the required Oxygen Transfer Rate is approximately 3.5kg/hour. Based on 2hr 10mins aeration, the oxygen transfer rate per cycle is a minimum of 11.83 kg/O2/cycle.

Air Supply
The air supply consists of a dry mounted Grundfos SE1.80.100.75 centrifugal pump and two (2) Mazzei 4091 Venturi Injectors which supply a combined air flow rate of 156 m3/hr (1300 litres per minute each, 2600 litres per minute combined), with a delivered O2 per m3/air of 35 grams as tested in our facility.

The liquid flow rate required to drive the two venturis is 36.2 l/sec or 2,172 ltrs/min - @ 1.41 bar at the venturi inlet (the pump provides the duty at 15 mtrs delivery head).

The Latest series of system operates with Variable speed drive control – and Dissolved oxygen target setpoints available to the operator.

Each of the 5 operating trains are 100% redundant and independent – but communicate via Ethernet comms and allow a network ID and subsequent sequence ID to ensure the systems operate evenly and in synchronization. If one system fails or shuts down due to lower loads – the system ID can be changed to ensure the balance of Trains are operating in a sequenced format.

This arrangement provides a huge amount of redundancy, operational flexibility and site security – resulting in a robust design that is easier to manage.

WASTE WATER SYSTEM OVERVIEW

From the standpoint of sources of generation, wastewater may be defined as a combination of the liquid or water-carried wastes removed from residences, institutions, and other establishments.

If untreated waste is allowed to accumulate, the decomposition of the organic materials it contains can lead to the production of large quantities of foul-smelling gases. In addition, untreated wastewater usually contains numerous pathogenic or disease-causing organisms, micro-organisms that dwell in the human intestinal tract. Wastewater also contains nutrients, which can stimulate the growth of aquatic plants and it may contain toxic compounds. For these reasons, the immediate and nuisance-free removal of wastewater from its sources of generation, followed by treatment and disposal is not only desirable but also necessary in any society.

WASTE WATER CHARACTERISTICS

The important contaminants of concern in wastewater treatment are listed in **Table 1.1**.

Table 1.1 - Important contaminants of concern in waste water treatment

Contaminants	Reason for Importance
Suspended Solids	Suspended solids can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged into the aquatic and land based environment. Example: faeces, dirt, and grit.
Biodegradable organics	If discharged untreated to the environment, their biological stabilisation can lead to the depletion of natural oxygen resources (which can kill animal life) and to the development of septic (unsanitary and noxious) conditions. Biodegradable organics are measured most commonly in terms of BOD (Biochemical Oxygen Demand). Example: carbohydrates, proteins, fats.
Pathogens	Communicable diseases can be transmitted by the pathogenic organisms in wastewater. Example: Hepatitis A, Giardia, and Cryptosporidium.
Nutrients	Both nitrogen and phosphorous, along with carbon and alkalinity, are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life resulting in ecological changes. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater.

The composition and quantity of wastewater produced will vary depending on the nature of the facilities, number of persons using the facilities, upstream management and the local environmental conditions. Typical compositions of domestic wastewater are presented in **Table 1.2.**

Table 1.2 Typical domestic untreated wastewater composition

Contaminants	Concentration		
	Weak	Medium	Strong

Suspended Solids (mg/L)	100	200	400
Chemical Oxygen Demand (mg/L)	250	500	900
Biochemical Oxygen Demand (mg/L)	110	250	450
Nitrogen (Total as N) (mg/L)	20	60	100
Organic N (mg/L)	8	15	20
Free Ammonia (mg/L)	20	50	80
Nitrites (mg/L) & Nitrates (mg/L)	0	0	0
Phosphorous (Total) (mg/L)	5	10	25
Chlorides (mg/L)	30	100	400
Sulphate (mg/L)	20	30	50
Alkalinity as $CaCO_3$ (mg/L)	50	200	300
Fats, Oil & Grease or FOG (mg/L)	2	5	15
Total Coliform (orgs/100mL)	10^6-10^7	10^7-10^8	10^7-10^9

PLANT DESIGN PERFORMANCE SPECIFICATIONS FOR ECOFARMER 1250 SBR HYBRID WWTP

BASIS FOR DESIGN

When designing a wastewater treatment system, hydraulic and organic loadings must be fixed as a basis for design. The wastewater treatment system is then sized according to this basis and the effluent standard requirements. This Sewage Treatment Plant has been designed in this manner. Failure to observe the hydraulic and organic loadings may result in the discharge of effluent that does not meet the required standards. If the loadings are not exceeded (and upstream management and servicing procedures are adequate) the treatment plant will produce a high quality secondary treated effluent.

Table 2.1 presents the effluent quality that can be expected from the Sewage Treatment Plant if the influent loadings are not exceeded. The treatment plant is designed for specific influent concentrations. The influent concentrations relative to the hydraulic load for design are proportional, meaning the influent concentrations can be higher, if the hydraulic load is lower. The system will need to be tuned to the site concentrations experienced. These influent characteristics are detailed in the table below.

Characteristic	Average Influent	Desired Effluent Quality
PDWF[1] (m^3/day)	40 m3 Min Flow	250 m3 Max Flow
BOD (mg/L)	360	<20
SS (mg/L)	360	<30
Total N (mg/L)	100	<20
NH3 – N (mg/L)	80	-
Total P (mg/L)	20	<7.5
Faecal Coliforms (units/100 mL)	-	<1000

TANKS & SIZING

Tank Description	Function	Capacity L x W x H
Balance Tanks	Receives Raw sewage From the Site.	**D**: COERCO 50KL IND **Capacity**: 5 x 50,000 L
Waste Activated Sludge Tank	Waste Solids Storage Tank to assist in managing MLSS levels and system biological sludge age	**D**: COERCO 50KL IND **Capacity**: 1 x 50,000 L
5 x Sequential Batch Reactor (SBR) and Plant Room	Aeration, mixing, settling, decant. Treats effluent with a combination of air and mixing schedules controlled via the PLC an air induction pump adds the oxygen and then mixes the chamber for nitrogen conversion	**Each Train - Overall D**: 12000 L x 3000 H x 2400 W **Each Train - Nominal Usable SBR Process Area Capacity**: 50,000 L
Final Effluent/Chlorine Contact and blended RO brine storage Tanks	Treated effluent collection. Upon the decant phase of the SBR treated effluent is decanted and disinfected with Sodium Hypochlorite via chlorine dosing system and stored within the chlorine contact tank/ brine/ wet weather storage tanks before discharged to irrigation.	**D**: COERCO 50KL IND **Capacity: 5 x** 50,000 **L**

TREATMENT PROCESS OVERVIEW

The treatment process is arranged in an SBR (sequential batch reacting) configuration consisting of a primary tank, screen and balance tank front end. The SBR Process features a combined anoxic/aerobic biological suspended growth treatment process. This relies on bacterial action to achieve the following:

- Coagulate and remove the non-settle able colloidal solids and carbonaceous organic matter
- Convert the colloidal and dissolved carbonaceous organic matter into various gases and cell mass
- Reduce the nutrients such as nitrogen and phosphorus and other trace organic compounds

Anoxic degradation

The anoxic phase is designed to provide:

- Combined unheated but mixed Anoxic degradation / digestion
- Sludge storage in suspension
- De-Nitrification

Degradation Mechanism

Anoxic digestion is the process whereby which anoxic organisms use oxidised inorganic compounds such as nitrate and nitrite as electron acceptors instead of oxygen in the respiratory metabolism to convert the colloidal and carbonaceous organic matter into gases and cell tissue.

The equation provides a simplified representation of the decomposition process.

Complex Organic and Inorganic Compounds = > Energy + Waste Products

Energy is derived from the biochemical decomposition of the complex organic and inorganic molecules in processes similar to the way animals obtain energy from food. The energy is used for cell growth, maintenance and reproduction.

The waste products of these processes may be either gases (e.g. $CO2$ or $CH4$) or metabolic end products (e.g. alcohols and organic acids). The gases escape from the system and the soluble waste products are further degraded in subsequent treatment units.

The nitrate used in respiration will be reduced to nitrite and then to nitrogen gaseous forms, including N2 or N2 O: this anaerobic respiration process is referred to as denitrification.

Denitrification is performed by denitrifying bacteria, which are facultative aerobes (i.e. aerobic bacteria also capable of utilising oxidised nitrogen compounds e.g. nitrate in place of oxygen as electron acceptor in the respiration).

The bacteria use the carbon contained in the organic matter and the oxygen available from the nitrate to decompose organic matter. Under normal aerobic conditions, these bacteria will respire by aerobic respiration using oxygen. When the oxygen source is depleted, they will respire by anoxic respiration using nitrate as the electron acceptor.

BOD reduction is essential to maintain the efficiency of the subsequent nitrification process; Nitrate conversion to gaseous compounds (nitric oxide, nitrous oxide and N2) in the overall nutrient removal process.

Via the internal recycles of the process, nitrate produced by nitrification in the aerobic phase is recycled to the anoxic phase to result in denitrification. Prior to being converted to nitrogen gas (N2), nitrate undergoes a series of transformations shown under the following chemically simplified equation:

$$NO_3^- \Rightarrow NO_2^- \Rightarrow NO \Rightarrow N_2O \Rightarrow N_2$$

The denitrification process is governed by a number of factors such as the amount of dissolved oxygen, available carbon, available alkalinity/pH and temperature. The gaseous nitrogen products escape to the atmosphere and are therefore removed from the treated wastewater (final effluent).

The efficiency of the denitrification process is further governed by the supply of a good carbon source, which originates primarily from the incoming raw sewage supplied to the anoxic reactor, and to some extent also contained in the sludge recycled back from the aerobic phase through to the anoxic phase.

Mixed liquor suspended solids

Even though the volume of solid material being deposited is being reduced continually by anoxic or aerobic respiration (decomposition), a net increase of solids in suspension will always occur in an activated sludge system that is fed raw sewage due to the accumulation of non-biodegradable solids originating from the sewage as well as the net production of biomass originating from bacterial growth processes. If sludge is wasted from the system (as waste activated sludge), at steady state the inventory (concentration) of mixed liquor solids in suspension in the system will be constant. The mass of sludge wasted will be equal to the production due to processes of bacterial growth or accumulation of non-biodegradable organic matter. The system operator will need to tune the WAS system to achieve steady state inventory, based on the influent quality and system performance.

Aerobic processes

Aerobic growth and digestion takes place in the Aerobic stage and consists of the conversion of organic matter by aerobic microorganisms to new cell mass (biomass), followed by a series of death and cell regeneration processes sometimes called aerobic digestion.

The bacteria oxidize only a portion of the original waste stream (maximum net amount of 80%) introduced into the reactor into low-energy compounds such as nitrate, sulphate, carbon dioxide and water and through this will release energy to synthesize the remainder of the organic matter into new cellular material (biomass).

The cells produced (along with accumulated non-biodegradable organic material, collectively named the 'biomass') is settled out during the settle/decant phase of the system operation - and is recycled back through the bioreactor upon restart of the next batch treatment to reseed the process with active organisms and to maintain a desired mixed liquor solids concentration. The mixture of old and new synthesized cellular material must be managed by the system operator in order to allow stable and efficient settling of this material based on a suitable sludge age and biomass performance.

The bacterial re-seeding of the process allows the continuous degradation of organic compounds (carbonaceous organic matter) fed to the process as raw sewage.

Simultaneously with the aerobic degradation of organic compounds, specific bacteria named “nitrifying bacteria” will convert ammonia into nitrate (or sometimes small amounts of nitrite - that forms nitrogen as part of the overall nitrogen removal process). This conversion process is referred to as nitrification.

Nitrification consists of converting the ammonia present in the incoming sewage to nitrate. This conversion is represented by the following:

NH3 => NO2- => NO3-

The conversion of nitrite to nitrate occurs so rapidly that nitrite is usually non-detectable in the overall process. Low concentrations may be detected when part of the nitrification pathway is blocked (typically under conditions of low dissolved oxygen or low pH/ low wastewater alkalinity).

Degradation occurs under aerobic conditions (presence of oxygen). The efficiency of the process is highly dependent upon the BOD load, available amount of dissolved oxygen and ph. A high or low BOD load will reduce the nitrification efficiency since the nitrifying bacteria are slower growing and cannot easily compete for available oxygen supply conditions with bacteria oxidising carbonaceous (organic or BOD) compounds.

Optimum aerobic conditions required for successful aerobic digestion and nitrification are maintained by the use of dissolved air introduction in the aerobic tank, this air introduction system also provides the minimum mixing intensity required to keep the bacterial culture and all other compounds contained within the reactor in suspension.

Clarification

Settling is the main process occurring in the SBR for clarification of fluid. The solid material (biomass) that settles out in the SBR includes cellular material (old and new) and non-biodegradable / inert compounds, which were not used as energy by bacteria in the synthesis of organic matter. These combined create a biological floc, which combines and settles leaving behind clarified/clear fluid for decanting and disinfection.

These compounds will form a sludge layer at the bottom of the reactor which will be returned/re-mixed as “activated sludge” to re-seed the incoming effluent and continue the biological process (“Return Activated Sludge” or RAS). A portion of the RAS will be wasted and is then termed Waste Activated Sludge (WAS). The RAS, which includes the active microbial population, will undergo further cycles of growth and death/ regeneration in the Anoxic and Aerobic Reactors to maintain the biological process.

The clarified liquid stream leaves the SBR via the decant system as Secondary Effluent. The more efficient the clarification (settling) operation is, the higher the clarity (lower turbidity and suspended solids content) of the Secondary Effluent.

Disinfection and Instrumentation System

ACH also provides a final chemical polish/removal of remaining phosphorous and typically results in TP levels of less than 2.5 mg/l consistently when combined with the RWTS Hybrid SBR Process.

Historically – and when managed correctly – this process produces Turbidity values of less than 5 ntu. High Level warning limits and High High Level alarm limits will also be employed to notify the system operator that the system is performing outside recommended guidelines.

Chlorine is used to disinfect the final polished effluent from the SBR. The method used to deliver chlorine to the treated effluent is by way of chlorine dosing via a dosing system delivering a set amount of chlorine to the effluent flow during the decant process, with the system design allowing enough time to disinfect the body of water fit for final irrigation. Irrigation is inhibited for a minimum CCT or chlorine contact time in mg/min to ensure complete disinfection has occurred.

A secondary disinfection function is employed using a top up function built into the control system, providing a secondary – delayed delivery of chlorine that is fully adjustable by the system operato. This is a very reliable and robust disinfection platform that typically provides low detectable E-Coli and Coliform levels when operated and maintained correctly.

RWTS Proprietary Nitrogen and Phosphorous Removal System

Nitrogen, in the form of Ammonia predominantly in the raw sewage collected form the site, as well as phosphorous are the two key nutrients that require considerable reduction before the treated effluent can be discharged to the receiving environment.

A number of keys steps are employed with our Hybrid SBR design to reduce these nutrients to as low as practical and below expected compliance targets.

Removal Process Number One – RWTS Proprietary Chemical Nitrogen and Phosphorous Removal

RWTS employs smart chemistry and process design techniques to chemically bind Ammonia, Phosphorous and Magnesium within the process area of the system. Supplementary sources of chemical are delivered accurately during processing of sewage, using smart control techniques and software to produce an effective and efficient reduction of Ammonia/Nitrogen and Phosphorous, with some cases allowing up to 40% reduction of TN and TP with this step alone. In a standard operating environment such as this situation – the expected reduction should result in 30% removal with this step alone.

Removal Process Number Two – RWTS Proprietary Biological Nitrogen and Phosphorous Removal

A smart Anoxic operating phase controlled accurately by proprietary RWTS software and control methodology using advanced Dissolved Oxygen Monitoring and Control, combined with balanced Carbon to Ammonia operating ratios allow Phosphorous accumulating Organisms to Biologically take up more than they require for metabolism and multiplication, resulting in retained biological phosphorous removal occurring during treatment. Phosphorous ultimately ends up in the WAS tank and waste sludge and is maintained in an aerobic state in this tank to eliminate the chance of re-release back to the process area of the system.

De-nitrification occurs biologically when Nitrate is sacrificed during respiration requirements due to the oxygen molecule being extracted by capable denitrifying bacteria within the process area. Ideal de-nitrification conditions are controlled and maintained by design using RWTS's hybrid platform and proprietary techniques.

PROCESS DESIGN WORKINGS FOR EACH ECOFARMER 250 HYBRID SBR

Ratios and Equations

Target operating MLSS: 3500 mg/l – working range of 1200mg/l to 4500 mg/l

SBR Biological Process Area – Cycling Height: 50,837 litres

SBR Biological Process Area – Decant Height: 38,437 litres

Active Biomass: at 3500 mg/l = 3500 x 38,437 = 135000000 / 1000000 = 134.52 kg

Design Load: **250 EP @ 60 grams BOD/ep/day** and a maximum of 200 litres per ep/day
Design load is therefore 15,000 grams per day or 15 kg per day and a maximum hydraulic load of 50,000 litres per day with redundancy.

The basis of design is 250 persons at a maximum daily hydraulic throughput of 50,000 litres.

Food/Mixed liquor (FM) Ratio: 15/134.52 = 0.111 with a working range of 0.050 to 0.150

Available Cycles per day: 6 x 4 hour cycles – available aeration time of 150 minutes per 4 hour cycle

Oxygen delivery available per cycle: 150 minutes or 2.5 hours @ 2.7 kg per hour = 6.75 kg per cycle

Per cycle oxygen demand: averaged is 2,333 grams, multiply by 2.5 = 5.83 kg of oxygen required per cycle

AOTR Testing has been completed and checked inhouse at RWTS to determine aeration transfer efficiency of the aeration package designed for the system. The following figures reflect the as tested values:

At an air delivery rate of 1500 litres per minute, @ an AOTR of **30 grams of o2 /m3/hr air delivered** this equates to an AOTR of **2.7 kgs/hr**. 1500 litres per minute air delivery is the expected minimum available, 3 x Mazzei 3090 Venturi @ 500 ltrs per minute motive flow ea @ 1.4 Bar feed pressure.

The feed pressure, air delivery rate and aeration timing is all fully adjustable – allowing flexibility and the ability to optimise aeration control.

Per cycle peak oxygen demand: 5,888 grams, 2355 grams per hour actual demand.

Available O2 / O2 Demand Ratio = 2.70 kgs/2.355 kgs = 1.14:1 – or 14% reserve capacity at peak design

Actual Demand Calculations are as follows:

50,000 litres per day / 6 cycles = 8,333 litres per cycle / plus Purge allowance of 300 litres

8,633 x 300 mg/l BOD = 2590 grams BOD per cycle x 1.2 (O2 Take up requirement) = 3108 grams

8,633 x 70 mg/l NH3 = 604 grams Ammonia Nitrogen Per Cycle x 4.6 (O2 Take up requirement) = 2780 grams

Actual Total Demand per cycle = 5888 grams or 5.888 kgs / 2.50 hrs = 2355 grams per hour actual demand.

Summary

Each cycle is a sequence of multiple aeration & anoxic cycles followed by settling, decanting and re-filling. Each sequence is fully adjustable for optimum treatment and nutrient removal based on site conditions through the HMI screen.

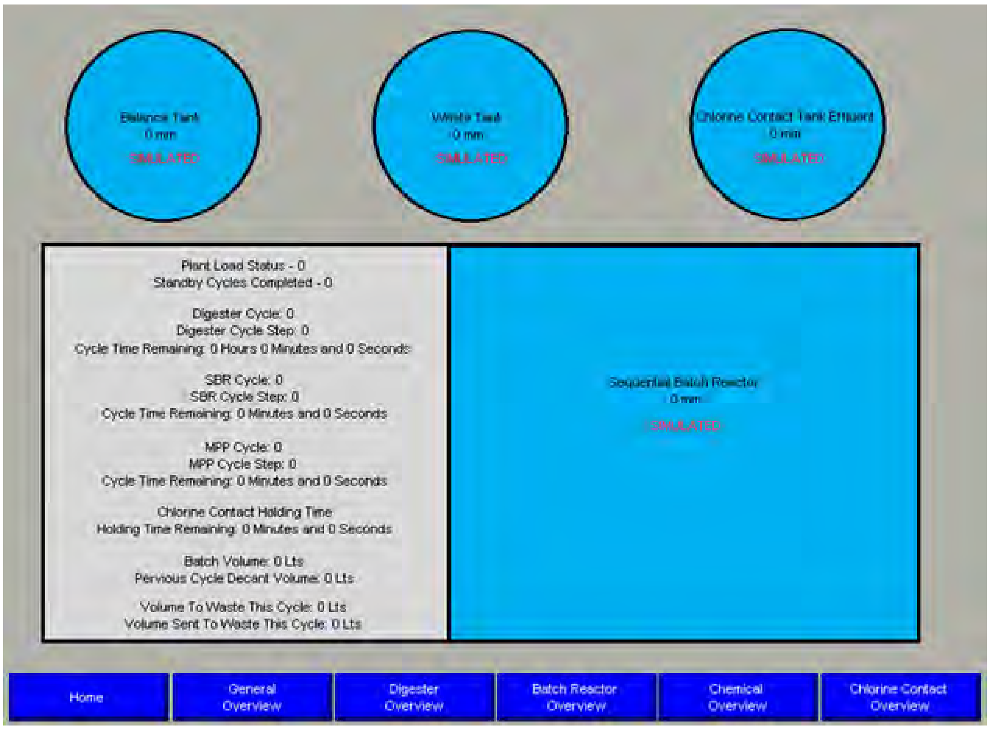
Smart dosing is provided for balancing of Carbon to Ammonia Ratio, as well as Ammonia/Nitrogen and Phosphorous

- Sludge age will average 8 - 21 days depending on hydraulic/organic loads
- Each cycle will decant approximately 9500 litres /treat approximately 8,400 litres of fluid – 5 trains provide a total maximum of 30 cycles per day.
- **WAS tank** provides storage for waste activated sludge, and foreign material removal – with a capacity of 50,000 litres usable storage. Waste sludge is then dewatered via Geobags and polymer dosing – with supernatant recovery using a geobag slab/bund and dewatering via dehydration. Geobags will be disposed of via regulatory allowable disposal – either using brown hazardous material waste bins supplied by a suitable licensed waste contractor – or via licensed/approved waste land fill on the site.
- **Flow Balance tank** is 250,000 litres usable in size. This will cater for 100 % of the daily peak load over 24 hours.
- **Chlorine contact/ Brine Storage** is 250,000 litres, Chlorine delivery can be adjusted to ensure adequate initial dose is provided for minimum PPM hours needed for effective disinfection – based on final effluent quality – with a target residual of 0.70 ppm after 3 hours of disinfection prior to release to irrigation/environment.

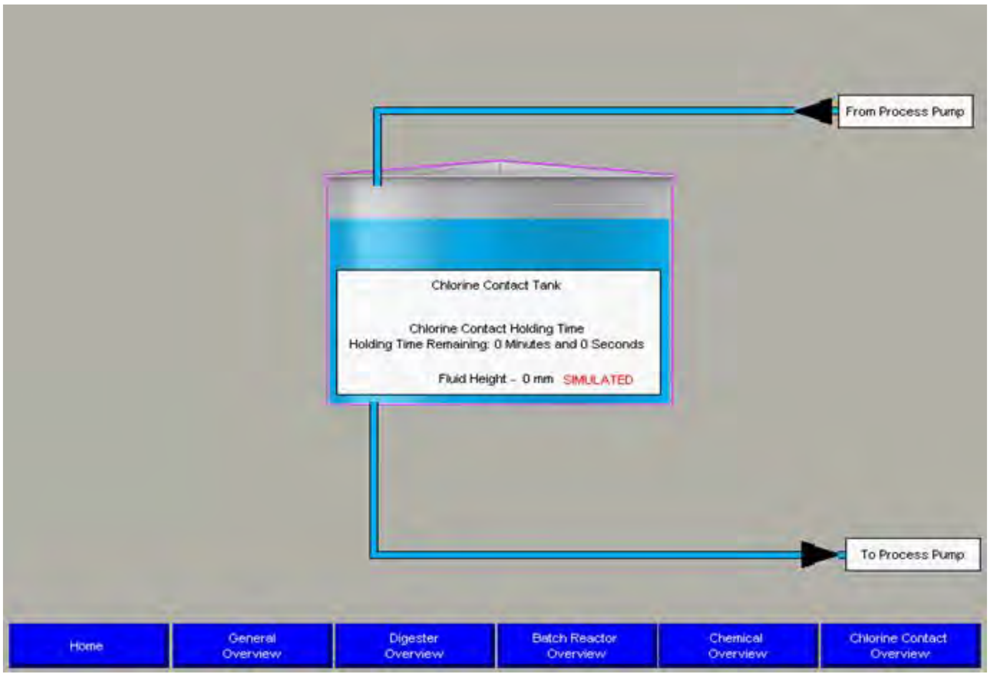
Example HMI screens are as per the below screen shots for the system – from left to right as you access them via the HMI:

HMI Screens

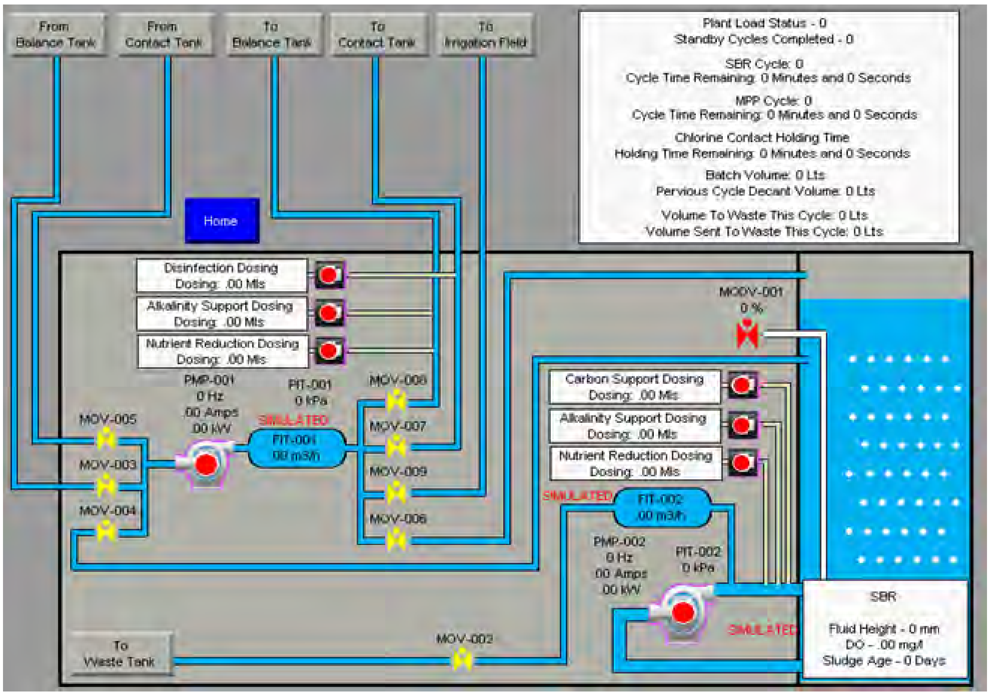
General overview



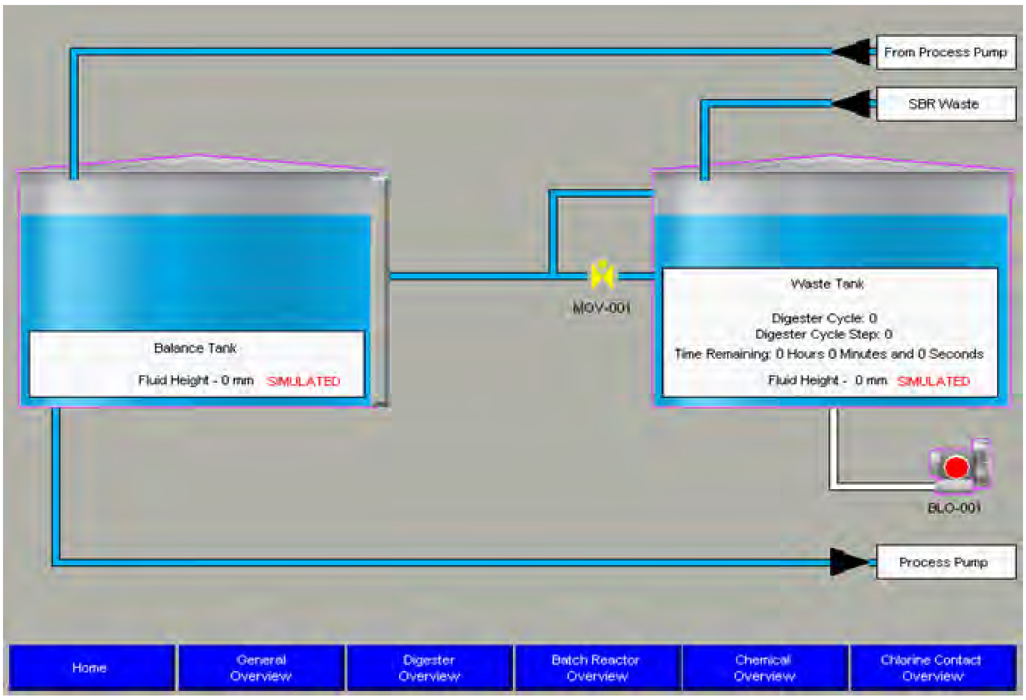
Chlorine Contact



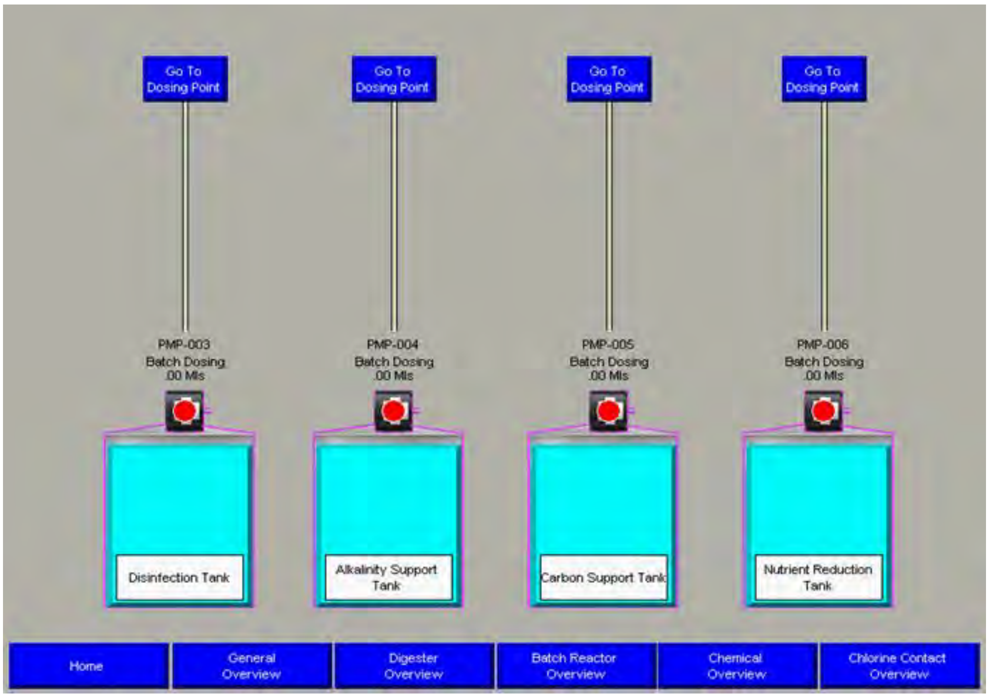
SBR OVERVIEW



DIGESTER OVERVIEW



CHEMICAL OVERVIEW



PUMPS AUTO OFF MANUAL

EQUIPMENT	DESCRIPTION	AUTO	OFF	MANUAL	MANUAL VALUE
PMP-001	Process Pump	AUTO	OFF	MANUAL	%
PMP-002	Aeration Pump	AUTO	OFF	MANUAL	%
PMP-003	Disinfection Pump	AUTO	OFF	MANUAL	
PMP-004	Alkalinity Support Pump	AUTO	OFF	MANUAL	
PMP-005	Carbon Support Tank	AUTO	OFF	MANUAL	
PMP-006	Nutrient Reduction Pump	AUTO	OFF	MANUAL	
BLO-001	Digester Blower	AUTO	OFF	MANUAL	

VALVES AUTO OFF MANUAL

EQUIPMENT	DESCRIPTION	AUTO	OFF	MANUAL	MANUAL VALUE
MOV-001	Digester Decant Valve	AUTO	OFF	MANUAL	
MOV-002	Waste Valve 2	AUTO	OFF	MANUAL	
MOV-003	Balance Tank Suction Valve	AUTO	OFF	MANUAL	
MOV-004	SBR Decant Suction Valve	AUTO	OFF	MANUAL	
MOV-005	Chlorine Contact Tank Suction Valve	AUTO	OFF	MANUAL	
MOV-006	SBR Fill Valve	AUTO	OFF	MANUAL	
MOV-007	Chlorine Contact Recirculation Valve	AUTO	OFF	MANUAL	
MOV-008	Balance Tank Recirc / Purge Valve	AUTO	OFF	MANUAL	
MOV-009	Irrigation Discharge Valve	AUTO	OFF	MANUAL	
MODV-001	Oxygen Inlet Modulating Valve	AUTO	OFF	MANUAL	%

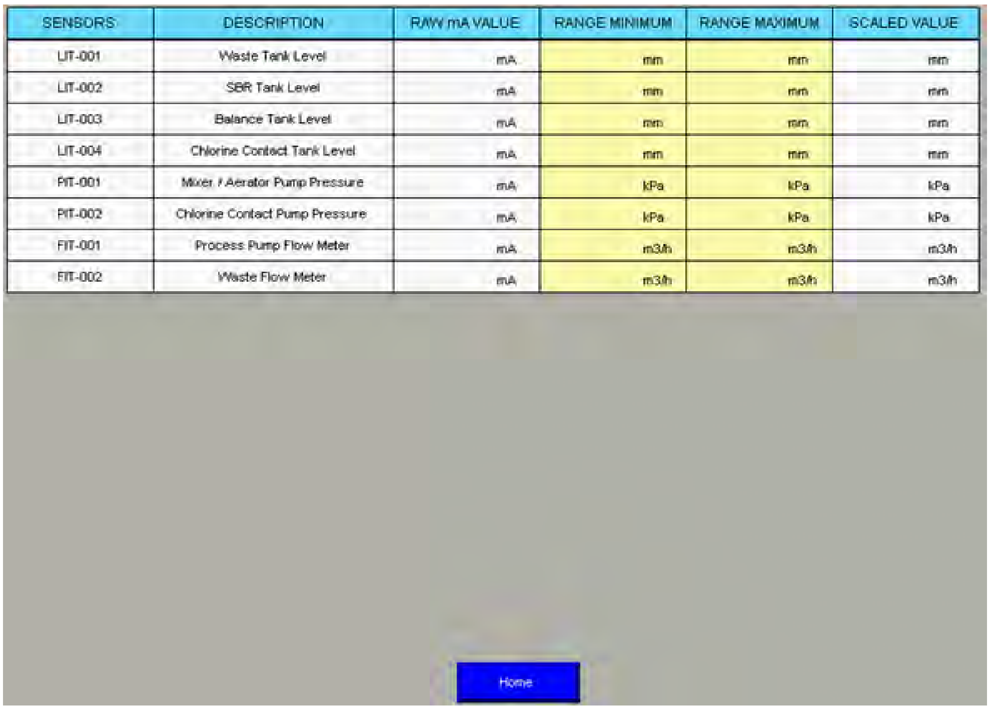
Home Pumps Valves

TRANSMITTER SIMULATION VALUES

SENSORS	DESCRIPTION	SIMULATED VALUE	ON/OFF	SCALED VALUE
LIT-001	Waste Tank Level	mm	Simulate	mm
LIT-002	SBR Tank Level	mm	Simulate	mm
LIT-003	Balance Tank Level	mm	Simulate	mm
LIT-004	Chlorine Contact Tank Level	mm	Simulate	mm
PIT-001	Mixer / Aerator Pump Discharge Pressure	kPa	Simulate	kPa
PIT-002	Chlorine Contact Recirculation Pump Discharge Pressure	kPa	Simulate	kPa
FIT-001	Multi Purpose Flow Meter	m3/h	Simulate	m3/h
FIT-002	SBR Waste Flow Meter	m3/h	Simulate	m3/h

Home

ANALOG SCALING

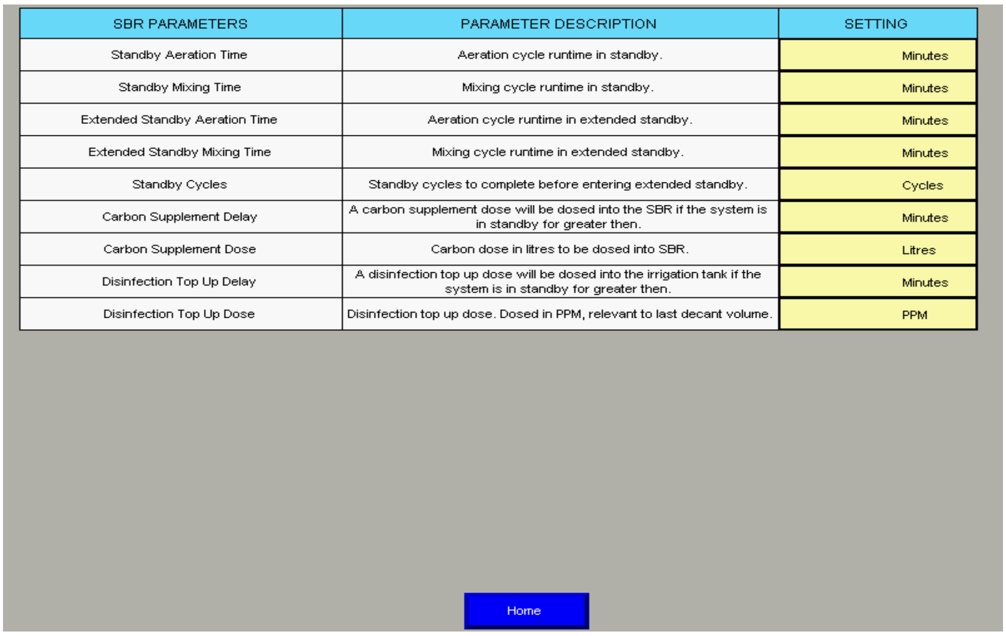


SENSORS	DESCRIPTION	RAW mA VALUE	RANGE MINIMUM	RANGE MAXIMUM	SCALED VALUE
LIT-001	Waste Tank Level	mA	mm	mm	mm
LIT-002	SBR Tank Level	mA	mm	mm	mm
LIT-003	Balance Tank Level	mA	mm	mm	mm
LIT-004	Chlorine Contact Tank Level	mA	mm	mm	mm
PIT-001	Mixer / Aerator Pump Pressure	mA	kPa	kPa	kPa
PIT-002	Chlorine Contact Pump Pressure	mA	kPa	kPa	kPa
FIT-001	Process Pump Flow Meter	mA	m3/h	m3/h	m3/h
FIT-002	Waste Flow Meter	mA	m3/h	m3/h	m3/h

PLANT OPERATING MODE

MAIN NAVIGATION

SBR STANDBY



SBR PARAMETERS	PARAMETER DESCRIPTION	SETTING
Standby Aeration Time	Aeration cycle runtime in standby.	Minutes
Standby Mixing Time	Mixing cycle runtime in standby.	Minutes
Extended Standby Aeration Time	Aeration cycle runtime in extended standby.	Minutes
Extended Standby Mixing Time	Mixing cycle runtime in extended standby.	Minutes
Standby Cycles	Standby cycles to complete before entering extended standby.	Cycles
Carbon Supplement Delay	A carbon supplement dose will be dosed into the SBR if the system is in standby for greater then.	Minutes
Carbon Supplement Dose	Carbon dose in litres to be dosed into SBR.	Litres
Disinfection Top Up Delay	A disinfection top up dose will be dosed into the irrigation tank if the system is in standby for greater then.	Minutes
Disinfection Top Up Dose	Disinfection top up dose. Dosed in PPM, relevant to last decant volume.	PPM

SBR PARAMETERS

SBR PARAMETERS	PARAMETER DESCRIPTION	SETTING
Balance Tank Holding Capacity (TNK-001)	Total Capacity Of Balance Tanks in Litres.	Litres
Balance Tank Head At Capacity (TNK-001)	Static Pressure Difference Between Level Transmitter and Overflow.	mm
Balance Tank Minimum Height (TNK-001)	Minimum Height Required to be Maintained in the Balance Tank	mm
Balance Tank Start Refill Height	Calculated Balance Tank Level Required To Start A Cycle	0 mm
Reactor Transfer Volume	Minimum Volume Of Fluid Required in Balance Tank to Start a Fill Cycle.	Litres
Balance Tank Mixing (TNK-001)	Balance Tank Mixing Time.	Minutes
Pipework Purge Time	Pipework Purge Time	Seconds
Normal Demand Level	When the balance tank level rises above this setpoint. Normal demand parameters are used.	mm
Peak Demand Level	When the balance tank level rises above this setpoint. Peak demand parameters are used.	mm
Pump Parameters	Pump Speed and Current Limiting Settings	Pump Parameters
Low Demand Parameters	Settings runtime parameters for SBR Cycles.	Low Demand Parameters
Normal Demand Parameters	Settings runtime parameters for SBR Cycles.	Normal Demand Parameters
Peak Demand Parameters	Settings runtime parameters for SBR Cycles.	Peak Demand Parameters
Sludge Wasting	Sludge Wasting Parameters.	Waste Parameters
Chemical Dosing	Plant Chemical Dosing Parameters	Dosing Parameters
Dissolved Oxygen Control	Dissolved Oxygen Control Valve Positioning.	DO Parameters
Irrigation Parameters	Irrigation Parameters	Irrigation Parameters

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LOW DEMAND PARAMETERS

LOW DEMAND PARAMETERS	PARAMETER DESCRIPTION	SETTING
Low Demand Refill Height	Height to refill SBR tank to in low demand.	mm
Low Demand Aeration 1 Time	Aeration cycle one runtime in low demand.	Minutes
Low Demand Mixing 1 Time	Mixing cycle one runtime in low demand.	Minutes
Low Demand Aeration 2 Time	Aeration cycle two runtime in low demand.	Minutes
Low Demand Mixing 2 Time	Mixing cycle two runtime in low demand.	Minutes
Low Demand Aeration 3 Time	Aeration cycle three runtime in low demand.	Minutes
Low Demand Mixing 3 Time	Mixing cycle three runtime in low demand.	Minutes
Low Demand Aeration 4 Time	Aeration cycle four runtime in Low Demand	Minutes
Low Demand Settling Time	SBR settling time in low demand.	Minutes
Low Demand Purge Time	Purges decant line to balance tank for set time.	Seconds
Low Demand Decant Level	Decant cycle will run until SBR level is below setpoint.	mm
Low Demand Decant Maximum Time	Maximum time the decant cycle is able to run in the event the SBR tank does not reach level setpoint.	Minutes

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NORMAL DEMAND PARAMETERS

NORMAL DEMAND PARAMETERS	PARAMETER DESCRIPTION	SETTING
Normal Demand Refill Height	Height to refill SBR tank to in normal demand.	mm
Normal Demand Aeration 1 Time	Aeration cycle one runtime in normal demand.	Minutes
Normal Demand Mixing 1 Time	Mixing cycle one runtime in normal demand.	Minutes
Normal Demand Aeration 2 Time	Aeration cycle two runtime in normal demand.	Minutes
Normal Demand Mixing 2 Time	Mixing cycle two runtime in normal demand.	Minutes
Normal Demand Aeration 3 Time	Aeration cycle three runtime in normal demand.	Minutes
Normal Demand Settling Time	SBR settling time in normal demand.	Minutes
Normal Demand Purge Time	Purges decant line to balance tank for set time.	Seconds
Normal Demand Decant Level	Decant cycle will run until SBR level is below setpoint.	mm
Normal Demand Decant Maximum Time	Maximum time the decant cycle is able to run in the event the SBR tank does not reach level setpoint.	Minutes

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PEAK DEMAND PARAMETERS

PEAK DEMAND PARAMETERS	PARAMETER DESCRIPTION	SETTING
Peak Demand Refill Height	Height to refill SBR tank to in peak demand.	mm
Peak Demand Aeration 1 Time	Aeration cycle one runtime in peak demand.	Minutes
Peak Demand Mixing 1 Time	Mixing cycle one runtime in peak demand.	Minutes
Peak Demand Aeration 2 Time	Aeration cycle two runtime in peak demand.	Minutes
Peak Demand Mixing 2 Time	Mixing cycle two runtime in peak demand.	Minutes
Peak Demand Aeration 3 Time	Aeration cycle three runtime in peak demand.	Minutes
Peak Demand Settling Time	SBR settling time in peak demand.	Minutes
Peak Demand Purge Time	Purges decant line to balance tank for set time.	Seconds
Peak Demand Decant Level	Decant cycle will run until SBR level is below setpoint.	mm
Peak Demand Decant Maximum Time	Maximum time the decant cycle is able to run in the event the SBR tank does not reach level setpoint.	Minutes

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WASTE PARAMETERS

PARAMETER	PARAMETER DESCRIPTION	SETTING	
Sludge Wasting Method	Select To Waste By Percentage Or Volume.	Percentage	Volume
Volume to Waste	Volume of Fluid To Waste From SBR Each Cycle.	Lts	
Waste Maximum Runtime	Maximum Time Waste Valve Will Open In A Cycle.	Minutes	
Settling Start Time	Time the the day the sludge digester will start settling.	O'clock	
Settling Time	Time during the sludge digester will settle before decanting.	Minutes	
Decant Runtime	Time during the sludge digester decant valve will open after settling.	Minutes	

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DOSING PARAMETERS

CHEMICAL PARAMETERS	PARAMETER DESCRIPTION	SETTING	
Disinfection Dosing (PMP-003)	Disinfection PPM Dose During Decant Cycle.	PPM	
Disinfection Top Up Dose (PMP-003)	Disinfection PPM Dose Top Up Dose In Standby.	PPM	
Alkalinity Support Dosing (PMP-004)	Alkalinity Support Dosing Point	Balance Tank	SBR
Alkalinity Support Dosing (PMP-004)	Alkalinity Support PPM Dose Per Cycle	PPM	
Carbon Support (PMP-005)	Carbon Support PPM Dose During Second Anoxic Cycle.	PPM	
Carbon Support (PMP-005)	Carbon Supplement Dose in Litres After Delay In Standby Mode.	Litres	
Nutrient Reduction Dosing (PMP-006)	Nutrient Reduction Dosing Point	Balance Tank	SBR
Nutrient Reduction Dosing (PMP-006)	Nutrient Reduction PPM Dose Per Cycle	PPM	

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DO PARAMETERS

CYCLE	AERATION START SETPOINT	DERATE AT % OF CYCLE	DERATING STARTING POINT	DERATING END POINT
Low Load Aeration 1 Setting	DO	%	DO	DO
Low Load Aeration 2 Setting	DO	%	DO	DO
Low Load Aeration 3 Setting	DO	%	DO	DO
Low Load Aeration 4 Setting	DO	%	DO	DO
Normal Load Aeration 1 Setting	DO	%	DO	DO
Normal Load Aeration 2 Setting	DO	%	DO	DO
Normal Load Aeration 3 Setting	DO	%	DO	DO
Peak Load Aeration 1 Setting	DO	%	DO	DO
Peak Load Aeration 2 Setting	DO	%	DO	DO
Peak Load Aeration 3 Setting	DO	%	DO	DO
Standby Aeration Setting	DO	%	DO	DO
Extended Standby Aeration Setting	DO	%	DO	DO

Air Valve Max Clamp	%
Air Valve Min Clamp	%

Air Valve PID Gains - Kc	
Air Valve PID Gains - Ti	
Air Valve PID Gains - TD	
Air Valve PID Gains - FC	

No DO Probe | DO Probe Installed

Back | DO Calibration

DOSING PUMP CALIBRATION

Disinfection Pump - PMP-003	SETTINGS
Pump Flow Calibration	Abort Calibration
Measured Calibrated Volume	Mls
Chemical Strength (%)	%

Alkalinity Support Pump - PMP-004	SETTINGS
Pump Flow Calibration	Abort Calibration
Measured Calibrated Volume	Mls
Chemical Strength (%)	%

Carbon Support Pump - PMP-005	SETTINGS
Pump Flow Calibration	Abort Calibration
Measured Calibrated Volume	Mls
Chemical Strength (%)	%

Nutrient Reduction - PMP-006	SETTINGS
Pump Flow Calibration	Abort Calibration
Measured Calibrated Volume	Mls
Chemical Strength (%)	%

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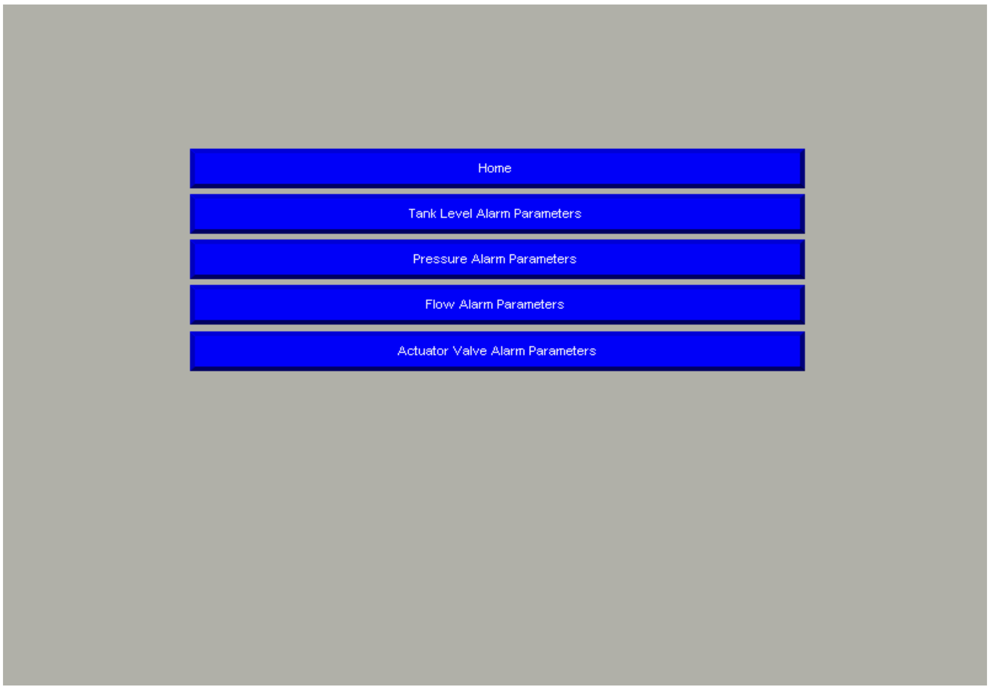
ALARM NAVIGATION PAGE



LEVEL ALARMS - ALARMS PAGE 1

SENSORS	DESCRIPTION	ALARM VALUE	DELAY
LIT-001	Waste Tank Low Level Alarm	mm	Secs
	Waste Tank Low Level Warning	mm	Secs
	Waste Tank High Level Warning	mm	Secs
	Waste Tank High Level Alarm	mm	Secs
LIT-002	Sequential Batch Reactor Low Level Alarm	mm	Secs
	Sequential Batch Reactor Low Level Warning	mm	Secs
	Sequential Batch Reactor High Level Warning	mm	Secs
	Sequential Batch Reactor High Level Alarm	mm	Secs
LIT-003	Balance Tank Low Level Alarm	mm	Secs
	Balance Tank Low Level Warning	mm	Secs
	Balance Tank High Level Warning	mm	Secs
	Balance Tank High Level Alarm	mm	Secs
LIT-004	Chlorine Contact Low Level Alarm	mm	Secs
	Chlorine Contact Low Level Warning	mm	Secs
	Chlorine Contact High Level Warning	mm	Secs
	Chlorine Contact High Level Alarm	mm	Secs

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PRESSURE ALARMS - ALARMS PAGE 2

SENSORS	DESCRIPTION	ALARM VALUE	DELAY
PIT-002	Mixer / Aerator Low Pressure Alarm	kPa	Secs
	Mixer / Aerator Low Pressure Warning	kPa	Secs
	Mixer / Aerator High Pressure Warning	kPa	Secs
	Mixer / Aerator High Pressure Alarm	kPa	Secs
PIT-001	Balance Mixing Low Pressure Alarm	kPa	Secs
	Balance Mixing Low Pressure Warning	kPa	Secs
	Balance Mixing High Pressure Warning	kPa	Secs
	Balance Mixing High Pressure Alarm	kPa	Secs
PIT-001	Reactor Refill Low Pressure Alarm	kPa	Secs
	Reactor Refill Low Pressure Warning	kPa	Secs
	Reactor Refill High Pressure Warning	kPa	Secs
	Reactor Refill High Pressure Alarm	kPa	Secs
PIT-001	Pipework Purge Low Pressure Alarm	kPa	Secs
	Pipework Purge Low Pressure Warning	kPa	Secs
	Pipework Purge High Pressure Warning	kPa	Secs
	Pipework Purge High Pressure Alarm	kPa	Secs
PIT-001	Decant Purge Low Pressure Alarm	kPa	Secs
	Decant Purge Low Pressure Warning	kPa	Secs
	Decant Purge High Pressure Warning	kPa	Secs
	Decant Purge High Pressure Alarm	kPa	Secs

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PRESSURE ALARMS - ALARMS PAGE 3

SENSORS	DESCRIPTION	ALARM VALUE	DELAY
PIT-001	Decant Low Pressure Alarm	kPa	Secs
	Decant Low Pressure Warning	kPa	Secs
	Decant High Pressure Warning	kPa	Secs
	Decant High Pressure Alarm	kPa	Secs
PIT-001	Treated Effluent Recirculation Low Pressure Alarm	kPa	Secs
	Treated Effluent Recirculation Low Pressure Warning	kPa	Secs
	Treated Effluent Recirculation High Pressure Warning	kPa	Secs
	Treated Effluent Recirculation High Pressure Alarm	kPa	Secs
PIT-001	Irrigation Discharge Low Pressure Alarm	kPa	Secs
	Irrigation Discharge Low Pressure Warning	kPa	Secs
	Irrigation Discharge High Pressure Warning	kPa	Secs
	Irrigation Discharge High Pressure Alarm	kPa	Secs

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FLOW ALARMS - ALARMS PAGE 4

SENSORS	DESCRIPTION	ALARM VALUE	DELAY
FIT-002	SBR Waste Low Flow Alarm	m3/h	Secs
	SBR Waste Low Flow Warning	m3/h	Secs
	SBR Waste High Flow Warning	m3/h	Secs
	SBR Waste High Flow Alarm	m3/h	Secs
FIT-001	Balance Mixing Low Flow Alarm	m3/h	Secs
	Balance Mixing Low Flow Warning	m3/h	Secs
	Balance Mixing High Flow Warning	m3/h	Secs
	Balance Mixing High Flow Alarm	m3/h	Secs
FIT-001	Reactor Refill Low Flow Alarm	m3/h	Secs
	Reactor Refill Low Flow Warning	m3/h	Secs
	Reactor Refill High Flow Warning	m3/h	Secs
	Reactor Refill High Flow Alarm	m3/h	Secs
FIT-001	Pipework Purge Low Flow Alarm	m3/h	Secs
	Pipework Purge Low Flow Warning	m3/h	Secs
	Pipework Purge High Flow Warning	m3/h	Secs
	Pipework Purge High Flow Alarm	m3/h	Secs
FIT-001	Decant Purge Low Flow Alarm	m3/h	Secs
	Decant Purge Low Flow Warning	m3/h	Secs
	Decant Purge High Flow Warning	m3/h	Secs
	Decant Purge High Flow Alarm	m3/h	Secs

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FLOW ALARMS – ALARMS PAGE 5

SENSORS	DESCRIPTION	ALARM VALUE	DELAY
FIT-001	Decant Low Flow Alarm	m3/h	Secs
	Decant Low Flow Warning	m3/h	Secs
	Decant High Flow Warning	m3/h	Secs
	Decant High Flow Alarm	m3/h	Secs
FIT-001	Treated Effluent Recirculation Low Flow Alarm	m3/h	Secs
	Treated Effluent Recirculation Low Flow Warning	m3/h	Secs
	Treated Effluent Recirculation High Flow Warning	m3/h	Secs
	Treated Effluent Recirculation High Flow Alarm	m3/h	Secs
FIT-001	Irrigation Discharge Low Flow Alarm	m3/h	Secs
	Irrigation Discharge Low Flow Warning	m3/h	Secs
	Irrigation Discharge High Flow Warning	m3/h	Secs
	Irrigation Discharge High Flow Alarm	m3/h	Secs

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ACTUATOR VALVE ALARMS – ALARMS PAGE 6

SENSORS	DESCRIPTION	DELAY	DISABLE
MOV-001	MOV-001 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-002	MOV-002 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-003	MOV-003 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-004	MOV-004 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-005	MOV-005 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-006	MOV-006 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-007	MOV-007 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-008	MOV-008 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MOV-009	MOV-009 Alarm delay if correct feedback signal is not received.	Secs	Disabled
MODV-001	MODV-001 Alarm delay if correct feedback signal is not received.	Secs	Disabled

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IRRIGATION PARAMETERS

SBR PARAMETERS	PARAMETER DESCRIPTION	SETTING
Chlorine Contact Tank Recirc Stop Level	Chlorine Contact Recirculation Stop Level	mm
Chlorine Contact Tank Recirc Start Level	Chlorine Contact Recirculation Start Level	mm
Irrigation Stop Level	Irrigation Stop Level	mm
Irrigation Start Level	Irrigation Start Level	mm
Chlorine Contact Holding Time	Chlorine Contact Holding Time After Decant	Minutes

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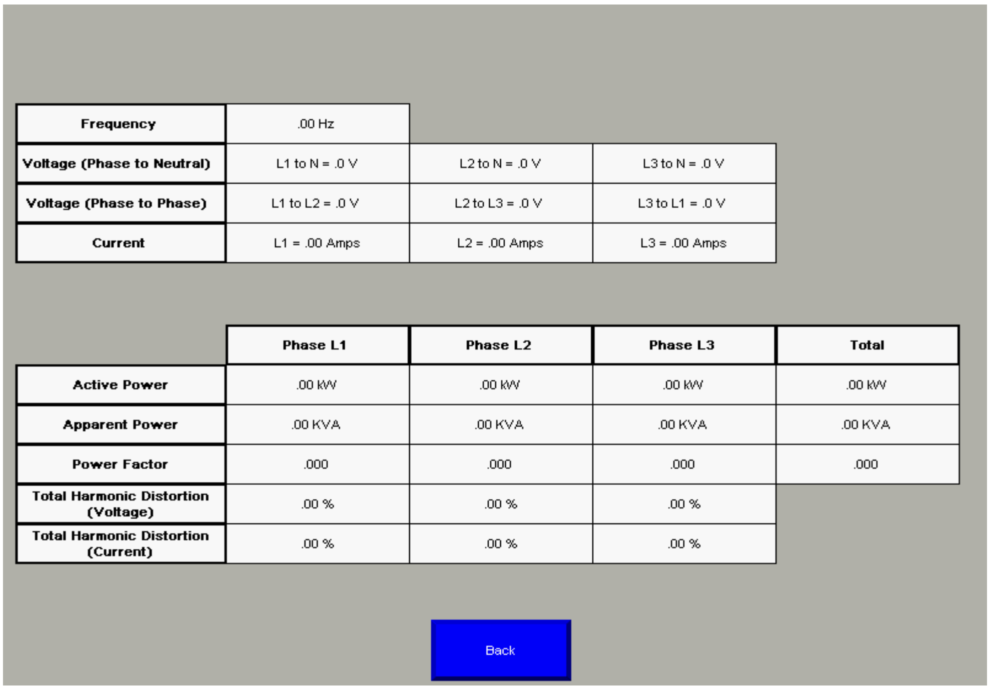
ENERGY MONITORING



Frequency	.00 Hz			
Voltage (Phase to Neutral)	L1 to N = .0 V	L2 to N = .0 V	L3 to N = .0 V	
Voltage (Phase to Phase)	L1 to L2 = .0 V	L2 to L3 = .0 V	L3 to L1 = .0 V	
Current	L1 = .00 Amps	L2 = .00 Amps	L3 = .00 Amps	

	Phase L1	Phase L2	Phase L3	Total
Active Power	.00 kW	.00 kW	.00 kW	.00 kW
Apparent Power	.00 KVA	.00 KVA	.00 KVA	.00 KVA
Power Factor	.000	.000	.000	.000
Total Harmonic Distortion (Voltage)	.00 %	.00 %	.00 %	
Total Harmonic Distortion (Current)	.00 %	.00 %	.00 %	

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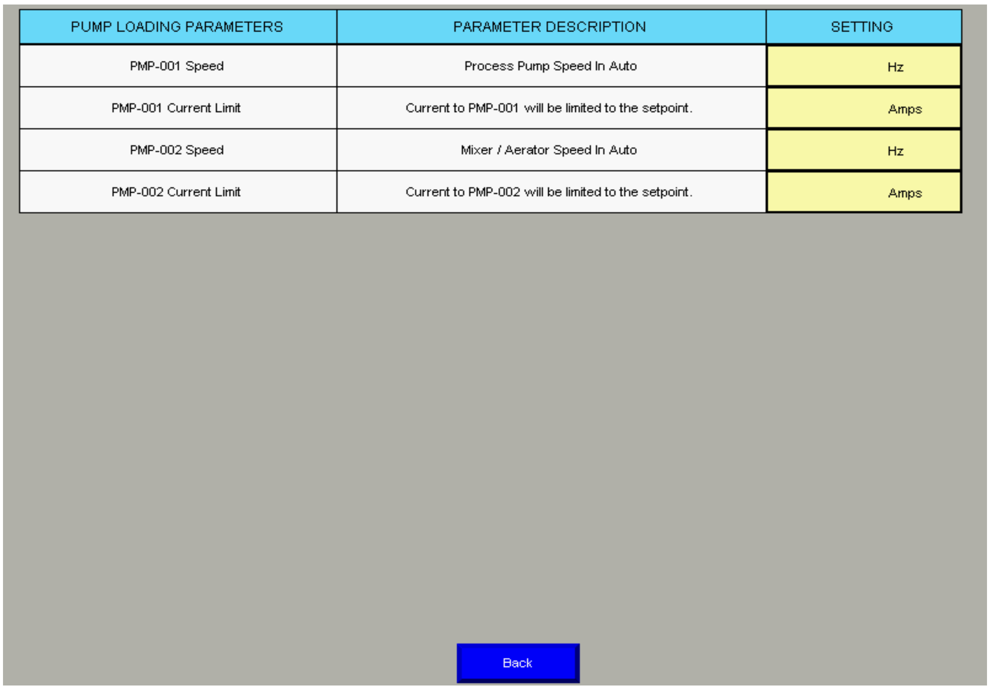
HMI RESET

ALARM PAGE

PUMP PARAMETERS



PUMP LOADING PARAMETERS	PARAMETER DESCRIPTION	SETTING
PMP-001 Speed	Process Pump Speed In Auto	Hz
PMP-001 Current Limit	Current to PMP-001 will be limited to the setpoint.	Amps
PMP-002 Speed	Mixer / Aerator Speed In Auto	Hz
PMP-002 Current Limit	Current to PMP-002 will be limited to the setpoint.	Amps

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DISSOLVED OXYGEN CALIBRATION

Dissolved Oxygen Value	.00 mg/l
Dissolved Oxygen Concentration	.00 %
Temperature	.00 oC
Slope	.00 %
Deviation Value	.00
Salinity	.00 uS/cm
Atmospheric Pressure	.00 bar

Dissolved Oxygen Probe Calibration

Step 1 - Remove probe from SBR.
Step 2 - Wipe probe clean.
Step 3 - Wait to measurement data to stabilise
Step 4 - Press Calibrate Button. Calibration will take approx 30 seconds.
Step 5 - Reinstate probe into SBR.

Calibrate Probe

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DATA LOGS PAGE 1 – FLOW LOGS

	Today	7 Day Average	Historical Data From 0 Days Ago
SBR Fill Volume	.00 m3	.00 m3	.00 m3
SBR Decant Purge Volume	.00 m3	.00 m3	.00 m3
SBR Pipework Purge Volume	.00 m3	.00 m3	.00 m3
SBR Decant Volume	.00 m3	.00 m3	.00 m3
Irrigation Volume	.00 m3	.00 m3	.00 m3
SBR Waste Volume	.00 m3	.00 m3	.00 m3

Home | Pump Logs

DATA LOGS PAGE 2 - PUMP LOGS

	Run Hours Total	Historical Data From 0 Days Ago	Flow Today	Historical Data From 0 Days Ago
PMP-001	0 Hours	0 Hours		
PMP-002	0 Hours	0 Hours		
PMP-003	0 Hours		0 ml	0 ml
PMP-004	0 Hours		0 ml	0 ml
PMP-005	0 Hours		0 ml	0 ml
PMP-006	0Hours		0 ml	0 ml

Home Flow Logs

DATA LOGS PAGE 3 - VALVE LOGS

	Cycles	Historical Data From 0 Days Ago
MOV-001		
MOV-002		
MOV-003		
MOV-004		
MOV-005		
MOV-006		
MOV-007		
MOV-008		
MOV-009		

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DATA LOGS PAGE 4 - CYCLE LOGS

	Cycles	Historical Data From 0 Days Ago
Standby Aeration	0	0
Standby Mixing	0	0
Extended Standby Aeration	0	0
Extended Standby Mixing	0	0
Reactor Refill	0	0
SBR Cycles	0	0
Balance Mixing	0	0
SBR Waste	0	0
Pipework Purge	0	0
Irrigation Recirculation	0	0
Irrigation Discharge	0	0
Critical Fault - Cat 1	0	0
Critical Fault - Cat 2	0	0

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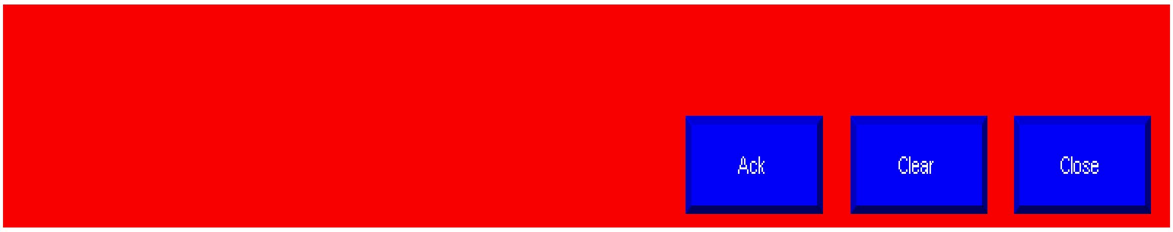
DAIGNOSTICS

ALARM BANNERS



Note: Only trained persons to operate the engineering pages of the HMI all changes must be reported back to RWTS engineering team for verification of process change. Failure to do so may result in poor effluent quality and risk of plant failure.

SYSTEM SOFTWARE PLATFORM AND PROGRAM

The platform basis is as follows:

Waste activated sludge management

One option provided – percentage (%) of daily inflow

Range = 0.00 to 10.00% with a default setting of 5.00% (two decimal places available)

The system measures the Batch volumes based on the flow meter log value for the previous days total throughput – and automatically calculates the volume eg: previous daily total volume of 1,400 litres and then multiplies it by the percentage target (using default for the example of 5 %) = 70 litres to waste per batch

The system will then allow one WAS function per day – on the first sequence after the Operator Nominated time of day – which is adjustable.

The WAS function will operate and measure the wasted volume of water in ltrs – which, once achieved, will stop the WAS function and allow the system to continue with the Refill Phase – which is the next step in the operating sequence.

The operator is then given a sludge age display – based on reactor volume with a range of 0 days up to 150 days – with a given calculated displayed value based on the following calculation:

Combined addition of wasted volume over the past Variable number of days is completed until it reaches or exceeds the nominated process volume in the system reactor – which is calculated as follows:

Liquid height (variable operator selection in Flow Balance Settings – default of 2.1 mtrs)

Reactor length – fixed at 9.5 mtrs
Reactor Width – fixed at 2.38 mtrs

Equation is a follows: (Variable H) x 9.5 x 2.38 =
2.1 x 9.5 x 2.38= 47,481 ltrs reactor capacity

The system continues to subtract days - 1,2 3, and so on until it equals or exceeds the capacity calculated – and then displays based on the number of days it took to complete the equation – with the display showing as

System Sludge Age in Days = “Result”

Waste sludge will be sent to Geobags held within a concrete bunded slab with recovery sump for supernatant – and dosed with polymer automatically during the wasting sequence. Geobags will be rotated once full to allow them to dehydrate, allowing them to reinstated and topped up on rotation until they are full and ready for disposal and replacement with new Geobags. The bags are a purpose designed 1 m3 holding volume fabricated bag using quality material – with lifting straps to allow removal and changeover with a small Telehandler of forklift.

OPERATING PLATFORM SETTINGS

Standby Operation

Aeration Standby = ? minutes 0-60 mins adjustable- default 30 minutes

Mixing Standby = ? minutes 0-60 mins adjustable- default 30 minutes

As soon as standby is started – a counter starts counting with the following outcome:

After min number of standby operation FOR (v) – default setting of **4** complete cycles (Aeration and Mixing = 1 cycle) the system enters Extended Standby Operation.

Extended Standby Operation

Extended Aeration Standby = ? minutes 0-60 mins adjustable - default 30 minutes

Extended Mixing Standby = ? minutes 0-60 mins adjustable- default 45 minutes

Flow Balance Settings

Min Flow Balance Height pump stop level = (V) 0.65 mtrs default adjustable
Flow Balance Pump Run Level = (V) 0.80 mtrs default adjustable
Flow balance tank Level system changes to normal operation mode from low load level = (V) 1.0 mtrs default adjustable (below this level the system operates under the low load settings, above it operates in normal settings)
Flow balance tank Level system changes to Peak operation mode from normal load level = (V) 1.5 mtrs default adjustable (below this level the system operates under the normal load settings, above it operates in Peak load settings)
Reactor Fill Height = (V) 2.15 mtrs default adjustable

Low Load Operation

Aeration Phase One Run Time = 0-120 minutes adjustable (default of 30 minutes)
Anoxic Phase One Run Time = 0-120 minutes adjustable (default of 60 minutes)
Aeration Phase Two Run Time = 0-120 minutes adjustable (default of 30 minutes)
Anoxic Phase Two Run Time = 0-120 minutes adjustable (default of 60 minutes)
Aeration Phase Three Run Time = 0-120 minutes adjustable (default of 30 minutes)
Anoxic Phase Three Run Time = 0-120 minutes adjustable (default of 60 minutes)
Aeration Phase Four Run Time = 0-120 minutes adjustable (default of 30 minutes)
Settle Time = 0- 90 minutes adjustable (default of 60 minutes)
Decanter Purge Time = 0 – 300 seconds adjustable (default of 60 seconds)
Decant Time Out setting if level not reached = = 0-60 minutes adjustable (default of 30 minutes)
Decant Height Setting = (V) 1.90 mtrs default adjustable

Normal Load Operation

Aeration Phase One Run Time = 0-120 minutes adjustable (default of 60 minutes)
Anoxic Phase One Run Time = 0-120 minutes adjustable (default of 45 minutes)
Aeration Phase Two Run Time = 0-120 minutes adjustable (default of 60 minutes)
Anoxic Phase Two Run Time = 0-120 minutes adjustable (default of 45 minutes)
Aeration Phase Three Run Time = 0-120 minutes adjustable (default of 30 minutes)
Settle Time = 0- 90 minutes adjustable (default of 60 minutes)
Decanter Purge Time = 0 – 300 seconds adjustable (default of 150 seconds)
Decant Time Out setting if level not reached = = 0-60 minutes adjustable (default of 30 minutes)
Decant Height Setting = (V) 1.80 mtrs default adjustable

Peak Load Operation

Aeration Phase One Run Time = 0-120 minutes adjustable (default of 60 minutes)
Anoxic Phase One Run Time = 0-120 minutes adjustable (default of 30 minutes)
Aeration Phase Two Run Time = 0-120 minutes adjustable (default of 45 minutes)
Anoxic Phase Two Run Time = 0-120 minutes adjustable (default of 30 minutes)
Aeration Phase Three Run Time = 0-120 minutes adjustable (default of 30 minutes)
Settle Time = 0- 90 minutes adjustable (default of 60 minutes)
Decanter Purge Time = 0 – 300 seconds adjustable (default of 150 seconds)
Decant Time Out setting if level not reached = = 0-60 minutes adjustable (default of 30 minutes)
Decant Height Setting = (V) 1.70 mtrs default adjustable

Decanter and SBR Fill Height Settings

Decant stop height setting – **All Load Operations** = 1.70 mtrs default (adjustable) (absolute minimum of 1.65)
SBR refill height setting - **All Load Operations** = 2.15 mtrs default (adjustable) (absolute maximum of 2.25) (0.45 mtrs operating range equates to 10,175 litres decant volume in total each cycle – and a realised net processed fluid volume of approximately 9,000 litres after purge and backwashing.

Chemical Dosing Settings

Chemical dosing requires a setup with the following:

Dosing Pump Setup Page: - **Operator to input the strength of each chemical and the size of the dosing pump used to dose that chemical based on the dosing pump nameplate!**

Chemical strength % = ??
Dosing Pump Size = ?? ltrs/hr

Alkalinity Support = **Operator Adjustable Dosing Target in mg/l of delivered Chemical**

Carbon Support = **Operator Adjustable Dosing Target in mg/l of delivered Chemical**

Nutrient Removal = **Operator Adjustable Dosing Target in mg/l of delivered Chemical**

Mathematics for the dosing equation is as follows:

Fluid Batch Volume **(eg: 10,500 ltrs)** x Dose rate in mg/l **(eg: 15mg/l) /1,000,000/ Strength of chemical as a decimal point (eg: 47% strength would be 0.45) = ltrs chemical x 1000 = mls chemical.**

The example equation would be as follows: 10,500 x 15/1,000,000/0.47 = 0.335106383 ltrs x 1000 = 335.106383 mls chemical required

Dosing is then calculated based on the following:

Dosing pump size in ltrs hr@ 100% speed setting **= (eg: 6.0)** ltrs/hr **= (6000)** mls/hr

mls/hr/3600 = mls second

mls chemical required / mls/sec = ?? seconds of dosing pump run time

The example equation would be as follows using our chemical required answer from the example above: 6000/3600 = 1.6666 mls per second (This is the dosing pumps delivery rate)

335.106383 (mls chemical required) / 1.6666 (mls of chemical delivered per second) = 201.0718726749 seconds – round up = **202 seconds of dosing pump runtime**. This runtime is adjusted automatically in the PLC software based on the volume of fluid processed each time – and takes into account the strength of chemical and size of dosing pump settings the operator has selected in the setup page – as well as the required dosing rate target in mg/l for the chemical that the operator has placed into the chemical dosing target setting for each chemical.

Chlorine Dosing = **Operator Adjustable Dosing Target in mg/l of delivered Chemical**

The chemicals are dosed based on the Volume of fluid decanted to Chlorine Contact from the reactor (Taking into account the reduction in fill volume due to losses from the Decant Purge Sequence) – directly proportional and taking into account the strength of the chemical as a %.

Chlorine Dosing – boost/Top Up Dose of chlorine = **Operator Adjustable Dosing Target in mg/l of Residual Chemical** to allow a maintenance dose of chlorine to be added to the chlorine contact tank and maintained at that level at all times.

Irrigation

Daily Discharge Volume and Active time control system

Maximum Hydraulic Discharge Volume per 24 hour day setpoint - a Supervisor Adjustable Volume to be set in Litres/24 hours allowable to Irrigation system – for example: 19,000 litres.

When the daily volume is reached – the system inhibits irrigation until the following day.

The start and stop times each day are adjustable by the site operator – eg: 6.30 am start and 6.00 pm stop – only irrigating during daylight hours.

Data Logging

30-day visual data log on HMI - System provides the following logged information:

- Total WAS Flow Daily
- Total Purge Flow Daily
- Sludge Age Daily
- Total Decanted Effluent
- Total Number of decant cycles
- 7 day average values for all of the above
- Total Treated Effluent Irrigated (discharged to irrigation)
- Hours in each operating mode
- Run Hour Meters for Dosing Pumps and main pumps.
- 7 day average values for all of the above

GENERAL TIPS ON GOOD SYSTEM OPERATIONAL PRACTICES

The following information is intended for an audience that already has previous experience and is qualified in Water and Waste Water Operations to a minimum level of Certificate 111 (WP 30215 or equivalent).
Please note: RWTS cannot provide the equivalent orientation/training skills needed to meet the Certificate 111 level of experience – this is a formal qualification via the National Training Platform in Australia.
RWTS can provide basic training and orientation for the intended system operator – and provide support through onsite visits, via phone and e-mail.
It is recommended that the system operator be already qualified to Certificate 111 **Water and** Waste Water Operations, or immediately be enrolled in the course.

Remote On-Site Sewage Treatment Systems - Upstream Management Requirements

Upstream Management Overview

Any location that requires an on-site stand-alone sewage treatment system will need to consider the overall site conditions and the requirements of the sewage treatment system to ensure the biological process operates as designed – and final treated effluent quality meets the site environmental license conditions and requirements.

Locations that don't have accommodation, laundry, kitchen and meals preparation occurring on site should consider the overall raw water quality characteristics and ensure the Sewage Treatment System is balanced chemically – providing the Biomass and individual Bacteria the correct balance of Nutrients, Food and Trace Elements for optimum operation. A qualified site operator with the correct tools and instruments will be able to make the required assessment and ensure the system is balanced – adding individual products to the system to ensure it is balanced and operating correctly.

For all "Traditional Remote Sites" that have on site accommodation, laundry, kitchen and in some cases potable water treatment waste water and would be considered a small city where all wastewater generated has to be treated and disposed of on-site – the following considerations should be given to the management of the site and how waste streams are controlled – ensuring optimum conditions are provided for the sewage treatment facility – allowing environmental compliance and stable system operation.

Cleaning and Bleaching Liquids

Harsh cleaning chemicals have the "potential" to impact greatly on sewage treatment systems – but if used correctly will not impact the systems operation.

Bleaches/Oxidising Agents – are used for disinfection, whitening, removal of moulds and scum and are a common product used in traditional domestic and commercial living environments. Conservative use of these products will provide the required cleaning outcome – with little to no impact on your sewage treatment facility.

The key to ensuring the impact is minimal is to avoid large left over volumes of liquid solutions (such as mop buckets full of bleach) being dumped down the drain – which end up in the sewage treatment system – the dumping of "left over cleaning chemicals" to sewer should be avoided at all times. It is best to spread the left over products over a suitable paved (concrete or bitumen) area and allow them to evaporate.

The same principal is applied when cleaning commercial kitchens – with cooking equipment usually cleaned with a spray on foam product – however larger material is generally cleaned by physical removal first and the overall strategy should not involve large amounts of cleaning products being wasted – ending up down the drain and on their way to the sewage treatment facility.

Caustic and Acidic Cleaners

Typically used in the kitchen environment – these cleaners, if used correctly are safe and will not impact on the sewage treatment facility.

Your cleaning product supplier should be consulted and notified about the site operation and management requirements (Running an on-site Sewage Treatment System) – with most major suppliers now providing products that are more suited to this type of operation.

Again – care should be taken to avoid large amounts of additional unused chemical entering the sewer network – as these "shock doses" in one large hit can provide unbalanced conditions and result in a failure of the sewage treatment system biomass – in some cases the system will take weeks to recover in the event the biomass suffers "die back" as a result of the shock dose received.

FATS OILS AND GREASE (FOG) and Grease Trap Management

One of the largest problems in any sewage treatment system is FOG carry over – resulting in compliance failure most of the time, and at a minimum – expensive repairs and system recovery costs.

Typically – THREE key contributors lead to FOG breakthrough into the sewage treatment network – and are outlined below:

Grease Trap Sizing is Inadequate – in a least 60% of all cases tested – grease trap sizing is a major contributor to FOG breakthrough. A Grease Trap that is too small will result in the waste water temperature remaining too high all the way through the unit – and as a result the fats oil and grease stay in a dissolved state due to the water still being too hot.

Grease traps rely on “cooling” of the waste stream through a labyrinth path – and as the water cools below 40 degrees Celsius through the trap – the fats oil and grease “congeal” back into a solid form and float on the surface of the retention chamber in each compartment of the unit. It is quite easy to determine if a grease trap is being overloaded – as they usually have three compartments – with the first compartment designed to complete most of the removal of FOG, the second compartment to catch the remainder – and the third is an insurance only and should catch minimal material. During inspection of a grease trap the depth of material in each compartment can be checked to determine how the unit is performing.

In addition – temperature testing of the fluid in each compartment during kitchen peak periods (cooking and dishwashers active) will also provide live data as to how well the unit is performing.

If the Grease Trap is undersized – the FOG will continually break through and impact the sewage treatment system – causing huge issues with the system operation, high costs continually due to pump outs and unplanned maintenance and make the system painful in all aspects to own and manage.

This is a regular problem that is almost always overlooked or considered “trivial” when the site planning stages are considered.

Grease Trap is Inadequately Maintained

Even if the grease trap is sized correctly – poor management of the unit will result in the same conditions as having a unit that is undersized.

The reason for this is that as material is removed and floated off into the top of each chamber – the available room for water is reduced – effectively the system removes material and stores it from the top down. As the unit continues to get full of removed material – the available water for temperature reduction is reduced.

If allowed to get too full of material – eventually the unit will foul all three compartments and allow FOG breakthrough to occur – and carry over into the sewage treatment system.

Regular inspection of the grease trap should be completed – usually every two days on a new site to gain an understanding of how rapidly the unit fills up with material – and then once a baseline is established every four to five days – usually completed by the site waste water treatment plant operator and recorded on the daily log sheet for the site records.

On average – a correctly sized grease trap will require pump out once every four weeks – however this can also be as low as every 7 days depending on site kitchen staff behaviour – type of food being cooked and the clean-up methodology used in day to day kitchen practices.

Kitchen Waste Management

It has been noted that in a lot of cases when inspecting site systems and problems with FOG carry over that although the grease trap is adequately sized – the site cannot obtain more than 7 days between pump outs – and the question is regularly asked – "why?"

The contributor – in most cases that have been investigated is poor kitchen management practices.

Poor training of kitchen staff – lacking procedures on how to manage clean up and waste oil recovery, grittle clean-up resulting in scraping of all waste being dropped into floor wastes and generally poor ongoing behaviour/thinking of staff due to lack of time or a "lazy" approach. Once its down the drain the evidence is gone has been the mentality found in a lot cases.

This however is very untrue – as the above editorial has explained.

It is recommended that the nominated facility manager and the kitchen supervisors have a solid management system in place – with clear requirements that are "best industry practice" to ensure that all recoverable fats, oil and grease are recovered and placed into recovery storage drums for collection and removal from site – therefore reducing the pump out requirements for the grease trap and the high costs involved in doing this more regularly than should be normally required.

Ultimately – it everyone's responsibility to ensure the upstream management is completed in a manner that protects the downstream system from operating problems, damage and unplanned maintenance.

The final determination on effectiveness of upstream management should be provided by weekly feedback during team meetings via the nominated Qualified Water and Waste Water Treatment Plant Operator (Minimum Certificate Three Qualification). Investigations can be completed by means of independent site Auditing – completed by a representative of the waste water system manufacturer. Documented findings with photographic evidence and a written report provided, outlining the site operating conditions. It is advisable to complete at least one independent audit every six months – or quarterly, in the event that the site is experiencing ongoing operational challenges – each audit is also an opportunity to provide additional training to the system operator.

In addition – General housekeeping and maintenance should be completed to **minimise water leaks on site** – as these cost money to manage due to increased hydraulic load on wastewater systems not to mention the cost of the water in the first place.

Good Practice System Management Tips

- Ensure pump station inspections are completed – and debris periodically removed via pump truck – this will ensure pump reliability is maintained and reactive maintenance is minimized.
- Ensure the inlet screen on the STP is kept clean and free of fouling – adjust the nozzle wash system interval if needed to reflect a screen clean regime that is suitable for site conditions. Manually clean any major fouling if required – using safe work practices and lock out methodology to complete the task.
- It is noted in the above specifications that the MLSS level is designed to operate at 3000 mg/l at bottom decant level (system in standby). This equates to a full operational system that is running a designated batch sequence (full operating height) as an MLSS of 2500 mg/l – which is the likely state the system will be in when testing of settle ability and MLSS samples are being taken from the sample points.
- Settle ability testing using a "settle-ometer" should be completed multiple times per week to establish biomass behavior and system stability. A system that is running at optimum efficiency and has healthy biomass behavior will provide the following results as a rule of thumb:

A settleability test should be completed over a 30 minute period – recording the value of the sludge settling rate at the 5 minute, 10 minute, 20 minute and 30 minute intervals.
The majority of the biomass in the sample taken should coagulate and settle within 5 minutes of the sample being taken and gently mixed for 10 seconds.
The following 25 minutes will see only a minor increase in sludge compression (possibly another 5 % compression) with the final result recorded at 30 minutes.
If being managed correctly, with a healthy biomass – the settled sludge volume should be approximately 30% of the total cylinder height – and the fluid above the sludge should be extremely clean and clear – we refer to this clear fluid as the supernatant.

- If the system has a biomass behavior that would typically be deemed in the lazy or in the poor category – the individual results will see a much slower selling rate, and may also see less compression in the final result.
- A note of warning – if the settling rate is still fast – with visible compression nice and tight (not fluffy flocs floating around) – and the final result provides a settled result that is considerably higher than 30 % - we suggest that the MLSS WAS settings may need to be increased and that the actual operating MLSS is higher than it should be.
- If in doubt, or if in need of establishing a baseline value for MLSS – take a sample and send it to a suitable laboratory for MLSS testing via the bake out method – and complete a settle ability test at exactly the same time as the lab sample are taken from the system – thus allowing a settleability result as a reference to the MLSS result from the LAB once received.

Nutrient results – although possibly not required for the site Environmental compliance requirements – are necessary to trend the system biomass performance and overall system health. The following individual items should be tested regularly each week to ensure the system behavior is stable and within design:
Ammonia mg/l
Nitrate mg/l
Phosphorous mg/l
Alkalinity mg/l
Ph (Ph units)
Free chlorine mg/l

Turbidity (FNU)
The above results will allow a system performance trend to be developed, showing nitrification, denitrification, clarification and biomass performance.
In the event that the system is difficult to manage biologically, the above results should be tested on the raw influent, along with BOD and FOG (Total Fats Oil and Grease) - to determine the quality of fluid the system is treating is within the design requirements.

- Complete regular inspections of the bioreactor (usually done when inspecting the inlet screen) to ensure that elevated levels of crusting and debris are not forming on the surface of the fluid in the reactor. In the levels are deemed too high, it is advised to use a vacuum truck to remove the scum and crust only from the system. High levels of crust build up typically occur when higher than normal levels of FOG (Fats Oils and Grease) are entering the system – or the MLSS operating Level is higher than normal – which will require manual wasting of MLSS to the WAS tank to correct it.
- Sucrose dosing is a carbon based BOD supplement/ additive used to balance the AMMONIA:BOD ratio on the system and enable better complete Nitrification/Denitrification performance by the system. In addition, the Sucrose will support the system in lower inflow periods of operation by providing some supportive carbon as food for the biomass – noting that this will only support the system to a point where the nutrient imbalance will become problematic and result in a hard to manage biomass – RWTS can provide support and advice on this if the situation arises.
- Ensure the chemicals for the system are topped up regularly and do not “run out” as this will likely result in non-compliant final effluent quality and a hard to manage system. Keep a record of chemical usage to enable trending – and make sure the system is using consistent amounts in relation to the volume of fluid being treated.
- Ensure the daily log sheet for the system is being completed to maintain a record of system operation – this is important as the information will be needed by the State regulatory body (DWER) for ongoing reporting .

EFFLUENT DISPOSAL CALCULATION DETAILS AND DESIGN METHODOLOGY

The total treated wastewater volume will be 250,000 litres per day.

A total volume of Reverse Osmosis Reject at 120,000 litres per day will be blended with the treated wastewater for the sewage treatment system.

Irrigating Treated Effluent Plus Reverse Osmosis Reject as a Blended Effluent Stream

EcoFarmer 1250 SNR Sewage Treatment System Only Data

The effluent quality characteristics of the standard system are secondary effluent with the following characteristics:

- BOD < 20 mg/l
- SS < 30 mg/l
- TN < 20 mg/l
- TP < 7.5 mg/l
- Faecal Coliform < 1000 cfu/100ml
- Total Coliform < 1000 cfu/100ml
- E/Coli < 1000 cfu/100ml

Using peak flow numbers – the site will be processing 91,250 m3 per annum (250 kl/day)

Using average numbers – the site will be processing 73,000 m3 per annum (200 kl/day)

Peak Flow numbers for nutrients (STP Effluent only) therefore become:

TN - 20mg/l x 91,250 m3 = 1825.00 kgs

TP – 7.5 mg/l x 91,250 m3 = 684.38 kgs

1825kgs /480 kgs TN allowance per ha/annum = 3.80 ha minimum required.

685kgs /120 kgs TP allowance per ha/annum = 5.70 ha minimum required.

Total maximum Potable water required per day (equating to maximum raw sewage) = 250,000 litres

Reverse Osmosis Recovery – absolute worst case by design of 67.5%

Therefore the total amount of water we will need to deal with is raw water supply to the RO System of 250/0.675 = 370,000 litres peak design.

The raw bore water ranges on average between 900 us/cm and 1500 us/cm electrical conductivity

Obviously drier periods and seasonal influences can see this value rise – in some cases for short periods of time closer to 2000 us/cm.

Electrical Conductivity of the **final combined effluent stream** is designed to within an average expected of 1600 - 2800 us/cm for final combined treated effluent.

Maxim Target Application rate = 3.5 mm per day – 370,000/3.5 = 105,714 m2 or 10.60 HA

Peak Load Irrigation Design Methodology

The following detail is the new systems **maximum design basis detail:**

System maximum hydraulic flow rate = 250,000 litres per day – plus RO Reject (@ 67.5 % recovery) = Total of 3**70,000 litres per day**

System Maximum Phosphorous output = 7.5 mg/l or **685.0 kg per annum**

System maximum Total Nitrogen Output = 20 mg/l or **1825.0 kgs per annum**

Maximum allowable Phosphorous loading per HA for location = 120 kg

Maximum allowable Nitrogen loading per HA for location = 480 kg

Effluent Disposal Area Nominated = 10.60 ha

Maximum Actual Hydraulic Loading Rate per m2 per Day – 3.50 mm
Maximum Actual Phosphorous application rate per HA = 63.43 kg year
Maximum Actual Nitrogen Loading Rate per HA = 169.00 kg year
Maximum EC of Treated Effluent 2800 us/cm

Normal Average Load Design Methodology

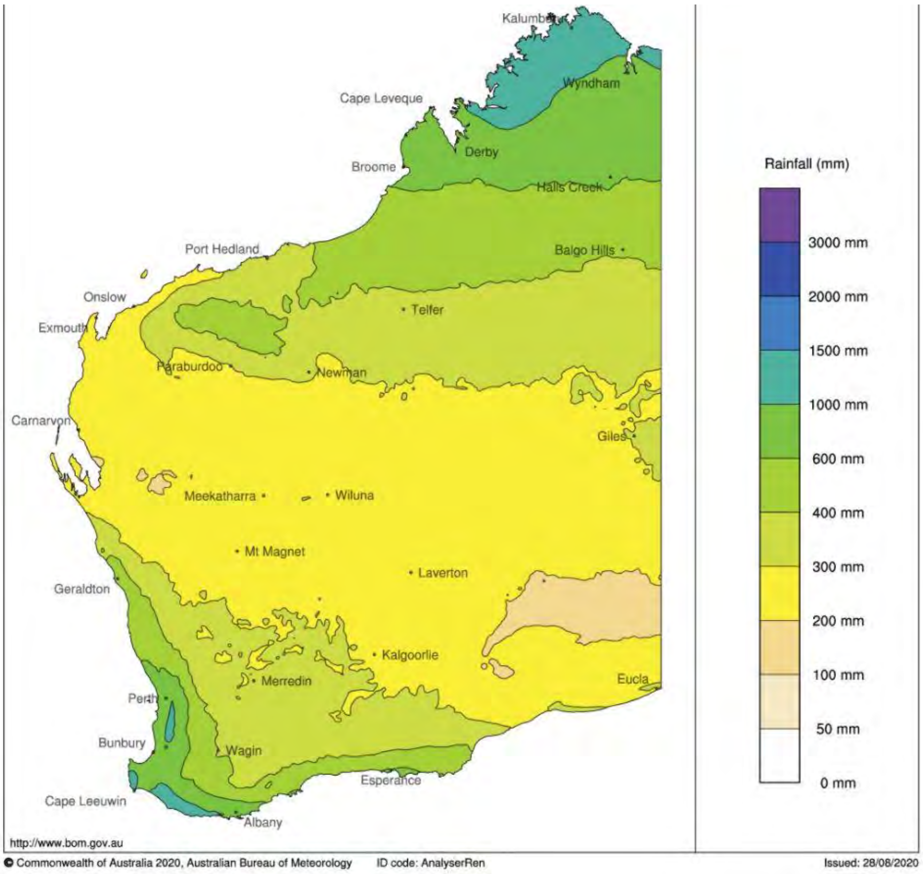
The following detail is the systems **normal/average site load expected due to the site accommodation capacity and nominated occupancy potential:**

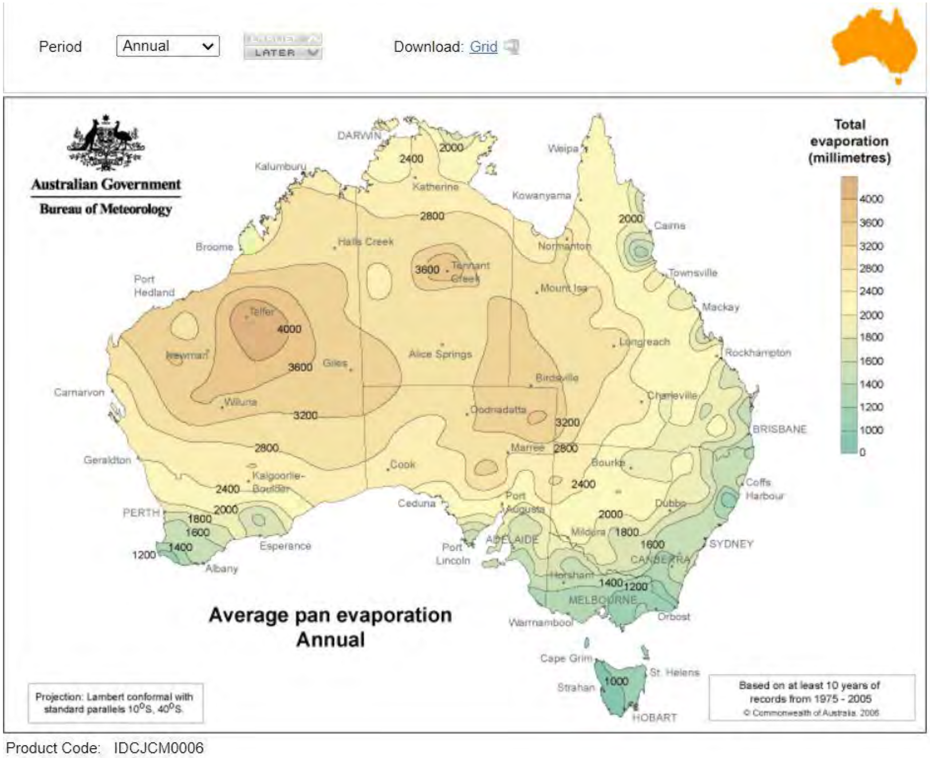
Number of persons on site Maximum (EP 800 @ 200 l/pp/pd average usage

System hydraulic flow rate = 160,000 litres per day – plus RO Reject (@ 70% recovery for normal design) = Total of **230,000 litres per day**

Average Actual Hydraulic Loading Rate per m2 per Day – 2.17 mm
Average Actual Phosphorous application rate per HA = 40.60 kg year
Average Actual Nitrogen Loading Rate per HA = 108.15 kg year
Average EC of Treated Effluent > 1200 us/cm & < 2000 us/cm

The Point Potential for Evapotranspiration at the nominated site is approximately 3200 mm per annum, similarly – Evaporation rates for the region are also 3200 mm per annum with the maximum irrigation rate at 3.50 mm per day or 1278.00 mm per annum it is clear that the actual migration of effluent water into the sub soil structure will be minimal and provide limited benefit to the vegetation growing in the nominated effluent disposal application area of 108,000 square metres.




Period
Annual
Download: Grid
Australian Government
Bureau of Meteorology
Total evaporation (millimetres)
4000
3600
3200
2800
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2000
1800
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1400
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1000
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Average pan evaporation
Annual
Projection: Lambert conformal with standard parallels 10°S, 40°S.
Based on at least 10 years of records from 1975 - 2005
© Commonwealth of Australia 2006
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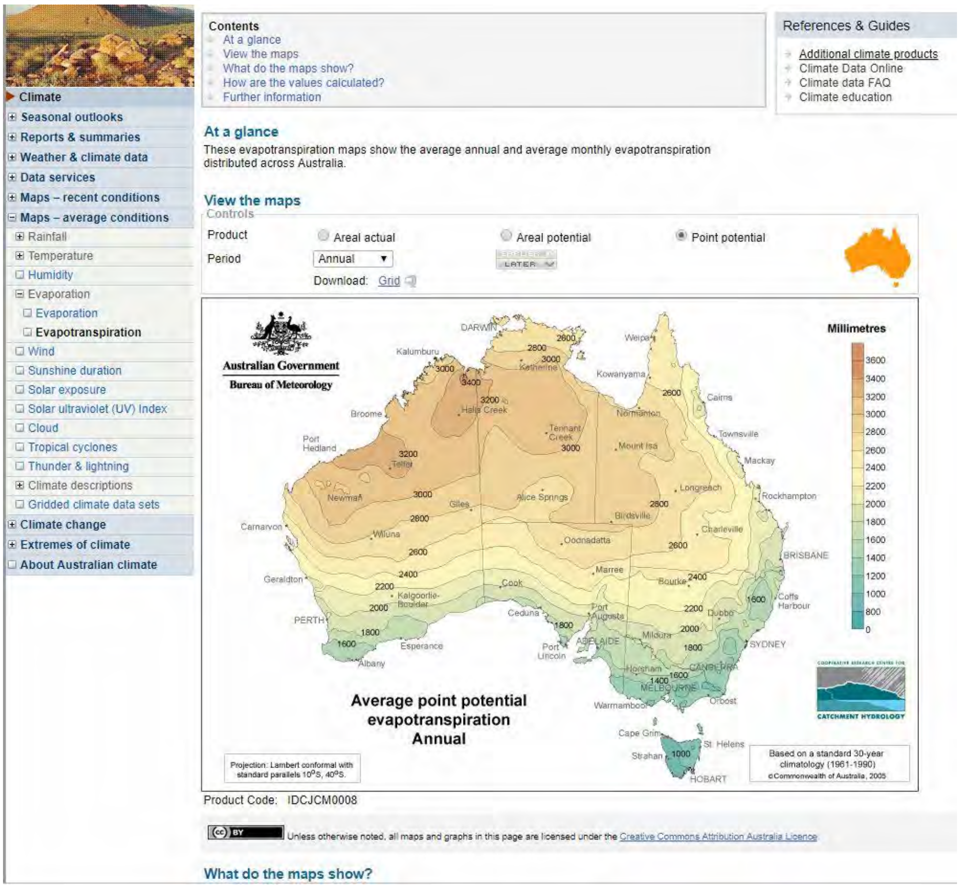
Climate
Seasonal outlooks
Reports & summaries
Weather & climate data
Data services
Maps – recent conditions
Maps – average conditions
Rainfall
Temperature
Humidity
Evaporation
Evaporation
Evapotranspiration
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Climate Data Online
Climate data FAQ
Climate education
At a glance
These evapotranspiration maps show the average annual and average monthly evapotranspiration distributed across Australia.
View the maps
Controls
Product
Areal actual
Areal potential
Point potential
Period
Annual
Download: Grid
Australian Government
Bureau of Meteorology
Millimetres
Average point potential evapotranspiration
Annual
Projection: Lambert conformal with standard parallels 10°S, 40°S.
Based on a standard 30-year climatology (1961-1990)
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CATCHMENT HYDROLOGY
Product Code: IDCJCM0008
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What do the maps show?

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	39.0	37.2	35.8	31.6	26.0	22.4	22.3	24.8	29.2	33.6	36.6	38.3	31.4	31	1965 1997
Mean minimum temperature (°C)	25.3	24.4	22.4	18.4	13.0	9.6	8.1	10.1	13.7	17.9	21.4	23.9	17.3	31	1965 1997
Rainfall															
Mean rainfall (mm)	51.4	80.1	38.6	25.3	23.2	25.0	12.6	10.5	4.1	3.9	9.8	27.0	317.8	32	1965 2003
Decile 5 (median) rainfall (mm)	35.8	57.5	23.9	12.0	12.5	9.8	4.1	2.6	0.0	0.7	5.0	16.1	307.8	37	1965 2003
Mean number of days of rain ≥ 1 mm	4.5	5.0	3.3	2.6	2.6	2.3	1.7	1.4	0.6	0.8	1.5	3.2	29.5	34	1965 2003
Other daily elements															
Mean daily sunshine (hours)															
Mean number of clear days	9.2	7.8	11.5	11.6	14.4	14.6	21.0	21.7	22.4	19.6	15.4	11.5	180.7	31	1965 1998
Mean number of cloudy days	6.5	7.8	6.0	6.9	7.1	7.3	4.4	3.0	1.6	1.5	2.7	4.6	59.4	31	1965 1998
9 am conditions															
Mean 9am temperature (°C)	31.7	29.7	28.3	24.4	18.9	15.2	14.2	16.6	21.2	25.6	29.0	31.1	23.8	29	1965 1997
Mean 9am relative humidity (%)	36	42	37	41	49	55	49	42	31	25	24	31	39	20	1973 1997
Mean 9am wind speed (km/h)	10.5	10.4	9.1	7.7	6.8	6.9	7.5	8.2	10.4	11.2	10.5	10.5	9.1	30	1965 1998
9am wind speed vs direction plot	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF		
3 pm conditions															
Mean 3pm temperature (°C)	37.6	35.9	34.6	30.7	25.3	21.6	21.5	24.0	28.4	32.5	35.3	36.9	30.4	29	1965 1997
Mean 3pm relative humidity (%)	23	27	23	26	31	34	27	24	17	14	14	19	23	20	1973 1997
Mean 3pm wind speed (km/h)	10.1	10.7	8.8	7.7	7.9	8.3	9.3	9.2	10.2	11.0	10.2	9.6	9.4	30	1965 1998
3pm wind speed vs direction plot	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF	PDF		

The existing irrigation system will ensure even distribution is applied across the 106,000 square metre application area.

Final summary of Rainfall, Evaporation Potential and effluent application

- The number of average rain days with rainfall greater than 1.0 mm/day is 29.5 days
- The total average rainfall per annum for Newman is 317.80 mm
- The **Short-term Maximum design** for application rate of Effluent is 3.50 mm/day at Peak Maximum loading
- The average design for application rate of Effluent is 2.17 mm/day at Normal Design loading
- The Annual Average application rate of effluent is potentially – 1278.00 mm per year, operating at average load 365 days per annum.
- The evaporation rate potential for the location is 3200.00 mm per annum – or effectively over double the expected application rate for the location.
- The maximum humidity level for the area averages at no more than 34% - resulting on consistently high evaporation potential for 90% of the year.
- The Average Combined Effluent and rainfall application is 1405.50 mm per annum – resulting in an evaporation deficit of over 1600.00 mm per annum for the site.

The system has an operator adjustable start and stop time for irrigation available (7.00 am to 6.00 pm for example) as well as an adjustable run time and delay off time to enable the operator to correctly cycle the system to improve evaporation loss and reduce load on the nominated area. This provides system flexibility and allows the operator to tune the system to site conditions.

In summary – the Effluent Disposal System provides the following outcomes:

- Efficient Application with good distribution uniformity
- Capitalises on evaporation every day – minimising the impact on the receiving environment
- Easy to operate and maintain – low operator input needed
- Low application rates based on utilising evaporation assistance
- Fit for purpose design that is robust and reliable.

Project Manning Schedule

There is no current fixed manning schedule for the project moving forward – however a peak occupation period of months is expected to occur during the rise and reduction of workforce flow for the project.

The overall nominal average per annum for site occupancy is expected to be 80%, or 640 persons.

SERVICING

Daily Checklist

STP & WTP Daily Checklist

	Item	Yes	No
1	Record System Data Log readings		
2	Visually inspect surrounding area for leaks & valving position, report on findings		
3	Inspect plants for visual alarms report & comment on such events		
4	Record tank levels		
5	EXAMPLE: balance tanks ½ full at time of inspection. This will allow for habitual timing, if the tank levels stray form this point dramatically, we may possibly avoid a crisis through the peak periods of the day. Inspect the process Aeration for its correct operation		
6	Record the PLC display For example: At time of inspection the PLC stated the plant was in settling		

7	Inspect the Soda Ash dosing tank fill as required		
7	Inspect the Sucrose dosing tank fill as required		
8	Inspect the Alum dosing tank fill as required		
9	Inspect the chlorine dosing tank fill as required		
10	Inspect the levels within the final effluent tanks and record		
11	Inspect irrigation pump set for leaks and valving position		
12	Walk irrigation field and isolate and reinstate areas as needed		
13	Record chemical consumption on site and re order as required		
14	Record usage of chemical stocks on site remaining		
15	Record pressures on Recirculation/ Irrigation Pump		
16	Sample effluent and test for free chlorine level and nutrients		

WEEKLY STP SERVICING CHECKLIST

In addition to Daily Checklist

	Item	Yes	No	Comment
System monitoring and recording				
1	Record and sample MLSS within aeration sequence of SBR chamber			
2	Record DO value on aeration sequence adjust times if necessary			
3	Record DO value on mixing sequence adjust times if necessary			
4	Record pH value within SBR chamber			
5	Record pH value in final treated water			
6	Record DO value in final treated water			
7	Record residual chlorine in final treated water			
8	Complete final effluent samples as per EA conditions, pack and send to lab for further testing			
System mechanical checks				

WAS tank				
9	Check operation – arrange removal of waste activated sludge if required			
10	Measure and record sludge and crust levels advise client of pump out			
11	Check all tanks and external connections for leaks			
Balance tank				
12	Activate balance pump and view pump operation			
13	Check pump operation and flow value through flow meter			
14	Record and analyse meter data			
15	Open and clear control valves of debris			
16	Check operation of the non-return valves			
17	Activate high level switch and view alarm			
SBR and Plant Room				
19	Check operation of aeration and mixing pump			
20	Check operation of Waste activation sludge valve and advance or retard timing of sludge wasting pending on MLSS test			
21	Check automatic valves for sequencing and operation			
22	Check decant sequencing and operation			
23	Check decant line for debris and fouling			
24	Check all external connections are free of leaks to and from container			
25	Check HMI for alarms page and record if available			
26	Check timers in HMI for sequencing timing adjust if necessary			
27	Check manual and automated operation of the chlorine disinfection unit, test flow and clean if required			
28	Check manual and automated operation of the Alum coagulation unit, test flow and clean if required			

29	Check manual and automated operation of the sucrose solution unit, test flow and clean if required			
30	Check manual and automated operation of the Soda Ash solution unit, test flow and clean if required			
31	Check all chemical tank levels and fill as required			
32	Spray hatch hinges with lubricating spray			
33	Clean chemical bund in control room container			
34	Inspect ladder and hand rail system if installed			
35	Complete site written report and communicate findings with site representative			
Final effluent				
36	Check all equipment relating to Final treated effluent storage and disposal			
Pump stations				
37	Skim off all fats and grease that may have accumulated via pump truck if required			
38	Inspect control board for integrity			
39	Clean and test for automation the level activation switches			
40	Check non-return valve operation			
41	Open and flush all valving to remove debris			
42	Manually run pumps and test loading by qualified electrician			
43	Reseal cast lid with white grease			
44	Inspect inlet pipe from camp and seal around well			
Irrigation field				
45	Test irrigation pump operation			
46	Walk irrigation field and check for ponding			
47	Walk irrigation field and check for broken sprinkler heads and pipework repair as required			
48	Check all timers through control system and adjust if required			

49	Check storage tanks for integrity and report			
50	Check irrigation rate to land on an extended run period and ensure no ponding occurs on the run times set in the control system			
51	Check filters/ strainers and clean if required			

DESIGN LIFE AND BIOLOGICAL PROCESS/TREATED EFFLUENT QUALITY CERTIFICATION

Remote Water Treatment Services – engaged by Rio Tinto for the HD1 Accommodation Village Project to provide water and wastewater equipment, installation and ongoing operational support and maintenance hereby provide the following statements:

RWTS have completed a full design review of the Ecofarmer 1250 sewage Treatment System being installed at the Rio Tinto HD1 Accommodation Village Project – Via Newman WA and hereby confirm the system will easily perform to the design calculations stated in the supporting documentation provided above.

The system has been designed and fabricated in a transportable/ semi-permanent or permanent installation arrangement to provide continuous service with the required maintenance for a 25 year life expectancy. The system is independently structurally certified by a Registered Practicing engineer in Australia. The biological Process for the Ecofarmer WWTP has also been independently engineer certified by Ganden Consulting who provide registered engineering services throughout Australia.

As the entire system core structure is- at its thinnest point, 6mm thickness carbon steel, protected by a corrosion inhibitor coating designed specifically for water and waste water treatment applications – it is crucial that the integrity of this corrosion inhibitor coating be maintained.

Although the system design has an allowance for corrosion to occur, whilst maintaining structural integrity – any coating damage will result in accelerated deterioration of the steel structure – and premature failure of the core system structure.

Remote Water Treatment Services recommends the following be carried out: Routine general inspection of the overall system structure is to be carried out (daily, weekly, monthly subject to the system owner's schedule) with the structural condition of the system core to be inspected. This would typically be done by the responsible person operating the system process and ensuring the system is compliant with environmental conditions for effluent quality and overall operation.

In addition – it is recommended **the system have a Bi-annual "Major Inspection" completed** – where the core structure and process area are inspected for coating integrity and any potential corrosion spots that have taken hold within the system core. Any coating damage or corrosion should be repaired as soon as possible to reduce the damage potential to the system core. Although this is not considered mandatory for the ongoing reliability of the system, this procedure will help extend the life of the system and minimise potential failure points due to poor corrosion management.

In order to complete the major inspection on the system – the process area will need to be emptied and all of the biomass removed from the system to expose the internal system coating. The inspection should cover 100% of the internal and external core of the system to ensure the coating integrity is maintained.

Any corrosion areas that are left unmanaged will result in a life expectancy reduction on the system core structure.
With correct maintenance and coating management the system core structure service life will exceed 25 years.

For any queries or assistance required in managing the Ecofarmer 250 Sewage Treatment System please contact the Remote Water Treatment office in Tingalpa Qld.

[redacted]

Water and Waste Water Engineering/Technical Design and Operations Support
Remote Water Treatment Services – Brisbane Office
EXECUTION

Signed signatory on behalf of the company Remote Water Treatment Services Pty Ltd.

Director

Name: [redacted]

Signature:

Dated: 6th September, 2024

Position: Managing Director

QBCC license #: 1286708

Signatory Process and Technical Design Lead

Name: [redacted]

Signature:

Dated: 6th September, 2024

Position: Senior Design Lead Process and Water