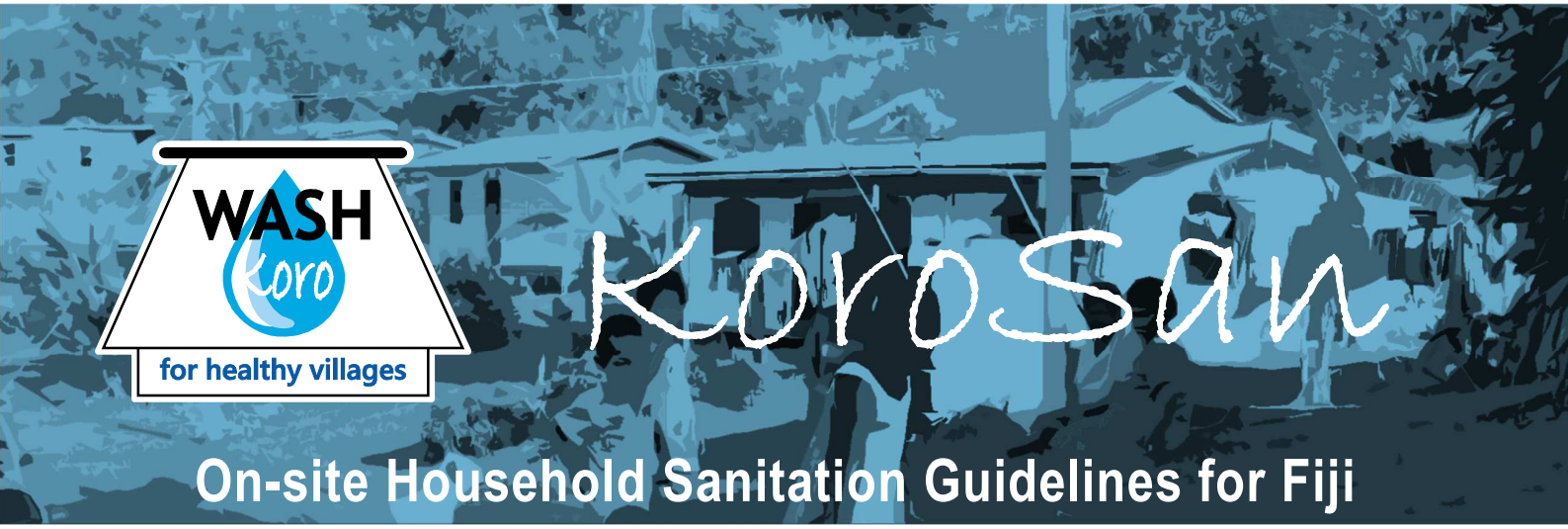

#7 GREYWATER MANAGEMENT

1 PURPOSE

A safe, sustainable, effective and affordable sanitation system is an essential service for the health and wellbeing of all people. This guideline provides information for the design and construction of greywater management services for rural dwellings, clusters of dwellings, schools or community buildings in Fiji that are not serviced by a reticulated sewer service. Greywater is the wastewater that comes from sinks (including kitchen and bathroom sinks), tubs, baths, washing machines and showers. It does not include blackwater from flushing toilets or urinals.

See KoroSan #1 for further guidance on choosing an appropriate wastewater management service, and KoroSan #2 for assessment of your soil, site and wastewater flows.

2 WHY DO I NEED TO MANAGE GREYWATER?

Greywater is generally of lower strength than blackwater and so the temptation is simply to let greywater discharge into the nearest drain or on to surrounding land in the hope that it will soak away. This has been common practice in many villages and if the discharges are small and the soils drain well (such as sandy soils), this may be acceptable practice and may not cause too many problems or health risks. However, greywater contains contaminants such as soaps, lint, and silt from showers, basins and laundry and, fats, oils, greases and organic solids from the kitchen sink. It can cause clogging of soils, resulting in ponding, odours and potential habitat for mosquitos. Although it is not considered as high a microbiological health risk as black water, it can contain disease organisms (e.g., pathogenic bacteria and viruses), and does pose potential health risks.

If there are many houses discharging greywater into the same drain or area of land and volumes are quite high, the drain can soon become polluted, smelly and a health risk to the villagers. If the soils are poorly draining clays, wet ponded areas establish which can also be a health risk. Therefore, sustainable practices for greywater management are recommended.

3 GREYWATER VOLUME

There is little reliable data on typical greywater volumes from village dwellings in Fiji. The daily greywater discharge per occupant from Fijian village dwellings is likely to be highly variable as it is dependent on what facilities are in the dwelling, the capacity of the water supply, and the behaviour of the occupants. Greywater daily volume per occupant can be high as 140 L for a fully equipped house. For a dwelling with a shower and flushing toilet but no washing machine where clothes are washed by hand in a tub or in a nearby stream, the daily greywater volume is likely to be about 100L/occupant. Dripping taps, or taps kept flowing to rinse clothes, can increase the daily volume significantly. It is sensible to minimise the quantity of water used and therefore the amount of greywater needing treatment by fitting water-conserving fixtures (e.g., low volume shower heads), maintaining tap washers and moderating behaviour to reduce wastage (e.g., limiting time in the shower)

Recommended design estimates for daily greywater volume per occupant for different activities are shown below in Table 1.

Table 1: Daily greywater flow estimates for Fijian households.

Source	***Daily volume/occupant***
Kitchen and bathroom sinks	15 L
Laundry	30 L
Shower	95 L

4 GREYWATER MANAGEMENT OPTIONS

4.1 COMBINE WITH BLACKWATER AND MANAGE TOGETHER

For dwellings with flush toilets it is necessary to install an on-site wastewater service to manage the toilet wastewater (blackwater); typically, a septic tank with outflow to a soakage field. Combining greywater and blackwater together and treating them in the same system is common practice in many countries and may be the most economic option to consider. Greywater volumes are often three or more times that of the blackwater, which means the capacity of the septic tank and the size of the soakage field need to be significantly and proportionally increased to manage the higher volume of combined wastewaters. The following is an example of the implications of including the greywater with the blackwater wastewater management system for a dwelling with 6 – 8 occupants.

Table 2. Example of separate and combined blackwater and greywater septic tank systems for a dwelling with 6 to 8 occupants

Blackwater only	***Combined black and greywater***
Daily design volume 240 – 320 L/day	Daily design volume 1000 to 1400 L/day
Septic tank minimum capacity: 2400 L	Septic tank minimum capacity: 4030 L
Soakage field dimensions: Base area, 25 m² (600mm wide and total length 42 m length)	Soakage field dimensions: Base area, 120 m² (600mm wide and total length 200 m length)

Refer to KoroSan #3 and #4 for appropriate design and construction of septic tanks and land applications systems, respectively. Do not attempt to use an existing blackwater system that has not been specifically designed for the additional discharge (~3-fold greater) from a combined black and greywater system.

4.2 DEDICATED GREYWATER MANAGEMENT OPTIONS

For dwellings with dry toilet systems (pit toilet, ecoVIP2 or composting toilet) a dedicated greywater system will be required. Where flushed toilets are installed, it can also be advantageous to manage greywater separately from blackwater. This has historically been the common practice in Fiji, and the plumbing in many houses is arranged in this way. Because of the lower strength and different characteristics of greywater, it can often be managed more effectively and simply using dedicated systems.

The key criteria for the design of an appropriate greywater system are:

- Minimise greywater storage time (greywater becomes very smelly when stored).
- Avoid any surface ponding of the greywater.
- Encourage aerated soil ecology to breakdown and stabilise greywater contaminants.
- Avoid direct discharge to surface and ground water bodies.

Two household greywater management options are recommended:

1. Greywater soakage drums for free draining sandy soils.
2. Greywater garden with an under-drain for poorly draining (clay) soils.

GREYWATER SOAKAGE DRUMS

For dwellings with up to 6 permanent occupants, located on free draining sandy soils installation of two soakage drums per house is recommended. Add one extra drum for every additional 3 permanent occupants. One drum alone is only likely to be sufficient for houses with 3 or fewer permanent occupants. The soakage holes for each drum should be placed at least 1.5m from each other.

The drums are filled with coconut husk to provide a coarse pre-filter to capture and degrade particulate matter and fats in the greywater. A bed of large stones or gravel beneath the drum provides for further filtration and soakage into the soil below. The recommended design of the soakage drums is detailed in Figure 1.

Materials required for each soakage drum:

- 220 L plastic drum with lid removed. Steel drums may also be used, but will rust and have a relatively short life in the ground.
- Enough coconut husk to fill the drum.
- Large stones or coral rock, 75mm to 150mm diameter.
- About 8 m^2 of filter cloth or polyethylene sheet.
- 50mm concrete lid for the drum.
- Concrete mix for the collar.
- PVC pipe (at least 50mm diameter) to convey grey water to the drum and system to enable ready changeover of flow from one drum to the other.

OPERATION AND MAINTENANCE

- For dwellings with 2 or more drums, alternate the greywater loading between each drum on a monthly cycle. Swapping from one of the drums to the other allows them to recover between dosing periods. This allows for sustainable greywater treatment and maintenance of infiltration capacity.
- Inspect the drums monthly.
- When the coconut shells become compacted, smelly or blocked, remove the husk and replace with new material.

Figure 2. Greywater soakage drum.

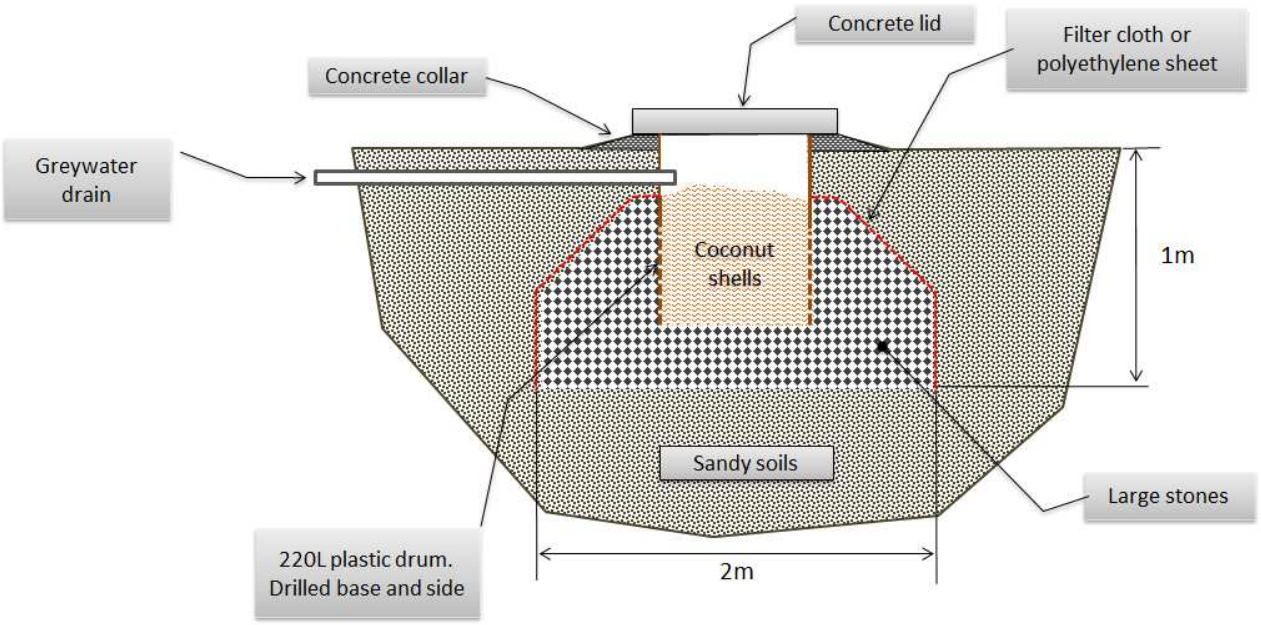

Figure 3. Plastic drum with top cut off and holes drilled in the base and sides (left) and after filling with coconut husk and provision of concrete collar and inspection cover (right)

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GREYWATER GARDEN – VEGETATED SOAKAGE TRENCHES

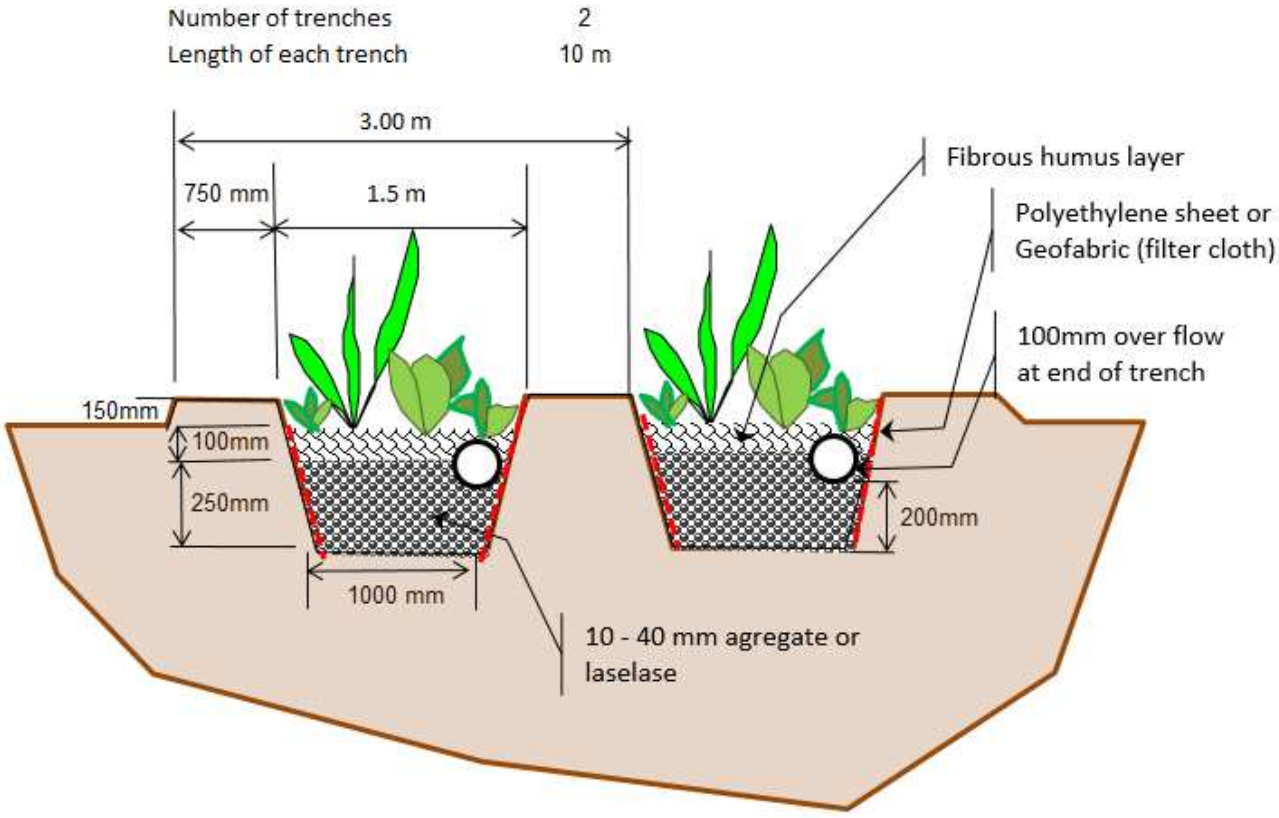
Managing grey water on poorly draining soils and sloping land is more difficult and must be done carefully. The drum system described above will fail in poorly draining soils. The recommended greywater system for these sites is an alternating vegetated soakage trench.

The greywater garden is a gravel filled trench in which wetland plants are grown. The reason for requiring at least two greywater gardens is to alternate the loading between them. The greywater contains suspended organic solids which will build up over time, at the top end of the trench. When this occurs switching to the other trench for a period of months will then allow the biodegradation of organic solids by the established garden ecology.

Refer to Figures 3 and 4 for the design detail for a greywater garden for a dwelling with up to 8 permanent occupants.

As the soils for this system are generally poorly draining it is necessary to install underdrains as shown Figures 3 and 4. Effluent from the underdrain will be of improved quality, but will still be a potential health risk. It should be discharged into a safe place, such as a wetland swale or vegetated drain, away from where people come into contact with it.

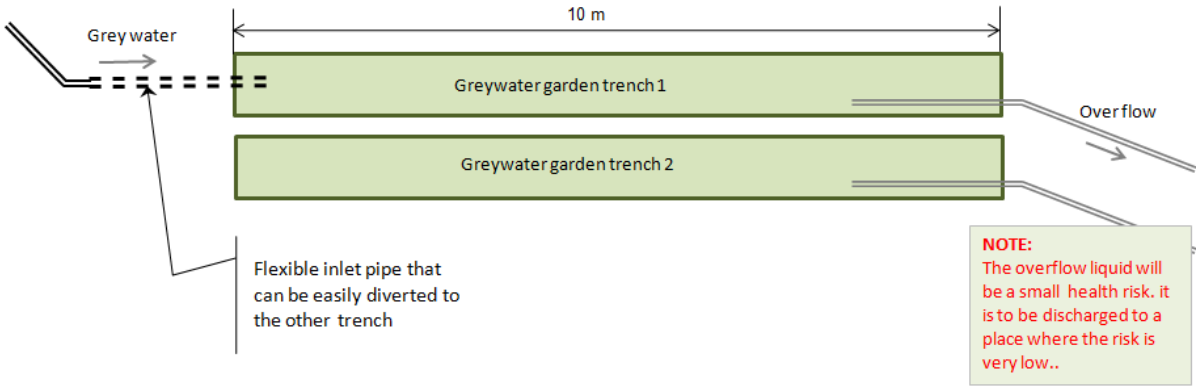
Figure 4. Cross-section of the alternating greywater garden for up to 8 occupants.



NOTES

1. The number and length of trenches will depend on daily hydraulic load.
   Two alternating trenches each 10m long will be required for a dwelling with up to 8 occupants.
   This is a total of 2.5m of trench length per house occupant.
2. Each trench needs to be laid on a flat and level grade.
3. Wastewater is then gravity fed, by securely attached flexible or movable pipe to the top end of one trench.
4. Every 3 months or when the active trench starts to be come over loaded with organic solids at the inlet end of the trench, move the greywater inlet pipe to another trench. Alternate loading of trench every 3 months as determined by organic buildup.
4. A 100mm drain pipe is to be installed 200mm (to the invert) from the bottom end of each trenches to collect and direct wastewater in excess of soakage, to a safe soak hole or surface drain.

Figure 5. Schematic plan view of the alternating greywater garden.



Schedule of quantities

Washed gravel	9 m^3
Polyethylene sheet or filter cloth	20 m^2

5 WHERE SHOULD I SITE A GREYWATER MANAGEMENT SERVICE?

- Check for and avoid other buried services; water supply pipelines, stormwater pipes, power and telecommunication cables.

Where NOT to site a greywater system:

- Close to areas used for growing, processing or storing food.
- Public areas where villagers and children gather, play and recreate.
- Areas where roof water drains to.
- Areas where soils become wet and saturated at any time or are wetlands.
- Areas subject to flooding and tidal surges and surface flooding after heavy rainfall.
- Areas where ground water is less than 500 mm below ground-level at any time throughout the year.
- Within 20m of a well or bore used for a village water supply where the abstracted groundwater is more than 15m below ground level.
- Within 50m of a well or bore used for a village water supply where the abstracted groundwater is less than 15m below ground level.
- Within 20m of a surface water body used as a village water supply or bathing/swimming area
- On land that slopes more than 15° (25%).

6 WORKMANSHIP

The construction of the greywater system must be carried out by or under the supervision of a suitably qualified and experienced tradesperson.

7 RISKS

ODOURS

It is possible that the greywater systems may give rise to nuisance odours. This is likely to be as a result of the drums or trenches becoming blocked and the ponded greywater become anaerobic or ponding to occur and the greywater remaining stagnant. Flow should be directed to the other drum or trench, to allow the current one to rest and recover.

INSECT INFESTATION

If insects do become a nuisance, then it may be necessary to spray with a suitable insecticide. Try to avoid surface ponding which will attract insects.

STORMWATER ENTERING THE DRUM AND GREYWATER GARDENS

Ensure that there is no risk of water, especially after rainfall, entering the greywater system. If necessary, construct stormwater diversion drains around the grey water system.

This guideline was produced in consultation with the Fiji Department of Water and Sewage and the Ministry of Health as part of the WASH Koro Project led by the National Institute of Water and Atmospheric Research (NIWA). The project was supported by the New Zealand Aid Programme through the Partnerships for International Development Fund of the Ministry of Foreign Affairs and Trade. Care has been taken to make sure the information provided is correct and fit-for-purpose, but we accept no liability for any errors or omissions, or the consequences of their use or misuse. The views expressed in these guidelines do not necessarily reflect those of the New Zealand or Fiji Governments.

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For more information contact:

The Department of Water and Sewage.
The Ministry of Health, or your local
Provincial Council

KoroSan Guidelines

The WASH w project has produced the following series of technical and participatory guidelines to help mobilise villages and settlements to improve their water supply, sanitation and hygiene. These guidelines may be freely disseminated provided the source is acknowledged.

KoroSan #	Title
1	Choosing a village wastewater management service
2	Site, soil and wastewater flow assessment
3	Septic tank construction using concrete blocks.
4	Land application systems
5	Maintaining your septic tank and land application system
6	Water-less ecoVIP2 toilet
7	Greywater management
8	Village participation in water and sanitation actions

KoroSan – for healthy villages