AQUATEC-MAXCON

Water Treatment Technology and Equipment

OPERATION AND MAINTENANCE INSTRUCTIONS

IPSWICH WATER

GOODNA SLUDGE DEWATERING PLANT

VOLUME 1 – SECTIONS 1 TO 10

JOB NO. 8426A

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THIS MANUAL IS YOUR GUIDE TO THE BASIC OPERATION AND MAINTENANCE OF YOUR NEW EQUIPMENT.

PLEASE TAKE TIME TO READ IT CAREFULLY, AS WITH ANY EQUIPMENT, NEW OR OLD, PROPER CARE AND MAINTENANCE IS ESSENTIAL FOR TROUBLE FREE OPERATION. OUR COMPANY WILL BE GLAD TO PROVIDE FURTHER INFORMATION OR ASSISTANCE AND IS EQUIPPED TO HANDLE YOUR FUTURE SERVICE NEEDS.

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1 WORKPLACE HEALTH AND SAFETY

1.1 GENERAL

All reasonable care must always be taken to ensure the plant is without risk to the health and safety of the people who operate and maintain the plant as required by the Workplace Health and Safety Act. An employer has an obligation to ensure the workplace health and safety of each of the employer's workers at work.

1.2 PLANT MISUSE

The plant must not be misused. The plant must only be used for the purposes for which it has been designed and, in the interests of safety; the safe working loads on the items of the plant shall not be exceeded.

1.3 OWNER'S RESPONSIBILITY

All persons performing work on the plant must be competent and capable of performing the work and must be familiar with the plant. Adequate information, instruction, training and supervision must be provided to enable the persons to perform work without risk to health and safety.

It is the owners' responsibility to ensure all persons entering or working on the plant use the appropriate personal protective equipment. Personal protective equipment includes gloves, safety glasses, hard hats, ear protection, safe footwear and, where necessary, specialist protective clothing for hazardous areas.

All maintenance, service and repair must be performed as and when required. This not only enhances the life of the plant but also prevents the plant from deviating from the design intention in a way that is a risk to health and safety.

1.4 ISOLATION OF EQUIPMENT

Any item should always be isolated before maintenance or repairs commence to ensure the inadvertent operation of the item does not result in risk to the health and safety of any person.

Where the item is isolated, and total or partial plant shutdown will result, any total or partial shutdown should not allow a hazardous situation to be created.

Where the item cannot be isolated, another person should be stationed at the controls of the plant and an effective means of direct communication should exist between the persons carrying out the maintenance and the person stationed at the controls.

1.5 SAFEGUARDS

All safeguards provided as protection against moving parts must be retained in position at all times except when maintenance or servicing is being undertaken.

ALL SAFETY GUARDS MUST BE REPLACED PRIOR TO START UP OF THE PLANT.

2 PROCESS & EQUIPMENT DESCRIPTION

2.1 GENERAL

The Stage II sludge dewatering augmentation at the Goodna Wastewater Centre (WWC), which is defined by this Contract, broadly involves the provision of an additional WAS thickening and sludge dewatering train, and associated process needs, services and tie-ins.

All WAS from the WWC will be thickened by the resultant two mechanical thickeners in the Stage II facility. Thickened waste activated sludge (TWAS) from the mechanical thickeners is then directed to the associated dewatering unit for dewatering. In the future, TWAS from the new mechanical thickener may also be pumped to future aerobic digesters for stabilisation.

Scope of this Contract, in part, included the design, construction, supply and installation of the following items:

- Feed sludge pumping station including variable speed drives, WAS buffer tank and macerator.
- One mechanical thickening unit. The device is a gravity drainage deck (GDD), similar to, and located alongside the original unit.
- One mechanical dewatering unit. The device is a belt filter press (BFP), similar to, and located alongside the original unit.
- Two dewatered sludge handling conveyors.
- An inclined conveyor loading dewatered sludge into the new sludge cake storage hopper.
- An elevated sludge cake hopper system rated to hold 100m^3 of sludge.
- Two new polymer storage, batching and dosing systems to replace the existing polymer equipment. One facility to serve the two WAS thickening GDD's, whilst the other facility is to serve the two sludge dewatering BFP's.
- Relocation and augmentation of the existing dewatering facility's service water system including filtration and in-line UV disinfection units for supply of recycled water for GDD and BFP belt washing and polyelectrolyte dilution.
- Connection of the filtrate/washwater from the upgraded dewatering facility to the existing gravity line feeding the existing supernatant pump station.
- A 300mm gravity line from the filtrate manhole to the RAS manhole.
- Provision of a chute and flap gate on the dewatering system for future transferring thickened waste activated sludge from the outlet of the new WAS thickening unit to the future aerobic digester for stabilisation. Transfer pumps and pipes are not included.
- An upgrade to the process control and electrical equipment for the new sludge dewatering facilities.
- Controls to all equipment with SCADA interaction to the existing central control room.

2.2 DESIGN REQUIREMENT

The requirement of the Contract is to expand the current dewatering facility from 40,000 EP to 80,000 EP. The increase in the capacity of the sludge dewatering facility is to deal with an increase in plant capacity following the closure of Carole Park WWC and redirection of sewage flow to Goodna WWC. This dewatered sludge produced by the Goodna WWC will then be trucked away for disposal.

The designs for this Contract are flexible enough to allow for thickened sludge to be directly placed onto the BFP's for dewatering, or through the WWC's decommissioned anaerobic digesters or future aerobic digesters for stabilisation before being dewatered. The thickening of the waste activated sludge is designed to be no less than 3.0% TS and is a critical aspect of this project, to ensure that the future aerobic digestion system does not become hydraulically overloaded.

2.3 PROCESS DESIGN PARAMETERS

Table 2.1 Process design criteria

Item	Unit	Existing Stage 1 Design Criteria	Required this stage	Total Stage 2 Design Criteria
WAS Buffer Tank	No.		1	1
Minimum volume	m^3		20	20
Macerator	No.		1	1
Minimum flow	m^3/h		220	220
WAS Thickening Feed Pumps and pipework	No.		3 progressive cavity type pumps (2 duty, 1 standby)	3 progressive cavity type pumps (2 duty, 1 standby)
Variable Speed Drives			VSDs for all units	VSDs for all units
Minimum capacity	m^3/h		110	110
Maximum mass load	kg/h		550	550
Average mass load	kg/h		460	460
Average concentration	% TS		0.42	0.42
Maximum concentration	% TS		0.50	0.50
WAS Thickening				
Design capacity	EP	40,000	40,000	80,000
Number of thickening units		1	1	2
Capacity/unit	EP	40,000	40,000	40,000
Hours operation	h/wk	30	30	30
Total mass of WAS	kg/d for 7 day wk	1,500	1,500	3,000
Minimum WAS flow to thickener	m3/h	110	110	220
Maximum WAS load to thickener	kg/h	550	550	1,100
Average WAS load to thickener	kg/h	460	460	920
Minimum WAS Concentration	mg/L	2,500	2,500	2,500

WAS load/unit	kg/h	550	550	550
Item	**Unit**	**Existing Stage 1 Design Criteria**	**Required this stage**	**Total Stage 2 Design Criteria**
WAS load/unit	m3/h	110	110	110
Minimum thickened WAS (TWAS) concentration	% TS	3.0	3.0	3.0
Thickener solids capture	%	>95	>95	>95
Total TWAS production rate at 3.0%	m3/h	18.3	18.3	36.6
Sludge dewatering				
Capacity - Undigested thickened WAS	kg/h	550 kg/h @ 3%TS	550 kg/h @ 3%TS	1,100 kg/h @3%TS
Maximum volumetric feed rate - Undigested thickened WAS	m^3/h	55	55	110
Capacity - Aerobic digested sludge	kg/h	660 kg/h @ 1%TS	660 kg/h @ 1%TS	1,320 kg/h @ 1%TS
Maximum volumetric feed rate - Aerobic digested sludge	m^3/h	66	66	132
Number of dewatering units		1	1	2
Hours operation	h/wk	30	30	30
Total mass of sludge to be dewatered	kg/d for 7 day wk	2,020	2,020	4,040
Minimum dewatered cake concentration	% TS	12%	12%	12%
Dewatering unit solids capture	%	>95	>95	>95
Outloading conveyor from new Belt Filter Press				
Minimum conveyor capacity	m^3/h		8	8
Conveyors for feeding sludge storage bin				
Minimum conveyor capacity	m^3/h		15	15
Dewatered Sludge Storage Hopper				
Capacity	m^3		100	100
Wet sludge mass	tonnes		100	100

Table 2.2 Process design criteria Polymer Systems

Item	Unit	Polymer System Required this stage	Polymer System 2 Required this Stage
Polyelectrolyte storage, batching and dosing systems	No.	1	1
To service		WAS thickening	TWAS dewatering
Polyelectrolyte type		Powdered Polymer	Powdered Polymer
Minimum feed hopper vol	m^3	2.5	2.5
Minimum Polyelectrolyte batching/make up/dosing capacity	kg/h	6	7
Polyelectrolyte usage	kg/tonne ds	3.5 - 4.5	3.5 - 4.5
Polyelectrolyte dosing pumps	No.	3 (2 duty and 1standby)	3 (2 duty and 1standby)
Variable Speed Drives		VSDs for all units	VSDs for all units

2.4 TREATMENT PROCESS DETAILS

Refer also the general P&ID drg. 8426A-033 in conjunction with the specific drawings nominated at each sub-section.

2.4.1 WAS Buffer Tank

Refer also drg. 8426A-006.

A concrete buffer tank of ID 4000mm and internal height 2000mm is provided, together with a pre-cast concrete roof. The tank has a minimum volume of 20 m^3 and is fed through the roof from the existing WAS pumps via a DN150 ABS branch from the existing delivery line. There is a DN100 branch in the line adjacent to the tank for a tanker connection point.

Other openings include a DN100 drain and a DN200 overflow line (both of which flow to the supernatant pump station), a DN250 suction line to the WAS thickening feed pumps; and in the roof are 2 off 100Ø openings, one each for an ultrasonic level element and float switch.

Access to the roof is provided by an inclined ladder, and there is a circular handrail assembly around the periphery of the tank. All access components are from hot dip galvanised steel.

2.4.2 WAS Thickening Feed Pumps

Refer also drg. 8426A-003.

There are three feed pumps provided, to work in a two-duty one-standby configuration. The delivery manifold of the pumps is designed such that each of two pumps is dedicated to service a GDD, whilst the middle pump serves as a common standby to either GDD The pump suctions are commoned from the downstream side of a macerator; in turn which is fed from the WAS buffer tank described above.

The three pumps are a Mono progressive cavity type pump, model C1BAC31RMA/G, each driven by an 18.5kW CMG gearmotor via a VF drive. The duty is 110 m^3/h @12m. There is a DN50 relief line from the delivery side of each pump which will relieve to drain when the pressure >400kPa.

The macerator is a Mono, Muncher model CT205FCW9B2, driven by a 4kW CMG gearmotor. Duty is 220m3/h.

2.4.3 Sludge Thickening Units

Thickening of WAS is required to achieve a thickened WAS concentration of no less than 3.0% Total Solids (TS), and this is achieved by the installation of a gravity drainage deck similar to the existing unit; being a Siemens / Sernagiotto Drainage Deck model No. GT2000-BSX, with a belt width of 2100mm.The belt is VF driven via a 2.2kW gearmotor for a belt speed range of 5.3 to 20 m/min.

This corresponds to a Stage II augmentation capacity of WAS sludge thickening and dewatering facilities of 40,000 EP (80,000 EP plant total with two machines), equating a design capacity of 550 kg/h and 110 m^3/h per machine. The GDD WAS thickening unit has been designed to handle an average feed suspended solids of 4,200 and a minimum of 2,500 mg/L.

The new GDD has been configured with a chute and flap gate to enable the selection of discharge of thickened WAS to the decommissioned anaerobic digesters, the future aerobic digesters or direct discharge to the dewatering unit (BPF) for direct dewatering. The transfer pumps and and full chute for discharge to the anaerobic digester are not included in this scope.

There is an access platform which runs the length of the GDD and BFP assemblies (refer drg. 8426-025).

2.4.4 Sludge Dewatering Units

Dewatering of sludge is required to achieve a dewatered sludge cake with a total solids content of no less than 12% total solids (TS), and this is achieved by the installation of a belt filter press unit, being a Siemens / Sernagiotto Belt Filter Press model BPF 2000 S7-BSX-L, with a belt width of 2100mm. The belt is VF driven via a 3kW gearmotor for a belt speed range of 2.8 to 8.5 m/min

The BFP sludge dewatering unit has a capacity to handle 550 kg/h of thickened WAS at a maximum feed flow of 55 m^3/h (as per the GDD), or 660 kg/h of digested sludge at a maximum feed flow of 66 m^3/h. There is a flocculation tank and mixer provided with the BFP to accommodate processing of future digested sludge. Refer also table 2.1 above.

The existing Stage 1 and new Stage II BFP dewatering units are normally operated in series with the related upstream Stage WAS GDD thickeners, to provide two identical sludge thickening and dewatering process streams.

2.4.5 Dewatered Sludge Conveyers to Storage

Refer also drg. 8426A-001.

The scope of supply included provision of a conveyor system to transfer sludge from the BFP dewatering units to a new storage hopper.

In the instance of the existing Stage I BFP, its existing horizontal conveyor, which conveyed the dewatered sludge from the discharge section of the press to outside the building, was

kept. A new horizontal conveyor was installed parallel to the existing to similarly convey dewatered sludge from the new press to a position just outside the building.

This Stage II BFP conveyor is a Spirac 280Ø shaftless screw type U320-SPX-416SS driven by a 3.0kW IP56 SEW gearmotor. The duty is 8m^3/h, which approximates 8 t/h.

Immediately outside the building, the two conveyors terminate over a new shallow pit. Within the pit and orientated transversely under the two conveyors is a short horizontal reversible transfer conveyor which normally conveys sludge from both conveyors to the transfer point at the eastern end of the conveyor to an inclined conveyor, for storage in the sludge hopper. When reversed, the conveyor conveys the sludge to the western end where it is transferred to the original outloading inclined slewing conveyor which loads directly into a truck. This mode is the standby condition when the inclined conveyor or storage hopper are not in service.

This transfer conveyor is a Spirac 365Ø shaftless screw type U420-SPX-416SS driven by a 1.5kW IP56 SEW gearmotor. The duty is 15m^3/h, which approximates 15 t/h.

The inclined conveyor shifts the sludge from the transfer conveyor to the top of the new storage hopper. The trough is suitably stiffened, and the conveyor has several supports to the hopper structure.

The 47^0 Inclined conveyor is a Spirac 365Ø shaftless screw type OK420-SPX-416SS driven by a 9.2kW IP56 SEW gearmotor. The duty is 15m^3/h, which approximates 15 t/h.

2.4.6 Sludge Hopper

Refer also drgs. 8426A-010, -018, -019, -020 & -021.

Sludge is stored in an elevated hopper of design capacity 100m^3, or 100 tonnes. The main body is rectangular, with two (almost square) conical sections under to allow sludge to be gravity discharged to a truck via pneumatic piston operated clamshell gates. The system is designed to allow a sludge outload rate to a truck of 1m^3/min.

The rectangular section is 4500 i/s x 8860 i/s x 1900 high. The two 4-sided conical sections are 2550 high and at the top are 4385 i/s x 4500 i/s, reducing to 1500 square i/s at the outlet. The stiffened main platework is 8mm thk.

The hopper is supported mainly by three portal frames comprising 410UB60 columns and 310UB40 beams. The frames are tied-together and braced such that a truck can drive longitudinally between the frames.

Under each of the six stub columns mounted on the hopper and the corresponding portal column is mounted a load cell complete with top and bottom plates to align interface with the columns. The readouts from these cells are relayed to the SCADA for reading and recording bin mass and outloaded mass.

The roof over the hopper is fabricated from suitably flanged 16mm thk fibreglass, which is pitched to provide rigidity. Between the outlet of the inclined conveyor above and the roof is progressively a stainless discharge chute, flexible hose and stainless inlet chute to the roof inlet flange; all vertically aligned.

Under each conical outlet is mounted a clamshell gate assembly consisting of two clamshells or gates; each covering half the hopper opening when they are closed. One pivoted clam shell is operated by a linear action pneumatic piston mounted on a conical hopper side. On this clam shell is mounted a 20mm thk driving gear quadrant which meshes with an identical driven gear quadrant which operates the other pivoted clam shell. This ensures the clamshells open and close together; albeit opposite each other. When the gates (clamshells) are closed, they seal against a lurethane seal which limits loss of water.

Each gate has a bracket mounted proximity sensor.

All steelwork is abrasive blast cleaned and painted to suit either internal or external surfaces (the exception being the gear quadrants, which are not painted).

Midway along the length of the hopper is an elevated platform, upon which is mounted a control panel that allows the truck driver to operate the gates and manage the outloading. Access to the platform is provided by an inclined ladder. Ladder and platform is fabricated from hot dip galvanised steel.

2.4.7 Polyelectrolyte Storage, Batching / Maturation, Storage and Dosing

Refer also drgs. 8426A-035 & -037.

Two complete and separate polyelectrolyte (poly) storage, batching and dosing systems have been installed, with one system dedicated to serving the WAS GDD thickening (6 kg/h capacity) and the second system serving the sludge dewatering BFP (7 kg/h capacity). Refer also to Table 2.2. The systems replace the original equipment.

The PolyRex 4.0 series dry powder poly storage, batching, and solution storage tankage and ancillaries is a proprietary package from Tomal, with a unit capacity of 7.27 kg/h of dry powder (based 0.7kg/m^3 bulk density), prepared as 0.5% stock solution with 60 mins maturation time.

The package consists of a 2.5m^3 painted mild steel storage hopper, w/- access ladder and handrails; DN100 inlet pipe with male camlock connection, and high and low rotating paddle type level switches.

The powder is metered by a Tomal type 182P polymer metering feeder and heated transition spool into a dissolving cone and then wetted within a water driven ejector, which transfers the solution into the top of the batching and maturation tank, mounted adjacent.

The covered 304 ss batching /maturation tank is of capacity 2m^3, and has a top mounted agitator and pressure type level transmitter. The tank is mounted atop the solution storage tank.

After batching and maturation (usually 60 minutes), the solution is ready to be transferred by gravity via a motorised valve to the offset storage tank below, when the tank level drops. The 2m^3 304 ss storage tank is complete with a pressure type level transmitter and visual level gauge.

A control panel, incl. a Siemens S7 PLC automates the operation of the package. It is accessible from grade and is mounted on the powder storage hopper support frame.

2.4.8 Polyelectrolyte Dosing

Refer also drgs. 8426A-035 & -037.

Associated with each of the two separate Tomal polyelectrolyte preparation packages is a poly dose pumping and dilution system. Each dosing system is linked only to the related Tomal package and therefore one system services the thickening GDD's, and the other system services the dewatering BFP's.

Each system consists of three dosing pumps and dilution facilities. The pumps are a Mono progressive cavity type pump, model C13AC31RMA/G, each driven by a 1.5kW CMG gearmotor via a VF drive. The duty is 0 to 1200L/h. The middle pump serves as a common standby

The pump suction and delivery piping is mainly DN40 ABS, reducing to DN25 through the water control unit. There is a DN40 ABS relief line from the delivery side each pump which will relieve to the suction side when the pressure >400kPa.

Downstream of the delivery lines from the two duty pumps (one to each of the two GDD's), is a Tomal water control unit which allows control of dilution water into the two poly dose streams to the GDD's. The frame mounted dual outlet control unit consists (per outlet) of a water solenoid valve, flow rotameter and a throttling valve servicing each GDD.

Similarly, there is a water control unit with dual outlets associated with the BFP's.

The control unit is designed to dilute the 0.5% stock solution from the poly storage tank to 0.25% into the GDD's and BFP's.

The DN40 ABS diluted poly lines from each water control unit is transduced to DN50 HDPE and connect into the existing sludge feed lines in the case of the original GDD and BFP. For the new GDD, the DN50 line is manifolded with 3 off DN15 PVC hose take-offs, which are connected at 90^0 intervals into the upstream end of the static mixer in the sludge line.

2.4.9 Augmented Service Water System

Refer drgs. 8426A-040 & -041.

The recycled water supply system has been augmented, upgraded and dedicated to meet the washwater demands of the Stage II WAS thickening and dewatering equipment as well as general wash down requirements of the sludge dewatering facility; when all demand is simultaneous.

Additionally, the process upgrade included filtration and disinfection to achieve microbiological class A water. Allowance has been made to treat future water from the Western Recycled Water Scheme, anticipated to be of the following quality: faecal coliforms 10^6, NTU 10 (max) and TSS 15 mg/L. This recycled water will be treated in the new system to a quality after disinfection of: faecal coliforms 50% <10, NTU <2 (i.e. Class A standard), based on in-line UV treatment requirements: UV transmittance 45%, and min UV dose 60 mJ/cm^2.

The filtration unit is essentially for effluent polishing and is installed adjacent to the digester pump building; process-wise between the reclaimed effluent pumpstation and the digester (used as storage for treated water).

The filtration unit is a skid-mounted Vortisand model A3-30-SP, rated at 12.5L/s with a filtration capability nominally of 0.45µ. The Vortisand filter is - in brief - a two stage cylindrical filter that uses centrifugal force generated by a tangential inlet to introduce water with a swirling action to help remove the suspended solids and increase the effective filter surface area. This allows finer sand to be used in the lower section and the particles are filtered out at the media surface and not deeply into the sand like conventional filters. Further details can be accessed in Section 11.9.

In this instance, there are three 304 ss filter vessels used in an in-line configuration, and sized such that the design flow can be maintained whilst one of the filters is being backwashed. The skid comes complete with a backwash pump, and a PLC mounted within a control cabinet to provide an automated system.

Note that as with more conventional media filters, it is important to ensure that high bacteria levels do not occur, as this condition will contaminate the media and cause channelling, resulting in media carry-over and reduced efficiency.

The delivery side of the filter unit flows to the digester and to assist with demand control for water, there is an ultrasonic level detector installed in the roof to monitor storage levels.

From storage, the treated water is piped to the suction side of a new recycle water pumpstation via a DN100 ABS off-take from an existing DN150 DI pipe from the digester.

The pumpstation consists of a proprietary package from Lowara which includes three Lowara model GHV30/SV3304F110T multi stage vertical centrifugal pumps with duty: flow 51m3/hr head 80m motor 11kW 2-pole.

From the DN100 delivery manifold from the pumpstation, the recycle water is disinfected by two Trojan UV Swift in-chamber units model Trojan Swift SC D12, mounted in series, with each rated at 12.5L/s and a dose of 65,000 μW.s/cm^3. Each 316 stainless reactor chamber is DN150 and contains 12 low pressure amalgam lamps in protective quart sleeves. The common control system includes a panel with, amongst other features, individual lamp status indicators and a DVGW UV intensity sensor with display.

Following UV disinfection, the recycled water supply is suitable for usage in the sludge handling process stream.

2.4.10 Washwater Pipework

Refer drg. 8426A-038.

UV disinfected service water is supplied to the two GDD/BPF units for washwater purposes via an entrenched 90OD poly main. Both off-takes to the stage 1 and stage 2 units are DN50, with each off-take providing water to the GDD and related BPF. Upstream of the connections to each of the stage 2 GDD and BPF are pneumatically actuated valves which open when the related GDD and BPF are started automatically; similarly to the piping to the existing stage 1 unit.

2.4.11 Filtrate Pumping

For the existing Stage 1 sludge dewatering facility, filtrate/washwater from the WAS thickeners and sludge dewatering equipment is fed to the existing filtrate pipeline which conveys filtrate from the sludge drying beds to the existing supernatant pumping station. For the Stage 2 sludge dewatering facility, it is intended to enable separate collection of filtrate/washwater from the WAS thickeners and filtrate/washwater from the dewatering facility so that the sludge dewatering filtrate can be separately treated should it be required in the future.

The filtrate/washwater from the upgraded dewatering facility shall be connected to the existing gravity line feeding the existing supernatant pump station. A 300mm gravity line from the filtrate manhole to the RAS manhole is supplied. The supernatant pumping station shall also continue to receive filtrate, including rain run-off, from the existing drying beds.

The collection of filtrate and washwater from the WAS thickeners shall be set up to enable segregation from the collection of filtrate and washwater from the dewatering units. This segregation is to ensure that filtrate from the dewatering units which may be laden with a high concentration of soluble phosphorus (when, in future, the plant is upgraded to biological phosphorus removal and WAS is aerobically digested) can receive sidestream chemical treatment. The filtrate and washwater from WAS thickeners will not need sidestream chemical treatment as the phosphorus concentration in this stream should remain low.

2.4.12 Removal of Dewatered Sludge

The conveying transfer pit and sludge loading area is drained to the collection drain. The sludge storage hopper is built over the existing grading and collection drain

2.5 ELECTRICAL AND CONTROLS

The augmented plant includes a main switchboard incorporating controls for the stage 2 sludge dewatering facility and associated new equipment as outlined above.

The new MCC includes a Siemens S7 PLC, programmed to control the new equipment. The PLC will also be configured to interface the existing ET200 PLC rack.

For SCADA requirements, the existing Citect software will be modified to accommodate the new plant, with additional pages being configured for menu, mimic, alarm, events and trending.

3 EQUIPMENT SPECIFICATIONS

3.1 DRAWING NO. 8426A - 001

Sludge Handling – General Arrangement

Item	Description
Sludge Conveyors	47^0 Inclined conveyor, Spirac type OK420-SPX/SS driven by an SEW gearmotor with 9.2kW IP56 motor through a model KA97 gearbox with 30RPM output speed. Duty: $15m^3/h$, approximates 15 t/h Octagonal trough details: 420mm inside, fabricated from 3mm x 316 ss, and lined with 15mm Duraflo SPX (ultra high molecular weight polyethylene). Spiral details: 365mmØ, 398 pitch with 70x25 + 40x15 sections, fabricated from high tensile micro-alloy steel. Approx dry weight: 2200kg. Spirac Tag 5317-01.
	Transfer conveyor, Spirac type U420-SP/SS driven by an SEW gearmotor with 1.5kW IP56 motor through a model FA77B gearbox with 13RPM output speed. Duty: $15m^3/h$, approximates 15 t/h U trough details: 420mm inside, fabricated from 3mm x 316 ss, and lined with 12mm Duraflo SPX (ultra high molecular weight polyethylene). Spiral details: 365mmØ, 398 pitch with 70x25 + 40x15 sections, fabricated from high tensile micro-alloy steel. Approx dry weight: 500kg. Spirac Tag 5317-02.
	Belt press conveyor, Spirac type U320-SPX/SS driven by an SEW gearmotor with 3.0kW IP56 motor through a model FA87B gearbox with 13RPM output speed. Duty: $8m^3/h$, approximates 8 t/h U trough details: 320mm inside, fabricated from 3mm x 316 ss, and lined with 12mm Duraflo SPX (ultra high molecular weight polyethylene). Spiral details: 280mmØ, 330 pitch with 60x25 + 40x8 sections, fabricated from high tensile micro-alloy steel. Approx dry weight: 1550kg. Spirac Tag 5317-03.

GDD & BFP (Gravity Drainage Deck and Belt Filter Press)	Siemens / Sernagiotto drainage deck and filter press integrated assembly. Gravity Drainage Deck, model No. GT2000-BSX, capacity to 120 m^3/h. Serial No. 60407977070001 Fitted with a polyester twill belt of width 2100mm. Belt VF driven via a 2.2kW gearmotor for a belt speed range of 5.3 to 20 m/min. Also including: Frame: hot dip galvanised Distribution weir and gravity zone skirt box: 304ss Rolls: steel, rubber covered Pneumatic system controls Wash water consumption: 2.4 L/s @ 600 kPa Air consumption: 5 Nm^3 @ 600 kPa Weight (empty): 2500 kg Belt Filter Press, model BPF 2000 S7-BSX-L, volumetric capacity 60 m^3/h. Serial No. 60407978070001. solids capacity: WAS to 800kg/h (550kg/h specified); Digested sludge to 1200 kg/h (660kg/h specified). Unit fitted a polyester twill belt of width 2100mm. Belt VF driven via a 3kW gearmotor for a belt speed range of 2.8 to 8.5 m/min. Also including: Frame: hot dip galvanised Distribution weir and gravity zone skirt box: 304ss Rolls: steel, rubber covered – epoxy coated in lieu at high pressure zone rollers Cake scraper blades: plastic wear resistant Pneumatic system controls Wash water consumption: 4.9 L/s @ 600 kPa Air consumption: 7 Nm^3 @ 600 kPa Weight (empty): 7300 kg

3.2 DRAWING NO. 8426A - 003

Sludge Handling Pipework Arrangement

Item	Description
Macerator	Mono, Muncher model CT205FCT1B2, driven by a gearmotor assembly comprising a 4kW x 4 pole motor and a CMG SK9032.1AFHN gearbox; output speed 71 RPM. Duty: 220m^3/h Size: 250mm
Pumps (WAS thickened feed)	Mono, model C1BAC31RMA/G progressive cavity type pump, driven by a gearmotor assembly comprising an 18.5 kW x 4 pole IP56 motor and a CMG SK52FAL-180M/4 gearbox; output speed 261RPM. Duty: 110 m^3/h @ 12m
Flowmeter	Endress and Hauser, Promag 10W2H-S50A1AA0A4AA, DN200, w/- 4-20mA output.
Knifegate Valves (and Actuator)	Keystone lugged knifegate valves, Figure F952 176; DN150, DN200, & DN250, table D flanges. Keystone lugged knifegate valve, Figure F952 176; DN250, PN16, BS 4504 flanges. Keystone pneumatic double acting actuator to suit DN150 knife gate valve, Figure F738 size P4, c/w F791 240V AC solenoid 5 port 2-way, and limit switch kit.
Check Valves	Tyco ductile iron body swing check valve, DN150, Figure P404 FBE, table D flanges, c/w limit switches.
Pressure Relief Valves	Stubbe DHV716 DN50 set range 0.5-10 bar, set at 4 bar (400kPa)
Static Mixer	DN150 table D (part of Sernagiotto Dewatering train supply)

3.3 DRAWING NO. 8426A - 006

WAS Tank Details

Item	Description
Mixer	ABS mixer Type RW2822, Series S25/4D with integrated 2.5kW motor

3.4 DRAWING NO. 8426A - 010

Sludge Hopper

Item	Description
Pneumatic Actuator	SMC air cylinder, 250Ø, model CS1DN250-750-XAL20536, c/w double rear clevis, double rod clevis, stainless clevis pins and piston rod
Flow Controller	SMC flow controller, model AS4201FG-04-12S-1/2"
Control System	SMC control system, model XDL7080, c/w air receiver
Load Cell	QWM, model LPX 50000, c/w 32mm thk bearing top plate and 20mm thk bottom plate; and Ranger 5000 digital indicator with 4-20mA output.

3.5 DRAWING NO. 8426A - 035

Polymer Dosing

Item	Description
Polymer Make-Up Units	Tomal series PolyRex 4.0 polymer preparation unit capacity 7.27 kg/h of dry powder (based 0.7kg/m^3 bulk density), prepared as 0.5% stock solution with 60 mins maturation time. Complete with: Storage hopper, 2.5m^3 painted mild steel w/- access ladder and handrails; 600Ø roof manhole; DN100 inlet pipe with male Camlock connection; DCE Unimaster UMA70V dust filter and controller; high and low level rotating paddle type level switches. Tomal type 182P polymer metering feeder with 0.18kW Nord helical gear motor, and heated transition spool. Dissolving cone and associated ejector, pipework and instruments. Water flow 4.2m^3/h with pressure > 3.5 bar and < 6 bar. Preparation and maturation tank, 2m^3 304 ss, with Nord 0.75kW helical geared motor driven top mounted agitator; pressure type level transmitter; and water dilution system. Dosing tank, 2m^3 304 ss, with pressure type level transmitter and visual level gauge. Control panel, incl. Siemens S7 PLC.
Pumps (Polymer Dosing)	Mono, model C13AC31RMA/G progressive cavity type pump, driven by a gearmotor assembly comprising a 1.5kW x 4 pole IP56 and CMG gearbox SK272FAL-90L/4; output speed 251RPM. Duty: 0 to 1200L/h @ 2m
Relief Valve	+GF+ pressure relief valve, series V186, uPVC, DN40 flanged table D. Set range 0.5-10 bar, set at 4 bar (400kPa)

Flow Switch	Kelso, flow switch, series F25, 1" BSP.

3.6 DRAWING NO. 8426A - 040

Pump Building Pipework

Item	Description
Pump Package (Recycle Water)	Lowara triple Hydrovar VFD pump set, model GHV30/SV3304F110T with 3 off multi stage vertical centrifugal pumps model SV3304 each with 11 kW 2-pole motor, fitted with Hydrovar VFD controller; pump rated 51m^3/h @ 80m. Pump set includes: 3 off 0-10 bar transducers Stainless suction and delivery manifold and associated valves On/Off metal enclosure control panel Galvanised steel skid and panel stand
Butterfly Valve	Valveco butterfly valve, Part 721-BCEW100SEL, DN100.

3.7 DRAWING NO. 8426A - 041

Filter and UV Pipework

Item	Description
Filters	Vortisand high efficiency sand filtration system, Model AC3-30-SP INMR261 (2 micron nominal)

3.8 DRAWING NO. 8426A - 049

Filter Backwash Pipework

Item	Description
Pump Package (Recycle Water)	Lowara model FHE32-160/22 centrifugal pump; Duty 200L/m @ 30m head, 2.2kW, 415V
Air Compressor	Com-Pak Products Model SF-100S, ½ HP, 93L/min, 8kg/cubic m

3.9 DRAWING NO. 8426A - 050

Compressed Air Pipework

Item	Description

Solenoid Valve	SMC 316 ss solenoid valve, pilot operated 2 port ½" BSP, Code VX72240G-0407D
Pressure Switch	SMC 316 ss pressure switch, 3/8"BSP, c/w hysteresis scale plate, Code ISG231-031-W

3.10 DRAWING NO. 8426A - 052

UV Filter Pipework

Item	Description
UV Filter	Trojan UVSwiftSC D12, c/w control panel

3.11 DRAWING NO. 8426A - 054

Ultrasonic Sensor Details

Item	Description
Ultrasonic Level Transmitters	Endress and Hauser ultrasonic level transmitter, Model FMU40-ANB2A2, 2-wire, 4-20mA. Endress and Hauser ultrasonic level transmitter, Model FMU43-AKG2A2, 2-wire, 4-20mA.

4 EQUIPMENT SUPPLIERS

4.1 GENERAL

ITEM	SUPPLIER	CONTACT NO.
Poly Storage Hopper Poly batching Tank Poly Dosing Tank Tomal Equipment Related Piping and Instrumentation	Wartech Pty Ltd 18 Park Ave **BLAXLAND NSW 2774**	Ph: (02) 4739 9421 Fax: (02) 4739 5829
GDD & BFP	John Young (Kelvinhaugh) Pty Ltd 7 Widemere Rd **WEATHERILL PARK NSW 2164**	Ph: (02) 9609 1622
Vortisand Filters	Aquatec-Maxcon Pty. Ltd. 119 Toongarra Road **WULKURAKA QLD 4305**	Ph: (07) 3813 7100 Fax: (07) 3813 7199
Trojan UV	Aquatec-Maxcon Pty. Ltd. 119 Toongarra Road **WULKURAKA QLD 4305**	Ph: (07) 3813 7100 Fax: (07) 3813 7199
Pumps – Mono Macerator - Mono	Mono Pumps (Australia) Pty Ltd 2 Glenntanna Street **KEDRON QLD 4031**	Ph: (07) 3350 4582 Fax: (07) 3350 3750
Pumps – Lowara	Lowara Pumps QLD 50 Nestor Drive **MEADOWBROOK QLD 4131**	Ph: (07) 3200 6488 Fax: (07) 3300 3822
Sludge Conveyors	Spirac Engineering Pty Ltd 30 Cocos Drive **BILBRA LAKE WA 6965**	Ph: (08) 9434 0777 Fax: (08) 9434 0778
Valves	Tyco Flow Control Pacific 1189A Kingsford Smith Drive **EAGLE FARM QLD 4009**	Ph: (07) 3260 2444 Fax: (07) 3260 2140
Load Cells and Readout	Qld Weighing Machines Pty Ltd 45 Wentworth Place **BANYO QLD 4014**	Ph: (07) 3260 7555 Fax: (07) 3260 6222

ITEM	SUPPLIER	CONTACT NO.
Pneumatic Items (at Sludge Hopper)	SMC Pneumatics Pty Ltd 17 Shannon Place **VIRGINIA QLD 4014**	Ph: (07) 3865 3000 Fax: (07) 3865 3999
Hopper Roof	Anything Fibreglass 5 Lyndora Cl **RIVERHILLS QLD 4074**	Ph: (07) 3279 7304 Fax: (07) 32797306
E+H	Endress + Hauser Pty Ltd Unit 8/277 Lane Cove Road **NORTH RYDE NSW 2113**	Ph: (02) 8877 7000 Fax: (02) 8877 7099
Pressure Retaining Valve	George Fischer Pty Ltd Unit 1/100 Belmore Road **RIVERWOOD NSW 2210**	Ph: (02) 9502 8000 Fax: (02) 9502 8090
Pressure Relief Valve (Stubbe)	Air & Hydraulic Systems Pty Ltd. PO Box 419 **BROOKVALE NSW 2100**	Ph: (02) 9939 6199 Fax: (02) 9938 5972
Panel and Controls	J&P Richardson Pty Limited 114 Campbell Avenue **WACOL QLD 4076**	Ph: (07) 3271 2911 Fax: (07) 3271 3623

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5 EQUIPMENT OPERATION

5.1 REFERENCE DOCUMENTS

5.1.1 Piping and Instrumentation Diagram

This following Section 5 information should be read in conjunction with the Process and Instrumentation Diagram, drg. 8426A-033 (available in Section 12 – Drawings).

5.2 PLANT AUTOMATION

The new Siemens S7 PLC controls all the operations of the stage 2 sludge dewatering augmentation, and interfaces with the existing ET200 PLC rack in order to integrate and co-ordinate overall plant control.

The PLC's are connected to the existing plant SCADA system, so that control and operation of the overall plant is performed through the existing Operator Interface SCADA package CITECT. The augmented plant is accommodated within the software, with additional pages being configured for menu, mimic, alarm, events and trending. In addition to monitoring the current status of all plant items and instrumentation output readings, the operator can adjust operational parameters, check and reset alarms, and review historical trends of all instrumentation outputs.

Note however that the equipment packages are controlled individually, and hence not all operating parameters are available to the main plant SCADA. For details and interfacing between packages and SCADA, refer section 5.3 below.

5.2.1 Protection

All monitoring equipment is protected against power surges caused by lightning or phase failure.

All pumps and motors have a local emergency stop button located close to the drive, for rapid local shutdown in emergency situations.

5.2.2 Operational Requirements

The water treatment plant operates in full automatic mode with all necessary alarms and faults registered by the SCADA operator interface.

5.3 PROPRIETARY PACKAGES

5.3.1 Scope

There are several proprietary packages supplied within the scope of the augmentation and each of the packages has its discreet control system, whereupon not all the operational status of the components is available to the plant SCADA.

The proprietary packages include the following:

- Tomal PolyRex 4.0 Poly Preparation Units (2 off).
- Vortisand AC3-30-SP Sand Filter Skid.
- Trojan UVSwiftSC D12 units (2 off).

- GDD / BPF thickening / dewatering units
- Lowara Treated Water Pressure Pump Station.
- SMC Clam Shell Gate Control System.
- Mono Muncher – note the control unit has been integrated within the MCC wiring.

5.4 PLANT OPERATION

The following description of the augmented plant operation provides the basis for the new PLC program.

5.4.1 Manual Operation

Each plant item has been provided with a selector switch (Field-Off-PLC) at the Motor Control Centre (MCC) which allows it to be manually operated, independent of the PLC. This would normally only be necessary during testing operations or in circumstances where it is necessary for the operator to intervene in the operation of the plant. Note that motors have a field manual switch, however motorised valves do not.

It should be noted that the CITEC system provides a manual operation function for each motor and valve, but this will only function if the MCC selector is set to the Auto position.

It should also be noted that fault interlocking for thermistor, VF drive (where installed), low-flow switches and thermal overload faults has been provided for drives in the manual mode, but interlocks inhibiting operation under the various operating scenarios listed here-in have not been provided, and are available only in Auto mode.

5.4.2 Auto Operation

Each item of plant will normally have its selector switch set in the Auto position for automatic operation, whereby the operation of the whole plant and individual plant items will be controlled from the existing and new PLC's.

5.4.3 Equipment Control

Fixed Speed Drive Control

Each Fixed Speed Drive can be selected for Auto or Manual operation at the MCC panel.

In Manual, operation of fixed speed drive controls is only possible from the MCC panel.

In Auto, the drive starts and stops by the auto start Output from the PLC. The modes of PLC operation are as follows:

Manual On	Overrides the Process logic and starts the drive
Manual Off	Overrides the Process logic and stops the drive
Auto	The process logic operates the drive

The following faults are generated.

Fail to start	Drive running feedback has not been received after 10 seconds from the Auto start output being made

Fail to stop	Drive running feedback has remained on after 10 seconds from the Auto start output going off
Motor fault	Motor fault input has gone on.
Inhibited	Drive inhibited from operating due to an interlock

Variable Frequency Drive Controls

Each Variable Frequency Drive (VFD) can be selected for Auto or Manual operation at the MCC panel.

In Manual, the drive is started and stopped from the MCC. The speed of the drive can be adjusted manually using the VFD interface.

In Auto, the drive starts and stops from the auto start Output from the PLC and its speed is set by the PLC.

The modes of PLC operation are as follows:

Manual On	Overrides the process logic and starts the drive with fixed speed manually selectable from the operator station
Manual Off	Overrides the Process logic and stops the drive
Auto	The process logic operates the drive, with the speed determined by the process logic (typically a PID algorithm)

The following faults are generated

Fail to start	Drive running feedback has not been received after 15 seconds from the Auto start output being made
Fail to stop	Drive running feedback has remained on after 15 seconds from the Auto start output going off
Motor fault	Motor fault input has gone on
No flow fault	No flow fault input has gone on (limit switch on pump NRV not open)
Inhibited	Drive is inhibited from operating due to an interlock

Duty/Standby Operation

Drive duty toggles at each plant shut-down, in order to provide even operation of all units. If required, this feature can be deactivated by the operator through Citect.

Duty selection is made from the operator interface and is carried out by the operator.

Transfer from the duty to the standby unit will occur when one of the following faults is registered on the duty drive:

- Fail to Start
- Fail to Stop
- Motor fault

Duty toggling will not take place when a fault is active on a drive. The fault must be reset before toggling recommences.

Open/Closed Valve Control

Each open / closed valve can be selected for Auto or Manual operation from the operator interface.

There is no local control.

The following control modes are possible.

Manual Open	Overrides the Process logic and opens the valve.
Manual Closed	Overrides the Process logic and closes the valve.
Auto	The process logic operates the valve.

The following faults are generated.

Fail to open	Valve open feedback has not been received after 15 seconds from the Auto open output being made.
Fail to close	Valve closed feedback has not been received after 15 seconds from the Auto start output being unmade.
Inhibited	Valve inhibited from operating due to an interlock in the process logic.

Modulating Valve Control

Each modulating valve can be selected for Auto or Manual operation from the operator interface.

There is no local control.

The following control modes are possible:

Manual	Overrides the Process logic and allows the operator to fix the valve position.
Auto	The process logic operates the valve

The following faults are generated:

Fail to operate	Valve analogue feedback is not within +/- 5% of output signal for 15 seconds.
Inhibited	Valve inhibited from operating due to an interlock in the process logic.

Note: Valve closing times to be set at commissioning.

Solenoid Valve Control

Each solenoid valve can be selected for Auto or Manual operation from the operator interface.

There is no local control.

The following control modes are possible.

Manual Open	Overrides the Process logic and opens the valve

Manual Closed	Overrides the Process logic and closes the valve
Auto	The process logic operates the valve

The following faults are generated.

Inhibited	Valve inhibited from operating due to an interlock in the process logic

5.5 FUNCTIONAL SPECIFICATION

Section 5.5.5 Interface to New PLC summarised the various signals generated by the plant and the operation of the items of equipment.

5.5.1 Sludge Dewatering System

GDD/BFP No 1

The existing GDD/BFP No 1 may operate in either of 2 modes:

Mode 1: - GDD thickened sludge may be fed directly to the BFP. OR

Mode 2: -. It may operate as a GDD to produce thickened sludge for anaerobic digestion. The digested sludge may then be feed to the BFP for dewatering

This capability is retained, however for Mode 1 operation, WAS is now fed to the GDD via a new WAS Buffer Tank. A new polymer dosing system is installed.

GDD/BFP No 2

The new GDD/BFP No 2 will currently operate in Mode 1 only, however with installation of additional equipment it may operate in either Mode 1 or Mode 2:

GDD No 2 and BFP No 2

Mode 1: -To operate as one train only, where thickened sludge from the GDD is fed directly to the BFP, OR

Mode 2: -For future use. With installation of additional equipment, it may operate as Train 1 Mode 2, as a GDD to produce thickened sludge for anaerobic digestion. The digested sludge may then be feed to the BFP for dewatering

This Functional Description describes the operation of GDD/BFP No 1 and 2 when used as to operate as one train only (ie. Mode 1), where thickened sludge from the GDD is fed directly to the BFP, as well as the operation of the new WAS Buffer tank and the polymer makeup unit. This Functional Description does not describe the operation in Mode 2.

The status of all new equipment (i.e. on/off, open/close, etc.) is displayed on the SCADA system. The operator is able to control and monitor the operation of the plant as detailed in this functional specification.

The details of SCADA system interfacing points are listed in the attached 'PLC & SCADA I/O and Points List".

5.5.1.1 PLCS

The Sludge Dewatering PLC is installed in the Dewatering Building and connected to the Plant Main PLC.

The Sludge Dewatering PLC is the main PLC for the Sludge Dewatering Plant and provides the SCADA system interface for control and monitoring.

The following PLCs receive SCADA control commands via the Dewatering System PLC:

- one (1) PLC (OMRON type CPMI-4OCDR-A CPU) per Polymer Dosing System;
- one Effluent Water Pumpset PLC.

5.5.1.2 Processes

WAS is pumped using Stage III as well as Stage I and II WAS pumps to a WAS Buffer Tank. WAS from this buffer tank is pumped via a macerator by the WAS Thickening Feed pumps, dosed with polymer and then fed to GDD No 1 and No 2. Thickened sludge from the GDD is fed directly to its BFP.

The following equipment is used in process:

- Stage I and Stage II WAS Pumps (Ipswich Water)
- Stage III WAS Pumps (Ipswich Water)
- WAS Buffer Tank (with mixer)
- Macerator
- WAS Thickening Feed Pumps
- WAS Dosing Polymer Dosing System
- Flocculator
- Gravity Drainage Deck (GDD) No 1 and 2
- Belt Filter Press (BFP) No 1 and 2
- Effluent Pumps
- Cake Conveyors
- Air Compressor system

The Equipment listed will operate in a sequence with all safety interlocks required in order to have a safe operation.

5.5.1.3 Operational Mode

The WAS Thickening Feed pumps are used to feed WAS to GDD No 1 and or GDD No 2. Each of the GDD / BFP trains may operate independently, such that one stream could be operational whilst the other is off, or both could be operational at the same time.

GDD No 2 and BFP No 2 operate in one train, not separately, ie Mode 1 operation. Provision has been made to included a separate connection to BFP No 2 for future use and a BFP mixer tank so that they may operate individually if digested sludge pumps are installed in the future.

The process will operate in either **REMOTE AUTOMATIC** or **LOCAL MANUAL** mode as described in the following sections.

Remote Automatic

Both of the Plant processes are configured to operate automatically without Plant Operator intervention except for fault rectification and initiating the start/stop sequences.

START and STOP sequences are manually initiated by the Plant Operators, via the SCADA system.

Plant Operators may elect (via the SCADA system) to adjust the following set-point parameters:

Process	Equipment	Parameter
Sludge Buffer Tank	Stage I, Stage II and Stage III WAS Pumps	WAS feed rate to Buffer Tank
Sludge Thickening and Dewatering	Macerator and WAS Thickening Feed Pumps	WAS feed rate to GDD
	Polymer Dosing System	Polymer dosing pump speed

Local Manual

Plant Operators may elect to operate individual items of equipment directly.

Selection of this operating mode for each item of equipment is achieved at the Dewatering Building MCC by selecting FIELD on the FIELD/OFF/PLC selector switch for the respective equipment.

In LOCAL MANUAL mode, the whole of the operating responsibility for that process (Thickening or Dewatering) is transferred from the SCADA system to the person at the Dewatering Building MCC. All physical inhibits are maintained, but PLC inhibits are removed.

Operation of the following particular items of equipment is achieved via START/STOP field switches / pushbuttons:

- Macerator
- WAS Thickening Feed pumps
- Flocculator
- Gravity Drainage Deck
- Belt Filter Press
- Cake conveyors
- Effluent Water Pumpset

Note: when an item of equipment which is part of a process stream is selected to FIELD or OFF positions, that process stream becomes unavailable for PLC and SCADA control.

Switching of a sub-system (i.e. Effluent Water Pumpset, Polymer Dosing Systems and Air Compressor System) into LOCAL MANUAL mode is achieved at the respective control panel and allows operation of individual items of equipment within these subsystems.

If a sub-system is placed in LOCAL MANUAL mode, this will make the respective process stream unavailable for SCADA control.

5.5.1.4 Process Sequences

WAS Buffer Tank

The WAS Buffer is available to accept WAS from the ***WAS pumps*** via Remote SCADA control if the following pre-start conditions are met:

- At least one of ***Stage I or Stage II or Stage III WAS pump drive ready***, PLC input signal is on;
- ***WAS Buffer Tank High level float switch,*** PLC input signal indicates a High level is not present;
- ***WAS Buffer Tank Ultrasonic Level Indicator,*** PLC analog input signal is not above the High Level Set-point;

If one of these conditions is not met the PLC will take following actions:

- if a WAS pumps is not operational, them unavailable for SCADA control until the cause of unavailability has been cleared;
- if any of the WAS pumps are operating Stop the pump and then make the pump unavailable for SCADA control.

Sludge Thickening and Dewatering Process – Available for SCADA Control

The Sludge Thickening process is available for Remote SCADA control if the following pre-start conditions are met:

- ***WAS Buffer Tank Ultrasonic Level Indicator,*** PLC analog input signal is not below the Low Level Set-point;
- ***WAS Buffer Tank Mixer ready***, PLC input signal in on
- ***Macerator***, PLC input signal is on;
- Duty or Standby ***WAS Thickening Feed Pumps (for appropriate GDD 1 or 2)***, PLC input signal is on;
- ***Gravity Drainage Deck (GDD) drive ready***, PLC input signal in on;
- ***WAS Dosing Polymer Dosing System enabled***, PLC input signal is on;
- ***Effluent Pump fault*** signals is not on
    - at least one if one GDD's to operate,
    - at least two if for both GDD's to operate

- at least one of the Duty or **Standby *Air Compressor fault*** signals is not on;
- ***High Pressure Effluent Water Supply – Pressure Low*** signal is not on (this is applicable for an operating process only);
- ***Low Pressure Effluent Water Supply Water - Pressure Low*** signal is not on (this is applicable for an operating process only).
- ***Air Pressure Low*** signal is not on (this is applicable for an operating process only).
- ***Belt Filter Press (BFP) Drive Ready (for appropriate GDD 1 or 2)***, PLC input signal in on;
- ***Cake Conveyer Drive Ready (for appropriate BFP 1 or 2)***, signal is on;
- the ***Sludge Cake Hopper*** load cell not indicating above the High Set-point ;

If one of these conditions is not met the PLC will take following actions:

- if the process is not operational, make it unavailable for SCADA control until the cause of unavailability has been cleared;
- if the process is in operating condition, then carry out shut down sequence and then make the process unavailable for SCADA control.

5.5.1.5 Sludge Thickening and Dewatering – Start Sequence

The start sequence for the GDD and BFP are similar.

For an available process for SCADA control, the start sequence may be initiated by the Plant Operator via the SCADA display screen.

Start Sequence (start equipment appropriate to GDD being started ie 1 or 2)

- High pressure Effluent Water Pumps
  - Start one pump if one GDD's to operate,
  - Start two pumps if for both GDD's to operate
- Open control air solenoid valve
- Start Cake Conveyors.
- Open wash-water solenoid valve
- Turn on the audible alarm
- Start BFP
- Start GDD
- Start WAS Dosing Polymer Dosing Pump
- Open solenoid valve for dilution water to WAS Dosing Polymer Dosing
- Start WAS Thickening Feed Pumps

During operation, the following parameters are checked and monitored:

- WAS flow rate
- polymer dosing rate
- control air pressure not low
- wash-water (high pressure effluent water system) pressure not low
- WAS Buffer Tank level not low
- All drives in the process are Ready
- the ***Sludge Cake Hopper*** load cell not indicating above the High Set-point;

5.5.1.6 Sludge Thickening and Dewatering – Stop Sequence

The Stop Sequence is initiated by either the Plant Operator via the SCADA system or as a result of a trip fault.

Stop Sequence - (stop equipment appropriate to GDD being stopped ie 1 or 2)

The stop sequence is as follows:

1. Inhibit WAS Flow alarm and stop WAS Thickening Pump
2. Inhibit Polymer Flow alarm and stop Polymer Dosing Pump.
3. After pre-set time delay (Plant Operator adjustable) stop GDD
4. After pre-set time delay (Plant Operator adjustable) stop BFP
5. Stop Cake Conveyor after a pre-set (Plant Operator adjustable) time delay.
6. After a pre-set time delay (nominal 10 min.) close wash-water solenoid valve.
7. Stop Effluent Water Pump.
8. Close control air valve.

5.5.1.7 Faults (Alarm and Trip)

Faults are categorized as either *alarm* or *trip*, viz:

Alarm causes:

- local indication on the respective control panel or the Dewatering Building MCC
- computer screen alert indication via the SCADA system

Trip causes:

- identical response as for *alarm*
- stop of associated drive or sub-system
- Stop Sequence initiation of either the GDD or BFP

Fault *alarms* are as follows:

System	Parameter	Device
WAS Supply	WAS flow to GDD, low flow	flowmeter

Polymer Dosing Systems	general fault for: • Mixing tank overflow • Storage tank overflow • Dosing flow low • Batching make-up water low flow • Storage bin low level	from following via PLC output; • Level switch • Level switch • Flowmeter • Level switch
Effluent Water Systems	High Pressure System - low header pressure	pressure switch

Fault *trips* are as follows:

System	Parameter	Device
WAS Buffer Tank Mixer	mixer motor high current	contactor overloaded
WAS Thickening Feed Pumps	WAS Buffer Tank level low WAS Thickening Feed pump duty pump low flow macerator motor high current WAS Thickening Feed pump duty pump motor high current	Ultrasonic level transmitter flowmeter contactor overloaded contactor overloaded
Gravity Drainage Deck	belt tracking limit	limit switches
Belt Filter Press	belt tracking limit	limit switches
Polymer Dosing Systems	low dosing rate dry feeder high current blower high current agitator high current transfer pump high current dosing pumps high current	Flowmeter contactor overload contactor overload contactor overload contactor overload contactor overload
Effluent Water Systems	High Pressure System - duty contactor overload pump high current	contactor overload
Compressed Air System	low outlet pressure compressor motor high current	pressure switch contactor overload
Cake Conveyors	Traverse conveyor high torque Traverse conveyor drive motor high current Inclined conveyor high torque	electronic shear pin electronic shear pin contactor overload contactor overload contactor overload contactor overload
Sludge Cake Hopper	load above the High Set-point	load cell

5.5.2 *Polymer Dosing System*

General

The GDD and BFP Polymer Dosing Systems are provided with separate control panels.

Each Polymer Dosing Control Panel provides control for the following sub-processes:

- unloading of polymer from truck into the dry powder hopper;
- batch preparation by mixing polymer with effluent water;
- transfer of polymer solution to the dosing tank;
- dosing of polymer into dilution effluent water.

The batch preparation and polymer solution transfer operations are intended to be automatically controlled by the PLC (i.e. there is no REMOTE AUTOMATIC control). The batch preparation operation may be carried out as an automated process with local manual initiation, and indication is provided on the control panel to indicate batch-in-progress and batch-completion.

The dosing operation is fully automated and may be initiated in REMOTE AUTOMATIC and LOCAL MANUAL modes. A selector switch on the control panel allows operators to select between REMOTE and LOCAL control.

Alarms are also provided for low and high levels in the polymer dosing tank.

On receiving a signal to start (as part of the starting sequence of the respective GDD and BFP), the Polymer Dosing PLC will initiate a start sequence for the dosing process, viz:

- the dilution water solenoid valve will open provided there is no alarm condition;
- the duty dosing pump will start and run (if available) at the speed required to deliver the requisite flow of polymer;
- on generation of a low level signal from the dosing tank, the transfer valve will open to transfer mixed polymer from the batching tank;
- on emptying of the batching tank, automated production of a new batch will commence.

Note: the abovementioned sequence is programmed into the Polymer Dosing PLC. The Sludge Dewatering PLC's function is to signal to run the dosing system. After receiving a signal that the Polymer Dosing System is running, the Dewatering System PLC will move to the next step of the start sequence for the GDD or BFP.

In REMOTE AUTOMATIC mode, the dosing rate is paced to the WAS flow rate. The Plant Operator is able to read the dosing flow rate via the SCADA, and adjust the dosing pump running speed accordingly.

In the event of a dosing pump fault, a low flow alarm is generated by the dosing flowmeter will initiate the start of the standby pump. Failure to restore flow within a preset time will cause the dosing system to shut down which will initiate the stop sequence for the process.

Unloading of Dry Powder

When the Polymer Storage Bin (Hopper) level drops to that of the low level switch, an input is provided to the respective Polymer Dosing PLC, which in turn causes the POLYMER STORAGE BIN LOW lamp to light, and generates the ***Polymer Dosing general alarm*** input to the Dewatering System PLC.

Upon detection of this general alarm, the Plant Operator is required to attend at the Polymer Dosing Control Panel to ascertain the cause of the alarm and load the Polymer Storage Bin. If the operator is unable to immediately load the polymer storage bin, it is recommended that polymer supply be switched over to the second polymer system (via the SCADA control). If this is done, the operator should follow the valve map to set the polymer flow to the correct direction from the chosen polymer system to the required GDD. Both polymer systems can be used to supply polymer to either GDD or BFP of either dewatering train.

When the Polymer Storage Bin is full, the high level switch will provide input to the Polymer Dosing PLC and the **STORAGE BIN LEVEL HIGH** lamp will light (a signal to the Dewatering PLC is not required as this is not an alarm condition).

Polymer Batching

There is an ON/OFF selector switch on the Polymer Dosing Control Panel for selection for automatic or manual batching. When in the **OFF** position, the Plant Operator is able to initiate a batch process by depressing the **MANUAL BATCH START** push-button mounted on the panel. When in the **ON** position, the Polymer Dosing PLC carries out the batching process in response to the low-level switch in the mixing tank.

5.5.3 Effluent Water System

5.5.3.1 Filter Feed pumps (existing Grundfos):

Duty pump:

- ***operate when -*** the Ultrasonic level sensor in the Digester Water Storage Tank indicates a low level
- ***stops when -*** the Ultrasonic level sensor in the Digester Water Storage Tank indicates a high level

Ultrasonic level sensor in Digester Water Tank :

- ***indicated low level: -*** starts the existing (Grundfos) filter feed pumps when the Ultrasonic level sensor in the Digester Water Storage Tank indicates a low level
  - stops associated equipment, Process 2 as in Table 5.1, until low not indicated.
- ***indicated high level: -*** stops the existing (Grundfos) filter feed pumps when the Ultrasonic level sensor in the Digester Water Storage Tank indicates a high level

5.5.3.2 Vortisand Filters

Treated Effluent from the Chlorine Contact Tank is pumped via the Vortisand Filters to the Digester Water Storage Tank by the existing (Grundfos) filter feed pumps. On /Off signals are summarized in Table 5.1, Signal and Process Path.

SEQUENCE OF OPERATION FOR UNIT -Vortisand type A-3

Backwash can be initiated three different ways:

1. DPS (differential pressure switch), close contact for 15 seconds.
2. Manual start, push button depressed for 10 seconds.
3. Time delay 24 hours (adjustable).

Step by step of a BW (backwash) sequence for the PLC after a BW request:

1. The stager motor output is turned on.
2. When the index switch goes from close to open, the PLC stops the stager motor output.
3. BW timer starts for 8-minutes default. (Adjustable), tank 1 backwash. 2 and 3 in filtration.
4. At the end of this timer, the stager motor output is turned on.
5. When the index switch goes from close to open, the PLC stops the stager motor output.
6. BW timer starts for 8-minutes default. (Adjustable), tank 2 backwash. 1 and 3 in filtration.
7. When the index switch goes from close to open, the PLC stops the stager motor output.
8. BW timer starts for 8-minutes default. (Adjustable), tank 3 backwash. 1 and 2 in filtration
9. At the end of this timer the stager motor is turned on
10. When the index and home switches go from close to open, the PLC stops the stager motor output.
11. The BW counter adds 1 up.

	Valve 1a	Valve 2a	Valve 3a	Valve 4a	Valve 1b	Valve 2b	Valve 3b	Valve 4b	Valve 1c	Valve 2c	Valve 3c	Valve 4c
filtration	Open	Open	Close	Close	Open	Open	Close	Close	Open	Open	Close	Close
Bw tank A	Close	Close	Open	Open	Open	Open	Close	Close	Open	Open	Close	Close
Bw tank B	Open	Open	Close	Close	Close	Close	Open	Open	Open	Open	Close	Close
Bw tank C	Open	Open	Close	Close	Open	Open	Close	Close	Close	Close	Open	Open

When a BW is on, it is possible to go step by step by pressing the manual BW button (F4). The BW timer shows the time remaining on the operator interface.
The BW time delay request is a timer that starts at the end of the last BW, and when it reaches the set point, 24 hours (adjustable), the PLC starts a BW. If one of the other BW request starts a BW before the end of this timer, the timer resets at zero at the end of that BW.

Normal alarms are:

- Stager alarm (input change when no command by PLC or no feed back when output energized).
- Maintenance alarm (365 days warning adjustable).
- Periodic cleaning.

Treated Effluent from the Chlorine Contact Tank is pumped via the Vortisand Filters to the Digester Water Storage Tank by the existing (Grundfos) filter feed pumps.

Vortisand filters:

- ***operate when -*** the Ultrasonic level sensor in the Digester Water Storage Tank indicates a low level
- ***stops when -*** the Ultrasonic level sensor in the Digester Water Storage Tank indicates a high level

5.5.3.3 Trojan UV Unit

- On for dewatering (needs 3 minute warmup).
- Alarm signal for lamp failure. (Minor and Major alarms may be generated. Signal all Process **2,** as in Table 5.1, off if major alarm)

5.5.3.4 Wash Water Pumps

The pumps have been selected to match the duty requirements of the GDD and BFP. Two pumps are required to supply sufficient water when both the GDD and BFP are operating.

As part of the start-up sequence of the GDD and BFP, a signal is given to the Effluent Water Pumpset control panel PLC (after a 3 minute UV unit warmup delay) to start the appropriate number of pumps.

In order to distribute operational load on the pumps, the PLC is programmed to rotate the lead duty pump, and to start a standby pump if the duty pump(s) fails.

The Plant Operator is able to monitoring each pump's status via the SCADA system (run / fault indication).

LOCAL MANUAL control is effected by switching of the ***DUTY MANUAL/AUTO*** switch on the control panel. This isolates the control panel from remote PLC (Dewatering Building) control. Individual pumps can be selected for operation when in LOCAL MANUAL.

5.5.4 Compressed Air System

The Sludge Dewatering PLC receives a signal from the Air Compressor Control Panel to confirm availability. If not available, the GDD and BFP start sequence cannot be initiated. If running, the GDD and BFP is shut down.

If available, the Sludge Dewatering PLC will send a start signal during the GDD and BFP start sequences. On receipt of a run signal, the respective start sequence will move to the next step.

5.5.5 Interface to New PLC and Modified SCADA

Signal and Process Path Summary

Table 5.1, Signal and Process Path summary summarised the various signals generated by the plant and the operation of items of equipment.

Signals On/Off for:

Table 5.1 – Signal and Process Path Summary

Process Unit	Action
Chlorine Contact Tank Pumps (Existing Grundfos pumps)	On when low indicated by digester ultrasonic. Off when high
Vortisand Filters	On when low indicated by digester ultrasonic. Off when high.
Ultrasonic on digester	Signals high and low. Signal Chlorine contact tank pumps off when high on when low, signal process **2** off when low.
Lowara washwater pumps in pump building	On when operator turns on dewatering (delay wait for UV warmup)
Trojan UV	On for dewatering (needs 3 minute warmup). Alarm signal for lamp failure. (Minor and Major, signal all process **2** off if major alarm)
Dewatering train – GDD and BFP	On by operator (delay wait for UV warmup)
Dewatering train – Inlet valves	Open on dewatering on
Ultrasonic and float switch on WAS tank	Indicates high/low. Signal sent to WAS stage I, II, III supply pumps (pumps by IW) via SCADA
Macerator	On for dewatering
WAS pumps	On for dewatering
Polymer system	Pre-batching done when low level in polymer stock tank (controlled by polymer control panel automatically).
Polymer pumps	On for dewatering, with polymer.
Conveyors	On for dewatering. Alarm and all process **2** off for motor overload.
Flow meter	Signals for flow. Alarm and all process **2** off if dewatering on but no flow detected.
Sludge Hopper Load Cells	Signal when 100 tonne reached. Switches off all of process **2.**

1

2

Signals to PLC

From each of the packages listed in Section 5.3, the following signals connect to the Siemens S7 PLC and SCADA:

5.5.5.1 Tomal PolyRex 4.0 Poly Preparation Units

- General alarm
- Powder hopper full
- Mixer motor running
- Powder feeder running
- Stock tank Low Low level

- Auto selected

5.5.5.2 Vortisand AC3-30-SP Sand Filter Skid

Normal alarms are:

- Stager alarm
- Maintenance alarm (365 days warning adjustable).
- Periodic cleaning.

5.5.5.3 Trojan UV SwiftSC D12 units

Sequence of operation:

- On
- 3 minute warm-up
- Flow

Signals for on, off, alarm.

Switch for on, off:

Units include 2 control panels, 1 for each unit, with a digital display on each.

5.5.5.4 Siemens / Sergagiotto GDD / BPF units

- GDD control supply healthy
- GDD Motor isolator healthy
- GDD Motor drive healthy
- GDD Limit/lanyard healthy
- GDD Drive ready
- GDD drive running
- GDD run signal (from main PLC)
- BPF control supply healthy
- BPF Motor isolator healthy
- BPF Motor drive healthy
- BPF Limit/lanyard healthy
- BPF Drive ready
- BPF drive running
- BPF run signal (from main PLC)

5.5.5.5 Lowara Treated Water Pressure Pump Station

On when operator turns on dewatering (delay wait for UV warmup)

5.5.5.6 SMC Clam Shell Gate Control System

- Gate 1 open
- Gate 1 closed
- Gate 2 open
- Gate 2 closed

Clam shell gate interlock relay (from main PLC)

5.5.6 Alarms Summary

Alarms exist on most items of plant, including pumps, drives, systems and water quality monitoring instrumentation. Alarms alert operational staff to abnormal conditions that may result in performance outside the specified requirements, danger to plant and / or personnel, failure of equipment, and system faults.

There are two levels of alarms: critical alarms and non-critical alarms. Critical alarms cause plant operation to cease and require immediate attention. Non-critical alarms do not shut down the plant, but indicate a fault with a non-critical piece of equipment, or a partial fault in a critical system (such as failure of one dosing pump, or a GDD/BPF etc.). These may result in a reduction of plant performance or reduced output, and they may increase the likelihood of a plant shutdown if not attended to and rectified promptly.

5.5.7 Emergency Stops

An ***Emergency Stop*** (combined isolation switch) is provided for each main drive and subsystem. The GDD and BFP units are provided with lanyards.

On initiation of an ***Emergency Stop*** the respective drive is stopped immediately and the remaining equipment for the respective process (GDD or BFP) is stopped as per the normal sequence.

Starting of the respective process after an ***Emergency Stop*** requires local fault re-set of the effected equipment by the Plant Operator.

6

6 TROUBLESHOOTING GUIDE

Note – This Section does not list references to 'Error' messages on electronic devices. Refer to related documentation contained within Section 11 – Manufacturer's Information.

6.1 SIEMENS / SERNAGIOTTO GDD MODEL GT2000-BSX & BPF MODEL BPF 2000 S7-BSX-L

For Troubleshooting of the GDD, refer chart at Section 14 of Siemens O+M Manual located at Section 11.1 (first part).

For Troubleshooting of the BFP, refer chart at Section 15 of Siemens O+M Manual located at Section 11.1 (second part).

6.2 SPIRAC CONVEYORS TYPES OK420-SPX/SS; U420-SP/SS, & U320-SPX/SS

For Trouble-shooting chart, refer Section 6, from page 23 of Spirac Installation, Operating & Maintenance Instructions located at Section 11.2.

6.3 (ITT) LOWARA PUMPS FHE32-160/22 (FILTER BACKWASH) & GHV30/SV3304F1110XT (TREATED WATER), 4HMS5-PS15 (POTABLE WATER PRESSURE BOOST FOR POLYMER SYSTEMS)

For Troubleshooting Chart, refer Section 8 on page 23 of Instructions located at Section 11.3.

6.4 MONO PUMPS C1BAC31RMA/G (WAS) & C13AC31RMA/G (POLY DOSE)

For Diagnostic Chart, refer Section 2 of Mono Installation, Operation & Maintenance Instructions located at Section 11.4.

6.5 MONO MUNCHER (MACERATOR) GEARMOTOR

There are no troubleshooting details for the Mono Muncher.

6.6 ABS RW2822 MIXER

There are no troubleshooting details for the ABS mixer.

6.7 TOMAL POLYREX 4.0 POLY PREPARATION UNIT

For Troubleshooting Chart, refer Section 9 of Tomal Instruction Manual located at Section 11.7.

6.8 TYCO VALVES AND ACTUATORS

For Troubleshooting Guide, refer Keystone F79U (003 – 036) Repair and Maintenance Instructions located at Section 11.8.

6.9 VORTISAND AC3-30-SP SAND FILTER SKID

For Troubleshooting, refer related section within the Vortisand Operating and Maintenance Manual located at Section 11.9.

6.10 TROJAN UVSWIFTSC D12

For Troubleshooting, refer Section 8 – Alarms and Troubleshooting within the Trojan Manual located at Section 11.10.

6.11 ENDRESS & HAUSER PROMAG FLOWMETER

For Troubleshooting, refer Section 9 of E+H Operating Instructions, located at Section 11.11

6.12 ENDRESS & HAUSER PROSONIC LEVEL MEASUREMENT

For Troubleshooting, refer Section 7 of E+H Operating Instructions, located at Section 11.12

6.13 SMC CLAM SHELL GATE CONTROL SYSTEM

For Pneumatic Components Failure Procedure, refer page 4 of SMC Installation & Maintenance Manual located at Section 11.13.

7

7 MAINTENANCE

7.1 GENERAL

To ensure proper operation of the plant, the following should be observed.

a. The plant should be kept clean and tidy at all times. Not only is this of aesthetic value, but it also prevents premature deterioration of the equipment and lengthens the life of the equipment.

b. Each section of the plant should be inspected daily for correct operation.

c. All maintenance, repairs, modifications and significant deviations from normal operating or design conditions, including breakdown or other malfunction, should be recorded in the **Plant Service Log (Section 10.0)**.

d. **DO NOT UNDER ANY CIRCUMSTANCES HOSE THE EQUIPMENT DOWN UNLESS IT SPECIFICALLY STATES IT IS HOSE PROOF.** Wipe it down or follow the manufacturer's recommendations.

e. The lubrication schedule should be strictly adhered to, to ensure proper operation of the equipment. Lubricant properties deteriorate with time and use, therefore correct lubrication is essential. **Refer to Lubrication Schedule (Section 8.0)**.

f. After a month of operation, check the tension of all bolts associated with the plant, and thereafter periodically. Bolted connections on painted surfaces can loosen due to thinning of the paint underneath the bolt-head bearing surface.

g. Before commencing any maintenance procedures on items of equipment, the manufacturer's manuals stored in **Manufacturer's Information (Section 11.0)** should be studied carefully.

h. Operations and maintenance procedures should also be in accordance with local regulations and accepted codes of good practice.

The maintenance required for individual items is outlined in the following schedules:

7.2 SIEMENS / SERNAGIOTTO GDD MODEL GT2000-BSX & BPF MODEL BPF 2000 S7-BSX-L

Item	Description	50 hrs	200 hrs	500 hrs	1,000 hrs	2,000 hrs	3,000 hrs	5,000 hrs	10,000 hrs	20,000 hrs	Lubricant/Comments
7.2.1	**Siemens GDD GT2000 BSX**										
[a]	Remove solids from spray pipes	x									Turn handwheel
[b]	Grease rack and pinion	x									
[c]	Discharge air filter condensate	x									
[d]	Check level in oil lubricator	x									Parker oil
[e]	Check drip of oil lubricator	x									
[f]	Check wear of doctor blades		x			x					Replace at 2,000 hrs
[g]	Check operation of spray pipe		x								
[h]	Grease roller bearings			x						x	Castrol Optimol Optipit grease (replace at 20,000 hrs)
[i]	Check roller bearing seals			x						x	Replace at 20,000 hrs
[j]	Check plow sole			x						x	Replace at 20,000 hrs
[k]	Clean inside belt washing box			x							
[l]	Check wear on spray pipe brush				x						Replace as necessary
[m]	Check gravity zone HDPE bars				x				x		Clean at 10,000 hrs Replace at 30,000 hrs
[n]	Check seal on gravity zone skirts and wash boxes				x				x		Replace at 10,000 hrs
[o]	Check paddle sensor of tracking device				x				x		Replace at 10,000 hrs
[p]	Check roller coverings				x						
[q]	Check belt wear				x						Replace as necessary
[r]	Check oil in belt drive gearbox						x		x		Replace at 10,000 hrs or two years Shell Omala 220
[s]	Inspect all fasteners							x			
[t]	Check spray nozzles							x			Replace as necessary
7.2.1	**Siemens BFP 2000 BSX L**										
[a]	Remove solids from spray pipes	x									Turn handwheel
[b]	Discharge air filter condensate	x									
[c]	Check level in oil lubricator	x									Parker oil
[d]	Check drip of oil lubricator	x									
[e]	Check wear of doctor blades		x			x					Replace at 2,000 hrs
[f]	Check operation of spray pipe										
[g]	Grease roller bearings			x							Castrol Optimol Optipit grease (replace at 20,000 hrs)
[h]	Check roller bearing seals			x						x	Replace at 20,000 hrs
[i]	Clean inside belt washing box			x							
[j]	Check wear on spray pipe brush				x						Replace as necessary
[k]	Check belt wear				x						Replace as necessary
[l]	Replace oil in tank mixer speed variator							x			
[m]	Replace oil in belt drive gearbox and tank mixer								x		Shell Omala 220
[n]	Inspect all fasteners							x			
[o]	Check spray nozzles							x			Replace as necessary
[p]	Replace slide on belt tracking system										30,000 hrs

7.3 SPIRAC CONVEYORS TYPES OK420-SPX/SS; U420-SP/SS, & U320-SPX/SS

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.3.1	SPIRAC CONVEYORS										
[a]	Check for any "abnormal" noises and vibrations		x								
[b]	Check bell housing packing temperature with thermometer. If over 60°C, check grease		x								Grease if necessary
[c]	Check liner for wear			x							Replace if necessary
[d]	Check gland packing box for leaks			x							Re-tighten if necessary
[e]	Check the spiral for wear or damage			x							Replace if worn >20%
[f]	Check all fasteners and trough welds					x					
[g]	Check oil level and colour					x					Replace oil 6 – 12 monthly
[h]	Lubricate bell housing gland packing					x					

7.4 (ITT) LOWARA PUMPS FHE32-160/22 (FILTER BACKWASH), GHV30/SV3304F1110XT (TREATED WATER), 4HMS5-PS15 (POTABLE WATER PRESSURE BOOST FOR POLYMER SYSTEMS)

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.4.1	LOWARA PUMP										
[a]	Check for any "abnormal" noises and vibrations	x									
[b]	Check/verify correct operation of the pump				x						
[c]	Inspect all pump fasteners and seals				x						
[d]	Carry out complete inspection of the pump						x				Or as deemed necessary

7.5 MONO PUMPS C1BAC31RMA/G (WAS) & C13AC31RMA/G (POLY DOSE)

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.5.1	MONO PROCESS and DOSING PUMPS										
[a]	Check for any "abnormal" noises and vibrations	x									
[b]	Check/verify correct operation of the pump				x						
[c]	Inspect all pump fasteners and seals				x						
[d]	Carry out complete inspection of the pump						x				Or as deemed necessary
[e]	Replace oil in gearmotor						x				10,000 hrs or 2 years

7.6 MONO MUNCHER (MACERATOR) CT205FCT1B2

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.6.1	MONO MUNCHER										
[a]	Check for any "abnormal" noises and vibrations	x									
[b]	Check/verify correct operation of the muncher			x							
[c]	Inspect all fasteners			x							
[d]	Inspect gears, bearings and seals and re-grease						x				10,000 hrs
[e]	Replace oil in gearmotor						x				10,000 hrs or 2 years

7.7 ABS RW2822 MIXER

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.7.1	ABS MIXER										
[a]	Check the drive train for abnormal noises	x									
[b]	Check the gearbox for lubricant leakage			x							
[c]	Check the drive train for deviating temperature			x							
[d]	Inspect fasteners			x							
[e]	Replace oil										After a fault

7.8 TOMAL POLYREX 4.0 POLY PREPARATION UNIT

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.8.1	TOMAL PREPARATION UNIT										
[a]	Check for any "abnormal" noises and vibrations	x									
[b]	Inspect dissolver cone		x								Clean If necessary
[c]	Inspect ejector		x								Clean If necessary
[d]	Inspect feeder outlet		x								Clean If necessary
[e]	Inspect feeder bearings and gearwheels			x							
[f]	Inspect pressure reducing valve			x							
[g]	Inspect drain valves				x						Clean If necessary
[h]	Inspect agitator motor and gearbox				x						(sealed for life)
[i]	Inspect fasteners				x						
[j]	Inspect shut-off valves, regulating valves, check valves, and solenoid valves					x					
[k]	Inspect pressure switch					x					
[l]	Inspect flow meter and metering gauge					x					

[m]	Inspect feeder gearbox and motor					x				(sealed for life)
[n[	Grease feeder gearwheels					x				
[o]	Inspect feeder cylinder					x				

7.9 (TYCO) KEYSTONE F79U & F738 ACTUATORS

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.9.1	KEYSTONE ACTUATORS										
[a]	Check for any "abnormal" noises and vibrations	x									
[b]	Check air supply is clean and dry and there are no leaks		x								
[c]	Inspect fasteners				x						

7.10 VORTISAND AC3-30-SP SAND FILTER SKID

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.10.1	VORTISAND FILTERS										
[a]	Check for any "abnormal" noises, vibration, and leakage	x									
[b]	Inspect fasteners			x							
[c]	Inspect chlorine dosing pump			x							
[d]	Inspect diaphragms in valves						x				Replace with a kit if necessary
[e]	Inspect grommets inside backwash flow controller										Replace if necessary

7.11 TROJAN UVSWIFTSC D12

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.11.1	TROJAN UV										
[a]	Burned out lamps or change in colour of lamp glass										Replace components as necessary: On lamp status alarm, and at end of lamp life
[b]	Fouling, coating or scratching of quartz sleeves			x							Clean monthly or when low UV alarm occurs. Replace as necessary
[c]	UV sensor			x							Clean monthly or when low UV alarm occurs. Replace as necessary
[d]	Sleeve seal, O-ring Sleeve support washer Sleeve bushing Wear pads						☒				Or when sleeves are removed Replace as necessary
[e]	UV reactor chamber						☒				Clean chamber of settled solids build-up.
[f]	Overheating, moisture or corrosion of lamp socket pins										Replace component as necessary: Lamp status alarm or when lamps are disconnected.

7.12 SMC CLAM SHELL GATE CONTROL SYSTEM

Item	Description	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	Lubricant/Comments
7.12.1	SMC PNEUMATICS										
[a]	Check the operating pressure from the supply	x									
[b]	Check the operating pressure of the control system	x									Adjust as necessary
[c]	Check the level of condensate in the air service unit		☒								Empty as necessary
[d[	Check the oil level in the lubricator and the drop rate of oil		☒								
[e]	Check the filter cartridge and bowl in the service unit			x							Clean bowl as necessary. Clean or replace filter if pressure drop>50 kPa

7.13 QWM (WEIGH BIN SYSTEM)

Ensure load cells are kept free from a build-up of dirt and debris.

8

8 LUBRICATION SCHEDULE

8.1 GENERAL

The frequency of lubrication inspections should be based upon the historical data on installed equipment. Every operator application has its own effect on lubricants and each facility should pattern it's inspections around its particular needs.

The lubrication schedule should be followed until operating experience indicates otherwise.

All lubrication details, date, amount, type and quantity, etc. should be entered in the "Plant Service Log – Section 10" of this maintenance manual.

Refer to "Manufacturer's Information – Section 12" of this maintenance manual for comprehensive data regarding lubrication schedules.

WARNING!

FAILURE TO CARRY OUT THE MANUFACTURER'S RECOMMENDED MAINTENANCE AT THE STATED INTERVAL/S MAY VOID THE WARRANTY PERIOD.

8.2 SIEMENS / SERNAGIOTTO GDD MODEL GT2000-BSX & BPF MODEL BPF 2000 S7-BSX-L

Amarex Lubricating Schedule			
ITEM	LOCATION	LUBRICANT	PERIOD
GDD Bonfiglioli, model A503 NH50 i81,5 P100 B8	Gravity drainage deck	Shell Omala 220	At 200 hours, then every 10,000 operating hours, or at least every 2 years.
GDD plummer block bearings	Gravity drainage deck	Shell Retinex EP2	500 hours
GDD gears (opposite drive train)	Gravity drainage deck	Shell Retinex EP2	500 hours
Oil lubricator (pneumatics)	Gravity drainage deck	Parker oil	Top-up as necessary
BPF Bonfiglioli, model A503 NR i=154.6 P100 B8	Belt press filter drive	Shell Omala 220	At 200 hours, then every 5,000 operating hours, or at least every year.
GDD plummer block bearings	Belt press filter	Shell Retinex EP2	500 hours
GDD tensioning ram	Belt press filter	Shell Retinex EP2	500 hours
Oil lubricator (pneumatics)	Belt press filter	Parker oil	Top-up as necessary
BPF Bonfiglioli, model W86 UF1 RAPP.7 P90 B5/B7	Belt press filter mixer	Shell Omala 220	At 200 hours, then every 5,000 operating hours, or at least every year.
BPF Bonfiglioli variator, model V2F D24 P90 B3	Belt press filter mixer	Shell Tivela SC320	At 200 hours, then every 3,000 operating hours, or at least every year.

8.3 SPIRAC CONVEYORS TYPES OK420-SPX/SS; U420-SP/SS, & U320-SPX/SS

Spirac Lubricating Schedule			
ITEM	**LOCATION**	**LUBRICANT**	**PERIOD**
Conveyors bell housing gland packing	Within sludge building and outside adjacent	Castrol EPL2 Multi Purpose Extreme Pressure	Grease every six months
SEW Gearmotors KA97, FA77B & FA87B	Within sludge building and outside adjacent	Shell Omala 220 ~15.2 L for KA97 ~5.9 L for FA77B ~10.8 L for FA87B	Every 6 – 12 months
SEW Gearmotors KA97, FA77B & FA87B	Within sludge building and outside adjacent	Shell EP2 grease	Recommended with oil change

8.4 MONO PUMPS C1BAC31RMA/G (WAS) & C13AC31RMA/G (POLY DOSE)

Mono Pumps Lubricating Schedule			
ITEM	**LOCATION**	**LUBRICANT**	**PERIOD**
Nord Gearmotors: SK52FAL-180M4 (WAS)	Adjacent WAS tank	Shell Omala 220: ~2 5 L for SK52FAL	Every 10,000 hrs, or 2 years latest.
SK272F-90L4 (Poly Dosing)	Adjacent poly batch facilities	~0.6 L for SK272F	

8.5 MONO MUNCHER (MACERATOR) CT205FCT1B2

Mono Muncher Lubricating Schedule			
ITEM	**LOCATION**	**LUBRICANT**	**PERIOD**
Muncher gears, bearings and seals	Adjacent WAS tank	BP Energrease LC2	10,000 hr inspection.
Nord Gearmotor SK9032.AFH	Adjacent WAS tank	Shell Omala 220: ~3.3 L	Every 10,000 hrs, or 2 years latest.

8.6 TOMAL POLYREX 4.0 POLY PREPARATION UNIT

FEEDER LUBRICATING SCHEDULE			
ITEM	**LOCATION**	**LUBRICANT**	**PERIOD**
Feeder Gearwheels	Poly Dose Facilities	Molykote 165 LT 0.5 mL	6 monthly

8.7 SLUDGE HOPPER CLAM SHELL GATES

HOPPER CLAM SHELL LUBRICATING SCHEDULE			
ITEM	**LOCATION**	**LUBRICANT**	**PERIOD**
Clam Shell Gates	Under sludge hopper conical outlets	Shell Retinex EP2	3 monthly

9 RECOMMENDED SPARE PARTS

Requirement for spares will depend on the Principal's inventory management and criticality of operational requirements of the particular plant, together with availability of parts.

In some instances, recommended spares are listed within the supplier documentation included at 'Section 11 – Manufacturers Information' of this maintenance manual.

Aquatec-Maxcon can assist in the procurement of any spare parts that are deemed by the Client management to be necessary to be held in store.

Should any component fail and a replacement part or component be required, contact should be made to the supplier as listed in 'Section 4.0 – Equipment Supplier's' of this maintenance manual, quoting the following information:

a) Make and model number of equipment.
b) Serial number of equipment.
c) Gearbox ratio (where applicable).
d) Motor details (where applicable).

This information is usually found on the manufacturer's nameplate attached to the item of equipment. As mentioned above, reference should also be made to the relevant manufacturer's documentation contained in Section 11 of this manual.

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10 PLANT SERVICE LOG

The plant service log is used to record the operational history of the plant. Any information on maintenance, repairs, modifications, and/or significant deviations from normal operating or design conditions, including breakdown or other malfunction should be recorded. In maintaining this log, the cost of repairs and down time of the equipment and plant could be significantly reduced.

Failure to carry out the manufacturer's recommended maintenance on certain equipment at the stated intervals may void the warranty period.

EQUIPMENT SERVICED:	Item Name		
DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED:	Item Name		
DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

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EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

EQUIPMENT SERVICED: Item Name ....

DATE	ITEM	MAINTENANCE PERFORMED/COMMENTS	SIGN

11 MANUFACTURER'S INFORMATION

The manufacturer's literature for the equipment listed below is included to give detailed information regarding the individual items and equipment used in the plant.

Before commencing any maintenance procedures on items of equipment, the manufacturer's manuals should be studied carefully.

11.1 SIEMENS / SERNAGIOTTO GDD MODEL GT2000-BSX & BPF MODEL BPF 2000 S7-BSX-L]

11.2 SPIRAC CONVEYORS TYPES OK420-SPX/SS; U420-SP/SS, & U320-SPX/SS

11.3 (ITT) LOWARA PUMPS FHE32-160/22 (FILTER BACKWASH), GHV30/SV3304F1110XT (TREATED WATER), 4HMS5-PS15 (POTABLE WATER PRESSURE BOOST FOR POLYMER SYSTEMS)

11.4 MONO PUMPS C1BAC31RMA/G (WAS) & C13AC31RMA/G (POLY DOSE)

11.5 MONO MUNCHER (MACERATOR) CT205FCT1B2

11.6 ABS RW2822 MIXER

11.7 TOMAL POLYREX 4.0 POLY PREPARATION UNIT

11.8 TYCO VALVES AND ACTUATORS

11.9 VORTISAND AC3-30-SP SAND FILTER SKID

11.10 TROJAN UV SWIFT SC D12

11.11 ENDRESS & HAUSER PROMAG FLOWMETER

11.12 ENDRESS & HAUSER PROSONIC LEVEL MEASUREMENT

11.13 SMC (CLAM SHELL CONTROL)

11.14 QWM (WEIGH BIN SYSTEM)

11.15 GEORGE FISCHER (PRESSURE RETAINING VALVE V186 DN40)

11.16 STUBBE (PRESSURE RELIEF VALVE DHV716 DN50)

11.17 KELCO (FLOW SWITCH)

11.18 VALVECO (BUTTERFLY VALVES ON UV BYPASS)

11.19 TELEMACANIQUE INDUCTIVE PROXIMITY SENSOR (ON SLUDGE HOPPER GATES)

12 DRAWINGS

12.1 GOODNA SLUDGE DEWATERING.

Drawing No.	Drawing Title
8426A – 031	P & I D Legend
8426A – 033	P & ID
8426A – 032	Site Plan
8426A – 001	Sludge Handling - General Arrangement
8426A – 002	Concrete Slab Plan and Sections
8426A – 003	Sludge Handling - Pipework Arrangement
8426A – 005	GDD Filtrate & Washwater Discharge Pipe Arrangement
8426A – 006	WAS Tank Details
8426A – 010	Sludge Hopper – General Assembly
8426A – 011	Sludge Hopper – Platform Assembly
8426A – 018	Sludge Hopper – Roof Details
8426A – 019	Sludge Hopper – Grease Line Assembly
8426A – 020	Sludge Hopper – Discharge Chute Assembly
8426A – 021	Sludge Hopper – Clamshell Gate Assembly
8426A – 025	Sludge Handling – GDD Platform Assembly
8426A – 035	Polymer Dosing – Pipework Details
8426A – 037	Polymer Pipework Details
8426A – 038	Washwater Pipework Details
8426A – 040	Digester Building – Pipework Arrangement & Details
8426A – 041	Filters & UV Piping Arrangement
8426A – 049	Filter Backwash Piping Arrangement & Details
8426A – 050	Compressed Air Piping Arrangement
8426A – 052	UV Piping Arrangement
8426A – 054	Ultrasonic Sensor Mounting Detail

TPT 07204-S001	RAS Tank Details 1 of 2
TPT 07204-S002	RAS Tank Details 2 of 2
TPT 07204-S003	RAS Tank Details 3 of 3
Siemens 60406726a	BFP 2000 BSX-P=60 L/H
Siemens 60407977	GT 2000 BSX per cascade
Siemens 60407976	Cascade GT 2000 BSX / BPF 2000 BSX
Spirac 5317-00 (1 of 2)	Conveyors Overall Layout
Spirac 5317-00 (2 of 2)	Conveyors Sections
Spirac 5317-01	CV-01 General Arrangement
Spirac 5317-02	CV-02 General Arrangement
Spirac 5317-03	CV-03 General Arrangement