CAREX

Nutrients - nitrate

Edge-of-field nitrate reduction with woodchip bioreactors

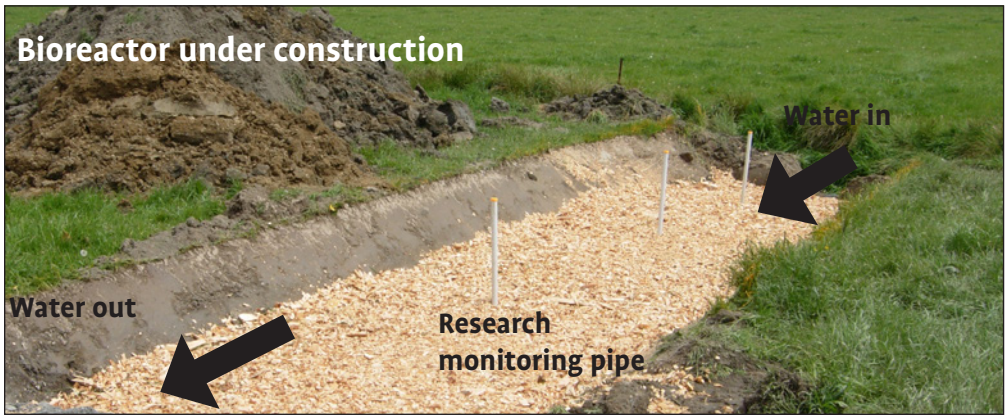
Handouts

1. CAREX Key Steps
2. Aquatic weeds
3. Sediments
4. **Nutrients - nitrate**
5. Biodiversity (coming soon)
6. *E. coli* (coming soon)

High levels of nutrients degrade water quality, increase algal blooms and aquatic weed growth. Elevated nitrate levels are an indicator of pollution and can pose a risk to human health. Nitrate mostly enters waterways from groundwater and sub-surface drainage water, such as tile drains.

Bioreactors are a tool used to reduce nitrate levels in water flowing into waterways that bypass riparian buffers.

How do bioreactors work? Bioreactors provide a carbon source (often wood chips) and a suitable low-oxygen conditions for microbes to convert nitrate to nitrogen gas, in a process called denitrification. Nitrogen gas then enters the atmosphere and is harmless.



Why woodchips? A practical, affordable, sustainable & long-lasting (10-15 years) carbon source. Untreated woodchips either hardwood or softwood, ~ 2.0cm in size (to avoid compaction when in bioreactor), are best.

On-going research & future trials Early results from our biorector trials in Canterbury are promising, with an average of *10% reduction* in waterway nitrate levels. To make a difference to water quality, edge-of-field tools to enhance nitrate removal must be complemented by land-based nutrient management practices.

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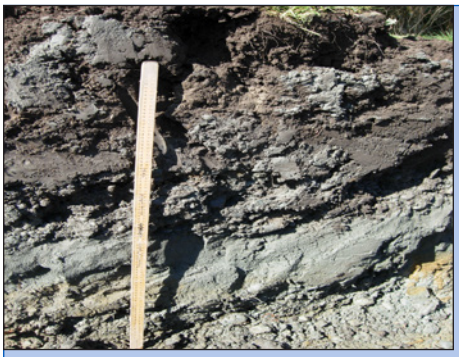
Solutions for agricultural waterways

Step by step - Building an edge-of-field bioreactor

You'll need to combine information about your farm with input from experts to get a bioreactor up and running.



1. Design & planning - *Consider several on-farm factors in design (see below). Careful planning is essential for operational success. Source woodchips.*

2. Site preparation - *Earthworks to dig the bioreactor pit. Lining the bioreactor with geotextile fabric depends on the heaviness of soils.*

3. Plumbing - *Install pipes and connect bioreactor to inflow, outflow and overflow structures, as required.*

4. Woodchip addition - *Digger fills in bioreactor with wood chips.*

5. Bioreactor cover- *Depending on soil type and other local conditions, a geotextile cover should be installed, especially if farming will continue over bioreactor. Top the bioreactor with soil.*

6. Monitoring & maintenance - *Check inflow structures and piping in winter/spring with higher flow. Maintenance will be site-specific and vary from year to year. Woodchips will need to be replaced after 10-15 years.*

Some bioreactor design considerations

- *Design type* - what is the source being treated (e.g., tile drains, open drains)
- *Size* - scaled to match nitrate load and water flow; 10-20m^3 is minimum recommended size to treat tile drains
- *Hydraulic residence time* - to allow sufficient contact time between nitrate-laden water and denitrifying microbes in the bioreactor
- *Slope* - inflow control structures to reduce back up of tiles, flooding or ponding in paddock
- *Soil type* - to line or not to line inside bioreactor
- *Drainage* - flow and nitrate load; high flow and low flow situations to design necessary diversions
- *Tile drains* - location, tile depth, diameter, slope, tile connectivity
- After bioreactor installation, paddock can be returned to productive land

There is still much to learn about this practical, low-cost tool making a difference in water quality in agricultural drains. We are looking for suitable sites for our next trials - if you are interested in bioreactors and think it might be a good fit on your farm, please contact us at carex@canterbury.ac.nz

For more details and steps to get you started, please check out our other handouts.