Reed Beds & Constructed Wetlands Tipsheet 50p

A brief introduction to a greener way to treat your sewage.

Centre for Alternative Technology Publications

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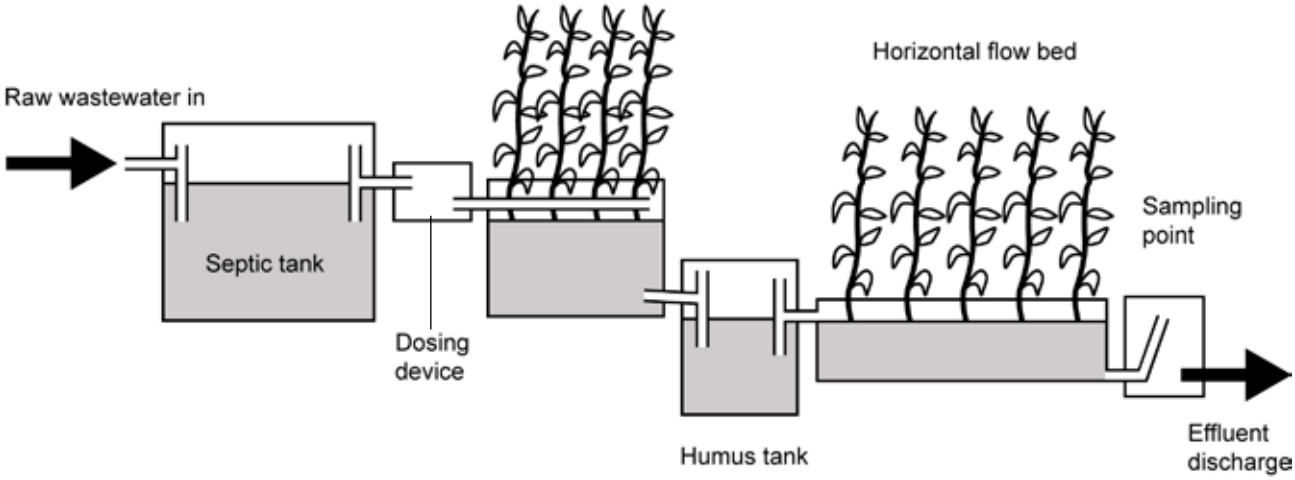


Horizontal flow bed

What are they?

Streams, pond, marsh and wetland ecosystems all contain many different physical and biological processes which help to purify water flowing through them. 'Constructed wetlands' are engineered wetland systems designed to harness these useful natural processes and optimise them for treating polluted wastewater, including sewage, agricultural slurries, industrial wastes, and even road run-off.

Reed beds are a particular type of constructed wetland usually consisting of a gravel-filled container or bed planted with reeds. Wastewater flows through the gravel and reed-roots and is purified by the actions of millions of bacteria, fungi and algae (micro-organisms) that digest the sewage. They can be used in several ways: sewage treatment companies commonly use reed beds as a 'polishing' stage at rural works following conventional treatment to give a cleaner effluent. Reed beds also effectively provide complete sewage treatment for households and small communities not served by mains sewerage, as described below.

Sewage treatment using reed beds

There are two basic types of reed bed, vertical flow and horizontal flow. At CAT we favour a system that combines the two. Before running sewage to the reed beds you need to separate the solids from the liquids in a settlement tank or conventional septic tank.

Settlement tanks

The water cleaning process begins here. A large chamber collects the dirty water and allows solids to either float (forming a 'crust') or sink (forming a 'sludge'). This stage is termed 'primary treatment'. The settled solids can either be pumped out periodically for treatment elsewhere, or let to a special type of reed bed specifically designed to treat sludge on site.

Vertical flow reed beds

The liquid from the settlement tank contains very little oxygen and lots of organic material and ammonia, making it very dirty and smelly. Vertical flow reed beds are designed to provide 'secondary treatment' by adding oxygen to this effluent and removing the pollutants.

A layered sand and gravel bed is planted with *Phragmites australis*, otherwise known as common reed. Effluent is introduced to the surface in doses so as to cover the whole bed. It percolates through the sand, gravel and plant roots, then flows out from the bottom. The bed always contains air spaces and is never waterlogged.

The organic material and fine particles are removed from the water as they become attached to the sand, gravel and plant roots, forming a slime. Aerobic micro-organisms in the slime break down the pollutants, while the reeds help provide these micro-organisms with oxygen, enabling them to work effectively and prevent the bed from blocking. The micro-organisms also reduce the levels of ammonia, which is toxic to most plants and animals, as well as very smelly.

At least two parallel vertical flow beds are necessary in a treatment system, so one can rest while the other is in use.

Secondary solids collection tanks

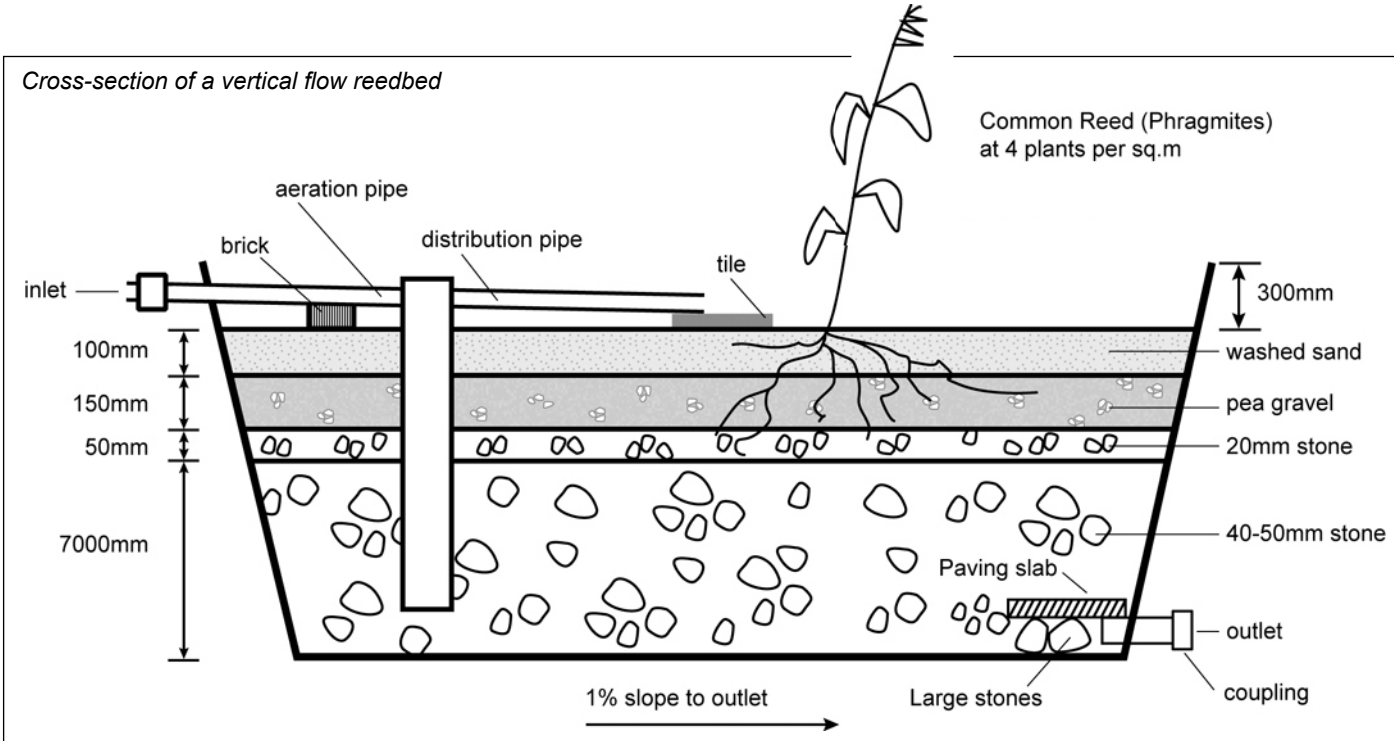
Dead micro-organisms are naturally washed out of the vertical flow reed beds. To prevent these secondary solids clogging the next reed beds, effluent is run through a tank where the solids settle out as a sludge.

Horizontal flow reed beds

Horizontal flow reed beds are suitable for 'tertiary treatment'. They are like a gravel-filled stream and constantly waterlogged. Dirty water flows in one end horizontally then through the bed and out of the other end. They provide an oxygen-depleted environment, which allows certain hungry bacteria to turn undesirable nitrates into harmless nitrogen gas (by poaching oxygen from the nitrate molecule).

This form of tertiary treatment also provides a great environment for single-celled organisms such as free-swimming

Cross-section of a vertical flow reedbed



ciliates and amoebae, which feed on smaller micro-organisms including human pathogens.

As there is no need for oxygenation in this bed, a variety of bog-loving plants can be used, including yellow flag (*Iris pseudacorus*), marsh marigold (*Caltha palustris*), reedmace or 'bulrush' (*Typha latifolia*), true bulrush (*Scirpus lacustris*) or water mint (*Mentha aquatica*).

Ponds and willow beds

Although you can treat your sewage adequately using a combination of vertical and horizontal flow reed beds, you may wish to pass it through a pond or willow bed in order to clean or 'polish' your effluent further, removing even more nitrates and phosphates. Both ponds and willows are excellent wildlife habitats, supporting a variety of insect, amphibian, bird and plant life.

How well do they work?

Performance data suggests that a well designed reed bed system can remove more than 98% of the organic matter in sewage, 60–80% of the nitrogen, and up to 60% of the phosphates.

An important issue is how well they work in winter. In the UK, reed beds continue to function during the winter, but less effectively than in summer. This is because bacteria work more quickly at higher temperatures. Sewage is usually relatively warm, so a frozen reed bed system is unusual in UK climates.

How big should they be?

It's impossible to give an exact figure for this as every situation is different. To design your own reed bed system you'll need a specialist manual (e.g. *Reed beds for the treatment of domestic wastewater*, see Further information). You may need help from specialist sanitation consultants, either at CAT or elsewhere, for the system to be approved by the Environment Agency.

How much maintenance is required?

During the first year, a certain amount of weeding may be necessary so the reeds aren't choked out by other plants. Once they are established, reed beds require very little maintenance. In a vertical flow reed bed the flow should be switched between parallel beds each week (which takes about three minutes) and the system should be checked over for blockages (a further three minutes).

Surplus or dead plants should be removed and there is a minimal amount of weeding to be done each spring.

Where are they appropriate?

This is perhaps the most important question. Constructed wetlands or reed beds are ideal for locations far from mains sewage and with a good fall (2m) in land levels at the site. Usually this means rural situations: often small communities or single households.

Often, they are a good complement to a septic tank, which removes sewage solids but doesn't produce effluent clean enough to discharge to a water course. By adding a reed bed after the septic tank, solids are removed and the sewage is cleaned to the required standards.

Reed beds are frequently a cost-effective way of thoroughly cleaning sewage and other wastewater. At the same time, they have an aesthetic appeal that most other sewage treatment methods lack and they provide a refuge for wildlife. However, if you live 'on the mains' then a low-flush toilet is likely to be a much better investment (see *Water Conservation in the Home*, below).

Further information

You may find the following CAT publications helpful:

- *Sewage Solutions: Answering the call of nature*, Grant, Moodie and Weedon, 2005 (3rd Edition), £12.00
  Helps you choose the best treatment system for your needs.
- *Lifting the Lid: An ecological approach to sewage treatment systems*, Peter Harper and Lousie Halestrap, 1999, £12.00
  A practical, ecological approach to toilet systems.
- *The Water Book: find it, move it, store it, clean it…use it*, Judith Thornton, 2005, £12.00
  The definitive guide to managing your H_2O.
- *Water Conservation in the Home Tipsheet* £0.50
  Tips for saving water and using it more wisely

The above titles are available direct from CAT Mail Order – tel. 01654 705959 to order or receive the complete Buy Green By Mail catalogue. Visit **www.cat.org.uk/catpubs** to order, read reviews or download tipsheets and factsheets.

The following title is not available from CAT:

- *Reed beds for the treatment of domestic wastewater*, Grant and Griggs, Building Research Establishment, 2001, £17.50.
  See www.brebookshop.com or Tel: 01344 404 407

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