

Bioreactors

What is a bioreactor?

A bioreactor is a woodchip filled trench placed on a farm to intercept and treat groundwater or surface water from crops.

Bioreactors are relatively inexpensive to construct and are efficient at removing nitrate (a form of nitrogen), provided the site conditions are suitable.

What does a bioreactor do?

Bioreactors convert nitrate in groundwater, or surface water, to nitrogen gas using microbes and a carbon source (typically woodchip) under low oxygen conditions. The potential for woodchip bioreactors to remove other nutrients, chemicals and pesticides is less studied.

Bioreactors are currently being trialled in different parts of Queensland to determine their treatment performance and design criteria in different production systems and climatic conditions.

Are all bioreactors the same?

No, there are two main types of bioreactor—a wall bioreactor and a bed bioreactor.

What is a wall bioreactor?

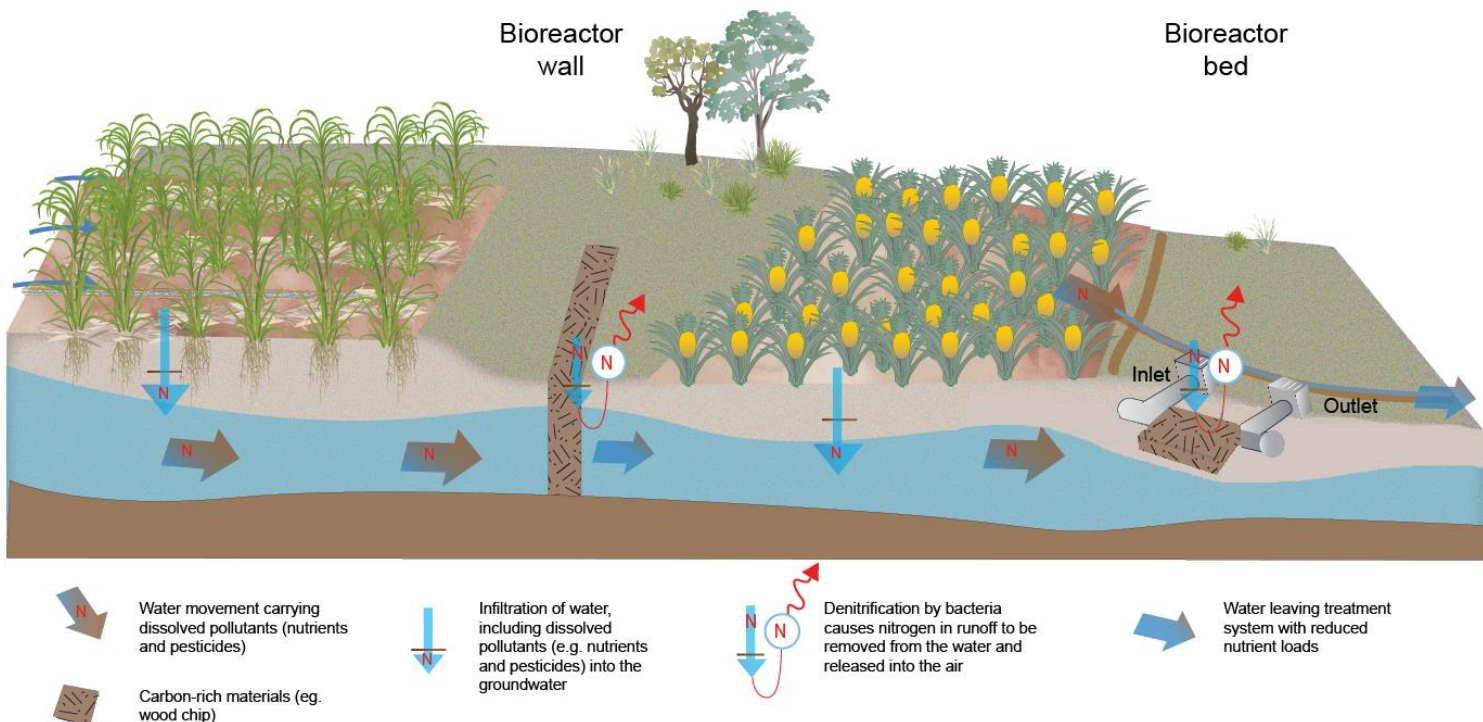
Bioreactor walls consist of a trench filled with woodchips or another carbon source, located perpendicular to the groundwater flow.

Denitrification (the conversion of nitrates to nitrogen gas) is enhanced in the presence of carbon and anoxic conditions and occurs as the groundwater passes through the wall.

What is a bed bioreactor?

Bioreactor beds consist of a bed of woodchips or other carbon source through which water from subsurface pipes (e.g. tile drains) or an open drain is passed. They are either in-line (within a drain) or off-line (water is diverted into the bioreactor via an offtake). An inlet and outlet structure is required in either instance. Excess flow is bypassed.

A sediment trap is generally required upstream of the woodchip to prevent clogging of the bioreactor bed.





What are the steps involved?

Site selection

The most important and time-consuming part of installing a bioreactor is choosing the right site and design. There are variables to consider such as the location in the landscape, hydrology, catchment area, pollutant of concern and production system management. It is recommended that you seek professional advice.

Approvals

Approvals may be required for the construction of a bioreactor. Please contact your local government and the Queensland Government to check what approvals are required. Prior to construction, check for any existing infrastructure by contacting electricity, water and telecommunication providers.

Engineering advice should be sought prior to construction to ensure the bioreactor is sized and sited appropriately, taking into account soil suitability, groundwater and local hydrology.

Construction

Bioreactors require earthworks to excavate a trench. For beds, an inlet and outlet into a farm drain or subsurface drain will need to be constructed and can be an open drain or pipe.

If you anticipate large amounts of surface water flowing across the site, you may consider installing an embankment to prevent damage to the bioreactor through scouring and/or topsoil loss or deposition.

Install geofabric or plastic on top of the woodchip, to prevent sedimentation and clogging of the woodchip over time. This will also allow the woodchip to be exposed later, if desired.

Time for establishment

A bioreactor can be constructed and operational within one to two days (depending on the size of the structure and any associated pipe work or other structures). Denitrification will commence almost immediately. The denitrifying microbes are naturally present in the environment. No 'seeding' is required.

Operation and maintenance

Operational requirements are minimal. Bioreactors operate passively. Typical maintenance of a bioreactor bed will involve occasional excavation of the sediment trap to remove sediment build up.

Monitoring

Check sediment traps. Check inlet and outlet structures for blockages. Measure flows and nitrate removal for ongoing design purposes.

Lifespan/replacement time

The expected life span of a bioreactor in Queensland is 10-12 years. This will depend on the location and the type of carbon source. After this time the carbon source will need to be added to or replaced.

Where can I find more information?

<https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/>

Content sourced from Department of Environment and Science WetlandInfo website.