7.6.4 Safety

The clarifier mechanisms are designed for a continuous operating torque of 35,929 N-m. Each clarifier mechanism is equipped with overtorque protection systems. At 120 percent of design torque (43,115 N-m), a Secondary Clarifier high torque alarm is generated. The mechanism is still within the “safe” range however, and continues to operate. At 130 percent overtorque (46,707 N-m), a Secondary Clarifier torque high-high alarm is generated by a hardwired torque alarm interlock; the mechanism is stopped when this alarm is triggered. The alarm must be acknowledged and manually reset at the starter to restart the mechanism.

7.6.4.1 Emergency Shutdown and Power Failure

In case of a plant-wide power failure the secondary clarifier mechanisms will NOT be serviced by standby power from the plant generator. If torque overload occurs due to an object falling into the tank, then the clarifier must be shut down to remove the object and to inspect the mechanism for damage, and repair if necessary.

7.7 RETURN ACTIVATED SLUDGE PUMPING

7.7.1 Process Description

Refer to Process and Instrumentation Drawing LI2.07

Refer to Instrumentation Drawing SI6.04

Activated sludge which settles in the Secondary Clarifiers is returned to the Pre-anoxic Zones of Bioreactor 1 and Bioreactor 2. This RAS provides a community of active microorganisms which use the influent organics as a food source. A pumping system is provided to return the RAS to the Pre-anoxic Zone. The solids at the bottom of each clarifier are collected using dual arm suction tube mechanisms. This system has direct hydraulic connection to the RAS pump suction, which allows for control of the RAS rate that is independent of blanket concentration, viscosity, or depth, providing more consistent solids removal than the old "organ pipe" suction mechanisms.

7.7.2 Design Criteria

RAS Pump No.1

Tag No.	S710-RAP
Type	Centrifugal
Duty	Clarifier 1

RAS Pump No.2

Tag No.	S720-RAP
Type	Centrifugal
Duty	Clarifier 2

RAS Pump No.3

Tag No.	S730-RAP
Type	Centrifugal
Standby	Clarifier 2 and 3

RAS Pump No.4

Tag No.	S740-RAP
Type	Centrifugal Drive Variable Speed
Capacity	120-230 L/s
Duty	Clarifer 3

RAS Pump No.5

Tag No.	S750-RAP
Type	Centrifugal Drive Variable Speed
Capacity	120-230 L/s
Standby	Clarifier 3 and future Clarifier 4

Flow Meters

RAS Pumping	S710-FIT
RAS Pumping	S720-FIT
RAS Line	S740-FIT
RAS Line	S741-FIT

Modulating Valves

RAS Line	S740-FCV
RAS Line	S741-FCV

7.7.3 Operation and Control

Refer to Figure 7-7

Solids settle to the bottom of each secondary clarifier and are collected by suction tube mechanisms 30 m in diameter. Each clarifier has a dedicated variable speed centrifugal RAS pump to withdraw settled sludge. RAS Pumps 1 (duty), 2 (duty), and 3 (standby) are associated with Clarifiers 1 and 2, while RAS Pumps 4 (duty) and 5 (standby) are associated with Clarifier 3. Flow meters downstream of each pump (S710-FIT, S720-FIT, and S745-FIT) measure and control the RAS withdrawal rate from each secondary clarifier.

The pumps convey the RAS from each secondary clarifier to a new common discharge header (S740-450-RAS) which in turn discharges to two existing RAS lines (S740-300-RAS-ST2 and S741-300-RAS-ST2), one for each bioreactor. Modulating valves (S740-FCV, S741-FCV) and flowmeters (S740-FIT, S741-FIT) distribute the flow as desired (usually 50 percent to each bioreactor), independent of how many clarifiers and pumps are in service. In normal operating conditions (three clarifiers, 3 RAS pumps, and 2 bioreactors in service) flow is split equally to each bioreactor.

If only one bioreactor is in service, RAS rates from in-service clarifiers are to be adjusted to keep the clarifier blanket and bioreactor MLSS concentration in the desired ranges.

7.7.4 Safety

The RAS pumps are directly controlled and protected by the VFD systems. The drive protects the motor and pump from numerous fault conditions, including overload, overtorque, overvoltage, undervoltage, phase loss, incorrect phase rotation, and locked rotor. If the specified duty pump fails, the standby pump will be started and will assume the load of the failed pump.

While a secondary clarifier is in service, its RAS system can be shut down for maintenance; the duration of such a shutdown should be limited to 2 hours or less. To repair or maintain a duty RAS pump, the appropriate valves must be manually opened or closed to isolate it, and to allow the standby RAS pump to run. The pump's COH switch should be turned to OFF, the disconnect switched to OFF, and locked out in accordance with the prescribed procedures. If a RAS pump must be taken off-line due to a low influent flow condition experienced by its associated clarifier, in HAND mode, the associated pump must be turned to the OFF position. The required isolation valves should also be opened or closed as appropriate.

For repair or maintenance of any RAS flowmeter or flow control valve, manually close the appropriate isolation valves to remove the instrument and, if not equipped with a bypass, replace it with a temporary spool piece.

7.7.4.1 Emergency Shutdown and Power Failure

In case of a plant-wide power failure the RAS pumps will NOT be serviced by standby power from the plant generator

7.8 WASTE ACTIVATED SLUDGE PUMPING

7.8.1 Process Description

Refer to Process and Instrumentation Drawing LI2.05

Refer to Process Drawing SP1.02, SP1.04

Refer to Instrumentation Drawing SI6.04

In the biological treatment process, the incoming organic matter in the wastewater consumed by the active microorganisms. A portion of the metabolised matter is converted to energy, and the remaining portion is converted into additional cell mass, or activated sludge, when the microorganisms reproduce. A portion of the activated sludge must be removed from the biological process regularly to maintain a steady cell population in the reactor. The amount of WAS removed is controlled to obtain a constant solids retention time.

7.8.2 Design Criteria

<u>WAS Pump No.1</u>

Tag No.	S810-WAP
Type	Recessed Impeller Centrifugal (Variable speed)
Capacity	15 L/s

<u>WAS Pump No.2</u>

Tag No.	S820-WAP
Type	Recessed Impeller Centrifugal (Variable speed)

- **Fermenter Gallery:** Pumps F630 SMP and F640 SMP pump sanitary from sump pit.
- **Aeration Basin Tunnel:** Pumps S768 SMP and S769 SMP pump sanitary from sump pit.
- **DAF Building:** Pumps T700 SMP and T705 SMP pump sanitary from sump pit.

13.1.3.3 Emergency Flood Pump

A single pump P270-P installed in the PC pump area will remove up to 40 L/s from the primary sludge sump pit, in the event that a local pipe breaks and the sump pumps cannot keep up with the inflow.

The pump is intended to operate in AUTOMATIC only. A level float switch in the pump pit detects an abnormal presence of liquid and starts the pump. The pump continues to run until the water is removed from the pit. The pump is fixed speed and will start and stop if the inflow is equal or less to the pump's capacity of 40 L/s. If the influx is greater than this, the pump will operate continuously until the leak is repaired.

The pump should be operated in HAND only to test. To test the pump, the pumps in the small sump should be set to OFF or HAND and in the pit filled. Because of the relatively high capacity of the pump compared to the volume of the sump, the pump can be run for only about 10 or 15 seconds during testing.

The pump starting generates a high priority alarm at the DCS and the reason for the alarm must be determined and corrected as soon as possible.

13.2 EFFLUENT WATER SYSTEM

13.2.1 Process Description

Refer to Figure 13-3 and 13-4

SE is used as a plant water source for non-potable applications such as for pump seal water, pipe and tank flushing, scum and foam wash down and lawn sprinkling.

13.2.2 Design Criteria

Flushing Water Pump No.1

Tag No.	S210 FWP
Type	Horizontal, Centrifugal
Rated Capacity	6.3 L/s at 51 m TDH
Driver	Constant Speed, Coupling
Motor Size	5.6 kW

Flushing Water Pump No.2

Tag No.	S220 FWP
Type	Horizontal, Centrifugal
Rated Capacity	22.7 L/s at 56 m TDH
Driver	Constant Speed, Coupling
Motor Size	22.5 kW

Flushing Water Pump No.3

Tag No.	S230 FWP
Type	Horizontal, Centrifugal
Rated Capacity	40 L/s at 60 m TDH
Driver	Constant Speed, Coupling
Motor Size	45 kW

Effluent Water Filter

Tag No.	S235 FIL
Type	Cartridge
Rated Capacity	50 L/sec
Efficiency	95 percent retention of particles 1 mm and greater

Flow Element

Tag No.	S235 FE
Type	Magnetic Flow Meter

13.2.3 Operation and Control

Refer to 13-5A and 13-5B

Effluent water is drawn from the channelling downstream of the secondary clarifiers (SCs) and is delivered to the suction header of the pumping system through line S205. Block valve S205-HV1 is located on the suction line at the base of the channel.

Three pumps are provided for distributing effluent water throughout the plant (one jockey pump S210-FWP and two duty pumps, S220-FWP and S230-FWP). Each pump is equipped with a discharge pump control valve (S210, S220, and S230-FCV) which serve to reduce hydraulic surges on pump start and stop. Each pump is provided with a suction (S210, S220, and S230-HV1) and discharge (S210, S220, and S230-HV2) isolation valve. These isolation valves should normally remain open.

The jockey pump operates when the demand in the system is nil or low. A portion of the flow from this pump is continuously recirculated back to the effluent channel through line S211 to prevent the pump from overheating when there is no demand from the system. An orifice plate is installed in line S211 to restrict the recirculation flow. A block valve (S211-HV2) and a check valve (S211-HV1) are provided on line S211.

The duty pumps operate when the flow demand increases. The two duty pumps are called to start and stop sequentially as the system demand rises and falls. These two pumps are equipped with pressure relief valves which allow a portion of the pump flow to discharge back to the effluent channel when the pumps are first started, or stopped, and the discharge control valves are closed. The pressure relief valves prevent pump operation at high discharge heads and limit the pressure in the system.

Prior to entering the distribution system, the effluent water passes through a cartridge filter to remove suspended matter. Effluent water passes through one of four parallel filter cartridges where suspended solids are removed. When the pressure drop across the filter reaches a preset level, the filter automatically initiates a backwash cycle. To minimize the disruption to effluent water flow, each of the four filter cartridges is backwashed individually in sequence.

The effluent filter is provided with suction and discharge isolation valves and a bypass line with a block valve.

Filtered effluent water enters the distribution loop and is distributed throughout the plant as required. Several isolation valves are located throughout the loop, which allow sections of the loop to be isolated for maintenance without shutting down the entire effluent water system.

The flushing water pumps may be operated in one of three modes: Hand, Computer-Manual, and Computer-Automatic.

Hand Control

To operate a flushing water pump in Hand mode, select Hand using the local Computer/Off/Hand (COH) selector switch. The pump will start and run continuously while in Hand mode. To stop the pump, return the COH switch to the Off position, or press and latch the Lock/Off/Stop (LOS) push-button.

Computer-Manual

To operate a flushing water pump in Computer-Manual mode, select Computer using the local COH switch. At the operator workstation, switch the pump control to Manual, and select the desired state: On or Off.

Computer-Automatic

To operate the flushing water pumps in Computer-Automatic mode, select Computer using the local COH switches. At the operator workstation, switch each pump to Automatic, and configure the automatic sequence as follows:

- **Automatic Start:** Select "Enable" to allow the automatic sequence to run. Select "Disable" to stop or prevent the automatic sequence.
- **Flushing Water Pump Duty Select:** Pump S220 is always lead
  Pump S230 is always lag

When the Automatic sequence is enabled, the pumps will start/stop according to the following schedule:

Increasing Demand

System Demand Flow s235-fit		Automatic Sequence Functions
L/sec	usgpm	
0 to 4.1	0 to 65	The jockey pump S210-FWP operates continuously
>4.1	>65	The duty no. 1 pump is started. The jockey pump stops following a time delay.
>22.38	>355	The duty no. 1 pump remains in operation. The duty no. 2 pump is started

Decreasing Demand

System Demand Flow s235-fit		Automatic Sequence Functions
L/sec	usgpm	
<20.81	<330	The duty no. 2 pump is stopped and locked out for a brief time delay.
<3.47	<55	The jockey pump is started. The duty no. 1 pump is stopped following a brief delay, and is then locked out for a brief period.

In the event that one of the flushing water pumps fails, the "next duty" pump will be started to replace the failed pump.

13.3 EMERGENCY EFFLUENT WATER PUMP

13.3.1 Process Description

Refer to Figure 13-3 and 13-4

Effluent is used as an emergency water source.

13.3.2 Design Criteria

Emergency Water Pump

Tag No.	S240 FP
Type	Horizontal, Centrifugal
Rated Capacity	120 L/s at 41 m TDH
Driver	Constant Speed, Coupling
Motor Size	75 kW

Flow Element

Tag No.	S235 FE
Type	Magnetic Flow Meter

13.3.3 Operation and Control

Refer to Figure 13-6

Effluent water is drawn from the channels downstream of the SCs and is delivered to the suction header of the pumping system through line S205. Block valve S205-HV1 is located on the suction line at the base of the channel.

The emergency water pump is equipped with a suction isolation valve (S240-HV1), a discharge check valve (S240-HV2), a discharge pressure relief valve (S241-HV1), and a discharge isolation valve (S240-HV3). The discharge pressure relief valve is located immediately downstream of the pump and is intended to prevent excessive pressure in the piping system.

A recirculation loop on the pump discharge is provided for pump testing. The emergency water pump will rarely be used, so this recirculation loop will provide a means of testing the

pump operation. A flow meter (S242-FE) and two block valves (S242-HV1 and HV2) are located on the recirculation loop. Block valve S242-HV1 should normally remain closed.

The emergency water pump discharges unfiltered SE directly into the effluent water distribution loop.

The emergency water pump is controlled in a semi-automatic mode with an emergency manual override.

13.3.3.1 Normal Operation

The emergency water pump controller can be started by any one of the following:

- Start command from the control system (initiated by a combination of system pressure below 65 psi and system demand flow above 1000 USGPM).
  - Low system pressure as detected by a dedicated pressure switch.
  - Start push-button on the pump control panel.

Once the emergency water pump has been started, it can only be stopped using the stop push-button located on the pump control panel.

13.3.3.2 Emergency Override

In the event that the pump fails to start when required, a manual start lever is provided to bypass the normal starting circuit. The lever is located on the lower right hand side of the pump control panel.

13.3.3.3 On Power Failure

Following a power failure, the emergency water pump will start automatically on low water pressure in the effluent water system.

The emergency water pump will continue to run until it is manually shut-off.

13.4 COMPRESSED AIR SYSTEM

13.4.1 Process Description

Refer to Figure 13-1 and 13-7

Compressed air is used in the plant for the operation of various air operated equipment. The supply system is divided into two sub-systems; service air for the air diaphragm pumps and hose stations, and instrumentation air for the air operated flow control valves. Instrument air is filtered and dried to produce the quality air needed for instrument operation.

13.4.2 Design Criteria

Air Compressor No.1

Tag No.	U110 CA
Type	Two-Stage, Non-Lubricated, Water Cooled
Capacity	7 SCM/min