



Water sensitive urban design

Biofilters

Summary

Biofilters (also known as biofiltration systems, bioretention systems and rain gardens) are excavated basins or trenches that are filled with porous filter media and planted with vegetation to remove pollutants from stormwater runoff. They use natural and physical processes to treat stormwater.

This brochure is part of a series that explain various aspects of water sensitive urban design. Please see *Water sensitive urban design in Western Australia* for background information on water sensitive urban design.

Main benefits

- They will work in a variety of climate, soil and groundwater conditions.
- Their flexible design (linear, basins, tree pits, planter boxes) allows them to fit into many different locations.
- Soil and sand filters provide good removal of sediment and heavy metals.
- Specially selected soil filter media and appropriate vegetation selection improves nutrient removal rates.
- They require less space than other infiltration systems due to their higher infiltration rate.

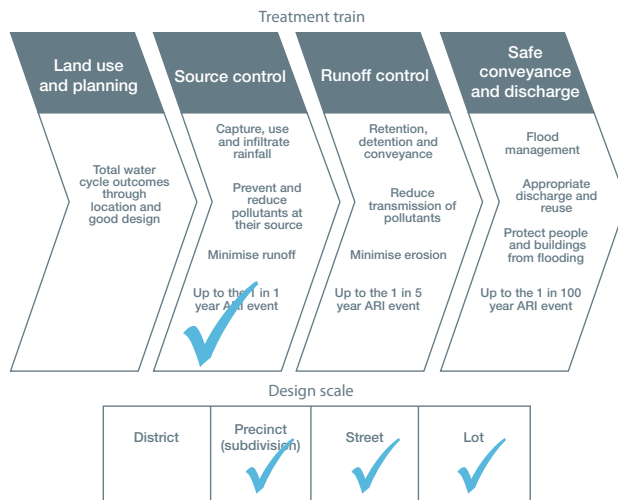
Design factors

- Ensure they are integrated into landscape design.
- Consider location as part of planning and design of roads and lots.
- Design to infiltrate or connect to the larger stormwater system where appropriate.
- Make the surface area at least 2% of the constructed, directly connected impervious catchment for water quality treatment.
- Size the storage volume to suit system hydraulics – ideally a 1-year critical average recurrence interval event.
- Use vegetation appropriate to the climate and desired pollutant removal.
- Incorporate a submerged zone and carbon source to promote vegetation health and resilience during dry periods and aid nitrogen removal.
- Consider the impact of potential acid sulfate soils on filter media and/or structures where relevant.

Target pollutants

- coarse sediment
- suspended solids
- phosphorus
- nitrogen
- heavy metals

Where they can be used in the water sensitive urban design process



Public open space biofilter, Meadow Springs, Mandurah



Roadside biofilter retrofit, Busselton CBD

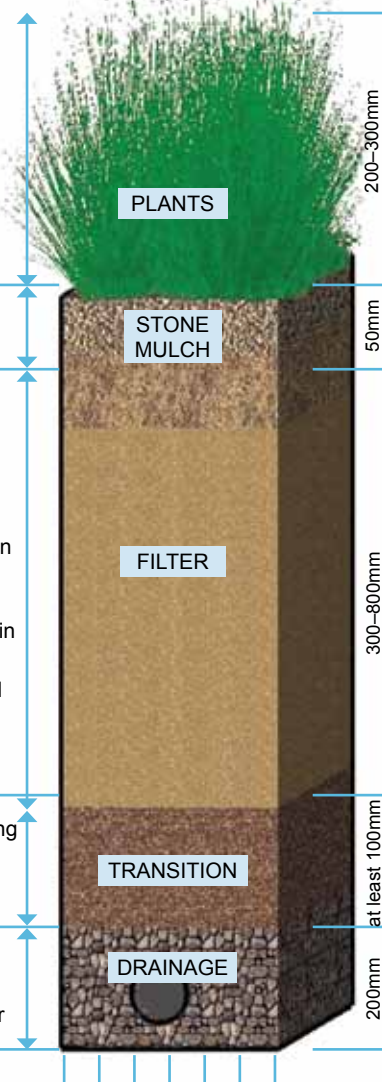


On-lot biofilter, Evermore Heights, Baldvies

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Biofilter elements



Design guidelines

Extended detention depth

At least 50% of the plants to be effective at nutrient removal.
Remainder to be local, native, ephemeral plants e.g. *Ficinia nodosa* (formerly *Isolepis nodosa*)
8–12 plants per m², depending on species

Stone 100% 4–13mm in size. No fines. Note that wood mulch will float under flooded conditions

Sandy loam
Saturated hydraulic conductivity in range 100–300mm/hr

Clay and silt	<3%	(<0.05mm)
Very fine sand	5–30%	(0.05–0.15mm)
Fine sand	10–30%	(0.15–0.25mm)
Medium to coarse sand	40–60%	(0.25–1.0mm)
Coarse sand	7–10%	(1.0–2.0mm)
Fine gravel	<3%	(2.0–3.4mm)

pH 5.5–7.5
Electrical conductivity <1.2dS/m
At least 3% low nutrient-content organic matter
<80mg/kg orthophosphate
<1000mg/kg total nitrogen content
Amend soil with 5% mulch and 5% hardwood chips (6mm) by volume

Clean, well-graded sand <2% fines
Clean, fine gravel or crushed rock 2–5mm and carbon source, if submerged

Perforated PVC subsoil pipe (if required)
Drainage layer (if there are no subsoil pipes) - should be at least as deep as the extended detention depth, however this should be based on individual site characteristics
Drainage layer (if subsoil pipes are used) - completely surround the subsoil pipe and at least 50mm over pipe

(Adapted from: Thompson McRobert Edgeloe Group 2008)

Required reading

Adoption guidelines for stormwater biofiltration systems, 2009, Facility for Advancing Water Biofiltration, Monash University, available at <www.monash.edu.au/fawb/products/index.html> for the most recent advice.

Australian runoff quality: a guide to water sensitive urban design, 2006, Engineers Australia, available at <www.arq.org.au>.

Construction and establishment guidelines: swales, bioretention systems and wetlands, 2009, Water by Design, South East Queensland Healthy Waterways Partnership, Brisbane, available at <www.waterbydesign.com.au/ceguide>.

Guideline specifications for soil media in bioretention systems, 2008, Monash University Facility for Advancing Water Biofiltration.

In situ monitoring of hydraulic conductivity, 2009, Monash University Facility for Advancing Water Biofiltration.

Stormwater management manual for Western Australia, 2004–07, Department of Water, available at <www.water.wa.gov.au>. See Section 4.2 of Chapter 9 – Structural controls. Suitable plant species for use in biofilters in Western Australia are being researched. Section 4.2 will be updated to reflect the findings from this research and the Monash University FAWB research.

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