TR/N/Env/001 Reed Bed Management System

1. Introduction.

Reed beds have been used extensively to treat wastewater worldwide. A lot of their popularity is due to the low maintenance required once installed. Their main use in this country is for treating sewage waste by taking up nitrates and phosphates from the sewage sludge. They are also used for the same purpose in domestic situations where a scaled down version is used.

2. Scope.

This Document only applies to the Newbridge on Wye reedbed system.

3. Content.

3.1 Basic principles of a reed bed water treatment system

A reed bed system usually begins with a large settlement tank to allow for the depositing of suspended solids before entering the system, as this would silt up the reed bed zone suffocating/burying the micro-organisms that carry out the main part of the treatment process.

After this settling has occurred, the effluent is introduced to the reed bed at a controlled rate, evenly in to the media. This then percolates through the rhizosphere (root zone) where it is then broken down by denitrifying bacteria. These micro-organisms convert the nutrients in the effluent from nitrates in to nitrite and then in to dinitrogen gas and ammonia. Some soak of this material ups themselves as nutrients.

The media chosen for the reed bed is important in that if it is too porous, the effluent will not spend enough time in the reed bed to be treated effectively. Therefore, the size of the media dictates the rate of flow through the bed itself.

The reeds that grow in this media provide favourable conditions in the rhizosphere for micro-organisms to inhabit. This is mainly due to the oxygen provided by the reeds through their roots. The size of the media also dictates the amount of surface area that is available for the establishment of the bacterial films that are the active part of the system.

Another point to be taken in to consideration is the establishment of the reeds. The roots of the reeds do not establish well in media with sharp edges, therefore river gravel or other rounded stone is more beneficial for more efficient root growth.

Vertical flow reed beds

This is the most used type in the UK as it generally takes up less room than a horizontal flow reed bed. In basic terms, the effluent to be treated is spread across the top of the reed bed evenly, usually via a large dispersal pipe. The effluent then slowly percolates down through a media of small, graded stone, sand and/or soil into the rhizosphere. It is then treated and allowed to drain into a rock filled area for aeration before being discharged.

Horizontal flow reed beds

Horizontal flow reed beds are usually larger and shallower than vertical flow beds. The average depth of the media is around half a metre deep. The effluent flows horizontally through the rhizosphere where treatment occurs. As opposed to the effluent being introduced evenly over the surface of the bed, it is introduced via an inflow pipe at one end of the bed and then discharged at the other end.

The Reed Bed

The reed bed at the Newbridge site is a large horizontal flow reed bed, with three main inflow ditches which feed the effluent into the bed, and two main collector ditches which direct the effluent in to a second reed bed for final treatment before it is discharged.

There is a large network of balancing pools, which hold back the high flow of effluent and double as siltation ponds. As well as these pools, oil interceptors prevent most organic and synthetic oils from washing into the reed bed. The effluent from the mill for the most part is organic, tree derived waste. So the process is like that of sewage treatment system. The only exception to this is the lack of nutrients present in the BSW's reed bed.

When the bacteria break down the organic material, a large amount of oxygen is used up in the process. This is the reason for the BOD (biological oxygen demand) consent value imposed by the environment agency. Through a series of aeration weirs at various points in the system, mainly at the dams, as much oxygen as possible is added to the effluent. The reeds themselves provide some oxygen through their roots.

3.1.1 Compartmental Description of the old reed bed network

Components

Structure /process.	Specific function.	General description.
Residue bunkers, Yard hygiene.	Contamination/ Limitation	Prevention.
Central site ditches and ponds.	Water collection/direction Siltation.	primary treatment/ Flow control
Oil interceptors.	Oil removal.	Primary treatment.
Step cascades, small Silt ponds and the Biodigester.	Aeration and Nutrient addition.	Effluent preparation and Flow control.
Settling ponds. Primary settling of Derived solids.	Flow control and Flow control.	Primary treatment and
Reed beds Stream bed after out flow	Solute removal. Aeration.	Secondary treatment. Tertiary treatment.

Compartment 1

The system begins in this compartment with an influent pipe at the far end of the sawn timber yard. As well as collecting the surface runoff from the site, the banks of the ditch provide a solid barrier from any leaks or overflows to neighbouring fields. The main purposes of this compartment are water collection and redirection along the ditch to the rock dam, and then the oil interceptor. The rock dam in this compartment is in place to impede the flow of water. This allows for some time for siltation and to provide some basic filtration via the stones. The needle litter from the spruce on the banks also provides some valuable nitrates to the system as they decompose. By keeping the ditch clear of vegetation, valuable ultraviolet light is allowed into the water, thereby producing much needed oxygen via photosynthesising flora. There is usually a lot of visible surface oil in this compartment as most of the site drains into it. This is dealt with by the oil interceptor.

Compartment 2

This compartment is situated across the road from compartment 4. The concrete silt trap here is the collection point for the main under ground drain on the site. There is usually a lot of rubbish here that in some cases has blocked the out flow and caused an overflow. This could be dangerous to anything travelling on the road, as there is a lot of dissolved oil in the effluent. The influent pipe comes directly from the drain at the dropsorter.
There are some planned discharges into this drain such as the emptying of the sprinkler system and pumping out of the debarker. When this is due to happen, the amount of recent rain should be taken in to account so that any overflow can be avoided if possible. Alternatively, the silt trap should be emptied prior to this planned discharge, even if only half full of silt, so that it can handle the extra load. The effluent from this compartment flows in to compartment 4 after passing through the oil interceptor.

Compartment 3

This area is a simple ditch system that drains into a soak away in the field below. It deals with the water that drains down from the weighbridge. There are drains and culverts that need to be kept clear to allow it to work. There is no treatment in this compartment.

Compartment 4
This compartment includes the oil interceptor, the wooden channels, and the small wooden silt traps, culminating at the bottom of the walkway. The main purpose of the silt traps is as the name suggests, to prevent silt from washing down into the reed bed. In times of high water flow they also act as holding areas, impeding the flow rate of the water. The wooden channels here are mainly to direct the water into the oil interceptor. In times of high flow, excess water is carried down into the system bypassing the oil interceptor, thereby not overloading it and washing it out. At the point where it is diverted there is an oil catcher board which is set so that the bottom half of the water flows under it thereby diverting the surface oil to the interceptor. The water that is redirected this way flows down a step cascade (series of splashboards providing oxygen) into the next compartment.

Compartment 5
The start of this compartment is situated below the bottom of the walkway at the large concrete inflow pipe. The two main purposes of this compartment are siltation and algae production. The algae are grown in four small wooden pools, which are partly washed out during times of heavy flow. This algae is then washed down stream to the reed bed, partly inoculating the system. Running parallel to these ponds are two large silt traps with splashboards situated on the front to provide further oxygenation. As in compartment 1, the large surface area of the standing water provides good conditions for light to penetrate, also allowing heat into the water.

Compartment 6
In this compartment two limestone rock dams have been installed. The main purpose of these dams is to regulate the flow rate by impeding the water. This allows time for siltation to occur. Incorporated into the woodwork of the dam is a leaf catching frame that stops the large amount of leaf litter collecting anywhere in the system. There is an overflow channel to take any excess water into the next pool, as opposed to flowing over the banks thereby eroding the supporting earth.
The woodwork is also designed so that like the oil catcher board in compartment 4, the water flows underneath boards that are set down into the water. This stops any surface oil from continuing down the system.
The limestone in the dams has been chosen because of its chemical properties. Through a process of ion exchange, the limestone binds salts to its surface. The salts that are present in the system manifest themselves as visible, persistent foams, which are slimy to the touch (as they are polysaccharidic in nature), compared with natural foam caused by turbulence. These salts are mainly present in secondary tree metabolites such as sap.
The main source of this material is the bark that is sun/air dried. Due to the climate becoming warmer and wetter this material is drying quicker and then being washed out by heavy deluges which elutes these salts very successfully. The liquor in the debarker has very high levels of these salts.
Apart from the organic sources, salts are present on site in small amounts in the dip treatment solution, saw shop cutting fluid, wax treatment liquor and most oils. Limestone has been used successfully in water treatment for centuries, however it does produce suspended solids. For this reason, only two have been used in the system. Compared to the amount of silt usually produced from the site under normal conditions, the SS levels produced by the limestone are negligible. There are pipes installed at the bottom of each dam to allow for draining during summer so that they can be cleared out.

Compartment 7

Two settling ponds make up this section of the system. The first pond is the largest settling pond in terms of volume, which is supported by a large dam. This dam has two small flow retarders, which can be physically removed in times of low flow to maintain a constant flow of effluent into the reed bed. The old dam in this compartment has been left in place to hold back the silt so that the new dam does not become blocked. The dams have both been constructed incorporating splashboards at the front of them for oxygenation. This also interrupts the flow of effluent, thereby avoiding scouring where it meets the pond bed. The smaller of the two dams does not have any adjustable components so should be full.

Compartment 8

This compartment is the final settling point for sediment before the feeder ditch. It consists of a settlement pond and a junction sluice that is used for draining the pond and collector ditch for cleaning. The sluice is very important to the system as if it is open the effluent will bypass the reed bed completely and be discharged into the collector ditch untreated.
The pond is about two feet deep; this depth allows ultraviolet light to penetrate and to heat up the water. There was willow planted around the edge of the pond originally. This was present to strengthen the banks. However, willow absorbs phosphorous from the effluent which the reeds could utilise for growth, so should be avoided in future. If any trees are to be planted, alder or any other species that can tolerate wet conditions should be utilised.

Compartment 9

The dam and main feeder ditch in this compartment are the last points in the system that regulates the flow entering the main reed bed. The level of the effluent here must be uniformly distributed to all the “V notch” boards. This ensures that all the reed bed receives the same amount of effluent. If this is not correct, parts of the reed bed will short circuit and die off, as where other parts of the reed bed will be washed out due to hydraulic overload. For this reason, it is also crucial that they are not blocked.

Compartment 10

This area is the old bypass ditch running along the bottom of the site. This is redundant as it is too close to the boundary; therefore, it was blocked off. It is included here so that it is checked for any effluent that may be leaking into it from the main collector ditch.

Compartment 11 and 12

Both compartments contain the collector ditches, which collect the water flowing out of the main reed bed. These ditches then direct the water into the deep-water swamp. The water here should be visibly cleaner than the water in the collector ditch. If this is not the case the sluice in compartment 8 should be checked for leaks. Alternatively, it may be due to a very high flow rate which will also need to be adjusted.

Compartment 13

This compartment is the freshwater swamp. It is comprised of an inflow ditch and a small reed bed running parallel to the main reed bed. The reeds here are predominantly common reeds, with some irises near the start of the bed. For the most part this area deals with any runoff from the field above and from the lower car park. The pollutants that it treats are low in concentration, therefore needing little treatment.

Compartment 14

This compartment is the outflow point for the whole system. The woodwork here consists of two channels. One for the freshwater swamp and one from the deep-water swamp. The two flows will mix here prior to leaving the system. This will dilute any possible remaining pollutants.

Compartment 15

This compartment used to contain the original reed bed system that had been in place since the 1980’s, it has since been dug out and replanted. The main purpose of this reed bed is further secondary treatment. It is an effluent polishing system that acts as a back up to the main bed. This is especially useful during times of high flow where the volume of water entering the system affects the lag time of the effluent in the main reed bed. So although it is not integral to the system, it is of great benefit. The area consists of a rock dam at the inflow point, a reed bed and finally another rock dam at the outflow. The rock dams in this section aerate the effluent providing oxygen that is used up during treatment. The rock dam at the end of the bed adds more oxygen to the effluent before it is discharged at the outflow point in compartment 14.

Compartments 16 (old network) and compartment 17 (new network planted circa 2005)

This is the main reed bed. It is the most important component of the system where the main part of the effluent treatment takes place. There are “V notch” boards and concrete channels that distribute the effluent evenly across the reed bed. There are smaller ditches that direct the treated effluent into the collector ditches.

It is important that as little ground impact as possible takes place in this area. If the ground is compacted, the conditions for the micro-organisms that treat the effluent are destroyed. This in turn leads to their death. It takes around six months for these micro-organisms to re-establish themselves under ideal growing conditions. They are also competing with other similar organisms competing to establish themselves quicker than the specific forms that are important for our needs. The condition of the reed stock and the rate at which the effluent passes through the system are the most important areas of this compartment.

3.1.2 Main pollutants for old and new reed bed networks

The pollutants produced on site are:

- Tree derived materials.
- Synthetic oils.
- Biocides (fungal emulsion for timber treatment).
- Sodium chloride
- Inorganic silt.
- Sewage.

Tree Derived Materials

- Organic silt is produced in the form of saw dust which, due to the high amounts of particulates, blocks out light and is deposited in the system.
- Secondary tree metabolites include phenols, terpenes and saponins. These are toxic to aquatic organisms. These compounds are the chemicals used by trees as pesticides and fungicides. This is why they are present in the bark and roots more than the heart wood as they are mainly produced in the cambian layer (the living part of the tree).
- Sugars, amino acids and inorganic salts are also derived from the bark. They raise the BOD of the effluent as well as increasing the likelihood of eutrofication. This is the sterilisation of an aquatic system caused by excess nutrients being taken up by plants. These plants then flush and shade out all other photosynthesising organisms, which then die off and decompose, creating more nutrients. This is then fed upon by anaerobic bacteria that thrive in oxygen depleted environments.

Synthetic Oils

- Floating oil films prevent the normal exchange of gases between the atmosphere and the stream water.
- Oils are lipid soluble and so destroy the structure of cell membranes. This has a direct toxic affect on aquatic organisms. As a pollutant travels up the food chain it becomes more and more concentrated. For example, if an otter eats twelve contaminated fish, it gets twelve doses of pollutant. This means that as well as a direct affect it also has secondary impacts on the ecosystem as a whole.
- Reed beds have been used in the middle east to mop up oil spills, however the reed bed at Newbridge is not designed to carry out this operation. Some oil will be treated

in the reed bed, however organic oil is easier to break down than synthetic as it is more basic/less processed.

- The oil interceptors have one failing. This is that they can be washed out by high flow rates. The woodwork, pond system and visible checks have taken this in to account. Detergents should be avoided as a cleaning up method as they are poisonous to aquatic organisms.

Biocides

- These are chemicals that are used on site to treat timber. Problems only arise from these materials when spillage occurs.
- They are used on site to kill wood rotting fungi and bacteria. The reed bed relies on bacteria as its active ingredient; therefore, a large spillage of these chemicals if left unchecked will result in serious damage to the system.
- If allowed to discharge to the outside environment, the effects would be very noticeable. It would seriously damage one of the base layers of the food chain. This would have a knock-on affect throughout the ecosystem.
- For specific affects of each individual chemical on site, refer to the COSHH sheets kept in the maintenance office at the green mill.

Inorganic Silt

- Suspended solid levels affect light penetration to plant life and bottom dwelling organisms.
- Deposition of silt also buries these organisms.
- The main form of silt from the site is clay. These particles are very small and highly soluble. For this reason, it takes longer to settle than most sediment loads.
- The silt deposits through a process of flocculation. This is where the positively charged particles of clay silt bind together and become heavier, this is then deposited.
- The size and number of balancing pools has been designed to facilitate this process as much as possible, and with proper maintenance will capture most of the silt.
- During times of high flow, the level of suspended solids will be higher due to scouring. This will also occur during any large-scale operations such as earthmoving or excavation work.

Sewage

- A Biodigester and septic tank treat the sewage produced on site. A registered contractor empties them both at six monthly intervals.
- The treated effluent from the Biodigester is released into the system. This is an important source of nutrients for the reed bed as there are no other significant sources on site. Fertiliser has been applied in the past and should be applied once a year.
- Most reed bed systems are built to treat sewage by absorbing the excess nutrients produced. This reed bed is unique in the fact that it does the opposite and so needs all available nutrients (nitrogen and phosphorous or N and P).

3.1.3 Oil interceptors

The oil interceptors are emptied every 6 months. This does not take in to account any incident that would warrant an interim emptying outside the normal schedule. This is carried out by a third-party waste disposal service. The items to be emptied are the oil interceptors, the bio digester and the septic tank. The positions of these are indicated on the compartmental map of the site. The oil interceptors predominantly protect the old reed bed network, however the sampling point is universal, so any effect on the old network may affect the stream network beyond the site.

3.1.4 Sampling regime

The reed bed at Newbridge has been installed to treat the runoff from the sawmill site. The environment agency has allocated discharge consent values for the following.

- Biological oxygen demand (BOD). This is the amount of oxygen decomposing bacteria need to break down organic material in a solution.

- Suspended solids (SS). This is the level of particulate mater held in a solution.

- PH. This is the measure of alkalinity and acidity of, in this case, water. The range of the scale is from 1 being very acidic to 10 being very alkaline.

Although there are no consent values laid down for nitrogen, it should be included in the sample analysis. This is a good indicator of how many nitrates the reed bed uses and how much is entering the system. A simple comparison of the level of nitrate present before and after each sample section will show if more is to be added. If the reeds are dying back the levels of nitrate should be checked for any obvious deviations. The reason for this sample regime is to ascertain if the discharge consent values are being met. These values are as follows:

BOD = < 10 mg/l

SS = < 80mg/l

PH = 5 - 9

Testing will be carried out by our independent 3rd party contractor (Currently JPR Environmental) and will be undertaken on a quarterly basis.

Sample type: Water.

Sample schedule: Samples need to be taken quarterly (Guidance only and may be weather or contractor availability dependant)

- 1st February.
- 1st May.
- 1st August.
- 1st November.

Interim Samples

There will be times when further water samples may need to be taken in addition to the planned dates. One sample should be taken under the following conditions:

- During times of extremely high flow rate in winter over a long period of time.
- During times of extremely low flow rate in summer (Drought type conditions).
- If any part of the system fails, (E.G a dam is breached, or an oil interceptor issue).
- Directly following an environmental incident such as a large spillage on site

Firstly, the incident needs to be rectified. For example, if it is an oil spill, it needs to be halted and disposed of appropriately. A sample should then be taken as soon as possible after the incident. It is after the first sets of results are received that any further remedial actions can be identified and carried out. Another sample should be taken on receipt of the results only if the consent values are not being met. A third sample should be taken on receipt of the second set of results, if the consent values are still not being met. This would suggest a major problem.

Following an environmental incident, a further sample should be taken one week after the event to establish whether the discharge consent values are still being met and to evaluate the level of damage to the system. If an interim sample is taken and a scheduled sample is due within one week, the scheduled sample will not need to be taken.

The reason for the extra samples during peak flow rates is to evaluate the seasonal difference in the concentration of pollutants in the effluent. Sample results will also identify if there is a failing in the system and where it is situated.

Sample Points: - There are 4 main sample points:

1. There is an 'on site' sample point situated at the inflow to compartment 5, at the large concrete pipe. This is to evaluate the effectiveness of the oil interceptors.
2. There is an 'on site' sample point situated at the dam leading into the feeder ditch in compartment 9. This is to evaluate the effectiveness of the balancing pools and limestone dams.
3. There is an 'off site' sample point situated at the outflow of the system in compartment 14. There is signage to indicate "Environment Agency Sampling Point". This is to evaluate the condition of the treated effluent leaving the site.
4. There is a further 'off site' sample point situated at where the stream meets the inflow to the river Ithon, which is a further downstream sample point used by Natural Resources Wales. This is to evaluate the condition of the treated effluent entering a major tributary.

Recording Results

Analysis results and any raised concerns will be communicated back to the Mill Manager and ESH Co-ordinator and will be stored on the site network server. If the results give any cause for concern, proactive measures will be put in place to address the concerns. If the results indicate that there has been a significant incident, then the conditions under the Part A2 Permit Ref: EPR/A2/3 will be examined and abided by

What to look for on the data sheet

When analysing the data there are some general guidelines that will help to identify potential problems or deviations from normal conditions. Any concerns must be discussed with the principal 3rd party contractor.

- The levels of suspended solids should be higher in winter than in summer.
- The pH level should be consistently 7 or 8.
- The BOD does fluctuate depending on conditions, however there should not be a large deviation from past results. A large deviation is a good indicator that there is a significant problem within the system.
- Nitrate levels should be evaluated and if found to be particularly low, a small amount of fertiliser should be spread (grow more has been used in the past).

3.1.5 Visual identification sheet

<u>Physical factors</u>

- Oil identification. There is a simple test to differentiate between synthetic oil and organic oil. Surface oil from organic sources has a silvery white shine to its surface compared to synthetic oils that produce the more common rainbow effect. When the surface is broken with a stick (stick test) the synthetic oil will flow back together like a liquid, as where organic oils brake up into pieces, with cracks appearing on the surface which do not flow back together as readily as synthetic oil.
- Foams. Most of the visible foams on site are non-persistent natural foams produced by the wash of the water. The more persistent foams are produced from various forms of salts. These 'persistent foams' can be identified by their continued presence down through the system. The foam has a slimy feel to it compared with natural foam. This is because it is polysacaridic in nature.
- Scouring/erosion. This can be easily identified by the presence of deposits of silt or stone in the system, especially after heavy rain. Banks being under cut and

collapsing are obvious signs. Widening holes underneath inflow pipes are another sign of increased erosion.

- Turbidity. A general visual comparison in the clarity of the water from compartment to compartment should indicate if there are particularly high levels of suspended solids in the water.

3.1.6 Weekly Checklist (Visual) – ESH Co-ordinator

Ditches:

- Must be clear with no signs of surface oil present.

Outflow:

- Water must be clear.
- Water Must have a natural odour.
- Flow rate must be healthy for the season.

Internal Sample required. Yes ☐ No ☐

Any concerns identified must be discussed with the Mill Manager and the Group ESH Manager.

3.1.7 Monthly check list (Visual) – ESH Co-ordinator

Index:

Compartment 1	**Sawn Yard Ditches**
Compartment 2	Oil Interceptors and Silt Trap
Compartment 3	Weigh Bridge Ditch
Compartment 4	Oil Interceptor and Bio Digester
Compartment 5	Algae Pond and Balancing Ponds
Compartment 6	Limestone Dams and Balancing Ponds
Compartment 7	Wooden Dams and Balancing Ponds
Compartment 8	Sluice, Balancing Pond and Dam
Compartment 9	Main Feeder Ditch
Compartment 10	Unused Bypass Ditch
Compartment 11	**Collector Ditch**
Compartment 12	**Collector Ditch**
Compartment 13	Fresh Water Swamp
Compartment 14	Outflow
Compartment 15	Deep-water Swamp
Any Signs of Water Pollution	Yes or No.
Ditches or Channels are Clear	Yes or No.
Banks are Secure	Yes or No.
Rock Dam is clear	Yes or No.
Amount of surface oil	High, Medium, Low or not present
Amount of leaf litter	High, Medium, Low or not present
Amount of silt	High, Medium, Low or not present
Water level looks correct for the time of year	Yes or No.
Direction of Flow is Correct	Yes or No.
Oil Interceptors are Working	Yes or No.
Outflow is clear	Yes or No.
All woodwork is safe and sound	Yes or No.
Bio-Digestor is working	Yes or No.
Algae pools are free of silt	Yes or No.
“V Notch” Boards are clear	Yes or No.
Invasive Vegetation Present	Yes or No.

Reeds are Looking Healthy	Yes or No.
Signs of Wildlife looking Healthy	Yes or No.

Internal Sample required. Yes ☐ No ☐

Any concerns identified must be discussed with the Mill Manager and the Group ESH Manager.

3.1.8 Problem Solving guide.

Comp	Possible Problems	Suggested Remedial Actions.
All	Ditches obstructed.	Unblock immediately if feasible
	Silt levels are full, see marker sticks in the relevant compartments.	Empty if full.
	Over hanging vegetation shading out the effluent.	Cut back or fell the offending vegetation.
	Visible surface oil present and identify it as synthetic or organic.	If a large amount of it is synthetic, soak up with white pads and dispose of as hazardous waste.
	Oil interceptors need emptying.	Usually emptied every 6 months. Evaluate the need for an interim emptying if problematic.
	Overflowing of the banks.	Identify cause and rectify immediately.
	Leaks in and around the sides of the dams and the woodwork.	Identify cause and rectify immediately.
	The boundary fence has gaps or other means of access by livestock and the general public.	Repair immediately.
	Leaf litter present, and where it is collecting.	Remove leaf litter and dispose of away from the system.
	Scouring/erosion of the banks and beds.	If erosion is affecting the integrity of the system it needs to be shored up to prevent future incidents.
	Condition of the effluent in respect to clarity, smell, foam and colour.	If the effluent changes visibly evaluate the need for a sample, referring to the sampling regime.
	Deposits of stone/gravel that have been carried down the system.	Remove any deposits out of the system.
General Instructions		
1	Walk along the ditch from the inflow pipe to the rock dam.	
	Inflow ditches are clear and flowing.	Clear blockages if present.
	Rock dam is clear of obstructions and is allowing through flow.	If silted up, remove stones by hand, wash and replace.
	Vegetation is obstructing the channel.	Clear vegetation if obstructing the flow.
	The integrity of the far bank is secure.	Rectify immediately if found.
2	Wet areas may be due to a blockage or leak in the woodwork.	If found trace back to the source and repair.
	Leaf litter present.	Remove if obstructing the flow.
	Obstructions present.	Remove immediately if found.
	Woodwork is leaking or diverting flow.	Rectify immediately if found.
	Level of silt in all areas	Empty by hand if needed.

3	Algae pools are full of sediment.	Dredge or empty by hand if full.
	Woodwork is leaking or diverting flow.	Trace to source and rectify if found.
	Leaf catching frame is full.	Clear if it is full and remove leaves from the system.
4	Water collecting or seeping through the dams that may indicate a leak.	If found trace to source and rectify.
	Level of silt present.	If up to the marker empty.
	Surface oil present; identify it as synthetic or organic using the stick test.	If synthetic, remove with pads and dispose of as hazardous waste.
	Leaf catching frame is full.	If it is full remove the leaves from the system.
5	Scouring and erosion of the banks.	If the banks are leaking, remove the flow retarders from the dam and shore up the area.
	Condition of the limestone in the dams.	If completely full/covered with silt, remove and wash the limestone. Replace limestone every five years.
6	Leaks around the sides of the dams.	If present rectify immediately.
	Condition of the woodwork.	Repair immediately if needed.
	Surface oil present and identify it as synthetic or organic using the stick test.	If synthetic soak up with white pads and dispose of as hazardous waste.
	Scouring and erosion of the banks.	If a large amount of scouring is taking place, board the channel.
	Dams are clear and the water is flowing.	Clear the dams of any obstructions.
7	Woodwork at the junction sluice is leaking.	If found trace to the source and seal.
	Wet areas that may suggest a leak.	If significant trace and seal it using plastic liner after draining the pond to allow access.
	Water is flowing in to the feeder ditch correctly.	If too low check for any blockages, if not found unplug a flow retarder to allow more flow.
	Level of silt present in the pond.	Dredge if full.
8	Water is flowing in to all of the feeder ditches evenly.	Adjust the v notch boards if out of alignment.
	V. notch boards are clear of obstructions such as leaves.	Clear debris out of the system if present.
	Woodwork at the end of the feeder ditch is secure and no leaks are present.	If present, trace to the source and rectify.
9	Level of silt in the feeder ditch.	Clear out carefully by hand maintaining the gradient.
	Over hanging vegetation blocking the flow of influent.	If so clear by hand and remove the cuttings from the swamp.

	Water flows in to the reed bed and not out of the end of the ditch in to the small collector ditch.	Reinforce/repair the woodwork to avoid short-circuiting.
10	There should not be any water present in this compartment as it is only used to empty the settlement pond/feeder ditch for cleaning.	If water is present, trace the water back to its source and rectify the problem.
	Leaf litter present.	If present clear out of the system so it is not washed in to the collector ditch.
11	Water flow in the ditch is not obstructed.	If so clear immediately.
	Wood work at the end of the ditch for is leaking.	If present trace to source and rectify.
	Carry out a visual check of the condition of the effluent as it has been through the reed bed and should be considerably ‘cleaner’.	If not visibly cleaner check the date of the last water sample and refer to the sampling regime.
12	Over flows or blockages present.	Remove or rectify these immediately.
	Over hanging vegetation restricting the flow.	Clear by hand if present.
13	Ditches are obstructed.	Remove if obstructing flow.
	Invasive vegetation encroaching on to the reeds.	Remove carefully by hand to encourage reed growth.
	Woodwork at the end of the ditch is secure and it is directing the flow correctly.	If incorrect trace to the source of the problem and rectify immediately.
	Level of scouring of the ditches.	If a significant amount of scouring, the channels should be boarded.
14	Woodwork is secure and there are no leaks.	If found trace to source and rectify the problem.
	Flow is being directed to the out flow correctly.	If incorrect, rectify to ensure correct flow.
	Carry out a visible check of the effluent here as this is where the outflow point is situated.	If visibly poor, refer to the sampling regime.
15	Woodwork at the end of the ditch is secure and it is directing the flow correctly.	If leaking trace to source and repair/redirect flow if incorrect.
	Reeds are being washed out.	If the reeds are being washed out, replant and peg down.
	Effluent is flowing through the gravel substrate and not short-circuiting.	Trace the effluent flow and unblock or rectify leak if present.
	Gravel should not be silting up, as there should not be a high level of suspended solids/silt present this far on in the system.	If present investigate possible causes such as particularly high flow rate for example.

3.1.9 Seasonal Tasks – Mill Manager to Arrange

Summer - May to October

- Coppice willow in all compartments.
- Hand grab all of the ditches placing the spoil so that it drains into the system, e.g. on the up-hill side of the ditch.
- Cut back all the vegetation over hanging the woodwork to about a foot from the edge of the wood to avoid blockages and shading.
- Empty the sediment pools after draining and the ditch in compartment 1 during dry weather so less volume is removed.
- During this operation there will be an opportunity to assess the dams more closely below the water line. This would be the best time to carry out any remedial work here as long as it does not interfere with dredging,
- However tasks should not be left undone until this occurs, as they will become compounded over time.

Winter - October to February

- In January clear vegetation from all of the ditches and remove from the swamp.
- Watch for erosion/scouring in all compartments during and after periods of heavy or prolonged rain.
- Check the rock dams for blockages by leaf litter and sediment, and clear immediately if impeding flow.
- Clear leaf litter in all compartments, removing it from the swamp for disposal, especially the oak litter.

Spring - February to May

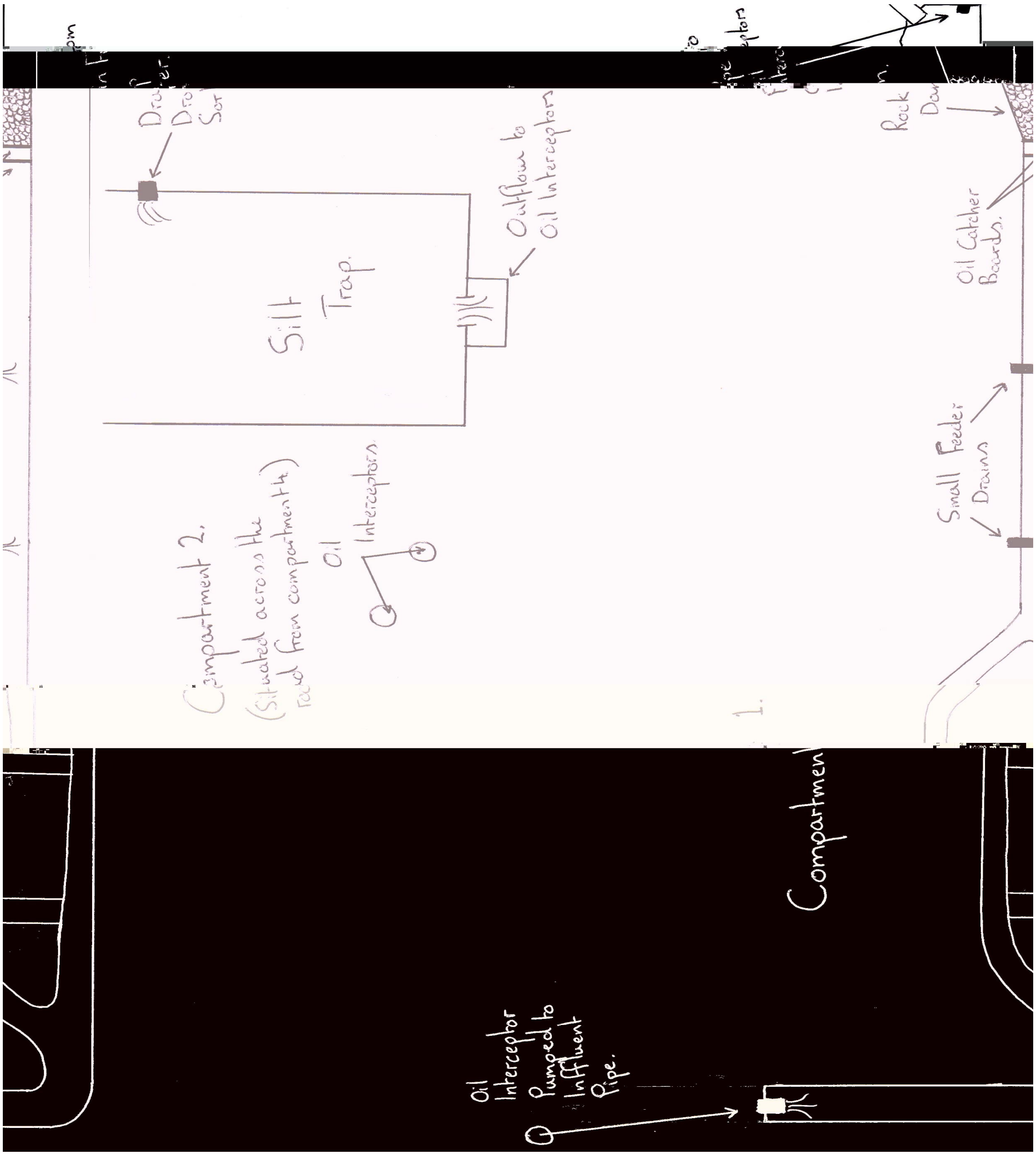
- Replanting of reeds to fill in gaps.
- Hand pull epiloba, giant hogs weed, and other weeds/invasive species, before they have time to go to seed.
- Replant any reeds that have been dug during clearing in the reed bed to fill any gaps.
- This should only apply to reedmace, common reed and irises, not sieves. Watch for erosion/scouring in all compartments during and after periods of heavy or prolonged rain.

3.1.10 Procedure for Water sample collecting.

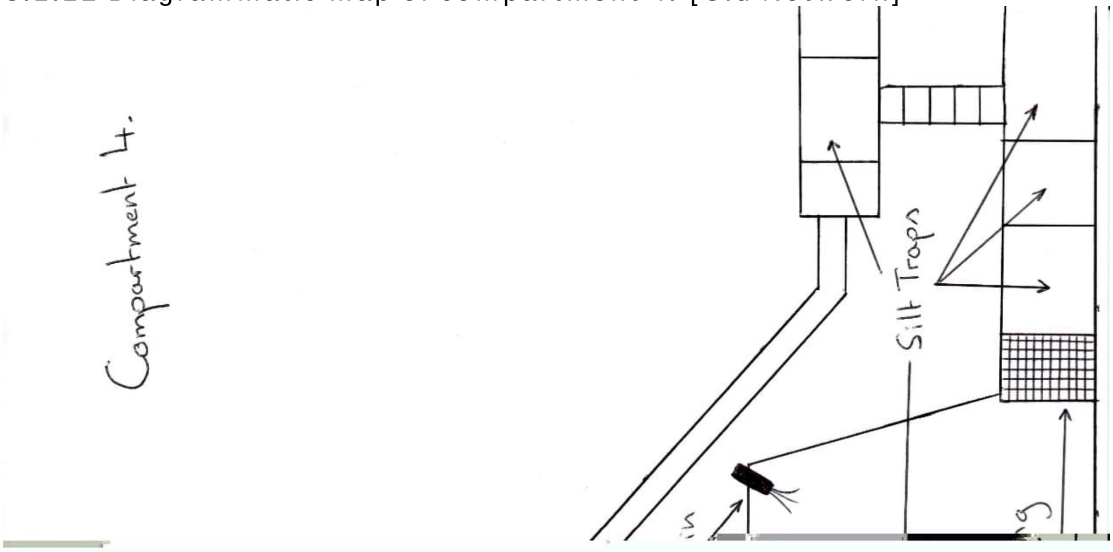
When taking a water sample it is important to follow the instructions that accompany the sampling instruments. In addition to this, to avoid contaminating the sample the following must be observed.

- Wear waterproof gloves.
- The sampler will not enter, splash, or otherwise disturb the sample area. This may lead to stirring up sediment and therefore giving a false result (as well as wasting money).
- The samples should be taken as soon as the sample kit arrives, as temperature is a crucial factor during the transport of the sample.
- Freezer blocks that accompany the kit should be placed in a freezer to maintain their temperature until needed.
- The samples should be received and dispatched on the same day.
- The samples should be taken at the three sample points situated in compartments 5 (the large concrete pipe at the start of the compartment). 9 (the dam leading in to the main feeder ditch, and 14 (the main sample point at the end of the system.

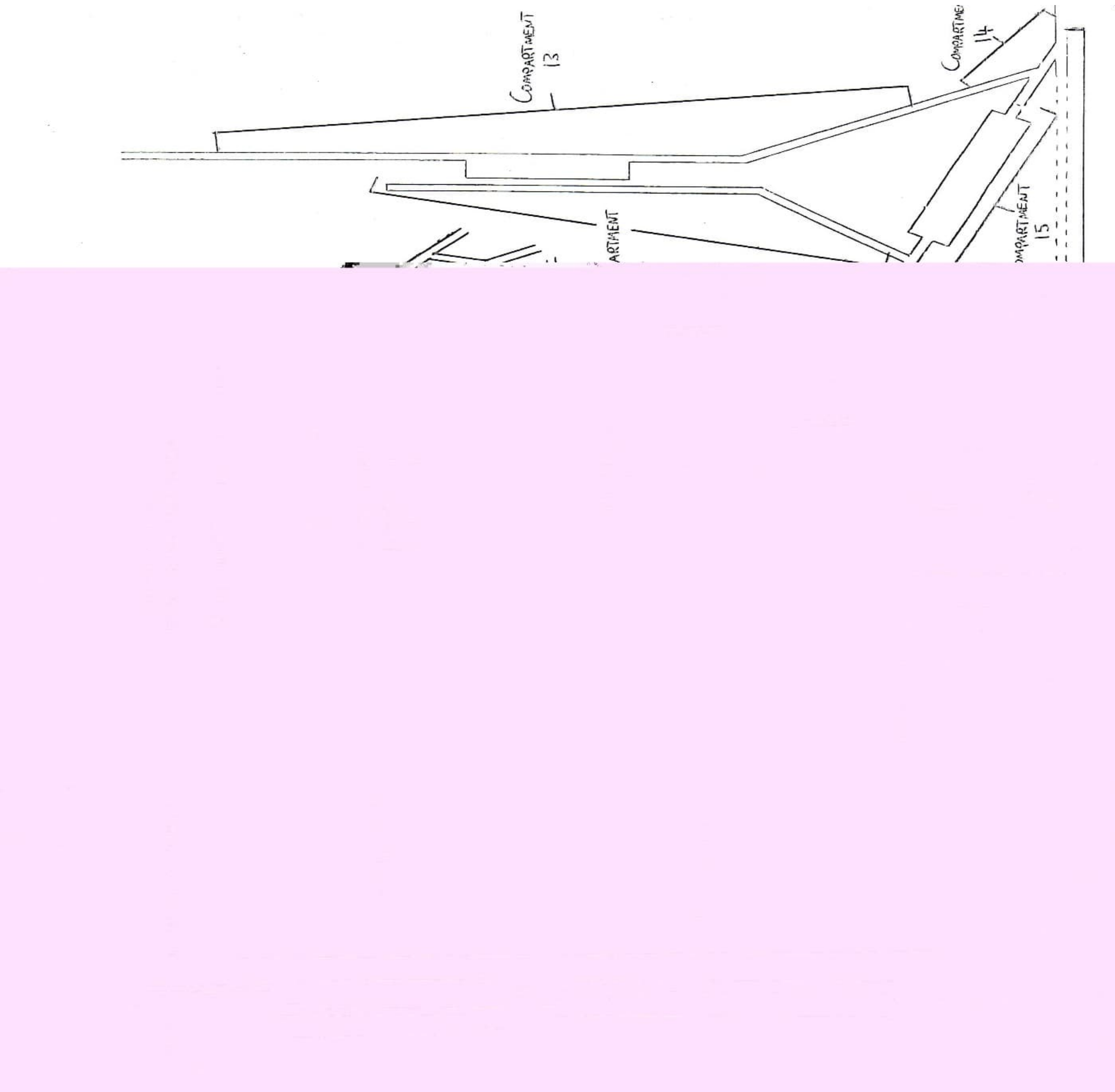
3.1.11 Diagrammatic map of compartments 1 and 2. [Old Network]



3.1.12 Diagrammatic map of compartment 4. [Old Network]

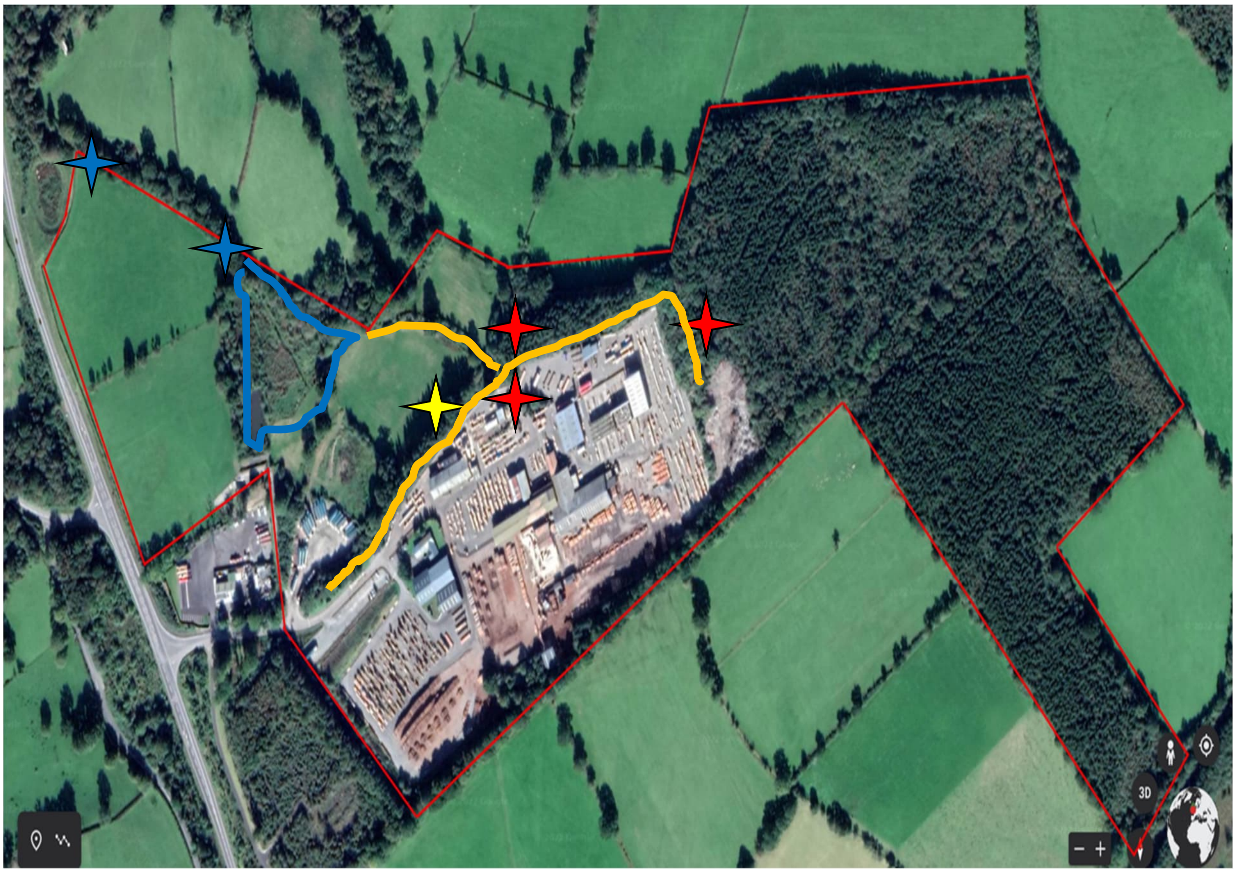


3.1.13 Diagrammatic map of compartments 4 – 16 [Old Network]



3.1.14 Principles of the new reed bed network.

The new reed bed network does not rely on a series of compartments, as in the old network, but works on a basic philosophy of gravity and filtration. The principles of filtration are exactly the same and all of the above text, including visual inspection of the system are exactly the same.



Key:

Red Lines:	Site Boundaries
Orange Lines:	Site Run-Off Ditches and Settelment Ponds
Blue Lines:	Reed Bed Area
	Interceptors
	NRW Sample Points
	Bio-Disc

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Approved By	John Smillie
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