CRC for Water Sensitive Cities

Fact Sheet: Stormwater biofilter monitoring and maintenance

Why monitor and maintain systems?

Routine maintenance is important to ensure the biofilter functions effectively across its entire, intended lifespan. Monitoring is required to assess if the system is performing well against its objectives, and to detect issues that may require maintenance attention, before it develops to require more significant and costly rectification works.

Maintenance work is distinct from larger renewal or resetting works that may be required to fix systems that are functioning poorly. Systems that follow good design principles, are well built and carefully established are not expected to require these extensive works. Instead, only relatively straightforward and regular tasks are required for ongoing maintenance. However, biofilters require additional monitoring and maintenance care during their establishment. Investment in this early establishment, and conducting monitoring and maintenance checks regularly can lead to long-term savings from avoided rectification works, prolonged biofilter life and more effective performance.

To function properly, stormwater biofilters must have a healthy and extensive vegetation cover, flows must be able to enter and pond across the entire surface, stormwater will infiltrate into the media relatively quickly and the system will drain and release outflows as designed. In particular, inspections must assess plant health, plant cover, sediment accumulation or other signs of clogging (e.g. waterlogging), and blockages caused by litter and debris (particularly at inlet, outlet or overflow points). Systems will also require more frequent monitoring across dry months, and some irrigation or watering may be required to sustain plants through prolonged dry spells.

How to plan an effective maintenance program

- Consider maintenance requirements as part of early design and seek feedback from maintenance personnel from the outset of the project, including ways to reduce maintenance by design, and facilitate maintenance ease, access and safety.
- Develop capacity building in the organisation and amongst contractors to undertake effective biofilter maintenance, including investment in skills and training – all personnel should understand the key objectives and functions provided by stormwater biofilters
- Clearly define asset ownership and responsibilities, and carefully draw contract arrangements to facilitate transition of the project at handover
- Develop an effective system to provide an inventory and record of all assets, their design and construction and up-to-date maintenance details
- When planning and budgeting, clearly distinguish between maintenance and extensive remediation or re-setting works
- Allocate sufficient budget for maintenance from the outset of the project, including additional resources during the critical establishment phase
- Provide maintenance crews with a diagram or plan of each system, with intended flow hydraulics clearly marked with arrows, and key aspects of the design labelled
- Clearly define the level of service to be provided for maintenance of each system, and accept this may vary with the complexity or visibility of systems to the public
- Plan for and provide additional maintenance during establishment and dry periods

For full details please refer to the Adoption Guidelines for Stormwater Biofiltration (CRC for Water Sensitive Cities, 2015)

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Monitoring and maintenance tasks

Many of the key tasks are illustrated in Figures 1 and 2.

Filter media

- **Holes, erosion or scour** – Check for erosion, scour or preferential flow pathways, particularly near inflow point/s and batter slopes (if present). Repair and infill using compatible filter media material. Add features for energy dissipation (eg. rocks and pebbles at inlet) if necessary.
- **Sediment accumulation / clogging** – Inspect for the accumulation of an impermeable surface layer (such as clayey sediment), ponding of water for more than a few hours following rain (including the first major storm after construction), or widespread moss growth. Repair minor accumulations by scarifying the surface between plants and if feasible, manual removal of accumulated sediment. Investigate the cause of any poor drainage.
- **Damage** - Check for damage to the profile from vehicles, particularly streetscape systems alongside parking or street corners. Also check for signs of pedestrian traffic across the filter surface, such as worn pathways. Repair using compatible filter media material.
- **Litter** - Check for anthropogenic litter and significant accumulations of organic litter, particularly in sediment pits, inlets, outlets and overflows. Remove litter to ensure flow paths and infiltration are not hindered.

Vegetation

- **Establishment** – The initial period after construction (up to the first 2 years) is critical to long-term success or failure of the biofilter. Additional monitoring and maintenance works are required to ensure a healthy and diverse vegetation cover develops, and that stormwater flows move through the system as the design intended (i.e. flows enter freely, covering the entire surface, ponding occurs to the design depth, high flows bypass and the infiltration rate is acceptable). Careful attention can avoid costly replanting and rectification works. New seedlings will require regular watering and irrigation, protection from high sediment loads and high flows. Refer to Water by Design's 'Construction and Establishment Guidelines'.
- **Plant health and cover** - Inspect plants for signs of disease, die-back, pest infection, stunted growth or senescent plants and assess the degree of plant cover across the surface. If poor plant health or cover is widespread, investigate to identify and address the causal factor (e.g. poor species selection, shading, too dry (e.g. oversized, dry climate, media with minimal water holding capacity, poor flow distribution, lack of irrigation), too wet (e.g. from clogging, undersizing) or smothering from litter. Treat, prune or remove plants and replace as necessary using appropriate species, aiming to maintain the original planting densities (6-10 plants/m^2 recommended). Provide watering or irrigation to support plants through long dry periods.
- **Weeds** – Weeds should be identified and removed as they occur. If left, weeds can out-compete the desired species, possibly reducing water treatment function and diminishing aesthetics. Manually remove weed species, avoiding the use of herbicide (if unavoidable use targeted spot spraying).
- **Pruning and harvesting** (if feasible) - It may be worth considering occasionally harvesting plants to permanently remove nutrients and heavy metals stored in aboveground plant material, and to promote new plant growth and further nutrient and metal uptake. Pruning may also benefit aesthetics.

Drainage

- **Inlet pits/zones, overflow pits, grates and other stormwater junction pits** - Ensure these are clear of litter, sediment and debris and remain structurally sound. More frequent inspection and removal will be required for systems with construction works in their catchment.
- **Underdrain** - Ensure that underdrain pipes are not blocked to allow the system to drain as designed.
- **Raised outlet** - Check that the weir/up-turned pipe is clear of debris.
- **Submerged zone** – Although the submerged zone helps to sustain the biofilter through dry periods, if drying persists for long enough (e.g. beyond 3 weeks) it will become drawn down and require replenishment. Check that the water level in the submerged zone is at the design level and top this up as required.

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Renewal

- **Monitor** for signs of clogging, widespread plant death or die-back, significant erosion or extensive sediment, litter or moss across the surface
- **Investigate and address the cause** to avoid a recurrence
- Take **action to restore system functionality** (e.g. retrofitting a submerged zone, modifying invert levels of flow control structures, replanting, scraping off and replacing top layer of filter media, media removal to restore desired ponding depth, erosion repairs, removal of gravel mulch)
- **Timely intervention** to address problems as soon as they become evident and before worsening.
- **Test metal accumulation in the filter media** to allow timely disposal before concentrations reach levels that require more costly disposal (depending upon state soil classification regulations).

  Recommend testing in year 5 and comparison against National Environment Protection Council (NEPC, 1999) Health and Ecological Investigation Levels. If sized appropriately with typical inflow concentrations, accumulation to levels of concern unlikely for 10-15 years. However, industrial and past-industrial catchments likely to accumulate metals more rapidly.
- **Typical renewal frequencies** (Water Sensitive Urban Design Life Cycle Costing – Data Analysis Report, April 2013. Parsons Brinckerhoff, prepared for Melbourne Water):
- **Remove and dispose of accumulated sediments** – every 2-5 years
- **Minor re-set** (replace plants and top 100 mm media) – after 10-15 years

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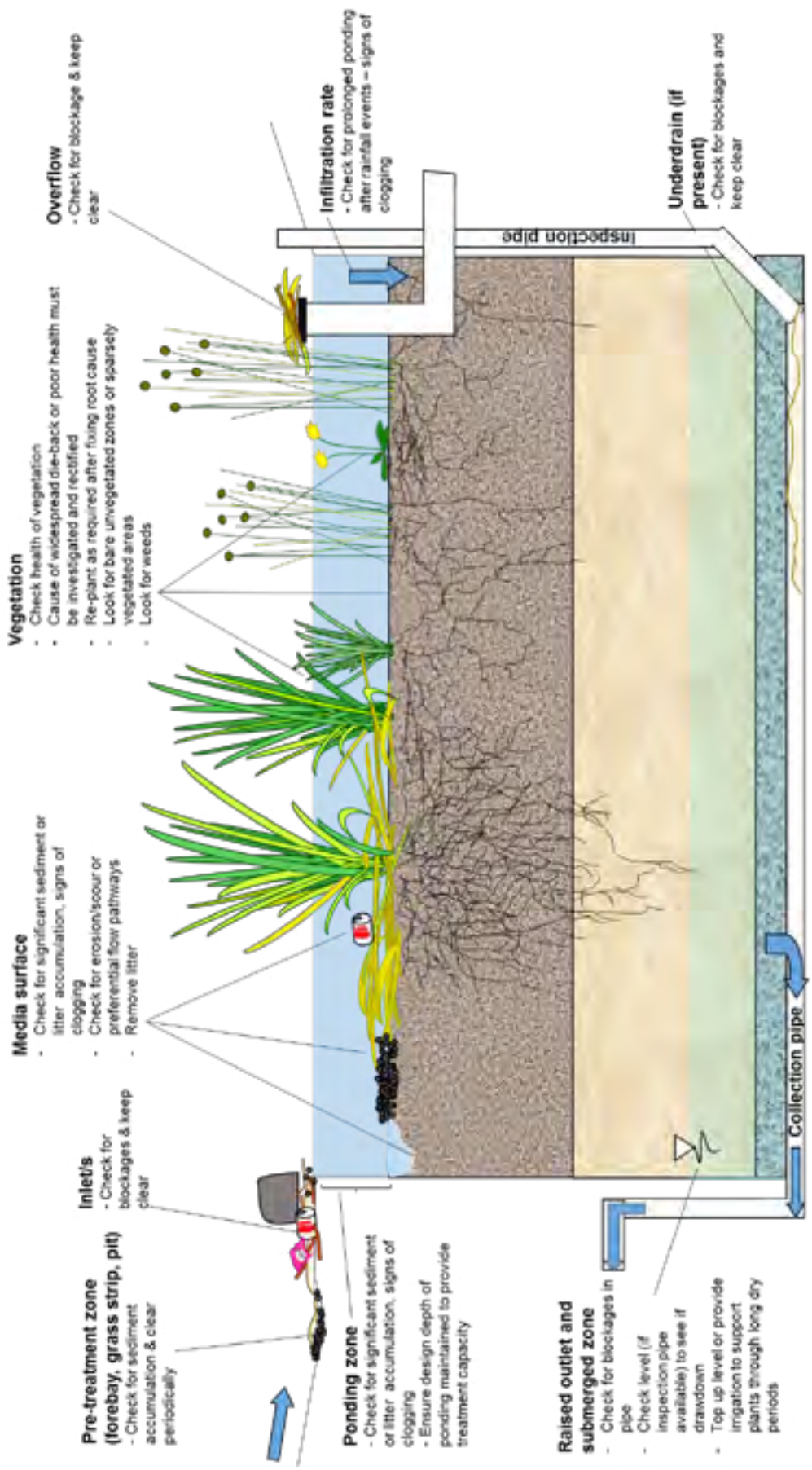

Figure 1. Critical checks and tasks for a monitoring and maintenance program

Blocked inlet – restricts flow entry, reducing proportion of flows receiving treatment

Plant die-back – severely reduces treatment efficiency and leaves media vulnerable to erosion

Poor vegetation spread – may be due to use of rock mulch

Clogging – build up of fine sediments, moss or plant litter on the surface reduces infiltration and treatment

Blocked overflow grate – can lead to flooding and damage to the filter and vegetation

Vehicle and pedestrian damage – impacts vegetation health and causes compaction

Figure 2. Common maintenance tasks

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Widespread plant loss or die-back – can indicate too much or too little water, or poor filter function

Plant die-back near inlet – may indicate high inflow velocities, sediment accumulation or poor species selection

Sediment accumulation – build up of fine sediments reduces infiltration and treatment

Litter accumulation (anthropogenic and organic) – unsightly and can hinder flow paths and infiltration

Holes, erosion and scour – compromise even flow distribution and treatment

Weeds – unsightly and can reduce treatment capacity

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