WaterFund
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DTF 50

DECENTRALISED TREATMENT FACILITY

OPERATION & MAINTENANCE MANUAL






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UPSCALING BASIC SANITATION FOR THE URBAN POOR

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Optimal functioning of a Decentralised Treatment Facility requires consistent coordination of operations of all the various Modules. It also requires observation of Health and Safety Standards. The DTF should be maintained and operated correctly in order to achieve maximum outputs.

This manual aims at equipping the DTF operators with the desired knowledge to effectively operate and maintain the facility while observing the health and safety requirements.

HEALTH AND SAFETY

1. HEALTH AND SAFETY

1.1 PERSONAL PROTECTIVE EQUIPMENT (PPE)

DEFINITION

According to Chapter 9 of the Occupational Safety and Health Policy Guidelines

Personal protective equipment refers to protective barriers / device or clothing that is worn by a worker in order to prevent any part of his or her body and that of the clients from coming into contact with a hazard(s) present at the place of work. Selection of PPE's will be done according to the risk assessment for specific work areas.

General guidelines for using PPE

- Assess the risk of the exposure to a hazard
- Select appropriate PPE
- Fit the PPE to the person
- Use the right PPE for the right purpose
- Avoid any contact between contaminated PPE and services or people outside the work area
- Discard the PPE appropriately
- Do not share PPEs
- PPE should never be carried home and should be cleaned within work area.

PPE Health and Safety

Safety Goggles
to wear while operating and/or maintaining. Prevent eye contact with sludge splash and spray, gas, dust and chemicals

Protective Helmet
to wear while operating and/or maintaining, and especially when entering confined space or trimming trees. Protects the head from bumping or falling objects

Overall & Apron
to wear at any time during operational hours. Provide the first line of defence against cuts, abrasion and impact. Prevent skin contact with sludge and chemicals. Protect against adverse weather or extreme temperatures, skin infection, disease or contamination

Gumboots
to wear at any time during operational hours. Keeps feet and legs dry when working in wet conditions. Prevent slipping and protect against cuts, punctures, falling objects, sludge and chemical splash

Respiratory Mask
to wear while operating and/or maintaining, and especially when entering confined space. Prevent inhalation of dust and gas, and offer protection in oxygen-deficient atmospheres

Rubber Gloves
to wear while operating and/or maintaining. Provide the first line of defence against cuts, abrasion and impact. Prevent skin contact with sludge and chemicals. Protect against electric shock, skin infection, disease or contamination

Harness & Safety Rope (Lanyard)
to wear when entering a confined space to prevent falls or retrieve a person from a tank

Additional Items

First Aid Kit:
to store on-site in a dry area. Ensure it includes all basic first aid items (compress, bandages, antiseptic wipes, non-latex gloves, scissors, sterile gauze, tweezers, aspirin tablets, etc.). Check expiration dates and replace any used or out-of-date contents

Fire Extinguisher:
to extinguish or control small fires in emergency situations. It is not intended for use on an out-of-control fire

Fire Blanket:
to extinguish starting fire. To be placed over a fire in order to smother it.

Bucket of Sand or Soil:
to extinguish small fires or cover spillage (sludge, oil, etc.)

LED Flashlight:
to be used for security or maintenance purpose when visibility is limited.

Anti-bacterial Soap:
to use for hands and body washing to avoid skin infection and prevent faecal-oral route disease transmission. Proper hand washing and hygiene are an effective barrier to stop the pathogens contained in the sludge from entering the mouth

1.2 SAFETY MEASURES

Use PPE as instructed

Do not smoke nor drink alcohol on-site

Cover any skin injuries such as cuts and abrasions to prevent infection

Control access to the site and do not leave visitors unattended

Keep the manhole covers closed at all time (unless in operation) to avoid falling and/or drowning hazards

During exhauster discharge event, prevent sludge spilling as much as possible by ensuring a tight connection into the receiving bay In case of splash or spilling apply absorbing material (saw dust, ashes, cardboard, etc.) onto the sludge puddle to reduce contamination risks and prevent slip injuries

Clean utensils and surfaces before food preparation and consumption

Clean working tools and monitoring equipment after each usage

Keep the paths and treatment platforms clear of obstructions, to prevent trip and fall injuries and to allow swift and safe movements within the site

Get vaccinated (primary and booster shots) for tetanus and hepatitis A

Label sampling so that potable and non-potable water are clearly distinguished

Leave the PPE, working tools and monitoring equipment on-site and clean them regularly. Shower at work and change into clean clothes and shoes before leaving the DTF site

Wash hands with soap and water before eating or smoking and whenever hands come in contact with wastewater and sludge

In case of fire, gather at the designated fire assembly point

Do not use defective equipment, repair or replace them when necessary

Confined Space Entry Procedure:

Working in an enclosed space, such as the DTF tanks and chambers, is dangerous because of the risks from noxious fumes, reduced oxygen levels or a risk of fire. Other dangers may include flooding/drowning or asphyxiation from other source such as dust or other contaminant.

Before entering a confined space (DTF tanks) ensure that:

- A permit that has been prepared by the operator, is signed by the supervisor before and after the task (approval and completion of task)
- All manholes of the tank have been left open at least 24h before entering the tank, to prevent oxygen deficiency and excess of harmful gas such as hydrogen sulphide
- The person entering the tank is wearing a respirator mask, a helmet and a safety harness
- There is one person located outside the tank ready to provide assistance if needed
- The harness is attached to a safety rope held by a person outside the tank

1.3 EMERGENCY PROCEDURES

In case of fire

KEY SKILL: Do not panic

1. Shout **"FIRE"**
2. Fight the fire if safe to do so
3. Call 999/911/112 or the fire brigade
4. Evacuate using acceptable route
5. Do not re-enter the site until told to do so

First aid for someone who's unresponsive and not breathing.

KEY SKILL: The delivery of chest compression

1. Check breathing by tilting their head backwards and looking and feeling for breaths
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Push firmly downwards in the middle of the chest and then release
4. Push at regular rate until help arrives

First aid for someone who's unresponsive and breathing

KEY SKILL: Place the person on their side and tilt their head back

1. Check breathing by tilting their head backwards and looking and feeling for breaths
2. Move them onto their side and tilt their head back
3. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it

First aid for someone who's bleeding heavily.

KEY SKILL: Put pressure on the wound

1. Put pressure on the wound with whatever is available to stop or slow down the flow of blood
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Keep pressure on the wound until help arrives

First Aid for burns

KEY SKILL: Cool the affected area

1. Cool the burn under cold running water for at least ten minutes
2. Loosely cover the burn with cling film or a clean plastic bag
3. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it

First aid for a broken bone

KEY SKILL: Immobilise the affected part

1. Encourage the person to support the injury with their hand, or use a cushion or items of clothing to prevent unnecessary movement
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Continues supporting the injury until help arrives

First aid for poisoning and harmful substance

KEY SKILL: Establish what? When? And how much?

1. Establish what they have taken. When? And how much?
2. Call 999/911/112 or your local hospital as soon as possible, or get someone else to do it
3. Do not make the person vomit

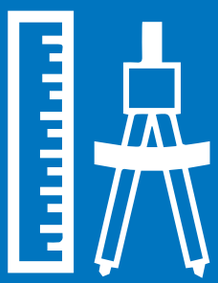
First aid for a head injury

KEY SKILL: Apply something cold

1. Ask them to rest and apply a cold compress to the injury
2. If they become drowsy or vomit, call 999/911/112 or your local hospital

1.4 EMERGENCY CONTACTS

NO.	CONTACT	WHEN TO CALL	TELEPHONE NUMBER
1.	Fire and Ambulance Services	*In any kind of emergency*	
2.	Local hospital	*In case of physical accident*	
3.	Local fire station	*In case of fire accident*	
4.	Local police station	*In case of robbery or to report a crime*	
5.	Water Service Provider	*For any matter regarding DTF*	
6.	Local public health office	*To report any public health related issue*	



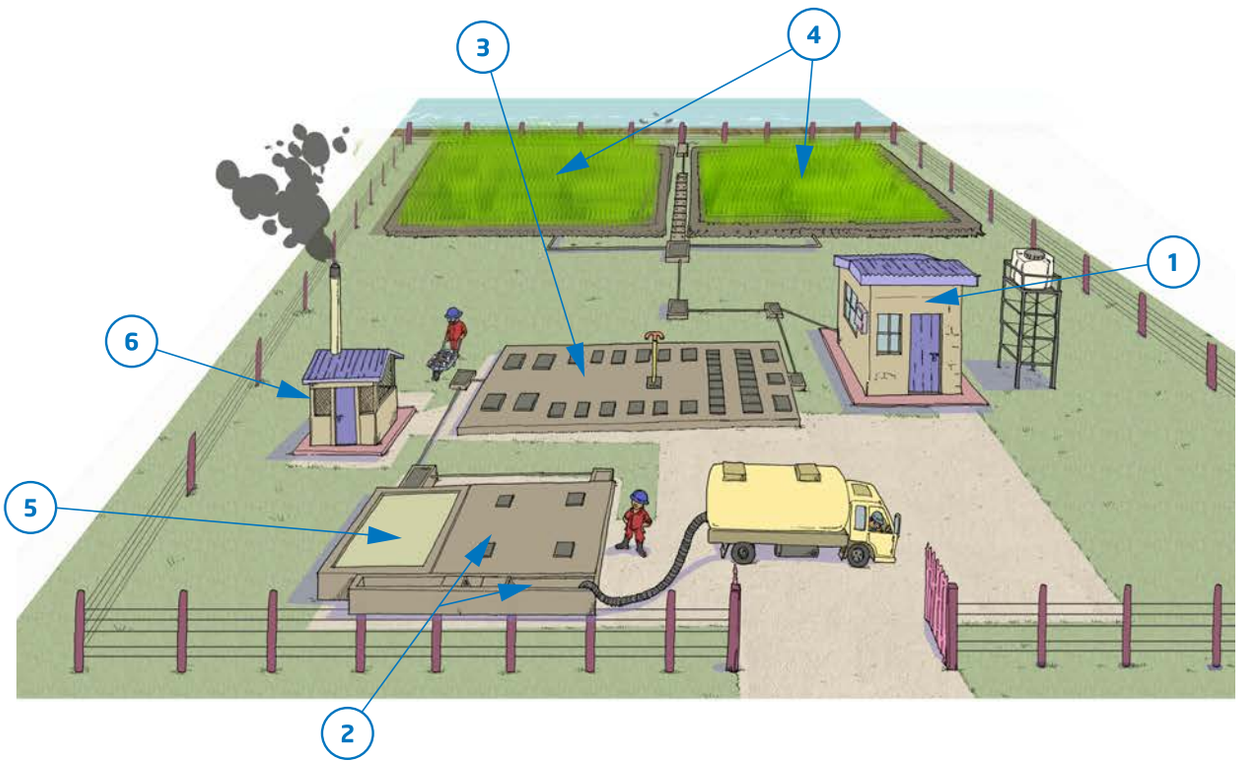
TECHNICAL DESCRIPTION

2. TECHNICAL DESCRIPTION

2.1 DTF OVERVIEW

The generic DTF has a capacity of 50 m^3/day. The various modules/stages of treatment in the DTF are as follows:

1. Operator Store
2. Receiving Bay / Balancing Tank
3. Anaerobic Reactor
4. Vertical Flow Constructed Wetland
5. Sludge Drying Bed
6. Waste Disposal Unit



2.2 DTF MODULES

1 Operator Store - OS

The OS is a two-room building, with one main office and one washroom with hand washing facility, shower and WC. The building is used as operator's office, tool and equipment store as well as guard's house. It is supplied with water (connected to service line or supplied by water bowser) and electricity (power grid or solar). Truck drivers as well as all visitors should report at the OS once they have entered the DTF. At this stage the operator has the duty to register the visitor once this one has been approved access.

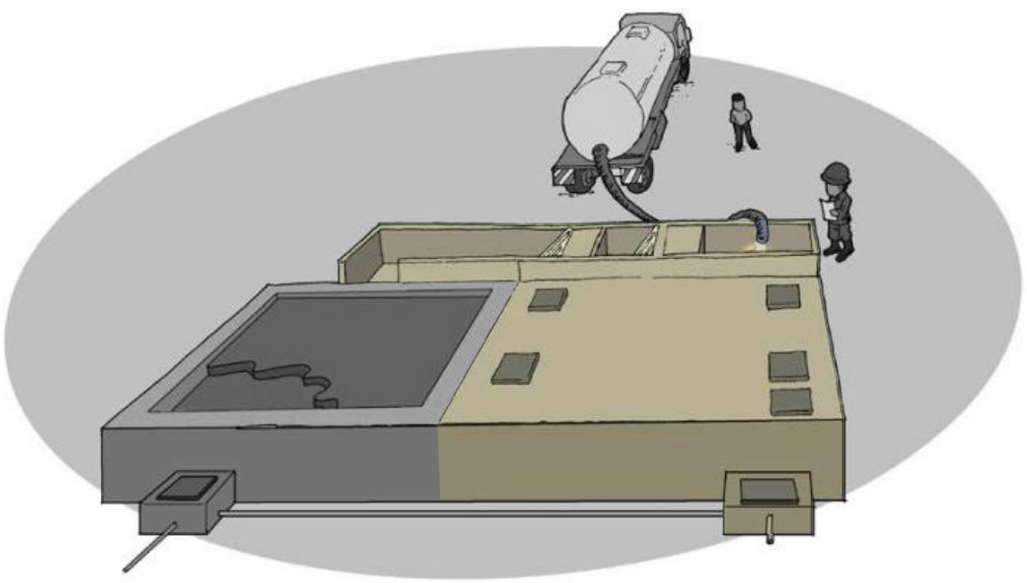
2 Receiving Bay / Balancing Tank - RBBT

The RBBT is the first module of the DTF which offers preliminary treatment to the faecal sludge or wastewater received. It is divided in two compartments:

- The RB is an inlet arrangement with coarse and fine screens. The exhauster parks at the dock station and offloads its contents. The solid waste is manually removed from the screens and placed on the platforms to dry-out. Once it is dry the waste is transported in the solid waste incinerator.

- The BT acts as a buffer tank. It can store up to 50 m^3 of faecal sludge or wastewater. It also controls the discharge towards the rest of the DTF at a flow rate of 2 m^3/h. The opening of the valve at the outlet should be regulated to allow for this flow rate. Therefore the BT can store the faecal sludge or wastewater up to 24h. In case the balancing tank exceeds its capacity, an overflow pipe has been provided to discharge the surplus of faecal sludge or wastewater.

The Receiving Bay is connected to a Sludge Drying Bed which is located side by side with the Balancing Tank. More information on the Sludge Drying Bed to follow.



3 Anaerobic Reactor - AR

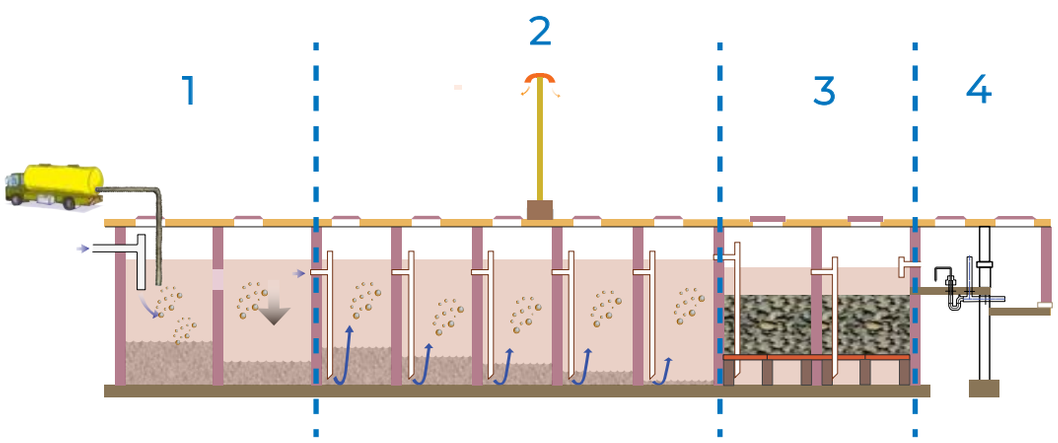
The AR comprises of 4 treatment modules:

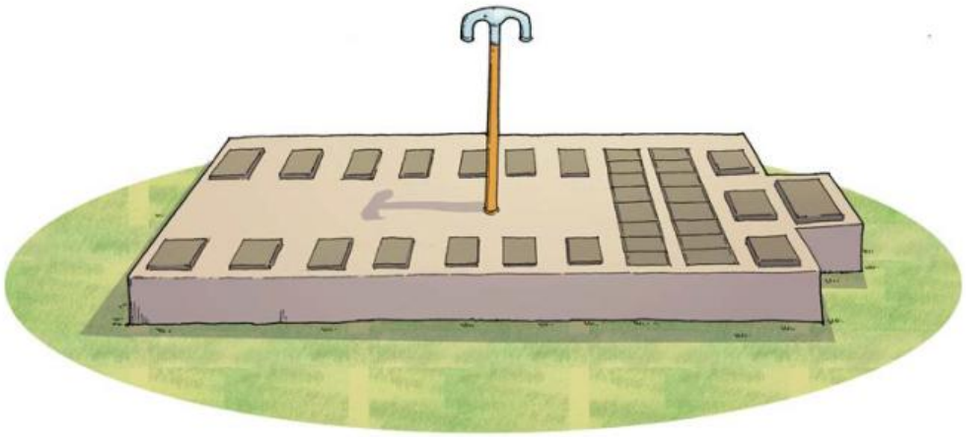
1 The Settler provides the first segregation of heavy and light material: the solids and sludge settle and accumulate at the bottom while the scum (lightweight materials including paper, fats and greases) rises to the surface. A baffle wall prevents the scum and sludge layer from moving from one chamber to another. The inlet-outlet level difference is 100 mm to give the required hydraulic gradient. The total volume of the Settler module is 48 m^3 with a water depth of 2.5 m and a Hydraulic Retention time (HRT) of 24 h.

2 The Anaerobic Baffled Reactor (ABR) comprises of 5 successive chambers and 14 parallel downpipes located at the inlet of each chamber, leading the incoming flow towards the bottom of the chamber. The ABR enables a biological secondary treatment through biodegradation of organic material by the micro-organisms contained in the settled sludge. The inflow is forced to pass through the activated sludge where anaerobic bacteria are feeding from the organic material contained in the inflow to be treated. The inlet-outlet level difference is 150 mm to ensure hydraulic gradient. The water depth is 2.5 m bringing the volume capacity to 96 m^3. The minimum Hydraulic Retention Time (HRT) is 48 h to ensure biological degradation of organic material.

3 The Anaerobic filters are contained in two successive compartments and 11 parallel downpipes located at the inlet of each chamber, leading the incoming flow towards the bottom of the chamber. The volume of both compartments is 48 m^3 with a water depth of 2.5 m and a minimum Hydraulic Retention Time (HRT) of 24 h. The filter media is seated on elevated 100 mm thick perforated slab to allow free passage of the incoming flow. The filter media consists of aggregates of 30-42 mm diameter. The Anaerobic filters offer both mechanical filtration and anaerobic digestion.

4 The Siphon comprising of a main chamber and a subsequent drainage chamber. The goal of the siphon is to provide intermittent flow to the next module. With the current design, the siphon releases intermittent flushes of 1.5 m^3 every 45minutes towards the Vertical Flow Constructed Wetland. The level difference between the siphon drainage chamber and the VFCW should be at least 0.9 m to allow sufficient pressure in the feeding pipe network.



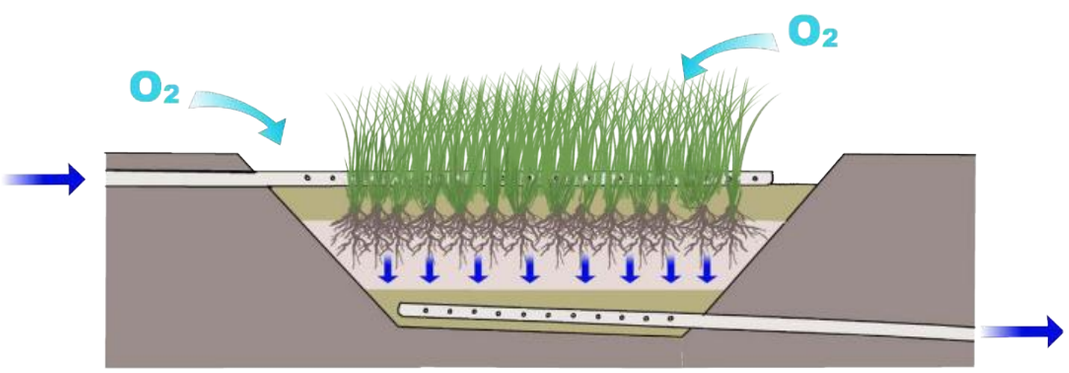


4 Vertical Flow Constructed Wetland - VFCW

The VFCW is the last module of the DTF treatment line. It offers the final cleaning process that improves the effluent quality before it is discharged to the receiving environment. The VFCW is a planted filter bed that acts as:

- a filter for removing solids
- a fixed surface upon which bacteria can attach
- a base for the vegetation whose roots permeate the filter media and harbour variety of micro-organisms

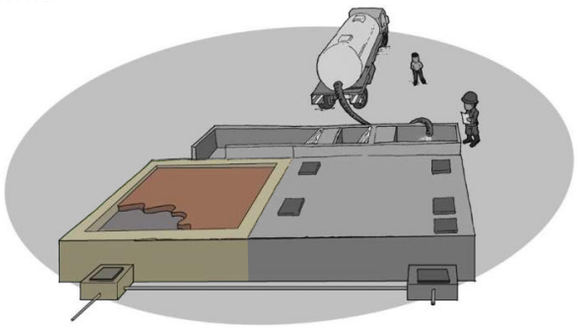
The pre-treated waste water from the ABR is loaded intermittently onto the surface of the VFCW through perforated pipe system. The water flows vertically down through the filter layer to the bottom of the bed where it is collected in a drainage pipe system. The waste water is treated by a combination of biological and physical processes. The intermittent batch loading and long resting periods enhance the oxygen transfer through the porous media and leads to high aerobic degradation activities. By forcing the organisms into a starvation phase between dosing phases, excessive biomass growth can be decreased and porosity increased. This is ensured by the intermittent load from the siphon and the alternate use of each filter bed: 1 bed is used for 15 consecutive days only. Nutrients and organic material are absorbed and degraded by the dense microbial population and pathogens are removed by natural die-off or predation by higher organisms.

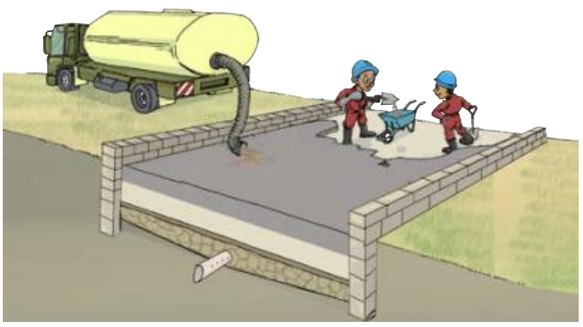


5 Sludge Drying Bed - SDB

The SDB is a treatment module that runs parallel to the main DTF treatment line. SDB is a shallow unplanted filter bed with media consisting of sand and gravel. An underdrain pipe at the bottom of the bed collects the leachate which is conveyed to the next treatment module

Sludge from other DTF modules (Balancing tank and Anaerobic Reactor) is discharged to the sludge drying bed for dewatering through the Receiving Bay. The passage of the sludge through the Receiving Bay enables the screening of the sludge which might contain coarse material, and the reduction of velocity to prevent disturbance of the superficial sand layer. A total of 18 m^3 of sludge can be received into the sludge drying bed. The drying process in a SDB is based on drainage of liquid through the sand and gravel to the bottom of the bed, and evaporation of water from the surface of the sludge to the air. Approximately 50 to 80% of the sludge volume drains off as leachate, which is then directed to the DTF treatment line for further treatment prior to discharge. After reaching the desired dryness, the sludge is removed from the bed manually and can be used as soil conditioner or base for organic fertiliser (compost). The thickness of dry sludge should not exceed 300 mm, leaving 400 mm of freeboard between the top level of the sludge and the edge of the bed.





6 Waste Disposal Unit

The Waste disposal unit includes the following elements:

- An incinerator (De Montfort model) to burn waste and reduce it. The incinerator destroys 67 kg of solid waste per hour.
- A waste store to securely accumulate waste that is to be incinerated and to stock the fuel material (wood or agro-residues) required to preheat the incinerator.
- A shelter to protect the incinerator, the operator and the waste being incinerated, the fuel and the operator's tools. Moreover, it supports the 4 m high chimney.

The incinerator is made of firebricks and prefabricated metal components. It comprises a primary and a secondary chambers. The burning zone of the primary chamber is accessible through a front door, which lets in air, allows the operator to light the fire and also allows the removal of ashes. Once the solid waste screened at the Receiving Bay is dry, it is dropped in through a loading door, above the primary chamber. The secondary chamber, which is inaccessible to the operator, is separated from the primary chamber by a brick column with an opening at the bottom to induce a cross draught during operation. Additional air is drawn into the secondary chamber through a small opening in the lower section of the rear wall of the secondary chamber. This air mixes with the partially burnt flue gas from the primary chamber and causes secondary combustion. The chimney mounted above the secondary combustion chamber releases the flue gases into the atmosphere.

DTF RULES & REGULATIONS

3. DTF RULES & REGULATIONS

3.1 Code of conduct

Operating wastewater and faecal sludge is a professional occupation that requires education, training and experience. In this profession, staff involved in the operation of a DTF must be dedicated to the protection of public health and act skilfully and conscientiously. DTF Operators have a direct impact on the environment, the preservation and protection of which affects the quality of life for all residents.

DTF Operators, in fulfilment of their professional duties, shall:

1. **Hold paramount the health and welfare of the public.**
   - » Follow all procedures and guidelines designed to prevent pollution from occurring
   - » Strive to increase public knowledge of the faecal sludge and wastewater treatment field and its importance by leading tours of the DTF

2. **Protect the property and the environment.**
   - » Properly and conscientiously operate and maintain the DTF
   - » Strive to maintain the aesthetic of the environment in and around the facilities

3. **Properly and accurately complete required records**
   - » Be objective and trustful in data collection and reporting
   - » Acknowledge errors and do not distort or alter the facts

4. **Follow and comply with the county and government rules and regulation**
   - » Be familiar with all details of the permit requirements that apply to the DTF and understand the consequences of violations caused by inaction or negligence

5. **Follow health and safety measures and ensure best possible service**
   - » Always consider your personal safety, the safety of the fellow workers and that of any other person present at the DTF site while performing your duty
   - » Endeavour to increase your knowledge and skills through continuing education activities

6. **Avoid unprofessional practices and act honourably, responsibly, ethically and lawfully so as to enhance the reputation of the profession**
   - » Accept personal responsibility for your professional actions
   - » Do not untruthfully criticize the Water Service Provider and/or other colleagues so as to injure professional reputation or employment

3.2 Site regulation

Operating hours:

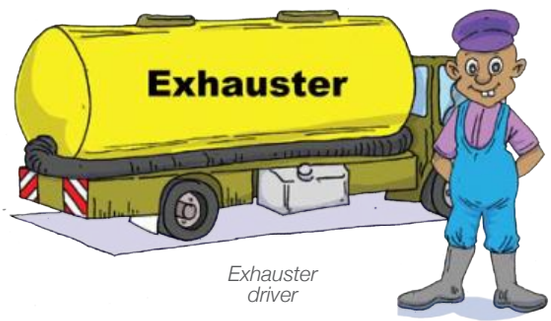
Access control:

On a daily basis and from an operational point of view, access to the DTF is strictly restricted to:

- DTF staff who possess a professional ID card that they should be able to show to the competent authority at any time
- Exhauster drivers that have been scheduled from the WSP office to discharge at a given date

DTF Security Guard

DTF Operator



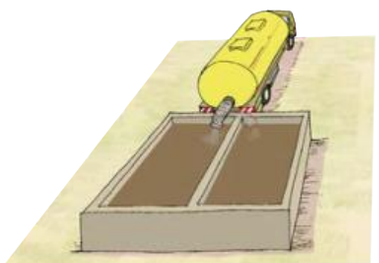
Exhauster driver

In case of exceptional event such as:

- External service provided: collection of lab sample, desludging, etc.
- Educational or exchange visit: schools, universities, communities, other WSP, etc.
- Official visits: governmental authorities, county, PHO, partner institutions, etc.

Collection of sample

Educational visit



Desludging

Authorisation should be given from the WSP who is in charge of organising the event and communicating with the DTF staff in time. Each visitor should be registered in the visitor's book and should obtain a Visitor's badge at the gate.

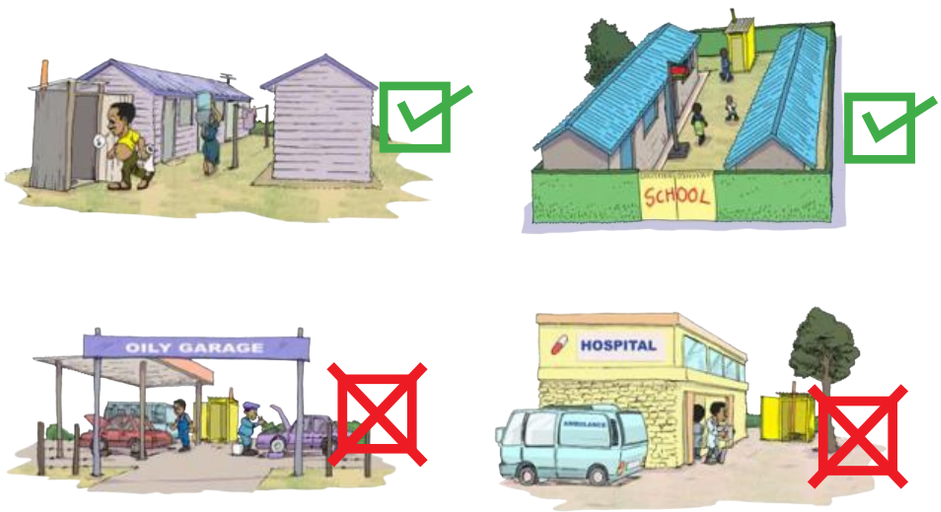
3.3 Discharge rules

DTF capacity

The DTF has a design capacity of 50 m^3 per day, which corresponds to the equivalent of approximately 6 exhausters per day.

Approving faecal sludge for discharge

Waste from different sources can have widely different characteristics, which may impact upon the operation and the treatment efficiency of the DTF. Residential faecal sludge (from pit latrines or septic tanks) is relatively free of toxic chemicals and therefore is the most suitable for the DTF. Faecal sludge from restaurants may have significant quantities of fats, oil and grease. Since the DTF is not equipped with grease traps, this source of faecal sludge is not recommended. Faecal sludge from auto repair shops, dry cleaning establishments and hospitals may contain toxic materials that are detrimental to the treatment process by killing the living biomass responsible of the treatment. Therefore, faecal sludge from these commercial or institutional settings is to be avoided.



START UP PERIOD

START-UP PERIOD

4. START-UP PERIOD

4.1 Objectives

For a newly built DTF, a transition period is necessary at the beginning before reaching the full potential of operation:

- to help the bacteria to multiply and by doing so reaching the required treatment efficiency,
- to enable reeds (from Vertical Flow Constructed Wetland) to grow and adapt to their environment,
- to define adequate operation, maintenance and monitoring procedures.

The time required for the start-up period may vary from 2 to 6 months, depending on the climatic conditions.

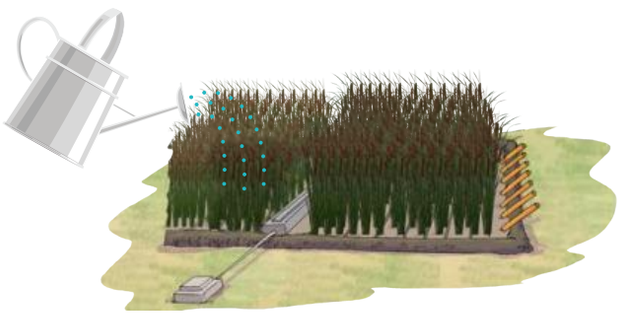
4.2 Conditions

Dry Season

Dry and rainy season have an influence on the treatment efficiency. Therefore, in order to assess the ideal loads and retention time, it is recommended that the start-up period covers at least two seasons.

Rainy Season

Before the first offload, ensure all tanks, chambers and pipes are empty and clean (sediment should be removed).



Water the wetland's reeds until the DTF is fully operational to avoid the plants from wilting and dying.

4.3 Inoculation process

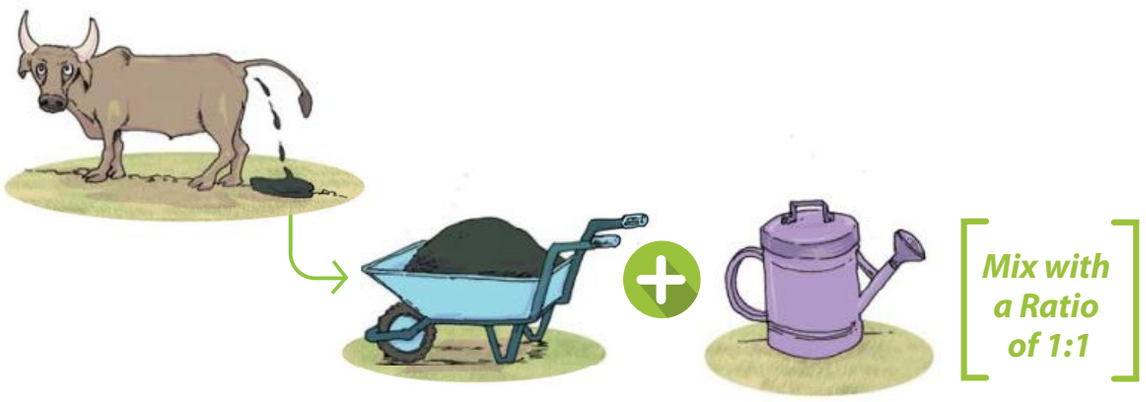
Inoculation of the DTF modules is done to activate the treatment process with fresh active bacterial material. Two procedures are possible:

Option 1

Discharge the faecal sludge from several exhauster trucks into the receiving bay at once, allowing it to flow into the DTF until it fills the whole anaerobic reactor. Considering the design of the two modules, a volume of around 192 m^3 must be filled (48 m^3 for the Settler, 96 m^3 for the ABR, and 48 m^3 for the AF). Assuming that the average capacity of an exhauster truck is 8m^3, the discharge of around 24 exhausters is necessary to fill the 2 settler compartments, the 5 ABR chambers and the 2 Anaerobic Filters compartments. Select the first 11 exhausters to offload a fresh thick sludge from pit latrines or septic tanks (high organic load). Leave the faecal sludge to stay for a period of 14 days. During this time the level of settled sludge is measured and recorded. After 14 days and if the quality of settled sludge and supernatant is satisfying (thick blanket of sludge and clear supernatant), start the operation gradually (see next chapter).

Option 2

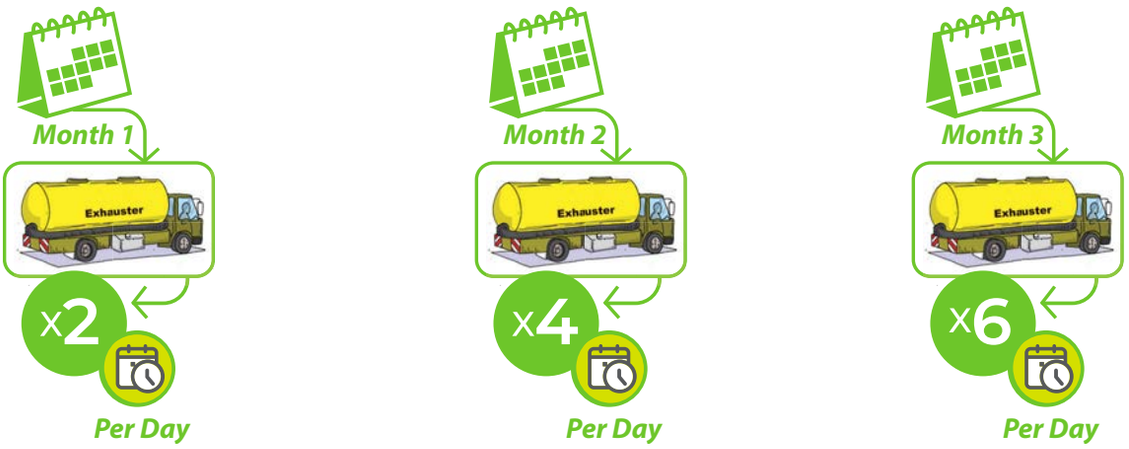
If the required volume of thick faecal sludge is not available, prepare the equivalent of 2.8 m^3 cow dung (approx. 46 wheelbarrows). The cow dung is mixed with water in 1:1 ratio (i.e. mix 1 bucket of water to 1 bucket of cow dung) and stirred to form a slurry. Filter the slurry by passing it through a 15 mm sieve (to remove all unwanted matter, such as fibre, wood, polythene, etc.). Pour the slurry in the 2 settler compartments and the 5 chambers of the ABR to form a layer with a thickness of 300 mm. Start operation the next day.



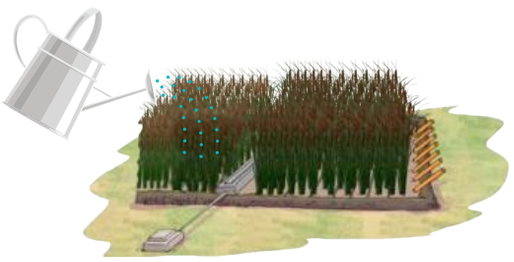
4.4 Gradual inflow

It is recommended to start operation with less than the full daily inflow (wastewater/sludge) capacity and to increase the daily quantity steadily over the first three months. This helps the bacteria to multiply and accumulate in the active sludge layer (Settler and ABR) and the biofilm (VFCW) without being flushed out.

- First month of operation: start with two exhausters (or 16 m³) per day
- Second month: increase to four exhausters (or 32 m³) per day
- From the third month: increase to the full capacity which is six exhausters (or 50 m³) per day



During the first two months, the reeds from the VFCW need to be irrigated with fresh water to compensate from the lower volume of effluent and to enable the young plants to acclimate gradually to their new environment.



4.5 Monitoring

During the first 6 months of the DTF operation, basic parameters (Temperature, pH, BOD, COD, Suspended Solid, TNb, TP, pathogens) should be measured on a monthly basis (see monitoring chapter).

OPERATION & MAINTENANCE

OPERATION & MAINTENANCE

5. OPERATION & MAINTENANCE

5.1 List of equipment

5.2 O&M procedures

5.2.1 Receiving Bay

General remark: before entering or operating in the receiving bay, open all covers (if any) for at least 1 hour, lift both screens to facilitate movement inside the module, and don't forget your respirator and helmet

Time interval	Task
Daily	· Rake the solid waste from the two screens after each exhauster offload and spread it on top of the drying platform. When the solid waste is dry, transport it into the solid waste incinerator. · Clean the receiving bay with water to avoid odours and remove silt and sludge residue. **Remarks** Cover the openings of the receiving bay at night and during rain event to prevent rain water to enter the system
Annually	· Clean the metal parts (screens and covers) and apply from time to time one coat of water paint and two coats of quality gloss paint to avoid corrosion.

Raking off the solid waste

Incineration of the solid waste

5.2.2 Balancing tank

General remark: when opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge)

Time interval	Task
Daily	· Stir the content of the balancing tank regularly (5 to 10 times a day) with a rod or stick to prevent sedimentation of the heavy particles · Inspect the outlet chamber to check for blockages and control the valve opening
Weekly	Inspect and remove the floating material that might have gone through the screens **Remarks** The floating material found in the tank should be disposed the same way as the solid waste
Monthly	· Remove the grit and settled sludge manually when it has hardened and accumulated (>5 cm) and dispose the material in the sludge drying beds **Remarks** Before entering the tank, ensure it is empty, leave the manholes open for at least 3 h and don't forget your respirator and helmet

Control of the flow rate

Removal of floating materials

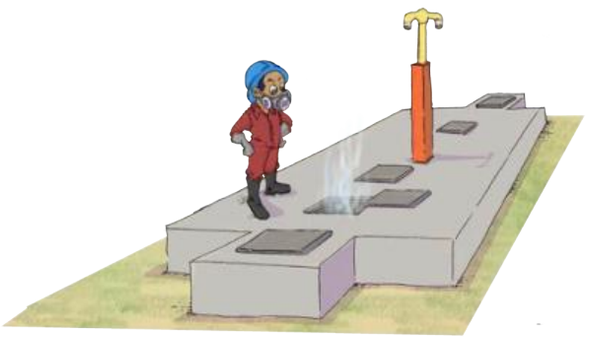
Removal of grit and settled sludge

5.2.3 Anaerobic Reactor

General remark:

When opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge)

Avoid as much as possible to enter the tanks due to presence of toxic gases and insufficient oxygen. In specific cases (cleaning, repairs, etc.) strictly follow the confined space entry procedures (see chapter 1.2 safety measures)



Settlers (first two chambers)

Time interval	Task
Daily	Inspect the inlet and outlet chamber daily to check for any blockages Inspect and remove the floating material from both tanks **Remarks** The floating material found in the tank should be disposed the same way as the solid waste
Weekly	Remove the scum with a skimmer and ensure the scum thickness does not exceed 5 cm **Remarks** The scum is disposed in the sludge drying beds
Monthly	Inspect and monitor the level of sludge (with the sludge judge) in both tanks
Semi-Annually	Remove the sludge with a vacuum pump when the layer has reached a thickness of 60 cm **Remarks** Leave a minimum of 10 cm layer of sludge to ensure active biomass The sludge is disposed in the sludge drying beds

Removal of floating materials

Monitoring of sludge level

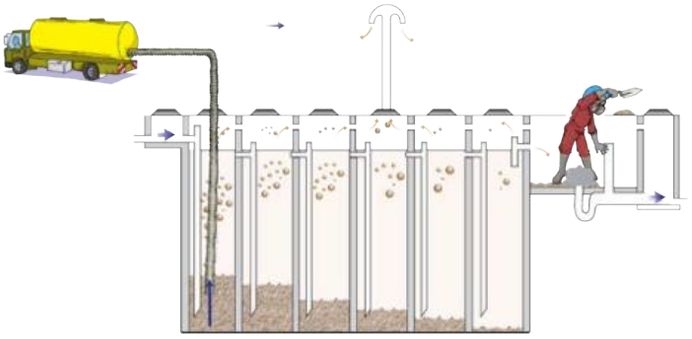
Anaerobic Reactor

Anaerobic Baffle Reactor (five following chambers)

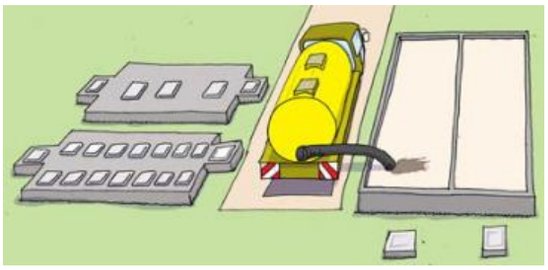
Time interval	Task
Daily	Inspect the inlet and outlet chamber daily to check for any blockages Inspect and remove the floating material from all 5 chambers **Remarks** The floating material found in the tank should be disposed the same way as the solid waste
Weekly	Remove the scum with a skimmer and ensure the scum thickness does not exceed 5 cm **Remarks** The scum is disposed in the sludge drying beds
Monthly	Inspect and monitor the level of sludge (with the sludge judge) in all 5 chambers
Semi-Annually	Remove the sludge when the layer has reached a thickness of 100 cm **Remarks** Leave a minimum of 30 cm layer of sludge to ensure active biomass The sludge is disposed in the sludge drying beds

Anaerobic Filters (two following chambers)

Time interval	Task
Daily	Inspect the outlet chamber daily to check for any blockages. Inspect and remove the floating material from the two compartments. **Remarks** The floating material found in the tank should be disposed the same way as the solid waste
Weekly	Remove the scum with a skimmer and ensure the scum thickness does not exceed 5 cm **Remarks** The scum is disposed in the sludge drying beds
Semi-Annually	· Clean thoroughly (with a high pressure hose) or replace the filter media · Check at the structural condition of the perforated concrete slab (unclog or replace if necessary) · Remove settle sludge or solid that has accumulated at the bottom of the compartment, below the perforate concrete slab



Desludging



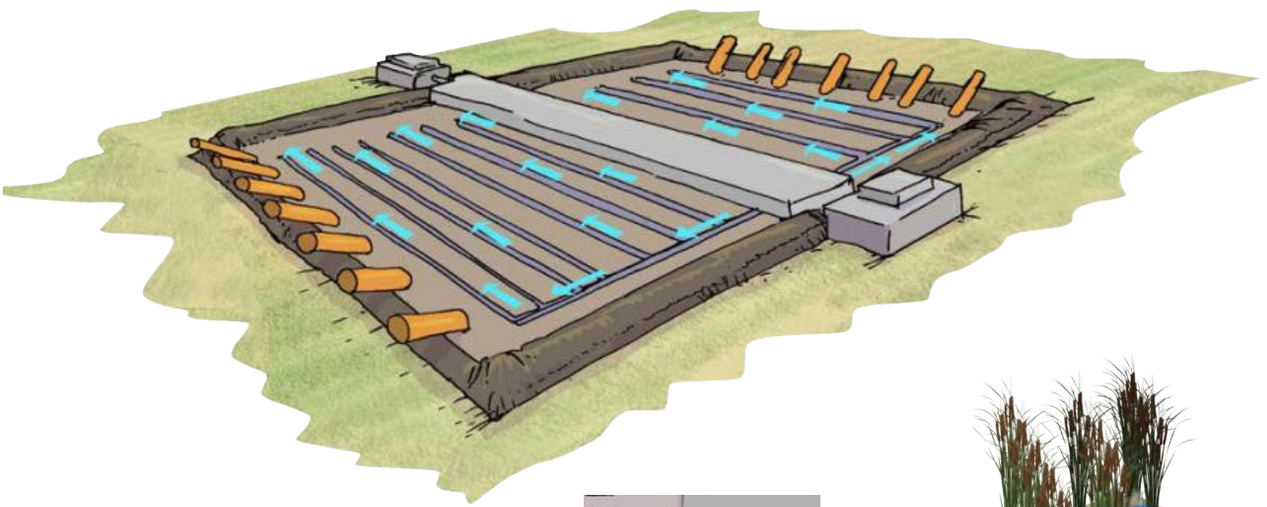
Disposal of sludge in the sludge drying bed

Siphon (last two chambers)

Time interval	Task
Weekly	Inspect the outlet chamber daily to check for any blockages Inspect and remove the floating material from the two compartments **Remarks** The floating material found in the tank should be disposed the same way as the solid waste
Monthly	Remove manually any settled sludge from the siphon chamber **Remarks** To operate in the siphon chamber, wait that the chamber is almost empty (when the flush has just occurred) to enter the chamber and don't forget your respirator and helmet The sludge collected is disposed in the sludge drying beds
Semi-Annually	Unscrew the bell and the vent pipe of the siphon to clean the underground piping thoroughly **Remarks** To operate in the siphon chamber, wait that the chamber is almost empty (when the flush has just occurred) to enter the chamber and don't forget your respirator and helmet

5.2.4 Vertical Flow Constructed Wetland

Time interval	Task
Daily	· Inspect of the feeding pipes to ensure flow is evenly distributed · Inspect the surface of the basin to ensure water level is below the surface (no saturation) · Ensure moderate growth of aquatic plants (reeds) · Inspect the embankments of the beds to ensure their stability
Weekly	· Inspect the central drainage channel to ensure that the flow is evenly drained, that there is no leakages in the basin (same volume coming in and out) and that no filter media is being washed out · Inspect the condition of the ball cock valves and the saddle clamps in the distribution chamber (no leakage)
Every 2 weeks	· Interchange the use of each wetland
Monthly	· Remove regularly the weeds and other plants that might interfere with reeds growth · Remove the plant litter when it entirely covers the surface of the wetland
Semi-Annually	· Harvest the aquatic plants (reeds) when vegetation become too dense · Dig out some of the most mature aquatic plants (tallest plants) and check for the roots length. If the roots are too long you should harvest the mature plants to prevent perforation of the plastic liner.
Every 5 years	· Replace or wash the filter media when it is clogged or when efficiency is reduced **Remarks** The washing is done by spreading the filter media on the ground outside the wetland, washing it with a high pressure hose and letting it dry for 1 day



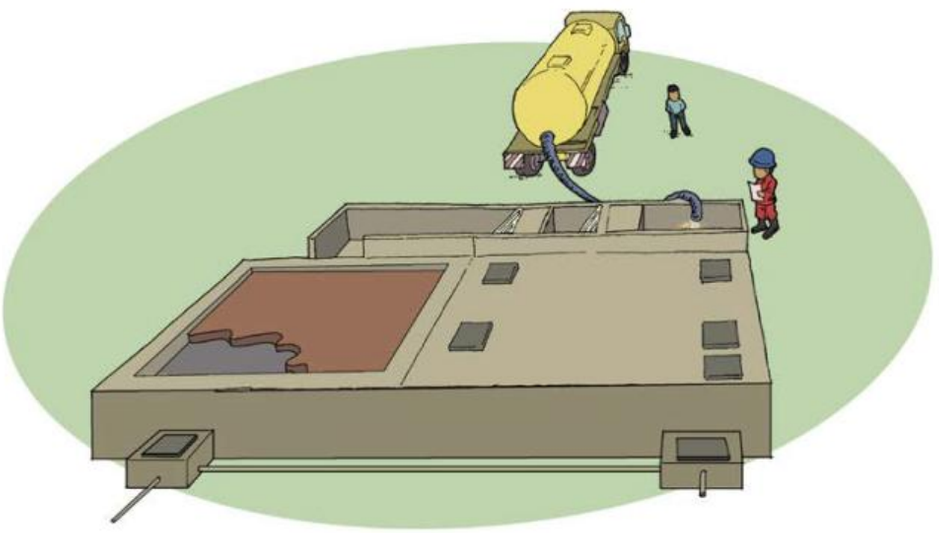
Evenly distributed flow

Filter media being washed out

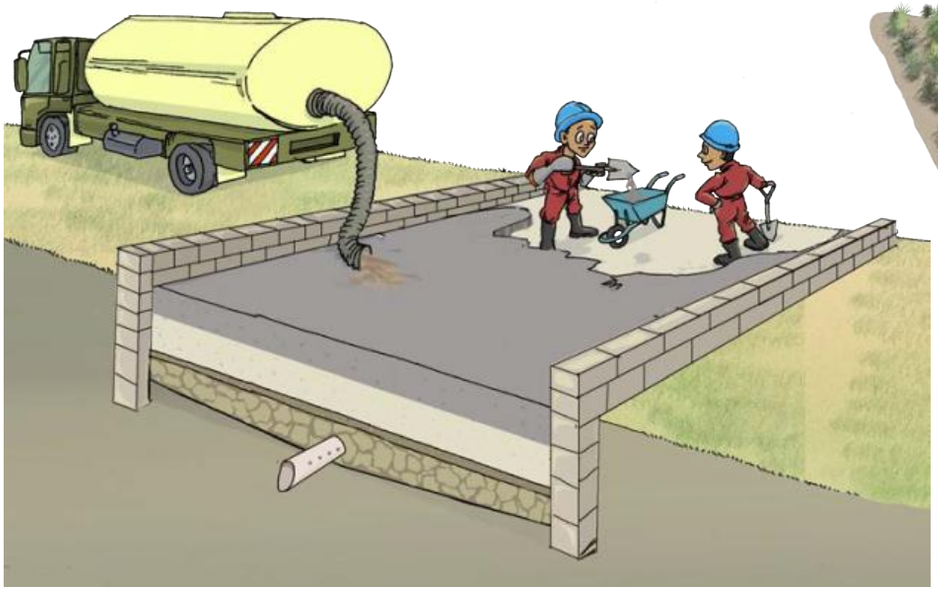
Weeding of the surface of the basins

5.2.5 Sludge Drying Bed

Time interval	Task
At every sludge discharge	· Ensure that before allowing the discharge of an exhauster in a bed, the sludge level allows a minimum of 40 cm freeboard · Ensure that the sludge is distributed evenly across the whole bed surface · Ensure that under dry condition the water contained in the sludge is being drained (no clogging in the filter media) · Remove and dispose of the solid waste that has been screened through the Receiving Bay or might have been discharged along with the sludge. · Clean the receiving bay with water to avoid odours and remove silt and sludge residue
Once the sludge is dry and has reached its maximum level	· Remove the dry sludge manually (with a shovel and a wheelbar-row) trying not to disturb the sand layer too much **Remarks** The dry sludge can be used as soil conditioner (for non- edible crops) or can be processed further with organic waste to produce compost (fertiliser)
Weekly	· Remove the weeds, plant's roots and leaves (from surrounding trees)
Monthly	· Inspect the outlet chamber of each bed to ensure that there is no clogging or breakage of the underdrain pipe, that there is no leakage at the bed liner level and that no filter media is being washed out
Semi-Annually	· Top-up (after 10-20 drying sequences) the sand layer
Every 5 years	· Replace or wash the filter media when it is clogged or when efficiency is reduced **Remarks** The washing is done by spreading the filter media on the ground outside the wetland, washing it with a high pressure hose and letting it dry for 1 day



Sludge Drying Bed attached to the Receiving Bay Balancing Tank



Discharge of the fresh sludge (manual removal of the dry sludge)

Weeding of the surface of the beds

Filter media being washed out

5.2.6 General

Time interval	Task
Daily	· Sweep the concrete surface: suspended slab and platforms of all modules · Inspect the soil moisture condition around the modules to identify any leakages from the pipes or from the modules themselves · Keep the operator store clean and tidy: clean the floor and the windows
Weekly	· Inspect around the DTF modules and remove the plants and roots which might interfere and damage the infrastructure · Keep the lawn green and healthy: grass cutting, watering, repairing, etc. · Remove the weeds · Water the ornamental plants
Monthly	· Check on the structural condition of each treatment module: cracks, settlement of structure, caving of the suspended slab, etc. · Control the corrosion on the metal parts: scrap rust, paint metal surfaces, repair corroded concrete reinforcement · Trim the trees
Semi-Annually	· Clean the external walls and slab of the module either with a high pressure hose or with a brush and some water

Trimming of trees

Painting

Floor sweeping

5.2.9 Waste Disposal Unit

The burning cycle contains three phases:

Preheating period: The primary chamber is loaded, lit and the temperature is brought to approximately 600˚C in 20 to 30 minutes by burning fuel material, i.e., firewood, coconut shells, etc., which is supplemented by kerosene or diesel fuel as may be necessary.

PHASE 1

PHASE 2

Solid waste disposal: Once the temperature in the primary chamber has reached 600˚C, the solid waste is loaded at a rate that maintains a constant and good, but not fierce, fire in the grate (approximately 6 kg/hr of solid waste).

PHASE 3

Burn down/close down period: 8 to 10 minutes after the entire solid waste has been loaded, an additional 1 kg to 2 kg of fuel material (wood or agro-residues) is added to ensure that complete burning occurs.

The operator must be on-site while the incinerator is functioning.

The incinerator should not be used to destroy:

- Broken thermometers
- Batteries
- Fluorescent light bulbs
- PVC piping
- Wet waste

The operator must inspect regularly the incinerator (metallic and masonry parts) and the Waste Disposal Unit structure (metallic or concrete parts) to check for any repair or replacement needed.

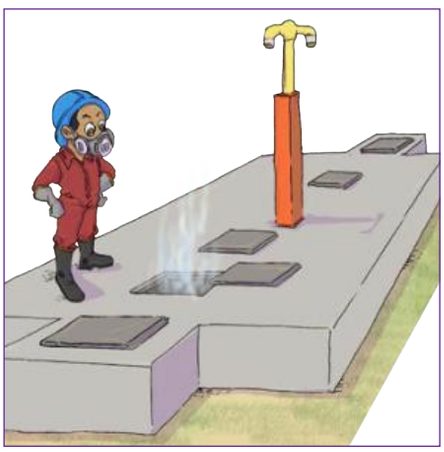
Incinerator

5.3 Troubleshooting

REMINDER

- When opening the manhole's cover, don't forget your respirator, don't face the manhole directly and wait at least 1 hour before operating in the tank (removal of floating material, scum or sludge).

- When entering a tank, make sure it has been emptied and that the confined space entry procedures (see chapter 1.2 Safety measures) are respected.

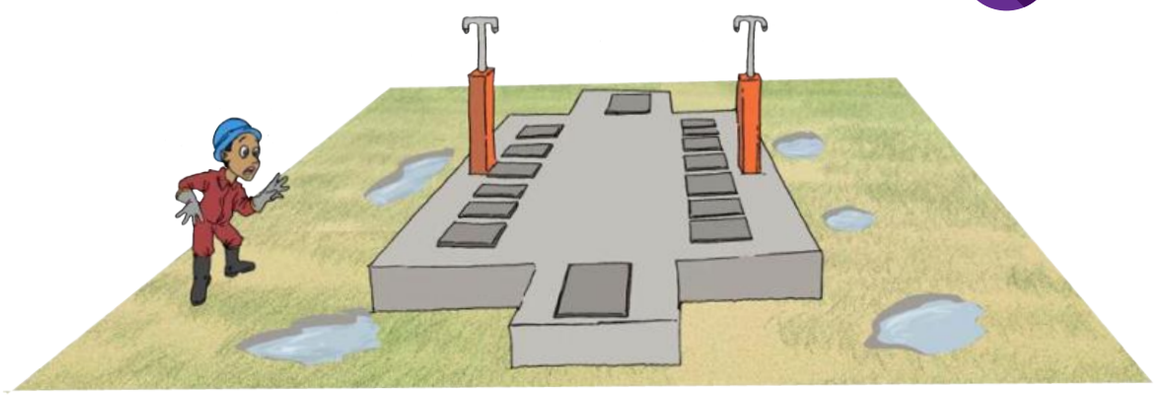


If the solid waste starts to smell and attract flies:

- Ensure that the drying process on the platform is complete before shifting the solid waste in the solid waste incinerator
- Prevent the solid waste from being in contact with water (rain)
- Cover the solid waste with a layer of ashes
- Incinerate the collected solid waste regularly (at least once a week)

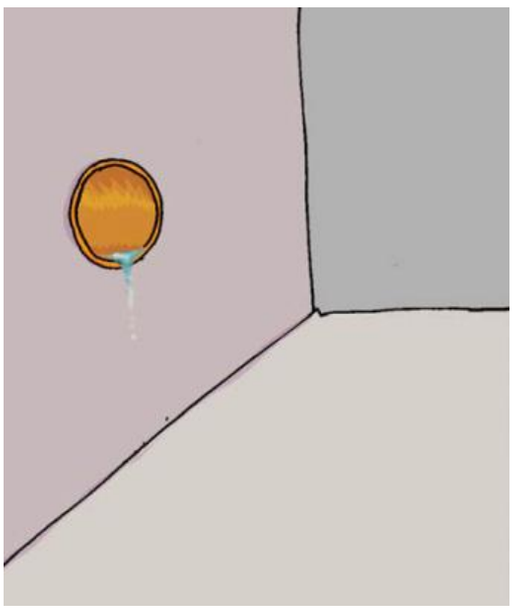
If you notice any unusual soggy area around the modules or above the pipelines:

- Stop the incoming flow by closing the balancing tank valve (and prevent the exhausters from offloading)
- Check at the water level of the modules next to the soggy area. If the water level of one of the module is below the outlet level, the leakage is located within the tank
- Test the water tightness of the nearby pipes by carrying out a water flow test from one chamber to another. If the volume of the water introduced in the first chamber is reduced in the next chamber, the leakage is located in the pipe in between
- When the leakage has been identified, organise for the necessary repairs: replace the pipe or repair the cracks in the tank with bituminous waterproof coating (Colaskote or equivalent)



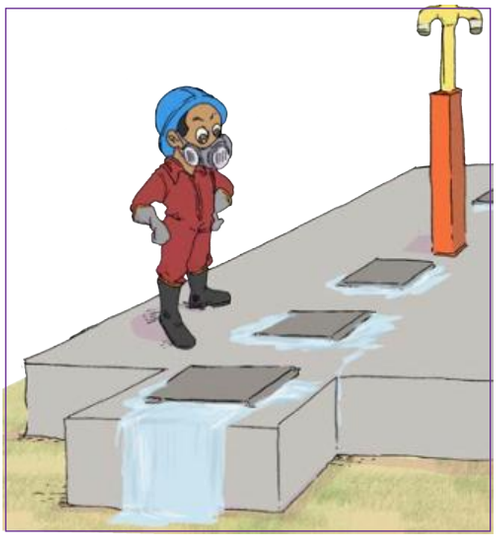
If there is no water flow in one of the module:

- Stop the incoming flow by closing the balancing tank valve (and prevent the exhausters from offloading)
- Determine if the leakage come from the prior module or the incoming pipeline and when the leakage has been identified, organise for the necessary repairs (see previous troubleshooting bullet point)



If there is an overflow in one of the module:

- Stop the incoming flow by closing the balancing tank valve (and prevent the exhausters from offloading)
- Inspect the outlet chamber of the module and the inlet chamber of the next module to check for blockages.
- When the blockage has been identified, remove manually the clogging material, dispose it with the rest of the solid waste and clean the chamber and pipes thoroughly



If you notice some unusual smell coming from the Settler or the ABR:

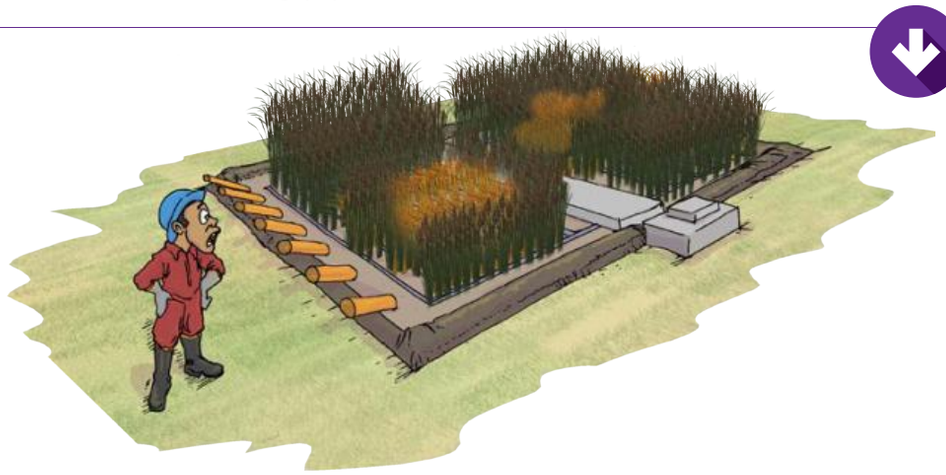
- Measure the flow rate in one of the inspection chamber to check if the flow rate is at 2 m^3/h and adjust the control valve of the balancing tank accordingly
- Inspect the inside of the tanks and remove any floating material.
- Check at the level of scum and sludge and remove if they are exceeding the recommended level

If you notice some unusual smell coming from the VFCW:

- Ensure that the siphon is functioning properly. If it is not the case, remove the sludge that has settled at the bottom of the siphon chamber. As a last resort, unscrew the bell and the vent pipe and clean the inside of the siphon with a high pressure hose
- Ensure that the bed has not been in use for more than 15 days. If it is the case, close the valve and switch to the other bed
- Check visually if one of the bed is saturated (water level above the surface).
- Remove the plant litter that might clog the surface of the beds
- Remove weeds and other plants that might interfere with reed growth
- Harvest some of the reeds if vegetation has become too dense
- As a last resort, replace or wash the filter media and check for clogging at the underdrain pipes level

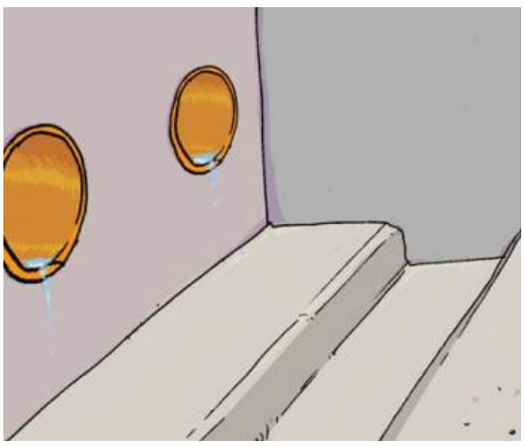
If part of the reeds has withered:

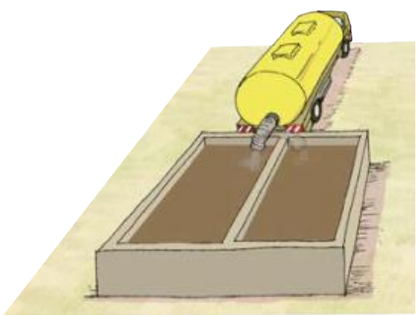
- It is a sign that the flow is not evenly distributed. Identify the dead zones by inspecting the feeding pipes at the surface of the beds
- If the dead zones are caused by clogging, remove the clogging material and clean the inside of the pipe with a high pressure hose
- If the dead zones are caused by the fact that the surface is not flat, rectify the level of the feeding pipes to ensure even distribution



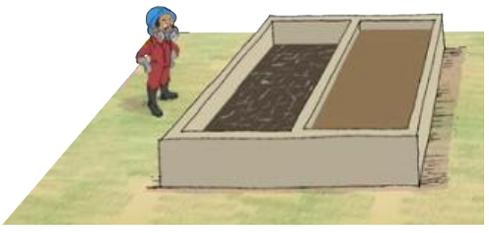
If there is no water flowing in the drainage channel of the VFCW:

- Check for leakages at the valve level in the inlet chamber and repair if necessary
- If the valve are not leaking, remove the filter media and identify the leakage in the PE liner. Repair with appropriate equipment: PE liner patch welded with hot wedge welding machine





1 week later



If the sludge disposed on the sludge drying beds stays wet for an unusual period of time:

- Check the outlet chamber for any clogging
- Remove the sludge and check for solid waste, weeds, roots or leaves that might clog the surface of the bed
- If no apparent clogging of the bed surface, replace or wash the upper part of the filter media (10 cm of the sand layer)
- As a last resort, replace or wash the entire filter media (sand + gravel) and check for clogging at the underdrain pipe level

MONITORING OF THE EFFLUENT QUALITY

6. MONITORING OF THE EFFLUENT QUALITY

6.1 List of equipment

6.2 Monitoring parameters

6.2.1 Visual inspection, on-site measurement and analysis

Parameters	Description
Level of sludge and scum	Biological reaction regulates the level of sludge and scum. However with time, both sludge and scum layers start to accumulate at the bottom and at the surface respectively. An ideal level of scum and sludge should be maintained in order to keep the balance between biological treatment (from the bacteria located in the sludge) and volume capacity of the treatment modules
Turbidity	Turbidity is the cloudiness of a fluid caused by the presence of particles like micro-organisms and suspended sediment. High turbidity can be an indication of high sediment load or high algal concentration
Odour	Odour is a sensory response to the chemical contained in the water. It can be used as an indicator for water quality

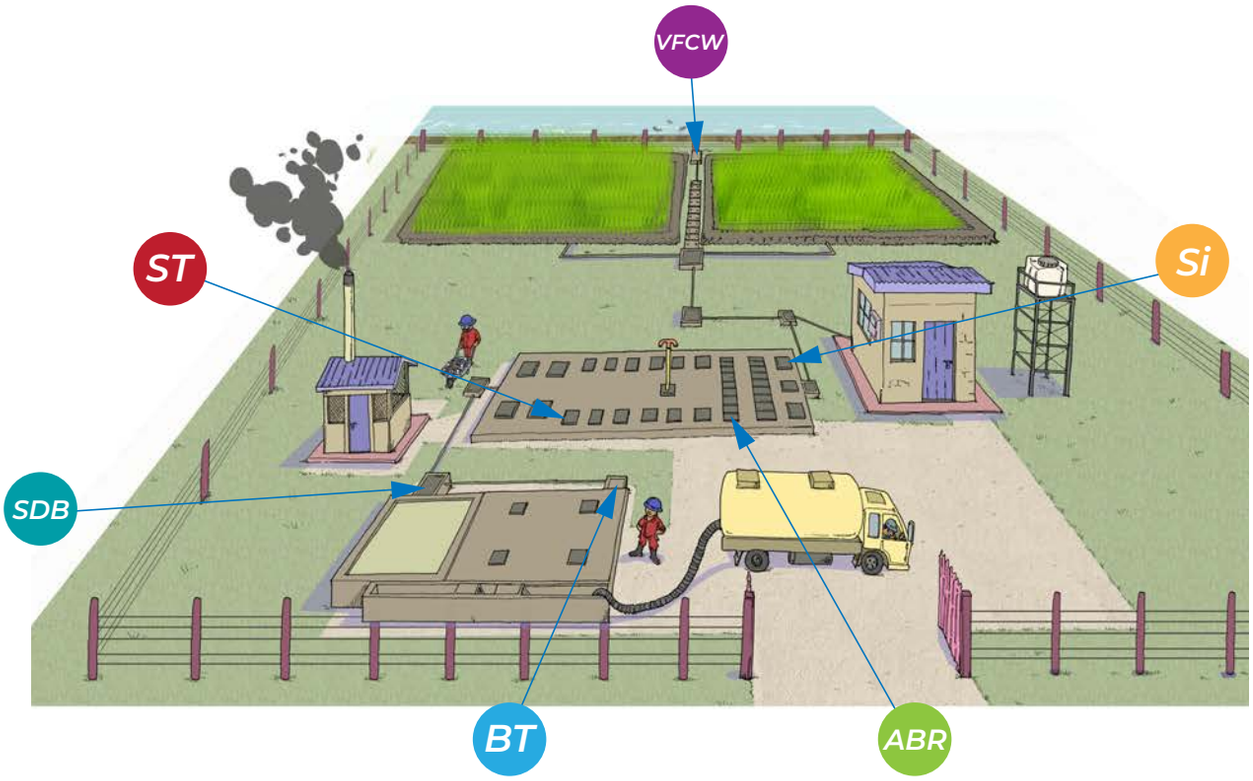
pH	pH has a profound effect on the rate of microbial growth. Acidic conditions (low pH) or basic conditions (high pH) alter the structure of enzyme responsible of microorganism growth
Dissolved Oxygen (DO)	Dissolved oxygen is defined as the relative measure of oxygen dissolved in water available to sustain life, including living bacteria. DO is an indicator of the health of a water body and its capacity to support a balanced aquatic ecosystem of plants and animal. Wastewater effluent that is not efficiently treated may contain inorganic pollutants that will deplete the dissolved oxygen and may lead to the death of marine organisms.
Temperature	Temperature measurement in wastewater treatment provides an important back up to pH, turbidity and DO measurement. The efficiency of activated sludge treatment process and the biological activity is greatly influenced by temperature

6.2.2 Measurement and analysis in laboratory

Parameters	Description
Total Suspended Solid (TSS)	Measure of the dry weight of particles trapped by a filter. Suspended solid can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment
Total Dissolved Solid (TDS)	Measure of the combined content of all inorganic and organic substances that are small enough to pass through a sieve. These substances are primarily minerals, salts and organic matter that can be a general indicator of water quality.
Biodegradable organics (BOD_5 and COD)	Composed principally of proteins, carbohydrates and fats, biodegradable organics are measured most commonly in terms of BOD (biochemical oxygen demand) and COD (chemical oxygen demand). These parameters monitor the available oxygen which has a direct impact on aquatic life. If biodegradable organics are discharged untreated to the environment, their biological stabilisation can lead to the depletion of natural oxygen resources and to the development of septic conditions.
Nutrients (NH_4, NO_3, NO_2, Total Phosphorus)	Both nitrogen and phosphorus, along with carbon are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life and increase the risk of eutrophication of water bodies.
Pathogens (E.Coli and Total Coliforms)	Communicable diseases can be transmitted by pathogenic organisms that may be present in wastewater.

6.3 Location for sample collection

Samples are taken in five distinctive locations of the DTF:



- **BT** In the outlet chamber of the Balancing Tank
- **ST** At the outlet of the Settler
- **ABR** At the outlet of the ABR
- **Si** In the Siphon chamber (outlet of the Anaerobic filters)
- **VFCW** In the outlet chamber of the Vertical Flow Constructed Wetland
- **SDB** In the outlet chamber of the Sludge Drying Bed

6.4 Monitoring procedures

SAFETY CONSIDERATION

- ☑ Always prohibit eating, drinking or smoking near samples and sampling locations
- ☑ Keep sparks, flames and excessive heat sources away from samples and sampling locations

6.4.1 On-site measurement and analysis:

Level of Sludge and Scum

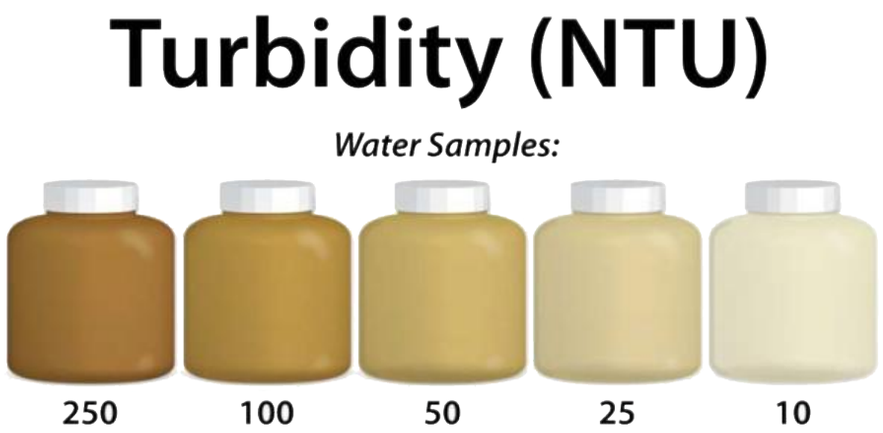
Procedures: the sludge and scum level is to be measured in the Anaerobic Reactor module: in the two chambers of the settler and in the five chambers of the ABR. Gently insert the sludge measurement tube vertically into the tank or chamber to be measured. Once the bottom of the tank is reached, screw the tube left and right to ensure it is sealed with the sludge. Plug the top of the tube with one hand and remove the tube carefully. Read and record the level of the sludge and the scum and release the content of the tube in the area of collection.

Analysis:

Settler tanks	Remedial actions
Scum layer > 5 cm	Remove the scum layer entirely
Sludge layer > 60 cm	Remove the sludge layer and leave a minimum of 10 cm sludge layer at the bottom
ABR chambers	**Remedial actions**
Scum layer > 5 cm	Remove the scum layer entirely
Sludge layer > 100 cm	Remove the sludge layer and leave a minimum of 30 cm sludge layer at the bottom

Turbidity

Collect effluent samples with the sampling rod and pour the liquid into a clean glass jar. Estimate visually the turbidity of each sample by comparing its colour with the turbidity colour chart. Turbidity is measured in a unit called NTU (Nephalometric Turbidity Units).



Analysis: according to the Kenyan Water Quality regulations, no turbidity limits are defined for effluent discharge into the environment. The turbidity values will be used for internal monitoring purposes. However it is recommended that the final effluent discharged into the environment (sample nr. 5) does not exceed **50 NTU.**

Tips: Try to take turbidity readings in the same light each time. Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance. If the sample stands for any length of time, shake your sample well before taking measurement.

Odour

The odour intensity is stated according to a predetermined rating system.

Odour intensity measurement	Odour strength
+	Barely perceptible
++	Slight
+++	Moderate
++++	Strong
+++++	Very strong

Half score is used when the observer is undecided

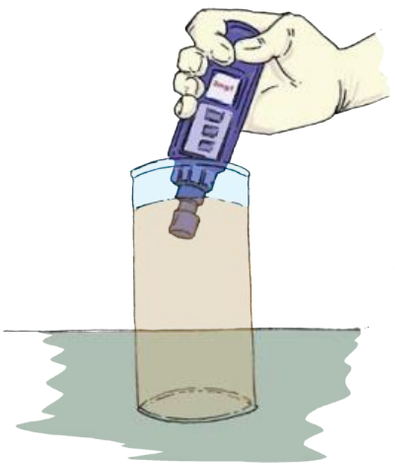
Offensive odour description	Potential compound responsible
Pungent, Irritating	Ammonia (NH3), Ozone (O3), Sulphur dioxide (SO2)
Rotten eggs	Hydrogen Sulphide (H2S)
Vinegar	Acetic Acid (CH3COOH)
Acrid	Formaldehyde (HCHO)
Fishy	Methylamine (CH3NH2)

DO (Dissolved oxygen)

For each sample location, collect a 250 ml sample with the sampling rod and measure the DO with the DO meter probe.

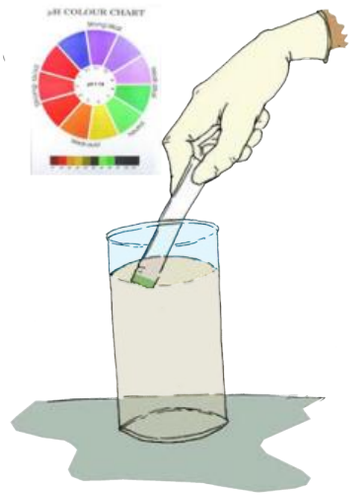
Analysis: Since the DTF is mainly using anaerobic treatment, the DO value is expected to be quite low until the VFCW (aerobic treatment). The minimum DO value that the final effluent (VFCW outlet) should reach before being released into the environment is **1.5 mg/L.**

Tips: Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance. The sample should not be agitated to avoid changes in gaseous content.



pH

Measure the pH with the pH test strip using the same 250 ml sample. Dip a pH test strip into the sample for several seconds (no need to stir the strip), remove the pH strip, hold it and wait for the colour indicator on the end of the strip to finish changing colour. Take a reading of the pH by comparing the colour indicator on the test strip to the chart that came with the pH test kit. Once the reading and recording is done, dispose of the used strip (it cannot be used again).



Analysis: Most microorganisms do well within a pH range of **6.5 to 8.5**. Therefore it is important to control the pH of the wastewater at each stage of the treatment to prevent extreme pH to cause significant microbial destruction.

Tip: Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance.

Temperature

Measure the temperature using the same 250 ml sample collected for the DO measurement. The optimum efficiency is obtained at a temperature ranging from 10 to 40°C. The temperature of wastewater is a function of seasonal changes therefore it is important to pair wastewater with ambient temperature measurements. The ambient temperature is measured with the thermometer. The wastewater temperature can be measured either with the thermometer or the DO meter probe.

Tip: Analyse individual samples as soon as possible after collection and preferably at the sample point, to avoid disturbance.

6.4.2 Measurement and analysis in an external laboratory:

For each sample location, collect a 1,000 ml sample in a clean plastic container (free of contaminants). Each sample will be send to the laboratory to be analysed for the following parameters: TSS, TDS, BOD_5, COD, total Nitrogen, E. Coli/Coliforms. Fill sample containers without pre-rinsing with sample (as it can bias results high when certain components adhere to the sides of the container). When filling the sample, leave an air space equivalent to approximately 1% of the container volume to allow for thermal expansion during shipment and use a thermos box for transport. If immediate analysis is not possible, refrigerate all the samples to be sent to the laboratory (<4°C but above freezing). Deliver samples to laboratory as soon as practicable after collection, typically within 2 days. Ensure that samples are accompanied by a complete chain-of-custody record including a sample analysis request.

According to the sixth schedule of the Kenyan Water Quality Regulation document (2006), the guided value for the aforementioned parameters are as follows:

Parameter	Guide value
BOD_5	30 (mg/L) max
COD	50 (mg/L) max
TSS	30 (mg/L) max
TDS	1200 (mg/L) max
NH_4	100 (mg/L) max
NO_3	100 (mg/L) max
NO_2	100 (mg/L) max
E.Coli	Nil/100 ml
Total coliform	1,000/100 ml

Chain-of-Custody Procedures

Properly designed and executed chain-of-custody forms will ensure sample integrity from collection to data reporting. This includes the ability to trace possession and handling of the sample from the time of collection through analysis to final disposition.

- Use labels to prevent sample misidentification. Label should include: sample number, location, name of collector, date and time of collection.
- Fill out the chain-of-custody and analysis request form (provided by the laboratory) to accompany each sample or group of samples.

6.5 Monitoring routine schedule

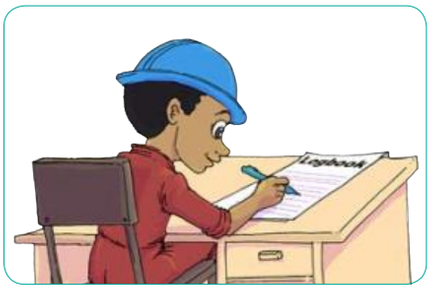
Parameter	Guided value	Sample location	Sample Frequency	Measurement type
Sludge level	60 cm max for Settler 100cm max for ABR	Settler and ABR tanks	1/month	On-site: visual inspection through sludge judge
Scum level	5 cm max			
Turbidity	50 NTU max (at the effluent)	BT, ST, ABR, Si, VFCW, SDB	1/month	On-site: visual, sensorial, DO meter, pH test strip and thermometer measurement on a 250 mL sample
Odour	-			
Dissolved oxygen (DO)	1.5 mg/l min (at the effluent)			
pH	Between 6.5 and 8.5			
Temperature	Between 10 to 40°C			
TSS	30 mg/l max (at the effluent)	BT, ST, ABR, Si, VFCW, SDB	4/year (results to be sent to WASREB)	Laboratory: send a 1,000 mL sample
TDS	1,200 mg/L max (at the effluent)			
BOD_5	30 mg/L max (at the effluent)			
COD	50 mg/L max (at the effluent)			
NH_4	100 mg/l			
NO_3	100 mg/l			
NO_2	100 mg/l			
E. Coli	Nil/100 ml			
Total coliform	1,000/100 ml			

RECORD KEEPING

RECORD KEEPING

7. RECORD KEEPING

7.1 Operator's logbook



The operator's logbook is intended for the operator to report its time schedule and to keep an on-site daily record of operation, maintenance and monitoring activities. The logbook is also used to report any events that is considered out of the ordinary, such as emergency response, injury, etc. Finally, the operator's logbook is a communication tool that is used to report instructions from the supervisor and/or recommendations from the operator him/herself.

The operator's logbook is to be filled every day by the operator and should be filed in a way that the supervisor or anyone from the WSP should be able to easily access the information.

OPERATORS LOGBOOK

Date: 26/09/2016 **Time of arrival:** 8:15 am

Operator's name: Charles Kamau **Time of departure:** 6:00 pm

Exceptional absence and replacement during the day:
Indicate timeframe, reasons, name and signature of the substitute

Absence from 1:00 pm to 3:00 pm for medical reason, replaced by John Kiiru

To be filled daily by the Operator

Exceptional events to be reported (disaster response, injury, communication with regulatory officials,etc.): Public Health officer Mr. Odhiambo has come to report a complain from a neighboor regarding the noise and smell. Will reach the WSP with an official letter.

Specific instructions from plant superintendent (if applicable): Cut the grass and trim the trees. Repair the part of the fence that has been vandalised.

Operation, Maintenance and Monitoring tasks undertaken:
Indicate if any breakdown or other malfunctions

- grass cutting, weeding, removal of dead leaf litter and trimming of trees
- watering of the ornamental plants
- screening of solid waste in RB
- removal of settled sludge in BT
- removal of floating material in BT, ST and ABR
- alternating the opening of the VFCW valves
- inspection and cleaning of the siphon chamber
- cleaning of the composting shed roof sheets
- fence could not be repaired today as the chainlink could not be purchased (to be done tomorrow)

on-site measurement:
- sludge and scum measurement
- turbidity, odour, temperature, ph, DO

Recommendations from operator:
Eventually, chain link of the whole fence should be replaced with superior quality to prevent from vandalism

Signature of operator: Charles Kamau

Signature of the operator mandatory

7.2 Manifest form

The manifest form is used to compile information regarding the origin of the sludge that is being discharged into the DTF (source, volume and special characteristics). It is a prerequisite for the sludge load to be discharged into the DTF. The manifest form is a key monitoring tool to identify the number of people served by the DTF.

The blank form is given to the exhauster driver from the DTF operator or the WSP office. When the driver wants to discharge the truck's content, the driver must submit the form duly filled (as indicated below) to the operator. Once the load is approved, the form is signed by the operator and remains at the operator office for data collection.

To be filled and submit by the driver to the operator prior to discharge

MANIFEST FORM

ORIGIN OF THE SLUDGE:

Date of collection: _26/09/2016____
Name (of plot owner or institution): ____St Andrews primary school__
Area:___Manyani_____
SafiSan toilets: Yes ☐ No ☒

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential	☑	4	4	unknown
Institutional *	☑	6	150	15-Jan
Commercial/Industrial **				

** Description of the institution or commercial/industrial waste (if applicable):*
Septic tank of a primary school

Name and signature of the exhauster driver: Date: 26/09/2016
Patrick Kariuki

Ref no.: __ 16-0001___ ***To be filled by operator***

Approved by authorized authority:
(Name and Signature) Charles Kamau

7.3 Reception book

The reception book is used to record the access of every exhauster into the DTF. The reception book is filled at the entrance by the operator, whether the exhauster will discharge its waste load or not.

Basic information such as date, time, plate number, driver's name, and truck capacity have to be reported. The operator assigns a reference number for each entrance (e.g. 16-0001) that will be used in other forms (e.g. manifest form) and reports if the discharge has been approved (according to the DTF regulations). The driver of the vehicle is requested to sign before leaving the site.

To be filled by the operator when an exhauster is entering the DTF site

RECEPTION BOOK

Ref. no.	Date	Time	Vehicle No.	Name of the Driver	Truck capacity	Discharge approval	Signature
16-0001	*26/09/2016*	*08:00*	*1DX105A*	*Patrick Kariuki*	*8 L*	*YES*	*KARIUKI*
16-0002	*26/09/2016*	*08:15*	*C4J6NV*	*Maina Keya*	*10 L*	*YES*	*Maina KEYA*
16-0003	*26/09/2016*	*10:40*	*JN9TWD*	*John Kimayio*	*10 L*	*NO*	*Kimayo*

To be signed by the driver

7.4 Store room inventory

Effective inventory management is crucial to ensure smooth operation of the DTF. The store room inventory form is used by the WSP to keep track of the equipment being stored at the DTF office in order to avoid duplicity or to replace the missing or defective items. The inventory is to be done at least once a year by the DTF operator and checked by the WSP supervisor.

Store Room Inventory

Ref Nr. : ...2017/01.....

Date: .....05.07.2017.....

Report done by: Charles Kamau	Date and Signature: 05.07.2017 Charles Kamau

Report checked by: Henry Ogalo	Date and Signature: 06.07.2017 Henry Ogalo

Nr.	Item	State	Quantity	Comment
1	rakes	used	1	
2	cover lifter	used	1	
3	skimmer	middly used	1	
4	overalls	new and used	4	1 overall needs to be replaced
5	DO metre	like new	1	
6	pH strip box	almost empty	1	
7	wheelbarrow	used	1	
8	ladder	broken	1	one step of the ladder is broken
9	panga	used	2	
...	...	...	...	...

To be filled by the Operator

To be filled by the Supervisor

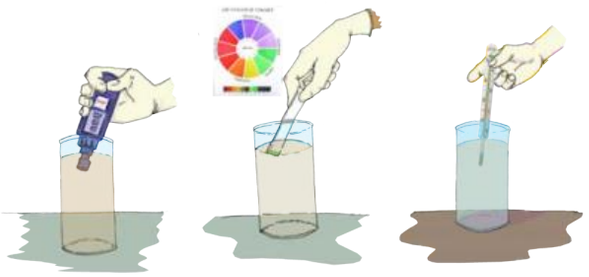
To be filled by the Operator

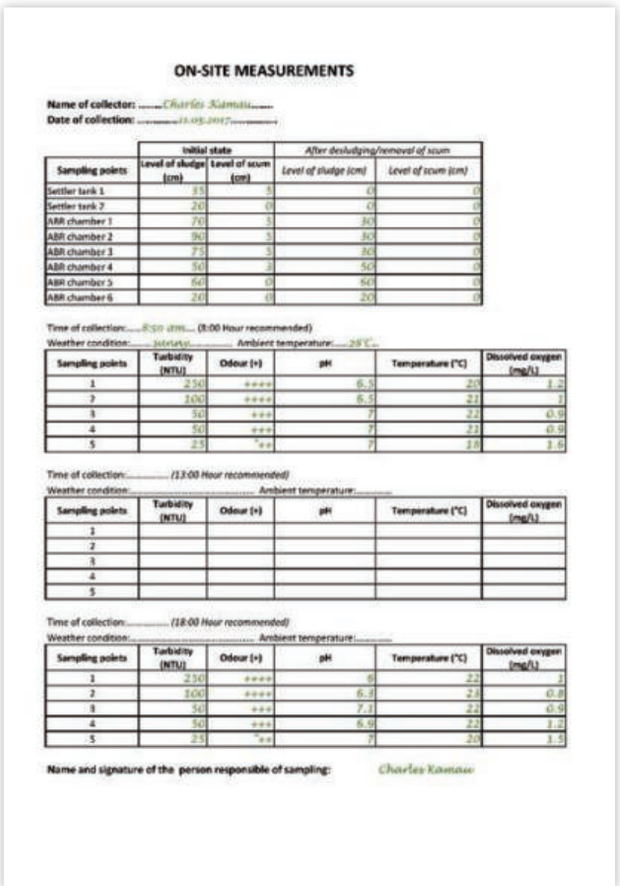
7.5 Monitoring of effluent quality logbook

Monitoring of effluent quality logbook comprises of:

- The on-site measurements form: to be completed each time samples are taken and analysed on-site (monthly)
- The laboratory measurements form: to be completed each time the results from the sampling are received from the laboratory (quarterly)

Both on-site and laboratory measurements forms are to be filled by the operator or the person in charge of sampling. The objective of the logbook is to monitor the performance of the DTF module by module. It will enable to take quick, adequate and precise remedial actions in case of a malfunction.





ON-SITE MEASUREMENTS

Name of collector: .....Charles Kamau.....
Date of collection: .....13.03.2017.....

Sampling points	Initial state: Level of sludge (cm)	Initial state: Level of scum (cm)	After desludging/removal of scum: Level of sludge (cm)	After desludging/removal of scum: Level of scum (cm)
Settler tank 1	35	5	0	0
Settler tank 2	20	0	0	0
ABR chamber 1	70	5	30	0
ABR chamber 2	90	5	30	0
ABR chamber 3	75	5	30	0
ABR chamber 4	50	5	50	0
ABR chamber 5	60	0	60	0
ABR chamber 6	20	0	20	0

Time of collection:.....8:50 am..... (8:00 Hour recommended)
Weather condition:.....sunny..... Ambient temperature:.....28°C...

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1	250	++++	6.5	25	1.2
2	100	++++	6.5	23	1
3	50	+++	7	22	0.9
4	50	+++	7	22	0.9
5	25	++	7	23	1.6

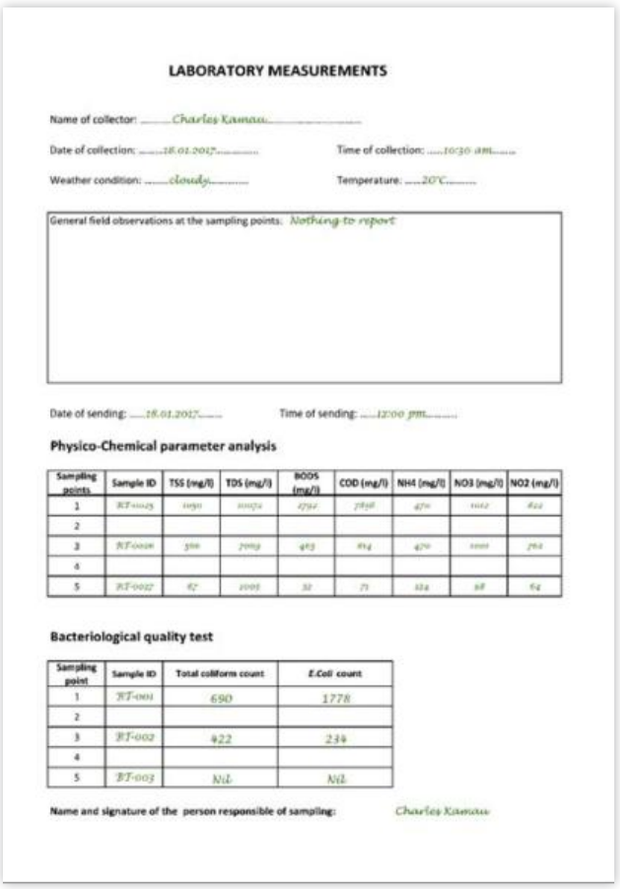
Time of collection:..... (13:00 Hour recommended)
Weather condition:..... Ambient temperature:.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1					
2					
3					
4					
5					

Time of collection:..... (18:00 Hour recommended)
Weather condition:..... Ambient temperature:.....

Sampling points	Turbidity (NTU)	Odour (+)	pH	Temperature (°C)	Dissolved oxygen (mg/L)
1	230	++++	6	22	1
2	100	++++	6.8	23	0.8
3	50	+++	7.1	24	0.9
4	50	+++	6.9	22	1.2
5	25	++	7	25	1.5

Name and signature of the person responsible of sampling: Charles Kamau



LABORATORY MEASUREMENTS

Name of collector: .....Charles Kamau.....
Date of collection: .....18.01.2017..... Time of collection: .....10:30 am.....
Weather condition: .....cloudy..... Temperature: .....20°C.....

General field observations at the sampling points: Nothing to report

Date of sending: .....18.01.2017..... Time of sending: .....12:00 pm.....

Physico-Chemical parameter analysis

Sampling points	Sample ID	TSS (mg/l)	TDS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	NO3 (mg/l)	NO2 (mg/l)
1	RT-1025	1050	10052	4752	7858	470	1012	822
2								
3	RT-1026	500	7003	483	814	470	1000	562
4								
5	RT-1027	67	1005	32	75	124	98	64

Bacteriological quality test

Sampling point	Sample ID	Total coliform count	E.Coli count
1	RT-001	690	1778
2			
3	RT-002	422	234
4			
5	RT-003	Nil	Nil

Name and signature of the person responsible of sampling: Charles Kamau

7.6 Chain-of-Custody and analysis request form

Once the samples are about to be sent to the laboratory, ensure that the sample analysis request sheet accompanies samples is duly completed and that it mentions the following information:

- Sample number
- Signature of collector
- Date
- Time of collection
- Sample preservation requirements
- Signature of persons involved in the chain of possession
- Date and time possession

Field portion: to be completed by the collector

Laboratory portion: to be completed by the laboratory personnel. Includes name of person receiving the sample, laboratory sample number, date of sample receipt, condition of each sample (ambient temperature, whether the container is full or not, colour, etc.) and determinations to be performed.

CARDINAL Laboratories

CHAIN-OF-CUSTODY AND ANALYSIS REQUEST

101 East Marland, Hobbs, NM 88240
(575) 393-2326 FAX (575) 393-2476

Company Name:		BILL TO	ANALYSIS REQUEST
Project Manager:		P.O. #:	
Address:		Company:	
City:	State: Zip:	Attn:	
Phone #:	Fax #:	Address:	
Project #:	Project Owner:	City:	
Project Name:		State: Zip:	
Project Location:		Phone #:	
Sampler Name:		Fax #:	

FOR LAB USE ONLY				MATRIX						PRESERV.			SAMPLING		
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER :	ACID/BASE	ICE / COOL	OTHER :	DATE	TIME	

PLEASE NOTE: Liability and Damages. Cardinal's liability and client's exclusive remedy for any claim arising whether based in contract or tort, shall be limited to the amount paid by the client for the analyses. All claims including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by Cardinal within 30 days after completion of the applicable service. In no event shall Cardinal be liable for incidental or consequential damages, including without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by Cardinal, regardless of whether such claim is based upon any of the above stated reasons or otherwise.

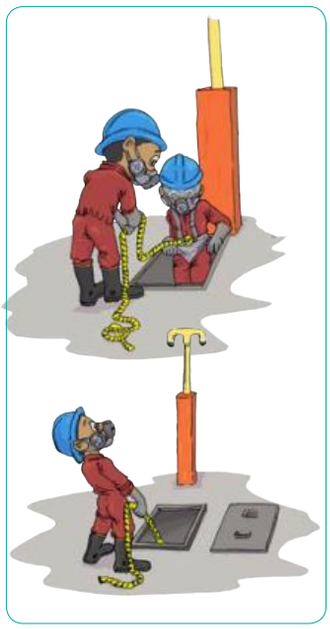
Relinquished By:	Date: Time:	Received By:		Phone Result: ☐ Yes ☐ No	Add'l Phone #:
				Fax Result: ☐ Yes ☐ No	Add'l Fax #:
Relinquished By:	Date: Time:	Received By:		REMARKS:	
Delivered By: (Circle One) Sampler - UPS - Bus - Other:		Sample Condition Cool: ☐ Yes ☐ No Intact: ☐ Yes ☐ No	CHECKED BY: (Initials)		

† Cardinal cannot accept verbal changes. Please fax written changes to (575) 393-2326

7.7 Confined space entry permit

Working in an enclosed space such as the DTF tanks and chambers is dangerous because of the risks from noxious fumes, reduced oxygen levels or risks of fire. Other dangers may include flooding/drowning or asphyxiation from other source such as dust or other contaminant.

Before entering a confined space (DTF tanks), a confined space entry permit must be prepared by the operator. The supervisor must approve by signing the form before and after the task has been completed. This form will ensure that all safety measures are respected prior to entry into the tank and that the name of the entrants and attendants are recorded.



CONFINED SPACE ENTRY PERMIT

PERMIT VALID FOR 1 SHIFT ONLY, ALL PERMIT COPIES MUST REMAIN AT THE SITE UNTIL SHIFT OR JOB IS COMPLETED

Date: _25.03.2017_ Permit No: __2017/01____ WSP: __NAWASCO____

Confined Space Locations: __Settler primary tank and ABR chambre no. 2____

Purpose of entry: _____Repairy for water tightness_____

Time in: __09:30 am____ Time out: ___02:00 pm____

Permit Canceled Time: _____

Reason Permit Canceled: _____

Supervisor on-site (Name and signature): _____Robert Mutua_____

Authorized Entrants	Authorized Attendants
John Kemboi	Charles Kamau Robert Mutua

Minimum requirements to review prior to entry	YES	NO	N/A
Manholes of the tank have been left open 24H prior to entry	x		
Respiratory mask	x		
Harness and safety rope	x		
Standby safety personel	x		

To be filled by the operator or the designated on-site supervisor

PERMIT AUTHORIZATION

I certify that all actions and conditions necessary for safe entry have been performed

WSP: NAWASCO

Technical manager or above: Henry Ogalo
(Name and signature)

Date and Location: 24.03.2017, Nakuru

To be filled by the Supervisor

ANNEXES

OPERATORS LOGBOOK

Date:_____ **Time of arrival: _____**

Operator's name: _____ **Time of departure: _____**

Exceptional absence and replacement during the day:
Indicate timeframe, reasons, name and signature of the substitute

Exceptional events to be reported (disaster response, injury, communication with regulatory officials,etc.):

Specific instructions from plant superintendent (if applicable):

Operation, Maintenance and Monitoring tasks undertaken:
Indicate if any breakdown or other malfunctions

Recommendations from operator:

Signature of operator:

MANIFEST FORM

ORIGIN OF THE SLUDGE:

Date of collection: _____

Name (of plot owner or institution): _____

Area:_____

SafiSan toilets: Yes ☐ No ☐

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential				
Institutional *				
Commercial/Industrial **				

** Description of the institution or commercial/industrial waste (if applicable):*

Name and signature of the exhauster driver: Date:

Ref no.: _____ ***To be filled by operator***

Approved by authorized authority:
(Name and Signature)

MANIFEST FORM

ORIGIN OF THE SLUDGE:

Date of collection: _____

Name (of plot owner or institution): _____

Area:_____

SafiSan toilets: Yes ☐ No ☐

Source	Check	Volume (m3)	Number of users	Last emptying date
Residential				
Institutional *				
Commercial/Industrial **				

** Description of the institution or commercial/industrial waste (if applicable):*

Name and signature of the exhauster driver: Date:

Ref no.: _____ ***To be filled by operator***

Approved by authorized authority:
(Name and Signature)

RECEPTION BOOK

Ref. no.	Date	Time	Vehicle No.	Name of the Driver	Truck capacity	Discharge approval	Signature

Store Room Inventory

Ref Nr. : ……………………………..

Date: …………………………………………………

Report done by:	**Date and Signature:**

Report checked by:	**Date and Signature:**

Nr.	Item	State	Quantity	Comment

ON-SITE MEASUREMENTS

Name of collector: ……..

Date of collection: ……..

	Initial state		*After desludging/removal of scum*	
Sampling points	**Level of sludge (cm)**	**Level of scum (cm)**	*Level of sludge (cm)*	*Level of scum (cm)*
Settler tank 1				
Settler tank 2				
ABR chamber 1				
ABR chamber 2				
ABR chamber 3				
ABR chamber 4				
ABR chamber 5				
ABR chamber 6				

Time of collection:…….. (8:00 Hour recommended)

Weather condition:…….. Ambient temperature:……

Sampling points	**Turbidity (NTU)**	**Odour (+)**	**pH**	**Temperature (°C)**	**Dissolved oxygen (mg/L)**
1					
2					
3					
4					
5					

Time of collection:…….. *(13:00 Hour recommended)*

Weather condition:…….. Ambient temperature:……

Sampling points	**Turbidity (NTU)**	**Odour (+)**	**pH**	**Temperature (°C)**	**Dissolved oxygen (mg/L)**
1					
2					
3					
4					
5					

Time of collection:…….. *(18:00 Hour recommended)*

Weather condition:…….. Ambient temperature:……

Sampling points	**Turbidity (NTU)**	**Odour (+)**	**pH**	**Temperature (°C)**	**Dissolved oxygen (mg/L)**
1					
2					
3					
4					
5					

Name and signature of the person responsible of sampling:

LABORATORY MEASUREMENTS

Name of collector: ……

Date of collection: ……. Time of collection: ……

Weather condition: …… Temperature: ……..

General field observations at the sampling points:

Date of sending: …… Time of sending: ……

Physico-Chemical parameter analysis

Sampling points	Sample ID	TSS (mg/l)	TDS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	NO3 (mg/l)	NO2 (mg/l)
1								
2								
3								
4								
5								

Bacteriological quality test

Sampling point	Sample ID	Total coliform count	*E.Coli* count
1			
2			
3			
4			
5			

Name and signature of the person responsible of sampling:

CONFINED SPACE ENTRY PERMIT

PERMIT VALID FOR 1 SHIFT ONLY, ALL PERMIT COPIES MUST REMAIN AT THE SITE UNTIL SHIFT OR JOB IS COMPLETED

Date: _____ Permit No: _____

Confined Space Locations: _____

Purpose of entry: _____

Time in: _____ Time out: _____

Permit Canceled Time: _____

Reason Permit Canceled: _____

Supervisor on-site (Name and signature): _____

Authorized Entrants	Authorized Attendants

Minimum requirements to review prior to entry	YES	NO	N/A
Manholes of the tank have been left open 24H prior to entry			
Respiratory mask			
Harness and safety rope			
Standby safety personel			

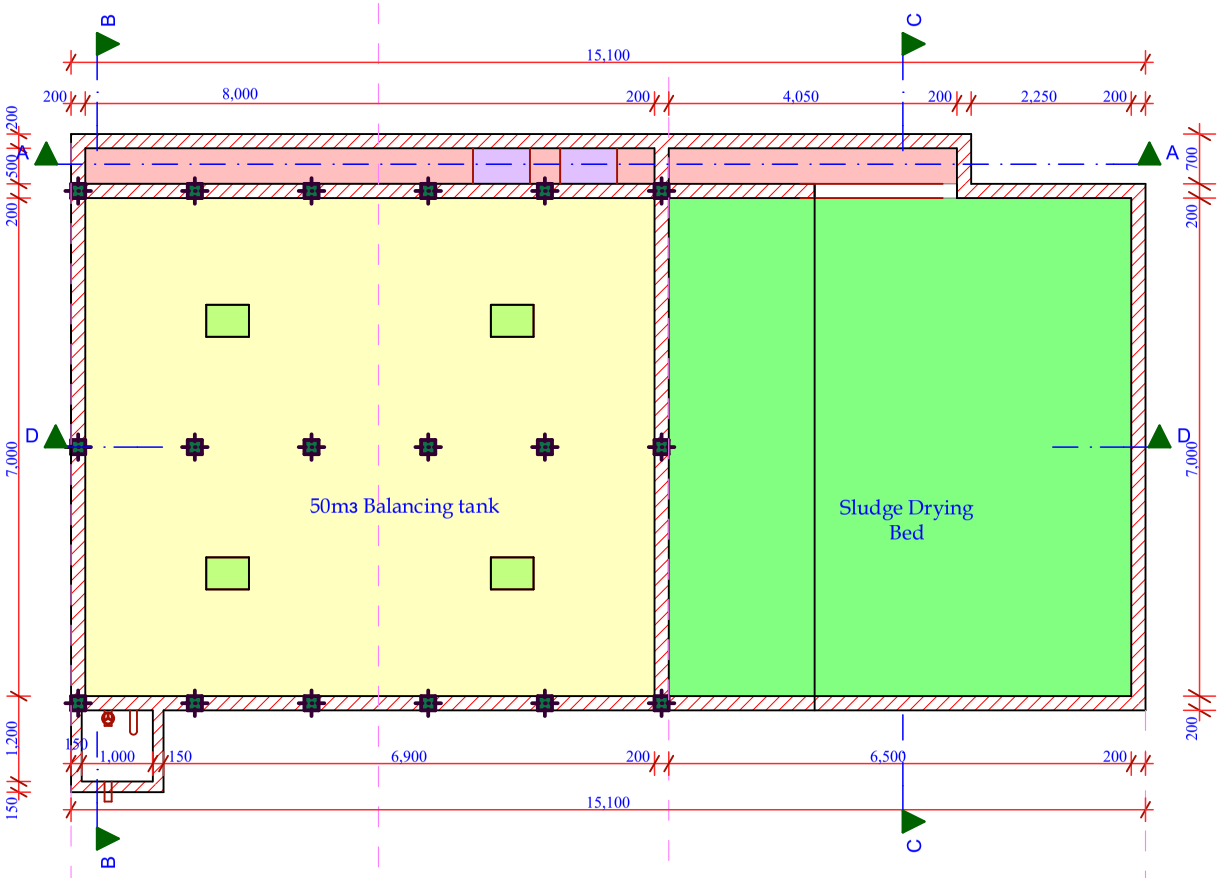
PERMIT AUTHORIZATION

I certify that all actions and conditions necessary for safe entry have been performed

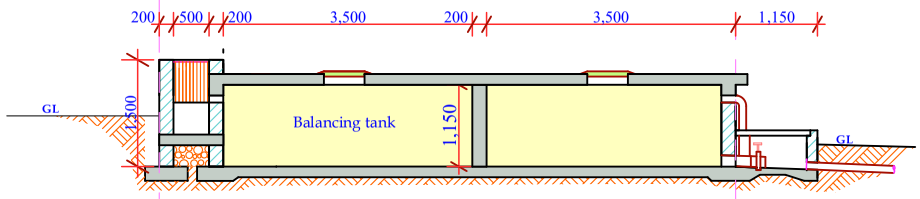
WSP:

Technical manager or above:
(Name and signature)

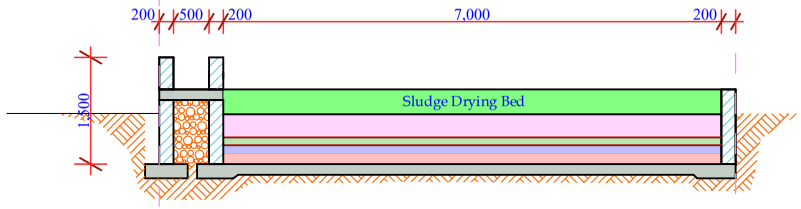
Date and Location:



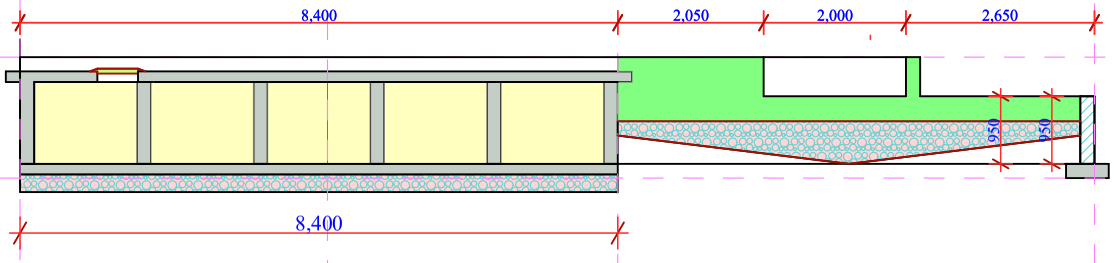
FLOOR PLAN



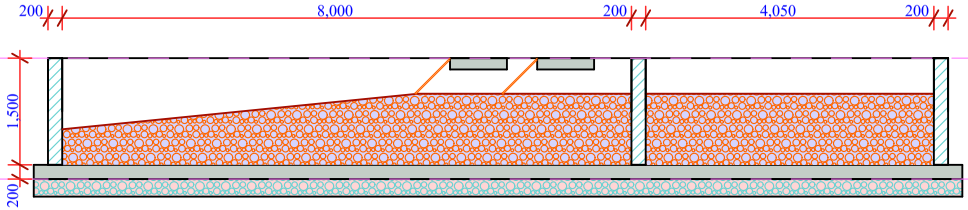
SECTION B - B



SECTION C - C

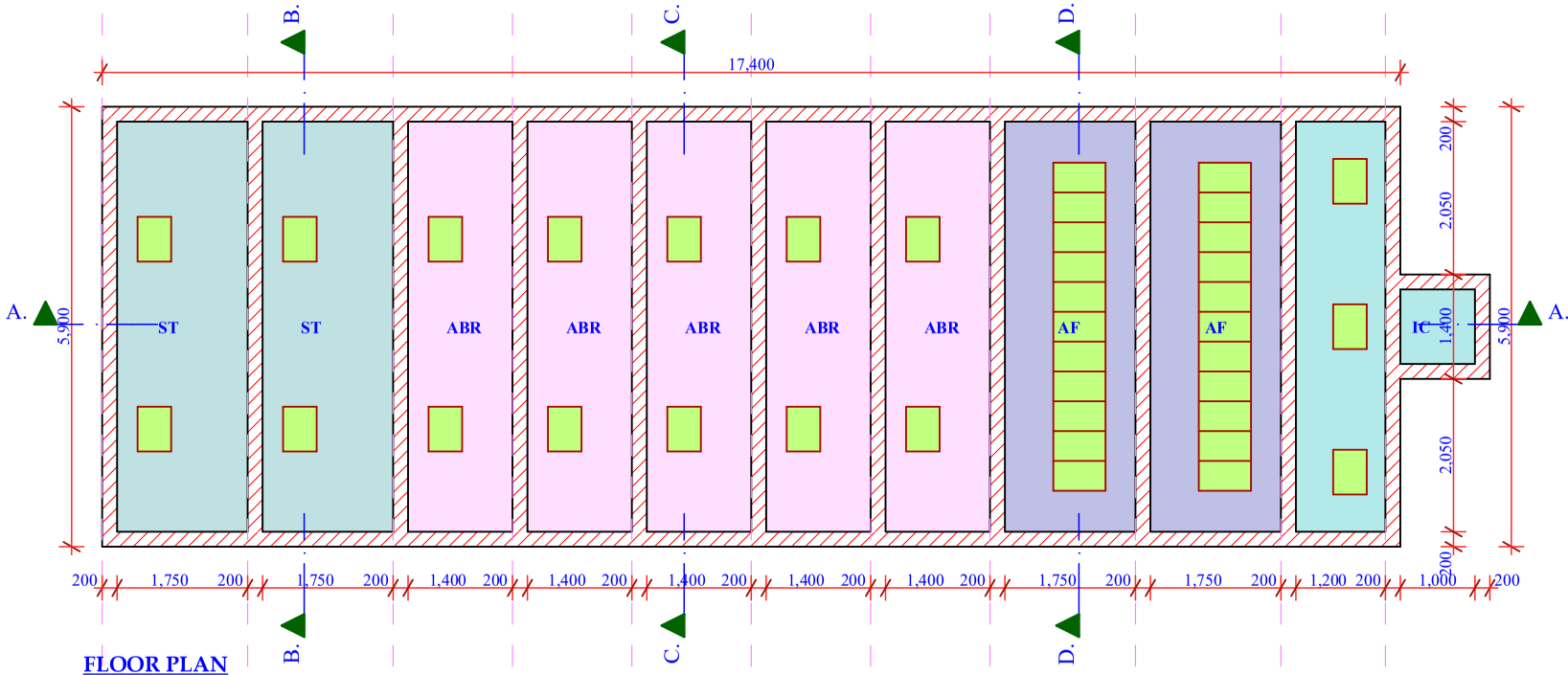


SECTION D - D

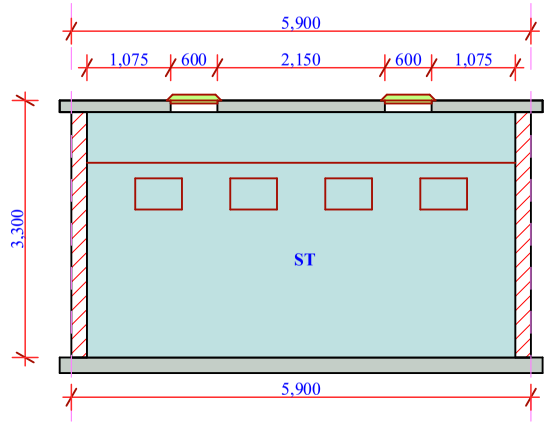


SECTION A - A

BALANCING TANK & SLUDGE DRYING BED



FLOOR PLAN



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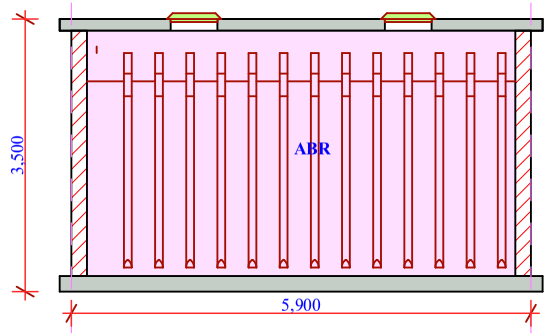

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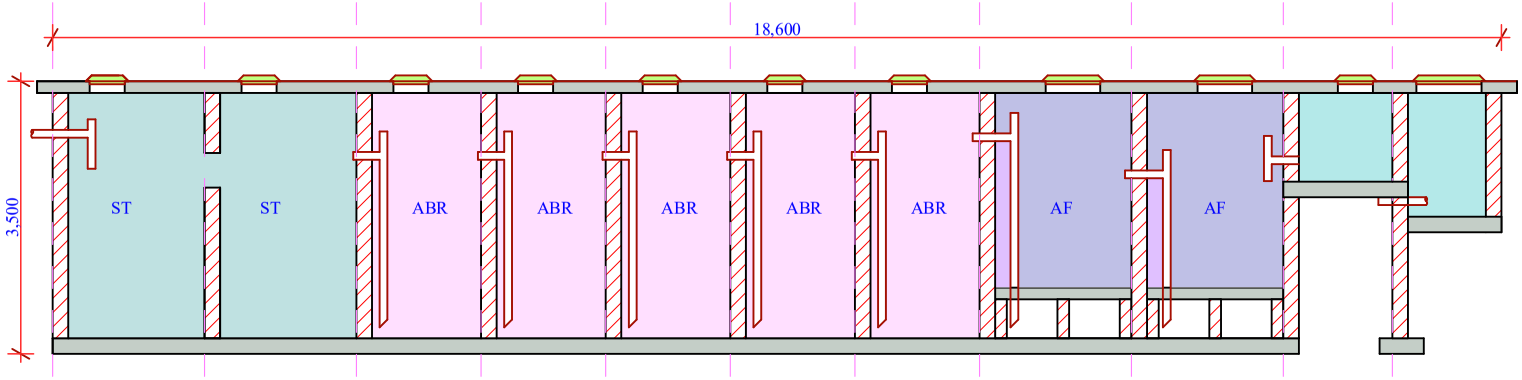
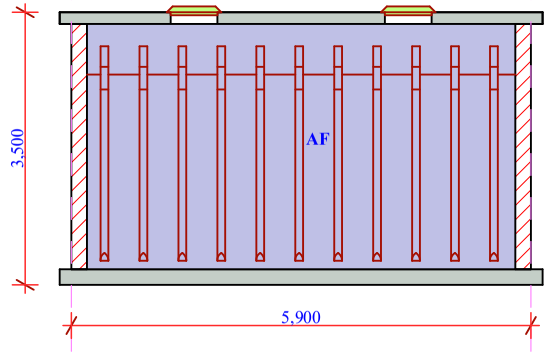
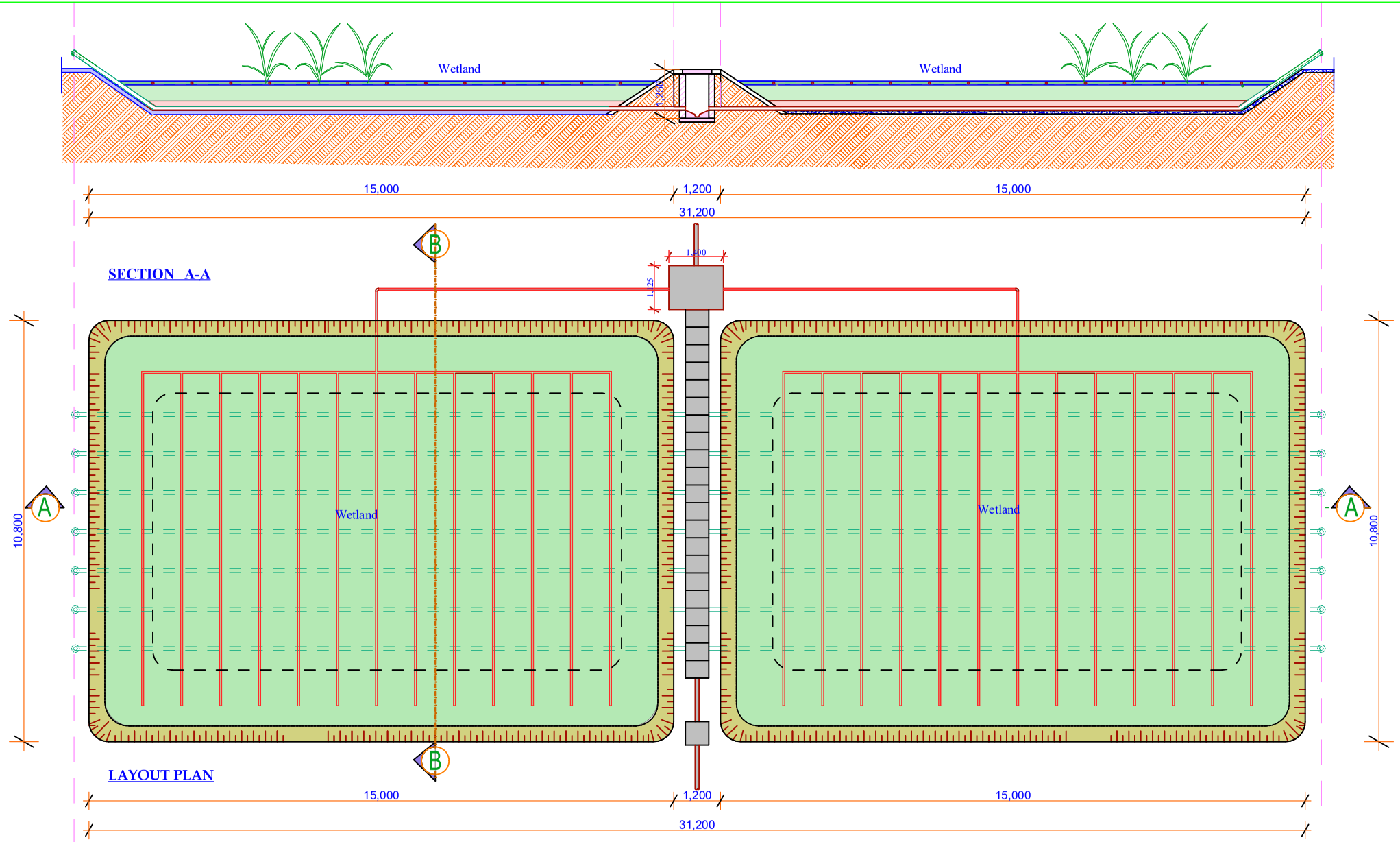


SECTION A - A



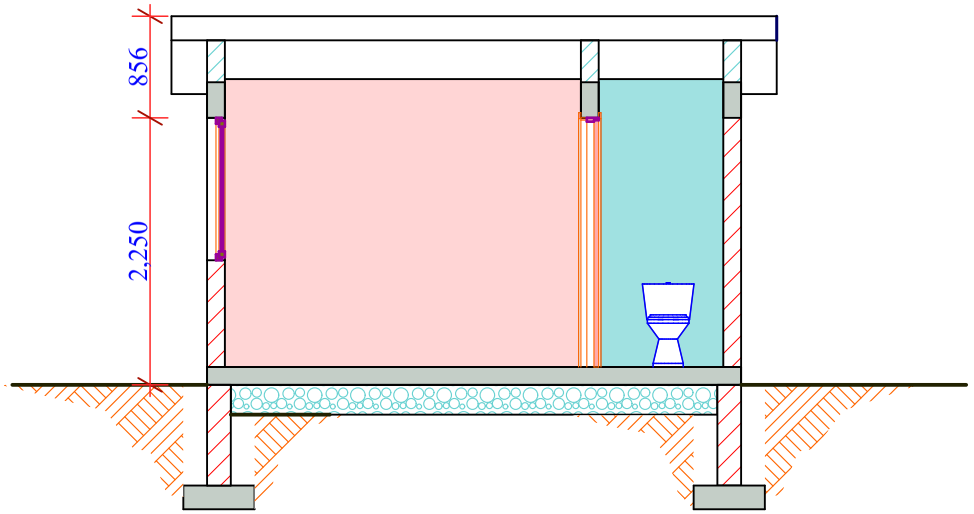
SECTION D - D

SETTLE, AEROBIC BAFFLE REACTOR & ANAEROBIC FILTER

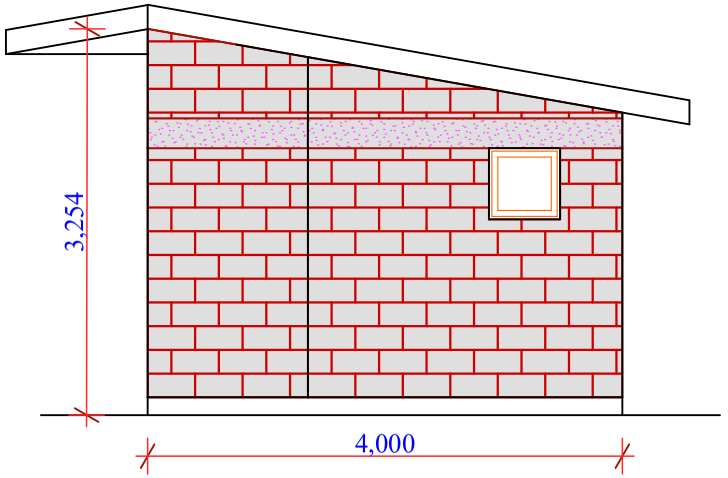


SECTION B-B

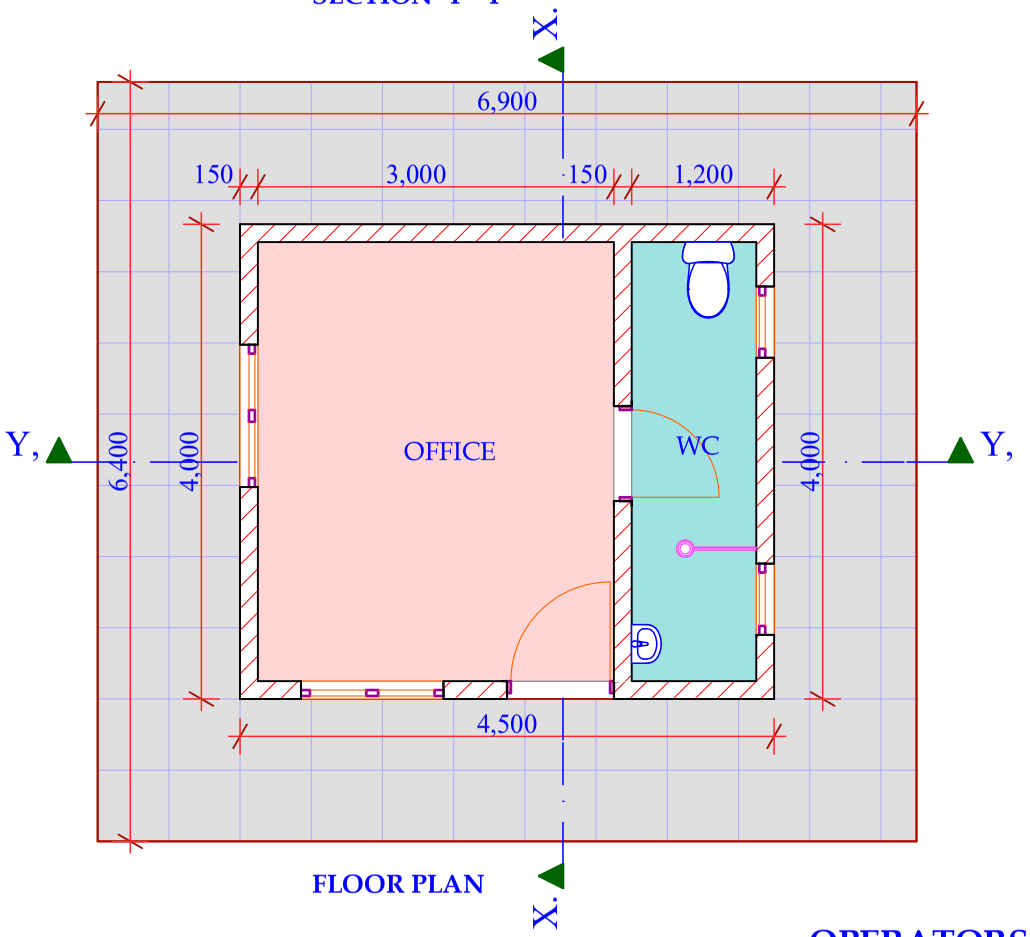
VERTICAL FLOW CONSTRUCTED WETLANDS



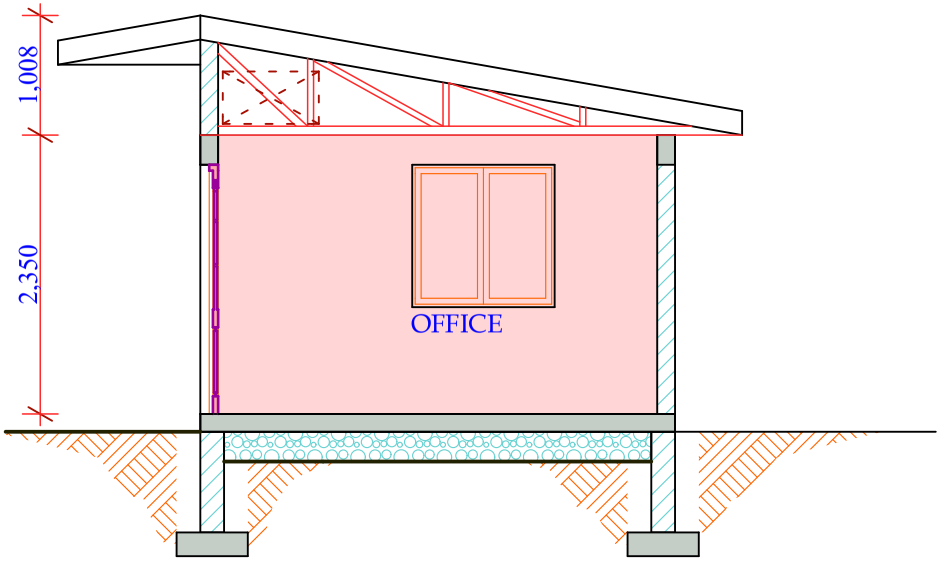
SECTION Y - Y



SIDE ELEVATION

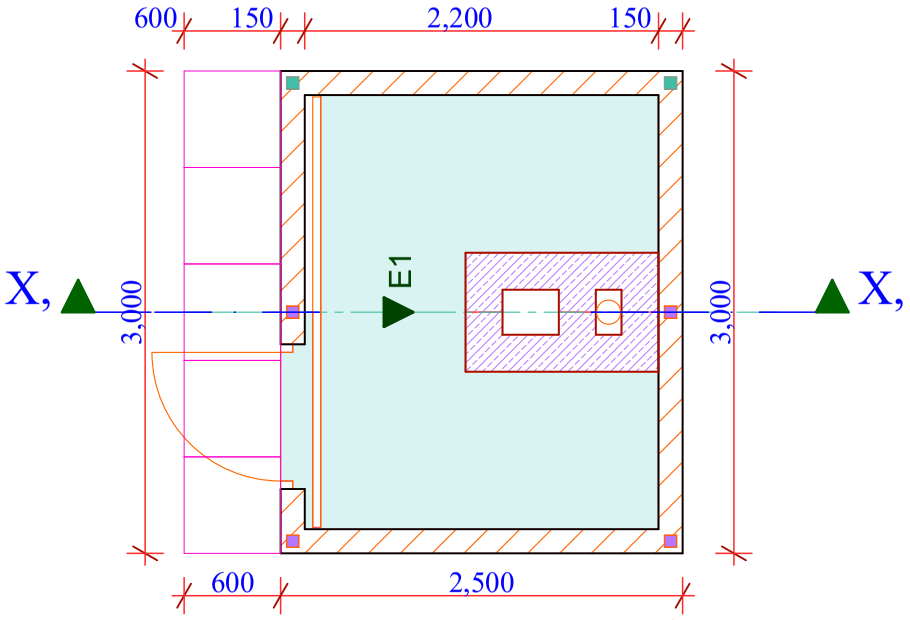


FLOOR PLAN

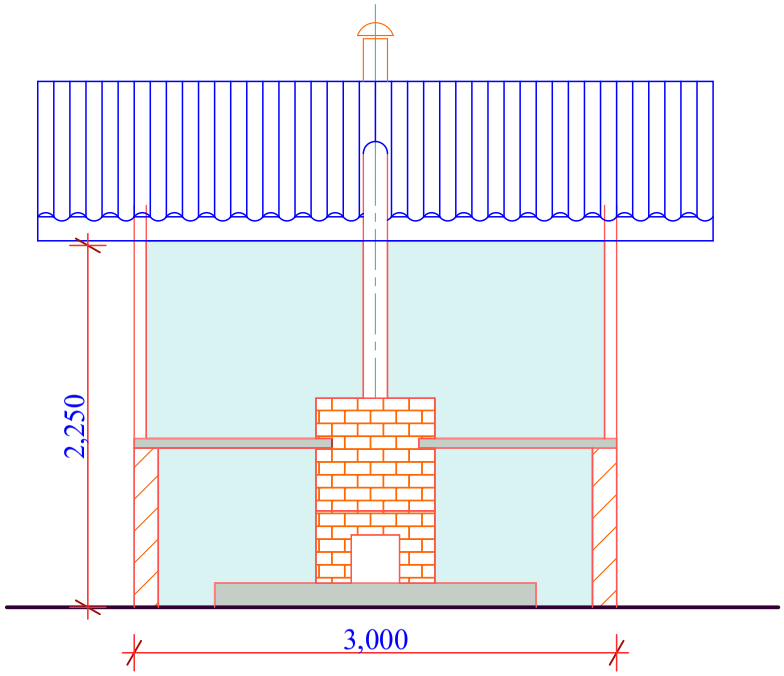


SECTION X - X

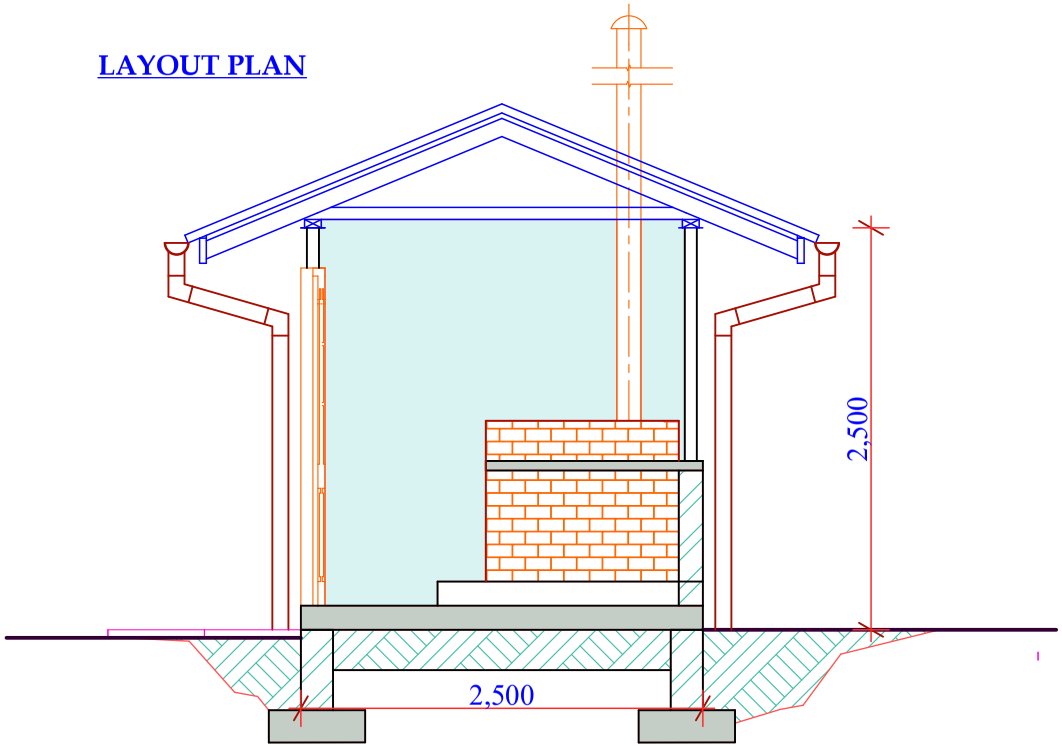
OPERATORS OFFICE



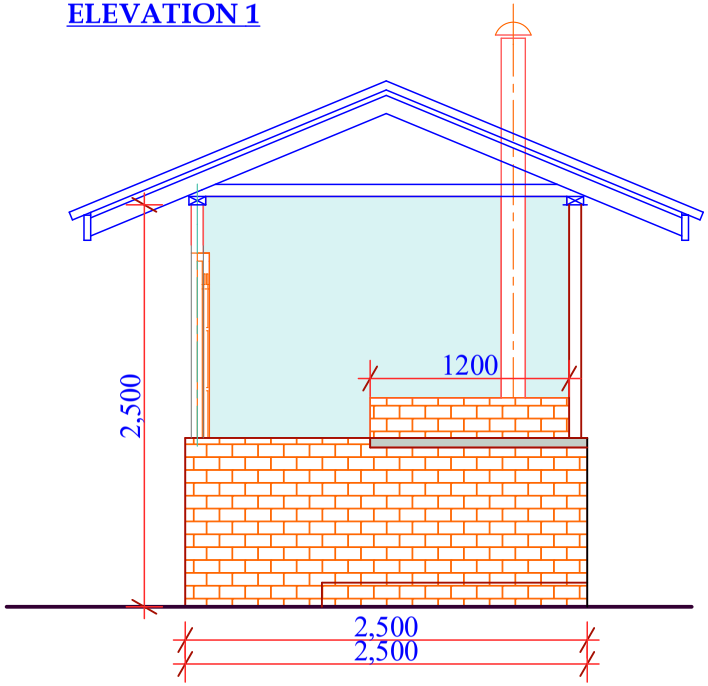
LAYOUT PLAN



ELEVATION 1

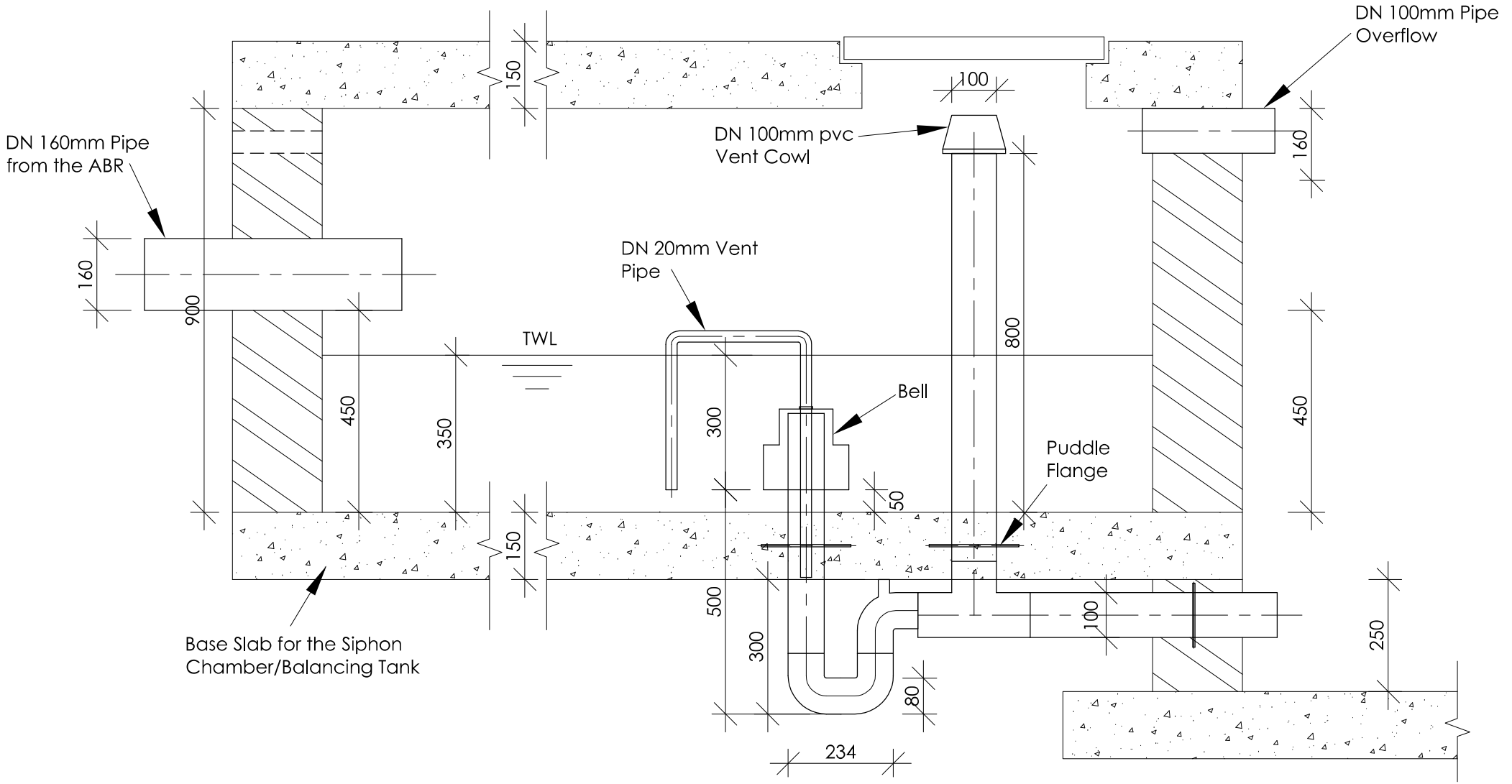


SECTION X - X



SIDE ELEVATION

INCINERATOR SHED



ANAEROBIC BAFFLED REACTOR

Project Title: Up-scaling Basic Sanitation for Urban Poor (UBSUP)	***Project Area***	***Designed and drawn by:*** *UBSUP technical team* ***Checked by:*** *Programme Manager Urban Investments* ***Approved by:*** *CEO WSTF*	***Notes:*** *See Above*	***Index-No.:*** / ***Description:***	***Date:*** ***Scale: As shown*** ***page:***

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