VOLUME 3

SECTION 4

Minimum Requirements for Waste Water Treatment Systems and Excreta Management in Jamaica

Regulated by
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CHAPTER I

BACKGROUND

1.0 INTRODUCTION

This Section of the manual is designed to assist Developers, Engineers, Land Owners, Technical Consultants, Regulatory Representatives and other Stakeholders to understand the minimum requirements for the design and construction of sewage treatment and excreta management systems to meet the Ministry of Health's standards for approving such systems. The requirements are established to ensure compliance with environmental public health standards for safe on-site wastewater treatment units.

The Section includes brief description of central treatment design requirements and application procedures as well as temporary treatment systems. Proponents requiring detailed design and construction requirements for such systems should consult the National Water Commission's Developer's Manual which also includes information on aspects of water supply and irrigation discharge requirements.

1.1 OVERVIEW

The Policy of the Ministry of Health is driven by considerations for preserving human health and environmental protection. It requires that all wastewater generated in Jamaica receive appropriate treatment using approved treatment methods dictated in part by adopted effluent guidelines before disposal to the environment. The Policy also sets limitations on the types of systems to be used in the treatment of wastewater and places particular emphasis on the use of water saving devices which is an approach to sustain the conservation of the water resource and at the same time, reduce the volume of wastewater generated.

1.2 THE ENVIRONMENTAL HEALTH UNIT

The Environmental Health Unit's (EHU) activities are regulatory in nature and in reality constitutes a regulatory Agency that makes recommendations on water and wastewater systems, through a systematic appraisal of engineering plans submitted to support the application of subdivision and development projects, including tourists resorts, and developments in the industrial and agricultural sectors. The legal basis for this mandate is enshrined in the **Public Health Act** and the **Town and Country Planning Act** and the **Local Improvements Act** wherein the Parish Council is required to consult and receive the advice and recommendation on all sewage treatment systems dealing with the treatment of wastewater from the Medical Officer (Health)/Local Health Department.

Currently the legal provision in the Town and Country Planning Act and the Local Improvements Act gives the Ministry of Health direct authority to review development and subdivision applications for waste treatment facility on behalf of the Parish Council. EHU recommendations are circulated to the Local Planning Authorities Health Department.

In addition, the Public Health Act through the **Public Health (Nuisance) Regulations** gives the Minister of Health and in extension the Medical Officers (Health), authority to take action where any situation existing or potential is likely to endanger the health and well being of the population.

1.3 INTERAGENCY COORDINATION

The Environmental Health Unit approaches its mandate utilizing an inter-agency strategy and coordinates with National Environment & Planning Agency (NEPA) and Water Resources Authority (WRA) in approving designs/systems. NEPA is the Competent Authority to issue Permits (to build) and Licences (to discharge) into the environment while the WRA prepares and supplies Technical Notes outlining the level of sewage treatment requirements for particular areas, based on the hydrogeology of the area.

CHAPTER 2

GENERAL PROVISIONS FOR WASTEWATER TREATMENT AND EXCRETA DISPOSAL

2.0 CHOICE OF SEWAGE TREATMENT

The choice of sewage treatment options lies with the Developer or homeowner. The choice is constrained by the nature of the project, the topography and hydrogeology of the proposed building site and prudent environmental public and environment health concerns.

The general preference is for developments to connect to existing central or community sewerage systems to reduce the impact on the environment. In cases where no central or community sewerage system exists or where such systems are not able to accommodate additional sewage flow, due to lack of capacity, high pollution loads or other reasons, or where a reasonable time for the formal connection to such systems has elapsed, on-site treatment must be considered as the alternative option.

2.0.1 On Site Systems

On-site systems may be of four general types, these are:

i dry excreta management systems (dry conservancy),
ii soil absorptive methods
iii liquid discharge treatment facilities (frequently package plants, pond or constructed wetland systems) and
iv evaporation and/or transpiration systems with no liquid discharge.

The EHU approves any of the above systems for sites based on the treatment level desired: **Primary, Secondary or Tertiary.** Details for these types of systems are discussed in **chapters 6 to 12**

2.1 SOIL ABSORPTIVE SYSTEMS

Where allowable, due to soil conditions and groundwater levels, soil absorptive systems are preferred due to cost considerations and environmental public health concerns. However, not all potential building locations can accommodate soil absorptive systems. For example, those with high water table or with very low percolation rates may not be suitable. Similarly locations with extremely high percolation rates due to karstification of limestone or other similar conditions are most times not suitable for soil absorptive systems.

Soil absorptive systems (without significant nutrient removal) are no longer permitted in Kingston and much of St. Andrew due to concerns over nitrate and other sewage contaminants impacting the water table. Most town centres and coastal areas are similarly not suitable for soil absorptive technologies due to high groundwater levels and pollution load.

2.2 WATER RESOURCE AUTHORITY'S ROLE

The Environmental Health Unit is guided, in most cases, by the Water Resource Authority (WRA) Technical Note which recommends the level of treatment (primary, secondary or tertiary) required. Proponents are therefore required to obtain and submit the WRA's Technical Note along with other documents.

2.3 NRCA'S ROLE

Effluent disposed via dry gully or other surface water source(s) from onsite or central treatment systems must meet the Natural Resources Conservation Authority Act (NRCA) effluent standards (Table 6). Proponents/Developers are required to contact the National Environmental Planning Agency to verify requirements and standards.

CHAPTER 3

THE ENVIRONMENTAL HEALTH UNIT APPROVAL PROCESS

3.0 SUBMISSION OF APPLICATIONS

All applications submitted to the Ministry of Health are directed to the Environmental Health Unit (EHU) for evaluation and recommendation. Submissions should preferably be channelled through the relevant Parish Councils or NEPA.

3.1

The **turnaround time** for reviews is usually:

i Three weeks - when the Technical Note from the Water Resources Authority is critical to decision making or if a site visit is required, and

ii Two weeks for all other submissions.

Submissions previously reviewed but not approved for various reasons by the EHU and are resubmitted with required amendments are usually completed within a shorter time frame. Amendments should be routed through the relevant Parish Council or NEPA.

Figure 1 provides a comprehensive overview of the approval processes.

3.2 SUBDIVISION APPLICATIONS

Persons intending to subdivide undeveloped land or developed properties are required to submit a subdivision application to the local Planning Authority (Parish Councils), whether the property will be used for commercial, industrial or residential purposes. The subdivision application is usually done in one of the following categories:

i Subdivision of properties nine (9) lots or less
ii Subdivision of properties more than nine lots

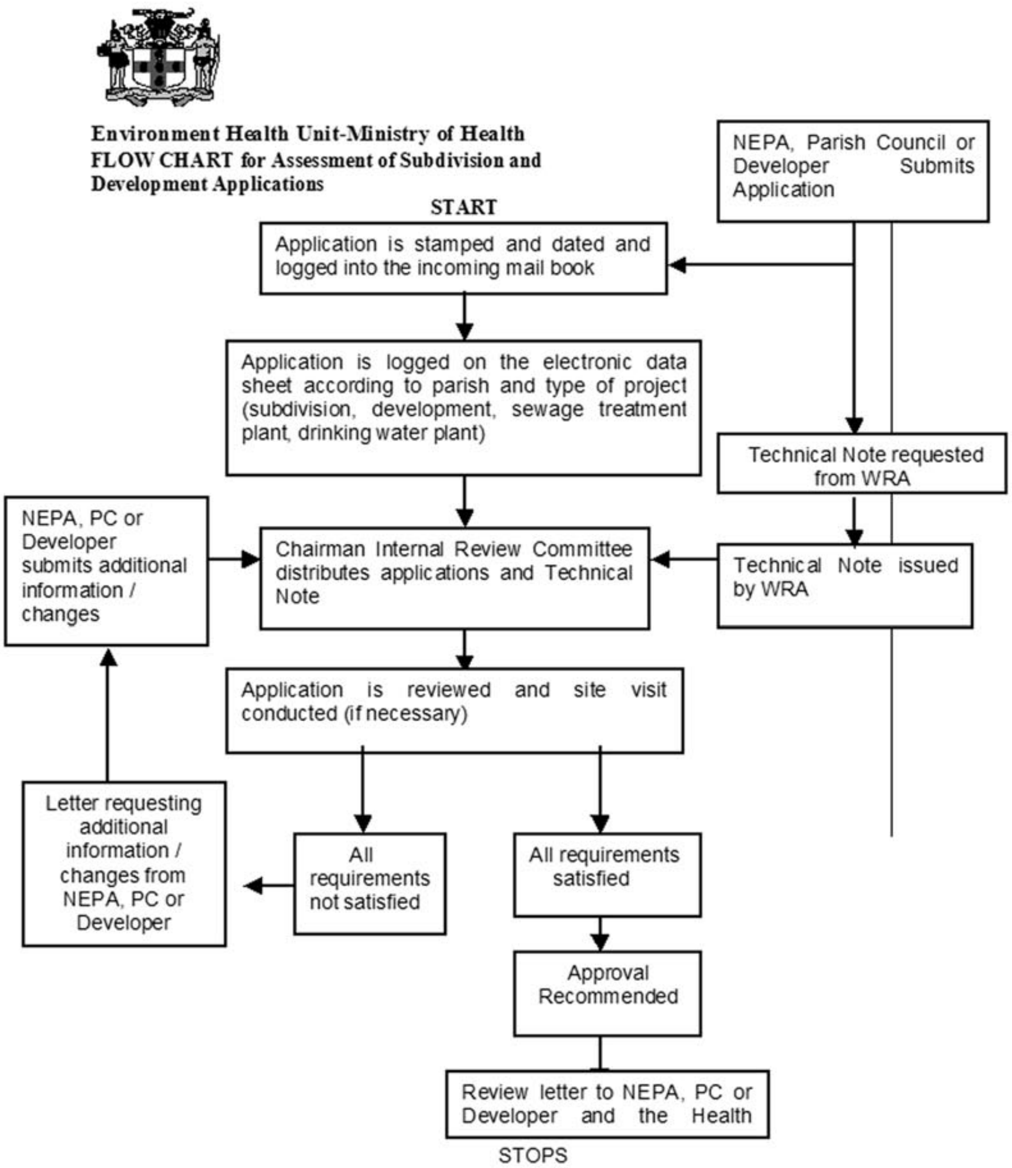


Figure 1: Flow Chart for the Processing of Applications

3.3 NINE LOTS AND UNDER

All applications for subdivision properties **nine lots or less** are to be submitted to Kingston and St. Andrew Co-Operation, or the Portmore Municipality or the local Parish Council. Depending on the parish, the local Council will either send copies of the application and drawings to NEPA or process the applications internally by way of a Subdivision Committee.

Where Councils have operational Subdivision Committee the application/s is forwarded to the relevant government agencies, including NEPA, for review/comments. The reviews from the various agencies are collated and used in deciding approval or rejection of the subdivision at the Subdivision Committee meeting. Presently, three parishes: Kingston and St. Andrew, St. Ann and St.

Catherine process applications through Subdivision Committees.

Other parishes send copies of the application and drawings to NEPA for circulation and compilation of comments/review by NEPA.

3.3.1 Information Required with Application

Applicants are required to submit the following along with submission:

i. Completed application forms (provided by the Parish Council)

ii Site survey plans completed by a Certified Land Surveyor

iii Review fee as published in the Jamaica Gazette.

iv Engineers report (if required)

An Engineer's report must accompany the submission in cases where:

i The Proponent proposes to connect multiple dwellings to a wastewater treatment system

ii The Developer proposes an alternative treatment system.

iii The site conditions are environmentally vulnerable to development

iv The treatment technology or development of site may create a public health concern.

A detailed Engineer's Report is not required if the proponent proposes a traditional onsite wastewater treatment system for single dwellings.

3.4 MORE THAN NINE LOTS

Applications for subdivisions with more than nine (9) lots must be submitted to the KSAC, the local Parish Council or the Portmore Municipality. They, will in turn, submit the copies of the application and drawings to the National Environment and Planning Agency (NEPA), the Agency with responsibility for forwarding the application to relevant government agencies, (Referral Agencies), as listed in Table 1. Each Agency will conduct independent internal review and forward comments/recommendations to the NEPA. A Subdivision Committee, comprising all the referral agencies members meets once per month to undertake a combined review of applications.

3.4.1 Information Required with Application

Applicants are required to submit the following along with submission:

i Completed application forms (number determined by the Parish Council)

ii An Engineer's Report, (section 1.3).

iii Site survey plan showing proposed location of sewage treatment system.

iv Detailed plan drawings and specifications for proposed treatment equipment.

v Review fee as published in the Jamaica Gazette

Information submitted for approval shall be in such detail as to permit a comprehensive evaluation to assure compliance with this manual and other supporting documentation.

3.5 SITE VISITS

3.5.1 Pre-approval Site Visits

Subdivisions that exceed nine lots or subdivisions with unique environmental public health concerns can trigger a site visit by relevant agencies prior to approval. Construction of temporary commercial and industrial systems may also require site visits prior to approval.

In such cases the EHU will contact the applicant on receipt of the application to organise the site visit. The preliminary or final engineer's report and relevant drawings must be received before a site visit is conducted. In cases where a site visit is mandatory no final approval will be granted until the visit and assessment are completed. Site visit reports become a part of the Applicants' file.

Table 1 Members of the Subdivision Committee

National Environmental Planning Agency [1]
Ministry of Health / Environmental Health Unit
National Irrigation Commission
National Works Agency
Office of Disaster Preparedness and Emergency Management
Mines and Geology Division
Jamaica Bauxite Institute
Water Resources Authority
Surveyor's Association [2]

[1] Agency Representative is meeting chairperson
[2] Representative is not a member of Committee, but regularly attends

3.5.2 Site Visits to Developments under Construction

Most major projects, especially those with centralised sewage treatment systems, will generate a construction site visit at the 50% and 90% construction points. This requirement is specifically mentioned in the letter of recommendation of the Project. It is incumbent on the Developer or Proponent to alert EHU at the appropriate time to allow for scheduling of this construction site visit. Construction Site Visits are used to confirm/verify that the type, size and location of the proposed sewage treatment solution is being constructed in accordance with the approved design.

3.6 Revision of Approved Plans

Deviations from approved plans and/or specifications must be submitted in writing to the MOH/EHU for review and approval. Changes in designs may adversely affect the capacity flow or operation of units, thus the stipulation. EHU will submit the necessary recommendations to NEPA (for amendment etc.) before changes are implemented.

Revised plans and/or specification shall be submitted a minimum of 30 days prior to the commencement of construction to permit sufficient time for review and approval. Special consideration will be given to emergency field conditions.

Waiver of the written approval and 30-day requirement will be at the discretion of the MOH/EHU. Structural revisions or other minor changes, not affecting capacities, flows or operation may be permitted during construction without approval. The proponent must however, advise the EHU on changes made. As built plans clearly showing all alterations shall be submitted to be placed on file with the

MOH/EHU after the completion of work.

3.7 Modifications and Expansions of Existing Facilities

Modifications and expansion of existing facilities shall be submitted for review as per standard subdivision/development submissions. In addition to the requirements outlined at 3.6, the Proponent must submit as-built drawings of the existing treatment system. Additionally, proposed tie-ins and schedule should be addressed to minimise downtime.

If required, a description of any temporary measures to be employed during construction phase to prevent or minimise loss of service shall be discussed and approved before commencing construction.

3.8 Temporary Systems (e.g. Special Events)

Temporary wastewater treatment systems, including portable chemical toilets are employed

- i during construction phases
- ii in cases where of there is a special event on a property or
- iii prior to installation of a permanent treatment system.

The MOH/EHU limits approval of temporary treatment systems prior to construction and implementation of a permanent system. The proponent must submit a detailed letter that outlines the reason for the temporary installation along with engineering design and specifications. A time schedule should also be submitted that outlines the start up date for the permanent treatment system.

Proponents shall consult the local Parish Council and Parish Health Departments when planning a special event that requires temporary wastewater treatment systems.

A type of portable chemical toilet can be seen on page 73 in "A Directory of Environmentally Sound Technologies for the Integrated Management of Solid, Liquid and Hazardous Waste for SIDS in the Caribbean Region").

3.9 Engineer's Report

An engineer's report must accompany the application forms along with detailed engineering drawings if the proponent proposes any of the following:

- i Development that exceeds nine (9) lots ii An onsite wastewater treatment system that is considered new or alternative

iii An onsite wastewater treatment system that will be connected to more than one dwelling(s)or to a group of dwellings

iv Site conditions are environmentally vulnerable to development

v Treatment technology or development of site may create public health concerns.

Application forms may be obtained from NEPA, the KSAC or the Parish Councils.

Drawings, final report and construction supervision should be undertaken by a Professional Engineer(s) licensed in Jamaica. The Engineer's Seal shall be affixed to the drawings and title page of the final report. The engineer is responsible for ensuring that the treatment system/s, once approved, is built according to the approved drawings.

Proponents may submit a Preliminary Design Report prior to the final report for initial review. This report shall detail the concept for the development. Although the MOH/EHU may offer comments on the preliminary design and may conduct a site visit, the development will not be approved until an Engineer's Report, pertinent drawings and other requested information are provided.

3.10 General Project Information

The following general information is required with applications:

i Proposed and future areas to be served, including proposed wastewater flow rates, wastewater characteristics and volumes of industrial and commercial areas

ii Site topography, soil type and meteorological information

iii Vulnerability of the site regarding flooding, landslides, geological faults and storm surges.

iv Soil percolation test (if an absorptive disposal method is proposed)

v Environmental public health situation in the surrounding areas. Supporting data with regard to diarrhoeal disease, typhoid endemic areas, gastroenteritis and other diseases are useful to support the submission.

vi Tourism potential of the surrounding area.

3.11 SEWAGE TREATMENT SYSTEM AND APPURTENANCES

The following information must be provided on sewage treatment systems and appurtenances.

i Plant location, plant site plan, including a description of the surrounding areas. Particular reference shall be made to the proximity of present and future developments, wells, streams, lakes, water plants, industrial sites, and other areas, which will be affected environmentally by the treatment plant.

ii A detailed analysis of the method of treatment and its efficiency and ability to meet discharge requirements.

iii Design calculations showing size and capacity of each unit or component part in relation to the provided design criteria. The calculations should show retention times, surface loadings, weir loadings, pump sizing, sludge wasting pumping rates and any other pertinent information regarding plant design.

iv Detail discussion on the means of effluent utilization or disposal

v Design calculations for each sewer showing present and future flows with minimum and maximum velocities.

vi Capability of existing interceptors to carry present and future flows.

vii Design calculations for all sewage lift stations including wet well sizing and pump curves.

viii Location of any bypasses and a detailed analysis of anticipated use.

ix The means of grit, grease, screenings, sludge utilization and disposal shall be discussed in detail, accompanied by the necessary design calculations.

3.12 Operations and Maintenance

The following information must be provided the operations and maintainance to be put in place:

- i A time schedule for completion of plant construction and plant start-up
- ii Operation and maintenance manual to include maintenance of all major equipment and appurtenances (Appendix 1).
- iii Staffing levels by trade or job classification and proposed training schedule
- iv List of analytical (testing) capabilities to be provided and available to operation and maintenance staff.
- v Spare parts list
- vi Size and type of emergency generator provided, if any.
- vii Emergency response plan

3.13 Drawings

The following drawings are to be provided:

- i Site plan showing location of all major sewer lines, lift stations, buildings and major equipment, include topographical deviations.
- ii Flow diagrams illustrating process treatment processes.
- iii Equipment diagrams for major equipment and appurtenances such as clarifiers, aeration or oxidation processes, digesters, etc.

CHAPTER4

RECOMMENDED WASTEWATER TREATMENT AND DISPOSAL SYSTEMS

4.0 RECOMMENDED SYSTEMS

The following sewage treatment and disposal systems or processes are acceptable methods of treatment (depending upon site specific circumstances) and are currently recommended:

- i Ventilated Improved Double Vault Pit Latrine (VIDP)
- ii Ventilated Improved Pit Latrine (VIP)
- iii Absorption Pit
- iv Soak-away Pit
- v Septic Tank
- vi Aerated Septic Tank
- vii Tile Field
- viii Evapotranspiration Bed
- ix Reed Bed (constructed wetland)
- x Mound System
- xi Intermittent Sand Filter
- xii Recirculating Sand Filter
- xiii Biodigester Septic Tank
- xiv Mechanical systems (Oxidation Ditch, Contact Stabilization Tank, Rotary Biological Contactor, Trickling Filter, Aerated Sludge Systems and Anaerobic systems)
- xv Pond Systems (aerobic and anaerobic ponds).

The combination of these systems or processes, provide a complete sewage solution. These combinations are site specific and must correspond to the level of treatment required as provided by the guidance in the Water Resources Authority Technical Note.

4.1 CONNECTION TO EXISTING CENTRAL TREATMENT SYSTEMS

Connection to existing central wastewater treatment systems requires approval and acceptance from the owner and/or operator of the sewage treatment system. Most of these systems are owned and operated by the National Water Commission (NWC). Acceptance from the NWC or other Operator must be outlined in an official letter signed by an authorised person, stating the effective date for connection.

4.1.1 Information Required

The following information is required:

i that only domestic sewage will be accepted.

ii the design flow rate of sewage anticipated by the Development.

iii design capacity of the treatment plant

iv current load being treated by the plant

v calculated extra capacity of the plant

vi at least six months performance data of the treatment plant (current data).

4.2 NON APPROVAL

No approval will be given for connecting to an existing central system that does not meet the discharge standards set by NEPA or if the central treatment plant meets the discharge standards but does not have extra capacity.

4.3 PROCEDURE FOR ASSESSING NEW TECHNOLOGY

The Ministry of Health welcomes new technology, but its performance should be documented or demonstrated before approval. The procedure for assessing new technologies is outlined in Figure 2.

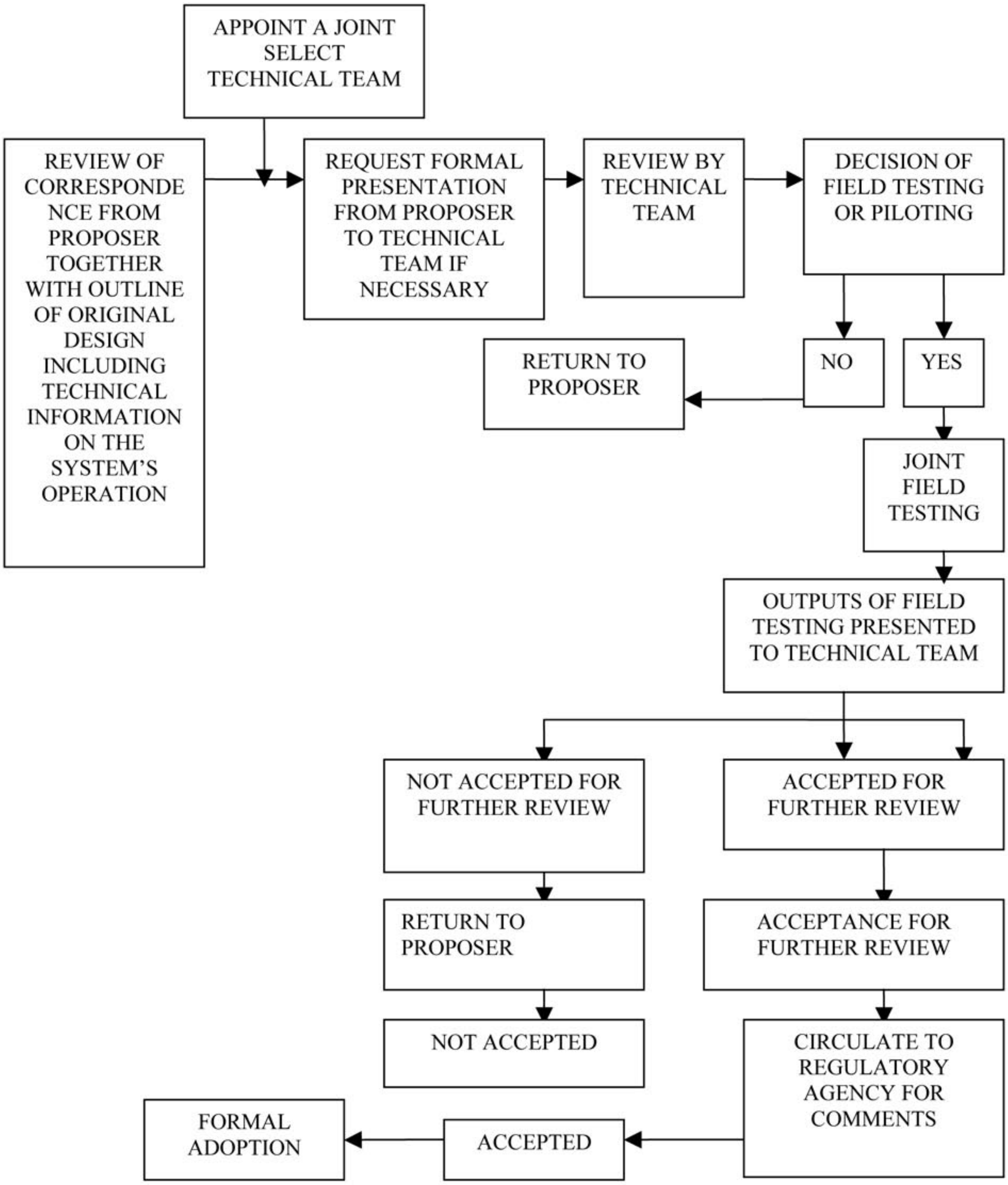


Figure 2. Procedure for Assessing New Technology

CHAPTER 5

DESIGN CAPACITY CALCULATIONS

5.0 POTABLE WATER REQUIREMENTS

Every developer must provide adequate quantities of potable water at reasonable pressure to meet the needs of occupants within the development. Generally, this will be by connection to a public water supply source from the NWC, Local Parish Council or private water provider. In instances where the proposed development area is not currently supplied by potable water, the developer is required to provide an alternate source/ supply of potable water, either via development of ground water resources or by other means, for example, rain water harvesting. Proposals for using alternative systems must be accompanied by detailed plans, calculations and technology to disinfect the water to meet potability standards.

5.0.1 Residential Developments

For residential developments, the nominal water consumption is assumed to be 230 L / person per day. For the purpose of system capacities, the following should be considered:

Studio	-	2 persons
1 bedroom homes	-	3 persons
2 bedrooms and greater	-	2 persons per bedroom

5.0.2 Starter Homes

For starter homes, which are expected to be enlarged, it may be necessary to consider a design based on a reasonable build-out potential for the specific home/project. If alternative per capita water consumption is proposed, the proponent must state the basis for such alternative water consumption rate and the justification, for approval by the MOH.

5.0.3 Commercial Development

For commercial developments or other types of construction, capacity may be developed by methods such as fixture count or by other means, which are acceptable to MOH. Table 2 shows the water usage per fixture while Table 3 shows the water usage of various types of facilities. These figures are not absolute and are to be used as a guide only.

5.1 WATER SAVING DEVICES

Developers proposing the installation and use of water saving devices may be permitted to reduce the per capita consumption rate.

Table 2 Water Use per Fixture[1]

Fixture	Water Use Per Day/Fixture	
	Litres	US Gallons
Bath Tub	30	8
Faucet	35	9.2
Shower	60	16
Toilet	25	6.6
Urinal	15	4

[1] *adapted from Metcalf/Eddy Wastewater, Treatment and Disposal, 3rd edition (pg. 17*

Table 3. Water Use by Facility Type[1]

Type of Facility	Water Use per Day		
	Litres	*US Gal*	Capita
Bar/Cocktail Lounge	55 – 75	14.5 – 20	Per Seat
Hotel – Resort	190 – 225	50 – 60	Per Guest
Hotel – Non Resort	150 – 190	40 – 50	Per Guest
Industrial Building (employees only)	55	15	Per Employee
Office Building	55	15	Per Employee
Hospital	750 – 900	200 – 240	Per Bed
Restaurant	100	26	Per Seat
	10	2.5	Per Meal Served
Theatre/Assembly Hall	10	2.5	Per Seat
Church			
Service Station	20 – 40	5 - 10.5	Per Vehicle Served
School w/cafeteria	55 – 80	14.5 – 21	Per Student

[1] *adapted from Metcalf/Eddy Wastewater, Treatment and Disposal, 3rd edition (pg. 28 - 29)*

5.2 SEWAGE SYSTEM CAPACITY

5.2.1 Basic Principles

The EHU adopts the following basic principles in determining sewage system capacity:

i For on-site sewage treatment systems, the calculation of the sewage system capacity is assumed to be the same as the water consumption.

ii For central sewage systems, the effect of infiltration and inflow will increase the sewage system flow above the water consumption figures.

5.2.2 Additional Flows

The actual additional flows will depend upon site-specific conditions such as:

i length of sewer lines
ii soil type
iii condition of sewer lines and
iv depth of water table.

5.2.3 Infiltration Rates

Engineers may use the standard method (L/cm diameter/km or US gallon/in diameter/mile) in providing submission of calculations and the design basis for infiltration rates. **Table 4** provides data on standard infiltration rates.

5.2.4 Central Treatment Systems

For wastewater treatment systems employing central treatment system components (sewer mains, treatment technologies) and relevant appurtenances, the developer shall consult **National Water Commission's Developer's Manual.**

TABLE 4. STANDARD SEWER INFILTRATION RATES FOR CENTRAL WASTEWATER TREATMENT FACILITIES[1]

Sewer Diameter		Infiltration	
Mm	*inch*	*US Gal/day /1000 feet*	*Litre/ Day /100 metres*
200	8	1,136	1,410
300	12	1,705	2,115
450	18	2,557	3,173
610	24	3,409	4,231
760	30	4,261	5,288
915	36	5,114	6,346
1220	48	6,818	8,461
1370	54	7670	9519
1524	60	8523	10577

[1]*Table is constructed using standard rate of 750 US Gal/day/inch. mile.*

5.3 RAW SEWAGE STRENGTH AND COMPOSITION

For domestic applications, the raw sewage strength and composition arriving at the wastewater treatment plant may be taken as medium strength with composition as shown in Table 5. If a developer wishes to utilize alternate concentrations or compositions, the justification for alternatives must be provided and approved by EHU.

TABLE 5. TYPICAL MEDIUM STRENGTH DOMESTIC SEWAGE

Parameter	Design Value
Total Suspended Solids, TSS	220 mg/L
Chemical Oxygen Demand, COD	500 mg/L
Biochemical Oxygen Demand, BOD_5	250 mg/L
Total Nitrogen (as N)	40 mg/L
Total Phosphorous (as P)	8 mg/L
Total Coliform Bacteria	10^7 - 10^8 MPN/100ml

5.4 TREATED WASTEWATER QUALITY STANDARDS

Systems which discharge treated wastewater must comply with effluent standards laid down by the NEPA per the nature of discharge.

5.4.1 Effluent Standards

The current NEPA standard for treated wastewater is shown in **Table 6.** This standard sets the minimum water quality to be obtained from NEPA by any system, which has liquid discharge of wastewater. A licence must be obtained to discharge to surface water such as to a river, stream or gully. The process for obtaining permits is described in Chapter 2. Developers are required to check with NEPA for information on requirements.

5.5 IRRIGATION WATER QUALITY STANDARD

The interim Jamaica Irrigation Standards is shown in **Table 6**. The water quality standard is more stringent for irrigation water than for discharge of wastewater. Subsurface or drip irrigation systems are preferred especially in areas where spray irrigation may cause a nuisance, such as close to roadways. If sprinklers are used, the spray should not be higher than 1 meter. Sprinklers with higher sprays will not be permitted in areas where the aerosols could become a public health hazard.

Table 6. NRCA Sewage Effluent Regulations (2004)

Parameter	*Units*	Water Quality Criteria	
		Direct Discharge	Irrigation
Chemical Oxygen Demand	*mg/L*	100	<100
Biological Oxygen Demand	*mg/L*	20	15
Total Suspended Solids	*mg/L*	20	15
Total Nitrogen	*mg/L*	10	NA[1]
Phosphates – P	*mg/L*	4	NA[1]
Ph		6	NA[1]
Faecal Coliform	*MPN / 100 ml*	200	12
Residual Chlorine	*mg/L*	1.5	0.5
Oil and Grease	*mg/L*	NA[1]	10
Giardia Cyst	*# / 100 ml*	NA[1]	<1

[1] NA = *not applicable*

5.6 DESIGN CONSIDERATIONS

5.6.1 Maximum Housing Density

The maximum housing density for on site systems has been established as follows:

i Dwelling units in excess of seven (7) per acre and aggregate population of greater than 300 persons shall be served by central sewage systems. This requires developers proposing projects having a density greater than seven (7) dwellings units per acre or those larger developments (which shall house more than 300 persons) to submit plans for the design and construction of central sewage treatment systems.

ii Developments having more than 300 persons with treatment of sewage on individual lots may be considered if justification is provided and approval is given by MOH

5.6.2 Flood Potential

Soil absorptive systems cannot be approved for areas that may be prone to flooding without approved flood mitigation measures. The EHU is guided by the WRA in determining areas prone to flooding. Flood mitigation measure should be approved by the National Works Agency.

5.6.3 Proximity to Wells, Ground and Surface Waters

Soil absorptive systems are only allowed on the recommendation of the WRA where the highest ground water levels are below 1.2 m from the bottom of the absorptive system. Similarly, the location of the septic tank and soil absorptive system must comply with the proximity guidelines shown in Table 3.6. Soil absorptive systems are not allowed in areas with karstic conditions.

Table 7. Soil Absorption System - Proximity Location Allowances

Component	Object	Minimum Distance metre
Septic Tank	Building Foundation	1.5
Septic Tank	Property Line	1.5
Septic Tank	Tile Field or Alternate	6
Tile Field or Alternate	Septic Tank	0.5
Tile Field or Alternate	Property Line	3
Tile Field or Alternate	Building Foundation	6
Tile Field or Alternate	Well - uncased	30
Tile Field or Alternate	Well – cased to at least 7.5 m	15
Tile Field or Alternate	River/Stream high water mark	45
Tile Field or Alternate	Fractured rock formation	3
Absorption or Soak Away Pit	Neighbouring Pit	3 X Pit Diameter

5.6.4 Sloping Ground

Steep grades require special attention to ensure good distribution of septic tank effluent to the tile field and/or other subsurface system. Subsurface Absorption systems shall be constructed in parallel with topographic contours. The minimum spacing requirements for absorption or soak away pits may be increased if system is constructed on sloping ground.

CHAPTER 6

TYPICALLY APPROVED COMBINATION OF TECHNOLOGIES

6.0 SPECIFICATIONS FOR COMPONENTS

This chapter defines and provides specifications for components of potential treatment methods and recommends combinations of components that will meet treatment requirements. Alternative or new treatment technologies are discussed within **paragraph 4.3**. **Chapter 7 to 12** describe the minimum standards for each treatment component. Refer to **Chapter 5** for site condition requirements and design capacity considerations.

6.1 CATEGORIES OF TREATMENT

The Environmental Health Unit makes recommendations on wastewater treatment systems treatment quality requirements for specific site conditions. The treatment quality levels are divided into three (3) categories: **primary, secondary and tertiary.**

6.1.1 Primary treatment

Defined simply as physical treatment prior to final disposal.

6.1.2 Secondary treatment

Defined as the removal of organic load (COD and BOD) and requires physical treatment and biological treatment prior to final disposal.

6.1.3 Tertiary treatment

Defined as nutrient removal / polishing step and is usually required when proposed developments are located within an environmentally sensitive area or area of public health concern. This treatment requires physical and advanced biological treatment. Sometimes chemical treatment may be used in combination with to obtain effluent requirements.

6.2 TYPICAL TREATMENT SYSTEMS

Tables 8 and 9 outline typical treatment systems approved by the EHU.

Alternatives from the recommended treatment systems may be approved by MOH if the proponent provides sufficient verification that the system will meet discharge standards.

6.3 DRY EXCRETA MANAGEMENT

Dry excreta management systems are good alternative treatment solutions where adequate potable water is not available in an area. Examples of any excreta management solutions are VIDP, VIP. Care must be taken, however, in sighting in these types of solutions so as not to contaminate water table or otherwise impact on the ground water levels.

They must be properly designed and constructed to specifications.

Table 8. Typical on-site Treatment Systems and Corresponding Treatment Requirement

Category	Treatment Requirements	Typical Treatment Systems
Dry Excreta Management	Not applicable	Ventilated Improved Double Pit Latrine Ventilated Pit Latrine Biolatrine (composting)
Primary Treatment	Settle solids	Septic tank + absorption pit Imhoff tank + absorption pit
Secondary Treatment	Settle solids and biological treatment	Septic Tank + Tile Field Septic Tank + Mounded Tile Field Septic Tank + Sand Filter Septic Tank + Tiled Chamber System Biodigester Septic Tank + Tile Field
Tertiary Treatment	Physical and biological treatment. May also include chemical treatment	Septic Tank + Evapotranspiration Bed Septic Tank + Reed Bed (Subsurface) Septic Tank + Sand Filter + Reed Bed (subsurface) Biodigester Septic Tank + Reed Bed (Subsurface) Biodigester Septic Tank + Evapotranspiration Bed

Table 9. Typical Central Systems and Corresponding Treatment Requirement

Category	Treatment Requirements	Typical Treatment Systems
Secondary Treatment	Settle solids and biological treatment	Septic Tank + Tile Field Septic Tank + Mounded Tile Field Septic Tank + Sand Filter Septic Tank + Tiled Chamber System Biodigester Septic Tank + Tile Field Mechanical systems *(Aerated Septic Tank, Oxidation Ditch, Contact Stabilization Tank, Rotary Biological Contactor, Trickling Filter, Anaerobic systems)*
Tertiary Treatment	Physical and biological treatment. May also include chemical treatment	Septic Tank + Evapotranspiration Bed Septic Tank + Reed Bed (Subsurface) Septic Tank + Sand Filter + Reed Bed (subsurface) Biodigester Septic Tank + Reed Bed (Subsurface) Biodigester Septic Tank + Evapotranspiration Bed Waste Stabilization Ponds + Reed Bed Mechanical systems with nutrient removal

6.4 SUBSURFACE ABSORPTION TECHNOLOGIES

If social-economic and other factors do not allow for water coverage systems, where site conditions are suitable, subsurface soil absorption is usually the best onsite method of wastewater disposal, for a single dwelling or cluster of dwellings, because of its simplicity, stability and low cost. Varying pre-treatment technologies may be required before disposal via subsurface absorption system, such as septic tank, aerated septic tank or biodigester septic tank, or equivalent.

6.4.1 Unacceptable Conditions for Soil Absorption Methods

No approval will be given for onsite soil absorption treatment methods if any of the following conditions apply to the site location:

i Connection to public sewer system is practical.

ii Soil conditions or topography are of such that individual disposal systems cannot function satisfactorily.

iii Groundwater conditions are of such that individual disposal systems may cause pollution of the groundwater supply.

iv Installations may create an unsanitary condition or public health nuisance (overtime)

v Densities higher than 7 dwellings units per acre or the aggregation exceeds 300 persons.

6.4.2 Guide to Designing Absorption Components

The following parameters are to be used as guide in designing the absorption components.

I Continuous saturation of the infiltration system is avoided

ii Aerobic conditions in soil immediately below distribution system is maintained

iii Dose the entire absorption system is uniform

iv Compaction and smearing of the infiltrative surface is avoided

v A large amount of sidewall surface as compared to the bottom surface area is provided

6.4.3 Percolation Rate

Absorption before designing any subsurface absorption system applicants must first determine that soil conditions are suitable. The soil shall have an acceptable percolation rate without interference from groundwater or impervious strata below the level of the absorption system (Table 10).

Tile fields, absorption beds or equivalent technologies are acceptable only if they meet each one of the following conditions:

i Depth to ground water

Table 10. Minimum Percolation Rate for Specified Groundwater Depth

Soil Percolation Rate		Required depth to groundwater	
min/in	*min/cm*	*feet*	*metre*
0 – 1	0-0.4	100	30
1 – 2	0.4-0.8	40	12
2 – 10	0.8-4.0	10	3
10 or slower	4.0 or slower	5	1.5

ii Soil Percolation Rates

Soils should have percolation rates between 0.8 – 24 min/cm^2. Soils out of this range should have designed a treatment system that does not employ sub-surface absorption system, such as intermittent sand filters, aerobic treatment systems or evapotranspiration systems.

iii Hydraulic Loading Rates

Hydraulic loading rates for tile fields may be calculated based upon soil percolation rates using methods published by United States Public Health Service **(USPHS, 1967)**. See Appendix 2 to correlate soil percolation rates to design hydraulic loading rates. If soil percolation tests are not available the maximum hydraulic loading rate 60 L/d/m2 must be used as a guide. In calculating loading rate it is recommended that, only the trench(es) bottom area, (trench width X trench length) is used and not the trench side wall area.

6.4.4 Soil Stratification

Rock formations or other impervious strata and maximum elevation of the groundwater table shall be at a depth greater than one metre below the bottom of each disposal trench or disposal pit.

6.5 TERTIARY TREATMENT SYSTEMS

Tertiary treatment systems protect the surrounding environment from intrusion of nutrient and biological pollution.

Typically it includes:

i Small package plants that discharge treated wastewater effluent to a gully or river

ii Systems with zero effluent discharge (evaporation/transpiration systems) and

iii Constructed wetlands, frequently referred to as reed beds

Tertiary treatment systems are recommended when site conditions do not support secondary treatment technologies or public health is likely to be at risk.

Treatment levels are determined using a combination of factors such as soil type, depth to ground water table, proximity to spring, wells and recreational water bodies, proximity to fault lines etc.

6.5.1 Treatment Systems with Liquid Effluent Discharge

Proponents proposing the use of these systems must submit a detailed engineer's report providing verification that wastewater effluent will meet NRCA discharge standards.

6.5.2 Treatment Systems with Zero Liquid Effluent Discharge

Evapotranspiration Bed Systems with prior connection to a septic tank technology is an acceptable onsite wastewater treatment system in Jamaica. These systems are approved by EHU if evaporation and transpiration exceeds precipitation and inflow in the proposed area.

6.5.3 Constructed Wetlands or Reed Beds

Constructed wetlands may be used to provide final or tertiary treatment provided sufficient preliminary treatment is done using appropriate technology (septic tank, biodigester septic tank, packaged plant). Subsurface flow constructed wetlands are preferred to reduce the potential for mosquito breeding.

CHAPTER 7

ON-SITE PRIMARY TREATMENT TECHNOLOGIES

7.0 PRIMARY TREATMENT TECHNOLOGIES

This chapter addresses technologies that treat raw wastewater.

On-site primary treatment technologies are designed to remove settable and floatable solids from raw sewage. Typically, these technologies are used in combination with a secondary or tertiary disposal/treatment technology in an effort to reduce clogging or overloading of systems. Absorption pits are not an acceptable method of primary treatment unless a septic tank is installed prior to discharge into the pit.

7.1 SEPTIC TANKS

Septic tanks or plain setting tanks is a watertight tank that is designed to slow the movement, temporarily store and partially treat raw wastewater.

The main purpose of the tank is to remove floatable material and as much of the settleable portion of the suspended solids in sewage as possible so that the tank effluent maybe treated and disposed by soil absorption.

All commercial, residential and industrial properties utilizing on-site absorption or non-absorption treatment technologies for sewage are required to install a septic tank, or its equivalent. All septic tanks shall conform to **Figure 3**. Minor variation in design may be permitted.

Septic tanks do not accomplish a high degree of removal of bacteria or inorganic material and hence should not be discharged on the ground surface or to deep drainage wells, fissures, lakes or streams.

7.1.1 Design and Construction - Minimum Standards

i Septic tanks shall have a liquid capacity of at least the average volume of sewage flowing into the tank during any 36-hour period, but in no case shall the liquid capacity of the tank be less than 2,650 Litres (700 US gallons). **Table 4.3** provides an estimated septic tank volume for residences per population.

Table 11. Minimum Required Capacity of Residential Septic Tanks

# persons served	Capacity (Litres)	Capacity (gallons)
1-5	2650	700
5-10	3450	900
11-20	6900	1800
21-30	10,350	2700

ii The effective depth for calculating capacity is taken from the invert of the outgoing drain to the average bottom of the tank and shall not be less than 1.5 metre or 5ft.

iii The width shall not be less than 0.07m or 2ft 6 inches nor less than one half of the length.

iv A separate tank ventilating pipe shall be provided if required by the building

v Suitable access shall be provided in the tank slab on the centre lines of incoming and outgoing drains and located to enable all connecting pipes to be properly maintained and serviced.

vi Tanks must be constructed of structurally sound, watertight and corrosion and decay resistant material, such as concrete, vitrified clay block, fibreglass, heavy-weight concrete block, ferrocement, burned brick or heavy-duty plastic

- The walls and base of all tanks shall be securely bonded together or be of monolithic or keyed construction. Walls and base of poured-in-place tanks shall have a minimum thickness of 100 millimetres (4 inches) throughout. A minimum thickness of 75 millimetres (3 inches) is allowed in pre-cast tanks that have been properly reinforced. These thicknesses do not apply to fibreglass and ferrocement tanks.

- A septic tank installed under a driveway or parking area shall have adequate reinforcement to support any anticipated load and access manholes brought up to grade.

- Septic tank covers shall be sufficiently strong to support anticipated loads and adequately secured to prevent infiltration of dirt or other foreign matter and the escape of odorous gases.

- Each compartment within a tank shall have an inspection port situated above the outlet baffle.

vii Septic tanks may have single or multiple compartment(s) of approved shape that provide settling of solids and accumulation of sludge and scum. It should have at least 2 compartments.

- As measured from the invert elevation of the outlet, the first compartment shall have at least two-thirds of the total required liquid capacity.

- Rectangular, elliptical and semi-elliptical septic tanks shall have a length of at least twice but not more than three times the width.

- The liquid depth of such tanks generally shall not be less than 1.2 metres (4 feet) nor more than 1.8 metres (6 feet). Tanks of other shapes and dimensions will be considered for approval when accompanied by data substantiating their effectiveness.

viii At least a 300 mm (12-inch) freeboard or void is required between the sewage level and underside of the tank cover.

ix Inlet and outlet construction

- Inlet and outlet connections of each compartment of a septic tank shall be so designed and installed as to retain sewage solids, scum and sludge effectively.

- The invert or flow line of the outlet pipe shall be set at a minimum of 300 mm (12 inches) below the bottom of the tank cover and the inlet pipe 50 mm (2 inches) higher.

- Outlet control devices are required for each for the tank and any compartments. These shall consist of baffles made of durable material extending from sidewall to sidewall or of pipe tees not less than 100 mm (4 inches) in diameter. The bottom of the baffle or tee shall extend at least 300mm (12 inches) above the surface of the liquid and the top shall be at least 100 mm (4 inches) above the invert of the outlet and not less than 50 mm (2 inches) below the bottom of the cover.

7.1.2 Location

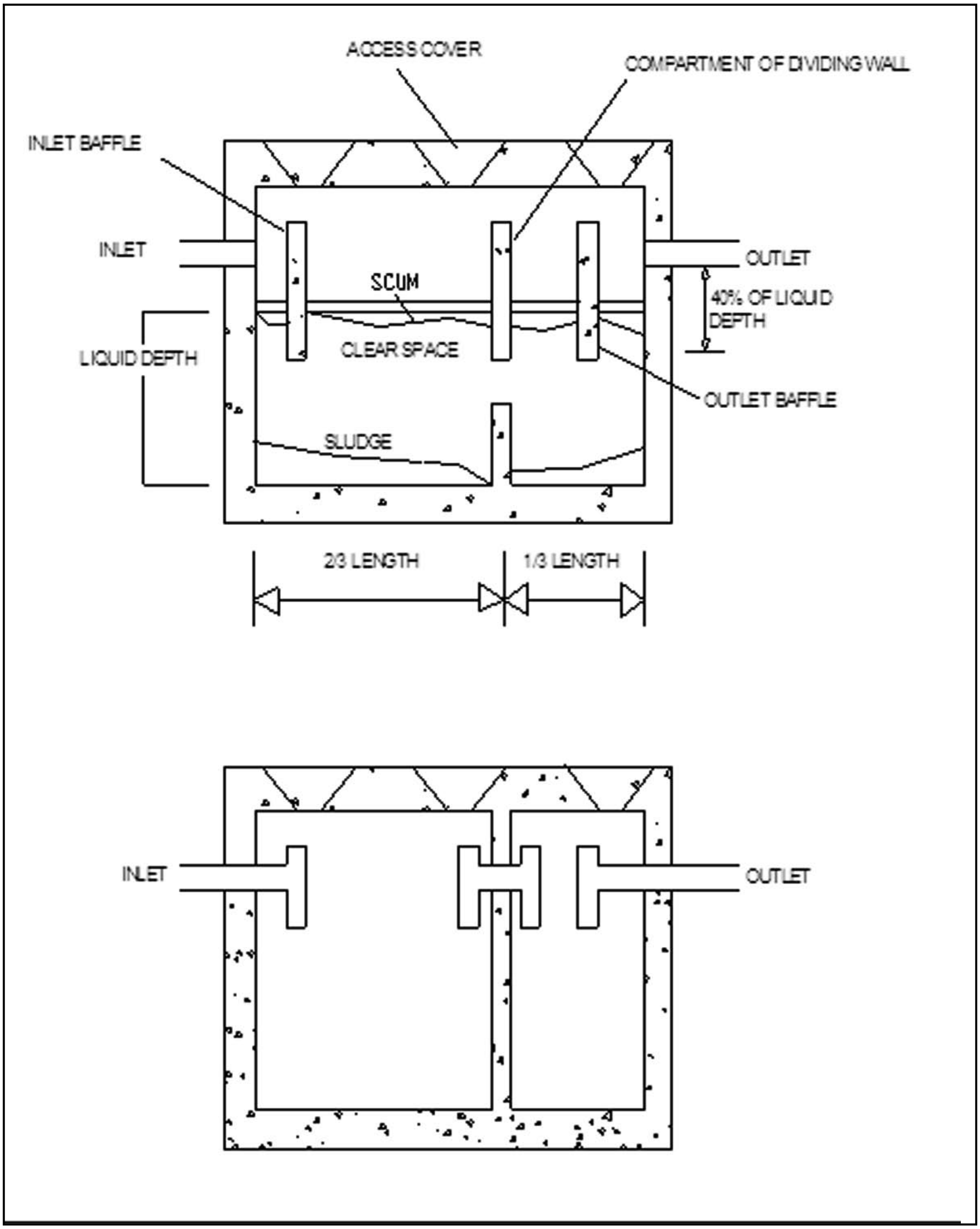
i No tank shall be located within 2.5 m (10 feet) of a building or site boundary.

ii Provision must be made for cesspool emptying vehicles to park within 3m of the tank.

iii The septic tank is to be located in compliance with **Table 7.** Distances from trees, swimming pools, sidewalks, driveways shall be such to prevent cave-in during construction.

iv The septic tank is to be installed at such depth that the top, or an approved access manhole to the tank, will be not more than 15 cm (6 inches) below the ground surface. The tank cover shall be adequately reinforced to support the load imposed. The pitch of the house sewer from the structure stubout to the tank should not exceed 20 mm per metre. Otherwise, an acceptable method such as drop manholes must be employed to assure a moderate entrance velocity of the raw sewage into the tank.

Figure 3. Typical Septic Tank



7.2 ABSORPTION PITS

An absorption pit is an excavated, boulder-lined pit, which receives liquid waste that percolates through the surrounding soil. This treatment method is not an acceptable treatment for raw wastewater. Absorption pits are acceptable to treat septic tank effluent or equivalent, if site conditions are appropriate. This method may also be used as final disposal after selected secondary or tertiary treatment technologies.

7.2.1 Acceptable Criteria

Areas that meet the following criteria may be acceptable for using this method:

i Low population density

ii Seasonal high water table exceeds 1.2 m from bottom of pit

iii Potable water well, surface water, open water supplies is greater than 30 m from proposed pit location.

iv Cesspool emptying truck shall have easy access to pit opening with three (3) metres.

v Limestone features, such as sink holes and faults are greater than 1.2 m. from proposed location of pit.

7.2.2 Design and Construction (Minimum Standards)

i Effective depth is taken from the invert of the incoming drain to the bottom of the excavation and should not be less than three (3) metres, measured from face to face of rubble stone lining.

ii The pit be of circular plan that is lined with properly packed 300 millimetres thick rubble stone tied with 200 millimetres concrete belt courses immediately beneath the incoming and at three (3) metres intervals on centre. The diameter at the bottom of the pit shall be greater than 2.4 metres.

iii The inside slope of the pit is no less than 1:6.

iv Absorption pits terminate at least 1.2 metre above the static groundwater level.

v The outlet from the septic tank be a minimum of 100 millimetres above the bottom of the distribution pipe.

vi Use of dynamite and jackhammer is prohibited in construction of absorption pits.

vii The pit shall be covered with a reinforced concrete slab 1'6" metric greater in diameter than the top of the excavation and finishing not less than 1'0" metric below associated ground levels

viii The slab be designed to support a minimum imposed load of 244 kg/m2 and no vehicles should be driven within 10 m of it except cesspool emptying trucks.

ix The minimum required capacity method is based on empirical data for absorption pits. It provides an estimate for the required capacity (Table 12).

Table 12. Minimum Required Capacity for Absorption Pits

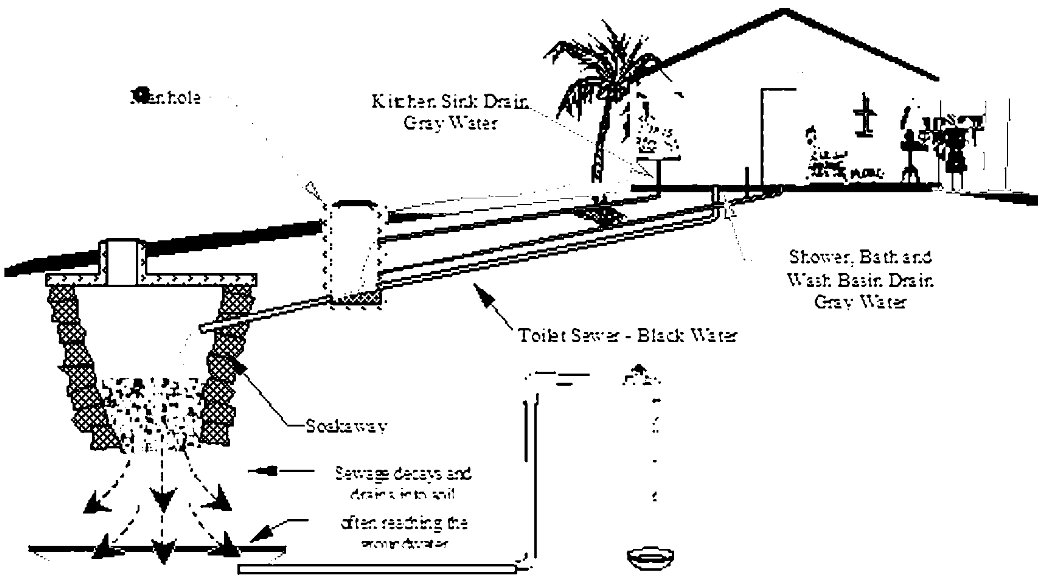
Number of Persons Served	Capacity (litres)	Capacity (U.S. gallons)
1-5	9,085	2,400
6-10	12,113	3,200
11-5	15,142	4,000
16-20	17,035	4,500

7.2.3 Location

i Minimum spacing between pits on the same contour must be three times the pit diameter (3.5 m minimum spacing).

ii Absorption pit be located greater than 1.5 m (5 feet) from building foundation. Other proximity requirements for pits are provided in Table 4.1

Figure 4. Absorption Pit (Gray 2001)



7.3 SOAK - AWAY PIT (SEEPAGE PIT)

A soak – away pit or leaching pit consists of one or more deep pits, filled with clean, coarse filter material. Pits should not be used where percolation tests shown an absorption rate of less than one inch per home. This system shall only receive (1) grey water from laundry, shower or sinks and (2) kitchen sinks that have passed through a grease trap. The wastewater seeps through the filter material and infiltrates through sidewalls into adjacent porous subsurface soil.

7.3.1 Design and Construction Minimum Standards

i The effective absorption areas shall be considered as the outside surface of the vertical sidewall area calculated below the inlet pipe, exclusive of any unsuitable soil or bedrock formations and the bottom area. The minimum effective sidewall absorption depth shall be 1.2 m (4 feet) of suitable soil formation.

ii The bottom of the pit shall terminate at least 1.2 m (4 feet) above the seasonal high ground water level in the disposal area.

iii The minimum diameter shall be 0.9 m (3 feet).

iv Seepage pits shall be filled with coarse stone that ranges from 20 – 300 mm (0.75 - 12 inches) in diameter and is free from fines, sand, clay or organic material. Linings of brick, stone, block or similar materials shall have a minimum thickness of 100 mm (4 inches) and shall be laid with overlapping, tight-butted joints. Below the inlet level, mortar shall be use in the horizontal joints only. Above the inlet, all joints shall be fully mortared.

v A structurally sound and otherwise suitable top shall be provided that will prevent entrance of surface water, dirt, or other foreign material, and be capable of supporting the overburden of earth and any reasonable load to which it is subjected. The top of the pit shall be covered with a minimum of 150 mm (6 inches) backfill.

vi Hollow disposal pits are prohibited.

vii Seepage pits shall be constructed in a manner in which will prevent or correct any smearing of the sidewall surface areas.

viii Breathers or inspection pipes may be placed in all seepage pits. The breather shall consist of perforated pipe placed vertically within the backfill of the pit. The pipe shall extend from the bottom of the pit to several inches (centimetres) above the ground level.

ix Proponents shall consider installation of multiple seepage pits. Minimum spacing between pits on the same contour shall be three times the pit diameter (3.5 m (12 ft) minimum spacing). Open joint or perforated distribution pipe shall run across each pit and then extend as a tight line pipe connecting pits in series. Minimum diameter of the distribution pipe shall be 50 mm (2 inches). A vertical perforated pipe at least 100 mm (4 inches) in diameter shall be placed within the backfill of the pit. The pipe shall extend from the distribution pipe to the bottom of the pit.

x Use of dynamite and jackhammer is prohibited in construction of percolation pits

7.3.2 Location

i A replacement area equivalent to 100% of the initial area shall be available for replacement seepage pit. This space shall not be used for permanent structures.

ii Proximity requirements for seepage pits are given in Table II-6.

iii Construction should not be permitted over percolation pits.

iv Vehicular traffic should not be permitted in the percolator pits area any time after its construction.

7.4 IMHOFF TANKS

An Imhoff tank operates similar to a conventional septic tank in the separation of settable and floatable solids and the decomposition of accumulated sludge. Unlike a conventional septic tank, the Imhoff tank has two chambers stacked vertically in which sedimentation occurs in the upper compartment and decomposition in the lower compartment (Figure 4.3) (Metcalf/Eddy 1029). The deflectors in the settling chamber prevents disturbance of this zone by gases produced in the sludge chamber and the sludge particles rising with these gasses. This therefore means a better clarified effluent than what can be achieved in a conventional septic tank.

Imhoff tanks may be substituted for a conventional septic tank and shall be constructed to conventional septic tank minimum standards provided care should be exercised in locating inch off tanks because of the possibility of odour nuisance.

7.4.1 Design and Construction Minimum Standards.

i Overflow rates should not exceed 24.4 cm3/m2 (600 US gallons/ft2) at the average flow rate, with detention of no less than three (3) hours.

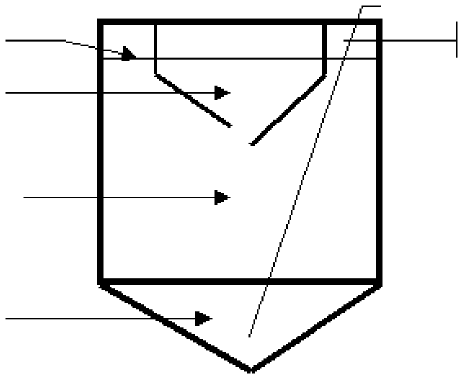
ii A deflector shall be installed at the base of the sedimentation chamber to prevent entrance of gases.

iii A gas vent shall be installed at 30 percent of the sludge compartment area.

iv Invert inlet shall be a minimum of 300 millimetres (12 inches) to water line.

v A sludge withdrawal pipe shall be installed to remove accumulated sludge from the sedimentation chamber.

Figure 5. Imhoff Tank



CHAPTER 8

DRY EXCRETA MANAGEMENT SYSTEMS

8.0 DRY EXCRETA SYSTEMS

Dry excreta disposal systems are waterless toilet systems used when

- i potable water is not accessible or limited
- ii dry seepage pits are not environmentally acceptable or
- iii in urban areas where land is scarce.

Pits constructed per absorption pit recommendations for dry excreta disposal are acceptable in areas where leachate does not cause any pollution to water sources and do not impose a threat to human health.

When leachate or odour is a concern 'improved' pit designs may be employed:

- i Ventilated Improved Pit Latrine and
- ii Ventilated Improved Double Pit Latrine. Other systems may be installed upon approval from relevant government agencies

8.1 VENTILATED IMPROVED DOUBLE PIT LATRINE (VIDP) AND VENTILATED IMPROVED PIT (VIP)

Although it is usually best to provide large deep pits, this may not be possible where rock or groundwater lies within one or two metres of the ground surface. VIP and VIDP systems are pit latrines with one or two watertight tanks (Figure 6). These dry latrines are designed to receive faecal matter, urine and small amounts of water. To reduce odour, these improved pit latrines have a vent pipe extending from the tank to a minimum of 45 cm above the superstructure. In an effort to discourage mosquito breeding, the superstructure is kept partially dark at all times, a cover is installed on the latrine seat and the vent pipe has a fly screen secured to the top.

The VIDP is a variation of the VIP latrine whereby it has two shallow pits side by side under a single superstructure. The pits are usually lined with bricks or blocks. The hole for the ventilation pipe for the pit not in use is sealed. Each pit may have its own squat hole or seat. Alternatively, slabs may be moveable, one with a hole for the pit in use and a plain slab for the other pit. Whichever design is used, only one hole must be available for defecation at any time. The latrine may be provided with two ventilation pipes (one for each pit) but more usually only one is fitted, to the pit in use.

Each tank or vault shall have a volume sized to handle excreta generated by the household(s) using the latrine over a period of 2 – 3 years. After 2 years of use, the waste should be allowed to **compost undisturbed**, for another 2 years before it is removed. During this time of composting, the second hole will be used. The latrine may be provided with two ventilation pipes (one for each pit) but usually only one is fitted to the pit in use.

Figure 6. Ventilated Improved Pit Latrine (VIP)

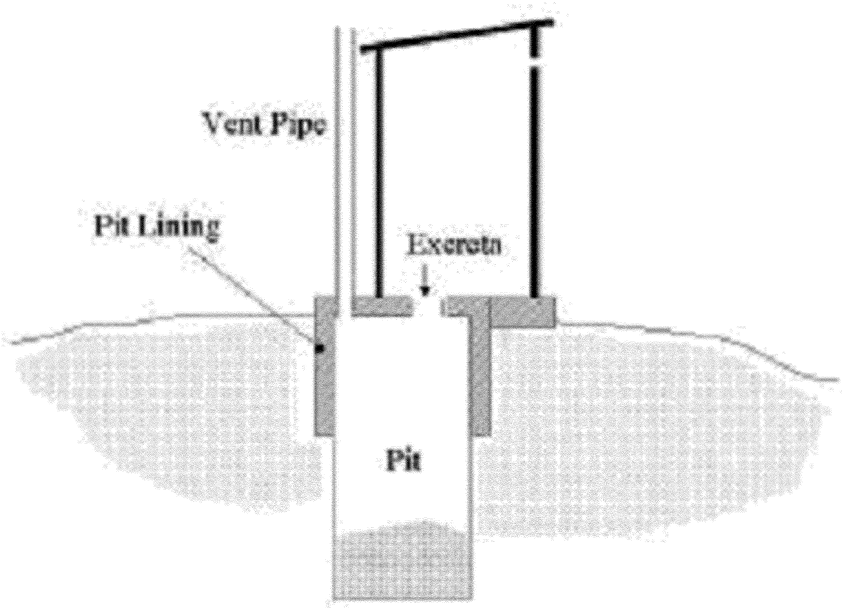
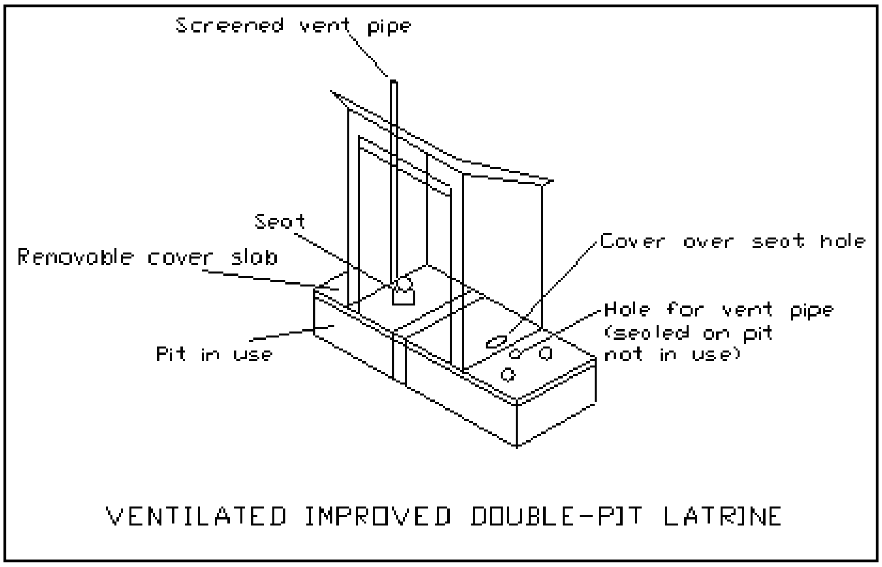


Figure 7. Ventilated Improved Double Pit Latrine



The waste is stored until pathogen reduction has occurred and metals concentration and other regulated parameters are sufficiently low. If waste is to be used, for example, application, to soil permission is required from the Local Planning Authorities.

8.1.1 Design and Construction - Minimum Standards

i The tanks shall be constructed of structurally sound, watertight and constructed with corrosion and decay resistant material, such as concrete, vitrified clay block, fibreglass, heavy-weight concrete block, ferrocement or burned hard brick. Another alternative is heavyweight plastic tanks.

ii In no case shall the volume be less than 1 m3 (35 ft3).

iii A ventilation pipe shall extend from a minimum of 15 cm (6 inches) into the tank(s). The pipe shall be no less than 10 cm (4 inches) in diameter.

iv A fly screen shall be securely installed at the pipe end that extends above the superstructure. The mesh aperture must not be larger than 1.2mm x 1.5 mm.

v The superstructure shall be designed to limit the amount of light entering the building. The minimum size of ventilation openings into the superstructure should be at least three times the cross-sectional area of the vent pipe.

v Each tank shall have an access to port to easily remove stabilized excreta.

8.1.2 Location

i Improved pit latrines shall be a minimum of 15 m (50 feet) from potable water sources, 30 m (100 feet) from kitchens and 15 – 45 m (50 – 150 feet) from building foundations.

ii The base of the pit shall be a minimum of 1.2 metres (4 feet) above the limiting zone or the seasonal high water table.

iii Construction of latrines is not allowed in flood prone areas.

8.2 Absorption Pit – Dry Excreta Disposal

This system uses a pit, as per absorption pit construction standards. Since the system is waterless, no septic tank shall be installed prior to the pit, instead the seat shall be installed directly over the pit. The proponent shall follow the absorption pit requirements for the cap.

The absorption pit system shall be used as a waterless toilet in limited circumstances.

8.3 Biolatrine

The technology on Biolatrine has been in existence for a long time and is still being exercised at different levels in many parts of the world. Biolatrine also referred to as 'Sanitary Units' were introduced in Tanzania as a further step in biogas technology exploitation and in order to contribute to the efforts against the growing problems of rural sanitation.

8.3.1 Characteristics

Biolatrines are relatively small units deployed at family or institutional level and are connected directly to biodigesters. These, fulfilling the purpose of normal septic tanks, bear the following additional characteristics:

i They do not require water; urine is sufficient as a softening agent;

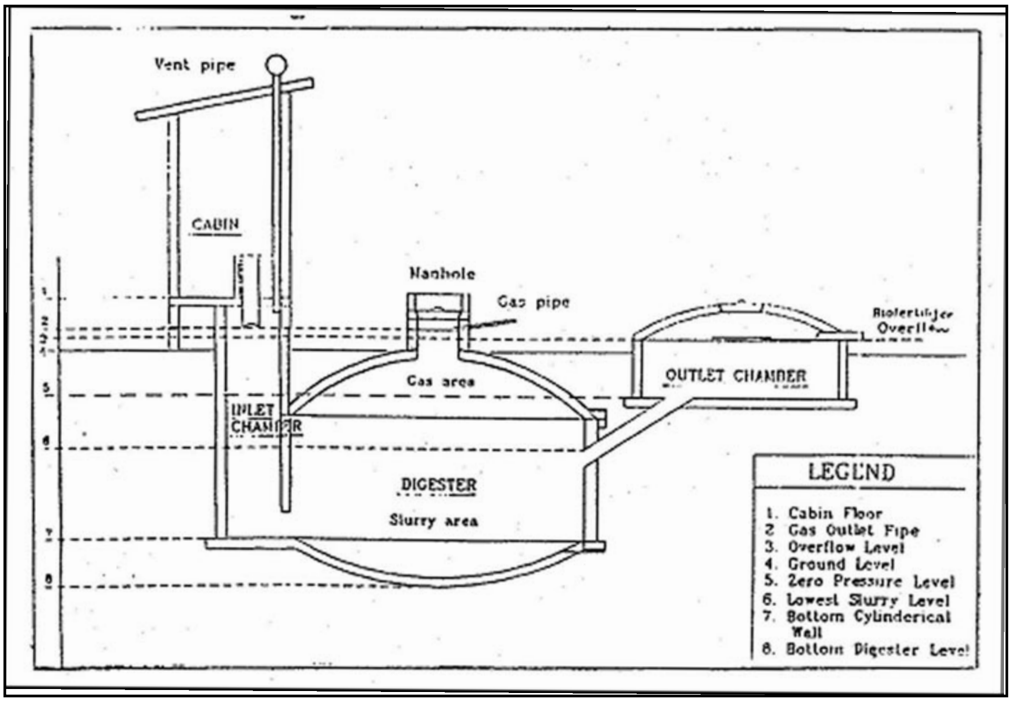
ii They are directly connected to the latrine, so avoiding an additional infrastructural transfer mechanism between the source of wastes and biodigester positions

iii The process of digestion is anaerobic; therefore biogas and digested slurry are the main products. While biogas is used for energy purposes, slurry is applied on soils to improve fertility;

iv They are cheap in relation to other methods of wastewater treatment **(Fig. 7)**.

Rural communities, including Institutions such as schools, clinics, etc., have the option of using pit latrines. These latrines cannot be emptied due to a lack of suction mechanisms and they therefore have to be abandoned once they are full and new ones dug.

Figure 8 Sanitary Biolatrine Unit. Source SRC



8.3.2 Design and Construction - Minimum Standards

i An average of 120 days retention time should be used in sizing the system. This allows for unpredictable feed additions.

ii A method for expelling or utilizing the biogas produced from the tank shall be considered in the design.

8.3.3 Location

Normally, the positioning of such latrines in many cases is due to limitations such as the proximity of latrines to be reached during the hours of night, requiring latrines to be close to sleeping places. In addition, other existent permanent or semi-permanent infrastructure (buildings, roads, etc.) determine the location of latrines.

CHAPTER 9

TEMPORARY DISPOSAL SYSTEMS

9.0 TEMPORARY TOILET FACILITIES

Temporary toilet facilities are often required when

(i) large gathering of persons exceeds normal capacity of existing facilities or

(ii) prior to construction of a permanent sanitation facility.

To accommodate these conditions or other similar circumstances temporary disposal systems may be installed. Prior to installation, the proponent must contact the local health department to register the event and obtain any necessary permits.

Proper maintenance including servicing and cleaning schedules is essential to the proper operation of temporary systems. The holding capacity and number of toilets shall be sufficient for the number of attendees/users to allow a realistic maintenance schedule.

Use of temporary facilities requires approval from the Local Health Department prior to locating/siting.

9.1 HOLDING TANK

A holding tank shall be permitted only as an interim to the construction of a public sewer; as an overflow facility or as a means of sewage disposal for limited, minor or temporary applications. If a holding tank will be used as a permanent treatment component, the proponent will require special approval by EHU with arrangements through a licensed cesspool emptier. Prior to installing the holding tank, the proponent must submit a copy of a Memorandum of Understanding with a seepage contractor with a detailed description of emptying schedule, including primary and alternative disposal sites.

Holding tanks installed as permanent systems must have a septic tank installed prior to the holding tank. For these systems, the proponent shall consider separation of grey and black waters. The grey water may be treated if site conditions permit.

9.1.1 Design and Construction - Minimum Standards

i The tanks shall be constructed of structurally sound, watertight and corrosion/decay resistant material. Acceptable material includes concrete, vitrified clay block, fibreglass, heavy-weight concrete block, burned hard brick or steel

ii The opening required for emptying the contents must be easily accessible for (1) cesspool emptying equipment and (2) inspection.

iii Adequate provision shall be made for cesspool emptying vehicles to park within three (3) metres (10 feet) of holding tank.

9.2 CHEMICAL TOILETS

Chemical toilets are waterless temporary toilet facilities that are prefabricated with a seat and excreta holding chamber. A caustic solution is maintained in the chamber to deodorize, disinfect and liquefy excreta for easy disposal. This system shall be installed for temporary use at mass gatherings, construction sites or other temporary establishments.

9.2.1 Design and Construction Minimum Standards

i The portable chemical toilet systems shall have proper ventilation, chemical solution, seat and door lock.

ii One seat shall be provided for every 25 women and one seat and one urinal shall be provided for every 35 persons. When these numbers conflict, use the greater value.

iii There should be one hand-washing unit for every 10 persons.

iv Waste removal of these systems shall be completed when the holding chamber is equal to or less than two-thirds full.

v The chemical solution shall be one (1) of the following:

- Four (4) kg lye (potassium hydroxide) per m3 of vault capacity.
- Ten (10) kg caustic soda or potash (sodium hydroxide) per seat in 50 Litres of water.
- One (1) kg chlorinated lime in 21 litres water or
- One (1) kg copper sulphate in 21 litres water

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CHAPTER 10

ON-SITE SECONDARY TREATMENT (INCLUDING SOIL ABSORPTIVE TECHNOLOGIES

10.0 BIODIGESTER SEPTIC TANK

A Biodigester Septic Tank (BST) is an on site sanitation unit which utilizes the anaerobic technology to treat sewage and other wastewater. The by-products of this process are biogas (a mixture of methane, carbon dioxide and trace amounts of other gases such as hydrogen sulphide) and a liquid effluent containing nutrients. Hence the BST is usually followed by a nutrient removal technology such as an evapotranspiration bed, wetland, pond or tile field. The follow-up technology is usually determined firstly by the environmental sensitivity of the disposal area and secondly by the available space and layout of the property.

The treatment of wastewater inside the BST is by anaerobic digestion. It is done by putrefactive bacteria, which break down the organic matter under airless conditions. The digestion process consists of two main phases acid forming and methane forming. In the first phase, complex organic matter is broken down into simpler forms while biogas is formed in the second phase. The composition of biogas is usually methane (CH4, 60 – 70 %), carbon dioxide (CO2, 20 – 40%), hydrogen sulphide (H2S, 0.5 – 1%) and other gases. The biogas can be piped to consumption point such as a modified gas stove, water heater, modified gas refrigerator, gas lamp, generator or diesel engine.

10.0.1 Advantages of Biodigester

The BST has many advantages over the traditional septic tank. These are as follows:

i Better treatment of sewage due to the longer retention time inside the BST (6 days) and the piping system, which passes the incoming wastewater through the sludge bed.

ii Lower maintenance cost due to infrequency of sludge removal. The BST is an anaerobic reactor within which most of the organic solids becomes liquefied and hence no need for sludge withdrawal even after several years.

iii The system pays for itself since a useable gas is produced from waste that would otherwise have no economic benefit. The larger the system the shorter the pay back period.

iv A second inlet to the BST can be attached to receive organic waste from the kitchen and garden. This will increase gas production and shorten the pay back period.

10.0.2 Design and Construction Minimum Standards.

i The biodigester septic tank should be designed with a minimum detention time of six (6) days.

ii The dome should always be coated to safeguard against leaks.

iii A method for expelling or utilizing the biogas produced from the tank shall be considered in the design.

iv The minimum height between the invert of the terminal manhole and the top of the dome shall be 20 cm.

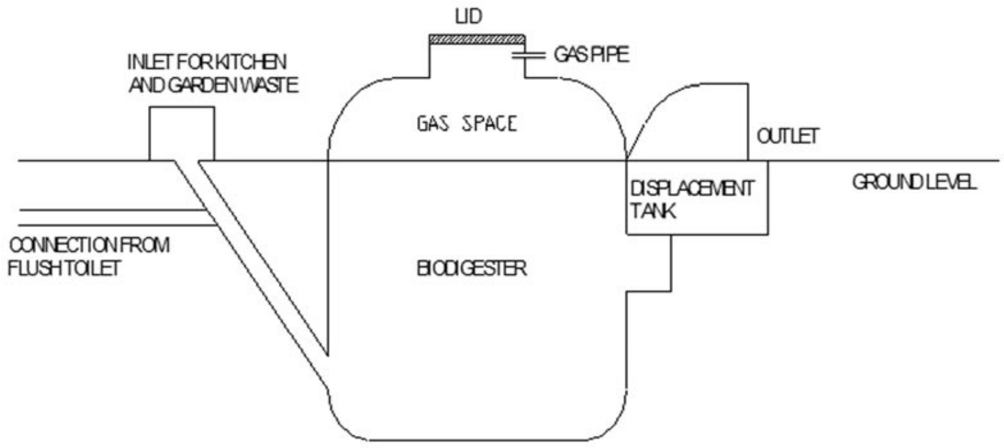
v A BST installed under a driveway or parking area shall have adequate reinforcement to support any anticipated load and access manholes brought up to grade.

10.0.3 Location

i No tank shall be located within 1.5m or 5ft of a building or site boundary.

ii Setback distances are similar as those outlined for the septic tank. Distances from trees, swimming pools, sidewalks, driveways, etc., shall be such to prevent cave-ins during construction.

Figure 9. Schematic of Biodigester Septic Tank

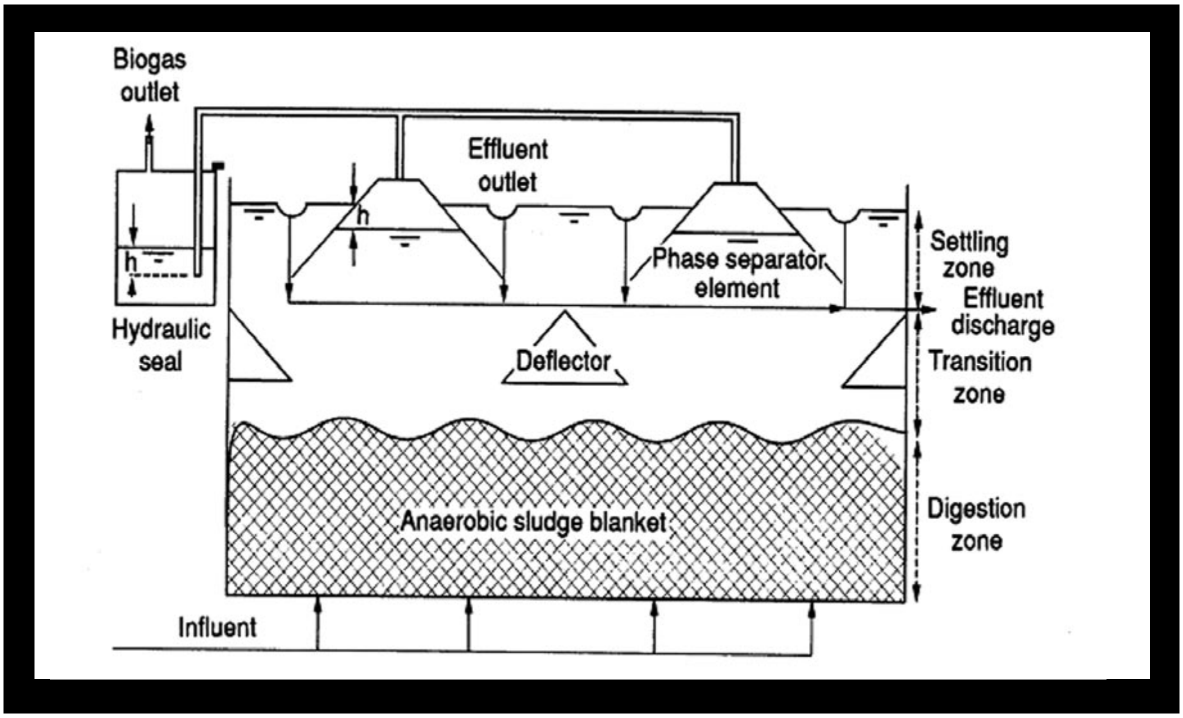


10.1 UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR

The Upflow Anaerobic Sludge Blanket Reactor (UASB) is an anaerobic contact process that requires little to no energy in treating wastewater. Untreated waste or septic tank effluent enters at the base of the reactor and passes through the sludge blanket. Methane (CH4) and carbon dioxide (CO2) are produced when the raw sewage reacts with the sludge blanket. These gases create a natural internal circulation, which helps maintain the sludge granules in suspension. The free gas and attached gas that rise to the surface strike a degassing baffle, which causes the attached gas to be released and escape through the top of the reactor to the gas collector (Metcalf/Eddy p428). Solids settle into the sludge blanket, while clarified effluent leaves the system through an upper baffle or equivalent.

An UASB reactor typically requires a subsurface wetland or other nutrient removal technology prior to final disposal. The reactor may be substituted for a Biodigester Septic Tank (BST). The retention time of 6 to 12 hours, as compared to the BST having 6 days, means that the UASB has a smaller footprint. This type of treatment system is usually for larger developments and requires more operation and maintenance than the BST

Figure 10. Schematic of an Upflow Anaerobic Sludge Blanket Reactor



10.1.1 Design and Construction Minimum Standards.

i To maintain the sludge blanket in suspension, the upflow minimum velocity of the raw sewage should range from 0.6 to 0.9

metres/hour.

ii Pre-treatment of the sewage is important. Screens and grit chambers must be installed to remove inorganic material before the sewage enters the sludge bed.

iii A method for expelling or utilizing the gas produced from the tank should be considered in the design.

iv The reactor height should be no less than 3.5 m.

10.1.2 Location

i The treatment plant and all its components should be at least 20 ft from the nearest property boundary.

ii Adequate access way should be provided for service vehicles.

10.2 AERATED SEPTIC TANK

Aeration may be introduced into a septic tank if the organic loading rate is greater than the capacity of a conventional septic system. The introduction of aeration in the first chamber promotes the growth of aerobic micro-organisms, which convert and remove biodegradable organic matter. In turn, the reduced organic and suspended solids content in the effluent may reduce the required subsurface disposal system. Maintenance of this system is greater than the conventional septic tank because of a higher production of sludge and the use of blowers or pumps to provide aeration. These systems are typically appropriate for small hotels, schools, apartment complexes, and very large residences with many occupants.

10.2.1 Design and Construction Minimum Standards.

i Aerated septic tanks may be substituted for a conventional septic tank. **The minimum standards outlined for septic tanks apply.**

ii A chamber after the aeration chamber shall be constructed to clarify the wastewater.

iii Pumps or blowers installed to provide aeration, should be provided with spares either as installed standby spares or as boxed spares located on-site.

10.2.2 Location

i No tank shall be located within 5'-0" of a building or site boundary.

ii Setback distances are similar as those outlined for the septic tank. Distances from trees, swimming pools, sidewalks, driveways, etc., shall be such to prevent cave-inin during construction.

10.3 ABSORPTION TRENCH (TILE FIELD)

An absorption trench system is a series of perforated pipes placed in narrow trenches. This technology utilizes the natural biological composition of soil to treat effluent from septic tanks or its equivalent. Beyond a secondary treatment technology, tile fields may be used as a final disposal of effluent from tertiary treatment systems.

The trench system consists of:

i feed line,
ii an absorption area,
iii a distribution network,
iv a cap, and
v top soil.

The septic tank effluent is pumped or gravity-fed into the absorption area through a series of perforated pipes located in the upper part of the coarse aggregate. The wastewater passes through the aggregate and infiltrates the trenches. Treatment of the wastewater occurs as it passes through the trenches and the unsaturated zone of the natural soil. The cap, usually a finer textured material than the fill, sheds precipitation, and retains moisture for a good vegetative cover. The topsoil provides a growth medium for the vegetation.

The sizing of tile fields for treatment of settled wastewater (after treatment in a septic tank) can be determined based on soil percolation rates.

10.3.1 Design and Construction Minimum Standards

i A watertight line shall connect the septic tank, diversion valve if used and the disposal trenches.

ii Distribution pipe shall run the length of each trench and connect each trench in series.

- Distribution pipe for gravity flow absorption systems shall be 100 mm-perforated PVC pipe.

- Distribution pipe for gravity-flow absorption systems shall be in straight lengths and have a minimum of two rows of round holes; each 6 – 13 mm diameter and located at approximately 150 mm intervals. The perforations shall be placed as to permit equal drainage along the length of the pipe and open ends of pipes shall be capped.

- In gravity-flow absorption systems with multiple distribution lines, the sewer pipe from the septic tank shall not be in direct line with any one of the distribution lines, except where drop boxes or distribution boxes are used.

- Any section of distribution pipe laid with non-perforated pipe, shall not be considered in determining the required absorption area.

- Breathers shall be placed at all ends of absorption trenches. The breather shall consist of perforated pipe at least 100 mm in diameter, placed vertically within the backfill of the trench.

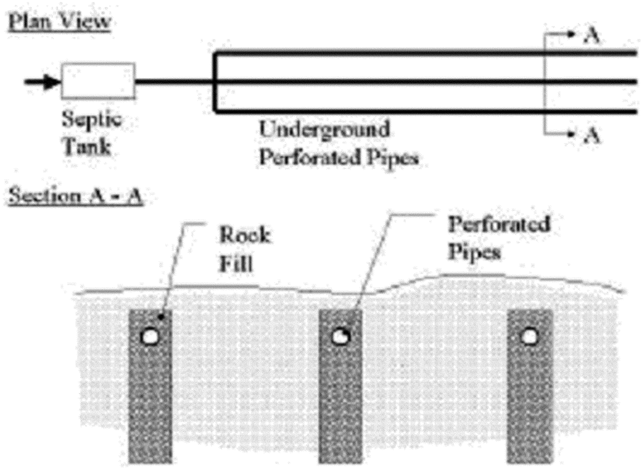
10.3.2 Trench Design

Disposal trenches shall be a minimum of 300 mm wide. Bottom of the trench shall be a minimum of 1.0 metre above static groundwater level. Each trench shall be not more than 30 m in length.

Loading rate shall be 61 l/m2/day if no percolation test was been done. (U.S. Manual of Septic Tank Practice, 1967). See Appendix 2.

Undisturbed material should be left between trenches.

Figure 11 Layout of a typical tile field



Each trench shall have parallel contour lines. Minimum spacing between trenches on the same contour shall be two times the total trench depth. Trenches not on the same contour shall be spaced as follows (Table 13):

Table 13. Trench Spacing

Slope of Ground Between Trenches	Minimum spacing Between Trenches
0% to 5%	2.0 times the total trench depth
5% to 10%	2.5 times the total trench depth
10% to 20%	3.0 times the total trench depth
Over 20%	4.0 times the total trench depth

10.3.3 Trench Construction

i Trenches shall be constructed perpendicular to groundwater flow when such knowledge exists.

ii Backfill shall be at least 300 mm of native soil over a protective layer of untreated building paper or other pervious material, such as a synthetic filter fabric to prevent infiltration of backfill into the filter material. Soil placed over trenches shall be compacted so that depressions will not occur.

iii Rock gravel fill shall extend from the bottom of the trench to 100 mm above the distribution pipe. Rock or gravel fill shall be clean and of uniform size, preferably 19 mm to 50 mm in diameter.

iv Absorption system excavations may be made by machinery provided that the soil in the bottom and sides of the excavation is not compacted. Strict attention shall be given to the protection of the natural absorption properties of the soil. Absorption system shall not be excavated when the soil is wet enough to smear or compact easily. Some smearing damage is likely to occur. All smeared or compacted surfaces should be raked to a depth of 25 mm, and loose material removed before the filter material is placed in the absorption area.

v Use of dynamite or jackhammer is prohibited in construction of disposal trenches.

vi Absorption areas shall not be constructed under paved or other imperious areas.

vii Both distribution pipe and trench bottom shall be approximately level. Use of Vshaped trenches is prohibited, except where soil conditions make construction of vertical wall impossible.

10.3.4 Location

i If possible, a tile field replacement area equivalent to 100% of the initial area shall be available for replacement of tile field. This space shall not be used for permanent structures.

ii No tank shall be located within 6 m of a building foundation or 3m to the property line.

iii Tile field should not be placed below the road surface.

10.4 CHAMBERED TRENCH SYSTEMS

A chambered trench system is a type of absorption trench system whereby the media is a dome, open-bottom chamber structure of an approved material and design. The open bottom permits infiltration of septic tank effluent into native or fill soils. The chamber provides allowance for peak flows. This system may substitute for the absorption trench systems.

Chamber Trench Systems shall follow design and construction minimum standards as conventional trench systems except where stated.

10.4.1 Design and Construction Minimum Standards

i Access ports shall be constructed to investigate chambers.

ii Chambers shall be placed over native soil or fill that meets percolation rate requirements. No allowance will be permitted for chambers to be placed over gravel or impermeable soils.

iii System installation shall follow manufacturer's instructions.

iv Chamber systems shall be considered experimental treatment methods.

10.5 MOUND TRENCH/BED DISPOSAL SYSTEMS

Typical subsurface absorption systems, including tile fields, are not acceptable methods of disposing of septic tank effluent when an impervious soil layer or groundwater is less than 1.2 m from surface. An alternative system is the mound or raised trench system, which is an absorption bed or trench system elevated above the natural soil surface in a suitable fill material.

Mound Systems shall be constructed to the satisfaction of the absorption trench (tile field) disposal system, unless stated.

Mound trench systems shall be considered if:

i The natural soil is of slow permeability with percolation rates exceeding 472 min/100 mm

ii The natural soil lay is highly permeable and shallow (less than 0.9 metres) over an impervious layer with percolation rates less than 7.9 min/100 mm or

iii The natural soil is highly permeable with the seasonal groundwater of less than 0.6 metres from surface.

Mound trench systems shall not be considered if:

i The soil in the area consists of fill. The natural soil layer has been compacted,

ii The proposed location is above a failing conventional system, or

iii The area does not have the minimum depths of soil specified.

(Referencing 902.2 of the 2003 International Private Sewage Disposal Code)

10.5.1 Design and Construction Minimum Standards

i Sufficient area at the native and fill interface shall be sufficient to permit proper drainage of wastewater away from the mound.

ii Mounds must be long and narrow and placed along topographic contours of the site.

Figure12 .Cross section of a mound system

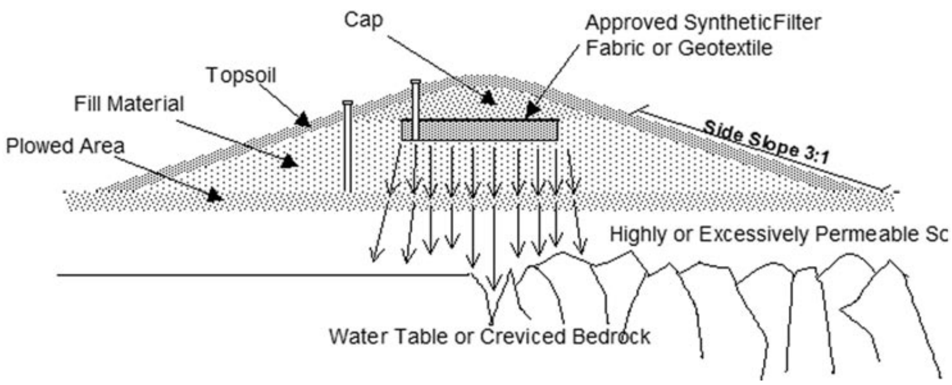
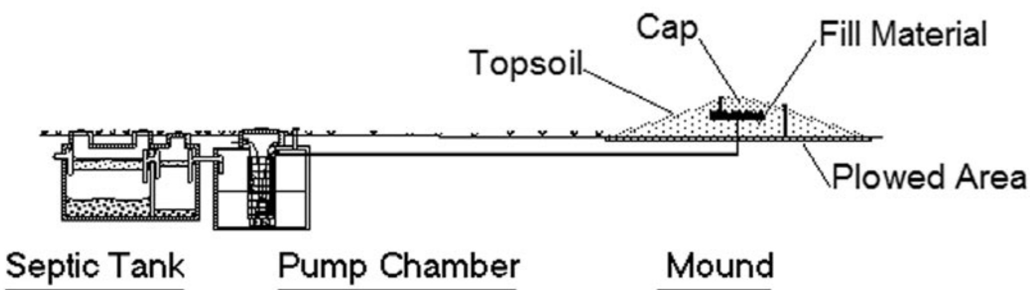


Figure 13. Cross Section of a Septic Tank Mound System



10.6 INTERMITTENT SAND FILTER SYSTEM

Sand filter systems are another alternative technology to the tile field system. This technology is typically used in areas where the soil is not suitable for effectively treating septic tank effluent or the seasonal groundwater level is less than 1.2 metres from the surface.

Intermittent sand filters are typically shallow beds with 600 – 760 mm of sand with surface distribution and bottom under-drain systems. These systems are dosed intermittently during the day with septic tank effluent or equivalent Effluent collected in the under-drain may be (1) directly disposed to a disposal field or (2) surface water source or dry gully following disinfection. The required level of treatment in the area determines the final disposal method.

Intermittent sand filters may be designed to provide free access (open filters) or may be buried in the ground (buried filters). Both open and buried systems designed to recirculate effluent through the system is discussed in the next section.

10.6.1 Design and Construction Minimum Standards

i Buried filters shall be structurally sound, watertight and constructed of materials resistant to corrosion or decay, such as concrete, vitrified clay, block, fibreglass, heavy weight concrete block, burned hard brick or heavy-duty plastic.

ii Open filters shall be constructed completely above ground or within the natural soil.

iii Sand filters shall be covered with a suitable material that will to reduce odour conditions, to avoid encroachment of weeds and infiltration of precipitation but will encourage air flow to the filter, such as non-compacted, mounded soil.

iv Filter beds shall be dousing twelve to twenty-four (12 - 24) times per day. The dousing system shall be designed to flood the entire filter during each cycle.

v Filter media shall be coarse sand (with an effective size ranging from 0.25-1.00 mm) or any washed durable granular material that is low in organic material. Filter media should be compacted after it is put in place. Care shall be taken to insure that media does not stratify with fine layer over coarse. Filter media should be in a 0.6-0.9 m deep bed. The area of the bed should be 1.5 m2/person (using the system) or 0.35 l/m2/day, whichever gives a larger area.

vi Distribution and under drain lines shall be constructed of an acceptable material with a minimum diameter of 100 mm. If continuous pipeline is used, conventional perforated pipe with 6-13 mm diameter holes placed approximately 150 mm apart is appropriate. The perforations shall be placed as to permit equal drainage along the length of the pipe and open ends of pipes shall be capped. All pipelines shall be vented with vertical risers to the ground surface. Distribution lines shall be vented downstream and under drains vented upstream. The network shall be a drip network.

vii Distribution lines shall be level and spaced at minimum 900 mm on centre. Approximately 250 mm of graded gravel 20 – 60 mm shall be used for pipeline bedding.

viii Under drain lines shall be laid directly on the filter floor, which should be slightly pitched to carry filter effluent to the drain line. Pipelines shall be provided for each 3.5 metres of trench width. The bedding material for under drain lines shall have a minimum of 250 mm washed graded gravel or stone with sizes ranging from 6 – 13 mm. The gravel or stone shall be overlain with a minimum of 60 mm of washed pea gravel interfacing the filter media.

ix The dousing tank should be equal in volume to the daily design flow.

CHAPTER 11

ON-SITE TERTIARY TREATMENT SYSTEMS

11.0 CONSTRUCTED WETLANDS

The use of wetland systems in the treatment of onsite wastewater disposal is commonly used at schools, commercial entities and rural residences. Typically, subsurface flow systems are used instead of free surface flow wetland systems in an effort to avoid developing mosquito-breeding areas. A subsurface flow wetland system provides treatment via a filter media within an aerobic root zone. The filter media is a gravel bed that is not directly exposed to the atmosphere. If designed properly, wetland systems will reduce biological oxygen demand, total suspended solids and some nutrients.

Free surface flow wetland systems are typically not recommended for small onsite treatment systems.

11.0.1 Design and Construction Minimum Standards

i Filter media – Filter media shall be of gravel, washed clean, rounded and resistant to crushing or breakage. The media size in the treatment zone shall be 20 – 30 mm, with the top 10 cm of 5-20 mm. Inlet and outlet zone areas shall have media of larger size, 40 – 80 mm to prevent washouts.

ii Vegetation shall have sufficient root zone and be an acceptable species for the climate and wetland conditions. Multiple types of native plants with varying root lengths are preferable.

iii Suspended solids shall be removed via septic tank or comparable pre-treatment technology to prevent clogging. Further pre-treatment may be required.

iv The depth of active filter media shall be 0.5 to 0.6 metres.

v The in pore hydraulic retention time shall be no less than three (3) days.

vi Recommended surface loading rate for wetlands shall be approximately 1.6 gal/m2d.

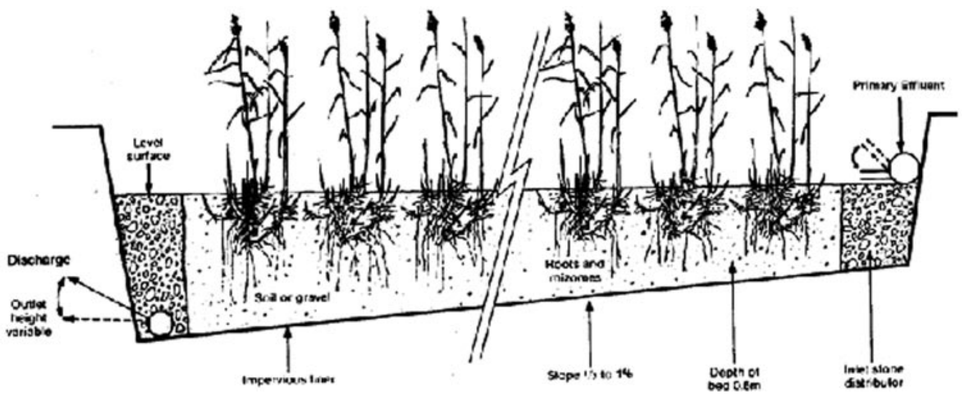
vii The bottom slope shall be 0.5 – 1.0 percent, while the top slope shall be approximately zero (0) percent.

viii The aspect ratio (L:W) is not usually a factor that has a great deal to do with the effectiveness of treatment. A suggested aspect ratio is approximately 2:1.

ix Constructed wetlands shall be lined with clay or a synthetic, impermeable liner.

Effluent shall be disposed in a manner that is sufficient for treatment requirements. Typical disposal methods include disinfection, followed by direct disposal to gully or further treatment via sub-surface absorption system.

Figure 14 Cross Section of a Subsurface Flow Constructed Wetland (Cooper, 1993)



11.1 EVAPOTRANSPIRATION SYSTEM

Evapotranspiration systems are similar to a constructed subsurface flow wetland, except the system is designed to have no effluent. Influent wastewater is disposed via transpiration through vegetation or evaporation from bed surface. These systems shall only be employed if all other technologies are deficient. Typically, evapotranspiration systems are installed in areas with (1) shallow groundwater or (2) groundwater is already compromised by wastewater contamination.

This system shall only be installed in areas were evapotranspiration exceeds precipitation. Systems may be considered in areas where a single month precipitation exceeds evapotranspiration, if sufficient storage is designed within the bed.

Some areas may support an evapotranspiration system with an absorption technology following. This system allows for a smaller required ET area. This system may not be acceptable in all areas.

Distribution and under-drain lines shall be installed as stated for intermittent sand filters, unless where stated.

11.1.1 Design and construction Minimum Standards.

i The loading rate shall be 10.7 l/m2/day.

ii An artificial liner is required between the evapotranspiration bed and natural soil if percolation of natural soil is less than 5 minutes / 25 mm or if no percolation test has been done.

iii Filter media shall be of clean sand with sufficient capillary rise capabilities. A 50mm topsoil cap shall be placed on top of sand filter medial. If required, a storage area may be constructed below the distribution pipes. This area shall be a clean rock media with a maximum depth of 300 mm.

iv The pit shall be 0.7 m deep with 20 cm of gravel as bottom layer with perforated distribution pipes running through. The gravel should be overlain with a layer of building felt with 0.5 m of sand above.

v ETB shall have a monitoring well in a corner.

vi Sand wicks may be incorporated in the gravel to provide continuous capillary rise in sand.

vii Influent to ET system shall be effluent from septic tank or comparable pre-treatment technology. The influent shall have limited suspended solids to prevent premature clogging of system.

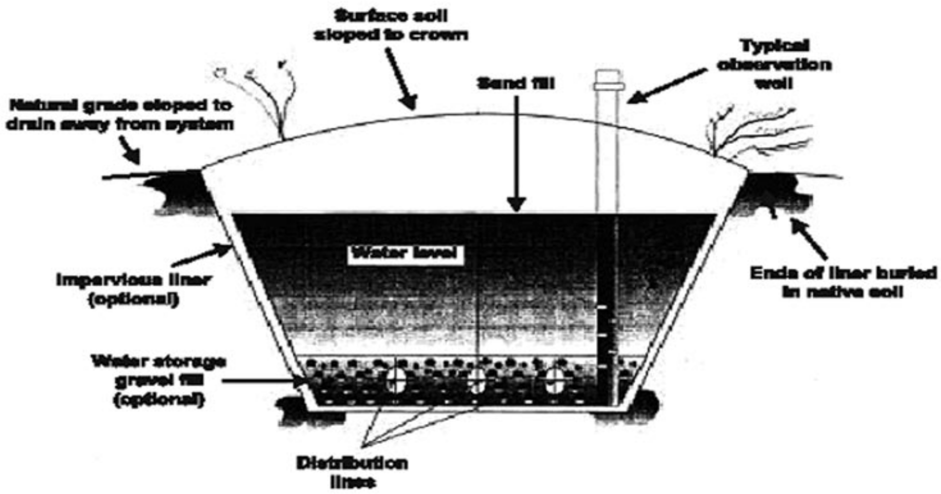
viii Employ low-flow devices or grey water to soak-away pit to reduce size of ET bed.

ix Top of ETB shall have a slope sufficient to prevent infiltration of precipitation. Interior sides of ETB below ground level shall have a slope of 1:1.

x Vegetation shall be similar to wetland flora. The vegetation shall have a deep root zone and leaves shall support proper transpiration.

xi Systems may be approved for an allowance of a given percentage of effluent. This will reduce the required bed size. Typically, effluent is treated via seepage pit or other sub-surface absorption system.

Figure 15. Cross section of an Evapotranspiration Bed



CHAPTER 12

AUXILIARY EQUIPMENT

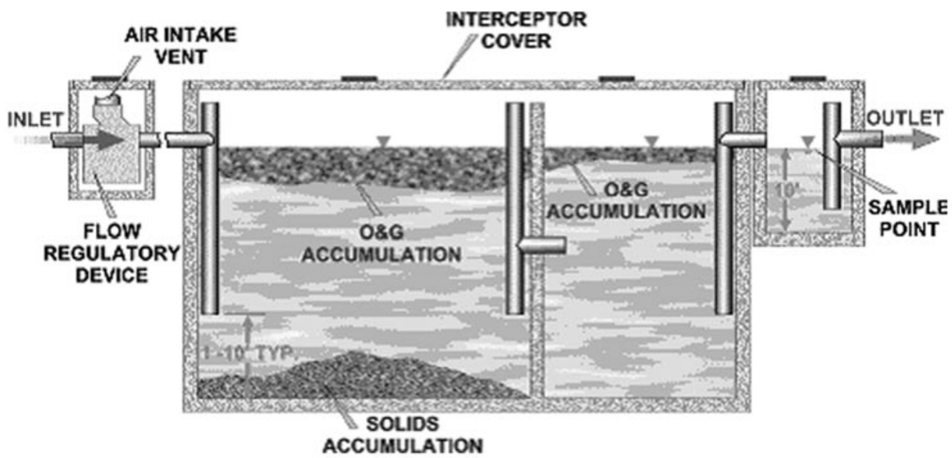
12.0 GREASE AND SEPTAGE HANDLING

Auxiliary equipment for central sewerage system including pumps, lift stations, wet wells, manholes, cleanouts, sewer pipeline and other appurtenances are not discussed within this manual. Proponents employing this equipment shall consult the National Water Commission's Developer's Manual.

12.1 GREASE AND SEPTAGE HANDLING

Separation and removal of septage, sludge and grease from wastewater will result in adverse affects in the final effluent quality or quality of soil absorption treatment. Unfortunately, proper treatment of sludge, grease and septage continue to be of grave concern in Jamaica due to the limited treatment sites available on the island.

Figure 16. Section Through a Grease Trap



12.2 SCREENS AND GRIT CHAMBER

Many secondary and tertiary treatment systems require pre-treatment steps by means of screens and grit chambers to remove inorganic material from the wastewater for an optimized performance of the treatment system. Screens remove plastics, twigs, pieces of cloth, rocks etc. that may end up in the wastewater stream. Grit chambers allow smaller pieces of rock, metal and bone which are denser than organic material, to settle out of the waste stream. The wastewater is slowed down just enough for the solids to settle out. If these are allowed to remain in the wastewater, they could cause damage to pumps through abrasion, clogging of pipelines or reduction of the effective volume for wastewater treatment in the sewage treatment plant.

Various types of mechanically and manually cleaned screens and grit chambers are available on the market. Figures 15 and 16 show a mechanical screen and a manual screen respectively.

Figure 17. Mechanical Bar Screens

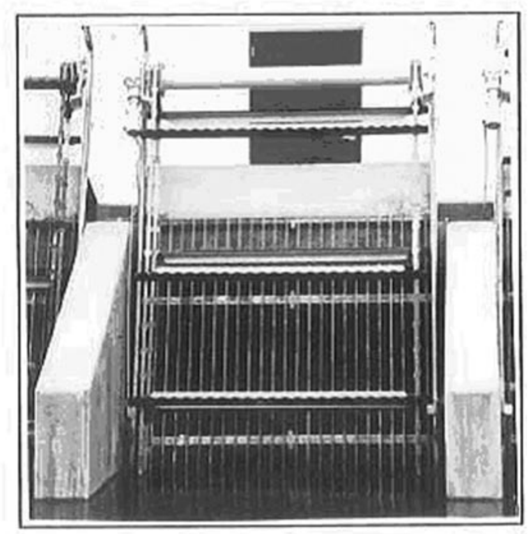


Figure 18. Manual Bar Screen

12.3 Contact Information

For further information please contact:

The Director
Environmental Health Unit (EHU)
Ministry of Health
2-4 King Street
Kingston

Tel: (876) 967-1100-9
Fax: (876) 967-4762
Email: knightp@moh.gov.jm
website: www.moh.gov.jm

Appendix I

OPERATION AND MAINTENANCE MANUAL, EHU/MOH

1.0 INTRODUCTION

Proper operation of new or modified sewerage works and improved operation of existing facilities are essential if effluent quality standards are to be met. In an effort to increase the probability of meeting effluent quality standards, it is mandatory that each sewerage works operator has access to an operation and maintenance manual which will act as a guide in all aspects related to the system operation and maintenance.

The design Engineer shall, therefore submit four (4) copies of an operation and maintenance manual to the Environmental Health Department for review and approval prior to the issuance of a certificate to operate. Upon final acceptance of the manual, the Engineer shall furnish four (4) copies of the corrected manual to the Owner.

The Owner shall locate the operation and maintenance manual in a place accessible to the operator on the site of the sewage treatment works.

1.1 GENERAL REQUIREMENTS

The operation and maintenance manual shall be designed for use by the operator. It should, therefore, be written on a reading level appropriate for the grade of operator necessary for the particular plant. Readability should be increased by use of short sentences, simplified vocabulary, etc. Use of illustrations is encouraged, especially where they can supplement involved instructions.

It is recommended that all manuals be in loose leaf form for expansion and updating purposes. If the manual is large, it is recommended that it be produced in at least two volumes. Manufacturer's manuals should be grouped together and should be cross-referenced to the main text, as appropriate. The manuals should be indexed and tabbed to simplify usage.

1.2 FORMAT REQUIREMENTS

The operation and maintenance manual of all sewerage works shall contain, but not be limited to, the following sections.

1.2.1 Lift Stations - Each unit of the lift station shall be related to its function. Schematic diagrams shall be used to show the location of all valves, pumps, controls, etc. and how they relate to the overall station operation. Items which should be considered are:

i pumps
ii level controls
iii valves and piping
iv ventilation equipment
v dehumidifiers
vi sumps
vii bar screens or baskets

1.2.2 Plant Layout and Flow Pattern - The plant type and a description of the basic process will be required. Each unit of the plant shall be related to its function and to the other units included in the process. Schematic diagrams shall be used to show the location of all valves, pumps, controls, etc., and how they relate to the over-all operation. Additional diagrams shall contain enlarged details of the complicated piping areas. Items which should be considered are:

i pumping
ii pre-treatment systems
iii screening and comminution
iv grit removal
v primary clarification
vi aeration and re-aeration
vii secondary sedimentation
viii trickling filters
ix sand filters
x sludge digestion
xi sludge conditioning
xii sludge disposal
xiii sludge drying beds
xiv gas control and use
xv disinfection
xvi effluent reuse systems
xvii wastewater lagoons
xviii odour control systems
xix chemical addition
xx effluent polishing systems
xxi other processes

1.2.3 Expected Efficiency of the System and the Principal Design Criteria

A detailed outline of the expected treatment efficiency in removing the required discharge constituents shall be presented. Principal design criteria shall be given with unit sizes, retention times, loading rates, etc., for each part of the sewerage system.

1.2.4 Detailed Operational and Control Procedures

Routine procedures of operation and control shall be detailed as well as alternate methods and emergency procedures. The pipelines, valves, and controls should be clearly marked as referenced in the detailed operation procedures.

A description of the various controls with recommended settings shall be given as related to:

i manual controls
ii automatic controls
iii physical controls
iv chemical controls
v biological controls
vi industrial waste monitoring
vii safety features.

Pump calibration curves, chemical makeup charts and other graphical aids which assist the operator shall be included.

1.2.5 Laboratory Controls

A brief discussion on required laboratory tests, why these tests are required, interpretation of the test results, and sampling procedures shall be presented as applied to:

i Each unit of the process
ii monitoring of effluent and receiving waters
iii water quality standards

Recommended laboratory testing manuals or books should be referenced with names and addresses of publishers.

1.2.6 Records

The operation and maintenance manual shall stress the importance of record keeping and graphing test results. Sample forms shall be enclosed which apply to:

i process operations
ii laboratory analysis

iii reports required by the regulatory agencies
iv maintenance

1.2.7 Maintenance

The manual shall contain a detailed recommended maintenance schedule for all facets of sewerage system maintenance. These schedules shall be for:

i normal equipment maintenance schedules as per manufacturer's recommendations
ii preventive maintenance summary schedules
iii special tools and equipment
iv housekeeping schedules, such as weed control, etc.

1.2.8 Trouble Shooting Guide

A trouble shooting guide shall be provided for each system unit (biological and mechanical) with a ready reference chart describing short-term and long-term solutions, and a brief description of the cause.

1.2.9 Safety Procedures

The operation and maintenance manual shall discuss safety procedures as related to:

i sewers
ii electrical equipment
iii mechanical equipment
iv explosion and fire hazards
v health hazards
vi handling of chlorine and other hazardous chemicals
vii open tank hazards

A list of recommended safety equipment shall be an integral part of the manual. It is recommended that the WPCF Manual of Practice No. 8 be used in conjunction with OSHA in addressing safety procedures.

1.2.10 Emergency Operating Plans and Procedures

The operation and maintenance manual for lift stations and treatment plants shall describe the effective automatic response for probable emergency situations which may be caused by the following:

Appendix 1

i Power Failure
- entire plant
- treatment process
- pumping stations
- false alarms

ii flood, hurricane, earthquake, fire, windstorms, freezing, explosions.
iii contamination of potable water supply
iv hydraulic overloading, ruptures, and stoppages
v by-passing
vi equipment breakdowns and process failures
vii failure of emergency warning equipment
viii labour strikes
ix spills of oils, toxic or hazardous materials into sewers or at treatment works
x personnel injury
xi other types of emergency situations

A general response pattern shall be established for each type of emergency and should follow the general response actions of

i early warning report
ii investigation
iii assess severity of the situation (including threat to the public health, water supplies, etc.)
iv determine response course of action and implement appropriate emergency plan)
v follow appropriate notification schedule (local-state-federal) depending on the type of emergency.

1.2.11 Emergency Readiness Program

The operation and maintenance manual shall also contain an emergency readiness program. The manual shall describe the appropriate program for maintaining readiness by addressing the following:

i equipment and parts inventory and chemical supplies necessary to handle emergency
ii personnel training on emergency operating procedures
iii charts on location of facilities
- sewers
- pump stations
- sewer overflow points

- flow regulators, valves, and controls
- wastewater storage

iv Alert and response system for each type of emergency

v early warning systems where applicable to warn downstream water users of spills, etc.

vi industrial waste monitoring and warning system within sewer networks to alert plant operators of spills and changes in waste consistency or hydraulic conditions that may adversely affect waste treatment.

1.2.12 Utilities

A map of all utilities showing key shut-off points shall be included in the manual for:

i electrical
ii gas
iii water
iv heat

1.2.13 Manufacturer's Equipment Data

Each manual shall contain data from equipment suppliers which contains:

i parts lists
ii assembly drawings
iii equipment trouble shooting guides
iv list of recommended spare parts and instructions for ordering equipment.

1.2.14 Appendix

The appendix of the manual shall contain:

i schematics
ii valve indices
iii sample forms
iv list of chemicals used in the plant and handling procedures
v list of chemicals used in the laboratory
vi effluent discharge permit and standards.
vii detailed design criteria
viii list of equipment suppliers with addresses and telephone numbers
ix supplier's manual

Appendix I

x local ordinances
xi operator certification and staffing requirements
xii details for reporting spills

Appendix 2

TILE FIELD SIZING

The sizing of tile fields for treatment of settled wastewater (after treatment in a septic tank) can be determined based on soil percolation rates. The following table is from the USPHS Manual of Septic Tank Practice (1967).

Table 14. Tile field application rates

Percolation Range Min/inch	Allowable Settled sewage application_Rate,	
	Litres/m2/day	(US Gal/Ft2/day)
1 200		5
2 140		3.5
3 120		2.9
4 100		2.5
5 90		2.2
6 80		2.0
7 77		1.9
8 73		1.8
9 69		1.7
10 65		1.6
12 57		1.4
15 53		1.3
20 45		1.1
25 41		1.0
30 37		0.9
40 33		0.8
50 28		0.7
60 24		0.6

Notes:

1.Soils that percolate slower than 60 minutes/inch are considered unacceptable for soil absorptive methods.

2. If no percolation test is done maximum loading rate shall be 61 L/M2/Day