CODE OF PRACTICE FOR SMALL WASTEWATER TREATMENT PLANTS

EPA Victoria
State Government of Victoria

June 1997

CODE OF PRACTICE FOR SMALL WASTEWATER TREATMENT PLANTS

Code of Practice for Small Sewage Treatment Plants (for populations under 500 persons)

First Published in 1979 by Health Commission of Victoria

Revised 1997

Published under the provisions of section 13(1) of the *Environment Protection Act 1970*

EPA Victoria
40 City Road Southbank Victoria 3006

Publication 500

ISBN 0 7306 7530 0

Printed on recycled paper

FOREWORD

EPA is continually looking for improved ways to ensure the environment is protected for the benefit of present and future generations of Victorians.

As industry and local government become more aware of their environmental responsibilities and committed to producing improved environmental outcomes, there is increasing scope for regulatory agencies such as EPA to move beyond traditional command and control approaches and apply alternative mechanisms to promote the adoption best practice environmental management (BPEM).

EPA's BPEM publications provide guidance on site selection, process design, technology choice, key operating parameters and procedures, contingency arrangements, and monitoring and auditing aspects.

Like other publications in EPA's BPEM series this Code of Practice avoids a highly prescriptive approach in favour of one based on quality management. The Code focuses on desired objectives and outcomes, allowing scope for innovative action to achieve 'win/win' results rather than on tight regulatory specifications.

Manufacturers of treatment plants however, should feel free to consider alternative measures on their merits and apply the best site-specific solution equivalent to, or better than, the suggested measures. In this way the Code provides a flexible framework within which innovation is encouraged. At the same time, those seeking greater direction or certainty can simply apply the suggested measures.

The underlying philosophy of BPEM guidelines and codes is to provide a forward looking approach rather than simply reflect what is presently the norm. By focusing on those elements which represent best practice and providing a systematic approach to achieving these the Code encourages designers and manufacturers to strive for continuing improvement in the environmental performance of their plants.

Environmentally aware people seeking a better environment or competitive advantage should find merit in this approach. Codes of Practice based on best practice environmental management will achieve benefits for the community in terms of sustainable improvements in environment quality.

I urge the industry and the community to consider the merits of this type of Code.

ROB JOY

ACTING CHAIRMAN

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

1.1 Scope

The principles and objectives of this Code of Practice have been adopted to facilitate the design of small wastewater treatment systems which serve less than 500 people. The accepted design criteria is generally more conservative than that for larger treatment works.

It is not within the scope of this Code to detail all the requirements essential for the operation of small wastewater treatment plants.

Further, the provisions of the Code are not intended to restrict the opportunity for designers or consultants to specify any material, method of construction, design and/or components of an innovative nature.

While national guidelines focus on broad environmental issues and objectives for environmental protection, this Code provides acceptable criteria and suggested measures suitable for local conditions.

The Code also encourages best practice environmental management so that treatment plants will have minimal impact on the environment.

Where the terms 'shall' and 'must' are used, they are intended to mean a mandatory requirement of the approving authority.

Other terms such as 'should' or 'suggested' and the like indicate best practice or desirable but not necessarily mandatory procedures or methods.

The observance of the technical requirements in this Code alone does not ensure the approval of a plant by the responsible authorities.

1.2 Performance objectives

Small wastewater treatment plants should be designed, constructed and managed to achieve the following environmental performance objectives:

- any discharges to surface waters to meet all statutory requirements
- measures employed to deal with emergencies without damage to any surface waters or to the soil/land
- all wastewater treated and retained on land wherever practicable and environmentally beneficial
- measures employed to conserve water resources or provides for the re-use or recycling of treated wastewater.

Table 1 shows water discharge limits for surface waters where effluent cannot be contained on land. The statutory basis for these discharge requirements is shown in Appendix A.

Where a discharge to surface waters is the only option available, effluent quality must satisfy the principles set out in *Managing Sewage Discharges to Inland Waters* (EPA Publication 473) and requirements of *SEPP (Waters of Victoria)*.

Where no quantitative nutrient objectives are specified in the SEPP, the discharge must not cause the nutrient levels in the receiving stream to exceed those specified in *Preliminary Nutrient Guidelines for Inland Streams* (EPA Publication 478)

Table 1: Minimum performance limits

Performance indicator	Annual median	Maximum* or 80th %
Biochemical oxygen demand (mg/L)	10	20
Suspended solids (mg/L)	15	30
Ammonia as nitrogen ** (mg/L)	5	10
Total chlorine residual (mg/L)	–	1,0
Bacteria *E.coli* (orgs/100 mL)	200	1,000
pH range (pH units)	–	6,5 to 8,5
Floatable matter	–	None visible

** 80th % limits apply where more than 5 samples are taken annually.*

*** To protect against nutrient enrichment, a minimum dilution of at least 1000: l will normally be required.*

1.3 Design elements

It is common practice to control wastewater treatment plant by reference to matters such as waste disposal, site selection, protection of surface waters and impact on neighbourhood amenity.

Accordingly, wastewater treatment plants need to be located in areas remote from residential development with sufficient available land for sustainable wastewater reuse. Proper design and construction will ensure effective wastewater reuse procedures can be managed on a sustainable basis.

This Code groups those design elements under the following headings:

- site analysis
- waste management
- design and construction
- operation and maintenance
- performance monitoring and reporting.

Each of the above elements has performance objectives and standards or suggested measures (that is, statements on how an objective can be achieved) to illustrate possible ways of meeting both the performance objectives and standards.

This approach permits and encourages alternative or innovative technology and effective solutions for best practice environmental management.

1.4 Definitions

For the purpose of this Code of Practice the following definitions apply.

Activated sludge

A flocculent microbial mass, usually chocolate brown in colour, produced by the aeration of wastewater. A long aeration time in contact with this sludge effectively oxidises wastewater.

Aerobic action

A biological process promoted by the action of bacteria in the presence of dissolved oxygen.

Anaerobic action

A biological process promoted by the action of bacteria in the absence of dissolved oxygen.

Baffle

Construction that minimises the discharge of floating matter.

Bio filter (also known as biological, rotating or trickling filters)

A durable bed of aggregate or discs made of suitable inert material on which bacteria and other organisms flourish. The bacteria on the surface of this material oxidises the organic matter in the effluent applied to the filter.

Biochemical oxygen demand (BOD)

A measure of the oxygen demanding substances in wastewater. It is expressed as the number of milligrams of oxygen required by micro-organisms to oxidise the organics in a litre of water over a period of time. It is expressed as mg/L.

Dosing device

A device that receives effluent from a settling tank or a septic tank and from which this effluent is automatically discharged to the filter distribution pipes in intermittent doses.

Effluent

The liquid discharged from a treatment unit. It may be qualified according to type of treatment for example, septic tank effluent, filter effluent or final effluent.

Humus tank

A tank through which filter effluent is passed to settle suspended solids, which should be removed from the tank at frequent intervals.

Maximum daily flow (MDF)

The maximum quantity of wastewater to be treated in any 24 hour period, including any permanent infiltration flow in a sewer during dry weather.

Mixed liquor

Mixture of pretreated wastewater and activated sludge undergoing activated sludge treatment in an aeration tank.

'Polishing' stage

Treatment stage used to upgrade the standard of effluent discharge. Its purpose is to reduce the residual solids in the effluent and the BOD associated with such solids.

Settling tank

A tank through which wastewater is passed to settle solids. The solids should be removed automatically by pump or other device at frequent intervals.

Wastewater

Any human excrete or domestic waterborne waste, whether untreated or partially treated, but does not include trade waste.

Sludge

The accumulated settled solids deposited from wastewater and forming a semi-liquid mass.

Supernatant liquor

The layer of liquid overlying the settled solids after separation.

Suspended solids (SS)

All particle matter suspended in wastewater or effluent. Expressed in milligrams per litre (mg/L).

Trade waste

The wastewater (other than wastewater) that comes from manufacturing, processing, or other commercial or industrial premises.

Wastewater

The water carrying wastes from residences and other premises.

20/30 standard

An effluent satisfying a standard of BOD not exceeding 20 mg/L and suspended solids not exceeding 30 mg/L.

1.5 Information required

Special consideration should be given to the design of small wastewater treatment systems serving individual establishments. The information and design factors in this Code should be taken into account when assessing such systems.

In environmental engineering, standards and codes do not remove the need for skilled advice based on a knowledge of wastewater treatment practice and local conditions.

The service of a competent environmental consultant should be engaged for the design and preparation of plans and specifications for any wastewater treatment plant.

When designing a small wastewater treatment plant, the following information should be determined before the design work commences:

a) the requirements of local council, planning and water authorities

b) the required effluent quality objectives, sludge disposal requirements and minimum treatment technology

c) sensitivity to fluctuating daily flows and peak hourly flows

d) the number of people served, waste characteristics of the wastewater and any special conditions affecting the design

e) site particulars, including the distance to nearest residential area or public place, water authority sewer and access for maintenance vehicles

f) the possibility of future extensions, duplication of the plant and ease of treatment plant removal

g) maintenance or contract personnel available to supervise plant operations.

Generally, plants designed to treat domestic wastewater in accordance with the requirements of this Code will produce an effluent quality not exceeding a maximum or 80th% of 20 mg BOD/L and 30 mgSS/L called a *20/30 standard.*

However, more stringent controls or technology may be necessary where local environmental conditions require a higher level of protection.

Provision of a 'polishing' stage or tertiary treatment for nutrient removal may need to be considered. The effluent quality objectives required should be discussed with the responsible authorities early in the design stage.

To ensure optimum performance of small wastewater treatment plants, it is important that the maintenance personnel are adequately trained in routine operations and maintenance procedures.

Discuss information and performance requirements with approval authority before making your application.

Before installing, altering or using any wastewater treatment plant, it is necessary for the owner to apply for approval. In many cases approvals or licences from responsible authorities may be required and it is the owner's responsibility to see that the written approval is obtained.

Figure 1 shows an illustration of a typical small wastewater treatment plant.

See Appendix B for typical details to be included in the plans and specifications to be submitted for the approval of a wastewater treatment plant.

See Appendix C for information needs checklist.

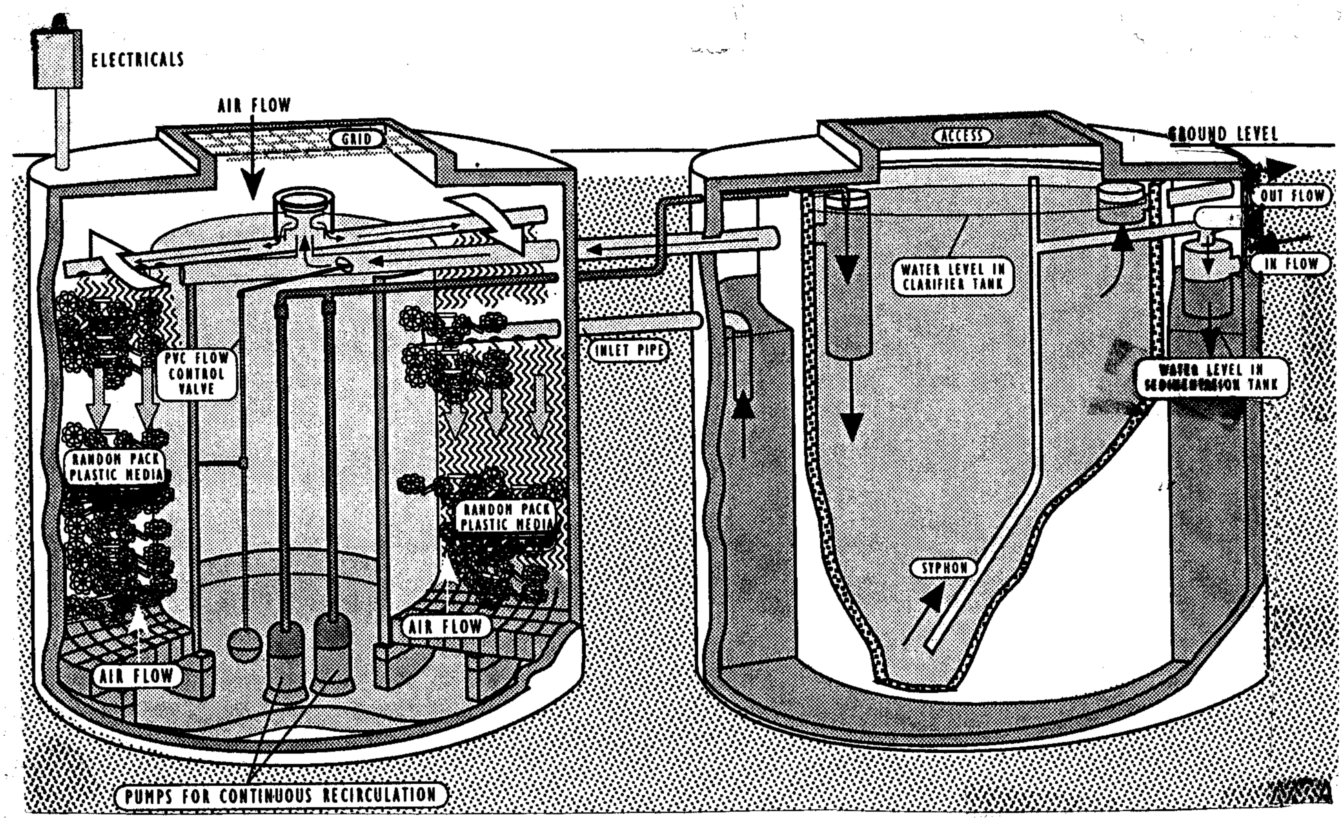


Figure 1: Perspective drawing of small wastewater treatment plant

2 WASTE MANAGEMENT

2.1 Objectives

Discharge to sewer rather than direct discharge to surface waters is the preferred option for managing wastewater. However, there are alternatives to be considered including:

- minimising wastewater
- treatment and reuse
- treatment and land use
- transport off-site for treatment.

Wastewater treatment plants serving small groups of houses and individual establishments such as schools, hotels and factories are prone to variable organic and fluctuating hydraulic loadings. These loadings are liable to occur when the contributing source is small or regimented and where the pattern of activity of individuals in the community is similar.

A small treatment plant is not, and must not be regarded simply as a scaled down version of a larger installation. The geometry, construction and scale of the plant in relation to peak flows can result in inefficient operation.

Where the volume of wastewater to be treated in individual plants serving facilities such as factories, hospitals or schools is less than 100 kilolitres per day, special attention must be given to plant design, construction and system stability.

2.2 System stability

People proposing to design small plants should be aware of the situations likely to produce extremes in organic and hydraulic loadings.

This can best be illustrated by an example, such as a school or factory, where weekend shutdowns reduce the organic loading.

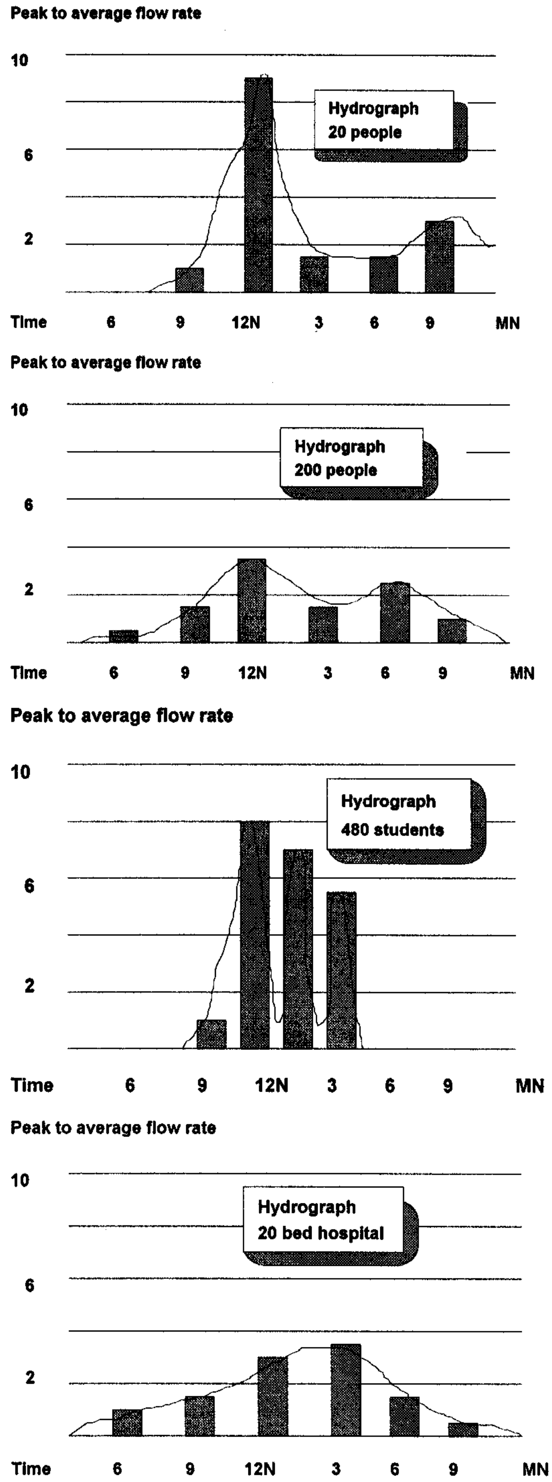


Figure 2: Observed peak flow hydrographs

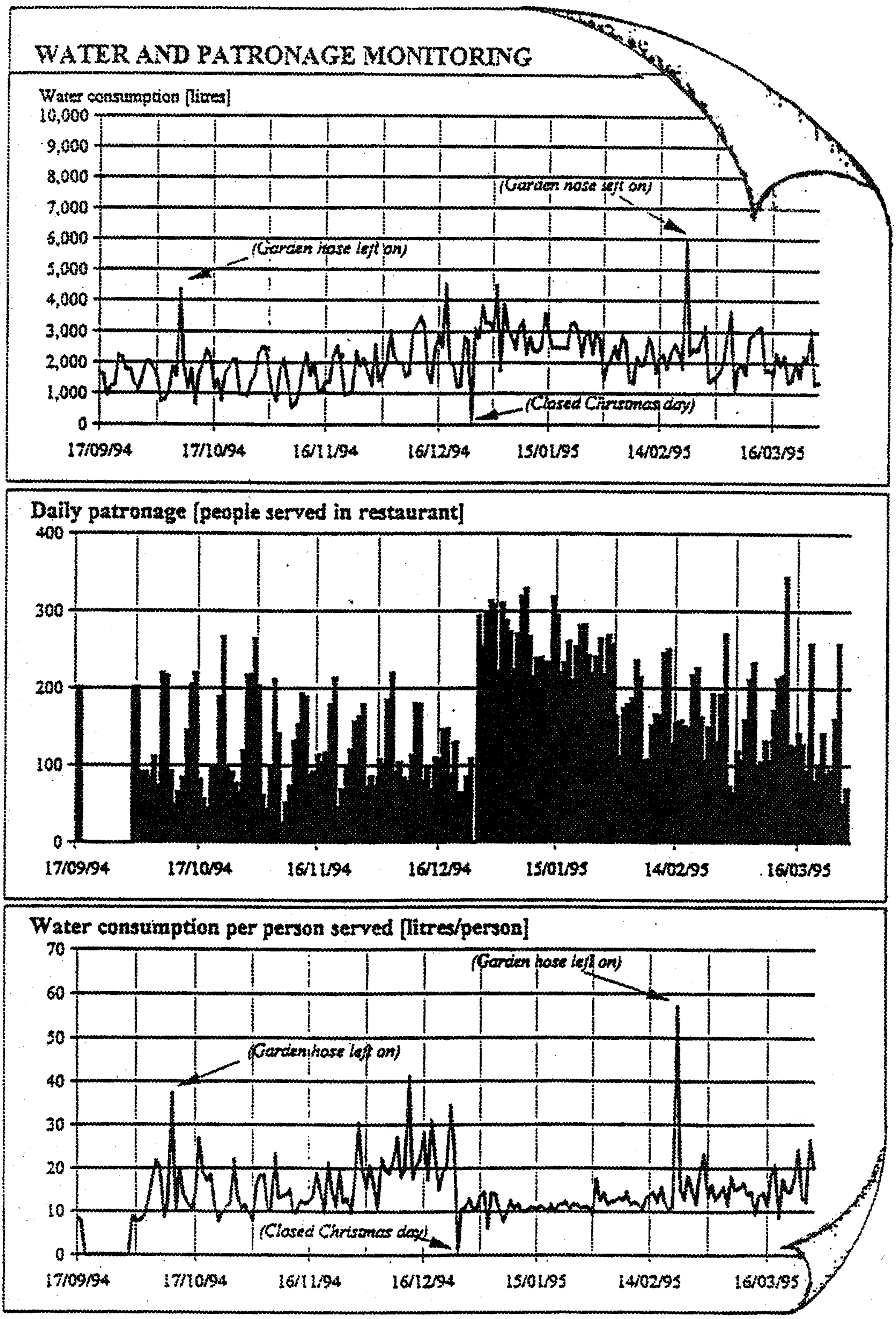


Figure 3: Evaluation of water usage and peak flow conditions

A normal eight-hour working day with peak flow of three to six times the average eight hour flow rate, when expressed in terms of the 24-hour average rate, could represent a peak flow of more than 10 times the average.

Figure 2 shows some typical examples of peak flow hydrographs.

The above points underline the necessity for flow balancing, such as balancing tanks or effluent recirculation from a storage tank or pump well and/or the need for conservative design factors.
The maximum hourly or peak flows upon which to base the design of a plant should be determined for each situation.

A typical example of such an evaluation is shown in Figure 3.

2.3 Accepted standards

Unless computations or other substantiating data covering the design of the wastewater treatment plant are submitted with an application for approval, the design factors and specification in this Code must be observed.

The following measures should be adopted:

a) The capacity of wastewater treatment plants is to be based on the loading rates in Table 2.

b) Where effective flow balancing is not incorporated in the plant, design peak hourly flows are to be based on rates in Figure 4.

c) Treatment plants should be ready for operation before any part of a subdivision, building or group of buildings to be served by the plant is occupied.

d) Facilities for the application of wastewater by irrigation are to be designed in accordance with the *Guidelines for Wastewater Irrigation* (EPA Publication 168).

e) Reuse of wastewater is to be undertaken in accordance with *Guidelines for Wastewater Reuse* (EPA Publication 464).

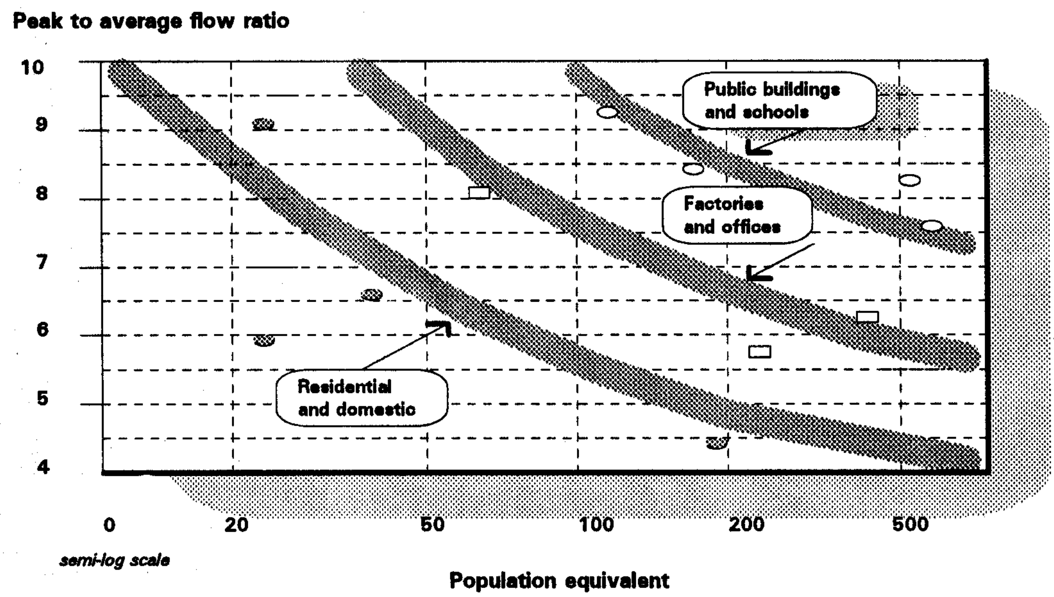


Figure 4: Peak hourly flows

Table 2: Guide to design rates for wastewater treatment plants

Contributing source	Daily flow * (Litres/person)	Organic load ** (g BOD/person/day	No. of persons} (unless otherwise noted)
Residential – flats and units			@2.5 persons/unit, ie
'A' rated. – { where each appliance is	125 – 180	45 – 55	toilet 15L, bathroom 50 L,
'AA' rated – { 25% more efficient, than	100 – 150	45 – 55	{ Laundry 45 L, plus 40 L per
'AAA' rated – { lower rated appliances	80 – 125	45 –55	person for other uses.
– established residential housing	125 – 180	50 – 60	3.0 persons/house
– new subdivisional schemes	150 – 200	60 – 75	3.5 persons/allotment
– casual camping sites	75 – 125	40 – 60	3.5 campers per site
– permanent resident sites	100 – 150	45 – 55	2.5 residents per site
Hotels, motels and guest houses			
– bar trade	5 – 8	5 – 10	per customer
– per resident guest	100 – 180	30 – 40	1.5 per room
– per bar attendant	750 – 1200	75 – 150	effective full-time
Hospitals – nursing	200 – 500	90 – 200	per patient bed
Restaurants			
– premises with less than 50 seats	30 – 50	40 – 65	{
– premises with more than 50 seats	20 – 35	28 – 45	{ @ 100 per 100 m^2
– eating houses	12 – 15	18 – 25	{
– tea room/coffee shop	5 – 8	8 – 12	{
Shops and shopping centres			
– per employee plus	10 – 15	10 – 15	5 per 100 m^2
– public access	5 – 8	3 – 10	10 per 100 m^2 retail floor area
Factories, offices, child care centres	15 – 25	10 – 20	5 per 100 m^2 excluding laundry
Schools and day training centres			
– day students	10 – 20	10 – 15	50 per 100 m^2
– student boarders	100 – 150	45 – 60	staff included
– conference facilities with refreshments	10 – 30	15 – 35	–
Public recreation areas			
– meeting halls and sports centres	~ 2	~ 1	50 per 100 m^2
– picnic areas/wine tasting and theatres	~ 3	~ 1.5	–
– golf clubs, private and social clubs	~ 10	~ 3	100 per 100 m^2
– basketball, squash and golf courses	~ 5	~ 2	20 per court, 400 per 18 holes
Miscellaneous – add to above			
– laundries – per wash load	85 – 145	40 – 65	8 loads/machine/day
– for shower/bath facilities	35 – 65	5 – 8	use per person

Note:

Variations of 25% in hydraulic flow are possible for each water reducing stage. The range of values listed above for AAA to A ratings are the best available at this time. Investigate each case at the design stage, especially if there is an existing system or if more water efficient appliances and taps are to be used.

* Daily flow varies according to number and type of water efficient appliance used. Flow figures are per person per day unless otherwise noted.

** Organic daily loadings may be averaged over population served per week and/or waste rnanagement procedures implemented

3 SITE REQUIREMENTS

3.1 Objectives

The location of any wastewater treatment plant should be as far as practical from dwellings, public places and any allotments which will possibly be built on within the life of the plant. There should also be sufficient land set aside to allow for any future alterations that there is no offensive odours detected at the property boundary.

Every treatment plant must be so positioned that it is not subject to flooding or is otherwise protected from flooding and has all weather road access.

Safe working practices and the use of safety equipment will avoid the hazards associated with wastewater treatment plants.

3.2 Accepted standards

Site analysis/land capability is checked using the criteria shown in Table 3 (Site capability rating for on-site wastewater management).

Buffer distances are established where surrounding terrain or prevailing wind will affect the dispersion or spread of odours, aerosol spray and/or disease vectors. Figure 5 shows accepted buffer distances for different types of treatment processes.

Stabilisation ponds are located at least 100 m from a source of water supply, 30 m from boundaries of residential premises and 15 m from camping sites.

No wastewater treatment plant is located within 15 m of a source of water supply, or at such greater distance as required by a responsible authority.

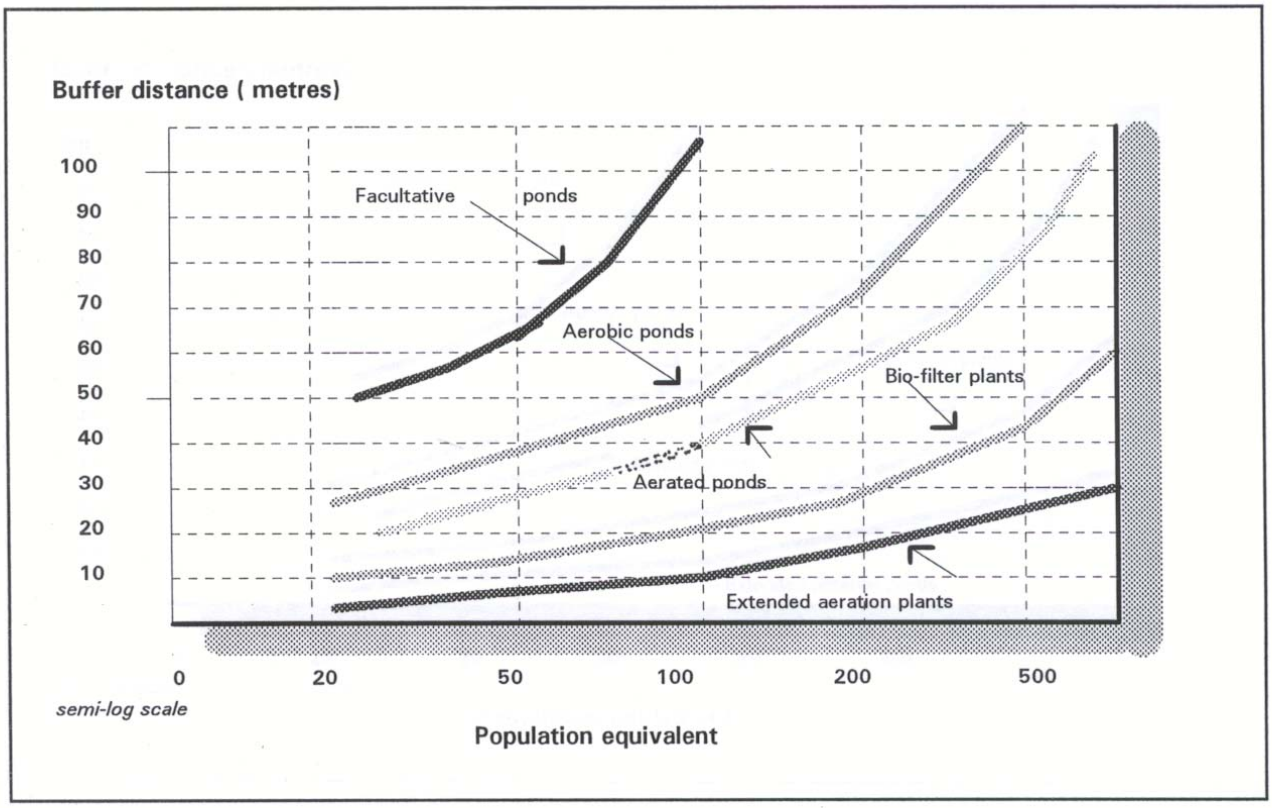


Figure 5: Suggested buffer distances

Table 3: Land capability rating for on-site wastewater management

Land features affecting use		Site capability rating			
		Capable (1)	Marginal (2)	Not capable (3)	Site rating
A	Slope of Land	0 to 15%	15% to 20%	> 20%	
B	Site drainage (to 1.5 m depth)	well drained	Moderate to imperfect	Very poor, poor or rapid	
C	Inundation/flooding, AEP (annual exceedance probability)	Never < 1% AEP	< 20 years 1 to 5% AEP	> 20 years > 5% AEP	
D	Depth to seasonal water or impervious layer (first water)	> 1.5 m	1.5 to 1.2 m	< 1.2 m	
E	Coarse fragments (% gravel & stones to soil volume)	2 to 20%	20% to 40%	> 40%	
F	Emerson test (relevant horizon)	Class 4,5,6 or 8	-	Class 1,2,3, or 7	
G	Mass movement hazard (land slippage)	Not present	-	Present or past failure	
H	Soil percolation rate (mm/h), or permeability (m/d)	15 to 500 0.06 to 2.0	500 to 1500 2.0 to 6.0	< 15 or > 1500 < 0.06 or > 6.0	
Note:	< less than > greater than	site rating satisfying all performance criteria =			

RATING	DEFINITIONS
(1) Capable	Land suitable for on-site use of *treated* wastewater. Standard performance measures for design installation and management are acceptable
(2) Marginal	Land area basically suitable for on-site use of *treated* wastewater. However, one or more land features may not be compatible for on-site use of wastewater. Careful site selection, design and supervision of system required to satisfy all objectives and performance criteria.
(3) Not capable	Area not suitable for on-site reuse of wastewater because several land features will make wastewater reuse impracticable. Partial correction is possible with specialist design and construction techniques to satisfy all objectives and performance criteria. Reticulated sewerage is usually the only acceptable option.
DRAINAGE	
Well drained	Water drains from the soil readily but not rapidly. Ground may remain wet for several days after heavy rainfall.
Moderate to imperfect	Water is drained from the soil slowly in relation to rainfall. Ground may remain water logged for up to a week.
Very poor, poor or rapid	Water is removed from the soil very slowly over more than a month or rapidly in several hours.

Where sufficient measures have been taken to effectively reduce odours and the spread of airborne aerosol spray, an acceptable buffer distance may be determined by the following empirical formula:

$$D_b = a\sqrt{P_e}$$

where

D_b = buffer distance in metres between the plant and nearest residential area

a = surface loading rate in g BOD/m^2d for pondage systems and the digester sludge storage rate in m^3/kg BOD for mechanical treatment type systems

P_e = equivalent population served by the plant or works (one person equivalent being taken as equal to 50 g BOD/d).

3.3 Site safety

The dangers faced by maintenance personnel are physical injuries, infections, asphyxiation and poisonous gases. The following steps must be taken to avoid these hazards.

a) Protect plants against accidents and unauthorised entry by the provision of a suitable fence or other acceptable means.

b) Provide access to the top of any plant more than 2 m above ground level by means of a stairway or step-type ladder in accordance with Australian Standard 1967, *Code for fixed Platforms, Walkways Stairs and Ladders.*

c) Provide all-weather road access for heavy vehicles to within pumping distance of the plant or other necessary maintenance points.

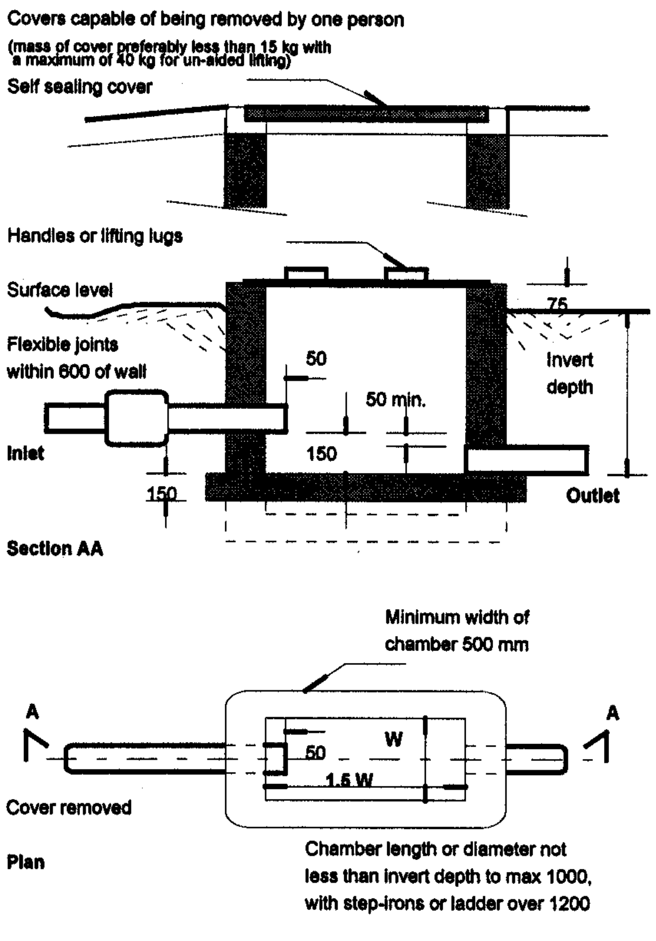
d) Store chemicals in accordance with the requirements for *Dangerous Goods.*

e) Undertake entry and maintenance in confined spaces in accordance with the requirements for *Confined Spaces.*

f) Provide access chambers for inspection and sampling purposes in appropriate places.

The measures detailed in Figure 6 will facilitate access to chambers for the purpose intended.

As-constructed plans will ensure easy location of inspection openings and drains for maintenance.



Notes:

1. Sampling point to be easily accessible.
2. Prevented surface water entering chamber.
3. Permits free flowing samples to be taken.

Figure 6: Access and sampling points

4 BIO-FILTRATION PROCESSES

4.1 Process principles

The key features of this type of process are:

(a) reduced maintenance time

(b) flow balancing achieved by the use of recirculation.

This type of process is suitable for treating domestic wastewater from commercial and industrial premises listed in Table 2.

Three types of biological filtration processes are considered in this section, although other types that satisfy the performance objectives may be used. These treatment plants are normally constructed on site with prefabricated units, however factory built units are available.

Type O – Rotating bio-contactor (RBC)

Wastewater passes through a form of primary settling tank (sewage tank) then flows into a horizontal trough (biological filter zone) in which the filter medium is rotated. The medium is partially submerged in the settled effluent and rotated through the wastewater and air to oxidise the organic matter. Biological slimes slough off the filter media and settle out in the secondary settling tank. The effluent from the settling tank passes to the contact chamber where it may be disinfected before being discharged from the plant.

Type 1 – Trickling bio-filter (TBF)

Wastewater enters a settling tank (sewage tank) then flows into a pump well (mixing tank). The resultant effluent and recirculated effluent mixture is sprayed onto the filter media through which it trickles and drains to the humus tank. The settling process removes the humus from the effluent prior to the contact chamber and subsequent discharge.

The return of treated effluent to the pump well is controlled by the recirculation valve and the desludging of the humus tank is carried out automatically by another pump.

Type 2 – Activated bio-filter (ABF)

The ABF is a treatment process combining a trickling filter with an activated sludge system. After initial settling, the effluent is mixed with return activated sludge from the aeration tank in the pump well and then distributed over the fixed media. Organic matter in the wastewater is oxidised by the organisms growing on the fixed media. The aeration tank provides additional aeration and a well settled sludge. The ABF system enables a trickling filter to be added to an activated sludge process or vice-versa, to obtain desirable process control when upgrading a plant.

4.2 Filter media

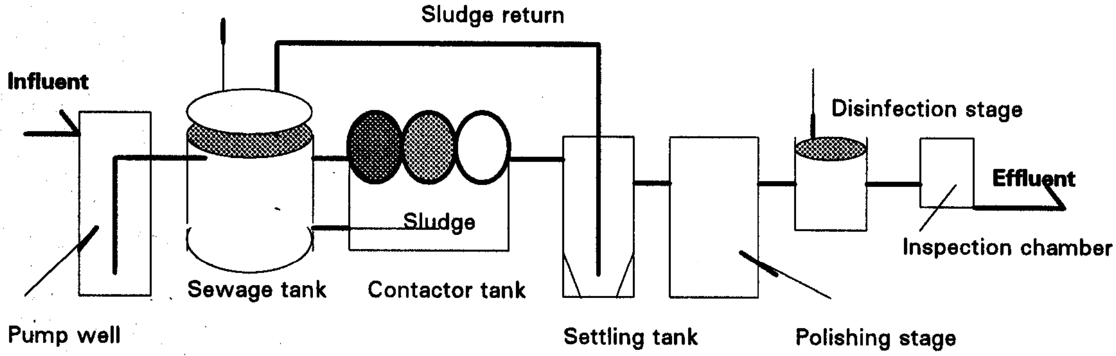
Filter media must be durable and strong enough to resist crushing under any likely imposed loadings. Stone media must be sound, well shaped and free from fines.

Plastic media may be used in accordance with manufacturers' specifications (although more expensive, plastic media offer advantages such as higher loading rates and longer design life).

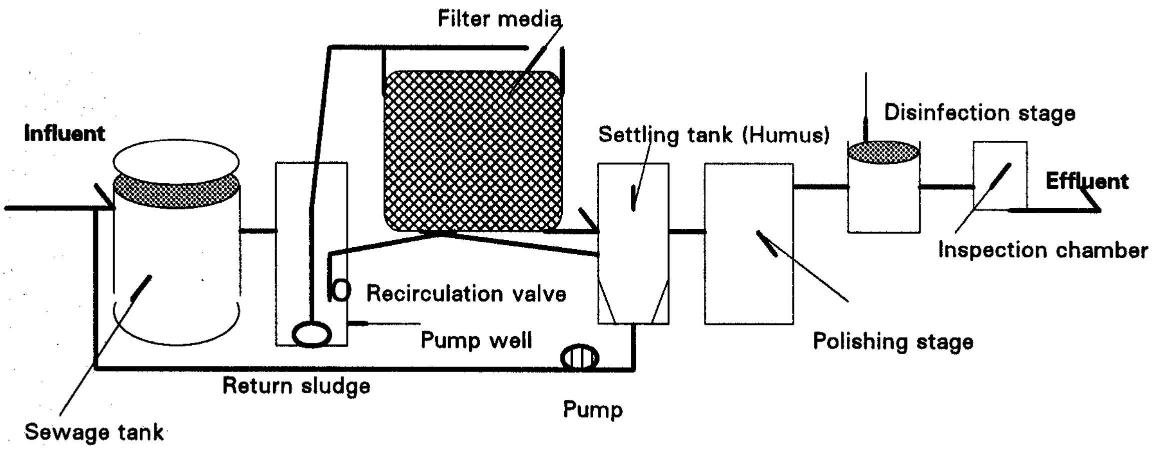
4.3 Accepted standard

See Table 4 for design rates and their application in Design Example for minimum requirements of big-filter wastewater treatment plants with flows up to 100 kilolitres per day.

Rotating Bio-contactor (RBC)



Trickling Bio-filter (TBF)



Activated Bio-filter (ABF)

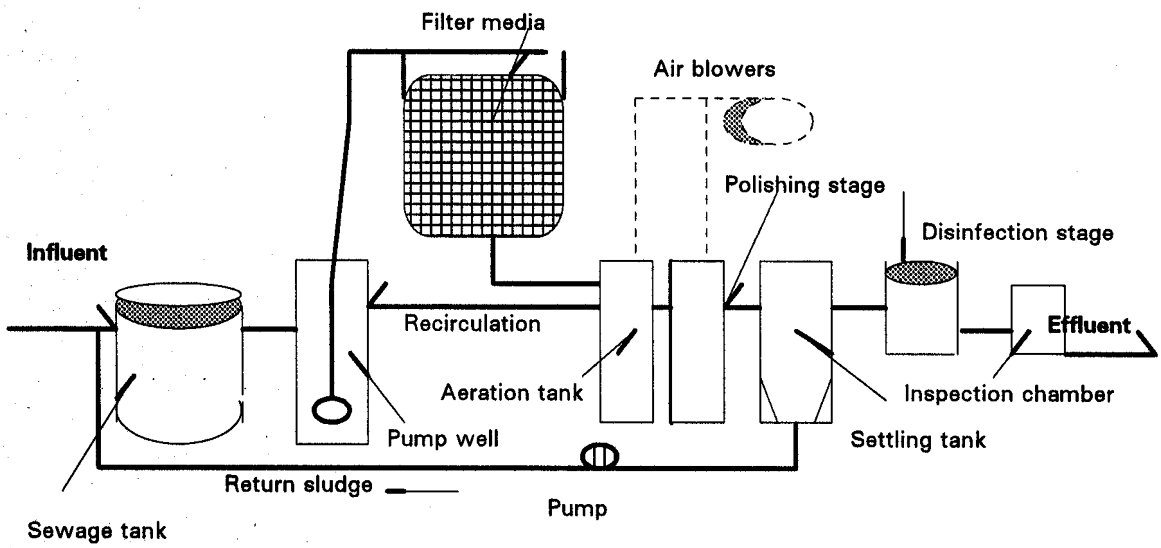


Figure 7: Schematic of bio-filter flow diagrams

4.4 Suggested measures

Plants using the big-filter process have the following features incorporated:

a) standby pumping equipment with automatic changeover in the event of duty failure and appropriate alarms to activate on failure

b) skilled attendance at regular and frequent intervals to ensure that the plant is operated and maintained in accordance with the maintenance schedule. The record of such work, in the form of Plant Maintenance Record, section 11 is submitted to the responsible authorities

c) suitable protection of plant materials against corrosion

d) wastewater is recirculated through the plant at an appropriate rate to compensate for any high variations in loading rates.

4.5 Maintenance of bio-filters

Wastewater treatment plants operating on the biological filtration process require regular inspection, monitoring and preventative maintenance if they are to operate and function effectively.

To maintain plant operation at optimum conditions – the basis on which the plant was approved – the following maintenance, regular tests and adjustments must be carried out by a competent person.

Details of maintenance and test results must be kept by the operator on a plant maintenance record.

Table 4: Design rates for bio-filter plants

Plant component	Design rates
Primary sewage tank – see Table 2	
Detention time @ *MDF* - plus	› 12 hours
Sludge storage*	2.0 m^3/kg BOD
Bio-filter (BOD applied load)	@ *MDF*
Type O Rotating media (RBC)	‹ 10 g/m^2d
Type 1 Stone media (TBF)	‹ 100 g/m^3d
Type 2 Plastic media (ABF)/(TBF)	‹ 500g/m^3d**
Type 2 Aeration tank	‹ 2000 g/m^3d
Ventilation of filters (* based on specific surface area of 100 m^2/m^3)	› 5% of filter surface area
(Hydraulic loading)	@ *MDF*
Type 0 Trough detention (RBC)	› 4.0 hours
Type 1 Stone filter media (TBF)	‹ 500 L/m^2d
Type 2 Plastic fixed media (ABF)	‹ 2,500 L/m^2d
Settling tank – see figure 4	@ *PHF*
Surface overflow rate	‹ 1,000 L/m^2h
Weir overflow rate	‹ 2,000 L/m.h
Detention – min of 4 h @ MDF	› 1.0 hour
Disinfection	
Maturation pond or	› 30 days
Contact chamber @ *PHF*	› 1.0 hour

* Separate sludge storage may be provided where primary tank exceeds 20 kL.

** Loading rates based on medium with specific surface area of 100 $^2/m^3$ and a minimum recirculation ratio of 1 to 5.

Higher loading rates may be used provided that adequate technical support data is supplied with application.

MDF – maximum daily flow, PHF – peak hourly flow, ‹ less than, › more than.

MAINTENANCE AND INSPECTION SCHEDULE

Weekly maintenance

- Check frequently for possible nuisance conditions such as insects, leakages and odours.
- Check the operation of pumps, control switches and alarm system.
- If disinfection is necessary, check that the dosage rate is satisfactory by testing for a disinfectant residual and check that an adequate quantity of disinfectant is available.
- Check operation of humus sludge and effluent recirculation.

Monthly maintenance

- Check standby electrical pumps or other equipment for duty operation.
- Check for obstructions and clear any blockages at inlets, transfer ports and outlets to tanks. Hose down and clean plant.
- Clean trickling filter distributor and/or check that effluent is evenly distributed over filter media.
- Check for ponding of effluent caused by overgrowth of algae and fungi in ventilation ducts and on surface of filter media. If found, remove it by hosing or forking.
- Check the height of sludge in tanks and if necessary arrange for desludging.
- Clean contact tank and remove any sludge accumulation from bottom of tank.
- Check that the polishing treatment stage (sand filter, waste stabilisation pond or other 'polishing' process) is functioning satisfactorily.
- Check effluent quality for turbidity by means of the clarity test.

Annual maintenance

- Desludge digester tank annually (or as required) in an off-peak period.
- Check all mechanical and electrical equipment (such as automatic change-over equipment, alarms) to ensure that it is functioning correctly.
- Clean and overhaul plant and equipment as required.

Operating instructions

When the plant is commissioned, the contractor should give the owner detailed operating and maintenance instructions and a plan showing the location of pumps, valves and inspection openings.

For easy reference in case of plant failure, the names, addresses and telephone numbers of service and maintenance contractors should be prominently shown on the schedule, for example.

Service contractors' names, addresses and telephone numbers

Installation by: ....

Maintenance operator: ....

Desludging contractor: ....

Pump supplier:..

Supplier of disinfectant: ....

DESIGN EXAMPLE – TRICKLING BIO-FILTER

To design a wastewater treatment plant for a proposed camping park of 20 sites on the outskirts of a holiday resort town. An annual occupancy of only 25% is anticipated, although during the summer months the park is expected to be full.

1. Determine the daily flow (MDF) and peak hourly flow (PHF)

(a)	Assume 3 persons per site @ 100% occupancy (Table 2)		
	Daily flow	= 20 sites x 3.5 persons x 100 litres/person	
		= 7000 litres per day	(7 kL/d)
(b)	For 70 persons, the peak to average hourly flow ratio is 6 (Figure 2)		
	Peak hourly flow	= 7000/24 x 6	
		= 1750 litres per hour (L/h)	
(c)	BOD Load	= 20 sites x 3.5 persons x 40 gBOD/person	
		= 2800 grams BOD per day	(2.8 kg/BOD/d)

2. Assessment of treatment process to be adopted

(a) Peak to average flow ratio is high, ie greater than 5 with significant seasonal and daily flow variations.

(b) Sufficient area for isolation of plant from camp sites.

3. Design of treatment plant (Biofiltration - Type 1)

(a)	Primary wastewater tank @ 12 h x MDF + 2 m^3/kgBOD, (Table 4)		
		= (7 x $^1/_2$) + (2 x 2.8 x 25%)	
		= 4.9 m^3	say (5 m^3)
(b)	Biological filter @ 100 gBOD/m^3d		
	(i) Filter Volume	= 2800/100	
		= 28 m^3	(28 m^3)
	(ii) Depth of media selected	= 2000 mm	(2 m)
	(iii) Surface area of filter	= 28/2.0	
		= 14.0 m^2	(14 m^2)
	(iv) Hydraulic loading on filter	= 7000/14.0	
		= 500 L/m^2d	
(c)	Settling tank - Peak hourly flow	= 1750 L/h	
	(i) Surface area @ 1000 L/m^2h	= 1750/1000	(1.75 m^2)
	(ii) Weir length @ 2000 L/mh	= 1750/2000	(0.87 m)
	(iii) Volume of tank @ I h x PHF	= 1750 L	(1.75 m^3)
(d)	Maturation pond @ 30 days x MDF	= 30 x 7 kL/d	210 kL (210 m^3)

4. Pump and pump well

Pump capacity	= Peak hourly flow + recirculation	
	= 1750 + 7000/24 x 5 (Sections 2 & 3)	(3200 L/h)
Pump well storage	= Pump cycle + emergency storage	
	= 2h@MDF	
	= 2 x 7000/24 (Section 8)	(584 L)

5 ACTIVATED SLUDGE PROCESSES

5.1 Process principles

Treatment plants are usually factory prefabricated, making them compact and easily portable at the expense of operational simplicity. They are suitable for treating domestic wastewater from institutional and residential buildings where the daily wastewater flow is uniform and comprehensive maintenance can be carried out.

Because of operational difficulties (such as insufficient organic food for the micro-organisms and the flushing of solids from plants under peak flow conditions) these systems are not recommended when the daily variation is more than 50%.

Type 1– Extended aeration (EA)

The extended aeration process involves treatment in three compartments – an aeration or mixed liquor compartment, a settling compartment and an aerobic digester.

Raw wastewater flows to the aeration compartment where it is aerated in a mixture with activated sludge. The sludge is separated from the mixed liquor in the settling compartment. The settled sludge (activated sludge) is then recycled to the aeration compartment, the waste sludge to the digester and the treated effluent leaves the plant over a baffled weir.

Type 2 – Contact stabilisation (CS)

The contact stabilisation process involved treatment in four compartments.

In the first compartment, wastewater is aerated with activated sludge. The mixed liquor then passes to the settling tank. After settlement, the treated effluent is discharged and the sludge is transferred to a third (re-aeration) compartment where it is aerated for a period during which time oxidation of absorbed organic material occurs.

A large proportion of the activated sludge is then returned to the first (contact) compartment and surplus sludge is wasted to the fourth (aerobic digester) compartment where it is further aerated and stored before being removed for disposal.

Type 3 – Anaerobic–aerobic (AA)

The anaerobic-aerobic process is based on the extended aeration process described above, but the organic loading on the aeration compartment is reduced by pre-treatment of the wastewater anaerobically. A large proportion of the solids and surplus sludge is stored in this compartment (the digester). If recirculation through the digester is carried out during short shutdown periods or during flow fluctuations, this compartment will provide the organic solids necessary for small installations.

Type 4 – Intermittent decant

The intermittent decant system is a fill and draw extended aeration process. In its simplest form a single tank – without primary settling – receives wastewater continuously. The wastewater aeration process operates for between 50% and 70% of the time. A cycle of aeration, settling and decanting occurs over a period of three to four hours. The discharge of treated effluent occurs intermittently during the decant period. The process produces a high quality effluent that can be adapted for nitrogen and phosphorus removal.

5.2 Accepted standard

The design rates in Table 5 are accepted minimum requirements for small activated sludge wastewater treatment plants with flows up to 100 kilolitres per day.

5.3 Suggested measures

Plants employing the activated sludge process will have the following features incorporated:

a) Standby mechanical aeration equipment with automatic changeover in the event of mechanical failure and appropriate alarms to activate on failure. Please note: adequate air supply can be achieved by installing two units, each with a capacity of 50% of the peak.

b) Surplus sludge storage (digester tank) and provision for vehicular access for the removal of sludge at regular intervals.

c) Arrangements for attendance at regular and frequent intervals to ensure that the plant is operated and maintained adequately in accordance with the maintenance schedule. The maintenance record of such work is submitted to the responsible authorities.

d) Suitable protection of plant materials against corrosion.

e) Air diffusers are installed in such a manner that they are capable of being readily removed for maintenance purposes.

5.4 Maintenance of activated sludge plants

To ensure effective operation, wastewater treatment plants using the activated sludge process require regular inspection, monitoring and preventative maintenance.

If the plant is to operate at optimum performance levels, regular tests, maintenance and adjustments should be carried out by a competent person.

Further details of maintenance and regular tests necessary for assessing plant performance are shown in section 11.

Table 5: Design rates for activated sludge

Plant component	Design rates
Aeration tank @ *MDF*	see Table 3
BOD loading (applied load)	
Type 1 Aeration tank (EA)	‹ 250 g BOD/m³
Type 2 Combined tank (CS)	‹ 500 g BOD/m³d
Type 3 Aeration tank (AA)	‹ 750 g BOD/m³d
Type 4 Intermittent (IDEA)	‹ 300 g BOD/m³d
Air blower – air supply @ *MDF*	
Type 1 }	› 300 m³/kg BOD
Type 2 } Air blowers*	› 200 m³/kg BOD
Type 3	› 200 m³/kg BOD
Type 4 Surface aerators	› 2500gO_2/kg BOD
Digester tank @ *MDF*	maximum 5m³
Type 1 Aerobic digester	› 1.0 m³/kg BOD
Type 2 Aerobic digester	› 2.0 m³/kg BOD
Type 3 Primary and digester tank	› 3.0 m³/kg BOD
Type 4 Pondage systems	15% of pond volume
Settling tank not Type 4	
Surface overflow rate @ *PHF*	‹ 1,000 L/m²h
Weir overflow rate @ *PHF*	‹ 2,000 L/m h
Detention time @ *MDF*	› 1 h
Disinfection	
Maturation pond or	› 30 days
Contact chamber @ *PHF*	› 1.0 hour

* Air supply 2 blowers @ 100% or @ 50% MDF standby

Higher loading rates may be used provided that adequate technical support data is supplied with application.

MDF – maximum daily flow, PHF – peak hourly flow, ‹ less than, › more than

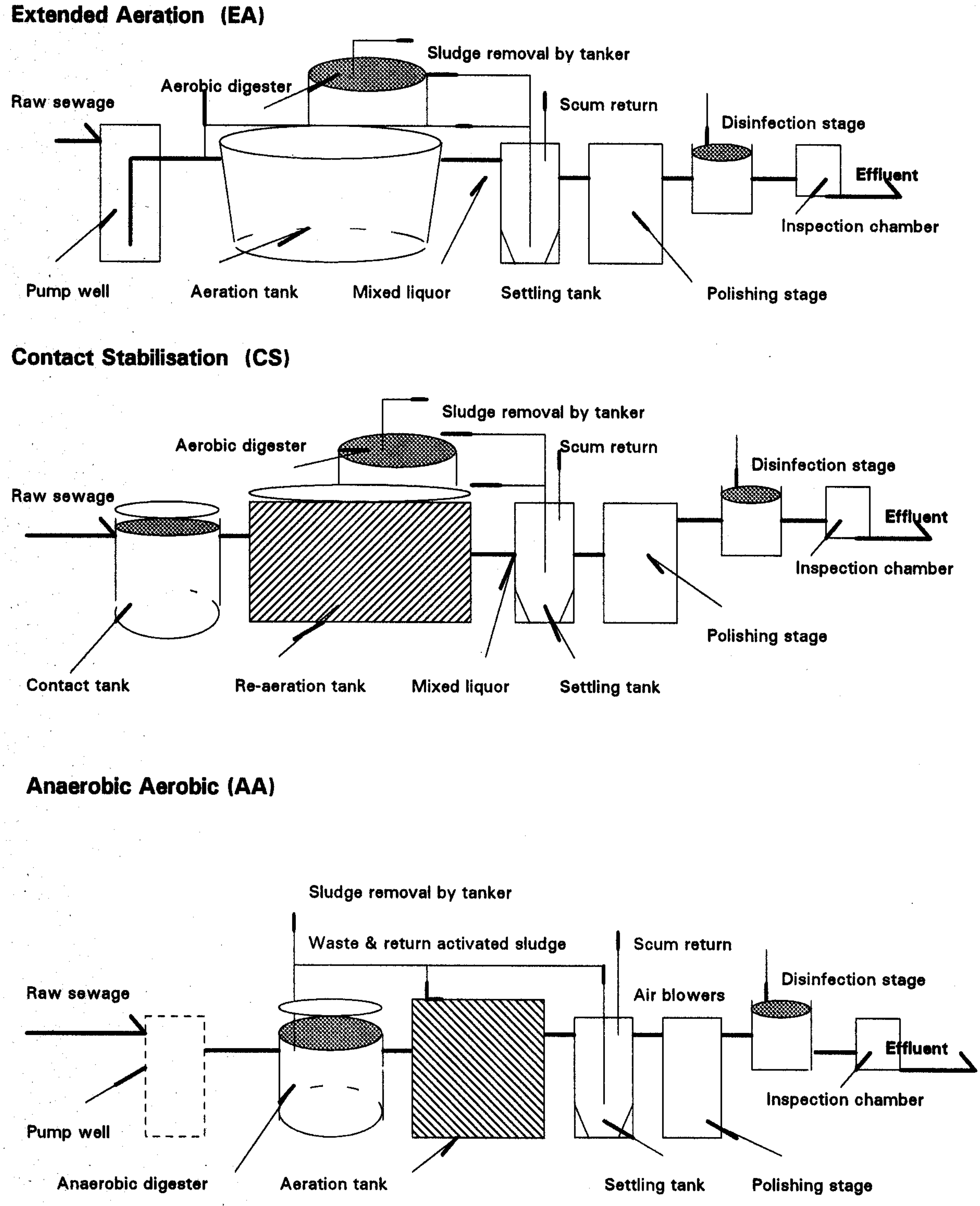


Figure 8: Schematic of activated sludge flow diagrams

DESIGN EXAMPLE – ACTIVATED SLUDGE

Requirement

To select a suitable wastewater treatment plant for a proposed new housing estate that will serve 50 allotments. Sewerage reticulation will not be available for at least five years.

1. Determine the daily flow (MDF) and peak hourly flow (PHF)

a) Assume 3 people per residence at 200 litres/person (Table 3).

Total flow	= 50 homes x 3 people x 200 litres/person	
	= 30,000 litres per day	(30kL/d)

b) For 150 people, the peak to average hourly flow ratio is 5 (Figure 3).

Peak hourly flow	= 30,000/24 x 5	
	= 6,250 litres per hour (L/h)	

c) BOD Loading = 5 homes x 3 people x 50 g BOD/person

Total BOD Load	= 7,500g BOD per day	(7.5 kg BOD/d)

2. Assessment of treatment process to be adopted

a) Peak to average flow ratio is moderate (that is, not more than 5) with negligible shut down periods and consistent daily flows.

b) Isolation of plant from residences will be poor (see Section 3). This will require a compact plant with a low profile and particular attention to environmental health safeguards.

3. Design of treatment plant (Activated sludge Type 1)

a)	Aeration tank @ 250 g BOD/m^3d	= 7,500/250, Table 6	
		= 30 cubic metres	(30 m^3)
b)	Air Blower - air supply	= 7.5 x 300/24 h, Duty Air blower ~ 300 m^3/kg BOD	
	Air Supply	= 93.75 m^3/h	(2 No. Blowers)
c)	Digester tank/sludge storage	= 1 x 7.5 Sludge holding tank @, 1 m^3/kg BOD	
		= 7.5 m	(7.5 m^3)
d)	Settling tank - Peak hourly flow	= 6,250 L/h	
	i) Surface area	= 6,250/1,000	
	Surface overflow rate @ 1,000 L/m^2h		
		= 6.25 m^2	(6.25 m^2)
	ii) Weirlength	= 6,250/2,000	
	Weir overflow rate @ 2,000 L/mh		(3.12 m)
	iii) Volume of tank	= 6,250 › (4 x MDF = 5,000)	
	Detention time ~ 1 h x PHF	= 6,250 L	(6.25 m^3)
e)	Contact chamber	= 30,000/24 Detention time @ 1 h x MDF	
		= 1,250 L	(1.25 m^3)

4. Buffer distance

$D_b = a \sqrt{P_e}$, hence = 1 x √ 150 people = 12.25m (12 m)

MAINTENANCE AND INSPECTION SCHEDULE

Daily maintenance

- Check the operation of the scum skimmer and sludge return mechanism and clear any blockages at inlet, transfer port or outlet.
- Check that the duty air blower and any pumps are operating satisfactorily and that no air diffusers are blocked.
- If disinfection is necessary, check that the dosage rate into the final effluent is satisfactory on a daily basis, by testing for a disinfectant residual. Ensure that an adequate quantity of the disinfectant is available.

Weekly maintenance

- Remove scum and biological slime growths from the various chambers of the plant and clean the sloping sides of the settling tank.
- Determine if sludge settleability volume is within the range specified in the maintenance schedule[1]. If the upper limit on a 30 minute test is exceeded, an appropriate amount of sludge should be wasted to the digester as specified in manufacturer's manual.
- Determine if dissolved oxygen is within the range specified in the maintenance schedule[1]. Check if the pH of mixed liquor or plant effluent is in the range specified in the maintenance schedule[1].
- Carry out any other tests and adjustments as specified by the manufacturer to maintain satisfactory plant performance.

Monthly maintenance

- Check all mechanical and electrical equipment (such as automatic change-over equipment alarms) to ensure they are functioning correctly.
- Switch standby electrical pumps or other equipment over to duty operation.
- Check the sludge level in the digester to determine whether it requires desludging by the contractor.
- Clean the contact tank and remove any sludge accumulation from the bottom of the tank.
- Check that any polishing treatment stage (sand filter, waste stabilisation pond or other 'polishing' process) is functioning satisfactorily.

Regular tests, maintenance and adjustments must be carried out by a competent person to maintain plant operation at optimum performance level.

Operating instructions

The contractor's detailed operating and maintenance instructions, including a plan drawn to scale showing location of plant items and inspection openings, should be kept by the owner at the plant.

Service maintenance contractors

For easy reference in case of plant failure, the names, addresses and telephone numbers of service and maintenance contractors should be shown on the maintenance schedule.

[1] The manufacturer's design limits for satisfactory performance are to be specified in the maintenance schedule.

6 STABILISATION PONDS

6.1 Pondage systems

Stabilisation ponds are a successful alternative form of wastewater treatment - particularly where large hydraulic and organic load fluctuations have occurred.

The scope of this specification and the design rates are limited to the treatment of effluent from septic tanks or wastewater treatment plants ('polishing' stage) in aerobic and maturation ponds.

Factors which determine whether a pondage system might be feasible are:

- availability of suitable land at the site
- compatibility of pondage system with neighbouring land use
- waste characteristics and effluent quality objectives.

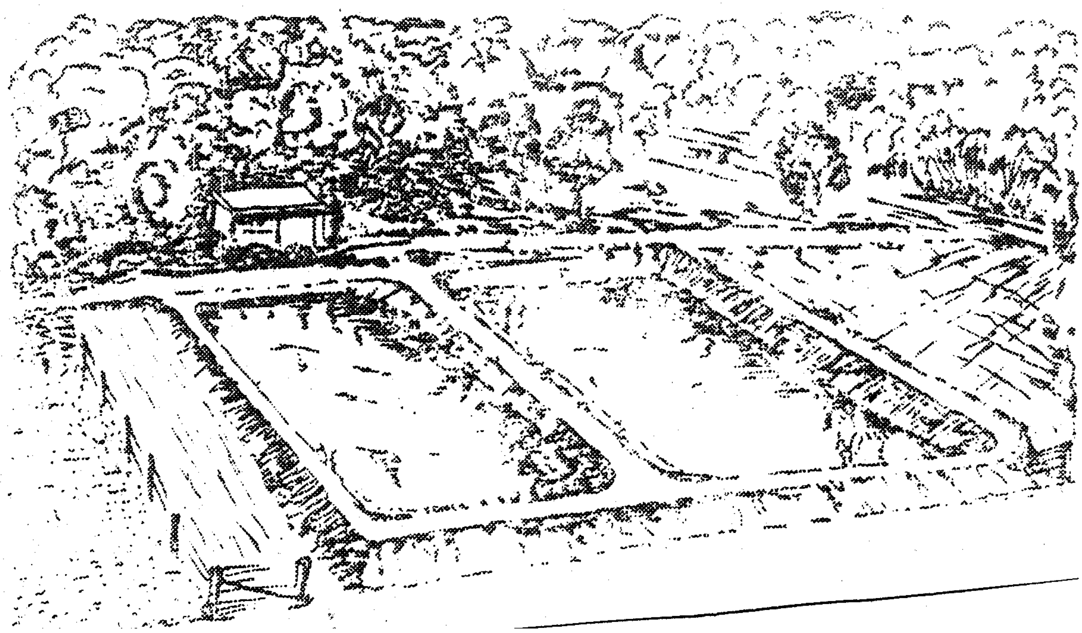
As construction techniques are determined by pond size, shape and location, this specification covers only small pondage systems - up to one hectare (10,000 m^2) in area with embankments less than 3m high.

6.2 Process principles

'Stabilisation pond' describes any pond or pond system designed for biological wastewater treatment. In stabilisation ponds, the organic waste is stabilised by micro-organisms and the number of disease causing organisms is significantly reduced - primarily due to the long detention periods. There are many different types of stabilisation ponds - such as anaerobic, aerobic, facultative, aerated and maturation ponds.

Anaerobic ponds deeper than 1.5 m are essentially digesters in which anaerobic bacteria break down the complex organic wastes. The action is similar to that in a septic tank. Due to odour emission, anaerobic ponds are not recommended for small scale systems.

Aerobic bacteria and algae use photosynthetic processes, break down the wastes in ***aerobic ponds*** *up* to 1m deep. At least two and preferably three ponds in series must be used, to minimise short circuiting of the flow.



Construction of pondage systems for wastewater treatment follows normal engineering practice for small dams.

Facultative ponds up to 1.5m deep are those in which the upper layer is an aerobic zone maintained by algae, and the lower zone is anaerobic.

Aerated ponds are mechanically aerated to supplement or provide the required dissolved oxygen.

A ***maturation pond*** provides a high bacteriological quality effluent. It is not intended to relieve an aerobic pond or conventional treatment plant that has proved to be inadequate. The principal factor in the design of a maturation pond is detention time (30 days for a depth of 2m). For efficient reduction of bacteria, the effluent discharging into the pond must be well oxidised (to the 20/30 standard). The degree of bacterial purification obtained is governed by the length of detention and number of ponds.

Evaporative pondage systems designed for complete retention of wastewater (no overflow) may be practical in areas where evaporation is greater than waste effluent and rainfall. If sludge accumulation near the inlet of ponds is not controlled, the performance of the pond will be affected. Annual desludging of the septic tank(s) will reduce any solids carry-over to the ponds.

Recirculation of effluent from final treatment pond back to inlet of the pondage system can reduce the BOD concentration of the wastewater entering the system. The organic load on the system is more uniformly distributed by the use of effluent recirculation. The provision of effluent recirculation will reduce odour generation from the primary pond and provide enhanced treatment of the effluent.

6.3 Accepted standard

Aerobic ponds using septic tanks for primary system treatment will have an applied BOD loading not exceeding 3.5 g BOD/m^{2}d, assuming a 30% reduction of BOD in the septic tanks.

A simplified procedure for determining pond area, is to use the wastewater loadings from Table 2 and divide by the design rates in Table 6 to establish the pond size.

See design examples for detailed explanation.

Table 6: Design rates for aerobic and maturation ponds

Treatment prior to pond system	Aerobic ponds – BOD loading	Maturation pond retention
Unoxidised effluent from septic tank or	5 g BOD/m^{2}d	30 days
Oxidised effluent (20/30 standard) from septic tank	– no pond	30 days

6.4 Suggested measures

Site features of land to be used for a pondage system are rated and assessed for suitability using Table 6.

Stabilisation ponds are constructed in accordance with the following requirements.

a) Square, rectangular, oblong or circular shaped ponds are acceptable.

b) Where rectangular, oblong or composite shaped primary ponds are envisaged, pond length should not exceed three times the width.

c) No pond should have an area of less than 50 m^2.

d) Construction of embankments will be dictated by normal engineering practice for small dams.

e) Protection of embankment against erosion and weed growth may be provided by means of concrete paving, asphalt, crushed rock or other material being placed along the waterline of the banks.

f) Erect suitable fencing around the pondage to prevent access of livestock and trespassing by people. Post appropriate warning signs as required.

When selecting a site for a pondage system the main considerations are topography, foundations and the availability of suitable embankment material.

Selection of a tentative site should be established by soil testing within the proposed pondage and borrow pit areas. Avoid materials such as gravels and sands, as well as springs, soaks and landslip areas.

Materials to be placed in the pond embankments must be sufficiently impervious to reduce seepage to a minimum.

The soil samples taken from the test bores should be identified in accordance with the Unified Soil Classification System.

Material containing about 20% to 30% clay, should provide a good impervious bank. Permeability tests should be carried out in material at the depth of pondage base excavation.

New ponds must be partially filled with relatively clean water or storm water. The edges of the ponds must be kept free of vegetation to reduce mosquito breeding. Protection of the embankment with concrete slabs around the verges of the ponds will restrict weed growth and erosion.

Table 7: Site selection rating for pondage systems

Site features affecting use	Land Capability Class Rating		
	I (Slight)	II (Moderate)	III (Extreme)
1. Gradient			
Slope	Less than 5%	5% to 15%	More than 15%
2. Drainage			
Site drainage	Well drained	Moderately drained	Poorly drained
Flood recurrence	Less than 1 in 100 years	20 to 100 years	More than 1 in 20 years
Seasonal high water table	More than 2 m	1 m to 2 m	Less than 1 m
3. Sub-soil			
Permeability or	Slower than 0.01 m/d	0.01 to 0.1 m/d	Faster than 0.1 m/d
Percolation rate of soil	Slower than 5 mm/h	5 to 50 mm/h	Faster than 50 mm/h
Depth to bedrock	More than 2 m	1 m to 2 m	Less than 1 m
4. Bank material			
Unified Soil Classification	GC, GM, SC, SM	CL, ML, CH, MH	SP, SM EP, OL, OH, Pt
Shrink/swell potential	Less than 12%	12% – 20%	More than 20%
5. Buffer distances			
Streams and watercourses	More than 100 m	15 m to 100 m	Less than 15 m
Dwellings	More than 100 m	30 to 100 m	Less than 30 m
Camping sites	More than 50 m	15 to 50 m	Less than 15 m
Site boundary – toe of bank	More than 10 m	2 m to 10 m	Less than 2 m

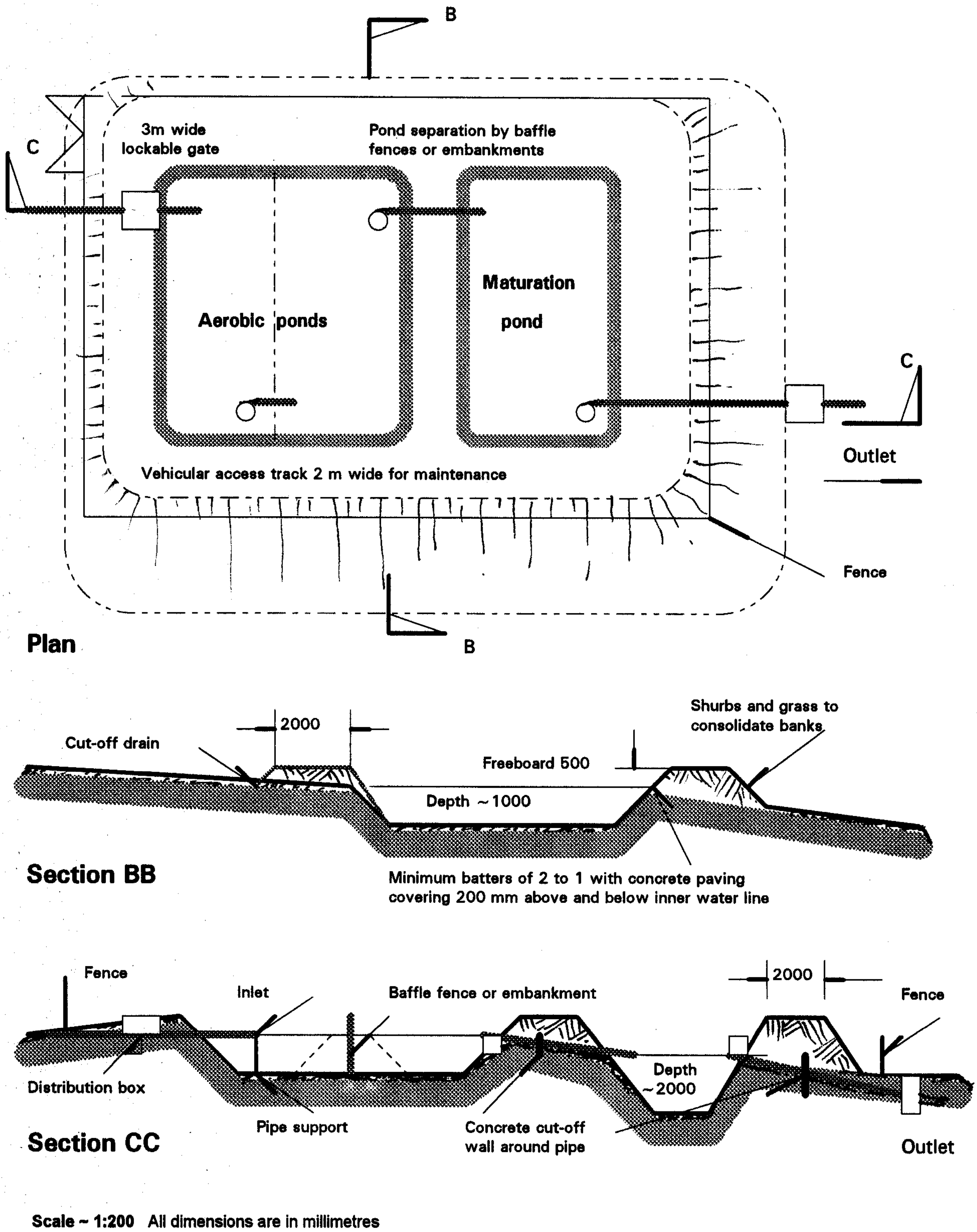


Figure 9: Waste stabilisation pond construction

DESIGN EXAMPLE – WASTE STABILISATION PONDS

To design a suitable wastewater treatment system for a community school of 500 students located in a rural area with 20% of the students boarding at the school. There are three term breaks of two weeks duration and an end of year break of six weeks in which there will be no discharge to the system.

1. Determine the daily flow (MDF) and peak hourly flow (PHF)

(a) Daily flow = 400 x 20 + 100 x 100 (Table 2)

= 18000 litres per day (18 kL/d)

(b) For 500 students, the peak hourly flow is 8 (Figure 2.3)

Peak hourly flow = 18000/24 x 8 = 6000 litres per hour

(c) BOD Loading = 400 x 8 + 100 x 30 (Table 2)

= 6200 gBOD/d (6.2 kgBOD/d)

2. Assessment of treatment process to be adopted

(a) Peak to average flow ratio, very high, ie 8 to 1, with complete shut down periods of more than one week.

(b) Large areas of land available in vicinity of playing ovals and isolated from dwellings.

Stabilisation pond system selected to cater for very high flows and vacation shut down periods.

3. Design of pond system

(a) Septic tank capacity = 2000 (sludge) + 18000 (daily flow)

= 20 000 litres ($20\ m^3$)

(b) Aerobic pond @ 5 g/BOD/m^2d, (Table 6)

Area of aerobic ponds - 6200/5

= 1240 m^2 (1240 m^2)

(c) Maturation pond

Pond 1 m deep with 30 days retention

= 18 kL/d x 30 days

= 540 kL (540 m^2)

(d) Total pond area = 1240 + 540

= 1780 m^2, say 3 ponds @ 600 m^2 = 1800 m^2 (1800 m^2)

Allowing for embankments and fencing, area required is 0.25 (ha) hectare.

4. Buffer distance

$D_b = a \sqrt{P_e}$

where a = 5 and

P_e = equivalent student population

= (400 x 8 + 100 x 30)/50 = 124 persons

hence $D_b = 5 \sqrt{124}$

= 55.6 say 60 m from residential area. (60 m)

7 POLISHING PROCESSES

7.1 Pebble clarifier

For wastewater treatment plant effluent to comply with the 20/30 standard or higher standards, it is often necessary to provide a further stage of treatment before discharge to a drain or stream. This treatment is not to upgrade a poor effluent; rather it is to reduce the residual suspended solids in the effluent. A sand filter or upward flow clarifier are such processes for 'polishing' an effluent.

In an upward-flow clarifier, the settling effluent is passed upwards through a layer of pebbles that is supported on a perforated grid. Tests have shown that this stage will remove approximately 30% of the BOD and 50% of the suspended solids.

Solids accumulate within the pebble bed and when a layer of solids appears evenly over the surface of the bed, cleaning is required. The level of the liquid in the tank is lowered to back-wash the filter media.

It is advisable to thoroughly backwash the filter media weekly by completely draining the tank and hosing down with a jet of high pressure water, while raking the pebble bed.

7.2 Clarifier construction

The clarifier is constructed in accordance with Figure 10 and section 7.3 similar to a settling tank.
A perforated grid of galvanised or plastic covered expanded metal grid decking or similar material with perforations of at least 2 mm diameter, supports the layer of pebbles. The total area of the perforations should be at least 60% of the floor area.

7.3 Accepted standard

The total pebble bed area may be calculated so that the rate of flow does not exceed 1000 litres per square metre per hour (1000 L/m^2h) at peak flow. The depth of the pebble bed is to be 150 mm and pebbles are to be of smooth round stone of 5 mm – 10 mm size.

7.4 Sand filters

A sand filter may be used for polishing or treating waste discharges.

Long term efficiency of a sand filter is affected by such factors as the effective size of the sand, the uniformity coefficient and the amount of clay and fine silt in the sand.

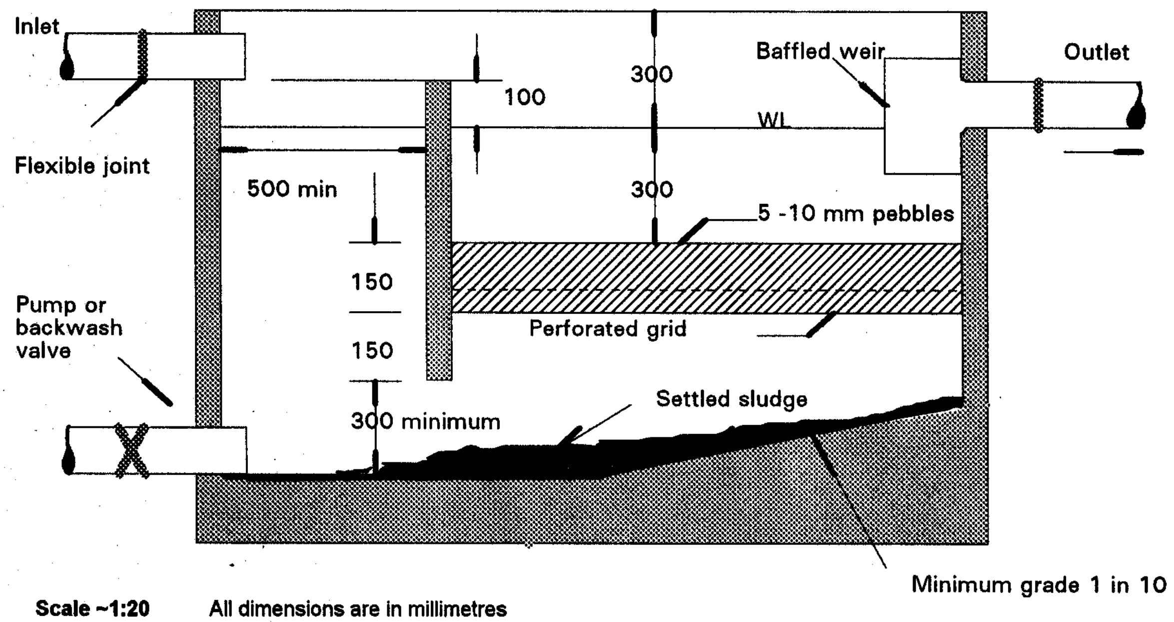


Figure 10: Pebble clarifier installation

7.5 Accepted standard

The design life of a sand filter is determined by the loading on the system. The following daily dosage rates represent best practice:

a) septic tank effluent 50 L/m^2d

b) intermittent and recirculating 100 L/m^2d

c) polishing of 20/30 standard 200 L/m^2d

7.6 Suggested measures

The construction features of a typical sand filter are illustrated in Figure 11.

To minimise the chances of anaerobic bacteria – such as *Beggiatoa* species – forming around the distribution pipes, it is good practice to vent the distribution pit. The dead ends of the distribution pipes may also be joined and provided with a ground vent.

It is important that the base of the sand filter is always above the groundwater table. Where a high water table or rock is encountered, above ground systems may be constructed with an impervious retaining wall around the filter.

A dosing device may be installed to improve the distribution of effluent over the surface of the sand and filter design service life. Where a sand filter exceeds 50 m^2 in area, an automatic dosing device – such as a dosing siphon, tipping trough or pump – must be installed. The volume of one cycle of the dosing device must be at least half the volume of the distribution pipes. It must not exceed the volume of the distribution pipes.

Sand specifications

Care must be taken in the selection of the filter sand, as fine sand tends to clog quickly and very coarse sand will not achieve satisfactory oxidation of the effluent.

Sands with a uniformity coefficient between one and four have similar hydraulic characteristics if the effective size is the same. Most sands contain clay particles that react with anionic detergents to reduce the permeability of the sand.

All filter sand must be clean washed sand which complies with the following requirements:

a) effective size[1] between 0.25 mm and 0.60 mm (0.40 mm – 1.00 mm for intermittent or recirculating and 0.60 mm – 1.00 mm for polishing sand filters)

b) uniformity coefficient[2] less than four

c) clay and fine silt less than 5% by volume.

Sand testing methods

It is not possible to accurately determine the effective size and uniformity coefficient of sand by visual inspection. It is essential that the sand samples must always be checked by mechanical analysis as follows.

a) A representative bulk sample of at least 2000g must be collected by means of a 50 mm diameter sampling tube from five (5) points around the sand deposit.

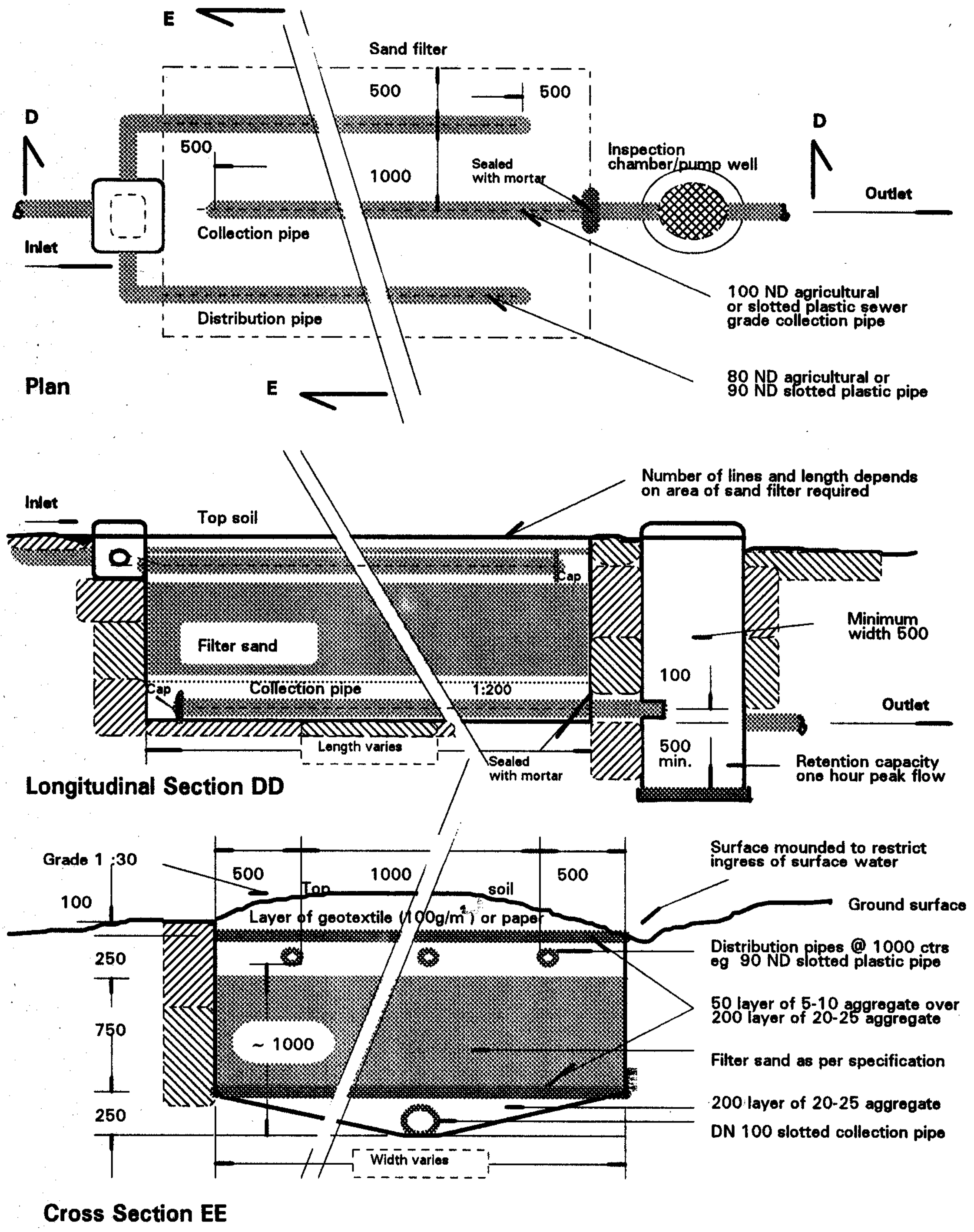
b) A test portion of 100g – 200g dry mass must be reduced from the bulk sample by means of a sample divider or by coning or quartering for sieve analysis.

c) The sieve analysis must be carried out in accordance with Australian Standard 1141 *Methods for Sampling and Testing Aggregates.*

A settling test to determine the amount of clay and fine silt in a sand sample must be carried out in accordance with AS 1141.

[1] Effective size(s) is the maximum particle size of the smallest 10% by mass.

[2] Uniformity coefficient is the ratio of the maximum particle size of the smallest 60% by mass of the sample, to the maximum particle size of the smallest 10% by mass.



Scale ~ 1:50 All dimensions are in millimetres

Note: All filter sand to be clean washed sand with:

1. Effective size between 0.25 and 0.60 mm
2. Uniformity co-efficient less than 4 and
3. Clay and fine silt less than 5% by volume

Figure 11: Sand filter installation

8 PUMPING SYSTEMS

8.1 Objectives

This relates to pumpsets designed to cope with flows of less than 100 kilolitres per day.

The pumping of wastewater should be avoided where practicable, by locating or designing the treatment system to make pumping unnecessary. Where unavoidable because of site conditions or the treatment system to be used, the following items should be taken into consideration when designing the system.

a) The location of pump wells is normally determined by site conditions but if practicable they should be located after a settling tank.

b) The selection of pumps should be governed by the volume of waste to be pumped. Pumps may also serve as a dosing device and/or flow equaliser for the plant.

c) Multiple pumps with automatic operation and changeover must be installed in all systems except for single dwellings or premises where the daily flow is less than 1000 litres.

8.2 Suggested measures

Pump wells are constructed in accordance with section 3 and Figure 12.

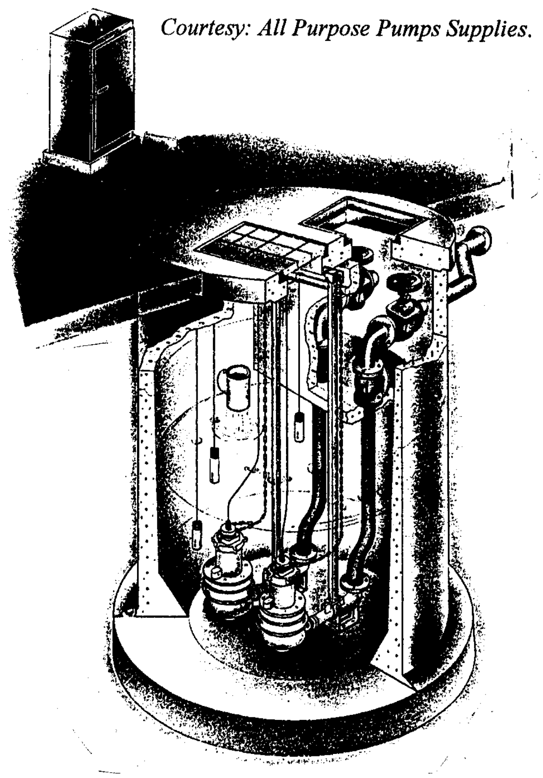
Pump stop and start (cut-out/in) levels to be located so that the duty pump will discharge a volume of liquid equal to approximately one (1) hour of MDF.

In emergency situations – such as power failure the well has an additional liquid storage capacity of at least (1) hour of MDF between pump cut-in and well inlet levels.

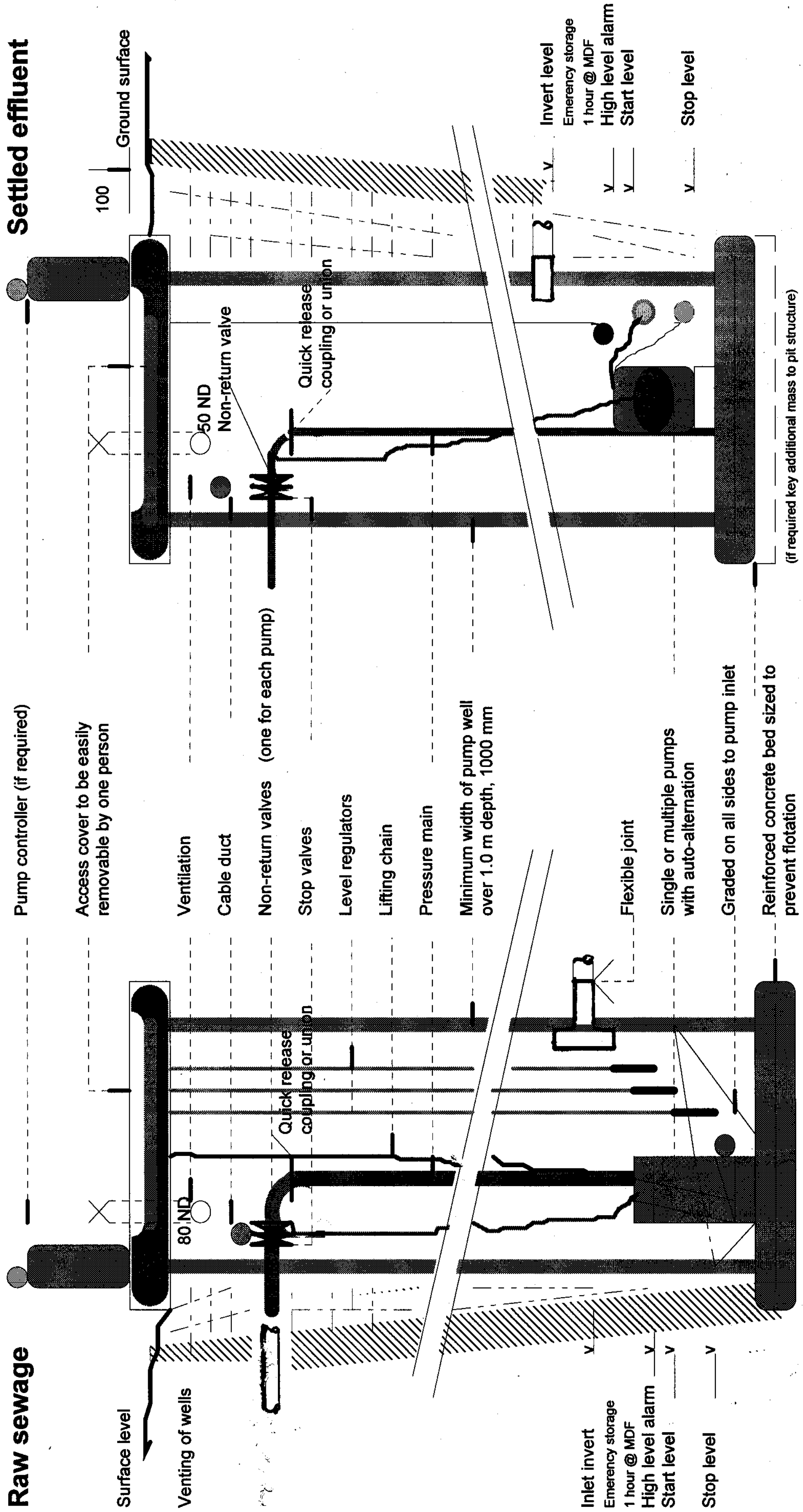
Alarm systems and controls are provided in an accessible location to indicate failure of the pumping system. The system has a suitable and permanently installed visual/audible warning device with mute facility. In the case of remote systems – such as those serving subdivisions – a telemetry alarm system with interrogation facilities should be installed to monitor the works. Pumps and control switches of a type suitable for wastewater works are installed in accordance with manufacturer's specifications.

Table 8: Impeller clearance and rating of pumps

Raw sewage (non-cutter type)	Nominal
Solid clearance	65 mm
Pressure main	80 mm
Power rating	0.75 kW
Settled/treated effluent	**Nominal**
Solid clearance	10 mm
Pressure main	25 mm
Power rating	0.25 kW
Cutter/grinder type pumps	**Nominal**
Pressure main	40 mm
Power rating	0.75 kW



Packaged pump stations ensure best practice installation and performance.



All dimensions are in millimetres

Figure 12: Pump wells installation

DESIGN EXAMPLE – PUMP WELL AND PUMPS

Requirement

Settled wastewater from a septic tank serving a 20 site camping park is required to be pumped to a stabilisation pond system located 150m away. The invert depth of the tank outlet is 1.6 m below the surface level and the proposed pond water level is 3 m above this level.

1. Determine the daily flow (MDF) and peak hourly flow (PHF)

Assume 3.5 people per site @ 100 litres per person and a peak to average hourly flow ratio of 6 (Table 2 and Figure 4)

a)	Daily flow	= 20 sites x 3.5 people x 100 litres/person	
		= 7,000 litres per day	(7 kL/d)
b)	Average hourly flow	= 7,000/24	
		= 292 litres per hour	
c)	Peak hourly flow	= 292 x 6	
		= 1,752 litres per hour	

2. Determine size of pump well

a) Pump well capacity between well inlet and invert to accommodate discharge volume and emergency storage (Figure 12)

= Pump cycle + emergency storage

= 2h@MDF

= 2 x 292

= 584 litres

b) Calculated pump cycle capacity plus emergency storage – assuming a pump well diameter of 1,050 mm

Well depth	$= 4 \times 0.584/3.14 \times (1.05)^2$	
	= 0.67m	(Cut-in /out 350 mm)
		(Inlet/cut-in 350 mm)

c) Check if mass of pump well is sufficient to prevent well floating to external hydrostatic forces when empty.

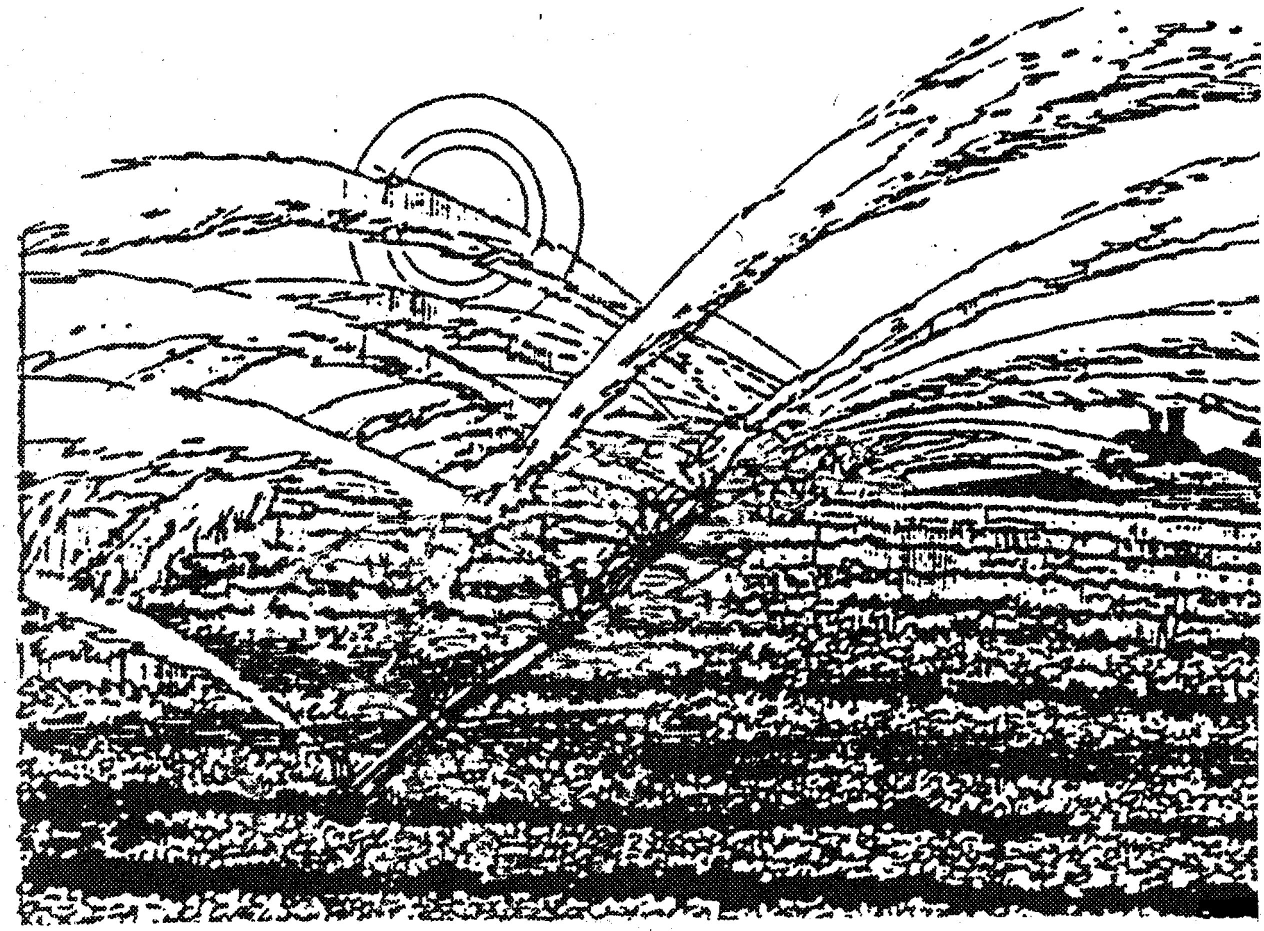
Mass of pump well	= mass of liquid displaced
Mass of RCP + T & B slabs	= mass of water displaced by well
	$= 2.4 \times 655$ kg/m $+ 3.14/4\ (1.05 + 0.15)^2 \times 2{,}500$ kg/m^3 x
	$= 3.14/4\ (1.2)^2 \times 2.4 \times 1{,}000$ kg/m = m^3
Depth of top and bottom slabs 'd'	= 0.4 m

Construction pump well using 2 No. 1.2 m x 1,050 mm RCPs walls 70 mm thick, top slab 100 mm and base slab 300 mm deep.

3. Selection of pump size

i)	Hydraulic capacity (PHF)	= 1,752 L/h	(0.5 L/s)
ii)	Total pumping head	= static discharge head + other head losses	

From pump manufacturer's tables and data sheets select pumps (duty and standby) for hydraulic capacity of 0.5 L/s at total pumping head.



9 WASTEWATER DISINFECTION

9.1 Objective

The objective of wastewater disinfection is to prevent the spread of waterborne pathogens found in wastewater, by protecting:

a) the source of water supplies

b) bathing beaches and water sporting areas

c) shellfish bed growing areas and other food sources.

Faecal coliform and the coliform group as a whole are the indicator micro-organisms for which bacteriological analyses of wastewater are most commonly performed. Found in the intestinal tract of humans and animals, these hardy micro-organisms are used as an indicator because their numbers can be determined by routine laboratory analysis.
Tests for pathogens are not adapted to such routine work and are made only in special investigations.
The reduction in number of faecal coliform organisms is used as an indicator of the efficiency of a disinfection process.

9.2 Disinfection methods

Ultra-violet radiation may be used for disinfection when other methods of disinfection are not possible or impractical.

The filtration of effluent through a slow sand filter effectively reduces the number of organisms and will remove the eggs of intestinal worms – including tapeworms present in the effluent.

Maturation (waste stabilisation) ponds whose primary function is to reduce the number of organisms through extended detention time are very effective in reducing the number of organisms dangerous to health.

Chlorination is a common disinfection method for destroying the micro-organisms that occur in wastewater. However, other disinfection methods that do not increase discharge toxicity should be used wherever practicable.

Pathogenic bacteria (the bacterial organisms that cause disease) are indicated by the presence of large numbers of *E.coli* organisms. These organisms are less resistant to chlorination than worms, cysts and viruses.

High levels of organic chlorine compounds from chlorinated effluent discharging to streams are toxic to fish life. Accordingly, high chlorine residuals are not to be discharged to streams with a low dilution rate.
In some instances, precise control of the chlorine residuals and dechlorination may be required in the form of a one-day dechlorination retention pond.

An effective disinfection level is accepted as have median less than 200 *E.coli* organisms per 100 millilitres and no more than 1 in 5 samples containing more than 1000 *E.coli* per 100mL to protect public health where there is a discharge to a source of potable water supply.

9.3 Suggested measures

Domestic wastewater contains millions of micro-organisms that are reduced in number during the various treatment stages. In primary settling tanks, a reduction of 30% to 40% of organisms is obtained. In full biological treatment processes, the reduction is between 90% and 95%. Further disinfection may be required to comply with standards for discharge.

The preference for satisfactory disinfection and reduction in the number of harmful organisms, in order is:

a) passing a 10/15 standard effluent through a UV radiation or micro-filtration unit

b) passing the effluent through an approved sand filter at a rate not exceeding 100 litres per square metre per day

c) retaining a 20/30 standard effluent in a maturation pond for a period of thirty (30) days

d) oxidising the effluent with chlorine to obtain a chlorine residual of 0.5 mg/L after a contact period of one (1) hour at MDF.

10 WASTEWATER REUSE

10.1 Wastewater reuse

Recycling of wastewater improves the level of land productivity and helps conserve water while protecting surface waters.

The higher the quality of water to be recycled the more uses it may be put to - landscape irrigation, irrigation of pasture or turf, trees and a range of horticultural and fodder crops are typical examples.

Issues to be considered are:

- salinity and nutrient levels of wastewater
- drainage of surface water
- reuse of stormwater run-off
- monitoring of soil and vegetation.

10.2 Accepted standard

Recycled water used for surface irrigation to have less than 20 mg/L BOD, 30 mg/L SS and coliform bacteria 10 orgs/100mL. When disinfected with chlorine there is a free residual of at least 0.5 mg/L.

10.3 Suggested measures

The design, construction and management of land for irrigation with wastewater must be in accordance with the *Guidelines for Wastewater Irrigation* (EPA Publication 168) or *Guidelines for Wastewater Reuse,* (EPA Publication 464).

A balance of evaporation and rainfall (water budget) needs to be considered. To allow for wetter years, a 90th percentile wet year (the wettest year in ten) must be allowed for in the design, with adequate storage in the non-irrigation period. Water budgets can be calculated using an EPA spreadsheet.

After heavy rains, irrigation areas must be drained to a sump or tailwater storage dam from which the first 5 mm of run-off is reused.

Where effluent is to be sprayed within 15m of any residential premises, the method and construction must comply with the requirements of *AS 1547 – Disposal systems for effluent from domestic premises.*

At least two warning signs must be placed along the boundary of the irrigation area to advise occupants of the premises that recycled water is used for irrigation.

Figure 13 is an example of a warning notice that should be located at all taps and hose cocks.

Size appropriately for observation distance: for example, 100 mm at 3 m as per AS 1319

Figure 13: Recycled water notice

11 PERFORMANCE MONITORING

11.1 General

Good management of a wastewater treatment plant is essential in achieving a consistently high level of environmental performance.

Field tests are an integral part of any treatment plant operation, as they provide the operator with a simple way to assess the performance of all facets of the treatment process. Test results should be recorded with the flow and/or applied loading rates, and any alterations to the plant or operational procedures should be noted at the appropriate time. Regular on-site tests will give the operator a quantitative record of the effect of any variation or changes on the treatment process. This will enable the plant to be adjusted and maintained at maximum efficiency.

11.2 Field tests

Satisfactory operation of most treatment processes can be achieved by using regular on-site field tests, but some processes - such as activated sludge - require daily testing and adjustment. For this reason, tests relevant to activated sludge plants are given special attention in this section.

Settleability tests

This test indicates the amount of settleable solids present in an efffluent. It is also used to determine the settling characteristics of sludge floc in the mixed liquor from aeration tanks.

To perform this test, collect a well mixed sample of the effluent and fill a clear graduated container. Allow the sample to stand for 30 minutes and record the volume of sludge in millimetres per litre of effluent sample.

An indication of the effectiveness of a treatment stage may be obtained by comparing the results of settling tests carried out on both the influent and effluent.

The efficiency of settling tanks can be determined from the results of the settleability tests.

$$Efficiency = 100 \frac{(a - b)}{a}$$

where
a = sludge volume in influent test,
b = sludge volume in effluent test

Satisfactory settling tank operation is indicated by an efficiency greater than 80%.

The settleability test is an important test for activated sludge plants. The mixed liquor in the aeration tank is examined to determine when sludge needs to be wasted to a sludge digester (sludge holding tank). It is also examined to ensure the aeration tank is operating satisfactorily.

Sludge must be wasted before it builds up to the point where the settling tank is overloaded and excess solids escape in the final effluent.

The settleability test is an important performance test for activated sludge plants.

The operator should note the volume of sludge in the test container and ensure that sludge is wasted before this level is reached in future. Initially, the settling test should be carried out daily while the sludge builds up to wash-out point (indicated by increase in solids in final effluent). This usually occurs when the sludge volume is in the range of 500 – 700 mL/L.

Dissolved oxygen test

This measures the amount of oxygen available for use by micro-organisms to decompose the wastewater. It is a useful test for activated sludge plants and is normally performed on the liquid from the aeration tank. The dissolved oxygen level in this tank should be maintained in between 1.0 mg/L and 4.0 mg/L.

Clarity test

This gives an indication of wastewater turbidity.

The test is performed using a clean plastic cylinder. A well mixed sample is poured into the cylinder which has a cross marked on the bottom. The cylinder should have a graduated scale fixed to its length and the effluent level is adjusted until the cross is clearly visible. The measurement on the scale is recorded in cent/metres for comparison with previous and future results.

An indication of the effectiveness of a particular phase of the Treatment can be obtained by comparing the results of clarity tests performed on the influent and effluent.

The clarity test and the settleability test are used to check the sludge return rate in activated sludge plants. If the supernatant from the aeration tank settleability test is clean but the final effluent is turbid, it indicates inadequate sludge return from the settling tank.

From the settleability and clarity tests, observations of the mixed liquor and final effluent, the operator can detect aeration malfunctions such as:

- inadequate dissolved oxygen (indicated by a cloudy supernatant or final effluent)
- over-aeration (indicated by fine suspended solids in the supernatant or final effluent)

- biological problems (such as fungi or other undesirable micro-organisms growing in the tank, indicated by a light fluffy sludge that settles only lightly leaving a clear supernatant).

pH test

Regular pH tests should be conducted to ensure that biological activity is not hampered by extreme acid or alkaline conditions. The pH of the effluent should be maintained between six and nine during all stages of the treatment process and should be close to seven for the final effluent.

To perform the test using a colour comparator, collect a sample and allow it to stand for a few minutes to let the suspended solids settle. The clear liquid is then decanted and the indicator added. The solution colour is compared to the chart and the corresponding pH value is noted.

Alkalinity

Most water supplies in the State have low alkalinity (expressed as calcium carbonate). High alkalinity provides the buffering capacity required for many of the treatment processes that are sensitive to pH changes. Where a water supply has less than 100 mg/L alkalinity (as CaCo3), the daily addition of lime may rectify problems such as impaired settling of solids.

Chlorine residual tests

The chlorine residual test is useful only at plants that employ chlorination in the disinfection stage of treatment. It checks that the effluent is being properly disinfected. (For proper disinfection to be assured, the effluent should contain more than 0.5 mg/L of total chlorine residual.)

The amount of free residual chlorine can be determined on site by calorimetric analysis, using the diphenyl-p-diamine (DPD) method. An appropriate tablet is crushed into a 10 mL sample of effluent and the solution colour is compared to the chart and the chlorine residual value noted.

Where ongoing operation and maintenance is required to be undertaken by a competently trained person, completion of a basic course of study or equivalent may be deemed to meet this requirement.

PLANT MAINTENANCE RECORD

Record of maintenance				Test data and monitoring record						Location ①
Date inspected	Meter reading	Flow (kL/d)	Pump c/over	DO (mg/L)	pH unit	MLSS (mL/L)	② BOD (mg/L)	SS (mg/L)	E. *coli* *(org/100mL)*	……………………………… ……………………………… ………………………
1	2	3	4	5	6	7	8	9	10	Remarks ③
4/12/96	945	34.5	Ok	4.5	7.2	-	15	25	350	←example only
Total No.										Certified operator
Annual median ④										………………………………
80th percentile										………/………/………

Notes

① Information to be kept for each discharge point. ② Nitrification inhibition method is not to be used ③ Attach comments on circumstances where objectives have not been achieved, including action taken or proposed. ④ Based on last 5 samples taken.

* All samples are to be obtained, preserved and analysed as specified in the most recent edition of EPA Publication 441, *A Guide to the Sampling and Analysis of Water and Wastewater.*

11.3 Performance monitoring

a) The operator of a treatment plant must undertake a monitoring program of the waste discharge as follows.

- Representative samples of the waste are to be obtained at the sampling point at least once every three (3) months.
- The samples to be analysed for:
  - ♦ biochemical oxygen demand
  - ♦ suspended solids
  - ♦ *E.coli* bacteria
  - ♦ ammonia (as N)
  - ♦ total nitrogen
  - ♦ total phosphorus
  - ♦ total residual chlorine (if used).

b) All samples must be obtained by, or under the instruction of, a qualified analyst. Samples must be preserved and analysed as specified in the most recent edition of the *A Guide to the Sampling and Analysis of Water and Wastewater* (EPA Publication 441).

c) All samples for analysis must be submitted to an analytical laboratory accredited by the National Association of Testing Authorities (NATA) for the specified analyses.

11.4 Recording requirements

The operator must, with regard to the monitoring, maintenance and inspection program:

a) cause the results of all analyses, observations and measurements to be accurately recorded in writing and signed by a responsible officer

b) cause the date and time of all sampling, inspections and maintenance works to be recorded

c) cause the record of analysis to bear a NATA stamp of endorsement

d) make the results of the monitoring program available to an authorised officer of the responsible authority upon any request to do so.

11.5 Reporting requirements

Every year the operator must submit to the responsible authority the previous 12 months' monitoring results obtained in accordance with the monitoring program.

11.6 Environmental management

To achieve a consistently high level of environmental performance, good management practices are essential.

Best practice environmental management for wastewater plants includes:

- a commitment from management to an environmental policy which is communicated to all employees
- adherence to best practice environmental management guidelines
- alert and informed supervision
- regular operator/maintenance training
- exercising control over the treatment process
- detailed written procedures for each activity established and used by operational staff
- understanding and control of all wastes and emissions
- contingency plans
- a high level of housekeeping on the site
- continuous improvement.

Risk management

Operators, through training and total quality management procedures, should be encouraged to identify problems before they arise, adopt a regular inspection and maintenance routine, take appropriate corrective measures when problems do arise, and adopt operating and reporting procedures that seek to prevent that happening again.

Accidents, equipment failure, climatic events and human errors often result in incidents where people and the environment are at risk.

Emergency preparedness

Wastewater treatment plants should develop and maintain contingency plans. The plans should provide for the avoidance and control of spills, leakage or breakdowns so as to prevent pollution of the environment.

The preparation of such plans should include:

- emergency holding and clean-up procedures
- action to minimise any adverse effects
- methods for wastewater disposal, and
- training of personnel in adequate identification of materials and correct operating procedures to avoid or minimise waste discharges.

Other likely incidents which should be anticipated may include:

- disruption of power supplies
- human error
- disruption caused by storms, flooding, fire etc.
- plant breakdowns, including drain blockages, pump failure
- wastes overloading treatment process
- temporary or permanent loss of trained personnel.

MANAGEMENT CHECKLIST

❑ **Planning**

- Have a waste management plan.
- Minimise waste.
- Write down the operating procedures.
- Have contingency plans.

❑ **Housekeeping**

- Keep records.
- Ensure good housekeeping.
- Exercise quality assurance.

❑ **Information and training**

- Develop good community relations.
- Regularly update systems.
- Provide training and information.

Training

To ensure optimum performance of small wastewater treatment plants it is important that the maintenance personnel are adequately trained in routine operations and maintenance procedures.

Where ongoing operation and maintenance is required to be undertaken by a competently trained person, completion of a basic course of study or equivalent may be deemed to meet this requirement.

The skills required to perform the above tests and knowledge to interpret the results are offered in appropriate training courses available at the Water Training Centre.

Water Training Centre
Deakin University, Waurn Ponds 3217
Tel: (03) 5244 0800 Fax: (03) 5244 0804

REFERENCES

AS 1319, *Safety signs for the occupational environment*

AS 1345, *Identification of the contents of piping, conduits and ducts*

AS 1546, *Small Septic Tanks*

AS 1547, *Disposal systems for effluent from domestic premises*

AS 2031.1, *Selection of Containers and Preservation of Water Samples*

AS 3500, *National Plumbing and Drainage Code*

BS 6297, *Design and installation of small wastewater treatment works and cesspools,* British Standards Institution, Code of Practice, 1983

DIN 4261, *Small wastewater treatment plants,* Deutsche Norm, German Standards, (DIN–Norman) Berlin, 1984

NSF (1983), *Standard 40 for Individual Aerobic Wastewater Treatment Plants,* National Sanitation Foundation

APPENDIX A – RELEVANT LEGISLATION

Environment Protection Act 1970

This Act establishes the jurisdiction and powers of the Environment Protection Authority, and the segments of the environment to be protected.

All wastewater treatment plants must conform with the relevant State environment protection policies and environmental regulations. These are briefly described below. The *key objectives* of these policies are incorporated in these guidelines.

Other information sources, as outlined below, are also available.

Regulations

The following regulations have been made under section 71 of the *Environment Protection Act 1970.*

Environment Protection (Prescribed Waste) Regulations 1987

These regulations list all wastes which the Authority considers should be more stringently monitored and controlled. Most types of hazardous industrial or commercial processing wastes, effluents and residues are included as 'prescribed wastes'. Inert wastes such as building rubble, uncontaminated packaging material, and domestic wastes are not included. Infectious substances, lime sludges, oil water mixtures and grease interceptor trap effluents and residues are included in the list of prescribed wastes, so that their generation, transport and disposal offsite can be controlled and monitored.

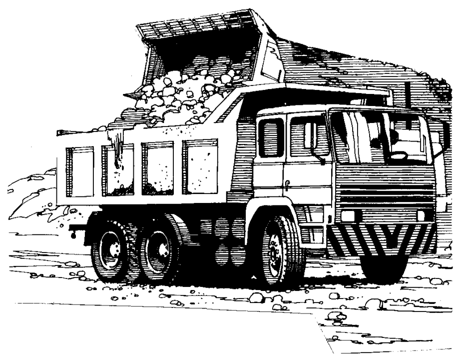
Environment Protection (Scheduled Premises and Exemptions) Regulations 1996

Premises from which more than 5000 litres per day of wastewater is discharge or accept prescribed wastes that are generated offsite for the purposes of storage, reprocessing, treatment or disposal are scheduled premises under the *Environment Protection Act 1970.*

Certain premises which reuse wastewater or discharge to sewer are exempt under the Regulations.

Before any works or major process modifications are carried out at scheduled premises, an EPA works approval may be required. Operating conditions for the premises are covered by an EPA licence which must be obtained prior to the start of operations.

Licences and works approvals for these premises take into account any environmental hazards that may be associated with the facility and place conditions on operations such as the storage of wastes, screening of incoming wastes, maintenance of accurate records and limitation on the types of wastes accepted by the facility.



Environment Protection (Transport) Regulations 1987

These regulations require the use of waste transport certificates for the transport of prescribed industrial waste. Any vehicle used for transport (with minor exceptions) of prescribed industrial waste must hold an EPA Transport Permit.

The Transport Certificate system allows EPA to track wastes from cradle to grave, and also gives useful information regarding the amounts of prescribed waste generated, transported, and disposed of in the state.

Industrial waste management policy

Waste Minimisation* – *No. s 52 Monday 29 October 1990

This Policy aims to protect human health and the environment by the minimisation of industrial waste, to conserve resources, to reduce costs associated with disposal, and to improve cost efficiency of industry avoidance.

The Policy's attainment program requires all premises subject to Works Approval to have waste management plans identifying waste minimisation options, with a focus on waste avoidance, reduction and reuse.

Premises issued with *Pollution Abatement Notices* may also be required to develop and submit waste management plans.

State environment protection policies

The Air Environment* – *No. 63 Monday 13 July 1981

Determines beneficial uses of the air environment to be protected, air quality indicators and objectives for specific gaseous components, and attainment programs to achieve these objectives for air.

Its scope includes emission controls, the control of odour and the provision of buffer zones.

Waters of Victoria* – *No. S 13 Friday 26 February 1988

Determines beneficial uses of the water environment to be protected, water quality indicators and objectives for specific segments of the water environment, sets emission limits for components in any discharges, variations with locality, and attainment programs to achieve these objectives. Promotes waste minimisation.

Groundwaters of Victoria, Draft 1994

Protects groundwater from activities potentially detrimental to groundwater quality. The overall goal of this policy is to maintain groundwater quality sufficient to protect existing and potential beneficial uses of aquifers throughout Victoria by prevention of groundwater pollution.

Objectives for groundwater quality must not exceed those levels specified for the beneficial uses in *Australian Water Quality Guidelines for Fresh and Marine Waters,* Australian and New Zealand Environment and Conservation Council, 1992.

Control of Noise from Commerce, Industry and Trade No. N-1* – *S31 Thursday 15 June l 989

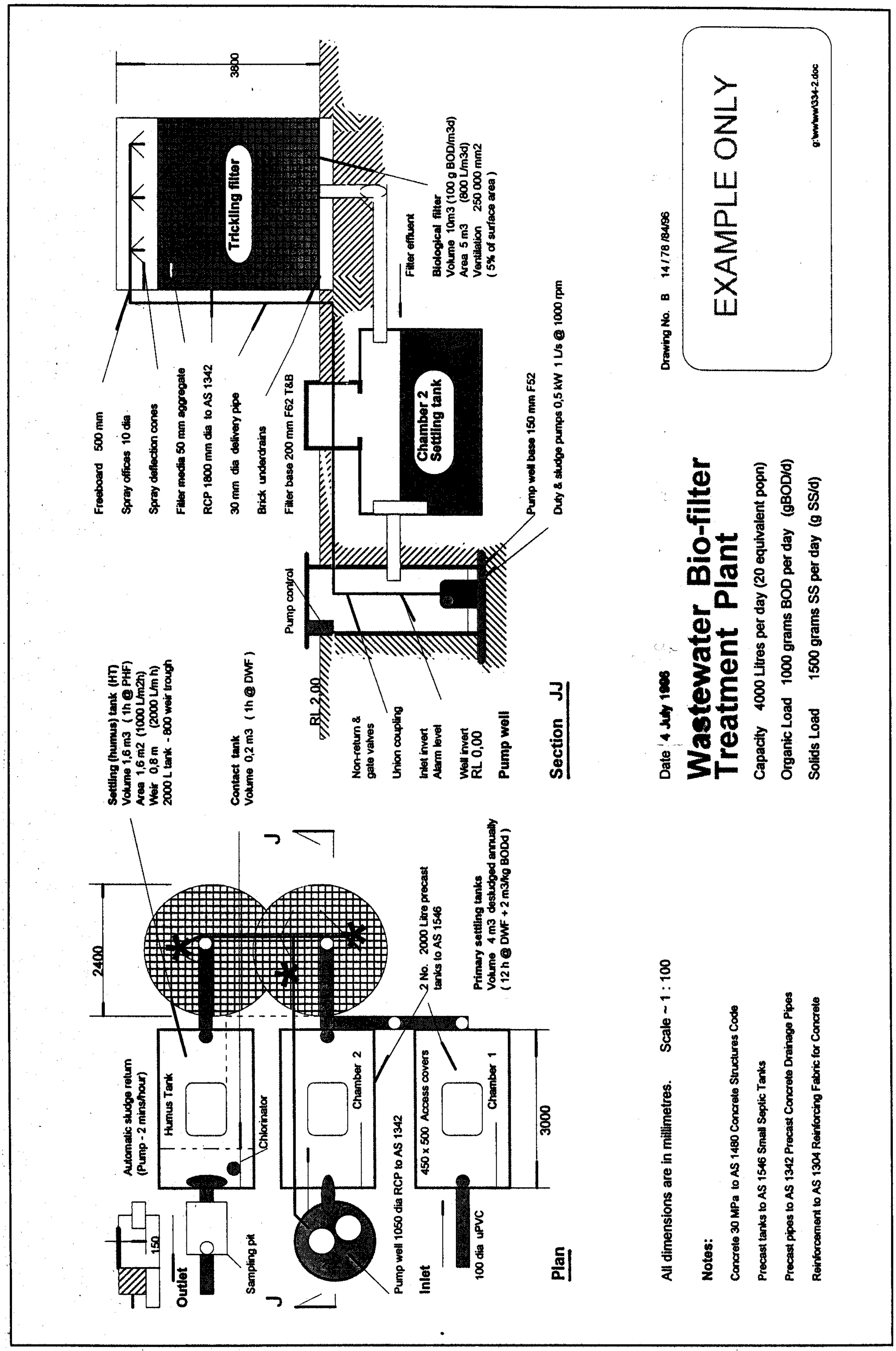
Protects people from noise from commerce, industry and trade in the Melbourne Metropolitan area that may affect the beneficial use of noise sensitive areas, and provides an attainment program to meet specified objectives.

(The policy is also used as a guideline elsewhere. Note that noise sensitive areas include domestic, recreational and hospital activities, particularly sleep at night.)

Typical noise limits in affected residential areas (dBA)			
Time of Day (hours)	Day 0700 – 1800	Evening 1800 – 2200	Night 2200 – 0700
Mainly Residential	50 – 54	44 – 48	39 – 43
Residential, commercial & industrial	54 – 59	48 – 52	39 – 43
Commercial	56 – 59	52 – 57	47 – 52
Industrial	63 – 68	57 – 61	52 – 66
Source: State Environment Protection Policy – Noise No N1-1989			

These guidelines have been documented in order to provide a summary of issues and to assist in understanding EPA requirements. They are for guidance only and are not intended to be either prescriptive or exhaustive. Each situation will be assessed by EPA according to its own merits

APPENDIX B – TYPICAL DRAWING DETAILS OF TREATMENT PLANT



APPENDIX C – CHECKLIST FOR WASTEWATER TREATMENT PLANTS

Issue	Objectives are achieved by	Ref.	✓
Waste management			
• Measures for reducing waste		5	
• Peak hourly flow		7	
• Design loadings		8	
Site requirements			
• Buffer distance		9	
• site safety		10	
• Land capability		11	
Wastewater treatment			
• Bio-filtration		12	
• Activated sludge		17	
• Stabilisation ponds		23	
• Polishing process		28	
• Disinfection and use of wastewater		35	
Performance management			
• Performance monitoring		40	
• Recording and reporting		40	
• Environmental management		40	
Regulatory requirements			
• Scheduled premises		44	
Environmental policies			
• IWMP (Waste minimisation)		45	
• SEPP (Waters of Victoria)		45	

This checklist summarises the specific environmental issues to be addressed for the installation of a treatment plant.
Provision is made in the list for proponents to check of each issue as it relates to a proposed system.
The issues are listed in the same order as they appear in the Code.

APPENDIX D – EPA REGIONAL OFFICES

Gippsland
7 Church Street, Traralgon 3844
Tel: (03) 5176 1744 Fax: (03) 5174 7851

North East
24 Ely Street, Wangaratta 3677
Tel: (03) 5721 7277 Fax: (03) 5721 2121

North West
43 Williamson Street, Bendigo 3550
Tel: (03) 5442 4393 Fax: (03) 5443 6555

South Metro
35 Langhorne Street, Dandenong 3175
Tel: (03) 8710 5555 Fax: (03) 9794 5188

South-West
Corner Little Malop & Fenwick Streets, Geelong 3220
Tel: (03) 5226 4825 Fax: (03) 5226 4632