Buffer strips

This fact sheet is one of a series which provides advice to extension officers and land managers on the use of buffer strips to improve farm run-off water quality, specific to coastal agriculture in the wet/dry tropics region between central and Far North Queensland.

Buffer strips

Buffers have many different purposes depending on the area to be buffered, the values of that area and the threats which the buffer is designed to manage. This factsheet deals specifically with buffer strips which have the primary purpose of intercepting water flow on its way to a watercourse or drain (may also be known as grassed filter strips).

Buffer strips work by allowing shallow dispersed flow to move through the vegetation, which then traps the sediments and particulate matter.

The flow into buffer strips needs to be dispersed and needs to remain that way as the water moves through the strip. Vegetation cover in the buffer strip needs to be similar in structure and must be maintained. The formation of concentrated flow channels should be avoided.

Where buffer strips are immediately adjacent to crop areas, the buffer can be slashed to manage pests.

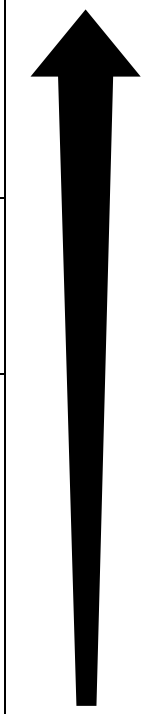
Treatment processes

Vegetation within buffer strips slows the speed of run-off, allowing sediments to be deposited into the buffer strip area.

Infiltration of water into the buffer strip also assists with the removal of other pollutants; however, buffer strips are less effective at removing dissolved nutrients and pesticides (Table 1). Buffer strips perform best when there is dense vegetation growth at the ground level, e.g. vegetation with multiple stems and groundcover, and shallow flow depths (below the vegetation height).

Example of a buffer strip. Photo: Peter Breen

Table 1 – Summary of buffer treatment processes

Pollutant Size / Type	Treatment Performance	Description of Buffer Treatment Process
Coarse to medium sized pollutants (e.g. coarse sediments and organic matter)		Vegetation facilitates enhanced sedimentation of particles, particularly coarse to medium sediments, through filtration and deposition.
Fine particulates (e.g. fine sediments and particulate nutrients)		Vegetation may also trap some fine particles which may retain or adsorb pollutants.
Dissolved pollutants (e.g. nutrients, chemicals and pesticides)		Direct uptake of nutrients by vegetation is achieved after infiltration. After infiltration, saturated sediments in buffer strips can provide suitable conditions for denitrification which transforms nitrate into nitrogen gas.

1 The Queensland Wetland Buffer Planning Guidelines has been developed to assist with the design of a wetland buffer that will maintain wetland environmental values and protect wetlands from current and future threats from adjacent land uses. Available at www.wetlandinfo.ehp.qld.gov.au

Use of buffer strips on farms to manage run-off

Vegetated buffer strips can be used as part of an overall farm drainage strategy to improve run-off water quality provided best practice farm management is implemented and a number of key design considerations are addressed. Planning treatment elements should also consider their position in the catchment and whether the location is suitable.

Sizing and site constraints

To improve performance, water flows need to be dispersed and shallow when entering buffer strips e.g. as sheet flows. These flows should enter the system laterally, ensuring all flows move throughout the full width of the buffer strip rather than through discrete channels.

Buffer strips are therefore less well suited to sites with:

- Steep topography (>4%)—flow velocities are likely to move quickly through the area, reducing treatment performance.
- Large catchment (>2ha)—flow volume and velocities will be too large to achieve optimal treatment performance.
- Channelised flows—buffer strips require dispersed surface flow and are unable to provide optimal treatment for channelled flows.

These site characteristics don't preclude the use of buffer strips, but they may require additional design considerations with cost implications to achieve desired treatment performance.

Even if the site constrains the use of buffer strips to treat run-off, they can still be an effective way to prevent erosion and provide some other buffer functions between the production area and adjoining drainage lines or waterways and should be considered as part of the farm layout.

Position and role in a run-off treatment train

Buffer strips provide good treatment (i.e. coarse sediment removal) prior to flows being conveyed along other treatment devices, such as swales, and are therefore best positioned as one of the first treatment systems in a treatment train (Figure 2).

The adoption of in-paddock best management practices and appropriate location within the drainage regime of the farm will protect the buffer strip from scour and high levels of sedimentation and will improve the overall water quality leaving the farm.

Buffer strips can also be located along receiving environments to protect existing vegetation, in-stream habitats and improve water quality entering these larger drains or waterways.

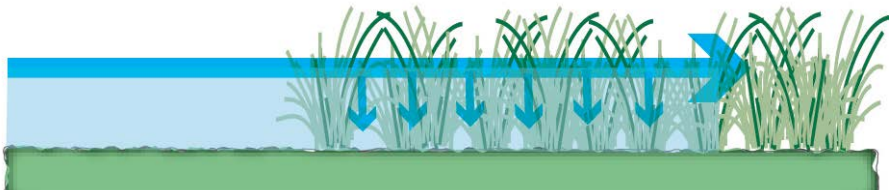


Figure 1 – Buffer strips trap sediments through deposition as surface flows move through the vegetation as sheet flow.

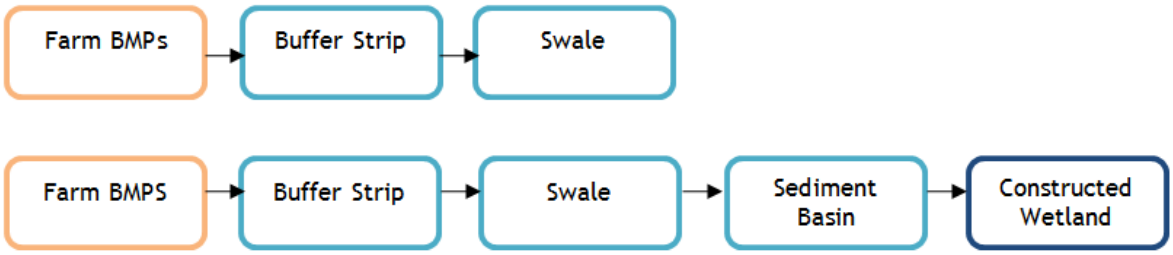


Figure 2 – Possible locations of buffer strips in farm run-off treatment trains.

Design, construction and maintenance

Design requirements

When designing vegetated buffer strips consider the following design features to enhance their treatment performance:

Width

Width will be driven largely by the available space, but the wider the buffer, the greater the treatment capacity.

Slope

Steep slopes through the buffer area will result in poor treatment performance as flow velocities will be high. Slow, uniform flows through the area will result in the optimal treatment performance.

Vegetation type

Buffer vegetation can be a mix of native grasses, sedges and rushes. The most cost effective approach is to seed the system with a mix of native species or if suitable vegetation exists nearby on farm, allow the vegetation to recruit or colonise naturally. Natural recruitment runs the risk of erosion, increased weediness and increased maintenance. Rhizomatous species should also be included in the mix to help resist traffic impacts.

Soils

Soils need to be suitable to support growth of buffer strip vegetation and may need to be watered during drought periods.

Flow velocities

Velocities through the buffer strips should be kept low, preferably less than 0.1m/s for frequent flows and less than 2m/sec in major storm events, to prevent damaging the vegetation.

Additional design considerations

Weed management

Dense stands of trees in buffer strips designed for run-off treatment should be avoided as while they can shade out weeds, they may also shade out the groundcovers. Densely vegetated groundcovers are preferable in these systems as they can make it difficult for weeds to establish by occupying the habitat. For more information on the different buffer designs and values refer to the Wetland Buffer Planning Guideline on www.wetlandinfo.ehp.qld.gov.au.

Sediment removal

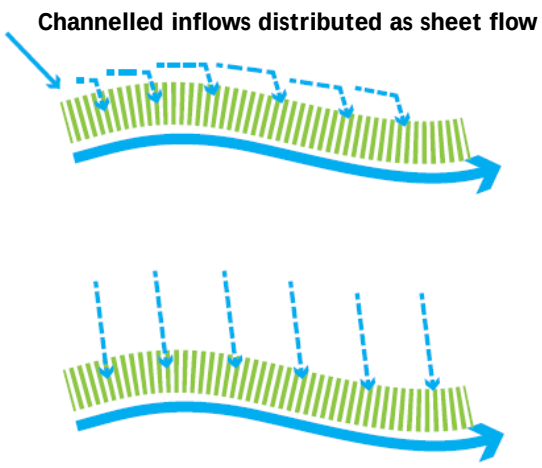
As the buffer strip will accumulate sediment over time it is important to design the area to allow for periodic removal of the sediment from the buffer strip and placement back onto the farm.

Traffic damage

Buffer strips need to be protected from traffic damage. As part of farm BMP, wet season routes need to be identified.

Key Design Questions

1. Is the farm run-off delivered to a buffer strip as sheet flow?
   - If not, can an inflow be dispersed via a contour drain to attain sheet flow?
2. Can run-off be directed to an area with the following characteristics?
   - be capable of retaining good vegetation cover
   - have a moderate slope or be flat
   - be capable of supporting sheet flow with no preferential flow paths.



Typical construction issues

Existing vegetation and approvals

A buffer strip can make use of existing vegetation, and should not involve removing any native vegetation. This avoids the requirement for any clearance approvals.

However, as the hydrology of the area may be altered (e.g. introduction of more flow through the vegetation), the sensitivity of the existing vegetation to periodic or extended wetting should be considered as should the potential impacts on any downstream wetlands and waterways.

Earthworks

Buffer strips should require only minimal earthworks, especially if flows already enter the area as sheet flow. If this is not the case, some earthworks may be required to create a contour drain along the upper edge of the buffer to disperse flows into the buffer. This could be done with small breaches in the swale at regular intervals. The amount of earthworks should be kept to a minimum to avoid disturbing acid sulfate soils and shallow bedrock. Exposing bare soils should be minimised during construction to reduce the risk of sediment moving off site. Also, earthworks within the vicinity of an area mapped as a wetland protection area may trigger an approval process.

Planting and establishment

Buffer strips need to be well vegetated. The most suitable species are grasses, sedges and rushes. Grass seeds can be used or naturally occurring grasses and groundcovers can be encouraged to germinate in the buffer area.

Use local guidelines if they are available to assist with plant selection or contact your local Landcare or NRM group. Naturally vegetated systems such as waterways, wetlands and riparian zones are a good reference from which to create a species template.

The dry season is the best time to establish a buffer strip to reduce the risk of run-off induced erosion. It allows for adequate establishment and root growth before heavy summer rainfall. Planting early in the dry season would take advantage of the existing moisture in the soil. Irrigation and weed management may be needed until the vegetation is fully established.

Cost implications/risk

The risk of not achieving the desired design planting densities is poor treatment performance and the colonisation of weeds in the buffer. Therefore, it is important that the vegetation in the buffer is established successfully.

Cost savings can be gained by using existing vegetated areas as buffers. Where this is not an option grass seed can be a cheaper alternative to seedlings.

Maintenance

Buffer strips rely on good, dense, similarly structured vegetation for optimal treatment. Adequate vegetation growth is the key maintenance objective for buffer strips while minimising channelisation.

The most intensive period of maintenance is during the plant establishment period when watering and replanting/reseeding may be required to ensure design densities of plants are achieved.

Typical maintenance will involve:

- Buffer vegetation being slashed to 300mm to maintain good cover and growth. Where buffers are immediately adjacent to crop areas the buffer can be slashed to 100mm to manage pests. The slashed material should be removed from the area and used on the farm.
- Weed management to prevent propagation of weeds downstream or in riparian zones.
- Replanting/reseeding of desired species to achieve design densities.
- Irrigating vegetation, as required.
- Removing sediment if its build-up is concentrated and impedes even flows through the buffer area. This should be done during the dry season to allow re-establishment of vegetation before the next wet season. Removed sediment should be disposed of in the farm blocks, away from the buffer and any other drainage lines.
- Filling any areas in the buffer that have been caused by erosion which are channelling flows.

The buffer strips should be inspected every six months or after every major rain event.

Slashed buffer between cane block and water reuse pit. Photo: E2DesignLab

Further information

This fact sheet is part of a series on run-off treatment systems, as listed below. The Wetland Management Handbook provides more detail on treatment structures and general farm management to improve water quality leaving farms.

These resources and other wetland management tools and guides are available at http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-management/

Number	Publication Title
Fact sheet 1	Farm run-off treatment systems—toolkit
Fact sheet 2	Buffer strips
Fact sheet 3	Vegetated swales and drains
Fact sheet 4	Sediment basins
Fact sheet 5	Constructed (treatment) wetlands

These factsheets were developed by the Queensland Department of Agriculture, Fisheries and Forestry (QDAFF), Healthy Waterways and E2DesignLab with funding from the Queensland Wetlands Program.

The Queensland Wetlands Program supports projects and activities that result in long-term benefits to the sustainable management, wise use and protection of wetlands in Queensland. The tools developed by the Program help wetlands landholders, managers and decision makers in government and industry. The Program is a joint initiative of the Australian and Queensland governments.

Contact wetlands@ehp.qld.gov.au
or visit www.wetlandinfo.ehp.qld.gov.au

QWP/2013/19

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