Article 12 (Part 3) Section D.2: Operation & Section F: Treatment, Abatement & Control

Note: All drawings referred to in this section of the response are included at the rear of this document, in the order in which they are referred to. However, drawings or attachments that may have been already referenced in Part 2 of the response, are included in Part 2 and not duplicated in this section

(a) For the Wastewater Treatment process, provide the following details:

(i) For each process step provide details of capacity and design criteria

The process steps for the wastewater treatment process are as follows (again, it should be noted that it is only the sludge treatment works (post Picket Fence Thickener) that is the licenceable activity and all other information given is for the purpose of providing a comprehensive overview of the overall WWTP operations):

Primary Treatment

- Flow (sewage) arrives to Works inlet building
- Sewage is screened automatic and manually raked screens prior to passing to grit traps
- Sewage passes to a distribution chamber where the flow is split between the two primary settlement tanks (PST)
- During storm conditions excess flow passes to the two storm tanks

Secondary Treatment

- Settled sewage flows to a selector tank and the Inclined Bubble Aeration (IBA) process
- Final settlement tanks separate the activated sludge flocs from the mixed liquor to produce settled effluent
- Settled effluent passes to the final effluent (FE) Sampling and Washwater Pumping Station prior to passing to outfall.
- Activated Sludge (RAS) is removed from the base of the Final Settlement Tanks (FST) and returned to the Selector Tank for mixing with the settled primary sewage
- This is introduced into the aeration tanks

Sludge Treatment

- The total sludge treated at the site consists of indigenous primary sludge from the Primary Settlement Tanks (PSTs) and surplus activated sludge from the Gravity Belt Thickener
- Primary sludge is thickened in a picket fence thickener and transferred to the sludge blending tank
- Activated sludge is thickened in the sludge building by a gravity belt thickener and transferred to the sludge blending tank
- Blended total sludge is pumped to the pasteurisation system
- Sludge is fed to the anaerobic digesters via the heat exchanger
- Sludge is transferred to sludge holding tanks
- Biogas generated within the digester is stored in a gas and is utilised to provide fuel to the boilers to heat the raw sludge

- The digested sludge flows by gravity to a digested sludge tank and pumped to sludge dewatering belt press streams
- Dewatered sludge cake is loaded into trailers/containers prior to being removed from site

Flow diagrams of the overall WWTP processes are shown in Drawings C1197-1001 and C1197-1005 and flow diagrams of the sludge treatment processes are shown in Drawings C1197-1002 and C1197-1006, as included with this response.

The capacity and design criteria are shown in the following Attachments for the sludge treatment part of the WWTP and for the non-licenceable section of the WWTP, for completeness:

Attachment C1197-8402	Screening and grit traps
Attachment C1197-8403	Primary Settlement Tank Design
Attachment C1197-8404	Activated Sludge Design (detailing the influent to the primary works and selector tank and IBA process)
Attachment C1197-8407	Settled Activated Sludge Production
Attachment C1197-8408	Picket Fence Thickener Design
Attachment C1197-8409	Gravity Belt Thickener Design
Attachment C1197-8420	Pasteuriser Design
Attachment C1197-8416	Heat Exchanger Design
Attachment C1197-8412/15	Anaerobic Digester Design (Sizing & Heat Loss)
Attachment C1197-8413/18	Biogas Equipment and Production
Attachment C1197-8410	Dewatering Belt Presses
Attachment C1197-8422	Liquor Řeturn Sump
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(ii) Provide details on influent monitoring, composite samplers and intreatment monitoring required for management of the plant

The following areas/items of plant will be monitored (both flow and sampling unless shown otherwise) during the operation of the WWTP:

Primary Treatment

- Inlet channel & inlet works raw sewage, screenings, grit (see Drawing C1197-2000)
- Inlet channel & post grit channel screened sewage (see Drawing C1197-2000)

Secondary Treatment

- PST to Aeration chamber settled sewage (see Drawing C1197-2006)
- Pre final effluent chamber & final effluent chamber secondary effluent (see Drawing C1197-2020)
- Final effluent chamber final effluent (see Drawing C1197-2000)
- At Selector tank RAS to aeration selector tank (see Drawing C1197-3006)

Storm Flows

 After storm tanks – storm overflow to FE Chamber (see Drawing C1197-2002)

At PST chamber – storm return (flow only) (see Drawing C1197-2004) •

Sludge Treatment

- Settled sludge (PST to PFT)After primary pumps and at picket fence thickener (see Drawing C1197-3006)
- Emergency primary sludge holding tank thickened primary sludge (see Drawing C1197-2008)
- Emergency secondary sludge holding tank thickened secondary sludge (see Drawing C1197-2009)
- After dewaterer feed pump stored digested sludge (see Drawing C1197-3006)
- Pasteuriser slab pasteurised sludge and return from cooler (see Drawing C1197-3006)
- After PFT Thickened primary sludge to sludge blending tank (see Drawing C1197-3006)
- Gravity Belt Thickener (GBT) sludge blending tank (see Drawing C1197-3006)
- Pasteuriser Slab- blended sludge to pasteuriser (see Drawing C1197-2004)
- Digester to Digested sludge tank (see Drawing C1197-3006)
- Digested sludge tank to dewaterer (see Drawing C1197-2004)
- Sludge Cake Skip final sludge product (see Drawing C1197-2011)
- Aeration tanks mixed liquor (see Drawing C1197-1016)
- Sludge building SAS to gravity belt thickeners, digested sludge to dewaterer, polymer use (see Drawing C1197-3006)

Other Flows

- <u>Other Flows</u> Sludge building liquer from gravity belt thickener (GBT) to Return Liquor chamber (see Drawing C1197-3006)
- Return liquor at PST splitter (see Drawing C1197-2004)
- At liquor chamber Return liquors (only sampling) (see Drawing C1197-1030)
- Inlet Works Building Odour Control Unit inlet air and outlet air (see Drawing C1197-3006)
- Sludge Building Odour Control Unit inlet air and outlet air (see Drawing C1197-3006)

Utilities

- Polymer dosing- sludge conditioning for dewatering- Sludge Building (see Drawing C1197-2011)
- Potable Water/Washwater (see Drawing C1197-2024)

Table 07 4084 3.a(ii) shows the monitoring and/or sampling that will be carried out during operation. The location of the monitoring is identified, with the measurement type, i.e. volumetric or flow rate, manual or auto-sampling for chemical or biological analysis. Also identified, where applicable, is the type of sampler to be used, size and equipment/sampler make or brand. The sampling interval for each one is given, ranging from continuous i.e. for volumetric measurements, flow rates at different parts of the plant, to daily or weekly, i.e. for chemical or biological analysis, to intermittently or spot checks.

In addition, the drawing reference for each drawing of where the sampling or monitoring point is located is provided in this table and the drawings showing these sampling/monitoring areas are included with this response.

(iii) Provide further details of sludge returns (SAS and RAS) including volume, removal rates, characteristics and controls

The sludge that will pass through the plant is as follows:

Sludge production is a percentage of the influent volume. The Plant is designed to cater for the maximum projected volume of influent in 25 years time.

Primary Sludge (as produced in the PST`s) - The projected maximum volume of primary (settled) sludge production is 6499 kg DS (Dry Solids)/day at a DS concentration of 3%, a density of 1009 kg/m³ and a volume flow rate of 214.79 m³/d. All based on the maximum projected inflow to the works in 25 years time.

Surplus Activated Sludge (SAS) - Sludge (activated sludge) produced in the final settlement tanks (part of the secondary treatment) is returned to the aeration tank inlet as it contains the bacteria for the aeration process. The rate of return of activated sludge (RAS) to the aeration tanks is determined by the dissolved oxygen demand of the settled sewage. Any activated sludge not required is therefore surplus (SAS) and is piped to the sludge treatment area where it is blended with the primary sludge and is therefore treated as part of the sludge treatment process.

The projected maximum volume of SAS production is 7748 kg DS/day at a DS concentration of 0.6%, a density of 1002 kg/m³ and a volume flow rate of 1269 m³/d.

Some details on RAS and SAS return can be seen in Attachment C1197-8404. However, these volumes and rates will not be available until the plant is commissioned as they are based on the quality of the sludges as settled in the Final Settlement Tanks (FST). These can be provided to the EPA as soon as they area available.

(iv) Provide further details of return liquors, including sources, volume, characteristics (including BOD load), return rates and controls. Provide details of the maximum volume and load to be returned to the WWTP

Return liquors arise from several discharge points within the works. Details of these return liquors are shown on Drawing C1197-1030, which is the P&ID for the liquor returns.

The liquor returns amount to an average of 185 m³/hr for pump design purpose. This flow rate comprises the following:

- Odour control units 1 & 2 indeterminate
- FST scum 0.14m³/hr
- Picket fence thickener 29 m³/hr
- Sludge tank overflows as and when

- Gravity Belt Thickener 111 m³/hr max
- Digester holding tanks as & when
- Gas condenser 0.10 m³/hr
- Polymer makeup overflow 3.6m³/hr
- Sludge dewatering 58 m³/hr

All these discharges are piped to (collected in) the Return Liquors pumping chamber tank (item 33 on Drawing No. C1197-3014). A duty pump (with standby) operates on float control to pump the contents to the splitter chamber at the inlet to the primary settlement tanks where they are mixed with the raw screened sewage for combined treatment in the PST's.

The return liquors that are returned to the start of the wastewater treatment process, i.e. into the inlet works, are detailed in Attachment C1197-8404.

Return Liquors						
Load BOD kg/d S.S kg/d NH3 Flow I/s						
Average Load 2005	993	1153	135 ^{°°}	21.3		
Average Load 2025 1035 1127 35.0 28.0						

The return liquors load is as follows:

(b) For the sludge treatment process, provide:

(i) Technical design specifications and operational details for each stage

The design specifications for the overall WWTP, including the sludge treatment, are detailed in Section 3.a(i). Please refer to this section for further information

(ii) Describe in more detail the AD process, operating conditions, throughput, retention time, heating mixing and cooling systems, quantities and characteristics of input and outputs, handling of digested sludge, and outputs other than digested sludge and biogas

The digestion process is working under mesophyllic conditions. Controls for the AD process are those relating to controlling the time and temperature; that is controls on the heating system and on the maximum flow rate through the system.

The Plant has been designed for a controlling temperature of 35 deg C in the digesters, and flow rate will be regulated accordingly and on production of sludges. Sludge arriving at the Digester (under pumping pressure against the head of the digester) is already heated (at 55 deg C) as a result of the pasteurization process and will enter the tank at 37 deg C. The pipework system is designed to enable heat to be lost before sludge enters the Digester. If there is insufficient heat loss (i.e. high ambient temperature) then a cooler heat exchanger is incorporated into the flow line which is fed by wash water, and if it is necessary the sludge can be diverted through this to provide cooling.

The flow into and out of the Digester is continuous but the `spot` retention time is 14 days.

The digester holding tank (of reinforced concrete) is designed to retain this temperature (35 deg C) over a specified temperature gradient of 1 deg C loss over one day when no heat is applied. Drawing No C1197-2019 shows the general arrangement of the Anaerobic Digesters and Drawing C1197-1021 shows the P&ID.

There are no other outputs from the digestion tanks other than digested sludge and biogas.

(iii) Provide further details on Biogas collection, storage and method of transfer. Provide details of any scrubbing, or moisture removal and details of the flare including location, design, temperature and residence time

As described in Part 2 Section D.1.i, biogas is produced as a product of digestion of the sludge in the digester tanks. This is utilised to provide the prime fuel source for the boilers, providing hot water for the pasteuriser system. Excess gas (or unused gas) is diverted to the waste gas flare for burning. Should there be insufficient gas available then the boiler system is designed to operate with gas oil. There is no provision for scrubbing.

The biogas collection system is located in the sludge treatment area, as shown in Drawing No. C1197-3006 (see attached). The pipework is shown, and the direction of flow of the biogas, from the 2 no digesters to the biogas condensate holder, shown in Drawing No. C1197-2023 and Drawing No. C1197-1024.

Biogas from the Sludge Digesters flows to the flexible membrane gasholder. Water from the gas condenses in the gas pipework and gravitates forward to the condensate trap/chamber.

Gas is prevented from escaping from the condensate trap by means of a water trap, condensate discharges into a small pumping chamber for subsequent return to the liquors treatment plant. A system of valves in the condensate trap allows isolation of the gasholder if necessary. Low-pressure fans pressurising the space between the outer membrane of the gasholder and the internal membrane bag maintain gas pressure. Vacuum and pressure relief valves on the gasholder allow discharge under abnormal circumstances. The set pressures of the relief valves will be lower on top of the digesters than at the gas holder so that if there is a high gas pressure the relief will be at high level to make the best use of dispersion for safety and odour reasons.

The gas holder (Drawing No. C1197-1024) is a flexible membrane gas holder of 100m³ capacity, which buffers the flow of biogas from the digesters and provides a reservoir of gas for semi-continuous operation of the boilers. The gas holder is constructed from two reinforced fabric membranes. The inner membrane is a hemispheric – cylindrical gas- holder, which is attached at its equator to the external, truncated spherical membrane, which is inflated by air pressure thus providing support to the inner membrane. The exterior membrane is inflated by two blowers, which maintain a constant air pressure in the outer membrane. The gas pressure is maintained by the exterior air pressure acting on the inner membrane.

The system operates at a working pressure of 200 mm wg. As the gas is utilised the inner membrane of the holder deflates under the constant pressure from the low-pressure fans. As the inner bag deflates an ultrasonic detector mounted in the top of the gasholder monitors the degree of deflation and computes a gas volume. Various set points will trigger various operations. As the inner membrane expands and fills with gas, the enclosed air volume between the inner and the outer membrane reduces, and to protect against this causing any excess air pressure, the air is automatically released through an air release valve mounted on the outer membrane. When gas consumption exceeds gas production the air blower provides air to replace the reducing gas volume whilst maintaining constant gas pressure.

Two air blowers configured as duty standby provide inflation air for the membrane Gasholder. These run continually in automatic and are rated for the maximum gas utilisation rate by the waste gas burner.

From the gas holder, the biogas is directed to the boilers, which are shown on Drawing No. C1197-3006. Gas is drawn from the gasholder via the condensate trap to the Boiler room for usage by the boilers (as the prime fuel source). The details of the gas use and flow rate for the boilers are shown in the P&ID for the boilers, included as Attachment C1197-8417.

A waste gas burner, located away from the gas holder, burns any excess Biogas, though as the hot water demand is high within the plant, use of this equipment will be limited and should be viewed as a standby route for the gas. This is shown in Drawing No. C1197-1024 and the Paip sheet is included as Attachment C1197-8418, which gives further details on the capacity, retention time etc.

This low level waste gas burner operates under control of the SCADA (the operation control system). If the biogas level in the gasholder exceeds a set point the burner starts and biogas is drawn from the gasholder through a series of actuated valves and flame arrestors. In order that sufficient temperature is reached within the burner fresh air is added to the biogas at the burners to increase the oxygen/biogas mixture.

(c) For the odour handling units, provide further details including a list of air streams extracted, characteristics of extracted air, controls for emissions of methane. Describe any other odour abatement measures. Describe any proposed controls for pathogens.

Odour Abatement

The P&ID diagram for the odour control is included as Drawing No. C1197-1026 and the data associated with the design are included as Attachment C1197-8419. This shows the 2 no. odour units, and the streams extracted and the characteristics of the extracted air. As detailed in Part 2.h of this response, these include:

- Inlet Works
- Grit Classifier
- Screenings Wash
- Inlet Works Building
- Screen/Grit Skips
- Primary Settlement Tank

- Picket Fence Thickener
- Gravity Belt Thickeners
- Sludge Blending Tanks
- Emergency Sludge Holding Tanks (Primary and Secondary)
- Sludge Building
- Sludge Dewaterers and Dewaterers Skip
- Liquor Returns

The characteristic of the air streams extracted include - average and maximum odour concentrations for each source, the average and peak H_2S (hydrogen sulphide) concentrations, and the flow rate for the air from each source.

Further detail has been included on the odour abatement measures, which entail covering of potentially odorous tanks etc and the odour control units (OCU-1 and OCU-2) in Part 2.h.

Methane Emissions

The methane produced in the anaerobic digestion process will not be emitted to the atmosphere and therefore there will be no methane emissions from this part of the plant. The abatement control for this is the utilisation of the methane as a biogas fuel for the boilers. The boilers will use the biogas as described in Part 2(i) of this response. Any excess biogas will be burned off, again described in detail in Part 2(i).

Control for Destruction of Pathogens

The primary proposed control for pathogens that may be generated during the wastewater treatment process is the pasteurisation process. Detailed description of the pasteurisation process is included as Attachment 07_4084 3.c. Drawing C1197-1020 shows the P&ID for the process.

The thermal sludge pastedriser is utilised to thermally pasteurise sewage sludge prior to sludge digestion in order to eliminate pathogens harmful to man from the sewage sludge and render it suitable for hygienic disposal as a Class `A` sludge.

The thermal pasteuriser operates on the basis of utilising heat to eradicate the pathogenic bacteria.

In the thermal pasteuriser, the sludge is held at a temperature of 55 deg C for a period of four hours after which, it can then be cooled to digester temperature and utilised as the sole source of digester heating.

The anaerobic digestion process also provides a control for pathogen destruction due to the retention time and temperature that the process is kept at. This is described in more detail in Part 3.c.

(d) Provide further details of process abatement and control for each stage of the wastewater treatment process, sludge treatment and odour control units. Submit Table F.1 for each stage

(i) Include details of the capacity, throughput and treatment efficiency, and waste products for each stage

Wastewater Treatment

The anticipated input to the wastewater treatment plant, in terms of the average and peak flows for both the current flows, and the predicted flows for the year 2025 (which is the maximum input for which the plant is designed) is shown in Attachment C1197-8404.

The expected average daily input for current situation (2005) is 277 l/s (average) and 611.3 l/s (max), and for the peak year (2025), the average flow is 441.3 l/s and the maximum is 981.7 l/s.

The loads for each year are shown in the Attachment C1197-8404. From the primary tanks, the removal efficiency rates for each parameter measured are as follows:

Suspended Solids (SS) (max.)	-	60%
Suspended Solids (SS) (min.)	-	55%
Biological Oxygen Demand (BOD) (max)	-	30%
Biological Oxygen Demand (BOD) (max)	-	25%

The percentage dry solids details are also included in Attachment C1197-8404. The loads to the secondary treatment are also shown in the attachment.

As discussed in the original application, until the plant is commissioned, the exact quality of the final treated effluent cannot be determined, as the exact nature of the raw sewage can only be predicted at present. At present, the sewage is discharging through a large number of outfalls into the River Suir, Suir Estuary and St. John's River, and therefore a composite quality and nature has been predicted for the design stage of the plant.

The commissioning phase will ensure that optimum efficiency rates of removal are achieved by adjusting and setting the controls/plant to achieve the required performance. More information can be provided as the commissioning phase is completed.

However, there are maximum limits that the WWTP are designed to meet in terms of the quality of the final treated effluent, which will be discharged to the Suir Estuary. These limits are as follows:

		Standard Target Target A B		Compliance	Criteria
Parameter	Unit			Target A	Target B
BOD	mg/l	25	50	No more than 3 daily samples per 60 days with	No samples with a
COD	mg/l	125	250	a value for any one parameter or all	value for any one parameter to be
Suspended				parameters to be greater	greater than the
Solids	mg/l	35	87.5	than the standards	standard

Sludge Treatment

The sludge volumes that will be produced are identified in Section 3.a(iii) and Attachment C1197-8404.

As for secondary treatment, the plant design efficiency rate is to produce 23% dry solids sludge cake, which is the condition that the sludge cake will be in when it leaves the site for land spreading or landfilling. The efficiency rates in practice will be available once the plant is commissioned and can be supplied to the EPA if required.

Odour Control Units

Details of the odour control units are shown in Part 2(h) of this response. As described in the odour dispersion model, for OCU 1, which treats the inlet building, the hydrogen sulphide removal rate i.e. efficiency is 99% and this equates to an odour removal rate of 97%.

For OCU 2, which treats the sludge building, the hydrogen sulphide removal rate i.e. efficiency is 99% and this equates to an odour removal rate of 95% in this case. Attachment C1197-8419 (Odour Control Design), included with Part 2.h.

(ii) Include details of in-tank monitoring and control systems

Section 3.a(ii) details the monitoring for the operation of the WWTP, and Table 07_4083 shows all the parameters for each monitoring/sampling point.

In terms of the control systems, there will be in-tank monitoring in the digester tanks for level and temperature. The main control is that of temperature, which is described in Part 3.b(ii). All other monitoring is described in Table 07_4084 3.a(ii) and shown in the drawings identified in Part 3.a(ii).

(iii) Control parameters for the Anaerobic Digesters

Controls for the AD process are those relating to controlling the time and temperature; that is controls on the heating system and on the maximum flow rate through the system.

The Plant has been designed for a controlling temperature of 35 deg C in the digesters, and flow rate will be regulated accordingly and on production of sludges. Sludge arriving at the Digester (under pumping pressure against the head of the digester) is already heated (at 55 deg C) as a result of the pasteurization process and will enter the tank at 37 deg C. The pipework system is designed to enable heat to be lost before sludge enters the Digester. If there is insufficient heat loss (i.e. high ambient temperature) then a cooler heat exchanger is incorporated into the flow line which is fed by wash water, and if it is necessary the sludge can be diverted through this to provide cooling.

The flow into and out of the Digester is continuous but the `spot` retention time is 14 days.

The digester holding tank (of reinforced concrete) is designed to retain this temperature (35 deg C) over a specified temperature gradient of 1 deg C loss over one day when no heat is applied. The in-tank monitoring of temperature and level will monitor these parameters, whilst flow rates into and out of the tanks are measured on the pipework, see Part 3.a(ii).

(iv) For each item of control equipment provide details of maintenance and calibration

Details of maintenance and calibration will be determined prior to operation of the WWTP. As the WTTP is still under construction, many items of plant have not yet been installed, and therefore suppliers and manufacturers guidelines on maintenance and calibration are not available in some cases.

Once the WWTP is complete, and prior to operation, a full maintenance and calibration schedule will be available and submitted to the EPA, as per their requirements, and it will be part of the "standing" O&M (Operation and Maintenance) procedures for Waterford WWTP.

(e) Compare the abatement, treatment or recovery system with BAT Standards

The Integrated Pollution Prevention and Control (IPPC) Reference (Bref) Document on Best Available Techniques (BAT) for the Waste Treatments Industries (August 2006)¹ has been referred to in this section.

Specifically, the techniques to consider in biological treatment have been taken into consideration during the design phase of the WWTP.

Selection of the appropriate biological treatment was based on the need for the best treatment to carry out the processed within the WWTP that achieves the optimum operational performance and reduces environmental issues, as well as providing an opportunity to use waste gas as a fuel.

Specific Storage and Handling Techniques

There is no storage of the wastewater as it enters the treatment works, but it is directed into the inlet works. Technique (b), (e) and (f) of the Bref document ¹, Section 4.2.2, have been employed for the WWTP by ensuring that the inlet works and primary settlement tanks are closed. The inlet works building is fully enclosed and under negative pressure and air from here, which may contain malodours, are sucked into the pipework to Odour Control Unit 1 (OCU 1), along with those from the primary settlement tanks.

Air exchanges of between 2 and 18.7 per hour are specified for different items of plant within the inlet works (2 air changes per hour for the overall building and for the primary settlement tank and between 8 and 19.7 for the individual items within the works building, including the pre-screen and post grit channel, the fine screens, the screenings compactors, the grit classifier and the grit channel).

The sludge works are also completely enclosed, in accordance with Technique (b) and (f), keeping all process within the structure. The building is under negative pressure and any malodourous air is sucked into OCU 2 from the building, which includes air from a number of items within the sludge works: the pasteurizer, picket fence thickener, the sludge tanks, the sludge dewaterer and the liquor returns. The air changes per hour for each item range from 2 - 6.

It should be noted that employees will not be routinely working in these areas, only for maintenance and monitoring purposes and therefore the air changes will be sufficient for these infrequent visits. As all the waste entering the plant is via pipes, there will be no vehicle access to the inlet works delivering waste. In accordance with Technique (e) there is a roller shutter door for the inlet works building, which is electrically controlled to ensure the door opening is kept to a minimum and shut completely. Maintenance will be regular, and details will be included in the Operations Manual, which will be finalized prior to commencement of plant operation.

For the sludge works, there is no vehicle access, with only doors for employee access, which will be kept closed at all times. No air curtains are considered necessary as the risk of odour escaping is minimal (due to the building being under negative pressure, and also will not be significant as a result of the odour control programme.

Technique (d) has also been employed for the last steps of the biological treatment, concerning the storage of solid wastes produced, i.e. dewatered sludge cake, grit and screenings. The skips/containers will be enclosed and the dewatered sludge cake taken off-site every day, as waste storage on site will <u>not</u> be permitted. The grit and screenings will be taken off-site once the skips are almost full and replaced with empty ones.

Increase the Retention Time in the Anaerobic Digestion process

The required anaerobic digester operating temperature is 35 deg C with a 'spot' retention time of 14 days. These are the design criteria to ensure optimum digestion conditions, which allow the digestate to spend more time under degradation conditions, at the temperature that ensures maximum degradation. The temperature of the sludge fed forward to the digesters is controlled by the amount of cooling water used in the "cooler" heat exchanger. As a result of this process, maximum biogas is produced to fuel the boilers, providing a beneficial use from what was essentially a waste product.

In relation to the pasterisation process, which is intrinsically linked with the Anaerobic Digestion process, there is increased retention time for this process. This is described in detail in Attachment 07_4084 3.c.

The relationship with the anaerobic digestion is that, having heated the sludge to a temperature up to 55 deg C (pasteurisation retention temperature), it can then be cooled to digester temperature and utilised as the sole source of digester heating. Hence, a control loop is established such that the digester is fed with pasteurised sludge either higher or lower than the required digester operating temperature of 35 deg C. Hence, in the summer months the temperature of the sludge going forward for digestion may be a little cooler than in the winter.

Techniques for the Reduction of Emissions when Biogas is used as Fuel

The biogas produced that is used as a fuel for the boilers, is methane, produced by the anaerobic digesters. The gas holder that will be part of the biogas system, will buffer out any peaks in production and therefore provide a steady supply of biogas to the boilers as and when it is required. This will ensure that the biogas is not wasted (by burning off excess during peak production times) and also reduces the need to use alternative fuel (diesel) for the boilers during times of low production.

Techniques a -d of the Bref document, Section 4.2.6 are not considered necessary for the WWTP, primarily because the gas produced is methane (CH₄) and not hydrogen sulphide (H₂S), which would required further abatement techniques.

In terms of the hydrogen suphide removal, there are activated carbon filters on each of the Odour Control Units (OCUs). The first step in the process, which is a biological media, strips the majority of the H_2S out of the gas, with the carbon filters acting as a polishing step, taking out the remainder of the H_2S (See Drawing C1197-1026) which is included with this response.

As the biogas is being used as a fuel, and the process is not a considerable source of fuel (only powering the boilers), it is not considered economically viable or environmentally justified for this plant.

Technique (e) has been employed by providing biogas storage and an emergency flare. Biogas is produced as a product of digestion of the sludge in the digester tanks. This is utilised to provide the prime fuel source for the boilers, providing hot water for the pasteuriser system. Excess gas (or unused gas) is diverted to the waste gas flare for burning. More details on the process are given in Section b(iii) of this section of the response (see above).

(f) Provide design details for the discharge outfall, and details of diffusers etc

Drawing No. 3126 shows the location and pathway of the final effluent discharge pipe and discharge point, which is marked on the drawing as a green line. The discharge point terminates in the centre of the Suir Estuary.

In summary, there will be three sections of the discharge pipeline, namely A. the land based section (227 metres); B; the section running parallel to the railway line above high water mark (399 metres); and C. the marine section (237 metres). Section C will have the diffusers, the pipe of which will be buried, and 20 diffuser ports, which will be exposed into the Estuary channel. Protection of these ports will be put in place.

See Attachment 07_4084 D.2(f) for more detail on the design details for the final effluent discharge outfall, including information on the diffusers.

(g) Provide details of final effluent wash water, including uses and volumes

Wash water is provided at the start of the operations at the WWTP from an adjacent source, which has been agreed. This will be the IDA borehole, located within the adjacent IDA Park, from which a spur will be directed to the WWTP facility. This source is considered to be only temporary, pending provision of a permanent supply from the public mains (which is not in place at present).

The quality can be deemed to be of potable standard but is not being used as a potable source and no special provision is made to keep it sterilized when on the site. Potable water will be brought on site from another source, in bottled form.

The quantities of wash water that are anticipated (volumes cannot be confirmed until the plant has been commissioned) are as follows:

Total	39,000l/d	
Boiler top up – as and when required Odour control unit – inlet Odour control unit – sludge Internal hose point	2,600 l/d 1,500 l/d 3,600 l/d	 keeping OCU moist keeping OCU moist into drainage system
For polymer make-up – SAS thickeners For polymer make-up – Dewaterers	9,821 l/d 21,478 l/d	 into sludge into sludge

The system is designed to use 40000 l/day.

Drawing No. C1197-1027 shows the wash water flow diagram for the WWTP.

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References

1. Integrated Pollution Prevention and Control (IPPC) Reference (Bref) Document on Best Available Techniques (BAT) for the Waste Treatments Industries, EPA, 2006

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Table 07_4084 F.1 Rev.2

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Wastewater Treatment Stage – Inlet Works

Emission point reference number : OCU-1 (Grid Ref: E 264547 N 112429)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
Hydrogen Sulphide	Odour Control Unit 1	According to equipment specification	As recommended by supplier	None

Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipments	Monitoring equipment calibration
Hydrogen Sulphide	Bi-annual Odour Survey at Determined Monitoring Points (closest receptors and boundary)	Hand held derome 631-X Has analyzer for odour surveys	In the field - Sensor calibration with Jerome H ₂ S functional test kit Also regular calibration by manufacturer approved facility

Sludge Treatment Stage – Sludge Building

Emission point reference number : OCU-2 (Grid Ref: E 264624 N 112338)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
Hydrogen Sulphide	Odour Control Unit 2	According to equipment specification	As recommended by supplier	None

Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipments	Monitoring equipment calibration
Hydrogen Sulphide	Bi-annual Odour Survey at Determined Monitoring Points (closest receptors and boundary)	Hand held verome 631-X H S analyser	In the field - Sensor calibration with Jerome H ₂ S functional test kit Also regular calibration by manufacturer approved facility

Sludge Treatment Stage – Adjacent to Sludge Building

Emission point reference number : A-01(a) Grid Ref: E 264576 N 112295)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
NOx	None	None	None	None
со	None	None	None	None

Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipment چي	Monitoring equipment . calibration
NOx	In-situ stack monitoring at Boiler stack A-01(a)	Testo 350 electrochemical analysis fitted with gas-drying unit (or similar)	As required by equipment manufacturer spec.
со	In –situ stack monitoring at Boiler stack A-01(a) For propriet	Testo 350 electrochemical analysis fitted with gas-drying unit (or similar)	As required by equipment manufacturer spec.
	C		

Sludge Treatment Stage – Adjacent to Sludge Building

Emission point reference number : A-01(b) (Grid Ref: E 264580 N 112295)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
NOx	None	None	None	None
со	None	None	None	None

Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipment چي	Monitoring equipment calibration
NOx	In-situ stack monitoring at Boiler stack A-01(b)	Testo 350 electrochemical analysis fitted with gas-drying unit (or similar)	As required by equipment manufacturer spec.
со	In –situ stack monitoring at Boiler stack A-01(b) For propriet	Testo 350 electrochemical analysis fitted with gas-drying unit (or similar)	As required by equipment manufacturer spec.
	Consent		

Surface Water Runoff

Emission point reference number : SW-1 (Grid Ref: 265022 112153)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
BOD	None	Not Applicable	Not Applicable	Not Applicable
COD	None	Not Applicable	Not Applicable	Not Applicable
Suspended Solids	None	Not Applicable	Not Applicable	Not Applicable
рН	None	Not Applicable	Not Applicable	Not Applicable
Hydrocarbons	Hydrocarbon Interceptors	Regular Inspection of interceptors	Not Applicable	Not Applicable

		Sec. Sec. Sec. Sec. Sec. Sec. Sec. Sec.	•
Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipment	Monitoring equipment calibration
BOD	by the Agency	Standard Laboratory	Standard Laboratory
COD	As Above	As Above	As Above
Suspended Solids	As Above to As Above	As Above	As Above
рН	On-Site pH meter	WTW-Water Meter or similar	As per manufacturers recommendations

Final Treated Effluent Stage – Discharge Point

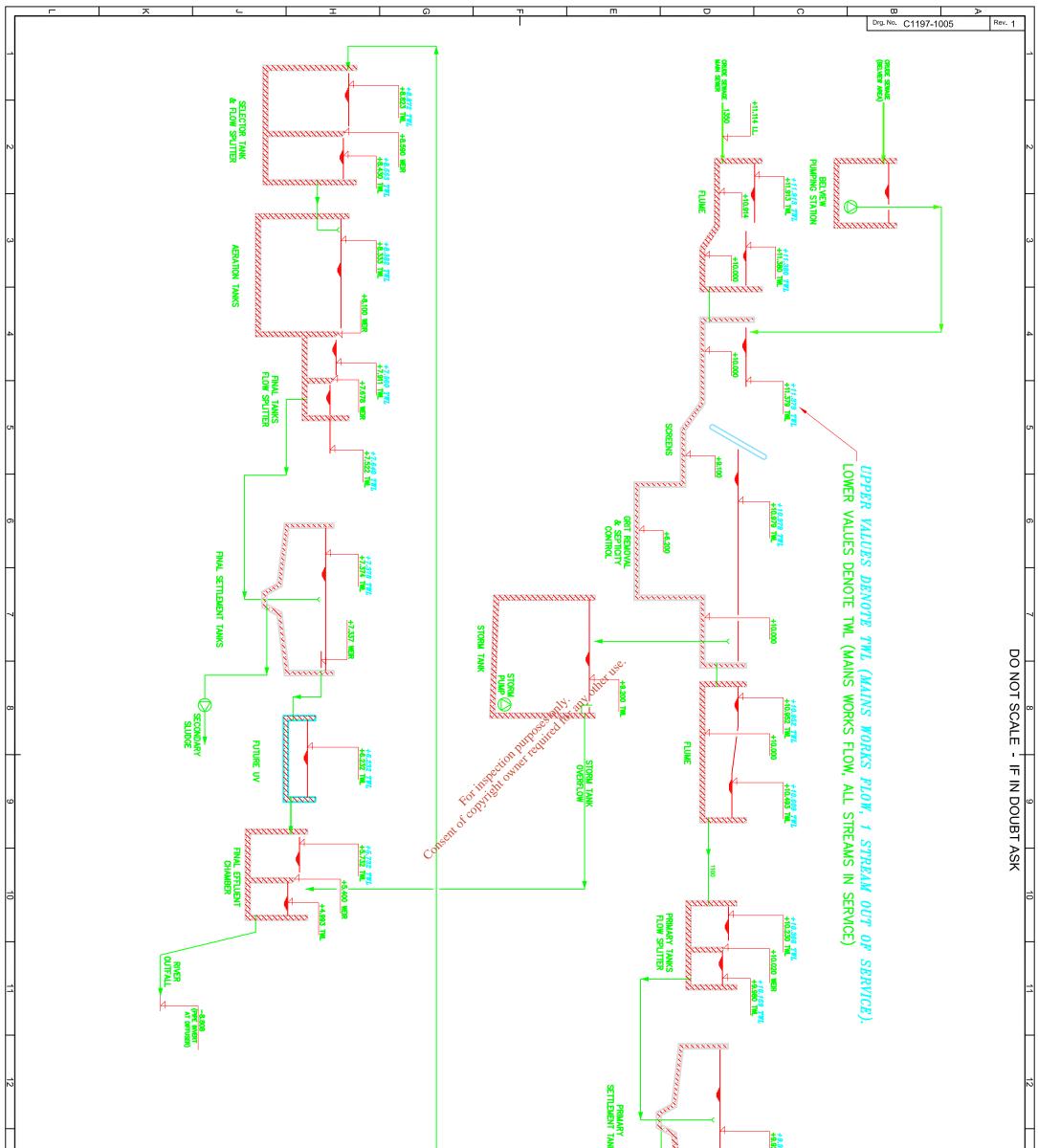
Emission point reference number : SW-2 (Grid Ref: 265602 112078)

Control ¹ parameter	Equipment ²	Equipment maintenance	Equipment calibration	Equipment back-up
BOD	The WWTP, which is described in Section D.2 performs the abatement function –	As required by supplier/manufa cturer specification	As required by supplier/manufa cturer specification	Manually sampling at three-hourly intervals - results weighted according to flow to establish the equivalent daily total load
COD Suspended Solids	As Above As Above	As Above As Above	As Above As Above	As Above As Above
pH	As Above	As Above	As Above	On-Site pH meter
Flow Temperature	As Above As Above	As Above As Above	As Above	Not Specified On-site temperature meter
		an purpose require		

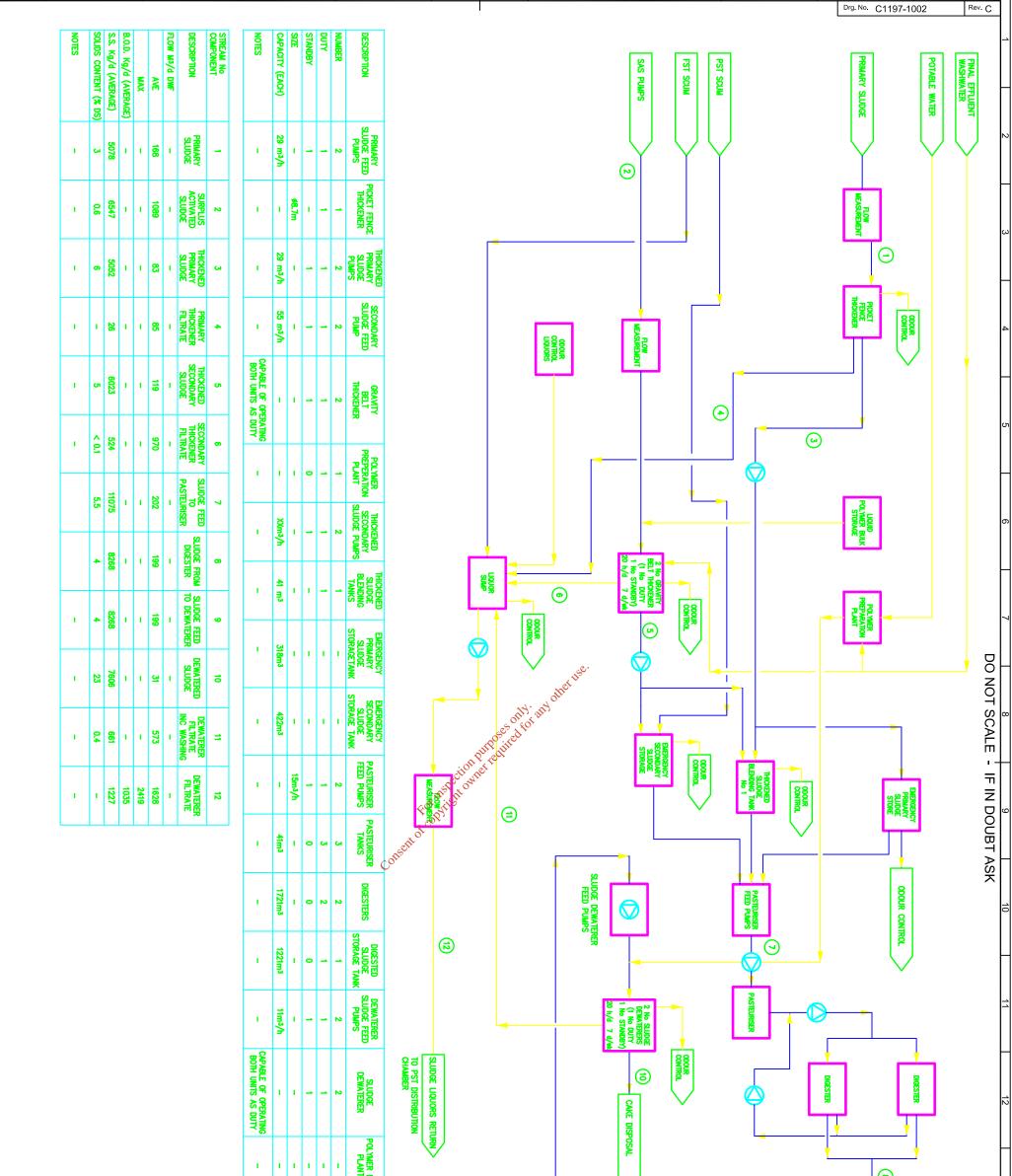
Control ¹ parameter	Monitoring to be carried out ³	Monitoring equipment	Monitoring equipment calibration
BOD	Composite samples will be analysed by an external accredited laboratory, approved by the Agency	Standard Laboratory	Standard Laboratory
COD	As Above	As Above	As Above
Suspended Solids	As Above	As Above	As Above
рН	Ongoing pH monitoring	On-Site pH meter	As per manufacturers recommendations
Flow	On-Site flow monitoring	Open channel flumes fitted with ultrasonic level device	As specified by equipment manufacturer
Temperature	On-Site temperature	On-Site temperature probe	As specified by equipment manufacturer

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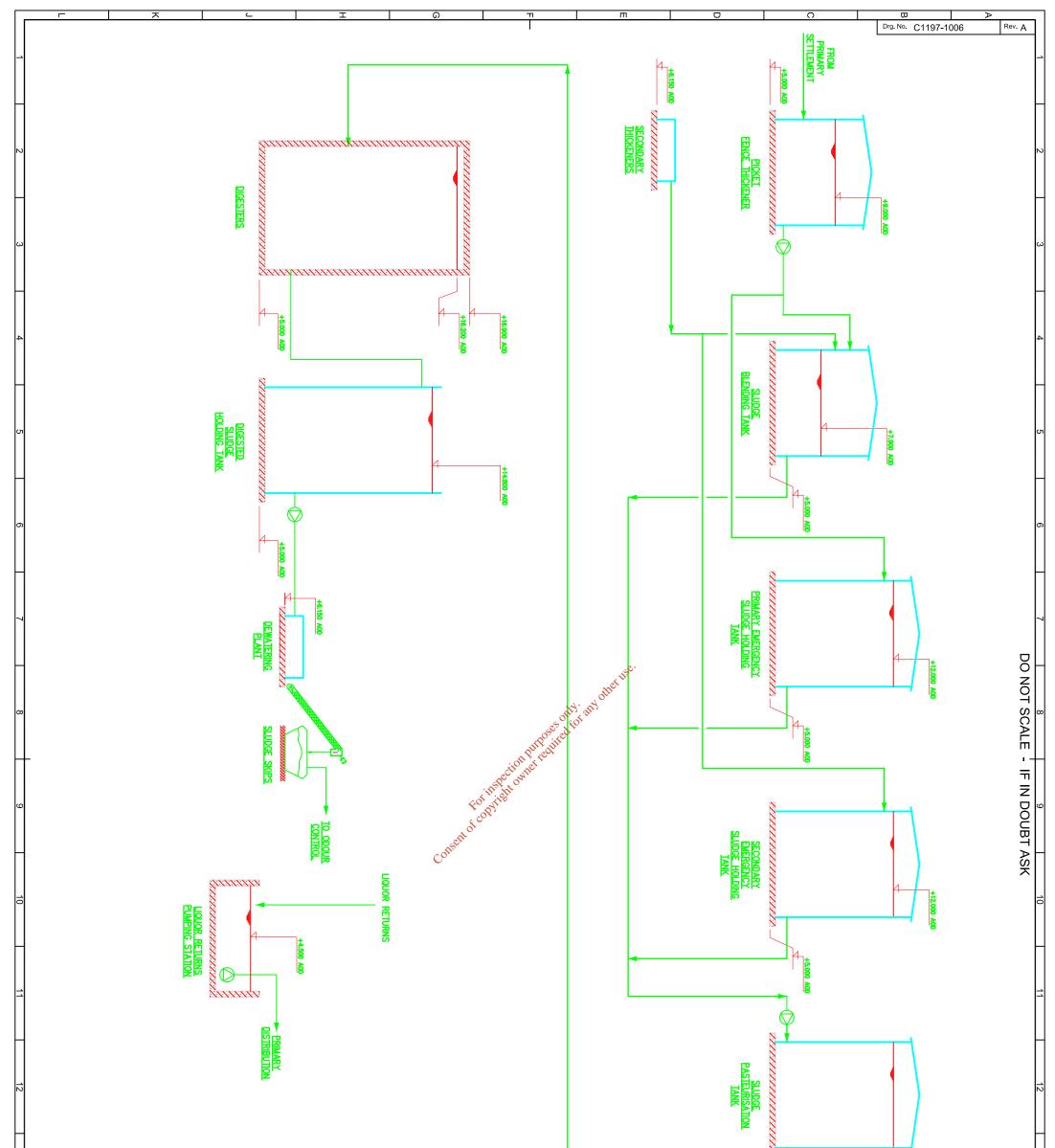


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PROCESS DESIGN CALCULATION

Contract Name : Waterford

Contract No: C1197

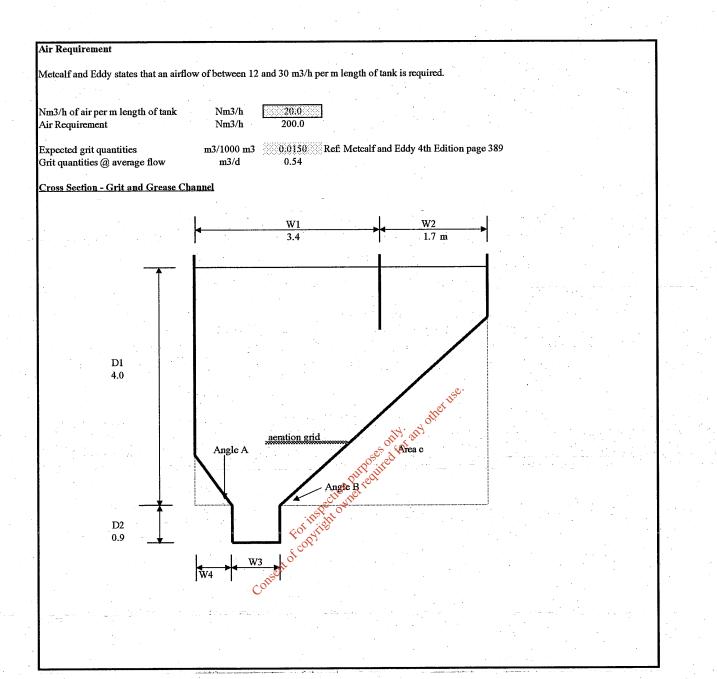
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Title : Grit and Grease Removal

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channel capable of taking 50%	of the flow is also	included shou	id one lane	be out of serv	vice.	
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Total channel width		5.10			11 ± 11	
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The airflow will be set on site.				1		
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#### PROCESS DESIGN CALCULATION

Contract Name : Waterford

Contract No: C1197

Document Ref: 8403

#### Title : PST Design

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JRAC imary Settlement Tank I	Design: Radia	I Flow		Project-Specific	<u>: Data</u>		
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PPLICATION ovides guidance in desigr TRODUCTION adimentation tank design i pths as a design criteria v actice where the surface le	s not a precise vhereas UK pr	e science; judgeme actice tends to igr	ent and exper lore this parar	ience are require	d. USA practic	e specifies t	
DIITE							
			Maximum	Minimum	Average		
low to Primary Tanks		(m³/h)	3534	1221	1564		From 8000-Design Basis
		lps	982	339	435		
uor returns		(m³/h)	101	77	77		
quired No. Tanks		[	2				
commended Surface Lo	ading		•				
commended Surface Lt	ading						
Radial Flow	Tanks	45	m³/m²d	all tanks in serv	vice		
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NK DESIGN				S OF	OT		
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Design Load	ng	m³/m²d [	45.0				
imum tank diameter		(m)	94 P	n P. reat			
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ant 01035 Guilace Aidd - J		(m)	11.2	nt.			
nimum stilling well diamet	er	(m)	¥800111	at 15 % of tank	diameter (	normal range	e 15-20%)
tual stilling well diameter		(m)	.520	Vol 4 section 7.6	states 10% liqui		
illing well surface area		(m²)	21.24		1		
locity in Stilling Well		(m/s)	on 0.02				
lling Well :Tank Diameter		% _01	16.3				
lling Well Area:Tank Area	l	%	2.64				
nk nett surface - per tank		(m²)	802				
tonko in anarstina	•			um Flow	Min Flow		Average Flow
i. tanks in operation nk Surface Gross Loading	<b>.</b>	(m ³ /m ² day)	2 52.7	1	18.2	2	1
nk Surface Gross Loading	5	(m³/m².day) (m³/m².day)	52.7 52.9	105.5 105.8	18.2 18.3	23.3 23.4	46.7 46.8
lowing for inlet diffuser dr	um)	(mº/m².day) m/h	52.9 2.20	4.41	0.76	23.4 0.98	46.8
and a moralitation of			£.4J	1 1 1	0.70	0.00	1 1.85
DE WALL DEPTH						······	
		4.1					
nk geometry is important ocity diffuser zone and th allow. Note that primary t ewall height. The values pe be steeper lower value	e sludge zone anks where a calculated be	(particularly in fin ctivated and prima low are based on a	al settlement ry sludge are	tanks) when tank cosettled have a	s are too higher minimui		
imary Sidewall Depth imary Sidewall Depth (Co tual Sidewall Depth	settled)	Minimum 2.10 2.40 2.50	Preferred 3 3		•		
FFUSER DRUM SIZING			· · · ·				
nk Diameter	(m)	32.00					· · · · ·
in Diameter	(iii)	32.00					
		Minimum	Maximum	1			
mary Drum Diameter	(m)	4.80	6.40				
orm Drum Diameter	(m)	4.80	6.40		• .		
	····/						
um Immersion	(m)	0.300	1.500	Should be at lea	ast 1m		

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Printed 09:05 30/10/2006 Page 1 of 2

#### FLOOR SLOPE

#### (Exception cone bottomed tanks [no sludge scrapers] typically 60 degrees)

Minimum floor slope is 7.5 degrees, preferred floor slope is 11 degrees.

Floor Slope Selected	degrees	7.5		
Depth due to slope	m	2.11	Vol 4 sect. 7.6 minimum specified wall height 2.5	m
Volume of cone	m3	22		

#### SCRAPER SPEED

Number of scraper blades Efficiency of Scraper	2 1.3 Note : Efficiency is 1.3 for scraper system, 1.0 for suction lift system.	

		Minimum	Maximum	Selected	
Peripheral scraper speed	m/min	1.2	1.5	1.5 Vol 4 sect. 7.6 maximum speed 2.5 m/min	
Circumference of tank	m	100.5			
Time Period Between Blade	mins	54.5	43.6	43.6	

NUMBER OF SCRAPERS IS SATISFACTORY

Preferred scraper speed is 1.5 m/min for primary tanks. Note for large tanks (>30m) this can be increased to 1.8 to 2m/min.

#### RETENTION TIME

Capacity of tank	m3	2033		
		Maximum	Minimum	Average
Inflow to each Primary Tank	(m³/h)	1767	611	782
Sewage retention time	hrs	1.2	3.3	2.6

Note that this is not a critical parameter but in order to prevent septicity the follwing guidelines should be adhered to where possible: -Retention period should not exceed 8 hours at DWF.

retention time at maximum flow shouldn't greatly exceed 2 hours.

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#### SLUDGE HOPPER

Where automatic or frequent manual desludging is employed, it is recommended that the hopper should have a nominal size based on a depth of approximately 1.5m. This provides for studge thickening within the hopper. The hopper should have sloping sides not less than 60 degrees to the forizontal and the base of the hopper should have a diameter not greatly exceeding 1m.

Diameter of hopper base Depth Of Hopper Volume of sludge hopper 1.51 (1.5) (1.5) (1.5) (1.5) (1.5) (1.5)

#### Weir Loading Criteria

Primary Tanks Must be greater than 100 m³/md to prevent surface effects. Preferred value of around 300 m³/md Maximum allowable 450 m³/md

#### V NOTCH WEIR SIZING (90° NOTCHES)

Max Notch Discharge (m3/d)	30.0	Maximum discharge per notch is 30-40 m ³ /d.
Min Number of Notches per tank Circumference m	1414 101	
Required No. V notches per 2m plate is	28	and since the maximum number of V notches in a 2m long plate is 19, a double sided
Required No. V notches per 2m plate is	20	
Actual No. V notches per 2m long plate		ing a wein is required worth reaction and factors for a with source of presses of the second source of the factors of the fact

Actual No Notches Act Notch Discharge	(m3/d)	200. 212.0					
Vert Head Thro Notch	(mm)	80.7	(normally around 30 to 35mm)			•	
Effective Weir Length Weir Loading	(m) (m3/md)	32.3 1313 2627	for a 45 degree V notch weir. (all tanks in operation) (1 tank out of service)	·	- 		 



#### PROCESS DESIGN CALCULATION

Contract Name : Waterford

#### Contract No: C1197

Document Ref: 8404

#### Title : Activated Sludge Design

Revision	No. of Pages	Date of	Purnose of Issue	Originator	Checked	Approved
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BOD         From 8000-Design Basis         mg/l         12.5.3         25.           NH3         mg/l         NLA         synALUE         synALUE           NH3         mg/l         NLA         synALUE         synALUE           P         NA         synALUE         synALUE         synALUE           Primary Lanks         2         From s402-PST         synALUE           SS Removal Efficiency (max)         %         20         From s402-PST           BODG Removal Efficiency (max)         %         0         -           TKNTR Removal Efficiency (max)         %         0         -           Primary Sludge Production         %         0         -           Primary Sludge Production (max)         %         0         -           Mar. Removal in year 2025         kg/d         5036         3694         277         130           Mar. Removal in year 2025         kg/d         5036         3933         3937         393         393 <td></td> <td></td> <td></td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td></td>				_					
SS         From 8000-Design Basis         mg/l         17.5         35           NH3         mg/l         N/A         #VALUEI         #VALUEI           P         N/A         #VALUEI         #VALUEI           P         N/A         #VALUEI         #VALUEI           Stamoul Efficiency (max)         %         90         From 8401-PST           SS Removal Efficiency (max)         %         90         From 8403-PST           DDG Fearousel Efficiency (max)         %         90         From 8403-PST           TNNTN Removal Efficiency (max)         %         0         -           TNNTR Removal Efficiency (max)         %         0         -           NNM4 Removal Efficiency (max)         %         0         -           NNM4 Removal Efficiency (max)         %         0         -           NNM4 Removal regradots         kg/d         3318         223         166           Mar Removal regradots         kg/d         5331         322         171         105           Mar Removal regradots         kg/d         5331         323         1271         1106         102           Mar Removal regradots         kg/d         2761         3392         254         102		From 8000-Design Basis		mg/l				•	
NH3         mgil         NA         PALUE           P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P         P <td< td=""><td>BOD</td><td>From 8000-Design Basis</td><td></td><td>mg/l</td><td></td><td>12.5 ·</td><td>25</td><td></td><td></td></td<>	BOD	From 8000-Design Basis		mg/l		12.5 ·	25		
N         NA         WALUEI           P         NA         #VALUEI           Primary Tanks         0.0         7 mm 4403-PST           SS Removal Efficiency (max)         %         000         From 4403-PST           SS Removal Efficiency (max)         %         000         From 4403-PST           BODS Removal Efficiency (max)         %         000         From 4403-PST           SK WMT Removal Efficiency (max)         %         00         From 4403-PST           NMAM Semeoral Efficiency (max)         %         0         0           NMA Removal in year 2025         kg/d         3048         2241         166         111         66           Max Removal in year 2025         kg/d         2078         3969         277         185         111           Max Removal in year 2025         kg/d         2033         39	SS	From 8000-Design Basis		mg/l		17.5	35		
P         N/A         #VALUEI           Primary Tanks         No. of Tanks         2         S           SS Removal Efficiency (max)         %         60         From \$403-FST           BOD Kennoval Efficiency (max)         %         20         From \$403-FST           BOD Kennoval Efficiency (max)         %         20         From \$403-FST           BOD Kennoval Efficiency (max)         %         0         0           NNH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Primary Sludge Production         %         0         0           Paramage Dry Solids         %/d         6539         369         277         166         111           Max Removal In year 2025         kg/d         6539         369         277         130         111         66           Max Removal In year 2025         kg/d         6558         397         226         129         111           Max Removal In year 2025         kg/d         6578         3953         347         111         66           Max Removal In year 2025         kg/d         2771         130         116         111	NH3			mg/l		N/A	#VALUE!		
Primary Janks	TN			•		N/A	#VALUE!		
Primary Janks									
No. of Tanks         2           SS Removal Efficiency (max)         %         60         From \$403-PST           SDD S Removal Efficiency (min)         %         50         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Parcentage Dry Solids         %         1.5         2         3           Max Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5078         396         277         165         111         66         111         66         102         Max Removal in year 2025         kg/d         5658         397         268         199         119         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         kg/d         44         573         3530         1066         103.31         1066         103.31 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									
No. of Tanks         2           SS Removal Efficiency (max)         %         60         From \$403-PST           SDD S Removal Efficiency (min)         %         50         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Parcentage Dry Solids         %         1.5         2         3           Max Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5078         396         277         165         111         66         111         66         102         Max Removal in year 2025         kg/d         5658         397         268         199         119         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         kg/d         44         573         3530         1066         103.31         1066         103.31 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									
No. of Tanks         2           SS Removal Efficiency (max)         %         60         From \$403-PST           SDD S Removal Efficiency (min)         %         50         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         From \$403-PST           SDDS Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Parcentage Dry Solids         %         1.5         2         3           Max Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5078         396         277         165         111         66         111         66         102         Max Removal in year 2025         kg/d         5658         397         268         199         119         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         kg/d         44         573         3530         1066         103.31         1066         103.31 <t< td=""><td>Primany Tanke</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Primany Tanke								
Sp. Removal Efficiency (max)         %         00         From \$403-PST           BOD5 Removal Efficiency (max)         %         00         From \$403-PST           BOD5 Removal Efficiency (max)         %         00         From \$403-PST           RMTN Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Primary Sludge Production         %         0         0           Max Removal In year 2025         kg/d         339         224         116         61           Max Removal In year 2025         kg/d         5353         332         527         17         180           Max Removal In year 2025         kg/d         5355         397         298         199         119           SECONDARY TREATMENT         Yr 2025         Xg/d         5353         333         357.0         11066         1033           Soluble BDD Component         Kg/d         199         102         445         445         445         445           Noft Removal In year 2025         k	TTING Y LOUKS								
Sp. Removal Efficiency (max)         %         00         From \$403-PST           BOD5 Removal Efficiency (max)         %         00         From \$403-PST           BOD5 Removal Efficiency (max)         %         00         From \$403-PST           RMTN Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (max)         %         0         0           Primary Sludge Production         %         0         0           Primary Sludge Production         %         0         0           Max Removal In year 2025         kg/d         339         224         116         61           Max Removal In year 2025         kg/d         5353         332         527         17         180           Max Removal In year 2025         kg/d         5355         397         298         199         119           SECONDARY TREATMENT         Yr 2025         Xg/d         5353         333         357.0         11066         1033           Soluble BDD Component         Kg/d         199         102         445         445         445         445           Noft Removal In year 2025         k	No. of Tanks					2			
SS Removal Efficiency (min)     %     55     From 8403-PST       BOD5 Removal Efficiency (max)     %     20     From 8403-PST       BOD5 Removal Efficiency (max)     %     0     0       TKMTN Removal Efficiency (min)     %     0     0       N-NH4 Removal Efficiency (min)     %     0     0       Primary Sludge Production     %     0     0       Max Removal In year 2005     kg/d     3043     225       Max Removal In year 2025     kg/d     5058     397       Max Removal In year 2025     kg/d     5058     397       Max Removal In year 2025     kg/d     5756     5353       Max Removal In year 2025     kg/d     5756     5353       Soluble BDD Component     %     4     4       Prementego Sububi BCD     %     1     10       Soluble BDD Component     %     1     10     10       Soluble BDD Component     %     4     4     4       Notati Tester     %     1     13     13       Ob Concentrations at DWE     1 <td>NU. UI TAINS</td> <td>·</td> <td></td> <td></td> <td></td> <td><u>~</u></td> <td></td> <td></td> <td></td>	NU. UI TAINS	·				<u>~</u>			
SS Removal Efficiency (min)     %     55     From 8403-PST       BOD5 Removal Efficiency (max)     %     20     From 8403-PST       BOD5 Removal Efficiency (max)     %     0     0       TKMTN Removal Efficiency (min)     %     0     0       N-NH4 Removal Efficiency (min)     %     0     0       Primary Sludge Production     %     0     0       Max Removal In year 2005     kg/d     3043     225       Max Removal In year 2025     kg/d     5058     397       Max Removal In year 2025     kg/d     5058     397       Max Removal In year 2025     kg/d     5756     5353       Max Removal In year 2025     kg/d     5756     5353       Soluble BDD Component     %     4     4       Prementego Sububi BCD     %     1     10       Soluble BDD Component     %     1     10     10       Soluble BDD Component     %     4     4     4       Notati Tester     %     1     13     13       Ob Concentrations at DWE     1 <td></td> <td></td> <td></td> <td></td> <td></td> <td>60</td> <td>E</td> <td>DOT</td> <td></td>						60	E	DOT	
BOD Semoval Efficiency (max)         %         30         From \$403-PST           RODS Removal Efficiency (max)         %         0         From \$403-PST           TKMTN Removal Efficiency (max)         %         0         0           N-NH4 Removal Efficiency (min)         %         0         0           Primary Sludge Production         %         0         0           Percentage Dry Solids         %         1.5         2         3         5           Max Removal Efficiency (min)         %         0         0         0         0           Percentage Dry Solids         %         1.5         2         3         5           Max Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5078         339         254         169         102           Max Removal in year 2025         kg/d         5068         397         298         199         119           SECONDARY TREATMENT         Max Removal in year 2025         kg/d         5726         5353         9373         10169         1033           Soluble BOD Component         kg/d         5726         5363         364730									
BOD Semoval Efficiency (min)         %         ZB         From \$403-PST           TKMTN Removal Efficiency (min)         %         0         0           N-NH4 Removal Efficiency (min)         %         0         0           Primary Sludge Production         %         0         0           Primary Sludge Production         %         0         0           Prenentage Dry Solids         Kg/d         3318         221         166         111         66           Min Removal in year 2005         Kg/d         3318         221         166         110         67           Min Removal in year 2025         Kg/d         5539         389         277         185         111           Min Removal in year 2025         Kg/d         5078         339         224         169         1102           Mar Removal in year 2025         kg/d         5058         393         333         106         10331           Secondary TREATMENT         Yr 2025         Yr 2025         Yr 2025         Yr 2025         49         49         445         496           Soluble BDD Component         Kg/d         2791         138         246         199         110         94         49         445									
VTKNTN Removal Efficiency (min)       %       0         N-NH4 Removal Efficiency (min)       %       0         Primary Sludge Production       %       0         Primary Sludge Production       %       0         Max Removal In year 2005       kg/d       3318       221       152       162       111       66         Max Removal In year 2005       kg/d       3022       203       152       101       61         Max Removal In year 2025       kg/d       5056       369       277       186       111         Max Removal In year 2025       kg/d       5056       339       224       169       102         Max Removal In year 2025       kg/d       5556       392       217       186       111         Max Removal In year 2025       kg/d       5553       3953       325       2171       130         Min Removal In year 2025       kg/d       5553       3953       8730       11069       1031         Stoble BOD Component       kg/d       776       5553       3953       4259       4945       494       49       52       494       49       49       100       0       0       0       0       0       0									
TKM/TN Removal Efficiency (min)     %     0       NH44 Removal Efficiency (min)     %     0       Primary Sludge Production     %     0       Percentage Dry Solids     %     1.5     2     3       Max Removal In yeer 2005     kg/d     3318     221     166       Max Removal In yeer 2005     kg/d     3318     221     166       Max Removal In yeer 2025     kg/d     5539     366     277     185       Max Removal In yeer 2025     kg/d     5506     333     225     217     130       Max Removal In yeer 2025     kg/d     5506     337     258     198     119       Secondary Treatment Stage     kg/d     5736     535     9353     9370     11069     10331       Soluble BOD Component     kg/d     2791     2791     2791     4259     494     445       Sto Secondary Treatment Stage     kg/d     0     0     0     0     0     0       Volatile SC Component     kg/d     1991     1776     3324     2954     433     365     155     3693     4875     4333       Volatile SC Component     kg/d     0     0     0     0     0     0     0     0       N							From 8403-	PST	
NLML Bemoval Efficiency (min)         %         0           Primary Sludge Production         %         0           Percentage Dry Solids         %         0           Max Removal in year 2005         kg/d         3318         221           Max Removal in year 2005         kg/d         5338         369         277           Max Removal in year 2025         kg/d         5059         339         2264         166         101           Max Removal in year 2025         kg/d         5050         433         325         217         186         102           Max Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT									
N-NH4 Removal Efficiency (min)         %         0           Primary Sludge Production         Sludge Production, m3/d           Percentage Dry Solids         %         1.5         2         3         5           Max Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2025         kg/d         5539         3369         277         185         111           Min Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5550         337         298         199         119           Scondary Treatment Stage         kg/d         5756         5353         3953         8730         11069         1031           Soluble BOD Component         kg/d         2711         2719         4259         4945         494         49         218         494         49         4259         4945         494         493         494         493         4259         4945         4945         494         494         494         494         494         494         494         494         494         494         494         494									
Vinary Sludge Production         Sludge Production, m3/d           Percentage Dry Solids         %         1.5         2         3         5           Max Removal in yeer 2005         kg/d         3318         221         166         111         66           Min Removal in yeer 2025         kg/d         6533         369         277         186         101           Min Removal in yeer 2025         kg/d         6503         339         254         165         102           Min Removal in yeer 2025         kg/d         6500         433         325         217         186         111           Max Removal in yeer 2025         kg/d         6500         433         326         1106         102           Min Removal in yeer 2025         kg/d         5736         5353         933         8700         11069         10331           Soluble BOD Component         Kg/d         2791         2459         4259         445         449         44         44         44         44         44         445         433         10068         10331         1004         10331         1024         445         433         4475         433         4475         4333         104         163	NI-NIHA Domoval F	fficiency (max)							
Skudge Production, m3/d           Percentage Dry Solids         %         15         2         3         5           Mar Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2005         kg/d         5539         369         227         135         111           Min Removal in year 2025         kg/d         6553         339         224         166         102           Mar Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025         20%         Max         Min         May         <	N-NH4 Removal E	Efficiency (min)		%		0			
Skudge Production, m3/d           Percentage Dry Solids         %         15         2         3         5           Mar Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2005         kg/d         5539         369         227         135         111           Min Removal in year 2025         kg/d         6553         339         224         166         102           Mar Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025         20%         Max         Min         May         <									
Percentage Dry Solids         %         1.5         2         3         5           Max Removal in year 2005         kg/d         3318         221         166         111         61           Max Removal in year 2025         kg/d         5338         369         277         185         111           Max Removal in year 2025         kg/d         5078         339         254         169         102           Max Removal in year 2025         kg/d         6500         433         3252         217         130           Min Removal in year 2025         kg/d         6500         433         3252         101         106           SECONDARY TREATMENT           Yr 2005         Yr 2025         Yr 2025         279         1069         1031           Soluble BOD Component         Kg/d         5736         5353         9353         4375         433         445         4445           Percentage Soluble BOD         %         49         52         455         445         445           Volatile SS Component         kg/d         0         0         0         0         0         0         0         0         0         0         0         0	Primary Sludge F	roduction							
Nax. Removal in year 2005         kg/d         3318         221         166         111         66           Min. Removal in year 2005         kg/d         5539         369         277         185         101         61           Min. Removal in year 2025         kg/d         5539         369         277         185         111           Min. Removal in year 2025         kg/d         6558         339         284         169         102.           Max. Removal in year 2025         kg/d         6558         397         288         199         119           SECONDARY TREATMENT									
Nin Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5539         369         277         185         111           Max Removal in year 2025         kg/d         6509         339         254         169         102           Max Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT           199         119         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110 <t< td=""><td>Percentage Dry S</td><td>olids</td><td></td><td></td><td></td><td>1.5</td><td></td><td></td><td></td></t<>	Percentage Dry S	olids				1.5			
Min Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         6539         369         277         188         111           Max Removal in year 2025         kg/d         65078         339         254         169         102           Max Removal in year 2025         kg/d         5958         337         298         199         119           SECONDARY TREATMENT           5958         337         298         199         119           SECONDARY TREATMENT            Yr 2025         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Treatment Stage         kg/d         2791         2791         494         49         45         49           Yotatile SS Component         kg/d         219         748         49         45         49         433         4333         4875         4333         4335         4333         4367         4333         4875         4333         4900         3467         4333         447         49         45         49         45         49         45         49         45         49         45	Max Removal in v	ear 2005	kg/d		3318	221	166	111	66
Max         Removal in year 2025         kg/d         5539         369         277         185         111           Min Removal in year 2025         kg/d         65078         339         254         169         102           Min Removal in year 2025         kg/d         6507         339         254         169         102           Min Removal in year 2025         kg/d         5507         339         254         169         102           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025 + 20%         Yr 2025 + 20%         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5353         5353         58730         11069         1031           Soluble BOD Component         kg/d         2791         278         4259         445         445           Thx Load To Secondary Treatment         kg/d         2791         278         435         433         324         2954         3900         3467         433           Valiatile SS Component         kg/d         49/d         442         431         739         975         867           NH4-N Load         kg/d         1295         1352         1352         1596         1596					3042	203	152	101	61
Nin Removal in year 2025         kg/d         5078         339         254         169         102           Max Removal in year 2025         kg/d         6500         433         326         217         130           SECONDARY TREATMENT								185	
Max         Removal in year 2025         kg/d         6500         433         325         217         130           SECONDARY TREATMENT					1				
Min Removal in year 2025         kg/d         5958         397         298         199         119           SECONDARY TREATMENT           BOD Load To Secondary Stage         kg/d         5736         5353         9353         9373         1065         1035           Secondary Stage         kg/d         2717         2736         5353         936730         11065         10331           Secondary Stage         kg/d         2719         2711         2791         2791         4259         4259         4945         484           Percentage Soluble BOD         %         49         52         445         3693         4875         4333           Volatile SS Component         kg/d         2489         2718         44155         3693         4875         4333           Volatile SS Component         kg/d         499         49         45         48           Volatile SS Component         kg/d         1381         1232         1352         1556         1596         1596           Volatile SS Component         kg/d         499         4155         143         143         165         165           Vizoos									
SECONDARY TREATMENT           Yr 2025         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         9730         11069         1031           Soluble BOD Component         kg/d         2791         2791         2791         2791         4259         445         4945         4845         4345         4333           Sto Secondary Treatment Stage         kg/d         2489         2218         4155         3693         4875         4333           Volatile SS Component         kg/d         1991         1770         3324         2954         3900         3467           Inorganic SS Component         kg/d         489         218         739         975         867           NH-A Load         kg/d         1204         1201         1352         1352         1596         156           Soluble BOD Component         kg/d         1204         1204         142         311         143         145         146           Soluble BOD Component         Volatite SS Component         0         0									
Yr 2005         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5736         5353         9353         4259         44945           Percentage Soluble BOD         %         49         52         4259         44945         4495           Sto To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	inin rionovarin ye		Ngro						
Yr 2005         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5736         5353         9353         4259         44945           Percentage Soluble BOD         %         49         52         4259         44945         4495           Sto To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	SECONDARY TR	EATMENT							
Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         58730         11069         10331           BOD Load To Secondary Treatment         kg/d         2791         2791         2459         4259         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4935         4333         Volatile SC Component         kg/d         1991         1770         3324         2954         3900         3467         4333         1010         1352         1356         1556         156         156         156         156         156         156         156         156         156         156         155         156         155         156         155         156         155         156         155         156         155 </td <td></td> <td><u></u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		<u></u>							
Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         58730         11069         10331           BOD Load To Secondary Treatment         kg/d         2791         2791         2459         4259         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4935         4333         Volatile SC Component         kg/d         1991         1770         3324         2954         3900         3467         4333         1010         1352         1356         1556         156         156         156         156         156         156         156         156         156         156         155         156         155         156         155         156         155         156         155         156         155 </td <td></td> <td></td> <td></td> <td>Yr</td> <td>2005</td> <td>Yr 2</td> <td>2025</td> <td>Yr 2025</td> <td>5 + 20%</td>				Yr	2005	Yr 2	2025	Yr 2025	5 + 20%
BOD Load To Secondary Stage         kg/d         5736         5353         9353         68730         11069         10331           Soluble BOD Component         %         49         52         449         494         45         48           TKN Load To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0									
Soluble BOD Component         kg/d         2791         2791         4259         4259         4945         4945           Percentage Soluble BOD         %         49         52         46         49         45         48           Notatile SS Component         kg/d         2489         2218         4155         3693         4875         4333           Volatile SS Component         kg/d         1991         1770         3324         2954         3900         3467           Volatile SS Component         kg/d         489         442         831         739         975         867           NH4-N Load         kg/d         1991         1352         1352         1596         1596           TN Load         kg/d         1201         1352         1352         1356         165           BOD concentration To Secondary Stage         518         296         313         292         370         346           Soluble BOD Component         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	BOD Load To Sec	condary Stage	ka/d						
TKN Load To Secondary Treatment     kg/d     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0						4259			
TKN Load To Secondary Treatment     kg/d     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0						NAG 2	r		
SS To Secondary Treatment Stage         kg/d         2489         2218         64155         3693         4875         4333           Volatile SS Component         kg/d         1991         770         3324         2954         3900         3467           Inorganic SS Component         kg/d         1991         770         3324         2954         3900         3467           Inorganic SS Component         kg/d         1991         770         3324         2954         3900         3467           NH4-N Load         kg/d         1204         422         831         739         975         867           TN Load         Volatile SS Component         kg/d         1352         1352         1596         1596           To Load         Yr 2005         Yr 2025         Yr 2025 + 20%         Yr 2025 + 20%         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min         Max         Min           BOD concentration To Secondary Treatment         0         0         0         0         0         0         0         0           St To Secondary Treatment Stage         138         123         139         124         163         145						0.9			
Volatile SS Component         %         80         1991         17701         3324         2954         3900         3467           Inorganic SS Component         kg/d         498         1209         442         831         739         975         867           NH4-N Load         kg/d         kg/d         1209         422         1352         1596         1596           TN Load         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0						A FE			
Volatile SS Component Inorganic SS Component         kg/d kg/d         1991 kg/d         1770 442         3324 831         2954 739         3900 975         3467           NH4-N Load         kg/d         498 kg/d         1201         1352         1352         1596         1596           NLaad         kg/d         kg/d         1201         1352         1596         1596           Concentrations at DWE         Yr 2005         Yr 2025         Yr 2025 + 20%           BOD concentration To Secondary Stage         One         318         296         313         292         370         346           Soluble BOD Component         0         0         0         0         0         0         0         0           TKN concentration To Secondary Treatment Stage         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0					2210	4155	3093	40/5	4555
Inorganic SS Component         kg/d         498         442         831         739         975         867           NH4-N Load         kg/d         1300         1352         1352         1596         1596         1596           TN Load         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0					all a		0074	0000	0407
NH4-N Load         kg/d         1202         M201         1352         1352         1596         1596           TN Load         kg/d         3         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0									
TN Load         kg/d         B         0         0         0         0         0         0         0           Concentrations at DWF         Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min <td></td> <td>ponent</td> <td></td> <td></td> <td>A42</td> <td></td> <td></td> <td></td> <td></td>		ponent			A42				
Concentrations at DWE						(			
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166	TN Load	·	kg/d	CON A	<u> </u>	0	0	0	0
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166			A1	1 19 -					
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166	Concentrations a	at DWF	· · · · · · · · · · · · · · · · · · ·	J.					
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166			ç	<u>,07</u>	0005	<u> </u>	005	V- 000	
BOD concentration To Secondary Stage         318         296         313         292         370         346           Soluble BOD Component         155         155         143         143         165         165           Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <td>1. Sec. 1. Sec</td> <td></td> <td>ζ O^γ</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	1. Sec. 1. Sec		ζ O ^γ						
Soluble BOD Component Percentage Soluble BOD         155         155         143         143         165         165           TKN concentration To Secondary Treatment SS To Secondary Treatment Stage         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         <		7.0	- A						
Percentage Soluble BOD TKN concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <td></td> <td></td> <td>alle</td> <td>1</td> <td>1</td> <td></td> <td></td> <td></td> <td>1</td>			alle	1	1				1
TKN concentration To Secondary Treatment Stage       0       0       0       0       0       0       0         SS To Secondary Treatment Stage       138       123       139       124       163       145         Volatile SS Component       110       98       111       99       130       116         Inorganic SS Component       28       25       28       25       33       29         NH4-N concentration       67       67       45       45       53       53         Concentrations at Average Flow         Yr 2005       Yr 2025       Yr 2025 + 20%         Max       Min       Max       Min       Max       Min         BOD concentration To Secondary Stage       240       224       245       229       290       271         Soluble BOD Component       117       117       112       112       130       130         Percentage Soluble BOD       0       0       0       0       0       0       0         COD concentration To Secondary Treatment       0       0       0       0       0       0       0         COD concentration To Secondary Treatment Stage       104       92			C ^U	155	155	143	143	165	165
SS To Secondary Treatment Stage       138       123       139       124       163       145         Volatile SS Component       110       98       111       99       130       116         Inorganic SS Component       28       25       28       25       33       29         NH4-N concentration       67       67       45       45       53       53         Concentration at Average Flow         Yr 2005       Yr 2025       Yr 2025 + 20%         Max       Min       Max       Min       Max       Min         BOD concentration To Secondary Stage       240       224       245       229       290       271         Soluble BOD Component       117       117       112       112       130       130         Percentage Soluble BOD       0       0       0       0       0       0       0         COD concentration To Secondary Treatment       0       0       0       0       0       0       0       0         COD concentration To Secondary Treatment       0       0       0       0       0       0       0       0       0       0       0       0       0       0			1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -			l .	_	Ι.	
Volatile SS Component         110         98         111         99         130         116           Inorganic SS Component         28         25         28         25         33         29           NH4-N concentration         67         67         45         45         53         53           Concentrations at Average Flow         Yr 2005         Yr 2025         Yr 2025 + 20%         Min         Max         Min				-	-		0	0	0
Volatile SS Component Inorganic SS Component         110         98         111         99         130         116           NH4-N concentration         28         25         28         25         33         29           NH4-N concentration         67         67         67         45         45         53         53           Concentrations at Average Flow         Yr 2005         Yr 2025         Yr 2025 + 20%         Min         Max         Min				138	123	139	124	163	145
Inorganic SS Component         28         25         28         25         33         29           NH4-N concentration         67         67         45         45         53         53           Concentration         Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min           BOD concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0				i i					
NH4-N concentration         67         67         45         45         53         53           Concentrations at Average Flow           Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min           BOD concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <td>Volatile SS Comp</td> <td>onent</td> <td></td> <td>110</td> <td>98</td> <td></td> <td></td> <td></td> <td></td>	Volatile SS Comp	onent		110	98				
Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         <	Inorganic SS Com	ponent		28	25		25	33	29
Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         <					67	45		53	53
Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min         Max         Min         Bob concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         14         14									
Max         Min         Bob         Max         Min         Bob         Max         Min         Max         Min         Max         Min         Bob         Max         Min         Bob         Max         Min         Max         Min         Bob         Display         Display <thdisplay< th="">         Display         D</thdisplay<>	Concentrations a	at Average Flow		,					
Max         Min         Bob         Max         Min         Bob         Max         Min         Max         Min         Max         Min         Bob         Max         Min         Bob         Max         Min         Max         Min         Bob         Display         Display <thdisplay< th="">         Display         D</thdisplay<>									
BOD concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         114         14         Volatile SS Component         83         74         87         77									
Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0				Max	Min	Max	Min	Max	Min
Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	BOD concentratio	n To Secondary Stage		240	224	245	229	290	271
Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0			1. A.					3	
COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0							1		
SS To Secondary Treatment Stage     104     92     109     97     128     114       Volatile SS Component     83     74     87     77     102     91       Inorganic SS Component     21     18     22     19     26     23				0	0	0	0	0	0
Volatile SS Component         83         74         87         77         102         91           Inorganic SS Component         21         18         22         19         26         23			+				1		
Volatile SS Component         83         74         87         77         102         91           Inorganic SS Component         21         18         22         19         26         23				104	32	103	"	120	l ''''
Inorganic SS Component 21 18 22 19 26 23	· ·			82	74	97	77	100	01
Nri4-iv concentration         50         50         35         42         42									
	NH4-N concentral	(101)		50	50	35	35	42	42
	L								

#### SLUDGE PRODUCTION

#### Extended Aeration

Note : This equation applies where primary tanks are not utilised and where extended aeration is practiced. It should not be used if trade effluents containing non-degradable or slowly biodegradable solids are present. For a more detailed calculation see spreadsheet entitled 'SAS Production Rate'.

Not used in design

Sludge Loading (F/M Ratio)	kgBOD/kgTSSd	0.3	1		
Temperature	degrees C	8	10	12	20
Ratio of non biodegradable solids in raw sewage / total SS in raw sewage.		0.2	0.2	0.2	0.2
Ratio of total raw sewage SS to raw sewage BOD (Fallback value =1.2)		0.72			
Temperature	degrees C	8	10	12	20
Sludge Yield		0.79	0.79	0.78	0.73
Max Sludge Production (Yr 2005)	kg/d	4556	4514	4466	4194
Min Sludge Production (Yr 2005)	kg/d	4252	4213	4168	3915
Man Oludaa Deaduatiaa (Me 0005)	1/-!	7.400	7004	7000	I
Min Sludge Production (Yr 2025)	kg/d	6934	6871	6798	6384
Max Sludge Production (Yr 2025)	kg/d	8792	8712	8619	8095
Min Sludge Production (Yr 2025)	kg/d	8206	8131	8045	7555

#### Conventional Aeration

For well settled sewage the following equation can be used. This applies for a temperature range of 7 to 25 C

	and the second					
Sludge Loading (F/M Ratio)	kgBOD/kgTSSd	0.27				· ••
Temperature	degrees C	8	10	12	20	]
0.75 used in tend	er design					-
SludgeYield		1.01	0.75	0.80	0.51	1
Max Sludge Production (Yr 2005)	kg/d	5810	4302	4569	2899	1
Min Sludge Production (Yr 2005)	kg/d	5423	4015	4264	2706	
Max Sludge Production (Yr 2025)	kg/d	9475	7015	745	4727	1
Min Sludge Production (Yr 2025)	kg/d	8844	6547	6954	4412	
Max Sludge Production (Yr 2025)	kg/d	11213	8302	8817	5594	1
Min Sludge Production (Yr 2025)	kg/d	10466	7748	8229	5221	
			A71 00			-

#### Selector Tank Volume

Selector Tank Volume		Se d'he			
Design Basis : minimum of 30 mins at DW	/F plus RAS or 10 mins at max flo	w plus RAS			-
Assuming RAS remains constant for both		A LET TO			•
	inspecto	Yr 2005	Yr 2025	Yr 2025 + 20	1%
RAS Flow	m3/h	752	2036	2036	
30 mins at DWF plus RAS	m3 🗡 న	730	1590	1590	
10 mins at max flow plus RAS	m3 _ 💦	479	912	912	
30 mins at DWF	No.	354	572	572	
Selector Zone Volume	m3	730	1590	1590	
	an an an an 🖓 🖓 an t-bha tha tha an				
MLSS	🔆 🕻 🕅 🖓 🖓 🖓 🖓	3.5	]		•••
Number of selector tanks		1	1		1.
Water Depth	m m	5	1		
Tank Length	m	12	1		
Tank Width	m in the second s	10	1		
Actual Volume per tank	m3	600			
Proposed Selector Tank Volume	m3	600	Selected to	give floc loading	>2.3
	· · · ·		- ·		
		DWF	Average	Peak	
Actual Retention Time	mins	51	39	17	
Actual Retention Time (inc RAS)	mins	25	22	13	
Floc Loading (>2.3)	4 	4.5 (BOD kg/d /l	Mixed Liquor M	ass in Selector)	
					*

Note: The Floc Loading should be greater than 2.3 to encourage the growth of floc forming bacteria. This can be increased by lowering the selector volume or mixed liquor suspended solids.

Selected F/M ratio Operating MLSS

0.3

Volume Required Volume Selected

10542 m 10600

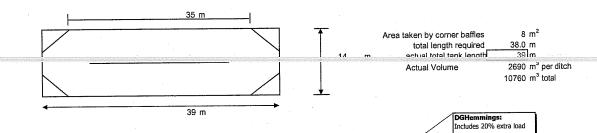
Based upon 2025 load with 20% extra as requirement to meet consent with one lane out of service.

### Inclined Bubble Aeration Ditch

Selector Volume Required	m3	600	
Total Volume For Oxidation ditch	m3	10600	
		Tender drawing	shows tank
Number of streams	m3	4	
Volume Per stream	m3	2650	
Minimum Sewage Depth	m	5 5	
Width of each lane	m	7 7	
Straight Length of each tank	m	38 48.5	
Actual Volume Per Tank	m3	2660 3395	
Recycle Ratio (FST to ditch)		1	

Ref: Vol 4 section 7.7.1 minimum sludge 5 days @ 10 deg C

### Inclined Bubble Aeration Ditch - Tapered Ends



### Actual F/M Ratio Max Year 2025 Max Year 2025 Average 2005 Max Min Max Max Min Min Max 3.5 0.25 3.5 0.23 3.5 3.0 0.17 3.5 MLSS in ASP kg/m3 3.0 0.18 0.29 0.27 Actual F/M Ratio SRT = Vol x MLSS/sludge prod SRT = 1/(yield x F:M) 6 6 5 5 d d 8 5 5 SRT 8 8 8 5 SRT

### **Operation With One Tank Out Of Service**

SRT	•	d	8.	8	5	6 .0	. 5	5	SRT = 1/(yield x F:M)
Operation With One Ta	ank Out Of Service	-				other us		•	
MLSS in ASP		kg/m3	3.0	3.0	A0 0	4.0	4.8 0.29	4.8	7
Actual F/M Ratio			0.24	0.22	0.29	0.27	0.29	0.27	SRT = Vol x MLSS/sludge pro
SRT		d d	6	6 6	5	5	5.	5	SRT = 1/(yield x F:M)
BRT		u			<u></u>	<u> </u>	L		
			Forinspecti	SWIPEL	· · · · ·				
		Consent	5						



Contract Name : Waterford

Contract No: C1197

ocument Reference: 8407

Title : SAS Sludge Production

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator	Checked	Approved
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	ntional Aeration PI	ants	Project-Specific Data				
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### Application

Provides guidance in the calculation of the quantity of WAS produced for conventional aeration plants which utilise primary tanks.

### Introduction

Sludge Load Produced (Average) 2005.

The calculation below can be used for a well settled sewage treating domestic sewage.

### 5353 From 8404 Activated Sludge Design BOD in settled sewage feed kg/d From 8404 Activated Sludge Design SS in settled sewage feed kg/d 2212 Ref: Vol 4 section 7.7.1 degrees C 10 Temperature of sewage F/M Ratio From 8404 Activated Sludge Design 0.17 Temperature of sewage degrees C 8 30 12 20 kgTS/kgBOD note: 0.75 in tender 0.91 0.75 0.72 0.46 **Yield Coefficient** kgDS/d 4883 2466 Sludge Production 4015 3852 tDS/yr 1406 900 \$782 1465 Sludge Dry Solids % Temperature 0.4 0.5 0.6 kg/m Sludge Density 1001 1001 1002 Sludge Volume m3/d 8 1219 975 813 ofcor 1003 802 668 10 12 962 769 641 20 616 492 410

	BOD in settled sewage feed	kg/d	8730	From 8404 A	ctivated Sludge	e Desian	
	SS in settled sewage feed	kg/d	3693		ctivated Sludge	0	•
	Temperature of sewage	degrees C	10	Vol 4 section			
	F/M Ratio		0.23	From 8404 A	ctivated Sludge	e Design	
	Temperature of sewage	degrees C	8	10	12	20	· · ·
	Yield Coefficient	kgTS/kgBOD	0.98	0.75	0.77	0.49	note: 0.75 in tender
	Sludge Production	kgDS/d	8557	6547	6735	4285	
		tDS/yr	3123	2390	2458	1564	
	Sludge Dry Solids	%	Temperature	0.4	0.5	0.6	1
	Sludge Density	kg/m3	remperature	1001	1001	1002	-
	Sludge Volume	m3/d	. 8	2137	1709	1424	- <b>-</b>
	oldage voldine	mora	10	1635	1308	1089	-
			12	1682	1345	1121	-
Produced	(Maximum 20% extra) 2025		20	1070	856	713 dghemm Only 30% across PST	BOD removal
d Produced	BOD in settled sewage feed	-	10331	From 8404 A	ctivated Sludge	dghemm Only 30% across PST e Design	BOD removal
Produced	BOD in settled sewage feed SS in settled sewage feed	kg/d	10331 4875	From 8404 A From 8404 A	ctivated Sludge	dghemm Only 30% across PST e Design	BOD removal
Produced	BOD in settled sewage feed	-	10331	From 8404 A From 8404 A Vol 4 section	ctivated Sludge	dghemm Only 30% across PST e Design e Design	BOD removal
Produced	BOD in settled sewage feed SS in settled sewage feed Temperature of sewage F/M Ratio	kg/d degrees C	10331 4875 10 0.27	From 8404 A From 8404 A Vol 4 section From 8404 A	ctivated Sludge ctivated Sludge \$.7.1 ctivated Sludge	dghemmi Only 30% across PST e Design e Design e Design	BOD removal
roduced	BOD in settled sewage feed SS in settled sewage feed Temperature of sewage F/M Ratio Temperature of sewage	kg/d degrees C degrees C	10331 4875 10 0.27 8	From 8404 A From 8404 A Vol 4 section From 8404 A From 8404 A	ctivated Sludge ctivated Sludge ?.7.1 ctivated Sludge 15	dghemmi Only 30% across PST e Design e Design	BOD removal
Produced	BOD in settled sewage feed SS in settled sewage feed Temperature of sewage F/M Ratio	kg/d degrees C degrees C kgTS/kgBOD	10331 4875 10 0.27	From 8404 A From 8404 A Vol 4 section From 8404 A	ctivated Sludge ctivated Sludge \$.7.1 ctivated Sludge	dghemmi Only 30% across PST e Design e Design e Design 20	BOD removal
roduced	BOD in settled sewage feed SS in settled sewage feed Temperature of sewage F/M Ratio Temperature of sewage Yield Coefficient	kg/d degrees C degrees C	10331 4875 10 0.27 8 1.02	From 8404 A From 8404 A Vol 4 section From 8404 A From 8404 A From 8404 A From 8404 A From 8404 A	ctivated Sludge ctivated Sludge ?.7.1 ctivated Sludge 15 0.67	across PST e Design e Design e Design e Design 20 0.51	BOD removal
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Produced	BOD in settled sewage feed SS in settled sewage feed Temperature of sewage F/M Ratio Temperature of sewage Yield Coefficient Sludge Production	kg/d degrees C degrees C kgTS/kgBOD kgDS/d tDS/yr	10331 4875 10 0.27 8 1.02 8 1.02 8	From 8404 A4 From 8404 A4 Vol 4 section From 8404 A4 10 0.75 7748 2828 0.4	ctivated Sludge ctivated Sludge ?.7.1 ctivated Sludge 15 0.67 6930 2529 0.5	dghemm           Only 30%           Only 30%           across PST           a Design           a Design           a Design           a Design           20           0.51           5237           1912           0.6	BOD removal
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### APPLICATION

Provides guidance in the calculation of the sludge pump capacity required for SAS desludging.

### INTRODUCTION

SAS sludge pumps are normally run on a timer basis.

The calculation below allows an estimate of the sludge pump capacity

INPUTS					1.1	and a second	
		Average	Maximum	a ser a ser a			
SS Load	kg/d	6547	7748				
No. duty pumps per tank		1	_				
Pump run time	mins/hr	60				н. н. 1	
		-		15	ç.		
AVERAGE SLUDGE QUANTITY RE	EMOVED			otherus	<i>.</i> .		
Dry Solids Content	%	0.6	. 0.6 8	0.7 V 0.7	0.8		
Sludge Density	kg/m3	1002	1002 d	1002	1002		2
Sludge Removed	kgDS/d	6547	654711	6547	6547		
	m3/d	1089	ction P1089	933	817	•	
SLUDGE PUMP DUTY		Feeding 1	Thickener 20 h	dav 7 d/wk (i	ref: 8409 Sec	condary Sludge Thickener)	
SLODGE FOMF DOTT		a vis	Ste				
Hours operated per day	hr/d	FO PYIT	20	20	20		
Duty GBT		01	1	1	1		
Pump flowrate required	m3/h	sent 54	54	47	41		
Fump now are required	( internet	OUS					
Selected Flowrate	m3/h	60				per duty pump.	
Actual run time	mins/hr	54	54	47	41		
MAXIMUM SLUDGE QUANTITY RI	EMOVED	Feeding 2 GI	3T thickener 12.6	h day 7 d/wk	k (ref: 8409 S	econdary Sludge Thickener)	
	· ·				T		
Dry Solids Content	%	0.6	0.6	0.7	0.8		
Dry Solids Content Sludge Density	% kg/m3	1002	1002	1002	1002		
				1002 7748	1002 7748		
Sludge Density	kg/m3	1002	1002	1002	1002		
Sludge Density Sludge Removed	kg/m3 kgDS/d m3/d	1002 7748 1289	1002 7748 1289	1002 7748 1105	1002 7748 966		
Sludge Density	kg/m3 kgDS/d	1002 7748 1289 12.6	1002 7748 1289 12.6	1002 7748 1105 12.6	1002 7748 966 12.6		
Sludge Density Sludge Removed	kg/m3 kgDS/d m3/d	1002 7748 1289 12.6 2	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day	kg/m3 kgDS/d m3/d	1002 7748 1289 12.6	1002 7748 1289 12.6	1002 7748 1105 12.6	1002 7748 966 12.6		
Sludge Density Sludge Removed Hours operated per day Duty GBT	kg/m3 kgDS/d m3/d hr/d	1002 7748 1289 12.6 2	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge	kg/m3 kgDS/d m3/d hr/d mins/hr	1002 7748 1289 12.6 2 51	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge Pipe diameter	kg/m3 kgDS/d m3/d hr/d mins/hr 0.15	1002 7748 1289 12.6 2 51 ]m	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge	kg/m3 kgDS/d m3/d hr/d mins/hr	1002 7748 1289 12.6 2 51	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		•
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge Pipe diameter CSA	kg/m3 kgDS/d m3/d hr/d mins/hr 0.15 0.018	1002 7748 1289 12.6 2 51 ]m m2	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge Pipe diameter CSA Pump Flowrate	kg/m3 kgDS/d m3/d hr/d mins/hr 0.15 0.018	1002 7748 1289 12.6 2 51 m m2 m3/h	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		
Sludge Density Sludge Removed Hours operated per day Duty GBT Time to remove sludge Pipe diameter CSA	kg/m3 kgDS/d m3/d hr/d mins/hr 0.15 0.018	1002 7748 1289 12.6 2 51 ]m m2	1002 7748 1289 12.6 2	1002 7748 1105 12.6 2	1002 7748 966 12.6 2		



Contract Name : Waterford

Contract No: C1197

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Title : Picket Fence Thickener

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### SCOPE 1.

To calculate the WRc thickener size for the Waterford WwTW.

SUMMARY 2.

•		
No. of WRc thickeners =	. 1	
WRc thickener diameter =	8.700	m
Total depth =	4.000	m :
Supernatant depth =	0.660	m
Launder width =	0.870	m
Launder TWL =	0.109	m below O/F

### REFERENCES 3.

Ref 1 for wastewater is Guidelines for design and operation of sewage sludge consolidation tanks WRc 1994 01.

Design the picket fence thickener to operate in continuous mode on primary sludge only. Assume that the primary tanks will be provided with an auto desludging system, which will operate on a semi-continuous basis for 24 hours per day, 7 days per week. Auto desludge regime is 24 desludges per day per PST (2 PSTs). 20 minutes per desludge. Therefore desludging for 20 min x 24 x 2 = 16 hours per day,

### CALCULATION

4.2.

4.

Design Basis 4.1.

Design								
						of any other	Se.	
4.1.1.	Sludge Breduction						s ^r .	
4.1.1.	Sludge Production			·	· · ·	off)		
	and the second second second		·	1.	×	to y	-	
					of	1.01		
		Min.	Avg.	Max.	~~ N	9		
	Sludge production =	3041.94	5077.79	6500.05	die	From 8404	-Activate	ed Sludge
	Ξ	126.7	211.6					
	Primary tank removal =	55.0	55.0	. 60,0 %		Assumed		
	Solids concentration =	3.0%	3.0%	^{رک} <u>3</u> 0% by		Assumed	1.5 miles 112	tionen an anna an
	Sludge density =	1008.6	1008.6	1008.6 kg	µm ⁻³			
	Sludge =	4.19	6.99	🕉 8.95 m ⁱ	³ h ⁻¹			
		,	to St					
	* · · · ·	. •	x cor					ta en la composición la composición
4.1.2.	Thickener Design		^o	*				
		and the set	F06.991			,		
		(Min.	Avg.	Max.				
4 C	No. of duty thickeners =	1	1	1				
	No. of standby thickeners =	0	0	0			•	
			· . •					
	Max by	draulic load	ing rate =	0.5 m	³ m ⁻² h ⁻¹	[Ref. 0	41	· · ·
		solids load	-			Ref: Vo		n 7 0 1
	. Max	50105 1000	Г			Ref: Vo		
WRoTh	lickener		Ļ	110.0 Kg	jiii u	ועפו. ענ	4 5000	
					4			
4.2.1.	Thickener Feed Rate	•						
4.2.1.	Thickener Feed Rate							
					-			
	······	Min.	Avg.	Max.				
	Days operation =	7.0	7.0	7.0 d				
	Hours operation =	24.0	24.0	24.0 h	d" .			
	No. of duty units =	1	1	1				
	Thickener unit feed flow =	4.19	6.99	8.95 m		· .		
	Solids concentration =	3.0%	3.0%	3.0% by				
•	Sludge density =	1008.6	1008.6	1008.6 <b>kg</b>	•	· · · ·		
	Thickener block feed solids =	126.7	.211.6	270.8 kg	1 h ⁻¹		1.00	

29,72 29.72 m³ h⁻¹ Maximum allowable thickener unit feed flow = 29.72

29.00 m³ h⁻¹ Chosen max instanteous pump rate

	Thisland On Pala				
4.2.2.	Thickened Solids				
	•	Min	٨٧٩	Mov	
	Thickener recovery =	Min. 99.5%	Avg. 99.5%	Max.	t of inlet solids Assumed
	Cake solids =	126.1	210.5	269.5 kg h	
	Solids concentration =	6.0%	6.0%	6.0% by v	
	Sludge density =	1017.4	1017.4	1017.4 kg n	
	Thickened sludge volume =	2.07	3.45	4.41 m ³ h	
	mickened slodge volume -	2.01	9.40	29.00 m ³ h	
				29.00 M I	Chosen max instanteous pump rate
4.2.3.	Thickener Filtrate				
		Min.	Avg.	Max.	
	Filtrate solids =	0.6	1.1	1.4 kg h	-1
	Approx. centrate density =	1000.0	1000.0	1000.0 kg n	1 ⁻³ Assumed
	Average Filtrate flow =	2.12	3.54	4.54 m ³ h	
				29.00 m ³ l	
	Filtrate solids concentration =	0.30	0.30	0.30 kg n	1 ⁻³
	. =	299	299	299 mg	
	Solids concentration =	0.03%	0.03%	0.03% by v	/t 140 mg/l
	Load =	15.2	25.4	32.5 kg/d	
	· · · · · · · · · · · · · · · · · · ·				
1.2.4.	Thickened Sludge Storage (	Emergency)			
•					
		Min.	Avg.	Max.	and the second secon
	Days operation =	3.0	3.0	3.0 d	Ref: Vol 4 section 7.9.3 storage of 3 days
	Hours production =	24.0	24.0	24.0 h d	
	No. of duty tanks =	1	1	1	
	Sludge storage volume =	148,74	248.29	317.83 m ³	
					<u>م</u> .
					only any offer use
4.2.5.	Thickener Diameter		, ,		e en la tra sette de la companya de
					A. A.
		Min.	Avg.	Max.	only are
	Hydraulic load =	4.2	7.0	29.0 m ³⁰	
	Solids load =	126.7	211.5	270.8 kg	
	No. of thickeners =	1		Du edi	
	Unit hydraulic load =	4.2	7.0	29.0 m ³ l	1 ¹ thickener ⁻¹
	Unit solids load =	126.7	211.6	290.8 kg h	¹ thickener ¹
	Hydraulic diameter =	3.266	4.220	8.593 m	
	Solids diameter =	5.934	J666	8.674 m	
			x 83		
		Thic	ener is	Solids limite	di .
		Diameterse	ected =	8.700 m	
	Diameter selected from	Permastore F	Range =	8.530 m	
1.2.6.	Depths	CO,			
•		Total	depth =	4.000 m	Ref: Vol 4 section 7.9.1; Needs to be at least 4m process depth
	and the second	Supernatant	-	0.660 m	Ref. 01
	4		${\cal C}_{\rm eff} = {\cal C}_{\rm eff}$	4.1	
.2.7.	Launder	с. 1919 г. – Алтан			
		•.			
		Launder	width =	0.870 m.	Ref. 01
			depth =		elow thickener O/F Ref. 01
		Liquiq	•		and a second
		Eldaio			
1.2.8.	Sludge Retention	Liquid			
1.2.8.	Sludge Retention		pacitv =	237.000 m ³	
1.2.8.	Sludge Retention	Chosen ca		237.000 m ³ 190.869 m ³	
4.2.8.	Sludge Retention		olume =	237.000 m ³ 190.869 m ³ 3.340 m	

		RE STAN		MENSION 5	10 10 10	15	ENCE THI 20	25	30	35	40	45	50
	l Height			1.47	2.867	4.264	5.661	7.058	8.455	9.852	11.249	12.846	14.043
Numb	er of rin	gs		1	2	3	4	5	6	7	8	9	10
	Actual	Floor	Sheets										
Ref	Diamete	Area m2	Per Ring	1.1			NOMINAL	CAPACITY	(m3)				·
8	2.56	5.14	3	7	14	21	.28	36	43	50	57	64	72
11	3.41	9.14	4	12	25	38	51	63	76	89	102	115	127
14	4.27	14.29	5	19	39	59	79	99	119	139	159	179	199
17	5.12	20.58	6	28	56	85	114	143	171	200	229	258	286
20 22	5.97 6.82	28.01 36.58	7 8	38 49	77 100	116 151	155 203	194 254	233 305	2782 356	312 407	351 458	390 509
. 22	0.62	50.58	0	72	100	151	205	234	505	550	407	-50	507
25	7.68	46.3	9	62	127	192	256	321	386	450	515	580	644
28	8.53	57.16	10	. 77	157	237	316	396	476	556	636	716	795
30	9.38	69.16	. 11	93	190	286	383	479	576	673	769	866	963
		00.1	10		226	2.47	150	571	696	801	016	1021	1146
33 36	10.24 11.09	82.3 96.59	12 13	111 130	226 265	341 400	456 535	571 670	686 805	801 940	916 1075	1031 1209	1146 1344
39	11.94	112.03	14	150	307	464	620	777	933	1090	1246	1403	1559
					201								
42	12.8	128.6	15	173	353	532	712	892	1071	1251	1431	1610	1790
45	13.65	146.32	16	197	401	606	810	1014	1219	1423	1628	1832	2036
47	14.5	185.18	17	222	453	684	914	1145	1376	1607	1837	2068	2299
50	15.36	185.18	18	249	508	766	1025	1284	1543	1801	2060	2319	N
53	16.21	206.33	19	249	566	854	1142	1431	1719	2007	22000	2583	
- 56	17.06	228.62	20	307	627	946	1266	1585	1904	2224	2543.	1 A A	· · ·
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59	17.91	252.06	2,1	339	· 691	1043	1395	1748	2100	2452	2804	1 A A	
62	18.77	276.63	22	372	759	1145	1531	1918	2304	.2691	3077		
64	19.62	302.35	23	407	829	1251	1674	2096	2518	2941	3363		
67	20.47	329,22	24	443	903	1363	1823	2282	027420	3202	3662		
70	21.33	357.22	25	480	980	1479	1976	2477	2976	3475	3974		
73	22.18	386.37	26	520	1059	1599	2139	2679		3758			1999 - 1997 - 1992 - 1992 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 - 1993 -
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81	23.89	480.68	28	647	1318	1990	26610	3333	4004	4676			
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84	25.59	514.4	30	692	1410	2129	2848	3566	4285				
86	26.45	549.27	31	739	1506	2273	3041	3808	4575				
89	27.3	585.27	32	787	1605	2422	3240	4058	4875		-		
92	28.15	622.43	33	837	1707	2576	3446	4315	5185	•			
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126		1157.4	45	1557	3174	4790	6407					1 · · ·	
129	39.24	1209.42	46	1627	3316	5005	6695						
131	40.09	1262.57	47	1698	3462	5226	6990						
134	40.95	1316.87	48	1771	3611	5451	7290	· ·					
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Contract Name : Waterford

Contract No: C1197

ocument Reference: 8409

### Title : GBT Design

Revision	No. of Pages	Date of	Purpose of Issue	Originator	Checked	Approved
	(Excluding Cover)	Issue				
1	2	10/11/2006	Contract Issue	DGH	RJW	RJW
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### 1. SCOPE

To calculate the thickener duties for the Waterford WwTW

### 2. SUMMARY

### 2.1. Scheme [Thickeners]

	Min.	Avg.	Max.	
No. of duty units =	- 1	1	2	
Thickener feed flow =	40.09	54.47	55.00 m ³ h ⁻¹	per machine
Thickener feed solids =	0.5%	0.6%	0.6% by wt	
Ξ	200.7	327.4	330.6 kg h ⁻¹	per machine
Thickened solids =	5.0%	5.0%	5.0% by wt	
Filtrate solids consent =	441	540	540 mg L ⁻¹	a de la seconda de

## 3. REFERENCES

				•		يري.
						y my other to
3.1.	Duty [Fi	om AS Plant]		tin eta	0 0 1	<b>BGHemmings:</b> Includes 20% extra load at
	3.1.1.	SAS Sludge Feed	ing i i i		ction purpose required	only 30%BOD removal across PST
• .			Min.	Ave	Max.	
		Sludge production =	4014.89	6545.43	7748.24 kg d ⁻¹	90 g.
		an the state is t	167.3	272.8	322.8 kg h ⁻¹	
		Solids concentration =		_0.6%	0.6% by wt	and the second sec
		Sludge density =	1001	1001.7	1001.7 kg m	3 .
		Sludge =	38.41	45.39	53.72 m ³ h ⁻¹	
	3.1.2.	SAS Buffer Tank	•	•		
		· · ·	Min.	Avg.	Max.	
		Days operation =	1.0	1.0	1.0 d	
	2000 - 100 100	Hours production =	0.0	0.0	0.0 h d ⁻¹	
		No. of duty tanks =	- 1	1	1	

0.00

0.00

 $0.00 \text{ m}^3$ 

Sludge storage volume =



### Thickener Feed Rate 3.1.2.

•	Min.	Avg.	Max.	
Days operation =	7.0	7.0	7.0 d week	1
Hours operation =	20.0	20.0	11.7 h d ⁻¹	Vol 4 section 7.9.7 treat average sludge load in < 20 hours
No. of duty units =	1	1	2	
Thickener unit feed flow =	40.09	54.47	55.00 m ³ h ⁻¹	
Solids concentration =	0.5%	0.6%	0.6% by wt	
Sludge density =	1001.4	1001.7	1001.7 <b>kg m⁻³</b>	
Thickener block feed solids =	200.7	327.4	330.6 kg h ⁻¹	per machine

### **Thickened Solids** 3.1.3.

	Min.	Avg.	Max.	
Thickener recovery =	92.0%	92.0%	92.0% by wt of	inlet solids
Cake solids =	184.7	301.2	304.1 kg h ⁻¹	per machine
Solids concentration =	5.0%	5.0%	5.0% by wt	
Sludge density =	1014.5	1014.5	1014.5 kg m ⁻³	•
Thickened sludge volume =	3.64	5.94	6.00 m ³ h ⁻¹	per machine
				÷

### **Thickener Filtrate** 3.1.4.

	Min.	Avg.	Max.	
Filtrate solids =	16.1	26.2	26.4 kg h ⁻¹	<b>.</b>
Approx. centrate density =	1000.0	1000.0	1000.0 kg m ⁻³	15 ⁶
Filtrate flow =	36.46	48.54	49.01 m ³ h ⁻¹	permachine
Filtrate solids concentration =	0.44	0.54	0.54 kg m 🔧	int
이 아이 아이 아이 아이 아이 아이 아이들.	441	540	540 mg 2	5
Solids concentration =	0.04%	0.05%	0.05% by wt	
Return Load =	321.2	523.8	619.9 kg/d	
Wash water and make-up consumption =	6.5	6.5	10165 m3 h-1	Sernagiotto Literature (1200N)
Total filtrate return =	43.0	55.00	² <b>∂</b> ¹ 1.0 m ³ h ⁻¹	
	+	orthis	an an	
3.1.5. Thickened Filter Sludge Sto	orage	ofcopy		

### Thickened Filter Sludge Storage 3.1.5.

- ¹	Min	Åvg.	Max.	
Days operation =	0.60	3.0	3.0 d	Vol 4 section 7.9.3 storage of 3 days
Hours production =	20.0	20.0	11.7 h d ⁻¹	production of thickened secondary sludge
No. of duty tanks =	1	1	1	÷
Sludge storage volume =	218.46	356.26	421.59 m ³	

# Printed: 16/11/2006 EPA Export 26-07-2013:02:15:17



Contract Name : Waterford

Contract No: C1197

### Document Reference: 8420

Title : Pasteurisier

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue			
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### **DESIGN BASIS FOR WATERFORD STW**

### 1. Indigenous sludge production

Yearly sludge production	0 0	tDS/year kgDS/day	·	
Primary sludge thickness	6	6	6	%DS by means of new Picket Fence Thickeners (EPS)
Density	1017	1017	1017	kg/m3
Secondary sludge thickness	5	5	5	%DS by means of a new SAS thickener (EPS)
Density	1014	1014	1014	kg/m3
				•

	Minimum	Average	Maximum	_ ·	
Primary sludge production	3041	5078	6499	kgDS/day	From 8408 Primary Sludge Thickening
Primary sludge volume	50	83	106	m3/day	
Secondary sludge production	3694	6024	7116	kgDS/day	From 8409 Secondary Sludge Thickening
Secondary sludge volume	. 73	119	140	m3/day	
Total indigenous sludge volume	122.6	201.9	246.7	m3/day	

Total indigenous sludge volume	122.6	201.9	246.7	m3/day
Percentage dry solids of the blend	5.4	5.4	5.5	%DS

### 2. Imported sludge

Type of imported sludge Unknown In the future, the sludge will be imported in consolidation tanks prior to digestion. Imported sludge will not be thickened.

Type of imported sludge ture, the sludge will be imported			•	otheruse.
or to digestion. Imported sludge	e will not be inic	keneu.	only	1. 202
	Minimum	Average	Maximum	<u>o</u> r
Yearly import	0	0	CO ite	tDS/year
Import 5 days a week	0 .	0	Dr.Och	kgDS/day
Thickness of imported sludge	3.0	3.0	on 013.0	%DS
Density	1009	1009 🞺	1009	kg/m3
Volume	0.0	0.0100	0.0	m3/day
ll sludge throughput		cent of copyrise		

### 3. Total sludge throughput

# PASTEURISATION PLANT DESIGN BASIS

	Minimum	Average	Maximum	_ · · ·
Total sludge production	0	• 0	0	tDS/year
· · · · · ·	6735	11102	13615	kgDS/day
Total volume	123	202	247	m3/day
Total percentage dry solids	5.41	5.42	5.41	%DS
-	Normally at n	naximum flow:	5.44	%DS

### 4. Check retention time in the digesters

No off digesters	2	]		
Individual volume	1721	m3	8412 Digester	design sheet
Volume	3442	m3	·	
Retention time	28.1	17.0	13.9	days
				·

### 5. Biogas production

Average gas production

3776 m3/day 8413 Gas production sheet

### PASTEURISATION PLANT DESIGN BASIS

### Sludge Input criteria

ŝ

	Sludge Make	Max 13615	Avg 11102	Min 6735	kg DS/d	
	Sludge Make			······		
	Flowrate	10.3	8.4	5.1	m3/h	• •
	Thickness	5.4%	5.4%	5.4%	% DS	
	Density	1016	1016	1016	kg/m3	
	Viscosity at 10 degC	35.12	23.32	14.6	Nm2/s	CHECK WITH LOWESTOFT DE
	For an upper bound slu	ıdge				
		Summer	Winter	л., , , , , , , , , , , , , , , , , , ,		
	Sludge Temp	15	5	J	degrees C	Assumed
	Enter Installed Digeste	r Capacity		3442	m3	•
	Specific Heat Capacity	1		4.186	kJ/kg.K	
						onditions will be defined
	using maximum opera operational conditions		ions (sludge th	roughput a	nd %DS) for s	summer and minimal
	operational conditions	for winter.				Ø)•
) <u>p</u> e	erational Requirement	5	4 · · .		· .	of 150
	Pasteurisation Temp	55	degrees (70 de			13. 20
	Pasteurisation Time	240	minutes as a n	ninimum (3	5 minutes mi	nimum recommended)
	Hrs of Operation	20				whine (22 hrs recommended)
	Range of flowrate	12.3	10.1	5.1	average (M)	ibad freated in 25 aodisy
		·	•		THEFT	
		. •		- Fr	.opy	
	•	Option 1		Option	2	
	Digestion Temp	35	Mesophilic	onse-	Thermophi	ilic
	•					
)ig	esters heat losses					· ·
The	design of the heat excl	angers is bar	sed on the max	imum and r	ninimum slud	lge flows, i.e.
		15.0	m3/hr.	5.1	m3/hr	
	See spreadsheet "Dige				/	· · · ·
	Note: This includes the	e neat losses	in the pipeline	<i>es</i> .		
						• •
		Maxi Summer	mum flow Winter	Mini Summe	mum flow r Winter	
•	Heat losses	95.4	206.1	47.7	103.1	kW
	The corresponding ris	e in temperal	ure is:			
	Tei	np (deg C) =		Energy (1	(W) X 3600	
• •						r) X Density (kg/m3)
			· .	•.		
	Temperature rise	6.5	14.1	7.9	17.1	deg C
	Final temperature	41.5	49.1	42.9	52.1	deg C
	· · ·					
					•	

### SIZING OF THE PASTEURISATION UNIT

### Sludge Input criteria

S	Sludge Make	Max 13615	Avg 11102	Min 6735	kg DS/d				
	Flowrate	10.3	8.4	5.1	15.0	m3/h	1 A 1		
						morn			
1	Thickness	5.4%	5.4%	5%	% DS				
I	Density	1016	1016	1016	kg/m3				
	Viscosity at 10 degC	35.12	23.32	14.6	Nm2/s				
	For an upper bound sludge								
- • ·					· . · .		•	· . · ·	
	Pasteurisation Temp		-	degrees min		•			
. 1	Pasteurisation Time			nimum (35 m					
]	Hrs of Operation	20	urs per day		wance for do Alfa Laval	own time	(22 hrs recom	mended)	
	Actual Flowrate	12.3	10.1	5.1	15.0	m3/h	Channei (0. SA =	018m x 0.2 0.0045	
	0	· · · ·					velocity =	0.925926	
cycles per	day option								14
Number of t	tanks	3		•			:		
Number of o	complete cyles per day	2		Therefore n	umber of ta	nk empti	es per day	6	
Fime of cyc	le	720 Max	min	720 15	720 15	·			2
Duration of	fill stage	280	min		15				150
	pasteurise stage	240	min	240	240			- 14 	ner
Duration of	empty stage	200	min	CHECK Avg	Min			1	×-
Volume of s	sludge	41.1	m3	33.7	20.4		ే	The Str.	
Discharge ra		12.3	m3/h				్ లో గ	50r	
	chosen tank size ate @ chosen tank size	164 15.0	min m3/h	135 15.0	82		1007.10L	*	
	ime @ chosen tank size	164.0	min	134.6	102.2		Diredir		
						dition	ot		
Fotal cycle	time sludge discharged	732.0	min m3/d	643.9 201.9	485.3 122.6	min min	N OK		
dle time	sudge discharged	-12.0	iii.5/d	76.1	234,7	min	puposes prince		
Pasteurisat	ion tank unit				Chosen	00			
	Volume of the bottom sect	ion		49.3		m3			
		Min	Average	Max 🖉	1				
	Retention time	240	293	579	199	min			
	Time allowed for filling bo	ottom section		0	0	min			
	Real retention time	240	293	579	- 199	min			
	Internal diameter of the un	it		3.5	<u>3.5</u> 0.005	m m			
	Wall thickness Lagging thickness			0.005	0.005	m			
	External diameter of the ur	nit .		3.61	3.61	m			
	Minimum sludge water de ( <u>Note</u> : the sludge water de			0.000	0.000	mm	N/A	-	
	( <u>typic</u> . the strange water at	pin is measure	u from me			on oj me	upper tunity		
	Volume in the top tank			49.3	41.0	m3			
	Freeboard in top tank Minimum lagging under th	e tank		0.500	0.500	m m			
	Partition between top and I		*	60	60	1	inc Chosen for	sizing	
	Maximum height of the top	p tank		7.150	6.282	m ·	6.250	m	
	and the second sec	· · ·							- <u>-</u>
	Total heigth of the pasteur	isation unit		7.850	6.982	]m _	6.750	m	
			•						
	Sludvo inlot ring diamater			0.150	0.200	lm	No en		
	Sludge inlet pipe diameter Sludge inlet pipe level			0.150	9.73	m m			
	Sludge outlet pipe top sect	ion diameter				m		•	
	Sludge outlet pipe top sect			10.509	8.773	m			
	Sludge inlet pipe bottom s Sludge outlet pipe diamete			0.150	0.150	m m	÷		
	Sludge outlet pipe level	2	• •	0.325	0.130	m			

Note: level 0.00 is taken as being at the bottom of the pasteurisation tank, including the bottom insulation. The level of pipes is the level of the center section of the pipes.

Sludge outlet pipe level

### EPA Export 26-07-2013:02:15:17

### PASTEURISATION TANK HEAT LOSSES Rev 1

Reason for revision: Heat losses for the three tanks configuration (previous calculations were for one tank).

Drawing ref:					
·				M	
		Minimum	Average	Maximum	
Temperatures					
	° C				
Heated raw sludge in		57	57	57	
Inside Pasteuriser	° C	55	55	55	
Air	⁰ C	-10	-10	-10	
Ground	° C	. 0	0	0	
Sludge					
Specific Heat	kJ/kg.ºC	4.186	4.186	4.186	
Feedrate	m ³ /h	5.1	10.1	12.3	
Solids concentration	% w/w	5.4	5.4	5.4	
-	kg/m ³	1015.7	1015.7	1015.7	al
Density	kg/m	1013.7	1015.7	1015.7	
Pasteuriser	1.1.1.1				
r asteur iser					
Retention time	mins	481,4	243.6	199.4	
recention time	line				
		,			· .
Total retention volume Selected	m ³	41.000	41.000	41.000	
	m ³	41.000	1	1	
Number of tanks	111	L	<u>i</u>	<u>.                                    </u>	
			• • •		
Thermal conductivities			<b>2</b> •		
	· .		15.000		
Steel Wall	W/m.ºC	45.000	45.000	45.000	45.000
	W/m.⁰C	45.000	45.000	45.000	45.000
Steel Floor		45.000			
Concrete roof	W/m.ºC	1.500 211	1.500	1.500	1.500
Steel roof	W/m.ºC	45.000	45.000	45.000	45.000
Roof/wall insulation	W/m.ºC	00.0037	0.037	0.037	0.037
Wet soil	W/m. ⁰ C	NIL (10.700	0.700	0.700	0.700
·	. 5	1000.000 50.000			
Film coefficients	- ctil	ner .			
		•			
Sludge	W/m C	1000.000	1000.000	1000.000	1000.000
Gas / air	Wm ² .°C	50.000	50.000	50.000	50.000
٣, ١	or.				
Thickness of soil heated by Pasteuriser	м. т	1.000	1.000	1.000	1.000
Gas / air QC	m		1.000	1.000	1.000
Thickness of soil heated by Pasteuriser Pasteuriser dimensions	m	1.000	• • • •	*****	• • • •
	, m	1.000 Steel Roof	Steel Roof	1.000 Steel Roof	1.000 Steel Roof
	m	1.000	Steel Roof	*****	• • • •
Pasteuriser dimensions	m m	1.000 Steel Roof with lagging and claddi	Steel Roof ng	Steel Roof	Steel Roof
Pasteuriser dimensions	m m	1.000 Steel Roof with lagging and claddi 3.500	Steel Roof ng 3.500	Steel Roof	Steel Roof
Pasteuriser dimensions	m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750	Steel Roof ng 3.500 .6.750	Steel Roof 3.500 6.750	3.500 6.750
Pasteuriser dimensions	m m	1.000 Steel Roof with lagging and claddi 3.500	Steel Roof ng 3.500	Steel Roof	Steel Roof
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground	m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750	Steel Roof ng 3.500 .6.750	Steel Roof 3.500 6.750	3.500 6.750
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall	m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000	Steel Roof           ng           3.500           6.750           0.000	Steel Roof 3.500 6.750	3.500 6.750
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground	m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750	Steel Roof ng 3.500 .6.750	3.500 6.750 0.000	3.500 6.750 0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall	m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000	Steel Roof ng 3.500 6.750 0.000 0.000	3.500 6.750 0.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height		1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750	Steel Roof ng 3.500 6.750 0.000 0.000 6.750	3.500 6.750 0.000 0.000 6.750	3.500 6.750 0.000 0.000 6.750
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground	, m , m , m , m , m , m , m , m , m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.750	Steel Roof           ng           3.500           6.750           0.000           0.000           6.750           6.750	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.750	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height	, m , m , m , m , m , m , m , m , m , m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.750 6.750 6.250	Steel Roof           ng           3.500           6.750           0.000           0.750           6.750           6.750           6.750           6.750           6.750           6.750	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.750           6.250           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height	, m , m , m , m , m , m , m , m , m , m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.750 6.750 6.250	Steel Roof           ng           3.500           6.750           0.000           0.750           6.750           6.750           6.750           6.750           6.750           6.750	Steel Roof           3.500         6.750           0.000         0.000           0.750         6.750           6.750         6.250	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.250
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth	m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.750 6.250 0.000	Steel Roof           ng           3.500           6.750           0.000           0.750           6.750           6.750           6.250           0.000	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.750           6.250           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard	, m , m , m , m , m , m , m , m , m , m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.750 6.250 0.000	Steel Roof           ng           3.500           6.750           0.000           0.750           6.750           6.750           6.250           0.000	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.750           6.250           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard	m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.750 6.250 0.000 0.500	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.750           6.250           0.000           0.500
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted vall height Wetted roof depth Sludge freeboard Height of gear box & motor	, m , m , m , m , m , m , m , m , m , m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.250 0.000 0.500 6.500	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500           0.500         60.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.250           0.000           0.500           60.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor	m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.750 6.250 0.000 0.500	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.750           6.250           0.000           0.500
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope	m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.250 0.000 0.500 6.500	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500           0.500         60.000	Steel Roof           3.500           6.750           0.000           0.000           6.750           6.750           6.250           0.000           0.500           60.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope	m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           0.000           0.570           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.250         0.000           0.500         0.500           60.000         3.031	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted vall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth	m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031 0.000	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.250           0.000           0.500           60.000           3.031	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500           0.500         3.031           0.000         0.000	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted vall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof	m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           0.000           0.570           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.250         0.000           0.500         0.500           60.000         3.031	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Above ground Total height Wetted wall height Wetted vall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope	m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.250 0.000 0.500 60.000 3.031 0.000 0.000	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000	Steel Roof           3.500         6,750           0.000         0.000           6.750         6.250           0.000         0.500           60.000         3.031           0.000         0.000	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Above ground Total height Wetted wall height Wetted vall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope	m m m m m m m m m m n m n m n m n m m n m m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031 0.000 41.000	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           41.000	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         0.000           0.500         0.500           60.000         3.031           0.000         0.000           41.000         41.000	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope Height	m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.250 0.000 0.500 6.500 6.000 3.031 0.000 41.000 0.005	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.300           0.500           60.000           3.031           0.000           0.000           41.000           0.005	Steel Roof           3.500         6.750           0.000         6.750           6.750         6.250           0.000         0.500           0.500         3.031           0.000         0.000           41.000         0.005	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000           0.000           0.000
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope Height Pasteuriser sludge volume Wall thickness Floor thickness	m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031 0.000 41.000 0.005 0.005	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.250           0.000           0.500           6.000           3.031           0.000           41.000           0.005	Steel Roof           3.500         6.750           0.000         0.000           6.750         6.750           6.750         6.250           0.000         0.500           0.500         0.500           0.000         3.031           0.000         0.000           41.000         0.005           0.005         0.005	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.005           0.005
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Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope Height Pasteuriser sludge volume Wall thickness Floor thickness Roof thickness Kalon thickness Kalon thickness Kalon thickness	m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.250 0.000 0.500 60.000 3.031 0.000 41.000 0.005 0.005 0.005 0.005 0.050	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           41.000           0.005           0.005           0.005	Steel Roof           3.500         6,750           0.000         0.000           6.750         6,250           0.000         0.500           60.000         3,031           0.000         0.000           41.000         0.005           0.005         0.005	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.005           0.005           0.050
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted wall height Wetted roof depth Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope Height Pasteuriser sludge volume Wall thickness Roof thickness Roof thickness Roof thickness Roof thickness Floor insulation thickness	m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.750 6.250 0.000 0.500 60.000 3.031 0.000 41.000 0.005 0.005 0.005 0.050 0.050	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.300           0.500           0.500           0.000           0.000           0.000           41.000           0.005           0.005           0.050	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           41.000           0.005           0.005           0.050	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000           0.000           0.000           0.000           0.005           0.050           0.050
Pasteuriser dimensions Inner diameter Overall height of Pasteuriser, roof & motor above ground Overall height of Pasteuriser, floor & base below ground Side wall Below ground Above ground Total height Wetted wall height Wetted vall height Sludge freeboard Height of gear box & motor Floor Slope Depth Roof Slope Height Pasteuriser sludge volume Wall thickness Floor thickness Roof thickness Wall insulation thickness	m m m m m m m m m m m m m m m m m m m	1.000 Steel Roof with lagging and claddi 3.500 6.750 0.000 6.750 6.250 0.000 0.500 60.000 3.031 0.000 41.000 0.005 0.005 0.005 0.005 0.050	Steel Roof           ng           3.500           6.750           0.000           6.750           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           41.000           0.005           0.005           0.005	Steel Roof           3.500         6,750           0.000         0.000           6.750         6,250           0.000         0.500           60.000         3,031           0.000         0.000           41.000         0.005           0.005         0.005	Steel Roof           3.500           6.750           0.000           6.750           6.750           6.750           6.250           0.000           0.500           60.000           3.031           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.000           0.005           0.005           0.050

8420 Past Tank Heat Losses

### Surface areas

			•			
Pasteuriser base					6	
Inner surface area		m ²	33.501	33.501	33.501	33,501
Outer surface area		m ²	33.741	33.741	33.741	33.741
Log mean suface area	• •	m ²	33.621	33.621	33.621	33.621
Pasteuriser base insulation in contac	t with air	4.11				
Inner surface area		m ²	33.741	33.741	33.741	33.741
Outer surface area		m ²	36.203	36.203	36.203	36.203
Log mean suface area		m ²	34.958	34.958	34.958	34.958
Wetted Pasteuriser wall in contact w	with soil					
Inner surface area		m ²	0.000	0.000	0.000	0.000
Outer surface area		$m^2$	0.000	0.000	0.000	0.000
Log mean suface area		m ²	0.000	0.000	0.000	0.000
Wetted Pasteuriser wall insulation i	n contact with soil			· · ·		
Inner surface area	•	m ²	0.000	0.000	0.000	0.000
Outer surface area		m ²	0.000	0.000	0.000	0.000
Log mean suface area		m ²	0.000	0.000	0.000	0.000
Wetted Pasteuriser wall above grou	nd level			-		
Inner surface area		m ²	68.722	68.722	68.722	68.722
Outer surface area		m ²	68.919	68.919	68.919	68.919
Log mean suface area		m²	68.820	68.820	68.820	68.820
Wetted Pasteuriser wall insulation i	n contact with air	5				
Inner surface area		m ²	68.919	68.919	68.919	68.919
Outer surface area	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	m ²	70.882	<b>270.882</b>	70.882	70.882
Log mean suface area		m ²	69.896	69.896	69.896	69.896
Dry Pasteuriser wall above ground	· · ·		· · ·	Str.		
Inner surface area		m ²	5.498 2	5.498	5.498	5.498
Outer surface area		m ²	25.5130	5.513	5.513	5.513
Log mean suface area	+ x	m ²	110 35506	5.506	5.506	5.506
Dry Pasteuriser wall insulation in c	ontact with air	on P	A LOOK			
Inner surface area		m20110	5.513	5.513	5.513	5.513
Outer surface area	· · · · ·	AL ON	5.671	5.671	5.671	5.671
Log mean suface area	<b>A</b>	JI HORE	5.592	5.592	5.592	5.592
Dry Pasteuriser roof		. Por				
Inner surface area	, Õ	m ²	16.837	16.837	16.837	16.837
Outer surface area	ent	m ²	16.982	16.982	16.982	16.982
Log mean suface area	Cous	m ²	16.909	16.909	16.909	16.909
Dry Pasteuriser roof insulation in co	ontact with air		68.919 70.882 69.896 5.498 V and 5.498 V and 5.506 5.513 5.671 5.592 16.837 16.982 16.982			
Inner surface area			16.982	16.982	16.982	16.982
Outer surface area		m ²	18.475	18.475	18.475	18.475
Log mean suface area		m ²	17.718	17.718	17.718	17.718
						÷

### Heating requirements

Heat losses from pasteurisation tank Heat loss		Tin-Tout			
Heat loss	ies –	Wall thickness +	Insulation thick +	1 .	
s	Sludge film coef x SA in	Therm.cond x SAmean	Therm.cond x SAmean	Air film coef x SA out	
and the second					
e: The air film coefficient insulation has not been take	en into account in the	following calculations.			
		· .			
Pasteuriser floor	kW	1.680	1.680	1.680	0.000
Wetted Pasteuriser wall in contact with soil	kW	0.000	0.000	0.000	0.000
Wetted Pasteuriser wall in contact with air	kW	3.362	3.362	3.362	0.000
Dry Pasteuriser wall in contact with air	kW	0,269	0.269	0.269	0.000
Dry Pasteuriser Roof in contact with air	kW	0.852	0.852	0.852	0.000
	1 112	6.16	6.16	6.16	0.00
Sub - total	kW		6.16	6.16	0.00
Assuming the three tanks are full	kW	6.16	0.10	0.10	
leat required by feed sludge	kW	0.000	0.000	0.000	0.000
		0.616	0.616	0.616	0.000
Aiscellaneous losses (pipes etc) : there is no heat losses in the heat exchangers.	kW	0.616	0.010	0.010	
. mere is no neurosses in me neur exenangeror					
OTAL HEAT REQUIRED FOR SITE	kW	6.8	6.8	6.8	0.0
Equivalent temperature drop based on feed rate	only d°C	1.1	0.6	0.5	#DIV/0!
Equivalent temperature drop	d⁰C	3.4	. 1.7	1.4	#DIV/0!
eality, the sludge spend three time the amount of time s is taken into account in the equivalent temperature e temperature depletion has been calculated using the Energy (kW) = Sludge Specific Heat = Mass Flux (kg/s)=	following formulas.	c Heat x Mass Flux x (1	in Tout		
Energy (kW) =	Sludge Specifi	c Heat x Mass Flux x (I	in-ioutr	•	
Sludge Specific Heat =	4.186	kJ/kg/dK	dille	100 A.	
Mass Flux (kg/s)=	Sludge Flow (1	m3/hr) x density (kg/m3	)/3600		
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### Contract Name : Waterford

Contract No: C1197

Document Reference: 8416

Title : Heat Exchanger

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator		
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# HEAT EXCHANGER DESIGN

### 2. DESIGN WITH INCREASED FLOW (for AL)

	 			t exchangers	111 1	. As a set of the set	A 1.C.	Lang	It is nonolly	15m7/hr
TLO	 abudaa ti	low through	the hear	t evenangers	33/111 ne	advised by	Alla	C avai	II IS USHAIIN	1.201.2/10

Feed flow through the heat exchangers		. · [	15	m/hr					
		-	`						
Recirculation around the hot water heat ex	changers								
		· r							
Say recirculation around the hot water HE is		. L	15	m3/hr minii	mum		· .		
				• • • • • •			· · · ·		
Town own two of what should react water	15	5	15	5	deg C	:			
Temperature at inlet of heat recovery	15			· · ·					
The maximum percentage dry solids that will	be recircula	ted is 6%DI	S.	· ·		· ·		·	
The minimum is still 5%DS.									
			14	· . ·	_				
Mass Flux	4.23	4.23	4.23	4.23	kg/s	· · ·	•		· . ·
Energy	443	620	443	620	kW	5.2	5 N		
						·			
Temperature rise	25	35	25	35	deg C				
Sludge temperature out	40	40	40	40	deg C	•			
· · · [					net				
Heat Exchanger No.2 (Hot water)					oth				
near Exchanger No.2 (1101 water)				nty an	Jdeg C.				1
		•	d	es only any			la deter	a filia eta	
Raw sludge			Ro	ilet	_	er die se	e - 11		
Sludge temperature in	40	40	40,00	× 40	deg C				
. —			ction per t						
Allowance must be made for the heat losses it	n the pasteur	isation tan	Sand such de	termining		· · · · ·			. • •
the temperature of the sludge after the hot wa	ter heat excl		lêjir.	• * * *					
tit	60	6.80P	6.8	6.8	JWW (see (	alcs Paste	urisation Ta	ank Heat Lo	sses)
Heat losses Rise in temperature	<u>6.8</u> 0.47		1.12	1.12	deg Celsi				,
Sludge temperature out	55	of 55	56	56	deg C			÷. *	
Chosen temperature	57.0	57.0	57.0	57.0	deg C				
The energy (kW) needed to heat the raw slud	ge is:		•			*	·		
			• •	*					•
Energy $(kW) = S$	pecific Heat	x Mass Flu	ıx x (Tin-Tou	t)					
		T/1 / 117				÷			
Specific Heat = Mass Flux (kg/s)= S		cJ/kg/dK (m2/hr) x d	ensity (ka/m?	8) / 3600					
Mass Flux (kg/s) = S	studge r low	(III.5/III.) X u	cusity (kg/m.	, 5000 ·					1.1
Mass Flux	4.23	4.23	4.23	4.23	kg/s	• •.			
Energy	301	301	301	301	kW			· ·	
The equivalent energy will have to be provid	led using Ho	t Water.		-					
Maximum acceptable temperature for the ho	t water		. 70	deg C					
		11 - A.		. · ·		·		1.1	i.
		021	744	921	lkW			19 J. 19	
Total energy requirement	744	921	/44	921		· · · ·	2		
				· · ·					
3. ENERGY NEEDED AT PLANT START	T/P						•		
5. ENERGI NEEDED AT I LANT START	01			• •		· · · ·			
There is no heat recovery when the plant is s	starting up ar	d the slude	e will be heat	ed by mean	s of the hot			1	
water heat exchangers only.	0 °r ***				· .			$(0, \dots, 1)^{n-1}$	
<b>č</b> , <b>č</b>	Maximu	m flow	Minim	um flow					
	Summer	Winter	Summer	Winter					
Temperature in		5	15	5	· .	e e e é é	5 - S - S - S - S - S - S - S - S - S -		
Flowrate	15.0	15.0	5.1	5.1					. '

Temperature needed

57 57

Flowrate	15.0	15.0	5.1	5.1	m3/hr
Mass flux	4.23	4.23	1.44	1.44	kg/s
Energy needed	744.1	921.2	253.5	313.8	kW

57

57

Purchase 2 new boilers operating as duty/assist.						
Each will be rated at	500	kW				
Duty/assist	1000	kW				

okay for normal operation

Consent for inspection purposes only any other use.



Contract Name : Waterford

Contract No: C1197

ocument Reference: 8412

Title : Digester Sizing

Revision	No. of Pages	Date of	Purpose of Issue	Originator	Checked	Approved
	(Excluding Cover)	Issue		_		
1	1	20/11/2006	Contract Issue	DGH Dan	K	- De
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### DIGESTER SIZING

	DIGESTER SIZING						
			Case 1	Case 2	Case 3	Case 4	
	Number of Digestors	1	2	2	2	2	
	Number of Digesters	m ³ /d	246.47	209.04	201.52	122.39	I
	Total Feed Volumetric Flowrate	iii /u	240.47	203.04	201.02	122.00	
	All Digesters in Service		1	·.			
	Flowrate per Digester	m³/d	123.24	104.52	100.76	61.20	Check against pasteurisation design sheets 8420
	Retention Time Required	d	14.0	14.0	14.0	14.0	Ref; Vol 4 scetion 7.9.6
	·						
	Minimum Digester Capacity Required	m³	1725	1463	1411	857	
	Allowance for Grit build-up	%	1.0	5.0	5.0	5.0	
	Design Capacity	m ³	1743	1536	1481	900	
							•
	Capacity Selected	m³	1700	1700	1700	1700	
							-
	Ratio of Diameter to Height (h=nxd)		0.90	0.90	0.90	0.90	
	Floor Slope Selected	degrees	10.00	10.00	10.00	10.00	
	Calculated Diameter	m	13.255	13.255	13.255	13.255	
	Calculated Height	m	11.930	11.930	11.930	11.930	
			40.000	13.300	13.300	13.300	1
	Selected Diameter	m	13.300	12.000	12.000	12.000	Height restriction of 16.9m AOD, GL = 5m AOD
	Selected Height	m	12.000	12.000	12.000	12.000	
	Mathematical Option and Tamle	m ³	1701	1721	1721	1721	Note: Tendered volume 1660 m3
	Volume of Selected Tank	m di	1721 14.0	16.5	4-7-4	00.4	Note. Tendered volume Todo nio
	Retention Time in Selected Tank	u.	14.0	10.5		۰ <u>۲</u> ۵۰۱	
						112	
	Some Digesters Out of Service					28.1	
	Dome Digesters out of Corried				A. A.	- · · ·	
	Number of Digesters Out of Service		1	1	OTT & BEE	1	]
• •	Number of Digesters Remaining	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	1	1_0	Nº 1	1	The second se Second second s Second second seco
	Flowrate per Digester	m ³ /d	246.47	209.04	201.52	122.39	
	Retention Time Required	d	14.00	14.00	14.00	14.00	
	•		ż	10 Plet			
	Minimum Digester Capacity Required	m ³	3451	2927	2821	1713	
	Allowance for Grit build-up	%	1,000	5.0	5.0	5.0	
	Design Capacity	m ³	Q948510	3073	2962	1799	
			<u></u> 08,				_
	Capacity Selected	m³	ð 1600	1600	1600	1600	
		Ś	\$×		,		<b>-</b>
	Ratio of Diameter to Height (h=nxd)	CORS	0.90	0.90	0.90	0.90	
	Floor Slope Selected	degrees	10.00	10.00	10.00	10.00	
					40.000	40.000	
	Calculated Diameter	m	12.990	12.990	12.990	12.990	
	Calculated Height	m	11.691	11.691	11.691	11.691	
	O L de L Dissestes		13.300	13.300	13.300	13.300	7
	Selected Diameter	m	12.000	12.000	12.000	12.000	
÷	Selected Height	m	12.000	12.000	12.000	12.000	<b></b>
	Volume of Selected Tank	m ³	1721	1721	1721	1721	
	Retention Time in Selected Tank	d	7.0	8.2	8.5	14.1	
	Retention Time in Selected Tank	u	7.0	0.2	0.0		
	Digester Size Selection Summary						
					· .		
	Selected Diameter	m	13.300	13.300	13.300	13.300	· · · · · · · · · · · · · · · · · · ·
	Selected Height	m	12.000	12.000	12.000	12.000 -	
	Volume of Selected Tank	. m ³	1721	1721	1721	1721	

8412-Digester Sizing

Contract Name : Waterford

Contract No: C1197

Document Reference: 8415

Title : Digester Heat Loss

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator		Approved
<u> </u>	3	04/06/2007	Contract Issue	DGH	BRIND	DG.
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### DIGESTERS HEAT LOSSES - Mesophilic operation

Drawing	references:	

Drawing references:				•	· · · · · ·	
		Maxim	um flow	Minimu	m flow	
Temperatures		Summer	Winter	Summer	Winter	
	· · · · · ·					· · · ·
Operation of digestion		Mesophilic	· · · · · · · · · · · · · · · · · · ·			-, .
Raw sludge in	°C	37	39	37	-40	Indicative values, not used in ca
Inside Digester	⁰ C	35	35	35	35	Average
Air	• • • C	15	-10	15	-10	To allow for windchill
Ground	°C	()	0	0	0	1
	- 1		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		<b>_</b>
Sludge	1					
2. aug						
Specific Heat	kJ/kg.ºC	4.186	4.186	4.186	4.186	
Feedrate	m ³ /h	12.34	12.34	5.11	5.11	]
Solids concentration	% w/w	5.41%	5.41%	5.41%	5.41%	
Density	kg/m ³	1015.7	1015.7	1015.7	1015.7	<b>_</b>
Density	Kg/III	1013.7	1015.1	1015.7		
Digester		÷.,		•		· · · · · ·
			· · ·			
Retention time *	days	13.9	13.9	14.0	14.0	
(with 1 digester in service only)		6.97	6.97	7.02	7.02	
		,				- · · . -
Total retention volume Selected	m³	3442	3442	1721 · · ·	1721	
No digesters		2	2	1	1	
Retention volume of each digester	m ³	1721	1721	. 1721	1721	· · · ·
Maximum permitted heatlosses	•	·	· .		÷ .	_ A CARACTER STATE
Temperature drop	°C	1.00	1.00	1.00	1.00	
Time	ь.	24	24	24	24	
Energy	kJ	7.317E+06	7.317E+06	317E+06 84.69	7.317E+06	-
Rate of heat loss per digester	kW	84.69	84.69 1000 1.5 1.5 1.5 1.5 1.5 1.5 1.5	84.69	84.69	
			84.69 84.69 100 100 1.5 1.5 1.5 1.5 1.5 1.5 1.5	<b>,</b>		
Thermal conductivities			off's are		-	
	0		es Xor			
Steel Wall	W/m.ºC	45	100°.108	45	45	
Steel Floor	W/m.ºC	. 45	JIT CUIL 45	45	45	
Concrete wall	W/m.ºC	1.5 🔊	1.5	· 1.5	1.5	
Concrete floor	W/m.ºC	1.5 000	S 1.5	1.5	1.5	
Concrete roof	W/m.ºC	1.0°° 054,	. 15	1.5	1.5	·
	W/m.ºC	ill the	1.5	45	45	· · · · · · · · · · · · · · · · · · ·
Steel roof		FOLASTION	45	- 45		
GRP roof	W/m.ºC	CO.037		· · · · ·	1.5	
Roof/wall insulation	W/m.ºC	0.7	0.037	0.037	0.037	
Wet soil	W/m.ºC	0.7	0.7	0.7	0.7	
	N ^e	2 ^V				
Film coefficients	Cons	· ·			•	
				1000	1000	
Sludge	W/m ^{2.0} C	1000	1000	1000	1000	
Gas and external air	W/m ^{2.0} C	50	50	. 50	50	
			1	1	1	
Thickness of soil heated by digester	m	. 1 .	1	1		
Primary digester dimensions						
NB area sums will need to be changed if different		Concrete Roof	Concrete Roof	Concrete Roof	Concrete Roof	
			•	• • • • • • • • • • • • • • • • • • • •		•
					:	
Inner diameter	m	14.25	14.25	14.25	14.25	
Overall height of digester, roof & motor above gr	ound m	12.30	12.3	12.3	12.3	,
Overall height of digester, floor & base below gro		1_356	1.356329738	1.356329738	1.356329738	
•						
Side wall					<u>.</u> .	
Below ground	m	0.1	0.1	0.1	0.1	
Above ground	m	11.650	11.650	11.650	11.650	
Total height	m	11.750	11.750	11.750	11.750	
Wetted wall height	m	10.750	10.750	10.750	10.750	
Wetted roof depth	m	0.000	0.000	0.000	0.000	
Shudao Gashaard	·	1 pho	1.0	1.0	1.0	
Sludge freeboard	m	1.000	1.0	1.0	1.0	en e
Height of gear box & motor	m	-	1. A.			ter a star de la sec
Floor	· · · · · ·	2		· · ·	: .	
	0	10.0	10.00	10.00	10.00	
Slope	m	1.256	1.256	1.256	1.256	
Depth	m.	1.230	0 دغہ 1	1,220	ل <i>ل ش</i> د ۱	
Roof	· .		19 - A. A.			· ·
	0	na		0.0	0.0	· .
Slope		0.0	. 0.0	0.0 0.0	0.0	
Height	<b>m</b>	0.00	0.0		0.0	
	3			2440	2442	
Total digester sludge volume	m ³	3442	3442	3442	3442	
Wall thickness (average)	m .	0.500	0.500	0.500	0.500	
	· · ·			· · · · · ·		i i i i i i i i i i i i i i i i i i i
(c) A set of the se						

8415 Digestor Heat Losses

# 8420 Waterford pasteurisation plant Rev 1 (incl.8415,8416,8417,8420,8124)

				÷	•
· · · · · · · · · · · · · · · · ·	·	0.5	0.500	0.500	0.500
Floor thickness	m	0.300	0.300	0.300	0.300
Roof thickness	 	0	0.000	0.000	0.000
Wall insulation thickness Floor insulation thickness	m	0	0.000	0.000	0.000
Roof insulation thickness	m	0	0.000	0.000	0.000
					· · · ·
Surface areas					
Digester base					
Inner surface area	m ²	161.9	161.9	161.9	161.9
Outer surface area	m ²	167.6	167.6	167.6	167.6
Log mean suface area	m ²	164.8	164.8	164.8	164.8
2					
Wetted digester base insulation in contact with air	2		0.0	0.0	0.0
Inner surface area	$m^2$	0.0	0.0		
Outer surface area	m ²	0.0	0.0	0.0	0.0
Log mean suface area	m ²	0	0	0	0
Wetted digester wall in contact with soil			and the second sec		· · ·
Inner surface area	m ²	4.8	4.8	4.8	4.8
Outer surface area	m ²	5.4	5.4	5.4	5.4
Log mean suface area	m ²	5.1	5.1	5.1	5.1
Log mean surder area			· · · ·	an a	
Wetted digester insulation wall / soil	2			0.0	0.0
Inner surface area	m ²	0.0	0.0	0.0	0.0
Outer surface area	m ²	0.0	0.0	0.0	0.0
Log mean suface area	m ²	0.0	0.0	0.0	.0.0
Wetted digester wall above ground					
Inner surface area	m ²	476.8	476.8	476.8	476.8
Outer surface area	m ²	510.2	510.2	510.2	510.2
Log mean suface area	m ²	493.3	493.3	\$ 493.3	493.3
			10	<u>کې .</u>	•
Wetted digester wall insulation in contact with air	<b>n</b> , .		i and i A	0.0	0.0
Inner surface area	m"	0.0	O. O. D. ALL	0.0	0.0
Outer surface area	m	0.0	es we for	0.0	0.0
Log mean suface area	m	0.0	476.8 510.2 493.3 0.01 0.01 0.01 0.0 0.0 0.0 0.0 0.0 0.0	0.0	0.0
Dry digester wall above ground		Ś	N. Lord	44.9	44.8
Inner surface area	m	44.8	44.8	44.8	
Outer surface area	m²	47.9	47.9	47.9	. 47.9
Log mean suface area	m²	465 11	46.3	46.3	46.3
Dry digester wall insulation in contact with air		to St.			
Inner surface area	m ²	0.0	0.0	0.0	0.0
Outer surface area	m² 📣	0.0	0.0	0.0	0.0
Log mean suface area	m ² 15 ^{et}	0.0	0.0	0.0	0.0
	Co				
Dry digester roof in contact with air	2	150.5	150 5	159.5	159.5
Inner surface area	m ² m ²	139.3	166 3	166.3	166.3
Outer Surface area				160.5 162.9	162.9
Log mean suface area	m ²	162.9	162.9	104.7	102.9
Roof insulation in contact with air					
Inner surface area	m ²	0.0	0.0	0.0	0.0
Outer Surface area	m ²	0.0	0.0	0.0	0.0
Log mean suface area	m ²	0.0	0.0	0.0	0.0
	•				

### Heating requirements

The typical equation for the Heat losses for wetted wall is				•	
Heat losses =		Tin-Tout		•	
	1 +	Wall thickness +	Insulation thick	±	• • • • • • • • • • • • • • • • • • •
Sludge film	coef x SA in 7	Therm.cond x SAmean	Therm.cond x SAme	ean 4ir film coef x SA out	
				(this later is not take	n into accounts in calcs)
		<i>x</i> ¹			
Notes: In the following calculations, this formula is corre	cted for dry su	rfaces and includes a C	las film coefficient in	stead of the sludge film c	oefficient.
It is also corrected if there is no insulation.					
The heat losses from digester floor consider that t	here is 1 meter	thickness of wetted gr	ound below the diges	ter.	
However, CHANGE FORMULA ACCORDING	TO THE MAT	ERIAL USED.			
Heat losses from digesters					
Digester floor	kW	3.3	3.3	3.3	3.3
Wetted digester wall in contact with soil	kW	0.1	0.1	0.1	0.1
Wetted digester wall in contact with air	kW	29.5	66.4	29.5	66.4
Dry Digester wall in contact with air (gas space)	kW	0.0	0.0	0.0	0.0
Dry Digester Roof in contact with air	kW	14.8	33.2	14.8	33.2
Dry Digester Root in condict with an		i a de la composición		1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	
Sub - total	kW	47.7	103.1	47.7	103.1
Sub - Max					
Heat required by feed sludge	kW	0.0	0.0	0.0	0.0
Miscellaneous losses (pipes etc)	kW	9.5	20.6	4.8	10.3 (Estimate)
					· · · · ·
TOTAL HEAT REQUIRED FOR SITE	kW	95.4	206.1	47.7	103.1

47.7

### TOTAL HEAT REQUIRED FOR SITE TOTAL HEAT REQUIRED PER DIGESTER

Quick heat losses estimation

Assuming that a digester has been designed to loose not more than 1 degrees C per m3 per day in winter;

103.1

Specific Heat x Digester Volume (m3) x Density of deg C 24 x 3600 Heat Loss (kW) = othe

In summer, the heat losses are half the winter heatlosses (approximatively).

	Max	imum floxes 2501	Minimu		
	Summer	Whiter	Summer	Winter	
kW	97.4	194.9	97.4	194.9	
		AV. S	48.7	97.4	single digester
	, is a set of the set	D' NOT			
alues. The calc	ulations will take into	account the calculated val	ues.		
:	instit			1 1 A	
	FOL MILS				
	1.08				1
	S COL		- N 19		· .
	x ^o		• · · ·		•
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47.7

103.1

The estimated values are very close from the calculated values. The calculations will take into account the calculated values.



Contract Name : Waterford

Contract No: C1197

### ocument Reference: 8413

Title : Gas Production

No. of Pages	Date of	Purpose of Issue	I Unginator	Спескеа	Approved
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DIGESTER GAS PRODUCTION					
		Case 1	Case 2	Case 3	Case 4
Total Sludge Volatile Solids	kg VS/d	10298	8737	8391	5091
	3				
Specific Gas Yield	m ³ /kg VS	1.00	1.00	1.00	1.00
Net Gas Calorific Value	MJ/m ³	22.50	22.50	22.50	22.50
Minimum Volatile Solids Destruction			-		
Minimum Volatile Solids Reduction	%	40	40	40	40
Minimum Volatile Solids Destroyed	kg VS/d	4119	3495	3357	2037
Minimum Gas Yield (Total)	m³/d	4119	3495	3357	2037
Minimum Net Gas Fuel Value (Total)	kW	1073	910	874	530
Average Volatile Solids Destruction					
Average Volatile Solids Reduction	.%	45	45	45	45
Average Volatile Solids Reduction	kg VS/d	4634	3932	3776	2291
Average Gas Yield (Total)	m ³ /d	4634	3932	3776	2291
Average Net Gas Fuel Value (Total)	kW	1207	1024	983	597
Maximum Volatile Solids Destruction				- · · · · · ·	: 
· · ·					
Maximum Volatile Solids Reduction	% ka \/S/d	50	50	50 .	50
Maximum Volatile Solids Destroyed	kg VS/d	5149	4369	4196	2546
Maximum Gas Yield (Total) Maximum Net Gas Fuel Value (Total)	m ³ /d kW	5149 1341	4369	3196 1093	2546 663
			OULTS	· ·	
			87 NY	· ·	
Gas Production Por Digester (All Digest	are in Sondo		<u> </u>		
Gas Production Per Digester (All Digeste	ers in Servic	e) II	oquired		
Minimum Gas Production	m ³ /d	20600	official for a contract of the	1678	1018
Minimum Gas Production Average Gas Production	m ³ /d m ³ /d	20600 2317	1747 1966	1888	1146
Average Gas Production	m ³ /d	20600	1747	1	
Minimum Gas Production Average Gas Production Maximum Gas Production	m ³ /d m ³ /d m ³ /d	20602 2317 2574	1747 1966	1888	1146
Minimum Gas Production Average Gas Production Maximum Gas Production	m ³ /d m ³ /d m ³ /d	20602 2317 2574	1747 1966	1888	1146
Gas Production Per Digester (All Digester Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige	m ³ /d m ³ /d m ³ /d sters Out o	20602 2317 2574	1747 1966	1888	1146
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Minimum Gas Production Average Gas Production Maximum Gas Production <b>Gas Production Per Digester (Some Dige</b> Minimum Gas Production ( Average Gas Production	m ³ /d m ³ /d m ³ /d esters Out o	2060 2317 2574 f Service)	1747 1966 2184	1888 2098	1146
Minimum Gas Production Average Gas Production Maximum Gas Production <b>Gas Production Per Digester (Some Dige</b> Minimum Gas Production ( Average Gas Production	m ³ /d m ³ /d m ³ /d esters Out o pre- m ³ /d m ³ /d	2060 2317 2574 f Service) 4119 4634	1747 1966 2184 3495 3932 4369	1888 2098 	1146 1273 2037 2291
Minimum Gas Production Average Gas Production Maximum Gas Production <b>Gas Production Per Digester (Some Dig</b> e Minimum Gas Production Average Gas Production Maximum Gas Production	m ³ /d m ³ /d m ³ /d esters Out o pre- m ³ /d m ³ /d	2060 2317 2574 f Service) 4119 4634	1747 1966 2184 3495 - 3932	1888 2098 	1146 1273 2037 2291
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration	m ³ /d m ³ /d esters Out o m ³ /d m ³ /d m ³ /d	2060 2317 2574 f Service) 4119 4634 5149	1747 1966 2184 3495 3932 4369	1888 2098 3357 3776 4196	1146 1273 2037 2291 2546
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume	m ³ /d m ³ /d esters Out o p ^{3/2} m ³ /d m ³ /d m ³ /d	2060 2317 2574 f Service) 4119 4634 5149 246.47	1747 1966 2184 3495 3932 4369 209.04	1888 2098 	1146 1273 2037 2291 2546 122.39
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Dry Solids	m ³ /d m ³ /d esters Out o m ³ /d m ³ /d m ³ /d m ³ /d kg DS/d	2060 2317 2574 f Service) 4119 4634 5149 246.47 14247	1747 1966 2184 3495 3932 4369 209.04 12086	1888 2098 3357 3776 4196 201.52 11625	1146 1273 2037 2291 2546 122.39 7056
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Dry Solids	m ³ /d m ³ /d esters Out o p ^{3/2} m ³ /d m ³ /d m ³ /d	2060 2317 2574 f Service) 4119 4634 5149 246.47	1747 1966 2184 3495 3932 4369 209.04	1888 2098 	1146 1273 2037 2291 2546 122.39
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Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Volume Digesters Feed Volatile Solids Reduction of Volatile Solids Volatile Solids Destroyed	m ³ /d m ³ /d esters Out o m ³ /d m ³ /d m ³ /d kg DS/d kg VS/d	2060 2317 2574 f Service) 4119 4634 5149 246.47 14247 10298 40 4119	1747 1966 2184 3495 3932 4369 209.04 12086 8737 40 3495	1888 2098 3357 3776 4196 201.52 11625 8391 40 3357	1146 1273 2037 2291 2546 122.39 7056 5091 40 2037
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Volume Digesters Feed Volatile Solids Reduction of Volatile Solids Volatile Solids Destroyed Volatile Solids in Digesters Outlet	m ³ /d m ³ /d esters Out o m ³ /d m ³ /d m ³ /d m ³ /d kg DS/d kg VS/d kg VS/d kg VS/d	2060 2317 2574 f Service) 4119 4634 5149 246.47 14247 10298 40 4119 6179	1747 1966 2184 3495 3932 4369 209.04 12086 8737 40 3495 5242	1888 2098 3357 3776 4196 201.52 11625 8391 40 3357 5035	1146 1273 2037 2291 2546 122.39 7056 5091 40 2037 3055
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Volume Digesters Feed Volatile Solids Reduction of Volatile Solids Volatile Solids Destroyed Volatile Solids in Digesters Outlet Dry Solids in Digester Outlet	m ³ /d m ³ /d esters Out o m ³ /d m ³ /d m ³ /d m ³ /d kg DS/d kg VS/d kg VS/d kg VS/d kg DS/d	2060 2317 2574 f Service) 4119 4634 5149 246.47 14247 10298 40 4119 6179 10128	1747 1966 2184 3495 3932 4369 209.04 12086 8737 40 3495 5242 8591	1888 2098 3357 3776 4196 201.52 11625 8391 40 3357 5035 8268	1146 1273 2037 2291 2546 122.39 7056 5091 40 2037 3055 5019
Minimum Gas Production Average Gas Production Maximum Gas Production Gas Production Per Digester (Some Dige Minimum Gas Production Average Gas Production Maximum Gas Production Digester Outlet Solids Concentration Digesters Feed Volume Digesters Feed Volume Digesters Feed Volatile Solids Reduction of Volatile Solids Volatile Solids Destroyed Volatile Solids in Digesters Outlet Dry Solids in Digester Outlet	m ³ /d m ³ /d m ³ /d seters Out o m ³ /d m ³ /d m ³ /d m ³ /d m ³ /d kg DS/d kg VS/d kg VS/d kg VS/d kg VS/d kg VS/d	2060 2317 2574 f Service) 4119 4634 5149 246.47 14247 10298 40 4119 6179	1747 1966 2184 3495 3932 4369 209.04 12086 8737 40 3495 5242	1888 2098 3357 3776 4196 201.52 11625 8391 40 3357 5035	1146 1273 2037 2291 2546 122.39 7056 5091 40 2037 3055
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# enpure

# PROCESS DESIGN CALCULATION

## Contract Name : Waterford

## Contract No: C1197

### locument Reference: 8418

### Title : Gas System Equipment

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator	Checked	Approved
1	1	20/11/2006	Contract Issue	DGH	DG	DG
2	1	16/04/2007	Whessoe valve information changed	DGH	RJM	DG
2 3	number of the second seco	07/01/2008	Gas holder sized to give 1 hours retention	RJM	Ho.	76
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### GAS HOLDER, EXCESS GAS BURNER AND DIGESTER PRESSURE/VACUUM RELIEF VALVES SIZING

One Unitin		Case 1	Case 2	Case 3	Case 4	
Gas Holder						
Number of Gas Holders		1	1	1	1	
Average Gas Production Rate	m³/h	193	164	157	95	
Retention Time in each Gas Holder	min	60	60	60	60	
Capacity of each Gas Holder	m ³	193	164	157	95	·
Selected Capacity of each Gas Holder	m³	200	200	200	200	
Retention Time at Minimum Production Rate	min	70	82	86	141	
Retention Time at Average Production Rate	min	62	73	76	126	
Retention Time at Maximum Production Rate	min	56	66	69	113	
Excess Gas Burner						
Maximum Gas Production Rate	m³/h	215	182	175	106	
Gas Burner Oversizing Margin	%	25	25	25	25	<b>1</b>
Gas Burner Capacity Required	m³/h	268	228	219	133	-
Digester Pressure/Vacuum Relief Valve - Pre	essure Re	lief Conditi	ion			
Maximum Gas Production Rate	m³/h	107	91	87	53	
Mixing Compressor Flowrate	m³/h	0	0	0	· 0	Mechanical Mixing
Digester Feed Volume	m³/h	15	15	15	15	Ref: Pasteurisation design sheets 8420
Pressure Relief Rate Required	m³/'n	122	106	102	1 VSC 68	

### Digester Pressure/Vacuum Relief Valve - Vacuum Relief Condition

riessule Keller Kale Keyulleu	0170	122	.100	102 4	V 00		
				othey	×		
Digester Pressure/Vacuum Relief Valve - Vacuum Relief Condition 💦 🔊							
Digester Height (Centre of Cone to TWL)	m	13.173	132773	5 13.173	13.173		
Drain Pipe Diameter (ID)	m	0.20	6 20	0.20	0.20		
Drain Pipe Length	m	10.00	<b>15.0</b>	18.0	20.0		
Roughness	mm	0.5	0.5	0.5	0.5		
Fittings K _T		Q 20	2	2	2		
	•.	NY Y					

Maximum vacuum relief rate will occur when the friction loss in the outlet line is equal to the static head above the outlet. To evaluate this, the flowrate at which the static head is equal to the friction loss must be determined. Note that the friction factor and hence the friction loss is dependent on the flowrate so the equations must be solved by iteration.

To solve, use the following procedure :

From "Tools" menu choose "Goal Seek" In "Set cell" box enter "C64", "D64", "E64", "F64" In "To value" box enter number contained in ceil C39, D39, E39, F39 In "By changing cell" box enter "C56", "D56", "E56", "F56"

Maximum Flowrate Water Temperature for Design	m³/h ℃	882 35.0	824 35.0	794 35.0	776 35.0
Water Density	kg/m ³	994	994	994	994
Water Viscosity	mNs/m ²	0.7204	0.7204	0.7204	0.7204
Velocity Revnolds Number	m/s	7.80 2152745	7.28 2010124	7.02 1937033	6.86 1892508
Friction Factor	fus	0.02495	0.02495	0.02496	0.02496
Dynamic Head Loss	m H₂O	13.17	13.17	13.17	13.17
Vacuum Relief Flowrate Required	m³/h	882	824	794	776



Contract Name : Waterford

Contract No: C1197

### ocument Reference: 8410

Title : Digested Sludge Dewaterer

Revision	(Excluding Cover) Issue			Purpose of Issue	Originator	Checked	Approved
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### 1. SCOPE

To calculate the dewaterer duties for the Waterford scheme

### 2. SUMMARY

### 2.1. Scheme [Thickeners]

•	Min.	Avg.	Max.	
No. of duty units =	1	1	2	
Thickener feed flow =	6.04	10.35	10.35 <b>m³ h⁻¹</b>	
Thickener feed solids =	3.9%	4.1%	4.1% by wt	
Ξ.	238.3	429.6	429.4 kg h ⁻¹	
Thickened solids =	23.0%	23.0%	23.0% by wt	
Filtrate solids consent =	3697	3923	3923 mg L ⁻¹	

### 3. REFERENCES

••.	· .	· .		•			other
3	.1.	Duty [F	rom Digester]			only	
	÷	3.1.1.	Sludge Feed			nurposes et le	Ref: 8413 Sludge Digestion Gas Production
						tion Petreet	
				Min.	Avg	Max.	· · · · · · · · · · · · · · · · · · ·
1.			Sludge production =	4765.00	8591,00	\$0128.00 kg d	Ref: 8413 Sludge Digestion Gas Production
				198.5	\$958°	422.0 <b>kg h⁻</b> '	
			Solids concentration =	3.9%	\$ 4.1%	4.1% by wt	
			Sludge density =	1011.3	×°1011.9	1011.9 kg m ⁻³	
			Sludge =	5.03 ^e	8.63	10.17 m ³ h ⁻¹	
		3.1.2.	Digested Sludge Buffer Tan	ik i i	*		
•							
	- 1 - 1	•		Min.	Avg.	Max.	
			Days operation =	5.0	5.0	5.0 d	Ref: Vol 4 section 7.9.3
÷.,			Hours production =	24.0	24.0	24.0 h d ⁻¹	
			No. of duty tanks =	1	1	1	
			Sludge storage volume =	604.09	1035.41	1220.65 <b>m</b> ³	
		3.1.2.	Dewaterer Feed Rate				
							n an
				Min.	Avg.	Max.	
			Days operation =	7.0	7.0	7.0 d week	
•		1.	Hours operation =	20.0	20.0	11.8 h d ⁻¹	Clause 7.9.7 treat average sludge load in < 20 hours
÷		÷	No. of duty units =	1	1	2	
			Thickener unit feed flow =	6.04	10.35	10.35 m ³ h ⁻¹	per machine
			Solids concentration =	3.9%	4.1%	4.1% by wt	
		1 - E	Sludge density =	1011.3	1011.9	1011.9 <b>kg m⁻³</b>	
			Thickener block feed solids =	238.3	429.6	429.4 kg h ⁻¹	

### Page 1 of 2

### 3.1.3. Thickened Solids

	Min.	Avg.	Max.
Thickener recovery =	92.0%	92.0%	92.0% by wt of inlet solids
Cake solids =	219.2	395.2	395.0 kg h ⁻¹ per machine
Solids concentration =	23.0%	23.0%	23.0% by wt
Sludge density =	1070.3	1070.3	1070.3 kg m ⁻³
Thickened sludge volume =	0.89	1.61	1.60 m ³ h ⁻¹ per machine

### 3.1.4. Thickener Filtrate

	Min.	Avg.	Max.	
Filtrate solids =			34.4 kg h ⁻¹	a de la compansión de la c
Approx. centrate density =	1000.0	1000.0	1000.0 kg m ⁻³	
Filtrate flow =	5.16	8.76	8.76 m ³ h ⁻¹	per machine
Filtrate solids concentration =	3.70	3.92	3.92 kg m ⁻³	
= · · · · · = · ·	3697	3923	3923 mg L ⁻¹	
Solids concentration =	0.37%	0.39%	0.39% by wt	
Return Load =	381.2	687.3	810.2 kg/d	
Wash water and make-up consumption =	20.3	20.3	20.3	Sernagiotto Literature (BPF 2000)
Total filtrate return =	25.4	29.0	58.0 m ³ h ⁻¹	

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Contract Name : Waterford

Contract No: C1197

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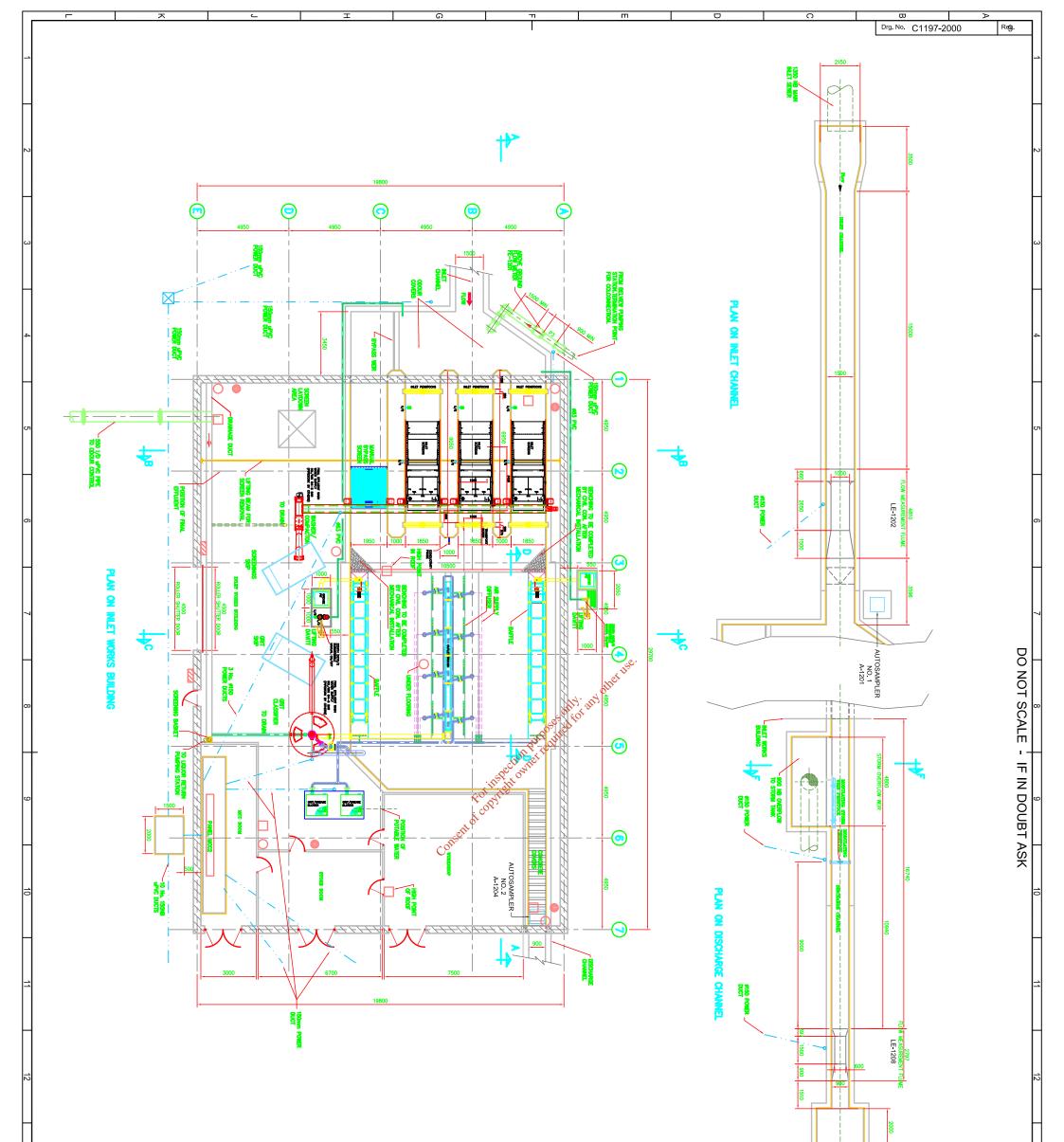
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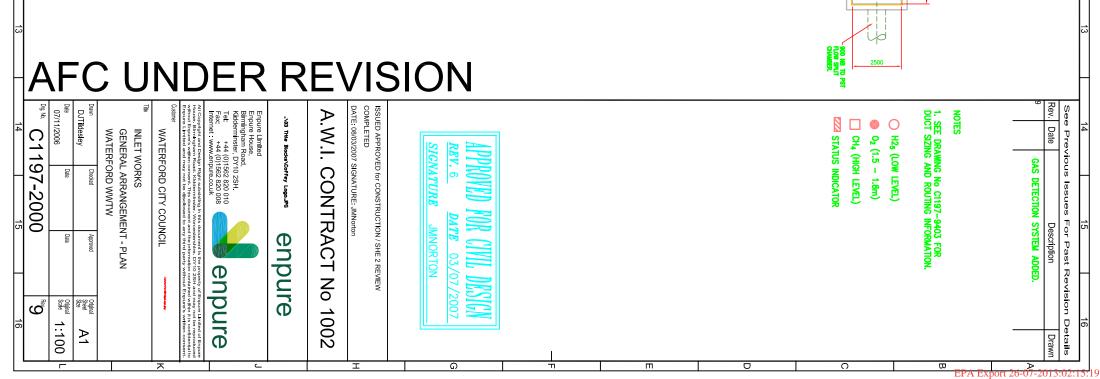
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		starts per hour		4.0	3.0	4.0	3.0	3.0	4.0	. 3.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	00		3.0	3.0	4.0	3.0	•																	
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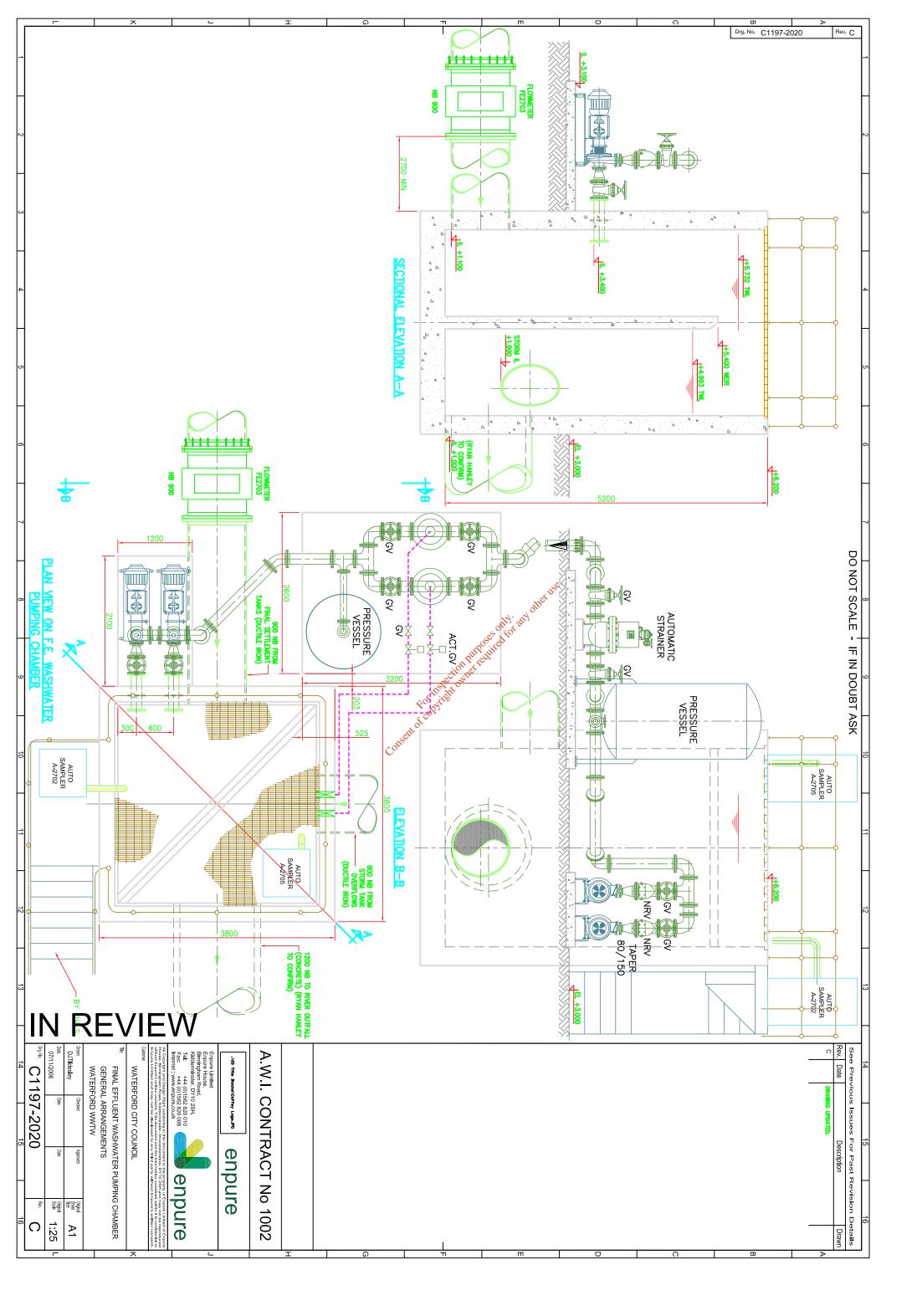
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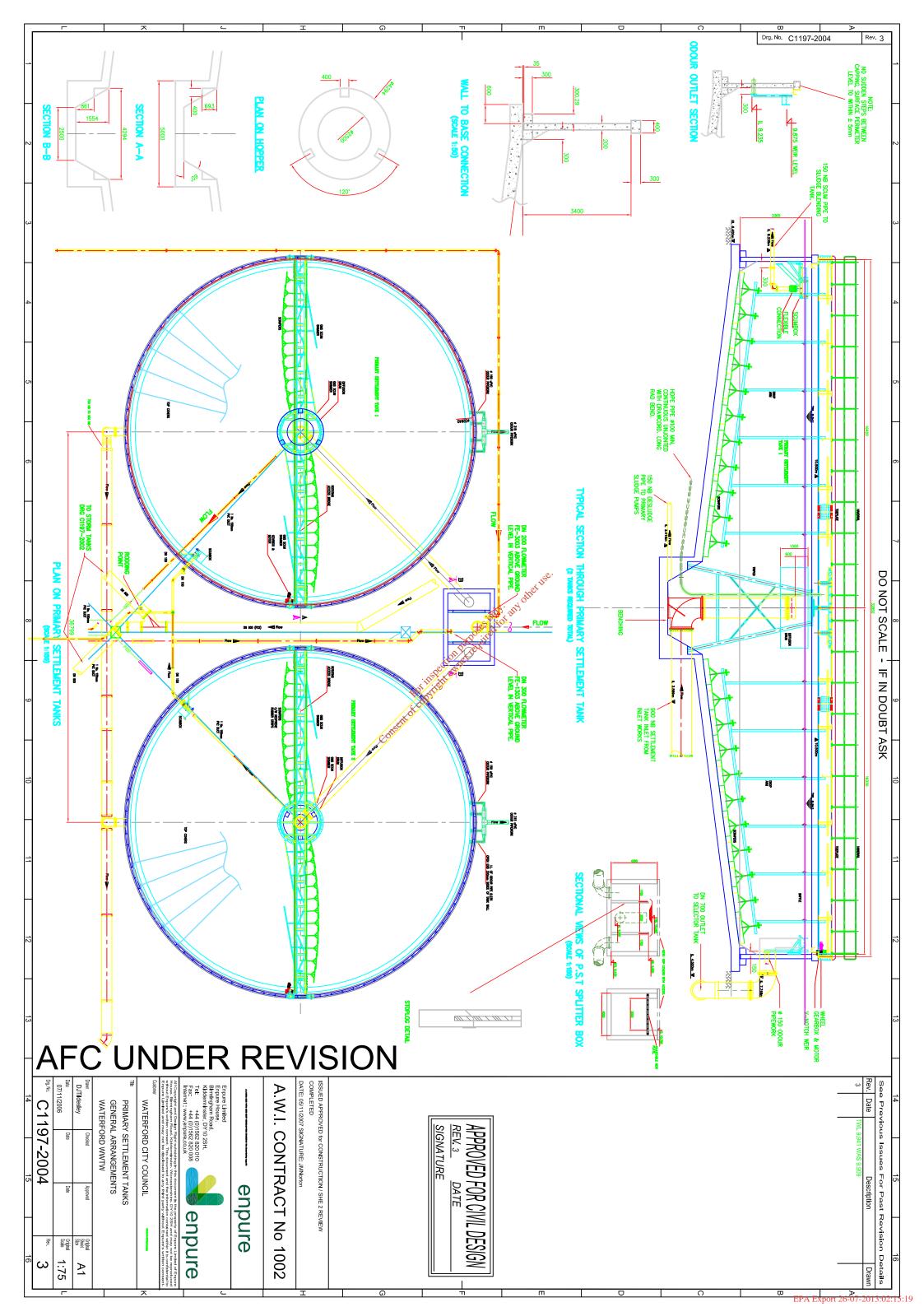


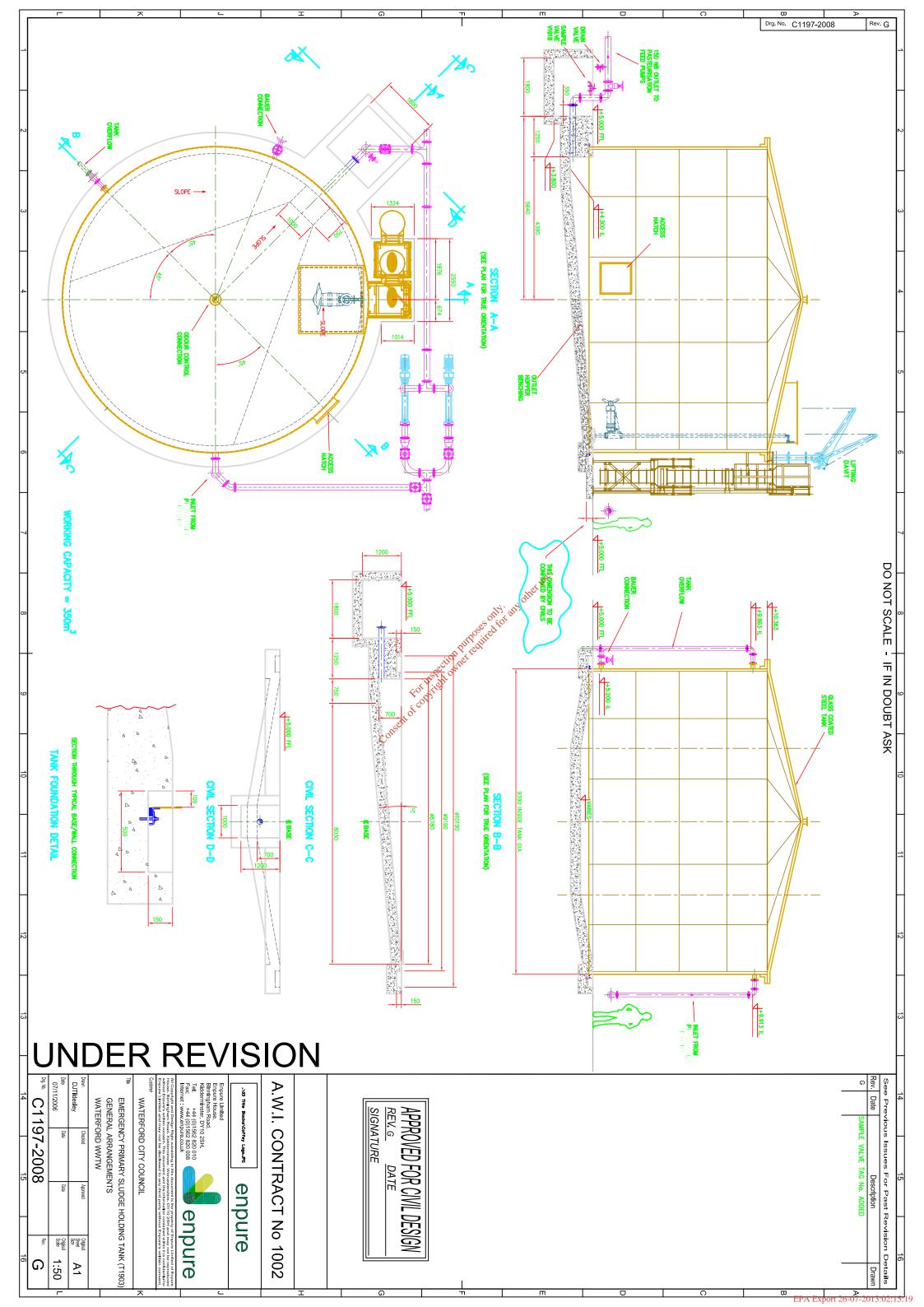


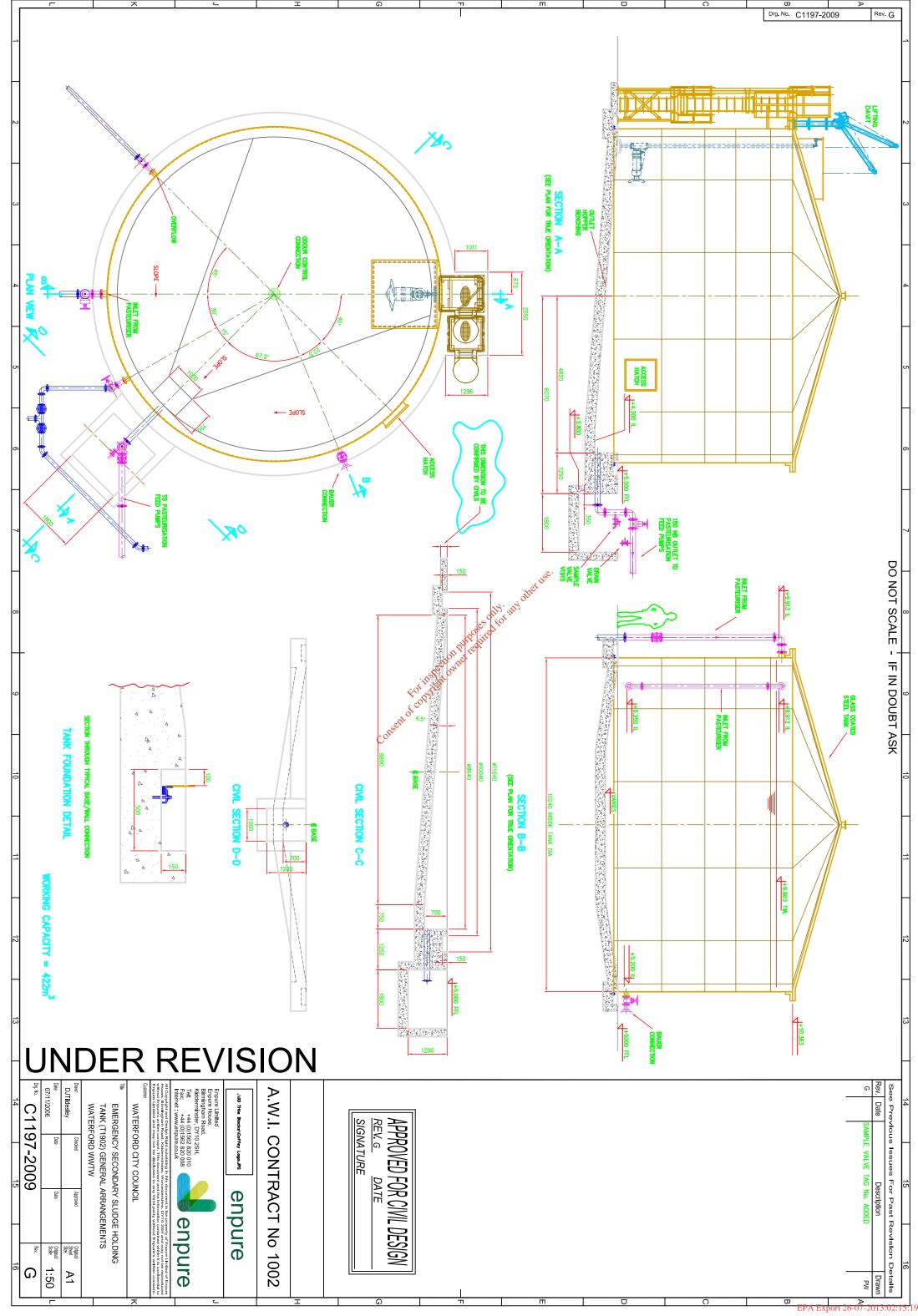


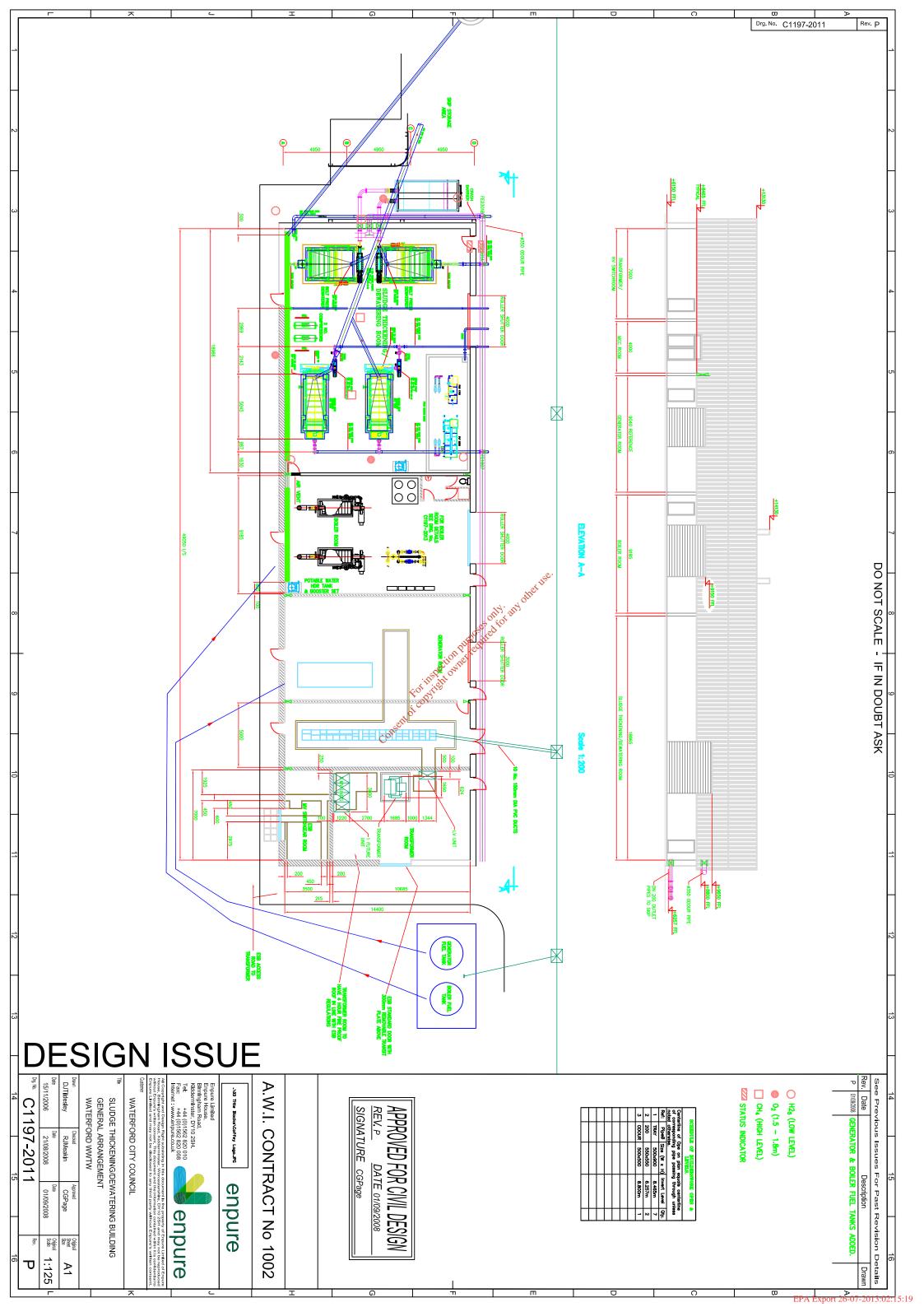
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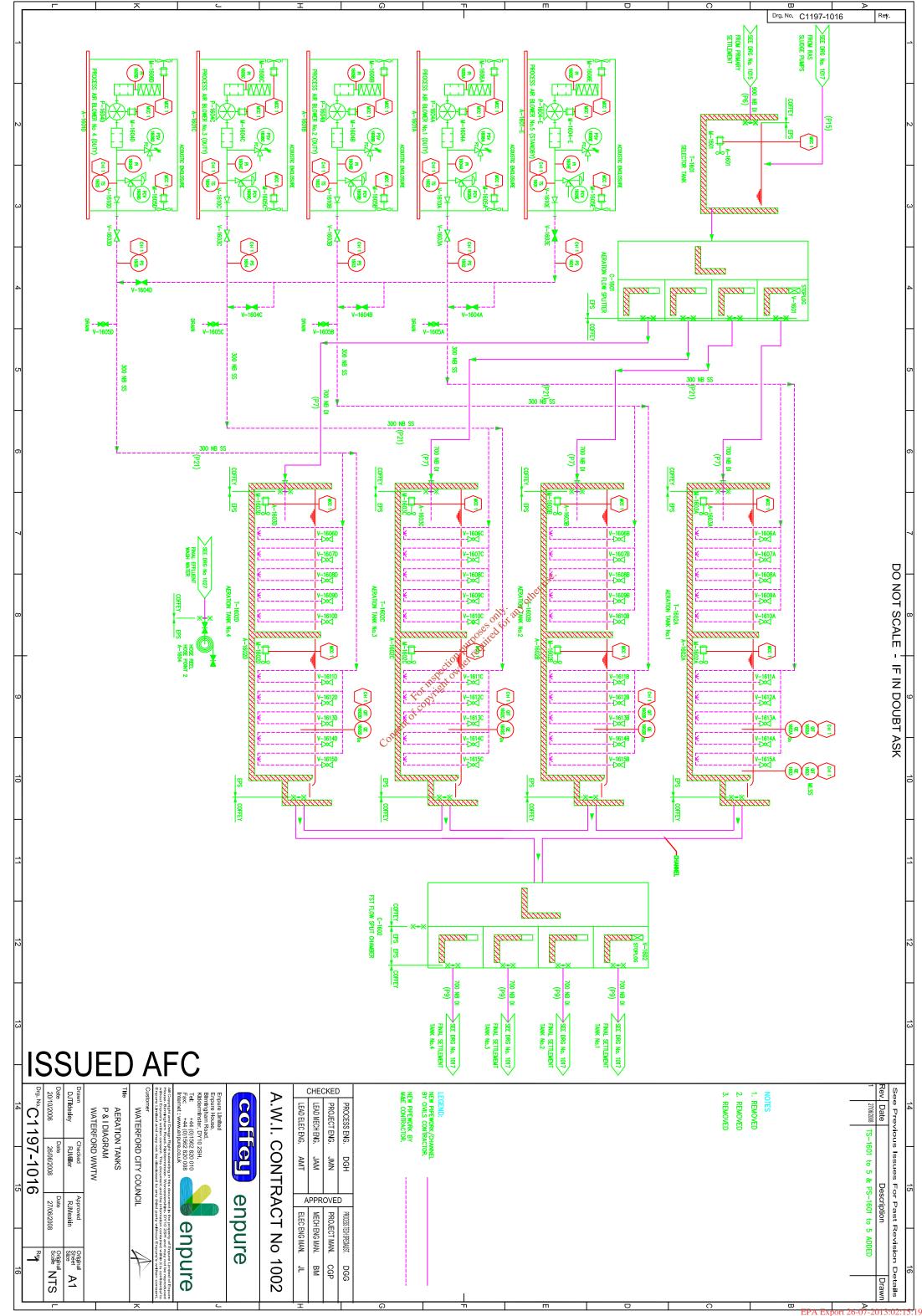


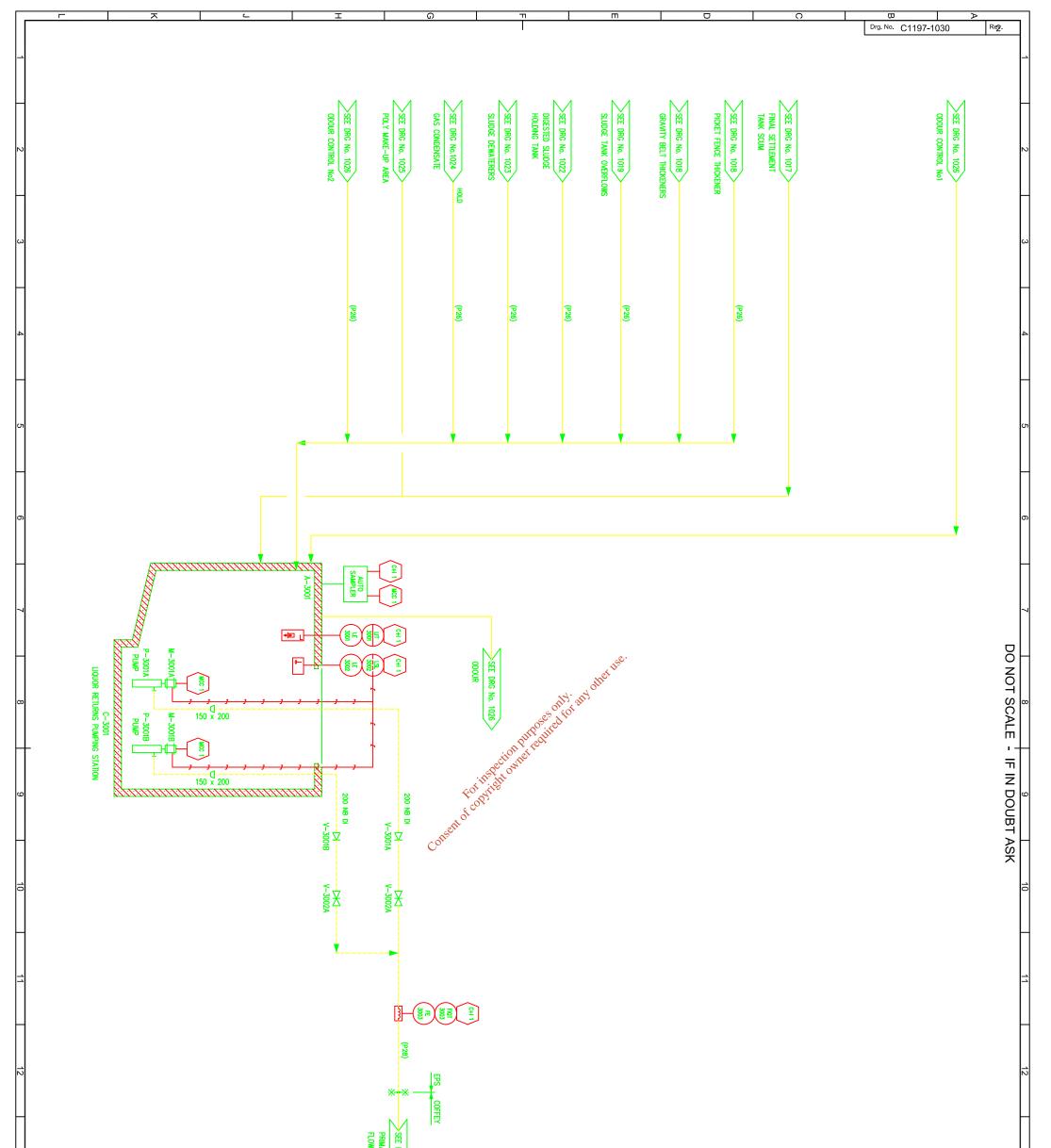




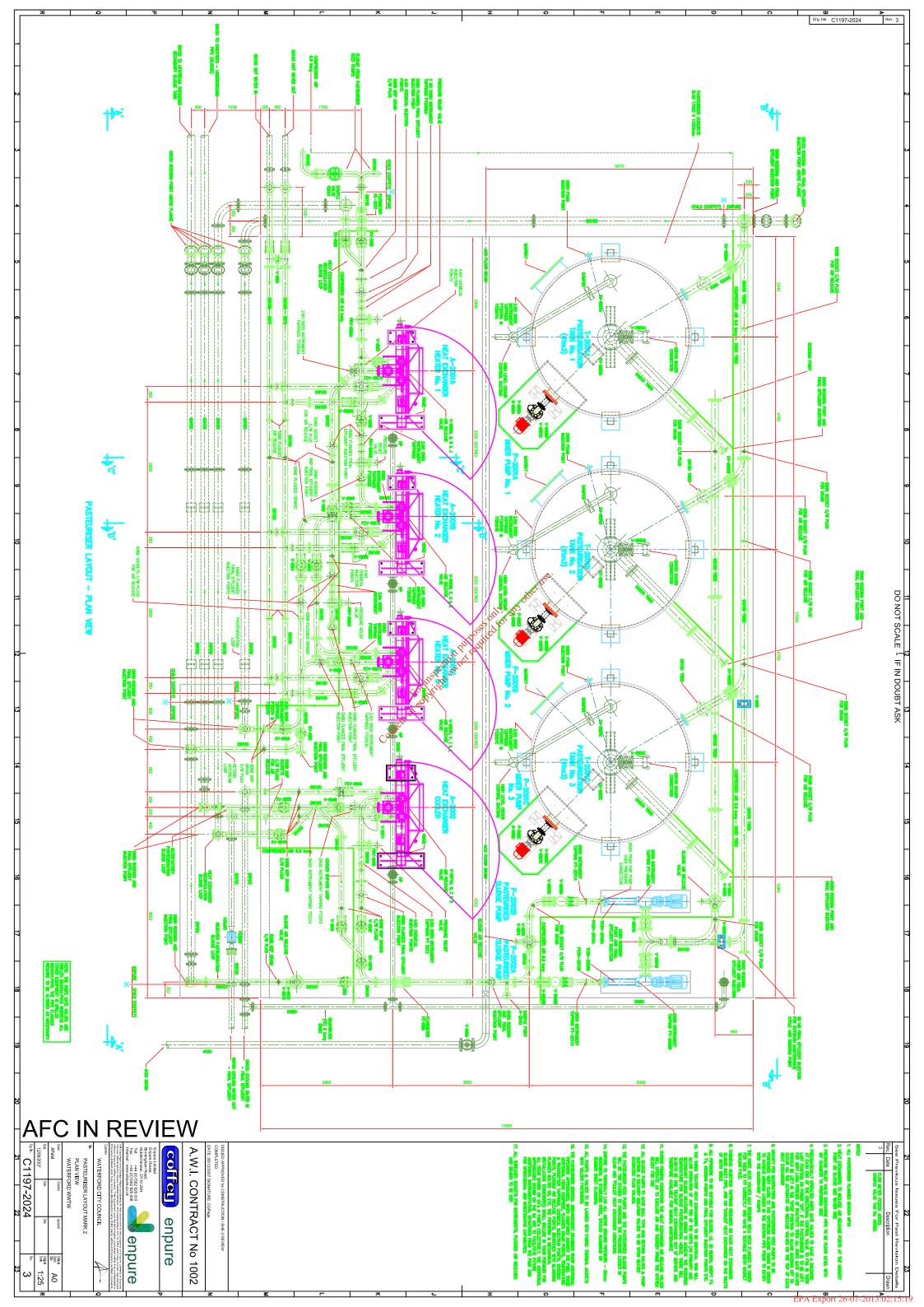








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# Table 07_4084 3.a(iii) Monitoring, Measuring & Sampling Information Sheet

# Rev 4 09.09.08

	Measuring	Location	Measurement Type	Description	Size	Туре	Pipe Ref	Drawing Ref.	P & ID Ref	Samplin
	Primary Treatment									
1A	Raw Sewage	Inlet Channel	Volumetric	Open Flume	1m throat	Arkon	n/a	C1197-2000	C1197-1012	Cont
1C	Screened Sewage	Inlet Channel	Flow Rate	Flume	0.6m throat	Arkon	n/a	C1197-2000	C1197-1012	Cont
1B	Raw Sewage	Inlet Works	Flow Rate	Flowmeter	300 NB	Siemans	P3	C1197-2000	C1197-1012	Cont
1A/1B	Raw Sewage	Inlet Works	Temperature	Auto Sampler			n/a		C1197-1012	We
			BOD							Mc
			COD							We
			ph							We
			SS							We
17	Screenings	Inlet Works	% TDS							S
18	Grit	Inlet Works	% TDS							S
			% VS							S
28	Inlet air	Inlet Works OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Cont
29	Outlet air	Inlet Works OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Cont
1C	Screened Sewage	Post Grit channel	Temperature	Auto Sampler			n/a	C1197-2000	C1197-1012	Twice
			BOD							We
			COD							5 times/we
			SS							We
	Secondary Treatment									
4A	Storm Return	At PST chamber	Flow Rate	Flowmeter	300 NB	Siemans	^{5€} P27	C1197-2004	C1197-1013	Cont
6	Storm Overflow	After Storm tanks	Flow Rate	Flowmeter	900 NB	Sieman	P8	C1197-2002	C1197-1013	Cont
6	Storm Overflow	After Storm tanks	BOD	Auto Sampler		ally any	P8	C1197-2002	C1197-1013	Inter
4	Flow to Storm	Not measured. Calc. wil	I be made be deducting s	storm overflow fro	om flow to storn	n to give storr	n return for tr	reatment	1	
			SS		AFO NE MU	Chille.	<b>D</b> aa	04407.0000	01107 1010	Inter
7	Settled Sludge (PST to PFT)	After Primary Pumps	Flow Rate	Flowmeter	150 NB	Siemans	P22	C1197-3006	C1197-1018	Cont
7	Settled Sludge (PST to PFT)	At PFT	% TDS	Manual Sample	25 NB Met	B/valve	P22	C1197-3006	C1197-1018	Inter
5	Settled Sewage	At Aeration chamber	Flow Rate	Flowmeter	6900 NB	Siemans	P6	C1197-2006	C1197-1015	Cont
5	Settled Sewage	At Aeration chamber	BOD	Auto Sampler	of of		P6	C1197-2006	C1197-1015	Inter
-	e e me e e mage		COD		N ^{O1}					Inter
			ph	Conse						Inter
			ŚS	C						Inter
8	RAS to Aeration Selector Tank	At Selector Tank	Flow Rate	Flowmeter	600 NB	Siemans	P15	C1197-2006	C1197-1017	Cont
21	Mixed Liquor	On aeration tanks	DO	DO meter		Siemans			C1197-1016	Cont
21	Mixed Liquor	On aeration tanks	DO	DO meter		Siemans			C1197-1016	Cont
21	Mixed Liquor	On aeration tanks	DO	DO meter		Siemans			C1197-1016	Cont
21	Mixed Liquor	On aeration tanks	DO	DO meter		Siemans			C1197-1016	Cont
21	Mixed Liquor	On aeration tanks	ph							We
21	Mixed Liquor	On aeration tanks	SS							5 times
21	Mixed Liquor	On aeration tanks	SSV							Twice
21	Mixed Liquor	On aeration tanks	SSI							Twice
21	Mixed Liquor	On aeration tanks	Microspic Exam							We
22	Aerated sewage	On aeration tanks	MLSS	MLSS meter		Siemans			C1197-1016	Cont
2	Secondary Effluent	Pre. FE Chamber	Flow Rate	Flowmeter	900 NB	Siemans	P12	C1197-2020	C1197-1027	Cont
2	Secondary Effluent	FE Chamber	BOD	Auto Sampler			n/a	C1197-2020	C1197-1027	We
			COD							5 times/we
			ph							
			SS							5 times/we
	Sludge Treatment									
9	SAS To Gravity Belt Thickeners	Sludge Building	Flow Rate	Flowmeter	150 NB	Siemans	P16	C1197-3006	C1197-1018	Cont
9	SAS To Gravity Belt Thickeners	Sludge Building	% TDS	Manual Sample		B/valve	P16	C1197-3006	C1197-1018	Inter
10	GBT to Sludge Blend Tank	At S/Blend Tank	Flow Rate	Flowmeter	100 NB	Siemans	P19	C1197-3006	C1197-1018	Cont

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10	GBT to Sludge Blend Tank	At S/Blend Tank	% TDS	Manual Sample	25NB	B/valve	P19	C1197-2010	C1197-1019	Intermittent
		Outlet of emergency								
		secondary sludge								
23	Thickened Secondary Sludge	holding tank	As Required	Manual Sample	50 NB	B/valve		C1197-2009	C1197-1019	Spot
		Outlet of emergency	ŀ							
		primary sludge holding								
24	Thickened Primary Sludge	tank	As Required	Manual Sample	50 NB	B/valve		C1197-2008	C1197-1019	Spot
25	Thckened Primary Sludge	After PFT	% TDS	Manual Sample	50 NB	B/valve	P25	C1197-2007	C1197-1018	Spot
11	RTN Liquor to PST Splitter	At Splitter	Flow Rate	Flowmeter	200 NB	Siemans	P28	C1197-2004	C1197-1030	Intermittent
11	Return Liquors	At liquor chamber	BOD	Manual Sample	200 110	Clemans	n/a	C1197-2018	C1197-1030	Intermittent
			COD	Manual Gampic			Π/a	01137 2010	01137 1030	Intermittent
			SS							Intermittent
			00							internitterit
12	Blended Sludge to Pasteuriser	P/riser Skid	Flow Rate	Flowmeter	100 NB	Siemans	P40	C1197-2024	C1197-1020	Continuous
12	Blended Sludge to Pasteuriser	P/riser Skid	ph	Manual Sample	50mm	B/valve	P40	C1197-2010	C1197-1019	Monthly
12	Dichaed Oldage to Pastedhiser		Alk (mg CaCO3/l)	Manual Gampic	John	D/ valve	140	01137 2010	01137 1013	Monthly
			% TDS							Weekly
			% 1D3 % VS							
22	Return from Cooler	Pasteuriser slab	Flow rate	Flow meter	65 NB	Siemans	P32	C1197-2024	C1197-1020	Monthly Continuous
32							P32 P41			
33	Pasteurised Sludge	Pasteuriser slab	ph Alleoliaite	Manual Sample	50 NB	B/valve	P41	C1197-2024	C1197-1020	Spot
			Alkalinity							Spot
			% TDS				<u>ر</u> و.			Spot
			% VS				12 C		0	Spot
13	Digested Sludge to Dewaterer	Sludge Building	Flow Rate	Flowmeter	150 NB	Siemans	P46	C1197-3006	C1197-1023	Intermittent
13	Digested Sludge to Dewaterer	Sludge Building	Flow Rate	Flowmeter	150 NB	Siemans	P46	C1197-3006	C1197-1023	Intermittent
		Digested Sludge Tank				es a for				
13	Digested Sludge to Dewaterer	Outlet	% TDS	Manual Sample	50 NB 🔬	× B/valve	P20	C1197-2014	C1197-1022	Intermittent
			% VS		a Put	<u>8</u> 2				Intermittent
	Stored Digested Sludge to	After dewaterer feed			action net					
26	Dewaterer 1	pump 1	As Required	Manual Sample	50 NB	B/valve	P46	C1197-2014	C1197-1022	Spot
	Stored Digested Sludge to	After dewaterer feed			tot siles					
27	dewaterer 2	pump 2	As Required	Manual Sample	े. ⁵ 0 NB	B/valve	P46	C1197-2014	C1197-1022	Spot
30	Inlet air	Sludge OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Continuous
31	Outlet air	Sludge OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Continuous
34	Liguor from GBT 1	Sludge Building	рН	Manual Sample	25 NB	B/valve			C1197-1018	Spot
35	Liquor from GBT 1	Sludge Building	pH	Manual Sample	25 NB	B/valve			C1197-1018	Spot
20	Potable Water	Pre Site Storage	Flow Rate	Flowmeter						Continuous
3	Final Effluent	<u> </u>	Flow Rate							Continuous
3	Final Effluent	FE Chamber	BOD	Auto Sampler			n/a	C1197-2020	C1197-1027	Intermittent
-			COD						,	Intermittent
			ph							Intermittent
			SS							Intermittent
14	Final Sludge Product	access road	Weight	Weighbridge				C1197-3002	C1197-1023	Intermittent
14	Final Sludge Product	Discharge to skip	Nitrogen	Manual Sample	150 NB	B/valve		C1197-2011	C1197-1023	Occasional
· <del>т</del>	That Globye Troduct	Discharge to ship	Phosphorous	Manual Cample		D, valve		01107-2011	01107-1020	Occasional
			Potassium							Occasional
			Temperature							5 times per weel
			% TDS							5 times per weel
			% VS							Weekly
			Dry Solids							5 times per weel
			Heavy Metals							Occasional
			Faecal Coliforms							5 times per week
						B/valve		C1197-2011	C1197-1023	Occasional
14	Final Sludge Product	Discharge to skip	Nitrogen	Manual Sample	150 NB	D/valve		01197-2011	01197-1023	Occasional
14	Final Sludge Product	Discharge to skip	Nitrogen Phosphorous	Manual Sample	100 NB	D/valve		01197-2011	01197-1023	Occasional

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			Temperature % TDS % VS Dry Solids Heavy Metals							5 times per week 5 times per week Weekly 5 times per week Occasional
			Faecal Coliforms		TDO	TDO			04407 4000	5 times per week
30	Inlet air	Sludge OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Continuous
31	Outlet air	Sludge OCU	H2S	Gas monitor	TBC	TBC			C1197-1026	Continuous
32	Return from Cooler	Pasteuriser slab	Flow rate	Flow meter	65 NB	Siemans	P32	C1197-2024	C1197-1020	Continuous
33	Pasteurised Sludge	Pasteuriser slab	ph	Manual Sample	50 NB	B/valve	P41	C1197-2024	C1197-1020	Spot
	_		Alkalinity							Spot
			% TDS							Spot
			% VS							Spot
	Utilities									
19	Polymer Usage	Sludge Building								Intermittent
19A	Mixed Polymer to GBT 1802A	Sludge Building	Flow Rate	Flowmeter	50 NB			C1197-2011	C1197-1018	Continuous
19A	Mixed Polymer to GBT 1802B	Sludge Building	Flow Rate	Flowmeter	50 NB			C1197-2011	C1197-1018	Continuous
19B	Mixed Polymer to dewaterer 1	Sludge Building	Flow Rate	Flowmeter				C1197-2011	C1197-1023	Continuous
19B	Mixed Polymer to dewaterer 2	Sludge Building	Flow Rate	Flowmeter				C1197-2011	C1197-1023	Continuous

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Contract Name : Waterford

#### Contract No: C1197

Document Ref: 8404

#### Title : Activated Sludge Design

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Effluent Consent Standard         Average         96 % lie           CDD         Press 3000-Design Basis         mg/l         [22.5]         125           SS         Press 3000-Design Basis         mg/l         [7.5]         2.5           SS         Press 3000-Design Basis         mg/l         [7.5]         2.5           SS         Press 3000-Design Basis         mg/l         [7.5]         2.5           NIG         mg/l         [7.5]         2.5         2.5           P         Etimary, Tanks         [2.1]         #VALUE!         #VALUE!           SS Removal Efficiency (max)         %         [2.2]         Frem 8403-RST           SS Removal Efficiency (max)         %         [2.2]         Them 8403-RST           TAVT N Removal Efficiency (max)         %         [2.2]         Them 8403-RST           TAVT N Removal Efficiency (max)         %         [2.2]         [2.3]           Natik Removal In year 2005         kg/d         [3.3]         [2.7]         [3.6]           Primary Studge Production         %         [2.2]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]         [3.6]									
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VTKNTN Removal Efficiency (min)       %       0         N-NH4 Removal Efficiency (min)       %       0         Primary Sludge Production       %       0         Primary Sludge Production       %       0         Max Removal In year 2005       kg/d       3318       221       152       162       111       66         Max Removal In year 2005       kg/d       3022       203       152       101       61         Max Removal In year 2025       kg/d       5056       369       277       186       111         Max Removal In year 2025       kg/d       5056       339       224       169       102         Max Removal In year 2025       kg/d       5556       392       217       186       111         Max Removal In year 2025       kg/d       5553       3953       325       2171       130         Min Removal In year 2025       kg/d       5553       3953       8730       11069       1031         Stoble BOD Component       kg/d       776       5553       3953       4259       4945       494       49       52       494       49       49       100       0       0       0       0       0       0									
TKM/TN Removal Efficiency (min)     %     0       NH44 Removal Efficiency (min)     %     0       Primary Sludge Production     %     0       Percentage Dry Solids     %     1.5     2     3       Max Removal In yeer 2005     kg/d     3318     221     166       Max Removal In yeer 2005     kg/d     3318     221     166       Max Removal In yeer 2025     kg/d     5539     366     277     185       Max Removal In yeer 2025     kg/d     5506     333     225     217     130       Max Removal In yeer 2025     kg/d     5506     337     258     198     119       Secondary Treatment Stage     kg/d     5736     535     9353     9370     11069     10331       Soluble BOD Component     kg/d     2791     2791     2791     4259     494     445       Sto Secondary Treatment Stage     kg/d     0     0     0     0     0     0       Volatile SC Component     kg/d     1991     1776     3324     2954     433     365     155     3693     4875     4333       Volatile SC Component     kg/d     0     0     0     0     0     0     0     0       N							From 8403-	PST	
NLML Bemoval Efficiency (min)         %         0           Primary Sludge Production         %         0           Percentage Dry Solids         %         0           Max Removal in year 2005         kg/d         3318         221           Max Removal in year 2005         kg/d         5338         369         277           Max Removal in year 2025         kg/d         5059         339         2264         166         101           Max Removal in year 2025         kg/d         5050         433         325         217         186         102           Max Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT									
N-NH4 Removal Efficiency (min)         %         0           Primary Sludge Production         Sludge Production, m3/d           Percentage Dry Solids         %         1.5         2         3         5           Max Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2025         kg/d         5539         3369         277         185         111           Min Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5550         337         298         199         119           Scondary Treatment Stage         kg/d         5756         5353         3953         8730         11069         1031           Soluble BOD Component         kg/d         2711         2719         4259         4945         494         49         52         494         494         49         218         4916         400         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0									
Vinary Sludge Production         Sludge Production, m3/d           Percentage Dry Solids         %         1.5         2         3         5           Max Removal in yeer 2005         kg/d         3318         221         166         111         66           Min Removal in yeer 2025         kg/d         6533         369         277         186         101           Min Removal in yeer 2025         kg/d         6503         339         254         165         102           Min Removal in yeer 2025         kg/d         6500         433         325         217         186         111           Max Removal in yeer 2025         kg/d         6500         433         326         1106         102           Min Removal in yeer 2025         kg/d         5736         5353         933         8700         11069         10331           Soluble BOD Component         Kg/d         2791         2459         4259         445         449         44         44         44         44         44         445         433         10068         10331         1004         10331         1024         445         433         4475         433         4475         4333         104         145	NI-NIHA Domoval F	fficiency (max)							
Skudge Production, m3/d           Percentage Dry Solids         %         15         2         3         5           Mar Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2005         kg/d         5539         369         227         135         111           Min Removal in year 2025         kg/d         6553         339         224         166         102           Mar Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025         20%         Max         Min         May         <	N-NH4 Removal E	Efficiency (min)		%		0			
Skudge Production, m3/d           Percentage Dry Solids         %         15         2         3         5           Mar Removal in year 2005         kg/d         3318         221         166         111         66           Min Removal in year 2005         kg/d         5539         369         227         135         111           Min Removal in year 2025         kg/d         6553         339         224         166         102           Mar Removal in year 2025         kg/d         6500         433         325         217         130           Min Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025         20%         Max         Min         May         <									
Percentage Dry Solids         %         1.5         2         3         5           Max Removal in year 2005         kg/d         3318         221         166         111         61           Max Removal in year 2025         kg/d         5338         369         277         185         111           Max Removal in year 2025         kg/d         5078         339         254         169         102           Max Removal in year 2025         kg/d         6500         433         3252         217         130           Min Removal in year 2025         kg/d         6500         433         3252         101         106           SECONDARY TREATMENT           Yr 2005         Yr 2025         Yr 2025         279         1069         1031           Soluble BOD Component         Kg/d         5736         5353         9353         4375         433         445         4445           Percentage Soluble BOD         %         49         52         455         445         445           Volatile SS Component         kg/d         0         0         0         0         0         0         0         0         0         0         0         0	Primary Sludge F	roduction							
Nax. Removal in year 2005         kg/d         3318         221         166         111         66           Min. Removal in year 2005         kg/d         5539         369         277         185         101         61           Min. Removal in year 2025         kg/d         5539         369         277         185         111           Min. Removal in year 2025         kg/d         6558         339         284         169         102.           Max. Removal in year 2025         kg/d         6558         397         288         199         119           SECONDARY TREATMENT									
Nin Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         5539         369         277         185         111           Max Removal in year 2025         kg/d         6509         339         254         169         102           Max Removal in year 2025         kg/d         5558         397         298         199         119           SECONDARY TREATMENT           199         119         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110         110 <t< td=""><td>Percentage Dry S</td><td>olids</td><td></td><td></td><td></td><td>1.5</td><td></td><td></td><td></td></t<>	Percentage Dry S	olids				1.5			
Min Removal in year 2005         kg/d         3042         203         152         101         61           Max Removal in year 2025         kg/d         6539         369         277         188         111           Max Removal in year 2025         kg/d         65078         339         254         169         102           Max Removal in year 2025         kg/d         5958         337         298         199         119           SECONDARY TREATMENT           5958         337         298         199         119           SECONDARY TREATMENT            Yr 2025         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Treatment Stage         kg/d         2791         2791         494         49         45         49           Yotatile SS Component         kg/d         219         748         49         45         49         433         4333         4875         4333         4335         4333         4367         4333         4875         4333         4900         3467         4333         447         49         45         49         45         49         45         49         45         49         45	Max Removal in y	ear 2005	kg/d		3318	221	166	111	66
Max         Removal in year 2025         kg/d         5539         369         277         185         111           Min Removal in year 2025         kg/d         65078         339         254         169         102           Min Removal in year 2025         kg/d         6507         339         254         169         102           Min Removal in year 2025         kg/d         5507         339         254         169         102           SECONDARY TREATMENT         Yr 2005         Yr 2025         Yr 2025 + 20%         Yr 2025 + 20%         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5353         5353         58730         11069         1031           Soluble BOD Component         kg/d         2791         278         4259         445         445           Thx Load To Secondary Treatment         kg/d         2791         278         435         433         324         2954         3900         3467         433           Valiatile SS Component         kg/d         49/d         442         431         739         975         867           NH4-N Load         kg/d         1295         1352         1352         1596         1596					3042	203	152	101	61
Nin Removal in year 2025         kg/d         5078         339         254         169         102           Max Removal in year 2025         kg/d         6500         433         326         217         130           SECONDARY TREATMENT								185	
Max         Removal in year 2025         kg/d         6500         433         325         217         130           SECONDARY TREATMENT					1				
Min Removal in year 2025         kg/d         5958         397         298         199         119           SECONDARY TREATMENT           BOD Load To Secondary Stage         kg/d         5736         5353         9353         9373         1065         1035           Secondary Stage         kg/d         2717         2736         5353         936730         11065         10331           Secondary Stage         kg/d         2719         2711         2791         2791         4259         4259         4945         484           Percentage Soluble BOD         %         49         52         445         3693         4875         4333           Volatile SS Component         kg/d         2489         2718         44155         3693         4875         4333           Volatile SS Component         kg/d         499         49         45         48           Volatile SS Component         kg/d         1381         1232         1352         1556         1596         1596           Volatile SS Component         kg/d         499         4155         143         143         165         165           Vizoos									
SECONDARY TREATMENT           Yr 2025         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         9730         11069         1031           Soluble BOD Component         kg/d         2791         2791         2791         2791         4259         445         4945         4845         4345         4333           Sto Secondary Treatment Stage         kg/d         2489         2218         4155         3693         4875         4333           Volatile SS Component         kg/d         1991         1770         3324         2954         3900         3467           Inorganic SS Component         kg/d         489         218         739         975         867           NH-A Load         kg/d         1204         1201         1352         1352         1596         156           Soluble BOD Component         kg/d         1204         1204         142         311         143         145         146           Soluble BOD Component         Volatite SS Component         0         0									
Yr 2005         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5736         5353         9353         4259         44945           Percentage Soluble BOD         %         49         52         4259         44945         4495           Sto To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	inin rionovarin ye		Ngro						
Yr 2005         Yr 2025         Yr 2025 + 20%           BOD Load To Secondary Stage         kg/d         5736         5353         9353         4259         44945           Percentage Soluble BOD         %         49         52         4259         44945         4495           Sto To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	SECONDARY TR	EATMENT							
Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         58730         11069         10331           BOD Load To Secondary Treatment         kg/d         2791         2791         2459         4259         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4935         4333         Volatile SC Component         kg/d         1991         1770         3324         2954         3900         3467         100         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0		<u></u>							
Max         Min         Max         Min         Max         Min           BOD Load To Secondary Stage         kg/d         5736         5353         9353         58730         11069         10331           BOD Load To Secondary Treatment         kg/d         2791         2791         2459         4259         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4945         4935         4333         Volatile SC Component         kg/d         1991         1770         3324         2954         3900         3467         100         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0				Yr	2005	Yr 2	2025	Yr 2025	5 + 20%
BOD Load To Secondary Stage         kg/d         5736         5353         9353         68730         11069         10331           Soluble BOD Component         %         49         52         449         494         45         48           TKN Load To Secondary Treatment         kg/d         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0									
Soluble BOD Component         kg/d         2791         2791         4259         4259         4945         4945           Percentage Soluble BOD         %         49         52         46         49         45         48           NCN Load To Secondary Treatment Stage         %/d         2489         2218         4155         3693         4875         4333           Volatile SS Component         %/d         1991         1770         3324         2954         3900         3467           NH4-N Load         kg/d         489         442         831         739         975         867           NH4-N Load         kg/d         1991         1352         1352         1596         1596           TN Load         kg/d         1201         1352         1352         1356         165           BOD concentration To Secondary Stage         Min         Max         Min         Max         Min         Max         Min           Soluble BOD Component         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0	BOD Load To Sec	condary Stage	ka/d						
TKN Load To Secondary Treatment     kg/d     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0						4259			
TKN Load To Secondary Treatment     kg/d     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0						NAG 2	r		
SS To Secondary Treatment Stage         kg/d         2489         2218         64155         3693         4875         4333           Volatile SS Component         kg/d         1991         770         3324         2954         3900         3467           Inorganic SS Component         kg/d         1991         770         3324         2954         3900         3467           Inorganic SS Component         kg/d         1991         770         3324         2954         3900         3467           NH4-N Load         kg/d         1204         422         831         739         975         867           TN Load         Volatile SS Component         kg/d         1352         1352         1596         1596           To Load         Yr 2005         Yr 2025         Yr 2025 + 20%         Yr 2025 + 20%         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min         Max         Min           BOD concentration To Secondary Treatment         0         0         0         0         0         0         0         0           St To Secondary Treatment Stage         138         123         139         124         163         145						0.9			
Volatile SS Component         %         80         1991         17701         3324         2954         3900         3467           Inorganic SS Component         kg/d         498         1209         442         831         739         975         867           NH4-N Load         kg/d         kg/d         1209         422         1352         1596         1596           TN Load         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0						A FE			
Volatile SS Component Inorganic SS Component         kg/d kg/d         1991 kg/d         1770 442         3324 831         2954 739         3900 975         3467           NH4-N Load         kg/d         498 kg/d         1201         1352         1352         1596         1596           NLaad         kg/d         kg/d         1201         1352         1596         1596           Concentrations at DWE         Yr 2005         Yr 2025         Yr 2025 + 20%           BOD concentration To Secondary Stage         0         0         0         0         0         0           Soluble BOD Component         0         0         0         0         0         0         0         0         0         0           TKN concentration To Secondary Treatment Stage         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <td></td> <td></td> <td></td> <td></td> <td>2210</td> <td>4155</td> <td>3093</td> <td>40/5</td> <td>4555</td>					2210	4155	3093	40/5	4555
Inorganic SS Component         kg/d         498         442         831         739         975         867           NH4-N Load         kg/d         1300         1352         1352         1596         1596         1596           TN Load         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0					all a		0074	0000	0407
NH4-N Load         kg/d         1202         M201         1352         1352         1596         1596           TN Load         kg/d         3         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0									
TN Load         kg/d         B         0         0         0         0         0         0         0           Concentrations at DWF         Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min <td></td> <td>ponent</td> <td></td> <td></td> <td>A42</td> <td></td> <td></td> <td></td> <td></td>		ponent			A42				
Concentrations at DWE						(			
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166	TN Load	·	kg/d	CON A	<u> </u>	0	0	0	0
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166			A1	1 19 -					
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166	Concentrations a	at DWF	· · · · · · · · · · · · · · · · · · ·	J.					
Max         Min         Bob         Concentration To Secondary Stage         318         296         313         292         370         346         346         315         1155         1143         1143         165         165         175         138         123         139         124         163         145         165         165         175         138         123         139         124         163         145         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         165         166			ç	<u>,07</u>	0005	<u> </u>	005	V- 000	
BOD concentration To Secondary Stage         318         296         313         292         370         346           Soluble BOD Component         155         155         143         143         165         165           Percentage Soluble BOD         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0 <td>1. Sec. 1. Sec</td> <td></td> <td>ζ O^γ</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	1. Sec. 1. Sec		ζ O ^γ						
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SS To Secondary Treatment Stage       138       123       139       124       163       145         Volatile SS Component       110       98       111       99       130       116         Inorganic SS Component       28       25       28       25       33       29         NH4-N concentration       67       67       45       45       53       53         Concentration at Average Flow         Yr 2005       Yr 2025       Yr 2025 + 20%         Max       Min       Max       Min       Max       Min         BOD concentration To Secondary Stage       240       224       245       229       290       271         Soluble BOD Component       117       117       112       112       130       130         Percentage Soluble BOD       0       0       0       0       0       0       0         COD concentration To Secondary Treatment       0       0       0       0       0       0       0       0         COD concentration To Secondary Treatment       0       0       0       0       0       0       0       0       0       0       0       0       0       0			1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -			l .	_	Ι.	
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Inorganic SS Component         28         25         28         25         33         29           NH4-N concentration         67         67         45         45         53         53           Concentration         Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min           BOD concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0				i i					
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Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         <	Inorganic SS Com	ponent		28	25		25	33	29
Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         <					67	45		53	53
Yr 2005         Yr 2025         Yr 2025 + 20%           Max         Min         Max         Min         Max         Min         Max         Min         Bob concentration To Secondary Stage         240         224         245         229         290         271           Soluble BOD Component         117         117         112         112         130         130           Percentage Soluble BOD         0         0         0         0         0         0         0           COD concentration To Secondary Treatment         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         14         14									
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SS To Secondary Treatment Stage     104     92     109     97     128     114       Volatile SS Component     83     74     87     77     102     91       Inorganic SS Component     21     18     22     19     26     23				0	0	0	0	0	0
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Volatile SS Component         83         74         87         77         102         91           Inorganic SS Component         21         18         22         19         26         23				104	32	103	"	120	l ''''
Inorganic SS Component 21 18 22 19 26 23	· ·			82	74	97	77	100	01
Nri4-iv concentration         50         50         35         42         42									
	NH4-N concentral	(101)		50	50	35	35	42	42
	L								

#### SLUDGE PRODUCTION

#### Extended Aeration

Note : This equation applies where primary tanks are not utilised and where extended aeration is practiced. It should not be used if trade effluents containing non-degradable or slowly biodegradable solids are present. For a more detailed calculation see spreadsheet entitled 'SAS Production Rate'.

Not used in design

Sludge Loading (F/M Ratio)	kgBOD/kgTSSd	0.3			
Temperature	degrees C	8	10	12	20
Ratio of non biodegradable solids in raw sewage / total SS in raw sewage.		0.2	0.2	0.2	0.2
Ratio of total raw sewage SS to raw sewage BOD (Fallback value =1.2)		0.72			
Temperature	degrees C	8	10	12	20
Sludge Yield		0.79	0.79	0.78	0.73
Max Sludge Production (Yr 2005)	kg/d	4556	4514	4466	4194
Min Sludge Production (Yr 2005)	kg/d	4252	4213	4168	3915
Man Oludae Deaduation (V- 0005)	1 lat	1 7400	7001	7000	00.40
Min Sludge Production (Yr 2025)	kg/d	6934	6871	6798	6384
Max Sludge Production (Yr 2025)	kg/d	8792	8712	8619	8095
Min Sludge Production (Yr 2025)	kg/d	8206	8131	8045	7555

#### Conventional Aeration

For well settled sewage the following equation can be used. This applies for a temperature range of 7 to 25 C

	and the second					
Sludge Loading (F/M Ratio)	kgBOD/kgTSSd	0.27				· ••
Temperature	degrees C	8	10	12	20	]
0.75 used in tend	er design					-
SludgeYield		1.01	0.75	0.80	0.51	1
Max Sludge Production (Yr 2005)	kg/d	5810	4302	4569	2899	1
Min Sludge Production (Yr 2005)	kg/d	5423	4015	4264	2706	
Max Sludge Production (Yr 2025)	kg/d	9475	7015	745	4727	1
Min Sludge Production (Yr 2025)	kg/d	8844	6547	6954	4412	
Max Sludge Production (Yr 2025)	kg/d	11213	8302	8817	5594	1
Min Sludge Production (Yr 2025)	kg/d	10466	7748	8229	5221	1.1
			AY 00			-

#### Selector Tank Volume

Selector Tank Volume		e e	die			
Design Basis : minimum of 30 mins at D	WF plus RAS or 10 mins at ma	x flow plus RAS	re .			
Assuming RAS remains constant for bot		ction per re				•
	TSP	x or	Yr 2005	Yr 2025	Yr 2025 + 2	20%
RAS Flow	m3/h 🔨 🖓	8	752	2036	2036	
30 mins at DWF plus RAS	m3 🌾 🔊		730	1590	1590	
10 mins at max flow plus RAS	m3 2005		479	912	912	
30 mins at DWF	No.		354	572	572	
Selector Zone Volume	m3		730	1590	1590	
	and an an experience in the	4 1 ¹ 1 1 1 1 1 1				
MLSS	( <b>\g</b> /m3		3.5	1		
Number of selector tanks		-	1	1		1.0
Water Depth	n m		5	1		
Tank Length	m		12	1		
Tank Width	m	1	10	1		
Actual Volume per tank	m3		600	_		
Proposed Selector Tank Volume	m3		600	Selected to g	ive floc loading	g >2.3
•						
			DWF	Average	Peak	
Actual Retention Time	mins		51	39	17	
Actual Retention Time (inc RAS)	mins		25	22	13	
Floc Loading (>2.3)	· · ·	4.5	(BOD kg/d /N	lixed Liquor M	ass in Selector	)
		Breast Constant	•			*

Note: The Floc Loading should be greater than 2.3 to encourage the growth of floc forming bacteria. This can be increased by lowering the selector volume or mixed liquor suspended solids.

Selected F/M ratio Operating MLSS

0.3

Volume Required Volume Selected

10542 m³ 10600

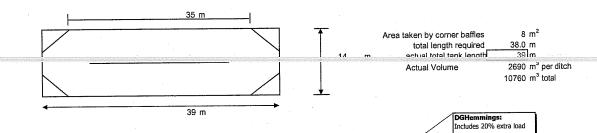
Based upon 2025 load with 20% extra as requirement to meet consent with one lane out of service.

#### Inclined Bubble Aeration Ditch

Selector Volume Required	m3	600	
Total Volume For Oxidation ditch	m3	10600	
		Tender drawing	shows tank
Number of streams	m3	4	
Volume Per stream	m3	2650	
Minimum Sewage Depth	m	5 5	
Width of each lane	m	7 7	
Straight Length of each tank	m	38 48.5	
Actual Volume Per Tank	m3	2660 3395	
Recycle Ratio (FST to ditch)		1	

Ref: Vol 4 section 7.7.1 minimum sludge 5 days @ 10 deg C

#### Inclined Bubble Aeration Ditch - Tapered Ends



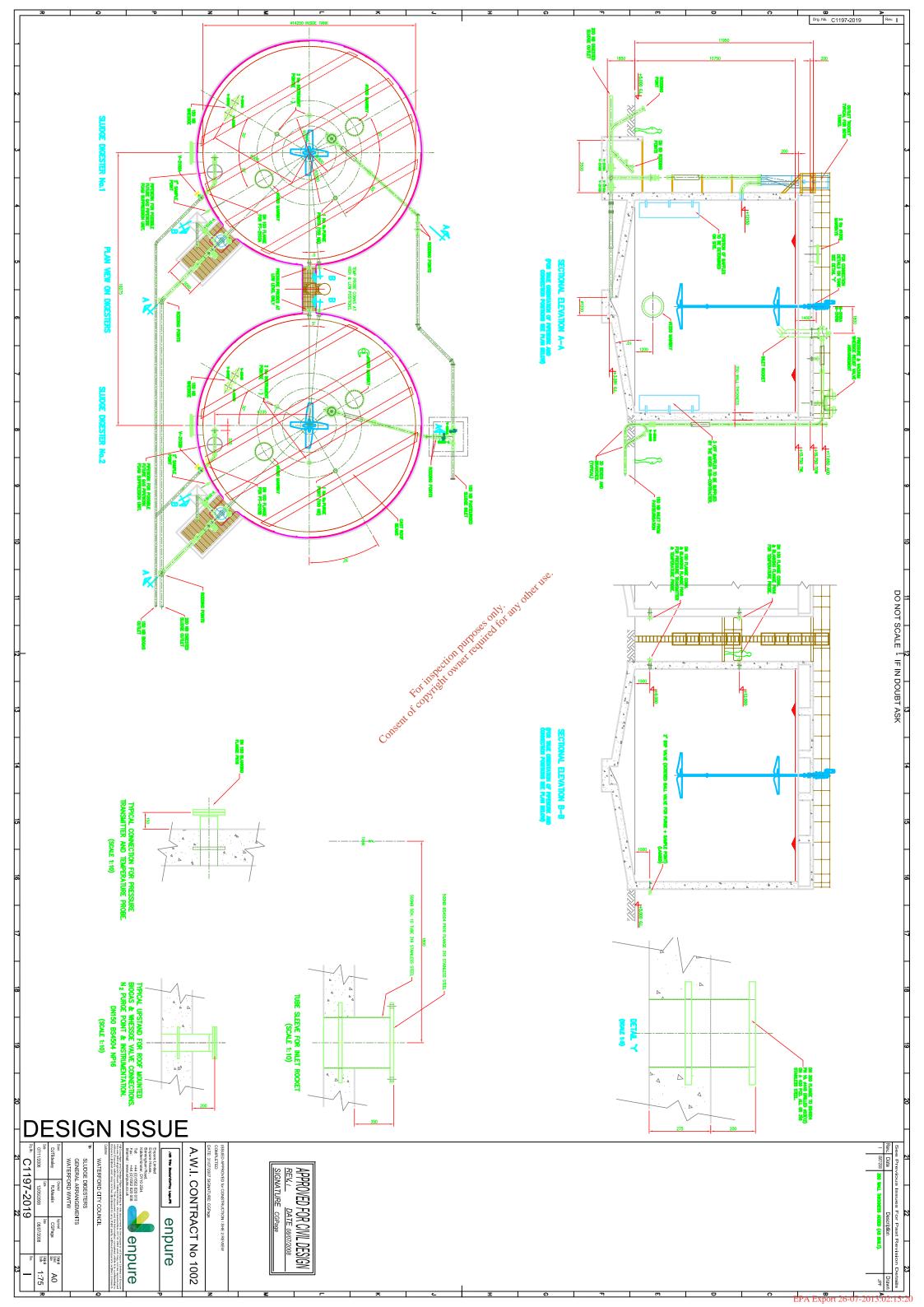
#### Actual F/M Ratio Max Year 2025 Max Year 2025 Average 2005 Max Min Max Max Min Min Max 3.5 0.25 3.5 0.23 3.5 3.0 0.17 3.5 MLSS in ASP kg/m3 3.0 0.18 0.29 0.27 Actual F/M Ratio SRT = Vol x MLSS/sludge prod SRT = 1/(yield x F:M) 6 6 5 5 d d 8 5 SRT 8 8 8 5 SRT

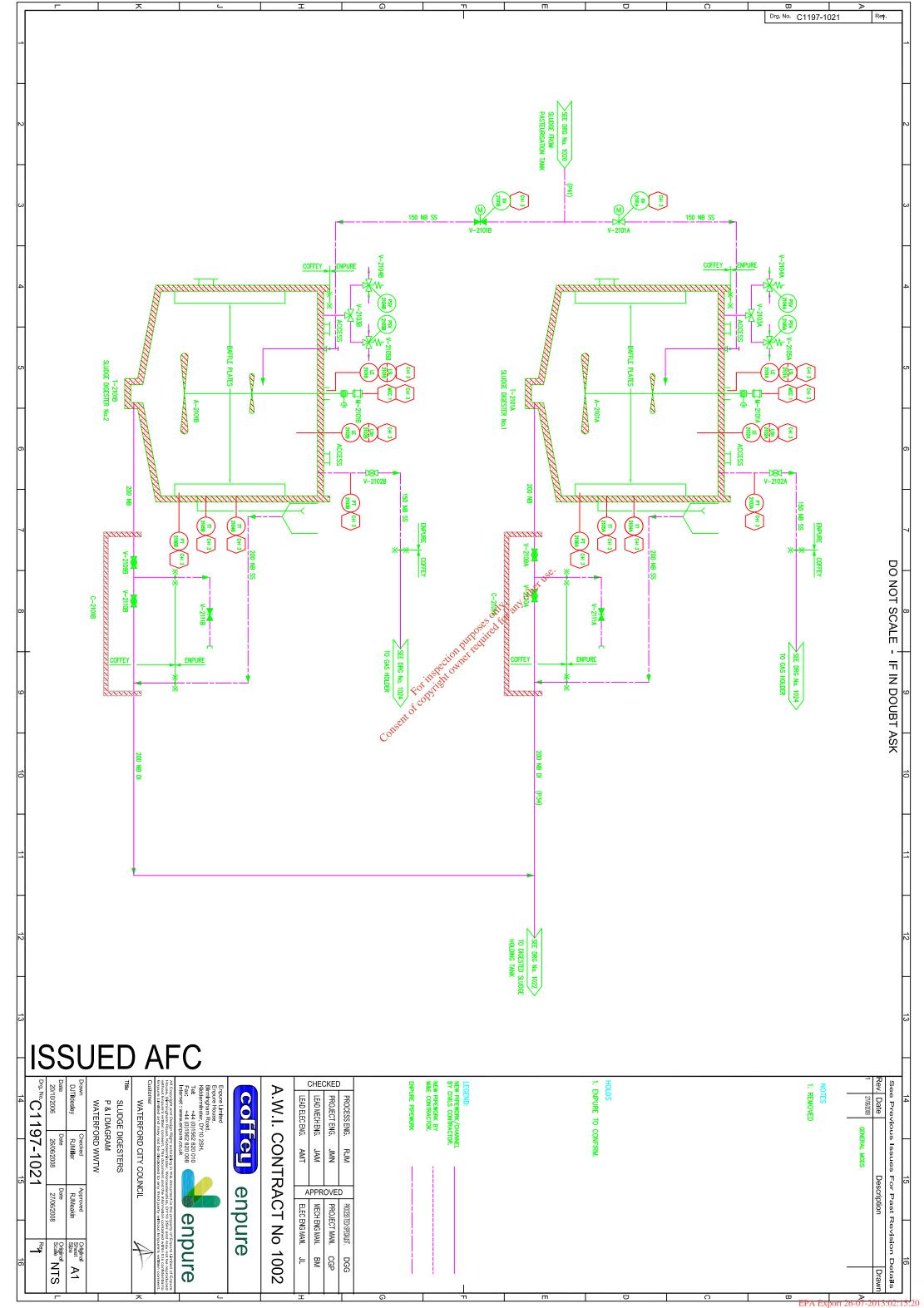
#### **Operation With One Tank Out Of Service**

SRT	•	d	8.	8	5	6 .0	. 5	5	SRT = 1/(yield x F:M)
Operation With One Ta	ank Out Of Service	-				other us		•	
MLSS in ASP		kg/m3	3.0	3.0	A0 0	4.0	4.8 0.29	4.8	7
Actual F/M Ratio			0.24	0.22	0.29	0.27	0.29	0.27	SRT = Vol x MLSS/sludge pro
SRT		d d	6	6 6	5	5	5.	5	SRT = 1/(yield x F:M)
BRT		u			<u></u>	<u> </u>	L		
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		Consent	5						



Encure Limited Encure House, Birmitgham Road. Kiddemmister, DY10 2SH. Tel: - +44 (01562 820 010 Internet : www.enplute.co.uk MiCoopdan.ad Caeban Road. Kiddemister, Write Encurer I and South Compared to Encure House: - +44 (01562 820 010 Internet : www.enplute.co.uk MiCoopdan.ad Caeban Road. Kiddemister, Write Encurer I and South Compared to Encure House: - +44 (01562 820 010 House: - +44 (01562 820 010 MiCoopdan.ad Caeban Road. Kiddemister, Write Encurer I and South Compared to Encure House: - ++44 (01562 820 010 Microsoft Road. Kiddemister, Write Encurer I and South Compared to Encure House: - ++44 (01562 820 010 Microsoft Road. Kiddemister, Write Encurer I and South Compared to Encure House: - ++44 (01562 820 010 Microsoft Road. Kiddemister, Write Encurer I and South I is contained with it is contained with the contained to Encure I and the property of Encure Vertice Compared to Encure WATERFORD CITY COUNCIL The SITE LAYOUT MAIN FEATURES WATERFORD WWTW Dam Date Checked date and South Add South Add Date South Add Date South Add Date South Add Date South Add Date South Add Add Date South Add Date South Add Date South Add Add Date South Add South Add Microsoft Add South Add Microsoft Add	A.W.I. CONTRACT No 1002	<ul> <li>&amp; DICESTION CONTROL BUILDING</li> <li>FUEL TANK</li> <li>SKIP HOLDING AREA</li> <li>SURFACE WATER WONTORING CHAMBER</li> <li>THICKENED PRIMARY SLUGGE TANK</li> <li>THICKENED SECONDARY SLUGGE TANK</li> <li>BELVIEW SEWER PUMPING STATION</li> <li>RETURN LIQUORS PUMPING CHAMBER</li> <li>RAS PUMPIS (6 No TOTAL)</li> <li>FRIMARY SLUGGE PUMPIS (3 No)</li> </ul>	<ul> <li>PICKET FENCE THICKENER</li> <li>SLUDGE BLENOING TANK</li> <li>SLUDGE DIGESTER</li> <li>DIGESTED SLUDGE TANK</li> <li>CAS HOLDING TANK</li> <li>CAS HOLDING TANK</li> <li>ODOUR CONTROL UNIT - INLET</li> <li>ODOUR CONTROL UNIT - SLUDGE</li> <li>MASTE GAS BURNER</li> <li>DISCHARGE MONTORING CHAMBER</li> <li>ADMINISTRATION BULDING TOWN</li> </ul>	THIS DRAWING TO BE READ IN         CONJUNCTION WITH TEXT OF 3 d) (i)         WATER LICENCE         ************************************	Vious Issues For Past Re Description FIRST ISSUE





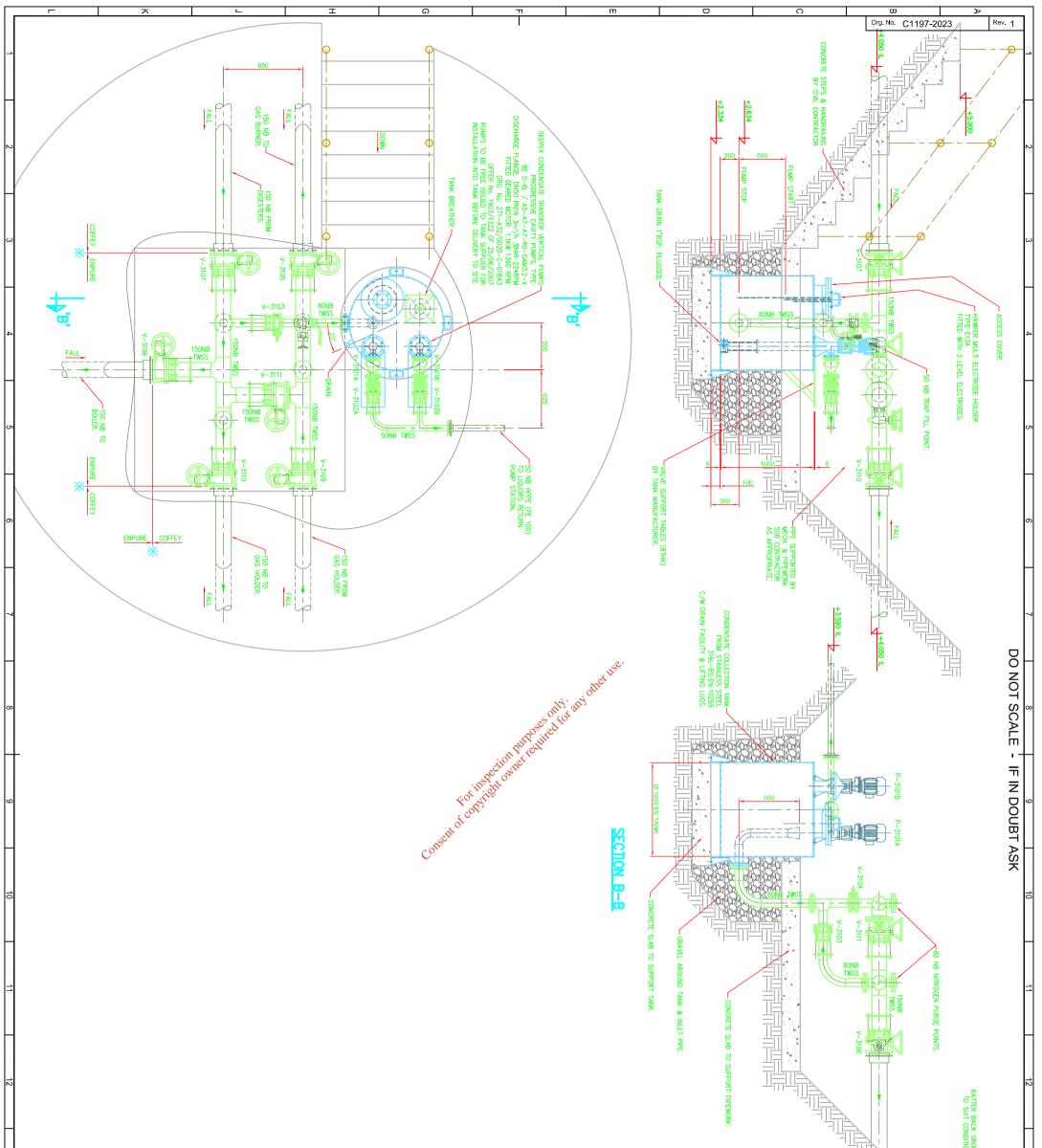
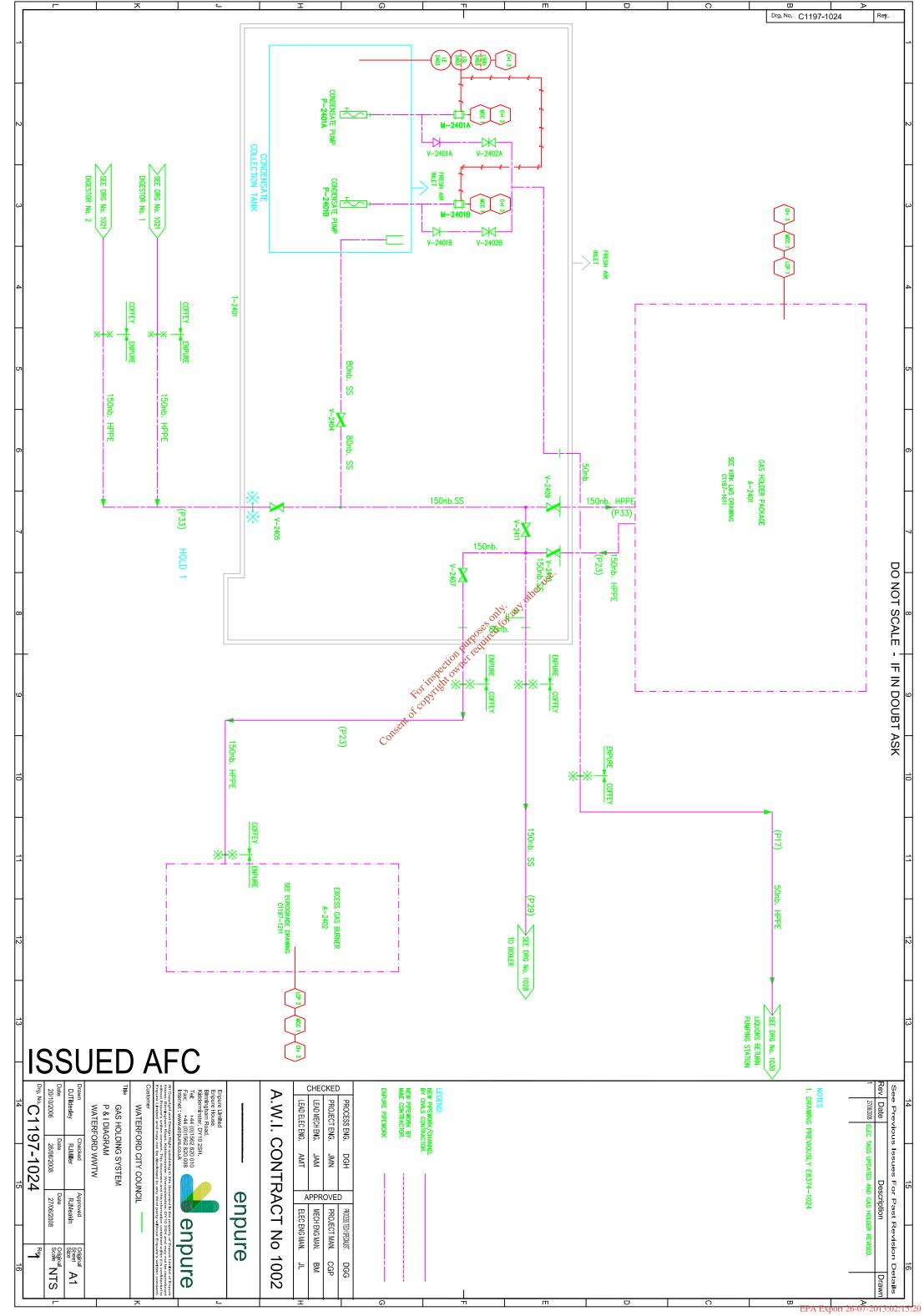


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Contract Name : Waterford

Contract No: C1197

Document Reference: 8417

Title : Bolier

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# 8420 Waterford pasteurisation plant Rev 1 (incl.8415,8416,8417,8420,8124)

	1					· · · · · · · · · · · · · · · · · · ·		
BOILER SIZING								
		Case 1	Case 2	Case 3	Case 4			
		0030 \$		0000				
Total Heat Required by all Digesters	kW	253	314	744	921	Ref: 8416 H	leat Exchar	iger Design
Total Heat Required by all Digesters					· · ·			
Number of Duty Boilers Selected	· · · ·	1	1	2	2			
		,						
Output Required by Each Boiler	kW	253	314	372	461			
Boiler output required to be specified to suppliers	Suppliers to	select actu	al boiler mod	el to meet th	e			
required output and advise actual output, efficient	cy and fuel in	out requirem	ents. Calcu	lation given t	Delow			
is for preliminary assessment purposes only.						1		
	L\A/	500	500	500	500			-
Boiler Output Selected (Each)	kW	80	80	80	80	· · · · · · · · · · · · · · · · · · ·		
Boiler Efficiency (Assumed)	%	00	00	00		1	· · · ·	-
Estimated Fuel Input Required (Each)	kW	625	625	625	625			
Estimated Fuel input Required (Each)	RVV	02.0	020					
Sludge Gas Usage					· .		• •	
Sludge Gas Usage				-				
Gas Net Calorific Value	MJ/Nm ³	22.5	22.5	22.5	22.5			
Approximate Gas Flowrate (Each)	Nm ³ /h	100	100	100	100			• •
Approximate Gas Flowrate (Total)	Nm ³ /h	100	100	200	200			
Approximate Gas Flowrate (Total)		100						
Minimum Gas Yield (Total)	m ³ /d	2291	2291	3776	3776	8413 Gas I	Production	
				1				1. 1. 1.
Proportion of Minimum Gas Yield Consumed	%	105	105	. 127	127			
by all Boilers							·	
				•				
Standby Fuels			· ·	5°.				
				et				-
Fuel Oil Net Calorific Value	MJ/m ³	36900.00	36900.00	36900.00	36900.00			
Fuel Oil Flowrate (approx)	m ³ /h	0.06	0.06	0.06	0.06			
	l/h	61	061	61	61			
		ļ	<u> </u>	· ·				-
LPG Net Calorific Value	MJ/m ³	93.900	93.90	93.90	93.90	·   · · · · ·		
LPG Flowrate (approx)	Nm ³ /h	23,96	23.96	23.96	23.96			· · · · · · · · · · · · · · · · · · ·
		to Por						
Natural Gas Net Calorific Value	MJ/Nm ³	38.62	38.62	38.62	38.62			
Natural Gas Flowrate (approx)	Nm ³ /to	58.26	58.26	58.26	58.26	1	<u> </u>	<u>`</u>

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Contract Name : Waterford

Contract No: C1197

ocument Reference: 8418

#### Title : Gas System Equipment

Revision	No. of Pages	Date of	Purpose of Issue	Originator	Checked	Approved
	(Excluding Cover)	Issue				
1	1	20/11/2006	Contract Issue	DGH	DG RM	DG
2		16/04/2007	Whessoe valve information changed	DGH	RM	1/2
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# GAS HOLDER, EXCESS GAS BURNER AND DIGESTER PRESSURE/VACUUM RELIEF VALVES SIZING

		Case 1	Case 2	Case 3	Case 4	
Gas Holder						
Number of Gas Holders		1	1	1	1	-
Average Gas Production Rate	m³/h	193	164	157	95	
Retention Time in each Gas Holder	min	20	20	20	20	]
Capacity of each Gas Holder	m ³	64	55	52	32	-
Selected Capacity of each Gas Holder	m³	65	65	65	65	J
Retention Time at Minimum Production Rate	min	23	27	28	46	
Retention Time at Average Production Rate	min	20	24	25	41	
Retention Time at Maximum Production Rate	min	18	21	. 22	37	
		•			· · ·	
Excess Gas Burner			•		•	
Maximum Gas Production Rate	m³/h	215	182	175	106	
		05	0.5	25	25	7
Gas Burner Oversizing Margin	%	25	25		133	J .
Gas Burner Capacity Required	m³/h	268	228	219	155	
					1. 1. A.	
Digester Pressure/Vacuum Relief Valve - Pr	essure Re	lief Conditi	on		:	
Maximum Gas Production Rate	m³/h	⁵ 107	91	87	53	
Mixing Compressor Flowrate	m³/h	0	0	. 0	0	Mechanical Mixing
Digester Feed Volume	m³/h	15	15	15	15 ⁰ 15	Ref: Pasteurisation design sheets 8420
Pressure Relief Rate Required	m³/h	122	106	102	x *	
		•	×	9. 07 or	• • •	
Digester Pressure/Vacuum Relief Valve - Va	icuum Rel	ief Conditi	on o	tor o	e e e	
Digester Height (Centre of Cone to TWL)	m	13.173	11 13 173	13.173	13.173	na senten en e

		<u>_</u>			
Drain Pipe Diameter (ID)	m	0.20	0.20	0.20	0.20
Drain Pipe Length	m	0.00	15.0	18.0	20.0
Roughness	mm	. 5 05	0.5	0.5	0.5
Fittings K _T	×	A 1002	2	2	2
	. 🔨				

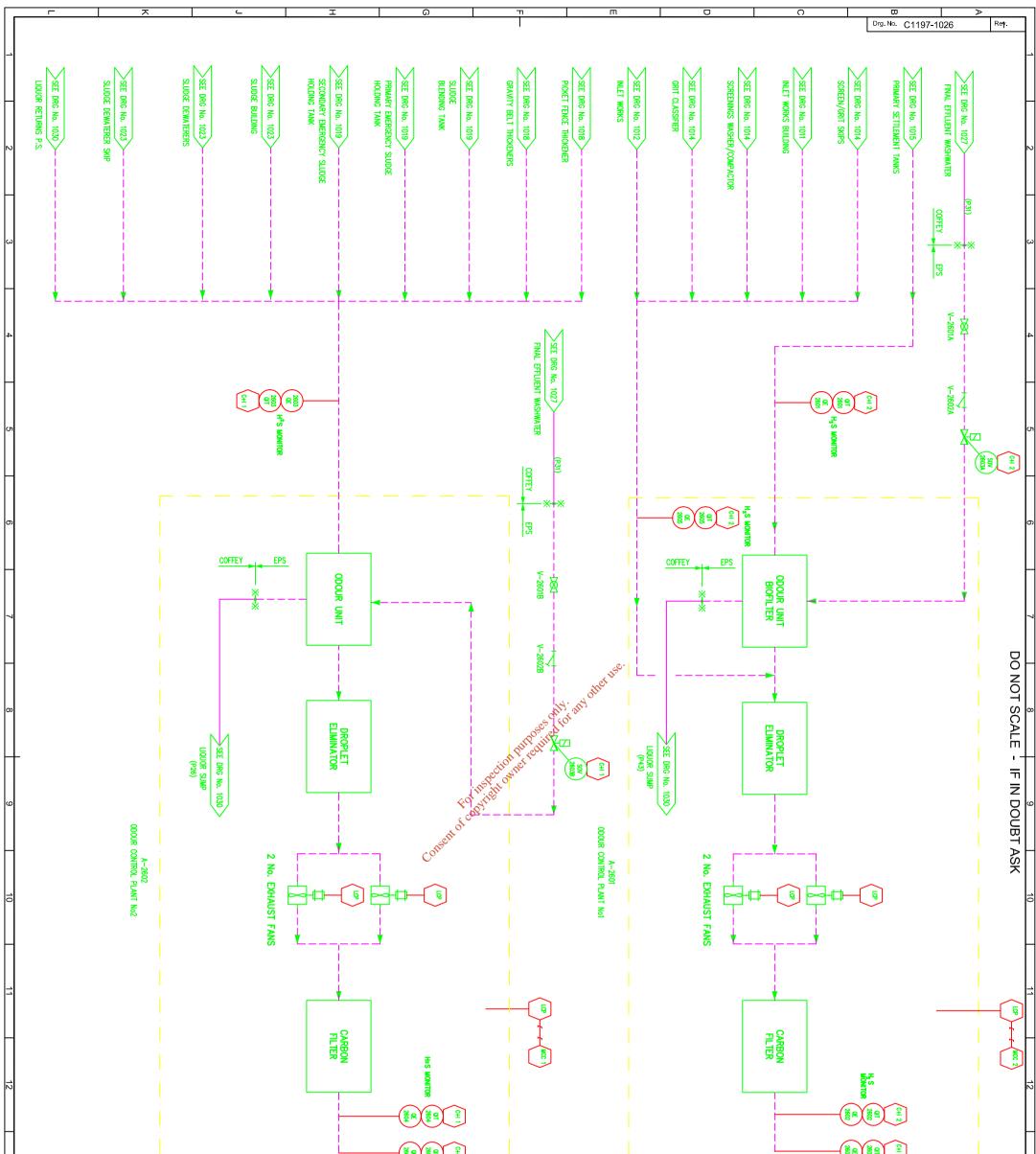
Maximum vacuum relief rate will occur when the friction loss in the outlet line is equal to the static head above the outlet. To evaluate this, the flowrate at which the static head is equal to the friction loss must be determined. Note that the friction factor and hence the friction loss is dependent on the flowrate so the equations must be solved by iteration.

To solve, use the following procedure :

From "Tools" menu choose "Goal Seek" In "Set cell" box enter "C64", "D64", "E64", "F64" In "To value" box enter number contained in cell C39, D39, E39, F39 In "By changing cell" box enter "C56", "D56", "E56", "F56"

	 			1 A A	

Maximum Flowrate	, m³/h	882	824	794	776
Water Temperature for Design	°C	35.0	35.0	35.0	35.0
Water Density	kg/m ³	994	994	994	994
Water Viscosity	mNs/m ²	0.7204	0,7204	0.7204	0.7204
Velocity	m/s	7.80	7.28	7.02	6.86
Reynolds Number		2152745	2010124	1937033	1892508
Friction Factor	fus	0.02495	0.02495	0.02496	0.02496
Dynamic Head Loss	m H₂O	13.17	13.17	13.17	13.17
Vacuum Relief Flowrate Required	m³/h	882	824	794	776



	FC	V	CLEANED AIR TO ATMOSPHERE VIA VENT STACK				CLEANED AIR TO ATMOSPHERE VIA VENT STACK	13
Customer       WATERFORD CITY COUNCIL       Tile     ODOUR CONTROL       P & I DIAGRAM     Approved       WATERFORD WWTW     Checked       Date     Checked       201/0/2006     Date       201/0/2006     26/06/2008       Dig. No.     C1 197-1026       Nat     15	Corpore to the designment of the operative of Enserve to the operative of the operative the	PROJECT ENG:     DGH     PROJECT ENG:     JMN       HEAD MECHENG:     JAM     PROJECT MAN.     CGP       LEAD MECHENG:     AMT     PROJECT MAN.     CGP       A.W.I. CONTRACT NO 1002	LECEND: NEW PIPEWORK/CHANNEL BY CIVILS CONTRACTOR. NEW PIPEWORK BY MAZE CONTRACTOR.			NOTES 1. REMOVED	7/10/2008 UPDATED TO SUPPLIERS INFORMATION	14     15     16       See Previous Issues For Past Revision Details
			G	т п	C		port 26-07-2013:	



Contract Name : Waterford

Contract No: C1197

#### ocument Reference: 8419

Title : Odour Control Design

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator	Checked	Approved
1	4	23/01/2007	Draft Issue	DGH	DR	
2	•	00/02/2007	Contract Issue	DGH	F.S.Q	rear and an array of the second
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PURAC Contract No.	C1197		-		• • •					•
Contract Litle PURAC Document No.		전 1. 사람이 사용 전 2013 1. 1999 1988 - 1999 - 1995 - 1995 1988 - 1995 - 1995 - 1995 - 1995	•		•	•	•			
Date Revision	09/02/07 2					· . :		•		
List Odour Control Unit Names	P&ID no.	Ave Odour concentration (OU _E /m ³ )	Max Odour concentration (OU∈/m ³ )	Ave H ₂ S conc (ppm)	Peak H ₃ S conc (ppm)	Air flowrate (m ³ /hr)				
Combined Treatment OCU	326	0 0	0		0.0	0 0	•			* .
Inlet Treatment OCU	C1197-1026 TBC	0 63533	0 63533	0.0 19.2	0.0 19.2	0 13815				
Sludge Treatment OCU	385 g S.*	97976 0	97976 0	49.0 0.0	49.0 0.0	5042 0				
Other discharges		0	0	0.0	0.0	0				
Check calc integrity		72743 OK	72743 OK	27.1 0K	27.1 OK	18857 OK				
Areas to be odour controlled	Orange cells require input		ර්					· .		
Process Area	Process Fluid	P&ID no. & GA no.	O	Lag No(S)	Air extracted to:	Ave Odour concentration (OU _E /m ³ )	Max Odour concentration (OU _E /m ³ )	Converted average H ₂ S conc. (ppm)	Converted peak H ₂ S conc. (ppm)	Air flowrate (m ³ /hr)
Pre-screen and post-grit channels	Raw Sewage	C1197-1012 & 2000/1	1	T-1201 101-19	Inlet Treatment OCU	131243	131243		39	388 [/]
Fine Screens Including bypass	Raw Sewage	C1197-1012 & 2000/1	4	A-1201A/B/C & A-1202	Inlet Treatment OCU	81000	81000	24	24	704
Screenings Compactors	Raw Sewage	C1197-1014 & 2000/1	and the second	A-1401	high Treatment OCU	8000	80000	40	40	32
Grit Classifier	Grit	C1197-1014 & 2000/1	1.5.1.5.1.5.1.5.1.5.1.5.1.5.1.5.1.5.1.5	A-1402.	Intel Treatment OCU	160000	160000	80	80.	32
Grit Channel	Raw Sewage	C1197-1012 & 2000/1	<b>3</b>	T-1202A/B	Inlet Treament OCU	65833	65833	20	20	1004
Preliminary Treatment Building	NIA NIA	C1197-1012 & 2000/1			Inlet Treatment OCU	150	150	0 	0	7247
Primary Sedimentation Tank	Screened Sewage	C1197-1015 & 2004	2	T-1501A/B	Inlet Treatment OCO	157664	157664	47	47	4407
Pasteuriser	Sludge	C1197-1020	ô	T-2001A/B/C	Sludge Treatment OCU	630000	630000	315	315	246
Picket Fence Thickener	Primary Sludge	C1197-1018	·	T-1801	Sludge Treatment OCU	420000	420000	210	210	178
Secondary Sludge Thickener	Secondary Sludge	C1197-1018 & 2011	<b>8</b>	A-1802A/B	Sludge Treatment OCU	280000	280000	140	140	60
Sludge Building	N/A	C1197-1018 & 2011	1.		Sludge Treatment OCU	800	800	0	0	3580
Emergency Primary Sludge Tank	Primary Studge	C1197-1019		T-1903	Sludge Treatment OCU	315000	315000	158	158	276
Emergency Secondary Sludge Tank	Secondary Sludge	C1197-1019	<b>.</b>	T-1902	Sludge Treatment OCU	315000	315000	. 158	158	329
Sludge Blending Tank	Sludge	C1197-1019	1 1	T-1901	Sludge Treatment OCU	630000	63000	315	315	41
Sludge Dewaterer	Sludge	C1197-1023 & 2011	8	A-2301A/B	Sludge Treatment OCU	00096	96000	48	48	06
						0	0	0	0	0
Liquor Return PS	Sludge Liquors	C1197-1030	1	C-3001	Sludge Treatment OCU	78750	78750	39	39	240
				- この時にはないたいであるのである。						ないなどの思想であ

Odour calculation - Rev 1 (Under revision)

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Orange cells require input

														-		headspace	1 Darimatar		Darimeter	IN AN AN
•	• • • •							:		•		•	- - -		volume (per unit)	/ Gross volume				
Process Area	Process fluid	No.	Vessel Shape Working D	Vorkin	g Dimensions / Details	ns / De	ails		Ť	Headspace / Gross Vessel Dimensions / Details	oss Ves	sel Dimer	isions / E	letails	Ē	۳ ۳	ε	٤		(per unit) m ³ /hr
Pre-screen and post-grit channe Raw Sewage	ie Raw Sewage	<b>-</b>	Rectangular	52.4 r	52.4 m length	1.8 m	m deep	1.5 m width	tinti i i i i i i i i i i i i i i i i i	52.4 m length	0.5	m deep	1.5 ח	m width	141.5	39.3	107.8		Perimeter	
Fine Screens including bypass Raw Sewage	Raw Sewage	4	Rectangular	10	m length	2.20	M deep	2.2 m width	989 - 38 38 - 3	10 m length	-	m deep	2.2	m width	48.4	22.0	24.4		Perimeter	
Screenings Compactors	Raw Sewage	-	Other	4	m3 volume		N OF C	- C							4.0	4.0	N/A		NA	
Grit Classifier	Grit	-	Other	4	m3 volume		<del>of)</del>	N AC							4.0	4.0	N/A		NA	
Grit Channel	Raw Sewage	~	Rectangular	10	m length	2.2 m	m deep	5.1 m with		10 m length	0.5	m deep	5.1 п	m width	112.2	25.5	30.2		Perimeter	400
Preliminary Treatment Building	i NA	-	Rectangular	29.3 1	29.3 m length	6.38 m	deep	19.4 m widen		29.3 m length	6.38	m deep	19.4 m	m width	3623.7	3623.7	97.4		NA	
Primary Sedimentation Tank	Screened Sewage	2	Circular	32	m diam	E ε	m deep		6 <mark>0</mark> 2.	32, Indiam	1:37	m deep			2412.7	1101.8	100.5		Perimeter	
Pasteuriser	Sludge	ю М	Other	41	m3 volume					8103 8103					41.0	41.0	N/A		N/A	
Picket Fence Thickener	Primary Sludge	-	Circular	8.7 n	m diam	4.5 m	m deep		8	8.7 m diam	0.5	m deep			267.5	29.7	27.3		Perimeter	ø
Secondary Sludge Thickener	Secondary Sludge	2	Rectangular	5.6 П	m length	0.75 m	deep	1.2 m width	ALCON ALCON	5.6 m length	800	m deep	1.2	m width	5.0	5.0	13.6		Cover	
Sludge Building	NA NA	-	Rectangular	19.5 n	19.5 m length (	6.38 m	deep	14.4 m width	.57.	19.5 m length	e.38	M deep	14.4	m width	1790.1	1790.1	67.8		N/A	N
Emergency Primary Sludge Tan Primary Sludge	n Primary Sludge		Circular 5	9.38 m d	ian.	5.6 m	m deep			9.38 m diam	. 2	m deep			387.0	138.2	29.5		Cover	
Emergency Secondary Sludge   Secondary Sludge	T Secondary Sludge	-	Circular	10.2 m d	ä	5.6 m	m deep			10.2. m diam	8	m deep			461.2	164.7	32.2		Cover	
Sludge Blending Tank	Sludge	-	Circular	5.12 m d	iam	2.9 m	m deep		<u>.</u>	5.12 m diam	•	m deep			59.7	20.6	16.1		Cover	
Sludge Dewaterer	Sludge	2 1	Rectangular	<u>۲</u> ۵	m length	0.75 m	m deep	2 m width		5  m length	0.75	m deep	<u>۲</u> ۲	m width	7.5	7.5	14.0		Cover	
	00.	0	Rectangular		m length	<u>E</u>	m deep	m width	ŧ	m length		m deep	<u>с</u>	m width	0.0	0.0	0.0		NA	
-iquor Return PS	Sludge Liquors	-	Rectangular	ع د	m length	4 2	m deep	5. m width		3 m length	4	m deep	ع م	m width	60.0	60.0	16.0		Perimeter	240

Prepared by DGHemmings 09/02/2007

Odour calculation - Rev 1 (Under revision)

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											r								
			Calc	Calculations for zoning dec	or zoning	g declassific	lassification ventilation rate	lation rate											
Process Area	CH, rate of	-i e		LEL % Density	ensity	<u>ш</u>	BS safety factor				Ven	tilation rat	Ventilation rates per unit m ³ /hr	m³/hr	Safety	Final rate	Choose	Actual flowrate	Actual air
	emission	AIF changes per hour	Temp	· .		Grade of release		Gas production	Temperature corrected	Actual gas production		:				î.	unit unit		cnanges per hour (based on
	m m sec x 10	di mont e contra	۲	Ÿ	kg / m²		¥	rate kg/s	rate kg/s	rate kg/s	Rate 1	Rate 2	Rate 3	Rate 4		m ³ /hr		m³/hr	licanshare)
Pre-screen and post-grit channel	6.9	8.0	· 8	2.3	0.72 Se	Secondary	0.5	7.03E-06	5.35E-06.	Corrected	388.1	<b>1.1</b>	MA	314.4	%0	388.1	Max xSF	388.1	6.6
Fine Screens including bypass	6.9	8.0	8	5.3	0.72 Se	Secondary	988 989	2.40E-06	1.83Ė-06	Corrected	87.8	0.4	N/A	176.0	%0	176.0	Max xSF	176.0	8.0
Screenings Compactors	-0.0	8.0	20	5.3	0.72 Se	Secondary	0.5	0000000	0.00E+00	Corrected	N/A		NA	32.0	%0	32.0	Max xSF	32.0	8.0
Grit Classifier	0.0	8.0	20	5.3	0.72 Se	Secondary	0.5	0.00+400.0	0.00E+00	Corrected	N/A	0.0	NA	32.0	%0	32.0	Max _X SF	32.0	8.0
Grit Channel	6.9	4.0	8	5.3	0.72 Se	Secondary	0.5	5.57E-06	<u>)</u> ()	Corrected	108.7	0.9	400.0	102.0	26%	502.0	Max xSF	502.0	19.7
Preliminary Treatment Building	0.0	2.0	8	2.3	0.72 Se	Secondary	0.5	0.00E+00	0.00E400	Corrected	N/A	0.0	N/A	7247.4	%0	7247.4	Max xSF	7247.4	2.0
Primary Sedimentation Tank	<b>6</b> .9	2.0	20	5.3	0.72 Se	Secondary	0.5	1.20E-04	9.13E-06	Georrected	361.9	18.6	N/A	2203.6	%0	2203.6	Max xSF	2203.6	2.0
Pasteuriser	163.0	2.0	55	5.3	0.72 Se	Secondary	0.5	4.81E-05	6.07E-05	Corrected	NA	13.9	N/A	82.0	%0	82.0	Max xSF	82.0	2.0
Picket Fence Thickener	289.0	6.0	20	5.3	0.72 Se	Secondary	0.5	5.57E-04	4.24E-04	Corrected	98.4	86.5	8.0	178.3	%0	178.3	Max xSF	178.3	6.0
Secondary Sludge Thickener	163.0	6.0	20	5.3 0	0.72 Se	Secondary	0.5	5.91E-06	4.50E-06	Corrected	0.0	o, c	N/A	30.2	0%	30.2	Max xSF	30.2	6.0
Studge Building	0:0	2.0	20	5.3	0.72 Se	Secondary	0.5	0.00E+00	0.00E+00	Corrected	Sea Sea	0.0	2.0	3580.2	%0	3580.2	Max xSF	3580.2	2.0
Emergency Primary Sludge Tank	289.0	2.0	20	5.3	0.72 Se	Secondary	0.5	8.05E-04	6.13E-04	Corrected	0.0	125.2	N/A	276.4	%0	276.4	Max xSF	276.4	2.0
Emergency Secondary Sludge T	163.0	2.0	8	5.3	0.72 Se	Secondary	0.5	5.41E-04	4.12E-04	Corrected	0.0	84.1	N/A	329.4	%0	329.4	Max xSF	329.4	2.0
Sludge Blending Tank	289.0	2.0	8	5.3 0	0.72 Sei	Secondary	0.5	1.24E-04	9.46E-05	Corrected	0.0	19.3	NA	41.2	%0	41.2	Max xSF	41.2	2.0
Sludge Dewaterer	110.0	6.0	20	5.3 0	0.72 Set	Secondary	0.5	5.94E-06	4.52E-06	Corrected	0.0	0.9	N/A	45.0	%0	45.0	Max xSF	45.0	6.0
0	0:0	2.0	8	5.3 0	0.72   Ser	Secondary	0.5	0.00E+00	0.00E+00	Corrected	N/A	0.0	NA	0.0	%0	0.0	Max xSF	0.0	#DIV/0
Liquor Return PS	110.0	2.0	20	5.3 0	0.72 Sec	Secondary	0.5	4.75E-05	3.62E-05	Corrected	57.6	7.4	240.0	120.0	. %0	240.0	Max xSF	240.0	4.0
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Odour calculation - Rev 1 (Under revision)

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Date Revision

			OU concentration calculation	ion calculation					Fir	Final Calculated Odour, H ₂ S and airflow rates	dour, H ₂ S an	d airflow rates		
Process Area	Frechen data E _f (OU / s /m ² ) E	North data E _n (OU / s /m ² )	UKWIR value OU _E .s ⁻¹ .m ²	* Surface area per tank A (m²)	Superficial air velocity V (m / s)	Emission rate E _{qut} (OU / s)	Specified Odour concentration (OU _E / m ³ )	Odour concentration (OU⊾ / m³)	Chosen H ₂ S correlation factor ppb H ₂ S/OU _E	Direct H ₂ S correlation (ppm)	Factor of safety (peaking factor)	Odour concentration using SF (OU _E / m ³ )	Estimated H ₂ S conc. using SF (ppm)	Total flow m³/hr
Pre-screen and post-grit channels	<u>.</u>		180	78.6	0:004	14148		131243	0.3	39.4	1.0	131243	39.4	388
Fine Screens including bypass			180 ·	22.0	0.002	3960		81000	0.3 .	24.3	1.0	81000	24.3	704
Screenings Compactors			180	NA	NA	₹ S	80000	80000	0:5 ·	40.0	1.0	80000	40.0	32 .
Grit Classifier			360	N/A	NA	of Bri	160000	160000	0.5	80.0	1.0	160000	80.0	32
Grit Channel			180	51.0	0.003	~	otho	65833	0.3	19.7	1.0	65833	19.7	1004
Preliminary Treatment Building				568.4	0.004	0	MICT	150	0.3	0.05	1.0	150	0.05	7247
Primary Sedimentation Tank			120	804.2	0.001	96510	ogine ogine	2. 157664	0.3	47.3	1.0	157664	47.3	4407
Pasteuriser			480	N/A	N/A	NA	630000	63000	0.5	315.0	1.0	630000	315.0	246
Picket Fence Thickener			350	59.4	0.001	20806		420000	0.5	210.0	1.0	420000	210.0	178
Secondary Sludge Thickener			350	6.7	0.001	2352		280000	0.5	140.0	1.0	280000	140.0	60
Sludge Building				280.8	0.004	0	800	800	0.5	0.4	0.1	800	0.4	3580
Emergency Primary Sludge Tanl	- ×-		350	69.1	0.001	24186		315000	0.5	157.5	.5	315000	157.5	276
Emergency Secondary Sludge Tank	Tank		350	.82.4	0.001	28824		315000	0.5	157.5	1.0	315000	157.5	329
Sludge Blending Tank			350	20.6	0.001	7206		630000	0.5	315.0	<b>1.</b> 0	630000	315.0	41
Sludge Dewaterer			120	10.0	0.001	1200		96000	0.5	48.0	1.0	96000	48.0	6
0.0				0.0	0.000	0		0	0.2	0.0		0.	0.0	0
Liquor Return PS			350	15.0	0.004	5250		78750	0.5	39.4	1.0	78750	39.4 ·	240
al da herten er en sterre af sterre af tweeter er en server her		Supplementations and a super-	Contraction of the second second second	2.10.2023/04/05/2012/2022/2022	AB1601242120212012120	응용 이 전 2 같은 것은 그 가장 아니었다.	A DESCRIPTION AND A DESCRIPTION OF	Sector strate the foreign of the sector	74 24 40 80 80 80 80 80 80 80 80 80 80 80 80 80	and the first of the second of the second of the	A CONTRACTOR OF A			1001

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