REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND FORESTRY

DEPARTMENT OF WATER AFFAIRS and FORESTRY

CODE OF PRACTICE: VOLUME 9

WET SANITATION COLLECTION, CONVEYANCE AND TREATMENT SYSTEMS

GENERAL GUIDELINES

Revision: 4 Date: September 2011

PREFACE

Sanitation plays a pivotal role in economic development of Namibia because increasing the coverage of improved sanitation facilities will contribute significantly to the health of the population which in turn drives the nation's economy. The Namibia National Sanitation Strategy for the 2010 to 2015 has been developed, setting out a course of actions and activities for the implementation of sanitation in a coordinated manner.

As this strategy was developed through a comprehensive consultation process with various partners and stakeholders, the previous uncoordinated approach to sanitation implementation experienced in the past has already improved through initiatives that have brought about a more uniform, consistent and higher quality approach. The major investment in sector capacity building and development that is needed to enhance the delivery of the implementation programme will in turn support the achievement of Vision 2030 and the WATSAN Millennium Development Goals.

A series of Sanitation Codes of Practice have been developed to give further guidance on the planning and implementation of alternative types of sanitation facilities. The additional Sanitation Codes of Practice have filled the gaps in the existing Water Supply and Sanitation Codes of Practice that have been developed over the past two years by the Directorate of Resource Management within the Department of Water Affairs and Forestry of the Ministry of Agriculture, Water and Forestry. The most updated list is given below:

Volume No.	Description	Originator
1	Septic Tank Systems	DRM
2	Pond Systems	DRM
3	Biological Filtration Systems (Trickling Filters)	DRM
4	Biological Treatment Activated Sludge Processes	DRM
5	Bottled Water: Bottled Natural Waters; Processed Water; Mineral Water; Carbonated Water; Flavoured Water	DRM
6	Wastewater Reuse: Greywater, Reclaimed Domestic Effluent; Industrial Effluent	DRM
7	Disposal of Water and Wastewater Solids	DRM
8*	Dry Sanitation Systems	DWSSC
9*	Wet Sanitation Collection, Conveyance and Treatment Systems	DWSSC
10*	Re-use of Sanitation Waste Products	DWSSC

* - It is recommended that Codes of Practice 8 to 10 should be used together because of the close links between them all.

- DRM – Directorate of Resource Management
- DWSSC – Directorate of Water Supply and Sanitation Coordination

It is intended that the Codes of Practice will become obligatory for Ministries, Regional and Local Authorities, Communities, Private and Non-Government Organisations and Donors to follow to achieve the initiatives set out in the five year National Sanitation Strategy.

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DEFINITIONS

General:

Aerobic treatment:	Treatment of wastewater with the help of micro-organisms that rely on oxygen;
Disposal:	Discharge, deposition or dumping of any liquid or solid waste onto land or water;
Dry Sanitation:	Disposal of human excreta without the use of water for flushing or anal cleansing;
Excreta:	Faeces and urine;
Groundwater:	Any water resource found within the bedrock, below the surface of the ground;
Liner:	Layer of impenetrable material/sheeting placed in a waste collection pit to prevent infiltration of waste into the ground. May be made of building construction materials, synthetic materials, or a combination thereof;
Pathogens:	Micro-organisms such as bacteria, viruses and protozoa that cause disease;
Pit latrine:	A form of sanitation with a pit for accumulation and decomposition of excreta from which liquid can infiltrate;
Sanitation Facilities	Interventions (usually construction of facilities such as latrines) that improve the management of excreta and promote sanitary (healthy) conditions;
Soak pit/Soak-Away:	A pit usually situated to receive effluent from a septic tank and designed so that the effluent slowly seeps into the ground through perforated sides and bottom;
Superstructure:	Screen or building enclosing latrine to provide privacy and protection for users;
Suction truck:	A vehicle used for sludge removal from septic tanks and lined latrine pits;
Vent Pipe:	A pipe that facilitates the escape of gases and odours from a latrine or septic tank;
VIP:	Ventilated Improved Pit Latrine = dry latrine system with dark interior and screened vent pipe to reduce odour and fly nuisance;
VIDP:	Ventilated Improved Double Pit Latrine = dry latrine system identical to VIP, except with two collection pits;
Water Resource:	Includes a watercourse, an aquifer, the sea and meteoric water;
Water-Borne Sanitation Systems:	Disposal of human excreta through a sewerage conveyance system with the use of water for flushing.
Wet Sanitation Systems:	Includes collection systems such as conservancy tanks, conveyance systems such as vacuum systems and treatment facilities such as oxidation ponds.

1. INTRODUCTION

Water-borne sanitation systems have been widely implemented throughout the world and especially in developed countries where such systems have been the preferred method of choice to collectively serve large communities for many decades.

Typically, water-borne sanitation systems will include flush or pour-flush systems that will discharge into a pit latrine, conservancy/septic tank or to a water-borne collection system (Water Supply and Sanitation Policy (WSASP), 2008). These systems are explained in detail in this Code of Practice.

In Namibia, major towns have also been provided in the past with water-borne sanitation systems consisting of a flushing toilet that discharges into a water-borne sewerage system or series of septic/conservancy tanks. Currently, worldwide, improving sanitation coverage is again a priority and the trend has been to provide water-borne collection systems, even for smaller towns and settlements, in an attempt to meet the Millennium Development Goals. This trend has taken place despite Namibia being amongst the most arid countries in the world. Within Africa, the climate is second in aridity only to the Sahara Desert (Aquastat, 2005) and many regions are already constrained by severe water shortages, which are aggravated by periodic droughts.

Implementation of new water-borne sanitation systems should be carefully considered in Namibia and where such systems are provided, emphasis should be placed on minimal flushing water usage and the possible reuse of the final effluent and other waste-products. Water-borne systems require a large capital investment, reliable supply of water and a high level of expertise for operation and maintenance and are therefore often not the most suitable solution for a specific community. Effective sanitation should focus not only on infrastructure but also on human hygiene behaviour change through health promotion to ensure long-term improvement and protection of public health.

Besides the general shortage of water, a large portion of the population in Namibia cannot afford to pay for water supply and sanitation services. Even amongst consumers that can afford these services, there is a wide-spread culture of unwillingness to pay and the general thinking amongst the population is that water supplies (and sanitation services) should be provided by the government free of charge. This impression is in direct conflict with WSASP which states that in Namibia “water is an economic good” and cost recovery is a key principle set out in the policy document. Since water-borne collection systems rely on water to operate, the principle of cost recovery also applies to the investment in and operation and maintenance of both sanitation collection and treatment systems.

Where new water-borne sanitation systems are being considered, only recently developed systems that put emphasis on water-saving devices should be considered. As a minimum, this includes dual flushing mechanisms and urine separation devices, which are also further discussed in this Code of Practice. There are a multitude of other methods and devices that result in a reduction of water usage, such as grey water recycling for flushing. If water-saving devices are used, the design of the sewerage collection system must be checked to ensure the self-cleansing velocities are still achieved.

Capital investment for water-borne collection and treatment systems can range from N$ 30,000 to N$ 80,000 per household connection depending on circumstances compared with a range of N$ 3,000 to N$ 8,000 per household connection for dry sanitation facilities. In addition, community water-borne systems take a long time to implement and are often not the most suitable technology option offering a sustainable solution for either urban but more especially rural agricultural communities in Namibia. In the urban context, a combination of wet and upgradable dry sanitation technologies are often the most practical and economically sustainable solution for Namibian circumstances.

This Code of Practice addresses wet sanitation systems, with emphasis on flushing systems that use minimal flushing water. Collection and final treatment systems taking environmental conditions and technical appropriateness into account as per the Namibia National Sanitation Strategy 2010/11 – 2014/15 (MAWF, 2009), are also being addressed. Where final treatment is discussed, reference should be made to the other Codes of Practices (CoP 1 - 6) that have already been listed in the preference to this Code of Practice and are available from the Department of Water Affairs and Forestry (DWAF) within the Ministry of Agriculture, Water and Forestry (MAWF).

The purpose of this document is to provide comparative information about different types of wet sanitation systems so that the user can make informed decisions regarding the optimum choice of a system for the specific community situation.

2. TECHNICAL REVIEW

2.1 Background

Wet sanitation systems will mainly be considered for urban areas where individual households will be connected to a common collection system that discharges into a treatment facility. In communities located in rural areas where adequate water resources are available, the community may also wish to consider and implement a collective wet sanitation system. In this case, it should be noted that any treatment and disposal facilities required will become the responsibility of the community to operate and maintain. The Sanitation Services Planning Tool (DAWF, 2010) included in Appendix A should be used to assist future planners and small groups of rural households to select the most appropriate sanitation system for their specific use.

Owners of sanitation systems should realise that wet sanitation systems are much more expensive to construct, operate and maintain properly compared to dry sanitation systems.

Reuse of the final effluent for selected agricultural purposes, such as biogas production, reuse of dry or compost waste as fertilizer and even in certain cases as blended potable water supply is encouraged, subject to a detailed feasibility study, to augment the limited resources and ensure that water supplies for the population can be sustained in future. Further details can be found in Code of Practice No.10 - Reuse of Sewage Waste Products.

2.2 System Selection Criteria

There are many different wet sanitation systems available to choose from and clients and communities often base their choice of system only on factors such as capital cost and availability of funding, whilst ignoring the appropriateness of the system for their specific environmental conditions. This should, however, be one of the most important factors to be considered, since experience has shown that sanitation systems that work well under certain conditions and locations do not necessarily function well at all under other conditions. The most important aspects to consider include the following:

2.2.1 <u>Cultural aspects. Social standing and acceptance.</u> Only where a community can afford and is willing to pay for all services should an appropriate wet sanitation system be considered. In general, dry sanitation systems should be the first consideration. Specific cultural aspects, such as men/women/in-laws using the same toilet, should be taken into consideration when planning new systems. Also, user education on how to use the new facilities and most importantly health hygiene promotion must both be included in the implementation process.

2.2.2 <u>Environmental Conditions</u>. Typically, suitability of a wet sanitation system should take account of the following:

- <u>Topography</u>. For gravity sewer systems, the area to be served should ideally have a system of collection sewers designed and built along natural, sloping contours. Pumping stations for raw sewage should be avoided wherever possible due to the significant energy requirements, easy clogging of the pumps and need for regular maintenance.
- <u>Flooding and Groundwater Conditions</u>. In areas where there is a high risk of flooding or where the groundwater table is very shallow, toilets should be built above the flood-line or highest groundwater level wherever possible. This is recommended so as to minimise groundwater and storm water ingress and so that households do not make illegal connections of their rainwater collection system into collection sewers.

- Soil conditions. For gravity sewers where there is little or no subsoil and hard-rock is present, excavation costs are likely to be expensive. Where infiltration systems are considered, the number of users and suitability of the soil conditions must be first established with soil percolation tests as fully described in the Code of Practice, Volume 1, Septic Tank Systems (DAWF, 2008).

2.2.3 Technical appropriateness. Wet sanitation systems require a higher level of skills, not only to implement them but also to operate and maintain them. This does not just apply to the collection and final treatment system, but to the water supply (for flushing), where the inspection of the operations need to be regularly maintained to prevent water losses. Certain collection and conveyance systems such as conservancy tanks and vacuum sewers may only be considered and implemented if there is a capable contractor easily available to conscientiously support the servicing and maintenance of the system and the community can afford to pay for such a service (from an outside contractor).

2.2.4 Affordability. Water-borne sewer systems must be considered as a whole, including the collection and final treatment of the wastewater. Even if low-key technology such as an evaporation pond is used for final treatment, such a system still needs maintenance and the planner must ensure that the community has the financial means to ensure that the whole system is properly operated and maintained.

2.2.5 Reuse of final effluent and waste products. Due to water being a limited and scarce resource in Namibia, advanced sewage treatment to obtain a final effluent suitable for potential reuse should be encouraged subject to cost benefit analysis. Agricultural production or recreation and amenity facilities can be irrigated with final effluent but only after proper treatment of the raw sewage. There are a number of examples of local authority schemes using treated effluent in Namibia. Guidelines for Effluent Reuse have been drawn up and further details can be found in the Code of Practice, Volume 6, Wastewater Reuse (DAWF, 2010).

Section 2.3, discusses the options for implementing the most appropriate wet sanitation collection and conveyance systems for Namibia. Emphasis will be placed on water-saving measures and these should be considered during the planning and feasibility stages, except if better systems are developed or a sanitation specialist can identify other methods.

2.3 Appropriate Wet Sanitation Collection and Conveyance Systems for Namibia

Appropriate systems will be discussed under:

- Acceptable wet toilet systems;
- Conveyance systems;
- Final treatment systems.

Reuse of final waste effluent will not be discussed in this document, but can be read up in the Code of Practice, Volume 10, Reuse of Sanitation Waste Products (DAWF, 2010).

2.3.1 Wet Toilet Systems

The following wet sanitation systems would be acceptable for implementation in Namibia: Pour-flush Toilets; Full/low flush toilets - only with dual flushing mechanisms; Urine diversion/separation toilets. The implementation of urine diversion/separation toilets should be encouraged. This is further elaborated on under Section 2.2.1.3.

The planner must allow also for a hand-washing facility inside or adjacent to the toilet. This does not need to be a wash-basin. A simple system would constitute a 2 litre, plastic cool drink bottle that is fixed by a rope or wire to the outside of the toilet structure. The use of soap for washing hands after defecation is recommended.

2.3.1.1 Pour-Flush Toilets (see Figure 1). Pour-flush toilets are not connected to the potable water supply system. However, after defecation, the pan requires flushing with 2 to 3 litres of water. The water retained in the pan provides a seal against odours, flies and mosquitoes. Water used for flushing is generally carried by hand to the latrine and can also be relatively clean grey water such as bath, shower or hand-basin effluent or water of a lesser quality that would otherwise not be suitable for drinking. Low volumes of flushing water are required.

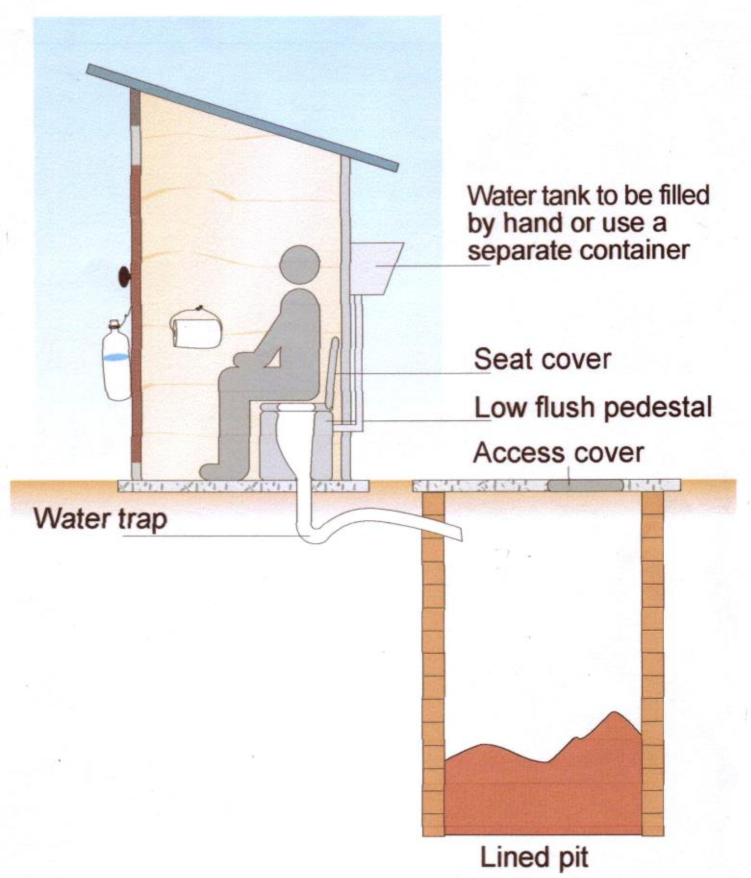


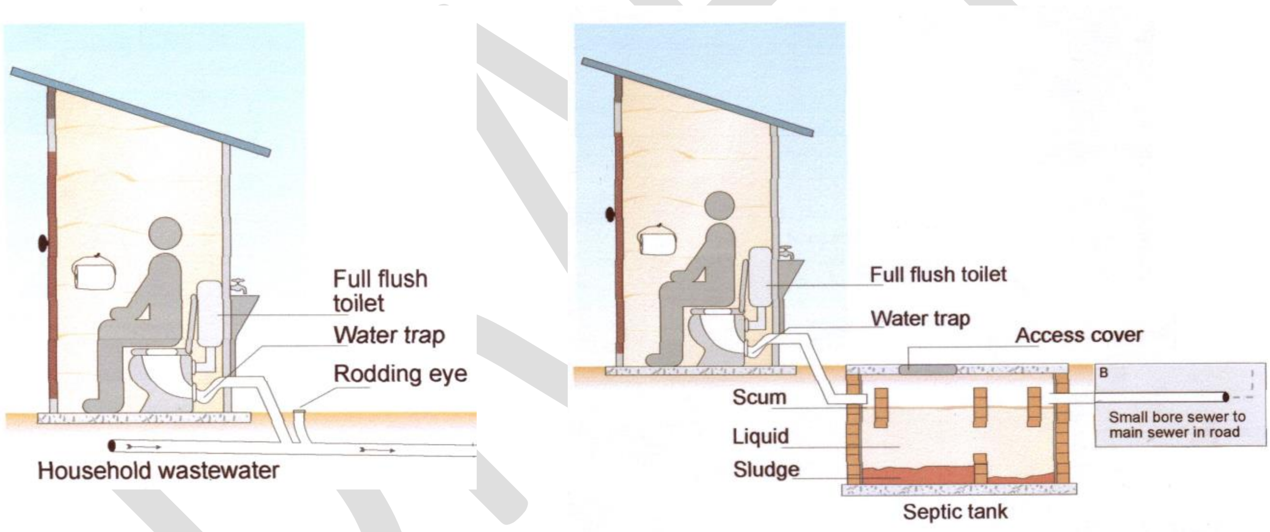
Figure 1: Pour-flush toilet (National Sanitation Task Team, 2002)

Pour-flush toilets can discharge into a conservancy tank, catch-pit or septic tank that is connected to the central sewer system, but are not allowed to finally discharge effluent into the surrounding soil. If a catch-pit is chosen, this must of the double-pit type. Both pits must be lined and access must be allowed for periodic, manual cleaning of the pit. Users must be made aware that the pit will fill up and a switch over to a second pit will be required. The first pit, after switching over to the second pit, will then need to be left to dry out and must be manually emptied when dried out.

User education and health hygiene promotion is essential; not only after implementation but also as follow-up to ensure that the catch-pits are alternated and emptied when full.

2.3.1.2 Full/Low-flush Toilets (see Figure 2). These toilets use more water than the pour-flush toilets and are permanently connected to the potable water supply of a household. Low-flush systems should be installed where possible with a dual (small/big) flushing mechanism. These systems allow flushing with a smaller volume (1 to 2 litres) of water after urinating or larger volume (4 to 6 litre) of water after defecation. They have a flushing water bowl that is permanently connected to an uninterrupted household water supply and therefore use high-quality potable water. Skilled, organised and effective operation and maintenance capability is required to prevent the toilets from leaking or being blocked and thereby wasting water.

These toilets can discharge into a septic tank that overflows into a sewerage conveyance system [Figure 2 (b)] or discharge directly into a sewerage system [Figure 2 (a)]. A further option is to discharge into a conservancy tank which must be periodically emptied. A treatment facility is required at the end of the sewerage system. Even the low-flush toilets use substantially more water than the pour-flush systems and they are therefore not allowed to be built utilising a catch-pit nor are they allowed to discharge final effluent to the surrounding area. Skilled, organised and effective operation and maintenance capability is required to keep the conservancy/septic tanks, the sewerage conveyance system and treatment facility fully functional.



(a) With discharge directly -
to central sewer

(b) With discharge to septic tank
overflow to central sewer

Figure 2: Full/low-flush toilet system (National Sanitation Task Team, 2002)

User education, health hygiene promotion and follow-up visits should be allowed for before/after implementation to ensure that users maintain their toilet, collection or tank systems properly and that no water is wasted.

2.3.1.3 Urine Diversion/Separation Toilets (see Figure 3). A relatively new technology is to install urine separation pans or weirs into the toilet bowl in order to separate urine and faeces. Similar to full-flush toilets, these systems are permanently connected to the potable household water supply. However, they have separate flushing lines to the urine collection section and solids collection section and therefore use substantially less water for flushing, compared to full-flush toilets. The system allows half and full flushing: During half-flushing, only 2.4 litre of water is used, of which only 0.3 litres is used to flush the urine collection section; during full flushing, 4.2 litre of water is used. Both the urine and solids collection sections have a water seal, which minimises bad odours.

This system allows separate collection of the urine, for example in a bladder connected to the urine collection bowl's outlet pipe, for later use as fertiliser. Alternatively, the toilets can discharge into a conservancy tank, septic tank that overflows into a central sewer system or discharge directly into a central sewer system. A treatment facility is required at the end of the collection system.

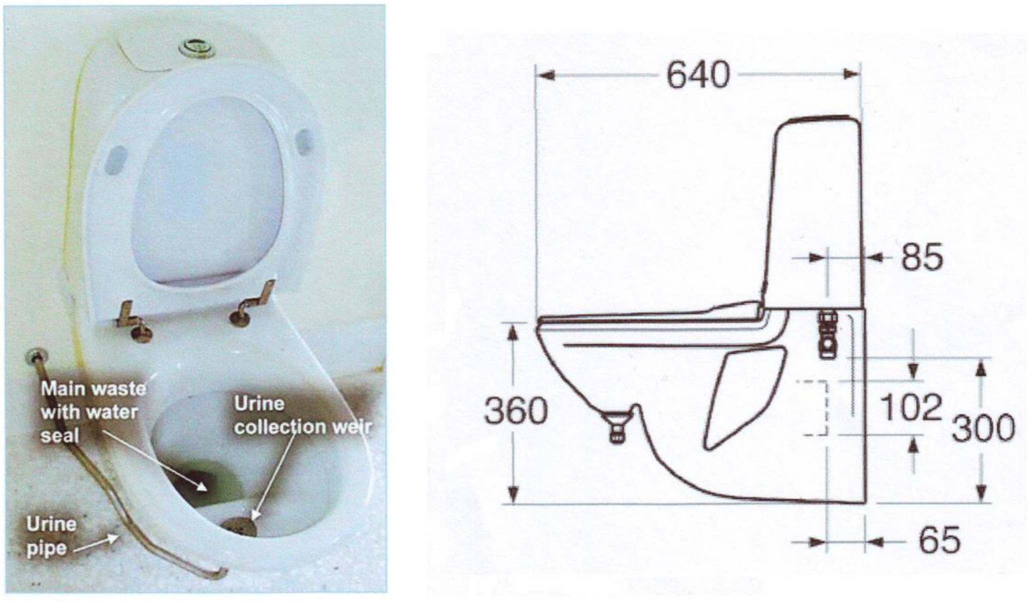


Figure 3: Wet urine separation system (Gustavsberg)

Currently, these systems are not locally manufactured and are technically more involved than full-flush toilet systems. They are therefore approximately 50% more expensive (than full-flush toilet systems) but have many advantages such as lower water consumption and reuse of urine as fertilizer. Again, skilled, organised and effective operation and maintenance capability is required to keep the waste disposal and collection system and treatment facility fully functional.

The urine separation toilet system is highly recommended for Namibia because of its low water requirement for flushing. Also, these systems can first be installed to operate as individual, dry sanitation systems and later be connected up to a potable water supply system and water borne sewerage with final effluent treatment system to operate as an integrated wet sanitation system.

2.3.2 Wet Sanitation Collection and Conveyance Systems

Depending on the selection criteria for wet sanitation collection and conveyance systems as reflected in Section 2.2, there are several different types of systems that are suitable in different circumstances for use in Namibia. For example:

1. Conservancy tanks;
2. Septic tanks with overflow to a gravity or vacuum sewer collection system;
3. Gravity sewerage system;
4. Vacuum sewer collection system.

Further details are given below:

2.3.2.1 Conservancy tanks.

A conservancy tank is a robust, sealed tank that is designed to discharge safely into and storing raw sewage until full. They can be built from brick, concrete, plastic (HDPE), GRP or even steel (suitably protected against corrosion). The tank must be built such that it contains odours, does not allow flies or other flying insects to freely enter and breed therein and can be emptied when full. A conservancy tank is emptied normally with a suction pump into a tanker truck or tanker mounted onto a trailer. The owner pays for having the conservancy tank emptied when full.

There are numerous small towns in Namibia that still use conservancy tanks and either have a tanker (Honeysucker) provided for by the MRLGHRD or utilise a private contractor to empty these tanks and discharge the contents typically into an evaporation pond. Generally local authorities operate the systems satisfactorily so long as they are able to maintain the vehicles and are able to have a serviceable discharge point. In providing a community service, private contractors need to be registered by the local authorities and supervised to ensure that they adhere to the approved discharge consent and do not undertake unauthorised discharges.

Servicing conservancy tanks is regarded as an intermediate technically/mechanically level of service and will require adequate manpower input. The equipment employed needs regular cleaning and maintenance (e.g. suction pump, truck or tractor motor, valves, hosepipes etc.). A qualified driver is required to drive the truck or tractor and one or two workers are needed to handle the sludge extraction equipment.

Despite the relatively sophisticated mechanical equipment employed, all towns where conservancy tanks have been constructed in Namibia are able to service these. It is recommended that conservancy tank systems can also be discussed as one possible implementation option with small, rural communities, subject to the following:

- Communities should not be larger than ca 1 000 people;
- Tanks should be sufficiently large sized so that they need not be emptied more than once per month. Guidance on sizing is given in the Code of Practice, Volume 1, Septic Tank Systems (DAWF, 2008);
- There must be a Honeysucker available, either owned by a private contractor or Local Authority to reliably serve that community for many years;
- The Local Authority or community must have capable (mechanical) skilled individuals available to operate and provide regular maintenance to the Honeysucker;
- Evaporation ponds, which must have an impenetrable, lined anaerobic section, and must be available for the final discharge of the effluent. These ponds must conform to the requirements of the Code of Practice, Volume 2, Pond Systems (DAWF, 2008).

2.3.2.2 Septic tanks with overflow to a sewer conveyance system

A septic tank is used to collect raw sewage and allows the solids to settle out and the organic matter to decompose under anaerobic (lack of oxygen) conditions before discharging the effluent as grey-water. The final effluent is still high in organic matter and ammonia-nitrogen and does not conform to the legal Namibia requirements set by the Ministry of Agriculture, Water and Forestry for final discharge. Where septic tanks are considered, these must be provided with at least two chambers and the design must adhere to the Code of Practice, Volume 1, Septic Tanks Systems (DAWF, 2008).

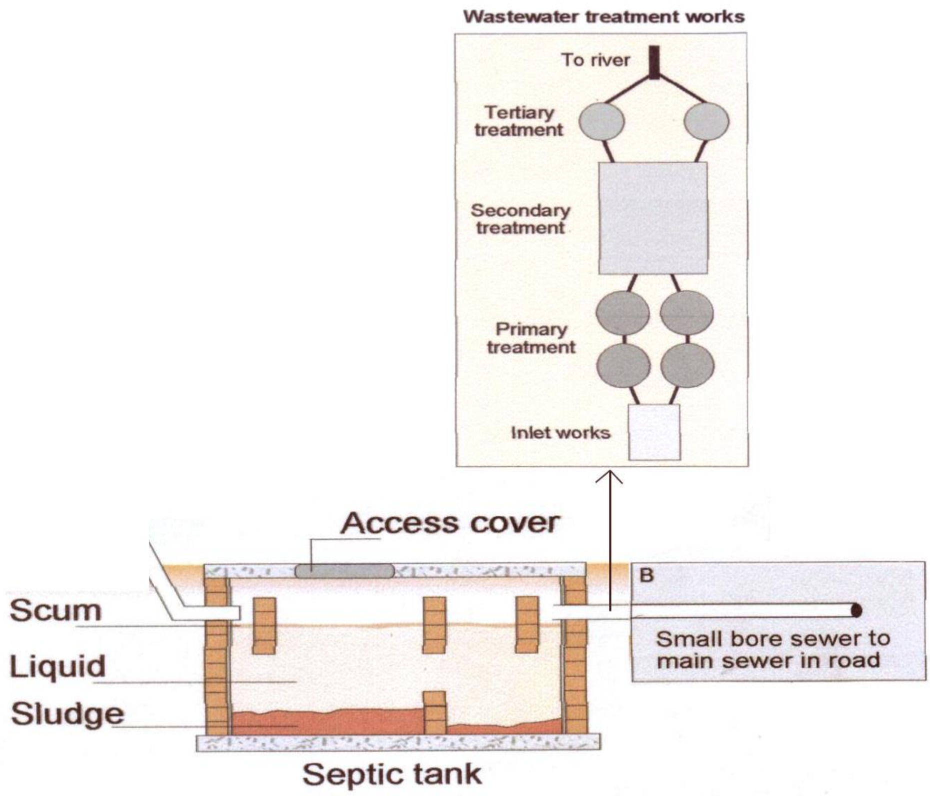


Figure 4: Typical septic tank connected to a sewerage system (adapted from National Sanitation Task Team, 2002)

Septic tanks with perforated walls or a final overflow into the surrounding soil are not allowed (see Code of Practice Volume 1, 2008) any more for communities larger than single households living for example on a private farm. Where septic tanks are provided for communities with sewerage conveyance systems, the final outflow must be treated in a treatment plant. Figure 4 shows a typical set-up where the septic tank discharges into a sewerage system.

Advantages:

- Solids are retained in the tank before reaching the sewer – no blockages are experienced due to solids and foreign objects in raw sewage;
- Requires smaller diameter sewers to transport the final effluent to treatment works. Capital infrastructure costs are therefore cheaper;
- Pumps are less prone to blockages because solids have been removed in the septic tank;

- Requires less maintenance if discharges into the sewerage conveyance system;
- No stormwater flows or groundwater infiltration are experienced;
- The biological load on the final treatment plant is lower due to partial degrading of organic matter in the septic tank. This will ease the load on the treatment processes at the plant.

Disadvantages:

- The construction costs for a septic tank are relatively high, depending on the size and design of the tank, contractor availability, location of the site and local geological conditions, amongst other considerations.
- Septic tanks need periodic emptying of sludge (approximately every 12 months). A honeysucker is needed for this with an associated capital, operation and servicing cost.

2.3.2.3 Gravity sewerage system

With a gravity sewerage system, each household is connected to a network of sewers that serves the community. The sewers carry raw sewage by gravity flow to a treatment facility. System must be laid with sufficient slope to ensure proper flushing of the sewers to prevent settling out of solids and thereby blocking the system. Self-cleansing velocities are determined by referring to hydraulic tables (Ackers Tables) that provide the diameter and gradient of the sewer. Care must be taken when low flush, household toilet systems are connected to ensure that self-cleansing velocities are designed in the gravity sewerage system. Computer programmes are available to design systems particularly that are extensions to existing sewerage systems which minimise the depth of the main sewer. (see the Red Book for further details).

Trenching can be expensive, especially when unfavourable soil conditions are encountered such as hard-rock and with large, flat areas to serve. To prevent sewers from running too deep, intermediate collection sumps with lifting pumping stations may be required. This increases operating (power) and maintenance costs. Rags and other foreign objects thrown into manholes create blockages both in the sewer and at the pumping station. A community served by a gravity sewer system therefore needs to provide for 24 hour maintenance backup. As a minimum, and depending on the size of the total network system, a team consisting of a pick-up truck with a driver and two labourers is often required to properly maintain the system so long as it is not too extensive in size.

Groundwater ingress into gravity sewers can also be a problem because it places an additional burden on the capacity of the treatment facility downstream of the sewer system. Municipalities and communities served by a gravity sewer system must therefore ensure that:

- NO stormwater is allowed to be diverted (from properties) into the gravity sewer network;
- Run-off from roofs may not be discharged into the sewer network;
- NO stormwater collected in street run-off is allowed to be diverted into the gravity sewer network;
- Underground pipes must be watertight so that groundwater can not infiltrate into the sewer network.

The advantages and disadvantages of a gravity sewerage system are as follows:

Advantages:

- A gravity sewerage system is a well-known system with well-established design parameters which are standard practice in Namibia;
- Easy to extend and make new connections;
- Relatively straight forward to operate and maintain
- Easy method of transport of raw sewage;
- Can maintain a minimum velocity (at design flow), reducing the risk of hydrogen sulfide (odour producing) and methane gas (explosive).

Disadvantages:

- Construction costs can be high in unfavorable soil conditions;
- Where intermediate pumping stations are required, pumps can be prone to blockages due to rags and foreign objects being thrown into the sewers;
- The gravity sewerage system can be prone to groundwater and stormwater ingress (see also next point);
- Manholes associated with gravity sewers can be a source of additional stormwater inflows and infiltration if the manhole covers are not sealed. This will increase the volume of wastewater to be carried and hence the size of sewers and pumping stations;
- Manholes can be the source of solid waste which will cause blockages if the manhole covers are not sealed.

2.3.2.4 Vacuum sewers

Sewage effluent gravitates from households to a "Collection Chamber". The chamber is connected to a sewerage network that is under constant vacuum, generated by a vacuum pumping station at the end of the network. When a certain volume of waste water is stored in the collection chamber, a pneumatic controller opens a valve and, due to a constant negative pressure in the vacuum mains, the accumulated wastewater is sucked from the collection chamber and discharges into the next section of system. Sewage is transported by vacuum through the sewerage network to a collection tank inside the terminal vacuum pumping station. When a pre-determined volume is reached in the tank, sewer discharge pumps are activated and the sewage is pumped from the tank to the final treatment facility. Figure 5 depicts this principle.

This is an example of one proprietary system owned by a major German contractor which has been installed in a number of locations in Namibia. Installation and operation/maintenance experience is now being built up by local authorities but technical and financial support is required to ensure continuous operation. Some of the advantages and disadvantages are given below:

Advantages:

- Particularly suitable as the choice of technology in flat areas where pumping stations maybe required if a gravity sewerage system is chosen;

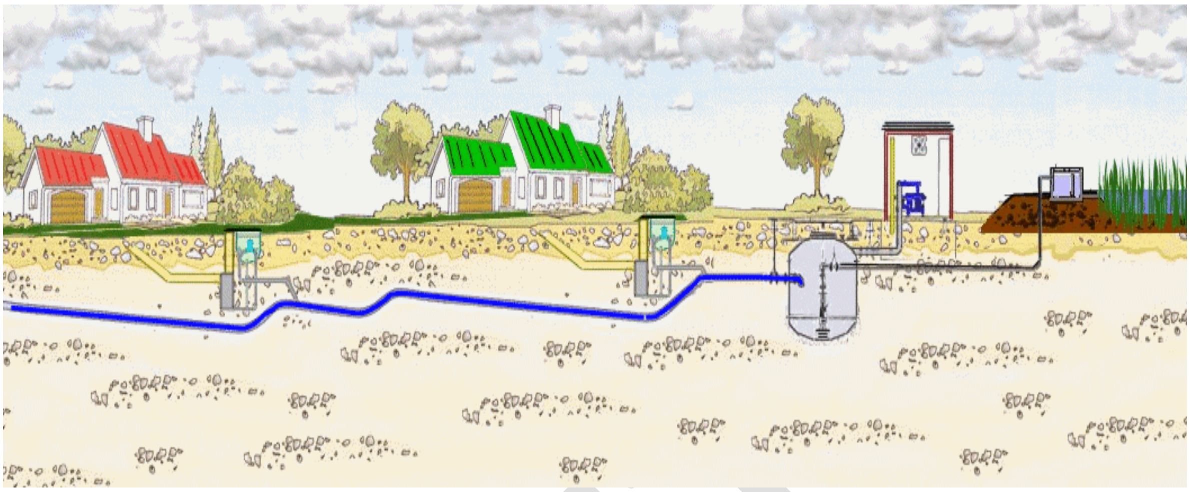


Figure 5: Vacuum sewer collection system (courtesy Roediger Vacuum)

- Overall construction costs may be less than gravity sewerage system in certain applications mainly because sewer trenches are at maximum 1.2m deep;
- The system is not dependant on effluent volumes and flow velocities. Sewage effluent is transported by vacuum rather than volumes of water. This means the system should operate according to the design criteria at low flow volumes;
- No access to the system means that foreign objects are unlikely to enter the system;
- Storm water or ground water infiltration should not enter the system.

Disadvantages:

- Since this is a proprietary system all the design work is carried out in Germany mainly to protect the intellectual property rights:
- Strict levels of construction supervision are required on site requiring a full time presence which affects the overall cost of construction and will make costs comparable with a gravity sewerage system;
- High operational and maintenance costs (power consumption and spare parts sourced from Germany). Specialised materials and equipment must be imported and are not readily available off the shelf in Namibia;
- System operational principals are simple but operators and local authorities must employ more experienced staff to operate the system effectively. Experience has shown that vacuum system is not the preferred choice of technology for small towns and village councils in Namibia because they cannot attract and retain experienced operating staff;
- Local authorities need regular training and operations support which puts pressure on the recurrent budgets of local authorities which can make tariff charges too high for customers based only on operation/maintenance cost recovery;
- The system is dependent on constant, reliable power supply (generation of vacuum by vacuum pumping station). Power outages will result in collection chambers overflowing;
- Experience in Namibia has shown that if blockages or equipment failures arise at any one of the collection chambers, the vacuum pressure in the system cannot be maintained resulting in continuous

running of the pumps at the terminal pumping station. This causes wear on the pumps and increases the power consumption and operating costs enormously;

Whereas there are certain applications in Namibia that justify the vacuum sewerage system as a possible choice of collection technology, local authorities, such as villages and small towns must be prepared to finance the potential high operation and maintenance costs and employ experienced managers to operate the system. This goes beyond the ability for local residents to pay for the connection fees and high monthly sewerage charges and consequently, the systems fall into disrepair leaving households no option to return to their conservancy tank and septic tank systems.

In Namibia, the vacuum sewerage system should ideally only be considered for private developments with affluent communities (such as golf-developments) where there is a competent body corporate that can employ technically skilled people to operate and maintain the system or can afford a long-term operation and maintenance contract with the specialist supplier of such a system.

2.3.3 Final effluent treatment

Sewage effluent collected from water-borne sewerage systems that discharge into a common treatment facility should not be regarded as a nuisance but instead be regarded as a valuable resource not only for the effluent but also of nutrients for potential recovery and re-use. If properly treated, the final effluent can be re-used safely for selected agricultural applications or gardening and watering lawns without the need to even add additional fertilisers. Utilisation of other waste products obtained from sewage effluent such as biological sludge and biogas is also possible. This is dealt with in the Code of Practice, Volume 10, Reuse of Sanitation Waste Products (DAWF, 2011).

Biological treatment is the most common form of treatment used for sewage treatment in Namibia. Figure 6 gives a system comparison of some of the major parameters of interest in commonly employed biological treatment systems.

SYSTEMS ITEMS	IMHOFF TANK	OXIDATION POND	OXIDATION DITCH	BIOdek (BIOLOGICAL FILTER)	ROTATING BIOLOGICAL CONTACTORS	ACTIVATED SLUDGE PROCESS	MECHANICAL BIO SOIL
LAND AREA (M2)	3 . X1	21 . X1	5 . X1	X1	1.5 . X1	X1	5 . X1
POWER RATING (kW)	NONE	NONE	5 . X2	X2	X2	6 . X2	6 . X2
SKILLED LABOURS REQUIREMENT	NO	NO	YES	NO	NO	YES	NO
SPECIAL MECHANICAL EQUIPMENTS	NONE	NONE	AERATORS	PUMP	GEAR MOTOR & SHAFT	AERATORS	AERATOR & PUMP
BOD REDUCTION EFFICIENCY (%)	60 TO 50	80 TO 90	> 90	> 90	> 90	> 90	70 TO 90
AMOUNT OF SLUDGE PRODUCED (% OF BOD)	40	40	100	40	40	100	40
ABILITY TO TAKE SHOCK LOADINGS	OK	OK	BAD	GOOD	GOOD	BAD	OK
NOISE PROBLEM	NONE	NONE	LOW	NONE	NONE	LOW	YES
ODOUR PROBLEM	LOW	HIGH	LOW	LOW	LOW	LOW	LOW
INSECT PROBLEM	LOW	HIGH	NONE	NONE	NONE	NONE	NONE
CLOGGING/SILTING PROBLEM	LOW	HIIGH	LOW	LOW	LOW	LOW	LOW

Figure 6: Comparison of various biological treatment systems (courtesy Munters)

Biological effluent treatment plants that are provided for communities with water-borne sewerage systems in Namibia can be broadly grouped together within the following two major categories: Pond Systems and Advanced Biological Treatment Systems. These systems can be further sub-divided with Attached and Submerged Growth Systems as the most commonly employed technologies in Namibia. Details are given below.

2.3.3.1 Pond Systems

These systems are regarded as low-key technology and have proved very suitable for Namibian conditions. Pond systems cannot produce a final effluent compliant with the currently applicable Namibian standards for final effluent discharge to the environment. DAWF therefore requires all sewage that reaches and is treated in ponds, to be fully evaporated (evaporation ponds) or reused for gardening or selected agricultural applications, for which maturation ponds are required. DWAF also requires that the anaerobic ponds should be lined to avoid possible contamination with aquifers particularly those used for municipal water supplies.

These will now be discussed briefly, but more information on this topic and full design parameters can be obtained from the Code of Practice, Volume 2, Pond Systems (DAWF, 2008).

Pond systems can vary from a single, anaerobic pond, up to a series of shallow ponds, with the major ones constructed in Namibia being:

- Facultative Ponds, also generally known as Oxidation Ponds. These consist of at least one anaerobic pond, the primary pond, followed by a series of two or more aerobic ponds, called secondary ponds. Effluent from the anaerobic pond is converted into carbon dioxide, water and new bacterial and algae cells in the presence of oxygen. The aerobic process relies on algae that require sunlight to produce excess oxygen, which is used by bacteria to further break down organic matter in the effluent.

  Final effluent from these ponds cannot be reused nor can it be discharged into the environment. Facultative/Oxidation Ponds have been provided some years ago for most of the smaller towns throughout the country. In most towns, they are currently overloaded, not well maintained, not fenced in any more and discharge a final effluent not conforming to current legislation.

- Maturation Ponds. These are tertiary ponds added to the above oxidation pond system to allow polishing of the final effluent to a quality where it can be reused for gardening and selected agricultural use. At least four to five additional ponds with a total retention time not less than 25 days are required to polish the effluent from an oxidation pond system before it will be suitable for reuse.

- Evaporation ponds. Where there is no demand for the effluent from a pond system, DAWF requires that all water needs to be evaporated. This is achieved by providing more/larger ponds with a sufficiently large surface area for natural evaporation. Such a system covers a large surface area because rainfall must also be catered for when designing the total evaporation surface area required.

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Figure 7 depicts the minimum requirements of a pond system for producing an effluent suitable for reuse, i.e. a system of Oxidation Ponds with maturation ponds added.

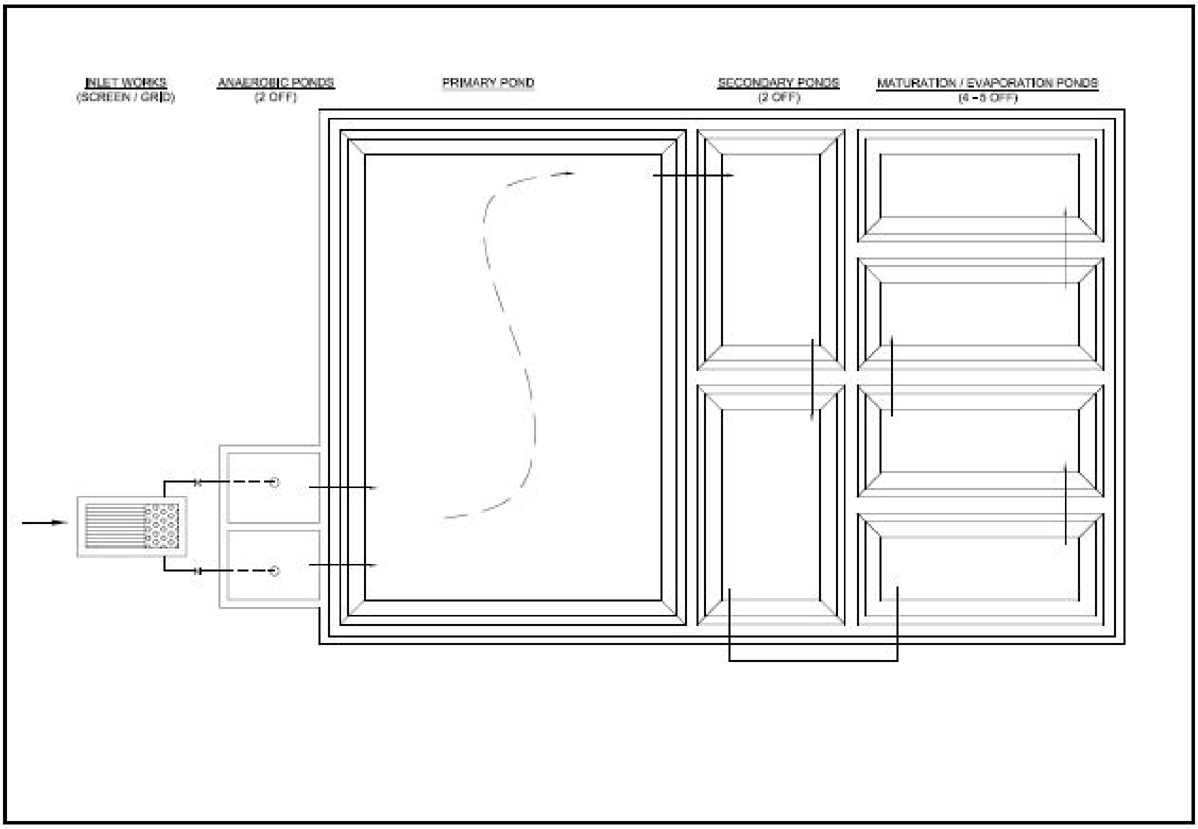


Figure 7: Maturation Pond System for producing a final effluent for reuse (DAWF Vol 2, 2008)

Advantages:

- Low-key technology – no mechanical and electrical equipment employed;
- No power required;
- Low, simple maintenance only necessary. Maintenance includes cleaning of inlet screens, keeping the sides and inside ponds free from weeds and bushes, emptying anaerobic section out about once every five years;

Disadvantages:

- Produces odours and attracts flies and other nuisance insects;
- Large surface area (footprint) required. Sometimes insufficient land is available or land is very expensive;
- If not re-used, all effluent must be evaporated (large surface area required);
- Overall high construction cost. Anaerobic section of pond system must also be lined with impenetrable liner to meet DWAF requirements;
- Final water quality does not conform to Namibian effluent discharge standards;
- The area must be fenced but fences are often stolen that raises security and health risks for the community;
- In low lying areas and where stormwater enters the collection system, the ponds are prone to flooding during the rainy season.

Current pond systems in Namibia are almost all overloaded. However, for smaller communities in rural areas they could be the technology of first choice where a water-borne collection system has been installed.

New Pond Systems. When new pond systems are being considered for a community, the following specific requirements need to be taken into account:

- Only settlements up to 5,000 people are allowed to install new evaporation ponds. The reason being, a valuable resource is wasted when this effluent is not re-used for selected applications;
- The first, anaerobic pond must be lined with an impenetrable liner;
- No final effluent may be discharged to the environment, i.e. all effluent must be re-used or evaporated. This will affect the sizing of the pond system;
- When maturation ponds are provided and the final effluent is re-used (selected application only), disinfection of the effluent must be carried out;
- The ponds must be properly fenced-in and locked at all times;
- The distance to the closest residential area should not be less than 500 m, preferably 1,000 m;
- If re-use is considered, maturation ponds of not less than 40 days' retention time must be added after the oxidation/facultative ponds.

2.3.3.2 Advanced Biological Treatment Systems

Advanced biological treatment systems employ biological processes that can achieve carbonaceous material removal and nitrification much faster and more efficient than pond systems. They have been developed to overcome the two major shortcomings of pond systems, namely:

1. Pond systems take-up large areas of valuable land (in urban areas)
2. Pond systems do not produce a final effluent quality that is suitable for discharge into the environment.

In comparison, advanced biological treatment systems take up only a fraction of the space requirements and can produce a final effluent suitable for discharge into perennial rivers, dams and/or the environment in general.

In a limited number of locations, advanced biological treatment plants have been built in Namibia because they are regarded as first-world technology. They need energy to operate and are mechanically and technically more complex, which requires competent operation and maintenance personnel and a process specialist to optimise the day-to-day operation of such plants.

There are many different advanced biological treatment systems available on the market, but all rely on the following basic unit processes:

- Screening of the raw sewage, mainly to remove foreign objects such as rags and plastic bags;

- Primary settlement to remove the bulk of the large, heavy solids. This is generally integrated with an anaerobic unit in a tank such as a primary settler, septic tank or even anaerobic pond;
- Aerobic treatment. Air is added to the effluent to provide sufficient oxygen for carbonaceous material removal and nitrification through aerobic microorganisms. This is generally an energy-intensive step because mechanical equipment is employed;
- Secondary settlement during which the microorganisms are again separated and removed from the effluent;
- Disinfection. Typically chlorine or ultraviolet (UV) light treatment is used to inactivate/kill off viable microorganisms that may become a potential health hazard before the final effluent is discharged into the environment.

These basic unit processes can be extended to include biological nutrient removal, *viz* nitrate and phosphate removal.

Figure 8 depicts these basic unit processes schematically in two widely used advanced biological treatment processes:

1. Activated Sludge (Three-Stage Phoredox Process)
2. Trickling Filter systems (New-Generation Trickling Filters).

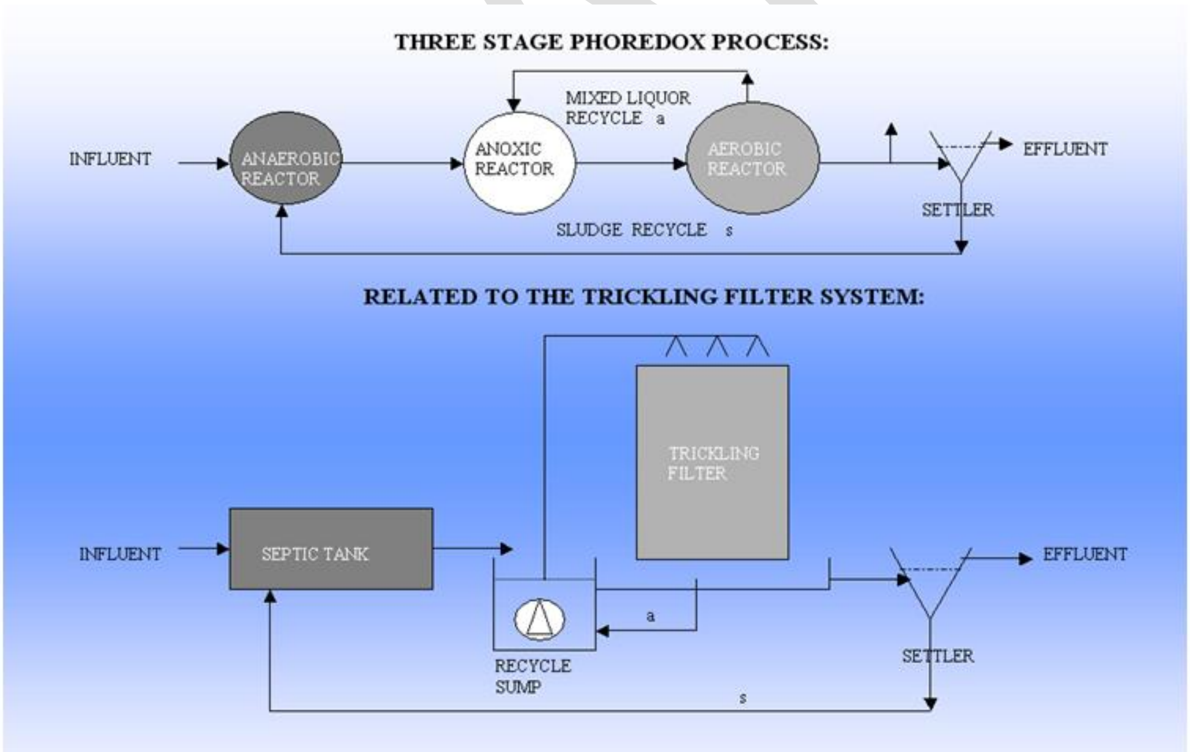


Figure 8: Schematics of typical Activated Sludge and Trickling Filter plants (courtesy ASE)

Existing advanced biological treatment plants built in Namibia generally use either submerged- or attached-growth systems. The latter system refers to the biomass employed in the aerobic step which is required for carbonaceous material removal and nitrification:

- Submerged growth systems. The biomass is freely floating in aerated, mixed, biological tanks/reactors. Typical systems employed include Activated Sludge Processes, Oxidation and Pasveer Ditches and Sequential Batch Reactors. For more information on the Activated Sludge Processes the reader is referred to the Code of Practice, Volume 4, Biological Treatment Activated Sludge Processes (DAWF, 2008).

Advantages:

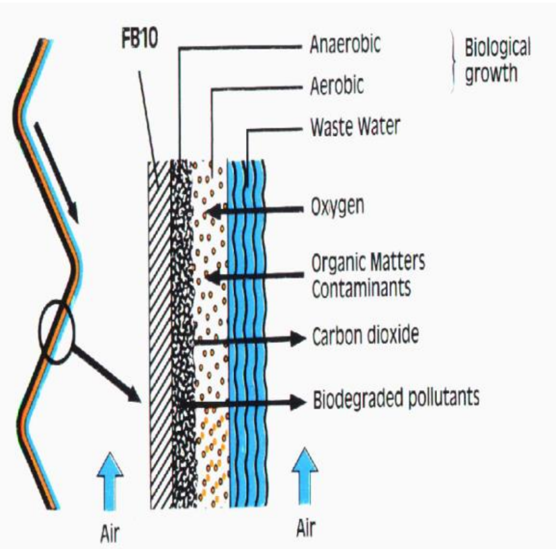
- High quality of final effluent is produced which can be re-used or discharged to the environment;
- Well-established processes and detail design parameters are readily available.

Disadvantages:

- High capital costs;
- High energy demand;
- Substantial mechanical equipment employed;
- Regular maintenance required including cleaning of inlet screens, regularly servicing and maintaining pumps, gearboxes and motors;
- Process control and adjustments can be difficult - requires involvement of highly experienced process specialist;
- Sensitive already to short-term power outages – a 30 minute power outage will already result in a change in biomass culture after start-up;
- Need stand-by generator to ensure oxygen input when power outages occur;
- High sludge wastage – need sludge treatment such as a digester or belt press system;
- High operation and supervision required - requires 24 hr per day presence on site, which means that a minimum deployment of 2 people per shift is required to satisfy safety and Namibian employment law requirements;
- Operator(s) need advanced training;

- Attached-growth systems. An attachment media such as stone, styropur™ or plastic sheeting is provided in the aerobic stage for the biomass to grow on. Systems employed include Rotating Biodiscs and old and new-generation Trickling Filters. The reader is referred to the Code of Practice, Volume 3, Biological Filtration Systems (Trickling Filters) (DAWF, 2010) for further information on this topic.

  Attached-growth systems in the form of the new-generation Trickling Filter Plants have proved to be the most simple and reliable advanced treatment systems currently employed in Namibia. These systems employ specially developed, profiled plastic media that ensures a maximum wetting rate for microorganisms to grow on (see Figure 9).



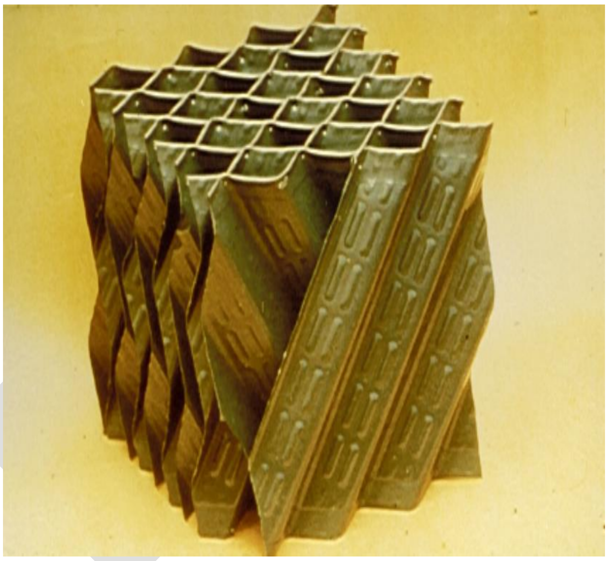


Figure 9: Plastic media employed in new-generation Trickling Filters (courtesy ASE)

The specific new-generation Trickling Filter systems employed in Namibia incorporate increased circulation over the media and nitrate-rich recycling to an anoxic tank to also achieve denitrification. The systems are compact, available as containerised plants, are easy to operate and maintain and need a minimum level of specialist process input, once commissioned.

Advantages:

- Lower capital costs than pond or activated sludge systems;
- Simple process control - no major process parameters to adjust;
- Reliable, stable process which can absorb large flow and load fluctuations;
- Medium level technology used. The most advanced mechanical equipment employed are pumps;
- Low power requirement – only about a third of activated sludge requirements;
- Not sensitive to short and medium (up to 12 h) power interruptions;
- Low sludge production (compared to activated sludge processes);
- Little operational supervision required - does not require 24 hr presence on site;
- Operator(s) do not need an advanced level of training;
- Low, simple maintenance required. Mainly requires cleaning of inlet screens, servicing and maintaining pumps;
- Produces a final effluent that can be re-used or discharged to the environment.

Disadvantages:

- Not well researched - only very few Namibian engineers available or capable of designing such a plant;
- Need for power on site including a back-up generator;
- Periodic sludge removal required.

Figure 10 depicts some typical new-generation Trickling Filter Plants that can be found in Namibia.

Small Trickling Filter Plants - for Lodges

Big Trickling Filter Plants – for Towns

Containerised, Package Trickling Filter Plants – for Sensitive Areas.

Figure 10: New-generation Trickling Filter plants found in Namibia (courtesy ASE)

3. DISCUSSION AND RECOMMENDATIONS

Comparative information about different types of wet sanitation collection, conveyance and treatment systems have been described so that the user can make educated decisions regarding the optimum choice of a system for a specific application.

This document should be used as a guideline only and technical specialists should still undertake the necessary area specific condition assessments before finally selecting on any specific system.

To assist in this exercise, the Planning Tools for Rural and Urban Areas have therefore been included in this Code of Practice (Appendix A).

The urine separation toilet system is highly recommended for use in Namibia because of its low water requirement for flushing. Also, these systems can first be installed to operate as individual, dry sanitation systems and later be connected up to a potable water supply network and water-borne system to operate as a fully-fledged wet sanitation system.

Conservancy tanks, despite requiring substantial manpower resources and mechanical equipment that requires servicing and maintenance, work well throughout Namibia. Therefore, although not a technology of first choice, such systems can be considered for small communities in rural areas.

Gravity sewerage systems generally work well and can be provided to communities that have sufficient water resources available and can operate and maintain their sewers and final effluent treatment facility.

Providing vacuum sewers should be avoided as far as possible. Should a community install such a system, a high level of construction site supervision is first required and subsequently, a service and maintenance contract with the specialist supplier should be entered into for at least 3 years after commissioning.

There are various options for the final treatment of raw sewage effluent from water-borne sanitation systems. Evaporation ponds could be provided in rural areas with communities not exceeding 5,000 people. For larger communities, advanced treatment facilities (Trickling Filter Technology) should be considered.

Advanced Biological Treatment is appropriate where re-use of the final effluent is chosen for selected agricultural applications and irrigation of lawns or gardens.

New-Generation Trickling Filter Technology is recommended as Advanced Biological Treatment Technology for Namibia. Trickling Filter technology has the advantages that it:

- Is simple and easy to control and operate;
- Has a low energy consumption;
- Needs little maintenance;
- Is suitable for fluctuating flow and load conditions;
- Gives a final effluent suitable for re-use or discharging into the environment.

Final effluent, if re-used or discarded to the environment, needs to conform to certain final effluent quality standards which are legally promulgated and enforceable.

Every treatment facility needs to have a Wastewater Discharge Permit, for which an application needs to be made to DAWF. Similarly, a permit is required for reuse of the final effluent or waste products after treatment. Relevant forms are obtainable from DAWF.

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<u>Proprietary Systems</u>

GEA 2H Water Technologies GmbH, Dieselweg 5, 48493 Wettringen, Germany. <www.gea-2h.com>

Roediger Vacuum GmbH, Kinzigheimer Weg 104-106, 63450 Hanau, Germany. <www.roevac.com>

APPENDIX A: SANITATION SERVICES PLANNING TOOLS FOR RURAL AND URBAN AREAS

Guide to Planning Tools

1. Purpose of the Planning Tools:

Planning tools designed to help provide guidance for decision making are used once communities have been selected to be provided with improved sanitation services. The selection criteria would use processes such as the fair distribution planning and financial tool (also known as the equitable distribution tool) to identify priority regions and urban and rural communities.

Two Sanitation Services Planning Tools have been developed, *viz* for:

- Rural Areas;
- Urban Areas.

The Rural and Urban Sanitation Services Planning Tools were drawn up primarily as guidelines to provide sanitation facilities to serve individual households. The Tools are intended to used by:

- Planners (government and private) when considering new extensions (towns, villages and communities);
- Consultants and technical advisers when acting for their clients to select the most appropriate sanitation systems for their specific project conditions;
- Donor organisations and NGO's involved in sanitation throughout Namibia as a quick reference to assess the most appropriate technology to be employed for specific local conditions and areas they are active in;
- Municipalities, towns, villages and communities to make a quick assessment of the choice of appropriate technologies that could be promoted in their specific area;
- Communities or even individual households pre-dominantly in rural and urban communal areas that may wish to take the initiative and be informed about how to choose and implement the most suitable sanitation system to meet their circumstances;

These tools are not meant for Governmental Offices such as schools, clinics, police stations and regional offices. Here, shared facilities are likely to be provided.

2. Key to numbers in Planning Tool:

1) The planner/designer must obtain all design specifications of the existing sanitation system including any treatment facility, assess if there is spare capacity and get written permission of the owner that the new proposed system may be connected to the existing system. Should the planner/designer not have the specialist knowledge to assess the

capacity of the existing system, he/she must appoint a specialist consultant to do this assessment.

2) Water should only be considered to be "freely available" and "affordable" if:

- Department of Water Affairs must always be consulted to determine the safe yield of community or settlement existing water supplies to confirm the availability of additional supplies needed for the new sanitation services;

- There is a guaranteed water supply also in times of drought, e.g. a sufficient and shallow borehole or perennial running river;

- When a formal communal water supply institution exists such as a water point committee, latter must be consulted as part of the planning process including the water use for that specific community;

- In broad terms, a household should be willing to pay for at least 25 l/p/d (urban) of additional water if a water–borne system is selected;

- The tapping point for a household should preferably be within the dwelling but not be further than 30 m from the dwelling and should be easily accessible;

- Where there is energy required to transport the water supply to the dwelling, e.g. electricity or fuel for pumping, this source must be very reliable and affordable to the users.

3) Operation and Maintenance: The level of technical expertise and availability of technical resources within the community should be established before deciding on a potable water supply and distribution system where a new wet sanitation system is being considered.

4) Cultural Aspects: For dry and wet systems, only on-site systems should be considered, no shared, communal facilities should be implemented. These are classified as improved sanitation systems. Also, cultural habits such as different members of the same family that would not normally use the same toilet must be considered when consulting with the community. Cultural sensitivities must be included within any community participation approaches.

All toilet systems, dry or wet, should be installed with a hand-washing facility built-in next to the toilet. Where urine diversion, dry sanitation systems are selected, a separate urinal system maybe added.

5) Environmental Impact: Topography, climatic conditions, soil conditions, ground water table and raw water aquifers should be thoroughly investigated, including single households relying on e.g. pit latrines: Percolation tests and infiltration area sizing must be undertaken as per Code of Practice: Volume 1 – Septic Tank Systems (DWAF, 2008). Special consideration must also be given during times of high rainfall. Even when flooding only occasionally occurs (1 in 10-year flood), there will be a danger of sewage contaminating the surface run-off and this should be taken into account in the design and choice of sanitation technology selected.

6) Sanitation Technology - Flush Toilets: Where wet sanitation systems are chosen particularly for new housing developments only water-saving toilet systems should be considered. As a minimum they must be fitted with a two-volume (big/small) flushing mechanism or, alternatively, must be of the urine-separation type with separate flushing to each section of the toilet bowl.

7) Households: HH are regarded as typically a single family consisting of not more than 8 permanent members.

8) Affordability and Cultural Aspects: The final choice of a specific sanitation technology should lie with the end-user or community where a group of HHs are being served and will typically will depend on:
    - Cost;
    - Aesthetics;
    - Cultural and personal acceptability
    - Staged system where the option of upgrading is practical in the future.

9) Technical Appropriateness – Water-borne Collection systems: All collection systems should be be designed as gravity. Where pumped systems are necessary, the minimum number of transfer pumping stations should be installed. Ideally, the area to be serviced should slope towards a single low point where a treatment plant should ideally be installed. Water-borne collection systems are preferred in circumstances where the soil is such that trenching is easy and inexpensive.

    There are certain conditions under which a vacuum sewer collection system would be appropriate to install/use, such as rocky subsoil or flat terrain. This type of collection system requires a specialist technical operators to service and maintain the system. Such a system should only be considered as a last resort for small communities and, when selected, the appointment of a specialist service and maintenance contractor would be the preferred option.

10) Technical Appropriateness – Mechanical Collection: An able contractor would be one that has the financial means to acquire, operate and maintain a tanker with extraction pump (e.g. “Honeysucker”). The contractor must also be conscientious to empty tanks immediately when called out. In smaller, more isolated communities, other affordable options must be considered.

11) Technical Appropriateness – Final Treatment: For final treatment of sewage effluent collected using a wet sanitation system, a specialist designer must be consulted to provide the most appropriate final treatment system for that specific community. Where possible, reuse of treated effluent (for selected agricultural produce, gardening or lawns for sports fields) of the final effluent is recommended. However this is likely to require more costly advanced treatment processes. In addition, advance treatment systems will require access to a high level technical expertise which will impact on future operational and maintenance cost. In most instances, a service contractor will be required to manage, operate and maintain such treatment systems.

    When advanced treatment is considered, low-key technology that gives a final effluent suitable for reuse and conforming to the effluent standards such as new-generation trickling filters should be the first type of technology considered. Trickling filters are cheaper to build than evaporation ponds, have a much smaller footprint than even oxidation ponds (5% of area only required), need no specialist knowledge to operate, require little maintenance, need no adjustments to operating parameters and produce a final effluent conforming to current legislation for environmental standards in Namibia (General Standard). However, they need access to an energy source..

Where a community does not have access to technical expertise, ponds should be considered. In this case, strict adherence to the Code of Practice: Volume 2 – Pond Systems (DWAF, 2008) is required. Specifically, the following requirements need to be taken into consideration:

- The anaerobic pond must be lined with an impenetrable liner;
- No final effluent may be produced, i.e. all effluent must be evaporated;
- The ponds must be properly fenced-in and locked at all times;
- The distance to the closest residential area should not be less than 500 m and preferably 1 000m;
- If reuse is considered, maturation ponds of not less than 40 days' retention time must be added after the oxidation/facultative ponds.

12) Next Steps:

The future steps that are recommended to be followed once the steps in the planning tool have been undertaken are:

1. Ensure that Water Supply-Sanitation-Hygiene (WASH) principles using the National Saniation Strategy are followed. Hand-washing facilities should always be available at toilet facilities
2. Undertake initial planning with urban or rural communities
3. Carry out pre-planning baseline surveys of communities identified using planning tools
4. Use decision-making tools to compare and choose sanitation technologies for each HH. Discuss HH contributions.
5. Set up management information and performance monitoring
6. Develop and promote health promotion and later conduct hygiene awareness raising with the community including sharing information
7. Develop and facilitate a procurement and implementation programme to provide sanitation services
8. Monitor and assess the performance of the components of the next steps. Carry out a post-commissioning baseline survey
9. Continue to support communities through a mentoring process of advise and facilitation based on a comparison of the two baseline surveys

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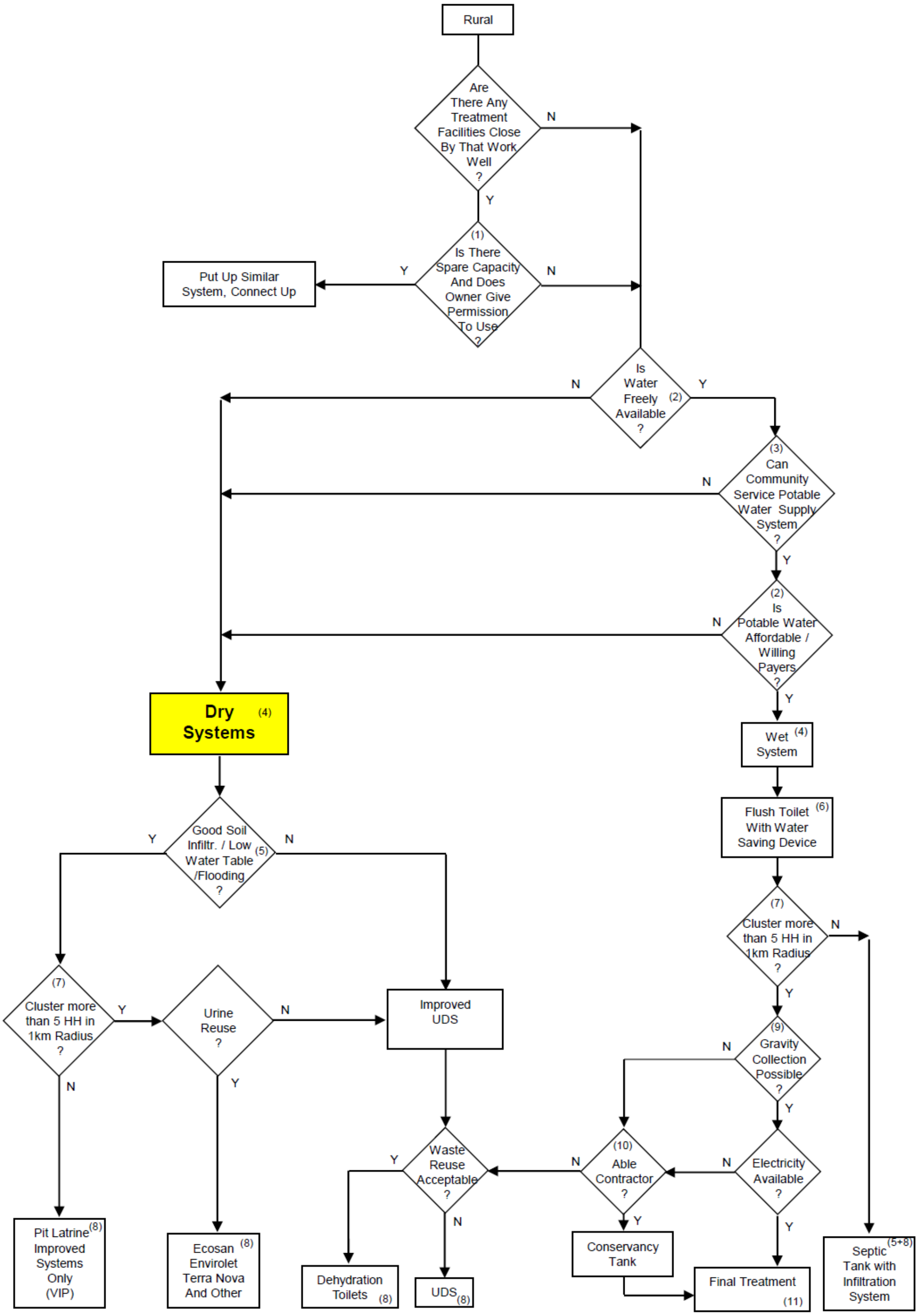
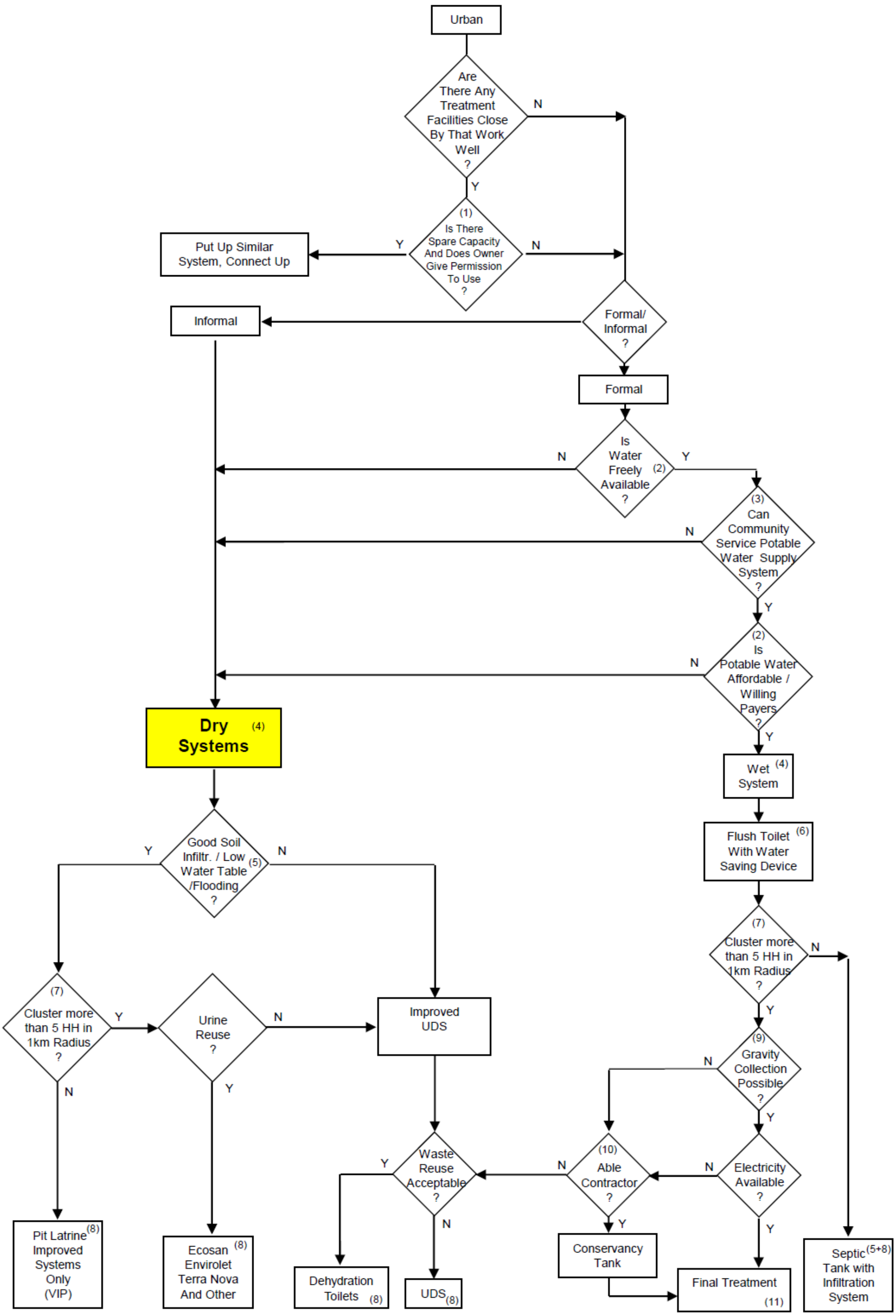
Sanitation Services Planning Tool : Rural Areas



HH = Households

Sanitation Services Planning Tool : Urban Areas



HH = Households