

WATER SENSITIVE URBAN DESIGN (WSUD)



Inspection and maintenance guidelines

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About this guide

This guide will assist private property owners and asset managers to effectively manage water sensitive urban design (WSUD) assets and their maintenance requirements.

This guide is set out in 3 parts:

- A An overview of managing assets.
- B A description of each asset type and associated functional components.

C A visual catalogue of asset component condition. Asset owners and managers can use the reference and inspection sheets in Part B, along with Part C, to determine the condition of an asset's functional components. Depending on the condition score, the maintenance sheets in Part B can guide asset owners and managers with the maintenance requirements. You can use the photos below to navigate to each section.



1. Rainwater tanks



2. Biofilters



3. Biofilter street tree pits



4. Wetlands



5. Vegetated buffer strips and swales



6. On-site stormwater detention (OSD)



7. Gross pollutant traps (GPTs)



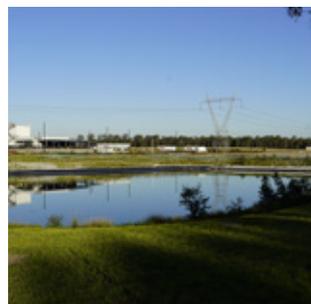
8. Filter cartridges



9. Pit inserts



10. Permeable paving



11. Temporary sediment basins

Glossary and abbreviations

Amenity	The quality of being attractive, something that is intended to make a place more pleasant or comfortable
DCP	Development Control Plan
Catchment	An area of land which drains all run-off water to the same lowest point
Confined space	An enclosed or partially enclosed space that: <ul style="list-style-type: none">• is not designed or intended primarily to be occupied by a person• is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space• is or is likely to be a risk to health and safety from:<ul style="list-style-type: none">◦ an atmosphere that does not have a safe oxygen level◦ contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion◦ harmful concentrations of any airborne contaminants◦ engulfment
Detention time	The time it takes for water to flow from the inlet to the outlet
Functional component	The discrete parts that form the asset
GPT	Gross pollutant trap. A GPT is a structure used to trap litter and large pieces of debris (>5 mm) transported through the stormwater system
Impervious area	The hard surfaces (e.g. roofs and pavement) within a catchment
Invert level	The floor or base level of a pipe or pit
IWCM	Integrated water cycle management
LGA	Local government area
Macrophyte	Types of plants that grow in waterlogged conditions, such as reeds in surface wetlands
Mains water	Drinking water supplied by Sydney Water or other external service providers
Nutrients	Elements that are important for biological growth, but are also a type of stormwater pollutant. Major nutrients of interest in stormwater are nitrogen and phosphorus
Orifice plate	This plate controls the flow of water discharging from an on-site stormwater detention system
OSD	On-site stormwater detention
Pavement	Any outdoor hard surface (e.g. concrete, asphalt, and pavers)
Positive Covenant	A title registered with NSW Land and Property Information for ongoing operation and maintenance of WSUD assets that exist on-lot
Rainwater	Runoff from roof surfaces
RHAA	Rainwater Harvesting Association of Australia
Scour	The removal of sediment by fast or swiftly moving water
Stormwater	Runoff from all urban surfaces
Suspended solids	Suspended solids refer to small, solid particles which remain suspended in water as a colloid or due to the motion of water
UPRCT	Upper Parramatta River Catchment Trust
WHS	Workplace health and safety
WSUD	Water sensitive urban design



PART A

Managing water sensitive urban design (WSUD) assets



1. Water sensitive urban design (WSUD)

Water sensitive urban design (WSUD) is a scientifically proven technology and is an approach adopted by Penrith City Council to effectively manage stormwater. Stormwater has a detrimental impact on our waterways due to the excess nutrients and pollutants it carries. Additionally, after it has rained, large volumes of stormwater flow into our waterways contributing to creek bed and bank erosion. WSUD can provide an array of benefits to our community and environment including:

- improvement of waterway health by filtering, reducing and slowing the rate of stormwater before it flows into local waterways

- enhancement of flora and fauna habitat
- improved landscape attractiveness of streetscapes and other open spaces
- establishment of more green spaces to help reduce urban heat
- reduced reliance on drinking water as harvested stormwater is used as an alternative resource for uses such as irrigation and toilet flushing.

Please refer to the *Council's Development Control Plan (DCP)* for more information.

There are various types of WSUD assets that can be found across our City, many of these are listed in Part B of this document.

2. Common types of WSUD

- Rainwater tanks (with and without on-site stormwater detention)
- Biofilters (also known as bioretention systems or raingardens)
- Biofilter street tree pits
- Wetlands
- Vegetated buffer strips and swales
- On-site stormwater detention (OSD)
- Gross pollutant traps (GPTs)
- Filter cartridges
- Pit inserts
- Permeable paving
- Temporary sediment basins

3. Inspections

Part B includes reference and inspection sheets for different assets to help you determine the condition of assets and their functional components. The condition determines what type of maintenance should be taken. This is summarised by the chart below.

Part C is a visual catalogue of all functional components in various conditions, which can be used to guide condition scoring.

Each asset should be inspected routinely, as well as during or after rainfall, to assess whether the system is working correctly and as intended. The inspection frequency is adjustable for each functional component and can be dependent on design, catchment size, surrounds and maintenance history.

Functional component condition score:	Maintenance required:
Good (1) →	No maintenance required
Moderate (2) →	Routine maintenance (simple tasks)
Poor (3) →	Corrective maintenance (specialist skills required)

4. Maintenance

Maintenance requirements are identified through regular inspections of the assets and their functional components.

No maintenance

When a functional component is scored as good (1) during an inspection, no maintenance is required.

Routine maintenance

Functional components scored as moderate (2) require routine maintenance. This usually consists of simple manual tasks that can be completed using basic landscaping tools, such as rakes, spades, shovels and hoes. General advice for maintaining these functional components is in the 'Maintenance response and information' column of the maintenance sheets in Part B. Most assets will require this level of maintenance on a quarterly basis.

A lack of routine maintenance or infrequent inspections might reduce the overall asset condition and require greater efforts and costs to rectify later.

Corrective maintenance

Functional components scored as poor (3) require immediate rectification or renewal as they could be a public safety hazard or affect the asset function and operation. These may require consultants or contractors with specialist knowledge to identify the underlying issue and repair the asset.

The scale of such works can vary from a simple repair of a damaged or broken component, to a complete redesign or asset replacement.

Generally, a well-designed, constructed and maintained asset can have a life cycle of 20 to 30 years for vegetated assets or longer for non-vegetated assets. Civil elements and trees have a limited life and will eventually need replacement. Vegetated assets that can self-propagate may last indefinitely. Changes in the catchment condition, design or construction issues, or other emerging problems may cause an asset to require corrective maintenance.

5. Outsourcing management

Depending on your development's consent conditions, you may be required to enter into a maintenance contract for the first few years of the asset's operation. These contractors are specialised in WSUD assets and can identify operational issues and rectify them appropriately. They should also be suitably licensed to dispose of waste correctly.

Some maintenance contractors specialise in the inspection and maintenance of proprietary devices. Where parts or whole of the asset require replacement or repair, these contractors must be engaged to complete the necessary works.

Small routine maintenance tasks can be undertaken in-house; however, the most appropriate management option will depend on the size and complexity of the asset, and the skills and experience of the people managing them.

Under no circumstances should an untrained person enter a confined space. Where entering a confined space is necessary for an inspection or maintenance activity, a suitably qualified person must be used. Assets that commonly require confined space access, have this signage:



You can find more information about the expertise required for inspecting and maintaining each asset in Part B of this document.

6. Workplace health and safety (WHS)

Workplace health and safety (WHS) is mandatory in all inspection and maintenance activities and must apply to everyone.

It is important that inspection and maintenance contractors, sub-contractors and personnel:

- have a thorough knowledge of relevant WHS risks associated with maintenance and monitoring activities
- are equipped with adequate personal protective equipment (e.g. high visibility clothing, safety boots, ear plugs)
- have relevant training/certification to undertake the required inspection and maintenance activities (e.g. confined spaces training, plumbing licence, traffic control)
- maintain up-to-date WHS systems and processes, and can demonstrate compliance with these procedures through relevant written records.



PART B

1. Rainwater tanks



A rainwater tank captures and stores roof water for reuse on-site. It may also play a part in local flood control.

It is important that the tank fills and empties regularly, as water stored in tanks for extended periods can become a health hazard.

1.1. Functional components

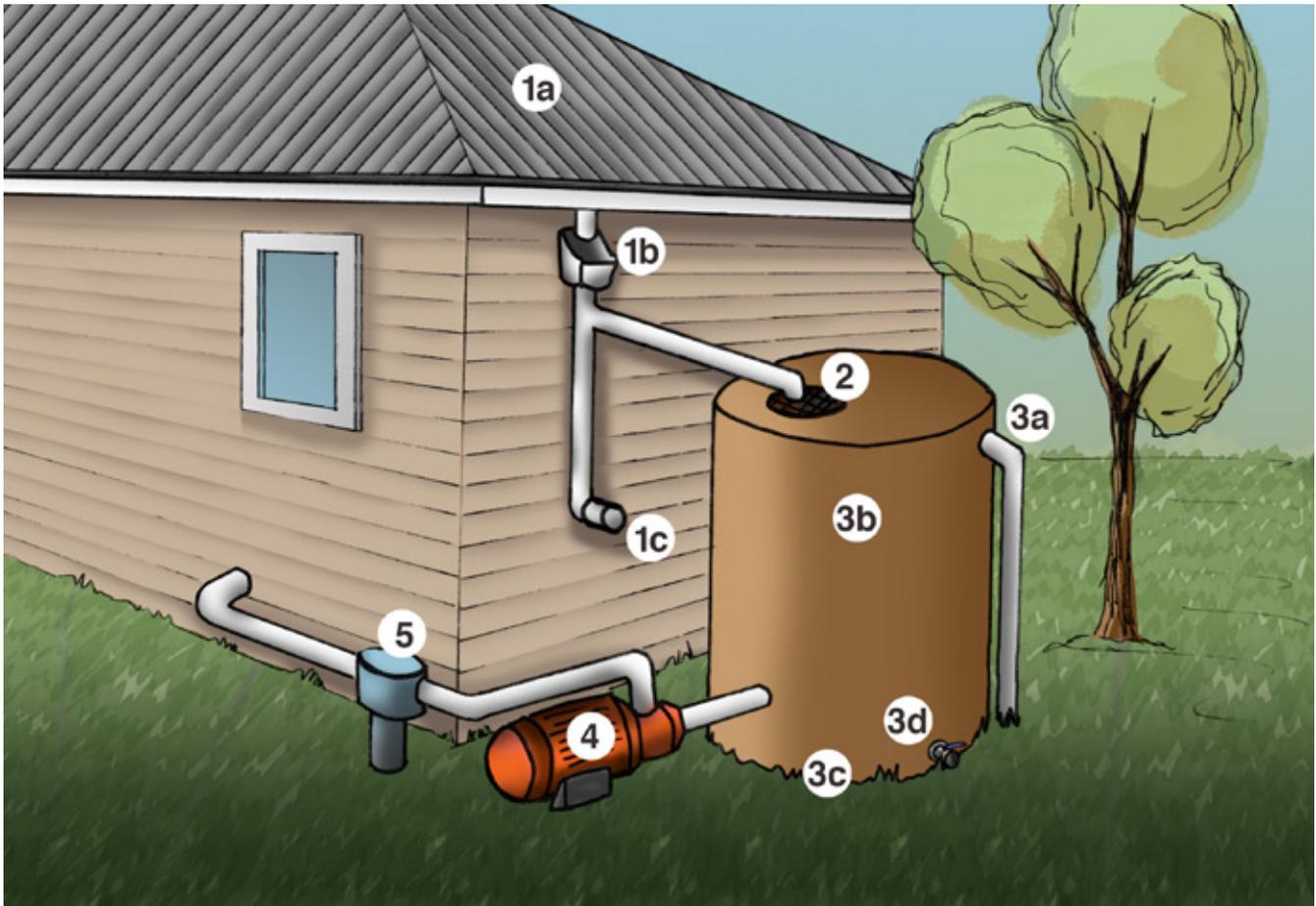


Figure 1: The functional components of a rainwater tank and its connections.

1. Roof, gutter and downpipes
 - a. Roof and gutters collect rainwater and direct it towards the rainwater tank (tank). Gutters are susceptible to a build-up of leaf litter from surrounding trees.
 - b. Downpipe screen (also known as a rainhead) is the connector between the gutter and pipe to the tank. This can include a leaf diverter and mosquito screen.
 - c. First flush device captures the initial dirty runoff from the roof and diverts it away from the tank.
2. Tank inlet screen. This filters the water entering the tank and keeps mosquitoes and pests out.
3. Tank. The tank stores captured water for reuse. Most tanks have an internal float valve which automatically determines when storage water levels are low and mains water top up is needed.
 - a. Overflow pipe, which connects the tank to the stormwater drainage network and drains excess rainwater into the stormwater drainage network (when the tank is full).
 - b. Tank body, which holds the majority of water and is commonly constructed of steel, concrete or plastic.
 - c. Tank base; the tank requires a solid and stable base to rest on.
 - d. Tap or a sludge valve, which is a valve located towards the base of the tank used to drain and de-sludge the tank.
4. Pumps, filters and valves. These may be used to supply reuse (indoor or outdoor) which takes water from the tank and pressurises it for use. Pumps, filters and valves often require a professional to undertake maintenance.

5. Rainwater supply pipe. This connects the rainwater tank to end uses such as irrigation systems, toilets, washing machines and hot water tanks. There may be a combination of the following devices (not shown on the diagram) on this pipe.

- Mains water top up (optional), which includes a rainwater/mains water supply diversion valve and dual check valve to enable the tank to be refilled with mains water supply when low on rainwater supply.
- Backflow prevention device, which prevents backflow of water from the tank into the mains water supply. A backflow prevention device is required whenever mains water top up is used.

- Flow meter, which monitors water usage from the tank and are generally only used for commercial and industrial developments.
- Isolation valve, which controls the flow of water from the mains water supply into the tank. Isolation valves may also need to be installed prior to and after pump systems.
- Dual check valve, which is a testable back flow prevention device to ensure the safety of mains water supply by preventing any cross-contamination.

Other features include:

- charged systems, which also have a pit and outlet pipe that can be drained and cleaned out.

1.2. Expertise required

Most rainwater tank maintenance and monitoring tasks are simple and non-technical; however, mechanical components (e.g. pumps, filters, backflow prevention devices and valves) require specialist skills to service. Rainwater tank maintenance and monitoring can also present challenging access and safety issues (e.g. on roofs, tank desludging) which may require specialised equipment. A complete rainwater tank condition inspection is typically undertaken by a qualified and licensed tradesperson, such as a plumber.

The property owner or owners' corporation can undertake some basic checks and maintenance to keep rainwater tanks in good working order. This includes; listening to confirm the pump is running when expected, cleaning leaf litter and debris from screens or filters, and replacing these as needed when they are accessible. Care should be

taken when cleaning gutters, as there are hazards associated with working at heights, and under no circumstances should an unlicensed person enter a confined space such as a rainwater tank.

For more information on backflow prevention devices, refer to your plumber or Sydney Water Corporation.

The Rainwater Harvesting Association of Australia (RHAA) provides general guidance on tank elements and maintenance including a troubleshooting guide of common issues and solutions for pumps:

www.rainwaterharvesting.org.au



Functional component condition score:

Good (1) →

Moderate (2) →

Poor (3) →

Maintenance required:

No maintenance required

Routine maintenance (simple tasks)*

Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
1 Roof, gutters and downpipes						
1a	Roof and gutters	25	6	Stable roof and guttering with minimal rust. Minimal leaf litter present on roof and in gutter. No impact on inflow into tank.	Roof or guttering has minor damage and/or areas of rust. Damage is not posing a safety risk. Leaf litter present on roof and/or in gutters and may impede flows into tank. No or minimal impact on inflow into tank.	Roof or guttering has major damage and/or extensive areas of rust. Damage is posing a risk to safety. Build-up of leaf litter on roof and/or in gutters. Major impact on inflow into tank.
1b	Downpipes and screens (rainhead)	8	6	Secure downpipe. No holes or leaks. Downpipe and screen (rainhead) are clear of leaf litter and debris.	Downpipe showing signs of wear and/or has holes or leaks. Downpipe and screen (rainhead) has some leaf litter and debris but water can still enter tank.	Downpipe is unstable and/or is not transferring inflow to tank. Showing extensive signs of wear. Downpipe and screen (rainhead) are blocked by leaf litter and debris.
1c	First flush device	12	6	Minimal blockage. Water can easily enter the first flush device.	Some blockages. Water can still enter the first flush device at a reduced rate.	Major blockage stopping most water from entering the first flush device.
2 Tank inlets						
2a	Screen	26	6	Water from roof delivered into tank correctly. No holes or damage to the screen. No blockages.	Water from roof delivered into tank through screen at a reduced rate. Some small holes/light damage. Can still function to remove most gross pollutants. Minor blockages.	Pipe from roof not delivering water to the tank correctly. Large holes/heavy damage to the screen. Gross pollutants can enter the tank. Severe blockages at the inlet.
3 Tank						
3a	Overflow	19	6	Overflow is free of blockages and is directly connected to the stormwater system. No erosion or scour at the overflow outlet.	Overflow is partially blocked and/or is indirectly connected to the stormwater system (via overland flow path). Minor erosion or scour at the overflow outlet.	Overflow is entirely blocked and/or completely disconnected from the stormwater system. Major erosion or scour at the overflow outlet.
3b	Body integrity	4	6	No damage to the body of the tank. No surrounding areas that suggest leakage.	Some small holes/cracks present in the tank body. Surrounds suggest that minor leakage could be occurring.	Tank body integrity is undermined by extensive holes and/or cracks.
3c	Base stability	2	6	Tank is stable with no damage to base.	Tank base is not completely stable, but unlikely to move. Some cracks and signs of wear on the footings and/or foundation.	Tank base is unstable, likely to move and posing a safety risk. Major cracking and wear of footings and/or foundation.
3d	Sludge	28	6	No sediment present in outflow. Water flowing from tank is clear.	Water is clear with small amounts of sediment present in outflow.	Water is discoloured and/or carries large amounts of sediment.
4 Pumps, filters and valves						
4a	Pump	24	12	Pump working correctly and clear of dust and debris.	Pump working but requires adjustment. Pump has accumulated dust and debris.	Pump not working or requires replacement. Produces an unusual noise or vibration when operating.
4b	Filter	11	12	Filter is clean and in good condition.	Filter requires cleaning or replacement.	Filter damaged or failed.
4c	Valves	32	12	Valves working correctly.	Valves working but require adjustment.	Valve systems are not working or require replacement.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
5	Mains backup, flow meter and backflow					
5a	Potable mains backup device	23	12	Potable mains backup working correctly.	Potable mains backup working but requires adjustment.	Potable mains backup system is not working or requires replacement.
5b	Backflow prevention device	1	12	Backflow prevention device (dual non-return valve) working and fitted correctly.	Backflow prevention device (dual non-return valve) working but requires adjustment.	Backflow prevention device (dual non-return valve) is not working, requires replacement or not fitted correctly.
5c	Flow meter	14	12	Flow meter working correctly and readings for top-up, pump and mains backup are consistent with last reading.	Flow meter readings are inconsistent with last inspection.	Flow meter system is not working or requires replacement.

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
1 Roof, gutters and downpipes						
1a	Roof and gutters	1	2	3	NA	Notes:
1b	Downpipes and screens (rainhead)	1	2	3	NA	Notes:
1c	First flush device	1	2	3	NA	Notes:
2 Tank inlets						
2a	Screen	1	2	3	NA	Notes:
3 Tank						
3a	Overflow	1	2	3	NA	Notes:
3b	Body integrity	1	2	3	NA	Notes:
3c	Base stability	1	2	3	NA	Notes:
3d	Sludge	1	2	3	NA	Notes:
4 Pumps, filters and valves						
4a	Pump	1	2	3	NA	Notes:
4b	Filter	1	2	3	NA	Notes:
4c	Valves	1	2	3	NA	Notes:

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
5	Mains backup, flow meter and backflow					
5a	Potable mains backup device	1	2	3	NA	Notes:
5b	Backflow prevention device	1	2	3	NA	Notes:
5c	Flow meter	1	2	3	NA	Notes:

Other:

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Maintained by _____
 (name/company)

Purpose of visit
 Maintenance
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Maintenance response and information	Maintenance completed Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.			
1 Roof, gutters and downpipes						
1a	Roof and gutters	<p>Response: Clean roof and gutters. Remove moss, lichen and debris.</p> <p>Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.</p>	Y	N	NA	Notes:
1b	Downpipes and screens (rainhead)	<p>Response: Manual removal of debris.</p> <p>Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.</p>	Y	N	NA	Notes:
1c	First flush device	<p>Response: Manual removal of debris.</p> <p>Information: Leaves and debris may need to be removed from roofs, gutters, first flush devices, tank inlets and outlets monthly where overhanging vegetation is present. Where overhanging vegetation is not present, an annual or 6 monthly clean may be sufficient. Commence with 3 monthly inspections and adjust as required.</p>	Y	N	NA	Notes:
2 Tank inlet						
2a	Screen	<p>Response: Remove grate and screen. Clean and repair as required.</p> <p>Information: Remove grate and screen and examine for rust or corrosion, especially at corners and welds. Depending on the type of screen, replacement may be as simple as just placing another screen on the existing fitting with no tools required.</p>	Y	N	NA	Notes:
3 Tank						
3a	Overflow	<p>Response: Repair overflow as necessary, remove debris and ensure adequate connection to stormwater drain.</p> <p>Information: If the overflow was previously not connected to a stormwater drain, check that erosion has not been caused.</p>	Y	N	NA	Notes:
3b	Body integrity	<p>Response: Remove grate to inspect internal walls. Check the condition of the tank walls and roof to ensure no holes, cracks or spalling have arisen due to tank deterioration. Contact licensed plumber to repair any defects or leaks as necessary.</p> <p>Information: Do not enter tank without confined space certification. Secure any open access covers to prevent risk of entry.</p>	Y	N	NA	Notes:
3c	Base stability	<p>Response: Contact licensed plumber if integrity is questionable.</p> <p>Information: If tank is on a stand or concrete slab, check structural integrity of support.</p>	Y	N	NA	Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
4 Pumps, filters and valves						
3d	Sludge	<p>Response: Siphon the bottom portion of the sediment from the tank or empty and rinse the tank by opening the cleaning outlet and allowing the water and sludge to pass out. Ensure sludge is appropriately disposed of.</p> <p>Information: First flush systems and mesh screens on tank inlets will reduce the amount of sediment and debris entering the tank thereby extending the time required before desludging is needed. For large tanks, it is recommended a professional tank cleaner be employed as confined space entry may be required. Plastic tanks should be tied down prior to being emptied if strong winds are present. Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	Y	N	NA	Notes:
4a	Pump	<p>Response: Clear any accumulated dust or debris. Check to see if power supply is switched on. Regularly service by a licensed professional, in line with manufacturer's instructions.</p> <p>Information: Contact the manufacturer, an electrician or a licensed plumber if you suspect there is a problem. DO NOT tamper with these systems as they have the potential to contaminate the mains water supply.</p>	Y	N	NA	Notes:
4b	Filter	<p>Response: Clean and replace cartridges, in line with manufacturer's instructions.</p> <p>Information: Typically the filter (if present) will require the most frequent attention.</p>	Y	N	NA	Notes:
4c	Valves	<p>Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions.</p> <p>Information: A licensed plumber will be able to advise of Sydney Water's requirements.</p>	Y	N	NA	Notes:
5 Mains backup, flow meter and backflow						
5a	Potable mains backup device	<p>Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions.</p> <p>Information: A licensed plumber will be able to advise of Sydney Water's requirements.</p>	Y	N	NA	Notes:
5b	Backflow prevention device	<p>Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions.</p> <p>Information: A licensed plumber will be able to advise of Sydney Water's requirements.</p>	Y	N	NA	Notes:
5c	Flow meter	<p>Response: Contact licensed plumber to rectify any malfunction, in line with manufacturer's instructions.</p> <p>Information: Flow meters are an easy way to tell if the system is working. Frequent flow readings ensure issues are detected early.</p>	Y	N	NA	Notes:

Other:



PART B

2. Biofilters



Biofilters (also referred to as bioretention systems or raingardens) are engineered garden beds that filter stormwater runoff through a vegetated filter media. Treatment of stormwater occurs as the water infiltrates/soaks down vertically through the system, where plant roots and microbes in the soil naturally remove pollutants. Biofilters can be constructed as basins (in raised beds, planter boxes or at ground level), swales or medians, and will have the same inspection and maintenance requirements.

2.1. Functional components

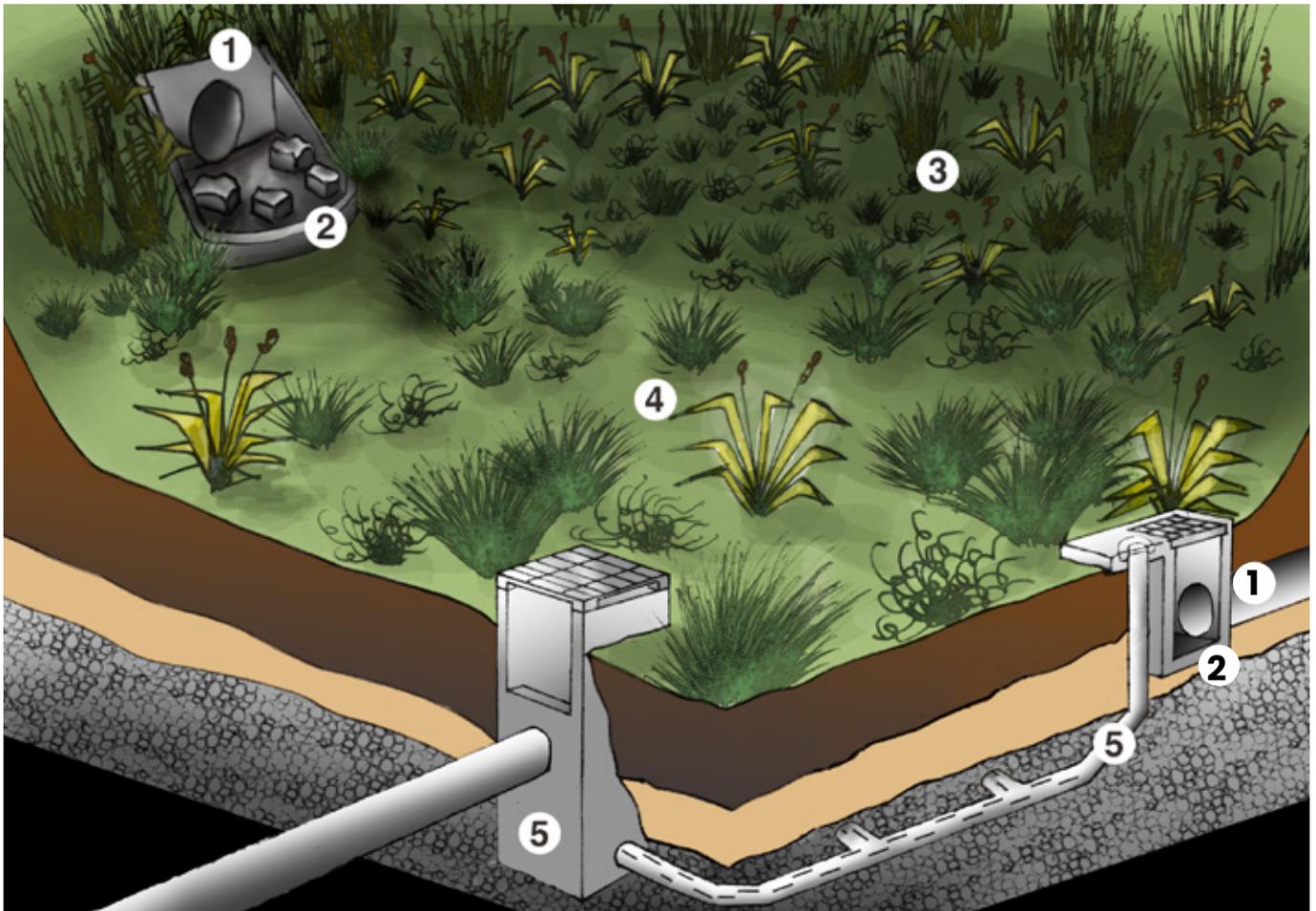


Figure 2: The functional components of a biofilter with a saturated zone.

1. Inlet. This includes an inlet pipe that can enter the biofilter via a surface inlet or an upflow pit. Surface inlets (left) often are encased in a headwall with a concrete pad and rocks for flows to spill onto.
2. Inlet sediment pits/forebay. Sometimes a sediment pit/forebay is installed to prevent sediment build-up, scouring of the filter media surface and to dissipate inflows.
3. Batters. These connect the lower biofilter surface with the surroundings at a gentle slope to reduce safety risk of the asset. Batters should be vegetated to help prevent erosion. Not all bioretention systems have vegetated batters/banks, they may have a retaining wall.
4. Biofilter surface. The biofilter surface is the flat surface at the bottom of the batters, and is the component that absorbs stormwater. To function correctly, this area must be flat and even, with dense vegetation cover. Plants are a critical component for pollutant infiltration capacity of the biofilter.
5. Outlet, overflow pit and inspection pipes. When it rains, stormwater infiltrates through the sandy layers (filter media) beneath the biofilter surface and then into slotted stormwater drainage pipes. These pipes generally drain to a stormwater pit, larger stormwater pipes and then into local waterways. Underdrains can be inspected by a vertical inspection pipe (known as flushing points).

The overflow pit usually has a grated cover that is elevated above the biofilter surface (usually 300 mm). This causes stormwater to build-up in the biofilter until water reaches the invert level of the grate before overflowing into the outlet pit.

It is vital that the outlet (overflow) pit is raised above the filter surface by approximately 300 mm to allow the biofilter to store water and encourage infiltration and treatment before overflowing. The depth between the outlet pit grate and biofilter surface is known as the extended detention depth.

Other features include:

- systems that are free-draining (retain no permanent water) or designed with a 'saturated zone' in their base, where permanent water is retained below the filter media. The upper part of the biofilter (filter media and extended detention) is always free-draining
- extended detention depth. This typically extends 100 mm to 300 mm above the surface of the system, within the batters of the biofilter. It detains stormwater temporarily during a rainfall event, allowing a greater volume of stormwater to be captured and slowly filtered

- mulch. This is not recommended but may be placed over the filter media to provide a protective covering. It consists of clean material such as gravel with minimal fine material (no organic mulch that floats as it can clog outlets) around plants to help prevent the evaporation of moisture and drying out of the filter media and reduce the growth of weeds. Jute matting can be used to stop erosion on banks and batters while plants establish. It is preferable to densely plant rather than using mulch
- liners, which prevent the exchange of water, sediments and nutrients from the biofilter with surrounding soils. Liners are usually installed in biofilters in the Penrith LGA due to possible interaction with soils that often have low infiltration capacity, water reactivity and salinity
- maintenance access ramps. This is generally a concrete or aggregate base driveway that facilitates access for machinery and is more common on large biofilters, particularly those that include a sediment forebay.

2.2. Expertise required

Biofilter condition inspections can typically be undertaken by the property owner as specialised equipment to access and view the system is generally not required. Depending on the outcomes of the inspection, further specialised assessment may be needed to understand the causes of some issues observed, such as clogging or plant loss.

Larger systems may be easier to maintain with specialised equipment, such as a high-pressure hose and suction truck to clean the underground pits and pipes.

During the establishment period, the vegetated components should be inspected more frequently.

Functional component condition score:

Good (1)	→
Moderate (2)	→
Poor (3)	→

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
Surrounds and other infrastructure					
Damage or removal of structures	6	6	Stable structures. No damage to surrounding structures. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1 Inlet					
1a Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b Erosion	9	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2 Inlet sediment pits and forebays					
2a Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
2b Permeability and clogging	20	6	No clogging of sediment pit. Pit can drain so that there is no standing water.	Some clogging of the drainage holes. Some evidence of standing water. Any standing water present is draining very slowly.	Clogging of drainage holes is preventing the pit from draining. Standing water is not draining.
3 Batters					
3a Erosion	9	6 (and after major rain events)	No erosion. Batters are densely planted.	Minor erosion. Some planting of batters. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Batters have little to no planting. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3b Plant health	22	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in <20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
3c Plant cover	21	6	Good vegetation cover in planted areas (>80% cover or >6 plants per m ²).	Moderate vegetation cover in planted areas (50-80% cover).	Poor vegetation cover in planted areas (<50% cover).
3d Litter and debris	17	6	No litter present.	Some litter present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/or blocking flows.
3e Vehicle or pedestrian damage	33	6	No compaction, plant loss, or vandalism impacting system function.	Minor compaction and/or plant loss. Does not pose risk to structural integrity or asset function.	Significant compaction and/or plant loss. Poses risk to structural integrity, public safety or asset function.
3f Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
4 Biofilter surface					
4a Erosion	9	6 (and after major rain events)	No erosion. Filter surface receiving water evenly.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
4b Extended detention depth	10	12	Design extended detention depth provided (design extended detention is typically between 100-300 mm).	50-75% of design extended detention provided (design extended detention is typically between 100-300 mm).	Less than 50% of design extended detention depth provided (design extended detention is typically between 100-300 mm).

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
4c	Leaf litter	16	3	Minimal leaf litter present or covers <20% of surface.	Some wet and decaying leaf matter present (covering 20-50% of surface). Aesthetic issue. Some obstruction of flow paths.	Large amount of wet and decaying leaf matter present (covering >50% of the surface). Impacting vegetation growth. Obstructing flow paths and blocking inlets or outlets.
4d	Permeability and clogging	20	12	Infiltration/hydraulic capacity of the system is preserved. In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (100-300 mm) for biofilters is drawn down over 1-3 hours after inflow to the system has stopped following rainfall. No algae or moss present on filter surface. No stagnant water ponding on surface.	In dry conditions, water poured on surface infiltrates through the surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding observed for longer than normal (>3 hours). 10-20% surface coverage of algae and moss. Small isolated ponds of stagnant water present.	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (100-300 mm) remains for >12 hours after inflow to the system has stopped following rainfall. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation. >20% surface coverage of algae and moss present on filter surface. Large volumes of stagnant water ponding on filter surface.
4e	Plant health	22	6	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in 10- 20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
4f	Plant cover	21	6	Good vegetation cover in planted areas (>80% cover or >6 plants per m ²).	Moderate vegetation cover in planted areas (50-80% cover).	Poor vegetation cover in planted areas (<50% cover).
4g	Litter and debris	17	6	No litter present.	Some litter present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/or blocking flows.
4h	Sediment accumulation	27	6 (and after major rain events)	No accumulated sediment or minimal sediment with no obvious impacts (<10%).	Some accumulated sediment (covering 10-50% of the surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
4i	Surface levels	31	6 (and after major rain events)	Even surface with no depressions or mounds. Base is flat with flows evenly distributed across asset surface. There is an adequate drop from the inlet to the filter surface (>100 mm).	Some small depressions or mounds present or preferential flow paths. Base is mostly flat with flows evenly distributed across most of asset. There is a small drop from the inlet to the filter surface (50-100 mm).	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short circuiting flows, blocking flows, limited flow distribution). Filter surface is at the same level or higher than the inlet.
4j	Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
5	Outlet, overflow pit and inspection pipes					
5a	Blockage	3	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
5b	Inspection pipes	15	6	Saturated zone system: water level is not above filter media depth. Non-saturated zone system: no standing water present in the inspection pipe.	Saturated zone system: water level is slightly above filter media depth. Non-saturated zone system: some standing water present in the inspection pipe.	Saturated zone system: water level is significantly above filter media depth. Non-saturated zone system: significant standing water present in the inspection pipe.
5c	Erosion	9	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
2 Inlet sediment pits and forebays						
2a	Blockage	1	2	3	NA	Notes:
2b	Permeability and clogging	1	2	3	NA	Notes:
3 Batters						
3a	Erosion	1	2	3	NA	Notes:
3b	Plant health	1	2	3	NA	Notes:
3c	Plant cover	1	2	3	NA	Notes:
3d	Litter and debris	1	2	3	NA	Notes:
3e	Vehicle or pedestrian damage	1	2	3	NA	Notes:
3f	Weeds	1	2	3	NA	Notes:

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
4	Biofilter surface					
4a	Erosion	1	2	3	NA	Notes:
4b	Extended detention depth	1	2	3	NA	Notes:
4c	Leaf litter	1	2	3	NA	Notes:
4d	Permeability and clogging	1	2	3	NA	Notes:
4e	Plant health	1	2	3	NA	Notes:
4f	Plant cover	1	2	3	NA	Notes:
4g	Litter and debris	1	2	3	NA	Notes:
4h	Sediment accumulation	1	2	3	NA	Notes:
4i	Surface levels	1	2	3	NA	Notes:
4j	Weeds	1	2	3	NA	Notes:
5	Outlet, overflow pit and inspection pipes					
5a	Blockage	1	2	3	NA	Notes:
5b	Inspection pipes	1	2	3	NA	Notes:
5c	Erosion	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
Surrounds and other infrastructure						
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1 Inlet						
1a	Blockage	Response: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 Inlet sediment pits and forebays						
2a	Blockage	Response: Unblock inlet sediment pits. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2b	Permeability and clogging	Response: Remove sediment and debris from drainage holes and ensure permeability. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
3 Batters						
3a	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
3b	Plant health	Response: Variable weekly watering for the first 6-8 weeks (until plants are established and actively growing) especially in dry weather. Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
3c	Plant cover	Response: Replant vegetation to achieve desired plant coverage. Information: Only use approved species for planting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>	
3d	Litter and debris	<p>Response: Manually remove litter.</p> <p>Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups.</p> <p>Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.</p>	Y	N NA Notes:
3e	Vehicle or pedestrian damage	<p>Response: Rectification works for structural issues to be undertaken immediately. Replace lost plants and reprofile filter surface if affected.</p> <p>Information: Refer to Works as Executed plans for specifications for structural repairs.</p>	Y	N NA Notes:
3f	Weeds	<p>Response: Remove weeds by using small shovels, mattocks or similar. Any trimmed or removed plant material must be taken off-site and disposed of appropriately.</p> <p>Information: The composition of plant species in the biofilter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well. Remove weeds before they flower and seed.</p> <p>Note: use of herbicides may compromise the integrity and performance of filter medium.</p> <p>Categories of weeds can be found on the NSW WeedWise website at: weeds.dpi.nsw.gov.au/Weeds/Categories</p>	Y	N NA Notes:
4 Biofilter surface				
4a	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required. Filter surface should be flat and even.</p> <p>Information: Typically required after heavy rainfall. For smaller incidents of scour and erosion, try transplanting some plants from a denser vegetated part of the biofilter. If you require further investigation into a current issue, refer to Water by Design (2012) <i>Rectifying Vegetated Stormwater Assets</i>.</p>	Y	N NA Notes:
4b	Extended detention depth	<p>Response: Remove overfilled material and re-level filter surface to include the extended detention depth as specified on the Works as Executed plans.</p> <p>Information: The depths of the material should meet those specified in the Works as Executed plans.</p>	Y	N NA Notes:
4c	Leaf litter	<p>Response: Manually remove litter.</p> <p>Information: The filter media should not be compressed during maintenance and monitoring activities as this can damage the underdrainage and reduce infiltration capacity. Forks and tongs may be used for litter pick ups.</p>	Y	N NA Notes:
4d	Permeability and clogging	<p>Response: If filter media is clogged, remove and replace media. Reprofile area and replant as required. Remove any algal presence by removing the top layer of filter media using a shovel and replace top layer of filter media and plants. Reprofile if required.</p> <p>Information: Conduct the hydraulic conductivity test in line with <i>Adoption Guidelines for Stormwater Biofiltration Systems (2015)</i> measurement of hydraulic conductivity. If the cover of moss or algal growth is >10%, refer to Water by Design (2012) <i>Rectifying Vegetated Stormwater Assets</i>.</p> <p>Note: the minimum hydraulic conductivity as defined by ASTM F1815-06 is to be a minimum of 100 mm/hr.</p>	Y	N NA Notes:
4e	Plant health	<p>Response: Variable weekly watering for the first 6-8 weeks (until plants are established and actively growing) especially in dry weather.</p> <p>Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death.</p>	Y	N NA Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
4f	Plant cover	<p>Response: Replant vegetation to achieve desired plant coverage.</p> <p>Information: Only use approved species for planting.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
4g	Litter and debris	<p>Response: Manually remove litter.</p> <p>Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups. Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
4h	Sediment accumulation	<p>Response: If accumulated sediment is present on the surface, remove by flat shovel, rake filter media and restore to design levels if required. Replacement of vegetation may be required.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
4i	Surface levels	<p>Response: Reprofile the filter surface to ensure a flat and even surface. The filter media should be low enough to allow for adequate extended detention depth.</p> <p>Information: Ensure the filter media is NOT filled up to the invert level of the inlet.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
4j	Weeds	<p>Response: Remove weeds by using small shovels, mattocks or similar. Any trimmed or removed plant material must be taken off-site and disposed of appropriately.</p> <p>Information: The composition of plant species in the biofilter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well. Remove weeds before they flower and seed. Note: use of herbicides may compromise the integrity and performance of filter medium. Categories of weeds can be found on the NSW WeedWise website at: weeds.dpi.nsw.gov.au/Weeds/Categories</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
5 Outlet, overflow pit and inspection pipes						
5a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
5b	Inspection pipes	<p>Response: Flush underdrain pipes using a water jet or pipe snake until a clear stream of water is present at the base of the outlet pit. If a saturated zone is present, the saturated zone should be drained before flushing out underdrain pipes.</p> <p>Information: Most underdrain pipes rarely need flushing and some underdrain systems are not connected to an outlet pit which makes inspection and flushing impossible. The inspection openings are often covered by vegetation and you may need to refer to the Works as Executed plans to find their location. Underdrainage pipes can be damaged if the water jet is too strong.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
5c	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Other:



PART B

3. Biofilter street tree pits



Biofilter street tree pits are small bioretention systems with filter media and underdrainage fitted into a street tree pit. They are very similar to bioretention systems in terms of design, operation, maintenance and monitoring requirements.

Biofilter street tree pits are usually free-draining. Additionally, the use of mulch is not recommended for these types of systems as it blocks the inlet.

3.1. Functional components

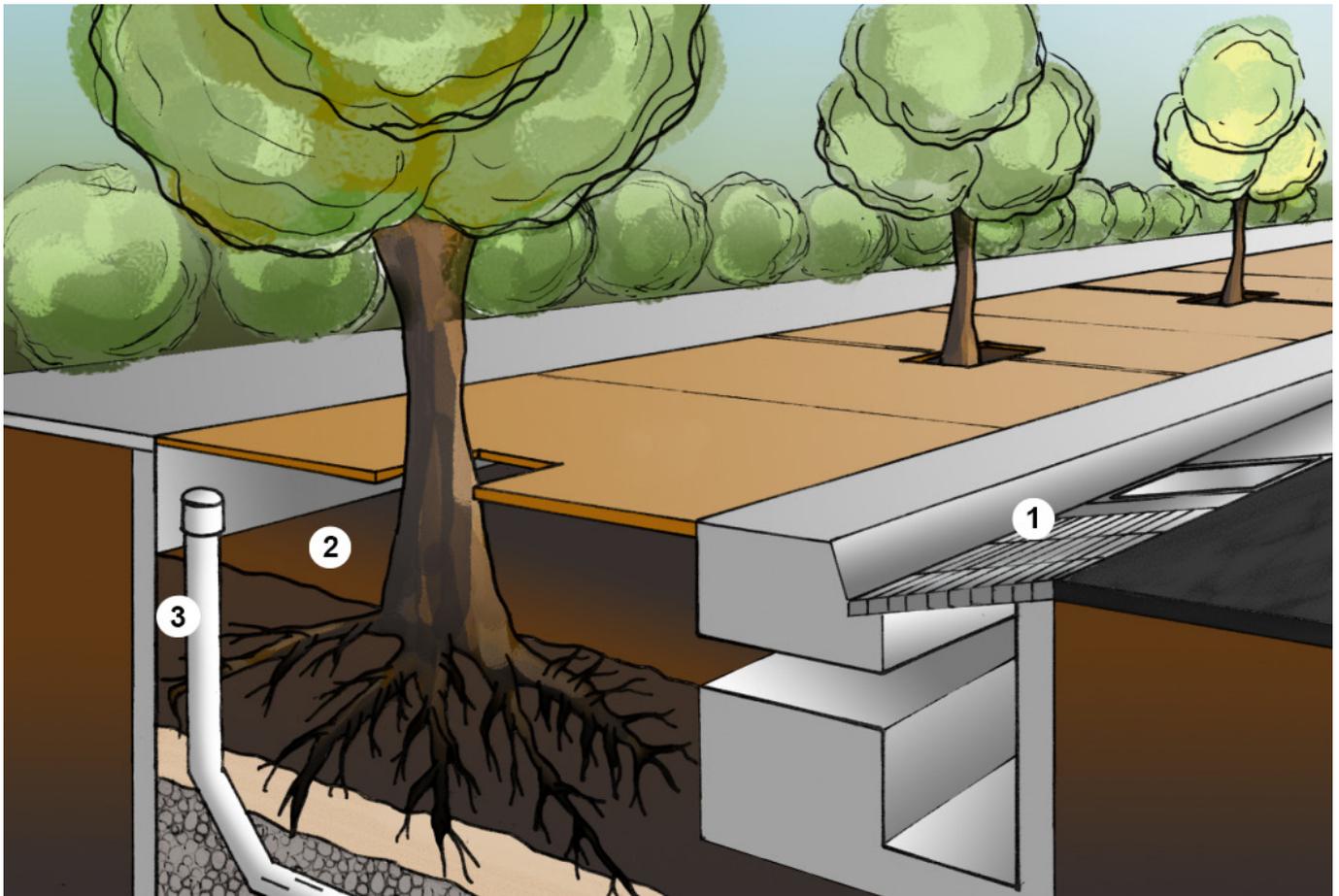


Figure 3: The functional components of a biofilter street tree pit.

1. Inlet. The inlet is where water is directed from the gutter towards the tree. This is usually a pit or direct opening from the kerb which diverts stormwater into the street tree pit for treatment. The inlet may contain a grate or filter to keep large items of litter out of the tree pit.
 2. Filter surface. This is where stormwater is directed so it can infiltrate down towards the tree's roots. To function correctly, the filter surface must be flat and even. The filter surface must be at a low enough level so that water can flow in from the inlet. All tree pits include a tree, but may also include other vegetation planted in the filter surface.
 3. Outlet, overflow and inspection pipes. Most tree pits include sub-surface (underdrain) drainage pipes. These drainage pipes are slotted and collect treated water at the base of the system, then drain the treated water into the stormwater drainage network. They are typically installed with flushing points for maintenance and monitoring. Tree pits usually don't require dedicated overflow structures as excess flows continue along the kerb.
- Other features include:
- tree pit covers constructed of a permeable pavement or a prefabricated metal grate, depending on levels of traffic
 - extended detention depth, which typically extends 100 mm above the surface of the system. It detains water temporarily during a rainfall event, allowing a greater volume of water to be captured and slowly filtered through the filter media.

3.2. Expertise required

Most of the inspection and maintenance tasks associated with biofilter street tree pit systems are straightforward, and can be easily inspected and maintained without specialised skills or equipment.

Basic horticultural skills and gardening equipment are, however, helpful.

Inspection and maintenance of the street tree itself may occasionally require the services of a specialised tree contractor.

During the establishment period, the vegetated components should be inspected more frequently.

Functional component condition score:

Good (1)	→
Moderate (2)	→
Poor (3)	→

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
Surrounds and other infrastructure					
Damage or removal of structures	6	6	Stable structures. No vandalism impacting amenity. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
Vehicle or pedestrian damage	33	6	No compaction, plant loss, or vandalism impacting system function.	Minor compaction and/or plant loss. Does not pose risk to structural integrity or asset function.	Significant compaction and/or plant loss. Poses risk to structural integrity, public safety or asset function.
1 Inlet					
1a Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2 Filter surface					
2a Erosion	9	6	No erosion. Filter surface receiving water evenly.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2b Extended detention depth	10	6	Design extended detention depth provided.	50-75% of design extended detention provided.	Less than 50% of design extended detention depth provided.
2c Leaf litter	16	3	Minimal leaf litter present or covers <20% of surface.	Some wet and decaying leaf matter present (covering 20-50% of surface). Aesthetic issue. Some obstruction of flow paths.	Large amount of wet and decaying leaf matter present (covering >50% of the surface). Impacting vegetation growth. Obstructing flow paths and blocking inlets or outlets.
2d Permeability and clogging	20	12	In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (50-100 mm) for bioretention systems is drawn down over 1-3 hours after inflow to the system has stopped following rainfall.	In dry conditions, water poured on surface infiltrates the surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding observed for longer than normal (>3 hours).	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (50-100 mm) remains >12 hours after inflow to the system has stopped following rainfall. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation.
2e Plant health	22	6	Healthy vegetation.	Tree or plants are stressed. Minor issue with tree that can be readily remedied (e.g. watering, spray for pests) or poor health (e.g. signs of disease, pests, wilting) in 20-50% of other plants.	Tree or plants are dying back. Significant issue with tree that requires major intervention or replacement or poor health (e.g. signs of disease, pests, wilting) in >50% of other plants.

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
2f	Plant cover	21	6	Tree present. Good vegetation cover in planted areas (>80% cover or >6 plants per m ²).	Tree not present, replacement only required. Moderate vegetation cover in planted areas (50-80% cover).	Tree not present and other functional issues. Poor vegetation cover in planted areas (<50% cover).
2g	Litter and debris	17	6	No litter present.	Some litter present. Diminished aesthetics and/ or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/ or blocking flows.
2h	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering 20-50% of surface). Causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Impeding flows. Smothering vegetation.
2i	Surface levels	31	12	Even surface with no depressions or mounds. Base is flat with flows evenly distributed across asset surface.	Some small depressions or mounds present or preferential flow paths. Base is mostly flat with flows evenly distributed across most of asset.	Significant depressions or mounds present or defined preferential flow paths. Surface levels are impacting flows through the asset (e.g. short circuiting flows, blocking flows, limited flow distribution).
2j	Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/ or declared invasive weed species present.
3	Outlet, overflow and inspection pipes					
3a	Blockage	3	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
3b	Inspection pipes	15	12	Saturated zone system: water level is not above filter media depth. Non-saturated zone system: no standing water present in the inspection pipe.	Saturated zone system: water level is slightly above filter media depth. Non-saturated zone system: some standing water present in the inspection pipe.	Saturated zone system: water level is significantly above filter media depth. Non-saturated zone system: significant standing water present in the inspection pipe.
3c	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
	Vehicle or pedestrian damage	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
2 Filter surface						
2a	Erosion	1	2	3	NA	Notes:
2b	Extended detention depth	1	2	3	NA	Notes:
2c	Leaf litter	1	2	3	NA	Notes:
2d	Permeability and clogging	1	2	3	NA	Notes:
2e	Plant health	1	2	3	NA	Notes:
2f	Plant cover	1	2	3	NA	Notes:
2g	Litter and debris	1	2	3	NA	Notes:
2h	Sediment accumulation	1	2	3	NA	Notes:

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
2i	Surface levels	1	2	3	NA	Notes:
2j	Weeds	1	2	3	NA	Notes:
3 Outlet, overflow and inspection pipes						
3a	Blockage	1	2	3	NA	Notes:
3b	Inspection pipes	1	2	3	NA	Notes:
3c	Erosion	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.			
Surrounds and other infrastructure						
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
	Vehicle or pedestrian damage	Response: Reprofile damaged or compacted surfaces and replace lost plants. Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1 Inlet						
1a	Blockage	Response: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 Filter surface						
2a	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Filter surface should be flat and even. Information: Typically required after heavy rainfall. For smaller incidents of scour and erosion, try transplanting some plants from a denser vegetated part of the treepit.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2b	Extended detention depth	Response: Remove overfilled material and re-level filter surface to include the extended detention depth as specified on the Works as Executed plans. Information: The depths of the material should meet those specified in the Works as Executed plans.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2c	Leaf litter	Response: Manually remove litter. Information: The filter media should not be compressed during maintenance and monitoring activities as this can damage the underdrainage and reduce infiltration capacity. Forks and tongs may be used for litter pick ups.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2d	Permeability and clogging	Response: If filter media is clogged, remove and replace media. Reprofile area and replant as required. Remove any algal presence by removing the top layer of filter media using a shovel and replace top layer of filter media and plants. Reprofile if required. Information: Conduct the hydraulic conductivity test in line with <i>Adoption Guidelines for Stormwater Biofiltration Systems (2015)</i> measurement of hydraulic conductivity. If the cover of moss or algal growth is >10%, refer to <i>Water by Design (2012) Rectifying Vegetated Stormwater Assets</i> . Note: the minimum hydraulic conductivity as defined by ASTM F1815-06 is to be a minimum of 200 mm/hr.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2e	Plant health	Response: Water tree as needed to manage water stress with regular watering until tree is established and actively growing, especially in dry weather. Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
2f	Plant cover	<p>Response: Water tree as needed to manage water stress with regular watering until tree is established and actively growing, especially in dry weather. Replant vegetation to achieve desired plant coverage.</p> <p>Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death. Only use approved species for replanting.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
2g	Litter and debris	<p>Response: Manually remove litter.</p> <p>Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups. Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
2h	Sediment accumulation	<p>Response: If accumulated sediment is present on the surface, remove by flat shovel, rake filter media and restore to design levels if required. Replacement of vegetation may be required.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
2i	Surface levels	<p>Response: Reprofile the filter surface to ensure a flat and even surface. The filter media should be low enough to allow for adequate extended detention depth.</p> <p>Information: Ensure the filter media is NOT filled up to the invert level of the inlet.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
2j	Weeds	<p>Response: Remove weeds by using small shovels, mattocks or similar. Any trimmed or removed plant material must be taken off-site and disposed of appropriately.</p> <p>Information: The composition of plant species in the treepit may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well. Remove weeds before they flower and seed. Note: use of herbicides may compromise the integrity and performance of filter medium. Categories of weeds can be found on the NSW WeedWise website at: weeds.dpi.nsw.gov.au/Weeds/Categories</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3 Outlet, overflow and inspection pipes			
3a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3b	Inspection pipes	<p>Response: Flush underdrain pipes using a water jet or pipe snake until a clear stream of water is present at the base of the outlet pit. If a saturated zone is present, the saturated zone should be drained before flushing out underdrain pipes.</p> <p>Information: Most underdrainage pipes rarely need flushing and some underdrain systems are not connected to an outlet pit which makes inspection and flushing impossible. The inspection openings are often covered by vegetation and you may need to refer to the Works as Executed plans to find their location. Underdrainage pipes can be damaged if the water jet is too strong.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3c	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:

Other:



PART B

4. Wetlands



A wetland is a vegetated wet basin (or series of wet basins) that filter and treat stormwater before it enters our waterways. The plants in a wetland capture fine particles and absorb nutrients from the stormwater; they slow and filter the water allowing sediment to settle. Wetlands commonly have a gross pollutant and sediment trap upstream of them to capture coarse material before it enters the main part of the wetland (the macrophyte zone).

4.1. Functional components

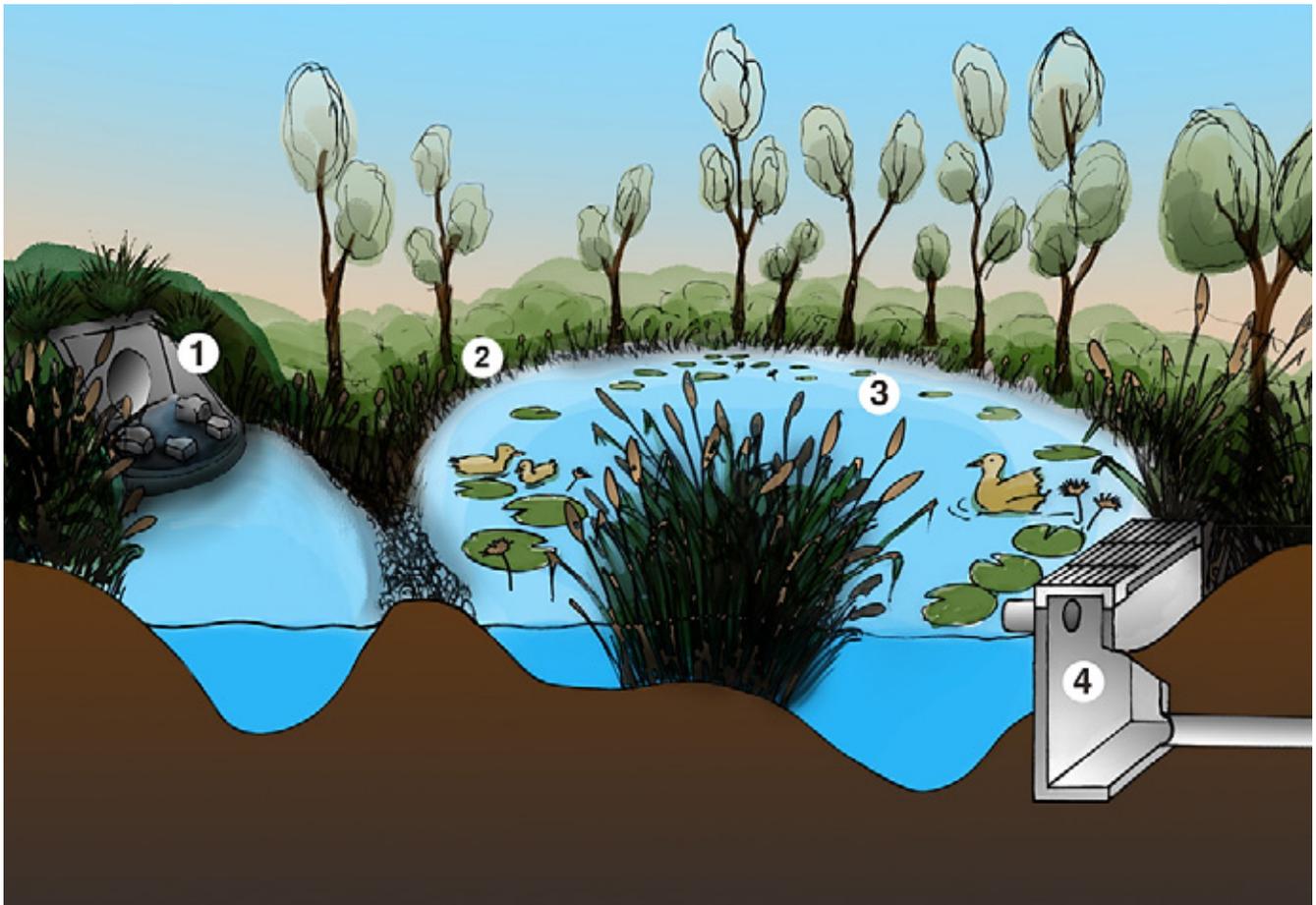


Figure 4: The functional components of a wetland.

1. Inlet. Water is piped into the inlet zone of the wetland, which acts as an open water sedimentation pond. The inlet zone reduces the velocity of inflows, traps coarse sediments, and protects the sensitive macrophyte zone.
2. Batters. Batters connect the wetland water surface with the surroundings at a gentle slope. Batters should be densely vegetated to aid water treatment and help prevent erosion. Vegetated batters also play an important role for bug and animal life living around the wetland.
3. Macrophyte zone. This is a densely vegetated zone where fine particles and dissolved pollutants are removed. Plant life can include submerged, semi-submerged and floating plants. This zone usually includes a range of shallow and deep water levels and may include areas that are only wet during rainy seasons (ephemeral zones).
4. Outlet and overflow. The outlet of a wetland is usually a partially submerged pipe or weir that drains to an outlet pit. The outlet pit contains an orifice plate or weir that controls the water level in the wetland. The outlet is usually set to allow for a typical detention time of 72 hours. Wetlands usually include an overflow weir that directs excess flow into the outlet pit or downstream of the wetland. This collects any flows in excess of the system's capacity and directs them into the stormwater drainage network.

4.2. Expertise required

In some cases, a small boat or kayak may be required for maintenance and monitoring of the open water body. In these cases, all appropriate boat licences and WHS requirements must be met.

During the establishment period, the vegetated components should be inspected more frequently.

Functional component condition score:

Good (1)



Moderate (2)



Poor (3)



Maintenance required:

No maintenance required

Routine maintenance (simple tasks)*

Corrective maintenance
(specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
Surrounds and other infrastructure						
	Damage or removal of structures	6	6	Stable structures. No vandalism impacting amenity. No safety risks.	Minor damage. Does not pose risk to structural integrity and/or asset function.	Major damage. Poses risk to structural integrity, public safety and/or asset function.
1	Inlet					
1a	Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass and/or restriction of inflows.
1b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety and/or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety and/or asset function (e.g. short circuiting of the majority of flows).
1c	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering 20-50% of inlet zone). Causing some redirection of flows through the system.	Accumulated sediment covering (>50% of inlet zone). Impeding flows. Smothering vegetation.
2	Batters					
2a	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety and/or asset function (e.g. short circuiting of the majority of flows).
2b	Plant health	22	12	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in <20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
2c	Plant cover	21	12	Good vegetation cover in planted areas (>80% cover or >6 plants per m ²).	Moderate vegetation cover in planted areas (50-80% cover).	Poor vegetation cover in planted areas (<50% cover).
2d	Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
2e	Litter and debris	17	6	No litter present.	Some litter present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/or blocking flows.
3	Macrophyte zone					
3a	Erosion	9	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3b	Floating plants	13	6	None or minimal nuisance floating plants present (<10%).	Low/moderate cover of nuisance floating plants (10-50%). Mechanical removal of nuisance floating plants is effective in managing blooms.	Nuisance floating plant blooms with high cover (>50%) are problematic. Impacting on wetland performance and are too extensive to remove mechanically.

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
3c	Mosquitoes	18	12	No isolated depressions which can become breeding sites when water levels recede. Deep pools provide refuge for predators. No dead or rafting vegetation.	Potential mosquito habitats observed (e.g. isolated pools, rafting vegetation).	Nuisance populations of mosquitoes observed and/or reported by local community. Numerous potential mosquito habitats observed (e.g. isolated pools, rafting vegetation).
3d	Plant health	22	12	Healthy vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in <20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
3e	Plant cover	21	12	Good vegetation cover in planted areas (>80% cover or >6 plants per m ²).	Moderate vegetation cover in planted areas (50–80% cover).	Poor vegetation cover in planted areas (<50% cover).
3f	Sediment accumulation	27	12	No accumulated sediment.	Some accumulated sediment (covering <50% of surface), causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface), resulting in impeded flows and smothering vegetation.
3g	Water levels	34	12	Water level variation as designed (with appropriate drawdown of attenuated flow following rainfall, and dry periods are not extensive (<70 days/year)). Diverse vegetation confirms confidence in appropriate water level variation.	Some concerns about water level variation, but impact on treatment performance is expected to be small.	Significant concerns about water level variation. Impact on treatment performance is expected to be significant.
3h	Water quality (oil slicks, odour, algae)	35	12	No water quality issues (e.g. oil slicks, odours, algae).	Some minor water quality issues visible (e.g. oil slicks, odours, algae) but no major impact on aesthetics or water quality.	Significant water quality issues (e.g. oil slicks, odours, algae). Heavily impacting aesthetics and/or water quality.
3i	Litter and debris	17	6	No litter present.	Some litter present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/or blocking flows.
3j	Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10–50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
4 Outlet and overflow						
4a	Blockage	3	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
4b	Erosion	9	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety and/or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety and/or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
1c	Sediment accumulation	1	2	3	NA	Notes:
2 Batters						
2a	Erosion	1	2	3	NA	Notes:
2b	Plant health	1	2	3	NA	Notes:
2c	Plant cover	1	2	3	NA	Notes:
2d	Weeds	1	2	3	NA	Notes:
2e	Litter and debris	1	2	3	NA	Notes:
3 Macrophyte zone						
3a	Erosion	1	2	3	NA	Notes:
3b	Floating plants	1	2	3	NA	Notes:
3c	Mosquitoes	1	2	3	NA	Notes:

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
3d	Plant health	1	2	3	NA	Notes:
3e	Plant cover	1	2	3	NA	Notes:
3f	Sediment accumulation	1	2	3	NA	Notes:
3g	Water levels	1	2	3	NA	Notes:
3h	Water quality (oil slicks, odour, algae)	1	2	3	NA	Notes:
3i	Litter and debris	1	2	3	NA	Notes:
3j	Weeds	1	2	3	NA	Notes:
4 Outlet and overflow						
4a	Blockage	1	2	3	NA	Notes:
4b	Erosion	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
Surrounds and other infrastructure						
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1 Inlet						
1a	Blockage	Response: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1c	Sediment accumulation	Response: Remove sediment, dry on-site, dispose and re-set surface levels as designed. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). Reuse on-site requires the waste material to be tested for contaminants to ensure it is suitable for the intended purpose (e.g. top dressing grassed areas). If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the macrophyte zone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 Batters						
2a	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2b	Plant health	Response: Variable weekly watering for the first 6-8 weeks (until plants are established and actively growing) especially in dry weather. Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2c	Plant cover	Response: Maintain between 6-10 plants per m ² . Carry out infill planting as required (using the original planting density scheduled). Information: Plants should be evenly spaced to prevent localised erosion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
2d	Weeds	<p>Response: Remove weeds by using small shovels, mattocks or similar. Any trimmed or removed plant material must be taken off-site and disposed of appropriately.</p> <p>Information: The composition of plant species on the batter may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well.</p> <p>Note: use of herbicides may compromise the integrity and performance of the system.</p> <p>Categories of weeds can be found on the NSW WeedWise website at: weeds.dpi.nsw.gov.au/Weeds/Categories</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
2e	Litter and debris	<p>Response: Manually remove litter.</p> <p>Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups.</p> <p>Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3 Macrophyte zone			
3a	Erosion	<p>Response: Minor erosion or scour can be re-profiled with hand tools while larger areas of erosion may require drawing down of the wetland levels and machinery. Affected areas should be replanted with the design vegetation.</p> <p>Information: In most cases, temporary measures, such as jute matting and establishing dense vegetation, will prevent further erosion. In some cases, additional scour protection may be needed, such as rock beaching.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3b	Floating plants	<p>Response: Mechanical removal is best suited to larger wetlands or large amounts of floating plants. In most cases, floating plants can be removed by hand using rakes and/or floating booms.</p> <p>Information: If issues are persistent, ongoing control is best achieved by ensuring the edges and macrophyte zones are densely planted with a good cover of emergent aquatic macrophytes to create shade and control the growth rate of floating plants.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3c	Mosquitoes	<p>Response: Remove any potential mosquito habitats. Fill in isolated depressions which could fill with water after rain. Remove dead or rafting edge vegetation around deep water zones which can create isolated pockets of water protected from predators. Maintain water in deep pools to provide ongoing refuge for mosquito predators, such as small native freshwater fish and macroinvertebrates. Ensure vegetation with thin, vertical, upright stems is maintained within the littoral zone around deep water zones. These maximise predation of mosquito larvae by allowing for passage of small fish and macroinvertebrate predators.</p> <p>Information: If there is an ongoing issue and nuisance population of mosquitoes in the WSUD asset, a site specific investigation should be undertaken to understand the cause and identify suitable actions.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3d	Plant health	<p>Response: If there is too much water (over inundation), adjust water levels in the wetland (see 3g Water levels). If there is a lack of water (establishment period or drought), irrigation or increased flows may be required to support vegetation. If there is disease or pests, prune affected plant matter (or remove entire plant where necessary), treat if appropriate and replant any plants that have been lost or removed. If there is shade from adjacent vegetation, look to trim back adjacent trees, or plant shade tolerant species.</p> <p>Information: Where water levels and inundation periods are an issue, review species selection and replant with species more suitable for the actual inundation conditions.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
3e	Plant cover	<p>Response: Replanting small areas can be achieved in a simple and cost effective manner by dividing and relocating existing mature vegetation with rhizomatous root systems. Choose vegetation from high density areas in a similar inundation zone. Simply remove and divide the mature plant by splitting it through the base into multiple sections. Directly plant these new sections into the area which requires replanting.</p> <p>Information: Where water levels and inundation periods are an issue, review species selection and replant with species more suitable for the actual inundation conditions. When vegetation is replanted, monitoring, weeding, infill planting and irrigation is required during establishment. If new juvenile plants are required for wetlands where water levels cannot be maintained at a low level during plant establishment, or grazing waterbirds are present, replant using larger, more mature plants. Otherwise, tube stock can be used for replanting.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3f	Sediment accumulation	<p>Response: If excessive sediment is covering >50% of the surface, remove plants as needed and set aside. Remove sediment, dry on-site, dispose and re-set surface levels as designed. Replace plants (if required) at 6-10 plants per m².</p> <p>Information: Wetlands should only very slowly accumulate sediment and not require sediment removal more than once in 20-30 years. If sediment is accumulating faster, upstream sediment basin management should be reviewed. Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3g	Water levels	<p>Response: If plants are water stressed, irrigation may be required and/or the water level topped up. Leaks at the outlet, through batters or base should be investigated and repaired, if relevant. If water levels are too high for long periods, the inundation frequency patterns should be assessed. Remedial actions may include modifying hydraulic structures (inlet and outlet) to create optimal water levels, modifying vegetation design and replanting to reflect actual inundation patterns, and modifying the outlet to release or divert frequent baseflows.</p> <p>Information: During a prolonged dry season, vegetation may become stressed (especially with a dry period of >70 days). Leaks may also result in reduced water levels causing vegetation to become water stressed. Inundation patterns with levels that are too high too frequently are a common cause of plant loss in wetlands.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3h	Water quality (oil slicks, odour, algae)	<p>Response: Minor slicks can be left alone if not impacting vegetation or asset function. The impact of moderate or major oil slicks should be minimised immediately with barriers such as floating booms. The outlet of the asset should be closed to prevent the risk of the oil spill entering downstream environments. For major spills, it will be necessary to remove the bulk of the spill with an eductor truck. If blue-green algae is present, or if there are other public health and safety concerns, signage should be placed around the wetland and public access restricted through temporary fencing. Specialist advice should be sought before actions are undertaken. Excessive filamentous algal biomass can impact asset function by blocking inlets and outlets and smothering vegetation. If the algae is impacting aesthetics or function of the wetland system, it can be removed by hand using rakes or with specialist machinery.</p> <p>Information: Wetlands are good at processing low to moderate concentrations of hydrocarbons. Blue-green algae presents a human health risk and must be eliminated or managed to protect the safety of the public as a priority. Filamentous algae can form visible chains which can appear as algal mats in both open and shallow water areas.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
3i	Litter and debris	<p>Response: Manually remove litter.</p> <p>Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups.</p> <p>Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
3j	Weeds	<p>Response: To manage free-floating aquatic weeds (e.g. <i>Salvinia</i>, water hyacinth), avoid large infestations by actively managing small infestations, undertake regular spot use of herbicide suitable for use in water bodies (e.g. Roundup Biactive*/ Glyphosate) on small infestations, and remove dead plants where possible to reduce carbon loading of the water body. For large infestations, mechanically remove plants where possible with a boat or harvester and spot spray remaining plants.</p> <p>To manage emergent weeds (e.g. lilies, <i>Typha</i>), lilies can be managed through repeated cutting below water level (but this approach requires commitment, including repeated cutting upon emergence of new leaves until plant energy reserves are diminished and plants die), and avoid large infestations by actively managing small infestations. When spraying emergent weeds, timing is critical for long term results. Spray towards the end of the growth season (e.g. February–March), wait for the spray to take effect (about 1 month for <i>Typha</i>, 1-2 weeks for lilies) then remove foliage ideally below water level, if possible. This technique and timing maximises treatment effectiveness. The timing ensures poison is transferred to the plants' roots/rhizomes (as the plant stores energy for the winter period) and removal of foliage below water level stops the transfer of oxygen to the roots.</p> <p>Information: Do not spray the whole water body. This provides spatial isolation and allows fish and other aquatic organisms to move away and seek refuge. Where harvesting of large infestations is not possible, treat small patches of weeds progressively to avoid impacts on aquatic habitat. Removal of dead foliage in and adjacent to the macrophyte zone is good practice to avoid carbon loading of the water body. Remove weeds before they flower and seed. Ensure soil and plant material is removed from tools and vehicles between maintenance activities and sites to prevent weed spread.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
4 Outlet and overflow			
4a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
4b	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:

Other:



PART B

5. Vegetated buffer strips and swales



Vegetated buffer strips and swales are simple stormwater transfer systems that treat runoff through filtration and sediment capture. Buffer strips are vegetated surfaces (usually grassed) that allow runoff to flow towards a downstream outlet. Swales generally form a sloped vegetated channel that conveys stormwater along a long path. In both systems, water is slowed and filtered as it flows through the vegetation, capturing large sediments and absorbing stormwater runoff.

5.1. Functional components



Figure 5: The functional components of a vegetated buffer strip.

1. Inlet. The inlet to a vegetated buffer strip or swale can simply be the area where water first flows into the asset. Often, buffer strips are used on the side of roads or driveways where the boundary between the paved area and the vegetated buffer strip would make up the 'inlet'.
A swale transfers stormwater down a channel and can have a traditional piped inlet or a simple buffer-style distributed inlet.
2. Vegetated base and batters. These are the surface areas of the buffer strip or swale with planted vegetation. Buffer strips and swales can be planted with mown grass or small shrubs. Vegetation is vital to avoid scouring and soil erosion. Buffer strips and swales must have an even grade to allow all water to eventually drain. An uneven surface may result in ponding and boggy conditions.
3. Outlet. The outlet of a buffer strip is the point at which stormwater finishes running over the surface. This is usually a pit, but buffer strips can also flow directly into swales, overland flow paths or biofilters. A swale usually has a defined outlet with a pit at the downstream end.

5.2. Expertise required

Buffer strip and swale condition inspections can typically be undertaken by the property owner, as specialised equipment to access and view the system is generally not required. The required maintenance is similar to maintaining a lawn or garden bed.

During the establishment period, the vegetated components should be inspected more frequently.

Functional component condition score:

Good (1)



Moderate (2)



Poor (3)



Maintenance required:

No maintenance required

Routine maintenance (simple tasks)*

Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
Surrounds and other infrastructure						
	Damage or removal of structures	6	12	Stable structures. No damage to structure or surrounding infrastructure. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	Inlet					
1a	Blockage	3	12	No litter/sediment present.	Some litter/sediment present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter/sediment present. Heavily impacting aesthetics and/or blocking flows.
1b	Erosion	9	12	Stable structures. No damage or safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
2	Vegetated base and batters					
2a	Erosion	9	12	Stable batters and base. No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety and/or asset function (e.g. short circuiting of the majority of flows).
2b	Plant health	22	12	Healthy and thriving vegetation.	Vegetation is stressed. Poor health (e.g. signs of disease, pests, wilting) in <20% of plants.	Vegetation is dying back. Poor health (e.g. signs of disease, pests, wilting) in >20% of plants.
2c	Plant cover	21	12	Dense vegetation cover in planted areas (>80% cover or 6-10 plants per m ²).	Moderate vegetation cover in planted areas (50-80% cover).	Poor vegetation cover in planted areas (<50% cover).
2d	Litter and debris	17	12	No litter present.	Some litter present. Diminished aesthetics and/or causing some visible blockage.	Large amount of litter present. Heavily impacting aesthetics and/or blocking flows.
2e	Sediment accumulation	27	12	No accumulated sediment, or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface) causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface) is restricting flows and smothering vegetation.
2f	Standing water or boggy conditions	29	12	Well drained surface with no ponding or boggy areas.	Temporary ponding and boggy conditions after rain events. Typically drying out within 24 hours.	Standing water present and/or continued boggy conditions, affecting asset performance and ease of maintenance.
2g	Surface levels	31	12	Even surface with no depressions or mounds.	Some small depressions or mounds present. Limited impact on flows through the asset.	Level of surface is impacting flows through the asset. Isolated pools present on the surface.
2h	Weeds	36	12	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
3	Outlet					
3a	Blockage	3	12	No blockage.	Partial blockage of outlet and/or overflow passage causing some obstruction of outflows or requiring removal.	Blockage of outlet and/or overflow preventing or significantly obstructing outflows.
3b	Erosion	9	12	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
2 Vegetated base and batters						
2a	Erosion	1	2	3	NA	Notes:
2b	Plant health	1	2	3	NA	Notes:
2c	Plant cover	1	2	3	NA	Notes:
2d	Litter and debris	1	2	3	NA	Notes:
2e	Sediment accumulation	1	2	3	NA	Notes:
2f	Standing water or boggy conditions	1	2	3	NA	Notes:
2g	Surface levels	1	2	3	NA	Notes:
2h	Weeds	1	2	3	NA	Notes:
3 Outlet						
3a	Blockage	1	2	3	NA	Notes:
3b	Erosion	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify) _____		<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
Surrounds and other infrastructure						
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1 Inlet						
1a	Blockage	Response: Clear inlet of sediment and debris. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating in the swale. For buffers and swales that receive runoff along the side of a paved surface, sediment generally accumulates at the boundary between the paved surface and swale/buffer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 Vegetated base and batters						
2a	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2b	Plant health	Response: Variable weekly watering for the first 6-8 weeks (until plants are established and actively growing) especially in dry weather. If required, mow grass/trim plants using a catcher. Any trimmed or removed plant material must be taken off-site and disposed of appropriately. Information: Watering during the plant establishment phase is important to enable quick plant establishment. Watering during dry periods after establishment may be required to prevent plant death.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2c	Plant cover	Response: Maintain between 6-10 plants per m ² . Carry out infill planting as required (using the original planting density scheduled). Information: Plants should be evenly spaced to prevent localised erosion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2d	Litter and debris	Response: Manually remove litter. Information: Contact with sharp objects is a risk when removing litter. All workers must follow WHS practices to reduce risk, including wearing personal protective equipment. Forks and tongs may be used for litter pick ups. Note: all disposal procedures are to adhere with NSW EPA and local authorities' requirements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
2e	Sediment accumulation	<p>Response: If accumulated sediment is present on the surface, remove by flat shovel, rake treatment surface and restore to design levels if required. Vegetation replacement may be required.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:
2f	Standing water or boggy conditions	<p>Response: Ensure swale/buffer is sloped towards the outlet so water can drain. Reprofile any local depressions or mounds so the swale/buffer is as even as possible. Replant if necessary.</p> <p>Information: Standing water is a good indicator that the swale/buffer is not sloped adequately towards the outlet.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:
2g	Surface levels	<p>Response: Ensure swale/buffer is sloped towards the outlet so water can drain. Reprofile any local depressions or mounds so the swale/buffer is as even as possible. Replant if necessary.</p> <p>Information: Standing water is a good indicator that the swale/buffer is not sloped adequately towards the outlet.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:
2h	Weeds	<p>Response: Remove weeds by using small shovels, mattocks or similar. Any trimmed or removed plant material must be taken off-site and disposed of appropriately.</p> <p>Information: The composition of plant species in the swale or buffer system may change over time and vary from the original planting schedule. The system should be left to reach its own balance of plant composition (excluding weeds) provided the system is functioning as intended. If replanting is required, look at what species are performing well. Herbicides should be avoided and only those suitable for use near waterways may be used to protect downstream receiving waterways.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:
3 Outlet			
3a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:
3b	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	<input type="radio"/> Y <input type="radio"/> N <input type="radio"/> NA Notes:

Other:



Above ground on-site stormwater detention system.

PART B

6. On-site stormwater detention (OSD)



On-site stormwater detention (OSD) is the temporary storage and controlled release of stormwater generated on-site. OSD temporarily stores and slows down the rate of stormwater runoff from a property so that it does not worsen flooding downstream, whereas a rainwater tank stores rainwater.

OSD systems can be located above ground or below ground. They should remain empty except during periods of rainfall and shortly after the rainfall ceases. Ponding of water should not last for more than 2 hours in most rain events. If ponding persists, it is likely that maintenance attention is required.

In some cases, below ground OSD systems can include proprietary filter cartridges.

6.1. Functional components of an above ground OSD

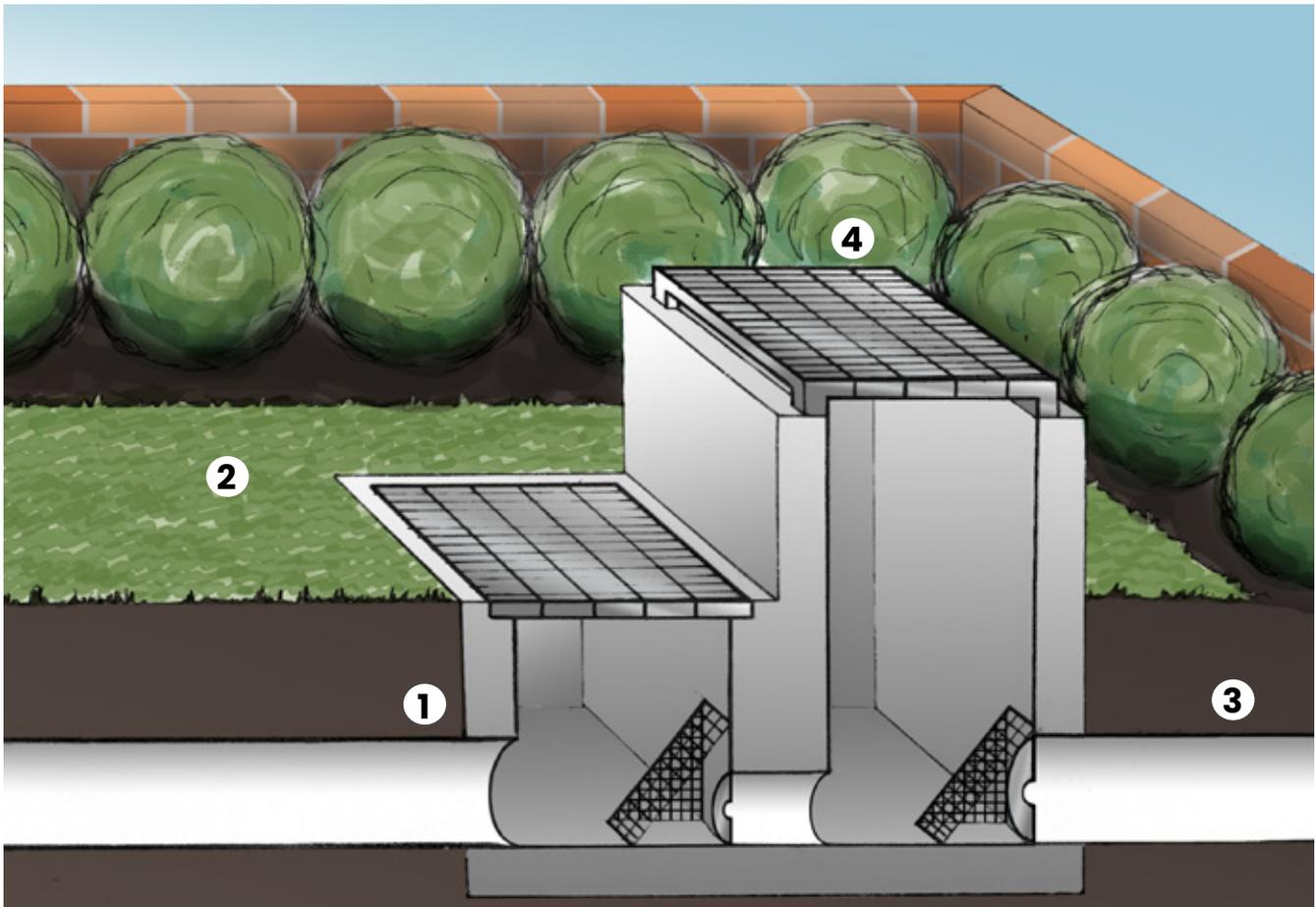


Figure 6: The functional components of an OSD with above ground storage.

1. Inlet. The inlet drains upstream roof downpipes and drainage to the OSD storage area.
 2. Storage area. The storage area of an above ground OSD is usually a walled-in or battered area that fills with stormwater during rain, and slowly drains afterwards. It may be a garden, lawn, car park, paved courtyard, tank, or a combination of these spaces, that temporarily store stormwater. It is vital to ensure the required volume to store water is preserved.
 3. Outlet. The outlet is where the water in the storage area drains through a discharge control pit and then through an outlet pipe. The discharge control pit usually has an orifice plate to control the rate at which stormwater leaves the site. This causes stormwater to pond in the storage area where it remains until the rain eases.
 4. Overflow. When the storage area is filled, water should be allowed to overflow from the system. This is usually achieved with an elevated pit or weir that allows water to fill up and spill over into the pit.
- The above pits include 2 sets of orifice plates:
- The primary orifice is a flat, stainless steel plate structure that controls the rate water discharges from the outlet for the extended detention storage.
 - The secondary orifice controls the rate water discharges from the detention storage. The orifice plates are covered by trash screens in front of the outlets. These are usually installed on a 45 degree angle to reduce the incidence of blockage.

6.2. Functional components of a below ground OSD

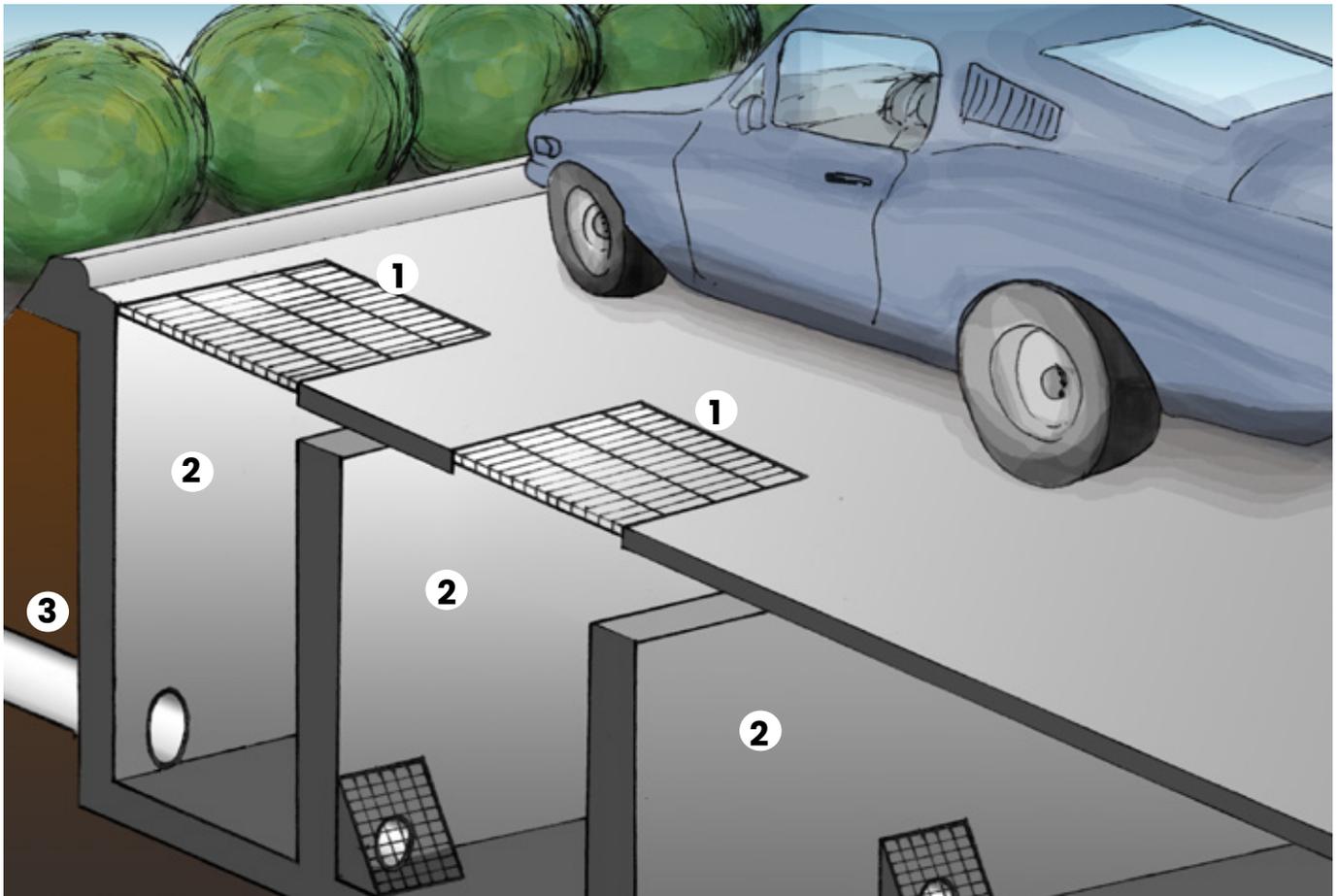


Figure 7: The functional components of an OSD with below ground storage.

1. Inlet. The inlet includes connection to downpipes and surface flow entering through pits.
2. Storage area. Below ground OSD systems have underground tanks that fill up with stormwater after rain. There can be 1 or multiple tanks in a series (as shown in the image above).
3. Outlet. The outlet is where water is discharged from the control pits, with the rate of discharge being controlled by the orifice plate. The outlet discharges water into the stormwater drainage network.

The primary orifice is a flat, stainless steel plate structure that controls the rate water discharges from the outlet for the extended detention storage. The secondary orifice controls the rate water discharges from the detention storage. The orifice plates are covered by trash screens which are located prior to the outlet usually installed on a 45 degree angle to reduce the incidence of blockage.

Other features include:

- Overflow outlet. This is a bypass to enable flows beyond the capacity of the on-site stormwater detention system to be discharged. Unlike the outlet, which includes an orifice plate, there are no controls on the discharge rate of the overflow outlet.

6.3. Expertise required

The Upper Parramatta River Catchment Trust's (UPRCT) (2005) *On-site Stormwater Detention Handbook* states that 'the majority of OSD systems, particularly those where a large proportion of the storage is located above ground, will be able to be maintained by property owners, tenants or handymen. Larger underground systems, particularly those with limited access and/or substantial depth, will require the owner to engage commercial cleaning companies with specialised equipment'.

Larger, below ground systems may require:

- access for specialised monitoring and maintenance vehicles
- special equipment for opening manholes
- confined spaces entry for some maintenance and monitoring tasks.

Property owners should not attempt to enter any confined spaces as this is dangerous. Property owners or owners' corporations will need to engage suitably qualified contractors to undertake the asset condition inspections and to carry out any required maintenance.



Functional component condition score:

Good (1)	→
Moderate (2)	→
Poor (3)	→

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.



Above ground on-site stormwater detention system.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
Surrounds and other infrastructure						
	Damage or removal of structures	6	6	Stable structures. No damage to structure or surrounding infrastructure. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1 Inlet						
1a	Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2 Storage area						
2a	Storage volume	30	6	No significant sediment accumulation or other volume reduction.	Some sediment accumulated, but no more than 5% of volume has been lost.	Sediment or debris accumulation resulting in 5% or more of volume being lost.
2b	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface), causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Significantly impeding flows.
2c	Standing water or boggy conditions	29	6	No standing water.	Standing water visible at time of inspection.	Standing water >5% of depth remains more than 12 hours since last rainfall.
3 Outlet (discharge control pit)						
3a	Blockage	3	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.
3b	Screen	26	6	No holes or damage to the screen. No clogging evident.	Some small holes/light damage. Can still function to remove most gross pollutants. Screen not securely attached to the wall of the pit.	Large holes/heavy damage to the screen. Gross pollutants can enter the tank. Screen completely detached from the wall of the pit.
3c	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface), causing some redirection of flows through the system.	Accumulated sediment (covering >50% of the surface). Significantly impeding flows.
4 Overflow						
4a	Blockage	3	6	No blockage.	Partial blockage of overflow causing some obstruction of outflows or requiring removal.	Blockage of overflow preventing or significantly obstructing outflows.
4b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
2 Storage area						
2a	Storage volume	1	2	3	NA	Notes:
2b	Sediment accumulation	1	2	3	NA	Notes:
2c	Standing water or boggy conditions	1	2	3	NA	Notes:
3 Outlet (discharge control pit)						
3a	Blockage	1	2	3	NA	Notes:
3b	Screen	1	2	3	NA	Notes:
3c	Sediment accumulation	1	2	3	NA	Notes:
4 Overflow						
4a	Blockage	1	2	3	NA	Notes:
4b	Erosion	1	2	3	NA	Notes:

Other:

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Maintained by _____
 (name/company)

Purpose of visit
 Maintenance
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>	
Surrounds and other infrastructure				
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	Y	N NA Notes:
1 Inlet				
1a	Blockage	Response: Inspect via manhole, pit or inlet. Remove litter, debris and sediment by hand, shovel or machinery. Information: Ensure that water can enter the system freely. Forks and tongs may be used for litter pick ups. Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y	N NA Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y	N NA Notes:
2 Storage area				
2a	Storage volume	Response: Remove any litter, debris and sediment by hand, shovel or machinery. Information: Ensure that the detention volume is maintained as per design. May require personnel with confined space clearance to carry out maintenance tasks. If detention volume is occupied by something else, reconstruct and replace the volume lost. Notify council of proposal.	Y	N NA Notes:
2b	Sediment accumulation	Response: If accumulated sediment is present on the surface, remove using a flat shovel and dispose. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y	N NA Notes:
2c	Standing water or boggy conditions	Response: System should be desilted and screens cleaned. Information: Water should drain away within hours after rain events.	Y	N NA Notes:
3 Outlet (discharge control pit)				
3a	Blockage	Response: Inspect via manhole, pit or inlet. Remove litter, debris and sediment by hand, or shovel. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.	Y	N NA Notes:
3b	Screen	Response: Use a broom, hose or high pressure hose to clean screen of debris. Replace screen if required. Information: Remove grate and screen and examine for rust or corrosion, especially at corners or welds.	Y	N NA Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
3c	Sediment accumulation	<p>Response: If accumulated sediment is present on the surface, remove using a flat shovel and dispose.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	Y	N	NA	Notes:
4 Overflow						
4a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	Y	N	NA	Notes:
4b	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	Y	N	NA	Notes:

Other:

Sheet 2 of 2



PART B

7. Gross pollutant traps (GPTs)



Gross pollutant traps (GPTs) capture litter, sediment and debris that is washed into the stormwater system. Most GPTs are proprietary products that vary in exact form and function, but are comprised of similar components.

7.1. Functional components

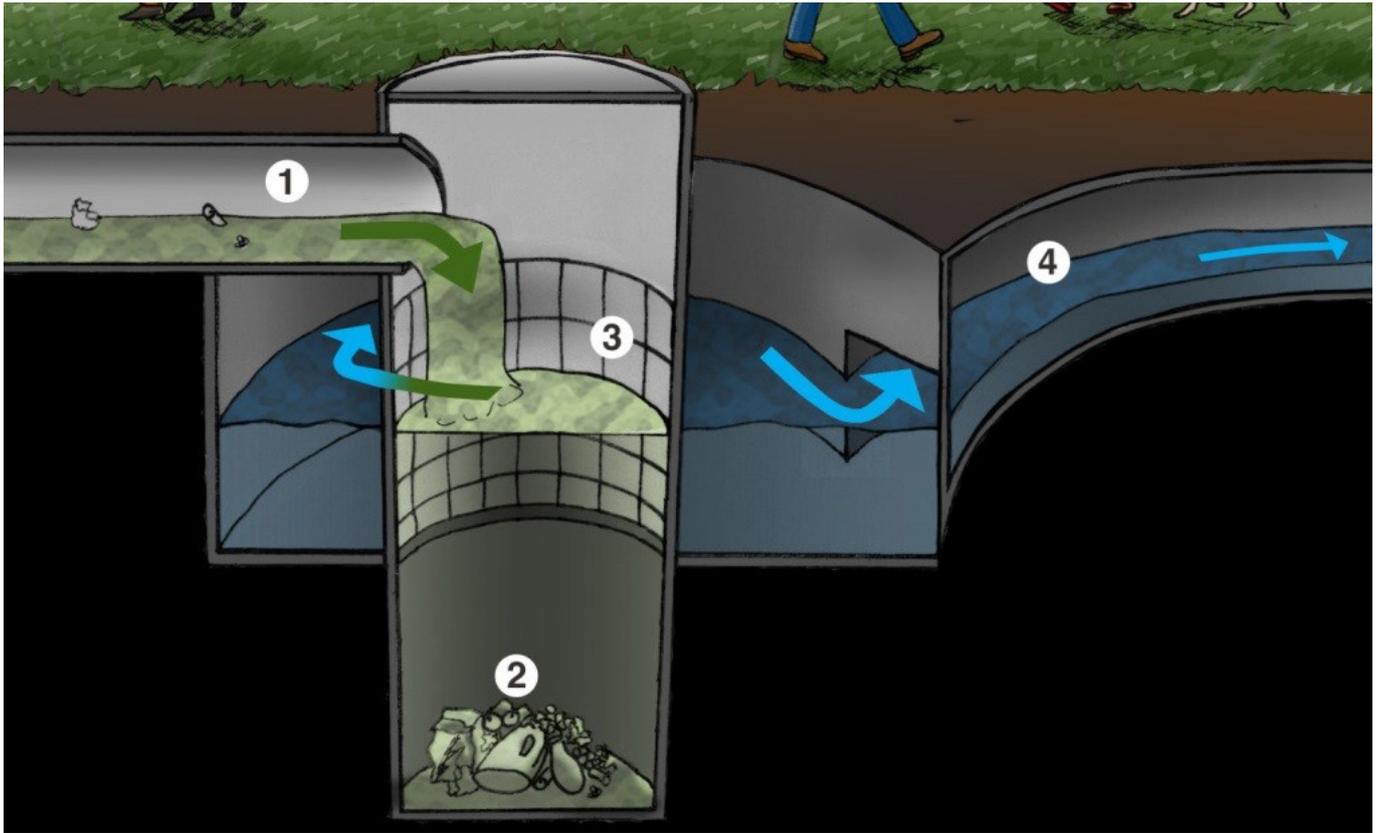


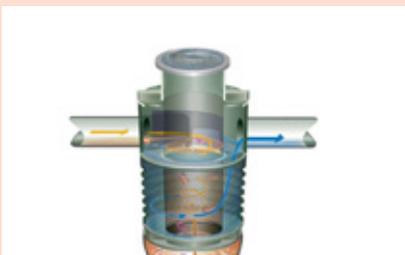
Figure 8: The functional components of a typical underground GPT.

GPTs include a wide range of different designs with different components. They can be proprietary devices or they may be designed and constructed to suit the site. In general, most private properties have smaller, underground GPTs with wet sumps. Many proprietary GPT products are available on the market. We have approved (or provided interim approval) for 6 GPTs (see Figure 9) to be used within Penrith.

Key components of most GPTs are:

1. Inlet. This is usually an underground pipe that diverts water into the GPT. The inlet can generally be viewed when the inspection cover is removed.
2. GPT sump. The GPT sump is where litter and debris captured by the screens is stored. During cleaning, the captured gross pollutants are removed from the GPT sump by an eductor or vacuum truck. Alternatively, a grab truck can be used for partial cleans.
3. Screens. GPTs generally use screens to separate out litter, sediment and debris from stormwater.
4. Outlet. The outlet is where GPTs discharge the screened water back into the stormwater drainage system.

Figure 9: Proprietary GPT products.



CDS®
Rocla

The target pollutants are primarily gross pollutants, oils and sediments found in stormwater.

The two methods of emptying CDS units are material grab and suction method. Both of these methods avoid entry into the unit.

Copyright © Rocla Pty Ltd.

Figure 9: Proprietary GPT products (continued).



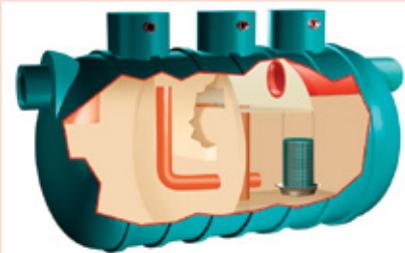
HumeGard®

Humes

The target pollutants are gross pollutants and coarse sediments from stormwater runoff.

Maintenance is performed by vacuum or grab truck.

Copyright © Holcim.



Stormceptor

SPEL Stormwater

This is an oil and grit separator that can capture hazardous material, spills, suspended sediments, free oils, floatable pollutants, and pollutants that attach to particles.

The top of the unit has a number of surface level manholes that allow inspection to determine sludge and oil levels.

Maintenance is performed by vacuum truck through these manholes, avoiding entry into the unit.

Copyright © SPEL Stormwater.



HumeCeptor®

Humes

This is designed to remove hydrocarbons and suspended solids from stormwater runoff. This unit can also be built specifically to capture emergency spills.

Maintenance is conducted with a vacuum truck, which avoids entry into the unit.

Copyright © Holcim.

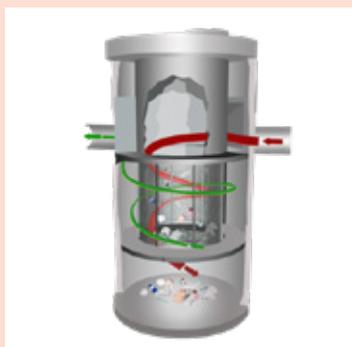


Vortceptor

SPEL Vortceptor

The SPEL Vortceptor separates and captures gross pollutants, sediment, silt, tss, some nutrients, oil & grease. Stormwater enters this chamber by being directed by a weir into a chute and then is circulated into the screening area. Maintenance can be conducted by either Vacuum Suction Cleaning or via Grab Cleaner.

Copyright © SPEL Vortceptor



OceanSave

Ocean protect

OceanSave is a vortex type GPT that removes litter, gross pollutants, sediment, and associated pollutants greater than 5mm. It removes some suspended solids and free-floating oil and grease via the inter baffle.

Maintenance can be conducted via Vacuum Suction Cleaning.

Copyright © Ocean protect

7.2. Expertise required

The required expertise depends on the type of GPT installed. Proprietary GPTs require specialised equipment such as cranes, tip trucks, clamshell grab excavators and eductor or vacuum trucks. There are many contractors who are experienced in maintaining GPTs and licensed to transport GPT waste.

The site may require access for specialised maintenance and monitoring vehicles, and specialised equipment for opening manholes and lids.

Confined spaces certification and equipment may be required for access to conduct some maintenance and monitoring tasks.



Functional component condition score:

Good (1) →
Moderate (2) →
Poor (3) →

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
Surrounds and other infrastructure						
	Damage or removal of structures	6	6	Stable structures. No damage to structure or surrounding infrastructure. No safety risks.	Minor damage. Does not pose risk to structural integrity or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	Inlet					
1a	Blockage	3	6	No accumulated solids or minimal solids with no obvious impacts.	Partial blockage of inlet causing some obstruction of flows or requiring removal.	Blockage of inlet preventing or significantly obstructing flows.
2	GPT sump					
2a	Debris, sediment and oil accumulation	7	6	None, or minimal accumulated solids/oil (<10% capacity).	Some accumulated solids/oil (>50% capacity).	Accumulated sediment/oil is reaching capacity (>75% capacity).
3	Screens					
3a	Damage	5	6	No holes or damage to the screen.	Some small holes/light damage. Can still function to filter most gross pollutants.	Large holes/heavy damage to the screen. Gross pollutants can pass through. Screen not securely attached to wall.
3b	Blockage	3	6	No accumulated solids or minimal solids with no obvious impacts.	Partial blockage of screen causing some obstruction of flows or requiring removal.	Blockage of screen preventing or significantly obstructing flows.
4	Outlet					
4a	Blockage	3	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	
1	Inlet					
1a	Blockage	1	2	3	NA	
2	GPT sump					
2a	Debris, sediment and oil accumulation	1	2	3	NA	
3	Screens					
3a	Damage	1	2	3	NA	
3b	Blockage	1	2	3	NA	
4	Outlet					
4a	Blockage	1	2	3	NA	

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
Surrounds and other infrastructure						
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1 Inlet						
1a	Blockage	Response: For proprietary GPTs, refer to suppliers' maintenance manual. Information: Unblock inflow pipes. Remove sediment from inflow areas.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 GPT sump						
2a	Debris, sediment and oil accumulation	Response: For proprietary GPTs, refer to suppliers' maintenance manual. Information: GPTs often require suction equipment to clean. Wet sump GPTs will need to be dewatered before maintenance can take place. If oil present, the GPT cannot be dewatered on-site.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
3 Screens						
3a	Damage	Response: For proprietary GPTs, refer to suppliers' maintenance manual. Information: Standing water in a wet sump system may have to be drawn down for screen maintenance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
3b	Blockage	Response: For proprietary GPTs, refer to suppliers' maintenance manual. Information: Standing water in a wet sump system may have to be drawn down for screen maintenance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
4 Outlet						
4a	Blockage	Response: For proprietary GPTs, refer to suppliers' maintenance manual. Information: Unblock outlet pipes. Remove sediment from outflow areas.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Pollutants removed (circle correct units)

- Gross pollutants _____ (m³) or (kg)
- Sediment _____ (m³) or (kg)
- Vegetation _____ (m³) or (kg)
- Oil/grease _____ (m³) or (kg)

Other:



SPELFilter cartridges.

PART B

8. Filter cartridges



Filter cartridges include sand filters and proprietary products that operate in a similar way to GPTs, but are designed to filter finer pollutants, such as fine solids, soluble heavy metals, oils and nutrients.

Filter cartridges may require a GPT upstream, or may include pre-treatment within the unit to prevent clogging from larger solids and litter. They typically need to be located offline with a high flow bypass, as they are designed to treat a limited flow rate.

8.1. Functional components

Many proprietary filter cartridges are available on the market. We have approved (or provided interim approval) for the following proprietary products (see Figure 10):

- StormFilter™
- Jellyfish®
- SPELFilter.

Regardless of the specific design, the key components common to most proprietary filters are:

1. diversion weir into inlet
2. inlet (pit or pipe)
3. pollutant storage area (pollutants may be stored wet or dry)
4. filter cartridges
5. outlet.

Figure 10: Proprietary filter cartridge products.

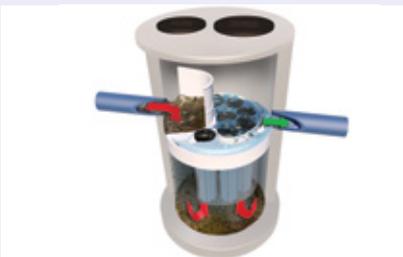


StormFilter™

Ocean Protect (formally known as Stormwater360)

The filter media within the cartridges captures fine solids, soluble heavy metals, oil, and total nutrients.

Copyright © Ocean Protect.

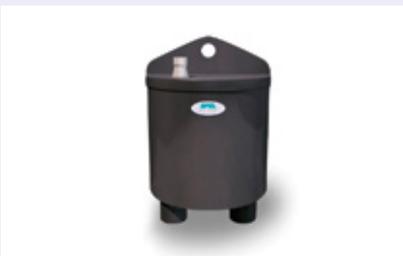


Jellyfish®

Ocean Protect (formally known as Stormwater360)

Uses gravity, flow rotation, and up-flow membrane to provide tertiary treatment to stormwater in an underground structure. It targets total suspended solids, total nitrogen, total phosphorus, total copper, and total zinc.

Copyright © Ocean Protect.

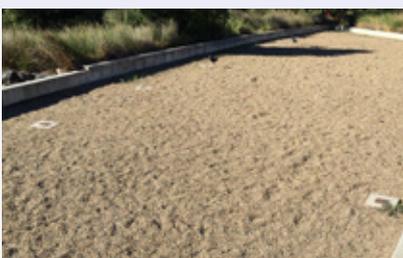


SPELFilter

SPEL Stormwater

The filter media within the cartridges captures fine solids, soluble heavy metals, oil, total nutrients and gross pollutants.

Copyright © SPEL Stormwater.



Sand filter (not a proprietary device)

A sand filter is similar to a biofilter system, with stormwater percolating through a filter media and being intercepted by perforated pipes in the bottom that are connected to the stormwater drainage network. It does not have a vegetated surface so is often installed underground. A sand filter requires regular maintenance as it can clog from the removal of gross pollutants and sediment.

8.2. Expertise required

Material removed from filter cartridges will need to be transported and disposed of at an appropriate waste facility which is licensed to accept such waste. There are many contractors experienced in maintaining filters and licensed to transport waste.

Some devices can only be maintained by their manufacturer as the filter media must be replaced with the same product.

The site may require access for specialised maintenance and monitoring vehicles, and specialised equipment for opening manholes and lids.

Confined spaces certification and equipment is required for access to conduct some maintenance and monitoring tasks.



Functional component condition score:

Good (1) →
Moderate (2) →
Poor (3) →

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
1	Inlet					
1a	Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
2	Filter					
2a	Litter and debris	17	6	Filter bed is clear of litter and debris.	Filter bed has some litter and debris present.	Filter bed has significant litter and debris present.
2b	Debris, sediment and oil accumulation	7	6	Filter is clear of oil and sediment (<10% capacity). No impact on flow through the filter media.	Filter has minor sediment or oil accumulation (10-50% capacity). Minor impact to flow through the filter media.	Filter has major sediment or oil accumulation (>50% capacity). Blocking the flow through the filter media.
2c	Erosion	9	6 (and after major rain events)	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3	Outlet					
3a	Blockage	3	6	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

Sheet 1 of 1

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
2 Filter						
2a	Litter and debris	1	2	3	NA	Notes:
2b	Debris, sediment and oil accumulation	1	2	3	NA	Notes:
2c	Erosion	1	2	3	NA	Notes:
3 Outlet						
3a	Blockage	1	2	3	NA	Notes:

Other:

MAINTENANCE SHEET – Filter cartridge

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
1 Inlet						
1a	Blockage	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Unblock inflow pipes. Remove sediment from inflow areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Notes:
2 Filter						
2a	Litter and debris	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the downstream.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Notes:
2b	Debris, sediment and oil accumulation	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste. If oil is present, the waste cannot be reused on-site.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Notes:
2c	Erosion	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Proprietary filter cartridges should not experience erosion of the filter media. Sand filters may require some re-profiling around the inlet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Notes:
3 Outlet						
3a	Blockage	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Unblock outlet pipes. Remove sediment from outflow areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Notes:

Other:



StormFilter™ cartridges



PART B

9. Pit inserts



These devices are fitted into stormwater drainage pits to capture litter, debris and other pollutants from urban runoff. They are often used as the primary treatment of stormwater before it enters a secondary or tertiary treatment system.

9.1. Functional components

Many proprietary pit inserts are available on the market. We have approved (or provided interim approval) for the following proprietary products (see Figure 11):

- Ocean Guard
- StormSack.

Regardless of the specific product, the key components common to most proprietary pit inserts are:

1. The drainage pit lid. Can be hinged or sit within a channel and are lifted using pit lifters or by hand
2. Inlet pipe. There may be more than one inlet into the pit
3. Screen or screening bag. Stops coarse materials (dependent on screen size) reaching the outlet
4. The outlet. Pits drain into the Council stormwater drainage system.

Figure 11: Proprietary pit insert products.



Ocean Guard (formally known as EnviroPod®) Ocean Protect (formally known as Stormwater360)

Designed to remove litter, debris and other gross pollutants from urban runoff. Can have oil-absorbent media to line the screening bag.



StormSack SPEL Stormwater

Designed for the capture of sediment, litter, oil and grease, and other gross pollutants. Ideal for retrofitting to existing pits.

9.2. Expertise required

Typically, maintaining pit inserts is simple and requires little specialist skills or equipment. Emptying of rubbish and gross pollutants is a simple task and may only require equipment to lift the pit cover. If the screening bag is damaged or clogged, it must be replaced.

In situations that require confined space entry, this should be carried out by an appropriately licensed contractor. Please consult the manufacturer's website or guide for further details.

Functional component condition score:

Good (1)	→
Moderate (2)	→
Poor (3)	→

Maintenance required:

No maintenance required
Routine maintenance (simple tasks)*
Corrective maintenance (specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component		Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)
1	Pit and grate					
1a	Damage or removal of structures	6	2-3	Stable structures. No vandalism impacting amenity. No safety risks. Hinges are functional and secure for safe pit and grate lifting.	Minor damage. Does not pose risk to structural integrity or asset function. Grate is slightly damaged or rusty.	Major damage. Poses risk to structural integrity, public safety or asset function. Grate and/or hinges are damaged causing unsafe pit and grate lifting.
2	Inlet					
2a	Blockage	3	2-3	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
3	Screening bag					
3a	Litter and debris	17	2-3	Screening bag is empty.	Screening bag is <50% full.	Screening bag is 100% full and overflowing with litter.
3b	Debris, sediment and oil accumulation	7	2-3	Screening bag is clear of sediment and oil. No impact on flow through the screening bag.	Screening bag has minor sediment or oil accumulation at the bottom of the bag. Minor impact to flow through the screening bag.	Screening bag has major sediment or oil accumulation on the bottom and sides of the bag. Blocking the flow through the screening bag.
3c	Damage	5	2-3	Screening bag has no holes or other damage.	Screening bag showing signs of wear and tear.	Screening bag has a hole or other damage.
4	Outlet					
4a	Blockage	3	2-3	No blockage.	Partial blockage of outlet causing some obstruction of outflows or requiring removal.	Blockage of outlet preventing or significantly obstructing outflows.

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
1 Pit and grate						
1a	Damage or removal of structures	1	2	3	NA	Notes:
2 Inlet						
2a	Blockage	1	2	3	NA	Notes:
3 Screening bag						
3a	Litter and debris	1	2	3	NA	Notes:
3b	Debris, sediment and oil accumulation	1	2	3	NA	Notes:
3c	Damage	1	2	3	NA	Notes:
4 Outlet						
4a	Blockage	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
1 Pit and grate						
1a	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:
2 Inlet						
2a	Blockage	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Unblock inflow pipes. Remove sediment from inflow areas.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:
3 Screening bags						
3a	Litter and debris	Response: Empty screening bag and replace if clear of sediment, oil and damage. For proprietary products, refer to suppliers maintenance manual. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). If oil present, the waste cannot be reused on-site. A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:
3b	Debris, sediment and oil accumulation	Response: Replace screening bag. For proprietary products, refer to suppliers maintenance manual. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). If oil present, the waste cannot be reused on-site. A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:
3c	Damage	Response: Replace screening bag. For proprietary products, refer to suppliers maintenance manual. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). If oil present, the waste cannot be reused on-site. A pit is considered a confined space, requiring safety equipment and training.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:
4 Outlet						
4a	Blockage	Response: For proprietary products, refer to suppliers' maintenance manual. Information: Unblock outlet pipes. Remove sediment from outflow areas.	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> NA	Notes:

Pollutants removed (circle correct units)

- Gross pollutants _____ (m³) or (kg)
- Sediment _____ (m³) or (kg)
- Vegetation _____ (m³) or (kg)
- Oil/grease _____ (m³) or (kg)

Other:





PART B

10. Permeable paving



Permeable paving allows water to infiltrate through the paving, reducing the volume of runoff from hard surfaces such as roads, car parks and footpaths. This reduces local flooding and surface ponding, and promotes infiltration.

10.1. Functional components

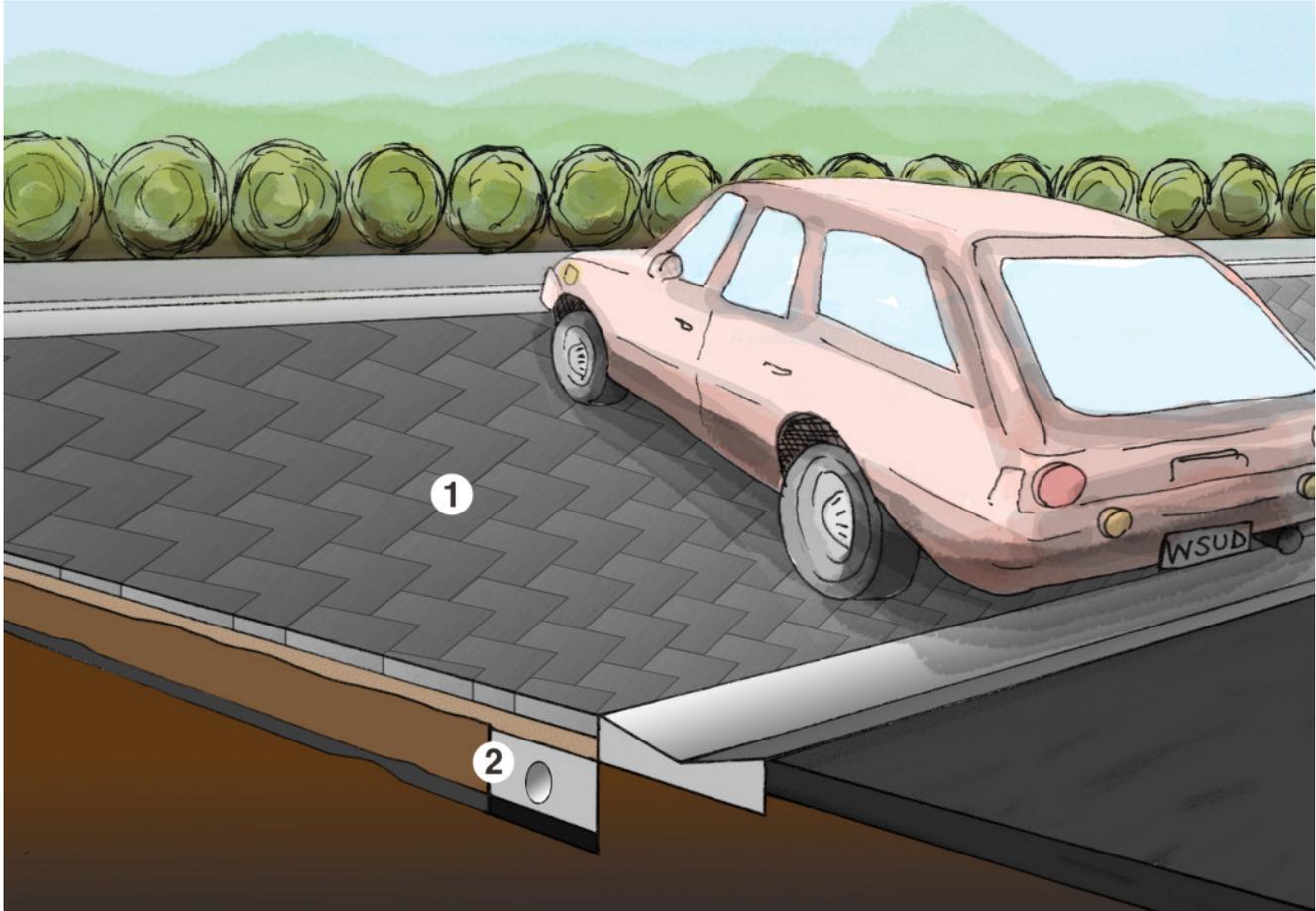


Figure 12: The functional components of permeable paving.

1. Pavement surface. A permeable pavement surface comes in 2 main forms:
 - The surface itself is permeable (and may be constructed in paving blocks or as a continuous surface of porous asphalt, concrete, pebble or rubber mix).
 - There are permeable gaps in the surface (typically gravel or sand filled voids) in a matrix of impermeable modular paving blocks.

For both configurations, it is essential the permeable pavement is even and level, and the pavement is kept clear of leaf litter and sediment.

2. Outlet. While permeable paving preferably drains directly into underlying soils, in situations of low infiltration, clay soils, permeable paving will have an underdrainage system with a liner. This typically comprises of a gravel layer and series of slotted pipes to direct subsurface flows to the stormwater system.

Other features include:

- base course on which pavers are normally laid. This is a coarse sand, gravel or aggregate base, like a normal pavement surface
- inspection pipes, which allow for the monitoring and maintenance of underdrainage pipes
- extended detention depth, which extends up to 50 mm above the surface of the system. It detains water temporarily during a rainfall event, allowing a greater volume of water to be captured and slowly filtered through the filter media.

10.2. Expertise required

Permeable paving can be visually inspected by a property owner or owners' corporation. If potential permeability and clogging issues are observed and not rectified with basic maintenance (using a broom and hose) or potential structural issues are identified, then a more detailed inspection and infiltration testing by a specialist contractor should be obtained.

Functional component condition score:

Good (1)



Moderate (2)



Poor (3)



Maintenance required:

No maintenance required

Routine maintenance (simple tasks)*

Corrective maintenance
(specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
1 Pavement surface						
1a	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. minor loose pavers, no significant tripping hazards in pedestrian trafficked areas).	Major erosion. Posing risk to structural integrity, public safety and/or asset function (e.g. loose pavers, tripping hazard).
1b	Permeability and clogging	20	12	In dry conditions, water poured on surface infiltrates almost immediately. Minimal fine sediment accumulation or visible surface crust. In wet conditions, surface ponding (100-150 mm) is drawn down within 2-3 minutes after inflow has ceased.	In dry conditions, water poured on surface infiltrates surface slowly but ponding clears within minutes. Some fine sediment accumulation or surface crust evident. In wet conditions, surface ponding (100-150 mm) takes 3-10 minutes to drawdown.	In dry conditions, water poured on surface ponds with minimal infiltration. Significant fine sediment accumulation or extensive surface crust. In wet conditions, surface ponding (100-150 mm) remains on the surface for >10 minutes after inflow has ceased. Presence of algae or moss may indicate persistent wetting (e.g. baseflows) or clogging requiring further investigation.
1c	Sediment accumulation	27	6	No accumulated sediment or minimal sediment with no obvious impacts.	Some accumulated sediment (covering <50% of surface). Causing some redirection of flows over the system or reduced infiltration.	Accumulated sediment (covering >50% of the surface) and impeding infiltration.
1d	Vehicle or pedestrian damage	33	6	No broken pavers or damage which impacts the system's function.	Minor damage to pavers. Does not pose risk to structural integrity or asset function.	Significant paver damage. Poses risk to structural integrity, public safety and/or asset function.
1e	Surface levels	31	6	Even surface with no depressions or mounds.	Some small depressions or mounds present. Limited impact on flows through the asset.	Level of surface is impacting flows through the asset (e.g. short circuiting flows, blocking flows and/or reduced extended detention depth). Isolated pools created on the surface.
1f	Weeds	36	6	Limited weed cover (<10%) and no declared invasive weed species.	Low/moderate weed cover (10-50%) and no declared invasive weed species.	High weed cover (>50%) and/or declared invasive weed species present.
2 Outlet and inspection pipes						
2a	Blockage	3	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet and/or overflow preventing or significantly obstructing outflows.
2b	Inspection pipes	15	12	No water is present in the inspection pipe.	Some water is present in the bottom of the inspection pipe.	Water is close to the pavement surface.

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
1 Pavement surface						
1a	Erosion	1	2	3	NA	Notes:
1b	Permeability and clogging	1	2	3	NA	Notes:
1c	Sediment accumulation	1	2	3	NA	Notes:
1d	Vehicle or pedestrian damage	1	2	3	NA	Notes:
1e	Surface levels	1	2	3	NA	Notes:
1f	Weeds	1	2	3	NA	Notes:
2 Outlet and inspection pipes						
2a	Blockage	1	2	3	NA	Notes:
2b	Inspection pipes	1	2	3	NA	Notes:

Other:

Date	_____	Purpose of visit		Rainfall conditions	
Location	_____	<input type="checkbox"/> Maintenance		<input type="checkbox"/> Rainfall today (___ mm)	
Asset name	_____	<input type="checkbox"/> Response to complaint		<input type="checkbox"/> Rainfall in last 3 days (___ mm)	
Asset ID	_____	<input type="checkbox"/> Other (specify)	_____	<input type="checkbox"/> No recent rainfall	
Maintained by (name/company)	_____				

Functional component	Maintenance response and information		Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>			
1 Pavement surface						
1a	Erosion	<p>Response: Where required, top up material in joints and voids with correct fill material.</p> <p>Information: Refer to Works as Executed plans for specifications for fill material.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1b	Permeability and clogging	<p>Response: Cleaning with a vacuum sweeper (e.g. a street sweeper). Washing with a high pressure hose.</p> <p>Information: Vacuum cleaning should preferably be used. Cleaning with a high pressure hose may be adopted if sweeping and vacuuming are ineffective. Cleaning with a high pressure hose is best suited for fully permeable surfaces, as it is likely to wash gravel or sand out of the permeable spaces between block pavers. Gravel and sand materials may need to be topped up after cleaning.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1c	Sediment accumulation	<p>Response: For coarse sediment accumulation, sweep with a stiff broom and wash with high pressure hose. A vacuum sweeper may be required to remove fine particles from the pavement.</p> <p>Information: Void and joint material may need to be topped up after cleaning.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1d	Vehicle or pedestrian damage	<p>Response: Replace broken pavers, if required.</p> <p>Information: Void and joint material may need to be topped up after pavement repair.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1e	Surface levels	<p>Response: Remove uneven pavers and reprofile. Fill underlying material where required. Replace any broken pavers.</p> <p>Information: Ensure that any pavers or fill material is the same as specified on the Works as Executed plans.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
1f	Weeds	<p>Response: Remove weeds.</p> <p>Information: Weeds should be removed by hand. The use of herbicides is not recommended because of the system's direct connection with the stormwater system. Categories of weeds can be found on the NSW WeedWise website at: weeds.dpi.nsw.gov.au/Weeds/Categories</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2 Outlet and inspection pipes						
2a	Blockage	<p>Response: Unblock outlet pipes/pits. Ensure the permeable pavement underdrainage pipes can drain freely.</p> <p>Information: There will usually be a nearby downstream pit where the underdrainage pipes drain into.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:
2b	Inspection pipes	<p>Response: Flush underdrainage pipes with a high pressure hose.</p> <p>Information: In addition to cleaning the pavement itself, most permeable pavements include underdrainage systems which need to be flushed annually to remove blockage and debris which accumulates in this part of the system.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Notes:

Other: _____



Permeable pavement made up of modular paving blocks and permeable gravel gaps.



Temporary sediment basin.

PART B

11. Temporary sediment basins



Temporary sediment basins are installed during the construction stage of a development to help manage stormwater impacts during construction. These open water bodies treat stormwater by allowing coarse particles and suspended sediments to settle.

11.1. Functional components

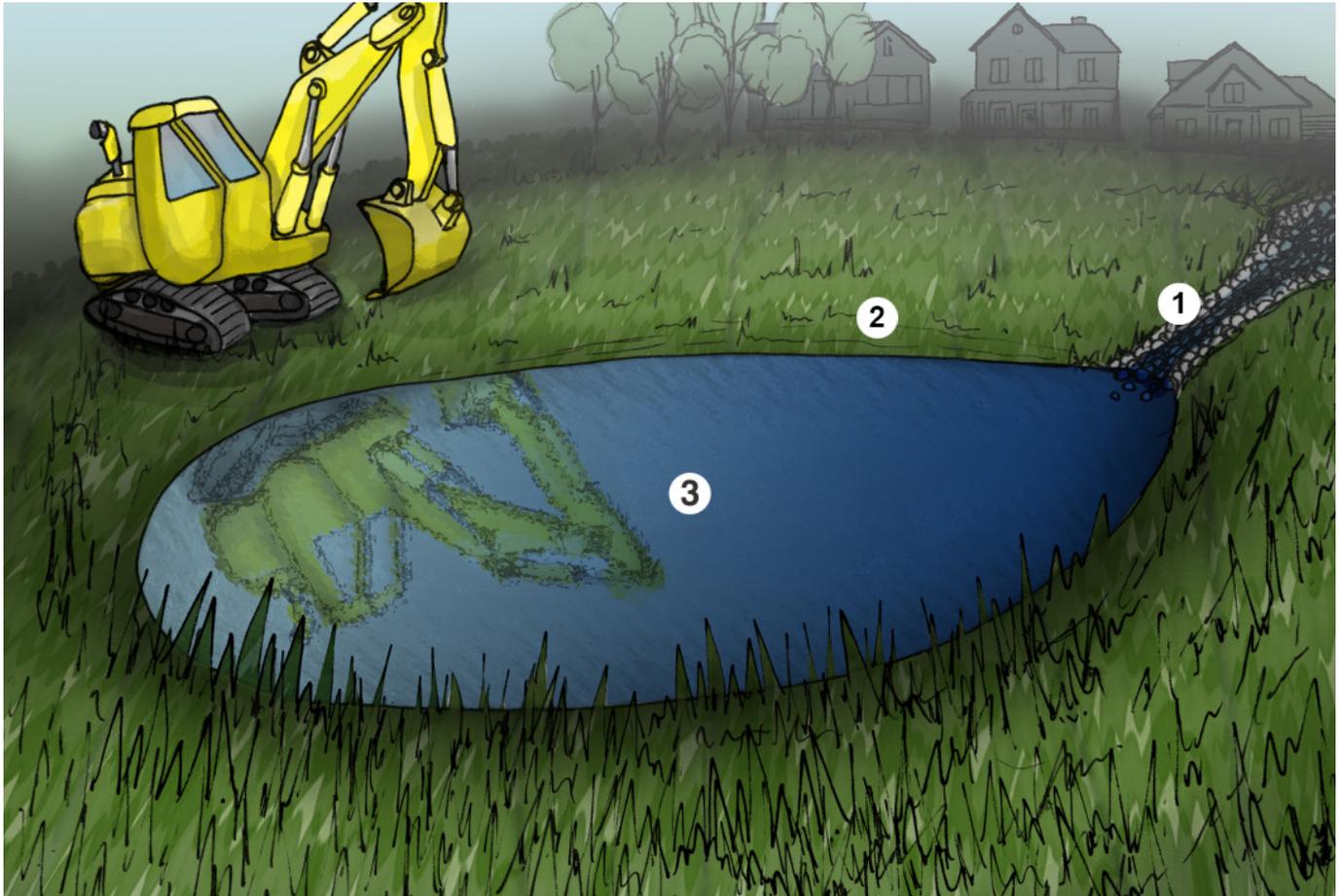


Figure 13: The functional components of a temporary sediment basin.

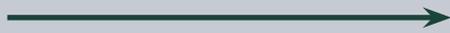
1. The inlet, which is usually a channel to direct stormwater flows into the basin.
2. Batters, which connect the temporary sediment basin water surface with the surroundings at a gentle slope. Batters on a temporary sediment basin may be vegetated, if desired.
3. Sedimentation zone, where water ponds allowing coarse sediments to settle out.
4. Outlet and overflow (not shown), which allow water to flow back into the stormwater drainage network. Some basins may include a riser outlet so that water drains away after sediments have settled and the basin is dry between rain events.
However, where soils are fine and dispersive, dry basins are generally not appropriate and most temporary sediment basins retain permanent water. Basins should include an overflow spillway to allow high flows to exit the basin.

11.2. Expertise required

Temporary sediment basins are normally maintained by civil construction contractors who have the necessary equipment and expertise to manage these systems.

Functional component condition score:

Good (1)



Moderate (2)



Poor (3)



Maintenance required:

No maintenance required

Routine maintenance (simple tasks)*

Corrective maintenance
(specialist skills required)*

*Refer to maintenance response and information in the following maintenance sheets.

Functional component	Part C number	Required frequency (months)	Good (condition score - 1)	Moderate (condition score - 2)	Poor (condition score - 3)	
Surrounds and other infrastructure						
	Damage or removal of structures	6	6	Stable structures (e.g. fences, steps, drainage pits). No vandalism impacting amenity. No public safety risks.	Minor damage. Does not pose risk to structural integrity, public safety or asset function.	Major damage. Poses risk to structural integrity, public safety or asset function.
1	Inlet					
1a	Blockage	3	6	No blockage.	Partial blockage of inlet causing some bypass of flows or restricted inflows.	Blockage of inlet causing significant bypass or restriction of inflows.
1b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
2	Batters					
2a	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).
3	Sedimentation zone					
3a	Floating plants	13	6	No or minimal nuisance floating plants present (<10%).	Low/moderate cover (10–50%). Mechanical removal of nuisance floating plants is effective in managing blooms.	Nuisance floating plant blooms with high cover (>50%) or are problematic. Impacting on temporary sediment basin performance.
3b	Mosquitoes	18	6	No isolated depressions which can become breeding sites when water levels recede. Deep pools provide refuge for predators. No dead or rafting vegetation.	Potential mosquito habitats observed (e.g. isolated pools, rafting vegetation).	Nuisance populations of mosquitoes observed and/or reported by local community. Numerous potential mosquito habitats observed (e.g. isolated pools, rafting vegetation).
3c	Sediment accumulation	27	6	Acceptable levels of accumulated sediment. Sediment does not impede flows or vegetation growth.	Sediment accumulation is on average 400–600 mm below normal water level or within 100 mm of the design maximum sediment level if specified.	Accumulated sediment is <400 mm below normal water level on average or >100 mm above the design maximum sediment level if specified.
3d	Water quality (oil slicks, odour, algae)	35	6	No water quality issues (e.g. oil slicks, odours, algae).	Some minor water quality issues visible but no major impact on aesthetics or water quality.	Significant water quality issues. Heavily impacting aesthetics and/or water quality.
4	Outlet and overflow					
4a	Blockage	3	6	No blockage.	Partial blockage of outlet or overflow causing some obstruction of outflows or requiring removal.	Blockage of outlet or overflow preventing or significantly obstructing outflows.
4b	Erosion	9	6	No erosion.	Minor erosion. Does not pose risk to structural integrity, public safety or asset function (e.g. limited short circuiting of flows).	Major erosion. Posing risk to structural integrity, public safety or asset function (e.g. short circuiting of the majority of flows).

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Inspected by _____
 (name/company)

Purpose of visit
 Inspection
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Condition score and evidence				Notes:
		Circle the score 1, 2, 3 or NA (not applicable) for each functional component based on good (1), moderate (2), or poor (3) conditions as noted in the reference sheet. Write why the score was given in the 'Notes' section.				
Surrounds and other infrastructure						
	Damage or removal of structures	1	2	3	NA	Notes:
1 Inlet						
1a	Blockage	1	2	3	NA	Notes:
1b	Erosion	1	2	3	NA	Notes:
2 Batters						
2a	Erosion	1	2	3	NA	Notes:
3 Sedimentation zone						
3a	Floating plants	1	2	3	NA	Notes:
3b	Mosquitoes	1	2	3	NA	Notes:
3c	Sediment accumulation	1	2	3	NA	Notes:
3d	Water quality (oil slicks, odour, algae)	1	2	3	NA	Notes:
4 Outlet and overflow						
4a	Blockage	1	2	3	NA	Notes:
4b	Erosion	1	2	3	NA	Notes:

Other:

Date _____
 Location _____
 Asset name _____
 Asset ID _____
 Maintained by _____
 (name/company)

Purpose of visit
 Maintenance
 Response to complaint
 Other (specify) _____

Rainfall conditions
 Rainfall today (___ mm)
 Rainfall in last 3 days (___ mm)
 No recent rainfall

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>	
Surrounds and other infrastructure				
	Damage or removal of structures	Response: Rectification works for structural issues to be undertaken immediately. Information: Refer to Works as Executed plans for specifications for structural repairs.	Y	N NA Notes:
1 Inlet				
1a	Blockage	Response: Unblock inlet pipes. Remove sediment from inflow areas. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training. If the inlet is cleaned regularly, it can reduce the amount of litter, debris and sediment accumulating on the filter surface.	Y	N NA Notes:
1b	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y	N NA Notes:
2 Batters				
2a	Erosion	Response: Re-profiling using hand tools or light machinery. Replant if required. Information: Typically required after heavy rainfall.	Y	N NA Notes:
3 Sedimentation zone				
3a	Floating plants	Response: Mechanical removal is best suited to large WSUD assets or large amounts of floating plants. In most cases, floating plants can be removed by hand using rakes and/or floating booms. Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).	Y	N NA Notes:
3b	Mosquitoes	Response: Remove any potential mosquito habitats. Fill in isolated depressions which could fill with water after rain. Removal of dead or rafting edge vegetation around deep water zones which can create isolated pockets of water protected from predators. Maintain water in deep pools to provide ongoing refuge for mosquito predators such as small native freshwater fish and macroinvertebrates. Information: If there is an ongoing issue and nuisance population of mosquitoes in the WSUD asset, a site specific investigation should be undertaken to understand the cause and identify suitable actions.	Y	N NA Notes:
3c	Sediment accumulation	Response: Clean out and dispose of accumulated sediment. Information: Sediment must be dried on site and transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site).	Y	N NA Notes:

Functional component		Maintenance response and information	Maintenance completed <i>Circle Y (yes), N (no) or NA (not applicable) and write what maintenance was done in the 'Notes' section.</i>
3d	Water quality (oil slicks, odour, algae)	<p>Response: Minor slicks can be left alone if not impacting vegetation or asset function. The impact of moderate or major oil slicks should be minimised immediately with barriers such as floating booms. The outlet of the asset should be closed to prevent the risk of the oil spill entering downstream environments. For major spills, it will be necessary to remove the bulk of the spill with an eductor truck.</p> <p>If blue-green algae is present, or if there are other public health and safety concerns, signage should be placed around the temporary sediment basin and public access restricted through temporary fencing. Specialist advice should be sought before actions are undertaken. Excessive filamentous algal biomass can impact asset function by blocking inlets and outlets. If the algae are impacting the function of the sediment basin, it can be removed by hand using rakes or with specialist machinery.</p> <p>Information: Blue-green algae presents a human health risk and must be eliminated or managed to protect the safety of the public as a priority. Filamentous algae can form visible chains which can appear as algal mats in both open and shallow water areas.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
4 Outlet and overflow			
4a	Blockage	<p>Response: Unblock outlet pipes. Remove sediment from outflow areas.</p> <p>Information: Waste must be transported to a waste facility that is appropriately licensed to accept such waste (if there is no opportunity for reuse on-site). A pit is considered a confined space, requiring safety equipment and training.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:
4b	Erosion	<p>Response: Re-profiling using hand tools or light machinery. Replant if required.</p> <p>Information: Typically required after heavy rainfall.</p>	<input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Notes:

Other:



PART C

Functional component condition reference



Part C provides a visual and descriptive summary of how each functional component looks when in a good, moderate, or poor condition. The images in this catalogue will help you correctly identify and condition score your WSUD asset's functional components.

1. Backflow prevention device

Applicable assets:
Rainwater tank

A backflow prevention device is used on water supply systems that have a potable backup. They ensure that water stored in a rainwater tank cannot flow back into the water supply pipe. Backflow prevention devices are important to ensure that the greater water supply network is not contaminated. These devices should only be maintained by a licensed plumber.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

2. Base stability

Applicable assets:
Rainwater tank

Rainwater tanks require a strong and stable base to support the tank when it is full. The base must be flat and compacted and can be constructed out of a variety of materials. If a base is not structurally adequate or completely flat, there is a chance that the tank will be unstable and potentially dangerous.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

3. Blockage

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, GPT, filter cartridge, pit insert, permeable paving, temporary sediment basin

Blockages generally consist of sediment accumulation, leaf litter and rubbish. It is important to remove any blockage impeding flow through an asset as it may prevent water entering, resulting in partial or complete bypass. In vegetated assets, blockages can prevent water reaching plants, resulting in plant loss, rapid asset failure and loss of environmental benefits. Blockages may also result in localised nuisance flooding.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

4. Body integrity

Applicable assets:
Rainwater tank

The integrity of a tank can reduce over time as tank materials age. This can manifest as holes or gaps in the tank body. Seals around taps and other connections should be checked for leaks or wear.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

5. Damage

Applicable assets:
GPT, pit insert

Damage can occur to a GPT or pit insert during cleaning or from a lack of cleaning. Damage normally occurs to the screen or screening bag, but can also occur to other components of the asset, such as the frame or oil absorbers.

In most cases, damage requires consultation with the proprietary supplier for repair or replacement.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

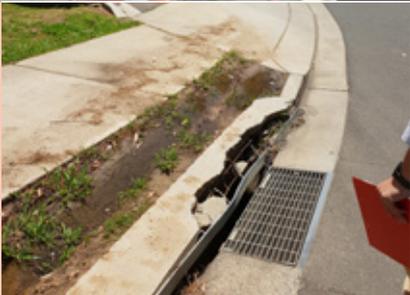
6. Damage or removal of structures

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, GPT, pit insert, temporary sediment basin

It is important to ensure structures within and adjacent to WSUD assets (e.g. bollards, seating, pathways, pits and pit lids, kerbs, downpipes) are in good working condition and do not pose a risk to the public. Structures can be impacted by age, impact from vehicles, vandalism, storm events and debris damage.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

7. Debris, sediment and oil accumulation

Applicable assets:

GPT, filter cartridge, pit insert

During storms, stormwater runoff can carry a large amount of debris, sediment and oil. WSUD assets are designed to trap this pollution to protect downstream receiving waters. However, an excessive accumulation of debris, sediment and oil can prevent a WSUD device from working correctly. This usually results from a lack of asset maintenance.

Example images

Condition rating	Example image - GPT	Example image - pit insert
Good condition		
Moderate condition		
Poor condition		

8. Downpipes and screen (rainhead)

Applicable assets:
Rainwater tank

Downpipes and screens deliver water from a roof into a rainwater tank. For the tank to function correctly, the downpipes and screen must not be leaking and kept clear of leaf litter and other debris. A screen with holes or gaps can allow debris into the tank.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

9. Erosion

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, filter cartridge, permeable paving, temporary sediment basin

Erosion is typically caused by high velocity flows, poor vegetation cover, poor soil conditions or a combination of these factors. It is important to identify the cause of the erosion before undertaking maintenance works. Erosion on batters, surfaces or around inlets/outlets can create issues for public health and safety while also impacting the function of the WSUD asset (e.g. erosion can result in the short circuiting of flows through a system and reduce treatment performance). Attention should be given to areas around inlets, outlets and the gaps between permeable pavers.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

10. Extended detention depth

Applicable assets:

Biofilter, biofilter street tree pit

The extended detention depth is the difference between the asset surface level and the outlet level.

When a storm event occurs, the extended detention depth is filled and draws down as water infiltrates through the filter media or flows through the outlet pipe/weir in a controlled manner.

It is important that the extended detention depth is not compromised through over-filling of filter media, mulch or excessive sediment accumulation. This reduces the storage volume of the asset, treatment effectiveness and can also result in system bypass.

To check extended detention, it is necessary to refer to the extended detention depth defined in the design of the asset and confirm this has been retained. It is very common for extended detention depth to be compromised in biofilter systems through over-filling during construction or maintenance.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

11. Filter

Applicable assets:
Rainwater tank

Before water is reused from a rainwater tank, it is usually filtered to remove pollutants. Filters will vary between uses and some tanks, primarily used for irrigation, may not have a filter at all. Filters often comprise of a cartridge that is easily replaceable. Further maintenance may require a licensed plumber.

Example images

Condition rating	Example image
Good condition	
Poor condition	

12. First flush device

Applicable assets:
Rainwater tank

A first flush device captures the initial runoff from a roof at the beginning of a rain event. This keeps a large amount of pollutants out of the tank, as the initial runoff tends to be the most polluted. A first flush diverter can be attached to the downpipe or tank.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

13. Floating plants

Applicable assets:
Wetland, temporary sediment basin

Nuisance floating plants can be an issue in assets where they grow in deep pools. Floating plants can exist on the water surface without any contact with the submerged soil. If allowed to bloom, these floating plants can take over from desirable species in the asset.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

14. Flow meter

Applicable assets:
Rainwater tank

A flow meter measures the amount of water that passes through a pipe. These can be placed on potable backup systems to measure how much potable water is used compared to rainwater. Flow meters should always be maintained by a licensed plumber.

Example images

Condition rating	Example image
Good condition	

15. Inspection pipes

Applicable assets:

Biofilter, biofilter street tree pit, permeable paving

An inspection pipe is an upturned pipe in the filter surface from a WSUD asset with subsurface drainage. It allows the cleaning and maintenance of the underdrainage pipe. Some biofilters are designed to hold permanent water in the bottom of the drainage pipe.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

16. Leaf litter

Applicable assets:

Biofilter, biofilter street tree pit

Leaf litter can accumulate and become saturated within a WSUD asset or in the immediate catchment area. Breakdown of the leaves in saturated conditions can produce fine organic matter that can leach nutrients into the asset and downstream waterways, and can also cause clogging of the filter media surface in the long term. A heavy leaf litter load can block inlets and outlets, while impeding flows and vegetation growth in the asset.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

17. Litter and debris

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, filter cartridge, pit insert

Large storms can wash litter and debris into WSUD assets. Large amounts of litter can block inlets and outlets and detracts from the amenity of the asset.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

18. Mosquitoes

Applicable assets:

Wetland, temporary sediment basin

Mosquitoes can be an issue in systems that contain isolated depressions that can store small amounts of stagnant water. Mosquito populations can be kept at bay by providing habitat for mosquito predators. These predators generally require deep pools connected to potential mosquito breeding areas.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

19. Overflow

Applicable assets:
Rainwater tank

It is important for a rainwater tank to have a defined overflow that allows controlled overflow to enter the greater stormwater system. A rainwater tank overflow should be kept clear of blockages at all times.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

20. Permeability and clogging

Applicable assets:

Biofilter, biofilter street tree pit, permeable paving

The filter or treatment surface should always be free-draining. Algal growth, moss or ponding water can be signs that the surface is not draining fast enough and that the filter material is clogged.

For a biofilter, the infiltration rate can be measured through a hydraulic conductivity test in line with *Adoption Guidelines for Stormwater Biofiltration Systems* (2015).

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

21. Plant cover

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale

Several WSUD assets require vegetation to effectively treat stormwater. To act effectively, a WSUD asset must have adequate plant coverage in the filter or treatment surface. A dense plant coverage is also important to prevent erosion of the filter surface and batters (see Figure 14).

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

Figure 14: Some preferred native plantings. For a more comprehensive list, refer to council preferred planting list located within *Addendum 2: PCC WSUD bioretention standard Drawings*.



Common Rush (*Juncus usitatus*)



Kangaroo Grass (*Themeda australis*)



Knobby Club Rush (*Ficinia nodosa*)



Spiny Mat-rush (*Lomandra longifolia*)



Swamp Foxtail Grass (*Pennisetum alopecuroides*)



Tall Sedge (*Carex appressa*)

22. Plant health

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale

Poor plant health can impact WSUD asset performance and be caused by inappropriate species selection, excessive inundation, competition from weeds, smothering by sediment, leaf litter and lack of water due to inlet blockage or flow distribution problems. Vegetated assets will likely not perform to their full capacity without healthy vegetation.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

23. Potable mains backup device

Applicable assets:
Rainwater tank

A potable mains backup device allows a rainwater reuse system to use potable water when the rainwater tank empties. These devices can be integrated with a flow meter and backflow prevention device, and should only be maintained by a licensed plumber.

Example images

Condition rating	Example image
Good condition	

24. Pump

Applicable assets:
Rainwater tank

Rainwater tanks that supply water for indoor use require a pump to generate the required pressure. Most rainwater tanks that service household irrigation do not require a pump. Pump issues can usually be identified through a lack of pressure or unusual noise during operation.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

25. Roof and gutters

Applicable assets:
Rainwater tank

The roof that supplies a rainwater tank must be kept clear of excessive leaf litter and debris. It is also important to ensure that gutters drain to the tank and are kept clear.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

26. Screen

Applicable assets:
Rainwater tank, OSD

Screens help to filter out large particles and litter from the inflow into systems, such as rainwater tanks and OSD systems. They are generally situated at the inlet of a system and can become clogged or broken. If a screen is clogged, the water inflow into the tank/storage area is restricted. If the screen is broken, large pollutants are allowed into the system.

Example images

Condition rating	Example image - rainwater tank	Example image - OSD
Good condition		
Moderate condition		
Poor condition		

27. Sediment accumulation

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, OSD, permeable paving, temporary sediment basin

Stormwater can deposit high levels of sediment in WSUD assets. Sediment accumulation in WSUD assets can change the profile of the asset, cause bypass, redirection and short-circuiting of flows, smother vegetation and clog filter media.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

28. Sludge

Applicable assets:
Rainwater tank

Primary screens help to filter the largest pollutants entering a rainwater tank system, but do not remove the finer sediment. As this fine sediment accumulates over time a layer of sludge forms on the base of the tank.

If water from the tank is cloudy with sediments, it suggests that the tank requires a de-sludge. Most tanks include a valve at the base that allows sludge to be drained.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

29. Standing water or boggy conditions

Applicable assets:

Vegetated buffer strip and swale, OSD

Some WSUD assets are designed with a slope to freely convey stormwater along their length. They will naturally infiltrate stormwater and will be wet following rainfall. However, they may retain water and become boggy when the surface slopes are too flat, or the outlets are set too high.

OSD systems are designed to hold stormwater during rain events and discharge at a controlled rate. Issues with OSD discharge may result in standing water in the storage area.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

30. Storage volume

Applicable assets:
OSD

An OSD system requires an available storage volume to detain the runoff from a storm. Any reduction in the OSD storage volume reduces the effectiveness of the system. The reduction in volume can occur from a build-up of sediment and debris, or from items that have been placed in the OSD storage area.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

31. Surface levels

Applicable assets:

Biofilter, biofilter street tree pit, vegetated buffer strip and swale, permeable paving

An evenly graded surface allows stormwater to flow through the WSUD asset, without the creation of preferential flow paths or isolated pools. It also ensures that the whole surface is engaged in treatment; full treatment performance can only be achieved if the entire filter surface is receiving equal runoff.

Common causes of uneven surface levels are lack of levelling during construction, erosion and slippage of batters.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

32. Valves

Applicable assets:
Rainwater tank

Valves are used at several connections within a rainwater tank system where a connection between pipes are required. Valves should be checked to ensure they are intact and not leaking. Any maintenance on a valve should be undertaken by a licensed plumber.

Example images

Condition rating	Example image
Good condition	
Moderate condition	

33. Vehicle or pedestrian damage

Applicable assets:

Biofilter, biofilter street tree pit, permeable paving

WSUD assets located within driveways, carparks or streetscape with high levels of vehicular and pedestrian movement can be damaged when these enter the asset. Damage includes compaction or erosion of the surface or damage to structure and vegetation. Permeable pavement can be particularly susceptible to vehicle damage.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

34. Water levels

Applicable assets:
Wetland

Wetlands are designed so that water levels can vary between designated levels, without harming vegetation. If water levels vary beyond the designated levels, this can cause harm to the vegetation. The normal water level of a wetland system should be checked at least 72 hours after previous rainfall.

Example images

Condition rating	Example image
Good condition	 A photograph of a wetland area with a clear, blue pond. The water is calm, reflecting the sky. The surrounding area is lush with green grass and young trees. In the background, there are some buildings and a clear blue sky.
Moderate condition	 A photograph of a wetland area with a pond. The water is slightly murky and reflects the surrounding trees. The shoreline is sandy and there is some dry grass. The background shows a line of trees and a clear sky.
Poor condition	 A photograph of a wetland area with a pond. The water is very murky and brown, indicating high turbidity. There are many fallen leaves floating on the surface. The background shows some trees and a cloudy sky.

35. Water quality (oil slicks, odour, algae)

Applicable assets:

Wetland, temporary sediment basin

The water quality within a WSUD asset can vary depending on the season and time since the last storm event. The water may have pollutants from a spill, high levels of hydrocarbons or high nutrient levels resulting in algal growth.

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

36. Weeds

Applicable assets:

Biofilter, biofilter street tree pit, wetland, vegetated buffer strip and swale, permeable paving

Weeds and nuisance plant species can impact the aesthetics and function of WSUD assets, and ideally these plants should be removed as soon as they appear (see Figure 15).

Categories of weeds can be found on the NSW WeedWise website at: <http://weeds.dpi.nsw.gov.au/Weeds/Categories>

Further details on specific weeds can be found at: <http://weeds.dpi.nsw.gov.au/>

Example images

Condition rating	Example image
Good condition	
Moderate condition	
Poor condition	

Figure 15: Some aquatic weeds. For a more comprehensive list and identification of aquatic weeds, refer to weeds.dpi.nsw.gov.au



Alligator weed (*Alternanthera philoxeroides*)*, †



Arrowhead (*Sagittaria montevidensis*)*, †



Bullrush (*Typha* sp.)



Salvinia (*Salvinia molesta*)*, †



Water hyacinth (*Eichhornia crassipes*)*, †



Water primrose (*Ludwigia peruviana*)†

* Weed of National Significance, † Copyright © Hawkesbury River County Council

Further reading

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Eastern Long Neck Turtle, Little Creek.

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