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FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

Dementia Care Centre on land to the rear of **Baird's**
Farm Shop, Crookthorn Lane

Document reference: 2868-BCH-ICS-RP-C-07.003

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April 2018
Project Number: ICS2868

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Date :	11 th April 2018
Project Number:	ICS-2868
Project Name :	Dementia Care Centre on Land to the Rear of Bairds Farm Shop
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Document Revision Record

Issue	Compiled By	Checked By	Date	Description
Draft	MBD	TST	11 April 2018	Initial Issue
A	TST	DJ	30 April 2018	Report updated to cover Lidsey Foul Water Assessment and Engineering Statement
B	TST	DJ	30 May 2018	Drainage Strategy amended
C	TST	DJ	19/10/2020	Drainage strategy and outfalls amended

Fore word

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1.0 Summary

A Flood Risk Assessment (FRA) and Drainage Strategy have been undertaken to accompany the planning application for the proposed development on land to the rear of Baird's Farm Shop, Crookthorn Lane, Climping, Littlehampton, BN17 5SN. This report has been prepared by Infrastruct CS Ltd on behalf of Brackley Investments Ltd in accordance with the guidelines set out in the National Planning Practice Guidance.

The following table is an overview of the flood risk for the proposed development of the site, based upon currently available information and finds the following –

ITEM	RESPONSE
Site Location	The site is located on land to the rear of Baird's Farm Shop, Crookthorn Lane, Littlehampton, BN17 5SN. The existing vehicular access from Crookthorn Lane (A259).
Size and Current Land Usage	The site covers an approximate area of 0.84Ha, which consists of a greenfield land with low planting.
Flood Zone	Flood Zone 1
Fluvial Flood Risk	low – Refer to Section 6.1
Overland Flood Risk	low – Refer to Section 6.2
Groundwater Flood Risk	Medium – Refer to Section 6.3
Sewerage Flood Risk	low – Refer to Section 6.4
Artificial Flood Risk	low – Refer to Section 6.5
Proposed Development	The site is to be developed to provide a new care home building with 64 beds, as well as 28 parking spaces and associated gardens.

Based on this assessment, it is concluded that in accordance with the Flood risk vulnerability and flood zone compatibility table in Section 5.6 from the Planning Practice Guidance document, the report considers the proposed development appropriate.



2.0 Introduction

2.1 Commission

Brackley Investments Ltd has commissioned Infrastruct CS Ltd, to prepare a Flood Risk Assessment (FRA) to support a planning application for the development of land to the rear of Baird's Farm Shop, Crookthorn Lane, Littlehampton, BN17 5SN.

2.2 Guidance

This flood risk assessment has been compiled in accordance with the recommendations of the National Planning Policy Framework and the National Planning Practice Guidance.

2.3 Aims and Objectives

The purpose of this flood risk assessment and drainage strategy is to assess the potential flood risks by and to the proposed development. It will identify the flood risk zone, potential sources of flood risk, consider the proposed drainage and will be used to support the proposed planning application.

3.0 Site Details

3.1 Location

The site is located 1Km north off the coast and 2.2 Km west of River Arun. The existing vehicular access is from Crookthorn Lane (A259) to the north. The site is bound by the Baird's Farm Shop and Café to the north, Climping Street to the west, a number of detached properties to the south and open green fields to the east.

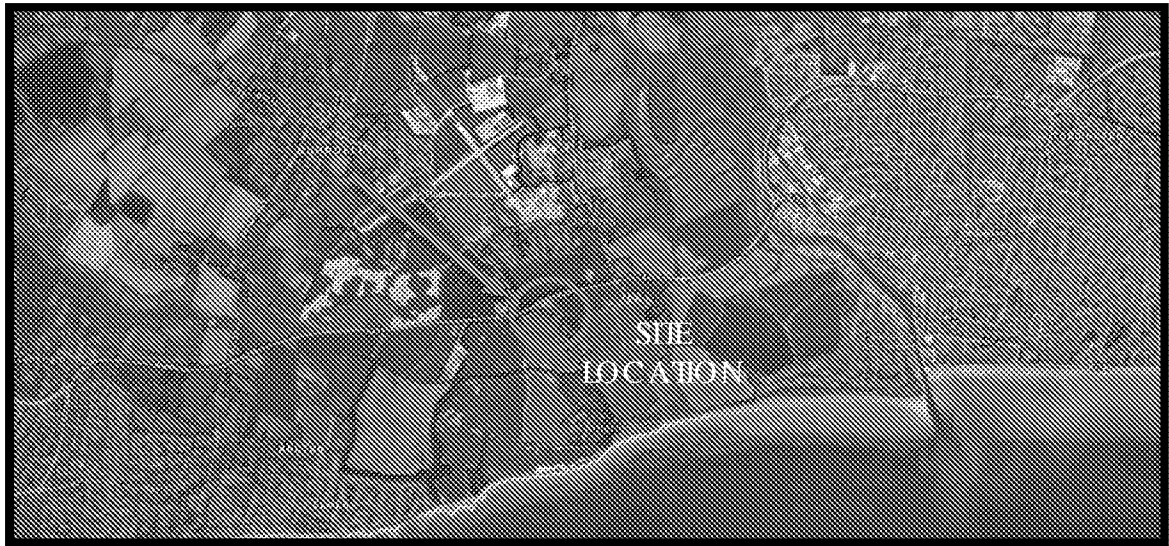


Fig 3.1.1 - Site location



Fig 3.1.2 – Site Context

3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is:

499971E, 101709N (Nat Grid SU99971 01709)

3.3 Topography and Site Description

The site covers an approximate area of 0.84Ha, which consists of greenfield land with low planting. Access to the site is via Crookthorn Lane.

Levels vary within the site between 5.97mAOD to the north, close to the existing shop, falling in a southerly direction down to a level of 5.05mAOD in the southernmost corner of the site. See Appendix A for the topographic survey.

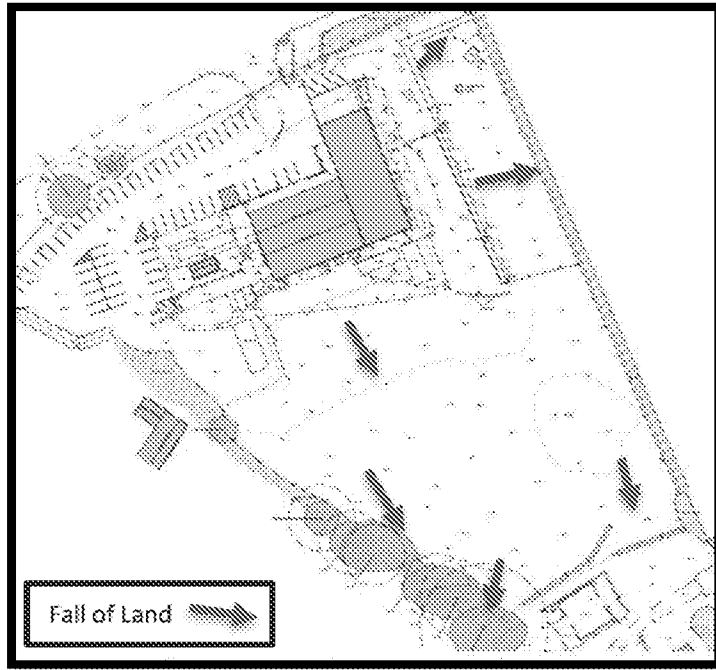


Fig 3.3 – Site Falls

3.4 Ground Conditions

Intrusive ground investigation works have been undertaken on the site and ground conditions were found to consist of a minimal thickness of topsoil (up to 0.20m) over yellowish sandy clay. The access road has around 0.55m of made ground overlying the natural ground.

3.5 Ground Water

Groundwater was encountered on site at a depth of 1.00m BGL.

3.6 Existing Site Drainage

The Southern Water records show a foul water sewer along Climping Street, approximately 1.5m deep, to the west of the site. The head of the surface water sewer, also within Climping Street, is located 75m to the south of the site. There is also a private surface water sewer which runs between the ditch system on the A259 and runs due south and connects into the ditch system 50m to the south of the site. This ditch system discharges into the aforementioned surface water sewer within Climping Street. The invert levels of this network are unknown. Southern Water sewer records found within Appendix B.

3.7 Existing Water courses

According to the Environment Agency map, the nearest main river water course to the site is the Rye bank Rife, that runs 750m to the south of the site. River Arun lies 2km to the east, reaching sea only 1 mile downstream. As mentioned in section 3.6 above, there is a

small section of ditch which runs east to west, 50m to the south of the site. This conveys flows from the private piped system into the Southern Water public surface water sewer in Climping Street.

3.8 Environment Agency Groundwater and Aquifer Protection

A study of the aquifer maps on the Environment Agency website revealed the site to be located on a Secondary Aquifer within the superficial deposits and on a Principal Aquifer within the bedrock deposits. The Environment Agency records also show that the site is located outside of any Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

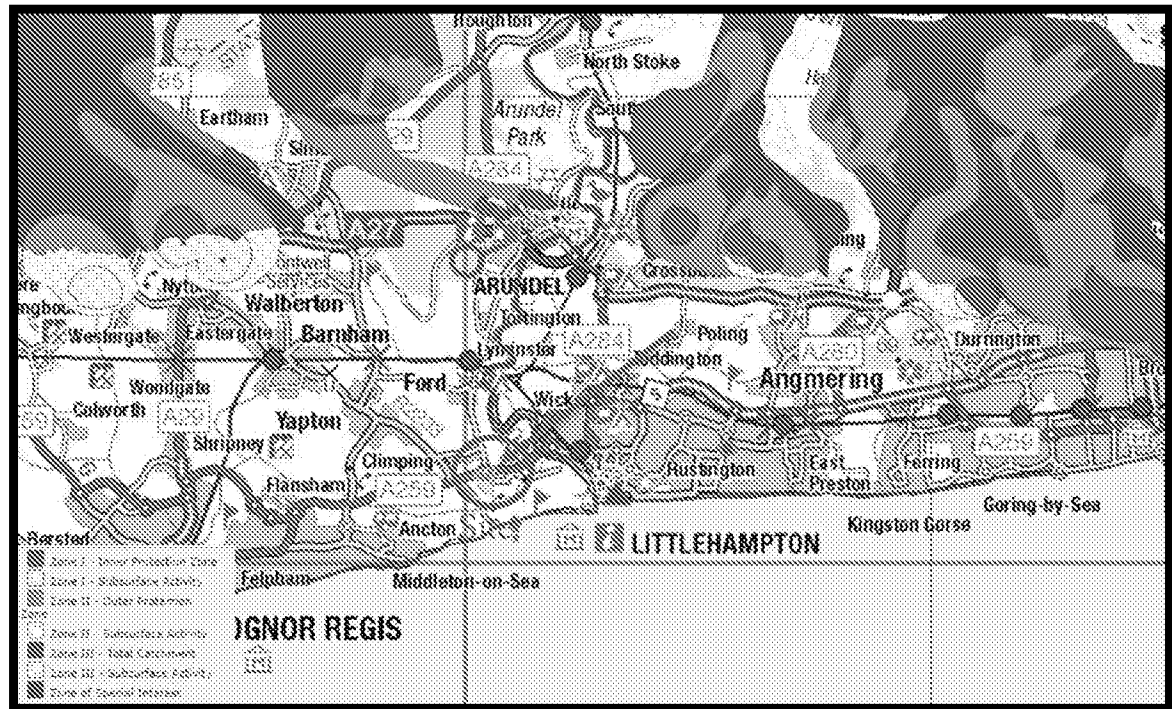


Figure 3.8.1 – Groundwater Source Protection Zone map from the Environment Agency website.

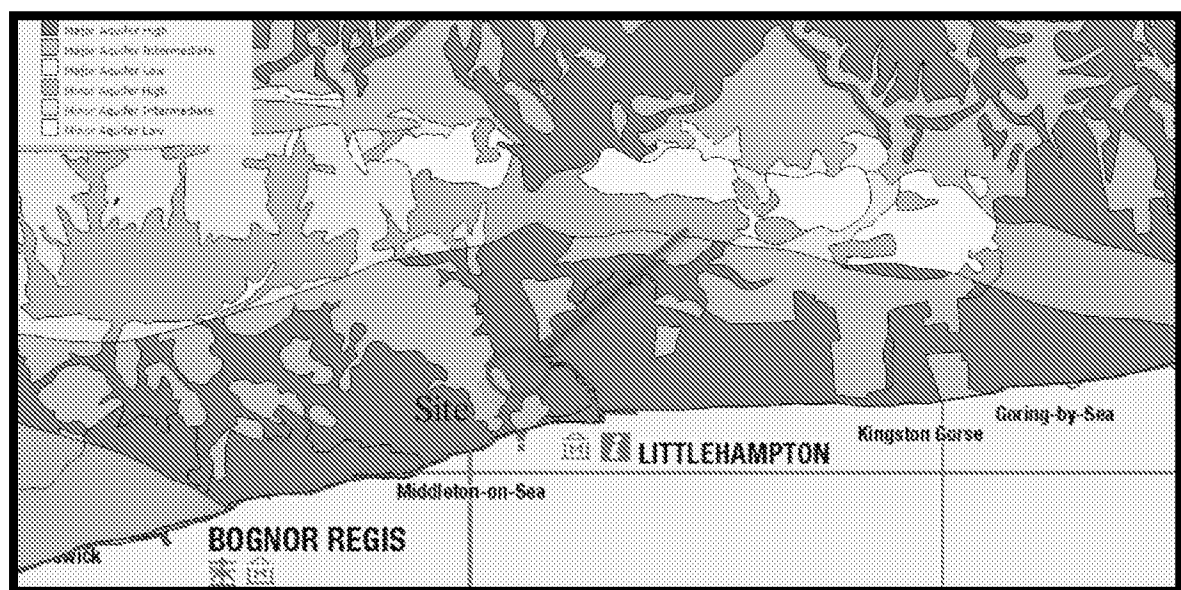


Figure 3.8.2 – Aquifer map from the Environment Agency website.



4.0 Proposed Development

The site is to be developed to provide a new dementia care centre with 64 beds, as well as 28 parking spaces and associated gardens. The proposed development plans can be found in Appendix C.

5.0 Flood Risk Policy

5.1 Environment Agency Flood Map

The flood map for the development site shown below suggests that the site wholly falls within flood zone 1, which is defined as land assessed as having a less than 1 in 1000 annual probability of river flooding in any one year. Flood map from Arun District Council SFRA can be found in Appendix D.

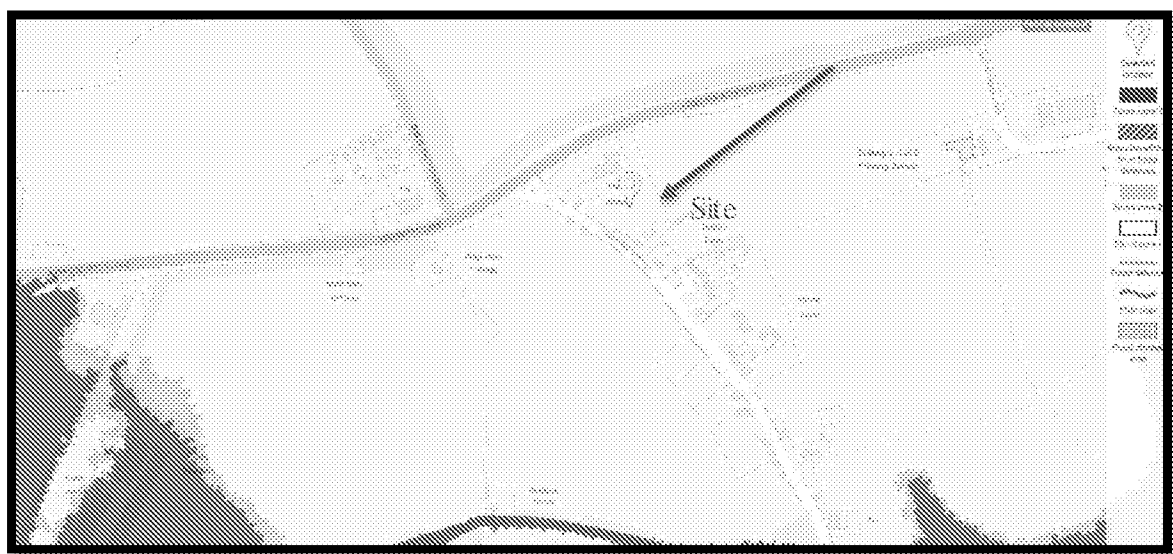


Fig 5.1 – Environment Agency Flood Zone map

5.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) give direction for development with respect to flooding.

These documents promote a sequential approach to encourage development away from areas that may be or are susceptible to flooding. In doing so it categorizes flood zones in the context of their probability of flooding, as shown in the table within Section 5.3 below.



5.3 Flood Zone Definition

The National Planning Policy Framework Definition of Flood Zones

Flood zone	Physical	Risk	Probability of flooding
1	< 1 in 1000 year	<1 in 1000 year	Low probability
2	Between < 1 in 1000 year and 1 in 100 year	Between <1 in 1000 year and 1 in 200 year	Medium Probability
3a	> 1 in 100 year	> 1 in 200 year	High probability
3b	Either > 1 in 20 or as agreed between the EA and the LPA	Either > 1 in 20 or as agreed between the EA and the LPA	Functional flood plain

5.4 Flood Zones – Table 1 NPPG - Flood risk and coastal change

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - Low Probability
Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses
All uses of land are appropriate in this zone.
FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.



5.5 Flood Risk Vulnerability Classification – Extract from Table 2 NPPG – Flood risk and coastal change

More Vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.
- Non-residential uses for health services, nurseries, and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

5.6 Flood Risk Vulnerability & Flood Zone Compatibility Table

Vulnerability classification flood zone	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
1	√	√	√	√	√
2	√	√	Exception test required	√	√
3a	Exception test required	√	x	Exception test required	√
3b	Exception test required	√	x	x	x

√ Development is appropriate x development is not appropriate

The above table, taken from Planning Practice Guidance (table 3), confirms that care homes within flood zone 1 is appropriate development.

5.7 Other Flooding Mechanisms

In addition to the potential for assessing flooding from fluvial and tidal sources NPPF also requires that consideration is given to other mechanisms for flooding:

- Flooding from land – intense rainfall, often in short duration, that is unable to soak into the ground or enter drainage systems, can run rapidly off land and result in local flooding.
- Flooding from groundwater – occurs when water levels in the ground rise above the surface elevations.
- Flooding from sewers – In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water sewers known as combined sewers. Flooding can result causing surcharging when the sewer is overwhelmed by heavy rainfall.
- Flooding from reservoirs, canals and other artificial sources – Non-natural or artificial sources of flooding can result from sources such as reservoirs, canals lakes etc, where water is held above natural ground levels.



5.8 Local Strategic Flood Risk Assessment SFRA and Local Policy

West Sussex LFA has adopted the policies shown below to statutory policy and best practice. Policies 1 to 6 set out the requirements for a drainage strategy to be compliant with the NPPF and Non-Statutory Technical Standards for Sustainable Drainage. Policies 7 to 10 set out expectations to be considered within a drainage strategy in response to environmental legislation and guidance that West Sussex County Council and the Local Planning Authorities have a duty to comply with. All the policies reflect the requirements of the Local Flood Risk Management Strategy, Surface Water Management Plans and Local Planning Authority Local Plans.

SuDS Policy 1: Surface runoff not collected for use must be discharged according to the following discharge hierarchy:

- to ground
- to a surface water body
- to a surface water sewer, highway drain, or another drainage system
- to a combined sewer where there are absolutely no other options, and only where agreed in advance with the relevant sewage undertaker.

The selection of a discharge point should be clearly demonstrated and evidenced

SuDS Policy 2: The drainage scheme proposed is to:

- a. protect people and property on the development site from flooding; and,
- b. avoid creating any additional flood risk outside of the development in any part of the catchment, either upstream or downstream.

Any drainage scheme must manage all sources of surface water, including exceedance flows and surface flows from offsite, provide for emergency ingress and egress and ensure adequate connectivity.

For large sites where development is to be phased, there will need to be a strategic site surface water management system that allows different parts of the site to be developed at different times while ensuring that each of the design criteria can be met.

SuDS Policy 3: Mimic Natural Flows and Drainage Flow Paths

1. Drainage schemes should be designed to match greenfield discharge rates and follow natural drainage routes as far as possible; pumps should therefore not form part of drainage schemes.
2. Greenfield runoff should be calculated from IH124 or a similar approved method. SAAR and any other rainfall data used in run-off storage calculations should be based upon FEH rainfall values.

SuDS Policy 4: Seek to Reduce Existing Flood Risk

1. New development should be designed to take full account of any existing flood risk, irrespective of the source of flooding.
2. Where a site or its immediate surroundings have been identified to be at flood risk, all opportunities to reduce the identified risk should be investigated at an early stage and subsequently incorporated at the detailed design stage.



SuDS Policy 5: Maximise Resilience

1. The design of the drainage system must account for the likely impacts of climate change and changes in impermeable area over the design life of the development. Appropriate allowances should be applied in each case.
2. A sustainable drainage approach which considers control of surface runoff at the surface and at source is preferred and should be considered prior to other design solutions.
3. Culverting an existing watercourse should only be considered if there is no feasible alternative.

SuDS Policy 6: Design to be Maintainable

1. A drainage scheme Management and Maintenance Plan should be prepared which demonstrates the function of the drainage system and a schedule of activities, access points, outfalls and any biodiversity considerations.
2. The Management and Maintenance Plan should also include an indication of the adopting or maintaining authority or organisation and may require inclusion within a register of drainage features.

SuDS Policy 7: Safeguard Water Quality

1. When designing a surface water management scheme, full consideration should be given to the system's capacity to remove pollutants and to the cleanliness of the water being discharged from the site, irrespective of the receiving system.
2. Interception of small rainfall events should be incorporated into the design of the drainage system.

SuDS Policy 8: Design for Amenity and Multi-Functionality Drainage design should from the outset consider opportunities for inclusion of amenity and biodiversity objectives and thus provide multi-functional use of open space with appropriate design for drainage measures within the public realm.

SuDS Policy 9: Enhance Biodiversity Drainage design should from the outset consider opportunities for biodiversity enhancement, through optimising the scope for surface systems, consideration of connectivity to adjacent water bodies or natural habitats, and appropriate planting specification.

SuDS Policy 10: Link to Wider Landscape Objectives Drainage design should from the outset consider opportunities to contribute to the wider landscape and ensure proposals are coherent with the surrounding landscape character area.

6.0 Flood Risk to The Development

6.1 Flooding from Fluvial Sources

The proposed development site lies entirely within flood zone 1 which is classified as land assessed as having a less than 1 in 1000 annual probability of river or sea flooding and is appropriate to all uses of land.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from fluvial sources.

6.2 Flooding from Overland Flows

The surface water flood data for the site, shown below, indicates that there is medium flood risk in some places immediately to the south, outside of the site. It is due to a land depression acting as a pond. Therefore, the risk will be reduced to low.

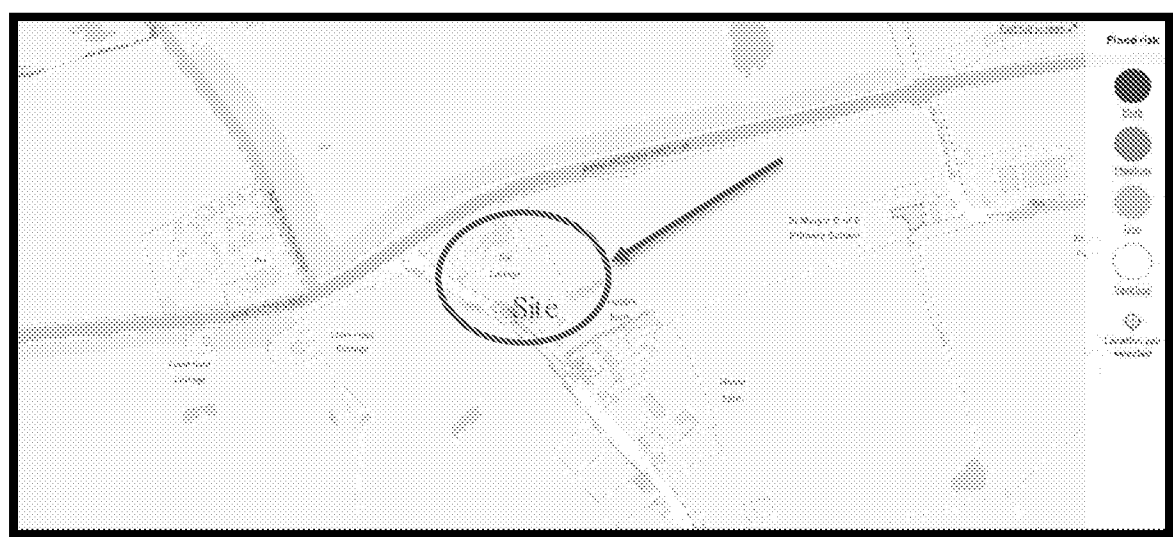


Fig 6.2 – Environment Agency Flood Risk from Surface Water map

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from overland flows.

6.3 Flooding from Rising Groundwater

Significant groundwater flood events have been recorded across the district. This risk is supported by the Areas Susceptible to Groundwater Flooding (ASGWf) mapping suggests that susceptibility to groundwater flooding is generally high across the district. This data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring, nor does it take account of the chance of flooding from groundwater rebound (rising groundwater levels resulting from a reduction in abstraction rates from groundwater).

Arun District Council map shows the site completely within the zone of >50% and <75%, and the indicative Risk of Groundwater Flooding prepared by Capita Symonds locates the site within a High-risk area. Both maps can be found in Appendix E. The water table level has been established at a depth of 1m BGL, however it should be noted that these were recorded in March 2018 during high tide and as such are likely to represent the worst-case scenario.



A second round of site investigation works were undertaken in September 2020. These undertook trial holes down to depths of 1.5m and no groundwater was encountered, which supported the earlier findings and conclusions.

It is, therefore, the consideration of this FRA that the site has a Medium risk of flooding from rising groundwater levels.

6.4 Flooding from the Local Sewerage Network

The Sewer Incident Report Form data supplied by postcode indicates that in the vicinity of the site there have been 22 recorded flood incidents. Also, the map prepared by the Capita Symonds used in the Strategic Flood Risk Assessment of the Arun District Council shows the site very close to a historic sewer incident. See full document in Appendix F.

The site is however higher than the adjacent drainage networks and so the risk of flooding via this mechanism is considered to be low.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by surcharging of the local sewer network.

6.5 Flooding from Reservoirs, Canals & Other Artificial Sources

From a review of the local area there are no artificial water sources in close proximity to the site.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by reservoirs, canals or other artificial sources.



7.0 Flood Risk As A Result Of The Development

7.1 Effect of The Development Generally

Development by its nature usually has the potential to increase the impermeable area with a resultant increased risk of causing rapid surface water runoff to water courses and sewers, thereby causing surcharging and potential flooding. There is also the potential for pollutants to be mobilised and consequently flushed into the receiving surface water system.

Increases in both the peak runoff rate (usually measured in litres per second l/s) and runoff volume (cubic metres m³) can result.

7.2 Surface Water Drainage & Sustainable Drainage Systems

Sustainable Drainage techniques (SuDS) covers a range of approaches to manage surface water runoff so that-

'Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.'

7.3 Peak Storm Design Criteria

The proposed sustainable drainage techniques for the development should accommodate the peak rainfall event for a 1 in 100 year storm event with an additional 40% allowance for climate change.

7.4 Existing Surface Water Runoff Rates

The site covers an approximate area of 0.84Ha, which consists of a greenfield land with low planting. The existing runoff rates calculated for site are highlighted below in table 7.4:

Return Period	Greenfield Runoff Rate l/s
1 in 1 year	2.5
Qbar	2.9
1 in 30 year	6.7
1 in 100 year	9.4

Table 7.4 Existing Runoff rates

Greenfield runoff rates were calculated using the ICP SuDS Method within Microdrainage Software. Calculations can be found in Appendix G.

7.5 Infiltration Testing

Intrusive infiltration testing has been undertaken at the site. The initial series of tests conducted in March 2018 found ground water at a depth of 1m and so infiltration testing was discounted due to the inability to implement a 1m unsaturated zone below infiltration devices. A subsequent dialogue with Mr Paul Cann, Arun District Council's Principal Drainage Engineer, confirmed that shallow infiltration devices such as permeable paving and swales would be considered and should be investigated fully to limit pumped surface water flows off site.

A subsequent site investigation was undertaken by Johnson Poole and Bloomer in September 2020. This report concluded that soakage rates were poor with rates between



6.58 x 10⁻⁶ m/s and 7.29 x 10⁻⁶ m/s. Full testing to BRE365 standards was not undertaken due to time constraints. Although these rates would not support conventional soakaways, the use of permeable paving could be considered.

7.6 Sustainable Drainage Hierarchy

A hierarchical approach has been undertaken in consideration of the application of SuDS in relation to the development. This is in order to meet the design philosophy of ensuring that surface water run-off is managed as close to its source as possible and the existing situation is replicated as closely as possible.

The following drainage hierarchy has been undertaken with reference to the procedures set out in the SuDS Manual (CIRIA C753, 2015) to assess the viability of the application of SuDS techniques to this scheme:

- * store rainwater for later use
- * use infiltration techniques, such as porous surfaces in permeable areas
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse.
- attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse,
- discharge rainwater direct to a watercourse
- * discharge rainwater to a surface water drain
- discharge rainwater to the combined sewer.

The sustainable drainage hierarchy shown above is intended to ensure that all practical and reasonable measures are taken to manage surface water higher up the hierarchy (1 being the highest) and that the amount of surface water managed at the bottom of the hierarchy is minimised. Storing rainwater for later use might be an option but it is not sufficient to accommodate the runoff from the whole development.



The site-specific drainage hierarchy checklist considered for the drainage design for this development is detailed in Table 7.6.

SUDS OPTIONS	Comments	Potential for flow rate control	Volume reduction	Maintenance requirement	Space requirement	Cost	Included in final detailed design
Rainwater harvesting	Rainwater from roof runoff collected for re-use. Cost-benefit considerations	L	M	H	L	H	Pos
Water butts	Rainwater collection from roof runoff. Included in final design	L	L	L	L	L	Y
Living roofs	Vegetated roofs that reduce runoff volume and rate	M	L	M	L	H	Y
Bio-retention	Shallow vegetated areas to retain and treat runoff.	L	L	M	M	L	N
Constructed wetlands	Waterlogged areas that can support aquatic vegetation. Replicate existing conditions and provide ecological benefit.	M	L	H	H/M	M	N
Swales	Shallow grassed drainage channels. Replicate existing conditions	H	M	L	M/H	L	Pos
Soakaways	Subsurface structures that dispose of water via infiltration.	H	H	L	L	M	N
Permeable pavements	Surface that infiltrate through surface. Retains pollutants.	H	H	M	L	M	Y
Tanked storage systems	Oversized pipes or cellular storage.	H	L	L	M	M/H	Y
Infiltration basins	Depressions in the ground to store and release water through infiltration	H	H	H/M	H	M/L	N
Detention basins	Temporary retention of runoff with controlled discharge	H	L	M	H	M/L	N

Table 7.6 Drainage design hierarchy (SuDS techniques considered for use in this scheme)

It should be noted that where the SuDS techniques are noted as feasible or possible it does not necessarily follow that they will all be used. Reference should be made to the drainage strategy drawing in Appendix H, which indicates the drainage proposals.



7.7 SUDS Techniques Employed

Building

Roof runoff from the proposed building is to be collected in a piped gravity drainage network prior to discharge into a pumping station placed near the front entrance. Water will be pumped to a discharge chamber to the east of the site where flows will then run via gravity into the private surface water system which runs between the A259 and the watercourse to the south of the site. Flows from the watercourse enter into the Southern Water public sewer and consent has been granted by Southern Water for a surface flow rate off site of 2l/s (Appendix). Green roofs are proposed on the top of building, for a range of reasons including the reduction of surface water runoff, visual benefit, ecological value and enhanced building performance. Water butts are also being suggested to reduce the runoff and collect water for later use. To cater for larger storm events & provide the necessary storage an attenuation tank is proposed beneath the site entrance.

The use of a pump for the surface water cannot be avoided on this site and all options for a gravity connection have been exhausted, however the proposed scheme will incorporate a high-level gravity overflow from the surface water system into the discharge chamber. As such should the pumps fail during a storm event, the below ground drainage system will slowly fill and then overtop into the gravity outfall, to provide a robust drainage solution and ensure the site will not be flooded.

The emergency overflow will start to become operational when the water level reaches 4.53m. This will only occur once the storage tank has been completely filled and the water level is 620mm below lowest ground levels on site.

Car Park Areas

The drainage for the hardstanding areas is to utilise the low infiltration potential of the natural strata and incorporate permeable asphalt and permeable block paved construction. Where necessary baffles have been introduced within the subbase to provide a lateral restraint to ensure water stored within the stone, will not flow down to the lowest point on site.

Exceedance Flows

The drainage system is to be sized and designed to cater for storm events associated with a 1 in 100 year storm event with 40% for climate change. However, should an extreme event occur, the overland flows will be guided away from buildings.

The proposed drainage arrangement plan for the development can be found within Appendix H with the supporting Microdrainage calculations contained within Appendix G.

Return Period	Existing Runoff Rate l/s	Proposed Runoff Rate l/s
1 in 1 year	2.5	2.0
Qbar	2.9	2.0
1 in 30 year	6.7	2.0
1 in 100 year	9.4	2.0

Table 7.7 – Existing and proposed runoff rates

7.8 Flood Risk Management

During the first year of operation of all types of SuDS, inspections should usually be carried out at least monthly (and after significant storm events) to ensure that the system is



functioning as designed and that no damage is evident. A full SuDS maintenance guidance can be found in Appendix I.

8.0 Proposed Foul Water Drainage System

The development proposals will seek to discharge foul water into a new pumping station via gravity. The pumping station is to be placed to the north of the development site, close to the building entrance.

The rising main is to run around the perimeter of the building and through the adjacent site prior to discharging via gravity into the Southern Water public foul sewer within Climping Street.

A predevelopment enquiry has been made to Southern Water and they have confirmed that the system has sufficient capacity to cater for the foul flows existing the site.

9.0 Lidsey Foul Water – Environmental Assessment

The development site appears to lie just outside the Lidsey Foul Water Treatment catchment area. For completeness however, this report confirms that the development is actively seeking to make a positive connection into the public sewerage network and as such there will be no discharge of treated foul effluent into the underlying ground strata. As such an Environment Assessment is not required.

10.0 Land Engineering Works Statement

The current levels strategy for the development site will ensure that the proposed scheme closely follows the existing topographical contours within the site to minimise earth movement. As such it is the consideration of this report that a Land Engineering Works statement is not required.

11.0 Recommendations and Conclusion

The development together with the site layout have been assessed in relation to the provision of SuDS drainage associated with the works.

The report has assessed the feasibility of implementing the SuDS hierarchical approach and has confirmed that this development is likely to be able to install suitable drainage measures into the design proposals.

Flood risk to the site has been assessed, and where risks have been deemed above low, mitigation measures have been proposed to reduce the risk to the site.

Therefore, in line with the recommendations of the National Planning Policy Framework, the development site lies within land classified as flood zone 1, which is considered at a low risk of flooding, and therefore appropriate for a development of this nature. Having assessed the other forms of flood risk to and from the development site, this report finds that the site is not considered at high risk from any other sources of flooding.



12.0 References & Bibliography

- The National Planning Policy Framework March 2012
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps <http://maps.environment-agency.gov.uk>
- Environment Agency indicative groundwater source protection zone maps <http://maps.environment-agency.gov.uk>
- Environment Agency indicative Aquifer designation maps <http://maps.environment-agency.gov.uk>
- CIRIA 2007, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for adoption 7th Edition
- Arun District Council SFRA Level 1 and Level 2 (Nov 16)
- Flood Estimation Handbook
- Environment Agency - Adapting to Climate Change: Advice for the Flood and Coastal Erosion Management Authorities March 2016



Appendix A - Topographic Survey



Appendix B - Southern Water Sewer Records

SEWER RECORDS PAGE 1 OF 2

102024



101446

O.S. REF. SU9901NE		Drawn by: yadavsa		The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. <i>WATERWORKS, 824C, 1999 are contributors of this data. Waterworks, 824C, 1999 are contributors of this data. Waterworks, 824C, 1999 are contributors of this data. Waterworks, 824C, 1999 are contributors of this data.</i>		
Scale: 1:2500						
Title: 283251_Bairds Farm Shop Crook	Date: 02/03/2018	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.				



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499498

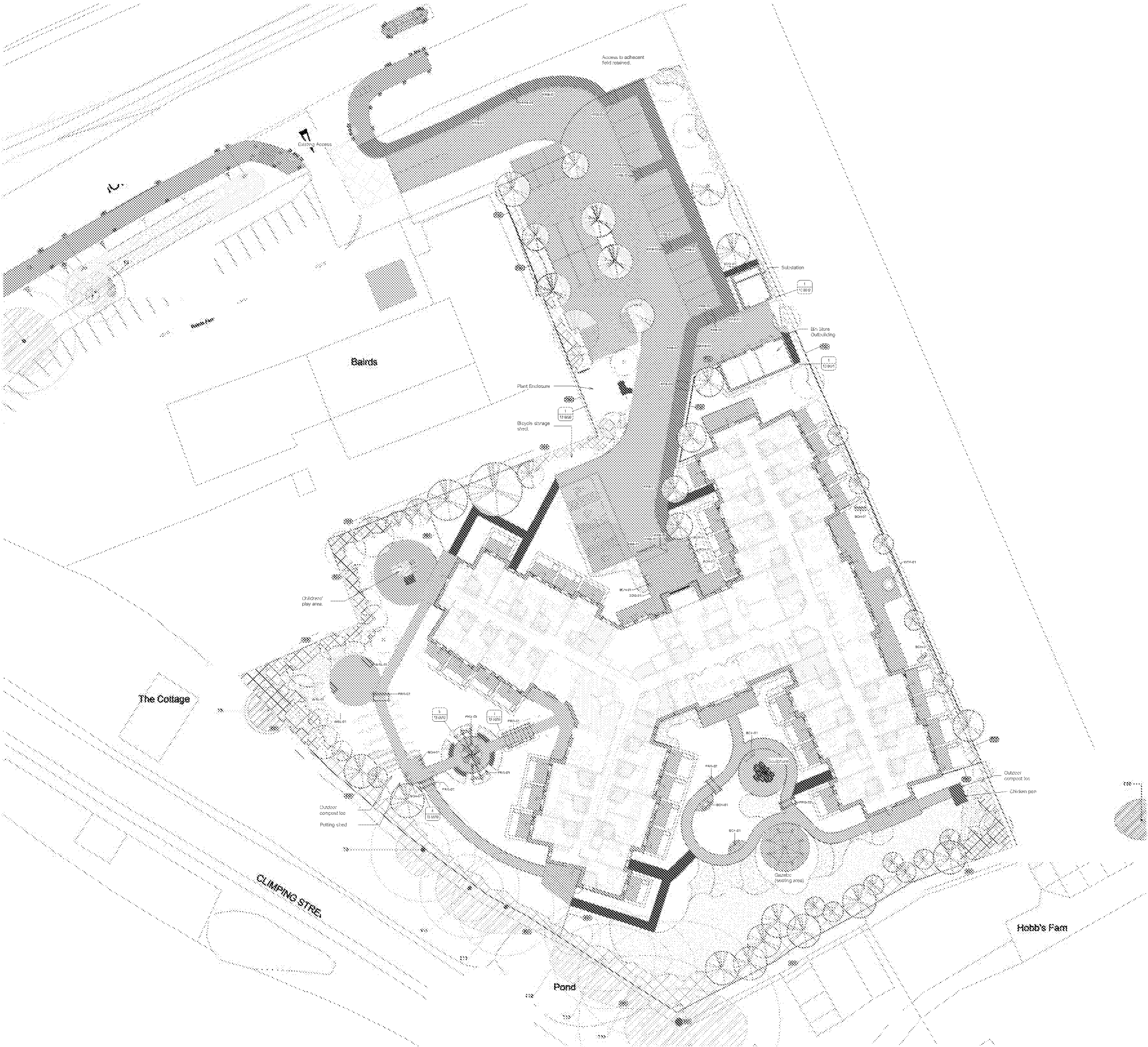
SEWER RECORDS PAGE 2 OF 2

[illegible][illegible]

Drawn by: yadavsa	
Title: 283251_Bairds Farm Shop Crookt	
Date: 02/03/2018	



Appendix C - Development Proposals



General Notes

This drawing shall not be scaled.

All dimensions are in mm unless otherwise stated.

All dimensions shall be checked on site prior to commencing the works and errors and omissions to be reported to the architects.

All works shall conform to the current edition of the Building Regulation and other statutory requirements.

All materials and workmanship shall conform with the relevant British Standard specifications and code of practice.

This drawing may incorporate information from other professions. Hunters cannot accept responsibility for the integrity and accuracy of such information. Any clarification and/or additions that are required appertaining such information should be sought from relevant profession or their appointed representative.

Hard Landscaping Material Legend

Notes: all external materials subject to approve by the LPA.
All hard surface build-up levels, surface falls and permeability properties to Civil Engineers details.

- Macadam surface finish.
- Macadam surface finish. Escape path only.
- Sunk set close textured, rising rounded gravel surface finish, 8mm Golden Pearl or equal approved.
- 6mm sized, double washed, decorative gravels surface dressing on bitumen or asphalt base or equal approved.
- Rectangular concrete block paving laid at herringbone pattern with painted units for demarcation of bays.
- Squares concrete block paving.
- Play Area as per Contract Provisional Sum.
- Timber bench, seating.
- 100mm height close boarded timber fence with 400mm rails on top.
- 1500mm high metal railing.

Keynote Legend	
Key Value	Keynote Text
BCH-01	Treated timber bench. Suitable for outdoor use.
BCH-02	125x50 concrete paving edging.
KPB-01	125x250 concrete bullnose kerb.
KPB-02	Chopped kerb.
KPB-03	Chopped kerb cantiloon.
PRG-01	Pegola, covered veranda.
PRG-02	Pegola gate.
PRG-03	Arbour.
WSL-01	Stainless steel rotary washing trees.
WTR-01	Water feature.

C	2020-08-28	OK	LV switch room and plant enclosure updated.
O	2020-08-28	OK	Preliminary for Tender issue.
D	2020-08-11	OK	External Works Preliminary Site plan updated.
A	2020-08-15	OK	Final issue.
Author	GH	Designer	

Ratification History

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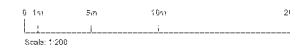
Hard Landscape Plan

Issued for Preliminary for Tender

hunters project number:	client project number:	scale:	drawn by:	checked by:
MS316	A0003	As indicated @ A0	GH	Checker

drawing title:
MS316- HUN- ZZ- SL- DR- A- 03-0010

revision:	date:	revised by:
1	2020-08-28	GH
LV switch room and plant enclosure updated.		



All drawings are to be printed in colour.

model ref.: C:\Users\Local\MS316 HUN MS A 03 0010 - 03\0010.dwg
Use figured dimensions only. All levels and dimensions to be checked on site. This drawing is to be read in conjunction with all other related drawings and specifications. Hunters is a trading name of Hunters & Partners Limited. © Hunters & Partners Limited. All rights reserved.



Appendix D - Flood Zones Map



Notes

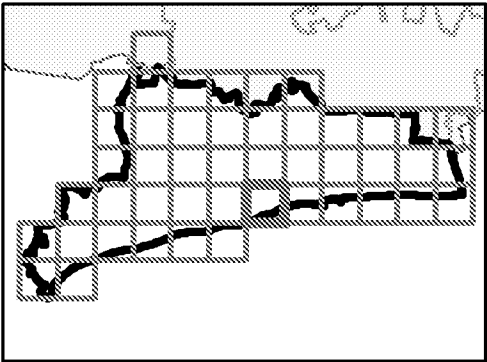
Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from sea in any year.

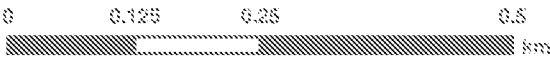
Zone 3b: This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed modelling exists. In the absence of detailed hydraulic model information, a precautionary approach has been adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific

Key Plan



Legend

- Arun District SFRA boundary
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2



REF	Date	Comments
A	June 2010	
B		
C		

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ARUN DISTRICT COUNCIL

LEVEL 1 SFRA: APPENDIX C FLOOD ZONES

Sheet No: 14 of 48 Index Number: AGC_14

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Appendix E - Risk of Groundwater Flooding Maps



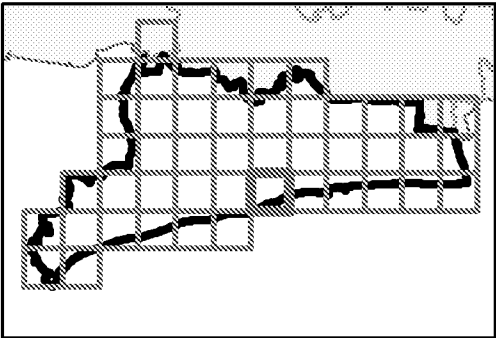
Notes

The Areas Susceptible to Groundwater Flooding (ASiGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The ASiGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

Key Plan



Legend

- Arun District SFRA boundary
- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%



REF	Date	Comments
A	June 2016	-
B		
C		

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ARUN DISTRICT COUNCIL

**LEVEL 1 SFRA: APPENDIX F
AREAS SUSCEPTIBLE TO GROUNDWATER**

Sheet No: 14 of 48 Index Number: AGC_14

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Appendix F - Historic Incidents of Flooding From Sewers



Notes:

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. The user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The 'coastal risk area' is based on advice from LA Engineers and requires further assessment.

Arun District Council SFRA

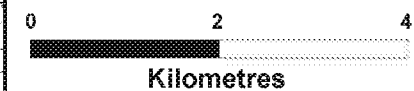
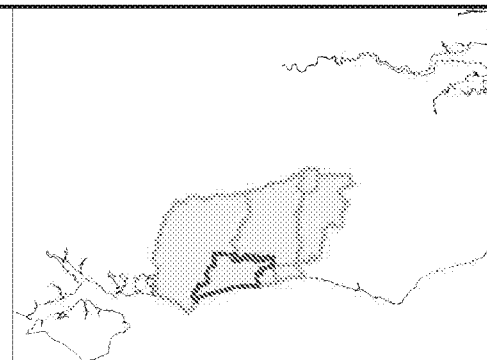
Map S - Historic Incidents of Flooding from Sewers



CAPITA SYMONDS

Legend

- Arun District Boundary
- Historic Incidents of Sewer Flooding



Scale at A3: 1:80,000

Date: 31/01/2008

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Map_S wor



Appendix G - Microdrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 515 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	3.307	0.307	0.0	2.0	2.0	49.0	OK
30 min Summer	3.406	0.406	0.0	2.0	2.0	64.8	OK
60 min Summer	3.506	0.506	0.0	2.0	2.0	80.7	OK
120 min Summer	3.592	0.592	0.0	2.0	2.0	94.5	OK
180 min Summer	3.626	0.626	0.0	2.0	2.0	100.0	OK
240 min Summer	3.637	0.637	0.0	2.0	2.0	101.6	OK
360 min Summer	3.632	0.632	0.0	2.0	2.0	100.9	OK
480 min Summer	3.612	0.612	0.0	2.0	2.0	97.7	OK
600 min Summer	3.596	0.596	0.0	2.0	2.0	95.1	OK
720 min Summer	3.581	0.581	0.0	2.0	2.0	92.7	OK
960 min Summer	3.554	0.554	0.0	2.0	2.0	88.4	OK
1440 min Summer	3.501	0.501	0.0	2.0	2.0	80.0	OK
2160 min Summer	3.422	0.422	0.0	2.0	2.0	67.4	OK
2880 min Summer	3.347	0.347	0.0	2.0	2.0	55.4	OK
4320 min Summer	3.216	0.216	0.0	2.0	2.0	34.5	OK
5760 min Summer	3.119	0.119	0.0	2.0	2.0	18.9	OK
7200 min Summer	3.052	0.052	0.0	2.0	2.0	8.3	OK
8640 min Summer	3.013	0.013	0.0	2.0	2.0	2.0	OK
10080 min Summer	3.000	0.000	0.0	1.9	1.9	0.0	OK
15 min Winter	3.345	0.345	0.0	2.0	2.0	55.1	OK
30 min Winter	3.459	0.459	0.0	2.0	2.0	73.2	OK
60 min Winter	3.573	0.573	0.0	2.0	2.0	91.4	OK
120 min Winter	3.676	0.676	0.0	2.0	2.0	108.0	OK
180 min Winter	3.721	0.721	0.0	2.0	2.0	115.1	OK
240 min Winter	3.740	0.740	0.0	2.0	2.0	118.1	OK
360 min Winter	3.749	0.749	0.0	2.0	2.0	119.6	OK

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.238	0.0	51.1	23
30 min Summer	86.178	0.0	68.8	37
60 min Summer	55.250	0.0	88.1	68
120 min Summer	34.177	0.0	109.2	126
180 min Summer	25.410	0.0	121.7	186
240 min Summer	20.436	0.0	130.5	246
360 min Summer	15.037	0.0	144.1	364
480 min Summer	12.081	0.0	154.2	434
600 min Summer	10.185	0.0	162.6	492
720 min Summer	8.854	0.0	169.7	558
960 min Summer	7.093	0.0	181.2	686
1440 min Summer	5.178	0.0	198.4	956
2160 min Summer	3.772	0.0	216.8	1364
2880 min Summer	3.009	0.0	230.6	1760
4320 min Summer	2.184	0.0	251.1	2508
5760 min Summer	1.738	0.0	266.5	3176
7200 min Summer	1.455	0.0	278.7	3824
8640 min Summer	1.260	0.0	289.7	4488
10080 min Summer	1.115	0.0	299.3	0
15 min Winter	128.238	0.0	57.2	22
30 min Winter	86.178	0.0	77.0	37
60 min Winter	55.250	0.0	98.9	66
120 min Winter	34.177	0.0	122.2	124
180 min Winter	25.410	0.0	136.3	182
240 min Winter	20.436	0.0	146.2	240
360 min Winter	15.037	0.0	161.4	354

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
480 min Winter	3.738	0.738	0.0	2.0	2.0	117.7	OK
600 min Winter	3.715	0.715	0.0	2.0	2.0	114.0	OK
720 min Winter	3.688	0.688	0.0	2.0	2.0	109.8	OK
960 min Winter	3.653	0.653	0.0	2.0	2.0	104.2	OK
1440 min Winter	3.574	0.574	0.0	2.0	2.0	91.6	OK
2160 min Winter	3.451	0.451	0.0	2.0	2.0	72.0	OK
2880 min Winter	3.335	0.335	0.0	2.0	2.0	53.5	OK
4320 min Winter	3.144	0.144	0.0	2.0	2.0	22.9	OK
5760 min Winter	3.022	0.022	0.0	2.0	2.0	3.6	OK
7200 min Winter	3.000	0.000	0.0	1.8	1.8	0.0	OK
8640 min Winter	3.000	0.000	0.0	1.6	1.6	0.0	OK
10080 min Winter	3.000	0.000	0.0	1.4	1.4	0.0	OK

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
480 min Winter	12.081	0.0	172.9	462
600 min Winter	10.185	0.0	182.1	566
720 min Winter	8.854	0.0	190.0	598
960 min Winter	7.093	0.0	202.9	738
1440 min Winter	5.178	0.0	222.2	1044
2160 min Winter	3.772	0.0	242.9	1476
2880 min Winter	3.009	0.0	258.4	1880
4320 min Winter	2.184	0.0	281.4	2596
5760 min Winter	1.738	0.0	298.5	3168
7200 min Winter	1.455	0.0	312.4	0
8640 min Winter	1.260	0.0	324.6	0
10080 min Winter	1.115	0.0	335.2	0

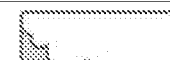
Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.500	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.213

Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)
0	4	0.000	4	8	0.213

Infrastruct CS Ltd		Page 4
The Stables High Cogges, Witney Oxfordshire		
Date 20/10/2020 13:17 File REVISED STORAGE 2020-10-12.SRCX	Designed by Tim.Trotman Checked by	
Innovyze	Source Control 2015.1	

Model Details

Storage is Online Cover Level (m) 5.300

Cellular Storage Structure

Invert Level (m) 3.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	168.0	168.0	0.800	168.0	209.6	0.900	0.0	209.6

Pump Outflow Control

Invert Level (m) 2.900

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.700	2.0000	1.300	2.0000	1.900	2.0000	2.500	2.0000
0.200	2.0000	0.800	2.0000	1.400	2.0000	2.000	2.0000	2.600	2.0000
0.300	2.0000	0.900	2.0000	1.500	2.0000	2.100	2.0000	2.700	2.0000
0.400	2.0000	1.000	2.0000	1.600	2.0000	2.200	2.0000	2.800	2.0000
0.500	2.0000	1.100	2.0000	1.700	2.0000	2.300	2.0000	2.900	2.0000
0.600	2.0000	1.200	2.0000	1.800	2.0000	2.400	2.0000	3.000	2.0000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 101 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	4.706	0.056	0.3	1.7	O K
30 min Summer	4.727	0.077	0.3	2.3	O K
60 min Summer	4.746	0.096	0.3	2.9	O K
120 min Summer	4.757	0.107	0.3	3.2	O K
180 min Summer	4.760	0.110	0.3	3.3	O K
240 min Summer	4.759	0.109	0.3	3.3	O K
360 min Summer	4.754	0.104	0.3	3.1	O K
480 min Summer	4.748	0.098	0.3	2.9	O K
600 min Summer	4.740	0.090	0.3	2.7	O K
720 min Summer	4.733	0.083	0.3	2.5	O K
960 min Summer	4.720	0.070	0.3	2.1	O K
1440 min Summer	4.701	0.051	0.3	1.5	O K
2160 min Summer	4.690	0.040	0.3	1.2	O K
2880 min Summer	4.684	0.034	0.2	1.0	O K
4320 min Summer	4.676	0.026	0.2	0.8	O K
5760 min Summer	4.671	0.021	0.1	0.6	O K
7200 min Summer	4.668	0.018	0.1	0.5	O K
8640 min Summer	4.665	0.015	0.1	0.5	O K
10080 min Summer	4.664	0.014	0.1	0.4	O K
15 min Winter	4.715	0.065	0.3	1.9	O K
30 min Winter	4.739	0.089	0.3	2.7	O K
60 min Winter	4.761	0.111	0.3	3.3	O K
120 min Winter	4.774	0.124	0.3	3.7	O K
180 min Winter	4.775	0.125	0.3	3.8	O K
240 min Winter	4.773	0.123	0.3	3.7	O K
360 min Winter	4.763	0.113	0.3	3.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	124.633	0.0	18
30 min Summer	83.789	0.0	32
60 min Summer	53.779	0.0	60
120 min Summer	33.337	0.0	98
180 min Summer	24.832	0.0	130
240 min Summer	20.006	0.0	164
360 min Summer	14.706	0.0	232
480 min Summer	11.818	0.0	300
600 min Summer	9.966	0.0	364
720 min Summer	8.665	0.0	428
960 min Summer	6.943	0.0	548
1440 min Summer	5.071	0.0	768
2160 min Summer	3.696	0.0	1128
2880 min Summer	2.949	0.0	1496
4320 min Summer	2.142	0.0	2208
5760 min Summer	1.705	0.0	2944
7200 min Summer	1.427	0.0	3672
8640 min Summer	1.235	0.0	4408
10080 min Summer	1.093	0.0	5112
15 min Winter	124.633	0.0	18
30 min Winter	83.789	0.0	32
60 min Winter	53.779	0.0	60
120 min Winter	33.337	0.0	114
180 min Winter	24.832	0.0	140
240 min Winter	20.006	0.0	180
360 min Winter	14.706	0.0	254

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	4.752	0.102	0.3	3.1	O K
600 min Winter	4.740	0.090	0.3	2.7	O K
720 min Winter	4.729	0.079	0.3	2.4	O K
960 min Winter	4.710	0.060	0.3	1.8	O K
1440 min Winter	4.693	0.043	0.3	1.3	O K
2160 min Winter	4.683	0.033	0.2	1.0	O K
2880 min Winter	4.676	0.026	0.2	0.8	O K
4320 min Winter	4.669	0.019	0.1	0.6	O K
5760 min Winter	4.665	0.015	0.1	0.5	O K
7200 min Winter	4.663	0.013	0.1	0.4	O K
8640 min Winter	4.661	0.011	0.1	0.3	O K
10080 min Winter	4.660	0.010	0.1	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	11.818	0.0	324
600 min Winter	9.966	0.0	390
720 min Winter	8.665	0.0	454
960 min Winter	6.943	0.0	566
1440 min Winter	5.071	0.0	782
2160 min Winter	3.696	0.0	1144
2880 min Winter	2.949	0.0	1524
4320 min Winter	2.142	0.0	2244
5760 min Winter	1.705	0.0	2952
7200 min Winter	1.427	0.0	3680
8640 min Winter	1.235	0.0	4368
10080 min Winter	1.093	0.0	4968

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.010

Time (mins)		Area
From:	To:	(ha)
	0	4 0.010

Infrastruct CS Ltd		Page 4
The Stables High Cogges, Witney Oxfordshire		
Date 20/10/2020 13:20	Designed by Tim.Trotman	
File Permeable Paving 2020-10-12.srcx	Checked by	
Innovyze	Source Control 2015.1	

Model Details

Storage is Online Cover Level (m) 5.150

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.02261	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	27.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.650	Cap Volume Depth (m)	0.000



Appendix H - Proposed Drainage Strategy

The design Engineer(s) have analysed this design as the scheme has been developed, in order to identify if there are any significant residual risk hazards (ie. unusual, unexpected, abnormal or difficult).

Residual risks HAVE been identified and are therefore shown on this drawing. These risks have not been possible to remove by design.

This statement assumes that a competent Contractor with the appropriate qualified staff will be employed for the works, and that they will be familiar with site wide construction risks and hazards that they can reasonably be expected to encounter as part of their work.

BURIED UTILITIES RISK NOTE

- Buried utilities are present on and in the vicinity of the site.
- The Contractor must satisfy themselves that they have seen utility returns for the area and that appropriate Risk Assessment Method Statement (RAMS) are in place and implemented to ensure that buried and/or overhead services are located prior to any works taking place.
- Any RAMS shall address safe procedures for protection and working in the proximity of services.

Refer to extract opposite

Cottage

Approximate tree root protection zone

Southern Water
Manhole Ref: 9602
CL: 4.697m (rec)
EL: 3.584m (rec)

Hand Dig construction within Root Protection Zone

ARUN DISTRICT COUNCIL CM/48/20/DOC

X:\FIS\Iohd 2860\Iohd 2868 - Bald's Eam. Shon. Coolthorn lane (Back of house street)\01 - Drawings\01 Civil 2868-BCH-K'S\01-XX-M3-C-003 Drawings De don dw

Survey Company info here

DRG NUMBER:	DATE RECEIVED:
Hunters	
DRG NUMBER: M9316-HUN-ZZSLDR-A-03-0010 D	DATE RECEIVED: 07.09.2020

NOTES

1. All dimensions and levels are in metres unless otherwise noted
2. This drawing is to be made in conjunction with the relevant Architect/Engineers drawings, specifications and CDM documentation
3. This drawings has been produced electronically and may have been photo reduced or enlarged when copied. Work to figure dimensions only (DO NOT SCALE). All dimensions to be checked on site. Any omissions to be reported to the engineer immediately.
4. This drawing contains confidential information that may not be clearly reproduced in black and white.
5. Digital copies of this plan can only be considered accurate if

Construction Note
It is essential that new drainage associated with the development is laid from the outfall(s) into the site. This is essential to avoid unforeseen obstructions where encountered (such as services). If the drainage is laid from the site out to the outfall(s) can result in significant abortive works to relay and overcome such obstructions.

Location of Public Sewers have been taken from record drawings which should be fully substantiated by the contractor prior to commencing works on site

Drainage Key

Sewers

- | | |
|-------|---|
| | Foul water drain (private/non adoptable) |
| | |
| | Surface water drain (private/non adoptable) |
| | |
| | Surface water sewer (Adoptable) |
| | Foul water sewer (Adoptable) |
| | |
| | Surface Water main |
| | |
| | Foul main |
| | |
| | Existing foul water sewer (Adopted) |

Chamber Key

- | PW | SW | |
|----|----|--|
| | | Mini access chamber (mac) - 300mmd * |
| | | PPC - 475mmd * |
| | | Adoptable demarcation manhole
within 1m of boundary * |
| | | Manhole
Depth 1.25 to 1.5m *
Depth 1.55 to 3.0m * |

* General note
(Refer to standard details & long sections for chamber sizes.
Size may need to increase dependant on number of incoming
pipes/size of incoming pipes)

- | | |
|---|--|
|  | Surface waterwading eye |
|  | Manhole reference number |
|  | Rain waterdown pipe (rod/double access) |
|  | Silt Trap (ST) with removable silt bucket |
|  | Solvent pipe/soil stack |
|  | Roof drain (rmp) code |
|  | Roughness (rmp) code |
|  | Line and storage channel |
|  | Cellular storage (refer to drawing for size) |

-
- Overland Flows Route
- Root protection zone (RPZ)
- Hand Dig construction within Root Protection Zone
- Buffer to prevent rapid through flow of water through permeable Surfacing
- Approximate Extent of Green Roof

P5	N1	IST	Ring main re-routed. On-site storage tank added	23/10/20
P4	N1	IST	Drainage outfalls and schedule amended	20/10/20
P3	SNN	IST	Drawing updated in line with revised site & GA layouts	12/10/20
P2	N1	IST	Layout and Drainage updated	11/05/18
P1	MED	IST	As built issue	11/04/18
REV	DRAWN	CHECK	REVISION COMMENTS	ISSUE DATE

DRAWING TITLE	SHEET NO.	SCALE
Proposed Drainage Strategy		

PROJECT	
Bairds Care Home	
Littlehampton	
Sussex	

CLIENT	 BRACKLEY	
--------	---	---

SCALE @ A1		ENGINEER
------------	--	----------

As Noted			MBD
			DRAFT
PROJECT NUMBER	STATUS	DATE	NJ
2868	S2	April 18	APPROVED TST

PROJECT	ORIGIN	PHASE	LEVEL	TYPE	ROLE	DWG NO	REVISION
BCH	ICS	01	XX	DR	C	003	P5



Appendix I- Southern Water Correspondence



from
**Southern
Water**

Tim Trotman
Infrastruct CS Ltd
The Stables
High Cogges Farm
Witney
Oxon
OX29 6UN

Your ref

Our ref
DS_CC_PDE-116790

Date
04 May 2020

Contact



Dear Mr Trotman,

Site: Bairds, Bairds Farm Shop, Crookthorn Lane, Littlehampton, West Sussex, BN17 5SN.

We have completed the capacity check for the above development site and the results are as follows:

Foul Water

Following initial investigations, there is currently adequate capacity in the local sewerage network to accommodate a foul flow for the above development at/downstream of manhole reference SU99019601. Please note that no surface water flows (existing or proposed) can be accommodated within the existing foul sewerage system.

Surface Water

There is currently inadequate capacity within the local surface network to accommodate a flow of **25 l/s** at manhole reference TQ00010550. Please note, there are no surface water sewers with sufficient capacity in the vicinity of the development site. Surface water should be disposed of by alternative means such as discharging the surface water via soak-away if effective at this location or to any local drainage water courses, subject to all interested parties' approval.

Please note, as on 1st April 2018 we have moved to the "New Connections Services Charging Arrangements". We understand that this may cause uncertainty for customers, particularly where they may have already committed to a development based on previous charging arrangements. We have worked with our stakeholders and Water UK to agree a set of principles by which we will base our charges. Please read through our new charging arrangement documents available via the following link:

southernwater.co.uk/infrastructure-charges

Alternatively, new appointees and variations (NAVs), also known as 'inset' companies, can provide new connection services or take ownership of the new water and wastewater connection infrastructure provided for a new development. NAVs are appointed by Ofwat and replace the

Southern Water, Southern House, Yeoman Road, Worthing, West Sussex, BN13 3NX
southernwater.co.uk

Southern Water Services Ltd, Registered Office: Southern House, Yeoman Road, Worthing West Sussex BN13 3NX Registered in England No. 2366670

regional water company. It is for the developer to choose whether to use a NAV or the regional water company to supply services for new sites, according to certain legal criteria.

It should be noted that this information is only a hydraulic assessment of the existing sewerage network and does not grant approval for a connection to the public sewerage system. A formal S106 connection application is required to be completed and approved by Southern Water Services. Please see the following link:

southernwater.co.uk/ConnectiontoPublicSewer/ApplicationForm

Should you require any further information, please contact us at the above mentioned phone number or address shown in the footer.

Yours sincerely,



Joff Edevane
Growth Planning Lead
Business Channels

Please note: - The information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

Tim Trotman

From: Developer Services [REDACTED]
Sent: 03 June 2020 14:19
To: Tim Trotman
Subject: RE: SWS-SUSXW-CC-004947 - DS_CC_PDE-116790 - Bairds, Bairds Farm Shop, Crookthorn LanR

Dear Tim,

Thank you for your email. After the reassessment, it is confirmed that the capacity available at manhole TQ00010550 is 2 l/s. Therefore any flows that are equal to or less than this would be allowed.

I hope this helps, if you have any further queries please do let us know.

Kind regards,

Hannah

Developer Services Team
Technical Service Delivery
Business Channels

From: Tim Trotman [<mailto:tim@infrastructcs.co.uk>]
Sent: 07 May 2020 11:54
To: Developer Services <Developer.Services@southernwater.co.uk>
Subject: RE: SWS-SUSXW-CC-004947 - DS_CC_PDE-116790 - Bairds, Bairds Farm Shop, Crookthorn LanR

Afternoon Joff,

Thank you for the speed in which you returned the enquiry given the current conditions, as it's much appreciated.

We note that your response confirms sufficient capacity for the foul water but an insufficient capacity for the adjacent system to cater for the surface water flows off site.

We have been exploring alternatives and are unable to find an alternative option.

As such is there a rate at which Southern Water would permit a connecting into the system within Climping Street. We had initially requested a flow rate off site of 25l/s, but wanted to establish whether a lower rate would be acceptable and if so, what would this be?

Regards

Tim

T. S. TROTMAN

M.Eng (Hons) C.Eng C.Wem MCIWEM FIHE
Managing Director

INFRASTRUCT CS LTD
Consulting Civil Engineers

Infrastruct CS Ltd, The Stables, High Coages Farm, High Coages, Witney, Oxon, OX29 6UN.

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Think before you print - only print this email if necessary.

From: Developer Services [REDACTED]
Sent: 04 May 2020 10:34 [REDACTED]
To: Tim Trotman <[REDACTED]>
Subject: SWS-SUSXW-CC-004947 - DS_CC_PDE-116790 - Bairds, Bairds Farm Shop, Crookthorn Lane, Littlehampton, West Sussex, BN17 5SN

Dear Mr Trotman,

Please find the Southern Water's response to your recent enquiry.

Yours sincerely,

Joff Edevane
Growth Planning Lead, Business Channels



from
Southern Water

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Appendix J - SuDS Management Plan



Infrastruct CS Ltd
The Stables
High Cogges Farm
High Cogges
Nr Witney
Oxon
OX29 6UN

SuDS MAINTENANCE GUIDE

OWNERS MANUAL

Scheme name: Bairds Care Home

Document reference 2868-BC H-IC S-XX-RP-C-07.010

Report Prepared By:

Tim Trotman

MEng (Hons), CEng, CWe m, FIHE, MCIWEM

On behalf of Infrastructure CS Ltd

October 2020

Project Number: 2868

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1.0 Introduction

This guidance provides best practice guidance on the maintenance of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within the Bairds Care Home development.

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

Like any drainage system maintenance is a necessary and important consideration of SuDS design and sufficient thought should be given to long-term maintenance and its funding during feasibility and planning stages. In particular, the following requirements should be given full consideration:

1.1 Who is responsible for maintenance of the suds features used for this scheme

The cellular storage and permeable paving features associated with the development are owned maintained by the end client or their representative if they have appointed a management company.

Following construction but prior to the completion of the development, the responsibility for maintenance shall lie with the developer.

1.2 Owner's manual

SuDS are different from conventional drainage and require different maintenance regimes. This manual details the following:

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

1.3 LOCATION OF SUDS TECHNIQUES USED ON THE SCHEME

The location of the SuDS features are shown on drawing 2868-BCH-ICS-01-XX-DR-C-003.

1.4 SUDS techniques used on this scheme:

- Green Roofs
- Pervious Pavements
- Geocellular/Modular Systems
- Silt traps and catchpits
- Flow control devices

1.5 Summary of how the techniques work for the scheme

Building

Roof runoff from the proposed building is to be collected in a piped gravity drainage network prior to discharge into a pumping station placed near the front entrance. Water will be pumped to a discharge chamber to the east of the site where flows will then run via gravity into the private surface water system which runs between the A259 and the water course to the south of the site. Green roofs are proposed for elements of the roof and water butts are also being suggested to reduce the runoff and collect water for later use. To cater for larger storm events & provide the necessary storage an attenuation tank is proposed beneath the site entrance.

Car Park Areas

The drainage for the hardstanding areas is to utilise the low infiltration potential of the natural strata and incorporate permeable asphalt and permeable block paved construction.

1.6 Maintenance requirements

These are detailed in the appropriate section of this document.

1.7 Areas where activities are prohibited

Heavy loads should not be allowed in areas where cellular storage is located. Failure to do so may cause structural damage and collapse of the cellular limits.

Permeable paving – No stock piling of materials should take place on areas of permeable paving as this will cause the surface to block and prevent the through flow of rainwater.

1.8 Accidental spillages

Health and safety considerations are a priority and addressing accidental spillages should only be attempted if the nature of the spillage is known and its potential hazardous properties understood. The source of the spillage should be stopped and excess surface spillage removed by suction tank or absorption mats. Silt traps and sumps should be emptied by suction tanker. Areas of affected permeable paving should have the surface and laying course removed. The surfacing blocks should be cleaned and re-laid on new bedding material. Heavy pollution of the sub-base will require removal and replacement of the sub-base.

1.9 Alterations

If any alterations are proposed to the development, the design Engineer must be notified so that the impact/implications of the work can be assessed. Utilities should be restricted in the designated service zone areas.

1.10 Health and safety

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

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

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.

2.0 Operation and maintenance activity categories

There are likely to be three categories of maintenance activities:

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

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

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks (e.g. sediment removal or filter replacement). Table 2 summarises the likely maintenance activities required for each SuDS component and guidance on specific maintenance activities is given in the following sections.

Remedial maintenance describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design, construction and regular maintenance activities. Where remedial work is found to be necessary, it

is likely to be due to site-specific characteristics or unforeseen events, and so timings are difficult to predict. Remedial maintenance can comprise activities such as:

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

Table 2 - Typical key SuDS components operation and maintenance activities
For full specifications, see individual chapters.

O & M activity	SuDS component																	
	Pond/wetland	Detention basin	Infiltration basin	Silt traps and catchpits	Soakaway	Infiltration trench	Filter trench	Modular storage	Pervious pavement	Swale/bioretention/green roofs	Filter strip	Sand filter	Pre-treatment systems	Perforated ring soakaways	Bio retention areas	Rain gardens	Oil interceptors	Flow control devices
Regular maintenance																		
Inspection				■				■	■	■								■
Litter/debris removal				□				□	■	■								□
Grass cutting				□				□	□	■								□
Weed/invasive plant control									□	□								
Shrub management									□	□								
Shoreline vegetation management																		
Aquatic vegetation management																		
Irregular maintenance																		
Sediment management (*)				■				■	■	■								■
Vegetation/plant replacement										□								
Vacumn sweeping and brushing									■									
Remedial maintenance																		
Structure rehabilitation/repair				□				□	□	□								□
Infiltration surface reconditioning									□	□								

■ Will be required

□ May be required

* Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

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

2.1 Regular maintenance activities

Inspections and reporting

Regular SuDS scheme inspections will:

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

Inspections can generally be required at monthly site visits (e.g. for grass cutting) for little additional cost, and should, therefore, be subsumed into regular maintenance requirements. During the first year of operation, inspections should ideally be carried out after every significant storm event to ensure proper functioning, but in practice this may be difficult or impractical to arrange.

Typical routine inspection questions that will indicate when occasional or remedial maintenance activities are required, and/or when water quality requires investigation include:

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

Litter/debris removal

This is an integral part of SuDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. High litter removal frequencies may be required at high profile commercial/retail parks where aesthetics are a major driver.

Grass cutting

It is recommended that grass cutting be minimised around SuDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or "lodging", when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water.

Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area.

For SuDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable.

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

Shrub management

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

Management of green waste

Appropriate methods should be implemented to dispose of green waste, including:

1 The development of wild life piles

These provide refuges, hibernation shelter, food and egg laying sites for a large number of animals. When rotted down at the end of 3–5 years they provide compost that can be used as fertiliser for planting areas outside of the SuDS system.

In general:

- wild life piles should be located in sunny or semi-shaded areas away from direct access by people
- their bases should be constructed using substantial prunings or other branch material laid in a criss-cross pattern
- seasonal shrub and other woody prunings should be added through the winter
- non-woody and grass cuttings should be added through the summer
- wild life piles should comprise tidy piles up to 1.2 m high
- new wild life piles should be constructed each year and old wild life piles should be used as compost to plant beds after 3–5 years
- wild life piles should be located above normal flood level of water courses and be protected by hedges or similar features.

A schematic of a typical wild life pile structure is shown in Figure 1.1.

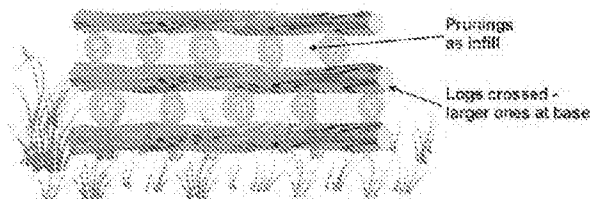


Figure 1.1 Schematic of a wild life pile (courtesy of Steve Wilson and Robert Bray of Sustainable Drainage Associates)

2 On- or off-site composting

A compost facility allows all green waste, particularly grass cuttings and prunings to be recycled and provide compost for mulching ornamental plant beds. The following process should be followed for composting:

- shred all arisings from site
- combine all arisings in active compost bin with grass cuttings not exceeding 70%
- turn and mix active compost when bin is >50% full, at weekly intervals for at least four weeks
- turn and mix full bin every 28 days until used
- combine adjacent compost bins/bays when contents are settled to 50% volume reduction
- Use compost after 3–4 months.

A schematic/photo of a typical composting structure is given in Figure 1.2.

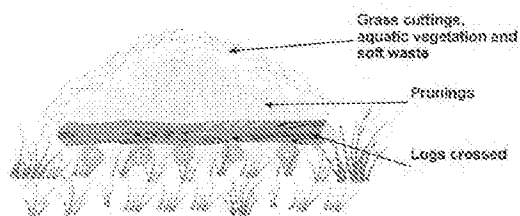


Figure 1.2 Schematic of a composting structure (courtesy Steve Wilson and Robert Bray of Sustainable Drainage Associates)

3 Disposal to land fill

As a last resort, green waste can be disposed of to some approved tips or land fill sites, although it is only accepted at certain locations.

2.2 Irregular maintenance activities

Sediment removal

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

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

Sediment accumulation will typically be rapid for the entire construction period (including time required for the building, turfing and landscaping of all upstream development plots). Once a catchment is completely developed and all vegetation is well-established, sediment mobility and accumulation is likely to drop significantly.

Vegetation/plant replacement

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

Inspection programmes should identify areas of filtration, or infiltration surfaces where vegetation growth is poor and likely to cause a reduced level of system performance.

Such areas can then be rehabilitated and plant growth repaired.

Vacuum sweeping and brushing

Pervious surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Advice issued with permeable pre-cast concrete paving suggests a minimum of three sweepings per year. Chapter 12 should be referred to for details of this process.

2.3 Remedial maintenance

Structure rehabilitation/repair

There will come a time with most SuDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. The SuDS design allows for vehicle access to undertake this work and consider the need for the overhaul without causing major disruption. For example, the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SuDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands). Rehabilitation activities for each SuDS component are described in the individual component chapters. The requirements should be identified in the owner's manual.

Infiltration surface rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration.

Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1. Scarifying to remove "thatch". Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.
2. Spiking or tining the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand and is best undertaken when the soil is moist. Spiking or tining with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top-dressing materials.
3. As a last resort, it may be necessary to remove and replace the grass and topsoil by:
 - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to land fill
 - removing damaged turf which should be composted
 - cultivating remaining topsoil to required levels
 - re-turfing (using turf of a quality and appearance to match existing) or re-seeding (to BS 7370: Part 3, Clause 12.6 (BSI, 1991) using seed to match existing turf) area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882 (BSI, 1994) to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

3.0 Applications of the principles of landscape maintenance

In contrast to conventional drainage, which comprises mainly sub-surface pipework and associated infrastructure, SuDS are predominantly surface systems. A key feature of SuDS is their integration within the local landscape and their amenity contribution, and it is appropriate therefore that landscape maintenance practice is applied to their management.

Landscape maintenance documentation

Typical landscape maintenance documentation and its potential relevance to SuDS systems is summarised below:

(A) Management plan – describing the management objectives for a site over time, and the management strategies that should be employed to realise these objectives and reconcile any potential conflicts that may arise.

Management plans are most appropriate for application in major parks and open spaces, wherever there are alternative choices for future action, and potential conflicts of purpose and priorities that need to be resolved. The following extract from *A guide to management plans for parks and open spaces* (Barber, 1991) sets out the types of management plans that can be prepared:

(i) Management plan

This predicts a degree of physical change, and therefore should present design proposals in its recommendations. It puts the emphasis on the presentation of anticipated physical change with much of the documentation being in support.

(ii) Outline plan

This is generally accepted as a more appropriate title for a management plan that wishes to establish the guiding principles, without providing detailed proposals which might constrain future options for achieving the outline objectives.

(iii) Maintenance plan

This is appropriate if the principal interest is in establishing the best way of maintaining an area, or where there is a need to match maintenance aspirations to a secure financial base. Planned maintenance programmes over longer timescales can be made more secure by the more public exposure of the need and the commitment that the Maintenance Plan should be able to guarantee. A Maintenance Plan can also establish changes in maintenance regimes that may be required to match a change in objectives e.g. the need to adapt operation and maintenance practices to accommodate specific wild life habitats that may develop.

For a SuDS scheme, the maintenance plan will generally be the most appropriate type of management plan to use. The document should include an explanation of the function of the SuDS scheme and why it is being used on the site.

Where the drainage system has an impact on the wild life value or public use of a site, it would be prudent to develop this simple explanation further to explain habitat enhancement goals, health and safety issues and long-term management implications.

Sites with special wild life or amenity interest may require detailed management plans, which monitor habitat development, infrastructure changes or damage to sites and ensure rapid responses to such changes, should they occur.

It is common for smaller commercial, industrial and housing sites to have a simple maintenance statement. In this case, a single page explaining the site management (including the sustainable drainage system) would be useful for all parties involved in the care of the development.

(B) Conditions of contract – appropriate conditions will be required. Advice can be sought from the Landscape Institute. Guidance is also provided in CIRIA publication C625 (Shaffer et al, 2004).

(C) Specification – detailing the materials to be used and the standard of work required. A specification, usually preceded by preliminaries, details how work shall be carried out and contains clauses that give general instructions to the contractor. Specific SuDS maintenance clauses may be included in a general specification or as a separate "Sustainable drainage maintenance specification" section.

(D) Schedule of work – itemising the tasks to be undertaken and the frequency at which they will be performed.

The tasks required to maintain the site and the frequency necessary to achieve an acceptable standard should be set out in the schedule of work.

Smaller sites will usually have simple specification notes given to a contractor as a basis for maintenance on a performance basis. Examples of performance criteria are items such as:

- length of grass
- tidiness
- extent of weed growth, etc.

This document will often form the basis of a pricing mechanism and can also act as a checklist to ensure the work has been carried out satisfactorily.

For additional information on the development of appropriate schedules, reference should be made to the operation and maintenance of sustainable drainage systems (HR Wallingford, 2004).

4.0 Frequency of maintenance tasks

Landscape maintenance contract periods are usually of one to three years' duration.

The three-year period is increasingly common to ensure continuity and commitment to long-term landscape care. The frequency of regular landscape maintenance tasks in a contract period can range from daily to once in the contract period. In practice most site tasks are based on monthly or fortnightly site visits, except where grass or weed growth requires a higher frequency of work. In many cases a performance specification is used with terms such as "beds shall be maintained weed-free" or "grass shall be cut to a height of 50 mm with a minimum height of 25 mm and a maximum height of 100 mm" to obtain the required standards.

Frequency can be specified within the schedule to include irregular items such as “‘meadow grass’ cut two times annually in July and September to a height of 50 mm, all risings raked off and removed to wildlife features, compost facility or to tip”, which provides flexibility for work that is not critical to the management of the site.

Maintenance tasks which suit a performance approach commonly include plant growth, grass cutting, pruning and tree maintenance. However, work tasks such as sweeping paths, regular litter collection and cleaning road surfaces will require work at an agreed frequency with more specific timings such as weekly, monthly or annually.

Where the frequency and timing of tasks is critical, a mixture of performance and frequency specification is necessary to provide effective maintenance.

SuDS maintenance generally tends towards a frequency requirement to ensure a predictable standard of care which can be recorded on site and which provides a reasonable basis for pricing work. A convenient frequency for many tasks is at a monthly inspection as this is the usual minimum site attendance required in a landscape specification. The monthly frequency should provide for an inspection of all SuDS features and checking all inlets and outlets.

Certain SuDS maintenance tasks however fall outside this monthly cycle and need to be accommodated in the contract. The two most obvious are:

- wetland vegetation maintenance
- silt management.

There are other tasks associated with ensuring the long-term performance of the systems that may be more difficult to predict and could even fall outside any contract period. It may therefore be more appropriate to review requirements for system rehabilitation at interim periods, when contracts are falling due for renewal.

5.0 References

- CIRIA C753 (2015) – The SuDS Manual
- Wildfowl & Wetlands Trust guidance (2012) – Maximising the potential for people and wildlife
- HR WALLINGFORD (2004). Whole Life Costing for Sustainable Drainage. Report SR 627.
- DEFRA (2010). Surface Water Management Plan Technical Guidance.
- Environment Agency (2015) - Cost estimation for SUDS. Summary of evidence.

GREEN ROOFS

DESCRIPTION

Green roofs are areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff.

OPERATION AND MAINTENANCE REQUIREMENTS

The most maintenance is generally required during the establishment stage (12 to 15 months), and this should usually be made the responsibility of the green roof provider. Maintenance contractors with specialist training in green roof care should be used, where possible.

Table below 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. Actual requirements will depend on the planting, the desired aesthetic and visual effect and the biodiversity objectives for the system. Maintenance specifications and schedules should therefore be specified for any individual green roof. If mechanical systems are located on the roof, then spill prevention measures should be exercised to ensure that roof runoff is not contaminated. The mechanical system area should be bunded and provided with separate drainage.

All maintenance actions carried out at roof level must be in full compliance with the appropriate health and safety regulations, and particularly those specifically dealing with working at height. Training and guidance information on operating and maintaining the roof should be provided to all property owners and tenants. Safety fastenings will be required for personnel working on the roof. Access routes to the roof should be designed and maintained to be safe and efficient, and walkways should always be kept clear of obstructions. Secure points for harness attachments should be provided when access near to the roof edges is required. Specific maintenance needs of the green roof should be monitored, and maintenance schedules adjusted to suit requirements.

Maintenance schedule	Required action	Frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (i.e. year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leave and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled.	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

PERVIOUS PAVEMENTS

DESCRIPTION

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltration to the ground, reuse, or discharge to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment.

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 facility to the client, it should be inspected for clogging, litter, weeds and water ponding and all failures should be rectified. After handover, the facility should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capability. Experience in the UK is limited, but advice issued with permeable precast concrete paving has suggested a minimum of three surface sweepings per year. Manufacturers' recommendations should always be followed.

A brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper, should be used and the sweeping regime should be as follows:

1. End of winter (April) – to collect winter debris.
2. Mid-summer (July/August) – to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced.

The likely design life (or period before pavement rehabilitation is required) has yet to be established for the UK. However, it should be no different from standard paving assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging.

If reconstruction is necessary, the following procedure should be followed:

1. Lift surface layer and laying course.
2. Remove any geotextile filter layer.
3. Inspect sub-base and remove, wash and replace if required.
4. Renew any geotextile layer.
5. Renew laying course, jointing material and concrete block paving.

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 of CIRIA C753.

Pervious pavement operation and maintenance requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weed.	As required.
	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 actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
	Initial inspection.	Monthly for 3 months after installation
Monitoring	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Implementation of the CDM Regulations (DETR, 1994) and generic health and safety criteria are presented in Sections 2.5.10 and 3.4.2 of CIRIA C697 respectively. Maintenance activities should be detailed in the Health and Safety Plan and a risk assessment should be undertaken.

SILT TRAPS AND CATCH PITS

DESCRIPTION

Silt traps and catch pits are circular or rectangular manholes and/or chambers with a sump in them to collect suspended solids. Some chambers have removable silt buckets to assist with the removal of accumulated silt deposits. Catch pits are usually concrete ring or segment structures and silt traps preformed plastic chambers.

OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground silt traps and catch pits systems. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements are described in the table below. Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements.

Silt traps and catch pits – operation and maintenance requirements

Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Inspection of silt traps and catch pits to assess silt accumulation	Monthly (and after large storms)
	Removal of accumulated silt from silt trap and catch pit sumps	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

ATTENUATION STORAGE TANKS

DESCRIPTION

Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The storage structure is usually formed using one of the following methods:

1. geo-cellular storage systems
2. plastic corrugated arch structures (constructed over and backfilled with an open-graded aggregate base)
3. aggregate base
4. oversize concrete pipes
5. oversize plastic pipes
6. corrugated steel pipes
7. precast or/ in situ concrete box culvert sections and tanks (including flat-packed concrete panels)
8. concrete panels
9. glass-reinforced plastic (GRP) tanks
10. hybrid structures using reinforced earth walls and concrete roof panels

OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of belowground storage systems. Maintenance responsibility for systems should be placed with a responsible organisation. The table below 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 of CIRIA C753.

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.

Attenuation Storage Tanks – operation and maintenance requirements

Maintenance schedule	Required action	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

FLOW CONTROL CHAMBERS AND DEVICES

Description

Flow control devices are usually installed in circular or rectangular manholes and are small orifice or vortex devices designed to hold back surface water and discharge at a low pre-specified rate. They are usually associated with up-stream storage tanks or modular storage that accommodates the peak flow volume until drain down at the attenuated discharge rate controlled by the flow control device.

OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of flow control devices. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements are described in the table below. Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements.

Silt traps and catchpits – operation and maintenance requirements

Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Inspection of flow control chamber to assess if system is draining down correctly and that the orifice or flow control device is not blocked. Assess if there are any silt accumulations in the chamber sump.	Monthly (and after large storms)
	Removal of accumulated silt from silt trap and catchpit sumps	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

APPENDIX A - MONITORING AND MAINTENANCE RECORD

You need to keep a record of the checks you have completed that are set out in the checklist below along with any additional checks you have made.

If you have a maintenance contract with a contractor, keep a record of any work carried out on your pond system by them. If invoices state the work carried out, these will be sufficient.

If you do the checks you should enter:

- The check or maintenance job
- Who did it;
- The result (for example when a bnormal noise heard, called in specialist to investigate).

Action	Date and Time	Carried out by	Result
For example, inlet and outlet pipes checked	06/04/2012 09.30	Mr A N Other	Obstruction cleared.

APPENDIX B - ACCIDENT AND INCIDENT RECORD

You should record any accidents, other incidents or near misses relating to the operation of the SUDS system for example untreated sewage being released into the ponds. The form could also be used to record health and safety incidents.

"Other incidents" covers impacts on the environment that are not accidents, such as failing to maintain the system, or vandals causing damage to the detention pond.

Date and time of the incident	
What happened, what was it about?	
Was anyone else aware of this – other witnesses? If so who?	
What caused it?	
What action did you take to fix the problem?	
What have you done to make sure that it does not happen again?	
Was there any significant pollution – for example: untreated sewage being discharged into a drain, river or stream? Yes / No If yes, what pollution occurred?	
If there was significant pollution then you must notify the Environment Agency on 0800 807060 as soon as possible. Have you done so?	Yes/No/not applicable At what time did you phone? EA Incident reference no.
You must also write or send an email to confirm this to the local office (see your accident management plan for the address). Have you done so?	Yes/No/not applicable
Please print your name, sign and date.	

APPENDIX C - KEY SITE AND EMERGENCY CONTACTS

This table contains information and contacts you may need in an emergency

SITE DETAILS		
Address:		
Postcode:		
Site access grid reference:		
SITE CONTACTS	Office Hours (specify)	Out of hours
Owner:		
General manager:		
Site manager:		
Site supervisor:		
Security contact:		
Landowner/agent:		
EMERGENCY SERVICES	Office Hours	Out of hours
Emergency		
Medical:		
Police:		
Fire:		
REGULATORS	Office Hours	Out of hours
Health and Safety Executive (HSE):		
Local Authority:		
Environment Agency	General number:	08708 506 506
	24 hour emergency hotline:	0800 80 70 60
Natural England/Countryside Council for Wales		
OTHER KEY CONTACTS	Office Hours	Out of hours
Adjacent landowners:		
Neighbours:		
Specialist advisors:		