SEPTIC TANK MAINTENANCE GUIDE

by
Mohsen A. Khalifé

Submitted to
NGANAMPA HEALTH COUNCIL

June 1997

First published in June 1997 by
Khalifé Environmental Engineering Consultancy
6 Spearing Parade
Gwynneville
Wollongong NSW 2500
Australia

Printed in Wollongong, Australia by
University of Wollongong Printery
ISBN 0 646 32506 X

FOREWORD

Nganampa Health Council (NHC) was established in December 1983 as a community controlled independent health service taking the responsibility for health care delivery on the Anangu Pitjantjatjaraku (AP) Lands. The AP lands is an area of 106,000 square kilometres which lies in the north west corner of South Australia.

NHC has long recognised the link between poor living environments and poor health status. Attack rates for diarrhoea, pneumonia, skin and eye infection are high. The Health Council strategy aims at reducing the level of these infectious diseases.

Previous work over the last twelve years has continued to highlight the need to better design, construct and maintain on-site wastewater disposal systems.

The Uwankara Palyanku Kanyintjaku (UPK) Report (1987), Housing for Health (1993) and Safe Disposal of Wastewater in Remote Aboriginal Communities (1997) have all indicated the need for ongoing maintenance of conventional septic tank systems and have contributed to better design and construction processes.

This guide is intended to provide relevant information to AP Services, the council body responsible for maintenance and NHC so that effective maintenance regimes can be planned and initiated.

Nganampa Health Council believes that functioning on-site wastewater disposal systems are critical for positive health outcomes.

June 1997

Stephan Rainow — Public/Environmental Heath Officer
Nganampa Health Council

CONTENTS

GLOSSARY OF TERMS

Absorption trench or Soakage trench	A system that uses the principle of absorption, which is limited to soil with good permeability between 0.05 m/d and 0.6 m/d.
Aerobic bacteria	Bacteria that grow in the presence of oxygen.
Anaerobic bacteria	Bacteria that grow in the absence of oxygen.
Anangu	"Our people" in the Pitjantjatjara language.
Biochemical Oxygen Demand (BOD_5)	Measure of the concentration of organic impurities in wastewater. The amount of oxygen required by bacteria while stabilising organic matter under aerobic conditions, expressed in mg/L.
Black water	Liquid and solid human body wastes and the carriage water generated through toilet usage.
Effluent	Liquid discharged from a small septic tank.
Grease trap	Known as sullage sump and mainly installed to trap oil and fats found in wastewater (grey water).
Grey water	The wastewater generated from a particular household excluding water closet (toilet) discharges.
Hydraulic Conductivity	As applied to soils - the ability of the soil to transmit water in liquid form through pores.
Hydraulic loading	Liquid flow to be handled by the septic tank
Infiltration	The downward entry of water into the soil.
Influent	Untreated wastewater.
NHC	Nganampa Health Council, Aboriginal-controlled area health council.
Percolation	The flow or trickling of a liquid downward through a contract of filtering medium. The liquid may or may not fill the pores of the medium.
Population mobility	Movement of residents within and between the communities.
SAHC	South Australian Health Commission
Scum	Any floating material on the surface of the septic tank.
Sludge	The accumulated, settled solid deposit from sewage and containing more or less water to form a semi-liquid mass.
Soil Texture	The relative proportions of the various soil separates in a soil.
UPK	Uwankara Palyanyku Kanyintjaku.
User habits	Unexpected discharge which may impair the septic tank conditions or contribute in highly concentrated influent (eg., extensive use of water, disposal of large objects in the toilet such as rags, cans, napkin and nappies and washing nappies in the shower).
Wastewater	Combination of the black and grey water, unless otherwise specified.

1 Introduction

There are over 250,000 on-site wastewater disposal systems or septic tanks around Australia, these are used by 12% or in excess of 2 million people (Geary and Gardner, 1996). In the Northern Territory of Australia, a total of 491 Aboriginal communities contain infrastructure and of these, 52 communities have waterborne sewage and effluent disposal systems, whereas the remaining are serviced by 1,946 conventional septic tank systems (CSTS) (Lange Dames and Campbell Pty Ltd, 1994).

Septic systems are individual on-site wastewater treatment systems that use bacteria and the soil to treat wastewater. There are many variations on the system design but most conventional septic tank systems (CSTS) consist of a grease trap, septic tank and a disposal area. The disposal area consists of a drain pipe or self supporting arch tunnel. A distribution box is involved if the disposal area is made up of two or more soakage trenches. CSTS operates commonly as follows:

- A grease trap is generally used to reduce or remove the oil, fats and grease concentrations which can impair the biological activities. Generally, grease traps are beneficial when expected concentrations of oil and grease are high (e.g. restaurant, petrol stations, etc.)

- The common septic tank used is a two compartment tank. The first compartment acts as a temporarily holding unit where treatment of domestic wastewater begins. Here heavy solids and lighter scum are allowed to separate from the wastewater. This is called the primary treatment. The solids stored in the tank are decomposed by bacteria. Solids not broken down, along with grease and other floating scum, must be removed periodically by a professional septic pumper.

- In the second compartment of the septic tank more solids settle out, allowing the relatively clear wastewater to leave the tank and flow into a distribution box, which separates the water flow into a network of soakage trenches.

- Openings in the sides and the bottom of the soakage trenches allow the water to filter through the surrounding gravel and ultimately percolate slowly into the surrounding soil. Bacteria and other microorganisms in the soil further treat and purify the liquid, this is called secondary treatment. A properly functioning septic system does not pollute the groundwater and should function for many years.

2 Maintenance Guidelines

The long-life operation of conventional septic tank systems relies significantly on the degree of maintenance provided. Newer on-site wastewater disposal systems, known as aerated septic tank systems, are well regulated by some councils and health departments in Australia where a quarterly inspection report is required. Unfortunately, attention to the older systems is neglected as the same authorities do not seem to be concerned about existing problems unless a neighbour complains of the smell or surfacing of wastewater. Occasionally yearly inspections do not take place and these systems are still being approved with no evidence of quality control on their performance (Spooner, 1997).

Knowing today's practice in maintaining on-site wastewater disposal systems and the health and environmental implications of failed ones, guidelines for both home owners and inspectors as well as specific regulations regarding detailing the extent of the inspection performed are needed.

This document serves as a guide only, all maintenance or repair procedures are the responsibility of the inspector or authority providing the service. When performing septic tank inspections, it is assumed that inspectors have the proper information, training, procedures, and/or licensing. Review of this document by NHC or other concerned authority before implementation of a maintenance plan is a must. A comprehensive inspection form is proposed in Section 11.

Generally the proposed inspection plan should at any time report the following:
1. Tank condition
2. Accumulated solids, sludge and floating scum depths.
3. Ponding wastewater level in the soakage trench(es).

3 Reporting Criteria

Inspectors should use their own description of failure. However, it would be helpful to report the operational conditions as follows:

Satisfactory. A system operation is considered satisfactory if at the time of inspection, the septic tank and disposal area appeared to be working adequately. Blocked main drains and/or unusual septic odours are not noticed.

Unsatisfactory. A system operation is considered unsatisfactory if at the time of inspection, the septic tank and disposal area are not working adequately and where there is evidence of failure and/or improper operation.

Unsatisfactory performance or system failure appears in the form of:

- Wastewater backing up into the house.
- Discharge or ponding of effluent on ground surface.
- Blockage of the system where wastewater backs up and leaks at tank or distribution box or static liquid level in distribution box is above outlets.

The above problems may be due to one or combination of the following:

- Hydraulic overloading: excess water in absorption area, disposal area may be undersized, improperly located, damaged fields may be improperly installed.
- Maintenance failure: fields damaged by solids flowing from tank/tree roots.
- Mechanical damage: driving over disposal area can damage piping/trenches and groundwater flowing into and flooding the absorption area.
- Other defects: damaged tank, baffles, distribution box, absorption system located in low/wet areas, components within 50m of a surface stream, pond, river, or well. The system may be located between 50 and 100m from a well with no acceptable water analysis.

4 Water Consumption and Septic Tank Failure

4.1 Wastewater flow

Water usage distribution in a particular household can give the technician/inspector an indication of user patterns, possible losses or leaks in the plumbing fixtures. However installation of multiple meters is costly, and visual observations are not reliable as minor losses are difficult to detect, therefore one main meter is recommended for installation at each house as a part of a septic maintenance program. The main meter reading should be reported every time a septic tank is inspected, with the difference between consecutive meter readings giving the total water consumption. Wastewater generation can then be estimated at 70% of the total water consumption. The main CSTS components and estimated water consumption are shown in Figure 1. The wastewater flow percentage is assumed based on the maximum wastewater flow encountered in the Pipalyatjara wastewater study (Khalifé et al., 1997).

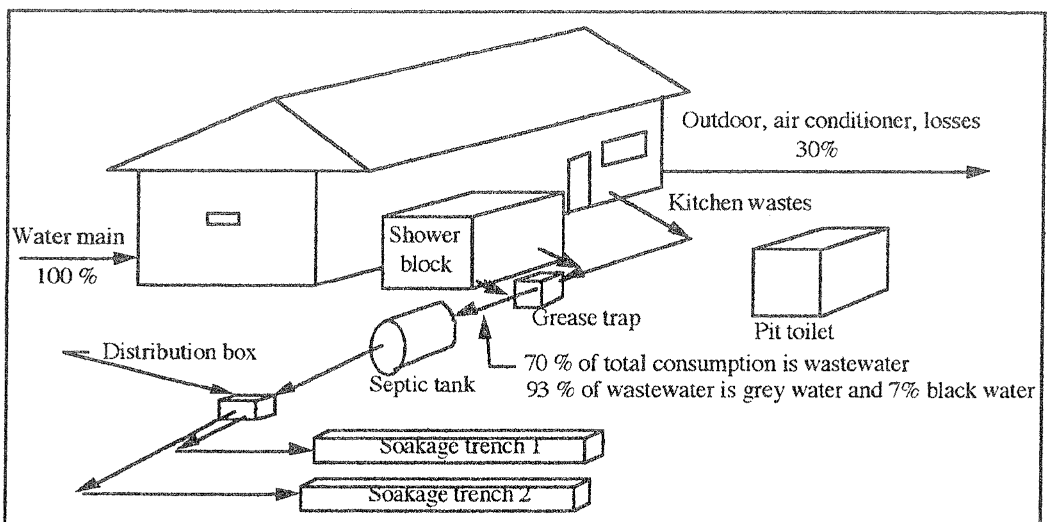

Figure 1 CSTS components and flow distribution.

4.2 Flow patterns in urban and remote areas

A comparison of flow patterns at different plumbing fixtures from urban and remote conditions is given in Table 1 and Figure 2. This is to indicate some similarity of user patterns and to ensure that septic tank failures are design rather than user problems. The total water consumption is however different. A population load of 4-6 per household in urban areas is not indicative to remote users where population load can reach 30 per household (Pholeros et al., 1993). This was evident in the field work where a maximum water consumption of 1635 L/capita.d was observed in a remote Aboriginal community (Khalifé et al., 1997) compared with 285 L/capita.d in urban NSW (White et al., 1994). The Pipalyatjara wastewater study reported a maximum of 2930 Litres of wastewater as being generated by an individual household per day (for an average population load of 10.6 per household). This volume is discharged into a standard septic tank of 3000 Litres capacity and is supposed to be percolating in the soakage trenches. The septic tank effluent was found concentrated in terms of volume (overloading) and pollutants (organics and solids) and is causing clogging of the disposal area. It should be noted that proper operation of the system is expected when 900 Litres of wastewater is generated per day.

Table 1 Urban and remote water consumption (Khalifé et al. (1997) and White et al. (1994))

Water use	%	
	Urban NSW	Remote SA
Laundry	15	19
Toilet	20	4
Kitchen	10	10
Shower	20	12
Bath	5	0
Outdoor	30	36*
Air conditioner	0	19
Water consumption	100	100

* The outdoor flow includes garden tap, laundry sink and losses.

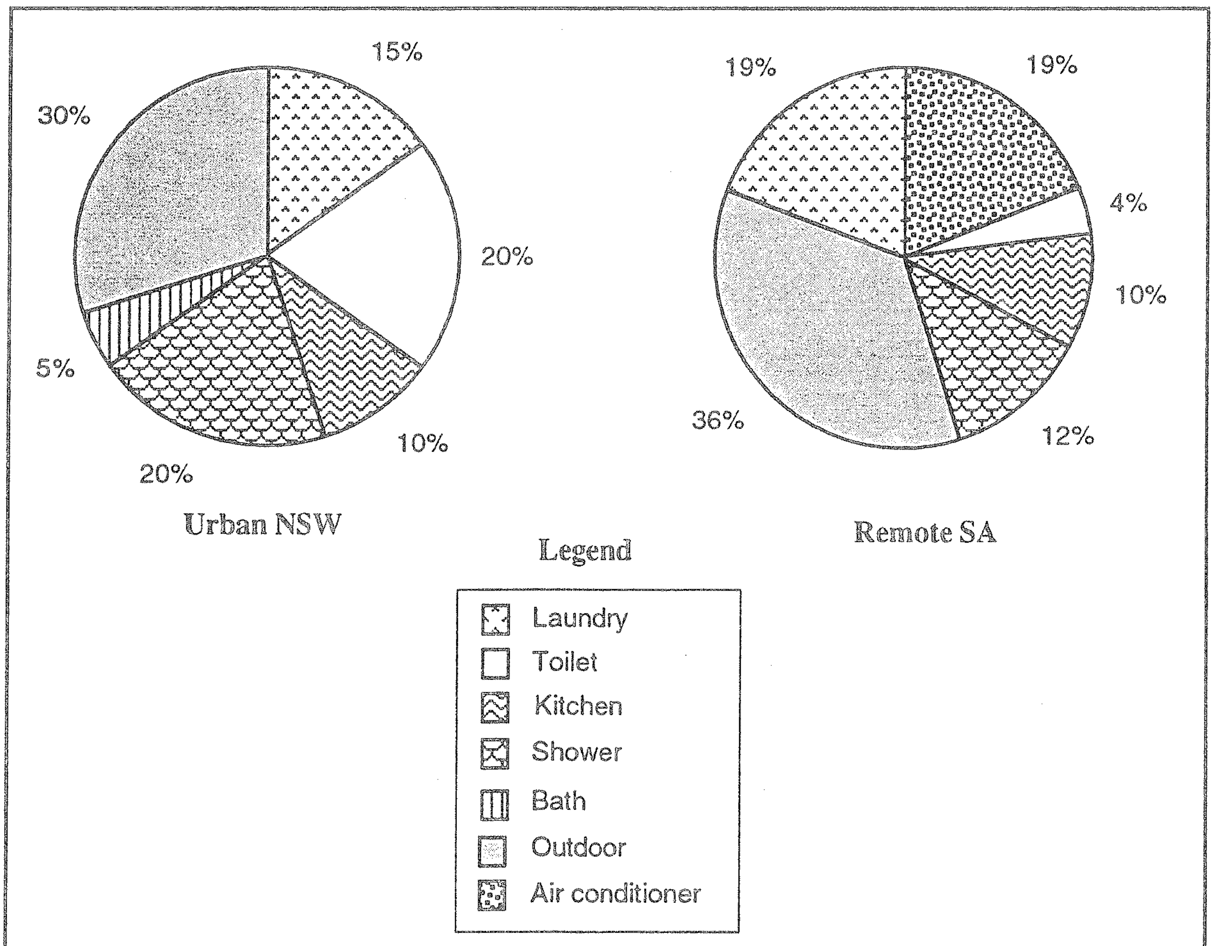

Figure 2 Flow distribution in urban NSW and remote Aboriginal community (Pipalyatjara).

4.3 Septic tank failure due to hydraulic overloading
Excessive wastewater flow is a positive indication of hydraulic overloading and is one of the main causes of septic tank failure. Therefore inspection is expected to be detailed and report the following:

Total consumption. Main water meter reading converted to flow based on the meter reading from previous inspection.

Average water consumption. The average water consumption in L/d is obtained by dividing the total consumption by the number of days between two consecutive inspections.

Population survey and water consumption per capita. Finding the average number of occupants since last inspection (ask occupants or neighbours). The water consumption in L/capita.d is then obtained by dividing the average water consumption in L/d by the number of occupants surveyed.

Wastewater flow into the soakage trench. The wastewater flow in L/capita.d can be estimated by assuming wastewater generation at a maximum rate of 70% of the total water consumed.

Reporting results. In addition to estimating wastewater flow, inspectors should report observation of any wastewater surfacing in the disposal area or ponding of effluent in the soakage trench(es) as hydraulic overloading.

5 Additives and Odour Control
5.1 Need for additives
Biological and chemical additives in septic tank systems are not needed to aid or accelerate decomposition of solids and are not a substitute for pumping out operations. These products include biologically based materials (bacteria, enzymes, and yeast), inorganic chemicals (acids and bases), or organic chemicals (including solvents). They do not reduce the need for regular pumping of the septic tank (Robillard and Martin, 1993).

5.2 Adverse effect of additives.
Some additives containing sodium hydroxide or potassium hydroxide provide some temporary relief immediately after use, but extended usage may result in sludge accumulation and a large increase in alkalinity, and may interfere with decomposition of solids. The resulting wastewater may severely damage the soil structure and accelerate clogging of the soakage trench(es). Generally technicians should refer to their local authority or codes restrictions about the use of chemicals. It should be noted that in some countries, organic chemicals solvents are prohibited from sales for the purpose of degreasing or declogging of on-site wastewater disposal systems.

5.3 Use of additives
The use of chemicals as part of maintenance practice can provide a short term solution. However, it is expected that both the user and technician are informed of the chemicals adverse effects. The householder input should be kept to a minimum to avoid possible contact with contaminated wastewater. Some precautions when using chemicals are listed below for both householder and maintenance provider.

5.3.1 Householder
Small quantities of caustics normally used in the home and added to plumbing fixtures, are not objectionable as far as operation of the tank is concerned. If the septic tanks are as large as required by regulation, dilution of caustics in the tank will be enough to overcome any harmful effects that might otherwise occur. Moderate use of soaps, detergents, bleaches, drain cleaners, or other material as normally used in the household should have no noticeable adverse effect on the system.

5.3.2 Maintenance provider
Additives claimed to be advantageous should be proven by properly controlled tests prior to approval in maintenance. For a clogged soakage trench, recovery of the soil/sewage interface may be accomplished by removing any static water from the system and injecting a strong solution of hydrogen peroxide. This practice should be approached by skilled technicians and

should be subject to compliance with local regulations. Hargett et al. (1985) reported the use of the hydrogen peroxide as hazardous. He also claimed reduction of the soil hydraulic conductivity caused by destruction of soil pores and continuity. Therefore do not rush to flush additives down the system!

5.4 Odour control
The anaerobic decomposition of organic matter containing sulfur or the reduction of mineral sulfites and sulfates in septic tanks produce "hydrogen sulfide" gas with a strong odour (smell of rotten eggs). Other volatile compounds also may be formed during anaerobic decomposition. These have far more offensive odour than that of hydrogen sulfide (Metcalf and Eddy Inc., 1991). The most common method to achieve odour control is using lime flushed down the toilet. A cup/day of lime flushed down the toilet until the smell is reduced is recommended (Health Commission of Victoria, 1983). The added lime will increase the wastewater pH, thus the production of hydrogen sulfide decreases. If the pH of wastewater in the second compartment or the soakage trench is between 6-8.5, the septic tank system does not suggest need for lime. Whereas if pH dropped below 6, careful addition of lime to ensure a pH less or equal 8.5 is suggested.

6 Message to Users
Below is a list of user behaviour that may impair the operation of septic tank systems. The user is to be advised on the following:

6.1 Appropriate use of washing machine
In 1996, a wastewater study carried out in Pipalyatjara found that 0 - 60% (0 - 1690 L/d) of the grey water discharged is from washing machines (Khalifé et al., 1997). The user is advised to spread the washing out during the week to avoid overloading the sewage system on a single day.

6.2 Careful use of detergent
Using too much phosphorus based detergent may result in the production of phosphate deposits in the soakage trenches and eventually lead to the blockage of soil pores, thereby leading to clogging of the soakage trenches. The consumer and community stores should be advised of using/selling phosphate free detergent.

6.3 Prohibited discharge
Disposal of cans, coffee grounds, cooking fats, paper towels, disposable nappies, cigarette butts, and other non-degradable materials into the household sewer can impair the operation of the septic tank as these materials won't decompose and will fill the septic tank and plug the system including the soakage trench.

6.4 Handling of oil and grease
High oil concentrations in septic tank can interfere with the growth of bacteria which in turn affect the treatment process in the septic tank. Dumping oil and grease down the drain may build up in the septic tank effluent thus reducing the wastewater infiltration rate in the soakage trench. Users are advised to place oil and grease wastes in a separate container and throw it out with the garbage.

7 Message to Technicians
Maintenance of septic tank systems is essential to ensure acceptable operational conditions. To avoid health hazards, a compulsory immunisation plan against hepatitis is recommended for people having direct contact with wastewater.

As maintenance records are not well documented in Aboriginal communities, a prepared inspection questionnaire to help in identifying common problems with septic tank operation is given in Section 11. Generally a service provider should report all observations in writing. This should be send to the local authority (NHC or SAHC) and copies should be kept in the community office.

7.1 Need for bacteria
Many bacteria are present in the materials deposited into the septic tank and will thrive as a result of the biological activities. Therefore, a "starter" is not needed for bacterial action to begin in a septic tank.

7.2 Open, inspect and pump out

- During pumping out operations, the manhole or the septic tank cover must be removed to ensure that all the solids have been pumped out and to minimise additional maintenance.
- Clean the septic tank every 6 months to 1 year (for a standard 3000 Litre tank). Pumping out frequencies corresponding to tank capacity and number of residents occupying the household are given in Table 2.

Table 2 Septic tank pumping frequency in years (Mancl, 1984)

Septic Tank	Number of persons in Residence									
Capacity in Litres	1	2	3	4	5	6	7	8	9	10
1900	5.8	2.6	1.5	1.0	0.7	0.4	0.3	0.2	0.1	-
2800	9.1	4.2	2.6	1.8	1.3	1.0	0.7	0.6	0.4	0.3
3400	11.0	5.2	3.3	2.3	1.7	1.3	1.0	0.8	0.7	0.5
3800	12.4	5.9	3.7	2.6	2.0	1.5	1.2	1.0	0.8	0.7
4700	15.6	7.5	4.8	3.4	2.6	2.0	1.7	1.4	1.2	1.0
5700	18.9	9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5	1.3
6600	22.1	10.7	6.9	5.0	3.9	3.1	2.6	2.2	1.9	1.6
7600	25.4	12.4	8.0	5.9	4.5	3.7	3.1	2.6	2.2	2.0
8500	28.6	14.0	9.1	6.7	5.2	4.2	3.5	3.0	2.6	2.3
9500	31.9	15.6	10.2	7.5	5.9	4.8	4.0	4.0	3.0	2.6

7.3 Investigate leaking taps or other plumbing fixtures

- Installing a water meter can indicate how much water is being used and the possibility of losses (leakage).
- Consider water as a valuable resource and avoid wastage. Ensure that there are no leaking taps or other plumbing fixtures. Advise residents to routinely check the float valve on their toilets to make sure it is not sticking and the water is not running continuously. It should be noted that hydraulic overloading (too much water down the drain) is a major reason for septic tank system failure. Such failure is often observed by wastewater ponding in the soakage trenches, sewage surfacing or backflow into the houses.

7.4 Beware of chemicals used

Be aware that some additives may do great harm. Refer to Section 5.3

7.5 Potential hazards of septic tank gases

If a septic tank is not vented, gases would be essentially sludge gases. These can comprise of methane (CH_4), nitrogen (N_2), and carbon dioxide (CO_2). Although these gases are not toxic, their proportions can suffocate human. Other toxic gases such as hydrogen sulfide can generate in septic tank and can cause immediate loss of consciousness, depressed respiration and death in 30-60 minutes if concentrations exceeds 500 mg/L (Dreisbach, 1961). Hydrogen sulfide concentrations in septic tank sludges would be 2900-13,600 mg/L. That concentration range would be about 6-27 times a lethal quantity (Winneberger, 1984). Therefore an inspector should at no stage consider going into a septic tank for desludging.

7.6 Finishing inspection and keeping records

- Before leaving the site, make sure that risers lids are not easily removable by children or other unauthorised persons. Also, seal septic tank manhole as this will help in keeping the odours within the tank.
- Keeping a record of all work performed including details such as owner name, date of service, number of residents, observations, repairs, etc. is an essential part of the service. Inspection reports should be filled on site.

8 Management Strategy

In terms of septic tank operation, as many as 75% of all system failures have been attributed to hydraulic overloading (Jarrett et al., 1985). Because regular inspection and maintenance is often neglected, a strategy is needed for on-site wastewater management. This can improve effluent wastewater quality and save the communities and home owners time and money. The strategy can be effective when used with other source reduction control such as phosphate bans and use of low-volume plumbing fixtures, as well as consideration of upgrading and regular maintenance. Septic tank management agencies are advised to the consideration of Sections 8.1 - 8.6.

8.1 Chemical additive restrictions

As stated in Section 5.3.2, the use of chemicals may have long-term adverse implications on the performance of the soakage trench(es).

8.2 Education

Many of the problems associated with improper use of septic systems may be attributed to lack of user knowledge on operation and maintenance. Educational materials for home owners and training courses for installers and inspectors can reduce the incidence of pollution.

8.3 Elimination of garbage disposals

Eliminating the disposal of garbage into septic tank systems can significantly reduce the loading of suspended solids, nutrients, and organics (biochemical oxygen demand or BOD_5), as well as decreasing the buildup of solids in septic tanks thus reducing pumping frequency.

8.4 Inspection and maintenance

The high degree of system failure necessitates regular inspections. Home owners can be provided with educational materials and can contribute to some extent in monitoring of their systems. Printed reminders to inform owners and inspectors of the due date for their system inspection/maintenance are beneficial.

Water quantity and quality monitoring programs can indicate the hydraulic and organic loadings. On inspection day, at least one grab sample from the effluent is to be analysed for temperature and pH. The pH measurement can give an indication about the acidity of wastewater in the tank. Generally tank deterioration or concrete corrosion is enhanced with low pH.

Septic tanks require pumping to remove accumulating sludge approximately every 6 months to 1 year. The frequency can vary depending on tank size and family size (Table 1). Failure to remove sludge periodically will result in reduced tank settling capacity and eventual overloading of the soil absorption system, which is more costly to remedy.

Authorised maintenance contractors should ensure that the inspection/maintenance is provided by a skilled technician and should demonstrate that the service has been performed on a periodic basis.

8.5 Phosphate detergent restrictions

Conventional septic systems are usually very effective at removing phosphorus. However, in some soil conditions and if a septic tank is close to surface waters, it is advisable to impose some restrictions or bans on the use of detergents containing phosphate. Eliminating phosphates from detergent can reduce phosphorus loads to septic systems by 40 to 50% (USEPA, 1980) and increase the life of the soakage trench(es).

8.6 Other options

- Upgrade or replacement of failing systems
- Design alternatives

9 Concrete Corrosion in Septic Tanks

Concrete and reinforcement degradation in septic tank is caused by hydrogen sulfide (H_2S) attack. H_2S gas is produced by the generation of sulfur found in the form of amino acids wasted from human metabolism, and in the form of inorganic compounds, as sulfate ions mainly produced by detergent (Derangere and Cochet, 1991). Concrete conditions in septic tanks is influenced by the wastewater quality. If oxygen is available in the wastewater in a sufficient amount, H_2S is oxidised into sulfuric acid in the solution and does not pass into the septic tank atmosphere (corrosion of submerged tank walls occur). If the effluent is poorly aerated (O_2 less than 0.1 mg/L) H_2S will not be oxidised and will pass into the atmosphere before condensation and the corrosion will affect the unsubmerged tank walls and the upper inner part of the tank. Generally concrete degradation in septic tank occur as follows:

1. Sulfate reduction into hydrogen sulfide (H_2S) in anaerobic effluent under microbiological process (heterotrophic bacteria) and transfer of sulfide formed to the atmosphere.
2. Conversion of H_2S to sulfuric acids (H_2SO_4) under microbiological process (Thiobacilli) on the unsubmerged concrete surface.
3. Reaction of sulfuric acids with concrete to give gypsum and ettringite.

As design improvement in the ventilation is needed to reduce H_2S production, the maintenance provider should inspect all venting pipes at the time of inspection. Concrete coating should be part of the manufacture process. The technician input at this stage is to test pH of wastewater in the tank and add lime to adjust pH to be greater than 6.

10 Answers to Common Questions

10.1 Health concern

Septic tank influent and effluent are highly contaminated with faecal coliforms and other organic matter. Also grey water (all wastewater excluding toilet waste) is contaminated, reclaiming of this wastewater should not be allowed under existing design conditions. If the wastewater is surfacing in the disposal area or sewage is experiencing backflow into the plumbing fixtures, the system should be reported for maintenance immediately. A failed system is capable of spreading disease, breeding mosquitoes and causing odours and a nuisance. Health risks, through residents and pets contact with contaminated soil and wastewater, may be significant.

10.2 Pumping frequency

To reduce the amount of solids and grease entering the soakage trench and the need for expensive repairs, septic tank should be pumped out regularly. Table 2 can be useful to the maintenance provider for establishing a reasonable septic tank maintenance schedule.

10.3 Water conservation measures

20-70% of the water consumption is wastewater going into the septic tank system (Khalifé et al., 1997). It is advised to inform the community of the following:

- Immediately report leaky fixtures (toilet, taps, etc.)
- Wash clothes/dishes only when you have a full load.
- Take short showers.
- Use water saving devices in your toilet tank or install a new low flow toilet.
- Install low flow shower heads.
- Don't use the toilet for waste disposal.

10.4 Symptoms of malfunctioning system

- When there are odours, persistent wet spots and/or fresh growth of grass in the disposal area.
- The plumbing drain becomes sluggish when used heavily or during wet weather.
- Problems continue even though the septic tank has been recently pumped out.

10.5 Contributing factors in CSTS failure

10.5.1 Management

- Poor wastewater management including (1) absence of records showing site layout with all system components, (2) site assessment, (3) quality control on both construction and installation, and (4) maintenance records.
- Poor planning and development in positioning the septic tank and disposal area.

10.5.2 Underdesigned system

- Tank capacity is small.
- Insufficient disposal area.
- Insufficient detention time for the biological treatment of wastewater in the tank.
- Lack of protection slab to septic tank and poor access to manhole for inspection.
- Grease trap is levelled with the ground surface.

10.5.3 Faulty installation

- Plugged lines, not enough gravel, smeared soil interface caused by excavation.

10.5.4 Soil conditions

- Percolation rates and long-term acceptance rates of effluent are not assessed properly.
- High groundwater table.
- Less than 1.8 metres of soil over bedrock.
- Relatively impervious soil.

10.5.5 Wastewater characteristics

- High pollutants concentrations of effluent discharged in the disposal area.

10.5.6 User mobility and habits

- Population mobility where large fluctuations in occupancy cause a decrease of the long-term acceptance rate of the disposal area.
- Discharge of rags, plastic and other non-degradable objects into the septic tank.
- Excessive use of detergent.
- Vehicle damage to septic structure.
- Excessive use of water and grey water generation.

10.5.7 Lack of maintenance

- Septic tanks are not pumped out when necessary.
- Absence of maintenance records.

11 Recommendations

General recommendations are listed below followed by a septic tank inspection form. These are addressed to the maintenance provider, consumer and the community and are to be used as a guide only. No modifications or alterations of existing septic tank systems or any plumbing fixtures are advised without the approval of the regulatory authority.

- Grey water can be highly contaminated and should not be used for irrigation.
- Repair plumbing fixtures if leakage is reported.
- Promote user education in the correct use of washing machines, detergent and efficient use of water (water conservation).
- Allow the disposal area to rest for a six month period (if two trench system in place).
- Frequent pumping of tanks.
- Pump-out operations do not exceed 1 year at any time.
- Keeping records of observations and copies of the inspection report in the community.
- Hire qualified management personnel.
- Train local Anangu people to service on-site disposal area.
- Residents should be advised that the soil in the backyard may be contaminated as a result of on-site wastewater disposal, especially if wastewater is surfacing.
- Sludge and scum thickness in the tank should be measured even if the system is in good operation.
- Careful handling of septic tank sludge as these contain high pollutants concentrations.
- Provide a comprehensive inspection report detailing observations and maintenance services.

Septic Tank Inspection Form

Inspector records

Inspector name ______________________

Inspector occupation ______________________

Date of previous inspection ______________________

Date of current inspection ______________________

Time starting inspection ______________________

Time finished inspection ______________________

Estimated number of days between inspections ______________________

Reason for not inspecting the system as scheduled ______________________

____

Weather condition and temperature ______________________

User details

Owner name, house No. and address ______________________

Community ______________________

Number of bedrooms ______________________

Current number of occupants ______________________

Previous number of occupants ______________________

House vacated since ______________________

System used by others (visitors, neighbours) ______________________

Pit toilet being used and how often ______________________

Occupant mobility from previous inspection ______________________

Septic tank information

System age ______________________

Septic tank capacity ______________________

Septic tank dimensions ______________________

Tank material: Concrete, steel, fibreglass, other ______________________

Type of septic tank: Manufacturer details ______________________

Sketch of site components if site plan is not available

Flow measurement

Main meter reading from previous inspection ______________________

Main meter reading from current inspection ______________________

Estimated flow between two consecutive inspections in Litres ______________

Estimated flow between two consecutive inspections in L/day ______________

Estimated wastewater flow as 70% of total water consumption in L/day ________

Estimated wastewater flow as 70% of total water consumption in L/capita.day ________

Pump out details

Tank last pumped out ______________________

Reason of current pump out operation if service is not scheduled ______________

____

Observed damage since last pump out ______________________

____

Garbage allowed into septic tank ______________________

Tank conditions

Tank top: visible, damaged or suspect ______________________

Ease of access to manhole ______________________

Ease of access to inspection ports ______________________

Damage to cover detected ______________________

Damage to baffles detected ______________________

Damage observed in concrete such as cracks or deterioration since last inspection ________

____

Inlet baffle: visible, damaged or suspect ______________________

Outlet baffle: visible, damaged or suspect ______________________

Wastewater, scum and sludge depths

Liquid level ______________________

Scum thickness at wastewater surface ______________________

Distance between bottom of scum layer and bottom of outlet pipe (pump out if within 80 mm) ____

Sludge thickness at bottom of tank ______________________

Distance between top of sludge layer and bottom of outlet pipe (pump out if within 200 mm) ____

Observed solids in septic inlet and outlet pipes ______________________

Yard observations

Parking above septic tank ______________________

Health concern

Wastewater surfacing in yard ____________________

Backflow of wastewater into toilet, kitchen, etc. ____________________

Occupants are in contact with wastewater as a result of a failed system ____________________

Other components

Aeration component available ____________________

Grease trap available and its age ____________________

Grease trap is levelled with surface ____________________

Grease trap is easily opened ____________________

Pit toilet available on site and its age ____________________

Low volume minimum-flush toilet installed and its age ____________________

Soakage trench(es)

Trench type: Plastic tunnel, pipe, etc. ____________________

Number of soakage trenches ____________________

Trench system absorption area in square meters ____________________

Length of soakage trench ____________________

Line from septic tank to soakage trench: visible, damaged, etc. ____________________

Parking above soakage trench ____________________

Inlet riser available ____________________

Inlet cap available and ease of opening by unauthorised persons ____________________

Evidence of solids carryover from septic tank (collect sample from inlet of soakage trench) ______

Summary of previous inspection comments ____________________

Current conditions: Smell, lush vegetation in yard, surfacing, trees over soakage trench _________

____

Storm drain is directed to tank ____________________

Runoff flow direction ____________________

Additional house construction or extension above disposal area ____________________

Distribution box

Location ____________________

Depth of liquid level above outlet pipe ____________________

Measure water depth at each soakage trench inlet ____________________

Evidence of solids escape from septic tank ____________________

Damage detected ____________________

Conclusions and recommendations ____________________

____

References

Derangere, D and Cochet, C. (1991). "Concrete Corrosion in Individual Septic Tank Systems." European Water Pollution Control, Vol 1., No. 6, November.

Dreisbach, R. H. (1961). "Handbook of Poisoning: Diagnosis and Treatment". Los Altos, CA: Land and Medical Publications.

Geary, P.M. and Gardner E.A. (1996). " Land Management for Urban Development: On-site Disposal of Effluent." Australian Society of Soil Science Inc., Queensland, Australia 22-24 April, pp 291-319.

Hargett, D.L.; Tyler, E.J.; Conserve, J.C. and Apfel, R.A. (1985). "Effects of hydrogen peroxide as a chemical treatment system." Proceedings 4th Nat. Sump. Individual and Small Community Sewage Treatment. Am. Soc. Ag. Engineers, Michigan. pp. 273-284.

Health Commission of Victoria (1983). "Code of Practice for Septic Tanks." Health Commission of Victoria, Melbourne.

Jarrett, A.R.; Fritton, D.D. and Sharpe, W.E. (1985). "Renovation of Failing Absorption Fields by Water Conservation and Resting." American Association of Agricultural Engineers, Paper No. 85-2630.

Khalifé, M.A.; Dharmappa, H.B. and Sivakumar, M. (1997). "Safe Disposal of Wastewater in Remote Aboriginal Communities." Research report submitted to Nganampa Health Council, GEM Engineering Research Centre, Department of Civil and Mining Engineering, University of Wollongong, NSW, Australia.

Lange Dames and Campbell (NT) Pty. Ltd. (1994). "Effectiveness of Treatment and Disposal of Effluent by Septic Tanks at Aboriginal Communities in the Northern Territory." The Department of Lands, Housing and Local Government Northern Territory.

Mancl, Karen (1984). "Estimating Septic Tank Pumping Frequency". Journal of the Environmental Engineering Division, Vol. 110-No.1, pp 1-736, February.

Metcalf and Eddy Inc. (1991). "Wastewater Engineering Treatment Disposal Reuse." Third edition, McGraw-Hill, Inc.

NHC, SAHC and AHO (1987). "Uwankara Palyanku Kanyintjaku - An Environmental and Public Health Review within the Pitjantjatjara Lands", December.

Pholeros, P.; Rainow, S. and Torzillo, P. (1993). "Housing for Health: Towards a Healthy Living Environment for Aboriginal Australia." HealtHabitat, NSW Australia.

Robillard, P.D. and Martin, K.S. (1993). "Preventing Septic System Failures". Penn State College of Agriculture - Cooperative Extension: Agricultural Fact Sheet #SW-161.

Spooner, A. (1997). "Personal communication." Health and Building Department, Campbelltown City Council, NSW.

USEPA (1980). "Design Manual - Onsite Wastewater Treatment and Disposal Systems." U.S. Environmental Protection Agency, Office of Water, Washington, DC.

White, P.; Delvecchio, J. and Cosic, M. (1994). "Water Use Down, But a Long Way to Go." Sydney Morning Herald, article, p7, October 1.

Winneberger, J.H.T. (1984). "Septic-Tank Systems - A Consultant's Toolkit; Vol.2 - The Septic-Tank." Butterworth Publishers, Boston.