

Appendix D – Other Supporting Information

- D.1.4 Clancy Flood Risk Assessment (FRA) and SUDS Strategy, 02/07/2019 (Report Reference 8/1982)

SU70NW106

I. B. M.

PROPOSED DEVELOPMENT AT BROOKSIDE ROAD, HAVANT, HAMPSHIRE

RECORD OF BOREHOLE No. 3

Type of Boring Shell and auger

SU70NW/106

Ground level 11.9' O.D.Dia. of boring 8in. to 10in.

71250558

Date started 10-11-66Lining tubes 8in. to 15in. dia.Date completed 10-11-66

Date and Depth of Boring	Depth of Casing	Water Level	Samples		Change of Strata		Description of Strata
			Depth	Type	Legend	Depth	
10-11-66	nil		1' 0"	D		1' 0"	Soft dark grey CLAY with topsoil and decayed vegetation
	nil		1' 0" - 2' 0"	U4(SO)		2' 0"	Soft dark grey SILT with some peat
	nil		2' 0"	D		2' 0"	Soft light grey clayey SAND with some gravel
	nil		2' 0" - 3' 0"	S(S)		3' 0"	
	7' 0"	2' 2' 0"	3' 0"	D & W		3' 0"	Dense flint GRAVEL with some chalk
	7' 0"		3' 0" - 4' 0"	C(64)		4' 0"	
	8' 0"		4' 0" - 10' 0"	B		10' 0"	Chalk COBBLES in a matrix of firm putty chalk with some flints
	10' 0"		10' 0" - 12' 0"	C(55)		12' 0"	
	12' 0"		12' 0"	D		12' 0"	
	12' 0"		12' 0" - 14' 0"	C(26)		14' 0"	
	14' 0"		14' 0" - 16' 0"	D		16' 0"	
	16' 0"		16' 0"	D		16' 0"	
	16' 0"		16' 0" - 17' 0"	C(56)		17' 0"	
END OF BOREHOLE Depth: <u>16ft</u> Elevation: <u>-4.1' O.D.</u>							

Key

- ± denotes ground-water first encountered
- U4() " 4 in. dia. undisturbed sample
- U1() " 1 1/2 in. " " "
- D " disturbed sample
- B " bulk sample
- W " water sample
- S() " standard penetration test
- C() " cone penetration test
- (24) " number of blows
- " sample not recovered

Remarks

Scale:

1 in. = 8 Ft.

FIG. 4

Form No. 195
(Revised 9/63)

Marshall Ridgway Limited

Site Investigation Division

SU70NW105

I.R.M.

PROPOSED DEVELOPMENT AT BROOKSIDE ROAD, HAVANT, HAMPSHIRE

RECORD OF BOREHOLE No. 2

Type of Boring Shell and auger

Dia. of boring 8 in. to 17 1/2 in.

Lining tubes 8 in. to 17 1/2 in.

SU70NW/105

Ground level 12.9' O.D. 3.45.

Date started 9-11-66

Date completed 9-11-66

Date and Depth of Boring	Depth of Casing	Water Level	Samples		Change of Strata		Description of Strata
			Depth	Type	Legend	Depth	
9-11-66	nil		1' 6" - 2' 0"	D U4(75)		1' 5"	Topsoil
	nil		5' 0" - 6' 0"	C(20)		6' 6"	Firm brown sandy CLAY with medium gravel and traces of chalk
	6' 6"		6' 6" - 7' 6"	D		6' 6"	
	7' 6"		7' 6" - 8' 6"	C(45)		9' 6"	Dense flint GRAVEL with some putty chalk
	8' 6"		9' 6"	D		9' 6"	
	10' 0"		10' 6" - 12' 0"	U4(84)			Firm grey CLAY and brown sandy CLAY with traces of chalk and flints
	10' 0"		12' 0" - 14' 0"	B		14' 6"	
	15' 6"		14' 6" - 16' 6"	C(51)			Firm putty CHALK with flints
	17' 6"	4' 6"	16' 0" - 17' 6"	U4			
	17' 6"		16' 0" - 17' 6"	B & W			
	17' 6"		18' 0" - 19' 0"	C(82)			
END OF BOREHOLE Depth: 17 1/2 in. Elevation: -4.6' O.D.							

Key

X denotes ground-water first encountered
 U4() .. 4 in. dia. undisturbed sample
 U1 1/2() .. 1 1/2 in. ..
 D .. disturbed sample
 B .. bulk sample
 W .. water sample
 S() .. standard penetration test
 C() .. cone penetration test
 (24) .. number of blows
 ° .. sample not recovered

Remarks

Scale:

1 in. = 8 Ft.

FIG. 3

Form No. 190
(Revised 9/63)

Mortice Ridgway Limited

Site Investigation Division

SU70NW104

I.B.N.
PROPOSED DEVELOPMENT AT BROOKSIDE ROAD, HAVANT, HAMPSHIRE

RECORD OF BOREHOLE No. 1 *SU70NW/104*
7112 05/2

Type of Boring *Shell and auger*
Dia. of boring *8 in. to 12 in. 6 in.*
Lining tubes *8 in. to 12 in.*

Ground level *14.1' o.d.*
Date started *8-11-66*
Date completed *8-11-66*

Date and Depth of Boring	Depth of Casing	Water Level	Samples		Change of Strata		Description of Strata
			Depth	Type	Legend	Depth	
8-11-66	nil		1' 6"	D		1' 0"	Topsoil
	nil		2' 6" - 3' 6"	C(5)		1' 0"	Firm brown sandy CLAY with gravel
	nil		4' 0"	D		1' 0"	Firm brown putty CHALK with flints and firm brown CLAY with fine gravel
8-11-66	5' 0"	5' 0"	5' 0" - 6' 0"	C(37)		6' 0"	
	7' 0"		6' 0" - 7' 0"	C(15)			
	10' 0"		11' 0" - 12' 0"	C(25)			Dense Flint GRAVEL with some firm putty chalk
	12' 0"		12' 0" - 13' 0"	B			
	13' 0"		13' 0" - 14' 0"	C(43)			
	16' 0"		17' 0" - 18' 0"	C(32)			
	19' 0"		19' 0"	D			
	19' 0"		20' 0" - 21' 0"	C(42)			
END OF BOREHOLE Depth: <i>19' 0" 6 in.</i> Elevation: <i>-5.4' o.d.</i>							
Key ⊕ denotes ground-water first encountered U4() .. 4 in. dia. undisturbed sample U1() .. 1 1/2 in. .. " .. D .. disturbed sample B .. bulk sample W .. water sample S() .. standard penetration test C() .. cone penetration test (24) .. number of blows ° .. sample not recovered				Remarks A standpipe was installed at a depth of 10' 0" 6 in. below ground level.			
						Scale: 1 in. = 8 Ft.	FIG. 2

Form No. 190
(Revised 9/65)

Morpheus Ridgway Limited

Site Investigation Division

SU70NW109

I.B.M.

PROPOSED DEVELOPMENT AT BROOKSIDE ROAD, HAVANT, HAMPSHIRE

RECORD OF BOREHOLE No. 6

Type of Boring.....Shell and auger

SU 70NW/109

Ground level.....4-2 1/2m
13-9' O.D.

Dia. of boring.....6in. to 10ft 6in.

Date started.....10-11-66

Lining tubes.....6in. to 15ft 6in.

7111057.1

Date completed.....10-11-66

Date and Depth of Boring	Depth of Casing	Water Level	Samples		Change of Strata		Description of Strata	
			Depth	Type	Legend	Depth		Reduced Level
10-11-66	nil		1' 6"	D		1' 6"	12.4'	Topsoil
	2' 6"		3' 0" - 4' 6"	U4(51) W		4' 6"	9.2'	Soft brown silty CLAY <i>BE</i>
	5' 0"		5' 6"	D		5' 6"	7.9'	Very soft light grey-brown silty CLAY with gravel and traces of chalk <i>1.8m</i>
	6' 6"	4' 6"	7' 0" - 8' 6"	C(58) B		8' 6"	3.9'	Dense flint GRAVEL
	10' 0"		10' 6" - 11' 6"	C(59)		11' 6"	0.9'	Soft brown sandy CLAY with flints <i>0.5</i>
	15' 0"		15' 6" - 16' 6"	C(57) B		16' 6"	0.9'	Very dense flint GRAVEL with some light brown sandy clay and traces of chalk
	15' 0"		15' 6" - 16' 6"	U4(23)		16' 6"	-2.1'	Firm brown putty CHALK with flints and firm brown CLAY with fine gravel <i>6.2m</i>
	15' 6"	4' 6"	17' 6" - 18' 6"	C(60) D		18' 6"		Chalk COBBLES in a matrix of firm putty chalk <i>UP 10m 5.6m</i>
								END OF BOREHOLE Depth: 10ft 6in. Elevation: -4' 2" O.D. <i>R.T.W. 2.10.83</i>
Key			Remarks					
I denotes ground-water first encountered								
U4() " 4 in. dia. undisturbed sample								
U1 1/2() " 1 1/2 in. " " "								
D " disturbed sample								
B " bulk sample								
W " water sample								
S() " standard penetration test								
C() " cone penetration test								
(24) " number of blows								
* " sample not recovered								

SU70NW370

SITE SOUTHMOOR LANE, HAVANT FIGURE 2a

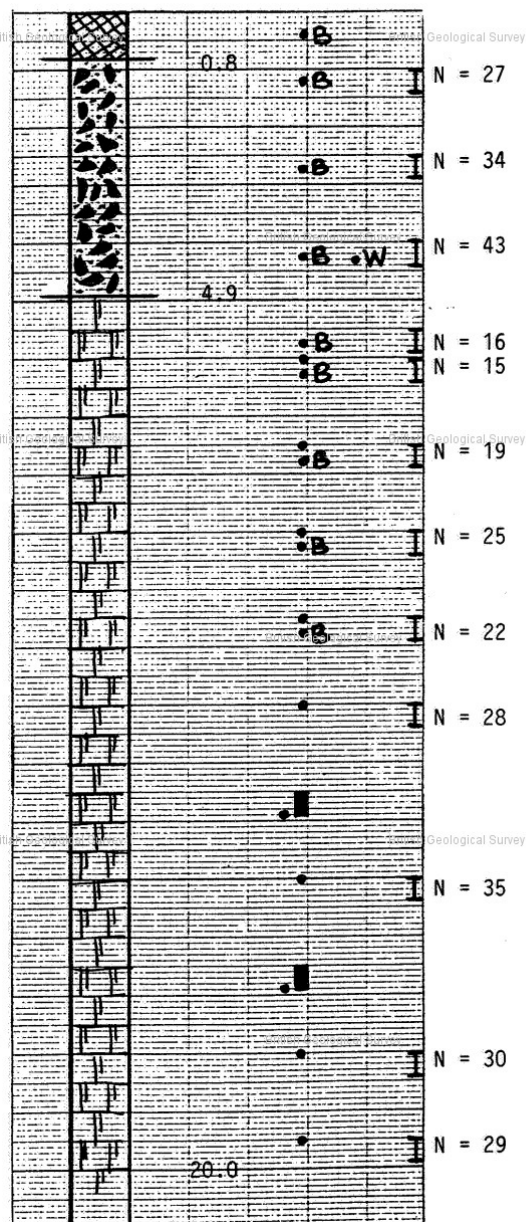
BOREHOLE 1 DIAMETER 150 mm DEPTH 25.0 m DATE 28-29/11/91

Scale: 1:100

TOPSOIL and rubble FILL

Medium dense/dense silty
clayey very sandy fine,
medium and coarse flint
GRAVEL with some chalk
nodules

Moderately strong/strong
white CHALK with some
flints



Continued

100mm diameter core sample

• disturbed sample

I N (Test 19, BS 1377.1975)

NR ... non-recovery

•W ... water sample

•B ... bulk sample

APPENDIX G

Operation and Maintenance

TABLE B.25 SuDS maintenance inspection checklist

General information									
Site ID									
Site location and co-ordinates (GIS if appropriate)									
Elements forming the SuDS scheme		Approved drawing reference(s)							
Inspection frequency		Approved specification reference							
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)							
Inspection date									
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date completed	
General inspection items									
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?									
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?									
Have any health and safety risks been identified to either the public or maintenance operatives?									
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?									
Silt/sediment accumulation									
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)?									
If yes, state depth (mm) and extent.									
Is removal required?									
If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)									

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TABLE SuDS maintenance inspection checklist
B.25

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging or blockage of outlets or drainage paths?								
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? (Check against approved planting regime.)								
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If yes, state action required								
Infrastructure								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (eg wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								

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TABLE SuDS maintenance inspection checklist
B.25

Inspection date									
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date completed	Date Completed
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)									
Other observations									
Information appended (eg photos)									
Suitability of current maintenance regime									
Continue as current									
Increase maintenance									
Decrease maintenance									
Next inspection									
Proposed date for next inspection									

BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

An introduction to sustainable drainage systems or SuDS

SuDS are a new environmentally friendly approach to managing rainfall that uses landscape features to deal with surface water. SuDS aim to:

- control the flow, volume and frequency of water leaving a development area
- prevent pollution by intercepting silt and cleaning runoff from hard surfaces
- provide attractive surroundings for the community
- create opportunities for wildlife.

SuDS at Robinswood Primary School and Matson Park

The SuDS are designed to prevent flooding of Robinswood Primary School and to control the flow of water from springs in Matson Park using attractive landscape features.

- A low bank has been constructed in the park as a dam when water flows down the route of an old ditch during heavy rain.
- The everyday flow from springs above the path in the park has been directed along a new stream in the park, which keeps a new wildlife pond full of water but also allows it to soak into the ground or flow onward to a controlled outfall into the school grounds.
- The controlled outfall into the school grounds allows heavy rainfall to leave the park slowly and make its way through green space above the school playing field.
- Exceptional storms or prolonged heavy rain can overflow from the park across a grass weir on the bank into the “environment space” at the top of the playing field retained by a low bank running along the contour to the old oak tree.
- The school wildlife pond, with a toddler fence around it, gives children in the school an opportunity to learn about animals and plants that live in water and to understand how the SuDS control system works.
- Water will slowly soak into the ground as it travels along the SuDS system, but in exceptional storms some water may overflow down the side of the playing field towards the road as it did in the past but without going through the school first.

Managing the SuDS

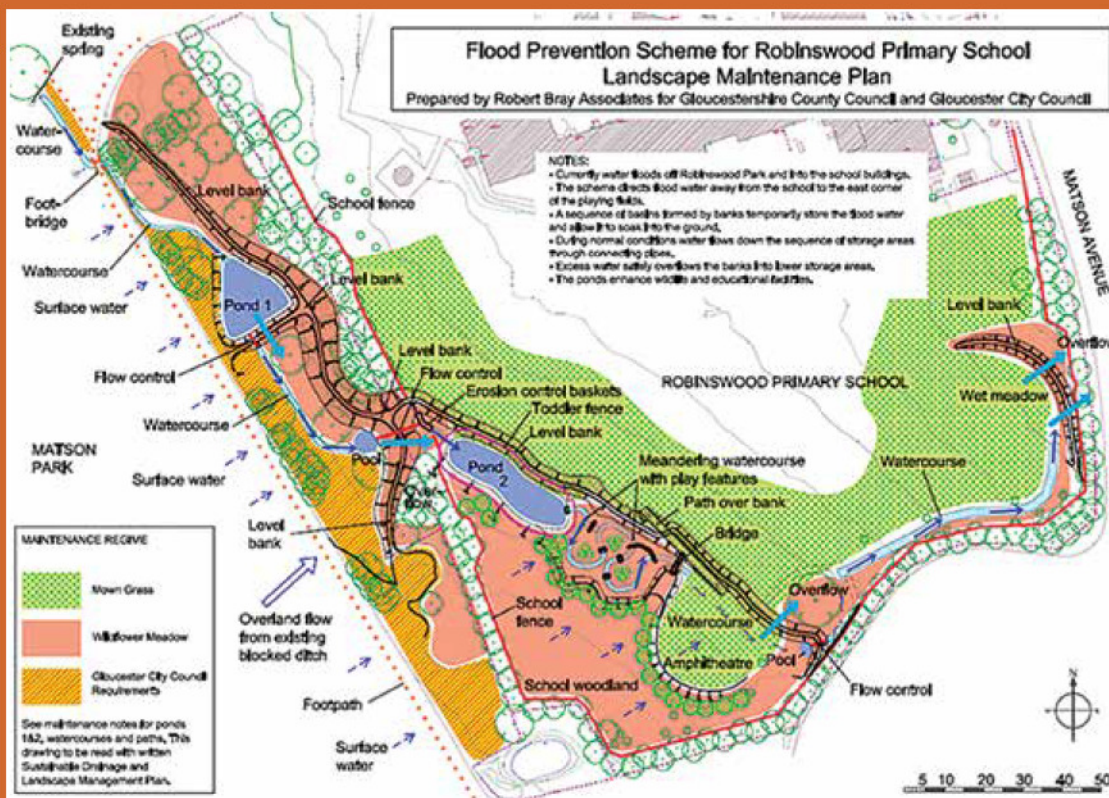
The SuDS at Robinswood Primary School have been designed for easy maintenance to comprise:

- regular day-to-day care – litter collection, grass cutting and checking the inlets and outlets where water enters or leaves a SuDS feature
- occasional tasks – managing pond vegetation and removing any silt that builds up in the SuDS features
- remedial work – repairing damage where necessary.

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School



Matson Park SuDS management

The SuDS sequence begins where the springs emerge above the path, near the park entrance from Underhill Road, and take a changed route under a new bridge to form a stream in the park.

Action:

- Strim or mow grass where the springs emerge and allow vegetation to grow to at least 100 mm or to full height annually in the low flow channel or stream bed.

The new stream carries water to the first wildlife pond (Pond 1 – see site plan).

Action:

- Mow the path verge and grass up to the stream as current practice by GCC.
- Cut stream vegetation annually in September–November, removing cuttings to a wildlife pile or from site.
- Allow grass beyond the stream to develop as meadow and cut at 100 mm September–November removing cuttings to a wildlife pile or from site.

The wildlife pond will develop wetland vegetation round the edge with reasonably short grass towards the park side to allow people to look at the water.

Longer meadow grass on the far side of the pond and beyond the stream will provide a home for wildlife and an opportunity for creative play.

Action:

- Mow the path verge and grass up to the stream and pond edge from park side as current practice by GCC.
- Cut meadow grass beyond stream at 100 mm September–November removing cuttings to a wildlife pile or from site.

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**BOX
B.2** **Example SuDS Maintenance Plan for Robinswood Primary School**

- Monitor how the pond edge develops, and cut 30% of vegetation at 100 mm each year during September–November, if required, removing cuttings to wildlife piles or from site.
- Occasionally remove pond vegetation, if it spreads across the pond, by hand clearing, raking or machine clearance, using a 1–3 tonne tracked vehicle, with cuttings removed to wildlife piles or from site.
- Check the outlet from the pond and the inlet on the other side of the bank are clear.

The stream flows onward from the pond through grass to a “micropool”, before it leaves the park through a final outlet into the school grounds “environment space” at the top of the playing field.

There is a grass overflow weir over the bank down to the school fence which should be cut annually to ensure that erosion does not occur. Brambles should be allowed to re-colonise the base of the bank on the school side for security reasons.

Action:

- Mow path verge and grass to the stream from the park side as current practice by GCC.
- Cut meadow grass beyond stream at 100 mm September–November removing cuttings to a wildlife pile or from site.
- Cut “micropool” vegetation annually September–November, if required, removing cuttings to a wildlife pile or from site.
- Cut overflow weir as meadow grass at 100 mm September–November removing cuttings to a wildlife pile or from site.

Robinswood Primary School SuDS management

Water from the Matson Park flows slowly through the bank, or overflows over a grass weir in exceptional rainfall. The water arrives on the school site through the fence onto a stone-filled basket channel flowing along a grass swale to the second wildlife pond and “environment space” (Pond 2 see site plan).

Action:

- Strim or mow grass around stone-filled basket channel and along the swale to the pond at 100 mm with grass at maximum height 150 mm.

The school wildlife pond will develop a wetland edge along the 1 m wide wet ledge before rising up to a flat dry ledge (or bench) provided for safety.

Action:

- Allow grass beyond the pond and away from the school side to develop as meadow and cut at 100 mm in September–November removing cuttings to a wildlife pile on site.
- On the school side, cut the grass regularly at 100 mm with grass at maximum height 150 mm for access.
- Monitor pond vegetation and cut 30% of edge at 100 mm each year, if necessary, during September–November, removing cuttings to wildlife piles.
- Occasionally remove pond vegetation if it spreads across the pond by hand clearing or raking being careful not to damage the pond liner.

The water leaves the pond under a small bridge into a swale maze flowing to a flat activity area.

Water leaves the southern end of the environment space through an outlet in the bank with a micropool in front of it.

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School
Action:

- Cut the grass in the swale maze channel once each year, September–November, at 100 mm removing cuttings to wildlife piles.
- Cut grass paths, verges and the flat activity area at 35–50 mm with 75 mm maximum, leaving cuttings *in situ* or remove to wildlife piles.
- Cut all other areas within the environment space as meadow cut at 100 mm in September–November removing cuttings to a wildlife pile on site during school summer holiday.
- Check that the outlet and the inlet on each side of the bank is clear.

Should water reach the outlet from the environment space then it will flow down a grass swale, a flat bottomed grass channel, to another holding basin before overflowing slowly through the boundary onto the road.

Action:

- Cut the shallow swale and meadow as part of normal playing field maintenance.

SuDS and landscape maintenance – summary

		Frequency	Unit Rate	Total
Regular maintenance				
1	Litter management			
1.1	Pick up all litter in SuDS and landscape areas and remove from site	12 visits monthly		
2	Grass maintenance – all cuttings to wildlife piles			
2.1	Mow all grass verges, paths and amenity at 35–50 mm with 75 mm max, leaving grass <i>in situ</i>	As required or monthly		
2.2	Mow all dry swales, dry SuDS basins and margins to low flow channels and other SuDS features at 100 mm with 150 mm max Cut wet swales or basins annually as wildflower areas	4–8 visits as required Annually		
2.3	Wildflower areas strimmed to 50 mm in September or at the end of school holidays Or Wildflower areas strimmed to 50 mm on 3 year rotation 30% each year	1 visit annually 1 visit annually		
3	Inlets and outlets			
3.1	Inspect monthly, remove silt from slab aprons and debris, strim 1 m round for access	12 visits monthly		
4	Hard surfaces – not applicable			
4.1	Sweep all paving regularly, sweep and suction brush permeable paving in autumn after leaf fall	1 visit		
Occasional tasks				
5	Inspection and control chambers – not applicable			
5.1	Annual inspection, remove silt and check free flow	1 visit		

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

		Frequency	Unit Rate	Total
6	Wetland and pond vegetation			
6.1	Wetland vegetation to be cut at 100 mm on 3–5 year rotation, 30% each year, all cuttings to be removed to wildlife piles or from site	As required		
7	Silt management			
7.1	Inspect swales, ponds, wetlands annually for silt accumulation	1 visit		
7.2	Excavate silt, stack and dry within 10 m of the SuDS feature, but outside the design profile where water flows, spread, rake and overseed	As required		
8	Native planting			
8.1	Remove lower branches where necessary to ensure good ground cover to protect soil profile from erosion	1 visit annually		
Remedial work				
9	Inspect SuDS system regularly to check for damage or failure Undertake remedial work as required	As required		

SuDS scheme checklist

SuDS schemes include landscape features and control structures to manage runoff as it flows to site outfalls. The following lists the SuDS components and extra features which may be found on a site.

- **Filter strips** are grass verges that allow runoff to flow through vegetation to a swale, wetland, infiltration area or other SuDS component.
- **Swales** are linear, flat-bottomed grassed or vegetated channels that convey water from one place to another. They can also store water and allow it to soak into the ground.
- **Underdrained swales** are stone-filled trenches with a perforated pipe in the bottom covered by engineered sandy soil and turf. These intercept dirty water and allow it to soak into the ground or lead it to a water storage feature.
- **Filter drains** clean, store and convey water to another feature or allow it to soak into the ground. They are stone-filled trenches, sometimes with a perforated pipe in the bottom. These may be enlarged to treat dirty water, as treatment trenches, or increase soakage into the ground, as infiltration trenches.
- **Permeable surfaces** are permeable block paving, porous asphalt, gravel or free-draining soils that allow rain to percolate through the surface into underlying drainage layers. They should be protected from silt, sand, compost, mulch etc.
- **Infiltration basins, trenches, soakaways** and most of the preceding SuDS features allow water to soak into the ground.
- **Basins, ponds and wetlands** are depressions in the ground where water is stored and treated. Water levels rise after rain and then drop to the normal level as the excess soaks into the ground or is released slowly to a watercourse or drain. Some water may be held back as a pond for final treatment, amenity or wildlife interest.
- **Bioretention areas** are planted areas with engineered topsoil over drainage layers that allow water to soak into the ground.

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

- **Green roofs** are planted with sedum or other plant material. They clean and absorb water allowing it to evaporate. Excess water is drained from the roof to other SuDS features.
- **Inlet and outlets structures** are often conveyance pipes protected with mesh guards. They should be free from obstruction at all times to allow free flow through the SuDS.
- **SuDS flow control structures** are usually small orifices in control chamber, slots or V-notches in weirs. They are usually near the surface, so are accessible and easy to maintain. They may be in baskets, in small chambers or in the open.
- **Inspection chambers** and rodding eyes are used on bends or where pipes come together. They allow cleaning of the system if necessary.
- **Overflows** can be below ground through gratings and chambers or over grass weirs in the open. They should be kept clear at all times to protect areas from flooding.
- **Flood routes (exceedance routes)** allow water volumes exceeding the capacity of the SuDS system to escape from the site without causing damage to property. This route should be clear of obstructions at all times.

SuDS design usually avoids use of below-ground structures such as gully pots, oil separators and other sumps, which are a wildlife hazard, often ineffective and expensive to maintain. SuDS design also reduces pipework, manholes and interceptors. However, water may be conveyed in surface features such as rills and channels, with changes in level managed in spouts or cascades. These hard landscape features require standard landscape maintenance.

Sustainable drainage maintenance specification
General requirements

General requirements	
Maintenance activities comprise ▪ regular maintenance ▪ occasional tasks ▪ remedial work	Frequency
Generally Litter Collect all litter or other debris and remove it from site at each site visit	Monthly

- **Avoid** use of weed-killers and pesticides, to prevent chemical pollution.
- **Avoid** de-icing agents wherever possible to allow bioremediation of pollutants in permeable surfaces.
- **Protect** all permeable, porous and infiltration surfaces from silt, sand, mulch and other fine particles.

Exclusions

- Maintenance of rainwater harvesting chambers, pumps etc.

Filter strips and swales

- **Filter strips** are grass verges next to hard surfaces that allow runoff to flow through vegetation, removing silt and pollution.
- **Swales** are linear, flat-bottomed grassed or vegetated channels that convey water from one place to another, which can also store water and allow it to soak into the ground.
- **Underdrained swales** are free-draining swales with stone-filled trenches in the bottom covered by engineered sandy soil and turf that clean dirty water and allow it to soak into the ground or lead it to a water storage feature.

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

Filter strips and swales	
Regular maintenance	Frequency
Grass Mow amenity grass access paths and verges surrounding swales and filter strips at 35–50 mm minimum and 75 mm maximum or as specified. Mow filter strips and swales at 100 mm with 150 mm maximum to filter and control runoff in normal grass swales, removing first and last cut in season, and if grass is longer than 150 mm removing cuttings to wildlife piles on site. Where marsh or wetland develops in the swale due to wet conditions then cut annually, or as required, at 100 mm, removing cuttings to wildlife piles on site	Monthly or as required Monthly or as required Annual or as required
Occasional tasks	Frequency
Where there is a build-up of silt on the filter strip, swale, underdrained swale or at inlets, ie 50 mm or more above the design level, then remove and spread on site. Undertake when ground is damp in autumn or early spring and transplant turf and overseed to original design levels. Spread excavated material on site above SuDS design profile, eg top of banks, in accordance EA (2010)	As required
Remedial work	Frequency
All damage to be made good to design profile unless there is a design flaw	As required

Filter drains

- **Filter drains** are stone-filled trenches, sometimes with a perforated pipe in the bottom, that collect, clean and store runoff before conveying the water to another SuDS feature or allowing it to soak into the ground.
- **Treatment trenches** are enlarged filter drains designed to treat a known volume of dirty water or increase soakage into the ground. They may also be used to intercept overland flows, when they are referred to as **cut off drains**.

Filter drains and infiltration trenches	
Regular maintenance	Frequency
Grass edges Mow 1 m min. wide grass surround to drain at 100 mm and 150 mm maximum to filter runoff and protect drain from silt	Monthly or as required
Occasional tasks	Frequency
Weeds Hand pull or spot treat individual weed growth, only if necessary, ensuring that weed-killer does not enter the filter drain. Weed growth usually dies in dry weather	As required
Remedial work	Frequency
Siltation at surface Where there is no protective geotextile, remove all stone and perforated pipe replacing as original spec. and include separating geotextile as below. Where there is a separating geotextile (see spec.) then remove surface stone layer and separating geotextile that protects the stone drain below. Replace geotextile and top stone layer	As required

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School
Pervious pavements

- **Pervious pavements** including permeable block paving, porous asphalt, gravel or free-draining soils that allow rain to percolate through the surface into underlying drainage layers. They should be protected from silt, sand, compost, mulch etc. Permeable block paving and porous asphalt can be cleaned by suction brushing.

Pervious pavements	
Regular maintenance	Frequency
Cleaning Brush regularly and remove sweepings from all hard surfaces	Monthly
Occasional tasks	Frequency
Permeable pavements: Brush and vacuum surface once a year to prevent silt blockage and enhance design life	Annually
Remedial work	Frequency
Monitor effectiveness of permeable pavement, and when water does not infiltrate immediately advise the client of possible need for reinstatement of top layers or specialist cleaning. Recent experience suggests that jet washing and suction cleaning will substantially reinstate pavement to 90% efficiency	As required

Infiltration systems – soakaways, infiltration trenches and infiltration basins

- **Infiltration basins, trenches, soakaways** and most of the preceding SuDS features allow water to soak into the ground.

Soakaways, infiltration trenches and infiltration basins	
Regular maintenance	Frequency
Grass edges Mow 1 m min. wide grass surround to drain at 100 mm and 150 mm maximum to filter runoff and protect infiltration structure from silt	Monthly or as required
Infiltration basins Protect grass surface from compaction and siltation and manage main area of basin for design function or appearance	As required
Occasional tasks	Frequency
Infiltration basins Where there is a build-up of silt in the basin at inlets (ie 50 mm or more above the design level), remove when the ground is damp in autumn or early spring and turf to the original design levels. Spread excavated material on site above SuDS design profile (eg top of banks), in accordance with EA (2010).	As required
Infiltration trench Hand pull or spot treat individual weed growth, only if necessary, ensuring that weed-killer does not enter the drain and inhibit natural breakdown of pollutants	As required
Remedial work	Frequency
Infiltration basin Where the infiltration basin is compacted, reinstate by removal of silt and de-compaction of the surface by scarifying, spiking or the use of hollow tines to the basin area	As required

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School
Detention basins, ponds and wetlands

- Detention basins, ponds and wetlands are depressions in the ground that store water. Water levels rise after rain and then drop to the normal level as the excess soaks into the ground or is released slowly to a watercourse or drain. Some water is often held back in a pond or wetland for final “polishing” treatment or amenity interest.
- Detention basins are usually dry.
- Ponds can be permanent or temporary and are mainly open water.
- Wetlands are mainly aquatic vegetation but can have small areas of open water like ponds.

Detention basins, ponds and wetlands	
Regular maintenance	Frequency
Grass Mow grass access paths and verges surrounding basins, ponds and wetlands areas at 35–50 mm minimum and 75 mm maximum, or as specified, to provide a cared-for appearance and allow pedestrian access	Monthly or as required
Mow rough grass areas for occasional access or habitat reasons at 100 mm and maximum 150 mm with cuttings removed to wildlife piles	As required, 4–6 times annually
Grass areas not required for access may be managed for wildlife interest and to reduce costs. Two cuts in July and September or one cut annually in September or October as specified, and cuttings removed to wildlife piles	Annually or as required
Wet woodland management Manage annually as detailed spec. with cuttings left in situ or removed to wildlife piles	Annually or as required
Wetland vegetation Cut (strim) at 100 mm with cuttings removed to wildlife piles September–October Or Maintain as a mosaic to be cut 25–30% in any one year at 100 mm in September or October with cuttings removed to wildlife pile	Annually or as required
Occasional tasks	Frequency
Where silt accumulates on apron or area in front of inlet or outlet, remove and land apply within design profile of SuDS. Where silt accumulates more than 150 mm in base of wetland, undertake a phased removal of silt subject to client approval. Confirm whether a liner is present to hold water or prevent pollution of groundwater and protect. Remove silt as instructed, but not more than 30% of pond or wetland area at any one time and to an agreed depth but not the subsoil layer. Retain as much representative existing vegetation as possible to ensure rapid re-colonisation of open areas. Stack excavated material adjacent to wetland to allow de-watering of silt. Undertake silt removal during September–October to minimise damage to protected wildlife and ensure regrowth of aquatic vegetation before winter. Spread excavated material on site above SuDS design profile, eg top of banks, in accordance with EA (2010).	Annually or every 3 years, as required

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

Detention basins, ponds and wetlands	
Remedial work	Frequency
Although not usually required, this may be needed due to damage to liners or control structures	Undertake as design details or as required

Inlets, outlets, controls and inspection chambers

- **Inlets and outlets structures** may be surface structures or conveyance pipes with guards or headwalls. They should be kept free from obstruction at all times.
- **SuDS flow control structures** can be protected orifices, slots weirs or other controls at or near the surface to be accessible and easy to maintain. They may be in baskets, in small chambers or in the open.
- **Inspection chambers** and rodding eyes are used on bends or where pipes come together and allow cleaning of the system if necessary. They should be designed out of the system where possible.

Inlets, outlets, controls and inspection chambers	
Regular maintenance	Frequency
Inlets, outlets and surface control structures Inspect surface structures, removing obstructions and silt as necessary. Check there is no physical damage. Trim vegetation 1 m min. surround to structures and keep hard aprons free from silt and debris	Monthly Monthly
Inspection chambers and below-ground control chambers Remove cover and inspect, ensuring that water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn	Annually
Occasional maintenance	
Check topsoil levels are 20 mm above edges of baskets and chambers to avoid mower damage	As necessary
Remedial work	Frequency
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary	As required
Repair physical damage if necessary	As required

Overflows and flood routes

- **Overflows** are overland across weirs, through gratings or within chambers and should be kept clear at all times to protect areas from flooding. They allow onward flow when part of the SuDS system is blocked.
- **Flood routes (exceedance routes)** allow water volumes that exceed the capacity of the SuDS system to pass through or round the site without causing damage to property. These routes should be clear of obstructions at all times.

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

Overflows and flood routes	
Regular maintenance	Frequency
Overflows – Jet the pipes leading from overflow structures annually and check by running water through the overflow. Check free flow at next SuDS feature – inlet to basin or chamber	Annually
Overflows – Remove any accumulated grass cuttings or other debris on top of grass weirs or stone-filled baskets overflows	Monthly
Flood routes – Make visual inspection. Check route is not blocked by new fences, walls, soil or other rubbish. Remove as necessary	Monthly
Remedial	Frequency
Overflows – If overflow is not clear then dismantle the structure and reassemble to design detail	As required

Ornamental planting and existing vegetation

- **Ornamental trees** – All ornamental planting to be kept weed free and pruned, using secateurs to keep the shrubs to an agreed and reasonable size.
- **Native trees and shrubs** – All native planting to be allowed to grow freely, removing overhanging branches as required.

Planting and existing vegetation – review	
Regular maintenance	Frequency
Grass maintenance	
Amenity grass – Mow all grass verges, paths and amenity grass at 35–50 mm with 75 mm max. All cuttings to remain in situ	16 visits
Rough grass – Mow at 75–100 mm but not to exceed 150 mm All cuttings to wildlife piles	4 – 8 visits
Wildflower areas strimmed to 50 mm in Sept–Oct. Or Wildflower areas strimmed to 50 mm July and Sept. Or Wildflower areas strimmed to 50 mm on 3 year rotation, 30% each year. All cuttings to wildlife piles	1 visit 2 visit 1 visit
Ornamental tree and shrub planting Weed all shrub beds as detailed spec. as necessary. Cut back planting from lights, paths and visibility sight lines in late autumn and as necessary. Cut hedges slightly tapered back from base with flat top at specified height. Do not mulch planting adjacent to permeable or porous paving surfaces. Remove stakes and ties from trees when no longer needed for support and within 3 years of planting. Protect from strimmer damage and remove competitive growth until well established	4 visits

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BOX B.2 Example SuDS Maintenance Plan for Robinswood Primary School

Planting and existing vegetation – review	
Native trees and shrub planting Prune to shape in year 1. Protect trees from strimmer damage and remove competitive growth until well established. Remove stakes and ties from trees when no longer needed for support and within 3 years from planting	1 visit
Existing trees Check existing trees for safety	1 visit
Remedial	Frequency
Replace trees and shrubs that fail in the first 5 years after planting. Carry out tree surgery as necessary	

Spillage – emergency action

Most spillages on development sites are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system.

Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by the Environment Agency, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s). (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

Contact the Environment Agency immediately.

Queries regarding a design feature

In the event of a concern or failure of a SuDS design feature contact:

Robert Bray Associates, Sustainable Drainage Consultants and Landscape Architects

Fairfield, Coronation Road, Rodborough, Stroud, Gloucestershire GL5 3SB

T: (01453) 764885

F: (01453) 765545

E: bob@robertbrayassociates.co.uk

W: www.sustainable drainage.co.uk

Heavy vibrating rollers are definitely not recommended around plastic pipes or tanks due to the high pressures that they can generate. Thin layers with smaller plant are recommended. DfT (2009) should be referred to for guidance for plant and methods for achieving compaction. The manufacturers' recommendations usually limit plant size above geocellular units to no more than 2300 kg/m width. However, the loading resulting from this will still need to be checked in the design. If such plant is to be used adjacent to the units, the resulting compaction pressures need to be checked.

Any arch or flexible pipe structures depend on the even resistance provided from soil or aggregate on both sides of the arch/pipe for their structural capacity. Even slight differences in the level of filling on each side of the arch/pipe as it progresses could potentially cause uneven deflections and increase the stress within the structure above design values. Close supervision during backfilling is therefore vital. The backfill around geocellular tanks should also be brought up evenly around all sides.

Bedding directly below a concrete pipe should have minimal compaction. The fill at the side of the pipe should be well compacted to a level 300 mm above the crown of the pipe. Only light compaction should be applied to the backfill directly over the crown of the pipe to a point 300 mm above it. With reasonable workmanship and supervision, the bedding factors used in the design should be relatively conservative.

21.12.6 Wrapping

All storage tanks should be watertight in accordance with the relevant standards. Geocellular and similar structures using geomembranes to hold water should be sealed in accordance with waterproofing standards (ie welded joints rather than adhesive taped) and the integrity of the seal checked on site through the use of non-destructive testing, to ensure that it is leak-proof. Advice on appropriate integrity and seam tests for geomembranes, that could be adapted for testing membranes around storage tanks, is provided in Mallett *et al* (2014). Care needs to be taken during installation to protect against damage of both the tank structure and the geotextile and the geomembrane wrapping. Follow-on trades can also cause damage and put the integrity and performance of the structure at risk.

21.13 OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of below-ground storage systems. Maintenance responsibility for systems should be placed with a responsible organisation. **Table 21.3** provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be developed during the design phase, and will be specific to the type of tank that is adopted. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

- Generic health and safety guidance is provided in **Chapter 36**.

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

21.14 REFERENCES

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20.14 OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organisation. Before handing over the pavement to the client, it should be inspected for clogging, litter, weeds and water ponding, and all failures should be rectified. After handover, the pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious pavements need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Extensive experience suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites. However, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports.

A brush and suction cleaner (which can be a lorry-mounted device or a smaller precinct sweeper) should be used for regular sweeping. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced. It is also possible to clean the surface using lightweight rotating brush cleaners combined with power spraying using hot water, as shown in **Figure 20.30**. This is done every two years at the site shown.

If the surface has clogged then a more specialist sweeper with water jetting and oscillating and rotating brushes may be required, especially for porous asphalt surfaces, to restore the surface infiltration rate to an acceptable level. The specialist equipment should be adjusted so that it does not strip binder from the aggregate in the asphalt.

The likely design life of grass reinforcement will be dictated by trafficking and is likely to be about 20 years if designed correctly. For concrete block permeable paving the design life should be no different from standard paving, assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging. Porous asphalt will lose strength and begin to fatigue due to oxidation of the binder. This is likely to occur slightly faster in porous asphalt than normal asphalt, so the design life will be reduced slightly. Porous concrete should have a similar design life to a normal concrete slab.



Figure 20.30 Deep cleaning a supermarket car park, Dundee (courtesy Abertay University)

The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

► Guidance on waste management is provided in **Chapter 33**.

Table 20.15 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be prepared during the design phase. Specific maintenance needs of the pervious pavement should be monitored, and maintenance schedules adjusted to suit requirements.

► Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

► Generic health and safety guidance is presented in **Chapter 36**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.