Graven Hill Village – Bicester, Oxfordshire

Sustainable Drainage Maintenance Manual

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This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2008, BS EN ISO 14001: 2004 and BS OHSAS 18001:2007)

Issue	Date	Prepared by	Approved by
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Comments	
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Comments

Disclaimer

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1. Introduction

Sustainable Drainage Systems (SuDS) work by mimicking the natural drainage system and provide a method of surface water drainage which can decrease the peak rate of surface water runoff, and hence reduce the risk of flooding. In addition to reducing flood risk these features can improve water quality and provide biodiversity and amenity benefits. A variety of SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff.

Waterman have been commissioned by to produce a Drainage Strategy, incorporating a range of SuDS facilities, for proposed A41 roundabout adjacent to Graven Hill Development, Bicester. It is proposed that SuDS such as pervious surfaces, swales & ditches, filter drains & perforated pipes, filter strips & rills and ponds are used to drain the Site. But where space is restricted or road hierarchy doesn't permit the use of the above therefore gullies, linear drainage channels, swales, filter drains and geocellular tank or oversize pipes would be used.

It is envisaged that any gullies, linear drainage channels, filter drains and piped system collecting highway drainage would be adopted by Oxfordshire County Council under S38 of the Highways Act 1980. Any features such as swales, ditches and ponds would be adopted and maintained by Cherwell District Council.

This report should be read in conjunction with Waterman's WIE11386-145-92-500- A41 Roundabout Drainage Strategy Rev A02.

This report prepared based on the guidance set out in the SuDS Manual (CIRIA C753 2015).

2. SuDS - Operation and Maintenance

Unlike conventional drainage systems, SuDS features should be viable, and their function should be easily understood by those responsible for maintenance. When problems occur, they are generally obvious and can be remedied simply, using standard landscaping practice. If systems are properly monitored and maintained, any deterioration in performance can often be managed out.

Like any drainage system maintenance is a necessary and important consideration of SuDS design and sufficient thought should be given to long-term maintenance in particular, the following requirements should be given full consideration:

1. Maintenance access – ensuring appropriate and long-term access to all points in the system where future maintenance may be required.
2. Forebays and/or appropriate pre-treatment structures to facilitate the sediment management process.
3. Bypass systems or appropriate temporary drainage infrastructure for use if required during sediment management or other maintenance activities.
4. The availability of disposal areas for organic arisings (green waste) and sediments.

Appropriate legal agreements between SuDS stakeholders that define maintenance responsibilities are presented in the SuDS Interim Code of Practice (NSWG, 2004) and CIRIA publication C625 (Shaffer et al, 2004). Specific maintenance requirements for each SuDS component are summarised in Section 32 of The SuDS Manual (CIRIA C753 2015).

2.1 Owners's Manual

SuDS are different from conventional drainage and require different maintenance programmes. Owners of developments with SuDS should be provided with an owner's manual (CIRIA, 2015). This should include the following:

1. location of all SuDS techniques in a site
2. brief summary of how the techniques work, their purpose and how they can be damaged
3. maintenance requirements (a maintenance plan) and a maintenance record
4. explanation of the consequences of not carrying out the maintenance that is specified
5. identification of areas where certain activities are prohibited (for example stockpiling materials on pervious surfaces)
6. an action plan for dealing with accidental spillages
7. advice on what to do if alterations are to be made to a development, if service companies undertake excavations or other similar works carried out that could affect the SuDS.

2.2 Level of Operation and Maintenance

There are many factors which will influence the type and intensity of maintenance required for SuDS at any particular site (CIRIA, 2015), including:

- type of SuDS scheme
- land-use associated with contributing catchment
- level of construction ongoing within the contributing catchment

- planting types
- habitat types that have been created
- amenity requirements of the area.

The demands on the SuDS scheme to perform a particular aesthetic function will be a key driver, with high frequencies of grass cutting and vegetation management often being required for appearance and amenity value rather than for functional reasons (CIRIA, 2015).

2.3 Operation and Maintenance Activity Categories

There are likely to be three categories of maintenance activities:

1. Regular maintenance (including inspections and monitoring).
2. Occasional maintenance.
3. Remedial maintenance.

Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections (CIRIA, 2015).

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (CIRIA, 2015).

Remedial maintenance comprises intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design (CIRIA, 2015).

Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict

Remedial maintenance items can comprise items such as (CIRIA, 2015):

- inlet/outlet repairs
- erosion repairs
- reinstatement or realignment of edgings, barriers, rip-rap or other erosion control
- infiltration surface rehabilitation
- replacement of blocked filter fabrics
- construction stage sediment removal (although this activity should have been undertaken before the maintenance contract)
- system rehabilitation immediately following a pollution event.

The maintenance regime of a site also needs to consider the response to extreme pollution events. A response action plan should be developed and communicated to all those involved in the operation of a site, so that if a spillage occurs it can be prevented from causing pollution to receiving waters (CIRIA, 2015).

2.4 Health and Safety

To comply with the Construction (Design and Management) Regulations 2015, designers must assess all foreseeable risks during construction and maintenance and the design must minimise them by the following (in order of preference):

1. Avoid.
2. Reduce.
3. Identify and mitigate residual risks.

Designers must also make contractors and others aware of risks in the Health and Safety file, which is a record of the key health and safety risks that will need to be managed during future maintenance work. For example, the file for a SuDS pond should contain information on the collection of hazardous compounds in the sediment so that maintenance contractors are aware of them and can take appropriate precautions. During construction the residual risks must be identified, and an action plan developed to deal with them safely (the health and safety plan) (CIRIA, 2015).

All those responsible for maintenance should take appropriate health and safety precautions for all activities (including lone working, if relevant) and risk assessments should always be undertaken. Relevant health and safety legislation should be followed at all times.

2.5 Regular Maintenance Activities

Regular SuDS scheme inspections will:

- help determine optimum future maintenance activities
- confirm hydraulic, water quality, amenity and ecological performance
- allow identification of potential system failures, e.g. blockage, poor infiltration, poor water quality etc.

Inspections can generally be required at monthly site visits (e.g. for grass cutting) for little additional cost, and should be subsumed into regular maintenance requirements (CIRIA, 2015).

During the first year of operation, inspections should ideally be carried out after every significant storm event to ensure proper functioning (CIRIA, 2015). Typical routine inspection questions that will indicate when occasional or remedial maintenance activities are required, and/or when water quality requires investigation include (CIRIA, 2015):

- are inlets or outlets blocked?
- does any part of the system appear to be leaking (especially ponds and wetlands)?
- is the vegetation healthy?
- is there evidence of poor water quality (e.g. algae, oils, milky froth, odour, unusual colourings)?
- is there evidence of sediment build-up?
- is there evidence of ponding above an infiltration surface?
- is there any evidence of structural damage that requires repair?

- are there areas of erosion or channelling over vegetated surfaces?

For large sites, it is recommended that an annual maintenance report and record should be prepared by the maintenance contractor which should be retained with the owner's manual (CIRIA, 2015). The report should provide the following information:

- observations resulting from inspections
- measured sediment depths (where appropriate)
- monitoring results, if flow or water quality monitoring was undertaken
- maintenance and operation activities undertaken during the year
- recommendations for inspection and maintenance programme for the following year.

Regular maintenance activities for each SuDS component are described in the individual component summaries in Section 32 of The SuDS Manual 2015.

2.5.1 Litter/Debris Removal

This is an integral part of SuDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. Litter removal is less of an issue for engineered or underground systems, such as pervious surfaces, filter drains and proprietary systems and will normally form part of routine open space maintenance.

2.5.2 Grass Cutting

It is recommended that grass cutting be minimised around SuDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or "lodging", when water flows across the surface (CIRIA, 2015).

In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese. Allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water (CIRIA, 2015).

Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance (CIRIA, 2015).

If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

In the past there have been recommendations that keeping grass short in filter strips and swales prevents the grass lodging over (ie being pushed over and flattened by the flow of water) and improves pollution removal. However, the risk of pollution removal being compromised is now considered to be minimal and there is no reason for a blanket requirement to keep grass short in all swales and filter strips.

2.5.3 Weed/Invasive Plant Control

Weeds are generally defined as vegetation types that are unwanted in a particular area. For SuDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable (CIRIA, 2015).

In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, i.e. during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies (CIRIA, 2015).

2.5.4 Shrub Management

Shrubs tend to be densely planted and are likely to require weeding at the base, especially during the first year to ensure that they get enough water. Shrubs should be selected so they can grow to their maximum natural height without pruning (CIRIA, 2015).

2.5.5 Aquatic/Shoreline Vegetation Management

Aquatic plant aftercare in the first one to three years may be required to ensure establishment of planted vegetation and control nuisance weeds/invasive plants. Once established, the build-up of dead vegetation from previous seasons should be removed at convenient intervals to reduce organic silt accumulation (e.g. every three years and at the end of landscape contract periods) (CIRIA, 2015).

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats (CIRIA, 2015).

The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas.

Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SuDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur (CIRIA, 2015).

Algae removal may be undertaken for aesthetic purposes during the first three to five years of a pond/wetland's life. The growth of algae, which is considered by some to be visually intrusive, is encouraged by nutrients introduced into the water body (CIRIA, 2015).

2.5.6 Management of Green Waste

Appropriate methods should be implemented to dispose of green waste (CIRIA, 2015) include the following:

1. The Development of Wildlife Piles

These provide refuges, hibernation shelter, food and egg laying sites for a large number of animals. When rotted down at the end of three to five years they provide compost that can be used as fertiliser for planting areas outside of the SuDS system (CIRIA, 2015).

2. On- or Off-site Composting

A compost facility allows all green waste, particularly grass cuttings and prunings to be recycled and provide compost for mulching ornamental plant beds (CIRIA, 2015).

3. Disposal to Landfill

As a last resort, green waste can be disposed of to some approved tips or landfill sites, although it is only accepted at certain locations. Consultation should take place with the environmental regulator to confirm appropriate protocols (CIRIA, 2015).

2.6 Irregular Maintenance Activities

2.6.1 Sediment Removal

To ensure long-term effectiveness, the sediment that accumulates in SuDS should be removed periodically. The required frequency of sediment removal is dependent on many factors including (CIRIA, 2015):

- design of upstream drainage system
- type of system
- design storage volume
- characteristics of upstream catchment area (e.g. land use, level of imperviousness, upstream construction activities, erosion control management and effectiveness of upstream pre-treatment).

Sediment accumulation should be monitored as part of the inspection regime for the surface water management system and appropriate frequencies determined for removal and disposal. Filter strips and swales will only accumulate very small volumes of sediment which can be removed by landscape contractors using hand tools at appropriate frequencies depending on the impact of the accumulation on the performance of the component in terms of hydraulics (eg sheet flow characteristics), water quality (eg vegetation cover) and amenity (eg visual).

2.6.2 Vegetation/Plant Replacement

Some replacement of plants may be required in the first 12 months after installation, especially after storm events. Dead or damaged plants should be removed and replaced to restore the prescribed number of living plants per hectare (CIRIA, 2015).

Inspection programmes should identify areas of filtration, or infiltration surfaces where vegetation growth is poor and likely to cause a reduced level of system performance. Such areas can then be rehabilitated, and plant growth repaired (CIRIA, 2015).

2.7 Remedial Maintenance

2.7.1 Structure Rehabilitation/Repair

There will come a time with most SuDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load (CIRIA, 2015). The SuDS design should allow for vehicle access to undertake this work and consider the need for the overhaul without causing major disruption.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SuDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands) (CIRIA, 2015).

2.7.2 Infiltration Surface Rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration (CIRIA, 2015). Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1 Scarifying to remove “thatch”. Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.

2 Spiking or tilling the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand, and is best undertaken when the soil is moist. Spiking or tilling with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top-dressing materials.

3 As a last resort, it may be necessary to remove and replace the grass and topsoil by:

- removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
- removing damaged turf which should be composted
- cultivating remaining topsoil to required levels
- re turfing (using turf of a quality and appearance to match existing) or reseeding (to Clause 12.6 of BS 7370-3: 1991) using seed to match existing turf area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882:1994 to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

3. Communal Infrastructure

3.1 Swales

Swales are linear shallow vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the stormwater runoff to settle out, providing effective pollutant removal (CIRIA, 2015).

3.1.1 Swales - Operation and Maintenance Requirements

Regular inspection and maintenance is important for the effective operation of swales as designed. Maintenance responsibility for a swale should always be placed with an appropriate organisation (CIRIA, 2015). Maintenance of swales is relatively straight forward for landscape contractors and typically there is only a small amount of extra work required over and above that required for any open space. More intensive maintenance work such as silt and/or vegetation removal is only required intermittently but it should be planned to be sympathetic to the requirements of wildlife. Adequate access must be provided to all swale areas for inspection and maintenance, including for appropriate equipment and vehicles. Grass cutting should not be carried out when the swale is wet. Operation and maintenance requirements for swales are described in Table 1.

Table 1 Swales - Operation and Maintenance Requirements (CIRIA, 2015)

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter removal.	As required
	Grass cutting – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible	Annually
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required	Annually, or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required.
	Re-level uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required.

Maintenance schedule	Required action	Frequency
	Remove build up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required.
	Remove and dispose of oils or petrol residues using safe standard practices	As required.
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation. Record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Half yearly

Sediments excavated from swales that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols (CIRIA, 2015).

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods (CIRIA, 2015).

Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the swale should be monitored, and maintenance schedules adjusted to suit requirements (CIRIA, 2015).

3.2 Trenches/Filter drains

Trenches/Filter Drains are shallow excavations filled with rubble or stone that create temporary subsurface storage for either infiltration or filtration of stormwater runoff. Ideally they should receive lateral inflow from an adjacent impermeable surface, but point source inflows may be acceptable (CIRIA, 2015). Infiltration trenches allow water to exfiltrate into the surrounding soils from the bottom and sides of the trench. Filtration or filter trenches can be used to filter and convey stormwater to downstream SuDS components (CIRIA, 2015).

Trenches can be used to capture sheet or point flow from a drainage area or can function as an off-line device. Infiltration treats runoff by filtration through the soil, reduces runoff rates and volumes and can help preserve the natural water balance, replenish groundwater and preserve baseflow. Filter trenches are used where underlying soils are impermeable, to drain hotspot runoff, or where groundwater is vulnerable to pollution. Filter trenches provide a quiescent zone for removal of fine silts and also encourage filtration, adsorption and biodegradation processes (CIRIA, 2015).

3.2.1 Trenches / Filter Drains – Operation and Maintenance Requirements

Regular inspection and maintenance is important for the effective operation of trenches / filter drains as designed. Maintenance responsibility for a trench /filter drain should always be placed with an appropriate

organisation (CIRIA, 2015). Adequate access should be provided to the trench/filter drains surface and maintenance points for inspection and maintenance, including for appropriate equipment and vehicles. Operation and maintenance requirements for trenches/filter drains are described in Table 2.

Table 2 Trenches / Filter Drains - Operation and Maintenance Requirements (CIRIA, 2015)

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal from trench surface, access chambers and pre-treatment devices	Monthly (or as required)
	Removal and washing of exposed stones on the trench surface	Annual (bi-annual the first year) or when silt is evident on the surface
	Trimming of any roots that may be causing blockages	Annual(semi-annual the first year)
	Remove weeds on the trench surface	Monthly (at start, then as required)
Occasional maintenance	Removal of sediment from pre-treatment devices	Six monthly
	Remove tree roots or trees that grow close to the trench	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace filter media	Five yearly
Remedial actions	Clear perforated pipework of blockages	As required.
	Rehabilitate infiltration or filtration surfaces	As required
	Replace geotextiles and clean and replace filter media, if clogging occurs	As required.
	Excavate trench walls to expose clean soils if infiltration performance reduces to unacceptable levels	As required.
	Inspect inlets, outlets and inspection points for blockages, clogging, standing water and structural damage	Monthly
Monitoring	Inspect pre-treatment systems, inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies	Half yearly

Sediments excavated from upstream pre-treatment devices that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to

confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods (CIRIA, 2015).

3.3 Filter Strips

Filter strips are vegetated strips of land designed to accept runoff as overland sheet flow from upstream development. They lie between a hard-surfaced area and a receiving stream, surface water collection, treatment or disposal system. They treat runoff by vegetative filtering and promote settlement of particulate pollutants and infiltration (CIRIA, 2015). The runoff is designed to flow across the filter strip at a sufficiently low velocity that sediment is filtered out, together with associated pollutants. They are often used as a pre-treatment technique before other SuDS techniques (e.g. swales, infiltration and filter trenches) to extend the life of downstream components (CIRIA, 2015). Under low to moderate velocities, filter strips effectively reduce particulate pollutant levels by removing sediments, organic materials and trace metals. Settling-out of sediment that contains clay particles removes sorbed nutrients and other pollutants (CIRIA, 2015).

The extent of infiltration tends to be limited during intense storms as only a small proportion of the runoff is lost, but it is the dominant mechanism for small rainfall events (CIRIA, 2015).

3.3.1 Filter Strips – Operation and Maintenance Requirements

Regular inspection and maintenance is important for the effective operation of filter strips as designed. Maintenance responsibility for a filter strip should always be placed with an appropriate organisation (CIRIA, 2015).

Access for maintenance vehicles must be available, but this is not usually a constraint due to the likely location of the filter strip adjacent to impermeable areas (CIRIA, 2015). Operation and maintenance requirements for filter strips are described in Table 3.

Table 3 Filter strips - Operation and Maintenance Requirements (CIRIA, 2015)

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal	Monthly (or as required)
	Grass cutting – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible	Annually
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required	Annually, or if bare soil is exposed over 10% or more of
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Re-level uneven surfaces and reinstate design levels	As required

Maintenance schedule	Required action	Frequency
	Scarify and spike topsoil layer to improve infiltration	As required
	performance, break up silt deposits and prevent compaction of the soil surface	
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required
Monitoring	Inspect filter strip surface to identify evidence of erosion, compaction, ponding, sedimentation and contamination (e.g. oils)	Half yearly
	Check flow spreader and filter strip surface for even gradients	Half yearly
	Inspect gravel diaphragm trench upstream of filter strip for clogging	Half yearly
	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Sediments excavated from a filter strip or upstream flow spreader that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling (CIRIA, 2015). However, consultation should take place with the environmental regulator to confirm appropriate protocols.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods (CIRIA, 2015).

3.4 Gullies

The traditional purpose of providing drainage for roads is to convey water as quickly as possible from the running surface, thus ensuring a clear safe path for road traffic, and to prevent water ingress to the road pavement structure to avoid potential damage to the structure of the road. Traditional road surface water drainage techniques involved collecting runoff in roadside gullies, drainage kerbs or other collection devices which convey runoff to underground closed pipe systems (WSP, 2009).

Road gullies usually comprise a small sump which is permanently full of water, intended to trap silt and sediments (WSP, 2009).

3.4.1 Gullies – Operation and Maintenance Requirements

Regular inspection and maintenance is important for the effective operation of gullies as designed. Maintenance responsibility for gullies should always be placed with an appropriate organisation. Operation and maintenance requirements for filter strips are described in Table 4.

Table 4 Gullies - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal	Bi-annual (or as required)
	Remove vegetation	Bi-annual (at start, then as required)
	Remove sediment	Bi-annual (or as required)
Occasional maintenance	Cleansing	Annually
Remedial actions	Repair erosion or other damage to design specification	As required
Monitoring	Inspection of priority areas and responding to reports from the public.	Monthly

Sediments excavated from gullies generally contain high levels of hydrocarbons and require disposed by landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods (CIRIA, 2015).

3.5 Pipework

Conveyance is the transfer of surface runoff from one place to another. It can take place through a range of systems including pipes. Controlled conveyance is an essential tool for managing flows and linking SuDS components together (CIRIA, 2015).

Flow is conveyed to, from and between SuDS components in either open channels, across vegetated surfaces or within pipework (CIRIA, 2015). The definition of flow structures are as follows:

- an inlet structure conveys flow into a SuDS component
- an outlet structure conveys flow out of a SuDS component
- a control structure restricts the rate of flow into or from an outlet structure.

All structures have both an entry and an exit.

Inlet from an unrestricted piped collection system

Piped inlets should be designed to meet the following criteria (CIRIA, 2015):

- to deliver the required maximum flow rate freely from the upstream collection system
- to be simple, robust and easily maintained (i.e. easily mowable, cleanable, repairable and obvious to site managers)
- to resist blockage

- to prevent erosion
- to minimise hazard to people (i.e. no exposed vertical trip edges or drops, no open pipework accessible by small children)
- to minimise hazard to wildlife (i.e. no exposed sumps, traps, gullies or open inlets to sewers)
- to be visually interesting or neutral (i.e. no negative aesthetic effect)
- to minimise vandalism risks.

Outlet Systems

Outlet structures control the flow out of the SuDS components, and determine the ability of the system to manage both low and high flows. Water quality flows are normally handled with smaller, more protected outlet structures such as orifices located within screened pipes or risers, perforated plates or risers, small pipes, reverse-slope pipes, and V-notch weirs.

3.5.1 Pipes – Operation and Maintenance Requirements

Regular inspection and maintenance is important for the effective operation of pipes as designed. Maintenance responsibility for pipes should always be placed with an appropriate organisation. Operation and maintenance requirements for filter strips are described in Table 5.

Table 5 Pipes - Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter Removal	As required
	Jetting	As required (Blockages/Reduced Capacity)
Occasional maintenance	Root Removal	As required
Remedial actions	Replacement and Repair	As required
Monitoring	CCTV	As required

Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal for large systems or in public environments. If maintenance is not undertaken for long periods, deposits can become hard-packed and require considerable effort to remove (CIRIA, 2015).

Replacement of the void fill will be necessary if the device becomes blocked with silt. Monitoring will give information on changes in infiltration rate and provide a warning of potential failure in the long-term. Roads and/or parking areas draining to soakaways should be regularly swept to prevent silt being washed off the surface (CIRIA, 2015). This will minimise the need for ongoing maintenance.

Maintenance responsibility should be placed with an appropriate organisation and maintenance schedules should be developed during the design phase (CIRIA, 2015).

4. References

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