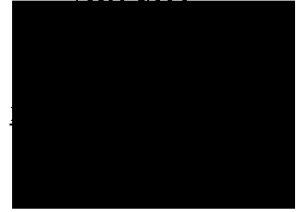


SDP

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SUDS MAINTENANCE PLAN

FOR

PROPOSED NEW RESIDENTIAL DEVELOPMENT

AT

FORD ROAD

ARUNDEL

Project: E19-003
Date: September 2022
Author: Nigel Grayer
Status: Planning
Revision: Second Issue

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APPENDIX 1

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APPENDIX 2

Proposed Storm Water Drainage System

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Surface Water Drainage Maintenance Plan

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Product Specific Maintenance Details

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1.0 Introduction

- 1.1 We have been appointed by Oakford Homes to provide a SuDS Maintenance Plan (SMP) for Ford Road, Arundel, to enable the storm water drainage system to be maintained and operated as intended within the design.
- 1.2 A Sustainable Drainage System Management Strategy was prepared as part of the planning application.
- 1.3 The SMP expands on this document as the drainage scheme has been developed for construction.

2.0 Proposed Storm Water Drainage System

- 2.1 The proposed storm water drainage system is as shown on the following drawing ([Appendix 2](#)).
 - E19-003-1101 Surface Water Drainage Plan
- 2.2 The storm water drainage system within the site has been designed to cater for a 100 year storm return period with a 40% allowance for climate change. On site storage/attenuation has been provided within each SuDS component.
- 2.3 The SuDS system aims to manage rainfall and use landscape features where possible to deal with surface water.
 - 2.3.1. Control the flow and volume of water leaving the development.
 - 2.3.2. Prevent pollution by intercepting silt and cleaning runoff from hard surfaces.
- 2.4 The flood risks to the site have been checked by using the Environment Agency Flood Maps in the planning approved FRA.

3.0 SuDS at Ford Road, Arundel

- 3.1 During rainfall events the storm water runoff is managed as follows:
 - Run-off from Block A roof will be collected by rain water down pipes to a below ground network of sewers. The outfall will be restricted to 1.0 l/sec via a hydrobrake manhole, which will finally outfall into the adjacent drainage ditch. The attenuated flows will be catered for in storage crates adjacent to the building.
 - Run-off from Block B will be similar to Block A. The only difference being the attenuation tanks will be suspended below the upper ground floor, above the flood plain level
 - The car parking/hard standing areas are all constructed using tanked permeable paving with storage crates below. The outfall will be restricted to 2.0 l/sec via a hydrobrake manhole before discharging to the adjacent drainage ditch.

4.0 Managing SuDS

4.1 The SuDS have been designed for easy maintenance to comprise:

- Regular day to day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS feature.
- Occasional tasks – checking the SuDS feature and removing any silt that builds up in the SuDS feature.
- Remedial Work – repairing damage where necessary.

5.0 SuDS Scheme Checklist

5.1 The following lists the SuDS components and extra features which are found on site:

Refer to drawing ref: E19-003-1003 Surface Water Drainage Maintenance Plan for item references (see [Appendix 3](#)).

E19-003 SuDS Maintenance Inspection Checklist is to be completed during each maintenance inspection (see [Appendix 4](#)).

- **Permeable paving** – used for car parking areas and will collect and treat surface water runoff (Item ref 01)
- **Surface water attenuation crates** – used to store surface water run-off (Item ref 02)
- **Surface water headwalls** – used to connect the surface water drainage to the existing surface water drainage ditch (Item ref 03)
- **Above ground surface water attenuation tanks** – used to store surface water run-off from Black B roof (Item ref 04)
- **Hydrobrake manholes** - (3 No.) to be used to restrict the surface water run-off as specified on the drawings (item ref 05)
- **Below ground drainage pipes** - convey water to the SuDS systems. They should be free from obstruction at all times to allow free flow (Item ref 06)
- **Catch pit manholes** – intercept silt from rainwater to ensure performance of SuDS features (item ref 07)

6.0 Sustainable Drainage Maintenance Specification

General Requirements

General Requirements	Frequency
Maintenance activities comprise • Regular Maintenance • Occasional tasks • Remedial work	
Generally Litter Collect all litter or other debris and remove it from site at each visit.	Monthly

- **Avoid use of weed-killers and pesticides to prevent chemical pollution**
- **Avoid de-icing agents wherever possible**
- **Protect all below ground drainage through careful selection and placement of hard and soft landscaping.**

Permeable Paved Areas

- Permeable block paving is porous to allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc.

PERMEABLE AND POROUS SURFACES (Item ref 01)	
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 Client of possible need for reinstatement of top layers or specialist cleaning. Recent experience suggests jet washing and suction cleaning will substantially reinstate pavements permeability. (Refer to Appendix 5 and O & M manual for specific requirements).	As required

Modular Crate System

- **Modular Crate System** is designed to provide storage capacity as well as allow run-off to flow through. (Ensure no excavations are carried out near crates to avoid damage).

MODULAR CRATE SYSTEM (Item ref 02)	
Regular Maintenance	Frequency
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
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
CCTV survey the perforated pipe between inspection manholes to ensure silt free and jet is required.	
Depending on findings it may be necessary to excavate and replace gravel trench and lining.	

Remedial Work	Frequency
Repair physical damage if necessary. (Ensure no excavations are carried out near crates to avoid damage).	As required
Monitoring	Frequency
Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed.	Annually
Survey inside of tanks for sediment build up and remove if necessary.	Every 5 years or as required

Surface Water Headwalls, Flap Valves and Watercourses

- **Outlet Structures** such as headwalls in drainage ditch. They should be free from obstruction at all times to allow free flow through. Clearance of watercourse and drainage ditches.

SURFACE WATER HEADWALLS (Item ref 03)	
Regular Maintenance	Frequency
Outlet Structures	
Inspect headwalls, removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
Trim vegetation 1m min surround to structures within watercourse and keep area free from silt and debris. Remove any sapling growth within the watercourse.	Monthly
Flap valves to be inspected to ensure free movement both opening and closing.	
Occasional maintenance	Frequency
Check topsoil levels are 20mm above edges of chambers to avoid mower damage	As necessary
Remedial Work	Frequency
Repair physical damage if necessary	As required

Above Ground Storage Tanks

- **The above ground storage tanks** are designed to store attenuation run-off and allow flows through.

ABOVE GROUND STORAGE TANKS (Item ref 04)	
Regular Maintenance	Frequency
Cleaning	
Inspect and clear outfall pipes to ensure free flowing.	Every 3 months

Occasional Tasks	Frequency
Inspect for damage.	Every 6 months

Hydrobrake Manholes (3 No.)

- **Hydrobrake Manhole** is used to restrict the surface water run-off to greenfield rates. (For product specific maintenance refer to Appendix 5 and O & M manual).

HYDROBRAKE MANHOLE (Item ref 05)	
Regular Maintenance	Frequency
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
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system.	Monthly or as required
Remedial Work	Frequency
All damage to be made good if necessary.	As required
Monitoring	Frequency
Inspect all the hydrobrakes to ensure they are in good condition and working.	Every 3 months

Below ground drainage pipes

Below ground drainage pipes convey water to the SuDS system. They should be free from obstruction at all times to allow free flow.

BELOW GROUND DRAINAGE PIPES (Item ref 06)	
Regular Maintenance	Frequency
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
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system.	Monthly or as required
Remedial Work	Frequency
Repair physical damage if necessary	As required

Monitoring	Frequency
Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed.	Annually
Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required

Catchpit manholes

Catchpit manholes intercept any silt in the rainwater runoff preventing the blocking up of SuDS features.

CATCHPIT MANHOLES (Item ref 07)	
Regular Maintenance	Frequency
Catchpit manholes. Inspect all catchpit manholes to ensure not full of silt. Any silt removal needs to be disposed of to an appropriate tip.	Monthly
Occasional Maintenance	Frequency
Inspect covers for damage.	Every 3 months

Management Company

A management company will maintain all the common areas on the site including the communal SuDS features. The management company will be funded by a charge to each of the properties which will pay for all maintenance and repairs to the features.

Management Company Details

Eaves Property Management Services Limited

Suite 1,

Stubbings House

Henley Road

Maidenhead

SL6 6QL

Spillage – Emergency Action

Most spillages on developments 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.

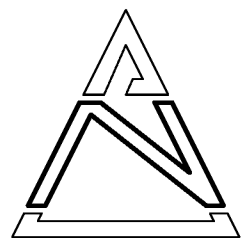


APPENDIX 1

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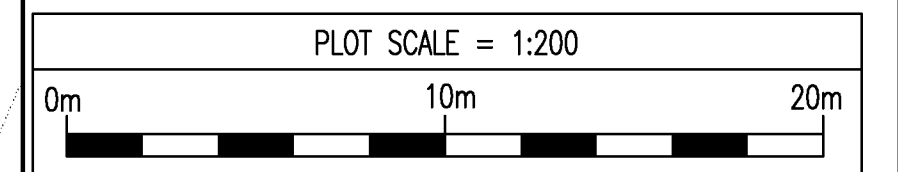
APPENDIX 2

Proposed Storm Water Drainage System



KEY	
	SITE BOUNDARY
	PROPOSED PERMEABLE SURFACED CAR PARK WITH VOIDED STONE BELOW
	PROPOSED SERVICE MARGIN STRIP
	PROPOSED BOLT TOGETHER STORAGE TANK
	PROPOSED CELLULAR STORAGE TANK
	PROPOSED SURFACE WATER DRAINAGE
	PROPOSED FOUL DRAINAGE
	EXISTING SW SEWER TO BE REMOVED OR GROUTED
	PROPOSED SURFACE WATER DIVERSION ROUTE
	EXISTING PUBLIC FOUL SEWER
	ROOT PROTECTION AREA
	FINN DRAIN
	ACO CHANNEL DRAIN
	SVP CONNECTION POINT
	RWP CONNECTION POINT
	DISTRIBUTION TANK
	GULLY
	PROPOSED FORMATION LEVEL

- NOTES
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 2. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT ALL SERVICES THAT ARE LIKELY TO BE AFFECTED BY THE PROPOSED WORKS ARE LOCATED PRIOR TO WORKS COMMENCING. TRIAL HOLES ARE TO BE DUG IF NECESSARY.
 3. ALL CONCRETE AT OR BELOW GROUND LEVEL ON SITE SHALL BE ABLE TO WITHSTAND SULPHATE CONCENTRATIONS IN ACCORDANCE WITH THE BRE SPECIAL DIGEST 1.
 4. ALL ADAPTABLE DRAINAGE WORKS TO BE UNDERTAKEN STRICTLY IN ACCORDANCE WITH SEVERN TRENT WATER REQUIREMENTS AND 'DESIGN AND CONSTRUCTION GUIDANCE FOR DESIGN OF FOUL WATER SEWERS OFFERED FOR ADOPTION UNDER CODE FOR ADOPTION AGREEMENTS'.
 5. ALL ADAPTABLE PIPEWORK SHALL BE RESISTANT TO A JETTING PRESSURE OF 4000PSI.
 6. ALL ADAPTABLE PIPELINES SHALL BE LOCATED A MINIMUM OF 1m FROM KERBLINES. ALL ADAPTABLE MANHOLES SHALL BE LOCATED A MINIMUM OF 500mm FROM KERBLINES.
 7. NO TREES SHALL BE LOCATED WITHIN 3m OF ADAPTABLE MANHOLES / PIPELINES.



AutoCAD.DWG VERSIONS OF THIS DRAWING NEED TO BE PRINTED USING THE SDP-STANDARD CTB FILE FOR CLARITY.

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T1	APR 22	TENDER ISSUE	RT	JWC
C1	27.05.22	CONSTRUCTION ISSUE	NJ	NG
C2	01.07.22	RETAINING WALL TO REAR OF NEW SUBSTATION REMOVED. TREE ROOT PROTECTION FENCING REVISED.	PK	NG
C3	18.07.22	PARKING SPACES REVISED, SURFACES AMENDED TO SUIT.	NJ	NG
C4	09.09.22	SURFACE WATER DRAINAGE PROPOSALS REVISED TO ACCOMMODATE PLANNING COMMENTS.		

STATUS

CONSTRUCTION

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CLIENT
OAKFORD HOMES

SITE
FORD ROAD, ARUNDEL

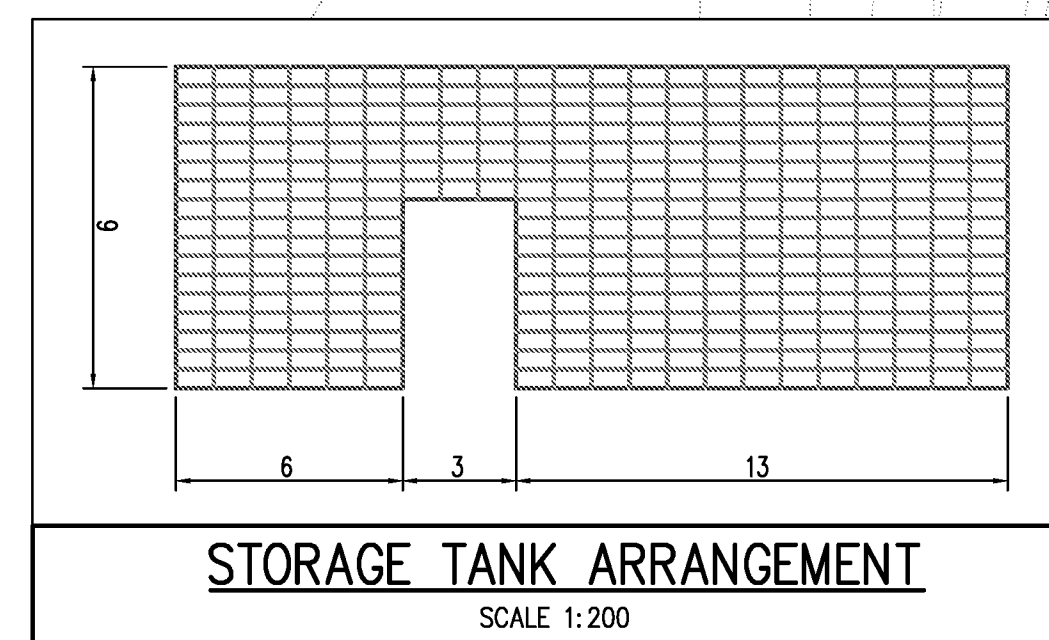
TITLE
Foul & Surface Water Drainage Plan

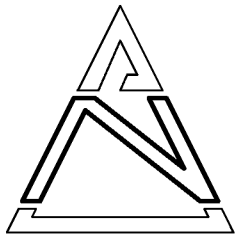
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Tel: 01727 844606. Fax: 01202 490601
Email: sdpsouth@sdpc.co.uk

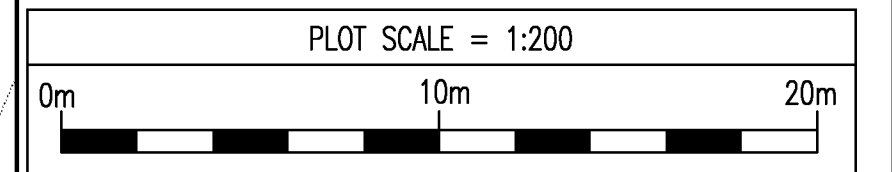
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KEY	
	DENOTES SITE BOUNDARY
	DENOTES HIGHWAY BOUNDARY
	PROPOSED SERVICE MARGIN
+2.800	PROPOSED LEVELS
+2.800	EXISTING LEVELS
FGL+2.80 TYPE=BLOCK B	FINISHED FLOOR LEVEL
25B	125X255MM PCC HALF BATTERED KERB TYPE HB2 – 125MM UPSTAND
50B	125X150MM PCC BULLNOSE KERB TYPE BN 50MM UPSTAND
6B 25B	125X150MM DROPPED KERB –TYPE BN 6MM UPSTAND PEDESTRIAN CROSSING 25MM UPSTAND VEHICULAR CROSSING
EF	50X150MM PCC EDGING –TYPE EF
CS2	125X150MM PCC CHANNEL BLOCK –TYPE CS2 LAID FLUSH
TE	TIMBER EDGING
BO	BOLLARD

- NOTES
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 3. ALL EXTERNAL WORKS STEPS WITH MORE THAN 3 RISERS REQUIRE A HANDRAIL / GUARDING TO ONE SIDE FOR PART M COMPLIANCE. HANDRAILS MUST BE PROVIDED ON ALL ACCESSIBLE DROPS GREATER THAN 600mm. DETAILS TO BE PROVIDED BY ARCHITECT.
 4. ALL RAMPED APPROACHES TO THE FRONT DOOR OF DWELLINGS WHERE THE GRADIENT IS IN EXCESS OF 1:20 REQUIRE A HANDRAIL TO ONE SIDE FOR PART M COMPLIANCE. DETAIL TO BE PROVIDED BY ARCHITECT.



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REV	DATE	DESCRIPTION	BY	CHK
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C1	27.05.22	CONSTRUCTION ISSUE	JWC	NG
C2	01.07.22	RETAINING WALL TO REAR OF NEW SUBSTATION REMOVED. TREE ROOT PROTECTION FENCING ADDED. SURVEY LEVELS WITHIN RED SITE BOUNDARY LINE REMOVED.	NJ	NG

STATUS

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SITE

FORD ROAD, ARUNDEL

TITLE

Site Levels Plan

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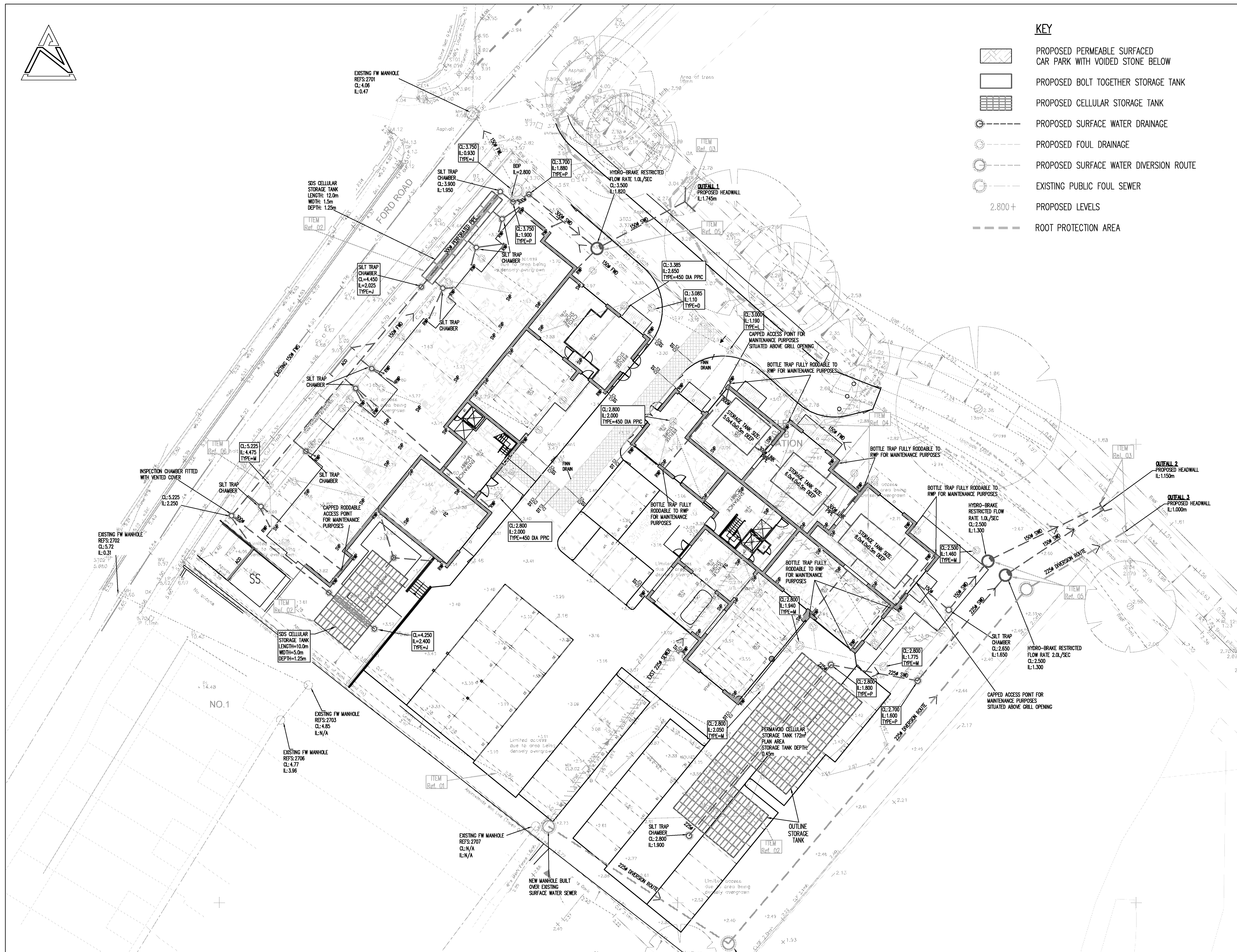
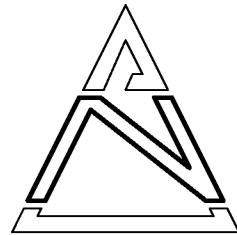
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Tel: 01727 844606, Fax: 01727 830771
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Email: sdpsouth@sdpcc.co.uk

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APPENDIX 3

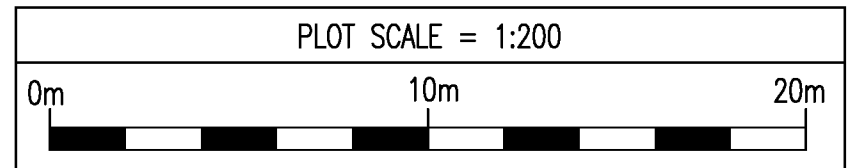
Surface Water Drainage Maintenance Plan



KEY

- PROPOSED PERMEABLE SURFACED CAR PARK WITH VOIDED STONE BELOW
- PROPOSED BOLT TOGETHER STORAGE TANK
- PROPOSED CELLULAR STORAGE TANK
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FOUL DRAINAGE
- PROPOSED SURFACE WATER DIVERSION ROUTE
- EXISTING PUBLIC FOUL SEWER
- PROPOSED LEVELS
- ROOT PROTECTION AREA

NOTES
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PLANNING

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CLIENT
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SITE
FORD ROAD, ARUNDEL

TITLE
SURFACE WATER DRAINAGE MAINTENANCE PLAN

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Email: mail@sdpc.co.uk
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Tel: 01727 844606, Fax: 01202 490601
Email: sdpsouth@sdpc.co.uk

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OAK097_1003	E19-003-1003	P1

ALL PROPOSED INSPECTION CHAMBERS & MANHOLES THAT HAVE A COVER LEVEL LOWER THAN THAT OF THE FLOOD LEVEL OF 4.12m TO BE FITTED WITH A SEALED COVER.

AN ADDITIONAL STORAGE VOLUME OF 164m³ IS PROVIDED WITHIN THE PERMEABLE PAVING SUB-BASE STORAGE STONE (30% VOID RATIO) BASED ON A DEPTH OF 400mm. THIS WILL HELP COMPENSATE FOR THE FLUVIAL FLOOD WATER

APPENDIX 4

SuDS Maintenance Inspection Checklist

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Appendix B: Maintenance inspection checklist

E19-003 Ford Road Arundel - SuDS maintenance inspection checklist (Table B25)			
General information			
Site ID			
Site location and co-ordination (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 (e.g. biodiversity, wildlife and visual aspects)	

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Appendix B: Maintenance inspection checklist

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?			Inspect drainage features to ensure there are no blockages, check to ensure regular maintenance has been carried out, notify the developer and report findings.					
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?			Small spillages of known organic substances to be removed with soak mats. For serious spillages of unknown or toxic compounds contact the EA immediately					
Have any health and safety risks been identified to either the public or maintenance operatives?			Make area safe, provide developer with details of risks to allow for appropriate action to be taken.					
Is there any deterioration in the surface of permeable or porous surfaces (e.g. rutting, spreading of blocks or signs of ponding water)?			Check to ensure regular maintenance has been carried out, report findings to the developer for further investigation.					

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Appendix B: Maintenance inspection checklist

Silt/sediment accumulation								
Is there any sediment accumulation at inlets?								
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 environment regulator)			If yes remove silt -refer to SuDS maintenance plan for silt /sediment removal method for specific drainage feature					
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground			If yes carry out silt removal - refer to SuDS maintenance plan.					
Does permeable or porous surfacing require sweeping to remove silt?			If yes sweep the permeable paving and vacuum if necessary to remove silts.					
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?			Remove litter and build up and any debris from drainage feature and catchment areas. Ensure pipes are unrestricted and free flowing					
Is there any evidence of any other clogging or blockage of outlets or drainage paths?			If yes, check regular maintenance has been carried out and is up to date. Remove any visible blockages. Arrange for survey to be carried out if required.					
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? Check against approved planting regime)			Continue with scheduled maintenance					
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)			If yes check maintenance plan for details and frequency of grass cutting and weeding requirements					
Is there any evidence of invasive species becoming established? If yes, state action required.			If yes inform developer to arrange further assessment					
Infrastructure								
Is there evidence of any accidental damage to the system (e.g. wheel ruts?)			If yes report findings to the developer for further assessment					

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Appendix B: Maintenance inspection checklist

Is there any evidence of cross connections or other unauthorised inflows?			If yes report findings to the developer for further assessment					
Is there any evidence of tampering with the flow controls?			If yes report findings to the developer for further assessment					
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)			If yes report findings to the developer for further assessment					
Above ground tanks								
Inspect tanks for any leaks or damage			If yes report for full details of parts – see O & M manual					
Inspect all suspended rainwater pipes for damage or leaks			If yes report for full details of parts – see O & M manual					
Inspect tank support structure for damage or corrosion			If yes refer back to developer					
Suitability of current maintenance regime								
Continue as current increase maintenance Decrease maintenance.			If current maintenance regime is found unsuitable, provide information to the developer to enable maintenance plan to be reassessed.					
Next Inspection								
Proposed date for next inspection								

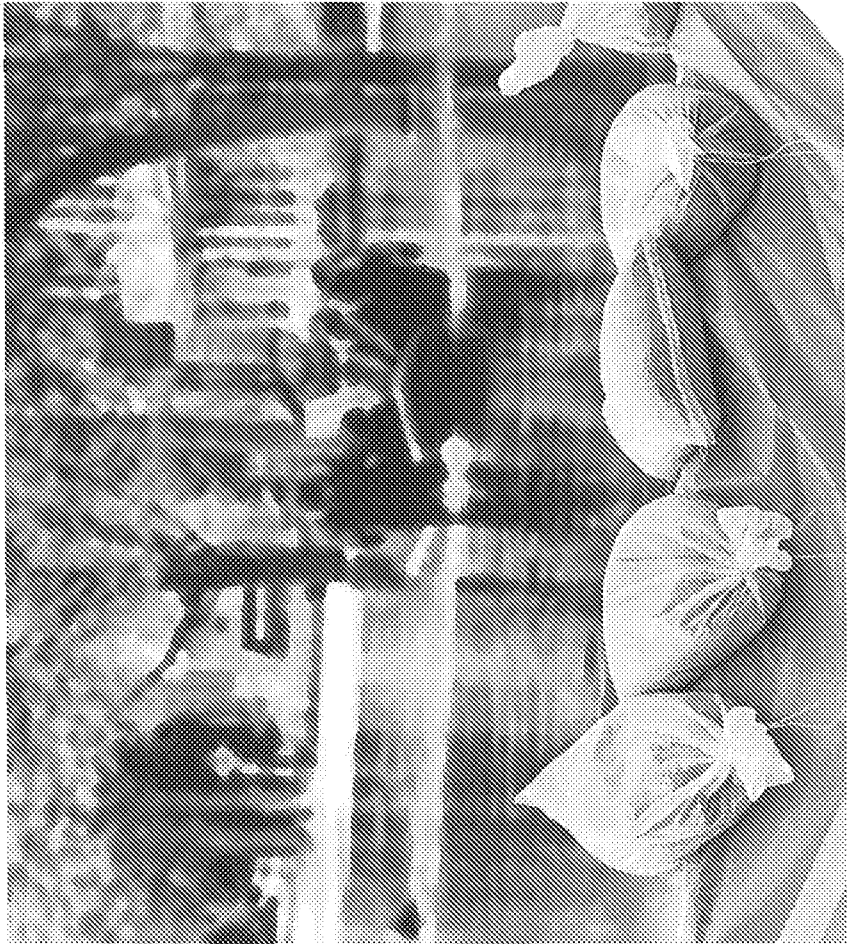
APPENDIX 5

Product Specific Maintenance Details

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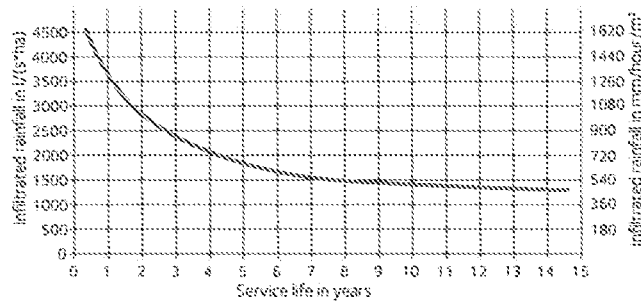
Many are among the worst off people in a troubled world. During the past year, the company has been turned off. During the past year, the company has been turned off. During the past year, the company has been turned off.

Only use these tags: `<math>`, ``



Surface infiltration rates and clogging

Research has demonstrated the build-up of detritus in the jointing aggregate will reduce the infiltration, but rate of reduction will decrease and stabilise over time. This effect is summarised in below.



The inclusion of the upper geotextile between the laying course and sub base may also reduce the infiltration rate through the pavement.

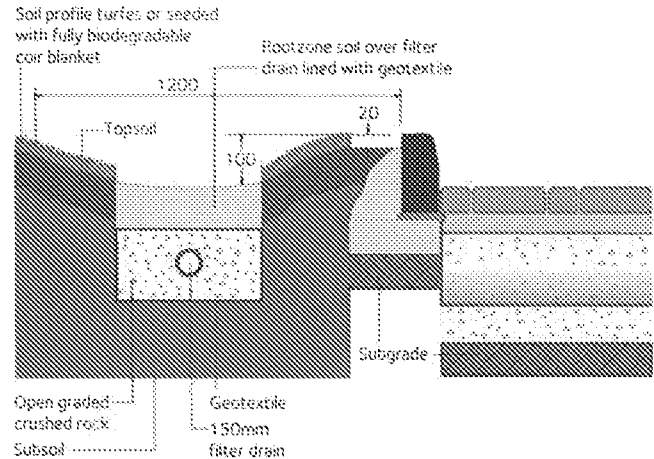
Typical rainfall in the UK is about 20mm/hour and an extreme event being 75mm/hour. Experiments have demonstrated that the infiltration rate for a newly laid Omega Flow block surface is over 4,000mm/hour. The permeable sub-base will have an infiltration rate many times this, at least 40,000 mm/hour.

The design procedure in the British Standard, Interpave guidance and PermCalc assumes the infiltration rate is approximately 400mm/hr, just 10% of the initial infiltration rate through the pavement surface, to allow for long term clogging, therefore providing a significant safety margin.

However, to ensure a long service life, it is recommended that care is taken to protect the pavement during and after construction to minimise clogging of the joints.

Landscaping adjacent areas

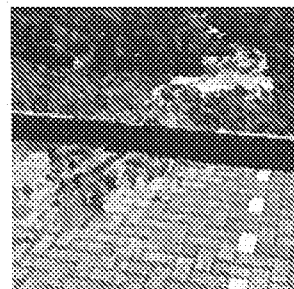
Landscaping and adjacent areas should be designed such that it does not cause soil, mulch and other materials to be washed onto the permeable surface causing clogging of the joints. A typical detail is shown in the diagram below.



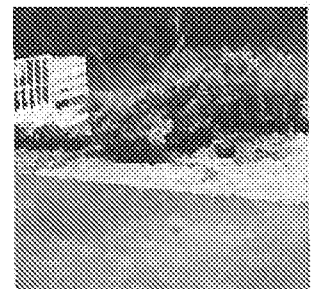
Landscaping should also be designed so that surface of the pavement is not continuously in the shade, which promotes the growth of moss in the joints.

Construction site precautions

Preventing and diverting impermeable contaminants such as soil and mud from entering the permeable sub base and permeable surface both during and after construction is imperative to ensure that the pavement remains permeable. Simple practices such as not allowing the storage of materials that could clog the pavement, such as top soil or mulch on the paved areas, and not allowing muddy construction equipment on the pavement are recommended. Additional measures such as installing silt fences and temporary drainage swales which divert runoff away from the area should be considered.



Do not store materials on the pavement that may lead to clogging.



Protect the newly laid paving from contaminated run off

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Brett Landscaping operate in the highest levels of independent certification

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- BS EN ISO 14001 Environmental Management System
- OHSAS 18001 Health and Safety Management System

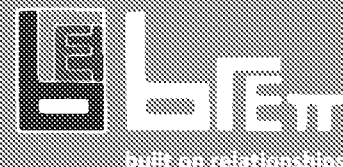
In addition, when designing projects under BREEAM we are also holders of
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All of these can help significantly when designing for sustainability.

PERMEABLE PAVEMENTS

COMMERCIAL MAINTENANCE GUIDE

CONTINUED



Health & safety and accessibility

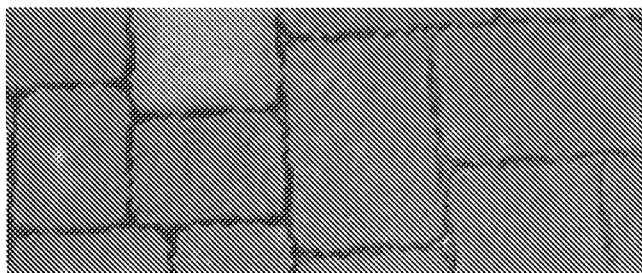
There is a perception that standing water in a permeable pavement can cause a potential health and safety issue, either due to stagnation of the water or freezing. This is not the case, as the pavement, if designed correctly, will drain after a rainfall event and thus there should not be water standing for any significant period of time.

Maintenance

As discussed (above), the infiltration rate of a permeable pavement will decrease due to the build-up of detritus in the jointing aggregate but stabilise with age. However, evidence suggests that infiltration rates always remain significantly higher than rainfall intensity, so, even without maintenance, there should be sufficient infiltration to accommodate rainfall events. It may be advisable to sweep occasionally but this should not be any greater than is normally undertaken on traditional pavements. However in reality, experience suggests that this is rarely carried out.

Unlike a conventional drainage system, a permeable pavement can be quickly visually assessed, particularly after a rain event as water ponding on the surface will indicate localized clogged joints may require remedial maintenance to restore the permeability. If the joints do clog completely it will be possible to rehabilitate by removing the clogged jointing aggregate, hand brooms, water blasting or a road sweeper, however care must be taken to ensure that only the detritus is removed. It may be necessary to top up the joints with new jointing aggregate.

To maintain structural integrity it is important to ensure that all the joints are full with the correct permeable aggregate. It may be necessary, particularly in the early life of the pavement, to top up the joints with permeable jointing aggregate.



The joints on the right are full, whereas the joints on the left require topping up with new joint aggregate.

Depressions, rutting and cracked or broken blocks, considered to be detrimental to the structural performance of the pavement or a hazard to users, will require appropriate corrective action.

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PERMEABLE PAVEMENTS FREQUENTLY ASKED QUESTIONS

Question: Why should I consider using a permeable pavement?

Answer: Planning for climate change is today a major driver for construction and the built environment. Environment Agency research following the flooding events in 2007 showed that approximately 66% of flooding was caused by surface water runoff.

The UK climate appears to be getting warmer and wetter and much of the existing drainage network is at near or full capacity. This means that it can't cope with the additional volumes of surface water drainage generated by new development, resulting in a significantly increased flood risk.

To address these issues the Government passed The Flood and Water Management Act (2010) that applies to England and Wales. This Act takes forward some of the proposals in previous strategy documents published by the Government and replaces existing drainage regimes with a Sustainable Drainage System (SuDs) regime.

Permeable pavements are seen as offering a cost effective method of attenuating and filtering surface water and satisfying the SuDs philosophy.

Question: How does a permeable pavement work?

Answer: Permeable pavements work by replicating the drainage patterns of an undeveloped site where up to 95% of rainfall is absorbed into the land with only 5% becoming surface water runoff. In this way the flow is attenuated, removing the early spike in surface water runoff and relieving pressure on the system downstream.

Depending upon site conditions it may be possible to allow the captured water to slowly infiltrate into the ground or discharge into the next stage of the management train. The typical flow rate of water leaving a permeable pavement is 2 to 7 l/s/ha (litres/second/hectare). Both these methods serve to significantly reduce the risk from surface water runoff especially when tied into a wider flood planning strategy.

Question: How does using a permeable pavement improve water quality?

Answer: Research by the Construction Industry Research and Information Association (CIRIA) has shown that a permeable pavement can remove 60 – 95% of suspended solids and 70 – 90% of hydrocarbons. The result of this is that the water infiltrating into the ground, or draining into the next stage of the management train, is significantly higher quality than if using an impermeable surface coupled to attenuation tanks.

Question: Does the Flood and Water Management Act (2010) cover permeable pavements?

Answer: Yes. Permeable pavements are seen as a vital component within a Sustainable Drainage System (SuDs) Management Train – this forms a key component of the future strategy for water management within the UK.

In the future it will be a mandatory requirement for surface water management to be taken into account at the design stage and there is no longer an automatic right of connection to the main sewer. Developments will need to comply with proposed National Standards which will be policed by SuDs Approval Bodies (SAB's). This engagement with the local authorities is a key point in gaining adoption of permeable pavements.

Question: Can I gain any benefits from using permeable pavement under the Code for Sustainable Homes (CFSH)?

Answer: Yes. Using Permeable pavements in a housing development can gain credits as follows.

Category 4: Surface Water Run off

1 credit because there is no run off from the first 5mm of rainfall (see Interpave guidance for justification)

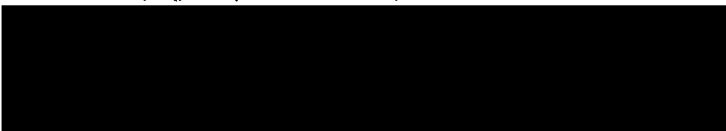
1 credit for improving the water quality

2 credits are available if flood risk is reduced. This includes a range of criteria, including the implementation of SuDs and permeable pavements

Category 8: Management (Home User Guide)

Up to 3 credits are available for the provision of a 'Home User Guide' for a large range of criteria, including details of SuDs within the property boundary, overview of reasons, benefits and advice on maintenance and operation

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 BES 6001 Responsible Sourcing of Construction Products (Very Good)
 All of these can help significantly when designing for sustainability

Question: Can I gain any benefits from using permeable pavement under Building Research Establishment Environmental Assessment Method (BREEAM)?

Answer: Yes. The CfSH formula is to be adopted in commercial/domestic buildings. In this respect BREEAM should really be seen as the Code for Sustainable Buildings. As such, permeable pavements should be seen as an important feature of non-domestic developments where the paved areas and subsequent risk of flooding as a result of climate change is a major consideration.

Question: Are there any other reasons why I should look at using permeable pavements?

Answer: Yes! In addition to making a more pleasant environment, research has shown that removing the risk of standing surface water makes our streets safer as vehicles are less likely to aquaplane. This comes on top of the 2.5 – 4.5 mph reduction in traffic speeds noted in the Manual for Streets which means that, in addition to enhancing the aesthetics of our urban areas, permeable pavements can also help to significantly increase safety and comfort for all road users.

Question: It appears permeable pavements are limited to car parking areas as there is little design information to support other applications. Is this true?

Answer: No. There are established design guidance documents for a wide range of applications from car parks to lorry parks/ bus terminals (up to 15msa). More details can be found in the Interpave guidance *Guide to the design construction and maintenance of concrete block permeable pavements* (Edition 6 2009) and British Standard document BS7533-13:2009 *Pavements constructed with clay, natural stone or concrete paving blocks and flags, natural stone slabs and setts and clay pavers*.

Permeable pavements can also be used in highly trafficked and highly loaded areas such as container ports. Information in designing for these applications is contained in an Interpave document *Heavy Duty Pavements – The Structural Guide of Heavy Duty Pavements for Ports and Other Industries* (Edition 4, 2007)

Brett Landscaping and Building Products have developed PermCalc – an on-line software tool for designing cost effective permeable pavements www.permcalc.co.uk

Question: Can the design life be in excess of 10 years?

Answer: Yes. There is no reason why they cannot be designed to a 20 or 25 year, or even longer design life, in the same way as normal road pavements are. The structural design methodology is based upon predicting the number of Million Standard Axles (msa's) which the pavement is expected to endure over its design life.

Question: What are the maintenance implications to ensure that the permeable paving performs at its design level?

Answer: Even if there is no maintenance it is unlikely that the whole pavement surface will become impervious. The Interpave, British Standard and PermCalc methodologies are based upon an initial infiltration rate of 4000 mm/hour through the paving surface but in the design procedure this is reduced by 90% to 400 mm/hour to allow for significant clogging of joints.

Question: Are there any special requirements regarding adjacent landscape areas?

Answer: Yes. It is good practice to ensure that any adjacent landscaped areas are designed to avoid mud and debris being washed and/or deposited on the pavement. This may necessitate the creation of a buffer zone at the toe of the slopes to avoid mud and other detritus washing onto the pavement.

Question: Can a permeable pavement be trafficked during the construction process or used to provide temporary access, as the current practice for constructing housing projects?

Answer: No – not without special precautions. During the construction process care must be taken to ensure that the pavement is not contaminated with general construction mud and other detritus. If there is a need to use the road for temporary access then the permeable sub-base can be overlaid with Dense Bitumen Macadam (DBM) to form a temporary site running surface.

The DBM surface remains in place permanently, but prior to the installation of the block layer, the DBM surface is cleaned and sufficient holes are punched or cored through it to allow water to flow into the sub-base. It is recommended to provide 75 mm diameter holes on a 750 mm orthogonal grid. The DBM thickness required and any compensation for a reduction in the hydraulic storage capacity must be taken into account in the design process.

It will be necessary to provide a temporary surface water management solution to deal with surface water runoff prior to converting the pavement into a permeable pavement.

Question: What maintenance is required?

Answer: Very little. The maintenance of permeable pavements is different to conventional pavements but is no more onerous than the requirements for conventional pavements which should have their oil interceptors maintained and their gullies cleaned out on a regular basis.

It is advisable to ensure that the joints remain full with suitable jointing aggregate. If there is any ongoing evidence of water ponding on the surface this will indicate that the joints have become impervious. If a site investigation proves this to be the case and it is considered that this is significantly impeding the hydraulic performance of the pavement then remedial action should be undertaken.

A sweeper with a jet wash and suction provides the best method of cleaning and removing detritus from the joints. If it is necessary to remove some or all the jointing aggregate then the aggregate should be replaced with suitable new aggregate.

Question: There is little information on the hydraulic characteristics (inflow, outflow, losses) from permeable pavements. How can the design still be undertaken?

Answer: This is really only an issue for those who are immersed in drainage research! There is enough design guidance, such guidance produced by Interpave – The Precast Concrete Paving and Kerb Association and the British Standards Institute.

Question: It has been stated that the poor performance of some permeable pavements is attributable to defects in the design, poor construction techniques, low permeability sub soils or lack of adequate preventative maintenance. Is this true?

Answer: This is true! It is also true that any other civil engineering structure that has a defective design, poor construction and lack of maintenance will also have poor performance. A correctly designed pavement using the appropriate design parameters and soil conditions, built in accordance with good construction practice will have a long life-span and be able to carry the required traffic loads without distress.

Question: What happens if the water in the sub-base freezes?

Answer: A permeable pavement acts as an insulator so the depth of frost penetration is low. Extensive research undertaken by Fergusson in the US and North America investigating all types of permeable pavements demonstrates that they are not adversely affected in cold climates.

Question: Do I need to consider the effects of frost heave?

Answer: Frost heave does not occur if the permeable pavement is designed correctly given the high void space in the sub-base. If the pavement is full of water and prolonged freezing does occur (an extremely unlikely combination in a temperate climate as the pavements are designed to drain quickly, typically within 24 – 48 hours) then ice mushrooms may appear at the surface in the joints between the blocks as the water expands in the pore spaces between the aggregates. The only record of this happening is in Mid Western USA where the winter climate is far more severe than in the UK. It should not be an issue in a correctly designed pavement in the more temperate UK climate.

Question: Should the pavement be inspected several times in the first few months, followed by regular annual maintenance?

Answer: Yes – this is the same as the recommendations for any drainage systems.

Question: What California Bearing Ratio (CBR) value should be used for the design?

Answer: The design CBR should be the lowest value which the subgrade can be expected to reach during the life of the pavement. This will vary depending upon the pavement drainage requirements:

In the case of System A, total infiltration or System B, partial infiltration where the water drains into the sub grade, then the soaked CBR value should be used. In the case of System C, no infiltration or tanked system, where water is contained within the pavement and does not percolate into the sub grade, this will normally be the Equilibrium Suction Index.

Question: Are permeable pavements needed in all of the trafficked areas of the development?

Answer: No. It is not necessary to design all the surface areas as permeable, as permeable pavements may have spare hydraulic storage capacity that can cope with run-off from adjacent impermeable surfaces including roofs.

It is normal practise to limit a ratio of impermeable to permeable area to about a ratio of 2:1. Ratios greater than 2:1 usually result in the permeable sub-base thickness becoming excessive and not cost-effective. Also, silt loads flowing onto the permeable pavement become excessive at ratios greater than this which significantly increases the risk of clogging.

Question: How do we deal with the maintenance of services and utilities within a permeable pavement?

Answer: Ideally sites should be planned to avoid the need for placing services underneath, or within, a permeable pavement.

Utilising the 2:1 rule and with appropriate layout design, services and utilities can be located within conventional impermeably paved areas creating service corridors or verges. These remove the need to accommodate the services within or under the permeable paved areas thereby avoiding any service excavations into, or through, a permeable pavement.

This approach can also form a key part of the overall design both visually and technically allowing designers to use their imaginations and realise the aspirations of Manual for Street 1 & 2.

PermCalc software identifies spare hydraulic capacity. This assists the designer in making informed decisions on locating services outside of the permeable areas.

Question: What is the cost of a permeable pavement and is it more expensive than conventional pavements?

Answer: There is no simple answer. Generally the initial construction costs of a permeable pavement are comparable with conventional pavements. The sub-base may be thicker and more expensive than conventional pavements but is balanced out by reduced ground works and negating the need for items such as gullies, connections and oil interceptors. Interpave has demonstrated that the Whole Life Costs of a permeable pavement in many cases provide a more cost effective solution. See www.paving.org.uk

For a particular project the only accurate method to quantify costs is to undertake a design and then cost this design. Brett has developed PermCalc, design software which uses the British Standard methodology as a basis for generating costed design suggestions. Therefore provides the capability to quickly run various 'what if' calculations to fully assess the cost implications based upon default construction rates or the client's construction rates.

PermCalc is available at www.paving.co.uk

Question: The Interpave guidance states that permeable pavements can be constructed with zero gradient. How does the water drain from these pavements?

Answer: There should be no standing water on the surface as water drains immediately into the pavement. For System C pavement, the subgrade will need to be designed with gradients to ensure drainage of the sub-base aggregate and to prevent ponding within the sub-base.

However, in reality there will be virtually no zero gradient sites as most sites are designed with a gradient for fit with the topography

Question: Can permeable pavements be used on steep sites?

Answer: Yes, but it may be necessary to increase the sub-base depth to compensate for the loss of storage capacity due to the slope or to construct dams or baffles within the sub-base to restrict the flow of water otherwise the water within the sub-base may discharge through the block surface at a lower level.

PermCalc automatically checks and increases the sub-base depth up to an arbitrary limit and if there is still insufficient hydraulic storage capacity, will introduce internal dams and determine the spacing of these dams. See www.permcalc.co.uk

Question: Is it possible to use fill material under a permeable pavement?

Answer: Yes, if filling is required to build up levels, then the fill material must have similar or superior properties to the existing subgrade after the completion of the filling operation.

For System A & B pavements, in addition to above requirement, the permeability must similar or superior and the fill material unaffected by the ingress of water.

Consideration must be given if it is proposed to use crushed concrete in System A or System B pavements as fill material. After water has infiltrated through the crushed concrete is it is likely that it will have an elevated alkalinity. This may not be desirable or be allowed to infiltrate into the sub grade or be discharged from the site.

Hydro International Warranty, Maintenance and COSHH Statement

This statement covers all Hydro International Hydro-Brake® Optimum, Hydro-Brake® and S-Type Vortex Flow Control units (hereafter referred to as "Flow Control").

Defects Liability Period Warranty

The standard Hydro International warranty covers products for one year from date of purchase and will only be considered for those defects or faults reported directly to Hydro International in writing. Warranties will not be considered for defects or faults caused by accident, acts of vandalism or unauthorised repair/rectification. Please Contact Hydro International for product specific details.

Maintenance

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size. The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced, please do not hesitate to contact the company so that an investigation may be made.

All Flow Control units are typically manufactured from grade 304 Stainless Steel, and if required they can also be manufactured in grade 316 Stainless Steel. Both materials have an estimated life span in excess of the design life of drainage systems.

COSHH

Flow Control units are manufactured from Stainless Steel, which is not regarded as hazardous to health and exhibits no chemical hazard when used under normal circumstances for the stated applications.

Manual Handling

The handling of Flow Control units should be in accordance with the current legislation and regulations:

- The Health and Safety at Work Act 1972
- The Management of Health and Safety at Work Regulations 1999
- The Manual Handling Operations Regulations 1992

All published and printed by the Health and Safety Executive.