Appendix 3: General project description

Client: Owner's Engineer: Local Designer: Environm. Consultant:

PROJECT: **119003 WEPA UK BRIDGEND**

CLIENT: **WEPA UK**

PHASE: **PLANNING APPLICATION**

DOCUMENT: **DESCRIPTION OF PROJECT AND PROCESS**

ID: **57100-0214**

Rev. 1

List of Contents

1.0 Introduction

1.1 Context

Background to the development

1.1.1 The WEPA Group is one of the leading private-label specialists in the consumer market. With modern processing facilities for recycled fibres, WEPA Group has established itself as an expert in high quality, sustainable and ecological products. The company is specialised in selling a broad range of paper products consisting of baking paper, stationery, art paper, sandwich and lining paper.

1.1.2 WEPA UK Limited intend to submit a Planning Application to construct a second tissue paper machine and associated development at the WEPA UK site in Bridgend. The new paper machine will produce tissue paper only and will have a theoretical maximum capacity of approximately 250 tonnes/day. The average daily output is expected to be approximately 206 tonnes/day, which would amount to an average annual output of 75,000 tonnes.

1.1.3 The developer considers design to be a key constituent of the project. At a concept and design level, the Project must achieve a high quality and inclusive design that respects the receiving environment. The architectural input has been fundamental to the evolution of the design. WEPA UK and their engineering consultant BHM are committed to following best practice during the design process and implementation of the design on-site, using all available guidance both published and through peer review and consultations to achieve the most appropriate design solution for the Bridgend site.

1.2 The Developer

1.2.1 WEPA UK Limited is the UK subsidiary of the WEPA Group headquartered in Arnsberg (North Rhine-Westphalia), Germany. The WEPA Group is an independent, family-owned company, founded in 1948. Since that time, the company has grown considerably and it now operates 22 paper machines at 13 locations across Europe. It employs some 3,900 people.

1.2.2 Now the third largest manufacturer of hygiene paper products in Europe, the WEPA Group is one of the leading private-label specialists in the consumer market. With modern processing facilities for recycled fibres, WEPA Group has established itself as an expert in high quality, sustainable and ecological products. The company specialised in selling a broad range of paper products consisting of baking paper, stationery, art paper, sandwich and lining paper.

1.2.3 Bridgend Paper Mill itself was built in 1950, over the following decades the site passed through several owners. From 2016, approximately £25m has been invested in new modern lines and technical equipment ensuring Bridgend remains at the global forefront of the paper industry. Since the WEPA Group purchased the second half of share of the current site in 2018, WEPA UK is now by 100% managed by the family-owned company.

1.2.4 Backed by its global parent brand, WEPA UK is an established leader in the UK and Ireland household paper markets, with major retailers forming part of its enviable, long-term client base. WEPA UK has more than 300 employees across two main sites in the UK - a paper mill and converting facility in Bridgend, and commercial office in Bolton.

1.2.5 WEPA UK is committed to bringing further inward investment to the Bridgend area through the development of the proposed plant in an environmentally acceptable and sustainable manner.

1.2.6 The office and contact address for the proposed development is:

WEPA UK Ltd.

Bridgend Paper Mills

Llangynwyd Bridgend

Mid Glamorgan CF34 9RS

1.3 The Project

Rationale of the Project

1.3.1 WEPA is currently the third largest supplier of toilet paper, napkins, kitchen rolls, etc. in Europe. WEPA UK is a growing consumer business selling high quality hygiene paper products in the UK retail sector. For 2019, WEPA UK is expected to produce approximately 50,000 tonnes of paper with its existing tissue paper machine (called “Jupiter”) as well as approximately 80,000 tons of finished goods. This means that the site in Bridgend currently imports and holds in storage approximately 30,000 tonnes of paper from other paper suppliers. When the CNV waste factor is added to jumbo reel requirements, the business needs to purchase approximately 34,000 tons of jumbo reel to supply the Bridgend converted volume. A further 8,000 tons of paper will be supplied to another converter to produce a customer's volumes, making 42,000 tons of purchased jumbo reel.

1.3.2 By 2021 this 42,000 tons of jumbo reel is expected to have increased towards the 50,000 tons per year level for the UK consumer business that cannot be produced in UK by WEPA. This paper will be purchased at a significant annual cost which would be eliminated by producing in-house with a new paper machine

1.3.3 WEPA UK Limited now proposes to construct and operate a second tissue paper machine (called "Neptune") at its Bridgend site. The new paper machine will produce tissue paper only and will have a theoretical maximum capacity of approximately 250 tonnes/day. The average daily output is expected to be approximately 206 tonnes/day, which would amount to an average annual output of 75,000 tonnes.

Description of the Project

1.3.4 The new development (Figure 1.4-1) will include the following:

- pulp storage for bales (virgin fibre),
- bale handling area,
- new sludge press building,
- paper machine building for a second production line (including the stock preparation),
- converting extension,
- auxiliary material storage incl. shipping area,
- new Jumbo reel storage
- high bay warehouse with a capacity of approx. 35,000 pallets, and
- shipping area for finished products.

Figure 1.4-1: Bridgend Paper Mill Site

1.3.5 It is assumed that all relevant existing auxiliary facilities (e.g. wastewater treatment plant, CHP power station etc.) as well as all utilities mains have sufficient capacity for the proposed expansion of the tissue paper mill.

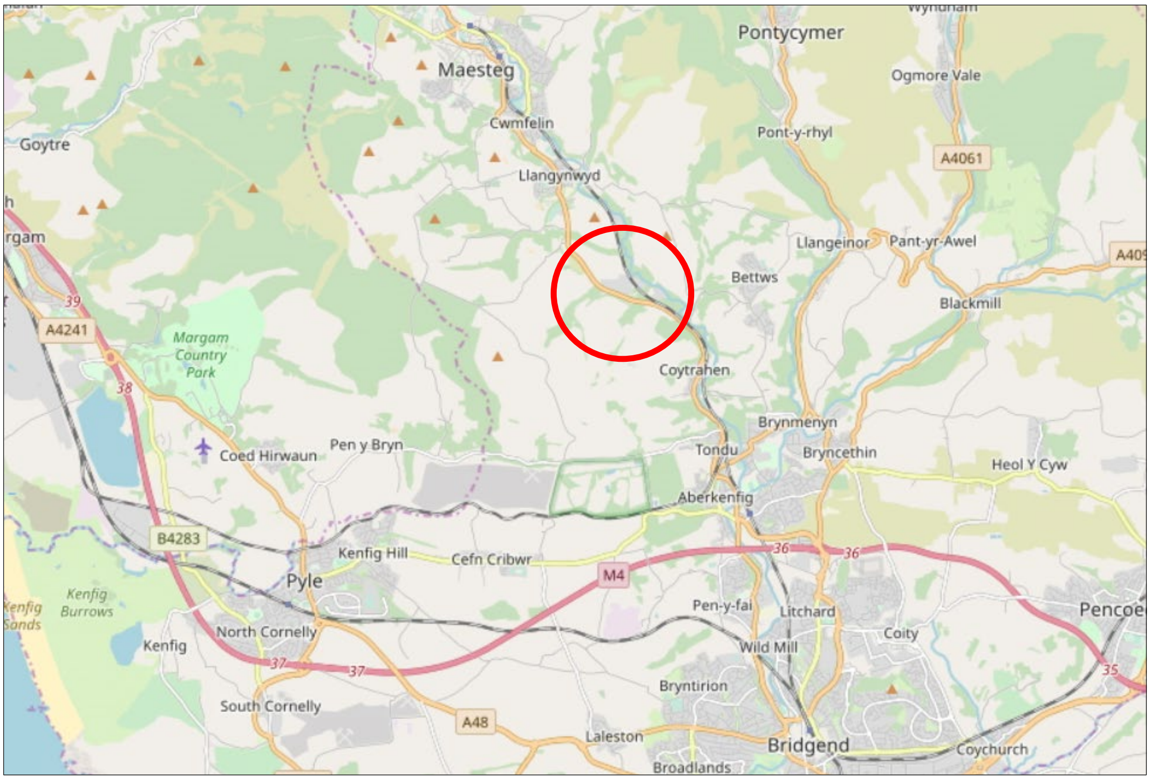
2.0 Site Appraisal

2.1 Site Location

2.1.1 The proposed development site is located on the site of the existing Bridgend mill site approximately 5 km to the north of Bridgend town centre, in an area bound to the south and to the west by the A4063, to the east by the River Llynfi, and to the north by open farmland. The site is orientated along its long axis in an approximate west to east direction and it is accessed via the A 4063 (Bridgend Road) between Maesteg and Coytrahen, with traffic generally proceeding south towards the M 4.

2.1.2 The Bridgend site covers a total area of around 25 hectares of which buildings and other hardstanding areas extend to approximately 15 ha. The new paper machine is centred on approximate National Grid Reference X: 287870, Y: 187088, as shown on Figure 2.1- 1. The location of the proposed paper machine 'Neptune' is within the existing WEPA UK site, situated adjacent the existing machine 'Jupiter'.

Figure 2.1-1: Site Location



Source: Open Street Maps Contributors

2.2 Site History

2.2.1 The history of the site and surroundings has been established from historical Ordnance Survey (OS) plans dated between 1877 and 1987 (www.old-maps.co.uk). Prior to development of the mill site most of the land in the area was undeveloped farmland with woodland in the bottom of the Nant Gwyn Valley. The two farmsteads of Brynllywarch-fach and Brynllywarch-fawr, were established by 1877, as was the Bridgend to Maesteg railway.

2.2.2 Signs of industrial activity, in the surrounding of the present day mill site, were two “old levels” and two quarries on the 1921 OS Map. Other signs of mining activity in the general area were an old tramway, airshaft and levels in the Nant Gwyn Valley.

2.2.3 Evidence from the Catalogue of Plans of Abandoned Mines held by the National Assembly for Wales shows two mine plans relating to workings beneath the western end of the mill site and extending into the expansion area around Brynllwarch-fach. All coal workings in the vicinity had been abandoned by 1944.

2.2.4 Aerial photographs indicate that earthworks were in progress at the mill site by 1947 and Wiggins Teape started production there in 1950 using water from the Afon Llynfi and power and steam from the adjacent Llynfi Power Station. By 1960, the mill was producing 20,000 tons per annum from four paper machines. Expansion took place in the early 1960s with a new machine and converting plant. By this time, the Nant Gwyn had been culverted, the filtration plant and sludge ponds had been extended and further settling tanks constructed. It was at this time that the three bungalows on the site were constructed. The current ‘Jupiter’ paper machine was installed in 1969.

2.2.5 The mill has continued to expand since the 1960s. Electricity and steam generation has been raised on the site. Parts of the mill site have been used for the tipping of ash from a nearby power station and unsuitable wastes from construction have been deposited to the east of the railway line. The historical map of 1962 displays a (settling) pond between the wastewater treatment plant and the A 4063.

2.2.6 Land in the vicinity of the development site has remained undeveloped with only a few buildings being constructed at the surrounding farmsteads.

2.3 Physical Setting and Baseline Conditions

Land use

2.3.1 The WEPA mill site is bordered to the south and west by the A4063. The River Llynfi runs to the east of the site. To the north of the site, there are open fields and farmland. In the immediate surrounding of the site, sheep farming is the predominant land use.

2.3.2 Woodland cover in the area is generally sparse, mainly confined to lining roads, around villages and along small streams and rivers such as the River Llynfi and its tributaries.

Figure 2.3-1: Development site and surrounding

Source: Bing Maps

2.4 Final Site Layout

2.4.1 The Final Site Layout includes the following buildings:

A - Pulp Storage (south-east)
B - Bale Handling (south-east)
B1 - Sludge Press building (south-east)
I - Pipe Bridge (south-east)
C - Paper Machine Building (south)
D - Converting Building (south-west)
J – New Jumbo Reel Storage (south-west)
E - Shipping Area (north-west)
F - Finished Product Storage (north)
G - Gate House (west)
T - Storage Area

Figure 3.3-1: Final Design

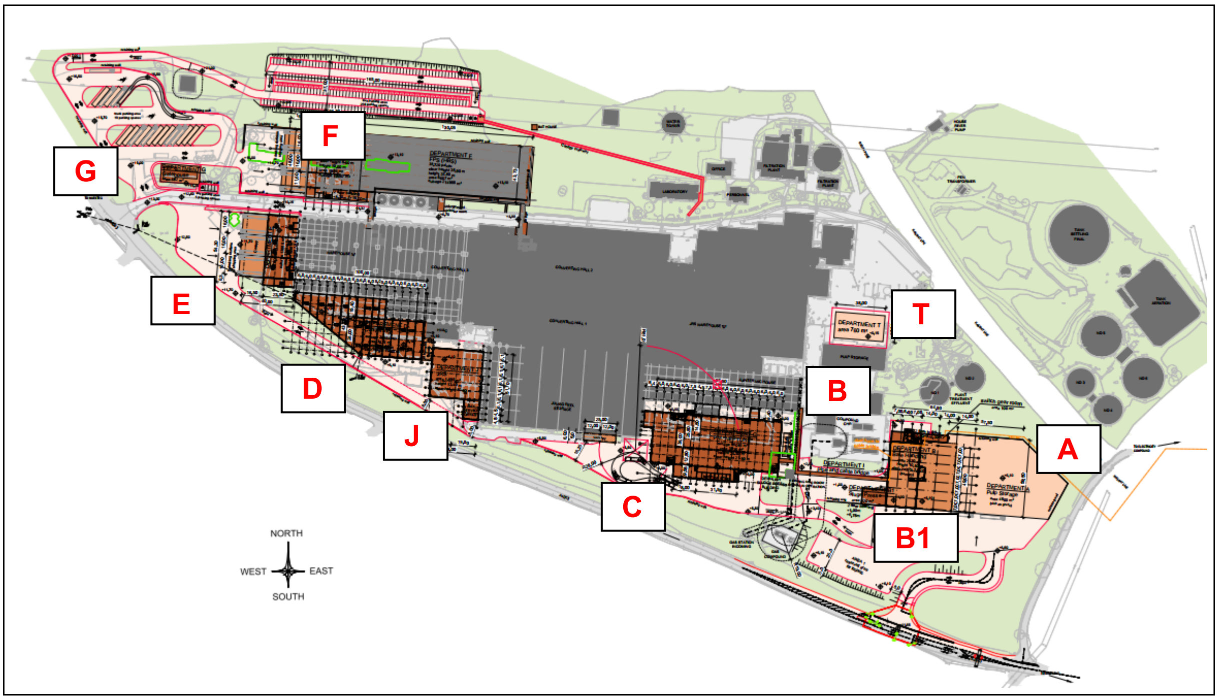


Table 3.3-1: Approximate building footprints and heights

Department	Footprint [m²]	Height [m]	Constr. Phase
Dept. A - Pulp Storage	4,530 m²	-	1
Dept. B - Bale Handling	2,935 m²	10.3 – 15.5 m	1
Dept. B1 - Sludge Press	240 m²	15,5 m	1
Dept. C - PM Hall	4,560 m²	19.0 – 25.0 m	1
Dept. D - Converting	3,024 m²	13.3 m	2

Dept. E - Shipping Area	1,384 m²	11.5 m	2
Dept. F - High Bay Storage	5,780 m²	42.0 m	3
Dept. F - Shipping Area	1,820 m²	11.0 m	3
Dept. F - Office	340 m²	15.0 -18.0 m	3
Depot G - Gatehouse	152 m²	4.3 m	3
Depot I - Pipe Bridge	-	-	1
Depot J - JRS	1,680 m²	13.5 m	2
Dept. T - Temp. Parent Reel St.	760 m²	-	1
JRS Canopy	150 m²	-	2
JR Transport Canopy	135 m²	-	2
Canopy Shipping Area - Dept. E	929 m²	-	2
Canopy Shipping Area - Dept. F	983 m²	-	3
Parking + Canopy Walkway	-	-	3

2.4.2 The Pulp Storage (A) will extended to increase storage capacity and make use of the surrounding available space. The south-east access road will be adapted to accommodate truck traffic arriving and leaving the Pulp Storage dispatch area.

2.4.3 The New Jumbo Reel Storage (J) will be attached to the existing Jumbo Reel Storage building in order to increase the storage capacity.

2.4.4 Another small storage area (Department T) will added north of the existing pulp storage. This storage will consist of a concrete slab for a tent and it will be used for Parent Jumbo Reel Storage.

2.4.5 The Converting Extension (D) will be attached to the existing converting facility to minimize traffic between the departments. Existing loading docks will be demolished and replaced by those attached to the future finished product storage. The Finished Product Storage (F) is located in the northern part of the site and will have a separate access for shipping traffic.

2.4.6 Existing traffic routes and facilities have been considered to optimise the layout in the best possible way.

2.4.7 The new Gate House (G) will be located north of the existing gatehouse. A Pipe Bridge (I) will connect the Bale Handling with the Paper machine buildings and with the new Sludge Press building (B1). The existing mill site infrastructure will be used to maintain the operation of the new buildings. Most of the currently available utilities are sufficient to operate the mill after expansion.

2.4.8 Traffic arrives at the west main access as well as at a secondary access and it will be routed around the buildings to their final destination.

2.4.9 There will be two parking areas: One in the west of the site for HGV parking and one north of the Finished Product Storage for employees. The employee car parking area has been moved to the west in order to be located within the “Employment Site Designation” under the Current LDP.

2.4.10 The Phase 1 buildings will add more space and capacities for storing raw materials, pre-treatment of the stock and producing tissue paper (A, B, B1, C, I and T). Phase 2 buildings are considered to extend converting and distribution capacities (J, D, E). The future Phase 3 will provide the High Bay Storage (F) including the new Shipping department with its administration office, the gatehouse (G), and all parking (truck and car) and paved areas.

2.4.11 The final layout shows the most effective and a well-balanced solution to arrange the different new buildings and facilities on site. Moreover, it integrates existing structures in a way that avoids any disruption of current mill operations.

2.5 Detailed Layout and Design

(A) Pulp Storage and (B) Bale Handling, Broke and Chemical Storage

2.5.1 The raw material for the paper making process is based on virgin fibre. The pulp needed for the paper production will be delivered by trucks to the pulp storage. The pulp is delivered in bales, 100(120) x 80 x 60 cm. These bales will be unloaded by forklifts and will be stored in the pulp storage. The maximum storage height is 5.5m. The fuel of the forklifts in this area is gas. Per shift, one employee is operating the forklift in this area. The storage capacity of the pulp storage is approximately 10 days storage for the consumption of the paper machine, in total 4,000 tons of pulp.

2.5.2 In addition, the waste "broke" paper from the trim removal system of the converting lines is stored as pressed bales in the pulp storage. This broke paper will be reused in the process. The Raw material storage area is located in the east of the WEPA UK Bridgend site. It will consist of a concrete base slab and a roof consisting of sheet metal covering the bale handling conveyors. The building is directly attached to the Bale Handling Building to the west.

2.5.3 The power for the new paper machine and other departments is controlled and distributed from the main substation in the annex building of the Pulp Storage area. The electrical power supply from the public grid will enter into the switchgear room and will be distributed to the transformers. After the transformers, the power will be fed to the MCCs in the MCC room. From the MCC room the power will be distributed to the different power consumers.

2.5.4 Broke Storage, Bale handling, Chemical storage (incl. technical + social rooms) are within one building department. Department B will be erected adjacent to the Pulp Storage and will cover an area of approximately 3,000m².

2.5.5 In the bale handling area approximately 4,000 tonnes of pulp will be stored. This is about a 10-day supply of both paper machines. Bale units will be transported with forklifts to the bale conveyors, one for ‘Jupiter’ one for ‘Neptune’ and one for broke material. These conveyors will feed the hydrapulpers, which are also located in the Bale Handling area. The pulpers break down the solid pulp bales into liquid paper stock to be used by the paper machine. Per shift, two employees work in the bale handling area (24/7 - continuously).

Figure 3.4-1: Layout of Pulp Storage (A) and Bale Handling (B)

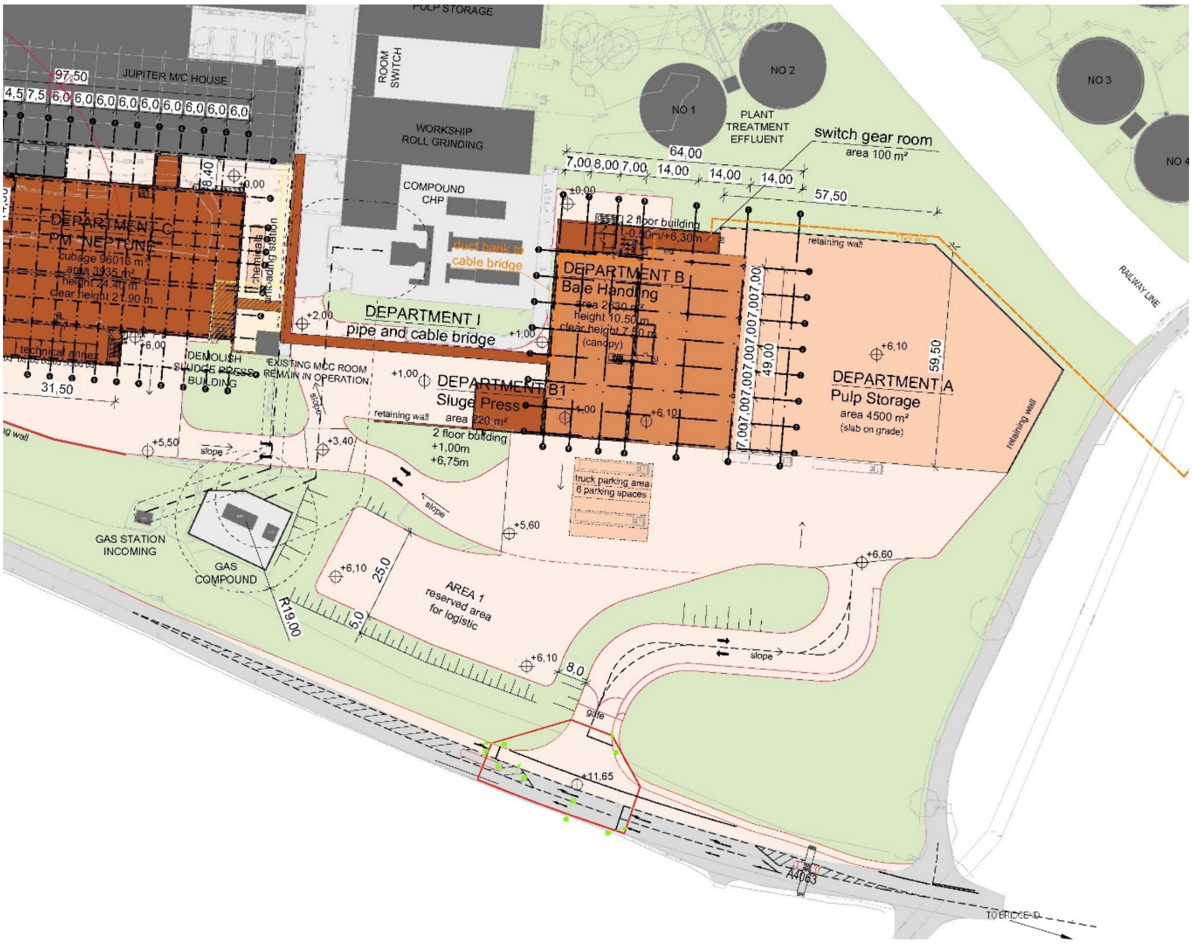
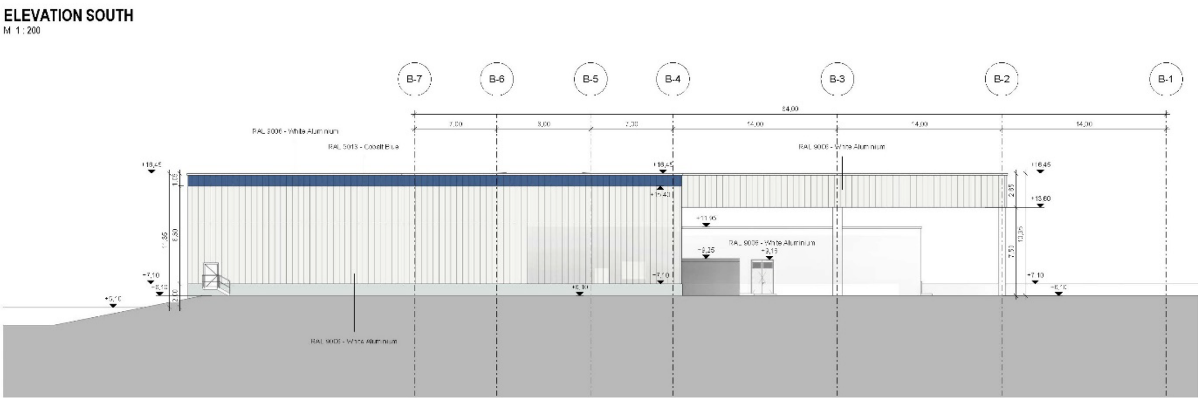


Figure 3.4-2: Design of Pulp Storage (A) and Bale Handling (B)



(C) Paper Machine 'Neptune'

2.5.6 The paper machine building will be attached to the building of the existing 'Jupiter' Paper machine. It will be built of precast and/or in-situ concrete structures. That means that all columns, beams, girders and floors will be made of concrete. In addition, wall panels and roof slabs will be pre-fabricated in accordance with fire resistance classes and regional codes.

2.5.7 The whole paper machine and all related process equipment are controlled and monitored in the PM control room. A technical annex building will be attached to the south of the Paper Machine Building.

2.5.8 Within the paper machine hall the pulped fibre material is pumped to the heart of the paper production process, the paper machine. A highly diluted paper stock enters the forming and dewatering section in order to create the required quality properties for the jumbo reels. The paper machine (PM) is based on best available technology (BAT) and is designed to produce a high quality product with low energy consumption and minimal environmental impact.

2.5.9 A combination of fabrics and felts at a speed of up to approximately 2,200m/min transfer the sheet from the forming section to the press section and into the drying section which consists of a big steam heated Yankee dryer (around 4,5m diameter) with gas fired high temperature hoods (500°C). At the end of the papermaking process, the sheet will be creped off the Yankee dryer and wound into a reel. The so-called jumbo reels have a diameter of around 3m and a width of 2.80m each (two parallel). Normally two employees per shift operate the paper machine.

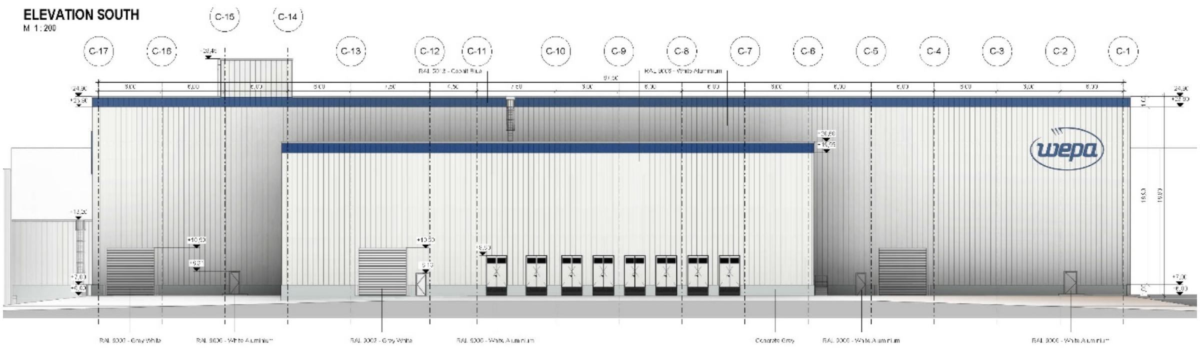
2.5.10 The paper machine and all related process equipment are controlled from a central control room. Per shift, 10 employees work in this area at the same time. These people are also responsible for maintenance in the paper machine building. Two personnel permanently staff the control room.

2.5.11 The site currently has a combined heat and power plant (Cogen) installed in 1995. This plant will generate approximately 40% of the total electricity required for the expanded site and produce all of the steam required for the new and existing paper machine. CHP is recognised at best available technology and is more efficient for the production of steam than conventional gas fired boilers.

2.5.12 A pipe bridge (M) connects the Bale Handling Building with the new 'Neptune' paper machine building and the existing 'Jupiter' machine building.

Figure 3.4-3: Layout of Paper Machine 'Neptune'

Figure 3.4-4: Design of Paper Machine 'Neptune'

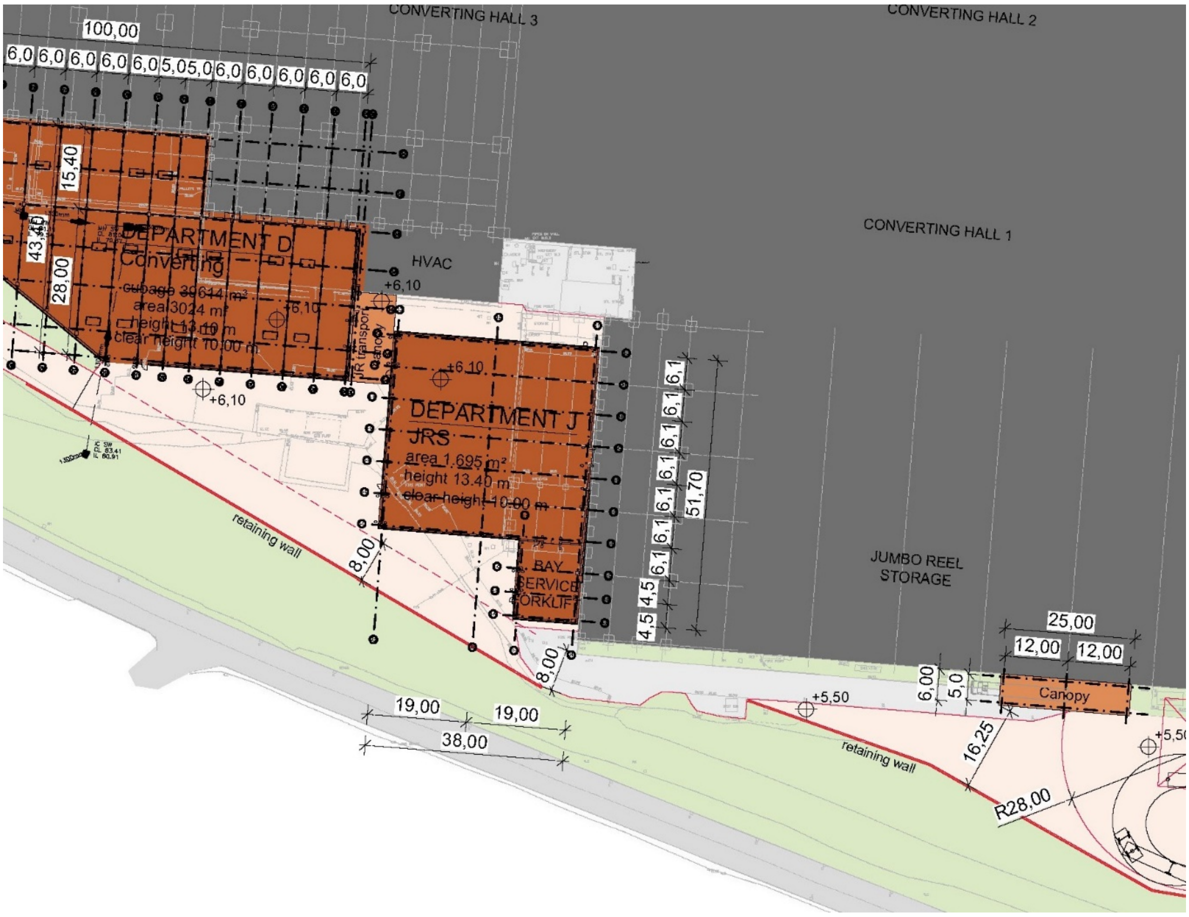


(J) New Jumbo Reel Storage

2.5.13 Adjacent to the existing Jumbo Reel Storage an additional New Jumbo Reel Storage (Department J). Department J is designed as a single-story building.

2.5.14 The floor slab and foundations shall be constructed out of reinforced in-situ concrete including single foundations in the area with load bearing columns and foundations at the outer edge of the department. The structural elements for this building are mainly structural steel columns and steel joist girders. The roof construction of the warehouse (JRS / department J) shall be a steel construction consisting out of joist girders, purlins and profiled decking. The columns are made out of structural steel. The design is similar to department D. The roof construction of the warehouse shall have a min. slope as required by code. The roof drainage would be performed by using a siphoned roof drainage system. The sandwich wall socket shall have a height of approx. 1m above the finished floor level and would be constructed out of pre-casted concrete elements (including insulation in-between the two concrete shells). Above this level, an IMP siding will be installed. Generally, all steelwork elements have to be coated and/or treated in accordance with fire protection regulations as well as corrosion protection requirements according to UK codes.

Figure 3.4-5: Layout of (J) New Jumbo Reel Storage



(D) Converting and (E) Shipping

2.5.15 The converting hall (D) is located in the south-western part of the mill site attached to the existing Converting and “Warehouse A” Building.

2.5.16 The jumbo-reels will be transported from the jumbo-reel storage by AGV or forklift into the converting halls and directly to the converting line where it will be used. There are seven converting lines currently in operation, this project will replace one of the older lines and add a new line (8 in total). When the forklift has placed the jumbo-reel in front of the converting line the jumbo-reel will be lifted with an overhead crane into the first section of the converting line which is an unwinder section.

2.5.17 After the unwinder section depending on whether the paper is already printed or not, there may be a printer. After the printer, there is the embossing section and the plybonding section, which is gluing the plies on the edges. Behind the gluing section, there is the rewinder. The rewinder is fed from a coremaking machine with cardboard cores. At the end of the rewinder section there is an accumulator where all the rolls with kitchen towel/toilet paper are stored and then cut with a log-saw into the required length. After the production section, the toilet paper and kitchen tower rolls are transported by conveyor to the packing machine. In this machine, several rolls are wrapped with film to form packs. These packs are transported by conveyors to a bundler where are wrapping the packs to bundles which fit on pallets. The bundles will be transported then with a conveyor to a palletizer machine. This machine is a robot which takes empty pallets from a temporary pallets store and is piling up the wrapped finish products on this pallet.

2.5.18 It is planned that the pallets will be transported with an LGV (laser guided vehicle = automatic shuttle) to a stretch wrapping machine. This stretch wrapping machine is wrapping the pallets with a plastic film and is also labelling the pallets. After this section, an electrical forklift will pick up the pallet and transport it to the finish product storage.

2.5.19 The Converting operation requires several types of raw materials (coreboard, printed film, glues, inks, stretch wrap). These items are currently stored in several locations across the site. This project will centralise all converting raw materials in the former pulp store area.

2.5.20 The current warehouse A will be retained and used as part of this development to enable production to continue while the new finished product storage warehouse is constructed. The existing laboratory and quality control department will remain untouched by this project.

2.5.21 In the shipping area (E), trucks will be loaded with finished products and empty pallets will be unloaded. The Shipping area will be operated with electrical forklifts. A small Shipping office will also be located within this area.

Figure 3.4-6: Layout of (D) Converting and (E) Shipping

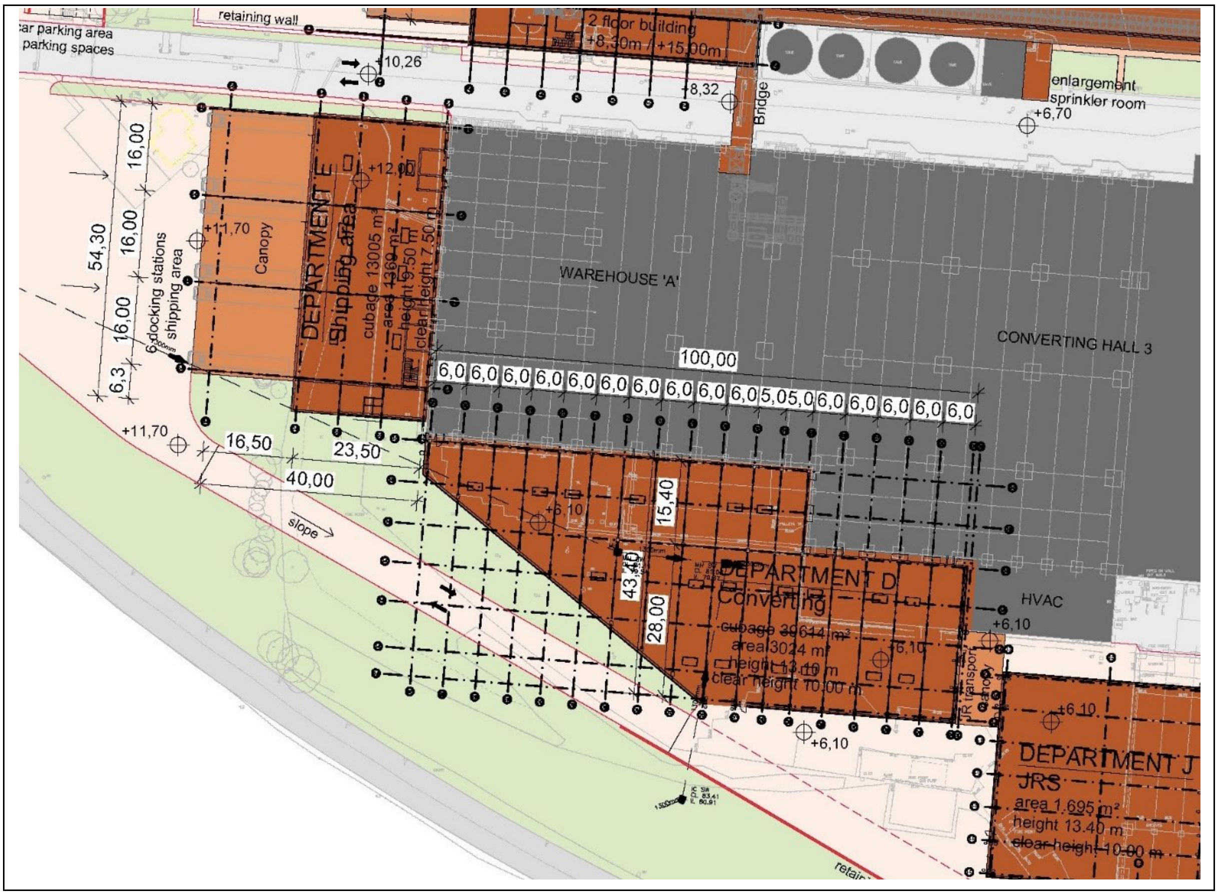


Figure 3.4-7: Design of (D) Converting

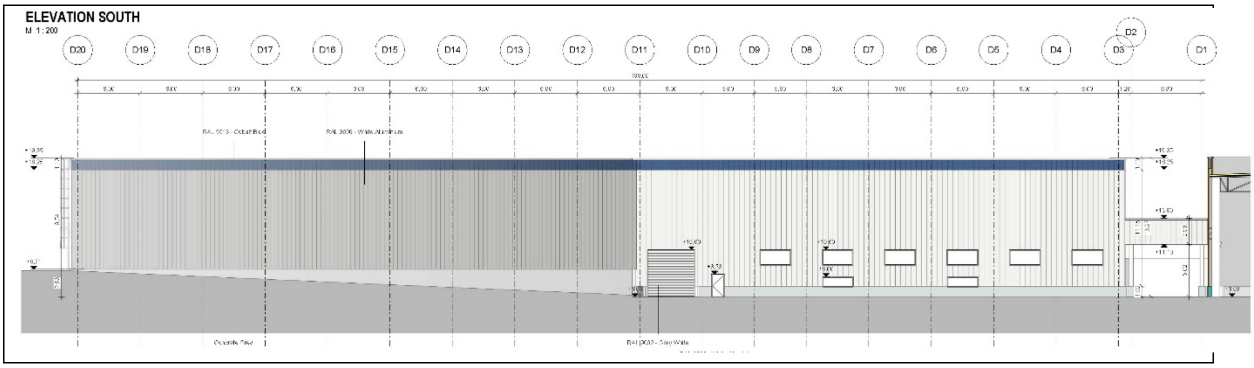
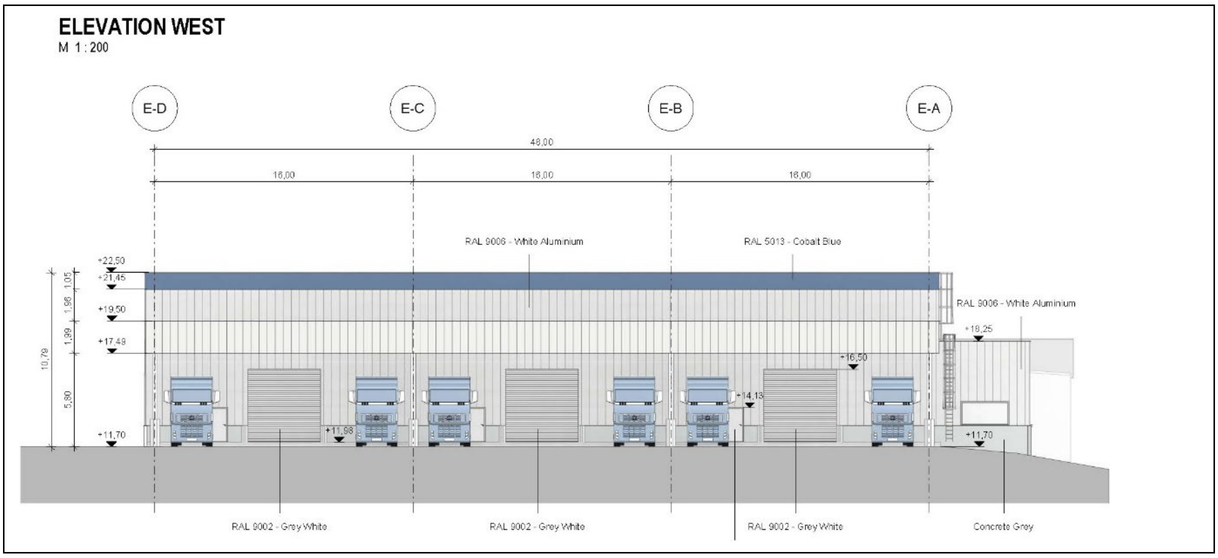


Figure 3.4-8: Design of (E) Shipping



(F) High Bay Warehouse, Shipping Area + Office

2.5.22 At the end of the production process, the finished products will be stored and shipped. The Finished Product Storage (or High Bay Warehouse) is located north of the existing Converting building and will be connected to the Warehouse A and the Converting by bridges.

2.5.23 From the buffer conveyor after the stretch wrapping machines in the converting, the pallets with the finished products will be transported by electrical forklifts into the high bay finished product storage. The maximum storage height of this storage building is 42m. The finished product storage will be fully automatic "state of the art" technology and it is operated with automatic elevators, shuttles and conveyors.

Figure 3.4-9: Layout of (F) High Bay Warehouse

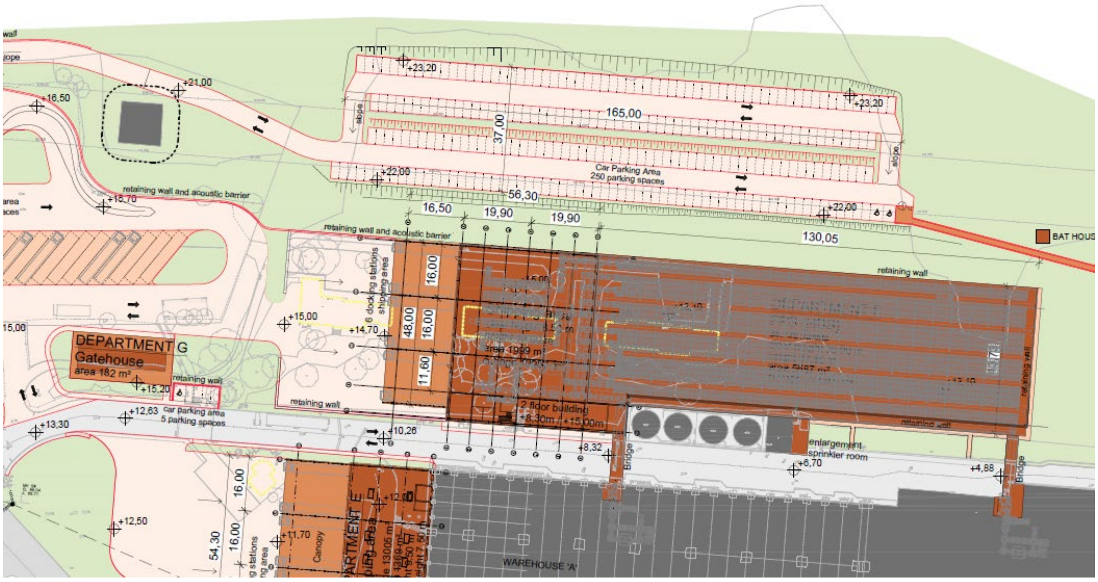


Figure 3.4-10: Design of (F) High Bay Warehouse

(G) Gatehouse

2.5.24 The gatehouse at the western access road of the site is a single-story building with a flat roof. The building consists of a gate office, toilets and building services. The Gatehouse will be staffed 24 hours / 7 days a week.

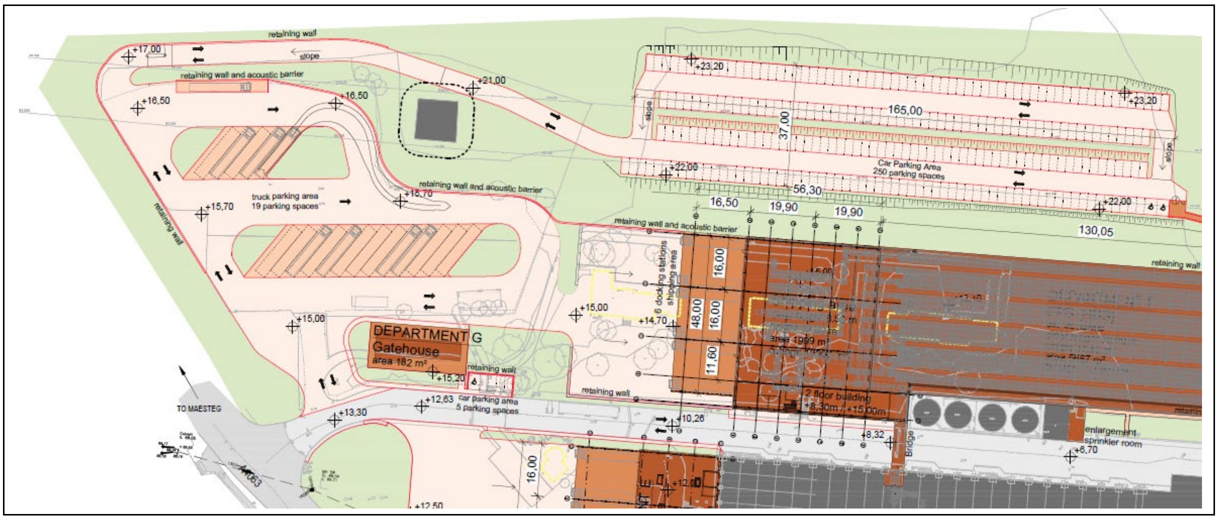
2.5.25 Cars and other vehicles will enter the mill site at the main gate at the west of the site.

2.5.26 In the event of trucks arriving too early for shipping or in case of all docking stations being occupied, they have to wait on the truck parking area in front of the Gate House.

2.5.27 Employees working in the production areas (paper machine, converting, storages, etc.) have a separate access from the main car park (north of the High Bay Storage), accessing the site via a footpath.

2.5.28 The car park will also have parking facilities for bicycles and motorbikes.

Figure 3.4-11: Layout of (G) Gatehouse and parking



2.6 Process Description and Technical Data

2.6.1 The key steps of the production process can be summarised as follows:

Creation of stock

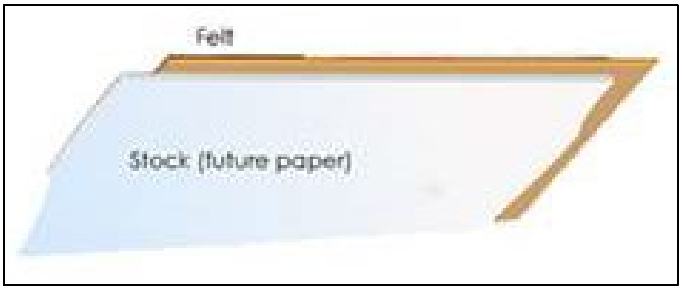
2.6.2 The pulp is dissolved using water. The fibers in the pulp can be either fresh or derived from recycled paper. The fibers usually come from wood, although they can also originate from e.g. straw or sugar cane residue. When the stock enters the machine, it comprises more than 99 per cent of water and less than one per cent of fibers.

Headbox

2.6.3 In the headbox, stock is sprayed into the machine and spread along the entire width of the machine in the gap between two rolls. On one roll there is a wire (screen cloth) and on the other a felt.

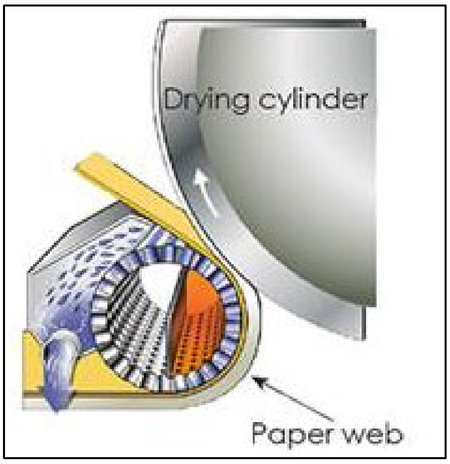
Felt

2.6.4 The stock attaches to the felt and follows it on into the machine. The felt is made of a thick textile and absorbs some of the water.



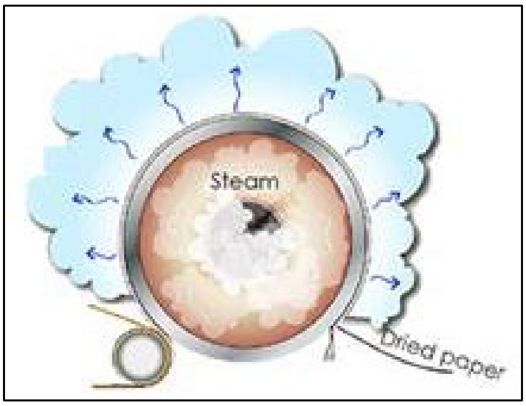
Pressing – press roll or so-called shoe press

2.6.5 In the press roll section, the paper web is pressed between a suction press roll or a so-called shoe press and the large Yankee dryer. The suction press roll is perforated and, together with the felt, removes the water from the paper web.



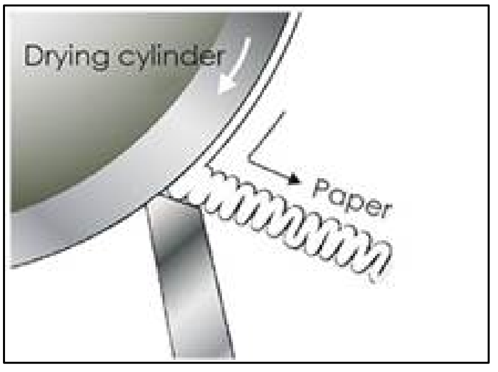
Drying cylinder – Yankee

2.6.6 The cylinder is heated up with steam under pressure. The paper web attaches to the hot surface of the drying cylinder. Water is now evaporated from the paper web.



Creping

2.6.7 The creped structure of the tissue paper is achieved when the paper web is scraped away from the drying cylinder using a steel blade.



Rolling up

2.6.8 The finished tissue paper is rolled up onto large jumbo reels. The paper is now ready for processing in other machines in order finally to be made into toilet rolls, kitchen rolls, paper tissues or paper towels

Materials Usage

Feed Stock Paper

2.6.9 For the operation of two paper machines, approximately 400 tonnes/day will be utilized.

Energy

2.6.10 Energy for the new plant will be supplied by the existing CHP power plant which uses natural gas only. The additional gas will be delivered via an existing below ground high-pressure gas pipeline.

2.6.11 The additional energy demand amounts to approximately:

558 KWh/ton @ 250 tpd = 5,812.5 kW/h @ 8,760h = 50.918 GWh per year.

Water Use (process water)

2.6.12 Paper mills commonly use freshwater in the production process for stock preparation and process water. The proposed development will produce 75,000 tonnes of paper per year. Based on a fresh water consumption of 6.5 m^3 per tonne, the new development will require approximately 488,000 m^3 of freshwater per year.

2.6.13 The increase in production will result in a change in the demand for water and a change in the effluent produced. At this stage it is expected that any associated change in abstraction and discharge volumes will however be accommodated within existing permit allowances and the current on-site effluent treatment plant has sufficient capacity to receive and treat the projected flows.

Chemical Additives

2.6.14 To improve the product properties and the production efficiency various chemical additives are applied in the process. Generally, chemical usage can be classified according to the following categories (Information summarized from BREF):

- Process Aids - Process Aids facilitate the operation of the paper production process in order to improve production efficiency and throughput. The process aid chemicals applied in the process are discussed below.
- Product Aids - Product aids are applied to optimise the specific properties of the paper according to the product requirements.

Waste Arisings

2.6.15 The principal waste arising from the operation of the plant include:

- Filters on air intakes will require changing periodically,
- Lighting units replaced as required,
- Waste from staff rooms etc.,
- Oily sludge from cleaning of oil interceptors,
- Waste oils and lubricants; oil residues arising from maintenance activities,
- Packaging waste (timber, cardboard, plastic etc.).

2.6.16 Waste generated during annual outages varies according to the scope of the outage work, and consist mainly of oil residues and scrap metals. The quantities of waste generated are relatively low. Waste will be segregated and stored in labelled containers until disposal off-site by a qualified contractor.

2.6.17 The sludge produced during the paper making process (as waste product) is collected, properly treated and reintroduced in the paper production process itself. The excess sludge that cannot be reintegrated is dried and used to make alternative agricultural products.

2.7 Waste Water Treatment Plant

2.7.1 The current effluent treatment system installed in 1991 has the capacity and capability to serve the new PM in addition to the current PM. A large part of the total amount of water needed for the tissue paper making process will be made available through intensive wastewater treatment, thus significantly reducing the total amount of fresh water taken from the River Llynfi. The treatment technology can be considered a suitable and well proven method.

2.7.2 The plant uses the biological oxygen demand (BOD) process, which remains best available technology. For the biological process, the wastewater has to be conditioned, i.e. additional nutrition **like** nitrogen and phosphor has to be added to the water coming from the production plant. Any excess water will be discharged to the River Llynfi via the existing effluent treatment plant.

2.7.3 The Plant Design Capabilities are described below:

Plant design capabilities

Average flowrate	-	18200m³/day
Maximum flowrate	-	27300m³/day
Peak hourly flowrate	-	1136m³/hr
Average BOD loading	-	1273Kg/day
Maximum BOD loading	-	3363Kg/day
Average Suspended Solids	-	546Kg/day

2.7.4 The additional water to be discharged for the new Neptune machine is 4,320 m³/day (maximum flowrate).

2.7.5 To prevent possible contamination and ensure the discharge of clean water, the drainage system is connected with the WWTP for some of the external areas where residue pulp might be present and collected within the rain water. Out of the calculation of 1440 minute 100 year Winter and the +40% climate change event, the maximum volume of rain water to be discharged per day is 1,299.8 m³/day.

Current maximum amount treated (including rainwater):	8,165 m³/day
New Neptune machine water use:	4,320 m³/day
Additional drainage water (100 year winter + 40% c.c.):	1,300m³/day
Total:	13,785 m³/day
Maximum Flowrate Plant capability:	27,300 m³/day

2.7.6 The Wepa mill Waste Water Treatment Plant has sufficient capability to treat the additional water required and produced by the machine and the system introduced with the new project.

2.8 Wepa mill Effluent Treatment Plant System manual

NORTHWOOD & WEPA LTD

BRIDGEND PAPER MILL

<u>DOCUMENT STATUS RECORD</u>

DOCUMENT REF NUMBER: EPR 04

DOCUMENT TITLE: Effluent Treatment Plant System Manual

ISSUE NUMBER	CHANGE DETAILS	ISSUE DATE	APPROVED BY
1	Creation of the Procedure	01.6.05	IG
2	Update consents & consents page added	26.6.06	IG
3	Hyperlinks Added	21.7.06	IG
4	High Sludge Blanket procedure added	24.7.06	IG
5	Procedure for start up after power dip added	25.9.06	IG
6	Security alarms added	24.10.06	IG
7	Emergency Power Supply added	02.11.06	IG
8	Mixing box high level added	18.01.08	IG
9	De-ink/Jonathan references voided. Bracket screen status updated. Molasses info added. PI references added. Responsibles/contacts updated.	18.8.08	DWL
10	All ETP test methods added	24.03.09	DWL
11	Tests updated	24.06.10	DWL
12	Sludge blanket lift procedure updated	09.02.12	RLM
13	Screw press inclusion, consents, links, ETP schematic, fire run-off updated.	14.11.12	RLM
14	ETM 007 updated, ammonia working range updated, responsible persons updated throughout.	22.10.13	RLM
15	Effluent Test Methods removed and referenced. Recycling of effluent flow chart updated	22.11.13	RLM
16	Appendix 8 updated	27.10.15	RLM

Contents (move cursor over required heading, press CTRL & click)

BRIDGEND PAPER MILL

EFFLUENT TREATMENT SYSTEM MANUAL

Introduction

The Effluent treatment system at Bridgend Paper Mills is described in detail below and is presented together with plant discharge records, performance charts versus consents and maintenance strategies.
The plant was commissioned in 1991 and remains a preferred effluent treatment process for Bridgend Paper Mills and the paper industry as a whole. The plant continuously produces a good quality effluent with few process problems.
It has built in systems to give maximum plant flexibility. The system was when designed, and continues to be, best practice for effluent treatment of a large paper mill. Testing regimes are in place to ensure that all consents set out in our operating permit are met at all times.

Bridgend paper mills operates a two stage effluent treatment system, comprising of primary treatment via 4 Dorr Oliver clarifoculators and 1 aquascreen filter. Secondary treatment consists of a Biwater activated sludge plant and a final settlement clarifier.

System Overview

Pre-treatment

There are initially two effluent streams that flow into the effluent mixing and distribution box.
The main stream from Jupiter machine passes through an Aquascreen, which removes any solid material such as plastic and wood. There is a bypass around the screen in case of blockage. The second stream, which is the ex-Jonathan machinehouse drain, goes straight to the effluent plant via the mixing box, but has very little flow.

The effluent then carries forward to the mixing box.
The mixing box is a central collecting point for all mill effluent drains. A series of valves and slides allows the distribution of flow into the clarifloculators.
Effluent exiting the mixing and distribution box is then gravity fed to any one of, or combination of 4 Dorr Oliver Clarifloculators.
No.1 and No.2 clarifloculators are now redundant.

No. 5 & 6 are used to collect and treat the effluent distributed via the mixing box. No. 3 & 4 can be used in an emergency.

Effluent from the mixing box is further distributed prior to the clarifloculators at the inlet to inspection chambers 1 & 2.

Primary Treatment

Primary settlement tanks 2 off 3100m³ (5 & 6) and 2 off 1200m³ (3, 4)(currently unused)

Dorr Oliver design clarifloculators using half bridge rotating outer scraper and central flocculation zone with inner rake and paddles.

Settled sludge removal is via 4 off Willet ram pumps

Supernatant liquor removal is via peripheral launder to manhole 1 collection chamber of concrete construction.

Balance tank

Concrete buffering tank collecting all effluent at start of secondary treatment.

Associated items:-

a. 1 off Archimedian Screw pump (M1), max flow - 316l/s, with screw failure alarm alarming at security gatehouse.
b. Penstock 4 effluent diversion valve.
c. Overflow mechanism to RAS pump station.
d. High level float alarm linked to the security gatehouse.

RAS pump station.

Receiving Return Activated Sludge via 825mm pipe into 730m3 collecting tank.

Associated items:-

a. 2 off Archimedian screw pumps (M10 & M11), max flow 475l/s, one duty and one standby working off--
b. High and low level float switches.
c. High sump level warning float alarm, alarming at security gatehouse.

Premix tank

Clarified primary effluent pumped via M1 screw pump is mixed with RAS pumped via M10 or M11 by the injection of air through 2 off aerators.

Oxidation Ditch.

Main aeration tanks 1 and 2 split into two by central separating wall with 2.5m x 2.5m linking hole.
Each tank is 55m long, 17.7m wide and has a depth of 3.5m, total volume of $6800m^3$.

Two 37kW mammoth brush rotor per ditch, with two rotors (M4 & M7) running constantly, drive the liquors around the tanks and introduce additional oxygen to liquors. M5 & M6 rotors are operated on oxygen concentration. Each rotor has a maximum oxygenation capacity of 9Kg O2/m of rotor length /hour. Dissolved oxygen is measured by Endress and Hauser Oxygen transmitter and recorded at the switch room recorder and on PI system.
Liquor level is controlled by a moveable weir system, which controls the oxygen input via the mammoth rotors.
Mixed liquor from the oxidation ditch flows over the weir and through a 900mm concrete pipeline to the centre of the final settlement tank.

Final Settlement Tank

45m diameter, $1591m^2$ surface area, $6100m^3$ volume.
A sludge blanket clarifier with central skirt distribution. Full bridge scraper with standard trailing scraper arrangement. Continuous draw off from the clarifier from central hopper of tank via hydrostatic head. The sludge flow is manually controlled back to the RAS pump station by a telescopic valve fitted at end of draw off pipe.

Lower drain valve fitted to bottom of telescopic valve.

Sludge blanket level is monitored by Bestobell Mobrey sludge blanket detector, which alarms at the security gatehouse when sludge is detected.

The peripheral launder is cleaned by high pressure spray system attached to the circulator arm bridge and can be run off timer or continuously.

Clarified water passes over the peripheral launder V weir plates with facility for +/- 50mm adjustment and flows by gravity to the final effluent chamber.

Final Effluent Chamber

A distribution chamber for effluent and Nant Gwyn stream flows of concrete construction with a series of plastic penstock valves to adjust effluent and Nant Gwyn stream flows as desired and as dictated by stream and effluent conditions.

Sludge Handling (activated)

Surplus activated sludge (SAS) is removed from the RAS line at the surplus activated sludge pit by 2 off positive displacement pumps, (M3 & M4) 1 duty and 1 standby. Flowrate variable up to 20m ^{3}/hr
The SAS is pumped to the screw press.

Associated items:-

a. Low-level float switch in SAS pit connected to M3 & M4 SAS pumps.

Picket Fence Thickener (taken out of service)

Thickening tank for sludge received from RAS system at ~ 0.7% solids.

8m diameter, SWD 3.5m. Full diameter fixed access bridge, central drive tube, picket fence, scraper mechanism, tilting valve assembly and inlet deflector drum.

Drain and overflow mechanism to RAS line.

Sludge Handling (Primary)

Settled sludge collected in the primary clarifloculators is fed to the screw press at a consistency of approximately 3% via Willet reciprocating pumps (see above) and pressed to approximately 50% dryness.

The sludge collects in a holding tank and enters an integral flow distributor which directs it into the disc thickener. This raises the consistency to about 20%. Filtrate is returned to effluent drain.
This thickened sludge is fed into the screw press via an inlet chute. The screw then propels the material towards the pressing zone, which builds up a counterpressure and drives the free water of the material treated through the basket. Solids are retained and expelled by the screw through the press exit aperture at a consistency of about 50%. Filtrate from the press re-enters the sludge holding tank.

Sludge generated is collected from the floor below the drum by mechanical means, loaded onto open top truck and disposed of via land-spreading.

Responsibilities

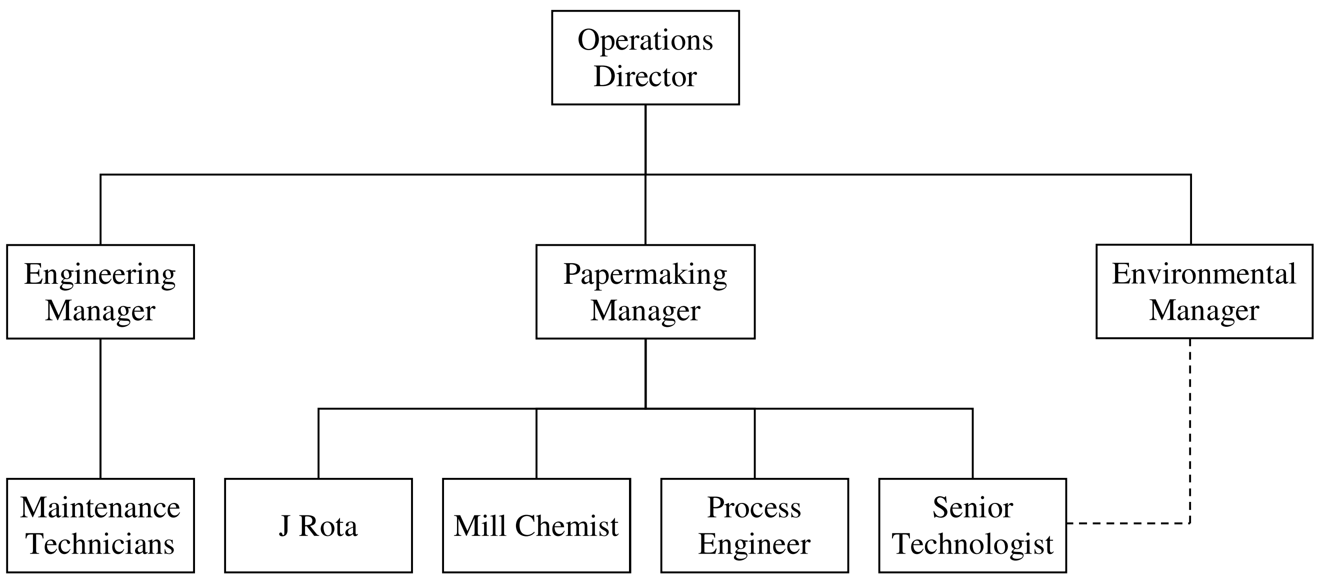
Senior Technologist – see current RR&Es

Mill Chemist - see current RR&Es & deputises for Technologist re effluent sampling

J Rota Operatives – see current RR&Es

Manning

<u>Organogram for effluent plant responsibility</u>



The effluent plant is continuously monitored by the PI system, which reports all major problems. Periodic manning is by 3 J Rota day operatives for the primary treatment system and Stockdale plant, and by the Technical Department for the secondary treatment. Plant inspection is performed at least once per day, every day.
Cover is provided 24hrs a day and 7 days per week. Out of normal hours cover is provided by the Shift Manager.

Chemical Addition

Nutromex

Nutrient addition, based upon a liquid mix, supplies nitrogen and phosphorus supplement to the activated sludge process.
Storage of the nutrient is in a bunded vented tank of $25m^3$ capacity.
Nutrient is pumped into the sewage stream to maintain predetermined nitrogen and phosphorus levels.
Adjustment is done manually under the direction of the Technical Department.

Sodium Hypochlorite

Used to control filamentous bulking. Fed from semi-bulk container by gravity into the RAS pit, the feed rate is varied according to the degree of bulking and plant viability.

Plant loading

Based on 917Kgs/ day
BOD

0.11Kg BOD per m^3 Aeration tank volume
0.03KgBOD per Kg Sludge Solids

Plant design capabilities

Average flowrate	-	$18200m^3$/day
Maximum flowrate	-	$27300m^3$/day
Peak hourly flowrate	-	$1136m^3$/hr
Average BOD loading	-	1273Kg/day
Maximum BOD loading	-	3363Kg/day
Average Suspended Solids	-	546Kg/day

Current Environment Agency consents (2011)

Maximum flow	**$17500m^3$/day**
	$729m^3$/hr
BOD	**10mg/l**
Suspended Solids	**40mg/l**
pH	**6.5 – 8.0**
NH_3	**1.0mg/l**
Max Temp	**25ºC**

Effluent Plant controls

Personnel - 24hr coverage via day operative, technical department and shift manager.

Flow Control

Flow into the plant is by gravity and buffered by the balance tank to maintain a constant flow to the oxidation ditch via the Archemedian screw pump.
Flows from the effluent treatment plant are monitored continuously by Endress and Hauser ultrasonic flow meter (Type. FMU 861). Flows are registered locally on the meter, logged on the Water Filtration Plant control computer and trended on the PI system.

Oxygen Level

Both oxidation ditches have Endress and Hauser DO transmitters linked to Mammoth Rotors M5 and M6 that bring in a rotor when the oxygen level falls below 1ppm.
DO level probes are set to control between 0.5 and 2ppm.

Sludge Blanket Level

Monitored by Bestobell Mobrey sludge blanket detector and set at 0.45m. Alarmed locally in the main switch room and at the security gatehouse.

Remote Monitoring

The BOD plant has a computer system dedicated to the monitoring of the plant remotely at the Jupiter machine control room.

The following pages are monitored:-

Plant Overview

Colour coded plan of plant that monitors plant status.
Green - running or okay
Yellow – warn
Red – Out of consent or pump/motor breakdown.

Level Alarms

Description of area of plant and status e.g. sump levels, DO (Dissolved Oxygen) levels etc.

Trend Menu

Trends BOD, Suspended Solids, pH, Temperature, DO levels, Influent and Effluent flows.

Status Menu

All pump and motors electrical status.

In the event of total power failure to the system the system will require rebooting as described in effluent monitoring system start up procedure (appendix 1)
Response to active alarms is described in

Sampling regime

The following samples are taken as and when required:-

Primary Outfall

BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), Suspended Solids and nutrient levels.

Secondary Aeration

Mixed liquor solids
Stirred Settled Sludge Volume Index
Nutrient levels
Microscopic analysis of sludge

Final Settlement Tank

Sludge blanket level.
RAS solids
Nutrient levels

Final Effluent Outfall
Suspended Solids
pH
BOD
COD
Nutrient levels
Total N & P

Primary Sludge

Moisture
Ash
Fibre fractionation

Monthly Sampling Regime

Influent and Effluent samples are taken on a monthly basis for independent evaluation for the following determinands.

Mercury, Cadmium, pH, COD, BOD, AOX (Adsorbable Organic Halides), suspended solids, microtox, pentachlorophenol, tributyltin, triphenyltin, phosphate and Total nitrogen.

Plant Failure

All pumps are doubled up as Duty/Standby. Pumps are linked to level sensors that start the standby pump if levels increase in tanks due to pump failure.

Rotors for aeration are also Duty/Standby and are started when Oxygen concentration falls below 1mg/l.

In the event of a total power failure to the plant, there is a backup ‘House Set’ that can be activated to provide power to essential plant and prevent spill of untreated effluent to river. Indication of power failure is registered at the security gatehouse alarm panel and relayed via radio to all relevant personnel.

In the event of effluent being below discharge specification, there is a facility on site to recycle all effluent generated by the mill, via a series of penstocks situated at the final distribution box.
Effluent is returned to the Water Filtration Plant via the River Pump House and all water is retained within the mill water courses.
Isolation of the River Pump House from the river is also possible by the closing of valves situated within the pump house.

In the event of a total plant failure due to power, mechanical breakdown or biomass problems, there is facility to bypass the BOD plant and recycle primary treated effluent back to the mill.

Abnormal working

Abnormal working occurs during mill cleaning operations or at shut periods.
Highly alkaline liquors flushed through the papermaking system as a cleaner are segregated from all other effluent streams and collected in a previously prepared clarifloculator.
Effluent held in this tank is pH adjusted to neutral by manual addition of an acid solution.

Once neutralisation has been achieved the effluent is discharged into the main effluent stream.
There is a procedure for total mill periods to run the BOD plant on oxygen and level controls only, to maintain a viable biomass for mill start up.

Effluent Recycle

Treated effluent from the mill can be either discharged to the River Llynfi or recycled by gravity to the River Pump House and pumped to the Water Filtration Plant, where it is reused in the process.
Generally the mill runs with a recycle flow of ~35%, though this can range from 0 – 100% dictated by process conditions and River Llynfi flow and effluent quality.

Responsibility for recycle/discharge flows is taken by the technical department or day operator. Out of hours responsibility is assumed by the shift manager.
Flow through the recycle channel is monitored using a Endress and Hauser ultrasonic flow meter and recorded locally on the meter and also at the Water Filtration Plant.

Maintenance

The design of the plant allows minimal regular maintenance due to the flexibility of the plant. Generally, the plant can be allowed to run to failure because of the back up systems. There are however, regular lubrication regimes in place to ensure that all critical plant is kept in optimum condition.
The Esso lubrication system produces a job ticket at set intervals to ensure that the routine lubrication takes place. Records of lubrication are maintained on the Esso lubrication system database.
Visual integrity checks are carried out as part of the daily routines on the plant and faults or concerns logged on the BOD plant log and acted upon using the PTM system.
For general repairs a PTM Request is submitted and scheduled for repair at the earliest opportunity.
Records of general repair maintenance are maintained on the mill SAP maintenance system.
Instrumentation maintenance is carried out on a weekly basis in accordance to a (PWR) ticket being produced. Records of instrument repair and calibration are maintained for inspection at the BOD plant ‘Biox’ cabin.
There is an ongoing programme to replace original plant equipment with equipment of improved design and capability. This is done when failure of existing plant occurs.

Measurement

All measurements on consents are monitored continuously and the instruments used are serviced and calibrated according to the manufacturers recommendations.
Records of servicing and calibration are maintained at the BOD plant cabin.
Flow monitoring equipment and methodologies of discharge and recycle flows are MCERTS accredited and subject to independent audits every 2 years.
Continuous BOD measurement instrument BIOX 1010 is serviced and calibrated to manufacturer’s guidelines. These records are maintained in the wet laboratory IPPC file.

Environmental Benchmarks

Substance	**Benchmark** mg/l
Mercury	0.0001
Phosphorous	0.065
Cadmium	0.005
Pentachlorophenol	0.002
Tributyltin	0.00002
Triphenyltin	0.00002
BOD 5	3.0

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Operating Procedures

The first stage of the effluent treatment at Bridgend is by physical means, the second stage effluent treatment utilises both physical separation and conversion processes.

Operating procedure for BOD plant

Biological Controls

There are several elements to the correct and proper operation of the activated sludge Biochemical Oxygen Demand (BOD) plant, each of which interrelates with the other. Due to these interactions reference must be made to the other prior to making any decision to make changes to the plant.

The sections of the BOD plant have been described in detail earlier in the overview of the plant.

The primary design of the plant is to remove soluble organic biodegradable compounds that remain after the primary settlement treatment stage.

The plant relies on two main elements:

1. Water loading (referred to as Hydraulic load)
2. BOD load (the dissolved organics in the water)

The plant which is made up of several tanks is filled with aerobic bacteria which uses the BOD content as a source of food, the water phase effectively being the transportation for the food, so in simple terms it's a balancing act between the amount of load (food) entering the plant and the mass of the solids (activated sludge in the plant). Maintaining a proportionate balance will give good conversion:-

Effluent (soluble organics) + Oxygen → Bio-conversion = Extra Biomass + Carbon Dioxide

It is important to maintain a constant flow with as few spikes or surges of flow as possible and a constant BOD loading.

The feed of organics to the plant is supplemented by a dose of nutrient that contains nitrogen and phosphorus, this is added to promote biomass growth.

F/M Ratio

The biological loading for the plant is expressed as:

Activated sludge loading or Food to Biomass F/M ratio

$$F = Kg\ BOD\ fed\ to\ plant\ per\ day = \frac{BOD(mg/l)\ x\ flow\ (m^3/d)}{1000}$$

$$M = Kg\ Biomass\ in\ the\ bioplant \quad = \frac{MLSS\ (mg/l)\ x\ V(m^3)}{1000}$$

where V = *volume of oxidation ditch* ($6800m^3$).

Typically activated sludge plants would run at an F/M ratio of 0.2 – 0.4

Bridgend mill activated sludge plant typically runs on a ratio 0.02.

The plant will run efficiently at what would be seen as a critically low F/M ratio, but biomass growth is much slower than if F/M was higher

Sludge Production

As the activated sludge is a living plant, the plant will continually produce sludge due to the conversion processes involved

Higher sludge production occurs at high f/m rations and conversely low sludge production occurs when the F/M ratio is low.

To maintain sludge levels in the plant consistent with the loading of the effluent entering the plant (F/M ratio) the sludge is 'wasted' when the levels reach a point where the plant is either saturated (too much sludge) or if the loading on the plant reduces (not enough food). These results are obtained from weekly measurements of the solids content of the MLSS (mixed liquor suspended solids) and RAS (return activated sludge).

Biomass wasting is done via P3 or P4 SAS (surplus activated sludge) pumps. Sludge is pumped off the plant until the sludge levels reduce enough to achieve a suitable F/M ratio.

The sludge ratio is traditionally maintained between the RAS and MLSS with a ratio of 2:1 being ideal for a good plant balance. Plant design is for RAS 0.8% and MLSS 0.4%, though typical results would be 0.45 and 0.35 (1.3:1) respectively.

The ratio between RAS and MLSS is controlled via the telescopic valve (Bellmouth) at the top of the FST (final settlement tank) draw off chamber. The rate of return is approximately equal to the flow into the plant.
It is important that the rate of RAS return from the FST is sufficient as not to hinder the settlement of sludge in the tank and not too high as to disintegrate the sludge blanket in the tank.

Sludge Settlement

The sludge within the FST must settle to produce a clear supernatant liquor or final effluent.

Settlement varies and is dependent on a number of factors.

1. Concentration of the sludge.
2. Biological make up of the sludge
3. Hydraulic load on the plant
4. Rate of RAS draw off from The FST
5. Nutrient level
6. Sludge age

There are three stages to sludge settlement:

1. Free settlement. - Initial settlement where sludge particles/flocs are free to settle easily
2. Hindered settlement. – As the flocs get closer and the sludge thickens, they interfere with each other and slow down the rate of settlement.
3. Compaction. – When flocs are clumped with little space between them they continue to concentrate slowly.

Controlling the level of the sludge blanket in the FST is crucial to prevent the solids building up to a point where the blanket could rise to the top of the FST and overflow to river. The blanket is continually monitored by the HSB probe which will alarm at the security gatehouse at 0.45 metres below the surface of the water.

Very high residence time in the FST can lead to the sludge becoming anaerobic. This should be avoided as this sludge will eventually rise to the surface of the clarifier and potentially break suspended solids consents.

A typical reason for poor settlement could be ‘Bulking’. This must be closely monitored by regular microscopic evaluation of the sludge.

Determination of settlement is by SSD or Stirred Sludge Density (see test methods).

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Nutrient Dosing

Macronutrients in effluent will vary due to activities in the mill (chemicals/furnish etc), the effluent process conditions and the operation of the effluent treatment plant. Nutrient addition has to overcome these variations so control is necessary. Deficiencies can lead to an overall reduction in plant performance and undesirable changes in the bacterial ecosystem as more adaptable species dominate e.g. Filamentous bacteria

Rule of thumb for dosing of nutrients to an activated sludge plant is a ratio of:

100 BOD: 5 Nitrogen : 1 Phosphorous

Bridgend mill uses Omex Nutromex P as a source of nitrogen and phosphorus.

The majority of the nutrient will be taken up by the biomass and is so removed from the system in the surplus sludge.

Excess nutrient can lead to breach of ammonia consent and denitrification at the FST, which can lead to nitrogen build up in the flocs of the blanket, which will in turn cause the flocs to rise to the surface of the FST.

Dosage is via P1 or P2 nutrient dosing pump and is increased or decreased according to laboratory results of primary and final effluent testing.

Increase and decreases in nutrient addition should be done in small steps of 5 – 10% of existing dose, as small changes to dosing can lead to significant changes in residual levels

A small residual of Ammonia is required in the final effluent test to ensure that the biomass is receiving enough supplements ~0.01 – 0.1Mg/l

Consent on Ammonia is 1.0mg/l

Action should be taken to reduce dosage at 0.6mg/l

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ANALYTICAL TEST METHODS

The following test methods are available in ***S:\Environmental\Environmental Mgt System (EMS)\4.4 Implementation and Operation\4.4.6 Operational Control\Effluent Test Methods***

- **ETM001** – Ammonia concentration
- **ETM002** – Nitrate concentration
- **ETM003** – Phosphate concentration
- **ETM004** – Iodine concentration
- **ETM005** – Bromine concentration
- **ETM006** – Free Chlorine conentration
- **ETM007** – Oil & Grease contamination of watercourses
- **ETM008** – Stirred Specific Volume (SSV)
- **ETM009** – Mixed Liquor Suspended Solids (MLSS)
- **ETM010** – Free Halogen concentration
- **ETM011** – Determination of suspended solids in effluent

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Ammonia

To comply with the variation to our IPPC permit No. BJ5805 Bridgend paper mill is required under the amended permit (commencing 02.11.11) to conduct a daily test on the final effluent from the plant to ascertain ammonia concentration (in the form ammoniacal nitrogen). Maximum values are reported to the EA within the quarterly returns report.

Note

The permit has a consent level of **1.0mg/l** over the weekly rolling average.

The operating levels are set between 0.01mg/l and 0.6mg/l

The laboratory normally takes care of ammonia testing and controlling, but in the event of the results being higher than 0.6mg/l at weekends, inform the mill manager, who will take measures to reduce the ammonia levels to normal operating range.

Check List

Check the ammonia level of the incoming waters i.e. River Llynfi at the abstraction point and Nant Gwyn (if it is being used).

Measure the Nutromex (nutrient) dosing

Check the BOD plant for any pump and or motor malfunction

Check the MLSS (mixed liquor suspended solids) and RAS (return activated sludge levels

Current and historic results are stored on the mill computer system:
S:\Green Dragon\Supereffluent (year)

Microbiology of the BOD plant

The microbes that make up the activated sludge are too small to be seen with the naked eye and must be viewed using a microscope. The organisms used at the BOD plant are mainly Bacteria (bugs) they are widespread and diverse and are the ‘workhorse’ of biological wastewater (effluent) treatment.

Activated sludge organisms derive both their energy and carbon from food i.e. organic contaminant of the effluent.

Microbes grow very quickly if conditions are correct. They reproduce by binary fission i.e. they split in half and make two identical copies. The time taken to grow then split into two identical copies under good conditions is usually around 15-45 minutes. One of the factors constraining this exponential growth is source of food. If the food is scarce growth slows (f/m ratio).

The condition of activated sludge can be established my simple microscopic investigation. To investigate sludge floc structure a microscopic magnification of 100x or 200x is adequate. The characterisation of sludge tends to be subjective, so regular microscopic investigations are important to become familiar with the microbiology of the plant and become receptive to subtle changes within the system.

Information obtained from such investigation can be:-

Form and structure of flocs
Type and quantity of filamentous organisms
Number and type of protozoa and higher life forms

Activated sludge floc comprises of:-

Living organisms (mainly bacteria)
Dead cells
Undigested large organic fragments e.g. paper fibres trapped in the flocs
Inorganic materials – grit, chalk, clays etc.

A good sludge would have a diverse life forms with a mixture of protozoa and metazoa with a variety of filamentous bacteria that will effectively bind the floc structure.

For microbial identification refer to appendix 3.

Mechanical and Electrical controls

PROCEDURE BOD PLANT SHUT DOWN AND START UP

The BOD plant normally operates in full automatic mode. Each major function has back-up facility to preclude, as far as possible, the accidental shut down of the plant. However, the plant requires an orderly shut down for extended periods of zero effluent flow e.g. holidays of more than 7 days. During such times it is important that the activated sludge is kept 'healthy'.

SHUT DOWN PROCEDURE

1 Switch the Main inlet screw pump M1 to AUTO for the duration of the shut. This will ensure that any extraneous waters entering the system will not overflow the default level and discharge to river via the ditch bypass.

2. Switch off the two duty rotors and switch on the two standby rotors to keep the sludge mixed and aerated.

3. Switch of Blowers.

4 Leave RAS pumps in Auto Mode –M10 and M11.

5. Leave Final settlement tank bridge running – M8 and M9.

6 Turn off the nutrient pumps -PI and P2.

7. Switch off SAS pumps, Pumps 3,4

8. Switch off any other chemical dosages to plant (if being used)

The Biox will continue to run until the final effluent chamber is empty whereupon the low water protection switch will trip the unit.

NB
When the plant is shut, ensure that the effluent is switched to 100%recycle at the effluent distribution box

START UP PROCEDURE

1. Allow mill effluent to flow through the plant.

2. Return MI to 'MANUAL' operation.

3. Return rotors M4 and M7 to ‘Manual’ and M5 and M6 to 'AUTO' mode.

4. Restart air blowers

5. Switch on Nutrient pumps PI or P2. (Manual Mode).

6. Start up the BIOX 1010 unit

7 Restart chemical dosing if necessary

Leave the effluent on 100% recycle until the plant has settled and all parameter are within consents Home

Procedure For Recycling Effluent at Bridgend Paper Mill ETP

Bridgend Paper Mill aims to reduce overall water use at the mill.
To keep in line with the IPPC (Integrated Pollution Prevention and Control) guidelines and a benchmark of 20m3/te, (based on effluent discharged to the river Llynfi), the recycling or closing up the water system is the simplest way of reducing water figures to within the benchmark figure.

Reasons for recycling

There are two main reasons for recycling;

1. To reduce overall water consumption
2. To protect the river from contamination when the effluent is out of consent, set out in our licence to discharge.

Recycling more than 50% for prolonged periods can cause process issues within the plant and must be monitored closely.

Restrictions

Closing the system (recycling) increases the demand on the disinfection systems and extra vigilance is required to ensure that biocide residual levels are maintained within the set limits. Conductivity, hardness, alkalinity and COD of mill water are likely to increase and should be monitored frequently.

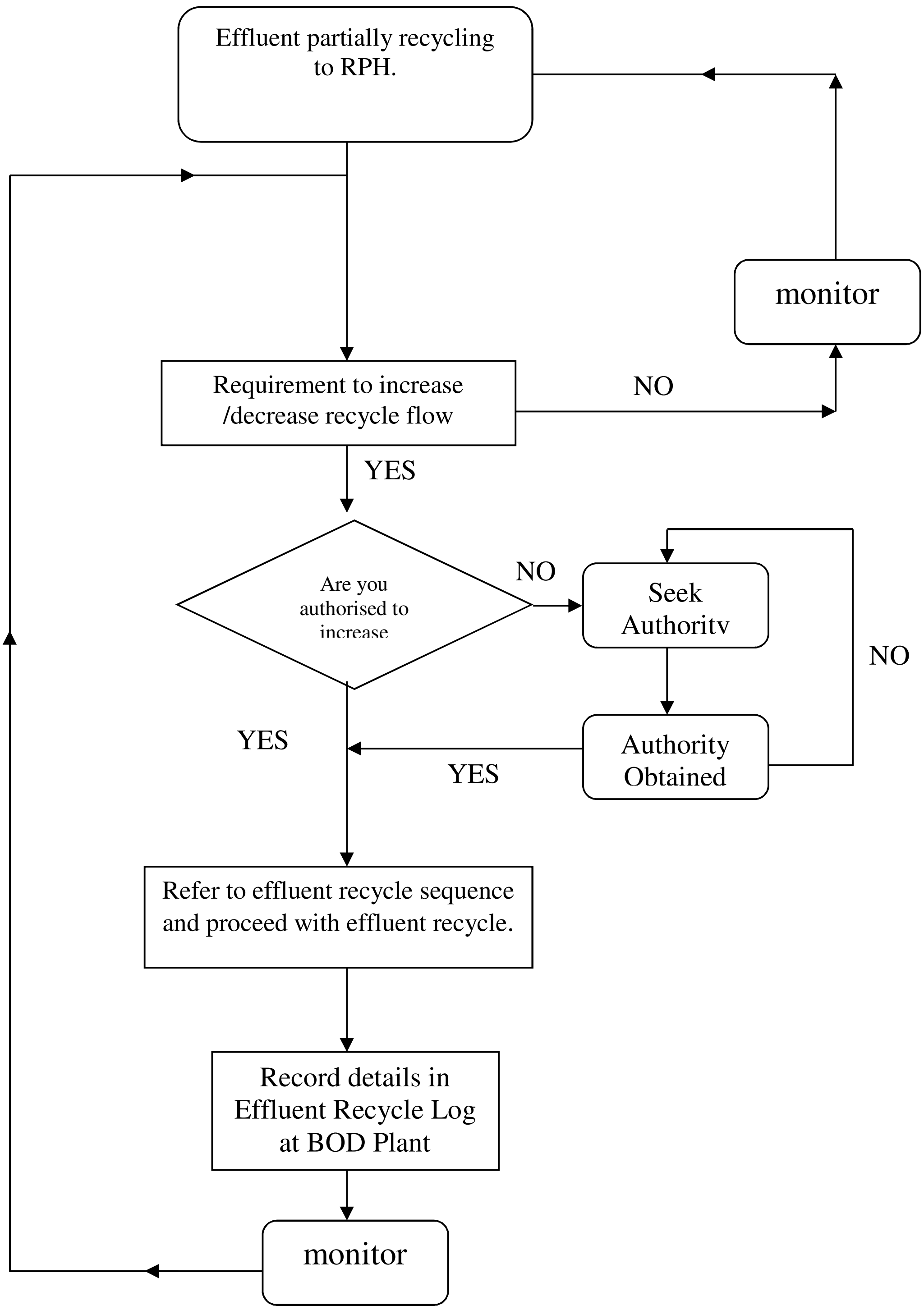
Normal running

During ‘normal’ running, effluent should be recycled back to the River Pump House at a rate that ensures that:

The overall discharge from the plant to the river Llynfi does not exceed the 17500m³/day i.e. average flow of 730m³/hour

Procedure
Refer to flow chart.

EFFLUENT RECYCLE FLOW CHART



Authorised Personnel
Papermaking manager
Process Technologist
Mill chemist
Process engineer
Shift manager
Water filtration plant operators

VALVE SEQUENCE FOR EFFLUENT RECYCLE AND DISCHARGE

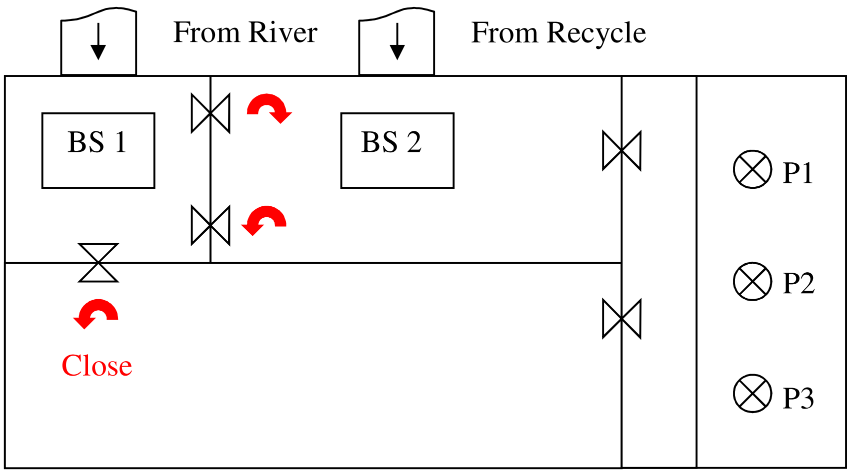
Sequence for 100% Recycle

Open Penstock 9
Close Penstock 6

At the River Pump House

To ensure that no recycled water backflows into the river at the River Grid (abstraction point), the following procedure must be adhered to.
Close all 3 valves around Brackett Screen 1.

See Below:



If Nant Gwyn flowing to River pump house

As Above **plus** divert Nant Gwyn flow to River Llynfi as follows:-

Open Penstock 8
Close penstock 7

Partial Recycle (normal running)

Penstock 9 partially open (approximately 2½ turns)
Penstock 6 open full

Nant Gwyn may or may not be flowing through recycle channel. If too much flow for both flows, divert Nant Gwyn flow to River Llynfi as above.

Increase to Partial Recycle

If partial recycle is required open Penstock 9 in increments of ¼ turn of the valve.

Discharge to River

If an increase in discharge or 100% discharge is required, the above procedures should be followed, but the sequence for the penstock adjustments reversed.

Emergency Procedure

In the event of a major spillage, or when effluent is out of consent, e.g. sludge blanket lift, high or low pH or high suspended solids and high BOD, the priority is to contain the effluent within the mill regardless of conditions at the mill.

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Emergency Procedure

BOD PLANT BLANKET LIFT PROCEDURE

If a HSB (High Sludge Blanket) alarm is activated at the security gatehouse, a visual inspection of the BOD plant is necessary to determine whether the clarifier sludge blanket has lifted.

Security officers must contact one the following:

Between 08:30 and 16:30

	Extension	Mobile
Process technologist	4519	07891 537 190
Day operator	4584	07967 886 139
Mill chemist	4615	07968 086 834
Technical manager	4595	07967 124 572
Shift manager	4613	07974 768 648

Outside these hours, the shift manager is responsible for the operation of the plant

If on inspection from the FST bridge, no blanket is visible, remove and clean the sensor in the clarifier then reset the HSB warning light in the switch room. No other action is required. However if the blanket has lifted significantly or indeed has overflowed the clarifier launder and is being discharged to river, then the following procedure should be implemented **immediately**, as our priority in this situation is to protect the river from pollution.

1. Recycle final effluent 100%, ensuring that the river is isolated. Make sure Nant Gwyn discharges to river as normal. These actions will protect against polluting the river.

2. Stop the flow into the balance tank at MH1, this will automatically start the primary effluent bypassing the plant and in turn recycling via the recycle channel.

3. For reducing the level in the oxidation ditches quickly, shut off M1. Be aware that M1 can only remain off until the balance tank is full to ground level.

4. If necessary, increase the RAS flow by opening the bell mouth.

5. Isolate the RPH from the river to prevent unauthorised discharge from the mill at the RPH.

6. A detailed inspection of the plant is now required, to ascertain the cause of the blanket lift before any remedial action can be taken as there can be several causes of blanket lift.

PARAMETERS TO CONSIDER WHEN ASSESSING PLANT

1. Flow – has the plant become unstable due to excessive hydraulic load
2. Nutrient levels – Is the clarifier denitrifying and causing the sludge to lift with the gas
3. MLSS/RAS ratio / concentration – Is the plant overloaded with sludge or is there enough sludge to form a blanket?
4. Sludge make up – What type of bacteria is the sludge made up of ? Is there an excess of filamentous?
5. DO levels. What is the oxygen concentration of the oxidation ditch?
6. Toxic shock – Has anything been released to drain from the mill that may have killed off the plant or caused the sludge to rise
7. F/M ratio – Is the plant being underfed or overfed?
8. Mechanical / electrical breakdown.- Is there a breakdown or malfunction of any part of the plant that may give rise to the poor settlement?
9. Recent historical data – what has been happening on the plant during the past month?

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Standard Procedure for Control of Run off Waters from a Major Fire at Bridgend Paper Mill

1. INTRODUCTION

In the event of a major fire, it is imperative that the watercourses within the mill and its immediate boundaries are protected from contamination by the run off water from fire fighting.
All steps must be taken to ensure that run off waters are contained within the mill effluent system.
In the event of there being a risk of run off water contaminating the Nant Gwyn, the following two stage procedure must be implemented.

2. SCOPE

This procedure covers any such incident within the Bridgend Mill site.

3. RESPONSIBILITY.

The Mill Controller (Normally the Shift Manager) is responsible for ensuring that this procedure is followed. He will call for the support of other personnel as required.

4. PROCEDURE

Procedure 1 - Amber Alert

1.a. The mill controller will monitor the run off water from fire-fighting activities.

b. If after assessment there is a risk of contamination.

2. Inform the Environment Agency of the situation (EA incident hotline 0800 807060). Inform Technical Manager, Effluent Plant Supervisor and J Rota operatives (if incident occurs during the day).

4. Instruct the shift technician to divert the Nant Gwyn flows to the River Pump House, using the following method: -

At the diversion box at the BOD Plant. (diag.1)

i. Shut Penstock 9
ii. Open Penstock 6
iii. Shut Penstock 8
iv. Open Penstock 7

(All effluent will now be discharged leaving higher capacity for capturing total Nant Gwyn flow)

Flows to be monitored at the final effluent outfall and River Pump House abstraction grid.

Procedure 2 must be implemented if: -

i. The fire is deemed to be major and fire fighting extensive with risk of contamination of both Nant Gwyn and River Llynfi.

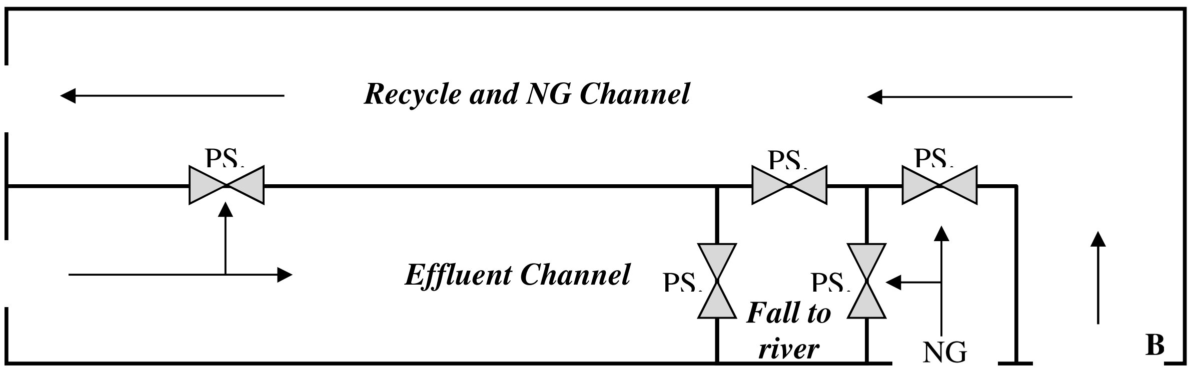
ii. After procedure 1, there is further risk of contamination of the River Llynfi by fugitive emissions.

Procedure 2 – Red Alert

1. Switch the river pumps to manual control to override level controllers (see river pump override procedure below)
2. Ensure that all Nant Gwyn water is pumped through the mill influent and effluent systems
3. Monitor flows until fire fighting has ceased and all risk of contamination has subsided.

Diag.1

Effluent Distribution Chamber



River pump override procedure

Override inverter-driven river pump P3

1. Select Main menu
2. Select F2 – River Pump House
3. Select F1 Pump control
4. Select Pump P3, Click MANUAL
5. Increase set point (S/P) to 100% using the + icon

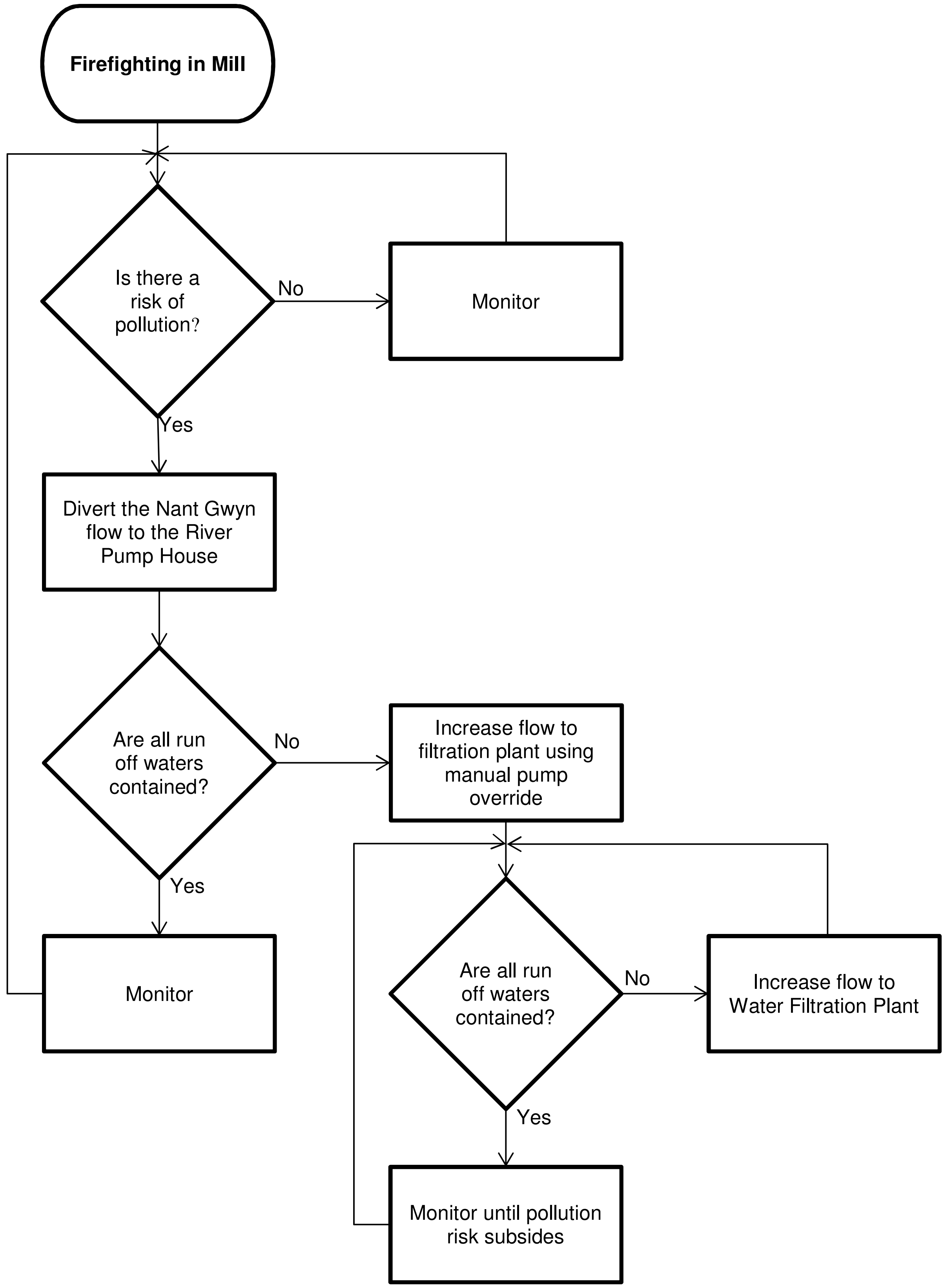
Monitor evacuation of water from river pump house. If insufficient, start river pump P2:

Start river pump P2

1. Select Main menu
2. Select F2 – River Pump House
3. Select Pump P2
4. Click START (The RUNNING box will flash red).

Pump P2 is not inverter-driven and pulls a fixed flow of 6000 l/m. Pump P3 may need its set-point lowered after starting P2. Monitor and adjust regularly throughout the incident.

5. Procedure in event of Firefighting



Problem Solving

What can go wrong?

Since the BOD plant is a dynamic living system, there can be a delay from the initial cause to seeing an effect and consequences within the plant. The time delay can be as long as a few weeks, with a gradual change in mixed liquor populations or as sudden as when the plant is subject to toxic shock.

Problems on the plant follow the path:

Cause → Effect → Consequences

If the plant performs badly, the final effluent will eventually suffer. BOD, Suspended Solids, pH and Ammonia levels are all likely to be affected.

If poor performance is noticed, the effluent must be put onto 100% recycle until such time that the effluent is within consents and settled

Toxic Shock

Some chemicals used in the papermaking process could have a serious effect on the activated sludge plant if they were released to drain in large quantities or even at a lower release rate over a longer time, though the latter is unusual.

There is potential for the biomass of the plant to be either inhibited or even killed off. In either case the final effluent quality is likely to suffer. If the biomass is inhibited BOD removal decreases with a subsequent effect on effluent quality. In the event of a total kill of the plant, the plant would require reseeding with activated sludge.

Accidental spills in the mill will cause problems at the plant and all steps must be taken to ensure tat any such spill is cleaned up and disposed of in a correct manner and not washed to drain.

If poor performance is noticed due to toxic shock, the effluent must be put onto 100% recycle until such time that the effluent is within consents and settled

Foaming

Two types of foam can occur at the BOD plant:-

1. Foaming caused by chemical applications at the mill
2. Biological foaming caused by the growth of certain filamentous micro-organisms.

Chemical foaming caused by process activities can be controlled by the use of defoamers at the balance tank that will suppress foam production and dissipate any foam that may have built up.

Foams are generally chemical initiated and foam up as a white froth at the balance tank and in severe cases at the final effluent.
Slight foaming on the river is normal. This is due to the mixing effect as the effluent hits the river. Normally this will dissipate at 20 – 30metres downstream of the discharge. If foaming becomes more severe defoamer must be used (described below).

If foaming is left untreated the foam becomes brown in colour as the activated sludge organisms become trapped. This can stabilise the foam and lead to significant problems. It is possible for filamentous organisms to grow in the foam and could lead to high suspended solids as the foam breaks up in the final effluent.

Defoamer Use

To add defoamer to the ETP, an IBC of suitable defoamer is set up on a bund near the ditch weir. There are 110v power sockets at that location for a small, outdoor chemical pump. Defoamer is pumped into the weir.
The defoamer pump should be started at a low setting and adjusted accordingly based on the status of the foam.

Denitrification

Can be caused when too much Nitrogen is present in the waste water or produced from ammonia by nitrifying bacteria.

Denitrification can occur in the FST. The Nitrogen gas bubbles become attached to the biomass and can cause the sludge to rise. This can give rise to pinfloccing in the final effluent or worse can cause the biomass to lift in the FST.

Control of Denitrification

1. Control of nutrient addition
2. Maintain a good oxygen level in the mixed liquor flow to the FST

Filamentous Bulking

The most troublesome microbial problem for the BOD plant is filamentous bulking. Filamentous bulking is a gross change in the bacterial ecology of the plant whereby the filamentous bacteria dominate such as Mithothrix parvicella, Sphaerotilus natans and Halocomenabacter hydrosis.

These types of bacteria prevent the usual floc forming. As a result, the sludge becomes difficult to settle and ‘bulks’. This is seen in very high SSVI levels and ultimately the FST blanket can reach the top of the tank and can potentially overflow to the final effluent.

There are several causes of filamentous bulking, but it generally occurs when conditions in the plant are poor. The shape of the floc, long and thin (like cotton) and has a large surface area. This large surface area enables it to absorb food and nutrient much easier than protozoa and metazoa or round floc forming bacteria. In poor conditions the filaments will grow and multiply at a faster rate changing the ecology of the plant.

Some common causes of increased filamentous growth:-

1. Nutrient imbalance – Nitrogen and phosphorous deficiencies
2. Low dissolved oxygen – Oxygen is a vital nutrient and should be maintained at 1 – 2mg/l
3. Slow degrading carbon sources – e.g. starch or paper fibres. High starch uses at the mill could lead to a carry over into effluent streams. Inefficient sludge removal at the primary treatment stage could again lead to carry-over into the BOD oxidation ditch.
4. Intermittent flow and load– If the load varies to the plant it could lead to periods of overloading or under-loading.

Remedial Actions and Controls in the event of filamentous bulking

Long term control of filamentous bulking can be achieved if the cause is identified, but shot term control can be gained by the following:

1. Lower the mixed liquor suspended solids to achieve more settlement in the FST
2. Treat the plant with sodium hypochlorite, as the filamentous are primary feeders and more exposed the kill can be effective
3. Treat plant with selective biocides i.e. biocides that will only kill the filamentous.
4. Dose with coagulants such as PAC (Polyaluminiumchloride) to increase settlement.
5. Bio-augmentation

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Appendix 1

Start up Procedure for Effluent Treatment Monitoring System

If the power is lost to the monitoring system, the system will require manual rebooting.

Procedure

1. Press the on/off button on the front of the computer
2. Enter User name: User Password: User

The system will automatically find the RS View application

If the system appears to lock when in the main page then:-

3. Click on security
4. Enter Username: Ian Password: Ian

The system should now be active

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Appendix 2

Procedure for Responding to Effluent Monitoring System Alarms

The effluent monitoring system situated at Jupiter machine control room is a comprehensive monitoring system for overseeing the process activities. There are several pages that show Plant overview, process trends, plant status and plant alarms. In addition to this, all trends and alarms are captured in the PI system.

In order to comply with the IPPC permit No. BJ5805ix, Bridgend Paper Mill **must** monitor the effluent treatment plant 24 hours a day seven days a week. During normal working hours this is overseen by day personnel. Out of hours monitoring is done by shift personnel. **All** problems with the system must be reported immediately

Records of alarms are automatically recorded in PI.
Note - Alarms are stored on the PC, but **do not** alert the user to an active alarm**.**

Procedure

1. F12 main menu

2. Scroll through Trends, Status and Alarm pages noting any alarms or high/low levels, trips or adverse trends

3. If an alarm, tripped motor is identified, or a trend is nearing consent, visit effluent treatment plant and take appropriate action.

4. Make notes of alarm and action taken in the monitoring log

5. If further action/backup is required, contact day personnel on emergency contact numbers (These numbers are held by the mill shift manager).

Permitted levels

	Minimum	Maximum	95%ile
BOD mg/l	n/a	10mg/l	5mg/l
Suspended Solids mg/l	n/a	40mg/l	25mg/l
pH	6.5	8.0	n/a
Temperature ° C	n/a	25	Daily Average
Discharge Flow m^3/day	n/a	17500	n/a
Ammonia mg/l	n/a	1.0	n/a

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Sludge Identification

6 Protozoa and metazoa

Protozoa, and frequently also metazoa, are almost always present in activated sludge. Some species are attached to the flocs whereas others are free in the water between the flocs. These organisms are (much) larger than bacteria, their 'length' varying from 10 to 10,000 µm (table 2). In addition, they also possess a characteristic shape. On account of the combination of characteristics, they are very conspicuous on a microscopic slide.

Table 2 *Order of magnitude of(micro-)organisms in activated sludge*

Group	Cell length (µm)	Remarks
bacteria	1–5	occasional colonies or filaments
protozoa		
-flagellates	10–30	occasional colonies
-amoeba	30–400	
-testate amoeba	30–200	
-heliozoa	40–200	
-ciliates	25–400 [1)]	occasional colonies
metazoa		
-rotifers	100–500	
-nematodes	500–3,000	
-tardigrades	200–1,200	
-worms	3,000–10,000	

1) A few species are much longer (up to 1000 µm)

Many protozoa/metazoa mainly feed on bacterial cells which are present free in the liquid or at the edges of the flocs. In this manner they remove many bacterial cells that are not firmly bound to the flocs. Free bacterial cells cannot be separated from the treated water through settling in the final clarifier. Protozoa are also indispensable for a far-reaching COD reduction, viz. a clear effluent.

Furthermore, protozoa/metazoa that consume sludge flocs (~ reduction of the sludge production) or consume other protozoa also exist.

The presence of certain species is relevant for the process conditions in the treatment plant. Assessing the composition of the population is, therefore, an important aspect of microscopic sludge investigation. This indicator function is further referred to in paragraph 6.3.

More than 200 different strains can be observed in activated sludge. Identification of these organisms is not really very easy and requires specialist knowledge. It is also unnecessary to identify all of these species for the purpose of process monitoring, distinguishing the most important main groups is sufficient. The following paragraphs contain a short description of these main groups, referring to several species that are regularly observed in activated sludge.

6.1 Protozoa

Like bacteria, protozoa are single celled organisms. As long as the sludge loading level is not extremely high, they are present in practically every activated sludge. Their population is always much smaller than that of the bacteria. The biomass of protozoa present in the treatment plant comprises, at most, a few percent of the total biomass.

Protozoa are divided into four groups:
. ciliates
. flagellates
. amoeba;
. testate amoeba;
. heliozoa

6.1.1 Ciliates

Ciliates are characterised by the presence of cilia (= vibrating hairs) on their cell surfaces. For some ciliates, the surface is completely covered with cilia whereas other species are only partly covered. Ciliates also exist which cilia are only present during a certain phase of their lives.

For many species, the cilia are arranged in a certain manner around the mouth openings. As a result, these cilia make the water flow in their vicinity. They fan, as it were, the food towards their mouth openings. These nutrient particles are subsequently taken up from the water by filtration. In addition, cilia contribute to the locomotion of several species.

Ciliates take in food particles by means of their mouth openings. According to the type of organism, this food can comprise organic fragments as well as bacterial cells or other protozoa. Therefore, predation plays an important part within such a mixed population. Some examples are given below:

. ciliates that mainly eat bacteria: *Aspidisca, Blepharisma, Carchesium, Colpidium, Chilodonella, Epistylis, Opercularia, Vorticella;*
. omnivorous species that consume bacteria as well as flagellates and small ciliates: *Euplotes, Stentor;*
. carnivorous species that mainly eat other ciliates: *Litonotus, Trachelophyllum, Hemiophrys, Suctorea.*

Bacterial cells transported with the influent form an important source of nourishment for ciliates. Sewage contains some tens of mg/l of bacterial cell material, a level that can also vary markedly according to the type of sewer, the weather conditions, the time of year, etc. The number of cells that are consumed is closely linked to the format of the organism. In this manner, small ciliates consume ca. 10 cells/min., larger ones *(e.g.'Opercularia)* more than 10 times as much whereas some nematode strains consume 5000 cells/min. Ciliates mainly exploit their food for the production of new cells. Movement costs little energy. As a rule of thumb, it is reckoned that 50% of the available food is used for cell synthesis.

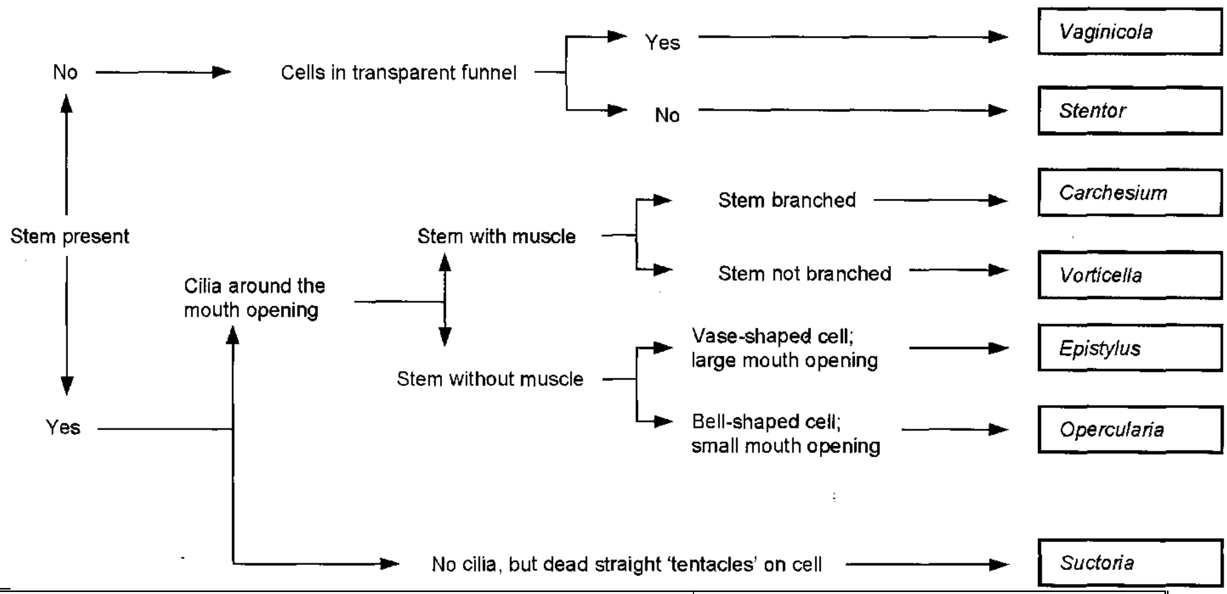
If the oxygen concentration is adequate, the size of the population is principally determined by the sludge load applied and the related sludge age. The population is at its maximum at a sludge load of ca. 0.3 kg BOO/kg MLSS.day (order of magnitude: 10^3-10^4 cells per ml). Fewer bacterial cells are available at lower sludge loading levels (floc more robust and relatively less transport with the influent), leading to a smaller ciliate population. At higher sludge loading levels, the sludge age is so short that the relatively slow-growing ciliates cannot be maintained in the sludge any more.

Quantities of thousands of specimens per millilitre are very suggestive of, and lead easily to, an over-estimation of the contribution of the ciliates to the total treatment process. The influence of a given group of organisms is not actually determined by quantity, but in terms of its contribution to the total amount of biomass in the treatment plant. The mass of several strains that frequently occur in activated sludge can vary from 0.1 ng to 10 ng, with peaks to 80 ng for *Stentor roesili,* a 'giant' among the ciliates. With 1 ng and 5000 specimens/ml and a total sludge concentration of 4 g/l, only 0.5% of the total biomass will comprise ciliates. The actual contribution of ciliates (and that of the other protozoa) to the total treatment performance is consequently very subordinate to that of bacteria.

Ciliates are subdivided into sessile (= attached), crawling and free-living species.

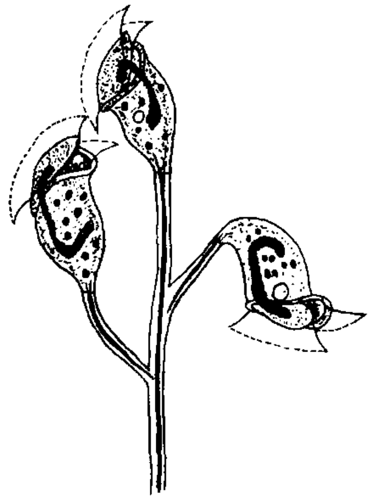
6.1.1.1 Sessile ciliates

The cells of sessile ciliates are usually positioned on a stem which is often attached to a sludge floc. The stems are branched in some strains, through which colonies of sometimes numerous cells arise. Fig. 68 represents an identification key for distinguishing sessile ciliates commonly occurring in activated sludge.



Carchesium

Carchesium is a sessile ciliate with bell-shaped cells. These cells have a diameter of 50-125 µm. There is a wreath/ring of cilia around the mouth opening and the rest of the cell surface is bare. The stem contains a contracting 'muscle'. The stems are mostly branched, thereby creating colonies. These colonies can reach a diameter of a few mm. The 'muscle' in the stem is interrupted at the points where branching occurs.



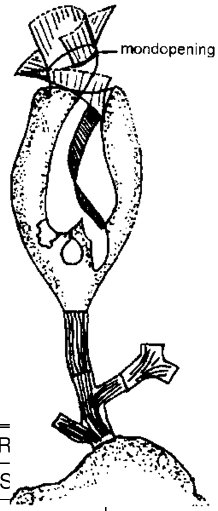
Carchesium sp. commonly occur in activated sludge at a sludge load less than ca. 0.2 kg BOD/kg MLSS.day.

Epistylis

Epistylis has somewhat 'vase' -shaped cells. They have a diameter of 70-100 µm. The stem is usually branched, which causes colonies to arise, but does not contain a 'muscle'. Therefore, the stems cannot contract (the cell actually does). The colonies can reach macroscopic dimensions (mm).

Epistylis sp. occur commonly in activated sludge, especially at sludge loading levels of 0.1 to 0.2 kg BOD/kg MLSS.day.

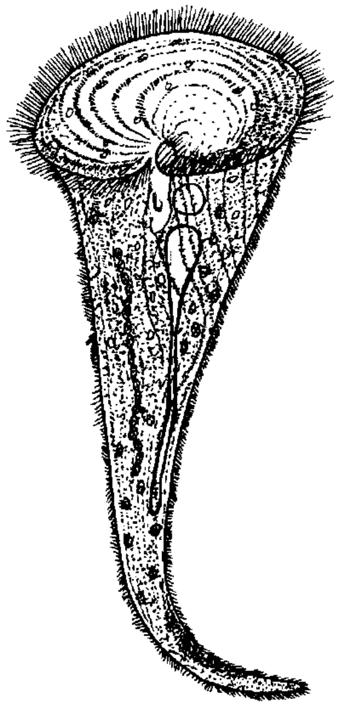
Opercularia



Opercularia has somewhat bell-shaped cells. The cell diameter is approximately 140 µm. The stems are branched, causing colonies to form. A non-contracting 'muscle' is present in the stem. In comparison with the other sessile ciliates, *Opercularia* has a small mouth opening.

Opercularia sp. mainly occur at higher sludge loading levels (0.2 to 0.3 kg BaD/kg MLSS.day).

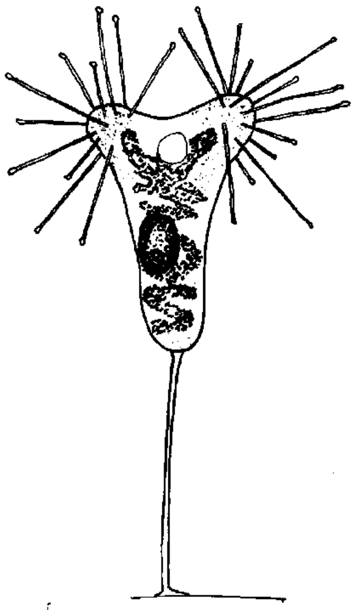
Stentor



Stentor is a ciliate with a very characteristic trumpet-shaped cell. It is usually, but not always, attached to a sludge floc. A wreath of cilia for transporting water and nutrient particles to the mouth opening is present at the broad extremity. The cell length can vary from 150 to 500 µm. It is, therefore, a large ciliate. *Stentor* does not possess a stem.

Stentor is chiefly observed in low-loaded treatment plants.

Suctoreans



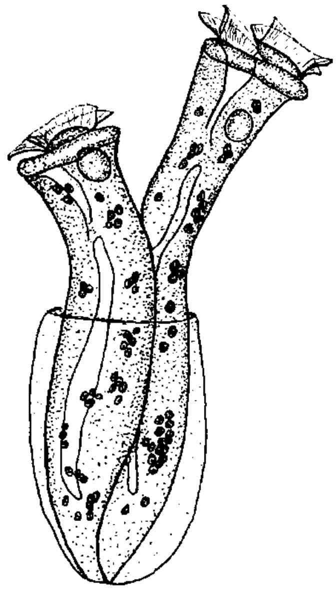
Suctoreans are ciliates, although cilia are absent on adult cells. The cilia disappear when the cell forms a stem with which the organism can attach itself to a surface, e.g. an activated sludge floc. Adults are therefore sessile. Some very characteristic, dead straight tentacles are present on the cell surface. These tentacles are thicker than the straight pseudopoda of the heliozoa. For most suctoreans, a small knob is present at the extremities of all the tentacles. This is a type of mouth for catching protozoa, which are sucked empty. Protozoa form the most important source of food for suctoreans. Depending upon the strain, both round and vase shaped cells can be observed in activated sludge. The cells in activated sludge usually measure 50-100 µm in length.

Suctoreans are regularly observed in activated sludge. The population is generally always small.

Vaginicola

Vaginicola is a sessile ciliate with a trumpet shaped cell. The cell is contained in a distinctly transparent funnel. Two cells are often present in this funnel. The cell can contract, meaning that it can disappear completely into the funnel. A wreath of cilia, which transports water and nutrient particles to the mouth opening, is present on the 'head' of the cell. The cell measures approximately 100 µm in length.

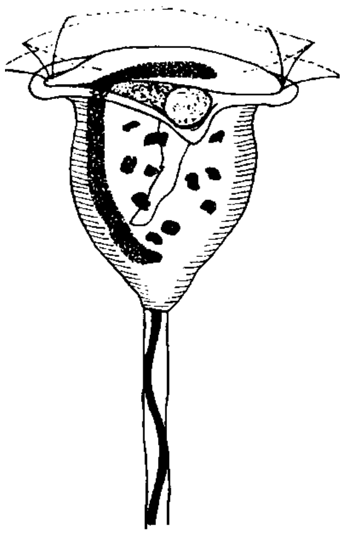
Vaginicola is chiefly observed in low loaded plants (oxidation ditch conditions).



Vorticella

Vorticella is a sessile ciliate whose cells measure 50-150 µm. These are somewhat bell shaped. A wreath of cilia is present around the mouth opening by which the organism directs water (containing nutrients) towards the mouth opening. The stem is never branched, meaning that *Vorticella* is a solitary organism. A contracting muscle is present in the stem.

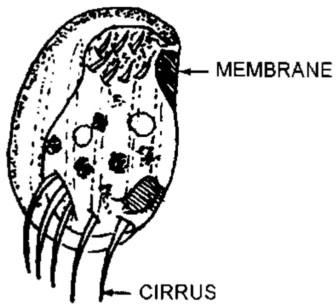
Vorticella sp. commonly occur at sludge loading levels < ca. 0.4 kg BOD/kg MLSS.day.



6.1.1.2 *Crawling ciliates*

The representatives of this group 'crawl' over the sludge floes and graze their surfaces. Bacterial cells that are not firmly attached to the floes are removed in this manner.

Aspidisca



Onderkant

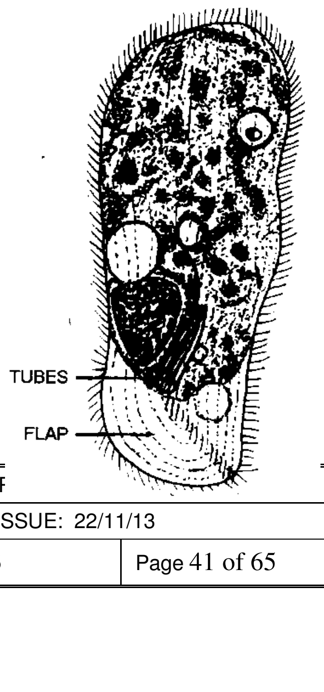
Zij-aanzicht

Aspidisca is a ciliate that crawls, often at a high speed, over the floes. Seen from above, the cell is round whereas the side view is more oval shaped. A distinct mouth opening is absent. Five ridges are present on the 'back'. The cilia are not individually implanted on the body but are present as cirri. Cirri are small bundles of cilia that come to a point and look like small feet. There are seven cirri on the front ventral side and five or more on the back of the cell. The cilia also form a membrane! ('strips' of cilia that are stuck together).

The sizes of the different Aspidisca strains can vary from 30 to 50 µm. The very common species Aspidisca costata has a diameter of 30µm. Aspidisca resembles Euplotes, which is larger (30-1 00 µm) and does not crawl over the floes.

Aspidisca occurs very frequently. As long as the sludge load is not too high <ca. 0.4 kg BOD/kg MLSS.day), this ciliate can be observed in almost every activated sludge.

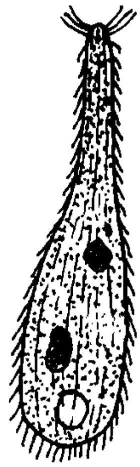
Chilodonella



Chilodonella is a crawling/grazing ciliate whose most important characteristic is an almost transparent flap on the front side. This flap often curls up when the organism crawls over the floc. Seen from the side, this flattened flap is also clearly recognisable. The mouth opening is surrounded by a bulge in the shape of a short tube. The cell length can vary from 40 to 125 µm.

Chilodonella commonly occurs in activated sludge if the sludge load is < ca. 0.2 kg BOD/kg MLSS.day.

Trachelophyllum



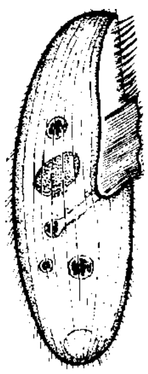
Trachelophyllum species are characterised by their flat, elongated cells, which are completely covered with cilia. The cilia are longer around the mouth opening and are ordered in a characteristic manner (bowed 'moustache hairs'). *Trachelophyllum* usually move rapidly through the water between the floes, but can also be observed crawling over them. The most common representative of this strain is *Trachelophyllum pusillum,* which has a cell length of 30 to 50 µm.

Trachelophyllum is a very commonly occurring ciliate at sludge loading levels less than ca. 0.4 kg BOD/kg MLSS.day.

6.1.1.3 Free-living ciliates

As the name suggests, these ciliates move freely in the water between the floes. The speed at which they move is highly variable.

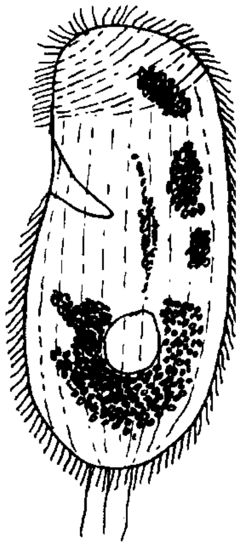
Blepharisma



The (light) pink cells of *Blepharisma* are very characteristic. These free moving ciliates have somewhat oval cells of 200 µm in length. A zone with strips of relatively long cilia is present near the mouth opening. The cilia transport water, containing nutrients, to the mouth opening.

Blepharisma is mainly observed at some higher sludge loading levels (0.1-0.4 kg BOD/kg MLSS.day).

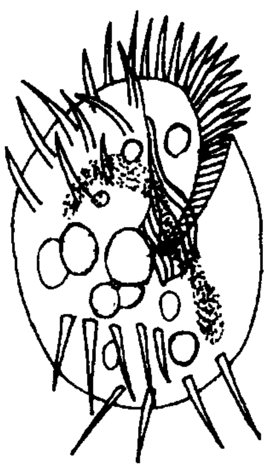
Colpidium



Colpidium is a free-moving ciliate possessing a kidney-shaped cell. The cell surface is covered with cilia. A few long vibrating hairs are present on the back of the cell. The zone around the mouth opening is dented inwards. The most usual species *(Colpidium colpoda)* has a cell length of ca. 100 µm.

Colpidium is less frequently observed than the other free-moving ciliates. This ciliate probably occurs most commonly at sludge loading levels of 0.1-0.4 kg BOD/kg MLSS.day.

Euplotes



Euplotes is a free-swimming ciliate with oval cells. The cilia are stuck together as cirri. There are nine cirri present on the front side and five on the back. These cirri function as pseudopoda. There is also a characteristic strip of joined cilia present on the cell, which transports nutrients to the mouth opening. Six ridges are present on the upper surface of the cell. The sizes of the different strains can vary from 30 to 100µm.

Euplotes resembles *Aspidisca,* but is usually bigger and is free swimming.

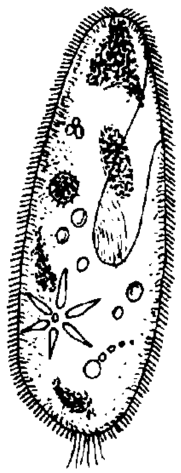
Euplotes commonly occurs in activated sludge, principally at sludge loading levels of 0.1-0.2 kg BOD/kg MLSS.day.

Litonotus (Lionotus)

The cells of *Litonotus* are shaped like a bottle (amphora). The neck, which is almost as long as the rest of the cell, is slightly bowed. The total length of the cell is ca. 100 µm.. The cilia on the outside of the neck are longer than those on the remainder of the cell surface. *Litonotus* usually moves through the water in an 'elegant' manner.

Litonotus commonly occurs in sludge loading levels lower than ca. 0.4 kg BOD/kg MLSS.day.

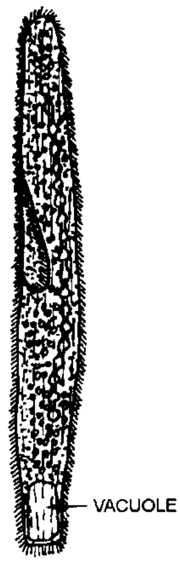
Paramecium



Paramecium is a free-moving ciliate whose cells slightly resemble slippers. It is a large ciliate. Cell length can vary from 180 to 300 µm. The cell surface is covered with cilia. The nucleus of the cell is large and usually clearly visible. The contractible star-shaped vacuole is very characteristic.

Paramecium is primarily observed at sludge loading levels of 0.1-0.3 kg BOD/kg MLSS.day.

Spirostomum



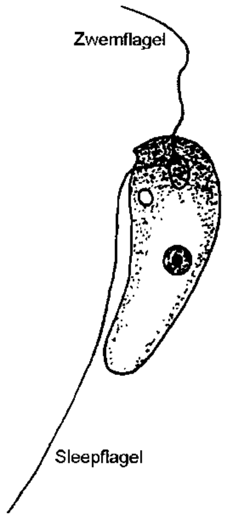
Spirostomum has a markedly elongated, flexible cell covered with cilia, with a characteristic vacuole present at the extremity. *Spirostomum* usually moves quickly through the liquid between the flocs. It is the largest ciliate present in activated sludge, the cell length varying from 500 to 900 µm.

Spirostomum commonly occurs in activated sludge, particularly in treatment plants with sludge loading levels less than ca. 0.2 kg BaD/kg MLSS.day.

6.1.2 Flagellates

Flagellates derive their name from the fact that they possess one or more (usually no more than eight) flagella. The flagella are longer than the cilia of ciliates. On account of their rapid movement, the flagella are quite often not clearly visible. The flagella assist the movement of the cell. Some species have a mouth opening with which they can consume nutrient particles such as bacteria cells. Other strains absorb dissolved nutrients through their cell walls. Because of their diameters of 10-30 µm, flagellates are noticeably smaller than ciliates. Therefore, a 40x objective should be used for microscopic viewing.

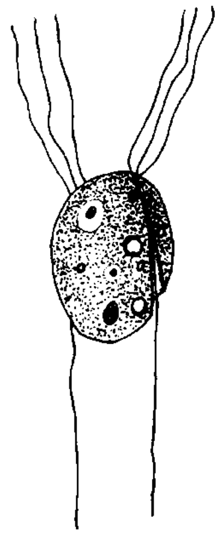
Bodo



Bodo is a free-swimming flagellate, which propels itself with a characteristic jerky movement. There are two flagella present, one swimming flagellum and one trailing flagellum at the rear. The flagella are longer than the oval cell. The cell wall is dented at the point where the flagella are implanted. The flagella are not always clearly visible. The cells are approximately 15 μm in length.

The presence of *Bodo* sp. indicates a high sludge load (> ca. 0.4 kg BOD/kg MLSS.day) and/or a lack of oxygen.

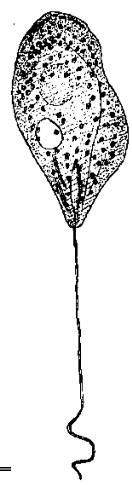
Hexamitus



Hexamitus is a free-swimming flagellate which moves rapidly in a straight line through the water (but does not rotate like *Trepomonas).* There are two groups of three flagella on the front side and two trailing flagella behind. The cell is somewhat oval-shaped and has a diameter of approximately 20 /lm.

The presence of *Hexamitus* indicates a high sludge load (>ca. 0.4 kg BOD/kg MLSS.day) an/or a lack of oxygen.

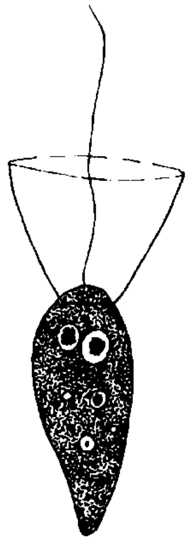
Peranema



Peranema is a free-swimming flagellate with a very characteristic, long, thick flagellum. A second much thinner (trailing) flagellum is also present, but this is hardly ever visible. Only the tip of the flagellum moves when the cell is in motion. The cell is usually 20-30 μm long.

This flagellate is regularly observed in activated sludge. In contrast to most other flagellates, the presence of *Peranema* is not indicative of specific process conditions such as a high sludge load or a lack of oxygen.

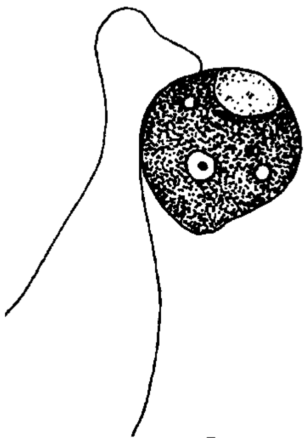
Monosiga



The cell is spherical to oval. A collar is present on its 'top' through which the flagellum emerges. *Monosiga* is usually fixed to a sludge floc. The cells are 1-15 µm in length.

The presence of *Monosiga* indicates a high sludge load (> ca. 0.4 kg BOD/kg MLSS.day) and/or a shortage of oxygen

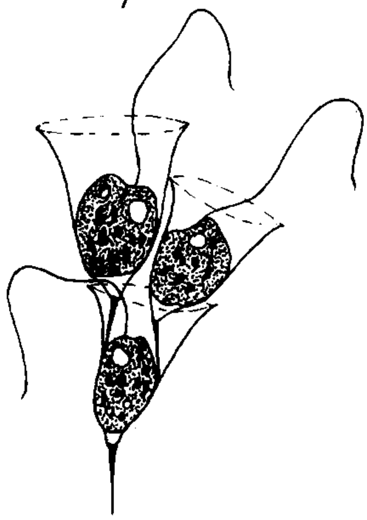
Pleuromonas



Pleuromonas is a flagellate that moves in a characteristically rapid and jumpy manner. The cells are usually not free-living in the water but are attached t2 the floes. *Pleuromonas,* like *Bodo,* has two flagella. The cell is attached to the floc by the longest flagellum. Cell diameter is 5-10 µm.

The presence of *Pleuromonas* indicates a high sludge load (> ca. 0.4 kg BOD/kg MLSS.day) and/or a shortage of oxygen.

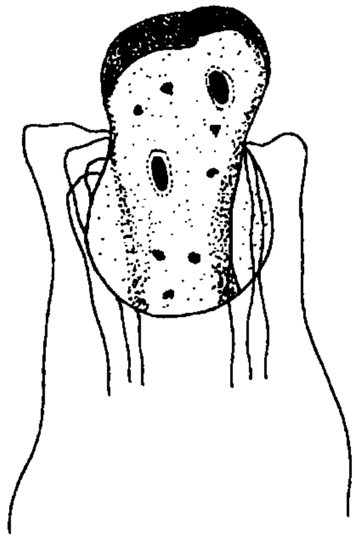
Poteriodendron



Poteriodendron is a flagellate whose most important characteristic is that it forms colonies of cells. The cells are contained in transparent funnels. These funnels are joined together into colonies by stems on their undersides. The diameters of the individual cells are ca. 20 µm. The cells have a flagellum which allows them to move inside the funnel but they cannot leave it.

Poteriodendron colonies are regularly observed in activated sludge. It is not known if this flagellate can be used as an indicator organism.

Trepomonas



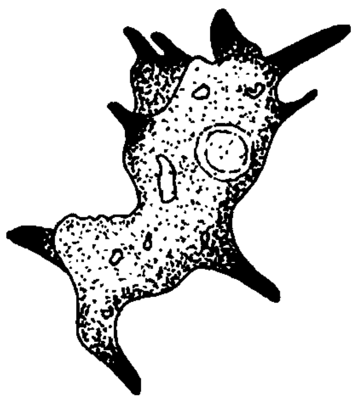
Trepomonas is a free-swimming flagellate which moves through the water in a characteristic rotating manner. Seen from above, the cell is oval and from the underside it is spherical. The cells measure approximately 20 µm in length. *Trepomonas* possesses two groups of four flagella which are implanted on the side of the cell. Besides two long (20 µm).flagella, six short (8 /lm) ones are also present

The presence of *Trepomonas* indicates a high sludge load (> ca. 0.4 kg BOD/kg MLSS.day) and/or a lack of oxygen.

6.1.3 Amoeba, testate amoeba and heliozoa

These organisms have in common that they can form pseudopoda. These pseudopoda are temporary extensions of the cell content.

Amoeba

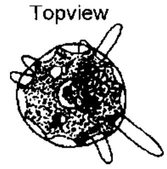


Amoeba are single-celled organisms possessing a flexible cell membrane which allows the shape of the cell to constantly change. They absorb nutrient particles (bacteria cells, other protozoa, etc.) by engulfing them. This resembles the uptake of food by a mouth opening. The sizes of the various strains range from 50 to 400 µm. Amoeba can be as big as a sludge floc and their particular structure sometimes resemble sludge floes. Apart from the odd exception, amoeba move extremely slowly (by means of the pseudopoda).

Amoeba are characteristic of somewhat higher sludge loading levels (0.1-0.4 kg BOD/kg MLSS.day) and/or shortages of oxygen. They are seldom observed in low loaded nutrient removal plants.

Testate amoeba

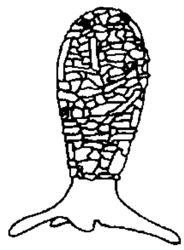
ARCELLA
Topview



In this group of amoeba, the cell is surrounded by a type of shell. There is an opening in the shell through which the pseudopoda can protrude. These pseudopoda are seldom visible on a microscopic slide. The cell form (round, beaker shaped, etc.) depends on the species in question.

ARCELLA
Sideview

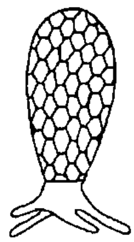
Arcella is a testate amoeba with a shell which, when seen from above, is round. The side view resembles the top of a toadstool. The shell has a clearly observable structure. In general, the shells are practically transparent, but in activated sludge they are usually coloured yellow-brown on account of the precipitation of iron compounds on their surfaces. The round opening on the underside of the shell is very characteristic.



DIFFLUGIA

The structure of *Euglypha* shells largely resembles that of a honeycomb. The sizes of the various testate amoeba can vary from 30 to 200 µm.

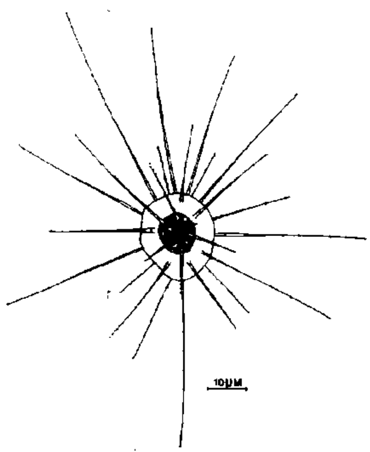
Testate amoeba are almost always present, and often in large numbers, in low-loaded activated sludge plants. *Arcella* is the most commonly occurring species. It mainly occurs under nitrifying conditions.



EUGLYPHA

Heliozoa

Heliozoa belong to the amoeba. They have spherical cells which are surrounded by needle thin, dead straight, retractable pseudopoda. The pseudopoda are not used for propelling the cell but for catching bacteria and protozoa. Organisms that come into contact with the pseudopoda are 'paralysed' after which they are consumed by the heliozoa. The cell diameter can vary from 40 to 100 µm.



Heliozoa are principally observed in low-loaded activated plants. The population is usually small.

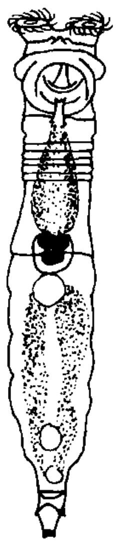
6.2 Metazoa

In contrast to bacteria and protozoa, metazoa are multi-cellular micro-organisms, meaning that they are 'higher' organisms. The sizes of the different species can vary from 100 µm to sometimes as much as 1-2 cm. Most metazoa feed on free-living bacteria cells or on very small floc particles. Species also exist that can consume whole sludge flocs.

The following metazoan groups can be present in activated sludge:
- Rotifers
- Nematodes
- Worms
- Tardigrades

Apart from exceptional cases, metazoa play a subsidiary role in activated sludge treatment plants. They are mainly observed at sludge loading levels lower than ca. 0.15 kg BOD/kg MLSS.day. To register the number of metazoa, a scale varying from 0 (= absent) to 3 (= numerous organisms/slide) is used.

6.2.1 Rotifers



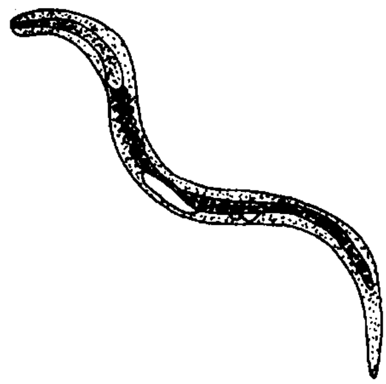
Rotifers are relatively large, distinctly mobile and elongated multi-celled organisms. The body length can vary from 100 to 500 µm and is surrounded by a type of armour into which the head and tail can be withdrawn. A few bunches of cilia are present on the head of the organism. These cilia can create a current in the direction of the mouth opening. They have a set of 'jaws' around their mouth openings by which they can crack particles filtered from the water. Particles larger than about 10 µm cannot actually fit in this mouth opening. Rotifers, therefore, principally consume free-living bacteria cells and small floc particles.

The tail is branched in a characteristic manner and is important to the movement of the organism. With this, a rotifer first attaches itself, after which the body is stretched. The tail is subsequently released, the head stays in place and the abdomen is drawn up. This manner of propulsion resembles the manner in which a slug moves.

Rotifers commonly occur in activated sludge with low loading levels. The size of the population is nearly always very limited in domestic treatment plants. Large numbers of rotifers are sometimes present in plants treating waste water from the agro- industry.

6.2.2 Nematodes

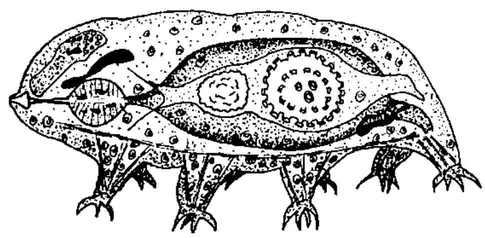
Nematodes have elongated, cylindrical and very flexible bodies. The extremities of this multicelled micro-organism are thinner than its central section. The cell length can vary from 0.5 mm to 3 mm. They are larger than most protozoa. They principally consume free-living bacteria cells and very small floc particles. They swallow/engulf food particles by contraction of the oesophagus. Owing to the fact that they do not possess 'jaws' and that their mouth openings are small, they cannot consume intact flocs. These exceptionally mobile animals are sometimes difficult to keep in focus during microscopic investigation. In addition, nematodes often 'crawl away' into the flocs and it can be a while before they reappear.



Nematodes are regularly observed in activated sludge with a low loading level, but they are almost never present in large numbers. It is not known if nematodes can be used as indicators for given process conditions.

6.2.3 Tardigrades

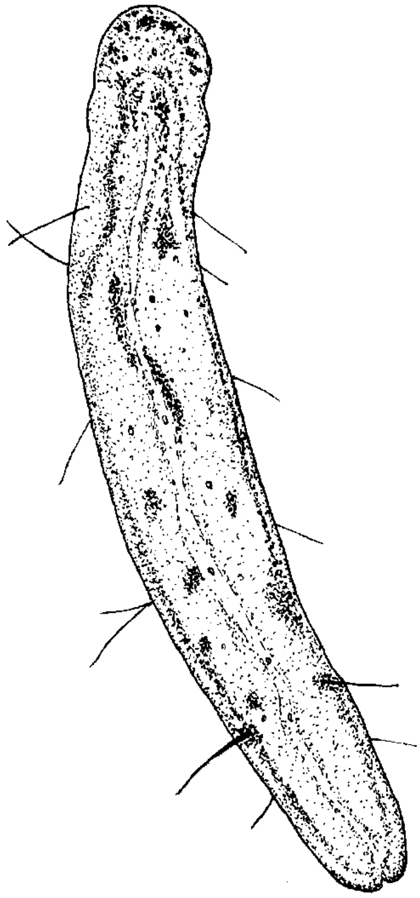
This is a multi-celled organism with a very striking form. A tardigade, sometimes known familiarly (to the experts) as a water bear, has pseudopoda with small claws, with which it crawls over the flocs and grazes them. This organism moves around somewhat awkwardly when free in the water. The size can vary from 200 to 1200 μm.



Tardigrades are occasionally observed at sludge loading levels of < 0.1 kg BaD/kg MLSS.day.

6.2.4 Worms

Worms are the largest organisms observed during the microscopic investigation of activated sludge. With diameters of approximately 0.1 mm and lengths to a maximum of 10 mm, their presence is very apparent on a wet slide. Oligochaeta are almost always involved, often *Nais elingius* and *Aelosoma* spp. Worms are able to consume sludge flocs or particles of flocs. A worm bloom (ca. 10^5 worms/I) is also connected with a reduction in sludge production.



Little is known about the growth of worms in activated sludge plants. They do not grow particularly slowly. Under the best of conditions they have a generation time of a few days. More than enough nutrients, in the form of sludge flocs, seem to be present. Consequently, one would expect worms to be present in virtually all treatment plants. However, they are not often observed at low sludge loading levels (oxidation ditch conditions). Sludges containing many worms usually originate from treatment plants with a sludge load of ca. 0.1 kg BOD/kg MLSS.day and in which the influent is pre-settled. A definite connection between their presence or absence and the process conditions is usually missing.

6.3 Indicator function

A new activated sludge plant can be started by opening the sewage supply and switching on the aeration system. Sludge flocs subsequently arise spontaneously in the aeration tank. These are removed in the final clarifier and recycled into the aeration tank. By constantly adding fresh sewage, without withdrawing the sludge from the system, the desired biomass concentration can be cultivated within a few weeks. During the start phase, the sludge loading level is constantly reduced and the treatment performance is increased.

A shift within the protozoa population takes place simultaneously, which is actually a characteristic succession of species. Many free-living bacteria cells (> 10^8 cells/ml) are present during the first days and the compounds, which have been transported with the sewage, are not yet fully processed by the bacterial biomass. An excess of food for flagellates and amoeba is created, and they also develop *en masse.* After a few days also free swimming ciliates appear. The numbers of flagellates and amoeba are reduced considerably thereafter. Because of the increase in the sludge concentration, the sludge load decreases constantly during such an initial phase. A subsequent scarcity of nutrients automatically results in a decrease in the growth rate of the free-living ciliates.

Many species disappear as soon as their population doubling rate exceeds the hydraulic retention time in the aeration tank. At this stage, the ciliates that are attached to the sludge flocs (e.g. *Vorticella),* or those that crawl over them (e.g. *Aspidisca),* appear and, therefore, are not easily washed out. This explains the domination of attached and crawling species at low sludge loading levels. Thecamoeba, and sometimes metazoa, also eventually appear with long sludge ages. By this time, a high level of treatment performance, including extensive nitrification, takes place; the number of bacterial cells that are not bound to the flocs is less than 10^6/ml.

Therefore, other strains grow as the treatment performance rises. This fact can also be used in the opposite sense: the presence of certain strains says something about the treatment results and the process conditions.

The connection between the sludge load and the composition of the population is shown systematically in Fig. 69. During the microscopic investigation of the sludge, it should be checked that the species present are characteristic for the load applied in the treatment plant. If the sludge load is not too high, mainly ciliates, testate amoeba and occasionally some metazoa should be present. A shortage of oxygen in a low loaded plant results in a decline of the COD removal rate and causes, therefore, a shift towards flagellates and amoeba within the population

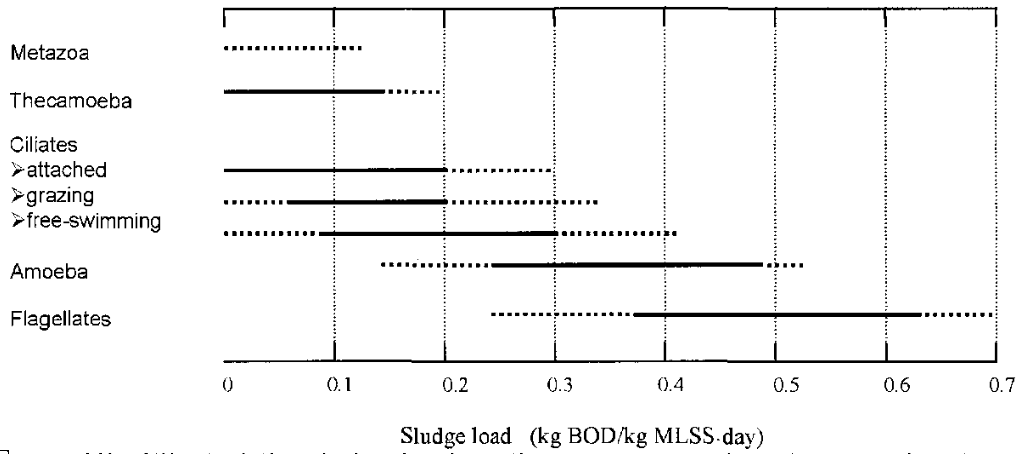
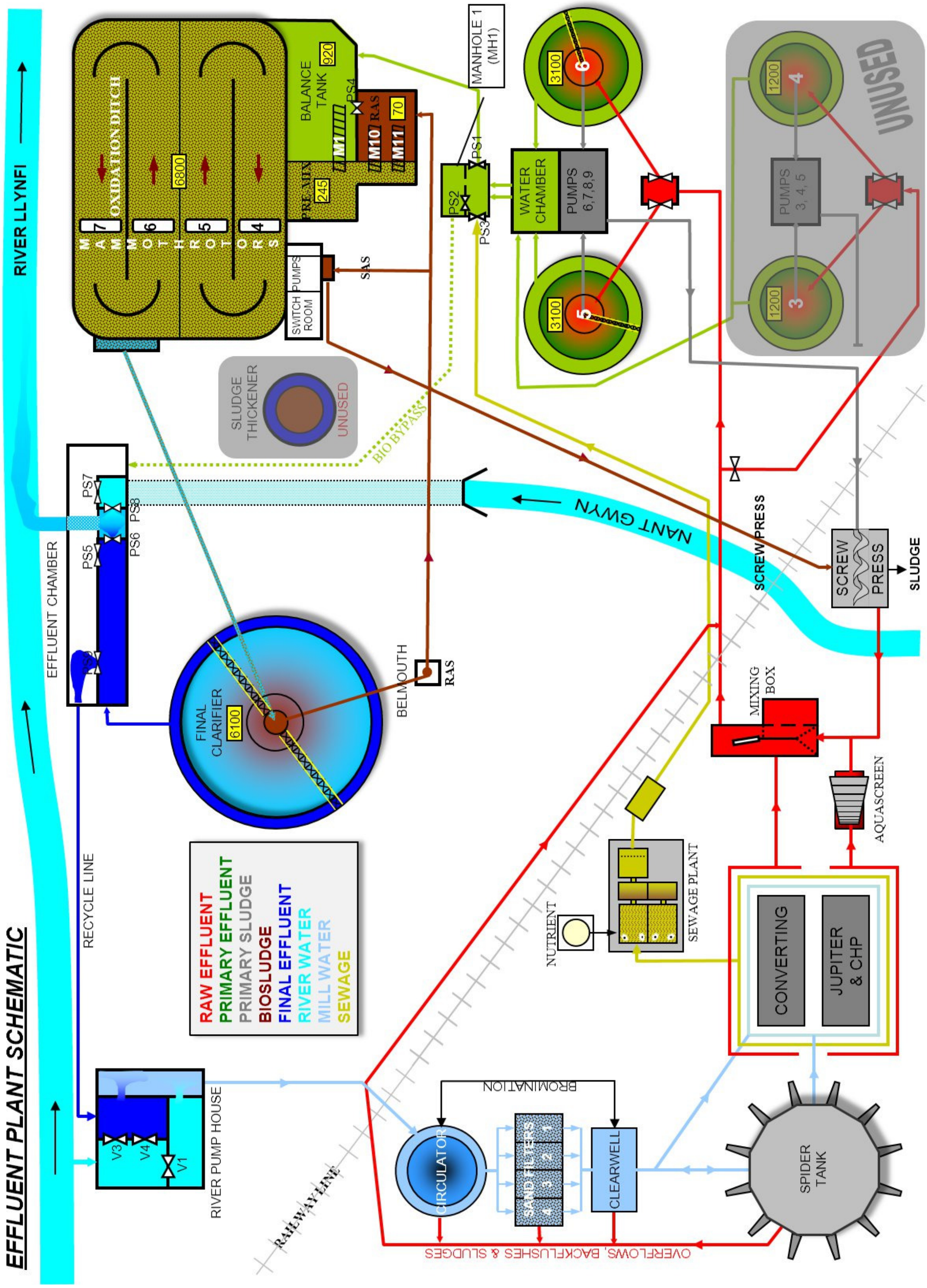


Figure 69 Effect of the sludge load on the occurrence of protozoa and metazoa (no lack of oxygen).

If protozoa and metazoa suddenly disappear, then toxic components are present in the influent. This can be followed within a few days by an explosive increase in the number of protozoa, because the number of free-living bacterial cells has considerably increased during their absence.

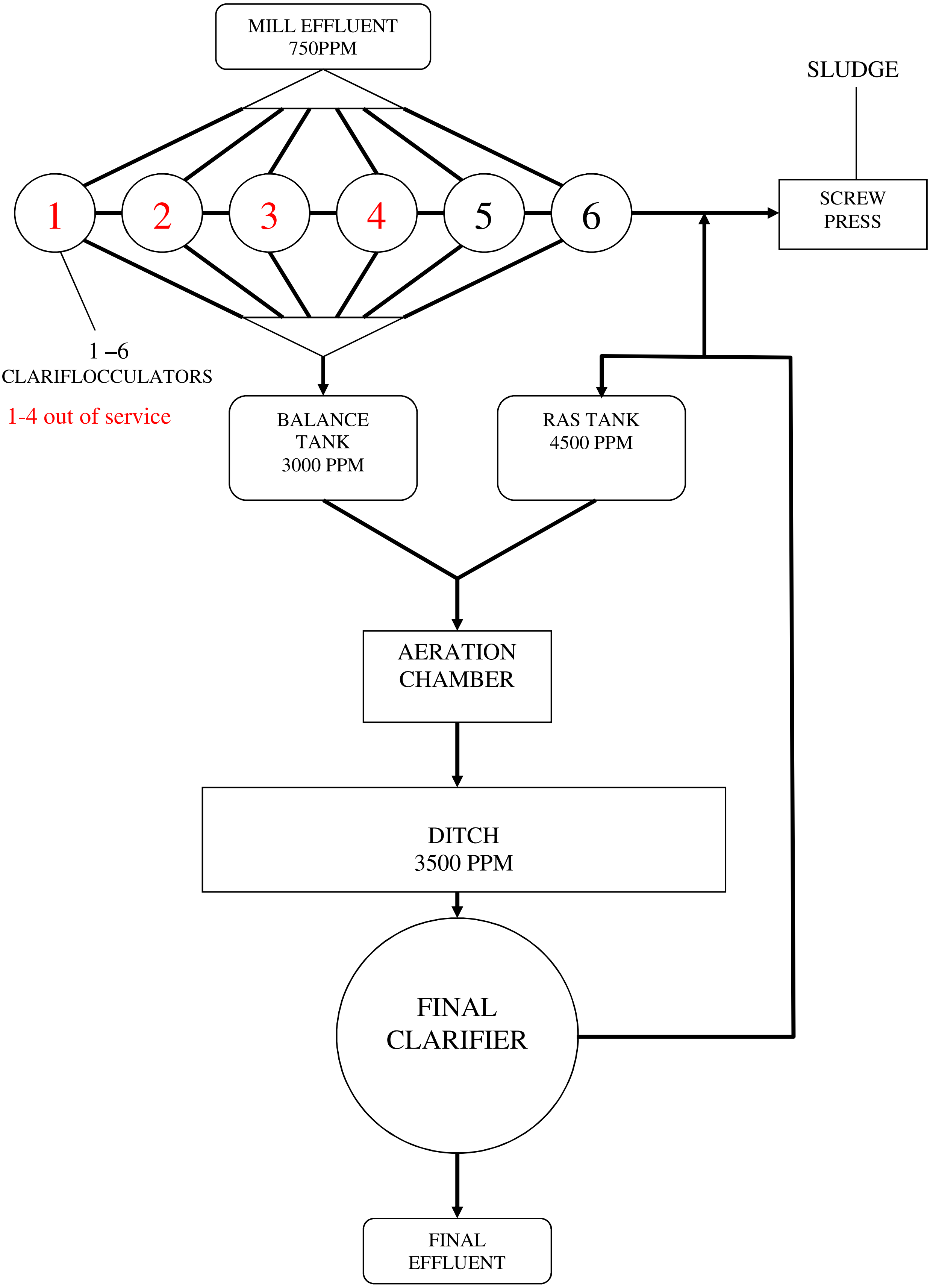
A strong increase in the number of worms in activated sludge can cause a decrease in the production of surplus sludge (see paragraph 9.7).

Appendix 4


EFFLUENT PLANT SCHEMATIC
RIVER LLYNFI
OXIDATION DITCH
6800
MAMMOTH ROTORS
7
6
5
4
BALANCE TANK
920
PREAIN
245
RAS
70
M1
M10
M11
PS4
SWITCH ROOM
PUMPS
SAS
MANHOLE 1 (MH1)
PS1
PS2
PS3
WATER CHAMBER
PUMPS 6,7,8,9
3100
6
5
1200
4
3
PUMPS 3, 4, 5
UNUSED
SLUDGE THICKENER
UNUSED
BIO BYPASS
EFFLUENT CHAMBER
PS5
PS6
PS7
PS8
NANT GWYN
SCREW PRESS
SLUDGE
FINAL CLARIFIER
6100
BELMOUTH
RAS
MIXING BOX
AQUASCREEN
SEWAGE PLANT
NUTRIENT
CONVERTING
JUPITER & CHP
RECYCLE LINE
RAW EFFLUENT
PRIMARY EFFLUENT
PRIMARY SLUDGE
BIOSLUDGE
FINAL EFFLUENT
RIVER WATER
MILL WATER
SEWAGE
RIVER PUMP HOUSE
V1
V3
V4
RAILWAY LINE
BROMINATION
CIRCULATOR
SAND FILTERS
1
2
3
4
CLEARWELL
SPIDER TANK
OVERFLOWS, BACKFLUSHES & SLUDGES

Appendix 5

Effluent Treatment



Appendix 6

Procedure for Restarting BOD Plant After Power Dip or Power Loss

On loss of power to the effluent treatment plant, the plant must be checked to ascertain what parts of the plant require resetting and or restarting. Refer to the table below for normal process running conditions.

Pump/Motor	Status	Mode
M1	Run	Manual
M10	Run	Manual
M11	Standby	Auto
M4	Run	Manual
M5	Standby	Auto
M6	Standby	Auto
M7	Run	Manual
M8&M9	Run	Manual
P1	Run	Manual
P2	Off	Off
P3	Off	Manual
P4	Off	Manual
FST Spray	Run	Manual
Biox 1010	Run	
Flow meters	Display value	
Turbidity meter	Display value	
Temperature monitors	Display value	
pH	Display value	
Effluent monitoring system	Reboot	
Aquacell sampler	Run	
Ammonia meter	Run	

All pumps and motors are fitted with a black reset button.
Ensure these buttons are depressed before pressing the start buttons.

On restarting the plant, Monitor the Final Settlement Tank sludge blanket level as increased hydraulic load at start up can destabilise the plant.

In the event of a prolonged power loss (if known) refer to Emergency Power Supply Procedure. **Emergency Power Supply Procedure**

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Appendix 7

Security Gatehouse Alarm Summary

Bridgend Paper Mill security gatehouse is the designated area for critical alarms from the effluent treatment plant to alarm to. The alarms are monitored on the GENT system.

All alarms activated on this system must be reported to the duty shift manager immediately for further investigation and remedial action(s).

Below is a list of items from the effluent treatment plant that will alarm on the GENT system:-

HSB – High Sludge Blanket **blanket_lift**
M1 – M1 Archimedes Screw Pump failure
RAS Sump – High Level in RAS sump indicating potential failure of M10/M11

	Alarm level	Max permitted	
BOD- High BOD level	5mg/l	10mg/l	**Quick guide**
Suspended Solids – High SS	25mg/l	40mg/l	Quick Guide
PH – High/Low pH	6.6 – 7.9	6.5 – 8.0	**Quick Guide**
High Discharge flow	15000m ^{3}	17500m^3	Quick Guide
High Discharge Temp	24°	25°	Quick Guide

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Appendix 8

Procedure for Running the BOD plant from Emergency Generator Supply (House Set)

1. INTRODUCTION

In the event of a major power outage, it is imperative that the effluent treatment plant (BOD) is maintained in a running condition to ensure that no overflows occur direct to river.

It must be the first priority to go direct to the plant and establish whether the electrically driven equipment is still operating.

If the equipment has stopped then it must be restarted after the auxiliary power supply is switched over.

2. SCOPE

This procedure covers any such incident within the Bridgend Mill site.

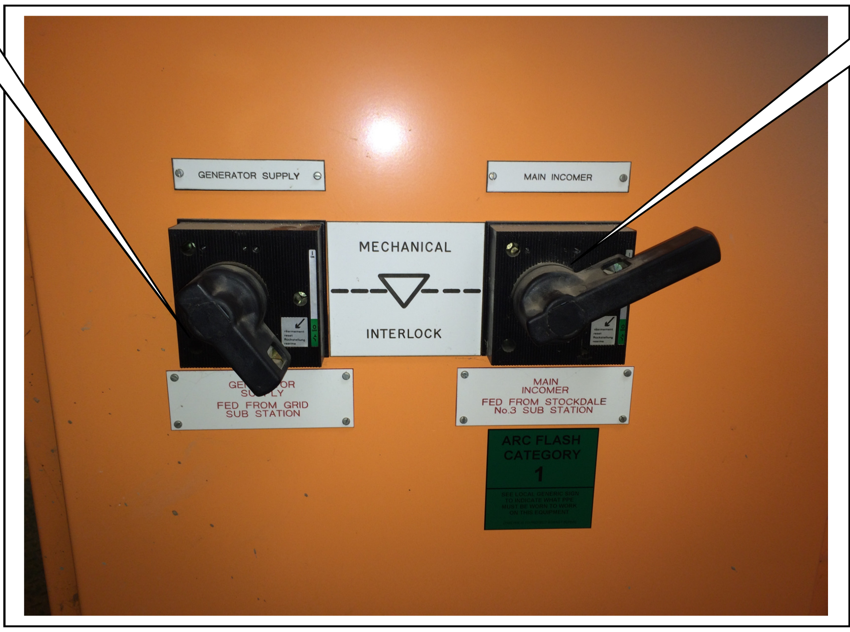
3. RESPONSIBILITY

The Mill Controller (Normally the Shift Manager) is responsible for ensuring that this procedure is followed. He will call for the support of other personnel as required.

4. PROCEDURE

1. The mill controller will establish that the House Set generator is running. If not it will need to be started before checking the BOD plant.
2. The mill controller will then go directly to the BOD plant together with a competent electrical technician.
3. On entering the switch room at the BOD plant, check all drives to ensure that they are operational.
4. If the equipment has stopped and supply has been lost, then instruct a competent electrical person to switch in the auxiliary power supply identified below. (This is fed from the House Set generator which should be running in the event of a power failure).


Isolator set


House set infeed
Main incomer
GENERATOR SUPPLY
MAIN INCOMER
MECHANICAL
INTERLOCK
FED FROM GRID SUB STATION
MAIN INCOMER FED FROM STOCKDALE No.3 SUB STATION
ARC FLASH CATEGORY 1

5. Please note that the auxiliary power supply is 100 amps and will only provide enough power to run the equipment specified below. Restart the following equipment <u>one at a time</u>.

Note: All pumps and motors are fitted with a black reset button. Ensure these buttons are depressed before pressing the start buttons.

a. One mammoth rota only, either no 4 or no 5

b. Either M10 or M11 screw pump

c. Final settlement tank bridge drive

6. Check to ensure that the equipment starts correctly and that all flows through the plant are restored.

7. Check the Effluent Chamber/Discharge Point and Manhole 1 to ensure that no overflow has occurred. If it has then contact the Environment Manager immediately.

8. Once mains power is restored then visit the BOD plant and switch the mains power back on.

9. THIS MUST BE DONE AS SOON AS THE HOUSE SET SWITCHES OFF AS OTHERWISE NO POWER WILL BE SUPPLIED TO THE BOD PLANT.

10. To switch back to mains power, visit the BOD switch room and reverse the position of the switches so that the main incomer is now live and the auxiliary incomer is switched off.

11. Then restart the following equipment <u>one at a time</u>:
    a. Both M10 and M11 Archimedes screws.
    b. M4 or M5 plus M6 or M7 mammoth rotors (2 running)
    c. Final clarifier bridge drive
    d. PI computer in corner of switch room.

12. Check to ensure that the equipment starts correctly and that all flows through the plant are restored.

When power is re-established the power switch over must be reversed and plant started as per normal running **(Start up procedure)**

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Shift Managers Check /Quick Reference Sheet for Responding to Security Alarms

BOD

Check trends on the Effluent monitoring system at Jupiter control room, or via PI.
Do Trends show high BOD value?
NO.
The problem is probably the signalling between the two systems. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.
YES
Check Biox 1010 unit at the BOD plant.

Is the display showing a high value i.e.>5mg/l
YES
Action: Monitor the trend. If the BOD approached 10mg/l put the Effluent to 100% recycle whilst the issue is investigated, call out if necessary and report via environmental near miss reporting system.
NO
The problem lies in the communication between the BIOX 1010 and the Effluent monitoring system. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.

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Shift Managers Check /Quick Reference Sheet for Responding to Security Alarms

Suspended Solids

Check SS trends within PI system (or the Effluent monitoring system at Jupiter control room)

Do Trends show high SS value?

NO
The problem is probably the signalling between the two systems. **Action**: Request further investigation from engineering department and report via environmental near miss system.
Yes
Action: Check the probe in the discharge channel for debris (algae/plastics). If debris is found around the probe, remove and replace probe and wait for alarm to reset.

If no debris is found, check the channel for water quality. Remove a sample and examine visually.
If the sample is turbid or contains higher than normal concentrations of suspended solids,
Action: Put the effluent to 100% recycle while the issue is investigated further and call out if necessary and report via environmental near miss reporting system.

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Shift Managers Check /Quick Reference Sheet for Responding to Security Alarms

PH High/Low

Check pH trends with PI system (or the Effluent monitoring system at Jupiter control room)

Do Trends show high or low pH value?

NO
The problem is probably the signalling between the two systems. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.
YES
Check the pH meter at the BOD plant.

Does the meter at the BOD plant show a high or low pH value?
NO
The problem lies in the communication between the pH meter and the Effluent monitoring system. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.
YES
Action: Take a sample and check with hand held pH meter (available from Lab)

Is pH outside consent limits? 6.5 & 8.0

YES
Action: Put effluent to 100% recycle, call out if necessary, report via environmental near miss reporting system.
NO
Action: Request further investigation from engineering department and report via environmental near miss reporting system

The pH meters have pre determined shelf lives so holding spares can be an issue. The same type of pH meter is used on the incoming river water. If issues are detected with the effluent pH meter then the incoming water meter can be used.

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Shift Managers Check /Quick Reference Sheet for Responding to Security Alarms

High Discharge flow

Check trends within PI system (or the Effluent monitoring system at Jupiter control room)

Do Trends show high discharge flow value?

NO
The problem is probably the signalling between the two systems. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.
YES
Action:
1.Increase recycle rates so that the discharge flow reduces to within acceptable limits and monitor.
2. Check for excessive flows on machines and reduce as far as practicably possible.
3. Check for overflows etc from water filtration plant.
4. Report via environmental near miss reporting system

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High Discharge Temperature

Check trends via PI system (or the Effluent monitoring system at Jupiter control room)

Do Trends show high Temperature value?

NO
The problem is probably the signalling between the two systems. **Action**: Request further investigation from engineering department and report via environmental near miss reporting system.

YES

Action:
1. Reduce the discharge flow to a level that the Nant Gwyn is effectively cooling the effluent to within consented limit (currently 25°C)
2. Check for sources of heat through machine systems.
3. Report via environmental near miss reporting system.

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High Mixing Box level

When the high mixing box level alarms at the security gatehouse, the shift manager must **immediately** visit the mixing box to confirm the alarm.

If the level is high, there is a danger that the mixing box could overflow to the Nant Gwyn stream.

Immediate action should be taken to reduce flows to the mill and on machine to prevent overflow.
Inspections must be made to check there are no fugitive overflows and close any drains that may be open. This includes water and stock. Index