

# Dewatering Equipment – Design Specification

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## Revision details

Version No.	Clause	Description of revision
4	All	Document reformatted. Foreword, Copyright, General Terms and Definitions added. Changed 'shall' and 'should' to 'must' where relevant to SWC. 'Sydney Water' replaced with 'SWC'. Section 1.4 added. Minor amendments to sections 2.1.3, 2.1.4, 2.3, 3.1.1, 3.2.1, Appendices 1 and 2. Minor editorial changes elsewhere.
3	All	General update
2	All	General update
1	All	New Revision

## Foreword

This Specification is for the design, supply and construction of dewatering equipment for SWC assets.

SWC makes no warranties, express or implied, that compliance with the contents of this Specification must be sufficient to ensure safe systems or work or operation.

It is the user's sole responsibility to ensure that the copy of the Specification is the current version as in use by SWC.

SWC accepts no liability whatsoever in relation to the use of this Specification by any party, and SWC excludes any liability which arises in any manner by using this Specification.

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## Copyright

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## Acronyms

Acronym	Definition
AS	Australian Standards
DC	Direct Current
DIN	Digital Input
EN	European Standards
EPA	Environmental Protection Authority
EPL	Environmental Protection License
HLR	Hydraulic Loading Rate
OTS	SWC Operational Technology Services
I/O	Input / Output
IP	International (Ingress) Protection Marking
PLC	Programmable Logic Controller
PCA	Process Capability Assessment (Report)

Acronym	Definition
PTC	Positive Temperature Coefficient
RDT	Rotary Drum Thickener
RSP	Rotary Screw Press
RTD	Resistance Temperature Detector
RPM	Revolutions Per Minute
SCADA	Supervisory Control and Data Acquisition
SLA	Service Level Agreement
SLR	Solids Loading Rate
SS316	Stainless Steel 316
UL	Underwriters Laboratories
VSD	Variable Speed Drive
WHS	Work, Health and Safety

## General Terms and Definitions

Term	Definition
SWC	The nominated person or organisation that has written authority to act on SWC's behalf.
Contractor	The person or organisation responsible for the delivery, installation and commissioning of products, materials, equipment, and components described herein.
Supplier	The person or organisation responsible for the fabrication or manufacture and supply of products, materials, equipment, and components described herein.
Tenderer	The person or organisation responsible for the submission of the tender.

# 1. General

## 1.1 Scope

At SWC's treatment facilities, there are several means to dewater digested sludges to biosolids and thicken waste activated and digested sludges for digester feed and recuperative thickening.

This Specification describes the general sizing and design requirements for dewatering equipment in SWC's wastewater treatment and water recycling plants. This Specification applies to centrifuges and rotary drum thickeners (RDTs) that are due for renewals, or for new designs and installations.

## 1.2 Exclusions

Thickening and dewatering processes and equipment NOT described in this Specification are excluded from the scope of this Specification.

## 1.3 Objective

The objective of this Specification is to provide technical specifications and criteria for standardisation of dewatering equipment in SWC's wastewater treatment plants. The intention is to ensure that a robust method for equipment selection and technical requirements are implemented to ensure the best possible quality and outputs are met for a reliable and capable 20-year life-cycle period.

This Specification will ensure reduced risk of undersized equipment being supplied, thus reducing the risk of throughput constraints leading to higher operations and maintenance costs.

## 1.4 Standards

Equipment supplied and installed must be new and in accordance with the requirements of this Specification, Needs Specifications (if supplied), Drawings and job specific Technical Specification (where supplied) and the latest editions of the relevant Australian Standards and Technical Specifications, Water Services Association of Australia (WSAA) Codes of Practice, Water Industry Standards and Product Specifications.

Where there is no suitable Australian Standard available, an agreed international standard and/or industry current best practice must be adopted.

If an international standard is proposed in lieu of an Australian Standard, a detailed assessment to show that the proposed standard is equivalent or superior to the relevant Australian Standard must be provided to SWC for acceptance.

The work must also comply with the requirements of all relevant bodies or codes, including but not limited to:

- SafeWork NSW
- NSW Environment Protection Authority (EPA)
- Power Supply Authorities
- Australian Communications and Media Authority
- Local Government Authority.

In the event of any ambiguity or discrepancy SWC must be consulted as to the interpretation to be followed in carrying out the work.

## 2. Centrifuges

### 2.1 Sizing standard

To ensure the best performance for both dewatering and thickening, the following principles must be applied.

*A centrifuge operating at ½ (50 %) of its HLR and SLR capacity for dewatering digested sludge, produces the driest cake and the cleanest centrate. For WAS thickening operating at up to 75 % capacity produces the best thickening and centrate (also potentially negating the need for polymer addition).*

There are 3 main values required for adequate sizing of the centrifuge. These are:

- Solids Loading Rate in kg/d (SLR)
- Hydraulic Loading Rate in kL/d (HLR)
- Desirable hours of operation per day.

The centrifuge specifications to the Supplier are generally expressed purely as a duty required of Solids Loading Rate (SLR) in kg/hr, and a respective Hydraulic Loading Rate (HLR) in m<sup>3</sup>/hr.

The sludge characteristics must be provided to the Supplier, such as:

- Sludge Type: Anaerobically Digested, Aerobically Digested or Waste Activated Sludge
- %VS: Percentage of Volatile Solids (e.g. 84 %)
- Temperature: 36 °C (for anaerobically digested sludge for example)
- Primary to WAS Ratio: For anaerobically digested sludges (e.g. 60:40)
- FOR WAS THICKENING: Provide the actual or expected SVI ml/g of the Waste Activated Sludge

#### 2.1.1 Steps for standard sizing method of digested sludges / sludge dewatering

- Check the latest Process Capability Report or growth data and obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads
- Allow for 20 hrs per day to treat the future daily required loads per centrifuge
- Apply the values from point a. above, to the following sizing formulae.

##### **Solids Loading Rate kg/hr**

$$= \text{Future Solids Loading Rate (kg / day) / 20 hrs X 2}$$

$$= \text{Solids Loading Rate to be specified to Supplier in kg/hr}$$

##### **Hydraulic Loading Rate m<sup>3</sup>/hr**

$$= \text{Future Hydraulic Loading Rate (kL / day) / 20 hrs X 2}$$

$$= \text{Hydraulic Loading Rate to be specified to Supplier in m}^3\text{/hr}$$

**EXAMPLE:** For Digested Sludge, if the future predicted peak Solids Load = 8,000 kg / day and the predicted peak Hydraulic Load = 520 kL /d

##### **Specification to the Supplier must be:**

- Digested Sludge Characteristics (as mentioned above)
- SLR in kg/hr = 8,000 kg / d / 20 hrs X 2 = **800 kg/hr (NOT the calculation, ONLY the kg/hr)**
- HLR in m<sup>3</sup>/hr = 520 kL / d / 20 hrs X 2 = **52 m<sup>3</sup>/hr (NOT the calculation, ONLY the m<sup>3</sup>/hr)**

***This ensures that the centrifuge offered will be operating at 50 % of the centrifuge capacity.***

## 2.1.2 Step for standard sizing methods of waste activated sludge for thickening

- a) Check the latest Process Capability Report and obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads
- b) Allow for 23 hrs per day to treat the future daily required loads per centrifuge
- c) Apply the values from point a. above, to the following sizing formulae.

### **Solids Loading Rate kg/hr**

$$= \text{Future Solids Loading Rate (kg / day) / 23 hrs X 1.33}$$
$$= \text{Solids Loading Rate to be specified to Supplier in kg/hr}$$

### **Hydraulic Loading Rate m<sup>3</sup>/hr**

$$= \text{Future Hydraulic Loading Rate (kL / day) / 23 hrs X 1.33}$$
$$= \text{Hydraulic Loading Rate to be specified to Supplier in m}^3\text{/hr}$$

**EXAMPLE:** For Waste Activated Sludge, if the future predicted peak Solids Load = 5,500 kg / day and the predicted peak Hydraulic Load = 2520 kL / d, then the specification to the Supplier must be:

**SLR in kg / hr = 5,500 kg / d / 23 hrs X 1.33 = 318 kg / hr (NOT the calculation, ONLY the kg/hr)**

**HLR in m<sup>3</sup> / hr = 2520 m<sup>3</sup> / d / 23 hrs X 1.33 = 146 m<sup>3</sup> / hr (NOT the calculation, ONLY the m<sup>3</sup>/hr)**

## 2.1.3 Materials of construction

- Bowl - Centrifugally Cast Duplex Stainless Steel (pitting corrosion resistant)
- Scroll - Centrifugally Cast Stainless Steel 316 or Duplex Stainless Steel
- Scroll Flights - Stainless Steel 316 minimum
- Scroll Flight Tip Protection - Tungsten Carbide Spray (minimum)
- Internal conveyor bearings to be sealed bearings and maintenance free between major overhauls.
- Inlet Tube - Stainless Steel 316 minimum
- Weir Plates - Stainless Steel 316 minimum
- Frame - Coated Steel to withstand coastal corrosive environments and outdoor applications irrespective if indoors or not. Coating must meet WSA 201.
- Cover - Stainless Steel 316
- Solids Discharge Ports - Tungsten Carbide or Equivalent Bushes
- Chutes - Stainless Steel 316
- Solids Diverter Valve - Stainless Steel 316
- Vibrate Take-up Joins - NBR/Rubber Spring Type
- Noise at 1 m from the centrifuge at full load ≤ 85 dB
- Special Tools and Lifting Tools must be provided to service the centrifuges
- Sample points integral with chutes to be made from Stainless Steel 316

## 2.1.4 Centrifuge controls

All centrifuge and other related equipment operational functions must be arranged for full automatic operation, governed by SCADA Control, to enable start-up and shutdown of the thickening/dewatering sequences.

The supplier shall provide a signal data map and wiring diagrams for Sydney Water's approval.

All alarms that are available to be signalled to the SCADA PLC, shall be configured to the SCADA PLC via the communications protocol and addresses available.

The Centrifuge main bowl and scroll drives must be variable speed drives.

The Centrifuge bowl speed must be capable of being set on SCADA via a set point write command to the centrifuge PLC in revolutions per minute (RPM).

The Centrifuge Differential Speed must be capable of being set on SCADA via a set point write command to the centrifuge PLC (this governs the scroll speed a differential speed of the bowl) in RPM.

Once the plant is operating it must be capable of continuous unattended daily operation. The Contractor is responsible to arrange the equipment in the best engineering manner to fulfil the fully automatic operation.

The control system must control the main functions of the centrifuge from start-up to cake-production through to shut down. This system must communicate with the plant PLC control system to allow various auxiliary systems to start and stop and be varied.

The preferred control system will allow the plant operator to adjust most of the centrifuge settings from the plant SCADA system without the need to attend the control panel provided with the centrifuge.

As a minimum, the following parameters must be adjustable from the plant SCADA system:

- Main Torque setpoint (kNm or % of drive)
- Divert to Outloading Torque setpoint (kNm or % of drive) if a diverter off-spec gate is required / recommended by the Supplier
- Divert to Centrate Torque setpoint (kNm or % of drive)
- Starting or "Base" differential speed (RPM)
- Flushing differential speed (RPM)
- Bowl speed (RPM)
- Flush/Shut-Down triggers such as high vibration, excessive torque or overloads of the drives, faults with machine drives and any other critical signals the manufacturer will request to shut-down the centrifuge. The centrifuge controller will send the output to the plant PLC input as to when the flush water valve must open and close. The plant PLC will send the output to the valve accordingly. Therefore, the centrifuge controller governs when to open and close the valve, not the plant PLC, though allows the operator to operate the centrifuge and manually open and close the flushing valve.
- Full control of each device individually in Local Mode (if selected from the controller, the plant PLC must interlock the centrifuge and the entire sequence from starting in this mode. The centrifuge must be in Remote Mode to allow for plant SCADA control and the automatic sequence.
- Defined Centrifuge logic provided for all sequences (centrifuge controller sequences/decanter status or step defined) to enable the plant PLC to schedule all surrounding assets and operate them as a system including centrifuge feed pumps, polymer dosing etc.

The minimum instrumentation to be supplied with each centrifuge must include but not necessarily be limited to the following:



- Vibration transmitters (signalled 4 - 20 mA signals back to plant PLC at all times) on main bearings - Both end bearings and signals for warning and shutdown alarms written from the Centrifuge PLC to the SCADA plant PLC, predominantly for trending of each device, and for stopping/inhibiting the sludge feed and polymer dosing systems controlled by the SCADA PLC.
- Torque transducer with torque auxiliary contacts and other controls referenced in this Specification (or calculated drive torque as a %) - set point written to centrifuge PLC, though indicated to SCADA PLC.
- Bowl and scroll speed measurement signals for indication only to the plant PLC.
- Temperature for main bearings (signalled 4 - 20 mA signals back to plant PLC always) both end bearings and signals for warning and shutdown alarms written to plant PLC, though controlled as a safeguard by the centrifuge PLC. The signals to the SCADA PLC are for trending and visual online readings from SCADA.
- Interlocks for torque, motor amperage and vibration controlled by centrifuge PLC, though mapped for indication to the plant PLC.
- The scroll conveyor torque must be continuously monitored and controlled by the centrifuge PLC so that optimum relative speeds are maintained. If the solids loading exceeds the set limit of the scroll drive torque, the drive must raise an alarm signals sent to plant PLC.
- Speed Transmitters (if equipped) must be continuously monitored and controlled by the centrifuge PLC so that optimum relative speeds are maintained. The bowl speed reference must be mapped to the plant PLC for indication. If no speed sensors are installed, the Supplier must calculate the speeds based on motor and VSD speed and pulley/gearbox ratios and provide the calculated speed signals back to the plant PLC.
- Total Instantaneous Power Consumption (module or calculated) signals back to the plant PLC in kW only if available by the Supplier of the centrifuge.

### 2.1.5 Testing and commissioning of centrifuges

The Contractor must allow for commissioning and initial optimisation time to achieve the desired output of the site.

The Contractor will ensure that the point-to-point checks are commissioned and provide ITPs as per contract specifications including the D0001440 Technical Specification - Commissioning.

The Supplier must provide a comprehensive optimisation report upon completion of the process optimisation and proving period after consistent operation of 30 days to SWC's satisfaction.

SWC's preference is to commence the wet commissioning with an 80 % deepest pond setting on the weir plates, at the safest, highest torque setting possible without compromising centrate.

## 2.2 Electrical – local control panel

The local control panel must be mounted in an accessible location for its relevant centrifuge.

The control panel must be of IP65 rating or higher for wet-area applications, and CPDMS0022 SWC Technical Specification - Electrical, for SCAs.

The panel must not be bolted to the centrifuge base-frame as excessive vibrations can loosen terminals and circuit board components within the logic controller. It must be mounted on the skid base or beside the centrifuge on a stainless-steel base-frame and away from locations prone to damage by maintenance and inspection activities.

Any HMI or local interface displays must also be rated for wet-area applications and mounted on stainless steel frames at an accessible height to minimise bending or straining to reach and operate the local controls. Again, IP rated as specified for outdoors in the SWC Technical Specification - Electrical.

Centrifuge Suppliers may decide to send all the hardware of the control system and VSDs loose, and to be installed by the Contractor to the SWC Technical Specification - Electrical.

## 2.3 Electrical - general control systems and electrical components

The electrical components such as the controller module/PLC, communication protocols, VSDs and instrumentation must be accepted by SWC OTS division.

This will require OTS to approve of the control system and whether the hardware is easily accessible, maintainable and compatible with SWC's PLC and communications architecture.

- Electric Motors for Bowl and Scroll to be Squirrel Cage 415 V and minimum of IP56.
- For motors of 5.5 kW and above, at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.
- For motors smaller than 600 kW, RTD and/or thermal switches must be provided on the motor winding and/or bearing when specifically requested by SWC.
- An Emergency E-stop on the local control panel, shall be wired as per the manufacturer's OEM instructions. This to ensure a safeguard of operation in case of an emergency, and generally will perform this function by activating a safety relay to the Bowl and Scroll VSDs upon pressing in the Emergency Stop or Latch Stop.
- The centrifuge cover shall also have a switch which shall trigger a safety relay to the Bowl and Scroll VSDs and act as per the E-Stop function. This switch shall also be wired to the OEM manufacturer's requirements.

## 2.4 See Appendix 1 for centrifuge datasheet

## 3. Rotary drum thickeners

RDTs are used within SWC's facilities to either thicken waste activated sludge prior to digestion, or for recuperative thickening of the digestion processes.

Thus, although the scope of supply is not limited to this Specification, it must be adhered to as a baseline and innovations and advancements identified in the tender submissions.

Design Consideration for SWC: It is important to note that if reclaimed effluent (RE) is used then it must be able to sustain 5 - 7 Bar of pressure at a quality of  $\leq$  200 micron. This is to minimise spray nozzle blockages, and to ensure that the pressure is adequate for effective cleaning of the RDT drum mesh.

Rotary Drum Thickeners shall be configured with the use of a static mixer and a flocculation tank at the inlet of each Rotary Drum Thickener for maximum polymer mixing and flocculation efficiency.

### 3.1 RDT sizing standard

To ensure the best performance for thickening, the following principle must be applied.

There are 5 main values required for adequate sizing of the rotary drum thickener (RDT). These are:

- Solids Loading Rate in kg/d (SLR)
- Hydraulic Loading Rate in kL/d (HLR)
- Required hours of operation per day
- % Primary Sludge in RDT Feed.
- % Waste Activated Sludge in RDT Feed.

The RDT specifications to the Supplier are generally expressed purely as a duty required of SLR in kg/hr, and a respective HLR in m<sup>3</sup>/hr.

#### 3.1.1 Steps for standard sizing method of digested sludges

- a) Check the latest Process Capability Report and obtain the peak hydraulic and solids loads expected in 20 years from the existing/current loads
- b) Provide Sludge Characteristics of the feed sludge
  - Sludge Type: Anaerobically Digested, Aerobically Digested or Waste Activated Sludge
  - %VS: Percentage of Volatile Solids (e.g. 84 %)
  - Temperature: 36 °C (for anaerobically digested sludge for example)
  - Primary to WAS Ratio: For anaerobically digested sludges (e.g. only: 60:40)
- c) Allow for 23 hrs maximum per day to treat the future daily required loads per RDT
- d) Supply the information based on future peak loads to the Supplier/manufacturer in the tender specification documents submitted.

#### 3.1.2 Design criteria

- a) Design Target Thickened Sludge Concentration must be submitted to the Supplier
- b) Capture rate must be  $\geq$ 95 % to ensure solids are separated adequately and minimising recycled solids back into the Treatment Plant
- c) Supply the information based on future peak loads to the Supplier in the tender specification documents submitted

- d) Thickened Sludge Hoppers must be either provided by the Supplier if available, or custom Thickened Sludge hoppers to be fabricated out of Stainless Steel 316 rigidly built to withstand any downstream potential pump cavitation
- e) The Thickened Sludge Hopper must have an inspection hatch, bottom and side mounted DN50 Stainless Steel Ports for an Analogue Level Transmitter (hydrostatic type) and Level Switch” Low” for installation of a capacitance level switch
- f) It is strongly recommended that an auger/cake progressive cavity pump is used for pumping high head and viscous Thickened Sludges. The Thickened Sludge Hopper base must match the perimeter of the auger/cake pump inlet chamber.

### 3.1.3 Materials of construction

The Rotary Drum Thickeners must comprise as a minimum the following components in the materials specified below:

- Drum Main Frame and Housing and Frame: Stainless Steel 304 minimum
- Drum Rotating Element Frame: Stainless Steel 304 minimum
- Drum Filter Mesh: As recommended by the Supplier for a minimum of a 5-year life
- RDT Cover: Hinged UV stabilised Plastics/ABS with SS316 locking points and fasteners, hinges and struts (if equipped). Lightweight durable materials are required to withstand the elements of outdoor installations.
- RDT Spray Bars: SS316 Tube/Pipe and fittings
- Spray Bar Water Spray Nozzles: SS316 or Equivalent in strength, rigidity and ability to withstand humid, coastal corrosive and odorous and acidic gases/environments. The spray-bar must withstand pressures of up to 10 Bar.
- Easily accessible spray nozzles for removal and cleaning
- Easy lift drum covers to allow for staff to open the covers without lifting aids such as cranes etc. Lifting assisting devices must be integral to the cover or drum thickener design as supplied.
- Motors and gearboxes must be coated to withstand coastal corrosive environments and outdoor applications irrespective if indoors or not. Coating must meet WSA 201.
- Odour extraction ports of minimum DN50 - DN100 mm from the enclosed unit.
- Sample points to be integral to the design of the RDT which are safe to sample from without splashing onto staff
- Flocculation Tanks: Must be manufactured from Stainless Steel 304 minimum
- Flocculation Tanks are to have at least 2 X minimum DN50 ports on the lid to allow for Level Transmitters and High-Level Switches, along with an adequately sized odour extraction ports. Flanged ends must be provided unless alternative connections are acceptable by SWC.
- The flocculation tank must have an overflow port attached to the high-level point of the flocculation tank. This overflow port must also be made of Stainless Steel 304 minimum with a flanged end to allow for easy pipe connection.
- The flocculation tank must have an accessible hinged lid for maintenance and product inspections.

## 3.2 General control systems and electrical components

SWC will program the RDT sequence in the SCADA PLC to the functional specification that is recommended and provided by the RDT supplier.

### 3.2.1 Electrical devices and Controls

The following electrical devices must be included as minimum to automate and enhance the operation of the screen.

- 1) For motors of 5.5 kW and above, at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.
- 2) For motors smaller than 600 kW, RTD and/or thermal switches must be provided on the motor winding and/or bearing when specifically requested by SWC.
- 3) Solenoid valves for spray systems, or 24VDC motorised stainless steel 316 ball valves with digital limit switches
- 4) Rotary speed sensor if recommended by the Supplier
- 5) A Level Transmitter and High-level switch (for flocculation tank). Reliable level indication is critical, thus hydrostatic type LTXs must be installed unless free-issued as inclusion by the RDT Supplier.
- 6) Flow Switches for spray system/s
- 7) Pressure switches for spray headers.
- 8) If provided with cover switches to stop the drive upon opening the lid, these switches must be latch stops and wired to the SCADA PLC so that the drive is stopped by the PLC in all modes, except for FIELD mode. A 24V local hand-station must be incorporated into the installation to allow for the RDT to be jogged (via a local jog button) and must have an Emergency Stop button mounted close to the jog button. The Emergency Stop must be wired to the drive as a “hard-wired” emergency stop.  
This allows for rotating the drum for routine pressure washing of the drum mesh,
- 9) Wiring must be in accordance to the SWC SCADA Standards and SWC Technical Specification – Electrical.

## 3.3 See Appendix 2 for rotary drum thickener datasheet

# Ownership

## Ownership

Role	Title
<b>Group</b>	Engineering and Technical Solutions (ETS)
<b>Owner</b>	Engineering Manager, Engineering and Technical Solutions
<b>Author</b>	Jason Smith, ETS – Senior Mechanical Engineer


## Change history

Version No.	Prepared by	Date	Approved by	Issue date
4	Mark Ziogas, Jason Smith	29 Oct 2021	Dinesh Dineshharan	29 Oct 2021
3	Mark Ziogas	18 Dec 2019	Tate Brammer	18 Dec 2019
2	Mark Ziogas	28 Mar 2019	Tate Brammer	28 Mar 2019
4	Mark Ziogas	28 Nov 2016	Iain McGregor	28 Nov 2016
0	Mark Ziogas	07 Nov 2016	Iain McGregor	07 Nov 2016

## Appendices

Attachment	Title
1	Data sheet for vendor supply of centrifuges
2	Data sheet for vendor supply of RDTs

## Appendix 1 Data sheet for vendor supply of centrifuges

			Schedule of Rates and Technical Proposal	
Supply of Centrifuges			SWC Location	
			<b>OPERATING CONDITIONS</b>	
			Duty/Standby (N+1 required)	
			Process Medium (Sludge Type)	
			Primary Sludge to WAS Ratio ( % / % )	
			Feed Sludge Dry Solids Concentration (%TSR)	
			Feed Sludge %Volatile Solids (%VS)	
			SVI (mL/g) – WAS Thickening Only	
			Feed Sludge Temperature (°C)	
			Fluid pH (pH)	
			Each Unit Duty Peak Requirement - HLR (m <sup>3</sup> /hr)	
			Each Unit Duty Peak Requirement - SLR (kg/hr)	
2	Model Identification	-	Tenderer to advise	
3	Manufacturer	-	Tenderer to advise	
4	Country of Manufacture	-	Tenderer to advise	
5	Leadtime (from order to Site delivery)	Weeks	Tenderer to advise	
			<b>Equipment Warranty Details</b>	
6	Warranty period post commissioning	Years	Tenderer to advise	
			<b>PERFORMANCE REQUIREMENTS</b>	
7	Equipment Noise Assessment @ 1 m	db	Tenderer to advise	
8	G-Force (maximum)	m/s <sup>2</sup> /9.81	Tenderer to confirm '>3000 (i.e. 'High G')	
9	Hydraulic Load Rate Capacity Minimum	m <sup>3</sup> /hr	Tenderer to advise	
10	Hydraulic Load Rate Capacity Maximum	m <sup>3</sup> /hr	Tenderer to advise	
11	Solids Load Rates (Min)	kg/hr	Tenderer to advise	
12	Solids Load Rates (Max)	kg/hr	Tenderer to advise	
13	Sludge Inlet Pressure Required	kPa(g)	Tenderer to advise	
14	Overall Solids Capture Rate	%	Tenderer to confirm > 95 % (REQUIRED)	
15	Vibration level at Maximum Speed	mm/s	Tenderer to confirm ≤6	
16	B <sub>10</sub> Bearing Life. Min design 8000 hrs	hours	Tenderer to confirm design	

Supply of Centrifuges			SWC Location
17	Centrifuge failsafe mode in the event of Power loss		Tenderer to confirm design features
<b>OTHER FEATURES (Optional or extra)</b>			
18	Flow Configuration (Co Current or Counter current)	-	Tenderer to advise
19	Weir Plate Design	-	Nb. Must allow for a full range of pond depth. Tenderer to confirm.
20	Negative Pond Depth Maximum	mm	Tenderer to advise
21	80 % Max Pond Depth (Of Min Radius)	Note	<b>Required to be set from Factory to Site.</b>
22	Odour Control	-	Fully sealed unit.
23	Scroll Conveyor Flight Wear Protection	-	Tenderer to confirm design
24	Scroll Conveyor Flight Tips Minimum Design Life	hours	Tenderer to confirm design
25	Feed Zone Wear Protection	-	Tenderer to confirm design
26	Scroll/conveyor bearings - SEALED. Min design 8000 hrs.	hours	Tenderer to confirm design
<b>SPEED REDUCTION / CONTROL</b>			
27	Bowl Speed (maximum)	rpm	Tenderer to advise
28	Scroll Speed (maximum)	rpm	Tenderer to advise
29	Differential Speed (maximum range)	rpm	Tenderer to advise
30	Drive Detail (Direct / Belt / Chain / Gearbox) VFD's per unit	-	Tenderer to advise
31	Type and Number of Stages	-	Tenderer to advise
32	Manufacturer	-	Tenderer to advise
33	Service Factor	-	Tenderer to advise
34	Final Drive Ratio	-	Tenderer to advise
35	Torque Control (Torque Sensor OR %Torque OR Both)		Tenderer to advise
36	Maximum Torque of Unit Offered	% / kNm	Tenderer to advise
<b>SOLIDS DIVERTER VALVE - OPTIONAL ONLY</b>			
			<b>Tenderer to provide detailed information, drawings, O&amp;M</b>
37	Description	-	Actuated sludge diverter valve to direct off-spec sludge to centrate outlet at start-up
38	Valve actuation method	-	pneumatic




Supply of Centrifuges			SWC Location
39	Time to fully actuate	s	Tenderer to advise
40	Valve limit switches	-	"Normally Open" 24 V DC required for both open and closed
41	Vibrate take-up joint	-	Required between solids diverter valve and centrifuge
<b>SOLIDS DIVERTER VALVE FLUSHING</b>			
42	Medium	-	Reclaimed Effluent (filtered to 500 µm)
43	Required pressure	kPa	Tenderer to advise
44	Flow (Instantaneous)	L/s	Tenderer to advise
45	Number of connections	-	Tenderer to advise
46	Connection size and type	-	Tenderer to advise
<b>SCROLL MOTOR DETAILS</b>			
47	Type	-	Electric squirrel cage induction motor
48	Model	-	Tenderer to advise
49	Manufacturer	-	Tenderer to advise
50	IP Rating	-	56
51	Frame	-	Tenderer to advise
52	Maximum Starts	/h	Unlimited
53	Power	kW	Tenderer to advise
54	Speed (nominal)	rpm	Tenderer to advise
55	Voltage	V	415 +10 % - 15 %
56	Frequency (nominal)	Hz	50
57	Suitable for VSD	Y/N	Tenderer to advise
58	Method of Mechanical Overload Protection	-	Tenderer to advise
59	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise
60	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise
61	Full load current	A	Tenderer to advise
62	Windings temperature protection	-	Required for motors $\geq 5.5$ kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings
63	Bearing temperature protection	-	Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings and/or bearings
64	Anti-condensation heater	-	Required - 240 V AC

Supply of Centrifuges			SWC Location
<b>BOWL MOTOR</b>			
65	Type	-	Electric squirrel cage induction motor
66	Model	-	Tenderer to advise
67	Manufacturer	-	Tenderer to advise
68	IP Rating	-	56
69	Frame	-	Tenderer to advise
70	Maximum Starts	/h	Unlimited
71	Power	kW	Tenderer to advise
72	Speed (nominal)	rpm	Tenderer to advise
73	Voltage	V	415 +10 % - 15 %
74	Phase	No.	Three
75	Frequency (nominal)	Hz	50
76	Suitable for VSD	Y/N	Yes
77	Method of Mechanical Overload Protection	-	Tenderer to advise
78	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise
79	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise
80	Full load current	A	Tenderer to advise
81	Windings temperature protection	-	Required for motors $\geq 5.5$ kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings
82	Bearing temperature protection	-	Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings and/or bearings
83	Anti-condensation heater	-	If Required - 240 V AC
<b>INLET FLUSHING</b>			
84	Medium	-	Reclaimed Effluent (filtered to 500 $\mu$ m)
85	Required pressure	kPa	Tenderer to advise
86	Flow (Instantaneous)	L/s	Tenderer to advise
87	Other	-	Connections provided by others in inlet pipework
88	Machine must be capable of slow wash cycles of forward/reverse bowl sequence No. of forward and reverse cycles (Max)	No. Cycles	Tenderer to advise or manufacturer to advise on recommended flushing sequence
89	Recommended forward and reverse low bowl speed RPM for water cycle.	RPM	Tenderer to advise or manufacturer to advise on recommended flushing sequence and Bowl Speed recommendation during flushing

Supply of Centrifuges			SWC Location
90	Recommended flush water flow during forward and reverse low bowl speed flushing cycles.	L/s	Tenderer to advise or manufacturer to advise on recommended flushing water flow requirements
<b>CRITICAL DIMENSIONS</b>			
91	Bowl Diameter	mm	Tenderer to advise
92	Bowl Length	mm	Tenderer to advise
93	Volume	L	Tenderer to advise
94	G - Volume	m <sup>3</sup>	Tenderer to advise
95	Length to diameter ratio	-	Tenderer to advise
96	Beach angle	degrees	Tenderer to advise
97	Inlet Flange Size	mm	Tenderer to advise
98	Inlet Flange Rating / Type	-	Tenderer to advise
99	Centrate Flange Size	mm	Tenderer to advise
100	Centrate Flange Rating / Type	-	Tenderer to advise
101	Solids Discharge Connection	mm	Tenderer to advise
102	Overall Length	mm	Tenderer to advise
103	Overall Width	mm	Tenderer to advise
104	Overall Height	mm	Tenderer to advise
<b>MATERIALS</b>			
105	Bowl	-	Tenderer to advise
106	Scroll	-	Tenderer to advise
107	Scroll Flights	-	Tenderer to advise
108	Inlet Tube	-	Tenderer to advise
109	Weir Plates	-	Tenderer to advise
110	Frame	-	Tenderer to advise
111	Cover	-	Tenderer to advise
112	Solids Discharge Ports	-	Ceramic and replaceable, Tenderer to confirm
113	Chutes	-	Stainless steel 316
114	Solids Diverter Valve	-	Stainless steel 316
115	Vibrate take up joint	-	Tenderer to advise
<b>WEIGHTS</b>			
116	Overall - Dry	kg	Tenderer to advise
117	Overall - Under full load	kg	Tenderer to advise
118	Rotating Assembly	kg	Tenderer to advise
119	Scroll Motor	kg	Tenderer to advise
120	Bowl Motor	kg	Tenderer to advise
121	Dynamic Loading	kN	Tenderer to advise
<b>OPERATIONAL NOISE</b>			
122	Sound Power Level at 1m	dB(A)	Tenderer to advise

<b>Supply of Centrifuges</b>			<b>SWC Location</b>	
<b>EQUIPMENT PRICING</b>				
123	Delivery DDP to site	Each	Tenderer to advise	
124	Installation	Hourly rate	Tenderer to advise	
125	Commissioning	Hourly rate	Tenderer to advise	
126	Lifting Frames or attachments required for installation	Unit	Tenderer to advise	
127	Training	Hourly rate	Tenderer to advise	
<b>Operation and Maintenance Manuals</b>				
128	O&M manuals	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
129	Drawings including, General Arrangements, Exploded views, and detail dimensional drawings	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
130	Piping and instrumentation diagrams	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
131	Signal data Map for communication addressing of signals back to site PLC and STEP files for #D BIM use in design and lifecycle modelling	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
132	Installation standard specifications and check sheets	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
133	Documented operational training guides,	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
134	Lubrication specifications and schematics	Y/N	Tenderer to confirm documentation has been provided as part of their submission	
135	A comprehensive catalogue of critical spare parts in the RFT response that is considered necessary for routine maintenance and breakdowns usage	Y/N	Tenderer to confirm documentation has been provided as part of their submission	

## Appendix 2 Data sheet for vendor supply of RDTs

			Schedule of Rates and Technical Proposal	
<b>Supply of Rotary Drum Thickeners</b>			<b>SWC Location</b>	
			<b>Process Duty - WAS Thickening and Recuperative Thickening - Municipal Wastewater</b>	
			<b>Units Required</b>	
			<b>OPERATING CONDITIONS</b>	
			Duty/Standby (N+1 required)	
			Process Medium (Sludge Type)	
			Primary Sludge to WAS Ratio (% / % )	
			Feed Sludge Dry Solids Concentration (%TSR)	
			Feed Sludge %Volatile Solids (%VS)	
			Feed Sludge Temperature (°C)	
			Fluid pH (pH)	
			Each Unit Duty Peak Requirement - HLR (m <sup>3</sup> /hr)	
			Each Unit Duty Peak Requirement - SLR (kg/hr)	
			Operation hrs per day	
<b>Item No:</b>	<b>Item</b>	<b>Units</b>	<b>SWC Requirement/Comment</b>	
<b>EQUIPMENT MANUFACTURING DETAILS</b>				
1	Equipment Make	-	Tenderer to advise	
2	Model Identification	-	Tenderer to advise	
3	Manufacturer	-	Tenderer to advise	
4	Country of Manufacture	-	Tenderer to advise	
5	Leadtime (from order to Site delivery)	-	Tenderer to advise	
6	Equipment Warranty Details			
7	Warranty Period post commissioning	years	Tenderer to advise	
<b>EQUIPMENT CAPACITY</b>				
8	Hydraulic Loading Rate - Maximum Capacity	m <sup>3</sup> /hr	Tenderer to advise	
9	Solids Loading Rate - Maximum Capacity	kg/hr		
10	Flocculation Tank Make	-	Tenderer to advise	
11	Flocculation Tank Model	-	Tenderer to advise	
12	Flocculation Tank Type	-	Tenderer to advise	

Supply of Rotary Drum Thickeners			SWC Location
13	Flocculation Supporting Equipment	-	Tenderer to advise
<b>AMBIENT CONDITIONS</b>			
14	Temperature Range	°C	0 to 45
15	Relative Humidity	%	40 to 80
<b>WASHWATER (RDT)</b>			
16	Fluid	-	Reclaimed effluent, filtered to 200 microns. Tenderer to confirm acceptance (Y/N)
17	Fluid - Additional Filtration Requirement (if required)	micron	Tenderer to advise
18	Consumption (per RDT)	L/hr	Tenderer to advise
19	Instantaneous maximum flowrate (each unit)	L/s	Tenderer to advise
20	Instantaneous minimum flowrate (each unit)	L/s	Tenderer to advise
21	Required minimum pressure (for effective drum washing)	kPa	Tenderer to advise
22	Typical duration wash water is on	minutes	Tenderer to advise
23	Typical duration wash water is off	minutes	Tenderer to advise
24	Number of solenoid valves	No off	Tenderer to advise
<b>DIMENSIONS (RDT)</b>			
25	Overall length	mm	Tenderer to advise
26	Overall width	mm	Tenderer to advise
27	Overall height	mm	Tenderer to advise
28	Sludge inlet flange size	mm	Tenderer to advise
29	Sludge inlet flange rating / type	-	Tenderer to advise
30	Flush water inlet connection size	mm	Tenderer to advise
31	Flush water inlet connection rating / type	-	Tenderer to advise
32	Liquid discharge connection size	mm	Tenderer to advise
33	Liquid discharge flange rating / type	-	Tenderer to advise
34	Thickened sludge discharge connection type / details	-	Tenderer to advise
35	Drum Diameter	mm	Tenderer to advise
36	Drum Length	mm	Tenderer to advise

Supply of Rotary Drum Thickeners			SWC Location
<b>ODOUR (FLOCCULATION TANK)</b>			
37	Odour Connection	-	Tenderer to advise
38	Odour Connection Size	NB / DN	Tenderer to advise
39	Odour Connection Type	-	Tenderer to advise
40	Odour Connection Standard	-	Tenderer to advise
<b>MATERIALS (RDT)</b>			
41	Covers	-	Tenderer to advise
42	Casing - Grade 304 stainless steel (min)	-	Tenderer to advise
43	Casing Thickness (minimum 2 mm)	mm	Tenderer to advise
44	Frame - Grade 304 stainless steel (min)	-	Tenderer to advise
45	Drum / Screen - Grade 304 stainless steel (min)	-	Tenderer to advise
46	Spray nozzles; (No off and type)	-	Tenderer to advise
47	Filter Type cloth or mesh	-	Tenderer to advise
48	Bearings	-	Tenderer to advise
<b>WEIGHTS (RDT)</b>			
49	Overall (dry)	kg	Tenderer to advise
50	Overall (wet/full)	kg	Tenderer to advise
51	Drum assembly	kg	Tenderer to advise
52	Motor and gearbox	kg	Tenderer to advise
53	No. of supports	no.	Tenderer to advise
54	Load per support (maximum)	kN	Tenderer to advise
<b>DRUM DRIVE MOTOR</b>			
55	Type	-	Electric squirrel cage induction motor
56	Model	-	Tenderer to advise
57	Manufacturer	-	Tenderer to advise
58	IP Rating	-	56
59	Frame	-	Tenderer to advise
60	Maximum Starts	no./hr	6
61	Power	kW	Tenderer to advise
62	Speed	rpm	Tenderer to advise
63	Voltage	V	415 +10 % - 15 %
64	Phase	No.	Three
65	Frequency (nominal)	Hz	50
66	Suitable for VSD	Y/N	Tenderer to advise
67	Method of Overload Protection	-	Tenderer to advise
68	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise

Supply of Rotary Drum Thickeners			SWC Location
69	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise
70	Full load current	A	Tenderer to advise
71	Windings temperature protection	-	Required for motors $\geq 5.5$ kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding and/or bearings
72	Bearing temperature protection	-	Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings or bearings
<b>GEARBOX (RDT)</b>			
73	Type	-	Tenderer to advise
74	Manufacturer	-	Tenderer to advise
75	Configuration	-	Tenderer to advise
76	Ratio	-	Tenderer to advise
77	Output Speed Range	rpm	Tenderer to advise
78	Torque Range	Nm.	Tenderer to advise
79	AGMA Service Factor	-	$>1.25$ , Tenderer to advise
80	Maintenance/Lubrication Requirements	-	Tenderer to advise
<b>SPEED REDUCTION / CONTROL (RDT)</b>			
81	Max drum speed	rpm	Tenderer to advise
82	Min drum speed	rpm	Tenderer to advise
<b>ACCESSORIES (RDT)</b>			
83	Drum Inclination Adjustment / Control	-	Tenderer to advise
84	Outlet adaptor	-	Sludge hopper and probes
85	Inlet flexible connection	-	Tenderer to advise
86	Drum lifting tool	-	Required
87	Other lifting and support devices	-	Tenderer to advise in Spare Parts submission
88	Drum speed/motion switch	-	Required
89	Overwash sensor	-	Tenderer to advise
90	Thickened sludge sample point with valve	-	Required
91	Liquid discharge sample point with valve	-	Required



Supply of Rotary Drum Thickeners			SWC Location
92	Other Flocculation Equipment Optional or Required (e.g. mixing valves etc)	-	Tenderer to advise details
<b>DIMENSIONS (FLOCCULATION TANK)</b>			
93	Flocculation tank required?	Y/N	Tenderer to advise
94	Diameter	-	Tenderer to advise
95	Height	mm	Tenderer to advise
96	Volume	litres	Tenderer to advise
97	Tank Dry Weight	kg	Tenderer to advise
98	Sludge inlet connection size	mm	Tenderer to advise
99	Sludge inlet flange rating / type	-	Tenderer to advise
100	Sludge outlet connection size	mm	Tenderer to advise
101	Sludge outlet flange rating / type	-	Tenderer to advise
101a	Polymer Inlet		
101b	Ventilation connection		
102	Overflow connection size	mm	Tenderer to advise
103	Overflow flange rating / type	-	Tenderer to advise
104	High Level Switch Make / Model Details (24 V DC VEGA preferred by SW: model Vegaswing).		Tenderer to advise
105	Analogue Hydrostatic Level Transmitter 24 V DC 4-20 mA (VegaWell or Vegabar preferred)		Tenderer to advise
<b>PERFORMANCE (Flocculation Tank) - If Required</b>			
106	Mixing Velocity Gradient	s <sup>-1</sup>	Tenderer to advise
107	Flocculation detention time at average feed rate	sec	Tenderer to advise
108	Flocculation detention time at peak feed rate	sec	Tenderer to advise
<b>PERFORMANCE (MIXING VALVES or OTHER) - If Applicable</b>			
109	Polymer injection and mixing valve minimum no. of pipe diameters upstream of RDT unit	No.	Tenderer to advise

<b>Supply of Rotary Drum Thickeners</b>			<b>SWC Location</b>
110	Typical valve pressure loss	kPa	Tenderer to advise
111	Maximum valve pressure loss	kPa	Tenderer to advise
112	Other Flocculation Devices		Tenderer to advise
<b>MATERIALS (FLOCCULATION TANK)</b>			
113	Main tank body. Grade 316 stainless steel preferred	-	Tenderer to advise
114	Main tank body thickness Minimum 2 mm	mm	Tenderer to advise
115	Lid / cover	-	Tenderer to advise
116	Mixer shaft and paddle	-	Tenderer to advise
<b>ODOUR (FLOCCULATION TANK)</b>			
117	Odour Connection (Required)	-	Tenderer to advise
118	Odour Connection Size. 100 mm (minimum)	NB / DN	Tenderer to advise
119	Odour Connection Flange Type	-	Tenderer to advise
120	Odour Connection Standard	-	Tenderer to advise
<b>FLOCCULATOR DRIVE (Flocculation tank)</b>			
119	Flocculator drive and mixer required?	Y/N	Tenderer to advise
120	Type	-	Electric squirrel cage induction motor
121	Model	-	Tenderer to advise
122	Manufacturer	-	Tenderer to advise
123	IP 56 Rating (Minimum)	-	Tenderer to advise
124	Frame	-	Tenderer to advise
125	Maximum Starts	no./hr	Tenderer to advise
126	Power	kW	Tenderer to advise
127	Speed	rpm	Tenderer to advise
128	Voltage	V	415 +10 % - 15 %
129	Phase	No.	Three
130	Frequency (nominal)	Hz	50
131	Suitable for VSD	Y/N	Yes - Required
132	Method of Overload Protection	-	Tenderer to advise
133	Efficiency (At 75 and 100 % of full load)	%	Tenderer to advise

Supply of Rotary Drum Thickeners			SWC Location
134	Power factor (At 75 and 100 % of full load)	-	Tenderer to advise
135	Full load current	A	Tenderer to advise
136	Windings temperature protection	-	Required for motors $\geq 5.5$ kW (at least one temperature sensing device of the PTC semiconductor type must be embedded in each of the three phases of each motor winding.) Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor winding or bearings
137	Bearing temperature protection	-	Where required by SWC, For motors smaller than 600 kW, resistance temperature devices (RTD) and/or thermal switches must be provided on the motor windings or bearings
138	Anti-condensation heater	-	Tenderer to advise
<b>FLOCCULATION TANK MIXER GEARBOX - If Required</b>			
140	Type	-	Tenderer to advise
141	Manufacturer	-	Tenderer to advise
142	Configuration	-	Tenderer to advise
143	Ratio	-	Tenderer to advise
144	Output Speed Range	rpm	Tenderer to advise
145	Torque Range	Nm	Tenderer to advise
146	AGMA Service Factor	-	$>1.25$ , Tenderer to advise
147	Maintenance/Lubrication Requirements	-	Tenderer to advise
<b>THICKENED SLUDGE DISCHARGE HOPPER</b>			
148	Length x Width	mm	Tenderer to advise
149	Height	mm	Tenderer to advise
150	Working Volume	m <sup>3</sup>	Tenderer to advise
151	Geometry	-	Sloped floor to discharge, Tenderer to advise
152	Mass Empty	kg	Tenderer to advise
153	Mass Full	kg	Tenderer to advise
154	Sludge inlet connection size	mm	Tenderer to advise
155	Sludge inlet flange rating / type	-	Tenderer to advise
156	Sludge outlet connection size	mm	Tenderer to advise
157	Sludge outlet flange rating / type	-	Tenderer to advise

Supply of Rotary Drum Thickeners			SWC Location
158	Overflow connection size	mm	Tenderer to advise
159	Overflow flange rating / type	-	Tenderer to advise
160	Drain Valve Required	-	Tenderer to advise
161	Tank body. Grade 316 stainless steel preferred	-	Tenderer to advise
162	Tank body thickness Minimum 2 mm	mm	Tenderer to advise
163	High Level Switch Make / Model Details (24 V DC VEGA preferred by SW).		Tenderer to advise
164	Analogue Hydrostatic Level Transmitter 24 V DC 4-20 mA (VegaWell or Vegabar preferred)		Tenderer to advise
165	Flushing Water Nozzle/Inlet (Min 50 mm)	DN	Tenderer to advise
<b>EQUIPMENT PRICING</b>			
166	Unit price DDP to site	No. of Units	Tenderer to advise
167	Delivery DDP to site	Unit Price	Tenderer to advise
167a	<b>Delivery DDP to site</b>	<b>TOTAL per site</b>	Tenderer to advise
167b	Sludge Hopper price -	Unit	Tenderer to advise
168	Installation	Hourly rate	Tenderer to advise
169	Commissioning	Hourly rate	Tenderer to advise
170	Lifting Frames or attachments required for installation	Unit	Tenderer to advise
171	Training	Hourly rate	Tenderer to advise
<b>DOCUMENTATION: Operation and Maintenance Manuals and Other</b>			
172	O&M manuals	Y/N	Tenderer to confirm documentation has been provided as part of their submission
173	Drawings including, General Arrangements, Exploded views, and detail dimensional drawings	Y/N	Tenderer to confirm documentation has been provided as part of their submission
174	Piping and instrumentation diagrams	Y/N	Tenderer to confirm documentation has been provided as part of their submission

<b>Supply of Rotary Drum Thickeners</b>		<b>SWC Location</b>	
175	Detailed Functional Description with reference to P&ID for native programming. All critical alarms identified and sequences in high detail.	Y/N	Tenderer to confirm documentation has been provided as part of their submission
176	STEP files for #D BIM use in design and lifecycle modelling	Y/N	Tenderer to confirm documentation has been provided as part of their submission
177	Installation standard specifications and check sheets	Y/N	Tenderer to confirm documentation has been provided as part of their submission
178	Documented operational training guides	Y/N	Tenderer to confirm documentation has been provided as part of their submission
179	Lubrication specifications and schematics	Y/N	Tenderer to confirm documentation has been provided as part of their submission
180	A comprehensive catalogue of critical spare parts in the RFT response that is considered necessary for routine maintenance and breakdowns usage	Y/N	Tenderer to confirm documentation has been provided as part of their submission