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Sustainable Drainage Options Appraisal

27 April 2026

Ishpal Soor
10 Old Hatch Manor, Ruislip, HA4 8QG

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Supervised by Mr Joseph Turner

CONTENTS

1. Introduction

The following document is a Sustainable Drainage Options Appraisal carried out by Oakshire Environmental, and includes details of the site, vulnerability classification, flood linkages, an evaluation of risk, evaluation of sustainable drainage options and a strategy for implementation.

1.1 Project Overview

The client's proposed project involves the erection of a new dwelling following the demolition of the existing dwelling at 10 Old Hatch Manor, Ruislip, HA4 8QG. Oakshire Environmental have carried out a Sustainable Drainage Options Appraisal & Strategy, as described below.

1.2 Purpose of Investigation

The objectives of the Sustainable Drainage (SuDS) Options Appraisal were to:

- Establish the context and setting of development at the site.
- Assess the nature of existing surface water management at the site.
- Calculate surface water storage volumes and runoff rates.
- Identify suitable sustainable drainage option(s).
- Outline a strategy for the implementation of suitable sustainable drainage option(s).
- Determine the requirement or scope of further investigations or maintenance at the site.

1.3 Scope of Work

- Desk studies have been carried out to establish the context and setting of development and the nature of existing surface water management at the site, through analysis of information obtained from sources including the Environment Agency, Local & National Authorities, Strategic Flood Risk Assessments and Digital Terrain Model (DTM) LiDAR topographical surveys.
- Quantitative surface water analysis has been conducted, to calculate runoff rates and storage volume requirements needed to meet Environment Agency, DEFRA and CIRIA guidance.
- Initial feasible options for sustainable drainage at the site have been identified, including assessment of potential constraints and generic objectives, based on the estimated cost, practicality and regulatory implications of their application.
- A detailed evaluation of sustainable drainage options has been conducted, including development of site-specific objectives, in order to determine which option(s) are most appropriate for the site.
- A strategy for the implementation of suitable sustainable drainage option(s) has been outlined.
- Recommended sustainable drainage option(s) have been assessed to determine the requirement or scope of further investigations or maintenance at the site.
- Supporting appendix includes photographs, maps and plans of the site.

1.4 Limitations

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This report excludes consideration of potential hazards arising from any activities at the site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities. Oakshire Environmental does not warrant or guarantee that the site is free of hazardous or potentially hazardous materials or conditions. It should be noted that this report has been produced for environmental purposes only.

2. Site

The following section provides a description of the site, location and proposed development, in addition to, planning and site history, utilising information obtained from the client and publicly available sources.

2.1 Site Description and Location

The site is located on Old Hatch Manor in Ruislip and covers an area of approximately 830m^2. The site comprises a detached bungalow and detached garage at the north with a brick paved driveway to the front and a patio and grass garden to the rear.

Ground levels across the driveway and patio adjacent to the dwelling are roughly flat at around 57.7mAOD while the rear garden slopes to the south to 56.6mAOD.

The site is bordered by Old Hatch Manor to the north with dwellings beyond and additional dwellings to the east, west and south.

Surface water from the existing dwelling and paving currently discharges to a Thames Water surface water sewer in Old Hatch Manor.

National Grid Reference: TQ 10021 87570

2.2 Proposed Development

The proposed development involves the construction of a new dwelling following the demolition of the existing dwelling.

The site currently has a building footprint of 174m^2 and a paved area of approximately 230m^2 while the remainder of the site is covered by grass gardens.

The proposed dwelling will have a footprint of approximately 218m^2 while the proposed driveway will cover an area of 89m^2 and the rear patio will cover an area of 85m^2. The remainder of the site will be covered by grass and planting.

2.3 Previous Investigations

No previous investigations regarding surface water management have been carried out at the site.

3. Sustainable Drainage Options

A Sustainable Drainage Options Appraisal requires the initial identification of feasible options for sustainable drainage at a site, based on the costs involved and the practicality of their application. Some methods may not be appropriate to a particular site and some may not be cost effective. Other site-specific constraints such as the available space can also determine the feasibility of a particular drainage option. The following section outlines objectives for the site, taking into account potential constraints, and includes a selection of feasible drainage options.

3.1 Feasible Drainage Options

The site is not at risk of flooding and the proposed development will result in a slight reduction in the impermeable surface cover across the site. Sustainable drainage options will, therefore, aim to reduce the rate and volume of runoff from the site to reduce the flood risk off-site, where possible.

BGS mapping shows that the site is situated on Lambeth Group bedrock comprising mainly clay with no superficial deposits indicating that infiltration SuDS are not likely to be feasible.

There are no watercourses in the vicinity of the site, however, there is a Thames Water surface water sewer in Old Hatch Manor to the north, therefore, in accordance with the Drainage Hierarchy, the most suitable option will be to discharge surface water to the existing surface water sewer following attenuation on site.

Options that would require a large area, such as ponds and basins, will also be discounted given the amount of amenity space these would take up on the site and a green roof will not be feasible due to the small flat roof area available and the limited benefit these provide in an extreme storm event.

In accordance with the 'National standards for sustainable drainage systems', where the volume of runoff discharged from the development to surface waters or sewers for the 1% AEP, 6-hour rainfall event is greater than the volume of greenfield runoff for the same rainfall event, the peak allowable discharge rate from the development for the 1% AEP event shall be limited to the 50% AEP greenfield runoff rate or 3l/s/ha, whichever is the greater.

Given the slope across the rear garden, surface water from the garden will not contribute runoff to the proposed drainage system and will not be factored into runoff calculations.

The 50% AEP greenfield runoff rate for the proposed development area is 0.2l/s while 3l/s/ha is 0.12l/s.

It is not considered feasible to limit the runoff rate from the site to 0.2l/s, due to the risk of blockages, therefore, it is proposed to limit the runoff rate for the 1% AEP rainfall event, including an allowance for climate change, to 1l/s. This will provide a 91% reduction to the existing 1% AEP runoff rate.

The following sustainable drainage options are, therefore, considered appropriate for the site and will be subject to a more detailed evaluation in the following section.

1. *Rainwater Harvesting*
2. *Pervious Paving*
3. *Attenuation Tank*

3.2 Detailed Evaluation of Drainage Options

Following the identification of feasible sustainable drainage options, a detailed evaluation of options, including development of site-specific objectives, is required to determine which option(s) are most appropriate for the site.

Table 1: Summary of Site-Specific Objectives

Mitigation Objective	Objective Type	Evaluation Criteria
Provide a reduction to the existing rate of runoff from the site	General/Technical	Runoff rate from the site to be as close as reasonably practicable to the greenfield runoff rate
Ensure that the implemented option can be maintained for the lifetime of the development	General/Technical	Allow maintenance of selected option for a minimum of 100 years
Enable development of a drainage strategy that meets regulatory requirements	Management	Drainage strategy to be agreed with Local Authority and carried out in accordance with relevant regulations
Enable development of a drainage strategy that meets the owner's requirements	Management	Drainage strategy to be agreed with site owner

3.3 Rainwater Harvesting

Rainwater harvesting supports SuDS objectives by reducing surface water runoff at source, lowering peak discharge rates, providing on-site storage, and enabling reuse of rainfall to reduce demand on potable water supplies.

The proposed development can incorporate water butts integrated with the downpipes from the dwelling roof. While these will provide some reduction in the rate and volume of runoff from the site, they cannot be relied upon to reduce the rate and volume of runoff in a storm event as the volume of storage at any particular time cannot be guaranteed. The proposed drainage strategy will, therefore, assume that the water butts are full and will provide no storage during a storm event.

3.4 Pervious Paving

Pervious paving could be implemented in the proposed driveway and patio paving adjacent to the proposed dwelling to provide a means of surface water storage close to the surface. Runoff from the roof of the proposed dwelling can also be discharged to the sub base of the pervious paving via downpipes.

Pervious paving also provides treatment of surface water to improve water quality through processes including the filtration of silt and the attached pollutants, biodegradation of organic pollutants (such as petrol and diesel within the pavement construction), adsorption of pollutants and the settlement and retention of solids.

A minimum infiltration rate of 2,500mm/h (7×10^{-4}m/s) is considered reasonable for a pavement surface to be considered pervious in respect to surface water management and most permeable paving designs can achieve infiltration rates of far more than this.

No vehicular traffic is anticipated on the proposed patio area and is classified as 'Traffic Category 1' while vehicular traffic on the proposed driveway will be limited to cars and light vans and is classified as 'Traffic Category 2'. The structural requirements for sites in Traffic Categories 1 & 2 require sub base thicknesses of at least 100mm and 150mm, respectively.

Due to the low permeability of the underlying soil, a 'Type C' system would be required in which water is retained within the sub base and discharged to the existing Thames Water surface water sewer to the north.

Calculations using HR Wallingford's uksuds tool show that a sub base thickness of at least 560mm will be required to manage runoff from the roof of the proposed dwelling and all areas of proposed paving.

3.5 Attenuation Tank

Alternatively, a geo-cellular attenuation tank could be installed beneath the driveway. This would be constructed using plastic cellular crates that provide a high porosity to reduce the volume required to provide the necessary storage.

This is likely to be less cost effective than pervious paving, given that pervious paving can be better integrated into the proposed development and pervious paving will also provide additional benefits through the treatment of surface water while an attenuation tank would provide no such water quality benefits.

While it would be feasible to provide surface water storage within an attenuation tank, pervious paving is considered to be more appropriate and will be favoured.

4. Recommendations

Following a detailed evaluation of feasible sustainable drainage options, the final option is selected, taking into account site-specific factors and the constraints outlined previously. The most appropriate sustainable drainage option at the site is considered to be via discharge to the existing Thames Water surface water sewer following storage within pervious paving. The details regarding this are outlined below.

4.1 Sustainable Drainage Strategy

Pervious paving should be implemented in the proposed driveway and patio adjacent to the dwelling and should comprise modular permeable paving (e.g. brick paving/concrete block permeable paving) or resin-bound gravel above a sub-base of clean coarse graded aggregate (or Type 3 MOT).

An impermeable flexible membrane should be laid across all areas of paving and lapped at the edges. This should be manufactured from high density polyethylene (HDPE), polypropylene or ethylene propylene diene monomer rubber (EPDM) and should be durable, resistant to puncture and unaffected by potential pollutants.

The subgrade soil should be profiled to have a fall towards an outlet at the north of the site with a gradient no flatter than 1:150 to aid the conveyance of water through the sub-base. A collector box, comprised of a geocellular box wrapped in a geotextile, should be situated at the north of the paving which will connect to an inspection chamber fitted with a vortex flow control device that will limit the discharge rate to 1l/s. This will then discharge to the existing Thames Water surface water sewer in Old Hatch Road to the north, subject to Thames Water approval.

Above the impermeable membrane, a sub-base comprised of coarse graded aggregate should be placed to a minimum depth of 560mm. Sub-base material should have a porosity of at least 30% in accordance with BS7533-13:2009 or DfT (1998) and should also have a minimum infiltration rate of 1 x 10^{-2}m/s. Sub-base should be laid in 100-150mm layers and compacted to ensure the maximum density is achieved without crushing the individual particles or reducing the porosity below the design value.

Downpipes from the proposed dwelling should be connected to filter chambers/catchpits and then connected directly into the sub base of the proposed driveway using diffusers, comprised of geocellular boxes wrapped in a geotextile, that extend into the sub base. Water butts should also be installed to allow water to be reused within the site. Downpipes at the rear of the dwelling will discharge to the water butts which will be fitted with overflow outlets to allow surface water to discharge to the downstream drainage network in the event that the water butts are full.

A non-woven geotextile layer should be laid on top of the sub-base to ensure that aggregate from the sand bedding layer is not washed down into the sub-base. This layer should be laid in accordance with manufacturers' instructions and with overlaps between adjacent strips of 300mm without any folds or creases. A 50mm bedding layer should then be placed on top of the geotextile layer. The bedding layer should comprise aggregate material of type 2/6.3 Gc 80/20 in accordance with BS EN 13242:2007.

Where modular permeable paving is used, paving blocks should be laid on the bedding layer to a minimum thickness of 60mm, however, advice should also be sought from the manufacturer on their recommendations. Manufacturer's advice should also be sought to determine the joint spacing and joint filling requirements of the block paving.

If resin bound gravel is used, the surface layer should be laid on top of the bedding course in accordance with the manufacturer's recommendations.

Treatment design should ensure that the surface layer has sufficiently small voids to trap silt within 30mm of the surface but still be permeable enough to allow water to flow into the sub-base.

4.2 Maintenance

The responsibility for the maintenance of all pervious paving installed on the site will be with the homeowner(s). The pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding. Sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites, however, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports. A brush and suction cleaner should be used for regular sweeping. If pavements become completely clogged, they can be rehabilitated using rotating sweepers and jet washing.

It is likely that the surface layer will become clogged to some degree over the lifetime of the development due to the build-up of silt and dirt from vehicles and off-site runoff. Despite reduction in surface infiltration due to clogging, available evidence indicates that the long-term reduced rate is more than sufficient in most cases to deal with any rainfall intensities likely to occur in the UK.

The following table provides guidance on the type of operational and maintenance requirements that are recommended and the frequency at which they should be carried out.

Table 2: Operation and maintenance requirements at the site

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturers' recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Removal of weeds	As required
Remedial actions	Remedial work to any depressions, rutting and cracked or broken areas of paving considered detrimental to the structural performance or a hazard to users	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation and establish appropriate brushing frequencies	Annually

5. Calculations

5.1 Greenfield Runoff Rates

The greenfield runoff rate for the site has been calculated using the uksuds tool from HR Wallingford.

Outputs are provided in the appendix.

5.2 Existing Runoff Rates

To calculate the brownfield runoff rate from the previously developed site, the industry-standard Modified Rational Method has been used which uses the following equation:

$$Q = 2.78CiA$$

Where:

Q = design event peak rate of runoff (l/s)

C = non-dimensional runoff coefficient which is dependent on the catchment characteristics

The runoff coefficient was split into two terms when the modified rational method was originally produced, however, the two coefficients are usually incorporated into a single term with a value of between 0.8 and 1.0 - depending on how effectively the catchment is drained and the level of impermeability. A runoff coefficient of 0.95 for roofs and 0.90 for paved areas has been applied.

i = rainfall intensity for the design return period in (mm/hr) and for a duration equal to the “time of concentration” of the network

The rainfall intensity was calculated by obtaining hydrological data from the FEH Web Service and assuming a critical duration of 15 minutes as a conservative estimate.

A = total catchment area being drained (ha)

The existing dwelling footprint and paved area within the proposed catchment area are 174m^2 and 218m^2, respectively.

The existing rates for the proposed catchment area are, therefore, as follows:

50% AEP = 3.1l/s

1% AEP = 11.3/s

5.3 Storage Volume

The storage volume required to restrict the runoff rate for the 1% AEP rainfall event, including an allowance for climate change, was calculated using the uksuds tool from HR Wallingford. An urban creep allowance of 10% and a climate change allowance of 40% were applied and hydrological data was obtained from the FEH Web Service.

Given the slope across the rear garden, surface water from the garden will not contribute runoff to the proposed drainage system and will not be factored into runoff calculations.

It is not considered feasible to limit the runoff rate from the proposed development area to the 50% AEP greenfield rate (0.2l/s), due to the risk of blockages, therefore, it is proposed to limit the runoff rate for the 1% AEP rainfall event, including an allowance for climate change, to 1l/s.

Calculations using HR Wallingford's uksuds tool show that a sub base thickness of at least 560mm will be required to manage runoff from the roof of the proposed dwelling and from all areas of proposed paving to 1l/s in the 1% AEP event, with an allowance for climate change, assuming a sub base porosity of 30% and a minimum paved area of 174m^2.

Outputs are shown in the appendix.

6. References

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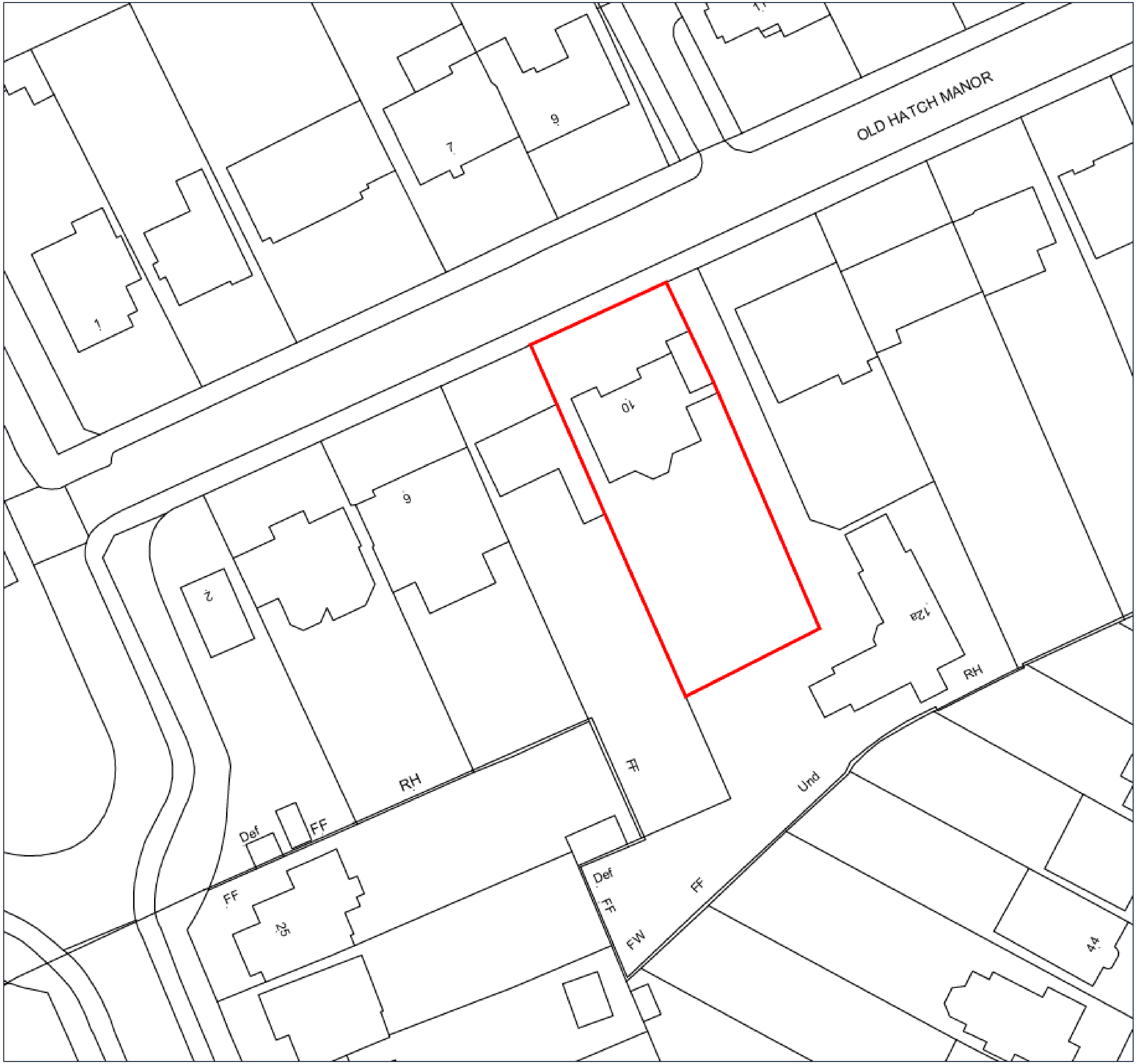
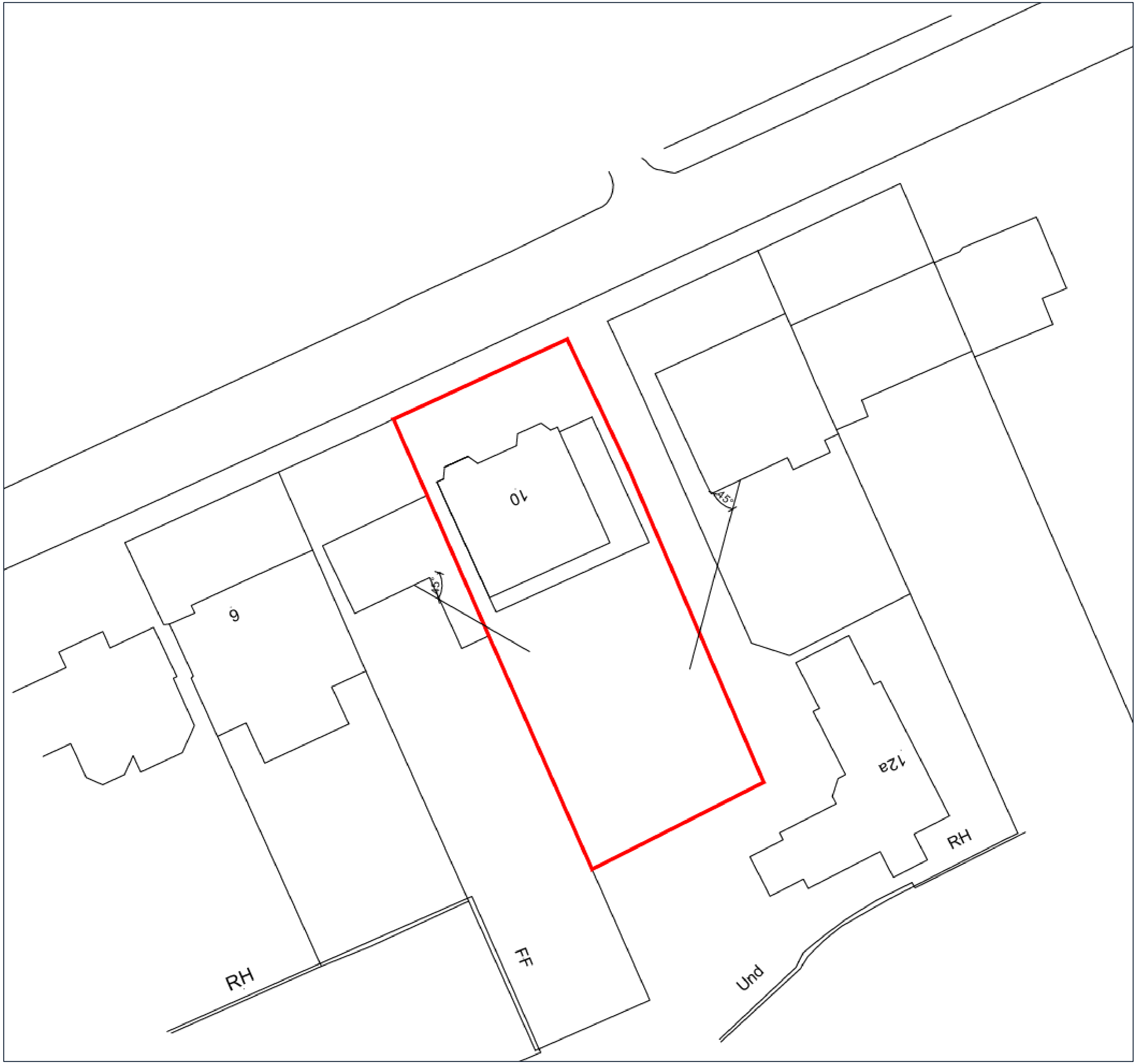
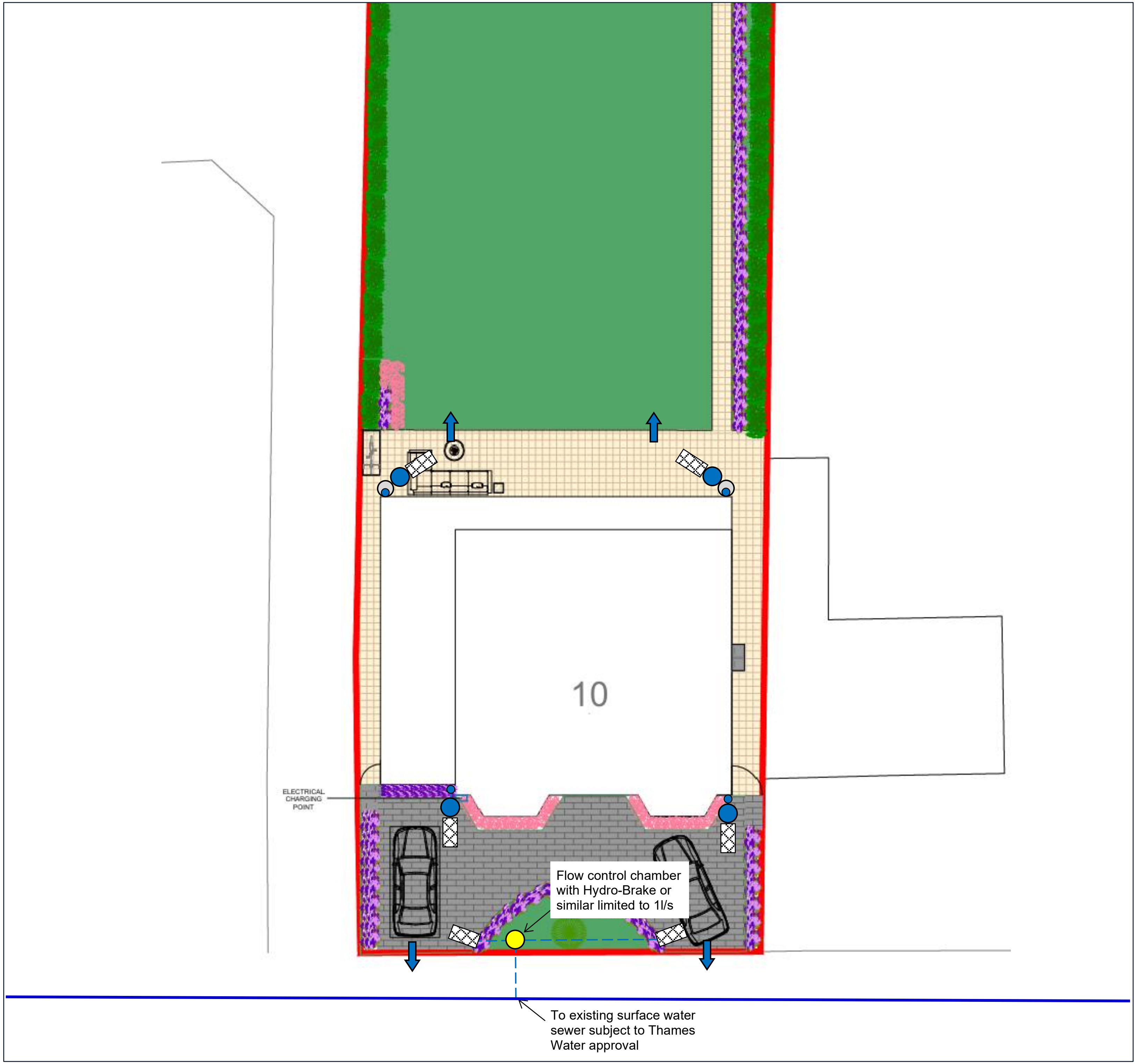


Appendix - Site Maps & Plans	
Description	
Existing location plan	
Sources	
Consilio Town Planning	
Key	
(red)	Site boundary
▲	North



Appendix - Site Maps & Plans	
Description	
Proposed site plan	
Sources	
Consilio Town Planning	
Key	
	Site boundary
▲	North



Appendix - Proposed Drainage Layout

Description

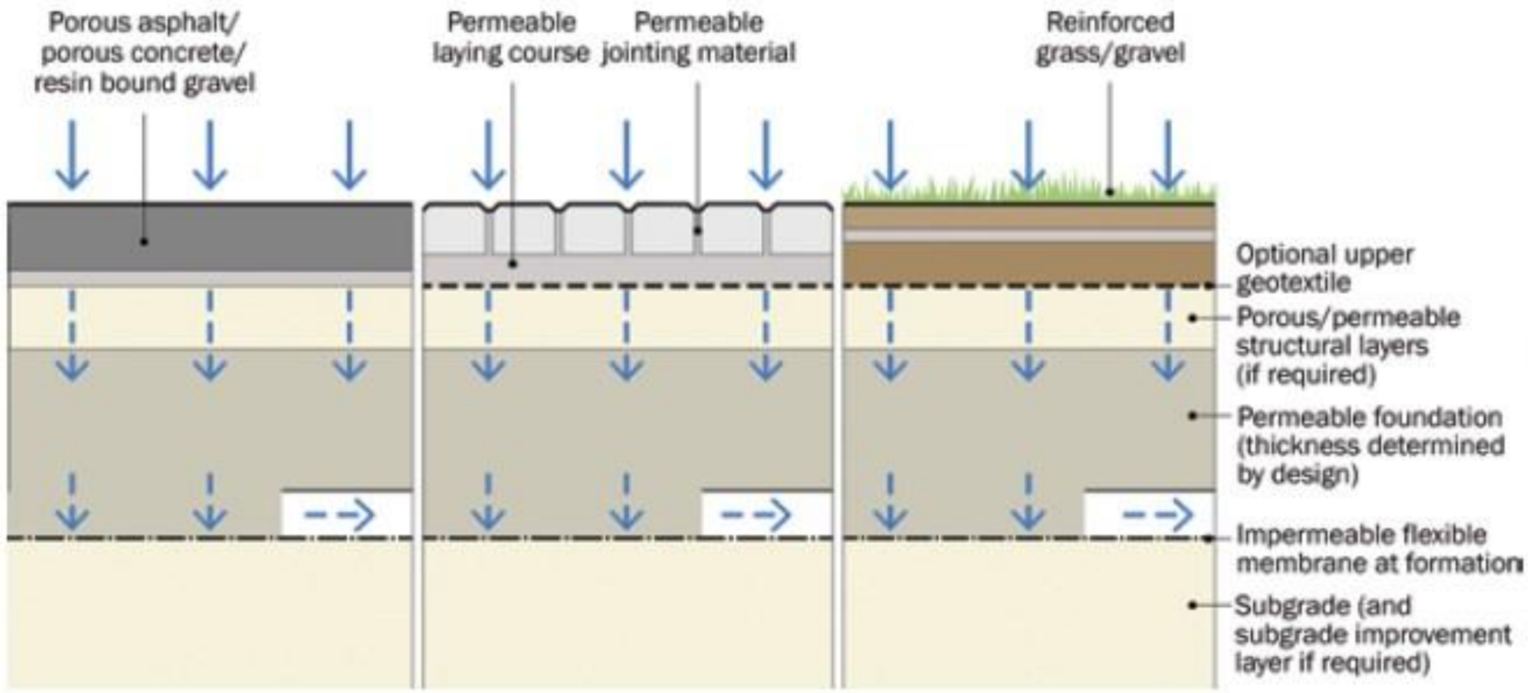
Proposed drainage layout

Sources

Consilio Town Planning
Oakshire Environmental

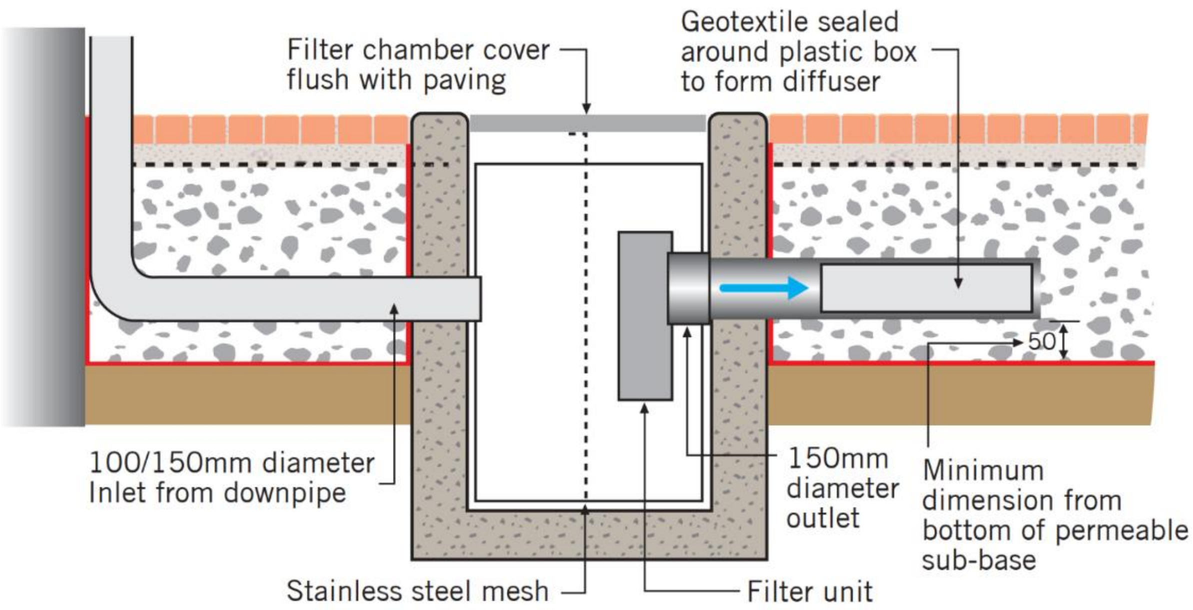
Key

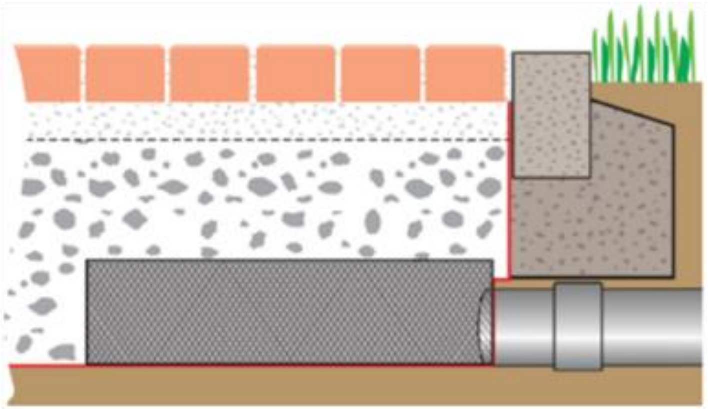
	Pervious paving - driveway (min. 560mm subbase)
	Pervious paving - patio (min. 560mm subbase)
	Downpipe
	Water butt
	Surface water pipe (100mm)
	Diffuser/collector box
	Inspection chamber
	Inspection chamber w/ vortex flow control device
	Exceedance route
	Existing Thames Water surface water sewer



Appendix - Example Construction Drawings
Description
Pervious paving cross section
Sources
The SuDS Manual

Appendix - Example Construction Drawings
Description
Example of diffuser inlet arrangement (above) and collector box arrangement at outlets (below)
Sources
Interpave, 2018





hr wallingford

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

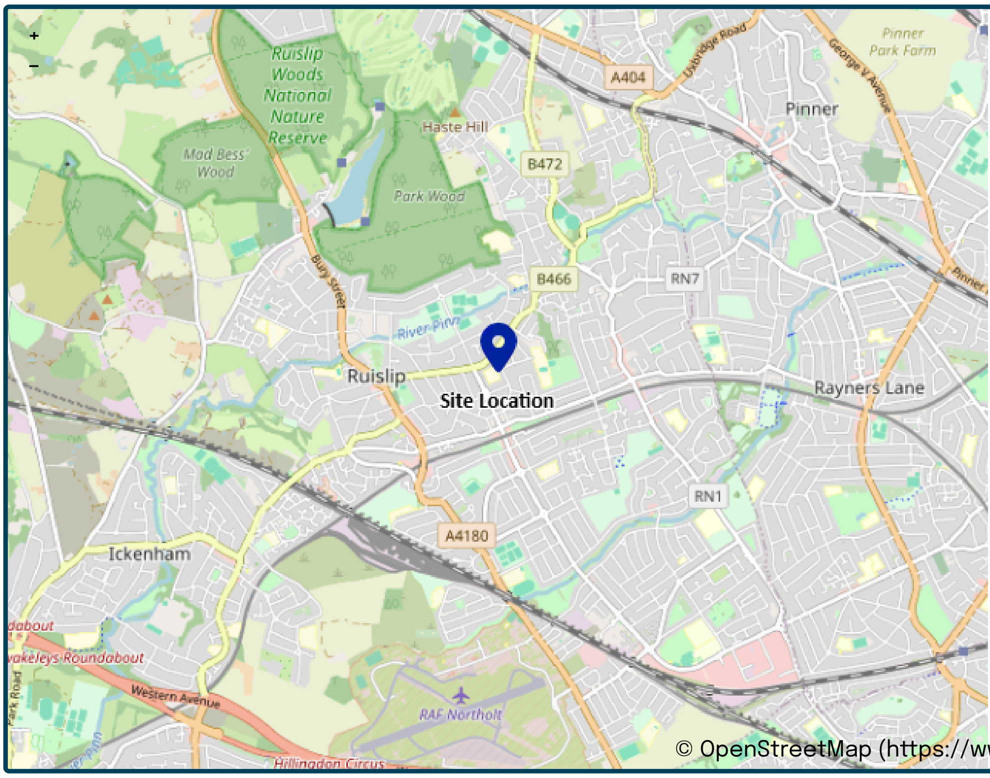
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	27/04/2026
Calculated by	Oakshire Environmental
Reference	Soor
Model version	2.2.3

Location

Site name	Old Hatch Manor
Site location	Ruislip



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Site easting (British National Grid)	510023
Site northing (British National Grid)	187562

Site details

Total site area (ha)	0.0392 ha

Greenfield runoff

Method

Method	FEH statistical (2025)

FEH statistical (2025)

	My value		Map value
SAAR9120 (mm)	681 mm		
BFIHOST19scaled	0.209		
QMed-QBar conversion	1.136		1.136
QMed (l/s)	0.2 l/s		
QBar (FEH statistical 2025) (l/s)	0.2 l/s		

Growth curve factors

	My value		Map value
Hydrological region	6		6
1 year growth factor	0.85		
2 year growth factor	0.88		
10 year growth factor	1.62		
30 year growth factor	2.3		
100 year growth factor	3.19		
200 year growth factor	3.74		

Results

Method	FEH statistical (2025)
Flow rate 1 year (l/s)	0.2 l/s
Flow rate 2 year (l/s)	0.2 l/s
Flow rate 10 years (l/s)	0.4 l/s
Flow rate 30 years (l/s)	0.5 l/s
Flow rate 100 years (l/s)	0.7 l/s
Flow rate 200 years (l/s)	0.9 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Surface water storage volume design tool

www.uksuds.com | Surface water storage volume design tool (https://www.uksuds.com/)

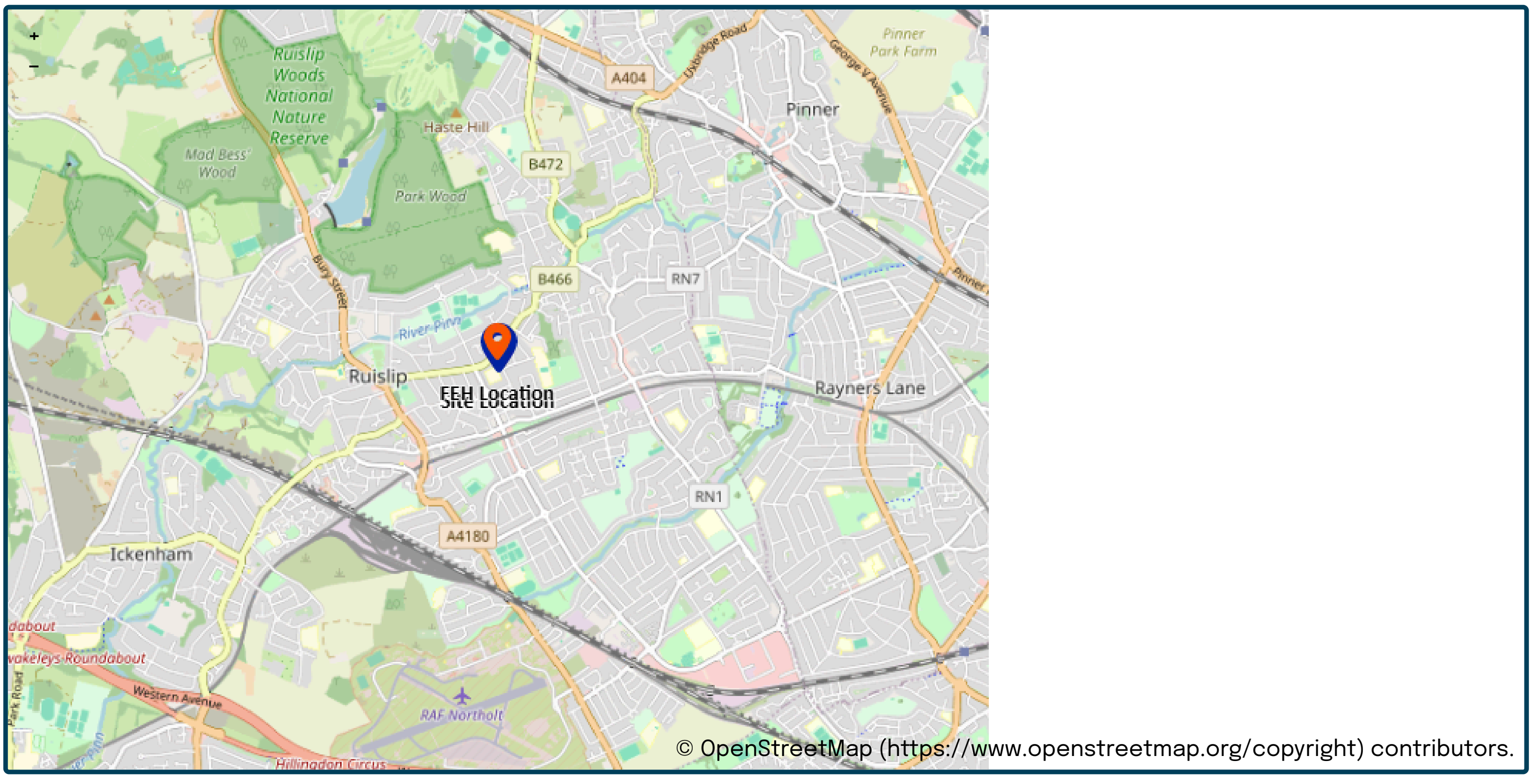
This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is recommended that the total storage volume for the site is distributed across the site using multiple SuDS and that hydraulic modelling software is used to undertake and finalise the detailed design of the drainage system.

Project details

Date	27/04/2026
Calculated by	Oakshire Environmental
Reference	Soor
Model version	2.2.3

Location

Site name	Old Hatch Manor - pervious paving
Site location	Ruislip



Site easting (British National Grid)	510021
Site northing (British National Grid)	187565

Site areas

Total site area (ha)	0.0392	ha

Roof area

Total roof area (ha)	0.0218	ha
Contributing roof area (ha)	0.0218	ha
Non-contributing roof area (ha)	0	ha

Paved area

Total paved area (ha)	0.0174	ha
Contributing paved area (ha)	0.0174	ha
Non-contributing paved area (ha)	0	ha

Grass / vegetated area

Total grass / vegetated area (ha)	0	ha
Contributing grass / vegetated area (ha)	0	ha
Non-contributing grass / vegetated area (ha)	0	ha

Total area

Total contributing area (ha)	0.0392	ha

Contributing areas with urban creep allowance

Urban creep allowance factor	+10%	
Contributing roof area (adjusted for urban creep) (ha)	0.0218	ha
Contributing paved area (adjusted for urban creep) (ha)	0.0174	ha
Contributing grass / vegetated area (adjusted for urban creep) (ha)	0	ha

Storage design parameters

Storage base shape	Rectangular / square	
Storage base length to width ratio	3:1	
Storage design depth (m)	0.56	m
Storage side slope (1 in x)	Vertical sided	
Storage voids ratio (%)	30% (e.g. aggregate filled structure)	
Storage volume design return period (years)	1:100 years	

Discharge flow rate from the site

Method

Type of site	Previously developed
Specify the method	FEH statistical (2025) + relaxation

FEH statistical (2025)

	My value		Map/default value
SAAR9120 (mm)	681 mm		
BFIHOST19scaled	0.209		
QMed (l/s)	0.2 l/s		
QMed-QBar conversion	1.136		1.136
Total area for greenfield runoff calculation (ha)	0.0392 ha		0.0392
QBar (l/s)	0.2 l/s		
Hydrological region	6		6
Return period (years)	1:2 year		
Growth curve factor	0.88		
Relaxation factor	1x		

Final discharge rate

Runoff calculation method	FEH statistical (2025) + relaxation
Design flow rate (l/s)	0.2 l/s

Blockage risk

Specify the method	Flow rate
Minimum discharge flow rate to prevent blockage	1l/s

	My value		Calculated value
Design orifice diameter (mm)	25 mm		25
Flow rate of orifice (l/s)	0.97 l/s		

Rainfall and runoff

Rainfall input type	FEH22 CSV file
	FEH_Point_Rainfall_FEH22_AM_510017_187570.csv
Distance from FEH location to site (km)	0 km
Climate change allowance factor	140%

Model results

- **Maximum discharge flow rate:** 1.0 (l/s)
- **Outflow orifice diameter:** 25 (mm)
- **Storage base length:** 23 (m)
- **Storage base width:** 7.6 (m)
- **Storage base area:** 173 (m^2)
- **Storage total volume:** 97 (m^3)
- **Storage total water volume:** 29 (m^3)
- **Storm return periods run:** 1, 2, 10, 30, 100, 200 (years)
- **Storm durations run:** 15, 30, 60, 120, 180, 240, 360, 540, 720, 900, 1080, 1440, 1800, 2160, 2880, 3600, 4320, 5040, 5760 (minutes)

Return Period (years)	Critical Duration (minutes)	Peak Flow Rate (l/s)	Max Depth (m)	Max water volume (m^3)	Max storage volume (m^3)
1	360	0.4	0.13	6.7	22
2	360	0.5	0.16	8.5	28
10	240	0.7	0.31	16	53
30	240	0.8	0.42	22	73
100	**240**	**1.0**	**0.56**	**29**	**97**
200	360	1.0	0.60	35	117

Please note runoff estimation and storage volume estimation are subject to uncertainty. Storage volume results are therefore reported to the nearest 1 m³ value, unless storage volumes are less than 10 m³, in which case, storage volumes are provided to 1 decimal place.

Disclaimer