Maintenance of SuDS

Steve Wilson and Owen Davies provide a perspective about the maintenance of sustainable drainage systems. This factsheet is helpful to any person or organisation likely to own SuDS, be responsible for their maintenance, or be responsible for agreeing payment for future SuDS maintenance (eg commuted sums).

The authors

Steve Wilson *is a Chartered Civil Engineer with 30 years experience of drainage and geotechnical engineering. He is a member of the Register of Ground Engineering Professionals. He is the Technical Director of the Environmental Protection Group, a company that specialises in the design of SuDS. Steve has a wealth of experience designing and constructing a wide range of SuDS projects and has a particular interest in combining hard and soft SuDS. He believes that SuDS can be applied to any site.*

He is lead author of CIRIA Report C609, SuDS, Hydraulic, structural and water quality issues and was a member of the project steering group for The SuDS manual. Steve has contributed to much of the design guidance on concrete permeable pavements. He regularly presents training courses for CIRIA and helped present DEFRA workshops to local authorities on the new National SuDS Standards.

Owen Davies *is a local authority engineer with 14 years of experience in highways and transportation. He has undertaken most aspects of highways and transportation. He has a considerable depth of knowledge of street works and network management. He is experienced in design and implementation of planned maintenance, road safety and accessibility. Owen has helped to deliver award winning crime reduction schemes in streets. He has implemented policies and licensing of temporary structures. He has also managed development control related issues affecting the public highway. This includes setting detailed design standards for developers to work to and ensuring designs are safe to construct and operate.*

He has project managed preparation of the London Asphalt Specification, 2009 and the London Asphalt handbook, 2011. He has also delivered the associated training courses.

Introduction

This fact sheet is intended for owners and responsible parties of sustainable drainages systems but it may also be of interest to designers who want to design systems with a low whole-life cost.

Maintenance should be considered at all stages of the planning, design and construction process. At the planning stage it needs to be considered in terms of who will be doing it and can they do it. Design considerations include providing source control, ease of access, health and safety and potential cost of maintaining features. During and at the end of construction, inspection is necessary to ensure the system has been constructed correctly and will not require remedial works.

Despite perceptions to the contrary, the maintenance requirements of well designed and constructed SuDS are quite simple and it

is easy to estimate the costs. **Well designed and constructed** SuDS that incorporate source control will be easy to maintain, regardless of whether they are landscape or hard engineered solutions. Poorly designed or constructed drainage systems without source control (eg end of pipe ponds, basins, wetlands and storage tanks) will be inherently more difficult and costly to maintain because of silt and should not be seen as good examples of SuDS components or schemes. Before considering any evidence on the maintenance of SuDS the reader should make sure it relates to a system with source control and not an end of pipe system.

The maintenance regime for SuDS assets should ideally be explained in a statement provided by the designer of the system (alternatively it could be provided by the organisation commissioning it or the SuDS approving body). In the absence of such a statement any maintenance regime should start by accurately mapping the assets and what is understood to be their intended performance.

Maintenance of SuDS fits within an overall asset management process:

- Mapping of SuDS assets
- Inspection
- Routine light (frequent) maintenance
- Routine heavy (less frequent) maintenance
- Reactive maintenance.

There should also be regular reviews of maintenance regimes to ensure that they are being effective and the performance of the systems is being maintained. Such regular reviews may also allow maintenance to be reduced.

Understanding the whole life maintenance costs for SuDS is an important part of asset management so that funding requirements can be identified.

Design

Design is key to how SuDS are maintained and ultimately to their whole life cost and asset deterioration. SuDS are primarily about source control and integrating drainage into the conceptual design of developments, not adding it in as a secondary process. This applies to both hard engineered and soft landscape solutions. The SuDS manual clearly defines source control along with the appropriate management train and proposed number of treatments required in generic situations. During design, consideration must be given to how any SuDS will be safely and easily maintained in the future. The most appropriate maintenance will depend on the location and nature of a particular site. There is no point implementing SuDS which will require maintenance by specialist contractors or require specialist equipment if these will be difficult or costly to obtain.

Supervision

It is vital that SuDS construction is supervised and inspected on completion if owners and SuDS approval bodies are to avoid taking on liabilities. This will help to ensure that the specified materials are being used and that they are being placed correctly. Incorrect materials or installation should be rejected as they will adversely affect the performance, maintenance costs and ultimately the serviceable life of SuDS.

susdrain

Maintenance considerations in design and specification of SuDS

Design

If maintenance is considered from the outset and considered in the design process there is no reason why SuDS should be more expensive to maintain than existing traditional drainage systems. For landscape solutions the maintenance will be predominantly vegetation management. The correct choice of planting is key to defining what the future vegetation maintenance will involve. Different plant selections have different maintenance requirements, some of which are more intensive than others.

Designers should provide an indication of the likely maintenance regime of their systems along with estimated costs of the maintenance. This is especially important with proprietary systems that rely on frequent maintenance. If a system requires special bespoke filters the supplier should be identified and the future owner or operator made aware of the costs. Sufficient information on the design and specification of the filters should be provided so that alternative supplies can be sourced if the original manufacturer ceases to trade.

Maintenance considerations in design and specification of SuDS

Materials

The choice of materials to be used in SuDS can have an impact on future maintenance. Where hard engineered systems use proprietary treatment products the installation should follow the manufacturer's requirements to minimise the risk of poor performance and increased maintenance costs. When implementing soft or bespoke SuDS the choice of materials will be key to low cost long-term maintenance. Consider using materials with known long term performance such as reclaimed granite setts or kerbs that are likely to be easy to replace in future if damaged.

If bespoke or high quality materials are used that might need replacing during the lifetime of the system the designer should consider whether that material will be available in future. With features that have a strong visual impact consider how single elements can be repaired or re-instated with little or no fuss to ensure consistency of design and material.

Imported soils should complement existing soils and any planting which is to be used. For example free draining loam would not be compatible with water loving plants. The topsoil depth should be suitable for the root depth of proposed planting to ensure plants thrive. There is a national plant database which can be used to help you in choices of planting and suitability for location.

http://tinyurl.com/plant-listings

Flora Local is another good source for local plants of local provenance.

http://www.floralocale.org

Maintenance requirements

A well designed sustainable drainage system will follow the management train principle and include source controls, followed by site and possibly regional features. Source control features can be hard, such as permeable pavements or landscape features such as swales. Bioretention systems are another source control solution that are a combination of engineering and landscaping. The routine maintenance of engineered source control systems is primarily ensuring that silt does not accumulate to excessive levels that compromise the performance of the feature.

Maintenance operations can be divided into the following categories:

- Regular (or routine frequent) - this covers items that are carried out typically with a frequency from monthly to annually. It includes item

such as inspection and monitoring, litter removal, grass cutting or other vegetation management, sweeping permeable pavements.

- Infrequent (or routine infrequent) - this covers items that are required typically with a frequency from annually up to 25 years (or possibly greater). It includes items such as wetland vegetation management, silt removal from swales, ponds or wetlands, scarifying and spiking infiltration basins and gravel replacement to filter drains.

- Remedial (or reactive) - this covers maintenance that is not usually required, but may be necessary as a result of vandalism, accidental damage, rainfall that exceeds the design capacity or similar events. Examples include repair of erosion in a swale or repair of permeable surfaces blocked for example by mixing concrete on them.

Most manufacturers provide guidance on the maintenance requirements for the "harder" or engineered solutions. The recommendations can also be checked using knowledge of the estimated time for silt to build up in the system combined with judgement. It is not difficult and further information is available is CIRIA Report C609 and SuDS for Roads. This can be then combined with the catchment area and the performance characteristics of a particular system.

For soft SuDS the regular maintenance simply comprises litter removal, grass cutting and other vegetation management that landscape contractors are familiar with and will carry out for the rest of the open space. Additional items for the SuDS include inspection and clearing of flow control structures (inlets and outlets) and occasional removal of silt. Details of maintenance items are provided for each SuDS feature in guidance published by Cambridge City Council and SCOTS (see below). An example is shown in Table 1 for ponds and wetlands, along with the likely frequency at which each element of work will be required. A similar approach is taken in the SCOTS spreadsheet.

There is a wealth of information on the subject of SuDS maintenance including the following:

- CIRIA. SuDS Hydraulic, Structural and Water Quality. Report C609

- HR Wallingford. The Operation and Maintenance of Sustainable Drainage Infrastructure (and Associated Costs). Report SR 626, HR Wallingford, Oxford, UK.

- CIRIA. The SuDS Manual. Can be downloaded here (www.susdrain.org)

- Cambridge City Council sustainable drainage design and adoption guide. Can be downloaded here (www.susdrain.org)

- SCOTS/SuDS Working Party – Whole life cost spreadsheet can be downloaded here. http://www.scotsnet.org.uk/best-practice.php

- The Drainage Channel Biodiversity Manual (Natural England 121) http://publications.naturalengland.org.uk/publication/50004

The guidance is listed in chronological order.

As experience of SuDS maintenance in the UK has developed the guidance has been refined and the most up to date information on maintenance of green SuDS is in the Cambridge Guide. There is also information produced by SCOTS/SuDS Working Party in Scotland in relation to maintenance of SuDS for Roads in the form of an MS Excel spreadsheet. The advantage of the SCOTS spreadsheet and the Cambridge City Council guidance is that the user can clearly see where the cost data has come from and what assumptions have been made. Users can override the assumed values if necessary. Further details on suggested refinements to the default values in the spreadsheet are provided in Box 1.

The UK SuDS Tools website also has an Operation and Maintenance Cost Calculator that is under construction at the moment. More details can be found here. http://tinyurl.com/uksuds

The Cambridge CC SuDS Adoption Guide includes maintenance schedules for different types of SuDS within the landscape. These are based on practical experience of maintaining SuDS in the landscape. The schedules list the general requirements to ensure the features function as originally designed and the biodiversity supported by the features is not compromised. Maintenance regimes are based on a long running study of practical SuDS maintenance and costs have been derived using standard references to provide a transparent cost schedule where all assumptions all clearly visible. The cost schedules have been benchmarked against the maintenance costs actually incurred on large SuDS schemes maintained by a local authority. This has shown that the costs estimated from the data in the guide are in close agreement with those incurred in practice (although this may vary regionally and over time, so always benchmark with local contractors before developing detailed cost estimates).

Box 1 – Refinement to SCOTS Spreadsheet

The SCOTS spreadsheet makes some assumptions that recent experience suggests may be overly cautious. The good thing about the spreadsheet is that the default values can be replaced.

An example would be the assumption made in the SCOTS costing spreadsheet that geotextile filters in permeable pavements need to be removed and replaced after 25 years. All the evidence is that silt is trapped in the joints and it is unlikely to completely clog a geotextile in the construction. The use of unit rates also requires care. An example is vacuum sweeping of permeable pavements. On a small site the cost is likely to be greater than the unit rates provided and will be based on the time spent travelling to and from the site plus the time spent sweeping. Costs based on visits to smaller sites are provided in the Cambridge guide.

Capital maintenance costs also appear excessive in the SCOTS spreadsheet, for example the default value for a swale is 50% of the construction cost after 20 years. It is difficult to see what could occur to a swale to require this level of work after 20 years, if it has been correctly maintained.

The latest experience is that the frequency of maintenance operations in the CCC and SCOTS documents are likely to be worse case requirements that are suitable for cost estimates (it is better to overestimate costs to ensure sufficient funds are available for future maintenance of an important asset and the sums of money should not be huge).

Table 1 - Maintenance requirement and costs for basin (Cambridge City Council)

Item	Frequency	Comments	Cost	
			Minimum cost for small areas of POS (based on fixed cost of a site visit)	£/100m² per visit for larger areas of POS
Litter removal	1 per month	Litter quantity and characteristics will be dependant on the site Litter may collect in ponds and wetland features Litter collection may be part of the general landscape maintenance Litter collection should be undertaken at each site visit and the beginning of any maintenance task, particularly grass cutting All litter must be removed from site	1 site visit with 3 men, 1 light van, mower and ancillary equipment. Half day visit comprises 3 hours on site and 1 hour travelling. Half day maximum area = 4000 m² (including pond or wetland vegetation) Cost per visit = £249	0.67
Inspect control structures to/from basin	1 per month	Surface control structures can be slot weirs, V-notch or gabion baskets with control in the stone fill. They can be inspected without removing covers or special keys. Maintenance of control structures in manhole chambers will be more expensive.		£5/ structure
Grass cutting on slopes and in bottom of basin – amenity grass	1 per month	All grass cuttings managed on site in wildlife or compost piles	Full day visit comprises 7 hours on site and 1 hour travelling. One day maximum area = 10000m² (including pond or wetland vegetation) Cost per visit = £498	1.14
Scrub clearance from bankside	1 per year	Overhanging branches and encroaching growth will normally be undertaken as part of landscape maintenance		5.83
Habitat mosaic 30% cut and remove to site wildlife piles (see Section on ponds and wetlands)	1 per year	Carry out September to November if possible to minimise disruption to wildlife		3.38
Scarify and spike base of infiltration basin if necessary at same time	1 per 5 years	This would typically be undertaken at the same time and as part of the visit to remove silt.	Inc in silt removal costs with nominal extra allowance for scarifying plant	1.29
Remove silt from base and place in site piles (see Section on ponds and wetlands)	1 per 5 years	Silt accumulation is slow if 'source control' features are located upstream in the 'management train' Only required once every 5 years	Assume 1 site visit with 3 men, 1 light van, small excavator and ancillary equipment. Basin area up to 1200m² Cost per visit = £689 Disposal of silt by truck with mechanical grab (assuming it is not special waste) £51.18/m³	
Extra cost if silt, grass cuttings, etc are removed from site during routine maintenance	To suit other operations	Ideally all cuttings should be used on site to construct and maintain wildlife piles but this may not be the best option in public open space and removal from the site may be needed.	£2.65/m² cleared. Assumes the waste is not classified as special waste and proportion of silt is minor (which should be the case if source control is in place upstream). Disposal of silt by truck with mechanical grab (assuming it is not hazardous or special waste) £55/m³	

= SUDS Specific Items

On some sites, simple observation of the SuDS on a regular basis has allowed a much more relaxed maintenance regime based on work being done when necessary rather than to a set timetable. Evidence from the Cambourne demonstration site in Cambridgeshire shows that the maintenance costs are low and that performance is not significantly compromised

(particularly for permeable pavements) if components are not regularly maintained. However, regular inspections should still take place to manage risks to performance from such reduced/constrained maintenance regimes.

Table 1 also provides costs for maintenance and assume that a specific visit to site is made to carry out the maintenance of the SuDS feature. In reality the SuDS maintenance will be incorporated into the general work required for the open space and thus there will only be nominal increase in the general landscape costs to allow for the SuDS.

For small sites a minimum cost is based on the fixed cost for a maintenance team to visit the site for a minimum period of time (half a day or full day). Rates can be used for larger areas based on unit rates in the SPON's external works and landscape price book. Judgement has to be used to find items that are comparable to the work required in SuDS features. For example a maintenance item for SuDS is to cut 25% to 30% wetland vegetation and remove to site wildlife piles. The rates used in SPONS for cutting grass or light woody undergrowth using strimmer not exceeding 30 degrees can be used. A contingency item can provide finance for items such as localised erosion, vandalism, etc.

Planning maintenance work

Well planned management operations can minimise the cost of maintenance. Matters to be considered include:

- Reducing carbon inputs (e.g. those associated with transport) by using synergies with other public realm maintenance work. Delegation to local people (community, Parish Council labour, etc) can also reduce carbon inputs. Simpler maintenance tasks should be integrated with inspections to eliminate a second visit being necessary.
- Community engagement: The provision of information on SuDS can support good maintenance and avoid problems being caused by inadvertent actions of the public. Community stewardship can be applied to some of the simpler aspects of inspection and maintenance. A key aspect of reactive maintenance is knowing what it is that people have become concerned about and who is responsible.
- Good quality public realm. Evidence from both the UK and other countries has shown that well designed and high quality SuDS landscape features are valued by the community and will be looked after. Conversely poor features that do not look good are not valued and may well be misused.

Health and Safety

Information on health and safety considerations during maintenance of SuDS should be available in the CDM Safety File relating to the asset. Outdoor maintenance workers face some hazards in relation to tools, plant and infection but adequate training and use of PPE where necessary will minimise the risks of adverse health effects or injury. Maintenance of SuDS on the surface will certainly be less hazardous than some of the operations required for some traditional drainage components such as entering confined spaces or heavy lifting to clean components of oil separators.

Silt

The vast majority of well-designed SuDS, whether "hard" or "soft", do not seem to suffer from problems with excessive and speedy silt accumulation if they apply the key concepts of the SuDS philosophy, ie source control with a correctly designed treatment train.

Examples include:

1. Hopwood Park MSA where a series of swales and basins has not required silt removal during 10 years operation and there is no evidence of serious silt accumulation.

2. Drainage to a sports centre in USA has had no maintenance for 12 years and silt accumulation is only apparent in inlets to bioretention areas. Volumes are not excessive

3. A pond at the Dunfermline Eastern Expansion where the results of measuring silt accumulation suggest that silt accumulation is not significant except during construction activities within the catchment.

4. Numerous pervious pavement systems that continue to operate despite silt accumulation and reduced surface infiltration rates.

The reason for this is that the silt load on each unit area of the system is very small because it is spread out throughout a catchment, rather than being concentrated to a small area as in traditional systems. It is also collected in places where it is easy to remove. Thus it will take a long time for silt to build up to levels that require large scale removal (the estimate for a pond at Dunfermline is 25 years or greater).

Conversely some SuDS can, understandably, exhibit large volumes of silt accumulation where the system serves a catchment with a high volume of silt in the runoff (eg timber yards). Silt also requires regular removal from systems without source control. Without source control SuDS will be far more difficult to maintain, the ecological value and value to the community will be reduced and maintenance costs will be higher.

Removal of silt from stormwater runoff is important because a large proportion of pollutants are attached to the silt particles. If the silt is removed then most of the pollution will be dealt with. Thus retention of silt in the SuDS is one of the prime objectives and should not be seen as a problem. If siltation is occurring the SuDS is doing its job correctly, whether it is a swale, a pond, a permeable pavement or a plastic tank system. The trick is to design the systems so that silt accumulation is spread over a wide area so that the impact is small and frequent large scale maintenance is not required.

For well-designed SuDS removal of silt is likely to be required only once every five years or so (or possibly even greater) and the volumes should not be great. This is based on the builds up of silt reported for several systems in the UK (Wilson and Derosa, 2006; Heal, 2000). The level of silt accumulation in any SuDS can be estimated using the SCOTS spreadsheet and will be dependent on catchment loading and whether there is a source control element. It should be recognized this is overall likely to be a worse case assessment for general runoff. Conversely it does not allow for one off events such as someone washing concrete off a hard surface which must be considered. However these are not usually likely to occur to all parts of a system and are best dealt with by a small contingency sum applied to all schemes that will build up to cover such abnormal or remedial maintenance.

Vegetation management

Vegetation management has an important role in the maintenance of landscape SuDS. Not all systems will be amenity grass that is just mowed. Planting such as wildflower grass mixes require more early maintenance whilst the sward is established but then require less frequent maintenance. Similarly more ornamental planting will require more intensive maintenance. Vegetation management has an important role in the maintenance of landscape SuDS. Not all systems will be amenity grass that are just mowed. Planting such as wildflower grass mixes require more early maintenance whilst

the sward is established but then require less frequent maintenance. Similarly more ornamental planting will require more intensive maintenance.

Accommodating wildlife in SuDS management

It is often perceived that maintenance of SuDS is incompatible with some wildlife. With a little thought and good management the presence of wildlife in SuDS can be easily accommodated. Timing is everything with the maintenance of SuDS so that it fits in with restrictions such as the bird nesting season, etc. Good practice for management of ponds or wetlands is to remove only 25% to 30% of vegetation at any one time. This is entirely compatible with management for wildlife.

Waste Management

There are usually three types of waste arising from SuDS maintenance. Litter and vegetation will be dealt with in the same way as for any open space, car park or similar maintenance. Silt requires special attention because it will contain low levels of metals, hydrocarbons and other pollutants. Silt should accumulate in all SuDS as that is the primary method of pollution treatment.

The requirement for source control has an impact on silt removal and meeting the requirements of waste management legislation. The Environment Agency has adopted a risk based approach in relation to removal of silt from SuDS (Environment Agency 2011).

Green Waste

Green waste from SuDS maintenance operations can be managed in a number of ways and is no different to that from normal landscape maintenance:

1. Shredded for surface spreading – as a mulch mimicking natural leaf or wood fall
2. As wildlife piles to provide habitat usually removed from managed landscapes (variety of 1.)
3. On-site compost piles (variety of 1.)
4. Removed from site to off-site composting facilities (eg Council Green Waste)
5. Removal from site to tip – least preferred and least sustainable but can be the most beneficial to the system as a whole as it reduces the nutrient load and therefore will encourage native species and discourage algal blooms.

Silt

The approach for silt disposal from SuDS Maintenance is:

1. Evaluate whether the silt in the site is likely to have a high risk of being defined as 'hazardous waste'. This will mainly be based on the land use within the catchment.
2. If this is the case, e.g. industrial or heavy vehicle management areas or end of pipe ponds without source control, basins, etc without source control then proceed to 'hazardous waste' disposal. This will require chemical analysis of the silt and compliance with all relevant waste management legislation.
3. Where there is low risk of pollution, e.g. housing, schools, commercial sites etc., with source control then agree a 'sustainable' approach to waste management with the Environment Agency:
4. Silt accumulation 'at source' – remove and land apply to vegetated surfaces outside the SuDS design profile but within, say, 10m of the SuDS component.
5. Silt accumulation in wetlands and ponds (very low if source control in place – remove, allow to dewater by the side of the SuDS component for 24-48 hours and land apply to vegetated surfaces outside the SuDS design profile but within, say, 10m of the SuDS component.

Details of the Environment Agency Regulatory Position Statement can be found here https://tinyurl.com/removal-of-silt

The Regulatory Position Statement distinguishes between SuDS that have a low risk of accumulating pollution (ie source control and landscape features draining housing where the silt can be applied to the ground in open spaces around the SuDS) and those with a higher risk such as those draining heavily used roads or low risk SuDS where silt is to be removed from the site.

Litter

Litter should be collected and taken away for disposal off site as it would be for any other space.

Invasive species

This can always be a potential problem if not monitored. Invasive species should be removed from SuDS as soon as they are spotted.

Further details can found here: http://tinyurl.com/non-native-species

Conclusion

Maintenance of SuDS is not difficult. It is however different to normal pipe and gulley/channel drainage. The use of source control will reduce the maintenance burden on the whole system because silt is kept spread out throughout the system rather than concentrating it in a small area. There is a lot of guidance available that provides information on the maintenance of SuDS. As mentioned above, maintenance can be categorised into three main groups: regular maintenance, occasional maintenance and remedial maintenance (see table 2). The level of inspection and maintenance will vary depending on the type of SuDS component and scheme, the land use, types of plants as well as biodiversity and amenity requirements.

Table 2 - Typical inspection and maintenance activities

Activity	Indicative frequency	Typical tasks
Routine/regular maintenance	Monthly (For normal care of SuDS)	• Litter picking • Grass cutting • Inspection of inlets, outlets and control structures
Occasional maintenance	Annually (Dependent on the design)	• Silt control around components • Vegetation management around components • Suction sweeping of permeable paving • Silt removal from catchpits, soakaways and cellular storage
Remedial maintenance	As required (Tasks to repair problems due to damage or vandalism)	• Inlet/outlet repairs • Erosion repairs • Reinstatement of edgings • Reinstatement following pollution • Removal of silt build up

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For further advice on maintaining SuDS schemes please contact Steve Wilson, EPG Ltd on: 07971277869 or email stevewilson@epg-ltd.co.uk