Land accessed from private lane between 25a & 25c Frognal

Application for planning consent

Sustainable Drainage Design
November 2018

Revision Schedule

Air Quality Statement
November 2018

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	Nov 2018	Final	S Neale	T Trotman	P Giesberg

Table of Contents

Planning for Sustainability
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1 Summary

A Flood Risk Assessment (FRA) and Drainage Strategy has been undertaken to accompany the planning application for the proposed redevelopment at 29-33 Arkwright Rd, West Hampstead, London NW3 6BJ. This report has been prepared by Planning for Sustainability in accordance with the guidelines set out in the National Planning Policy Framework.

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

ITEM	RESPONSE
Site Location	The site is located in London, West Hampstead, bound by Arkwright Road to the north and Frognal to the east. Finchley Road & Frognal tube Station is approx. 200 m to the west. Site access via lane between 25a and 25c Frognal. The approximate grid reference 526201 E, 185207 N.
Size and Current Land Usage	The current site is approximately 0.044 ha in plan and was previously used by Back Garden/Rear Access to nos. 29 to 33 Arkwright Road.
Flood Zone	The development site falls entirely within Flood Zone 1, which is classified as low probability of flooding.
Fluvial Flood Risk	**Low** – Refer to Section 6.1
Overland Flood Risk	**Low** – Refer to Section 6.2
Groundwater Flood Risk	**Low** – 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 proposals are for the development of land are Construction of 2 No. 2 storey (1 No. 2 bed, 1 No. 3 bed) properties including Landscaped gardens and communal access area.

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 Introduction

2.1 Commission

Planning for Sustainability was commissioned to prepare a Flood Risk Assessment (FRA) and drainage statement to support a planning application for the redevelopment at 29-33 Arkwright Rd, West Hampstead, London NW3 6BJ.

2.2 Guidance

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

2.3 Aims and Objectives

The purpose of this flood risk assessment 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.

3 Site Details

3.1 Location

The site is to the rear of nos. 29-33 Arkwright Rd, West Hampstead, London NW3 6BJ**,** within the rear gardens, bound by Frognal to the east, and a small access lane between No's 25a and 25c Frognal**.**

Fig 3.1.1 – Site Context

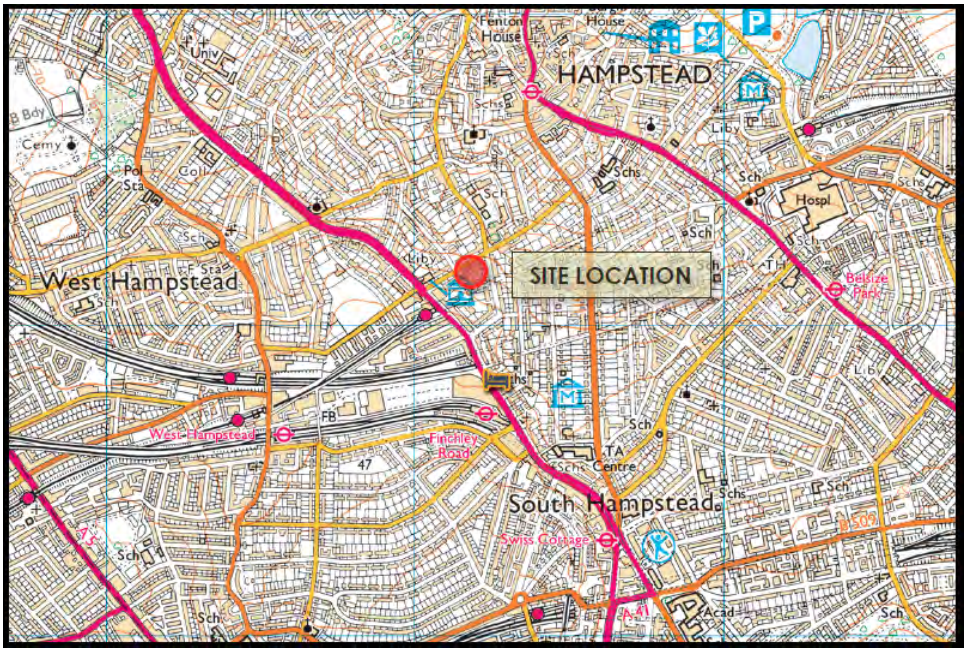

Figure 3.1.2 - Site location

3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is: 526201 E, 185207 N (Nat Grid TQ 26201 85207)

3.3 Topography and Site Description

The site covers an approximate brownfield area of 0.044 ha, and is located at the rear of nos. 29-33 Arkwright Rd, West Hampstead, London**.** The site is approximately rectangular on plan with its long axis running in a southwest-northeast direction. Levels vary within the site between 68.79 mAOD to the south-western corner and 72.40 mAOD to the north-eastern corner. The maximum fall across the site is 3.6 m over 35.5 m, giving a gradient of 10%. (1:10) See Appendix B.

3.4 Ground Conditions

Reference to the Geological survey of Great Britain indicates the following strata:

Superficial deposits: No superficial deposits recorded
Bedrock geology: London Clay Formation - Clay, silt and sand. Sedimentary bedrock formed between 56 and 47.8 million years ago during the Palaeogene period.

Intrusive site investigations carried out near the development and shown on the British Geological Survey database (BGS ID: 590718 BGS Reference: TQ28NE130 British National Grid (27700): 525980,185100) found Weathered London Clay to depths of >15mbgl.

3.5 Ground Water

Boreholes carried out in the vicinity of the site, found groundwater at 1.5mbgl**.** Further in situ testing is required to confirm the depth of groundwater. A review of the maps within the West Hampstead SFRA indicate that the site is at a low risk flooding.

3.6 Existing Site Drainage

The Thames Water wastewater plans for the development site have yet to be secured and can be found within Appendix C of this report. It should however be noted that from the 1st October 2011, many private sewers were transferred into public ownership and may not be recorded on the public sewer map.

3.7 Existing Watercourses

The nearest main river watercourse to the site is the Regents Canal, 2.1 km southeast, with the River Thames beyond, located 6.4 km to the southeast of the site.

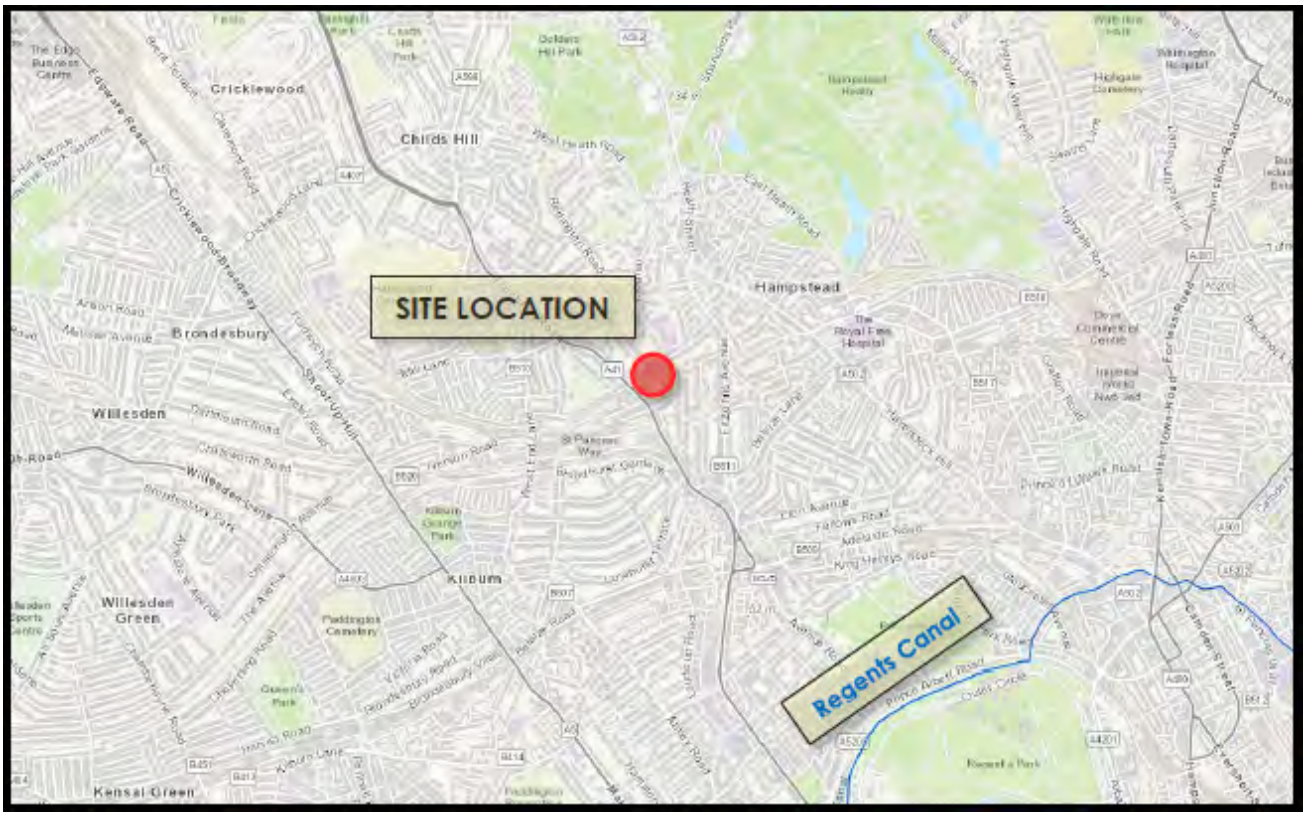

Fig 3.7.1 – Local Rivers

3.8 Environment Agency Groundwater and Aquifer Protection

Reference to the Environment Agency Groundwater protection zone map shows the area is sited within Minor Aquifer (High) groundwater protection zone. The Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes, and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

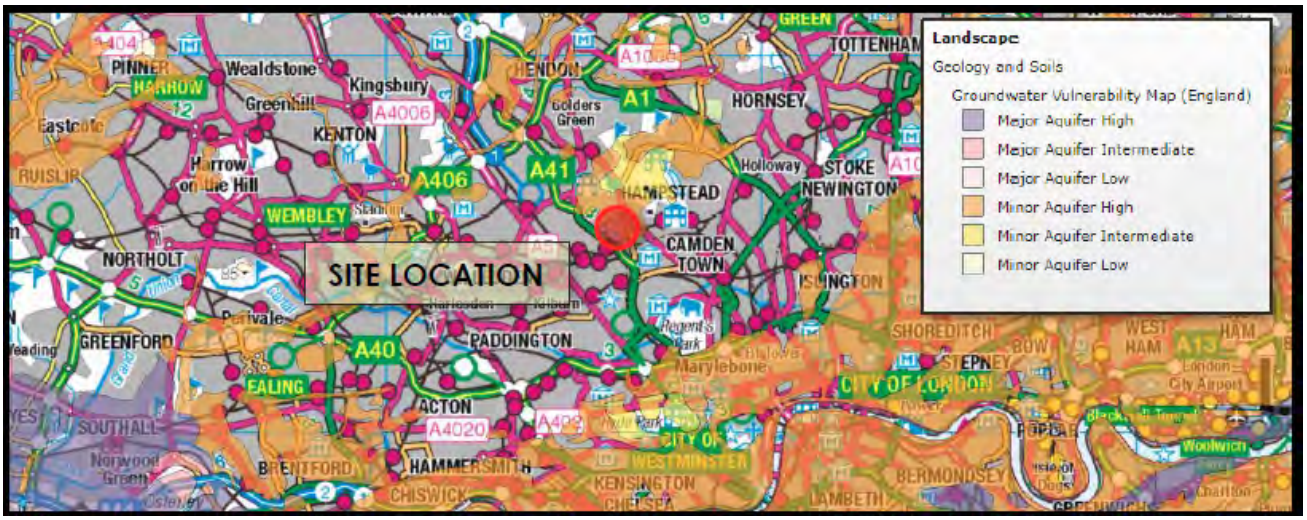

Fig 3.8.1 – Groundwater Protection Zones

The Environment Agency use the zones to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

4 Proposed Development

The current architectural proposals involve the construction of 2 No. 2 storey (1 No. 2 bed, 1 No. 3 bed) properties including Landscaped gardens and communal access area. The proposed development plans can be found in Appendix A.

5 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.

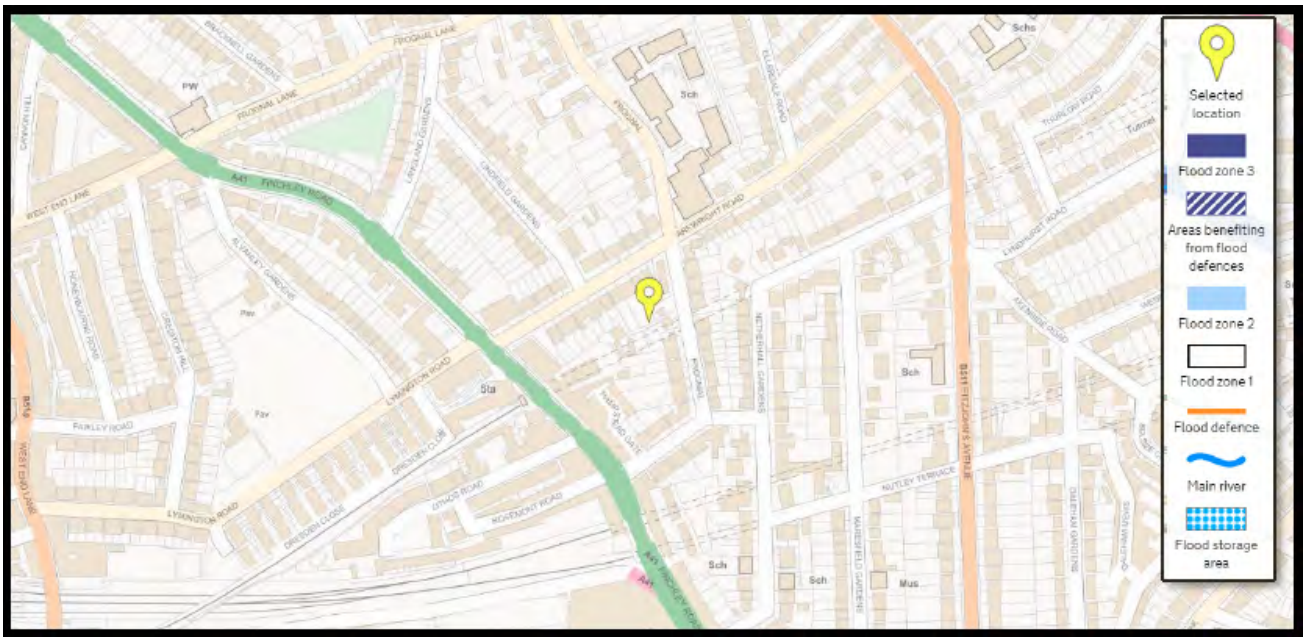

Fig 5.1 – Environment Agency Flood Zone map

5.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and the accompanying Planning Practice Guidance (PPG) gives 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	Fluvial	Tidal	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 PPG

(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 (PPG)

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 PPG (table 3), confirms that residential properties within flood zones 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.

6 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.

Fig 6.1 – Environment Agency Flood Risk from Fluvial Flows map

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 risk of flooding due to overland flood flows is considered low by the Environment Agency. The surface water flood data for the site, shown below, indicates that there is medium flood risk immediately to the East of the site, along Frognal, but very low risk within the site itself.

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 flow.

6.3 Flooding from Rising Groundwater

Section 3.5 of this report confirms that boreholes carried out in the vicinity of the site, found ground water at approximate depths of 1.5mbgl. A review of the maps within the West Hampstead SFRA also indicate the site has a low risk of flooding from Groundwater.

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

6.4 Flooding from the Local Sewerage Network

The nearest major sewers to the development site run within Frognal, to the east of the site. Should this sewer system surcharge and flood, the resultant flows would follow the main road and be channelled away from the site.

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

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 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 watercourses 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 m_3) 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 allowance for climate change. Table 5 of NPPG recommends for developments that have a life expectancy beyond 2085 that an additional factor of 40% is applied to the peak volume of runoff.

7.4 Existing Surface Water Runoff Rates

The development site area is approximately 0.044ha and consists of existing garden areas. The site currently has no form of drainage network and as such the site should be considered as greenfield. The existing runoff rates calculated for site are highlighted below:

Return Period	Greenfield Runoff Rate l/s
1 in 1 year	0.2
Qbar	0.2
1 in 30 year	0.4
1 in 100 year	0.5

Table 7.4 Existing Runoff Rates

Greenfield runoff rates were calculated using the FSR Method within Microdrainage Software. Calculations can be found in Appendix E.

7.5 Infiltration Testing

At the time of writing no site investigation works have been carried out on the development site, but it is anticipated that infiltration potential will be very low due to the presence of London Clays below the site.

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 strata 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	Pos
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	Y
Constructed wetlands	Waterlogged areas that can support aquatic vegetation. Replicates existing conditions and provides ecological benefit.	M	L	H	H/M	M	N
Swales	Shallow grassed drainage channels. Replicates existing conditions	H	M	L	M/H	L	N
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	N
Tanked storage systems	Oversized pipes or cellular storage.	H	L	L	M	M/H	N
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 D which indicates the drainage proposals.

7.7 SUDS Techniques Employed

The proposed dwellings utilise extensive green roofs for the two buildings to offer a degree of infiltration, evaporation and evapo-transpiration to reduce and lower surface water flow rates and volumes leaving the site. Externally paved areas are to be levelled to direct surface water into soft landscaping areas to provide biofiltration. As such the only mechanism for surface water to be generated from the development site is during intense and prolonged storm events where the green roofs will become saturated and unable to hold

further water. In these instances, a piped overflow will be provided into a positive drainage system located within the adjacent access road.

Flows off the development site will be reduced by means of a flow control value with upstream cellular storage to contain the 1 in 100 year storm event with 40% allowance for climate change. Flow rates have been restricted to 2 l/s, which is deemed to be the lowest reliable flow rate without compromising the drainage system and increasing the risk of blockage. Drainage calculations associated with the proposed system can be found within Appendix E of this report. Potential sediments will be trapped using catch pits. Urban creep has not been considered when sizing the drainage system, given the spatial constraints of the development site.

7.8 Residual Flood Risk & Exceedance

It is proposed that finished floor levels will be raised 150 mm above the average ground level to mitigate against the risk of any surface water flooding. The proposed surface water drainage measures will however be designed to contain the peak storm event that can be expected for a 1 in 100 year situation. A 40% allowance has already been applied to the site to account for future climate change. Should the system be subjected to an extreme storm event, the system will fail safe and divert flows onto the adjacent road.

7.9 Flood Risk Management

Unlike conventional drainage systems, SuDS features are 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. 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 F.

8 Proposed Foul Water Drainage System

Foul drainage from the development site is to connect into the adjacent combined drainage manhole located within the adjacent access road. The final design should be undertaken in consultation with Thames Water.

9 Recommendations and Conclusion

The development proposals 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 hierarchal 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.

10 References & Bibliography

- The National Planning Policy Framework July 2018
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps https://flood-map-forplanning. service.gov.uk/
- Environment Agency indicative groundwater source protection zone maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- Environment Agency indicative Aquifer designation maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- CIRIA 2007, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for adoption 7th edition
- Camden SFRA
- Flood Estimation Handbook
- Environment Agency - Adapting to Climate Change: Advice for the Flood and
- Coastal Erosion Management Authorities March 2016

Appendix A - Development Proposals

33 Arkwright Rd

29 Arkwright Rd

25e Frognal

25a Frognal

25b Frognal

Garden to 25b

25c Frognal

ACCESS LANE
OFF FROGNAL

C

A

notes:

General notes:
1. Do not scale drawings. Dimensions govern.
2. All dimensiions are in millimeters unless noted otherwise.
3. All dimensions shall be verified on site before proceeding with the work.
4. Square Feet Architects shall be notified in writing of any discrepancies.

Party Wall Act 1996:
Note: If the project progresses onto site without the involvement of Square Feet Architects the Client must seek advice prior to commencement of the planned works as detailed on the drawings to establish whether the works fall within the scope of the Act which required adjoining property owners to be served with a statutory notice.
C.D.M. Regulations 2015:
These drawings have been produced for the purpose of applying for Planning and Building Regulations only. If the project progresses on to site without the involvement of Square Feet Architects, the client and contractor must ensure that they fulfil the duties in respect of the construction (Design and Management) Regulations 1994.
If advice is required please do not

ur

owi

by applicant

PLANNING

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revision:

* – 13.07.17 – PreApp Amendments
A – 19.09.17 – Post PreApp Amendments
B – 06.11.17 – PreApp 'Follow–up' Submission
C – 05.02.18 – Final Pre–App Meeting
D – 29.03.18 – Design Review Panel Issue
E – 28.06.18 – Design Review Panel Amendments
F – 18.10.18 – Planning Issue

SQUARE FEET ARCHITECTS

A : 95 Bell Street, London NW1 6TL
T : 0207 431 4500
E : studio@squarefeetarchitects.co.uk
W : www.squarefeetarchitects.co.uk

drawing title:

PROPOSED SITE PLAN

client:

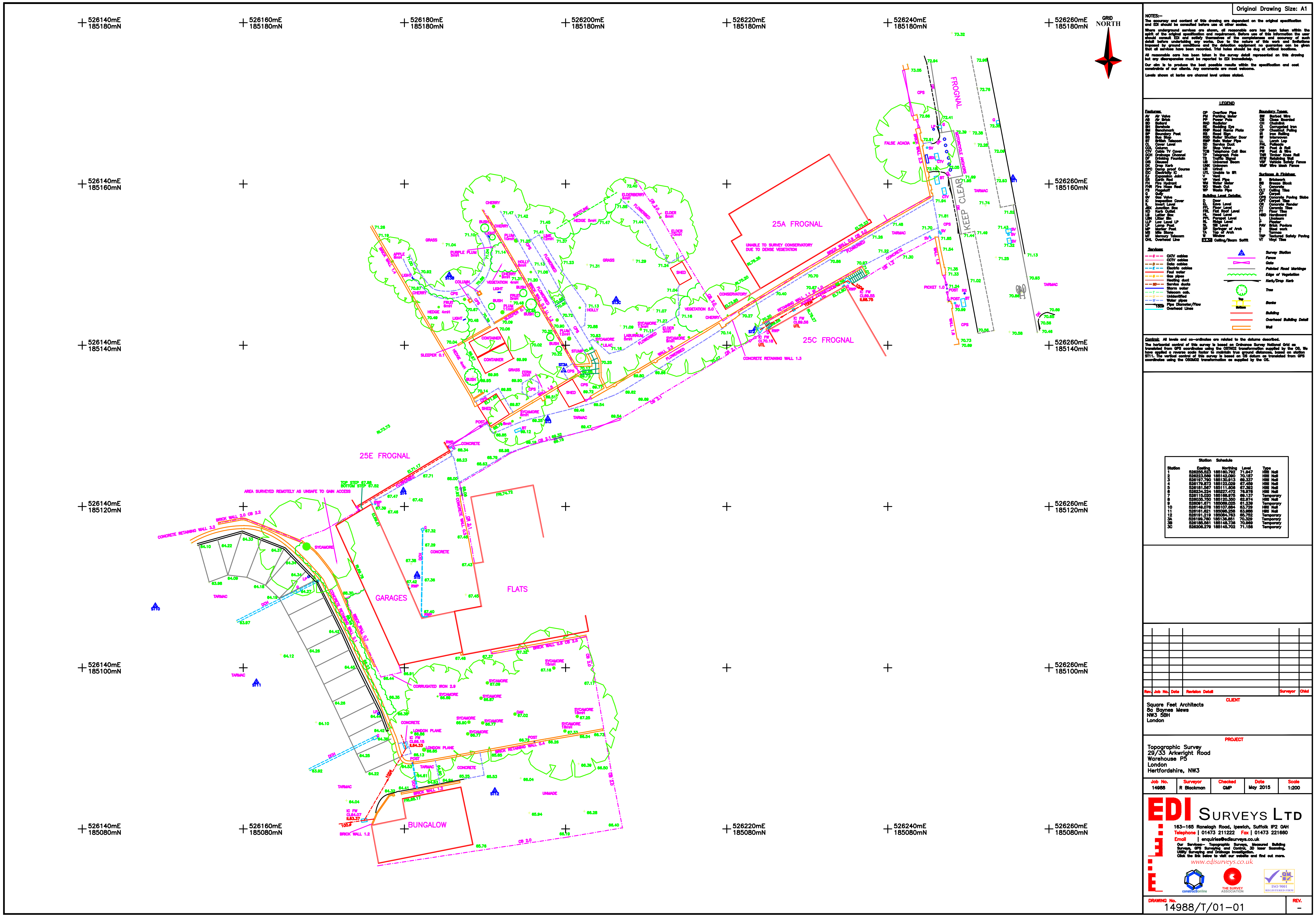
project:

29/33 Arkwright Rd, NW3 6BJ

date:

scale:

Appendix B - Topographic Survey


GRID NORTH
25A FROGNAL
25C FROGNAL
25E FROGNAL
FROGNAL
KEEP CLEAR
GARAGES
FLATS
BUNGALOW
AREA SURVEYED REMOTELY AS UNSAFE TO GAIN ACCESS
UNABLE TO SURVEY CONSERVATORY DUE TO DENSE VEGETATION
Original Drawing Size: A1
LEGEND
Station Schedule
Rev. Job No. Date Revision Detail Surveyor Chkd
CLIENT
Square Feet Architects
8a Baynes Mews
NW3 5BH
London
PROJECT
Topographic Survey
29/33 Arkwright Road
Warehouse P5
London
Hertfordshire, NW3
Job No. 14988
Surveyor R Blackman
Checked GMP
Date May 2015
Scale 1:200
EDI SURVEYS LTD
163-165 Ranelagh Road, Ipswich, Suffolk IP2 0AH
Telephone | 01473 211222 Fax | 01473 221660
Email | enquiries@edisurveys.co.uk
Our Services:- Topographic Surveys, Measured Building Surveys, GPS Surveying and Control, 3D laser Scanning, Utility Surveying and Drainage Investigation.
Click the link below to visit our website and find out more.
www.edisurveys.co.uk
DRAWING No. 14988/T/01-01
REV. -

Appendix C - Thames Water Sewer Records

Asset location search

Thames Water Property Searches

Infrastruct CS Ltd
High Cogges Farm
High Cogges
WITNEY
OX29 6UN

Search address supplied 25a
Frognal
London
NW3 6AR

Your reference ICS-3273

Our reference ALS/ALS Standard/2018_3926365

Search date 14 December 2018

Keeping you up-to-date

Notification of Price Changes

From 1 September 2018 Thames Water Property Searches will be increasing the price of its Asset Location Search in line with RPI at 3.23%.

For further details on the price increase please visit our website: www.thameswater-propertysearches.co.uk
Please note that any orders received with a higher payment prior to the 1 September 2018 will be non-refundable.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Asset location search

Thames Water Property Searches

Search address supplied: 25a, Frognal, London, NW3 6AR

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset location search

Thames Water Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

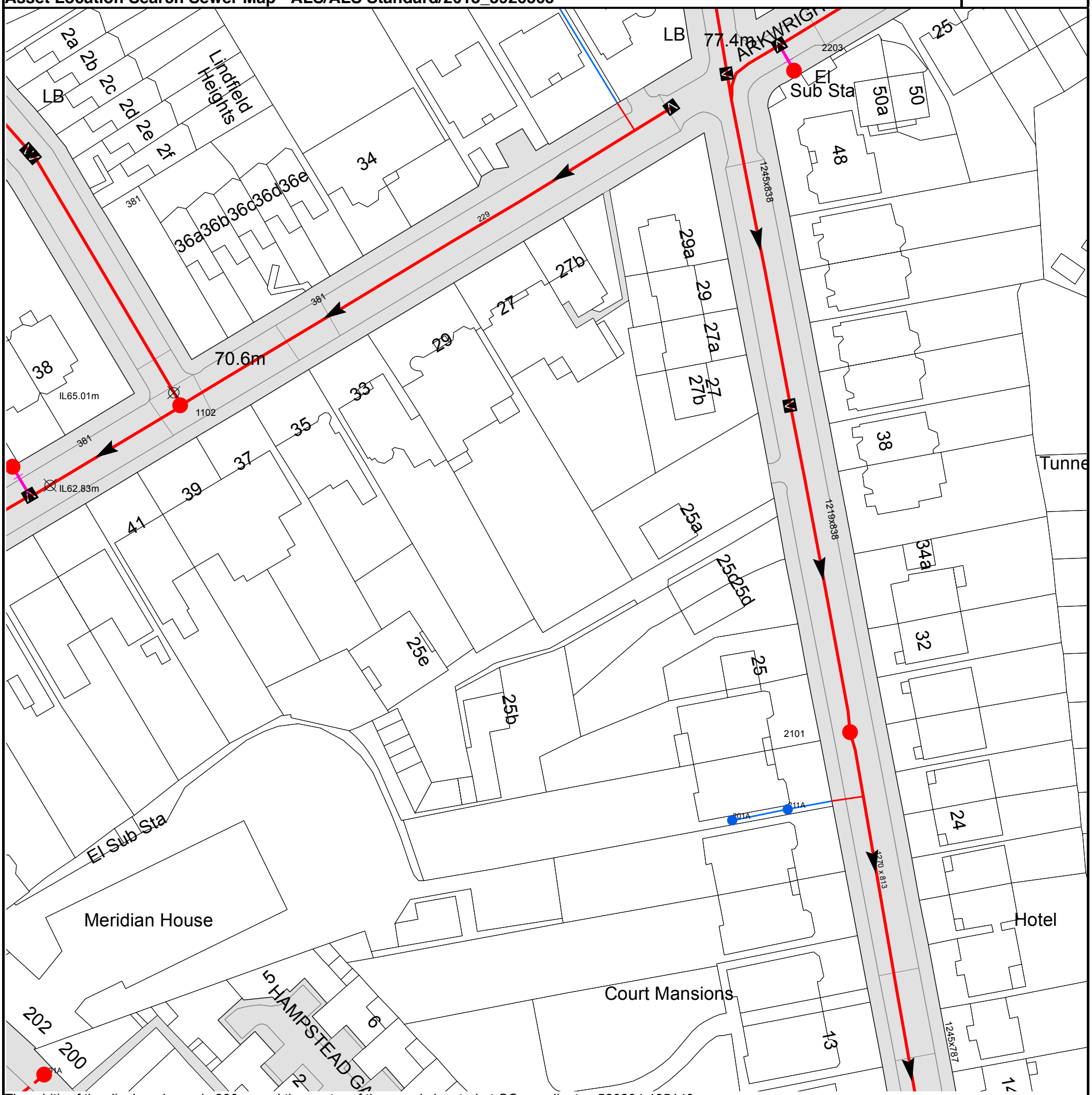
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2018_3926365



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 526204,185149

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
201A	n/a	n/a
211A	n/a	n/a
2101	69.04	62.55
1101	n/a	n/a
1102	70.36	64.86
2203	n/a	n/a
101A	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

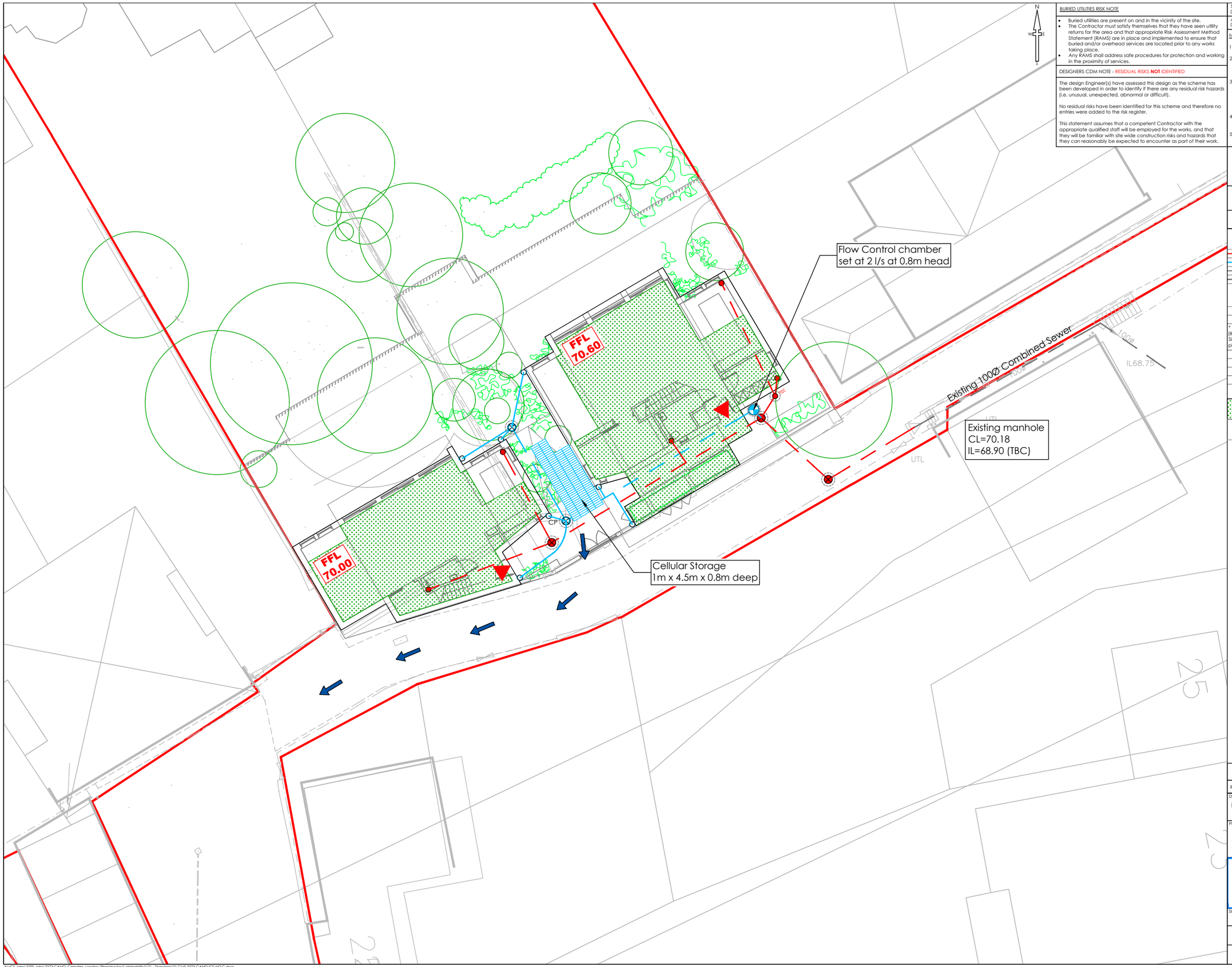
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix D - Drainage Strategy



N

W E

S

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.

DESIGNERS CDM NOTE - RESIDUAL RISKS NOT IDENTIFIED

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

No residual risks have been identified for this scheme and therefore no entries were added to the risk register.

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.

Surveyor: EDI Surveys Ltd
DRG: 14988/1/01-01 Date Received: 29/11/2018

Architect: Square Feet Architects
DRG: 1514_L_040 Date Received: 29/11/2018

NOTES

1. All dimensions and levels are in metres unless otherwise noted
2. This drawing is to be read in conjunction with the relevant Architect's/Engineer's drawings, specifications and CDM documentation
3. This drawings has been produced electronically and may have been photo reduced or enlarged when copied. Work to figured dimensions only (DO NOT SCALE). All dimensions to be checked on site. Any errors or omissions to be reported to the engineer immediately.
4. This drawing contains coloured lines / information that may not be clear if reproduced in black and white.
5. Digital copies of this plan can only be considered accurate if supplied directly by Infrastruct CS Ltd.

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 it 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

All manholes covers located within carriageways shall have no slip covers to prevent motorcycles/cycles losing control

Drainage Key

Sewers

	Foul water drain (private/non adoptable)
	Surface water drain (private/non adoptable)
	Existing foul water drain (private/non adopted)
	Existing surface water drain (private/non adopted)

Chamber Key

FW	SW	
		Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *

* 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)

	Rain water down pipe (roddable access)
	Silt Trap (ST) with removable silt bucket
	Soil vent pipe/soil stack
	Cellular storage (refer to drawing for sizes)
FFL XX.XX	Finished Floor Level (FFL)
	Green Roofing System
	Flood Exceedance Routing

REV	DRAWN	CHECK	REVISION COMMENTS	ISSUE DATE
P1	NJ	TST	Initial issue	19/12/18

DRAWING TITLE: Proposed Drainage Strategy
SHEET NO.: 1/1

PROJECT: Arkwright Road, Camden, London

S2 - INFORMATION

SCALE @ A1: 1:100 (0m, 2.5m, 5.0m)
ENGINEER: TST
DRAFT: EPR
APPROVED: DJ
PROJECT NUMBER: 3273
STATUS: S2
DATE: December 18

PROJECT	ORIGIN	PHASE	LEVEL	TYPE	ROLE	NO.	REVISION
CAMD	ICS	01	XX	DR	C	003	P1

X:\ICS Jobs\3200 Jobs\3273-CAMD -Camden, London (Planning for Sustainability)\01 - Drawings\01 Civil\3273-CAMD-ICS-M2-C.dwg

Appendix E - Microdrainage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	0.044	Urban	0.750
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	0.1
QBAR Urban	0.2
Q2 years	0.3
Q1 year	0.2
Q30 years	0.4
Q100 years	0.5

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

Half Drain Time : 16 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	69.288	0.238	0.0	2.0	2.0	1.0	O K
30 min Summer	69.551	0.501	0.0	2.0	2.0	2.1	O K
60 min Summer	69.705	0.655	0.0	2.0	2.0	2.8	O K
120 min Summer	69.640	0.590	0.0	2.0	2.0	2.5	O K
180 min Summer	69.478	0.428	0.0	2.0	2.0	1.8	O K
240 min Summer	69.318	0.268	0.0	2.0	2.0	1.1	O K
360 min Summer	69.158	0.108	0.0	1.9	1.9	0.5	O K
480 min Summer	69.097	0.047	0.0	1.7	1.7	0.2	O K
600 min Summer	69.081	0.031	0.0	1.5	1.5	0.1	O K
720 min Summer	69.071	0.021	0.0	1.4	1.4	0.1	O K
960 min Summer	69.059	0.009	0.0	1.1	1.1	0.0	O K
1440 min Summer	69.050	0.000	0.0	0.8	0.8	0.0	O K
2160 min Summer	69.050	0.000	0.0	0.6	0.6	0.0	O K
2880 min Summer	69.050	0.000	0.0	0.5	0.5	0.0	O K
4320 min Summer	69.050	0.000	0.0	0.3	0.3	0.0	O K
5760 min Summer	69.050	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	69.050	0.000	0.0	0.2	0.2	0.0	O K
8640 min Summer	69.050	0.000	0.0	0.2	0.2	0.0	O K
10080 min Summer	69.050	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	69.389	0.339	0.0	2.0	2.0	1.4	O K
30 min Winter	69.698	0.648	0.0	2.0	2.0	2.8	O K
60 min Winter	69.843	0.793	0.0	2.0	2.0	3.4	O K
120 min Winter	69.738	0.688	0.0	2.0	2.0	2.9	O K
180 min Winter	69.526	0.476	0.0	2.0	2.0	2.0	O K
240 min Winter	69.263	0.213	0.0	2.0	2.0	0.9	O K
360 min Winter	69.101	0.051	0.0	1.8	1.8	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.970	0.0	5.1	28
30 min Summer	96.172	0.0	7.0	44
60 min Summer	59.033	0.0	8.8	64
120 min Summer	34.999	0.0	10.6	96
180 min Summer	25.448	0.0	11.7	128
240 min Summer	20.187	0.0	12.5	152
360 min Summer	14.544	0.0	13.5	206
480 min Summer	11.522	0.0	14.3	260
600 min Summer	9.611	0.0	14.9	316
720 min Summer	8.284	0.0	15.4	376
960 min Summer	6.548	0.0	16.2	496
1440 min Summer	4.695	0.0	17.3	0
2160 min Summer	3.362	0.0	18.4	0
2880 min Summer	2.650	0.0	19.1	0
4320 min Summer	1.893	0.0	20.0	0
5760 min Summer	1.490	0.0	20.5	0
7200 min Summer	1.237	0.0	20.7	0
8640 min Summer	1.062	0.0	20.8	0
10080 min Summer	0.933	0.0	20.8	0
15 min Winter	148.970	0.0	5.9	31
30 min Winter	96.172	0.0	8.0	44
60 min Winter	59.033	0.0	10.0	64
120 min Winter	34.999	0.0	12.1	100
180 min Winter	25.448	0.0	13.3	136
240 min Winter	20.187	0.0	14.1	156
360 min Winter	14.544	0.0	15.3	206

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	69.076	0.026	0.0	1.5	1.5	0.1	O K
600 min Winter	69.065	0.015	0.0	1.2	1.2	0.1	O K
720 min Winter	69.058	0.008	0.0	1.1	1.1	0.0	O K
960 min Winter	69.050	0.000	0.0	0.9	0.9	0.0	O K
1440 min Winter	69.050	0.000	0.0	0.6	0.6	0.0	O K
2160 min Winter	69.050	0.000	0.0	0.4	0.4	0.0	O K
2880 min Winter	69.050	0.000	0.0	0.3	0.3	0.0	O K
4320 min Winter	69.050	0.000	0.0	0.2	0.2	0.0	O K
5760 min Winter	69.050	0.000	0.0	0.2	0.2	0.0	O K
7200 min Winter	69.050	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	69.050	0.000	0.0	0.1	0.1	0.0	O K
10080 min Winter	69.050	0.000	0.0	0.1	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
480 min Winter	11.522	0.0	16.2	262
600 min Winter	9.611	0.0	16.9	322
720 min Winter	8.284	0.0	17.5	376
960 min Winter	6.548	0.0	18.4	0
1440 min Winter	4.695	0.0	19.7	0
2160 min Winter	3.362	0.0	20.9	0
2880 min Winter	2.650	0.0	21.8	0
4320 min Winter	1.893	0.0	22.8	0
5760 min Winter	1.490	0.0	23.5	0
7200 min Winter	1.237	0.0	23.8	0
8640 min Winter	1.062	0.0	24.0	0
10080 min Winter	0.933	0.0	24.1	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)	20.800	Shortest Storm (mins)	15
Ratio R	0.439	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Green Roof

Area (m^3)	227	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.004125	24	28	0.001242	48	52	0.000374	72	76	0.000113	96	100	0.000034
4	8	0.003377	28	32	0.001017	52	56	0.000306	76	80	0.000092	100	104	0.000028
8	12	0.002765	32	36	0.000833	56	60	0.000251	80	84	0.000076	104	108	0.000023
12	16	0.002264	36	40	0.000682	60	64	0.000205	84	88	0.000062	108	112	0.000019
16	20	0.001853	40	44	0.000558	64	68	0.000168	88	92	0.000051	112	116	0.000015
20	24	0.001518	44	48	0.000457	68	72	0.000138	92	96	0.000041	116	120	0.000012

Model Details

Storage is Online Cover Level (m) 70.100

Cellular Storage Structure

Invert Level (m) 69.050 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	4.5	4.5	0.800	4.5	11.3	0.900	0.0	11.7

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	70
Invert Level (m)	69.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0	Kick-Flo®	0.502	1.6
Flush-Flo™	0.238	2.0	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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	1.8	0.800	2.0	2.000	3.0	4.000	4.2	7.000	5.4
0.200	2.0	1.000	2.2	2.200	3.2	4.500	4.4	7.500	5.6
0.300	2.0	1.200	2.4	2.400	3.3	5.000	4.6	8.000	5.8
0.400	1.9	1.400	2.6	2.600	3.4	5.500	4.8	8.500	5.9
0.500	1.6	1.600	2.7	3.000	3.6	6.000	5.0	9.000	6.1
0.600	1.7	1.800	2.9	3.500	3.9	6.500	5.2	9.500	6.3

Appendix F - SuDS Maintenance Manual

SuDS Maintenance Guide

Owners Manual

Scheme name: Land to the Rear of 29-33 Arkwright Rd

Document reference 3273-CAMD-ICS-XX-RP-C-07.002

Revision Schedule
December 2018

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	Dec 2018	Final	T Trotman	R White	P Giesberg

CONTENTS **PAGE NO.**

1.0 INTRODUCTION

This guidance provides best practice guidance on the maintenance of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within the Land to the Rear of 29-33 Arkwright Rd 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 MAINTENACE OF THE SUDS FEATURES USED FOR THIS SCHEME

Construction period - Following construction but prior to the completion of the initial sale of each dwelling, the responsibility for all the SuDS maintenance shall lie with the developer.

On the sale of each individual dwelling the house owner shall become responsible for the maintenance of all the SuDS features associated with that individual dwelling.

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 3273-CAMD-ICS-01-XX-DR-C-003

1.4 SUDS TECHNIQUES USED ON THIS SCHEME:

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

1.5 SUMMARY OF HOW THE TECHNIQUES WORK FOR THE SCHEME

The roof runoff from the two building will discharge via a piped system into a tanked cellular storage system with an attenuated discharge into the combined public system. Stormwater treatment chambers have been included in to the system to treat sedimentation, prior to discharge into the attention tank.

Discharge from the tanked cellular storage is controlled by a Hydrobrake or similar flow control device with the discharge limited to a rate of 2 l/s. The storage is sized to accommodate a 1 in 100-year storm with an allowance of 40% for climate change and is robustly designed to assume that there is free discharge into the system for all impermeable areas associated with the development.

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 soakaways are located. Failure to do so may cause structural damage and collapse of the cellular limits.

1.8 ACCIDENTAL SPILLAGES

Health and safety consideration are a priority and addressing accidental spillages should only be attempted if the nature of the spillage is known and it potential hazardous properties understood. The source of the spillage should be stopped and excess surface spillage removed by suction tank or absorption matts. 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 (eg 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.

It is important to note that these remedial activities will not be required for all systems, but for the purpose of estimating whole life maintenance costs, a contingency sum of 15-20% should be added to the annual regular and occasional maintenance costs to cover the risk of these activities being required.

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

O & M Activity	Silt traps and catchpits	Modular storage	Swale/bioretention/green roofs	Flow Control Devices
Regular Maintenance				
Inspection	■	■	■	■
Litter/debris removal	□	□	■	□
Grass cutting	□	□	■	□
Weed/invasive plant control			□	
Shrub management			□	
Shoreline vegetation management				
Aquatic vegetation managment				
Occasional Maintenance				
Sediment management (*)	■	■	■	■
Vegetation/plant replacement			□	
Vacumn sweeping and brushing				
Remdial 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, eg blockage, poor infiltration, poor water quality etc.

Inspections can generally be required at monthly site visits (eg 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 (eg 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 is 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 strimmed 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, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

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

In general:

- wildlife 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
- wildlife piles should comprise tidy piles up to 1.2 m high
- new wildlife piles should be constructed each year and old wildlife piles should be used as compost to plant beds after 3–5 years
- wildlife piles should be located above normal flood level of watercourses and be protected by hedges or similar features.

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

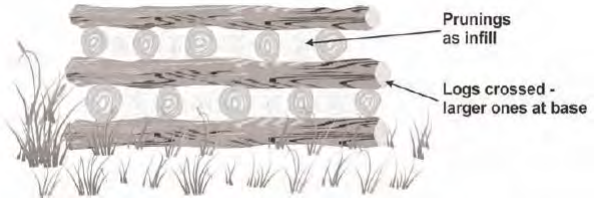


Figure 1.1 *Schematic of a wildlife pile (courtesy of Steve Wilson and Robert Bray of Sustainable Drainage Associates)*

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.

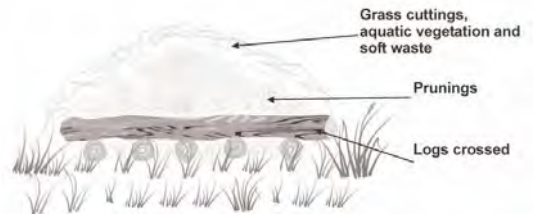


Figure 1.2 *Schematic of a composting structure (courtesy Steve Wilson and Robert Bray of Sustainable Drainage Associates)*

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

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 (eg 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.

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.

a) 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.
b) 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.
c) As a last resort, it may be necessary to remove and replace the grass and topsoil by:
    - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
    - removing damaged turf which should be composted

- cultivating remaining topsoil to required levels
- re-turfing (using turf of a quality and appearance to match existing) or reseeding (to 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 wildlife 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 wildlife 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 wildlife 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 arisings 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 predicable 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.

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.

6.0 GREEN/BROWN 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.

Brown roofs or 'Biodiverse Roofs' are similar to green roofs, characteristically consist of undulating growing media; typically 80mm – 150mm deep. This is planted with a variety of drought tolerant hardy plants or seed, such as wildflowers, sedums, grasses and perennials. Better reflecting the urban environment.

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/brown roof provider. Maintenance contractors with specialist training in green/brown 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/brown 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.

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 by 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.	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

7.0 GEOCELLULAR/MODULAR SYSTEMS

DESCRIPTION

Modular plastic geocellular systems with a high void ratio, that can be used to create a below ground infiltration (soakaway) or storage structure.

OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground modular storage systems. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements for modular systems 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.

Modular systems – 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
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Remedial actions	Repair/rehabilitation of 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 and after large storms

8.0 SILT TRAPS AND CATCHPITS

DESCRIPTION

Silt traps and catchpits are circular or rectangular manholes and /or chambers with a sump in them to collect suspended solids. Some chambers have removeable silt buckets to assist with the removal of accumulated silt deposits. Catchpits 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 catchpits 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 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 silt traps and catchpits to assess silt accumulation	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

9.0 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
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
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 inspect ion 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 act ions 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

10.0 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 abnormal 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	0800 80 70 60
Natural England/Countryside Council for Wales			
OTHER KEY CONTACTS		Office Hours	Out of hours
Adjacent landowners:			
Neighbours:			
Specialist advisors:			