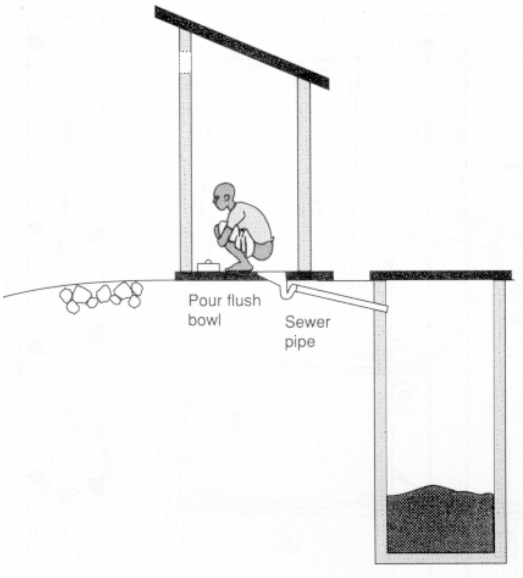
WASTEWATER DISPOSAL AND TRANSPORT OPTIONS

Leach pits

What is it? Leach pits hold faecal material in the same way as the pit of a pit latrine, while allowing wastewater to percolate into the ground.

When to use it? When the ground is free of cracks and the groundwater table does not reach within about 2 metres of the bottom of the pit, so that natural microbiological processes in the ground should ensure that pathogens do not reach the groundwater. (Some viruses may penetrate further but the research on these is limited and they do not appear to present a serious health hazard).



Advantages: Provided that the groundwater is deep enough, leach pits provide a simple mean of disposing of black water in a way that harms neither the environment nor public health.

Disadvantages: There may sometimes be a risk that high concentrations of leach pits in urban areas may increase levels of nitrates and other nutrients in groundwater. However the resultant risks are likely to be less than those of disposal above ground.

Pits have to be desludged from time to time and there is a significant risk to the health of workers if the pit has to be desludged by manual methods.

Separate provision will normally have to be made for the disposal of sullage (grey water) as water use rises.

Technical requirements The pit should have as much capacity as is possible but, to reduce the cost of the cover slab, should not be more than about 1.25 metres across. A cylindrical pit will normally be the most economically and can be built with a single brick (112mm) wall or equivalent. The pit lining should provide openings so that the flush water can percolate into the ground. The pit may be located under the latrine superstructure, as in a standard pit latrine design. However, it is easier to arrange for emptying the contents of the pit if it is off-set. Leach pits are not normally designed to cater for sullage water. If they are, the pit may not be able to cope with the amount of water discharged to it and flooding may be a problem as water use increases.

Pour-flush WC toilets can be provided with twin leach pits, so that the pits can be used in turn, with the contents of each left to decompose while the other pit is filling. This arrangement has the clear theoretical advantage that it reduces the health hazards associated with emptying the pit, since the contents have decomposed and should be free of pathogens by the time that the pit is emptied. Investigations in several countries reveal that users often do not use twin pit correctly. The system should only be considered if adequate arrangements are made to educate intended users in its correct operation.

More information For information on a number of on-plot technologies, including leach-pit design, see http://www.who.int/docstore/water_sanitation_health/onsitesan/ch04.htm.

OPEN DRAINS

What are they? A system of channels that picks up wastewater flows from individual households and conveys them to a disposal/reuse point. Drains may be unlined but it is much better if they are lined with either brick or concrete. In addition to wastewater, most open drainage systems carry stormwater run-off although they may not be designed to allow for peak run-off flows.

When to use them? To convey sullage/grey water. Open drains are not a satisfactory technology for transporting sewage, even when the solids have been removed in some form of septic/interceptor tank. There are two reasons for this. First, people can easily come into contact with the water in the drain, with its potentially high pathogen content. Second, since it is almost impossible to keep stormwater out of drains, any flooding will be flooding with diluted sewage.

Advantages Open drains are often the most common means of transporting wastewater. As such, they are well understood by the various stakeholders. They collect more silt than sewers and covered drains but are much easier to clean. Indeed, existing maintenance systems may be geared to cleaning them rather than sewers.

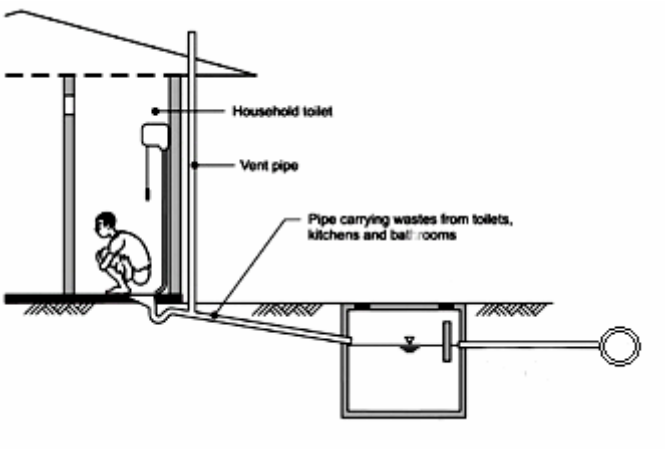
Disadvantages As indicated above, open drains designed to carry wastewater invariably also carry stormwater, which is likely to cause problems for downstream treatment facilities. They may smell and the presence of the drain reduces the usable width of the street. Silting and frequent blockages are likely to occur in collector sewers and covered drains to which open drains connect.

Technical requirements The drain should be large enough to carry the design flow, including at least moderate stormwater flows. However, it should not be too large. A common design fault is to provide large drain sections, even on branches carrying little flow. Over-sized sections are likely to become receptacles for rubbish and are more difficult to clean than smaller sections.

More information - There is relatively little information on the performance of open drains in developing countries. One source of information is DFID KAR Project R5477, Performance Based Evaluation of Surface Drainage in Low-Income Communities. Information on this project is available at http://www.dfid-kar-water.net/projects/files/R5477.html. See also Kolsky P. *Storm drainage: an intermediate guide to the low-cost evaluation of system performance*. London, Intermediate Technology Publications, 1998. Another site with general information on drainage is http://www.who.int/docstore/water_sanitation_health/Healthyvil/html/ch07.htm.

SEWERED INTERCEPTOR TANK SYSTEMS (SETTLED SEWERAGE)

What are they? Sewered interceptor tank systems (SITS) are sewer systems that include interceptor tanks on house connections, designed to settle solids and allow solids-free sewage to continue on to the sewers. Because the interceptor tanks attenuate (reduce) peak flows, sewers can be smaller than for conventional systems. Because they do not have to carry solids, they can be laid to flatter gradients than conventional sewers. SITS are also commonly referred to as settled sewerage, although this term is technically incorrect, since it is the sewage that has been allowed to settle not the sewerage.



When to use them? Consider their use when some or all of the following conditions apply:

- Existing household septic tanks can be used as interceptor tanks.
- The area is very flat so that the reduction in fall over that required for conventional sewers, reduces the need for sewage pumping
- There is a high water table so that the reduced fall that is possible with SITS reduces or removes the need to lay sewers below the water table.

Advantages SITS can be cheaper than conventional sewers, particularly in the situations identified in the 'when to use them?' section. They also tend to concentrate maintenance requirements at the interceptor tanks. Even when poorly maintained, they may catch large solids and so reduce the incidence of blockages in sewers.

Disadvantages Government authorities may not recognise and accept the system. In areas with good falls, it may be more expensive than conventional sewerage. The interceptor tanks have to be desludged from time to time. While interceptor tanks will reduce oxygen demand by a factor of perhaps 30%, there will still be a need for treatment.

Technical requirements Many interceptor tanks are rectangular in plan and designed with two compartments like a conventional septic tank. A circular plan will be cheaper and only marginally less efficient than a conventional tank. Some designs provide capacity equivalent to that of a septic tank (See septic tank note) while others provide small tanks, which are likely to quickly fill with sludge and thereafter operate mainly as a trap for large objects. The tank should have a 't' pipe on the outlet. SITS systems have operated successfully with sewer diameters as low as 38mm but a more normal minimum diameter would be 50mm or 75mm. These low diameters should only be used if regular desludging of interceptor tanks can be guaranteed. Some authorities state that there is no minimum gradient requirement and that sections of the sewer can be surcharged, provided that there is an overall hydraulic fall and no section of the sewer is surcharged above ground level. However, it may be better to define a minimum fall of the order of 1 in 500.

Sources of information http://www.sanicon.net/titles/topicintro.php3?topicId=8#settleds provides a general introduction to SITS. Links to specific schemes in Australia and the USA are available at http://www.efm.leeds.ac.uk/CIVE/Sewerage/links.html.

SEWERAGE

What is it? Sewerage is the term used to refer to a network of sewers, closed conduits, usually circular in cross-section and operating under gravity, that are used to convey wastewater. Most sewers are designed to convey either sewage or storm water but many carry both, in practice if not in theory. Some sewers, mainly in low-income areas with on-plot sanitation, have been designed to carry only sullage and storm water.

'Conventional' sewerage is normally assumed to be unaffordable to low-income people and thus inappropriate for use in the areas where they live. In practice, many people living in low-income areas do use simple forms of sewerage to deal with their liquid wastes. The cost of these is often comparable with that of other sanitation systems. For instance, tertiary sewers and house connections have been built in Pakistan and Indonesia for less than the equivalent of US$40 per household.

When to use? Consider sewerage when water use is greater than at least 60 litres per person per day and housing densities make it difficult to dispose of wastewater on or near plots. (This will typically at population densities greater than about 200 people per hectare). Explore other options, including SITS, in flat areas in which pumping is necessary, particularly where the groundwater table is high. If pumping is unavoidable, make sure that the financial and management arrangements required to support it are in place.

Advantages. Sewerage is an attractive option for users because it removes problems from their doorsteps, at least as long as it is operating satisfactorily. It deals with both faecal wastes and sullage water and can also be used to deal with storm water.

Disadvantages: Sewerage does not solve waste disposal problems but rather moves them away from the household environment. So, there will usually be a need for treatment to prevent deterioration of the environment. Sewers in low-income areas often require high levels of maintenance, particularly in areas where solid waste collection is deficient or non-existent.

Technical requirements The focus here is on the technical requirements to reduce costs and improve operation)

1. Limit the sewer depth where possible. Do this by routing sewers through gardens and yards, beneath sidewalks and/or in narrow lanes, thus avoiding heavy traffic.
2. For shallow sewers, use small inspection chambers rather than large manholes. The purpose of manholes and chambers is to gain access to the sewer and this can be done from ground level if the sewer depth is less than about 1. 25 metres). Provide benching up to the crown level of the pipe in manholes and chambers
3. Use appropriate locally available materials. Spun concrete pipes can be appropriate in some circumstances but may suffer corrosion if there are blockages and/or insufficient slope, so that sewage stays in the sewer for a long time, becomes septic (anaerobic) and produces hydrogen sulphide.
4. Pay particular attention to the design of manhole covers and ensure that covers can be replaced if they break, in order to minimise entry of garbage and silt to the sewer.

Sources of information For a general introduction to low-cost condomonial sewerage, see **http://www.sanicon.net/titles/topicintro.php3?topicId=8#simplifi**. Information on a number of low cost sewerage initiatives can be found in the D. Mara, (ed) 'Low Cost Sewerage', published by Wiley, Chichester, UK, **ISBN: 0-471-96691-6.**