BAND TECHNICAL PUBLICATIONS

TRICKLING FILTER O&M GUIDELINE

December 1984

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Canada

BTP-MS-15

Technical Services and Contracts

Services techniques et marchés

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December 1984

Disponible en français

QS-3445-000-EE-A1

Cette publication peut aussi être obtenue
en français sous le titre:

Ligne directrice pour le fonctionnement
et l'entretien d'un lit bactérien

TRICKLING FILTER
O&M GUIDELINE

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TRICKLING FILTER O&M GUIDELINE

1.0 INTRODUCTION

This publication provides guidelines for the operation and maintenance of trickling filters used to treat wastewater on Indian reserves.

The guidelines are intended to be used by wastewater treatment plant operators and maintenance supervisors. They do not replace the instructions provided by the individual equipment manufacturer, but rather form a supplement. Copies of the manufacturer's manuals should be available at all times. Copies of all drawings applicable to a facility's sewage system should be kept up to date at the facility and be available for use when needed.

2.0 DEFINITIONS

Definitions are given in Appendix 1. Although not all terms appear in this publication, they are frequently encountered in the literature on trickling filters.

3.0 RESPONSIBILITIES

The band's responsibilities are as follows:

a. to have a trained operator who is capable of operating and maintaining the installation;

b. to supply the operator with all the necessary tools, materials and parts needed for plant operation and maintenance;

c. to provide for proper instruction and orientation;

d. to provide opportunities for plant personnel to increase their knowledge by participation in meetings and special training courses; and

e. to obtain any permits required for operation of the plant from the appropriate regulatory agency.

The operator must:

a. operate the plant efficiently and meet the effluent qualities stipulated by regulatory agencies;

b. maintain the equipment, buildings and grounds;

c. maintain a safe and healthy environment;

d. perform tests and make the observations needed for the proper operation of the plant;

e. understand and apply laboratory tests and results;

f. warn the owner far enough in advance so that tools, parts and supplies will be available when needed; and

g. keep maintenance records up to date.

4.0 PROCESS DESCRIPTION

A trickling filter consists of a bed of coarse material (such as rock, plastic or other material) covered with biological growth. This is called the filter media. Wastewater is distributed over the top of the bed by a rotary distributor or fixed nozzles. As the wastewater trickles down through the openings of the media, organic matter is removed by contact with the microorganisms. The treated wastewater is collected by an underdrain system prior to final clarification.

In the treatment of domestic wastewater the trickling filter is usually preceded by a primary clarifier and followed by a final clarifier. Figure 1 shows a trickling filter and its principal components which include:

a. the distribution system which applies the wastewater to the filter media;

b. the filter media which provide a surface area for the microorganisms to grow; and

Figure 1

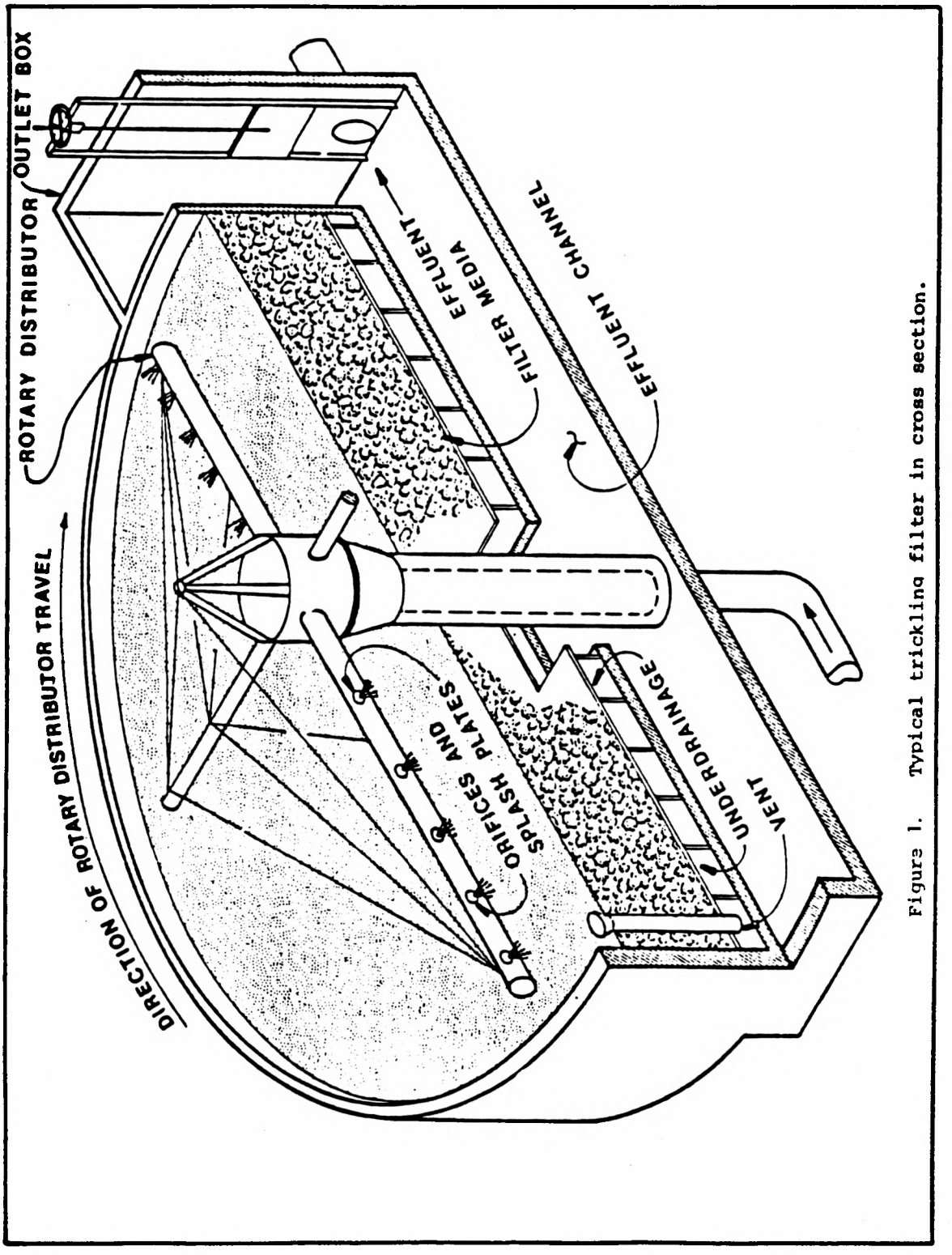


Figure 1. Typical trickling filter in cross section.

c. the underdrain system which supports the media, collects the effluent and ventilates the filter providing oxygen for biological growth.

5.0 FILTER MEDIA

The filter media must be hard, durable, and, as much as possible, free from fine material. Heavy loads that may crush the medium should not be permitted on the filter.

The surface of the filter should be kept free from accumulations of leaves or other debris to prevent clogging of the filter surface. Any ice should be broken up and removed.

6.0 DISTRIBUTION SYSTEM

6.1 General Remarks

For effective utilization of the filter unit, the wastewater should be uniformly distributed on the filter surface. Fixed nozzles or rotary distributors are used to achieve this.

6.2 Fixed Spray Nozzles

Fixed spray nozzles were employed in most of the early trickling filters, and many are still in use. The nozzles are attached to pipes laid in the filter bed and extend 150 to 300 mm above the surface. They are fed intermittently by a dosing tank with an automatic syphon (see Figure 2).

Dosing tanks with a syphon should discharge intermittently. Continuous discharge from the syphon chamber indicates that the vent is probably clogged. Any slime and grease adhering to the walls and piping should be removed daily.

Fixed nozzles should be inspected daily and, if clogged or damaged, should be cleaned and repaired. The distribution system should be flushed periodically by removing the nozzles at the end of the laterals.

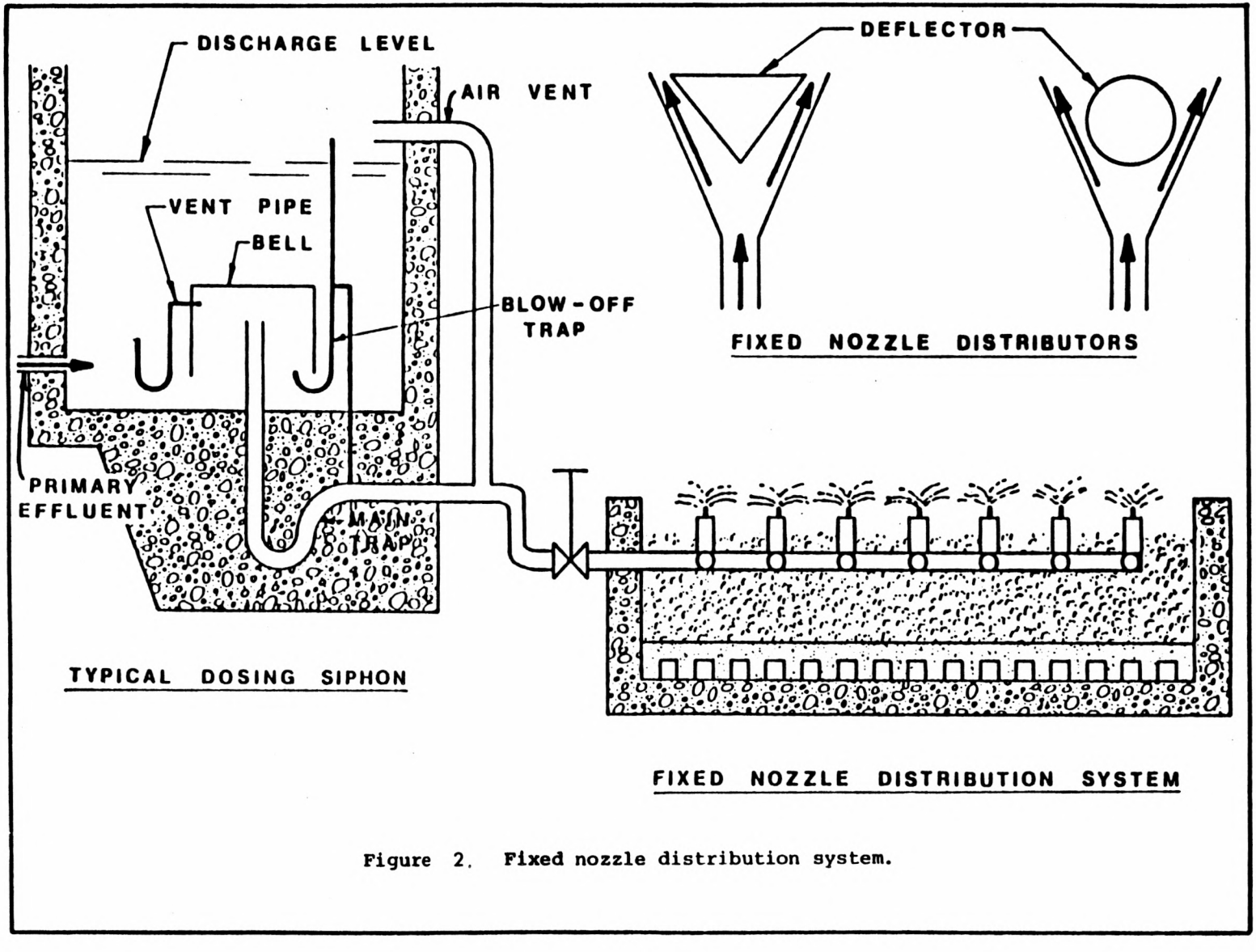


Figure 2. Fixed nozzle distribution system.

6.3 Rotary Distributors

Reaction-driven rotary distributors are used in most trickling filters today. The rotary distributor consists of a central column to which horizontal pipe arms are attached. The arms rotate by the reaction of the wastewater discharging from the nozzles or by the mechanical action of an electric motor (see Figure 1).

Orifices and nozzles should be inspected daily and clogged units should be cleaned. Scum and organic growth should be removed from the rotary distributors and the distribution system flushed periodically to remove any material that could cause clogging.

Guy rods should be adjusted for seasonal temperature changes to maintain the rotary arms in a horizontal position.

Uniform distribution of the wastewater over the filter can be assured by placing equal-volume pans at representative points on the filter and measuring the amount of water in each pan. The quantity of water in each pan should be about the same. If the filter is dosed intermittently in extremely severe weather, the gates at the ends of the arms should be left partly open to permit the arms to drain before wastewater freezes in the pipe.

7.0 UNDERDRAINS

The base of the filter supports the underdrainage system which in turn supports the filter medium. The underdrain system is generally designed to flow one-third to one-half full to permit ventilation of the bed. If possible, the underdrains should be inspected periodically to make sure they are neither clogged nor surcharged. If drains become clogged they should be flushed with a hose stream.

8.0 RECIRCULATION

There are a number of advantages of recirculating wastewater through the filter media:

- to reduce wastewater strength;
- to prevent drying or freezing;
- to cause more frequent sloughing;
- to discourage breeding of filter flies; and
- to ensure uniform wastewater application.

Recirculation is one of the few process steps over which the operator has control, and with adequate plant equipment a wide range of treatment is possible. Experience is required, however, to determine an effective method and rate of recirculation for a particular plant.

When selecting the recirculation rate it is recommended that operational control be based on filter response and plant performance. As a rule of thumb the underdrain conduits and effluent channels should not flow more than one-half full.

9.0 FINAL SETTLING TANK

The efficiency of treatment attained by trickling filter plants is greatly affected by the operation of the final settling tank (Figure 3). It is essential that sludge be removed from the final settling tank before it rises to the surface and is carried out with the final effluent. Sludge from the final settling tank can either be pumped back to the primary settling tank or directly to sludge handling facilities.

10.0 CHLORINATION

Refer to BTP-MS-4, Hypochlorination O&M Guideline for operating instructions and chlorine residual test procedures.

11.0 MAINTENANCE PROCEDURES

11.1 General Remarks

It is recommended that the operator of a trickling filter plant be given at least one week's training in basic wastewater treatment. Preventive maintenance is the key to a trouble-free operation. Inspect the mechanical equipment every day. Follow the manufacturer's recommendations on maintenance and lubrication. Keep the plant site looking attractive.

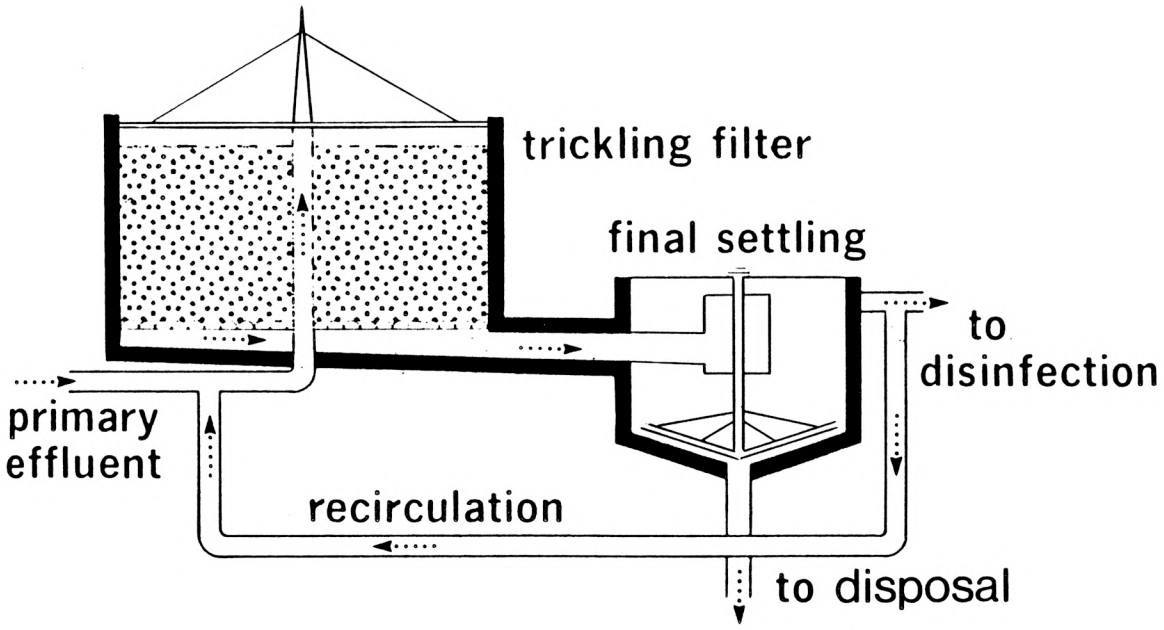
11.2 Procedures

11.2.1 Primary and Secondary Clarifiers

Daily:

a. Check the sludge level and pump as required.

FIGURE 3 TRICKLING FILTER SYSTEM



b. Observe the nature of the effluent.

c. Check the drive unit for excessive heat, noise and vibration.

d. Check the gear oil level and replenish as required.

e. Check the condition of the drive chains and sprockets and tighten as required.

f. Remove accumulations from inlet baffles and effluent weirs.

g. Clean the scum and grease removal equipment.

h. Check the controls and alarms.

11.2.2 Trickling Filter

Daily:

a. Check the effluent for clarity and odours.

b. Check the filter operation.

c. Check the rotation of distribution arms.

d. Check the orifices for clogging and clean as required.

e. Check that the distribution arms are horizontal and adjust guy rods as required.

f. Remove all debris from the filter surface.

g. Check the drive unit for excessive heat, noise and vibration.

h. Check for seal leaks and tighten up as required.

i. Check the lubricant levels and replenish as required.

Annually:

a. Shut down the filter.

b. Drain the distribution arms.

c. Inspect the drive unit. Repair if required.

d. Replace/repair badly worn, defective or damaged components.

e. Change oil and lubricants as required.

f. Flush the underdrains.

g. Check metal parts for corrosion -- clean and apply protective coating as required.

h. Start the filter and observe its operation -- adjust as required.

Daily records of preventive maintenance should be kept.

12.0 PROCESS CONTROL

Final effluent quality tests should be performed as required by regulatory agencies. Although effluent quality may deteriorate due to high organic or toxic loads, the system will generally recover to good performance several hours after returning to normal influent conditions.

To maintain the proper chlorine residual the hypochlorite feed rate should be adjusted in accordance with BTP-MS-4, Hypochlorination O&M Guideline.

13.0 TROUBLE-SHOOTING

A trouble-shooting checklist for trickling filters is presented in Appendix 2. The operator should use the checklist as a guide in correcting operational problems. If there are continual problems with a particular installation, contact the regional or district office for assistance.

14.0 SAFETY

Safety is one of the most important aspects of wastewater system operation. Use safety equipment as directed and follow all safety procedures. Good housekeeping is important. The operator and other personnel must be protected from hazards. Detailed safety procedures are given in BTP-MS-16, Safety Practices in Wastewater Systems.

15.0 REFERENCES

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New York State Department of Health. Manual of Instruction for Sewage Treatment Plant Operators. Albany NY.

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Water Pollution Control Federation. 1976. Operation of Wastewater Treatment Plants; MOP 11. Washington, DC.

Appendix 1

DEFINITIONS

Biochemical oxygen demand (BOD): the quantity of oxygen used in the biochemical oxidation of organic matter in a specific time, at a specific temperature, and under specific conditions.

Chlorination: the application of chlorine to wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

Chlorine contact chamber: a detention basin provided primarily to secure the diffusion of chlorine through the liquid -- also called a chlorination chamber.

Comminutor: a grinder or shredder that converts bulky solid wastes into small particles.

Cross-connection: a physical connection through which a supply of potable water could be contaminated or polluted.

Digester: a tank in which sludge is placed to permit digestion to occur -- also called a sludge digestion tank.

Dissolved Oxgen: the oxygen dissolved in a liquid, usually expressed either in milligrams per litre or percentage of saturation.

Effluent: wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial treatment plant.

Hydraulic loading: the flow (volume per unit time) applied to a unit process.

Influent: wastewater or other liquid, raw or partially treated, flowing into a reservoir, basin, treatment process, or treatment plant.

Organic loading: pounds of BOD, applied per day to a unit process.

Potable water: water that does not contain pollution, contamination, minerals, or infective agents and is considered satisfactory for domestic consumption.

Recirculation: the return of process effluent to the incoming flow.

Sanitary Wastewater: (1) domestic wastewater with storm and surface water excluded; (2) wastewater discharging from the sanitary fixtures of dwellings (including apartment houses and hotels), office buildings, industrial plants, or institutions; (3) the water supply of a community after it has been used and discharged into a sewer.

Screening: the removal of relatively coarse and floating solids by straining them through racks or screens.

Sludge: the accumulated solids separated from wastewater during processing, or deposits on the bottoms of streams or other bodies of water.

Settleable solids: (1) that matter in wastewater that will not stay in suspension during a preselected settling period, such as 1 h, but either settles to the bottom or floats to the top; (2) in the Imhoff cone test, the volume of matter that settles to the bottom of the cone in 1 h.

Suspended solids (SS): solids in suspension in wastewater or effluent; also called suspended matter.

Waste sludge: that portion of settled solids from the final sedimentation unit that is removed from the wastewater treatment facility to the solids handling facilities for utlimate disposal.

Wastewater treatment works: (1) an arrangement of devices and structures for treating wastewater, industrial wastes, and sludge; (2) a water pollution control plant.

Appendix 2

TROUBLESHOOTING GUIDE TO TRICKLING FILTERS

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
1. Filter Ponding	a. Media too small or not uniform in size.	a. Check size of media for uniformity.	a. Rake or fork the rocks on the filter surface. Heavy equipment should not be allowed on the filter.
	b. Rock media broken due to temperature extremes.	b. Fines clogging filter voids.	b. Flush media with high pressure stream of water.
	c. Improper operation of primary treatment units.	c. Excessive solids in filter influent.	c. Correct improper operation of primary treatment units.
	d. Excessive sloughing; excessive biological growth.	d. Slime growth clogging filter voids.	d. Flush media with high pressure stream of water and/or dose with chlorine to control slime growth.
	e. Excessive organic loading.	e. Check loading rates.	e. Increase recirculation or flood the filter to loosen and remove surface accumulations.
	f. Accumulation of leaves, debris, etc.	f. Inspect filter.	f. Remove debris from filter media.
	g. Snails, moss, roaches.	g. Visual inspection.	g. Flush filter and/or chlorinate to produce a residual of 0.5 - 1.0 mg/L.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
2. Filter Flies	a. Excessive biological growth on filters.	a. Visual inspection.	a. Remove excessive growth as described in 1d.
	b. Plant grounds provide breeding ground for flies.	b. Inspect grounds.	b. Maintain grounds so as not to provide a sanctuary for flies.
	c. Hydraulic loading too low to wash filter of fly larvae.	c. Hydraulic loading rate.	c. Prevent completion of fly life cycle by the following remedies: 1) Increase recirculation rate. 2) Flood filter for several hours at regular intervals. 3) Chlorinate to produce a residual of 0.5-1.0 mg/L. 4) Apply an insecticide to filter walls and areas breeding flies.
	d. Poor distribution of wastewater especially along filter walls.	d. Visual inspection.	d. 1) Unclog spray orifices or nozzles. 2) If alternating wet and dry environment exists, modify ends of distributor arms to maintain continuously wet filter walls.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
3. Odours	a. Excessive organic loading.	a. Check organic loading.	a. 1) Maintain aerobic conditions in all treatment units by adding forced ventilation equipment. 2) Chlorinate filter influent when plant flow is low. 3) Increase recirculation rate to dilute organic strength and improve oxygen transfer.
	b. Poor ventilation due to clogged vent pipes or filter drain.	b. Check vent pipes and filter drain.	b. 1) Clear vents and drain system of obstructions. 2) If underdrain system is flowing more than half full reduce hydraulic loading.
	c. Poor ventilation due to excessive biological growth filling media voids.	c. Inspect media voids.	c. Increase recirculation rate to filter.
	d. Poor house-keeping.	d. Visual inspection.	d. Remove debris from filter media and wash down distributor splash plates and walls above media.
	e. Septic filter influent.	e. Check influent for H_2S odour.	e. Correct upstream system by aeration or controlled prechlorination.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
4. Ice build-up on filter media.	a. Climate.	a. Air and waste-water temperature.	a. 1) Decrease recirculation. 2) Adjust orifices and splash plates for coarse spray. 3) Partially open dump gates at outer end of distributor arms to provide a stream rather than a spray. 4) Break up and remove ice formation. 5) Erect a wind screen in the path of prevailing winds.
	b. Uneven distribution during freezing weather.	b. Visual inspection.	b. Adjust distributors for more even flow (remove debris if it has clogged orifices).

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
5. Uneven distribution of flow on filter surface.	a. Clogging of distributor orifices.	a. Ponding in some areas with concurrent drying in other areas.	a. Remove and clean distributor nozzles and flush distributor piping.
	b. Inadequate hydraulic load on filter.	b. Hydraulic loading rate.	b. Maintain adequate hydraulic load.
	c. Seal leaks.	c. Seal.	c. Replace seal.
6. Snails, Moss and Roaches.	a. Climatic conditions and geographical location.	a. Visual inspection.	a. Chlorinate to produce residual of 0.5-1.0 mg/L.